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ENGLISH FOR MASTER'S STUDENTS

Учебное пособие по английскому языку для магистрантов

Казань – 2026

УДК 372.881.1

ББК Е70

*Принято на заседании учебно-методической комиссии ИМОИВ
Протокол №6 от 25 февраля 2026 года*

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Кондратьева И.Г., Сигачева Н.А., Маршева Т.В. English for Master`s Students / И.Г. Кондратьева, Н.А. Сигачева, Т.В. Маршева. – Казань: Казанский федеральный университет, 2026. – 154 с.

Данное пособие предназначено для магистрантов Института математики и механики им. Н.И. Лобачевского и Института физики. Учебное пособие содержит материалы по английскому языку, способствующие развитию навыков и умений профессиональной коммуникации, чтения и перевода аутентичных текстов. Пособие может быть использовано как для аудиторной работы, так и для самостоятельной работы студентов.

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Предисловие

Настоящее учебное пособие по английскому языку предназначено для магистрантов Института математики и механики им. Н.И. Лобачевского и Института физики Казанского (Приволжского) федерального университета уровня Intermediate / Upper-Intermediate.

Целью пособия является овладение студентами компетенциями устного и письменного научно-исследовательского и профессионально-ориентированного общения на английском языке. В задачи пособия входит развитие навыков и умений самостоятельно работать с аутентичными научными текстами (статьями) на английском языке, коммуникативных навыков для поддержания научно-исследовательских и профессиональных контактов, а также развитие навыков научного и делового письма.

Пособие состоит из 8 разделов, каждый из которых содержит тематические научные статьи и задания для их полного и точного понимания, а также задания по развитию компетенций в сфере научной коммуникации. Предшествующие текстам задания знакомят студентов с содержанием учебных текстов и способствуют усвоению и запоминанию специальных терминов по направлению обучения, устраняют трудности понимания прочитанного материала. Упражнения, предложенные после текста, позволяют определить уровень усвоения изученного материала, способствуют развитию навыков устного и письменного перевода, монологической и диалогической речи. В пособие также включены творческие задания по подготовке презентаций и докладов.

Первая часть каждого раздела направлена на совершенствование навыков профессионально-ориентированной коммуникации. Вторая часть ориентирована на развитие академических и научно-исследовательских умений.

Пособие содержит тексты для самостоятельной работы студентов, инструкции как составить краткий обзор научной статьи, аннотацию, рекомендации по составлению высказывания «My scientific interests».

Пособие может быть рекомендовано к использованию для аудиторной и самостоятельной работы студентов.

Материалы пособия прошли апробацию в студенческих группах.

CONTENT

Unit I. MATHEMATICS AND MATHEMATICIANS	
Part 1. The mathematician who sculpted the shape of space	6
Part 2. What are your career goals?	13
Unit II. ALGEBRA	
Part 1. Problems of algebraic equations	22
Part 2. The importance of critical thinking	25
Unit III. GEOMETRY	
Part 1. Geometry of generalized complex numbers	37
Part 2. How to report on an experiment	40
Unit IV. MECHANICS	
Part 1. Underactuated mechanical systems	51
Part 2. Developing confidence to communicate	54
Unit V. SECURITY	
Part 1. Computer security	64
Part 2. The importance of writing skills in science	71
Unit VI. DATA SECURITY	
Part 1. What is Data Security?	85
Part 2. Presenting your research paper ideas	90
Unit VII. PHYSICS IN MEDICINE	
Part 1. The role of physics in medicine	100
Part 2. Career development	107
Unit VIII. SCIENCE DEVELOPMENT IN THE 21ST CENTURY	
Part 1 Magnetic Resonance Imaging	119
Part 2 Science and technology in the 21st century	125
CHECK YOURSELF	134
Appendix 1. How to Express your Opinion in English	137
Appendix 2. Some Useful Phrases for Rendering Articles in English	139

Appendix 3. How to Make a Successful Presentation	140
Appendix 4. How to Write a Summary Essay	143
Appendix 5. Mathematical and Scientific Symbols	144
Bibliography	152

Unit I. MATHEMATICS AND MATHEMATICIANS

Part 1. The Mathematician Who Sculpted the Shape of Space

1. *Discuss the following questions with your classmates. Explain your answer. Express your attitude to the received response, your agreement or disagreement with the partner's opinion.*

- Why is it so difficult to choose your professional goal?
- What is more important in scientific career: talent or hard work?
- What character traits should a scientist possess?
- Do you know the most famous scientists in mathematics and mechanics?

2. *Read and translate the text. Be ready to make a review of the text using useful phrases given below.*

Text 1A

EUGENIO CALABI AS AN INVENTIVE MATHEMATICIAN

*Eugenio Calabi “had a special way of looking at things,”
said his longtime colleague, Jerry Kazdan.*

“Taking the less obvious choice was how he practiced mathematics.”

Eugenio Calabi, who died on September 25, conceived of novel geometric objects that later became fundamental to string theory.

Eugenio Calabi was known to his colleagues as an inventive mathematician — “transformatively original,” as his former student Xiuxiong Chen put it. In 1953, Calabi began to contemplate a class of shapes that nobody had ever envisioned before. Other mathematicians thought their existence was impossible. But a couple of decades later, these same shapes became extremely important in both math and

physics. The results ended up having a far broader reach than anyone, including Calabi, had anticipated.

Calabi was 100 years old when he died on September 25, mourned by his colleagues as one of the most influential geometers of the 20th century. “A lot of mathematicians like to solve problems that finish off work on a particular subject,” Chen said. “Calabi was someone who liked to start a subject.”

Jerry Kazdan, who taught with Calabi at the University of Pennsylvania for nearly 60 years, said that his colleague “had a special way of looking at things. Taking the less obvious choice was how he practiced mathematics.” One of Calabi’s main preoccupations, according to Kazdan, was to “ask interesting questions that no one else was thinking about.” The answers to those questions often had consequences of lasting significance.

Although Calabi made vital contributions to many areas of geometry, he is best known for his 1953 conjecture about a special class of manifolds. A manifold is a surface or space that can exist in any dimension, with an essential feature: A small “neighborhood” around every point on the surface looks flat. The Earth, for example, looks round (spherical) when viewed from afar, but a tiny patch of ground looks flat.

In graduate school at Princeton University, Calabi became interested in Kähler manifolds, named after the 20th-century German geometer Erich Kähler. Manifolds of this type are smooth, meaning that they have no sharp or jagged features, and they only come in even dimensions — 2, 4, 6 and up.

A sphere has constant curvature. Anywhere you go on the surface, regardless of the direction you set off in, your path bends the same amount. But in general, the curvature of manifolds can vary from one point to another. There are a few different ways that mathematicians measure curvature. One comparatively simple measure called the Ricci curvature was of great interest to Calabi. He proposed that

Kähler manifolds could have zero Ricci curvature at every point even while satisfying two topological conditions that globally constrain their shape. Other geometers thought such shapes sounded too good to be true.

Shing-Tung Yau was initially among the doubters. He first came across the Calabi conjecture in 1970, when he was a graduate student at the University of California, Berkeley, and he was immediately transfixed. To prove that the conjecture was true, as Calabi had laid out the problem, one had to show that a solution to a very thorny equation could be found — even if the equation was not solved outright. That was still a big challenge because no one had ever solved an equation of this specific type before.

After spending a few years thinking about the problem, Yau announced at a 1973 geometry conference that he had found counterexamples that showed the conjecture was false. Calabi, who was at the conference, did not raise any objections at the time. A few months later, after giving the matter some thought, he asked Yau to clarify his argument. When Yau reviewed his calculations, he realized he'd made a mistake. The counterexamples did not hold up, suggesting that the conjecture might be correct after all.

Yau spent the next three years proving the existence of the class of manifolds Calabi had originally proposed. On Christmas Day in 1976, Yau met with Calabi and another mathematician, who confirmed the validity of his proof, establishing the mathematical existence of objects now called Calabi-Yau manifolds. In 1982, Yau won a Fields Medal, math's highest honor, partly on the strength of this result.

Around that time, physicists trying to devise theories that unified the forces of nature started toying with the idea that fundamental particles such as electrons are in reality composed of exceedingly tiny vibrating strings. Different patterns of vibration manifest as different particles. For technical reasons, these vibrations only work out correctly in 10 dimensions.

Needless to say, the world does not appear to be 10-dimensional – there seem to be just three dimensions of space and one of time. By the mid-1980s, however, a group of physicists had realized that the six “extra” dimensions of the universe might be hidden in a minute Calabi-Yau manifold (less than 10^{-17} centimeters in diameter). String theory, as this physical framework was called, also held that the particles and forces of nature were dictated by the Calabi-Yau shape. This theory depended upon a property called supersymmetry, which arose from symmetry that was already built into a Kähler manifold — another reason why Calabi-Yau manifolds appeared to be the right fit for string theory.

By 1984, Yau already knew it was possible to construct at least 10,000 different six-dimensional Calabi-Yau shapes. It isn’t clear if our world is secretly filled with Calabi-Yau manifolds — concealed within dimensions far too small to be seen — but every year physicists and mathematicians publish thousands of papers probing their properties.

Yau said that the term comes up so often that he sometimes thinks his first name is Calabi. For his part, Calabi said in 2007, “I am flattered by all the attention that this idea has received,” owing to the connection with string theory. “But I’ve had nothing to do with that. When I first posed the conjecture, it had nothing to do with physics. It was strictly geometry.”

Calabi was not always determined to become a mathematician. His talent showed early — his father, a lawyer, quizzed him about prime numbers when he was a kid. But he decided to major in chemical engineering when he arrived at the Massachusetts Institute of Technology as a 16-year-old in 1939, after his family fled Italy at the outset of World War II. During the war, he served as a U.S. Army translator in France and Germany. After he returned home, he worked briefly as a chemical engineer before deciding to switch to math. He

got his doctorate at Princeton and held a series of professorships before landing at Penn in 1964, where he would remain.

He never lost his enthusiasm for mathematics, continuing to carry out research well into his 90s. Chen, his former student, remembered how Calabi used to intercept him in the math department's mailroom or in hallways: Their conversations could go on for hours, with Calabi scribbling down formulas on envelopes, napkins, paper towels or other scraps of paper.

Yau saved some of the napkins from his exchanges with Calabi. "I always learned from the formulas written on them, which conveyed Calabi's uncanny sense of geometric intuition," Yau said. "He was very generous about sharing his ideas and didn't care about getting credit for them. He just thought that doing math was fun."

Calabi called math his favorite hobby. "To follow your hobbies as a profession is the extraordinary luck I've had in my life."

Adopted from: <https://www.quantamagazine.org/june-huh-high-school-dropout-wins-the-fields-medal-20220705/>

3. Make a review of the text 1A. Practice using "Useful language".

Useful language

Speaking about the title, the author, the style of the article.

- The extract I'm going to give a review of is taken from...
- The author of the article is...

Discussing structure of the text

At the beginning of the extract the author:

- describes
- depicts
- touches upon
- explains
- introduces
- mentions

- recalls

The author makes a few critical remarks on...

The story begins with the:

- description of
- statement
- introduction of
- the mention of
- the analysis of a summary of
- the characterization of
- the enumeration of

Speaking about a scientific problem

- The topic of the extract is...
- The key issue of the extract is...
- The extract under discussion is devoted to the problem...
- The author in the extract touches upon the problem of...
- I'd like to mention briefly that...

Summing up

- Summing it up
- On the whole

4. Complete the abstract on the article by filling the gaps with phrases from the box.

Abstract

The relevance of the article is caused by the need of

This article is focused on

The leading methods of the research are

The article reveals that

The main result of the research is

Materials of the article can be useful for researchers in the field of ...

.

... researchers in the field of foreign language learning, enrichment foreign language teaching methodology and pedagogy.

... logical and gnosiological analysis, method of actualization, selection, systematization and generalization of foreign language teaching methods and original sources.

... the development of a pedagogical model of foreign language business communication concentrated teaching to masters at universities.

... negative effects of the traditional system of education are associated with inefficient organization of the educational process, which makes it necessary to identify and create the organizational and pedagogical requirements that increase the efficiency of foreign language business communication concentrated training to master's degree students.

... further improvement of the efficiency of foreign language business communication training to master's degree students.

... the developed model of foreign language business communication concentrated training to masters, which characterizes activity of all subjects of the educational process and its organization, requirements for the effective implementation of this model.

Let's practice writing

(Adopted from: Armer T. Cambridge English for scientists. Cambridge University Press.

<https://portal.tpu.ru/SHARED/m/MALORISS/studentam/SelfStudy/Tab2/Posobie5cours.pdf>)

5. Choose an English-language scientific journal in the relevant field of study. Indicate the Internet link to the journal. Make up a bibliographic description of the chosen journal using the questions as a plan.

- What is the name of the journal?
- What publisher publishes the journal?
- What year was the journal founded?
- What country is the journal located?
- What is the frequency of publications
- Are there printed and electronic journal versions?
- Is the magazine subscription paid or not?
- Do you need registration to read and download articles?

- What scientific areas does the journal cover?
- What scientific indices does the journal have?
- Who are the authors, what countries are they from?
- Is there any information about editorial etiquette policy? What are the main points?

Unit I. MATHEMATICS AND MATHEMATICIANS

Part 2. What Are Your Career Goals?

1. In pairs, discuss the following questions. Explain your answer. Express your attitude to the received response, your agreement or disagreement with the partner's opinion.

- Why did you choose a career in science?
- What field of science are you currently working or studying in?
- What would you like to do next in your work or studies?

2. Practice pronunciation of the words below. Check if you know their meaning.

1. goal [gəʊl] цель
2. disease [di'zi:z] болезнь
3. combat ['kɒmbət] бороться
4. pollution [pə'lu:ʃn] загрязнение
5. reduce [ri'dju:s] сокращать, уменьшить
6. capability [keɪpə'bɪlɪti] возможность
7. products ['prɒdʌkts] зд. средства
8. endeavor [ɪn'devə] пытаться
9. background ['bækgraʊnd] фон
10. transcend [træn'send] преодолевать, превзойти
11. alike [ə'laɪk] похожий
12. exhilarate [ɪg'zɪləreɪt] оживлять
13. prompt [prɒmpt] быстрый

14. achieve [ə'ʃi:v] достигать, добиваться
15. appropriate [ə'prəʊpɪt] соответствующий, подходящий
16. satisfying ['sætɪsfaɪɪŋ] удовлетворяющий
17. employment [ɪm'plɔɪmənt] занятость, работа
18. purpose ['pɜ:pəs] цель, задача
19. hurdle [hɜ:dl] препятствие, барьер
20. reward [rɪ'wɔ:dz] награда

3. Translate the following word combinations into Russian.

1. career goals
2. reduce pollution
3. space travel
4. natural world
5. through the media
6. demanding mentally
7. global communities
8. sufficient interest
9. helpful guides
10. primarily designed

4. Find the English equivalents to the following word combinations in the text. Make up your own sentences with these phrases.

1. надежные усилия
2. политическая сфера
3. различия между людьми
4. глубокий уровень
5. транспортное средство для космических путешествий

5. Read the text and answer the following questions:

1. What examples of career goals are mentioned in the text?
2. What will define which academic degree is the most suitable for you?

3. Who forms global communities of common interests that transcend the differences among individuals, corporate endeavors, or nations?
4. What level of education guarantees lifetime employment?
5. Whose helpful guide for doctoral studies in science and engineering is presented in the text?

Text 1 B

HOW TO CHOOSE A CAREER IN SCIENCE OR ENGINEERING

1. People seek careers in science or engineering for many reasons. Some have specific goals: they wish to cure diseases or combat hunger or reduce pollution; or they dream of developing the next laser, transistor, or vehicle for space travel; or they imagine building companies that capitalize on new engineering capabilities. Some choose careers in science or engineering because they are curious about the natural world. Others are motivated by the excitement and beauty of the intellectual world and hope to formulate theories that will lead to new ways of thinking about the world. Still others imagine educating people about science or engineering in schools or through the media; they want to provide counsel or shape public policies on issues of direct relevance to science or engineering. Each of these motivations is legitimate, each is valuable, and each flows naturally from an education in science and engineering.

2. Careers in science and engineering are essentially hope-filled endeavors that can improve people's lives and result in knowledge that all people can share. As the techniques and products of science and technology have become more central to modern society, a background in science and engineering has become essential to more and more careers. In fact, degrees in science and engineering are becoming as fundamental to modern life as the traditional liberal-arts degree. The contributions of scientists and engineers already extend beyond research and development and throughout the realms of teaching, business, industry, and government. People with bachelor's,

master's, and doctoral degrees in science or engineering are forming companies, managing businesses, practicing law, formulating policy, consulting, and running for political office. They are forming global communities of common interests that transcend the differences among individuals, corporate endeavors, or nations.

3. But if you are contemplating a career in science or engineering, how can you begin your planning most effectively? If you are an undergraduate or beginning graduate student – the groups for whom this guide is primarily designed – how well do your own skills and personality match the career you imagine? It is important to remember that science-oriented students are not all alike, any more than all artists or all politicians are alike. Your success will depend on going where your particular interests lead you. Are you exhilarated by the challenge of a new problem or puzzle or need? Does the complexity of the natural world prompt a desire to understand it? If so, science and engineering study – rigorous though it is – will provide you with the tools and concepts that you need to achieve your goals.

4. Your own goals will determine which academic degree is most appropriate for you. Many people find satisfying careers in a variety of positions after the bachelor's degree. Others, notably engineers, find that a master's degree equips them well for professional careers. For those who hope for careers conducting research and/or teaching at the university level, a PhD will probably be required.

No degree guarantees lifetime employment. Like professionals in other fields, you might still have to change jobs and even careers during your life – perhaps more than once. It is the purpose of this guide to help you lay the foundation for your journey, no matter how many turns your path takes.

5. Just how rigorous is the path to a scientific or engineering career? Graduate study, in particular, is demanding mentally, physically, and emotionally. Not everyone has the perseverance to complete years of concentrated study. But the experience of doing scientific or technical

work is supremely exhilarating for those with sufficient interest and determination. And many people will be willing to help you along the way and assist you over difficult hurdles as you gain the confidence to think and work independently.

6. Are you bright enough to become a scientist or engineer? Again, there is no standard against which to measure yourself; no kind of intelligence applies across all the many fields of science and engineering. But you can do no better than to trust in your deepest feeling. If your enjoyment of mathematics and science is real, you will probably want to understand, use, and explore them on a deeper level. One of the most helpful guides to doctoral study in both science and engineering is a slim book by scientist and writer Peter Medawar titled *Advice to a Young*

7. Scientist Medawar writes: "A novice must stick it out until he [or she] discovers whether the rewards and compensations of a scientific [or engineering] life are for him [or her] commensurate with the disappointments and the toil; but if once a scientist [or engineer] experiences the exhilaration of discovery and the satisfaction of carrying through a really tricky experiment ... then he [or she] is hooked and no other kind of life will do." And again Medawar is helpful: "One does not need to be terrifically brainy to be a good scientist. ... Common sense one cannot do without, and one would be the better for owning some of those old-fashioned virtues . . . application, diligence, a sense of purpose, the power to concentrate, to persevere and not be cast down by adversity." (Medawar 1979).

8. Make a list of reasons why you like to study science and engineering and a list of reasons why you don't. Compare the two lists. Make a list of the positive and negative aspects of various careers which you are interested in. Seek out people with science and engineering backgrounds who work in careers which you are interested in and ask them to have lunch with you so that you can ask them about their work and how they got where they are today. How do they spend their time?

What do they find most satisfying and most disagreeable? Does the life that they describe appeal to you?

9. If you're an undergraduate, talk with several graduate students; if you're a beginning graduate student, talk with several advanced students or postdoctoral students. Ask them what they have learned that they wish they had known early in their careers.

Adapted from: <https://www.nap.edu/read/5129/chapter/2>

After text tasks

6. *What is the main idea of the text? Choose the correct answer. Offer your own version of the main idea of the text.*

- a) Most people are looking for a career in science or technology.
- b) People with bachelor's, master's, and doctoral degrees in science or engineering are capable to form companies and managing businesses.
- c) People seek careers in science or engineering for many reasons.

7. *Mark true (T) or false (F) sentences.*

- a) People never find satisfying careers in a variety of positions after the bachelor's degree.
- b) Some people are motivated by the excellence and beauty of the intellectual world and hope to formulate theories that will lead to new ways of thinking about the world.
- c) People with a bachelor's, master's and doctor's degrees in science or technology do not have enough skills and knowledge to form companies, manage business.
- d) It is useful to look for people with scientific and engineering knowledge who work in the career in which you are interested.
- e) One does not need to be terrifically brainy to be a good scientist.

8. *What paragraph describes the contribution of scientists and engineers in science and technology?*

- a) 1; b) 2; c) 3.

9. Put the names of the paragraphs 1 – 5 in the correct order. Give titles to the paragraphs 6 – 9.

	Paragraph Title	Number
a	Effective planning of a career in science or engineering	1
b	The reasons why people are looking for a career in science or technology	2
c	Contribution of scientists and engineers to the development of science	3
d	Choosing the most appropriate academic degree	4
e	Rigorous path to a scientific or engineering career	5

10. Choose the answer to the given question. Make your own question to the text with the question word “Why”. Ask your partner this question.

What can help you to choose the most appropriate Academic degree for you?

- a) parents` recommendations;
- b) your own goals;
- c) teachers` advice.

11. Complete the sentence.

- 1.If your enjoyment of mathematics and science is real, you will probably
- 2.Careers in science and engineering are essentially hope-filled endeavors that can improve ...
- 3.In fact, degrees in science and engineering are becoming...
- 4.People with bachelor's, master's, and doctoral degrees in science or engineering are forming...
- 5.It is important to remember that science-oriented students are not...

Let's practice communication skills

(Adopted from: Armer T. Cambridge English for scientists. Cambridge University Press.

12. Make a comparative table of higher education in a foreign country and Russia and then answer the following questions.

Higher education for science in the Russian Federation

Qualification	Category	Duration	Place of study

1. Is science education abroad similar to science education in your country?
2. If you decided to study abroad, which qualification would be best for you?

13. Write a short essay on the suggested topics. Suggest some other relevant essay topics.

- what you enjoy most about working in your scientific field.
- what you would like to do (and not like to do) next in your career.
- which of your past and present experiences are most relevant to your future in science.

14. In pairs, take turns to interview your partner about his/her career path in science. What questions do you think are the most relevant?

15. Look at the application form (1-10) and add the information you need to provide when applying for a grant.

APPLICATION FORM

1. Applicant
2. Current appointment and address
3. Location of proposed study
4. Sponsor's recommendation
5. Departmental support

6. Project title
7. Project summary
8. Details of proposed research
9. Budget
10. Nominated referee with personal knowledge of applicant

16. In pairs, discuss the following questions.

1. Have you ever applied for a job in science? If not, what kind of job would you like to apply for in the future?
2. Which of the following documents are job applicants usually asked for in your country?
 - application form
 - biodata
 - cover letter (covering letter)
 - resume or CV (curriculum vitae)
3. Have you ever written one of these documents in English?
4. Do you think that the information you include and the way you organize a resume or CV in English will be the same as a resume or CV in your own language?

17. Complete the advice for interviews using the words and phrases given below.

application form, comfortable position, facing, late, phone number, questions, see, shuffle (выпутать), thank, tone of voice

Before your interview

Find out exactly who you will be talking to. Check whether they will be able to

(1) _____ you or just hear you. Check the date, time, the (2) _____ to dial in on, and the right code to access the conference call.

Read your CV and (3) _____ again. Practice answering questions you might be asked. Prepare (4) _____ to ask the interviewer.

During your interview

- Don't be (5) _____.
- Use your (6) _____ to sound confident and enthusiastic
- Do not (7) _____ papers (this will make a noise)
- Sit in a (8) _____ – do not move about too much
- Speak very clearly, (9) _____ the microphone
- When the interview is over (10) _____ the interviewer(s) and end positively

Unit II. ALGEBRA

Part 1. Problems of Algebraic Equations

1. Discuss the following questions with your classmates. Explain your answer. Express your attitude to the received response, your agreement or disagreement with the partner's opinion.

- Are you interested in finding out the truth?
- Do you give new ideas a fair hearing?
- Do you act impulsively, or do you evaluate the pros and cons of your decisions?

2. Read and translate the abstract, the introduction and keywords.

Text 2A

SOLVING A SYSTEM OF ALGEBRAIC EQUATIONS WITH SYMMETRIES

Abstract

We propose a method to solve some polynomial systems whose equations are invariant by the action of a finite matrix multiplicative group G . It consists of expressing the polynomial equations in terms

of some primary invariants Π_1, \dots, Π_n (e.g., the elementary symmetric polynomials), and one single “primitive” secondary invariant. The primary invariants are a transcendence basis of the algebra of invariants of the group G over the ground field k , and the powers of the primitive invariant give a basis of the field of invariants considered as a vector space over $k(\Pi_1, \dots, \Pi_n)$. The solutions of the system are given as roots of polynomials whose coefficients themselves are given as roots of some other polynomials: the representation of the solutions (x_1, \dots, x_n) breaks the field extension $k(x_1, \dots, x_n) : k$ in two parts (or more). © 1997 Published by Elsevier Science B.V.

Introduction

Let (F) be a system of p polynomial equations $F_i(x_1, \dots, x_n) \in k(x_1, \dots, x_n)$ where k is a commutative field. Solving (F) can mean many different things. For the numerical mathematicians it means finding approximated values of the isolated points of the variety defined by (F) . Our point of view is computer algebra and we shall not deal here with the numerical mathematician’s point of view; we just quote [20], where it is shown how the symmetries can be considered in the numerical methods using homotropies.

In computer algebra, solving (F) is usually meant to be finding a “convenient” system of generators of the ideal $I = (F_1, \dots, F_p)$, or of any ideal that has the same radical as I (and hence defines the same sub-variety of k^n , where k^n is an algebraic closure of k). A “convenient” system of generators is usually understood to be a triangular system with degrees as low as possible. Standard bases are such systems, but they break the symmetries of the system. Yet, Karin Gattermann is working on decreasing the complexity of standard bases by using symmetries.

Here, we shall not try to give generators of the ideal I . We shall try to express the points of the variety defined by I in k^n in successive steps, by introducing some intermediate field extensions between k

and the extension of k generated by the coordinates of the solutions of (F) .

For this, we shall use the symmetries of (F) and express the polynomials F_i , of our system (F) as algebraic elements over a transcendental extension of k . The way we express the F^i in terms of other polynomials using the symmetries of (F) can be seen as an application of a more general problem: how to express the invariants of a group in terms of a small number of them, in fact thanks to a primitive element. This idea was developed in the research, where it was used to compute relative resolvents, in computational Galois theory.

Adopted from: Colin A. Solving a system of algebraic equations with symmetries' //Journal of Pure and Applied Algebra 117& 118 (1997) 195-215 URL:

https://www.sciencedirect.com/science/article/pii/S002240499700011X?ref=pdf_download&fr=RR-2&rr=817a23e78bba84f8

3. Render the article. Practice using “Useful Language”.

Useful Language

1. The article under the title (the name) ... is taken from ...
2. It is written by ...
3. The theme of the article is closely connected with title of the article
4. This article deals with..., is devoted to ...
5. The main idea is expressed in the first (the last) paragraph
6. At the beginning the author describes, explains, introduces, analyses, gives a review of..., comments on, enumerates, points out...
7. From the article we learn that...
8. At the end the author concludes that ...
9. To my mind (in my opinion) ...
10. As far as I know, understand, remember...
11. For all I know...
12. First, to begin with...

13. The thing (problem, fact, point) is ...
 14. On the one hand..., on the other hand
 15. Summing it up..., overall (in short...)
 16. I can't but agree with the author that...
 17. I'd like to stress the point (the idea) that...
 18. As far as I am concerned I can add the following...
 19. I mean to say...
 20. But I'd like to say a few words in this connection...
 21. As far as I can see...
 22. More than that...
 23. Generally speaking...
- 4. *Make up a poster presentation about goals and objectives of your scientific research.***

Unit II. ALGEBRA

Part 2. The Importance of Critical Thinking

1. *Discuss the following questions with your classmates. Explain your answer. Express your attitude to the received response, your agreement or disagreement with the partner's opinion.*

- Do you break down a complex problem into parts?
- Do you have reasons for your confidence in your judgment?
- Do you take other people's experiences into account?

2. *Practice pronunciation of the words below. Check if you know their meaning*

1. construct [kən'strʌkt] строить
2. inconsistency [ɪnkən'sɪstənsɪ] непоследовательность
3. relevance ['relɪvəns] значимость
4. accumulating [ə'kju:mjʊleɪtɪŋ] накапливающий
5. to deduce [dɪ'dju:s] выводить

6. to seek [si:k] искать
7. exposing [ɪk'spəʊzɪŋ] выставяющий, разоблачающий
8. fallacy ['fæləsi] заблуждение
9. acquire [ə'kwaɪə] приобретать
10. strengthen ['streŋθən] укреплять
11. to enhance [ɪn'hɑ:ns] усиливать, повышать
12. hinders ['haɪndə] препятствовать
13. misconception ['mɪskən'sepʃn] недопонимание
14. compatible [kəm'pætəbl] совместимый
15. consensus [kən'sensəs] согласие
16. restricted [rɪs'trɪktɪd] ограниченный
17. flexible ['fleksəbl] гибкий, эластичный
18. diverse [daɪ'vɜ:s] разнообразный, различный
19. promote [prə'məʊt] способствовать, содействовать
20. comprehension [kəmprɪ'henʃn] понимание, осмысление

3. *Translate the following word combinations into Russian.*

1. logical connections
2. independent thinking
3. accumulating information
4. challenging consensus
5. diverse sources
6. process of self-evaluation
7. maintain objectivity
8. persistent biases
9. acquired through
10. human reasoning

4. *Find the English equivalents to the following word combinations in the text. Make up your own sentences with these phrases.*

1. оценка аргументов

2. вывести последовательности
3. довольно совместимый
4. гибкие интеллектуальные навыки
5. сознательное усилие

5. Match column A and B.

A	B
1. fallacy	a) выводить
2. to enhance	b) усиливать
3. consensus	c) заблуждения
4. to deduce	d) гибкий
5. flexible	e) согласие

6. Read the text and answer the following questions:

1. How critical thinking can help us?
2. Why doesn't critical thinking hinder creativity?
3. Why critical thinking is very important in the new knowledge economy?
4. What are the top three skills that supposed to be most relevant?
5. How to describe the way we think?

Text 2B

WHAT SHOULD WE KNOW ABOUT CRITICAL THINKING?

1. *Critical thinking is the ability to think clearly and rationally about what to do or what to believe.*

It includes the ability to engage in reflective and independent thinking. Someone with critical thinking skills is able to do the following:

- understand the logical connections between ideas
- identify, construct and evaluate arguments
- detect inconsistencies and common mistakes in reasoning

- solve problems systematically
- identify the relevance and importance of ideas
- reflect on the justification of one's own beliefs and values

Critical thinking is not a matter of accumulating information. A person with a good memory and who knows a lot of facts is not necessarily good at critical thinking. A critical thinker is able to deduce consequences from what he knows, and he knows how to make use of information to solve problems, and to seek relevant sources of information to inform himself.

2. Critical thinking should not be confused with being argumentative or being critical of other people. Although critical thinking skills can be used in exposing fallacies and bad reasoning, critical thinking can also play an important role in cooperative reasoning and constructive tasks. Critical thinking can help us acquire knowledge, improve our theories, and strengthen arguments. We can use critical thinking to enhance work processes and improve social institutions.

Some people believe that critical thinking hinders creativity because it requires following the rules of logic and rationality, but creativity might require breaking rules. This is a misconception. Critical thinking is quite compatible with thinking "out-of-the-box", challenging consensus and pursuing less popular approaches. If anything, critical thinking is an essential part of creativity because we need critical thinking to evaluate and improve our creative ideas.

3. Critical thinking is a domain-general thinking skill. The ability to think clearly and rationally is important whatever we choose to do. If you work in education, research, finance, management or the legal profession, then critical thinking is obviously important. But critical thinking skills are not restricted to a particular subject area. Being able to think well and solve problems systematically is an asset for any career.

4. Critical thinking is very important in the new knowledge economy. The global knowledge economy is driven by information and technology. One has to be able to deal with changes quickly and effectively. The new economy places increasing demands on flexible intellectual skills, and the ability to analyze information and integrate diverse sources of knowledge in solving problems. Good critical thinking promotes such thinking skills, and is very important in the fast-changing workplace.

5. Critical thinking enhances language and presentation skills. Thinking clearly and systematically can improve the way we express our ideas. In learning how to analyze the logical structure of texts, critical thinking also improves comprehension abilities.

6. Critical thinking promotes creativity. To come up with a creative solution to a problem involves not just having new ideas. It must also be the case that the new ideas being generated are useful and relevant to the task at hand. Critical thinking plays a crucial role in evaluating new ideas, selecting the best ones and modifying them if necessary

7. Critical thinking is crucial for self-reflection. In order to live a meaningful life and to structure our lives accordingly, we need to justify and reflect on our values and decisions. Critical thinking provides the tools for this process of self-evaluation.

8. Good critical thinking is the foundation of science and democracy. Science requires the critical use of reason in experimentation and theory confirmation. The proper functioning of a liberal democracy requires citizens who can think critically about social issues to inform their judgments about proper governance and to overcome biases and prejudice.

9. Some words about the future of critical thinking. In January 2020, the World Economic Forum issued a report "The Future of Jobs". It says: The Fourth Industrial Revolution, which includes developments in previously disjointed fields such as artificial intelligence and machine-learning, robotics, nanotechnology, 3-D

printing, and genetics and biotechnology, will cause widespread disruption not only to business models but also to labour markets over the next five years, with enormous change predicted in the skill sets needed to thrive in the new landscape. The top three skills that supposed to be most relevant are thinking skills related to critical thinking, creativity, and their practical application. These are the cognitive skills that our website focuses on.

10. Critical thinking is a metacognitive skill. What this means is that it is a higher-level cognitive skill that involves thinking about thinking. We have to be aware of the good principles of reasoning, and be reflective about our own reasoning. In addition, we often need to make a conscious effort to improve ourselves, avoid biases, and maintain objectivity. This is notoriously hard to do. We are all able to think but to think well often requires a long period of training. The mastery of critical thinking is similar to the mastery of many other skills. There are three important components: theory, practice, and attitude.

11. If we want to think correctly, we need to follow the correct rules of reasoning. Knowledge of theory includes knowledge of these rules. These are the basic principles of critical thinking, such as the laws of logic, and the methods of scientific reasoning, etc. Also, it would be useful to know something about *what not to do* if we want to reason correctly. This means we should have some basic knowledge of the mistakes that people make. First, this requires some knowledge of typical fallacies. Second, psychologists have discovered persistent biases and limitations in human reasoning. An awareness of these empirical findings will alert us to potential problems.

12. However, merely knowing the principles that distinguish good and bad reasoning is not enough. We might study in the classroom about how to swim, and learn about the basic theory, such as the fact that one should not breathe under water. But unless we can apply such theoretical knowledge through constant practice, we might not actually be able to swim.

Similarly, to be good at critical thinking skills it is necessary to internalize the theoretical principles so that we can apply them in daily life. There are at least two ways. One is to do lots of good-quality exercises. Exercises include not just exercises in classrooms and tutorials. They also include exercises in the form of discussion and debates with other people in our daily life. The other method is to think more deeply about the principles that we have acquired. In the human mind, memory and understanding are acquired through making connections between ideas.

13. Good critical thinking skills require not just knowledge and practice. Persistent practice can bring about improvements only if one has the right kind of motivation and attitude. The following attitudes are not uncommon, but they are obstacles to critical thinking:

- I prefer being given the correct answers rather than figuring them out myself.
- I don't like to think a lot about my decisions as I rely only on gut feelings.
- I don't usually review the mistakes I have made.
- I don't like to be criticized.

To improve our thinking, we have to recognize that the importance of reflecting on the reasons for belief and action. We should also be willing to engage in debate, break old habits, and deal with linguistic complexities and abstract concepts.

14. The *California Critical Thinking Disposition Inventory* is a psychological test that is used to measure whether people are disposed to think critically. It measures seven different thinking habits listed below, and it is useful to ask ourselves to what extent they describe the way we think:

1. Truth-seeking – Do you try to understand how things really are?
2. Open-mindedness – How receptive are you to new ideas, even though intuitively they do not agree with you?
3. Analyticity – Do you try to understand the reasons behind things?

4. Systematicity – Are you systematic in your thinking?
5. Confidence in Reasoning – Do you always defer to other people? How confident are you in your own judgment? Do you have a way to evaluate your own thinking?
6. Inquisitiveness
7. Maturity of Judgment – Do you jump to conclusions? Do you try to see things from different perspectives? Finally, as mentioned earlier, psychologists have discovered over the years that human reasoning can be easily affected by all kinds of cognitive biases. For example, people tend to be over-confident of their abilities and focus too much on evidence that supports their pre-existing opinions. We should be alert to these biases in our attitudes towards our own thinking.

15. In a survey conducted by the Higher Education Research Institute, 99.6% of university teachers agreed that critical thinking is a "very important" or "essential" goal for undergraduate education. But how should critical thinking be taught? There are lots of different issues to be investigated, such as:

- Should critical thinking be taught as a separate subject on its own, or should it be taught in combination with other specific subjects that the students are studying?
- Which are the topics that are most crucial? How useful are lessons in formal logic or Venn diagrams? How should we go about designing a curriculum?

Research from education psychology and cognitive science are very much relevant when designing an effective pedagogy for teaching critical thinking.

Adapted from: <https://philosophy.hku.hk/think/critical/definitions.php>

After text tasks

2. *What is the main idea of the text? Choose the correct answer. Offer your own version of the main idea of the text.*

- a) Critical thinking is a metacognitive skill.
- b) Critical thinking is the ability to think clearly and rationally about what to do or what to believe.
- c) Critical thinking is a higher-level cognitive skill that involves thinking about thinking.

3. *Mark true (T) or false (F) sentences.*

- a) Critical thinking should be easily confused with being argumentative or being critical of other people.
- b) We can use critical thinking to enhance work processes and improve social institutions.
- c) We often need to make a conscious effort to improve ourselves, avoid biases, and maintain objectivity.
- d) Critical thinking skills are restricted to a particular subject area
- e) In the human mind, memory and understanding are acquired through making connections between ideas.

4. *What paragraph gives information:*

- about the importance of critical thinking;
- about the future of critical thinking;
- that critical thinking is an important ability;
- that critical thinking plays a crucial role in evaluating new ideas, selecting the best ones and modifying them if necessary;
- that critical thinking can help us acquire knowledge, improve our theories, and strengthen arguments;
- that being able to think well and solve problems systematically is an asset for any career.

5. *Choose the correct answer to the given question. Make your own question to the text with the question word “Why”. Ask your partner this question.*

Why do some people believe that critical thinking hinders creativity?

- a) ... because, it is domain-general thinking skill.
- b) ... because, it is a metacognitive skill.
- c) ... because, it requires following the rules of logic and rationality.

6. Complete the sentences.

1. To be good at critical thinking skills it is necessary....
2. A critical thinker is able
3. We can use critical thinking to enhance
4. But critical thinking skills are not restricted to
5. Thinking clearly and systematically can improve

Let's practice communication skills

(Adopted from: Armer T. Cambridge English for scientists. Cambridge University Press.

<https://portal.tpu.ru/SHARED/m/MALORISS/studentam/SelfStudy/Tab2/Posobie5cours.pdf>)

7. Read the headlines and beginnings of two news articles reporting a recent scientific development. Then answer the questions below. Find 2 titles of articles from a scientific journal and a popular science magazine. What are their differences?

Headlines and beginnings

1. *“The ‘Chocolate Cure for Emotional Stress’”.*

There may well be another important reason for giving your sweetheart sweets for Valentine’s Day ...

2. *“New Evidence That Dark Chocolate Helps Ease Emotional Stress”*

The 'chocolate cure' for emotional stress is getting new support from a clinical trial published ...

Questions

1. Do you think the claims made in the headlines seem likely or unlikely? Why?
2. In general, how can the science reported in the media differ from the actual science? Why do you think there is a difference?

3. If you wanted to learn more about the research you see reported in the newspaper, where could you look for more information?

8. *You are a junior researcher and you are supervising a student. You have asked the student to investigate the claims in the headlines and then to write a critical review of the research. Complete the sentences below in your own words. Then in pairs, discuss your answers.*

a) If you read research critically, it means that you ...

b) You should always read research critically because ...

9. *Your friend has some questions about writing a critical review. In pairs, discuss questions 1-5.*

1. How long should my review be?

2. Can I write a critical review if I've only read the abstract?

3. How should I approach the reading? What should I read first?

4. Is it a good idea to think of questions I want answered?

5. Do I need to take notes or can I just highlight the relevant bits of the text?

10. *Before reading a research paper, your group mate writes seven questions to help him. Match the questions (1-7) to the section of the research paper below where you would expect to find the answer.*

Questions:

1. What variables were investigated?

2. How did the authors interpret the results?

3. What were the main findings?

4. Why is this research relevant?

5. Who/What was studied?

6. What procedure was used?

7. What was the hypothesis?

Sections of the research paper:

- A. Introduction: _____
- B. Method: _____
- C. Results: _____
- D. Discussion: _____

11. Read two extracts from your group mate's completed critical review and answer the question.

- 1. Which extract (A or B) ...
 - a) summarizes part of the research?
 - b) gives an evaluation?

Extract A. 30 young healthy adults completed a pre-trial questionnaire to assess the anxiety levels and based on this, they were classified as either high or low anxiety. All participants ate 40 g of dark chocolate a day for 14 days. On days 1, 8 and 15 blood samples were taken and changes were analyzed. The research found that after 14 days, the level of stress hormones was reduced in all participants. In addition, there was less difference between the two groups in energy metabolism and gut microbial activity.

Extract B. One problem with the research is the small sample size (only 30 people) which was further divided into smaller groups. There was also no control group in the study, making it impossible to conclude that chocolate was the cause of the changes seen rather than some other factor such as other food or drink, lifestyle change or activity level. Furthermore, only young healthy adults were investigated and so the results cannot be applied to those who are older or have pre-existing health issues.

12. Read and translate six extracts below from a critical review of another paper. What phrases should be used in the review of scientific articles? Suggest any other phrases.

- a) A bad thing about this research is there were only 20 participants. Another problem is all the subjects were hospital employees.
- b) Also, the blood flow in the brachial artery was measured before they drank the coffee, and 30 and 60 minutes after.
- c) The researchers looked at how the blood flow changed.
- d) The result of the research was that the people who drank caffeinated coffee had decreased blood flow to their upper arm.
- e) The results might not be the same for the general population. There was also no measurement of the changes in blood pressure and blood flow after one hour, so we can't know when blood flow returns to normal.
- f) 20 subjects, between the ages of 25 and 50, who usually drank little coffee, were given either a caffeinated or decaffeinated Italian espresso coffee. They gave blood before the coffee was drunk, and an hour later.

13. Put extracts a-f in the correct order to make two paragraphs. One paragraph should summarize part of the research; the other should give an evaluation.

14. Find a piece of published research you are interested in and then write two paragraphs of a critical review in an appropriate style.

Unit III. GEOMETRY

Part 1. Geometry of Generalized Complex Numbers

1. Discuss the following questions with your classmates. Explain your answer. Express your attitude to the received response, your agreement or disagreement with the partner's opinion.

- Have you ever participated in an experiment?
- Have you ever written a report on an experiment?

- Have you found more difficult to make an experiment or to report on it?
- Could you describe a laboratory experiment you took part in?
- Could you tell about scientific research methods you used in your experiment?

2. *Read and translate the text. Be ready to analyze the author's point of view using useful phrases given below.*

Text 3 A

GENERALIZED COMPLEX NUMBER SYSTEMS

Alternative definitions of the imaginary unit i other than $i^2 = -1$ can give rise to interesting and useful complex number systems. The 16th-century Italian mathematicians G. Cardan (1501-1576) and R. Bombelli (1526-1572) are thought to be among the first to utilize the complex numbers we know today by calculating with a quantity whose square is -1 . Since then, various people have modified the original definition of the product of complex numbers. The English geometer W. Clifford (1845-1879) developed the "double" complex numbers by requiring that $i^2 = 1$. Clifford's application of double numbers to mechanics has been supplemented by applications to noneuclidean geometries. The German geometer E. Study (1862-1930) added still another variant to the collection of complex products. The "dual" numbers arose from the convention that $i^2 = 0$. Well known in kinematics is the use of dual number methods for the analysis of spatial mechanisms, robotic control, and virtual reality. The ordinary, dual, and double numbers are particular members of a two-parameter family of complex number systems often called binary numbers or generalized complex numbers, which are two-component numbers of the form $z = x + iy$ ($x, y \in \mathbb{R}$) where $i^2 = iq + p$ ($q, p \in \mathbb{R}$). It can be shown that generalized complex number systems are isomorphic (as

rings) to the ordinary, dual, and double complex numbers when $p + q^2/4$ is negative, zero, and positive, respectively.

In this article we study the geometry of a one-parameter family of generalized complex number systems in which $i^2 = p$, so that $q = 0$ and $-\infty < p < \infty$. Those who know the geometries of Laguerre and Minkowski will recognize that they arise naturally from generalized complex planes. Moreover, interrelations among the various complex products become obvious when the story of these planes unfolds.

Adopted from: Harkin A.A., Harkin J. B. Geometry of Generalized Complex Numbers// MATHEMATICS MAGAZINE pp.118-129 URL:

<https://ds.amu.edu.et/xmlui/bitstream/handle/123456789/11712/Mathematics%20Magazine%20Vol.%2077%2C%20No.%202%2C%20April%202004.pdf?sequence=1&isAllowed=y#page=36>

3. Interpret the author`s point of view from the given extract.

Useful language

How to interpret the author`s point of view

- The author gives full coverage to...
- The author outlines...
- The extract contains the following facts.../ describes in details...
- The author starts with the statement of the problem and then logically passes over to its possible solutions.
- The author asserts that...
- The author resorts to this case to underline the importance of this problem...

Interpreting the author`s conclusions

- In conclusion the author says / makes it clear that.../ gives a warning that...
- In conclusion the author:
dwells on ...
points out ...
generalizes ...
reveals ...

exposes ...

gives a summary of ...

- At the end of the extract the author sums it all up by saying ...
- The author concludes by saying that../ draws a conclusion that / comes to the conclusion that ...

Let's practice writing

4. Write an essay about 250 words. Choose the topic.

- Peculiarities of a scientific style of writing
- Scientific research methods
- Rules of scientific communication
- Structure of a scientific article

Unit III. GEOMETRY

Part 2. How to Report on an Experiment

1. Discuss the following questions with your classmates. Explain your answer. Express your attitude to the received response, your agreement or disagreement with the partner's opinion.

- What parts should a report on an experiment include?
- Do you agree that theory is the most important part of the report? If no, give reasons, prove your idea.
- Why do we need to write a conclusion in a report?

2. Practice pronunciation of the words below. Check if you know their meaning.

1. result [rɪ'zʌlt] результат
2. attach [ə'tætʃ] прикреплять
3. data ['deɪtə] данные
4. experiment [ɪks'perɪmənt] эксперимент

5. critique [kri'ti:k] критика
6. conclude [kən'klu:d] заключить
7. summarize ['sʌməraɪz] резюмировать
8. possible ['pɒsəbl] вероятный
9. chart [tʃɑ:t] диаграмма
10. obtain [əb'teɪn] получать
11. explanation [eksplə'neɪʃn] объяснение
12. deviation [di:vɪ'eɪʃn] отклонение
13. sheet [ʃi:t] лист
14. value ['vælju:] значение
15. available [ə'veɪləbl] доступный
16. illustrate ['ɪləstreɪt] иллюстрировать
17. benefit ['benɪfɪt] выгода
18. encouraged [ɪn'kʌrɪdʒd] поощренный
19. explain [ɪks'pleɪn] объяснять
20. essence [esns] сущность

3. Translate the following word combinations into Russian.

1. Laboratory report
2. Technical report
3. Extremely short
4. Intelligent physics student
5. Scientific manner
6. Detailed diagrams
7. Theoretical predictions
8. Specific questions
9. Instructive exercise
10. Important formulas

4. Match column A and B.

A	B
1. experiment	a) кратко
2. purpose	b) эксперимент
3. concisely	c) цель
4. essential	d) важный
5. rationale	e) обоснование

5. Find the English equivalents to the following word combinations in the text. Make up your own sentences with these phrases.

1. Лабораторный отчет
2. Описание объекта эксперимента
3. Навык осознания
4. Используемые формулы
5. Теоретическими прогнозами

6. Read the text and answer the following questions:

1. How should data be presented?
2. What is the purpose of the experiment?
3. What are the stages of an experiment?
4. What do you expect from the results of the experiment?
5. Why do you need a report which must have certain content to accomplish?

Text 3B

SOME TIPS TO WRITE A REPORT ON AN EXPERIMENT

1. A laboratory report should communicate, as clearly and concisely as possible, the rationale for the experiment, what was done, what the results were and what the results mean. On the basis of a report on an experiment a reader should, basically, be able to repeat it and get similar results. The report should be as short and simple as possible to

accomplish these ends; it takes practice to learn how to write a technical report which does this well. Any report must have certain content to accomplish the above purpose and to facilitate the administration of the course. While the specific format outlined below is not essential for this, it is one way to accomplish it and students should find following it to be useful and instructive. However, as long as the objectives above are accomplished, this scheme may be reasonably modified for certain labs if desired. For instance, if an experiment has several parts which use different apparatus or if the same apparatus is used to do several different experiments, the material in some sections may need to be repeated for the various different situations and this should be organized in the most suitable way.

2.Heading

Identify the experiment by name and give the date performed, your name (first and underlined) and that of your lab partner(s), and lastly the name of your scientific supervisor.

Abstract

Give an extremely short (only a few sentences) description of the object of the experiment and a statement of your principal results.

Theory

Start with the motivation (or reason) for the experiment. Follow this with the theory behind the experiment. Give a brief presentation, in your own words, of the essential ideas behind the experiment. Include only the most important formulae (explaining the meaning of any symbols used). Do not give any derivations unless they are original. The purpose is just to establish the context of the experiment and state, for reference, the relations you will be using in analyzing your data. (The proverbial interested reader should be able to look up details elsewhere on the basis of your outline.) One paragraph, in good English, should suffice.

3. Experiment. Succinctly describe, in your own words, the apparatus used and the procedures followed to get your results. It is best to do this without reference to the lab manual. Relying on your own memory is more authentic and provides practice for your powers of observation. Tell what you did so that someone else could duplicate it from your description. Obviously, neither your TA nor the other students need this exposition (any more than they need your solutions to the homework problems for the lecture part of the course); they all know about the experiment. This is an instructive exercise, for your benefit, in attending to and understanding facts in a scientific manner and to give you practice in describing them intelligibly. Think of your reader as an intelligent physics student who has not done the experiment. You should demonstrate clearly to your scientific supervisor that you know and understand what you did and can articulate it simply. Often the simplest and clearest way to explain something is to give a schematic drawing. This means a drawing without the details that are not essential to the point you are trying to communicate. It is important to gain the skill of realizing and illustrating the essence of a situation. This will also make it easier for the TA to read and understand what you write. So, you are encouraged to use such drawings and you should include one of the apparatuses used. However, do not copy the detailed diagrams in the lab manuals directly, a rough sketch of the apparatus showing the relevant physical variables (e.g., x , y , $[\theta]$, etc.) is appropriate. Emphasize sketches of the equipment but three-dimensional artist's sketches are inappropriate. Such a drawing should illustrate what *you* have to say.

4. Data Analysis. Give one example of each calculation made; it should be clear that you understand what you are doing. You may do the other calculations separately and include only the final results. For your own benefit (and for the instructor's sanity): **BE NEAT!** Calculate errors and show any error formulae used; again, include one sample calculation. Clearly state the results you obtain. Data should be

presented in an organized form, such as in tables, charts and graphs, and stated in correct *SI* units. Do not use the tables from your original data sheets for this purpose. All data is to be recopied and reformatted in the Data Analysis section of the write-up. Experimental data should be compared to theoretical predictions and calculations. Include the error analysis (such as standard deviations and uncertainties) in your tables and with your final results. For help on error analysis, see the *Error Analysis* section in the lab manual. See the section on *Graphs and Curve Fitting* in the lab manual for an explanation on obtaining results from your graphs and data. If a book value for the measurement is available, state the number of standard deviations that your result differs from the accepted value.

5. Conclusion. Summarize, in a paragraph or two, what you conclude from the results of your experiment and whether they are what you expected them to be. Compare the results with theoretical expectations and include percent error when appropriate. Don't use terms such as "fairly close" and "pretty good;" give explicit quantitative deviations from the expected result. Evaluate whether these deviations fall within your expected errors and state possible explanations for unusual deviations. Discuss and comment on the results and conclusions drawn, including the sources of the errors and the methods used for estimating them. Include brief answers to the specific questions asked in the lab instructions.

6. Remarks

Please critique the experiment as presented in the lab manual. Could the lab be done in a better way? Do you have some other or original method for obtaining the same results? Your suggestions are encouraged and are used to improve the lab manual.

Data

Attach a copy of the initialed data which you took in the lab to the back of your lab write-up.

Adapted from:
http://teacher.pas.rochester.edu/PHY_LABS/Write_Report/Write_Report.html

After text tasks

7. What is the main idea of the text? Choose the correct answer.

Offer your own version of the main idea of the text.

- a) It is necessary to report on an experiment correctly using special rules.
- b) An experiment has several important parts which use different apparatus.
- c) The timeframe of speaking about the experiment is very limited.

8. Mark true (T) or false (F) sentences.

- a) It is important to gain the skill of realizing and illustrating the essence of a situation.
- b) A laboratory report should reveal real and clear results of the experiment.
- c) A report sometimes has certain content to accomplish the above purpose and to facilitate the administration of the course.
- d) A researcher should summarize, in a paragraph or two, what he/she conclude from the results of the experiment.
- e) You should never critique the experiment.

9. In what paragraph is it written...

- that you should give a brief presentation, in your own words, of the essential ideas of the experiment
- how to describe an experiment
- what a laboratory report should be like
- what are major parts of the report
- how to make a conclusion

10. Choose the correct answer to the given question. Make your own question to the text with the question word "Why". Ask your partner this question.

What are the most important things about a laboratory report?

- a) The report should be long and difficult.
- b) The report should be as short and simple as possible to accomplish these ends.
- c) The report should be understandable even for children.

11. Complete sentences.

- On the basis of a report on an experiment a reader should
- Any report must have certain content to accomplish
- When writing a theory you should start with
- You should demonstrate clearly to your scientific supervisor that... .
- Data should be presented in

Let's practice communication skills

*(Adopted from: Armer T. Cambridge English for scientists. Cambridge University Press.
<https://portal.tpu.ru/SHARED/m/MALORISS/studentam/SelfStudy/Tab2/Posobie5cours.pdf>)*

12. Do you agree that the scientific method is a process in which experimental observations are used to answer questions? Complete the collocations for describing the stages in the scientific method using given words and phrases.

a hypothesis – an experiment (x2) – conclusions – data (x3) – the question

1. analyse _____
2. collect _____
3. conduct (or run) _____
4. define _____
5. design _____
6. draw _____ form _____
7. interpret _____

- 13. Number stages (1-8) in the order you would normally do them. Read this extract from a student website and check your answers to the exercise.**

The scientific method is a process in which experimental observations are used to answer questions. Scientists use the scientific method to search for relationships between items. That is, experiments are designed so that one variable is changed, and the effects of the change observed. While the exact methodologies used vary from field to field, the overall process is the same. First, the scientist must define the question – what exactly they are trying to find out. Next the formation of a hypothesis comes, which is an idea or explanation for a situation based on what is currently known. The next stage of the method is the design of an experiment which will allow this hypothesis to be tested. Usually, a primary run of the experiment is conducted, and any changes to the experimental setup made. In each experimental run, data collection takes place, followed by data analysis.

Finally, the data is interpreted and from this, the scientist is able to draw conclusions.

- 14. Read the extract again to find the noun forms of the following verbs.**

Which word(s) use(s) the same form for the verb and the noun?

Analyze, collect, design, explain, form, observe, relate, run, vary.

- 15. Below are the summaries of five experiments. Read each summary and choose which word correctly completes the heading.**

Practical / Theoretical research

Murray Gell-Mann and George Zweig proposed that particles such as protons and neutrons were not elementary particles, but instead were composed of combinations of quarks and antiquarks.

Field / Laboratory experiment

Mark-and-recapture models were used to measure seasonal and habitat changes in house mouse densities on sub-Antarctic Marion Island.

External / Internal validity

The students were carefully matched for social status, subject area, ethnicity, education level, parental smoking, and exposure to targeted advertising

Descriptive / Experimental study

The amount of soy products eaten by each participant was assessed at the start of the study. During the 30 years of the study, the women's incidence of breast cancer was recorded.

Qualitative / Quantitative research

To investigate the effect of eating dark chocolate on stress levels, a blood sample was taken, and the levels of stress hormones measured. After eating the chocolate, a second sample was taken, and hormone levels measured again.

16. Can you think of examples of experiments which describe the headings in Exercise 14?

17. You are a research assistant working as part of a team investigating methods of rolling. In pairs, discuss the following questions.

- What does rolling consist of?
- What materials can be used in rolling?

18. Hydrogen could be an ideal energy source, but is difficult to store. In pairs, look at three possible methods of hydrogen storage below and discuss what you think the advantages and disadvantages of each one might be.

- a) contained as a gas in a high-pressure tank
- b) condensed into a liquid and stored in a tank

c) adsorbed onto a porous material

19. Complete the following summary on variables using given below words.

Affects, collecting, controlled, data, dependent, independent.

How much a variable (1) _____ a relationship can be discovered by (2) _____ experimental (3) _____ changes to the relationship as the variable is changed. In an experiment, there will be:

- one (4) _____ variable – this is the feature you are measuring;
- one or more (5) _____ variables – these are the variables which you change;
- one or more (6) _____ variables – these are not being tested and so, they stay the same.

20. You want to investigate the effect of different chemicals on the substance adsorption in the carbon fibers.

1. In this investigation, which of the following variables will be **independent** and which **controlled**?

- carbonization temperature
- type of substance
- heating rate
- nitrogen flow rate
- ratio of substance to carbon fibers

2. What will be the dependent variable?

21. In pairs, role play a discussion between a researcher and a supervisor about your experiment. First, decide which type of experiment (from Exercise 16) should be used to investigate the problem. Then discuss what the variables in the experiment might be. Use the language you studied.

Unit IV. MECHANICS

Part 1. Underactuated Mechanical Systems

1. Discuss the following questions with your group mates. Explain your answer. Express your attitude to the received response, your agreement or disagreement with the partner's opinion.

- What scientific resources do you use in your researches?
- What do your scientific researches include?
- Who are the most famous scientists in mechanics?
- What are peculiarities of a scientific style of writing?
- What are the rules of scientific written communication?

Text 4A

CONTROL OF UNDERACTUATED MECHANICAL SYSTEMS

Abstract In this paper we discuss the control of underactuated mechanical systems. Underactuated mechanical systems have fewer control inputs than degrees of freedom and arise in applications, such as space and undersea robots, mobile robots, exible robots, walking, brachiating, and gymnastic robots. The Lagrangian dynamics of these systems may contain feedforward nonlinearities, non-minimum phase zero dynamics, nonholonomic constraints, and other properties that place this class of systems at the forefront of research in nonlinear control. A complete understanding of the control of these systems is therefore lacking. We will discuss the application of geometric nonlinear control, as well as methods based on passivity and energy for stabilization and tracking control. We will survey some of the existing results and point to open research problems.

Introduction

A mechanical system may be underactuated" in several ways. The most obvious way is from intentional design as in the brachiation

robot of Fukuda [31], the passive walker of McGeer, the Acrobot, or the Pendubot. Underactuated systems also arise in mobile robot systems, for example, when a manipulator arm is attached to a mobile platform, a space platform, or an undersea vehicle. A third way that underactuated systems arise is due to the mathematical model used for control design as, for example, when joint exibility is included in the model. It is also interesting to note that certain control problems for fully actuated redundant robots are similar to those for underactuated robots.

The class of underactuated mechanical systems is thus rich in both applications and control problems. The class of underactuated mechanical systems is far too broad to survey in a single article. For fully actuated systems there are a number of control results that apply to the entire class, such as feedback linearization and passivity-based adaptive control. By contrast, with the exception of the collocated partial feedback linearization result discussed below, there are few results that are applicable to the entire class of underactuated mechanical systems. For example, the control problems for exible joint robots require somewhat different tools for analysis and controller design than the control problems for gymnastic robots like the Acrobot.

In this article we will confine our discussion primarily to control problems for serial link robots containing both active and passive joints, such as the Acrobot and Pendubot. Our ultimate goal for studying such systems is to understand problems of balance and locomotion in both biological systems and in robotic systems. The reader is referred to the literature for treatment of other classes of underactuated systems, such as exible link robots, exible joint robots, space robots, mobile robots or underwater robots.

The techniques we will discuss for control are mainly based on ideas of passivity and control of energy. Passivity based control has a long and rich heritage having its roots in passive network synthesis

and entering the control field via the Popov Criterion and the Kalman-Yakubovich-Popov Lemma. Passivity in Lagrangian systems is equivalent to the now familiar skew-symmetry property, long known in classical mechanics and whose rediscovery in robot control led to breakthroughs in adaptive control of fully actuated manipulators. In the nonlinear control field the exploitation of passivity has led to dramatic advances in controller design, with the appearance of concepts such as backstepping and more recently forwarding. These methods are not yet generally applicable to all underactuated mechanical systems but can be applied in special cases. In the area of robot locomotion, energy and passivity methods have already achieved some success. Indeed, the work of McGeer and others on passive walking shows that stable limit cycle walking can be achieved by the natural tradeoff between kinetic and potential energy without feedback control of any kind. This work is fundamental, since, for example, there is considerable experimental evidence that a great part of the swing phase in human locomotion is passive. The muscles of the human leg are active primarily during the double support period, when the initial conditions on the angles and velocities of each of the limb segments are being established, after which they essentially turn off and allow the leg to swing through like a jointed pendulum. This use of inertia and gravity coupled with the elastic energy stored and recovered from tendons, muscles, and bones, helps to account for the efficiency of animal locomotion.

Spong M. W. Underactuated mechanical systems //Control problems in robotics and automation. – Berlin, Heidelberg : Springer Berlin Heidelberg, 2005. – C. 135-150. URL: <https://people.csail.mit.edu/katiebyl/ucsb/ece594d/papers/Spong97.pdf>

2. Practice formulating your conclusion on the text.

- Taking into consideration the fact that
- The message of the extract is that..... /The main idea of the article is about
- In conclusion I'd like to...

- From my point of view...
- As far as I am able to judge...
- My own attitude to this extract is...
- I fully agree with / I don't agree with
- I have found the extract important / interesting /of great value

Unit IV. MECHANICS

Part 2. Developing Confidence to Communicate

1. Discuss the following questions with your group mates. Explain your answer. Express your attitude to the received response, your agreement or disagreement with the partner's opinion.

- Have you ever given presentations on your current or proposed research at a department seminar, a conference, or a similar forum? What information did you present?
- Did you feel nervous at the prospect of being asked questions about your research?
- What was the structure of your presentation?
- How to attract the audience`s attention?

2. Practice pronunciation of the words below. Check if you know their meaning.

1. the challenge of presenting [ði:] ['tʃælɪndʒ] [of 'prez(ə)ntɪŋ] задача презентации
2. important [ɪm 'pɔ:tənt] важный
3. calmly ['kɑ:mli] спокойно
4. emphasizing ['emfəsaɪzɪŋ] подчеркивание
5. practical ['præktɪkəl] практический
6. providing [prə 'vaɪdɪŋ] обеспечение
7. audience ['ɔ:dʒəns] аудитория (слушатели)
8. knowledge ['nɒlɪdʒ] знание

9. consider [kən'sɪdə] рассматривать
10. allot [ə'lɒt] предоставлять
11. unfinished [ˈʌn'fɪnɪʃt] незаконченный
12. guideline [ˈgaɪdlaɪn] директива
13. verbatim [və:'beɪtɪm] дословный
14. sympathetic [ˌsɪmpə'θetɪk] сочувствующий
15. significant [sɪg'nɪfɪkənt] значительный
16. feature [ˈfi:tʃə] особенность, свойство
17. gauge [geɪdʒ] измерительный прибор
18. selective [sɪ'lektɪv] отборный
19. expand [ɪks'pænd] расширяться
20. research [rɪ'sɜ:tʃ] исследование

3. *Translate the following word combinations into Russian. Make up your own sentences with these phrases.*

1. particular method
2. provide information
3. relevant knowledge
4. main hypothesis
5. prior knowledge
6. research question
7. principal points
8. broader context
9. naturally encourage discussion
10. key statements

4. *Find the English equivalents to the following word combinations in the text.*

1. понимать зрителя;
2. временной период рассказа;
3. практическое применение;
4. основные понятия;

5. информация на раздаточном материале.

5. Match column A and B.

A	B
1. to refer	a) предсказывать
2. to predict	b) ссылаться
3. be tempted	c) покрывать
4. to cover	d) предоставлять
5. to provide	e) искушаться

6. Read the text and answer the following questions:

1. How important is the amount of information in the presentation?
2. What points are to be focused on while preparing for a presentation?
3. How to overcome uncertainty?
4. What questions do you need to ask yourself to make a presentation?
5. How should you finish the act of communication?

Text 4B

I AM PLANNING TO USE A POWERPOINT PRESENTATION

1. Research higher degree students are often invited or required to give presentations on their current or proposed research at a department seminar, a conference, or a similar forum. Clear as well as complex communication material is a key aspect of professional development. But students are often understandably nervous when faced with the challenge of presenting. So it's important to think carefully of how successful presentations come about.

2. Why are you presenting? Are you outlining a particular method or approach? Are you emphasizing the practical application of your research? Are you providing an overview of your work-in-progress? You need to provide information that your audience will remember

later. But avoid trying to cover every small detail. Keep in mind your reason for presenting.

3. Even when presenting to your department, make a realistic appraisal beforehand of how much relevant knowledge or understanding your audience already has. Ask yourself:

- What kind of prior knowledge of my field does my audience probably have?
- How familiar are they with recent research in this area?
- How much technical knowledge do they possess?
- Do any of them use English as a second language? If so, will this affect my presentation?
- Are there any technical terms that you need to define for your listeners? You need to be able to present your research in a way that will engage and inform all of your audience, not just your supervisor. Think carefully about all these points as you compose your slides and decide how to pace your talk.

4. The timeframe of your talk is a key consideration. A short talk (10-20 minutes) needs to address the topic clearly and directly. It is very important not to exceed your allotted time or, even worse, to have to leave your talk unfinished. So be selective about what you say. Consider adopting the following structure:

What you're doing...

Introduce:

- yourself;
- your topic and the broader context of your research;
- the main hypothesis or research question;
- methods of data collection; and
- the key points your talk will cover.

What you've found (or expect to find) ...

Include:

- key findings, trends in your data, progress to date;

- any difficulties with your method.

Why this is important /relevant...

Specify:

- whether your results confirm your hypotheses;
- whether you may need to redesign any aspect of the research;
- likely implications, or possible applications

5. Well-designed, professional-looking PowerPoint slides can complement most presentations. They can reinforce key statements, help maintain interest and concentration, illustrate concepts that are difficult to explain, and serve as a guide for you, the presenter. However, if you're planning to use a PowerPoint, you need to consider the contents and organization of your slides carefully. To start with, identify your major concepts and principal points. Which ones will require a slide? Ensure the slides are not too cluttered (no more than 8-10 lines of the text); use large font size (24 pt is recommended) and present one topic per slide. Don't simply read out your slides verbatim! The slides should just list key points for you to expand on as you talk.

6. Slides must be discussed and integrated into the flow of your presentation. Your audience should know exactly why the slides have been used. So, if you're presenting pictures, diagrams, tables or graphs, you need to point out their significant features. This takes time. A good guideline is to spend two to three minutes to talk through the points on a slide. If you're presenting for 20 minutes – and you need to allow a few minutes at the end for questions – you may only have time to present a title slide and seven or eight other slides. Practice your presentation with a friend or sympathetic peer, to help you gauge if you have the right amount of material for the time allowed. Also practice your conclusion – to provide a summary for your audience and end your presentation on a strong note. PowerPoint slides can be a means of support, both for the speaker and audience. Don't allow them to take over and detract from the whole presentation. Ensure that

your slides are clear, easy to read, and relevant. Avoid unnecessary “special effects”!

7. Visual presentations need to present information simply and clearly. If you overwhelm your audience with information, they will be tempted to read rather than listen. A graph that you’ve prepared for your thesis, or a screen snapshot copied from a website, may be too detailed for your audience to see clearly or understand. Quantitative information can be presented as a graph or simple table. However, graphs should have bold lines with simple, clearly numbered axes, and strong contrast. Similarly, if you’re presenting information in the form of a bar chart with more than five categories that need to be differentiated, the chart will be difficult to read. In this case, reduce the amount of information in your slide; perhaps you can make two or more slides to indicate different trends in the data. Visuals containing mathematical equations can also be problematic for the audience. They should have ample white space; figures must be bold and large, as well as neat and accurate. Animated effects in PowerPoint can be useful for presenting data. You can set up your slide show so that each set of data appears with a mouse click, allowing you to speak about each data set before, or while, displaying it. This helps to keep your audience engaged. To simplify the data for your presentation you could prepare a subset of slides containing additional information, which could be shown later in response to questions. An alternative would be to include complex or detailed technical information on a handout that your audience can examine more closely afterwards. But distribute these handouts after the presentation or your audience will read them during your talk, instead of listening to you!

8. Many students feel nervous at the prospect of being asked questions about their research. However, a good presentation will naturally encourage discussion and interesting questions. Always spend some time before your presentation to consider those aspects of your research on which you might be questioned. Is your method or

approach unusual? Are there any aspects of your work that are problematic or controversial? What are its practical applications, if any? Generally, you should be able to predict about 75% of the questions you may be asked. You can prepare and practice possible responses. Listen attentively to your questioner. Paraphrase, or repeat, the question or comments, as in the following examples: “So, what you are asking is ...” “So, you’d like to know more about ...” This clarifies what has been asked. It also gives you some thinking time. It’s perfectly acceptable to take a short pause to think before responding to a question. If you can’t provide an answer, first acknowledge the question and say you don’t know, or: “Thank you for asking that question. I can’t answer that question at this point in my research.” or: “Unfortunately, I don’t have that information with me.” You can perhaps offer to find out the answer, or to refer to other sources where the information may be found. There is no shame in not being able to answer every question. Consider yourself a research apprentice. If you knew everything about your topic, you wouldn’t need to be undertaking research in the area.

Adapted from:
https://services.unimelb.edu.au/_data/assets/pdf_file/0005/470075/Presenting_your_research_Update_051112.pdf

After text tasks

7. *What is the main idea of the text? Choose the correct answer.*

Offer your own version of the main idea of the text.

- a) Speaking to the audience may be interesting and exciting.
- b) The main tips to be considered in making presentations.
- c) The ways of becoming a good listener.

8. *Mark true (T) or false (F) sentences.*

- a) Before the presentation some time should be devoted to considering those aspects of the research on which the presenter might be questioned.

- b) Animated effects in PowerPoint can spoil the presenting data.
- c) A good guideline is to spend two to three minutes to talk through the points on a slide.
- d) When having too much information, reduce it in your slide; perhaps you can make just one slide to indicate different trends in the data.
- c) Sometimes it is admitted to present several topics per slide.

9. What paragraph informs the audience about the importance of ...

- pointing out the presentation’s purpose?
- making a realistic appraisal beforehand of how much relevant knowledge or understanding your audience already has?
- considering the timeframe?
- considering the contents and organization of your slides?
- considering a special structure?

10. Put the titles of the paragraphs in the correct order.

Title	Number
a) Clear communication of technical or complex material is a key aspect of professional development.	
b) Presenting technical material visually.	
c) Using PowerPoint slides	
d) Consider your purpose	
e) Dealing with questions.	
f) The way of organizing slides	
g) Consider the structure	
h) Consider your audience	

11. Choose the correct answer to the given question. Make your own question to the text with the question word “Why”. Ask your partner this question. Express your agreement or disagreement with the partner's response.

How can slides contribute to improving your presentation?

- a) The slides should consider only the audience’ possible questions.

- b) The slides should only draw the audience' attention.
- c) The slides should consider only the key points of the presentation material.

12. Complete the sentence.

- a) Well-designed, professional-looking PowerPoint slides can complement
- b) Even when presenting to your department, make a realistic appraisal beforehand of
- c) It is very important not to exceed
- d) Your audience should know exactly
- e) A good presentation will naturally encourage

Let's practice communication skills

*(Adopted from: Armer T. Cambridge English for scientists. Cambridge University Press.
<https://portal.tpu.ru/SHARED/m/MALORISS/studentam/SelfStudy/Tab2/Posobie5cours.pdf>)*

13. Read the following extract from a website and then, in pairs, answer the questions below.

Extract from a website

The University Research Fellowship (URF) aims to develop science in the country by attracting outstanding scientists in their field to continue their research in Kazan Federal University or research institution. URF fellowships are awarded to individual scientists with future potential for leadership in their field. Successful applicants receive a 5-year grant covering salary, travel and relocation costs.

Questions

1. Can an organization apply for this scholarship?
2. Would you be interested in applying for URF? Why/why not?
3. What information might you need to include on your application form?

4. What are the advantages of attracting scientists ‘with future potential for leadership in their field’ to a country?

14. Think about a research project in your area. In pairs, take turns to summarize the project following the instructions (1-6) below.

Instructions

1. State the aims of your research.
2. Define what the problem is.
3. Explain why your topic is worth researching.
4. Say what the expected outcomes of the research are.
5. Outline the procedures you will follow.
6. Outline how you will limit your investigation.

15. Read your group mate’s completed project summary and say what you think the commercial applications of the research might be.

16. Read the Project summary. Make up a brief summary of aims, significance and expected outcomes of the research plan.

A 3-D odour-compass for odour-detecting robots

1. Odour-sensing robots offer many benefits over the current use of animals in similar roles, including safety, efficiency and durability. [A] **However, the robots which have been developed** to date are limited by the fact that they can only accurately detect and navigate towards odour plumes if they are within direct 'sight' of the chemical source. Clearly, in real world situations, obstacles may well impede the robot's detection ability, and at present, odour-sensing robots are therefore only of limited use. [B] **The proposed research will concentrate on developing** a robot which is able to gather readings in three dimensions and therefore overcome the limitations of current

models in odour-detection. [C] **This technology will make robots a more effective substitute for animals.**

2. [D] **This research aims to develop** existing robotic technology to create a three-dimensional (3-D) odour compass to be used as a navigation tool in searching for an odour source. [E] **This will then be tested experimentally** in simulated environments where wind direction is not stable or where obstacles interfere with odour distribution. A second stage in the research will be to develop the robot's environmental sensors, thus allowing it to safely negotiate the terrain to reach the source of the odour. [F] **This should produce a robot** which is able to both detect and move to the source of an odour, even on difficult terrain.

17. Complete the following sentences.

1. My main research focus was to
2. During my project, I focused on
3. As part of the scientific team, I have developed
4. I have been involved in investigating
5. Make a presentation of your project.

Unit V. SECURITY

Part 1. Computer Security

1. Discuss the following questions with your group mates. Explain your answer. Express your attitude to the received response, your agreement or disagreement with the partner's opinion.

- Why is computer security so important?
- Do you think your computer is becoming less or more secure?
- What can you do to enhance your computer security?
- Why do you think hackers do what they do?
- Do you think hackers add to new technology development?

2. Study the active vocabulary. Check pronunciation of the words below.

1. unauthorized access [ʌn'ɔ:θəraɪzd 'ækses] – незаконный доступ
2. sensitive data ['deɪtə] – конфиденциальные сведения; секретные данные
3. configuration settings [kən'fɪgju'reɪʃ(ə)n] – параметры конфигурации
4. user account [ə'kaunt]– учётные данные пользователя
5. corruption [kə'rʌpʃ(ə)n] – повреждение
6. reboot ['ri:bu:t] – перезагружаться; перезапускать систему.
7. security rating [sɪ'kju(ə)rɪtɪ] – общая оценка безопасности; рейтинг безопасности; класс устойчивости ко взлому
8. proprietary data [prə'praɪət(ə)rɪ] – собственные данные (фирмы или пользователя)
9. Common Criteria [kraɪ'ti(ə)rɪən] – стандарт "Общие критерии"; пакет критериев для тестирования систем защиты в компьютерных сетях
10. Trusted Computer System Evaluation Criteria (TCSEC) [ɪ'vælju'eɪʃ(ə)n] – критерии оценки безопасности защищённых вычислительных систем, "Оранжевая книга"
11. evaluation criteria– критерии оценки средств защиты информации Министерства обороны США
12. trusted application [trʌstɪd 'æplɪ'keɪʃ(ə)n] – доверенное приложение
13. be referred to as [rɪ'fɜ:d] – быть известным под именем; именоваться
14. rigorous ['rɪgərəs] – доскональный; тщательный
15. general-purpose operating system ['dʒen(ə)rəl'pɜ:pəs] – универсальная операционная система; операционная система общего назначения

16. discretionary access control – дискреционное управление доступом; избирательное управление доступом; управление доступом по усмотрению администратора или владельца ресурсов
17. security-related events – события, связанные с системой защиты
18. logon identifier – идентификатор для входа в систему
19. security hole – брешь в системе безопасности
20. trusted path – защищённый канал; защищённый маршрут

3. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1. All new users should create new n, c, o, c, t, s, a, u. 2. Having saved a couple of seconds while writing the code, you will spend weeks to catch this elusive memory o, t, o, r, u, c, p, i, n, r error. 3. Once the patches have been installed, users are recommended to t, o, r, e, o, b their computer/PC. 4. Logon identifiers record the identities of all users, making it easy to trace anyone who performs an t, i, h, u, a, d, u, o, r, z, e, n action. 5. Before we leave work each day, we make a c, u, a, k, b, p of all the records we have entered into the computer that day.

4. Match the beginnings (1-5) to the endings (a-e) to make definitions of the words in bold. Define 10 important scientific concepts from your field.

Beginnings

1. **Data corruption** is a process _____
2. **Security rating** is a measurement of _____
3. **Security hole** is an unintentionally unprotected _____
4. In computer security, **discretionary access control** is a type of access control defined by the TCSEC _____
5. **Sensitive data** is _____

Endings

- a) "as a means of restricting access to objects based on the identity of subjects and/or groups to which they belong... "
- b) confidential information that must be kept safe and out of reach from all outsiders unless they have permission to access it.
- c) how well particular software protects data from being seen by anyone who does not have permission.
- d) wherein data in memory or on disk is unintentionally changed, with its meaning thereby altered or obliterated.
- e) entry point into an otherwise secure computer, component, application, or other online resource.

5. Read and translate the text. Be ready to write a Summary Essay using instructions given below (Task 4).

Text 5 A

PROTECTING DATA

Preventing unauthorized access to sensitive data is essential in any environment in which multiple users have access to the same physical or network resources. An operating system, as well as individual users, must be able to protect files, memory, and configuration settings from unwanted viewing and modification. Operating system security includes obvious mechanisms such as accounts, passwords, and file protection. It also includes less obvious mechanisms, such as protecting the operating system from corruption, preventing less privileged users from performing actions (rebooting the computer, for example), and not allowing user programs to adversely affect the programs of other users or the operating system.

Security Ratings

Having software, including operating systems, rated against well-defined standards helps the government, corporations, and home users

protect proprietary and personal data stored in computer systems. The current security rating standard used by the United States and many other countries is the Common Criteria (CC). To understand the security capabilities designed into Windows, however, it's useful to know the history of the security ratings system that influenced the design of Windows, the Trusted Computer System Evaluation Criteria (TCSEC).

Trusted Computer System Evaluation Criteria

The National Computer Security Center (NCSC) was established in 1981 as part of the U.S. Department of Defense's (DoD) National Security Agency (NSA). One goal of the NCSC was to create a range of security ratings, listed in Table 6-1, to be used to indicate the degree of protection commercial operating systems, network components, and trusted applications offer. These security ratings, which can be found at <http://csrc.nist.gov/publications/history/dod85.pdf>, were defined in 1983 and are commonly referred to as "the Orange Book." The TCSEC standard consists of "levels of trust" ratings, where higher levels build on lower levels by adding more rigorous protection and validation requirements. No operating system meets the A1, or "Verified Design," rating. Although a few operating systems have earned one of the B-level ratings, C2 is considered sufficient and the highest rating practical for a general-purpose operating system.

TABLE 6-1 TCSEC Rating Levels

<i>Rating</i>	<i>Description</i>
A1	Verified Design
B3	Security Domains
B2	Structured Protection
B1	Labeled Security Protection
C2	Controlled Access Protection
C1	Discretionary Access Protection (obsolete)
D	Minimal Protection

In July 1995, Windows NT 3.5 (Workstation and Server) with Service Pack 3 was the first version of Windows NT to earn the C2 rating. In March 1999, Windows NT 4 with Service Pack 3 achieved an E3 rating from the U.K. government's Information Technology Security (ITSEC) organization, a rating equivalent to a U.S. C2 rating. In November 1999, Windows NT 4 with Service Pack 6a earned a C2 rating in both stand-alone and networked configurations.

The following were the key requirements for a C2 security rating, and they are still considered the core requirements for any secure operating system:

- A secure logon facility, which requires that users can be uniquely identified and that they must be granted access to the computer only after they have been authenticated in some way.
- Discretionary access control, which allows the owner of a resource (such as a file) to determine who can access the resource and what they can do with it. The owner grants rights that permit various kinds of access to a user or to a group of users.
- Security auditing, which affords the ability to detect and record security-related events or any attempts to create, access, or delete system resources. Logon identifiers record the identities of all users, making it easy to trace anyone who performs an unauthorized action.
- Object reuse protection, which prevents users from seeing data that another user has deleted or from accessing memory that another user previously used and then released. For example, in some operating systems, it's possible to create a new file of a certain length and then examine the contents of the file to see data that happens to have occupied the location on the disk where the file is allocated. This data might be sensitive information that was stored in another user's file but had been deleted. Object reuse protection prevents this potential security hole by initializing all objects, including files and memory, before they are allocated to a user.

- Windows also meets two requirements of B-level security: Trusted path functionality, which prevents Trojan horse programs from being able to intercept users' names and passwords as they try to log on. The trusted path functionality in Windows comes in the form of its Ctrl+Alt+Delete logon-attention sequence, which cannot be intercepted by nonprivileged applications. This sequence of keystrokes, which is also known as the secure attention sequence (SAS), always displays a system-controlled Windows security screen (if a user is already logged on) or the logon screen so that would-be Trojan horses can easily be recognized. (The secure attention sequence can also be sent programmatically via the SendSAS API, if group policy allows it.) A Trojan horse presenting a fake logon dialog box will be bypassed when the SAS is entered.

Trusted facility management, which requires support for separate account roles for administrative functions. For example, separate accounts are provided for administration (Administrators), user accounts charged with backing up the computer, and standard users. Windows meets all these requirements through its security sub-system and related components.

Adapted from: Windows Internals, Sixth Edition, Part 1 (pp. 487-489)

6. Write a Summary Essay of the text "Protecting Data". Follow the instructions given below*:

1. The introduction (one paragraph) contains: the title of the text; the name of the author of the text; the name of the journal / book in which the text was published; the place and year of publication; a one-sentence thesis expressing the main idea of the source.
2. The main part (one or more paragraphs) paraphrases and compresses the original text. Make sure that you include: basic information, but omitted minor points; one or more examples by the author;

3. The conclusion (one paragraph) contains: a summary of the entire text in one sentence; your opinion about the text.

** Useful linking words and phrases are given in appendix 4 “How to Write a Summary Essay”.*

7. Find an article from an English-medium journal, related to your research area. Practice writing Summary Essay of the chosen article, following the above instructions. Present your Summary Essay to the class and discuss it.

Unit V. SECURITY

Part 2. The Importance of Writing Skills in Science

1. In pairs, discuss the following questions.

- What kinds of text do you need to write in English for your work or studies?
- Why is it important to write your texts in an appropriate style?
- What can you do to take note of the different styles of language used in English texts

2. Practice pronunciation of the words below. Check if you know their meaning.

1. adverb [ˈædvə:b] наречие
2. editing [ˈeditɪŋ] редактирование
3. background [ˈbækgraʊnd] задний план
4. statement [ˈsteɪtm(ə)nt] заявление
5. especially [ɪˈspeʃ(ə)li] особенно
6. generalization [dʒen(ə)rəlaɪˈzeɪʃ(ə)n] обобщение
7. metaphor [ˈmetəfə] метафора
8. proofreading [ˈpruːfriːdɪŋ] читка корректуры
9. rhetorical [rɪˈtɔrɪk(ə)l] риторический
10. persuasive [pəˈsweɪsɪv] убедительный

11. conventionally [kən'venʃ(ə)nəli] условно
12. essential [ɪ'senʃ(ə)l] необходимый
13. diminish [dɪ'mɪnɪʃ] уменьшать
14. spelling ['spɛlɪŋ] правописание
15. punctuation [pʌŋ(k)tʃʊ'eɪʃ(ə)n] пунктуация
16. format ['fɔ:mæt] формат
17. possibility [ˌpɒsɪ'bɪlɪti] возможность
18. important [ɪm'pɔ:t(ə)nt] важный
19. skill [skɪl] навык
20. automatically [ˌɔ:tə'mætɪkli] автоматически

3. Translate the following word combinations into Russian.

1. passive voice
2. skills in science
3. break the rules
4. crutch of mediocre writing
5. catch errors
6. editing focuses
7. finish a piece of writing
8. most powerful lessons
9. long exposition
10. relying on figures

4. Read the text and answer the following questions:

1. What is one of the hallmarks of sloppy writing?
2. What writing rules should be observed?
3. What is one of the most important parts of the writing?
4. What is one of the most common manifestations of bad writing?
5. Do we need adverbs while writing? Why?

Text 5 B

HOW TO IMPROVE YOUR WRITING SKILLS IN SCIENCE

1. Use active instead of passive voice. One of the most common manifestations of bad writing is overuse of the passive voice. In English, the most basic sentence structure is S-V-O: Subject–Verb–Object. “*The zombie bit the man*” is an example of this sentence structure. The passive voice can cause confusion by putting the object first: “*The man was bitten by the zombie.*” It usually requires more words and use of a “to be” verb form, which can suck the energy out of your writing. Learn to avoid these constructions as much as you can. Using the passive voice isn't always bad. Sometimes there is no clear way to make a statement active, or sometimes you want the lighter touch a passive construction allows. But learn to follow this rule before you start making exceptions. The main exception to this is science writing, which conventionally uses the passive voice to put the emphasis on the results, rather than the researchers (although this is changing, so check the guidelines before you write). For example, “*puppies fed with spicy dog food were found to have more upset stomachs*” puts the emphasis on the finding rather than the person doing the finding. Cut the chaff. Good writing is simple, clear and direct. You don't get points for saying in 50 words what could be said in 20, or for using multi-syllable words when a short one does just as well. Good writing is about using the right words, not filling up the page. It might feel good at first to pack a lot of ideas and details into a single sentence, but chances are that sentence is just going to be hard to read. If a phrase doesn't add anything valuable, just cut it. Adverbs are the classic crutch of mediocre writing, and they often serve only to clutter up a sentence. A well-placed adverb can be delightful, but much of the time the adverbs we use are already implied by the verb or adjective – or would be if we had chosen a more evocative word. Don't write “*screamed fearfully*” – “scream” already suggests fear. If you

notice that your writing is filled with "-ly" words, it might be time to take a deep breath and give your writing more focus. Sometimes cutting the chaff is best done at the editing stage. You don't have to obsess about finding the most concise way to phrase every sentence; get your ideas down on paper however you can and then go through to edit out unnecessary stuff. Your writing doesn't just exist in a vacuum – it's experienced in conjunction with the reader's imagination. You don't need to describe every detail if a few good ones can spur the reader's mind to fill in the rest. Lay down well-placed dots and let the reader connect them.

2. Show, don't tell. Don't tell your readers anything that could be shown instead. Instead of just sitting your readers down for a long exposition explaining a character's background or a plot-point's significance, try to let the readers discover the same ideas through the words, feelings and actions of your characters. Especially in fiction, putting this classic piece of writing advice into practice is one of the most powerful lessons a writer can learn. For example, "*Sydney was angry after reading the letter*" tells the reader that Sydney felt angry, but doesn't give us any way to see it for ourselves. It's lazy and unconvincing. "*Sydney crumpled the letter and threw it into the fireplace before she stormed from the room*" shows that Sydney was angry without having to say it outright. This is far more effective. Readers believe what we see, not what we're told. Avoid clichés. Clichés are phrases, ideas or situations that have been used so often that they've lost any impact they once had. They're also usually too general to leave a lasting impression on your reader.

3. Whether you're writing fiction or nonfiction, cutting clichés out of your work will make it better. "*It was a dark and stormy night*" is a classic example of a clichéd phrase – even now a clichéd concept. Compare these similar weather-related opening lines: "*It was a bright cold day in April, and the clocks were striking thirteen.*" – 1984, by George Orwell. It's not dark, nor stormy, nor night. But you can tell

right from the start something's not quite right in 1984. “*The sky above the port was the color of television, tuned to a dead channel.*” – Neuromancer, by William Gibson, in the same book that gave us the word “cyberspace.” This not only gives you the weather report, it does so in such a way that you are immediately placed into his dystopian world. “*It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way – in short, the period was so far like the present period, that some of its noisiest authorities insisted on its being received, for good or for evil, in the superlative degree of comparison only.*” – A Tale of Two Cities, by Charles Dickens. Weather, emotion, damnation, and despair – Dickens covered it all with an opening line that leaves the reader ready for anything.

4. Clichés are also important to avoid when you’re writing about yourself. Saying you’re a “*people person*” says nothing definite about you. Saying you’re able to communicate well with a variety of people because you grew up in a bilingual family and lived in six countries growing up lets your reader know you’re a “people person” without you relying on lazy language.

5. Avoid generalizations. One of the hallmarks of sloppy writing is broad generalizations. For example, an academic essay might say something like “*In modern times, we are more progressive than people a hundred years ago.*” This statement makes a host of unfounded assumptions and doesn’t define important ideas like “*progressive.*” Be precise and specific. Whether you’re writing a short story or a scholarly essay, steering clear of generalizations and universal statements will improve your writing. This applies to creative writing, too. Don’t allow yourself to assume anything without examining it.

For example, if you're writing a story about a female character, don't assume that she would automatically be more emotional than a man or more inclined to be gentle or kindly. This kind of non-examined thinking keeps you in a creative rut and prevents you from exploring the variety of possibilities that real life presents.

6. Back up what you say. Don't speculate without providing evidence for your assertions. In creative writing terms, this is similar to the "*show, don't tell*" principle. Don't just say that without a strong police force society as we know it would break down. Why is that true? What evidence do you have? Explaining the thinking behind your statements will allow readers to see that you know what you're talking about. It will also help them determine whether they agree with you. Use metaphors and similes with caution. While a good metaphor or simile can give your writing punch and vigor, a bad one can make your writing as weak as a baby. (That, by the way, was a weak simile). Overusing metaphors and similes can also suggest that you aren't confident with what you're saying and are relying on figures of speech to explain your ideas. They can also become clichéd really quickly. A "*mixed*" metaphor mixes two metaphors so that they don't make sense. For example, "*We'll burn that bridge when we come to it*" mixes the common metaphor "*We'll cross that bridge when we come to it*" and "*Don't burn bridges.*" If you're not sure how a metaphor goes, look it up – or skip it altogether.

7. Break the rules. The best writers don't just follow the rules – they know when and how to break them. Everything from traditional grammar to the writing advice above is up for grabs if you know a transgression will improve your piece. The key is that you have to write well enough the rest of the time that it's clear you are breaking the rule knowingly and on purpose. As with everything, moderation is key. Using one rhetorical question to create a punchy opening can be very effective. Using a string of six rhetorical questions would quickly diminish their effect. Be choosy about when and why you break the

rules. Edit, edit, edit. Editing is one of the most essential parts of writing. Once you finish a piece of writing, let it sit for a day and then read it over with fresh eyes, catching confusing bits or scrapping whole paragraphs – anything to make your piece better. Then when you are through with the writing, give it another read, and another. Some people confuse “editing” with “proofreading.” Both are important, but editing focuses on considering what your content is and how it works. Don’t become so attached to your wording or a particular idea that you aren’t willing to change it if you discover that your ideas would be clearer or effective presented in another way. Proofreading is more technical and catches errors of grammar, spelling, punctuation, and formatting.

Adapted from: <https://www.wikihow.com/Improve-Your-Writing-Skills>

5. Find the English equivalents to the following word combinations in the text. Make up your own sentences with these phrases.

1. улавливать ошибки грамматики;
2. хорошо общаться с разными людьми;
3. чрезмерное использование пассивного залога;
4. один из отличительных признаков;
5. начиная с традиционной грамматики.

6. What is the main idea of the text? Choose the correct answer. Offer your own version of the main idea of the text.

- a) A scientific writing traditionally uses the passive voice to put the emphasis on the results, rather than the researchers.
- b) The importance of improving your writing skills in science.
- c) Editing is one of the most essential parts of writing.

7. Mark true (T) or false (F) sentences.

- a) One of the most common manifestations of bad writing is overuse of the passive voice.

- b) The best writers follow the rules - they never break them.
- c) A "mixed" metaphor mixes two metaphors so that they make sense.
- d) One of the hallmarks of sloppy writing is broad generalizations.
- e) Sometimes cutting the chaff is best done at the editing stage.

8. In what paragraph is it written that using one rhetorical question to create a punchy opening can be very effective?

- a) 1; b) 2; c) 3; d) 4; e) 5; f) 6; g) 7.

9. Put the names of the paragraphs in the correct order.

Title	Number
a) Avoiding cliches and generalizations	
b) Using an active, not a passive voice	
c) Editing is one of the most essential parts of writing	
d) Breaking the rules	
e) Cutting the chaff	
f) Backing up what you say	
g) Show, don't tell	
h) Being precise and specific	

10. Translate the sentence.

The main exception to the choice of the passive voice is science writing, which conventionally uses it to put the emphasis on the results, rather than the researchers (although this is changing, so check the guidelines before you write).

11. Match column A and B.

A	B
1. discover	a) заявление
2. metaphor	b) краткий
3. concise	c) обнаружить
4. statement	d) предположение
5. assumption	e) метафора

12. Complete the sentence.

Once you finish a piece of writing

13. Choose the sentence with the correct word order.

- a) A few good ones don't need to describe every detail mind you to fill in the rest if can spur the readers.
- b) Don't need to describe every detail if you can spur the reader's a few good one's mind to fill in the rest.
- c) You don't need to describe every detail if a few good ones can spur the reader's mind to fill in the rest.

Communication skills

(Adopted from: Armer T. Cambridge English for scientists. Cambridge University Press.

<https://portal.tpu.ru/SHARED/m/MALORISS/studentam/SelfStudy/Tab2/Posobie5cours.pdf>)

14. Match the beginnings to the endings of the questions. What other questions would you ask a young researcher?

Beginnings

- 1. What was you ...
- 2. Why was it ...
- 3. What was already...
- 4. How did you ...
- 5. What did you...

Endings

- a) ... approach the problem?
- b) ... important?
- c) ... expect to know after doing the research?
- d) ... investigating?
- e) ... known about the subject of your research?

15. Read five extracts from the introduction to the paper. Write a question to each extract.

1. _____

Such an extreme environment was thought to be uninhabitable, but microbial ecology studies reported the presence of microorganisms (Amaral-Zettler et al., 2002). Could the surface composition of Mars protect life against radiation?

2.

_____ A number of studies have investigated different extreme Martian surface conditions on terrestrial microorganisms. Nicholson and Schuerger (2005) reported that the spores of *Bacillus subtilis* were able to survive for 19 days under Mars atmospheric pressure and composition. Saffary et al. (2002), however, found that survival decreased due to ...

3.

_____ Potential habitability in the subsurface would increase if the overlaying material did play a protective role.

4.

_____ For many years now, scientists have speculated about the possibility of life on Mars (Klein et al., 1976; McKay, 1997). The discovery of liquid water on Mars would increase its habitability ...

5.

_____ We report here on our studies of protection by Rio Tinto Basin iron oxides and hydroxides on two microorganisms, *Acidithiobacillus ferrooxidans* and *Deinococcus radiodurans*, under simulated Mars surface conditions.

16. In pairs, discuss the following questions. Express your agreement or disagreement with the partner's opinion. Give reasons.

1. What is the purpose of an abstract?
2. How can an abstract help a researcher choose which papers to read?
3. What information does the abstract usually include?
4. Why do some people think a good abstract is even more important in the Internet age than it was before?

17. An abstract usually contains one or two key sentences from each section of a paper. Read the following extracts from the abstract. Match the sections (1 - 4) to the extracts (A-D).

Abstract section names

1. Introduction _____ 3. Results _____
2. Method _____ 4. Discussion _____

Extracts from the abstract

A

With the aim of evaluating this possibility two microorganisms, *Additbiobacillus fetrooxidans*, an acidophile, and *Deinococcus radiodurans*, a radiation-resistant microorganism, were exposed to simulated Mars conditions; that is, 95% CO₂, 2.7% N₂, 1.6% Ar and 0.6% H₂, 0 with a pressure of 7 mbars. Temperature was set at 150 K and ultraviolet radiation was in the wavelength range of 200-400 nm. Exposure was for different times under the protection of 2 and 5 mm layers of oxidised iron minerals. Survival was evaluated by growing the organisms on fresh media.

B

The resistance of organisms to extreme conditions like the conditions which exist on the surface of Mars under the protection of a thin material layer increases the possibility that life could exist on Mars.

C

Here we report that both the 2 and 5 mm thick layers provided enough protection against radiation and Mars environmental conditions for the bacteria to survive.

D

Current surface conditions on Mars are extremely challenging for life. However, Nicholson and Schuerger (2005) reported that *Bacillus subtilis* was able to survive for 19 days under Mars atmospheric

pressure and composition. The question is whether there are any features on Mars that could provide protection against the surface conditions. One possibility is that the surface material plays a protective role due to the fact that it is composed of iron oxides and hydroxides.

18. Read the titles of six research papers. In pairs, decide which titles you think are most helpful for the reader.

- Mobile Security
- Cybersecurity Challenges and Technological Integration
- A Review of Human Vulnerabilities in Cyber Security: Challenges and Solutions for Microfinance Institutions
- Incident Detection Based on Differential Analysis
- The Role of AI in Cyber Security: Safeguarding Digital Identity
- Enhancing Mobile Security through Comprehensive Penetration Testing

19. Read seven suggestions for writing the title of a research paper. Which suggestions should you use to write a good title? Which suggestions don't give good advice?

- a) Make it about 50 words long
- b) Write it as a question
- c) Begin with a phrase like 'A study of ... or An Investigation into ...'
- d) Include a joke or play on words
- e) Include important key words for internet search tools
- f) Include information such as the species studied, the treatment used, etc.
- g) Present the key result

20. Your group mate wants to compare and contrast the doping effects of TCNQ and F4-TCNQ. Read the following draft paragraph and underline the phrases he uses to describe a comparison or a

contrast. Make up your own sentences to compare and contrast some other experimental results in your scientific area.

In contrast to F4-TCNQ, the nonfluorinated version, TCNQ, showed a far less effective charge transfer, even though the fluorine atoms are not directly involved in the charge-transfer process. In the case of TCNQ, the electron affinity was 2.8 eV compared to 5.24 eV for F4-TCNQ. While charge neutrality was reached for F4-TCNQ, with TCNQ the Fermi energy remained at least 0.25 eV above the Dirac point, as shown in Fig. 4. The maximum shift of the band structure was obtained for a TCNQ coverage of 0.4 nm (see Fig. 4d), half that of F4-TCNQ, and no additional shift was observed for higher amounts of deposited molecules.

21. The phrases in bold describe the results of a number of other experiments. Match the beginnings (1-8) to the endings (a-h) to complete extracts from eight different research papers.

Beginnings

1. At high temperature and high pressure, an olivine **showed a noticeable ...**
2. The carbon nanotubes **had an extremely ...**
3. For the hydroxide-to-fiber ratio of 4:1, **slight ...**
4. TAGH **had only a minor ...**
5. The anxiety-related metabolic differences observed in urine **were significantly...**
6. **There were only marginal ...**
7. The robot demonstrated looping behaviour that was similar to that of the ...
8. When running horizontally on the high-h friction surface *T mauritanica*'s average speed **was considerably...**

Endings

- a) **... differences were seen between** the activation efficiency of NaOH and KOH.

- b) ... differences in the pH and temperature over the 3-month **period**,
- c) ... **effect on DNA** synthesis and did not interact with the EGF receptor,
- d) ... **high** capacity.
- e) ... **reduced** following 1 and 2 weeks of dark chocolate consumption,
- f) ... **slower than** *C. draconoides*.
- g) ... **drop in** strength.
- h) ... **successful at** locating the odour source.

22. Look at the phrases above and find adjectives and adverbs which express:

- a) a large degree
- b) a small degree

23. Complete the paragraphs from the results section of a paper using given words and phrases in the box.

Noticeably thicker, as can be seen in, resulted in, a longer, while, considerably contrast to

During the rapid heating, the Ni near the Ni/SiC interface reacted with the SiC, which resulted in carbon atoms moving into the Ni. The carbon atoms then separated onto the surface of the Ni during the cooling procedure, forming graphene layers (1) _____ Fig. 1b. In (2) _____ the grapheme generated using single-crystalline SiC, the graphene synthesised by this process is (3) _____ easier to remove from the SiC surface. A slower heating rate (4) _____ process. As shown in Fig. 4, more carbon atoms were released into the Ni in a long process. Higher carbon concentration in the Ni produced a (5) _____ carbon nanofilm on the Ni surface, (6) _____ a lower carbon concentration reduced the thickness of the carbon nanofilm and formed graphene.

Unit VI. DATA SECURITY

Part 1. What is data security?

1. In pairs, discuss the following questions.

- What is the purpose of data security?
- Why has there been a huge emphasis on data security of late?
- What does the security mechanism of encryption use?

2. Study the active vocabulary. Check pronunciation of the words below.

1. enhance [in'hɑ:ns] – усиливать; расширять; увеличивать; улучшать
2. data masking ['deɪtə 'mɑ:skɪŋ] – маскирование данных
3. redaction [rɪ'dæktʃ(ə)n] – редакция входных данных; компоновка входных данных
4. sensitive information – конфиденциальная информация; уязвимая информация
5. auditing procedure ['ɔ:ditɪŋ prə'si:dʒə] – процедура ревизии (базы данных)
6. data protection regulation ['regju'leɪʃ(ə)n] – Регламент о защите персональных данных (действует в Евросоюзе)
7. robust [rəʊ'blʌst] – устойчивый к сбоям; устойчивый к ошибкам; робастный
8. data security management [sɪ'kju(ə)rɪtɪ] – управление защитой данных
9. insider threat [ɪn'saɪdə θret] – внутрисистемная угроза (со стороны законных пользователей или персонала системы)
10. data breach [brɪ:tʃ] – уязвимость данных; утечка данных
11. crucial ['kru:ʃ(ə)l] – ключевой; критически важный
12. hack [hæk] – незаконно получать доступ к данным

13. high-profile [ˌhaɪ 'prəʊfaɪl] – крупнейший; получивший широкую огласку
14. entail [ɪn'teɪl] – охватывать; включать в себя
15. in stark terms [stɑ:k] – если говорить более предметно; если говорить конкретно
16. troubleshooting ['trʌb(ə)l'fju:tɪŋ] – выявление и устранение неисправностей
17. decryption key [di:'krɪpʃən ki:] – ключ декодирования
18. tokenization [ˌtəʊkənaɪ'zeɪʃən] – выделение базовых элементов
19. erasure [ɪ'reɪzə] – стирание (информации; записи, текста); уничтожение (информации)
20. masked character ['kæɪktə] – маскированный символ
21. data resiliency [rɪ'zɪlɪənsɪ] – устойчивость данных
22. ransomware attack ['rænsəmweə] – атака в целях вымогательства выкупа

3. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1. The application can h, c, n, e, n, a, e the image quality. 2. Developers must implement a s, b, r, o, u, t communication protocol to ensure data integrity. 3. From now on k, t, o, n, e, z, n, a, i, t, o, i will be spread on mobile applications and e-commerce. 4. Many users rely on the support team for s, h, r, o, n, u, e, o, t, o, t, i, g, b, u, l, e software problems. 5. The total cost of a successful a, w, a, r, n, o, m, r, s, e attack ranges from \$713,000 for smaller companies to millions for large organizations and municipalities.

4. Match the beginnings (1-5) to the endings (a-e) to make definitions of the words in bold. Define 10 important scientific concepts from your field.

Beginnings

1. An **insider threat** is _____
2. goal of **data masking** is _____

3. A **data breach** is any security incident _____
4. **Data security management** is _____
5. **Data redaction** is the process of removing or obscuring _____

Endings

- a) to protect sensitive data, while providing a functional alternative when real data is not needed.
- b) the practice of protecting an organization's data throughout its entire lifecycle, including creation, storage, use, sharing, and deletion.
- c) a type of cyberattack originating from an individual who works for an organization or has authorized access to its networks or systems.
- d) in which unauthorized parties access sensitive or confidential information.
- e) sensitive information from documents or datasets to protect privacy and prevent unauthorized access.

5. Read and translate the text. Be ready to write a Summary Essay using instructions given below (Task 4).

TEXT 6 A

SECURITY THREATS

Data security is the process of safeguarding digital information throughout its entire life cycle to protect it from corruption, theft, or unauthorized access. It covers everything – hardware, software, storage devices, and user devices; access and administrative controls; and organizations' policies and procedures.

Data security uses tools and technologies that enhance visibility of a company's data and how it is being used. These tools can protect data through processes like data masking, encryption, and redaction of sensitive information. The process also helps organizations streamline

their auditing procedures and comply with increasingly stringent data protection regulations.

A robust data security management and strategy process enables an organization to protect its information against cyberattacks. It also helps them minimize the risk of human error and insider threats, which continue to be the cause of many data breaches.

Data security is important to organizations in all industries all over the world. Organizations are legally obliged to protect customer and user data from being lost or stolen and ending up in the wrong hands.

Data cybersecurity is also crucial to preventing the reputational risk that accompanies data breach. A high-profile hack or loss of data can result in customers losing trust in an organization and taking their business to a competitor.

Data security and data privacy both involve protecting data, but they are different. Data security entails controlling access to data using stark, black-and-white terms. For example, a data security policy may dictate that no one other than someone troubleshooting a database issue is allowed to see customer payment information – period. In that way, you reduce your chances of suffering a data security breach.

Data privacy, on the other hand, involves more subtle, strategic decisions around who gets access to certain kinds of data. Using the same example, another organization may decide to help the development team to know if a lot of customers have been paying using PayPal. Then they could decide whether it would be wise to start accepting Payoneer, Skrill, or Stripe, too. The organization gives them access to payment info for the next two weeks.

When it comes to data security in cloud computing or on-premises environments, these kinds of decisions fall more under the purview of data privacy.

Organizations can use a wide range of data security types to safeguard their data, devices, networks, systems, and users. Some of the most common types of data security, which organizations should look to

combine to ensure they have the best possible strategy, are the following.

Data encryption is the use of algorithms to scramble data and hide its true meaning. Encrypting data ensures messages can only be read by recipients with the appropriate decryption key. This is crucial, especially in the event of a data breach, because even if an attacker manages to gain access to the data, they will not be able to read it without the decryption key.

Data encryption also involves the use of solutions like tokenization, which protects data as it moves through an organization's entire IT infrastructure.

There will be occasions in which organizations no longer require data and need it permanently removed from their systems. *Data erasure* is an effective data security management technique that removes liability and the chance of a data breach occurring.

Data masking enables an organization to hide data by obscuring and replacing specific letters or numbers. This process is a form of encryption that renders the data useless should a hacker intercept it. The original message can only be uncovered by someone who has the code to decrypt or replace the masked characters.

Data Resiliency. Organizations can mitigate the risk of accidental destruction or loss of data by creating backups or copies of their data. Data backups are vital to protecting information and ensuring it is always available. This is particularly important during a data breach or ransomware attack, ensuring the organization can restore a previous backup.

Organizations face an increasingly complex landscape of security threats with cyberattacks being launched by more sophisticated attackers. Some of the biggest risks to data security include accidental data exposure, phishing attacks, insider threats, malware, ransomware, cloud data storage.

Adopted from: <https://www.fortinet.com/resources/cyberglossary/data-security>

6. Write a Summary Essay of the text "Security Threats". Follow the instructions given below*:

1. The introduction (one paragraph) contains: the title of the text; the name of the author of the text; the name of the journal / book in which the text was published; the place and year of publication; a one-sentence thesis expressing the main idea of the source.
2. The main part (one or more paragraphs) paraphrases and compresses the original text. Make sure that you include: basic information, but omitted minor points; one or more examples by the author;
3. The conclusion (one paragraph) contains: a summary of the entire text in one sentence; your opinion about the text.

** Useful linking words and phrases are given in appendix 3 "How to Write a Summary Essay".*

Unit VI. DATA SECURITY

Part 2. Presenting Your Research Paper Ideas

1. In pairs, discuss the following questions.

- Have you ever presented your research to your team or study group? How did you prepare?
- Have you ever given a paper to a large audience at a conference?
- Why might presenting your research at an international conference be more difficult than presenting to your team or study group?

2. Practice pronunciation of the words below. Check if you know their meaning.

1. fascinate ['fæsineɪt] – увлечь
2. persuasive [pə'sweɪsɪv] – убедительный
3. appropriate [ə'prəʊpriət] – подходящий
4. emphasize ['emfəsaɪz] – подчеркнуть

5. preliminary [pri'limin(ə)ri] – предварительный
6. desired [di'zaiəd] – желаемый
7. perceive [pə'si:v] – воспринимать
8. outline ['aʊtlain] – набросок
9. require [ri'kwaiə] – требовать
10. speech [spi:tʃ] – речь
11. event [i'vent] – события
12. quote [kwəʊt] – цитата
13. paper topic ['peipə 'tɒpɪk] – тема исследования
14. summarize ['sʌməraɪz] – обобщать(резюмировать)
15. conclusion [kən'klu:ʒ(ə)n] – заключение
16. attention [ə'tenʃ(ə)n] – внимание
17. charm [tʃɑ:m] – очаровать
18. distracting [di'stræktiŋ] – отвлекающий
19. gather ['gæðə] – объединить
20. victory ['vɪkt(ə)ri] – победа

3. Read the text and answer the following questions.

1. Which problems can greatly hinder your presentation?
2. What is one of the best ways to start a presentation?
3. What manners should you show, if you want to charm auditory?
4. How much time should you take to present your result?
5. What should you say in conclusion?

Text 6 B

HOW TO PRESENT YOUR RESEARCH PAPER IDEAS

1. In this text you will learn the proven way to fascinate your professor and classmates while presenting your research paper topic. You will also find useful tips on how to build your speech and use your strong

points. You may write a splendid, award-winning research paper with an eye-catching research paper topic, brilliant research paper ideas, and reliable evidence. But, if you are unable to present it in a bewitching way to the audience, you will not get the results you deserve. The way you present a research paper stands for 50% of your success. Hesitation, trembling voice, uncertain body language can greatly hinder your presentation and spoil the net result. Once you appear to be persuasive, confident, and eloquent enough to get your research paper topic and research paper ideas across to the public, you may be sure to get the highest reward. Therefore, you should remember that writing research papers involves far more than information search, doing the research and putting down its results. By the end of the research, spend some time preparing to present your research paper in the most appropriate way. Usually, students are required to present their college research papers in 15-20 minutes maximum. If you have a gift of the gab, it might seem that 20 minutes won't be enough to give the clear outline of your research paper; and if you are one of those reticent students, you might think 20 minutes is far too much for your research paper. In both cases you should learn to keep within the limited time period and present the key points of your research paper at a time. For that purpose, be sure to practice the presentation of your research paper at home or where you can be at ease and comfortable, for example, in front of a mirror, your family, friends or colleagues. If possible, use a tape-recorder and listen to yourself. This way you will come to know your strong and weak points and will be able to emphasize your strong points during your presentation and get the research paper ideas across to the audience. The preliminary steps for preparing an oral presentation include a thorough choice of your clothes, which should be appropriate for the occasion. How you are perceived is very important. Thus, present the desired image to your audience so that they will get interested in your research paper topic.

2. Oral presentation requires an outline of the main research paper ideas you want to deliver in front of the audience. Put them down so that to have a backup in case you lose the track of ideas. Do not read your research paper. It is much better to present its ideas personally by explaining the key points. Of course, you do not need to memorize your research paper by heart, simply put down the points you want to dwell upon and organize your speech around them. The way you begin your presentation and end it counts most. So, make sure to make a fascinating introduction and conclusion. A good introduction should capture the audience's attention and warm you up. Some say that the best way to start the presentation is by introducing a joke, but you are rescuing seriously if your joke falls flat. It is much better to start on a genuine note. It will be good introduction if you:

- recollect some recent events or refer to a local event;
- tell a personal story, preferably one that is humorous;
- start with a good quote;
- ask a rhetorical or factual question;
- refer to something that has happened in class;
- state the reason why you chose this particular research paper topic.

You can choose any of these approaches, but make sure it is tied to your research paper topic. Once you have interested the audience, you can dwell on the body of your research paper. However, you should remember that you do not have much time to report your results in detail. That is why, summarize, give the main points, and hit the highlights. Interpret your results, talk about their significance, and only then clearly state your conclusions. It is also important to remember that your presentation should not replace your research paper, but rather whet the audience appetite for it. Thus, it is commonly useful to allude to information in the paper that can't be covered adequately in the presentation.

3. As it was pointed out earlier, your conclusion should be as strong as the introduction. Either end research paper presentation with a

concluding statement or invite questions, or both. When you reach the end of your presentation, use the words “*in conclusion*”, “*finally*”, or “*one more thing.*” Do not end your speech suddenly without recalling what you have said. By the end of the speech, say “*Thank you*” or “*Thanks for your attention*” or something like that, not “*Well, I guess that's about all I have to say*” or by just quitting. It is embarrassing when someone just stops without saying a word of conclusion. In this case people don't know whether you're done and it's time to clap or if you are going to continue. In order to charm the audience be sure to talk to the listeners, not the screen or the blackboard and try to establish the dialogue with the audience. Maintain eye contact, but not with just one person. This will make the whole experience feel more natural. You should get rid of distracting mannerisms like slapping your leg, playing with the keys in your pocket, pulling at your ear, nose, shuffling your notes, playing with the projector cord, or whatever. Body language plays an important role in everyday communication, and even greater in conference talks. If you are experiencing stage fright, take a deep breath before taking the floor. Try to gather your research paper ideas together. Walk slowly to the front, pause and look at the audience before speaking. Remain calm. And off you go to the victory!

Adapted from: <http://www.articlesfactory.com/articles/advice/how-to-present-your-research-paper-ideas.html>

4. Translate the following word combinations into Russian.

1. eloquent enough
2. highest reward
3. in both cases
4. the preliminary steps
5. backup in case
6. a genuine note
7. preferably one that is humorous
8. particular research

9. concluding statement
10. weak points

5. Find the English equivalents to the following word combinations in the text. Make up your own sentences with these phrases.

1. глубокий вдох
2. достаточно красноречивый
3. исследовательский документ
4. фактический вопрос
5. вспоминая сказанное

6. What is the main idea of the text? Choose the correct answer. Offer your own version of the main idea of the text.

- a) Writing a splendid research paper topic is very important for a speaker.
- b) Tips for making a good presentation.
- c) Body language plays an important role in making a good presentation.

7. Mark true (T) or false (F) sentences:

- a) Students are required to present their college research papers in 25-30 minutes maximum.
- b) It doesn't matter, which way you are going to present the topic.
- c) It's a good decision to get rid of distracting mannerisms like slapping your leg.
- d) Once you have interested the audience, you can dwell on the body of your research paper.
- e) It's important to remember that your presentation should replace your research paper.

8. In what paragraph is it written that the best way to start the presentation is by introducing a joke?

a) 1; b) 2; c) 3.

9. Put the names of the paragraphs in the correct order.

Titles	Number
a) The importance of making a good conclusion in your report	
b) Preparing yourself and preparing to present your research paper	
c) Present directly your research paper to auditory	

10. Choose the correct answer to the given question.

What should you do to charm your auditory?

- a) Tell your report without errors.
- b) Pay attention to details in presentation.
- c) Talk to the listeners, not the screen or the blackboard.

11. Translate the sentence.

As it was pointed out earlier, your conclusion should be as strong as the introduction.

12. Match column A and B.

A	B
1. shuffling	a) выучить наизусть
2. embarrassing	b) заявление
3. establish	c) затруднительный
4. statement	d) шарканье
5. memorize	e) установить

13. Complete the sentence.

Some say that the best way to start the presentation is

14. Choose the sentence with the correct word order.

- a) Usually, students in 15-20 minutes maximum are required to present their college research papers.

- b) Students are required to present their college research papers in 15-20 minutes maximum usually.
- c) Usually, students are required to present their college research papers in 15-20 minutes maximum.

Communication skills

*(Adopted from: Armer T. Cambridge English for scientists. Cambridge University Press.
<https://portal.tpu.ru/SHARED/m/MALORISS/studentam/SelfStudy/Tab2/Posobie5cours.pdf>)*

15. Match the beginnings (1 -5) to the endings (a-e) to make definitions of the words in bold. Define 10 important scientific concepts from your field.

Beginnings

1. **Data masking** is a way to create a fake, _____
2. **Sensitive information** is data that must be protected _____
3. The **software update** required _____
4. In **symmetric decryption**, _____
5. The IT department outlined a comprehensive **backup strategy** _____

Endings

- a) the sender and receiver must both possess the same secret key to decode the message.
- b) to safeguard the company's sensitive information.
- c) a soft reboot to apply the changes without losing unsaved work.
- d) from unauthorized access to safeguard the privacy or security of an individual or organization.
- e) but a realistic version of your organizational data.

16. Complete the following sentences using the words in the box.

Dimension, screen, single character, megabyte(s) (2), unit test, digital information, resolution, display, verify.

1. The computer's memory is measured in _____, where one _____ is equal to 1,024 memory bytes.

2. A unit of _____ that consists of 8 bits, commonly used to represent a _____ in computer systems.
3. The developer wrote a _____ to _____ that the add function correctly sums two numbers.
4. Each pixel on the _____ contributes to the overall _____ of the image.
5. Pixel resolution is the number of pixels in each _____ that the _____ device can show, typically expressed as width x height (e.g., 1920 x 1080).

17. In pairs answer the following questions.

1. How do we say these values?
a) % b) 5/a c) 10% d) 107 e) 10^{-9}
2. How do we say these symbols?
a) 28 % b) x (in e.g. 5 x 109) c) -
3. What is the difference between 1.356 and 1,356? How do we say them?

18. Read the information. Translate it.

The International System of Units (SI) is the most common measurement system around the world, particularly in the fields of science, commerce and trade. It is a modern form of the metric system and as such is devised around the number 10. The system consists of 7 base units and a set of prefixes. There are a number of other common SI-derived units.

19. In pairs discuss the following questions. Express your agreement or disagreement with the partner's opinion. Give reasons.

- 1 What units of measurement do you commonly use in your everyday life?
- 2 What units do you use in your work/study?

3 Which SI prefixes (metric prefixes) do you know? How do they change the quantity?

20. Discuss the following questions in pairs. Express your agreement or disagreement with the partner's opinion. Give reasons.

1. How is the information in the results section of a paper different from the discussion section?
2. Why do researchers usually keep the results and discussion sections separate?
3. Why might some researchers present the results and discussion together as one section?
4. Some papers include a conclusion section. What is the difference between a discussion and a conclusion?

21. Read three extracts from a research paper. Then match an extract (A-C) with the part of the paper it comes from: the materials and methods section, the results section or the discussion section

A. The majority of the activated carbons examined have surface ranging between 900 and 2000 m²/g, and the ratio of micropore volume to total pore volume ranges between 0.26 and 0.65.

B. The highest storage factor attained is 89 for compacted grain-based activated carbons from grain sorghum. Therefore, sorghum-based activated carbons will be effective for natural gas storage in the fuel tanks of moto vehicles.

C. Carbonisation and activation were performed in an electrical-resistance furnace under a steady flow of gaseous N₂. The samples were contained in cylindrical baskets made from 60 mesh stainless steel gauze.

UNIT VII. PHYSICS IN MEDICINE

Part 1. The Role of Physics in Medicine

1. In pairs, discuss the following questions and give feedback to the class.

- What role does physics play in medicine?
- What modern technologies are currently used in hospitals?
- What biotechnologies will we use in the future?

2. Study the active vocabulary. Check pronunciation of the words below.

1. branch [bra:ntʃ] – ветка, филиал, отделение, отрасль
2. sub-group – подгруппа
3. primarily ['praɪm(ə)rəli] – главным образом
4. revise [rɪ'vaɪz] – перерабатывать, исправлять, редактировать
5. preservation ['prezə'veɪʃ(ə)n] – сохранение
6. setup ['setʌp] – организация; учреждение
7. technique [tek'ni:k] – оборудование; аппаратура
8. hazard ['hæzəd] – риск, источник опасности
9. ionizing radiation hazards ['aɪənaɪzɪŋ] – опасные факторы ионизирующего излучения
10. brachytherapy [ˌbræki'θerəpi] – близкофокусная лучевая терапия; брахитерапия;
11. tissue ['tɪʃu:] – ткань
12. affect [ə'fɛkt] – воздействовать; оказывать воздействие
13. affected area ['e(ə)rɪə] – поражённая зона
14. maintain [meɪn'teɪn] – обслуживать
15. label ['leɪb(ə)l] – метить; прикреплять ярлык; метить радиоактивными изотопами
16. X-ray image ['eksreɪ 'ɪmɪdʒ] – рентгенограмма
17. obtain [əb'teɪn] – получать

18. perfusion [pə'fju:z(ə)n] – перфузия (акт переливания жидкости поверх или через ткань определенного органа)
19. non-invasive [ˌnɒnɪn'veɪsɪv] – неинвазивный; бескровный (относящийся к любому медицинскому тесту или лечению, которые не разрезают кожу и не проникают в какие-либо области тела)
20. cerebral blood flow ['serɪbrəl blʌd] – церебральный кровоток; мозговой кровоток; мозговое кровообращение

3. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1. The results are interesting due to the use in this case of a (i, a, s, o, n, n, v, n, i, e, v) ___ - _____ method. 2. The filter paper in the dish which had held no larvae was also (d, a, b, l, l, l, e, e) with a 'zero'. 3. A further study, therefore, is planned to reassess these children, after an interval, with myocardial (f, s, p, e, i, o, r, u, n) scans and exercise testing. 4. In literature, works on revision generally operate within the context of consistency (v, p, s, e, r, e, r, n, a, o, i, t). 5. This is the same data that we used to (n, o, u, d, c, c, t) the factor analysis that we reported earlier. 6. Several are intimately linked to growing (z, a, a, r, s, d, h) as pressure for new housing encroaches upon floodplains and old water meadows. 7. His (d, r, e, e, b, b, l, a, c, r, o, o) _____ circulation is infarcted. 8. The coronary vasculature is visible and there is a lack of adherent (s, s, i, u, e, t). 9. She decided to work in clinical (t, u, p, s, s, e,). 11. Additionally, the values of the performance index (b, t, i, e, o, d, a, n) are usually smaller than those determined by the penalty function method.

4. Match the beginnings (1 -5) to the endings (a-e) to make definitions of the words in bold. Define 10 important scientific concepts from your field.

Beginnings

1. **X-ray imaging** is a technique that _____

2. **Ionizing radiation** is the term given to forms of radiation _____
3. **Brachytherapy** is a form of radiation therapy where _____
4. **Single photon emission computed tomography (SPECT)** is a _____
5. It is the positively charged particle that, _____

Endings

- a) tumor cells are destroyed through the localized delivery of a radiation dose from radioactive sources.
- b) together with the electrically neutral particles called neutrons, make up the nucleus of an atom (**proton**).
- c) medical imaging technique that is based on conventional nuclear medicine imaging and tomographic reconstruction methods.
- d) relies on the differential absorption of photons by tissues based on their electron density.
- e) that are energetic enough to displace orbiting electrons from the atoms in the absorbing medium.

5. *Skim the text to find out what the author says about the issues you discussed in Task 1*

Text 7 A

MEDICAL PHYSICS

The application of physics principles, methods, and techniques in clinical practice and research has revolutionized the entire medical science field to improve human health and overall wellbeing.

What is Medical Physics? Medical physics is a branch of applied physics that utilizes physical sciences to prevent, diagnose, and treat human diseases. Medical physics can be categorized into multiple sub-groups: medical imaging physics, radiation oncology physics, non-

ionizing medical radiation physics, nuclear medicine physics, medical health physics, and physiological measurements.

Medical physics primarily focuses on ionizing radiation measurement, magnetic resonance imaging, and applying physics-based technologies (lasers and ultrasound) in medicine.

The term "medical physics" was first introduced by Félix Vicq d'Azir, a French physician, anatomist, and the general secretary of the Royal Society of Medicine, in Paris in 1778. In 1814, the most appropriate definition of medical physics was introduced in the revised edition of Nysten's medical dictionary. In this edition, medical physics was defined as "*physics applied to the knowledge of the human body, to its preservation and to the cure of its illnesses.*"

Key Roles of Medical Physicists. Medical physicists are healthcare professionals who have specialized training in applying physics concepts and technologies in medicine. They primarily work in clinical setups or in academic and research institutions. The key roles and responsibilities of medical physicists include the application of medical physics techniques for the diagnosis and treatment of human diseases and the protection of medical staff and patients from ionizing and non-ionizing radiation hazards.

Medical physicists specializing in radiation therapy are primarily involved in providing radiation treatments for cancer patients in collaboration with oncologists and other therapists. The treatments mostly include brachytherapy, wherein a radiation source is placed inside the body, or external beam radiation therapy, wherein linear accelerator-generated radiation is carefully delivered to affected tissues.

Medical physicists specializing in medical imaging are engaged in developing and maintaining various imaging techniques, including x-ray, computed tomography scan (CT-scan), and magnetic resonance imaging.

Medical physicists specialized in nuclear physics mostly conduct functional imaging of patients using positron emission tomography (PET), gamma camera, and biological substances labeled with radioactive markers (radiopharmaceuticals).

X-Ray and CT Scan

In X-rays, signals generated from a narrow X-ray beam transverse the affected area of interest to create planer images. Similarly, cross-sectional X-ray images obtained upon repeated scanning are digitally stacked to generate high-resolution, three-dimensional, or four-dimensional computed tomography (CT) images to analyze dynamic processes.

Tests for Ureteric Calculi: Radiograph, CT and Ultrasound

Besides providing quantitative and reproducible anatomical images, CT can produce high-quality functional information through dynamic perfusion scanning. During the perfusion procedure, a contrasting agent is administered, and repeated imaging of the affected region is performed at an interval of 3 – 5 seconds for 30 seconds. These images are subsequently stacked to form four-dimensional images. This technique is very useful in analyzing hemodynamic parameters, including blood flow and blood volume.

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) is a powerful non-invasive medical imaging technique that uses a strong, static magnetic field, magnetic gradients, and computer-induced radio waves to produce high-quality three-dimensional images of tissues and organs. The magnetic field applied to the body realigns the body's photons with that field. Subsequently, radio waves stimulate photons, and MRI sensors are used to detect energy (signal) released from photons.

In quantitative MRI, contrast differences between two tissues are maximized on a single image by utilizing the relaxation time differences of two tissues. The images are weighed based on the properties of one tissue. The modalities commonly used for

quantitative MRI include arterial spin labeling for cerebral blood flow measurement and diffusion tensor imaging for microstructural analysis.

Ultrasound

Ultrasound is a high-frequency sound wave that generates non-invasive images of different tissues and organs. The difference in mechanical properties at the interface of different organs/tissues causes ultrasound reflection. These reflections are measured to generate ultrasound images.

The main advantages of ultrasound over other medical imaging techniques (CT and MRI) are cost-effectiveness and real-time imaging at the bedside. Contrast enhancing agents, such as microbubbles, are used in ultrasound for functional imaging. Besides disease diagnosis, ultrasound is used for therapeutic purposes. For instance, high-intensity focused ultrasound removes affected tissues inside the body without damaging surrounding healthy tissues. In addition, ultrasound is used for targeted drug delivery.

Nuclear Medicine

In nuclear medicine, radioactive probes are used to observe physiological processes. The probes are also used for targeted delivery of therapeutic doses. A very small amount of radioactive probe is administered to the body during the procedure. The probe is subsequently absorbed by the organ/tissue under investigation. The radiation emitted from the probe due to decay is detected by a gamma camera, which generates digital signals for analyzing the functional state of the organ.

A gamma camera generates two-dimensional images when it remains stationary. In single-photon emission computed tomography, the camera is rotated to generate axial slices of the target organ. These slices can be used in PET scans to generate three-dimensional images.

Radiotherapy

Radiation therapy involves the delivery of ionizing radiation inside the body to destroy and eliminate cancer cells. For deep-seated tumors, high-energy photons are used. For superficial tumors, high-energy electrons are used. In addition, charged particles, including protons, are used in radiotherapy.

During the entire treatment procedure, medical imaging is performed to ensure safe and targeted delivery of the radiation and to assess radiation-induced changes in the anatomy.

Adopted from: <https://www.news-medical.net/health/The-Role-of-Physics-in-Medicine.aspx>

6. Mark true (T) or false (F) sentences.

1. The treatments mostly include brachytherapy, wherein a radiation source is placed outside the body, or external beam radiation therapy, wherein linear accelerator-generated radiation is carefully delivered to affected tissues.
2. Radiation therapy involves the delivery of ionizing radiation inside the body to destroy and eliminate cancer cells.
3. Medical physics primarily focuses on ionizing radiation measurement, magnetic resonance imaging, and applying physics-based technologies (lasers and ultrasound) in medicine.
4. Ultrasound is a low-frequency sound wave that generates non-invasive images of different tissues and organs.
5. High-intensity focused ultrasound removes affected tissues inside the body with damaging surrounding healthy tissues.
6. During the perfusion procedure, a contrasting agent is administered, and repeated imaging of the affected region is performed at an interval of 3 – 5 seconds for 30 seconds.
7. In quantitative MRI, contrast differences between two tissues are minimized on a single image by utilizing the relaxation time differences of two tissues.

7. Give a brief overview of the structure and contents of the text and retell it in English.

Unit VII. PHYSICS IN MEDICINE

Part 2. Career Development

1. In pairs, discuss the following questions.

- Why did you choose a career in science?
- What field of science are you currently working or studying in?
- What would you like to do next in your work or studies?

2. Practice pronunciation of the words below. Check if you know their meaning.

1. aptitude ['aptitju:d] способность
2. consumer [kən'sju:mə] потребитель
3. occupational [ɒkjʊ'reɪʃ(ə)n(ə)l] профессиональный
4. futility [fju:'tɪlɪti] бесполезность
5. curiosity [kjʊəri'ɒsɪti] любопытство
6. familiarize [fə'mɪliəraɪz] ознакомиться
7. embark [ɪm'bɑ:k] начинать
8. for instance [fɔ: 'ɪnst(ə)ns] например
9. pursuing [prə'sju:ɪŋ] преследуя
10. proceed [prə'si:d] продолжить
11. advisable [əd'vɪzəb(ə)l] целесообразный
12. crucial ['kru:ʃ(ə)l] ключевой
13. report-writing skills [rɪ'pɔ:t- 'raɪtɪŋ 'skɪlz] навыки написания отчётов
14. thereafter [ðe:r'a:ftə] после этого
15. gain experience ['geɪn ɪk'spɪəriəns] приобретать опыт
16. enable [ɪ'neɪbəl] позволять
17. advancement [əd'vɑ:nsmənt] продвижение
18. employability [ɪm'plɔɪə'bɪlɪti] трудоспособность
19. vast experience ['vɑ:st ɪk'spɪəriəns] огромный опыт

3. Read the text and answer the following questions:

1. What is a good way to increase student's scientific curiosity?
2. What skills are important for success?
3. How to get a PhD?
4. What are basic principles of research and development?
5. Why do researchers need to join an association?

Text 7 B

A CAREER IN R&D

1. **Research and development (R&D)** is rapidly becoming an essential department in many profits and nonprofit organizations. This means the need for engineers and scientists with great research skills and an aptitude to innovate is increasing. If you are looking to develop a career in R&D – be it to discover an HIV vaccine, design efficient manufacturing processes, develop new consumer products, or simply gather more information on a particular subject – one thing remains constant: you must be a well-educated professional with the right occupational skills.

2. Develop a Love for Science

Without a love for science, your efforts to pursue a career in R&D may end in futility. Right from high school, science subjects should be your favorite. If you find yourself querying basic observations like why the sky is blue or why people age, then you are ready for this profession. Reading science journals and watching documentaries is a good way to increase your scientific curiosity. Oh, don't forget math is equally important! In addition to letting a love for science grow in you, familiarize yourself with the skills that make competent R&D professionals. You will need teamwork skills to productively collaborate with other scientists or engineers, analytical skills to assess

the accuracy of your scientific findings, and outdoor skills, just in case the profession takes you to the forests!

3. Choose a Specialty

R&D is an expansive academic field. It is wise to choose an area of specialism as early as possible, so that you can embark on pursuing college education that focuses on your chosen area. Do you, for instance, want to know more about planet Earth and other celestial bodies so you can design space vehicles? Then pursuing a bachelor's degree in space studies or rocket science will give you the best foundation. Are you always keen to learn about the features of an upcoming iPhone and other telecommunication products? Why not pursue a bachelor's in telecommunication engineering? In short, undergraduate school should not be about pursuing a general B.Sc. degree.

4. Pursue Graduate-level Education

In R&D, undergraduate training is not sufficient. It can only get you hired as a lab technician. As such, you have to follow up your bachelor's with a master's degree. Although you can proceed to pursue a PhD as soon you are finished with grad school, it is advisable to take a pause and find employment as a research associate or assistant. This is crucial as you will get the opportunity to put your innovative skills to test, develop report-writing skills, and gain research experience. Thereafter, go for your PhD.

5. Join Professional Associations

Joining a relevant professional association enables you to network with other R&D professionals in your field and access their published works. Examples of research associations you could join include:

- British Science Association (BSA)
- American Association for the Advancement of Science (AAAS)
- Association of Clinical Research Professionals (ACRP)
- National Society of Professional Engineers (NSPE)

Some of these associations, like ACRP, offer research certifications that you can pursue to improve your competence and employability. Also, be sure to keep up with The Research and Development Society website.

With advanced qualifications and vast experience in R&D, no one will stand in your way to becoming an R&D manager.

Adapted from: <https://www.careeraddict.com/develop-a-career-in-research-and-development>

4. Translate the following word combinations into Russian

1. occupational skills
2. basic observations
3. scientific curiosity
4. space vehicles
5. research experience
6. productively collaborate
7. proceed to pursue
8. develop skills
9. nonprofit organizations
10. advancement of science

5. Find the English equivalents to the following word combinations in the text. Make up your own sentences with these phrases.

1. склонность к инновациям
2. потребительские товары
3. обширная научная область
4. как можно раньше
5. целесообразно принять

6. What is the main idea of the text? Choose the correct answer. Offer your own version of the main idea of the text.

- a) For career development you should improve your skills and pursue Graduate- level education.

- b) Without a love for science, your efforts to pursue a career in R&D may end in futility.
- c) Reading science journals and watching documentaries is a good way to increase your scientific curiosity.

7. Mark true (T) or false (F) sentences.

- a) It is wise to choose an area of specialism as later as possible, so that you can embark on pursuing college education that focuses on your chosen area.
- b) After finishing high school, science subjects should be your favorite.
- c) In R&D, undergraduate training is sufficient.
- d) Research and development (R&D) is rapidly becoming an essential department in many profit organizations.
- e) R&D is an expansive academic field.

8. In what paragraph is it written that it is wise to choose an area of specialism as early as possible?

- a) 2; b) 3; c) 1.

9. Put the names of the paragraphs 1, 2 and 3 in the correct order.

Title	Number
a) Choose a Specialty	
b) The need for engineers and scientists	
c) Develop a Love for Science	

10. Answer the question. Make your own question to the text with the question word “Why”. Ask your partner this question. Express your agreement or disagreement with the partner's opinion. Give reasons.

What is research and development (R&D)?

11. Translate the sentence.

Although you can proceed to pursue a PhD as soon you are finished with grad school, it is advisable to take a pause and find employment as a research associate or assistant.

12. Match column A and B.

A	B
1. Upcoming	a) Оценивать
2. Efforts	b) Улучшить
3. To assess	c) Усилия
4. To improve	d) Предстоящий
5. To develop	e) Развивать

13. Complete the sentence.

Reading science journals and watching documentaries is a good way...

14. Choose the sentence with the correct word order.

- a) This is crucial as you will get the opportunity to put your innovative skills to test, develop report-writing skills, and gain research experience.
- b) This is the crucial opportunity as you will put your innovative skills to get to gain, report-writing develop skills, and research experience test.
- c) As you will get the opportunity to put your crucial to test, innovative skills this is develop report-writing skills, and gain research experience.

Communication skills

(Adopted from: Armer T. Cambridge English for scientists. Cambridge University Press.
<https://portal.tpu.ru/SHARED/m/MALORISS/studentam/SelfStudy/Tab2/Posobie5cours.pdf>)

15. Discuss the questions in groups. Express your agreement or disagreement with the partner's opinion. Give reasons.

- 1. What can you tell about your career in science?

2. How do you prepare for your future profession?
3. How does university education help you to become a qualified specialist?
4. What does your scientific research include?
5. Who are the most famous scientists in physics?
6. What do you know about scientific and business ethics?
7. What are the rules of scientific communication?
8. What scientific works help you in your scientific research?
9. How to think as a scientist?
10. What are peculiarities of a scientific style of writing?

16. Discuss with the partner the following:

- a) a laboratory experiment you took part in
- b) scientific resources you use in your research
- c) goals and objectives of your scientific research
- d) scientific research methods you use in your research

17. Physics is a developing branch of science, isn't it? Prove it.

18. Make up a short project summary on your scientific area of about 150 words using the following words or phrases.

aims to – however – the initial phase – the proposed research – the study will indicate- practical application

19. Some phrases given below are appropriate when giving a formal talk on your research. Some are not. Define them.

Phrases

1. Good afternoon, everybody. / Welcome, ladies and gentlemen ...
2. To start, thank you / I'd like to start by thanking you all for coming to my talk today.
3. I'm Mike Downi and at present / My name is Mike Down and I'm a

PhD candidate at Northumbria University.

4. I'm going to talk today / My talk today is about my recent research investigating ...

5. I'll begin with explaining / To start with, I'll explain briefly how T-cell responses ...

6. After that, I'll / I'll go on to describe the alternative method I have been investigating ...

7. Finally, I will discuss / I'll conclude by discussing why this method could be useful as a way ...

8. I plan to talk for about 40 minutes, leaving plenty of time for ... / I will talk for about 40 minutes and then I'll answer any questions at the end of my talk.

20. Match each pair of phrases from exercise 23 (1-8) to their correct function (a-f) below. Note that one of the functions may be expressed with three different pairs of phrases.

Correct function

a) Give instructions for asking questions. _____

b) Greet the audience. _____

c) Introduce the topic of the presentation. _____

d) Introduce yourself. _____

e) Outline the structure of the presentation. _____

f) Thank the audience for coming. _____

21. In pairs, discuss the following questions. Express your agreement or disagreement with the partner's opinion. Give reasons.

1. Have you ever applied for a job in science? If not, what kind of job would you like to apply for in the future?

2. Which of the following documents are job applicants usually asked for in our country?

- application form
- biodata
- cover letter (covering letter)
- resume or CV (curriculum vitae)

3. Have you ever written one of these documents in English?

4. Do you think that the information you include and the way you organize a resume or CV in English will be the same as a resume or CV in your own language?

22. *The application form asks applicants to include a copy of their CV. In pairs, look at the list of possible headings for a CV (a-l) and then answer the following questions.*

Possible headings for a CV

- a) computer skills
- b) dissertations
- c) education
- d) grants and awards
- e) personal information
- f) presentations
- h) research experience
- i) study abroad
- j) teaching experience
- k) technical skills
- l) travel

Questions

1. Would you use all the headings (a-l) on your CV? Why / why not?
2. How would you organize the information in your CV? Put the list of headings (a-l) in the best order.

3. What kind of information would you include under each heading?
Make suggestions for each heading.

23. Rewrite the following sentences as bullet points in your scientific area for your report at the conference.

1. My main research focus was to generate specific carbohydrate oligomers by using pure cloned enzymes.

2. During my project, I focused on the creation of a new CD4 positive HeLa cell clone.

3. As part of the Cell Wall Genomics team, I have developed sensitive methods to determine the fine structure of pectin in maize.

24. In pairs, answer the following questions. Express your agreement or disagreement with the partner's opinion. Give reasons.

1. What is the correct order of information in a citation?

2. If the paper has not yet been published, what do you write instead of the volume and page?

3. If the paper has been submitted (given) to a journal but not yet accepted, what do you write instead of the journal name, volume and page?

25. Rewrite the following extracts from three different papers using either a relative pronoun (which, that, who, etc.) or a verb with -ing.

1. The adhesive apparatus is only activated on sloped surfaces, not on flat surfaces even when slippage occurs. This results in greatly reduced sprinting velocity on smooth, flat surfaces.

2. Consumption of dark chocolate resulted in the decrease in the stress hormone cortisol in the urine. This suggests potential benefits of dark chocolate consumption.
3. There is a broad range of sensors used in everyday life. They are classified based on the quantities and qualities they detect.
4. On exposure to metals, Bazoricus demonstrates considerable antioxidant enzymatic activity. This reflects a physiological adaptation to continuous metal exposure.
5. The researchers are developing a bio-absorbable zinc stent. It harmlessly erodes away over time, minimizing the normal chronic risks associated with permanent stents.
6. Genetic engineering is a fundamental tool within the synthetic biology field. It involves making changes to individual or collections of genes in a binary (on/off) manner.
7. Bioengineers are developing synthetic tissues. These tissues may contain live cells in conjunction with synthetic components, such as artificial vasculature and 3D-printed compartments.

26. Write a paragraph for a discussion section. The discussion section of a paper often describes limitations of the current research and what experiments could be done in future. Read the following statements about someone's research and decide whether they describe a limitation (L) or an idea for future research (F).

1. The process of charge transfer has not been investigated. ...
2. Desorption might occur because of the temperature used or because of the vacuum. ...
3. Try using higher temperatures at atmospheric pressure to see what happens....
4. Try doping with other TCNQ-related molecules.
5. The graphene sample thickness is not consistent....

6. F4-TCNG might be useful in silicon-based as well as graphene-based electronics. ...
7. Investigate different ways of applying the F4-TCNQ layer. ...

27. Look at the phrases below. Which can be used to express limitations and which suggestions for future research?

1. The scope of this study did not permit us to examine ...
2. Given this limitation, we do not know if/whether...
3. It is hoped that this research can serve as a basis for future studies into ...
4. This is a clear limitation of the study and raises further questions related to ...
5. These results are preliminary findings and suggest that further research on ...

28. The paragraph below describes the limitations and suggestions for future direction of a study looking at the production of grapheme layers. Complete the paragraph using the words and phrases given below.

clear – given – hoped – indicates – permit – raises – scope – serve – as

The study (1) _____ that it is possible to produce large-area graphene films using a solid-phase-based method. It is (2) _____ that this research can (3) _____ a basis for further studies into grapheme synthesis. One limitation of the present research is that the (4) _____ of the study did not (5) _____ us to investigate the differences between using 6H-SiC and 3C-SiC/Si substrates. (6) _____ this limitation, we do not know if this method is selective for the type of SiC substrate. In addition, the current study did not investigate a range of heating rates. It is possible that lower

temperatures could be used if the process were lengthened. This is a (7) _____ limitation of the study and (8) _____ further research questions related to the possibility of optimising processing conditions to better control graphene production.

Unit VIII. SCIENCE DEVELOPMENT IN THE 21ST CENTURY

Part 1. Magnetic Resonance Imaging

1. In pairs, discuss the following questions and give feedback to the class.

- When was MRI introduced as a clinical diagnostic device?
- What new technologies have influenced the development of MRI?
- What do you know about MRgFUS? What do the letters in the acronym mean?

2. Practice pronunciation of the words below. Check if you know their meaning.

1. data acquisition [ˈdeɪtə ,ækwɪˈzɪʃ(ə)n] – сбор данных
2. image reconstruction [ˈɪmɪdʒ ˈri:kənˈstrʌkʃ(ə)n] – воспроизведение изображения
3. induce [ɪnˈdju:s] – вызвать; приводить к (чему-л.)
4. MR-guided focused ultrasound [ˈʌltrəsaʊnd] – фокусированный ультразвук под контролем МРТ (МР-ФУЗ)
5. positron emission tomography [ɪˈmɪʃ(ə)n təˈmɒgrəfi] – позитронно-эмиссионная томография
6. utilize [ˈju:tɪlaɪz] - использовать; применять
7. gradient coil [ˈɡreɪdɪənt kɔɪl] – градиентная катушка
8. phased array coil [ˈfeɪzd əˈreɪ] – фазированная катушка
9. ultra-high-field MRI – магнитно-резонансная томография сверхвысокого поля

10. Signal-Noise Ratio (SNR) – соотношение сигнал/шум
11. dielectric resonance ['daɪ'lektrɪk 'rezənəns] – резонанс диэлектрической восприимчивости
12. implement ['ɪmplɪment] – внедрять; вводить в эксплуатацию
13. fiber-optic communication systems [ˌfaɪbər'ɒptɪk] – волоконно-оптическая система связи
14. digitizer ['dɪdʒɪtaɪzə] - преобразователь аналоговых сигналов в цифровые
15. insulated gate bipolar transistors [baɪ'rəʊlə] – биполярный транзистор с изолированным затвором
16. metal-oxide-semiconductor field-effect transistor ['ɒksaɪd] – полевой транзистор со структурой металл-оксид-полупроводник (МОП)
17. RF amplifier ['æmplɪfaɪə] – РЧ-усилитель
18. fidelity [fɪ'delɪtɪ] – верность воспроизведения; верность передачи
19. tissue metabolism ['tɪʃu: mə'tæbəlɪz(ə)m] – тканевой обмен веществ
20. impact [ɪm'pækt] – оказать влияние

3. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1. A properly designed operational l, i, f, e, i, a, p, r, m circuit can significantly enhance system stability. 2. The challenge is now to effectively m, t, i, m, e, p, e, n, l these new standards in practice. 3. A comparatively inexpensive d, o, c, t, o, r, s, i, c, m, e, n, u laser is used as a built-in source of radiation. 4. A gastroscope is a thick p, o, r, t, b, i, f, i, e, c _____ - _____ cable consisting of many optical fibers. 5. The magnetic field r, e, d, g, i, a, n, t coil is used to spatially encode magnetic spins within an imaging zone of the magnet during the acquisition of magnetic resonance data.

4. Match the beginnings (1-5) to the endings (a-e) to make definitions of the words in bold. Define 10 important scientific concepts from your field.

Beginnings

1. **MR-guided focused ultrasound** is _____
2. The **signal-to-noise ratio** compares the strength of _____
3. An **RF amplifier** is an electronic device that _____
4. **Ultrahigh field (UHF) magnetic resonance imaging** refers to _____
5. **Positron emission tomography (PET)** is _____

Endings

- a) a modern non-invasive imaging technique for quantification of radioactivity in vivo.
- b) imaging done on any MRI scanner with a main magnetic field (B₀) strength of 7 tesla or greater.
- c) a desired signal relative to background noise.
- d) a nonsurgical technique to destroy targeted areas of tissue without harming the surrounding tissue.
- e) amplifies low-power radio frequency signals to higher power levels, typically used in communication systems like radios, wireless transmitters, and receivers.

5. Skim the text to find out what the author says about the issues you discussed in Task 1

Text 8 A

MAGNETIC RESONANCE IMAGING TECHNOLOGY

Hiroyuki Kabasawa

Magnetic Resonance Imaging (MRI) was introduced in the early 1980s as a clinical diagnostic device. Since then, there has been a lot of technological development. In MRI technical development, advances in each MRI technical component, including data acquisition, image

reconstruction and hardware systems, have interacted with each other. Progress in each component has induced new technological development opportunities in other components. New technologies in basic sciences and engineering, for example, computer science, data processing, and semiconductors, have been immediately incorporated into MRI development, which results in innovative applications (Fig. 1).

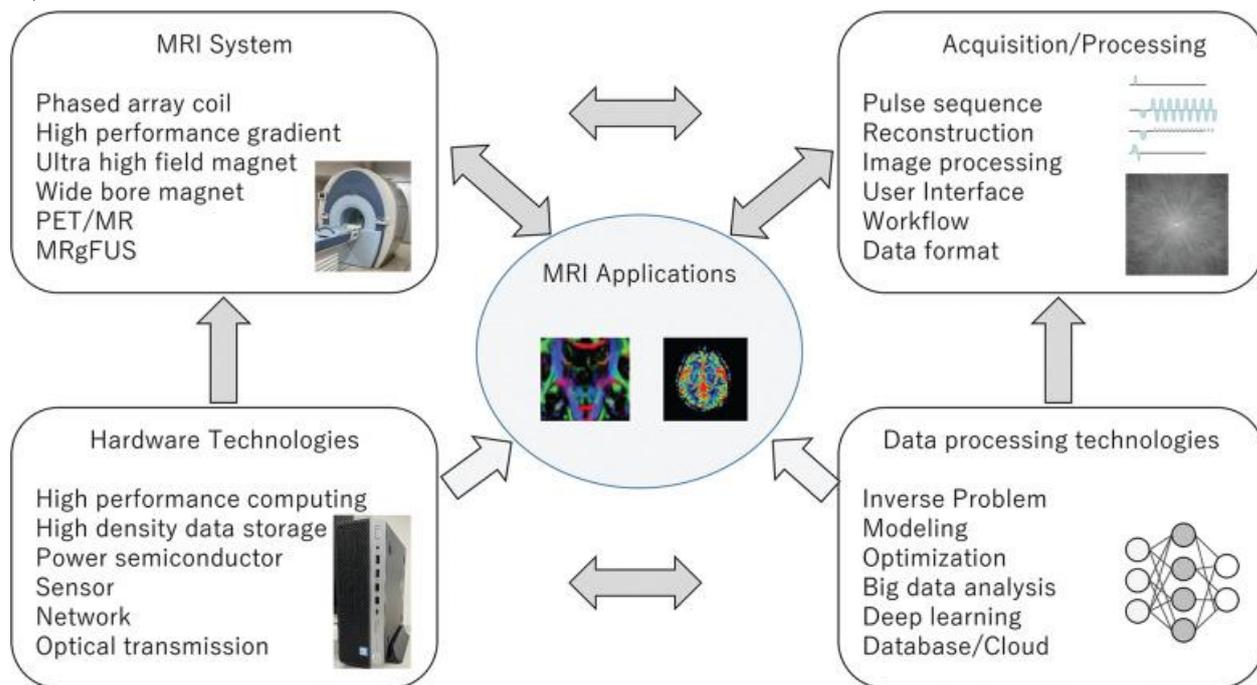


Fig. 1. MRI technology advances and the interactions between each technical component. Technical advances in basic sciences and engineering impact MRI technologies. Technical development needs in each element drive innovation in other elements. MRgFUS, MR-guided focused ultrasound; PET, positron emission tomography.

Magnetic Resonance in Medicine is a unique medical research field based on Magnetic Resonance Imaging and Spectroscopy (MRI/S) technology. MRI/S technology is the core part of this research field, and the advance of the technology leads to further success in MR medical research. The various needs of clinical radiologists and basic medical research scientists have always been invaluable inputs for technology innovation, stimulating MR technical development and resulting in new imaging technologies. The medical research

community utilizes new imaging technology to achieve innovative clinical results.

System Development

The 1.5T clinical MRI was launched as a commercially available clinical system in the early 1980s. The key MR system technologies, such as superconductive high-field magnet, shielded gradient coil, phased array coil, and so on, were developed in the first 20 years. A lot of significant achievements have been made, and it would be difficult to mention them all; however, ultra-high-field MRI, high-density phased array coil, and hybrid MRI systems are among the most significant innovations. Both ultra-high field and coil density contributed to high SNR, resulting in improved image quality and advanced applications.

Nowadays, most academic centers have a 3T MRI system, and it is the main platform for both clinical practice and MR research/technical development. For MRI systems higher than 3T, major MRI manufacturers started to develop a human 7T system from the early 2000s that was in operation by the mid-2000s.

RF penetration and uniformity has been a major challenge for high-field MRI, particularly at 7T or higher. In high static magnetic field, dielectric resonance associated with shorter RF wavelength and penetration depth results in destructive wave interference that causes transmitting RF field uniformity.

Phased array coil was invented in 1990. It has been implemented and available on clinical scanners since then. The role of the phase array coil became more important when parallel imaging (PI) technology was introduced on clinical MRI in the early 2000s.

Advancement in information and communication technology, including fiber-optic communication systems, RF relevant semiconductors, and digitizers, has led to RF transmitting and receiving (Tx/Rx) chain hardware improvement. The MRI analog transceiver was replaced by a digital one, and the MR signal is now

digitized in the MR room and transferred through optical fiber to the system. Both changes have contributed to significant SNR improvement.

Advancements in power semiconductor devices, such as insulated gate bipolar transistors (IGBT) and power metal-oxide-semiconductor field-effect transistors (power MOSFET), have driven improvements in MR gradient and RF amplifier hardware. These semiconductor devices enable us to control gradient and RF waveform with better fidelity.

With advances in semiconductor photon detection devices, integrated PET-MRI has been developed and implemented as a clinical scanner. Therapeutic intervention in the bore is one of the important MRI system innovations over the last two decades. The MR-guided focused ultrasound (MRgFUS) system was introduced for uterine fibroids treatment, and then its application for essential tremor treatment was developed. MRI is used for the treatment planning and temperature monitoring in the MRgFUS intervention. Tissue temperature change during the MRgFUS treatment is monitored to control energy delivery from an ultrasound transducer. The temperature change can be monitored non-invasively using MR signal phase change.

Future Outlook

MR technology is too broad to be comprehensively covered. New contrast mechanism developments, including hyperpolarized MRI, and new contrast materials may bring new imaging methods to see tissue metabolism and function.

Advances in computing power have significantly impacted MRI innovation. Sensing device technology and big data processing can provide better MR scanners and subject monitoring tools. Challenges in healthcare economics and aging societies will bring about opportunities for new technology development.

Finally, the importance of collaboration between MR manufacturers, physicists, radiologists, and technologists should be emphasized. This

collaboration is key to implementing new MRI advanced technology in clinical practice. It is the best source of innovation for MRI success in the future.

Adopted from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC9199974/>

6. Practice formulating your conclusion on the text.

- Taking into consideration the fact that...
- The main idea of the article is ...
- In conclusion I'd like to...
- From my point of view...
- As far as I can judge...
- My own attitude to this article is...
- I fully agree with / I don't agree with
- I have found the article important / interesting /of great value

7. Give a brief overview of the structure and contents of the text and retell it in English.

8. Make a presentation on one of the topics:

1. Innovative Applications of Physics in Advancing Medical Diagnostics and Treatment Technologies
2. Integrating artificial intelligence into medical imaging: improving diagnostics and developing radiology technologies.

Unit VIII. SCIENCE DEVELOPMENT IN THE 21ST CENTURY

Part 2. Science and Technology in the 21st Century

1. In pairs, discuss the following questions and give feedback to the class.

- What is the role of science and technology in the development of the nation?

- How has science and technology helped to improve human life?
- What emerging technologies should we watch for in the future?

2. Practice pronunciation of the words below. Check if you know their meaning.

1. advance [əd'vɑ:ns] прогресс, достижения
2. access ['ækses] доступ
3. breakthrough ['breik'θru:] прорыв
4. application [ˌæplɪ'keɪʃən] применение
5. condition [kən'dɪʃən] условие
6. poverty ['pɒvəti] бедность
7. emerge [ɪ'mə:dʒ] появляться
8. powerhouse ['paʊəhaʊs] электростанция
9. grasp [grɑ:sp] схватывание, восприятие
10. primary ['praɪməri] основное
11. labour ['leɪbə] труд, рабочая сила
12. adopt [ə'dɒpt] принимать, внедрять
13. enable [ɪ'neɪbl] позволять, включать
14. healthcare ['helθkeə] здравоохранение
15. subscription [səb'skrɪpʃn] абонент
16. leapfrog ['li:pfrɒg] обогнать, опередить
17. nuclear ['nju:kliə] атомная энергия
18. pose [pəʊz] представлять, ставить
19. issue ['ɪʃu:] проблема
20. inequality [ˌɪni:'kwɒlɪti] неравенство

3. Read the text and answer the following questions:

1. In what areas do we have technological revolution in the 21st century?
2. What technologies could improve the quality of life in developing countries?

3. Why the potential of the technology is of limited use in developing countries?
4. What are the challenges posed by technological revolutions?
5. How does the introduction of technology ensure economic growth?

Text 8 B

THE ROLE OF SCIENCE AND TECHNOLOGY IN THE 21ST CENTURY

1. Developments in science and technology are fundamentally altering the way people live, connect, communicate and transact, with profound effects on economic development. To promote tech advance, developing countries should invest in quality education for youth, and continuous skills training for workers and managers. Science and technology are key drivers to development, because technological and scientific revolutions underpin economic advances, improvements in health systems, education and infrastructure. The technological revolutions of the 21st century are emerging from entirely new sectors, based on micro-processors, tele-communications, bio-technology and nano-technology. Products are transforming business practices across the economy, as well as the lives of all who have access to their effects. The most remarkable breakthroughs will come from the interaction of insights and applications arising when these technologies converge. Through breakthroughs in health services and education, these technologies have the power to better the lives of poor people in developing countries. Eradicating malaria, a scourge of the African continent for centuries, is now possible. Cures for other diseases which are endemic in developing countries are also now possible, allowing people with debilitating conditions to live healthy and productive lives.

2. Access and application are critical. Service and technology are the differentiators between countries that are able to tackle poverty

effectively by growing and developing their economies, and those that are not. The extent to which developing economies emerge as economic powerhouses depends on their ability to grasp and apply insights from science and technology and use them creatively. Innovation is the primary driver of technological growth and drives higher living standards. As an engine of growth, the potential of technology is endless, and still largely untapped in Africa and other developing world regions across the globe. Less developed countries not only lack skilled labour and capital, but also use these less efficiently. Inputs account for less than half of the differences in per capita income across nations. The rest is due to the inability to adopt and adapt technologies to raise productivity. Computing for example, through unlocking infrastructure backlogs and managing integrated supply chains, can transform economic performance by enabling affordable and accessible services in education and healthcare. The combination of computers and the Internet, and mobile devices and the “cloud”, has transformed human experience, empowering individuals through access to knowledge and markets, changing the relationship between citizens and those in authority, as well as allowing new communities to emerge in virtual worlds that span the globe.

3. According to the United Nations International Telecommunications Union (UN-ITU), by the end of 2010 there were an estimated 5.3 billion mobile cellular subscriptions worldwide, including 940 million subscriptions to 3g services. About 90 percent of the world’s population can access mobile networks, with three-quarters of mobile subscribers living in developing economies. Cellular technology has allowed Africa to leapfrog the age of fixed line telephony, bringing affordable access to millions of people. However, the continued and equitable expansion of Information Communication Technology (ICT) depends on electricity. The real divide over the next 20 years will be between those who have access to reliable electricity to power these devices and those who do not. Other technologies under

development are interventions for cognitive enhancement, proton cancer therapy and genetic engineering. Revolutionary inventions include small underground nuclear power units called nuclear batteries that will be ultra-safe and maintenance-free; new types of photovoltaics that will make electricity from sunlight cheaper than that from coal; and myriad nano-technologies, some of which lower the cost and increase the reliability of many products – even in the poorest areas of the developing world.

4. Managing technological revolutions poses challenges. Certain innovations and discoveries will raise fraught bio-ethical issues, as genetic modification of food crops and cloning of human embryos has already done. There is a risk that their cost, particularly in the early stages of development, will worsen the present inequality by limiting access to wealthy individuals. This already happens in health care in certain G7 countries, where the demand for very high-cost diagnostic equipment and surgical interventions enabling longevity and better quality of life for older wealthy people overstretches public health care budgets, and lowers service quality in poor neighborhoods. Finally, resource-intensive technologies, focused on satisfying high consumption demand, like holidays abroad in costal resorts, wilderness areas, or iconic cities, increase carbon emissions and environmental damage. To promote technological advances, developing countries should invest in quality education for youth, continuous skills training for workers and managers, and should ensure that knowledge is shared as widely as possible across society.

5. In a world in which the Internet makes information ubiquitous, what counts is the ability to use knowledge intelligently. Knowledge is the systemically integrated information that allows a citizen, a worker, a manager, or a finance minister to act purposefully and intelligently in a complex and demanding world. The only form of investment that allows for increasing returns is in building the stocks and flows of knowledge that a country or organization needs, and in encouraging

new insights and techniques. Adopting appropriate technologies leads directly to higher productivity, which is the key to growth. In societies that have large stock and flows of knowledge, virtuous circles that encourage widespread creativity and technological innovation emerge naturally and allow sustained growth over long periods. In societies with limited stocks of knowledge, bright and creative people feel stifled and emigrate as soon as they can; creating a vicious circle that traps those who remain in a more impoverished space. Such societies stay mired in poverty and dependency. The investment climate is crucial, as are the right incentive structures, to guide the allocation of resources, and to encourage research and development. Successful countries have grown their ability to innovate and learn by doing, by investing public funding to help finance research and development in critical areas. Everyone is involved, i.e. big and small, public and private, rich and poor. The benefits that are certain to flow from technological revolution in an increasingly connected world and knowledge-intensive world will be seized by those countries and companies that are alive to the rapidly changing environment, and nimble enough to take advantage of the opportunities. Those that succeed will make substantial advances in reducing poverty and inequality.

Adapted from: <https://ieet.org/index.php/IEET2/more/chetty20121003>

4. Translate the following word combinations into Russian. Make up your own sentences with these phrases.

1. integrated supply chains
2. drivers to development
3. human experience
4. mobile networks
5. revolutionary inventions
6. increase the reliability
7. certain innovations

8. surgical interventions
9. poor neighborhoods
10. consumption demand

5. Find the English equivalents to the following word combinations in the text:

1. прорывы в области здравоохранения
2. изнурительные условия
3. драйвер технологического роста
4. уровень жизни
5. генная инженерия

6. What is the main idea of the text? Choose the correct answer. Offer your own version of the main idea of the text.

- a) Scientific impact on developing countries slows down the development of society.
- b) Innovative technology is a key driver to development.
- c) Successful countries have increased their capacity to innovate and train by investing public funds in the fight against corruption.

7. Mark true (T) or false (F) sentences.

- a) To promote technological advances, developing countries should not invest in quality education for youth.
- b) Successful countries have grown their ability to innovate and learn by doing, by investing public funding to help finance research and development in critical areas.
- c) The potential of technology is endless, and still largely untapped in Africa.
- d) In a world in which the Internet makes information ubiquitous, what counts is the ability to collect knowledge.
- e) Less developed countries not only have a large pool of skilled labour and capital, but also use them more effectively.

8. In what paragraph is it written that adopting appropriate technologies leads directly to higher productivity, which is the key to growth?

a) 1; b) 2; c) 3.

9. Put the names of the paragraphs in the correct order. Title the other paragraphs.

Title	Number
a) Scientific impact on developing countries	
b) Technological revolution of the 21st century	
c) Investing in future development	

10. Choose the correct answer to the given question. Make your own question to the text with the question word “Why”. Ask your partner this question. Express your agreement or disagreement with the partner's opinion. Give reasons.

What bio-ethical issues will certain innovations and discoveries raise?

- a) Pollution of the environment
- b) Genetic modification of food crops and cloning of human embryos
- c) Overcrowding of cities

11. Translate the sentence.

To promote technological advances, developing countries should invest in quality education for youth, continuous skills training for workers and managers, and should ensure that knowledge is shared as widely as possible across society.

12. Match column A and B.

A	B
1. advance	a) достижения
2. poverty	b) здравоохранение
3. grasp	c) бедность
4. healthcare	d) восприятие

13. Complete the sentence.

Revolutionary inventions include

14. Choose the sentence with the correct word order.

- a) The ability makes information ubiquitous in a world in which the Internet, what counts is to use knowledge intelligently.
- b) In a world in which the Internet makes information ubiquitous, what counts is the ability to use knowledge intelligently.
- c) What counts in a world to use knowledge intelligently in which the Internet makes information ubiquitous, is the ability.

Communication skills

*(Adopted from: Armer T. Cambridge English for scientists. Cambridge University Press.
<https://portal.tpu.ru/SHARED/m/MALORISS/studentam/SelfStudy/Tab2/Posobie5cours.pdf>)*

15. In pairs, discuss the following questions.

1. What kind of texts do you need to write in English about your work or studies?
2. Why is it important to write your texts in an appropriate style?
3. What can you do to take note of the different styles of language used in English texts?

16. You have some questions about writing a critical review.

Discuss the questions given below. Express your agreement or disagreement with the partner's opinion. Give reasons.

1. How long should my review be?
2. Can I write a critical review if I've only read the abstract?
3. How should I approach the reading? What should I read first?
4. Is it a good idea to think of questions I want to answer?
5. Do I need to take notes or can I just highlight the relevant bits of the text?

17. Read the beginning of the email sent to members of a laboratory. Then in pairs, answer the questions below.

Dear all,

Sooner or later, issues of Technology Transfer (sharing and using discoveries, inventions, materials, data etc.) will become important in your research career. Protecting your work from competitors and, where appropriate, making it attractive to the commercial sector will be important during your career as a professional scientist. What are the key issues that you must think about?

1. What is the purpose of the email?
2. What kind of discoveries, inventions, materials and data might you share with other scientists in your field?
3. What do you think are the key issues of technology transfer?

CHECK YOURSELF

Answer the questions.

1. How do you prepare for your future profession?
2. How does university education help you to become a qualified specialist?
3. What do your scientific researches include?
4. Who are the most famous scientists in field of study?
5. What do you know about scientific and business ethics?
6. What are the rules of scientific communication?
7. What scientific works help you in your scientific research?
8. How to think as a scientist?
9. What are peculiarities of a scientific style of writing?
10. Could you describe a laboratory experiment you took part in?
11. What scientific resources do you use in your research?
12. What are goals and objectives of your scientific research?
13. Could you talk about scientific methods you use in your research?
14. Mathematics and mechanics are developing branches of science, aren't they? Prove it.
15. Why did you choose a career in science?

16. What field of science are you currently working or studying in?
17. What would you like to do next in your work or studies?
18. Is science education abroad similar to science education in your country? Give examples!
19. If you decided to study abroad, which qualification would be best for you?
20. Have you ever applied for a job in science? If not, what kind of job would you like to apply for in the future?
21. Which of the following documents are job applicants usually asked for in your country?
 - a. application form?
 - b. biodata?
 - c. cover letter (covering letter)?
 - d. resume or CV (curriculum vitae)?
22. Have you ever written one of these documents (application form, biodata, cover letter (covering letter), resume or CV (curriculum vitae) in English?
23. Do you think that the information you include and the way you organize a
24. resume or CV in English will be the same as a resume or CV in your own language?
25. Why is it important for scientists to keep in touch with ...:
 - a) other people in their field (e.g., biology)?
 - b) people in their specialism (e.g., molecular biology)?
 - c) people in other fields of science?
26. When you have a problem at work, who do you usually ask for help?
27. Have you ever asked a question on a science internet forum? If so, was your question answered?
28. What kind of texts do you need to write in English about your work or studies?
29. Why is it important to write your texts in an appropriate style?

30. What can you do to take note of the different styles of language used in English texts?
31. How long should your review be?
32. Can you write a critical review if you have only read the abstract?
33. How should you approach the reading of a scientific article? What should you read first?
34. Is it a good idea to think of questions you want to answer?
35. Do you need to take notes or can you just highlight the relevant bits of the text when writing a critical review?
36. How is the information in the results section of a paper different from the discussion section?
37. Why do researchers usually keep the results and discussion sections separate?
38. Why might some researchers present the results and discussion together as one section?
39. Some papers include a conclusion section. What is the difference between a discussion and a conclusion?
40. What is the purpose of an abstract?

How to Express your Opinion in English

<p>1. Sentence starters</p> <p>I prefer...</p> <p>I think...</p> <p>I know</p> <p>I believe...</p> <p>In my opinion...</p> <p>The best thing about...</p> <p>The greatest part about...</p> <p>The worst part about...</p> <p>Everyone should...</p> <p>...is better than ... because...</p>	<p>2. General Point of View</p> <p>It is thought that...</p> <p>Some people say that...</p> <p>It is considered...</p> <p>It is generally accepted that...</p> <p>Disagreeing with an opinion</p> <p>I'm afraid I have to disagree.</p> <p>I'm sorry to disagree with you, but...</p> <p>That's not entirely true.</p> <p>On the contrary...</p> <p>I'm not so sure about that...</p>
<p>3. Personal Point of View</p> <p>I have seen/noticed/observed that...</p> <p>I just don't think it's right that...</p> <p>One argument in favour of ... is that...</p> <p>As far as I'm concerned...</p> <p>In my opinion...</p> <p>I'd like to point out that..</p> <p>Speaking for myself...</p> <p>Personally, I believe (feel, think) ...</p> <p>I am sure/certain/convinced that...</p> <p>As far as I understand/ can see,</p>	<p>4. Giving the opposite opinion</p> <p>Maybe, but it seems to me that...</p> <p>I partly agree, but I still believe that...</p> <p>I don't agree. In my opinion, ...</p> <p>I completely disagree.</p> <p>To me, ...</p>
<p>5. Clarifying your opinion</p> <p>No, that's not what I'm trying to say.</p> <p>What I mean is ...</p> <p>No, that's not what I mean.</p> <p>All I'm saying is that ...</p>	<p>6. Giving yourself time to think</p> <p>That's an interesting point.</p> <p>I've never really thought about that.</p> <p>Um, let me think.</p> <p>It's hard to say.</p>
<p>7. Agreeing with an opinion</p> <p>Of course,</p> <p>You're absolutely right.</p> <p>Yes, I agree.</p> <p>I think so too.</p> <p>That's a good point.</p> <p>Exactly.</p> <p>That's true.</p> <p>Neither do I.</p> <p>I couldn't agree more.</p>	<p>8. Making Suggestions</p> <p>I suggest/ think you should ...</p> <p>It might be better to ...</p> <p>If I were you ..., I would ...</p> <p>I (don't) think we/ you should...</p> <p>You/ we could ...</p> <p>Couldn't you/we...?</p> <p>How/What about...?</p> <p>Why don't you/we ...?</p> <p>Why not ...?</p>

9. Responding to suggestions

I was thinking exactly that myself.

Sounds good (to me).

OK, let's do/try that.

Yes, let's do that.

You're right.

That's a good idea.

It's a good idea, but...

But what if...?

The only thing/ problem is...

Some Useful Phrases for Rendering Articles in English

1. The article under the title (the name) ... is taken from ...
2. It is written by ...
3. The theme of the article is closely connected with title of the article
4. This article deals with..., is devoted to ...
5. The main idea is expressed in the first (the last) paragraph
6. At the beginning the author describes, explains, introduces, analyses, gives a review of..., comments on, enumerates, points out...
7. From the article we learn that...
8. At the end the author comes to the conclusion that ...
9. To my mind (in my opinion)...
10. As far as I know, understand, remember...
11. For all I know...
12. First of all, to begin with...
13. The thing (problem, fact, point) is...
14. On the one hand..., on the other hand
15. Summing it up..., on the whole (in short...)
16. I can't but agree with the author that...
17. I'd like to stress the point (the idea) that...
18. As far as I am concerned I can add the following...
19. I mean to say...
20. But I'd like to say a few words in this connection...
21. As far as I can see...
22. More than that...
23. Generally speaking...

How to Make a Successful Presentation

The topic

1. **Love your topic.** Your listeners will only ever be as excited about the topic as you are. If you are not interested in what you are saying, why on earth are you inflicting it on other people? Work might not always inspire passion, but you should always look for a hook; an exciting way in. As Garr Reynolds declares, the world needs you to stop being boring.
2. **Research.** Know what you are talking about. Don't guess. Don't assume. Read, listen, find facts and have an informed opinion.
3. **Context.** Presenting a pitch for a new product will sound very different when you give it to the marketing team to when you show the finance team. Think about your audience and tailor your topic to the way they think and prioritise.
4. **Relevance.** Have an answer to the question: why should anyone care?
5. **Distil to a single point.** By the end of this stage you should no longer have a topic, but a single clear thought or argument that you want to communicate. Keep it simple, keep it arresting.

The format

6. **Time limit.** There will be one, and if there isn't, make one. Then aim to fill three quarters of it, and leave time for questions. (If there are no questions, everybody gets to go home a bit early and they'll love you even more.) Restriction helps you focus on what is truly essential to the presentation.
7. **Plan on paper.** Ok, it doesn't have to be paper, it could be OneNote, or mind mapping software, or Evernote. The point is, don't start your presentation in PowerPoint, or any presentation software. You need to be able to pool your ideas and images together, move them around and play with structure first, then decide how to present it second.
8. **PowerPoint.** There is a lot of debate about whether PowerPoint is good or evil, but the fact is it's the standard. That does not mean that you have you use it in a standardly bad way though. Guy Kawasaki advocates the 10/20/30 rule: 10 slides, 20 minutes, 30-point font minimum.
9. **Slides should keep you going,** not hold you up. Consider the Pecha Kucha or Ignite methods, where you have a set amount of time on each slide, which then advance automatically.
10. **Images inspire.** Don't fall back onto boring stock photography and clip art. Consider using your own personal photographs or explore creative commons sources

like Flickr for more intimate and relatable imagery. (Just be sure to check the terms of the licence if you're giving a commercial presentation.)

The content

11. **Short and sweet.** This applies to the presentation as a whole and each word you use. Stick to short words and avoid jargon.
12. **Tell a story.** People respond to stories. Everybody creates narratives, it's how we understand the world. Find the story in what you want to say.
13. **Use examples.** Presentations can often get a bit abstract. Keep your points grounded in reality and use everyday experiences that anyone can relate to when explaining complex ideas.
14. **Pre-empt questions.** In *Writing to Deadline*, Donald Murray explains that to write well you have to keep answering the readers' questions. What will they want to know next? The same goes for presentations. Of course you want to spark interest and debate after your talk, but make sure no one has to ask an obvious question.
15. **Know what you can leave out.** Questions can arise, people arrive late: sometimes things don't run to plan. Know in advance which slides and points you can skip without losing key points or narrative flow.

The preparation

16. **Know how to use your tools.** If you are using PowerPoint, be sure you understand how. For example, pressing 'b' will blank the screen so that you can focus attention on what you are saying. You can also embed hidden clickable areas that take you from section to section.
17. **Rehearse.** You have to practice: you need to be familiar enough with your presentation that if the power fails and notes get lost, you could still communicate the core of your message. Go through the presentation three times in the morning, and three times at night in the run up to the the day. Any more than that and you risk sounding over rehearsed.
18. **Plan your outfit.** You will have enough to worry about on the day. It may seem silly but don't leave it to the night before to decide what you are wearing. Choose it, check it's clean and ironed and hang it up ready to fall into on the day. (Or pre-crumple your jeans and scruff up your hoody, depending on your audience.)
19. **Get a lay of the land.** If you can, try to find out what room you will be presenting in and exactly who you will be presenting to. Will you have to project your voice, or will it be relaxed and informal? Is it always freezing in there? Are the chairs uncomfortable? These factors will affect your audiences' attention span, and for those things out of your control, you need to be conscious of them in how you present.

20. **Run a fact check.** You did your research, but often in companies things can change pretty quickly. There might be a new budget forecast, or a change in the hierarchy. On the day before make sure your presentation is as up to date as you are.

The day

21. **Take everything you need (and a backup).** Have your laptop cables and connectors. Take a backup of your presentation on a memory stick incase you have to use someone else's hardware, and have some bullet point notes about the slides in case all technology fails.
22. **Arrive early.** Don't get flustered. Have time to find the loos, sort the technical stuff, get a drink (although avoid coffee and chocolate just before as they're bad for the vocal chords and you'll find yourself coughing), and warm up.
23. **Warm up.** There are lots of ways to relax and loosen up before a presentation. HP Biz Answers has a series of three videos that teach you how to use acting techniques to battle nerves, loosen your tongue and and stay focused.
24. **Connect with your audience.** Don't just run through the presentation by rote. Watch your audience to see if they are engaged, listen for murmurs and change tack if brows are furrowed. Be engaged to get engagement.
25. **Share and follow up.** Think of a way to share your presentation with attendees after the event, for example with Slide Share. Send a follow up email, thank people for their attendance and invite questions and feedback. Keep the conversation going.

<https://www.articulatemarketing.com/blog/how-to-make-a-successful-presentation>

How to Write a Summary Essay

A summary essay is a condensed version of an original text. It contains no opinions, but only the main ideas of the original. It should be clear, accurate, brief, understandable to a reader who has not read the original text, and non-biased. The structure of a summary is simple:

1. The introduction (usually one paragraph)
2. The body of a summary essay (one or more paragraphs)
3. The conclusion (a one-sentence summary of the entire text and your opinion of the text)

The structure of a summary essay		Linking words and phrases
Introduction	<p>1. The title of the text (article).</p> <p>2. The author(s) of the text (article), when and where it was published.</p> <p>3. The main idea of the text (article).</p>	<p>The text (article) is headlined ...</p> <p>The text (article) is titled ...</p> <p>The author of the text (article) is ...</p> <p>The text (article) is written by ...</p> <p>It is published in ...</p> <p>The main idea of the text (article) is ...</p> <p>The text deals with the problem of ...</p> <p>The article is devoted to ...</p> <p>The purpose of the text (article) is to give the reader some information (data) on ...</p> <p>The extract from the book is about ...</p>
Body	<p>4. The contents of the text (article). Some facts, data, figures.</p>	<p>The author starts by stating that ...</p> <p>The author writes (thinks, points out) that ...</p> <p>According to the article ...</p> <p>The article (text) describes ...</p> <p>Further the author reports (says) that ...</p> <p>Among the other problems the article raises the problem of ...</p>
Conclusion	<p>5. A summarising statement.</p> <p>6. Your opinion of the text.</p>	<p>In conclusion ...</p> <p>Summing the text (article) up ...</p> <p>Having analysed the information, it is possible to say ...</p> <p>I found the article interesting (important) ...</p>

Mathematical and Scientific Symbols

Common pronunciations of mathematical and scientific symbols are given in the list below.

Symbols

+	plus	/ˈplʌs/
-	minus	/ˈmaɪnəs/
±	plus or minus	/ˈplʌs ɔ: ˈmaɪnəs/
x	multiplied by	/ˈmʌltɪplaɪd baɪ/
/	over; divided by	/ˈəʊvə /dɪˈvaɪdəd/
÷	divided	/dɪˈvaɪdəd/
=	equals	/ˈi:kwəlz/
≈	approximately, similar	/əˈprɒksɪmətli/ /ˈsɪmɪlə tʊ/
≡	equivalent to; identical	/ɪkˈwɪvələnt tʊ/ /aɪˈdentɪkl tʊ/
≠	not equal to	/ˈnɒt ˈi:kwəl tʊ/
>	greater than	/ˈgreɪtə ðən/
<	less than	/ˈles ðən/
≥	greater than or equal to	/ˈgreɪtə ðən ər ˈi:kwəl tʊ/
≤	less than or equal to	/ˈles ðən ər ˈi:kwəl tʊ/
⋈	not greater than	/ˈnɒt ˈgreɪtə ðən/
⋈	not less than	/ˈnɒt ˈles ðən/
≫	much greater than	/ˈmʌʃ ˈgreɪtə ðən/
≪	much less than	/ˈmʌʃ ˈles ðən/
⊥	perpendicular to	/pɜ:pənˈdɪkjʊlə tʊ/
∥	parallel to	/ˈpærəlel tʊ/
≢	not equivalent to, not identical to	/ˈnɒt ɪkˈwɪvələnt tʊ/ /ˈnɒt aɪˈdentɪkl tʊ/
≠≈	not similar to	/ˈnɒt ˈsɪmɪlə tʊ/
²	squared	/ˈskweəd/
³	cubed	/ˈkju:bd/
⁴	to the fourth; to the power four	/tə ðə ˈfɔ:θ/ /te ðə ˈpaʊə fɔ:/
ⁿ	to the n; to the nth; to the power n	/tə ðɪ en; tə dɪ enθ; tə ðə paʊər en/

$\sqrt{\quad}$	root; square root	/ru:t/ /skweə ru:t/
$\sqrt[3]{\quad}$	cube root	/kju:b ru:t/
$\sqrt[4]{\quad}$	fourth root	/fɔ:θ ru:t/
!	factorial	/fæk'tɔ:riəl/
%	percent	/pə'sent/
∞	infinity	/ɪn'fɪnətɪ/
\propto	varies as; proportional to	/'vɛəri:z/ /prə'pɔ:ʃənəl/
.	dot	/dɒt/
..	double dot	/dʌbl dɒt/
:	is to, ratio of	/reɪʃiəʊ/
f(x) fx	f; function	/ef/ /'fʌŋkʃən/
f'(x)	f dash; derivative	/dæʃ/ /dɪ'rɪvətɪv/
f''x	f double-dash; second derivative	/'dʌbl dæʃ/ /'sekənd dɪ'rɪvətɪv/
f'''(x)	f triple-dash; f treble-dash; third derivative	/'trɪpl dæʃ/ / trebl dæʃ/ /θɜ:d dɪ'rɪvətɪv/
f ⁽⁴⁾	f four; fourth derivative	/fɔ:θ dɪ'rɪvətɪv/
∂	partial derivative, delta	/pɑ:ʃəl dɪ'rɪvətɪv/ /deltə/
\int	integral	/'ɪntɪgrəl/
Σ	sum	/sʌm/
w.r.t.	with respect to	/wɪð 'rɪspekt/
log	log	/lɒg/
log ₂ x	log to the base 2 of x	/lɒg tə ðə beɪs tu: əv eks/
\therefore	therefore	/'ðɛəfɔ:/
\because	because	/bɪ'kɒz/
\rightarrow	gives, leads to, approaches	/gɪvz/ /li:dz tu/ /əprəʊtʃəz/
/	per	/pɜ:/
\in	belongs to; a member of; an element of	/bɪ'lɒŋz/ /'membə/ /'elɪmənt/
\notin	does not belong to; is not a member of; is not an element of	/nɒt bɪ'lɒŋ/ /nɒt ə 'membə/ /nɒt ən 'elɪmənt/
\subset	contained in; a proper subset of	/kən'teɪnd ɪn/ /'prɒpə 'sʌbset/

\subseteq	contained in; subset	/ˈsʌbset/
\cap	intersection	/ˈɪntəsekʃən/
\cup	union	/ˈjuːniən/
\forall	for all	/fə rə:l/
cos x	cos x; cosine x	/kɒz/
sin x	sine x	/saɪn/
tan x	tangent x	/tæn/
cosec x	cosec x	/ˈkəʊsek/
sinh x	shine x	/ˈʃaɪn/
cosh x	cosh x	/ˈkɒʃ/
tanh x	than x	/θæn/
x	mod x; modulus x	/mɒd/ /ˈmɒdjʊləs/
°C	degrees Centigrade	/dɪˈɡriːz ˈsentɪɡreɪd/
°F	degrees Fahrenheit	/dɪˈɡriːz ˈfærənhaɪt/
°K	degrees Kelvin	/dɪˈɡriːz ˈkelvɪn/
0°K, – 273.15 °C	absolute zero	/absəlu:t zi:rəʊ/
mm	millimetre	/ˈmɪlɪmi:tə/
cm	centimetre	/ˈsentɪmi:tə/
cc, cm ³	cubic centimetre, centimetre cubed	ˈkjuːbɪk ˈsentɪmi:tə / ˈsentɪmi:tə ˈkjuːbd/
m	metre	/ˈmi:tə/
km	kilometre	/kɪˈlɒmɪtə/
mg	milligram	/ˈmɪlɪɡræm/
g	gram	/græm/
kg	kilogram	/ˈkɪləgræm/
AC	A.C.	/eɪ siː/
DC	D.C.	/diː siː/

Таблица

Examples

$x + 1$	x plus one
$x - 1$	x minus one
$x \pm 1$	x plus or minus one
xy	x y; x times y; x multiplied by y
$(x - y)(x + y)$	x minus y, x plus y
x/y	x over y; x divided by y;
$x \div y$	x divided by y
$x = 5$	x equals 5; x is equal to 5
$x \approx y$	x is approximately equal to y
$x \equiv y$	x is equivalent to y; x is identical with y
$x \neq y$	x is not equal to y
$x > y$	x is greater than y
$x < y$	x is less than y
$x \geq y$	x is greater than or equal to y
$x \leq y$	x is less than or equal to y
$0 < x < 1$	zero is less than x is less than 1; x is greater than zero and less than 1
$0 \leq x \leq 1$	zero is less than or equal to x is less than or equal to 1; x is greater than or equal to zero and less than or equal to 1
x^2	x squared
x^3	x cubed
x^4	x to the fourth; x to the power four
x^n	x to the n; x to the nth; x to the power n
x^{-n}	x to the minus n; x to the power of minus n
$\sqrt{\quad}$	root x; square root x; the square root of x
$\sqrt[3]{\quad}$	the cube root of x
$\sqrt[4]{\quad}$	the fourth root of x
$\sqrt[n]{\quad}$	the nth root of x
$(x + y)^2$	x plus y all squared

$(x/y)^2$	x over y all squared
$n!$	n factorial; factorial n
$x\%$	x percent
∞	infinity
$x \propto y$	x varies as y; x is (directly) proportional to y
$x \propto 1/y$	x varies as one over y; x is indirectly proportional to y
\dot{x}	x dot
\ddot{x}	x double dot
$f(x)$ fx	f of x; the function of x
$f'(x)$	f dash x; the (first) derivative of with respect to x
$f''x$	f double-dash x; the second derivative of f with respect to x
$f'''(x)$	f triple-dash x; f treble-dash x; the third derivative of f with respect to x
$f^{(4)}$	f four x; the fourth derivative of f with respect to x
∂v	the partial derivative of v
$\frac{\partial v}{\partial \theta}$	delta v by delta theta, the partial derivative of v with respect to θ
$\frac{\partial^2 v}{\partial \theta^2}$	delta two v by delta theta squared; the second partial derivative of v with respect to θ
dv	the derivative of v
$\frac{dv}{d\theta}$	d v by d theta, the derivative of v with respect to theta
$\frac{d^2 v}{d\theta^2}$	d 2 v by d theta squared, the second derivative of v with respect to theta,
\int	integral
\int_0^∞	integral from zero to infinity
Σ	sum
$\sum_{i=1}^n$	the sum from i equals 1 to n
$\log_e y$	log to the base e of y; log y to the base e; natural log (of) y
\rightarrow	gives, approaches
$\Delta x \rightarrow 0$	delta x approaches zero

$\lim_{\Delta x \rightarrow 0}$	the limit as delta x approaches zero, the limit as delta x tends to zero
$Lt_{\Delta x \rightarrow 0}$	the limit as delta x approaches zero, the limit as delta x tends to zero
m/sec	metres per second
$x \in A$	x belongs to A; x is a member of A; x is an element of A
$x \notin A$	x does not belong to A; x is not a member of A; x is not an element of A
$A \subset B$	A is contained in B; A is a proper subset of B
$A \subseteq B$	A is contained in B; A is a subset of B
$A \cap B$	A intersection B
$A \cup B$	A union B
$\cos x$	cos x; cosine x
$\sin x$	sine x
$\tan x$	tangent x, tan x
$\operatorname{cosec} x$	cosec x
$\sinh x$	shine x
$\cosh x$	cosh x
$\tanh x$	than x
$ x $	mod x; modulus x
18 °C	eighteen degrees Centigrade
70 °F	seventy degrees Fahrenheit

^

^Decimal Fractions

0.1	nought point one	/nɔ:t pɔɪnt wʌn/
0.01	nought point oh one	/nɔ:t pɔɪnt əʊ wʌn/
0.0001	nought point oh oh oh one	/ten pɔɪnt əʊ əʊ əʊ wʌn/
1.1	one point one	/wʌn pɔɪnt wʌn/
1.2	one point two	/wʌn pɔɪnt tu:/
1.23	one point two three	/wʌn pɔɪnt tu: θri:/
1.0123	one point oh one two three	/wʌn pɔɪnt əʊ wʌn tu: θri:/
10.01	ten point oh one	/ten pɔɪnt əʊ wʌn/
21.57	twenty-one point five seven	/'twentɪ wʌn pɔɪnt faɪv 'sevən/
2.6666666666....	two point six recurring	/tu: pɔɪnt sɪks rɪ'kɜ:riŋ/
2.612361236123...	two point six one two three recurring	/tu: pɔɪnt sɪks wʌn tu: θri: rɪ'kɜ:riŋ/
2.5 million	two point five million	/tu: pɔɪnt faɪv 'mɪljən/

^

SI Units: Prefixes

10^{-24}	yocto	y	/'jɒktəʊ/
10^{-21}	zepto	z	/'zeptəʊ/
10^{-18}	atto	a	/'atəʊ/
10^{-15}	femto	f	/'femtəʊ/
10^{-12}	pico	p	/'pi:kəʊ/
10^{-9}	nano	n	/'nanəʊ/
10^{-6}	micro	μ	/'maɪkrəʊ/
10^{-3}	milli	m	/'mɪlɪ/
10^{-2}	centi	c	/'sentɪ/
10^{-1}	deci	d	/'desɪ/
10^3	kilo	k	/'kɪləʊ/
10^6	mega	M	/'megə/
10^9	giga	G	/'gɪgə/
10^{12}	tera	T	/'terə/
10^{15}	peta	P	/'petə/
10^{18}	exa	E	/'eksə/

10^{21}	zetta	Z	/'zɛtə/
10^{24}	yotta	Y	/'jɒtə/
10^{27}	xona	X	/'zəʊnə/
10^{30}	weka	W	/'wekə/
10^{33}	vunda	V	/'vʊndə/

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Bibliography

1. Антонова М.Б. Английский язык для академических целей: прикладная математика, компьютерные науки и вычислительная техника – Academic English: Research Writing for Applied Mathematics, Computer Science and Engineering. B2 – C1: учебник / М.Б. Антонова, А.В. Бакулев. –Москва: Флинта, 2022. – 356 с.
2. Гарагуля С.И. Английский язык в сфере информационных систем и технологий – English for Information Systems and Technology: учебник / С.И. Гарагуля – Москва: КНОРУС, 2021 – 422с.
3. Гузикова М.О. Чтение и письмо на английском языке для академических целей – English writing and reading for academic purposes: учебно-методическое пособие / М.О. Гузикова, Н.А. Завьялова. – 2-е изд., стер. – Москва: ФЛИНТА; Екатеринбург: Изд-во Урал. ун-та, 2021. – 104 с.
4. Курашвили Е.И. Английский язык для студентов-физиков. Второй этап обучения: учеб. пособие 2-е изд., перераб. и доп. / Е.И. Курашвили – М.: Астрель: АСТ, 2005. – 189 с.
5. Маршева Т.В., English for Biotechnology: учебно-методическое пособие / Т.В. Маршева, Л.Н. Юзмухаметова, А.А. Богданова. – Казань: Казанский федеральный университет, 2024. – 131 с.
6. Никрошкина С. В. Английский язык для магистрантов. Научная деятельность: учебное пособие. / С.В. Никрошкина – Новосибирск: Изд-во НГТУ, 2023. – 75 с.
7. Семенова, А.А. English for students of applied physics – Английский язык для студентов-физиков: учебное пособие / А.А. Семенова, Н.Н. Николаева. – Москва: Издательство МГТУ им. Н.Э. Баумана, 2021. – 190 с.
8. Сигачева Н.А. English for undergraduates of Physics: учебное пособие / Н.А. Сигачева, Х.Ф. Макаев – Казань: Казан. ун-т, 2020. – 121с.
9. Сиполс, О.В. Develop Your Reading Skills: Comprehension and Translation Practice. Обучение чтению и переводу (английский язык): Учебно-методическое пособие / О.В. Сиполс. – 5-е изд., перераб. и доп. – Москва: ФЛИНТА, 2023. – 330 с.
10. Christopher G. De Pree, Ph.D. Physics Made Simple – by Broadway Books, a division of Random House, Inc., 2004. – 197 p.
11. Armer T. Cambridge English for scientists. Cambridge University Press. // URL:

<https://portal.tpu.ru/SHARED/m/MALORISS/studentam/SelfStudy/Tab2/Posobie5cours.pdf>

12. Cambridge dictionaries online. [Интернет-ресурс]. – Режим доступа: <https://dictionary.cambridge.org/>

13. Oxford English dictionary. [Интернет-ресурс]. – Режим доступа: <https://www.oed.com/>

14. Словарь Мультитран. URL: <http://www.multitrans.com/>

Учебное издание

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ENGLISH FOR MASTER`S STUDENTS

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