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English for Students of Mathematics and Mechanics

(Part one)

Учебное пособие
под ред. Л.Н. Выгонской

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Учебное пособие предназначено для студентов I курса механико-математического факультета. Его цель — формирование навыков самостоятельной работы с литературой по специальности, обучение адекватному переводу, развитие навыков устной и письменной речи.

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Предлагаемое учебное пособие является I частью учебного комплекса, разрабатываемого преподавателями кафедры английского языка механико-математического факультета МГУ в соответствии с учебной программой курса английского языка для механиков и математиков.

Пособие состоит из введения, 17 уроков и приложения. Во введении обращается внимание на умение пользоваться англо-русским и толковым англо-английским словарями, даются рекомендации, как учить слова, расширяя свой словарный запас, объясняется, что такое адекватный перевод. Каждый урок включает предтекстовые задания, текст и послетекстовые упражнения. При этом система упражнений предполагает тщательный анализ тех языковых явлений на фонетическом, лексическом и грамматическом уровнях, которые представляют трудности для русскоговорящих учащихся. Такой анализ помогает студентам добиться полного и максимально точного понимания текста. В приложении приводятся образцы рефератов, дается их анализ.

Материалом для этой части послужили в основном тексты из Compton's Encyclopedia, посвященные различным областям механики и математики. Тексты не подвергались адаптации и каким-либо изменениям. Поэтому возможно некоторое несовпадение взгляда авторов текстов на отдельные вопросы механики и математики с тем, как они рассматриваются на факультете.

Выражаем искреннюю благодарность рецензентам — доктору филологических наук, профессору Е.Б. Яковлевой и доктору физико-математических наук, профессору Н.Н. Смирнову за ценные замечания, а также аспирантам механико-математического факультета МГУ Н.Н. Андрееву, М.В. Фейгину, К.Э. Фельдману и А.А. Черепанову за помощь, оказанную при подготовке пособия к печати.

Contents

Введение

О пользовании словарем

Как показывает практика, не все студенты свободно ориентируются в англо-русском словаре, важность же эффективного использования словаря как основного источника информации по английскому языку вряд ли можно переоценить, и, несмотря на то, что словари снабжены многочисленными пояснениями, некоторая детализация отдельных сторон работы со словарем оказывается, в чем убеждает педагогический опыт, далеко не излишней.

Поскольку данное пособие ставит своей целью развитие навыков *самостоятельной* работы над текстом, мы привлечем внимание к основным информативным единицам словарной статьи, чтобы студент с первого момента приобщения к научному сообществу быстро и полностью считывал фонетическую, лексическую и грамматическую информацию.

Итак, я, студент восполняю пробелы в пользовании, казалось бы, хорошо известным мне источником информации. *На что я, возможно, не обращал внимание?* На то, что в пределах словарной статьи, когда я ищу значение неизвестного слова, мне помогают сориентироваться разные шрифты (например, курсив, жирный шрифт), цифры (римские, арабские), пунктуация (запятая, точка с запятой), значки (скобки, тильда, ромб, прямоугольник), сокращения (частей речи, стилистические пометы и др.) При всем многообразии отечественных словарей и вносимых со временем изменений, подход к организации статьи по существу один. Тем не менее, нашим студентам мы рекомендуем в первую очередь "Новый англо-русский словарь" под ред. В.К. Мюллера.

Последнее предварительное замечание, быть может самое важное. Когда мы изучаем иностранный язык, мы изначально запрограммированы на ошибки, так как все время вмешивается родной язык, диктуя произношение, казалось бы, сходного в двух языках звука (в русском "а", в английском [ʌ], [a:], [ɑ]), построение предложения (тогда как в английском прямой порядок слов), словосочетания, многозначность слова, наличие или отсутствие предлога у глагола (ждать — *wait for*, зависеть от — *depend on*, следовать за — *follow*) и т.д.

Поэтому при обсуждении пользования словарем мы будем указывать на типичные ошибки носителей русского языка в английском, приучая студента к анализу в этом направлении — подходу, который лег в основу пособия по развитию навыков самостоятельной работы над научным текстом.

Транскрипция

1. Она может быть дана дважды в статье, если разные части речи произносятся по-разному, например, *export:* глагол [əksˈpɔ:t], существительное ['ekspɔ:t].

2. В отличии от русского языка, в английских словах бывает два ударения, главное ['- -] и второстепенное [-,-], например , examination [ig,zæmi'neiʃ(ə)n]. Без соблюдения такого произношения слово с трудом воспринимается естественными носителями языка и приводит к нарушению общения.

3. Один из знаков в транскрипции может быть выделен курсивом или (в зависимости от издания словаря) взят в круглые скобки. Это означает, что данный звук может не произноситься, то есть слово имеет два варианта произношения. Например, ['gəuld(ə)n] *golden.*

4. Чтобы быть правильно понятым, необходимо изучить произношение отдельных звуков английского языка, слов в потоке речи, элементы интонации и три правила произношения, кардинально отличающиеся от русского языка (пленка прилагается). И еще одно. Таково свойство английского языка, что каждое новое вам слово при всей похожести сочетания букв нельзя произносить по ассоциации с известным, здесь нет правил. Только *словарь* даст ответ. Вспомните, например, три формы глагола *read.*

Цифры, буквы и другие пометы

1. *Римские цифры* означают омонимы, на каждый из которых заведена статья, Так, когда известно слово *school* как "школа", а по тексту оно не подходит, надо смотреть в словаре *school II* "косяк рыб".

2. *Жирные арабские цифры с точкой.* По ним легко пробежать глазами в словарной статье. Это части речи. После них даны сокращения английских названий. В первую очередь надо знать следующие: *n* — существительное, *v* — глагол, *a* — прилагательное, *adv* — наречие.

Очень важно, прежде чем искать значение слова в словаре, точно определить по предложению, какая это часть речи.

3. *Светлые арабские цифры с круглой скобкой.* Это значения каждой части речи.

4. *Буквы русского алфавита с круглой скобкой.* Это значения словосочетаний. Так, в статье на слово *mean* Ia8) *разг.* скромный, смущающийся приводится словосочетание *to feel ~*, которое имеет два значения: а) чувствовать себя неловко; б) чувствовать себя нездоровым.

При поиске значений слова обратите внимание на следующие пометы: область знания — *эк.*, *мат.*, *хим.*, и т.п.; стиль — *разг.*, *книжн.*, *поэт.*; варианты языка — *амер.*

Поясним также следующие сокращения:

1) *pl.* — множественное число, *sing.* — единственное число. Например, *means* [mi:nz] n pl. 1) (часто употр. как *sing.*) средство, способ. То есть, это слово имеет данное значение, когда используется в форме множественного числа, а употребляться может в значении и единственного, и множественного числа.

2) *attr.* — употребление существительного в качестве определения. Это типично для английского языка и относится к цепочке из нескольких существительных, где последнее слово является определяемым, а все предыдущие — определениями. Например, *stone wall* — каменная стена, *space flight control centre* — центр управления космическим полетом.

Теперь перейдем к отражению идиоматики языка в словаре. *Идиома* — это неразложимое словосочетание, значение которого не выводится из значения ее компонентов. Яркими примерами являются пословицы и поговорки, например, в русском языке "ко-

гда рак свистнет". Менее заметными являются остальные. Когда вы посмотрели отдельно все компоненты словосочетания в словаре, а при переводе получаете абсурд, то определите границы этой идиомы и ищите ее на одно из главных слов после знака ромба ◇ в конце словарной статьи или в конце каждой части речи в словарной статье. Например, *in the mean time.* Подставляя все значения слова *mean,* вы не получите значение этой идиомы "между тем, тем временем". Чем больше вы будете работать с текстами, тем быстрее сориентируетесь в предложении и выделите идиому, чтобы сразу искать ее после знака ◇.

Значок прямоугольника ▭ тоже обозначает идиомы, но встречается только в глагольных статьях и отражает идиоматические сочетания глагола с предлогом. Эти предлоги выделены жирным шрифтом и даны в алфавитном порядке, что облегчает их поиск. Например, после значений глагола *make* дан ▭, и если вы, скажем, ищите *make up,* то найдете а) пополнять, б) собирать, в) мириться и т.д. Английский язык богат такими идиоматическими сочетаниями глагола с предлогом, на это нужно обращать внимание при работе с текстом как для перевода, так и для изложения содержания.

В связи с этим очень важно отметить, что при изучении английского языка вы должны постоянно обращать внимание на наличие или отсутствие предлога у глаголов и других частей речи, в разного рода фразах *по сравнению с русским языком,* будь то идиоматические сочетания или свободные.

Пример разных предлогов в двух языках: состоять *из* — consist *of, по* причине — *for* the reason.

Пример отсутствия предлога в одном языке: заниматься — deal *with;* причина чего-либо — reason *for,* влиять *на* — influence.

Пример совпадения предлогов в двух языках: *под* влиянием — *under* the influence.

Остановимся отдельно на глагольных статьях, поскольку именно глагол и его формы вызывают основные трудности при изучении английского языка.

У неправильных глаголов после транскрипции в круглых скобках приводятся его вторая и третья формы. Если они совпадают, дается одно слово, например *read* [ri:d] *(read).* Если не совпадают, то между ними стоит точка с запятой, например *go* [gəu] *(went; gone).* Если же вы видите между словами запятую, то она от-

деляет варианты одной и той же формы, например, *learn* [lə:n] (*learned, leant* [lə:nt]).

Следующие сокращения означают:
past — Past Indefinite, т.е. II форма, *went.*
p.p. — Past Participle, т.е. III форма, *gone*
pres.p. — Present Participle, т.е. IV форма, *going.*
Они помогут вам найти в словаре начальную форму глагола. Так, если вы ищете в словаре значение went, то находите словарную статью, где сказано: *went — past* от *go* 1. *v.*

Таким образом, словарь является *основным* пособием справочного характера для изучающего язык, но нельзя игнорировать и озвученный материал в лингафонном кабинете. Как показывает практика, в огромном количестве случаев естественный носитель английского языка речь студентов, в особенности при *чтении, не понимает* не столько из-за акцента как такового, сколько из-за несоблюдения нескольких правил произношения, приводящего к изменению смысла высказывания.

Три правила произношения таковы:

I. Звуки [p,t,k] в начале слова перед гласным в ударном слоге произносятся с придыханием:

put take cat.

Исключение: если этим звукам предшествует [s]:

stake spoke skate.

II. Звонкие согласные на конце слова не оглушаются, в отличие от русского языка.

good [gud] big [big] above [ə'bʌv]

Сравните: дед [дет], стог [сток]

Оглушение в английском языке может привести к изменению смысла, например

made [meid] vs mate [meit]

side [said] vs sight [sait]

III. Звуки [l,m,n] 1) после кратких гласных в конце слова,
2) перед [d,z]
произносятся долго:

kill sun come killed comes suns

Использование толкового словаря

Толковый англо-английский словарь необходим иностранцу, изучающему язык не столько для поиска значений, сколько для осознания идиоматичности чужого языка, то есть своеобразия сочетаемости слов и их употребления. Мы рекомендуем нашим студентам *Longman Dictionary of Contemporary English*. Одно из его преимуществ с нашей точки зрения в том, что в словарных статьях имеются не только дефиниции и примеры, но и раздел USAGE, помогающий изучающему язык разобраться в различии между сходными по смыслу словами. Так, например, словарная статья на слово *insure* включает раздел Usage, где сопоставляются слова *assure, ensure* и их производные. А, скажем, в статье *intellectual* дается ссылка на слово *intelligent* и предлагается сравнить заглавное слово со *spiritual*. Статья, организованная таким образом, выполняет важнейшую функцию при изучении чужого языка: привлекая внимание иностранца к сопоставлению слов английского языка, приучает его искать такие различия с помощью словаря, замечать в текстах своеобразие сочетаний данного слова по сравнению с сочетаниями другого, сходного по значению, т.е. помогает сориентироваться в *употреблении* слов, кажущихся похожими, в частности по ассоциации с родным языком. Можно сказать, что такой словарь учит изучать язык, а не только предоставляет разнообразную информацию о нем.

В конце этого словаря приводится список слов, использованных в определениях и примерах. И это еще одно преимущество словаря для иностранца, так как список представляет собой оптимальный набор слов, тщательно отобранных по разным параметрам, в том числе и стилистическим. Для начала достаточно знать эти слова в их первом значении.

Как учить слова

I. Какие слова учить?

Не все. Многие не надо учить вообще, некоторые нужно лишь понимать, когда их читаете или слышите — это пассивный словарный запас. Важны те, которые необходимо использовать самому, т.е. активный словарь.

Если ваша задача — чтение с целью получения информации,

то не надо смотреть каждое слово в словаре. Найдите только те, которые действительно важны для понимания текста. Общий смысл и так будет ясен.

В некоторых случаях вы сможете угадать смысл слова. Определите сначала, какая это часть речи, а контекст и форма слова помогут вам в этом. Если цель — перевод, то определив часть речи, найдите слово в словаре.

II. Что значит знать слово?

1. Знать значение мало. Также необходимо знать:
а) с какими словами оно обычно ассоциируеся, б) есть ли у него грамматические особенности, в) как оно произносится.

2. Старайтесь учить новые слова не отдельно, а во фразах.

3. Записывайте прилагательные вместе с существительными, с которыми они ассоциируются и наоборот, например,
present century, rough comparison, tremendous difference, great achievements.

4. Записывайте глаголы со структурой (т.е. глагол+прил, глагол+–ing) и с существительными, с которыми они связаны, например,
to reach conclusions, to make a discovery, to become familiar with, is used for ...-ing, to overcome resistance.

5. Записывайте существительное во фразах, например,
in contact with, the science of ...-ing.

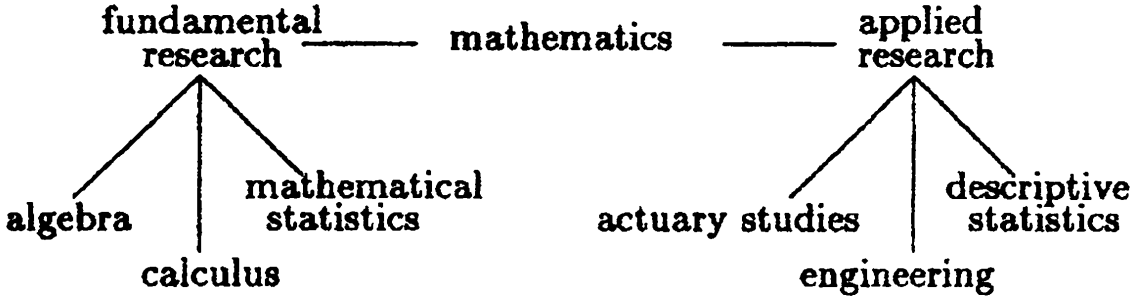
6. Записывайте слова вместе с предлогами, например,
for this purpose, proportional to

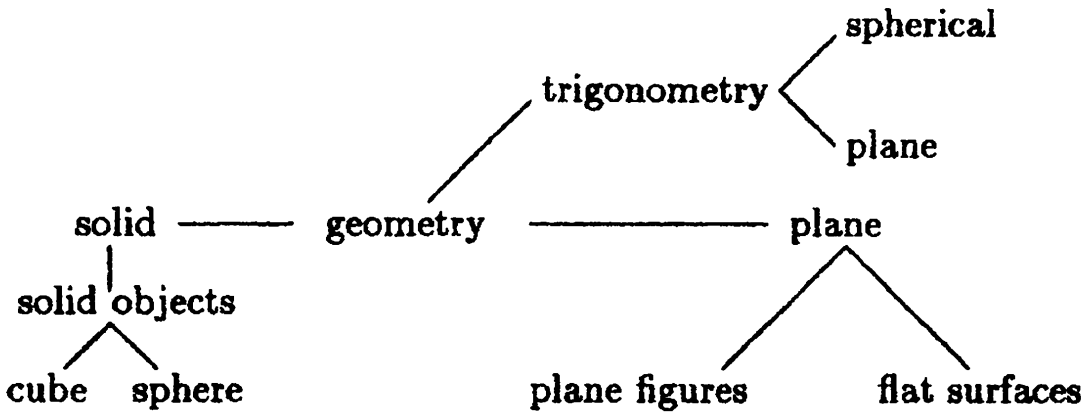
7. Отмечайте грамматические характеристики. Например, правильный глагол или неправильный, или когда существительное используется только во множественном числе, например, *means.*

8. Отмечайте сложности с произношением того или иного слова. Например, два ударения в слове.

III. Способы изучения слова.

1. Учите вместе слова из одной области.

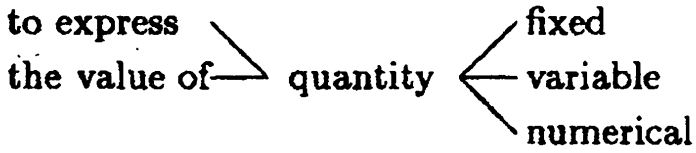


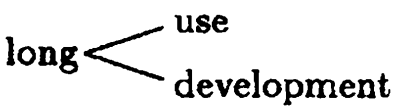


2. Учите вместе слова с одной грамматической особенностью, например, неправильные глаголы, существительные в форме множественного числа (mathematics, mechanics, physics).

3. Учите вместе однокоренные слова, например,
science scientific scientist

4. Рисуйте диаграммы и схемы.





5. Встретив синоним и антоним, запишите их вместе, указав стилистические особенности, если они есть, например,
stop=cease (more formal)

Предлагаемые в нашем пособии упражнения содержат вопросы, которые вам необходимо научиться задавать самим себе при изучении языка по специальным текстам. Отвечая на них, вы научитесь работать с научной литературой самостоятельно, в том числе и расширяя свой словарный запас.

Как переводить специальные тексты

При пользовании словарем необходимо понимать, что слово в тексте имеет одно-единственное значение, *контекстуальное,* если, конечно, целью автора не является игра слов, что в научной литературе практически исключено. Поэтому и выписывать из словаря надо одно значение. Как его определить?

Прежде всего ориентируйтесь на тематику текста и стиль изложения, что позволит исключить словарные значения, помеченные как относящиеся к другим областям знаний (напр., биол., хим.) и другому стилю (напр., разг., устар., поэт.). До перевода рекомендуется прочитать весь текст, потом абзац и затем читать по предложению, чтобы легче было ориентироваться в контексте и таким образом прогнозировать значение неизвестного слова.

Одна из важнейших целей обучения — это *адекватный* перевод. Что это такое? Начнем с того, что он исключает две крайности, в которые часто впадает студент, то есть дословный и вольный варианты. В первом случае даже при правильном выборе словарных значений получается калька с оригинала, когда русский перевод по порядку слов в предложении, по сочитаемости слов, иногда даже по наличию или осутствию предлогов имитирует английский оригинал, игнорируя законы русского языка. То есть текст по-русски не звучит, так по-русски не говорят, слова так не сочетаются.

Вторая крайность, вольный перевод, является скорее интерпретацией, толкованием оригинала, отражением своего, пусть даже правильного, понимания идей текста, изложением содержания, но никак не адекватным переводом. Надо осознавать, что переводчик — это тень автора, и нравится нам это или нет, согласны мы с точкой зрения оригинала или нет, и даже когда и если мы можем изложить мысль автора по-другому, мы обязаны перевести именно то, что он пишет, а не то, как мы это понимаем. При

вольном переводе русский текст звучит, как правило, лучше, чем при дословном, поскольку студент далеко уходит от оригинала, толкуя содержание своими словами.

Так что же такое адекватный перевод? Это золотая середина. Ваш текст должен точно (а не дословно и не вольно) передавать идею английского текста, на хорошем русском языке, соблюдая его грамматические, лексические и стилистические нормы.

Перевод с русского языка и реферирование.

Требование к переводу с русского языка на английский, естественно, то же — адекватность. Что же касается формы, т.е. хорошего английского языка, здесь, как мы рассчитываем, вам поможет наше пособие. В упражнениях показаны примеры анализа лексики и грамматики, которому необходимо научиться, чтобы самостоятельно совершенствовать свое знание английского языка по текстам профессиональной тематики.

Подчеркнем еще раз, что этот анализ текстов построен на выявлении характерных особенностей английского языка *по сравнению* с русским. Такой подход поможет вам избежать типичных ошибок носителей русского языка в английском, заставляя обращать внимание, например, на непредсказуемость с точки зрения русского языка наличия или отсутствия предлогов у глаголов.

Попытайтесь, в частности, взять себе за правило подвергать сомнению саму идею, что если в русском языке какое-то слово сочетается с рядом других, то так будет и в английском. Скажем, в русском языке глагол *принимать* может сочетаться с такими словами: *гостей, без доказательств, радиопрограмму, приглашение, решение.* И если вы знаете только глагол *receive* или еще один в значении *принимать*, например, *accept*, то это не значит, что любой из них можно использовать для перевода вышеуказанных сочетаний русского языка. Законы сочетаний слов в разных языках разные. Еще один пример. Сравните возможные варианты перевода на английский язык прилагательного *сложный:*
сложная кривая — *composite* curve
сложная теория — *sophisticated* theory
сложная конструкция — *elaborate* design

более сложный вид уравнения — an *aggravated* form of the equation
сложная судьба — *ill-fate, bad luck, misfortune.*

Анализируя таким образом специальные тексты и выписывая для активного пользования (при переводе и реферировании) разного рода сочетания слов с их грамматическими особенностями, вы сможете встать на путь создания *своего* хорошего, адекватного перевода с русского языка на английский и написания реферата по международным стандартам.

Желаем вам удачи!

Unit 1

Pronunciation

I. *Study the three rules of pronunciation:*

a) *Unlike Russian* (сад[сат], бег[б'ек]), *consonants at the end of words are not devoiced. Pronounce the following:*

cube change language solid need record liquid fluid involve is method as solve

b) *Pronounce the sounds* [p, t, k] *in stressed syllables with aspiration before a vowel:*

cube compass count calculate chemistry calculus company curve power polygon purpose caused tabulate topology term

Compare: study discover statement

c) *Prolong* [l, m, n] *at the end of words after short vowels and before* [z, d]:

find sign signs kind old come comes

II. *Study how -ed forms are pronounced:*

[d] after vowels and voiced consonants	[t] after devoiced consonants	[id] after [t,d]
referred	balanced	represented
concerned	produced	restricted
inscribed	based	included
caused		
used		

Make -ed forms and pronounce them:

provide raise extract utilize solve comprise involve require discover analyze process relate consist apply

III. *Study how -(e)s is pronounced:*

[z] after vowels and voiced consonants	[s] after devoiced consonants	[iz] after [s, z, ʃ, ʒ, tʃ, dʒ]
plays	points	distances
methods	results	branches
problems		

Pronounce the following words:

deals curves circles changes forces processes surfaces triangles figures sciences quantities lines includes angles involves spheres cubes reaches bodies man's requires

IV. *Read the following letters:*

A, I, E, V, T, D, S, H, C, W, P.

V. *How many stresses are there in the following words as compared with Russian? Use your dictionary if necessary:*

mathematics mathematician differential equilibrium application algebraic analytical calculation trigonometry geometric interpretation

VI. *Say how these international words are pronounced. Register their transcription in your vocabulary, underline the sound or the stress pattern you are likely to confuse with Russian, e.g.* ***process*** ['prəuses] *vs* ***процесс:***

special cylinder financial effect chemistry dynamics specific company analysis integral function method object basis result

VII. *Say how* ***-able*** *is pronounced in* ***variable, probable*** *as compared with the adjective* ***able****.*

Text

Mathematics

Mathematics is the oldest of the sciences. It began with man's need to count objects and to measure distances. A mathematician uses numbers and signs to calculate fixed quantities or to compute variable quantities.

Mathematics is known as the most exact of all the sciences, since the proper use of its methods can provide only one correct answer to a specific problem. It is the language used by all the other sciences. It is the basis for precision in such branches as astronomy, chemistry, and physics.

Research Mathematics

Algebra is the study of relationships between numbers as they are represented by symbols. Its processes consist of multiplication, division, raising to a power, and extracting a root.

Arithmetic is the science of computation by the use of numbers. Addition, subtraction, multiplication, and division are the basic processes of arithmetic.

Calculus is the system of mathematics used to figure the rate of change of a function. It includes other specialized methods of treating problems which utilize algebra.

—*Differential calculus* deals with the rate of change of a variable and is a means for finding tangents to curves.

—*Integral calculus* is concerned with the limiting values of differentials and is a means of determining length, volume, or area.

Geometry is the branch of mathematics which deals with the measurements and relationships of lines and angles.

—*Analytical geometry* is the application of algebraic results to geometry.

—*Descriptive geometry* is used to solve problems dealing with the space relationships of geometric forms which comprise an object.

—*Differential geometry* is the application of calculus to the study of flat surfaces and curves.

—*Elliptic geometry* deals with symmetrical forms that are not true circles.

—*Plane geometry* is restricted to magnitudes of two dimensions in a single plane. It is concerned with polygons, triangles and circles that can be drawn with a ruler and compass.

—*Trigonometry* is the geometric treatment of triangles.

Spherical trigonometry involves triangles inscribed in circles.

—*Solid geometry* deals with figures of three dimensions such as cubes, cylinders, and spheres.

—*Topology* is the geometry of distorted geometric forms.

Metamathematics is the study of symbols, terms, and methods of mathematics for the purpose of establishing consistency.

Statistics includes the collection of numerical facts, together with the processes of tabulation and interpretation. It is the science of reaching conclusions from materials that are variable and of predicting results in terms of probability.

—*Descriptive statistics* is concerned with the collecting and tabulating of data and the summarization of processed data.

—*Mathematical statistics* deals with mathematical proofs used in statistical methods.

Applied Mathematics

Actuary studies involve the calculation of risk and the establishment of premiums and dividends for insurance companies.

Auditing is the analysis of the financial records used in business and industry and the preparation of statements and reports based on these records.

Engineering of all kinds requires the use of many branches of the science of mathematics.

Statistics involves collecting, tabulating, and analyzing data to discover relationships between variable happenings so as to predict the probable outcomes under known conditions.

Mechanics

Mechanics is concerned with the effects of forces acting upon bodies in motion or at rest.

Dynamics is a branch of mechanics that deals with the forces which produce motion or which change motion.

—*Aerodynamics* is the study of fluid mechanics as it is related to motion between a fluid (air), and a solid.

—*Hydrodynamics* is concerned with liquids in motion.

—*Kinematics* is the study of motion apart from its effects upon bodies.

—*Kinetics* deals with the changes in motion as they are caused by forces not in equilibrium.

Statics is a branch of mechanics which concerns balanced forces or bodies at rest.

—*Aerostatics* is the study of fluids at rest.

—*Hydrostatics* is the study of the forces that are produced by liquids at rest.

Development

VIII. *Spell the words pronounced as follows:*

['sistəm] ['beisik] [di'tɜ:min] ['a:nsə] ['simbl] [tʃeindʒ] [tri:t] ['meʒə] ['vælju:] [mi:n] [leŋθ] ['æŋgl] ['trɑiæŋgl] ['eiriə] ['sɜ:fis] [tru:] ['sɜ:kl] [dɑi'menʃ(ə)n] [ə'næləsis] [sfiə] ['likwid] ['pɜ:pəs] [ru:t] ['vɒlju:m] ['kwɔntiti]

IX. *Use your dictionary to show what difference there is in pronunciation and meaning between the words in each of the following groups:*

reach — rich, analysis — analyses, basis — bases, since — science — sins, root — rude, prove — proof, proves — proofs, cause — course

X. *Find the difference in pronunciation of the words* ***use, object, process, extract*** *as verbs and nouns.*

XI. *Note down the pronunciation of the preposition* ***of*** [əv]. Read the following phrases:

the most exact of all the sciences
the proper use of its methods
the study of relationships
the science of computation
the rate of change of a function
in terms of probability

XII. *Compare British and American pronunciation.*

Br		Am
[bra:ntʃ]	branch	[bræntʃ]
[ka:nt]	can't	[kænt]
['a:nsə]	answer	['ænsər]

Grammar

XIII. *Observe* ***-s in mathematics****. Find in the text more examples of nouns in -s with a singular meaning.*

XIV. *Why is the Superlative Degree of* ***old*** *and* ***exact*** *formed in a different way?*

the oldest vs the most exact

XV. *Say what part of speech and part of sentence used is and how it is pronounced.*

It is the language used by all the other sciences.

XVI. *Give four forms of the verbs (Indefinite Infinitive, Past Indefinite, Past Participle, Present Participle):*

deal begin know find be draw

XVII. *When speaking of purpose an infinitive is used, as in the following sentence:*

A mathematician uses numbers and signs to calculate fixed quantities or to compute variable quantities.

Find more examples in the text. Compare with Russian translation.

Vocabulary

XVIII. 1). *Observe various modes of expressing the basic functions of science. What alternatives are possible? Check against the text. Pay attention to prepositions and grammar as compared with Russian:*

is the study of
is the system of
is the application of ... to
is concerned with
is restricted to
includes
involves

2). *Identify Active and Passive Voice in the above expressions.*

3). *Learn to expand:*

... is the branch of ... which/that deals with
... is the study of ... which concerns

XIX. *Study prepositions as compared with Russian:*

answer to consist of raise to under known conditions
application to apart from means of/for + -ing

XX. *Use your dictionary to find the contextual meaning of* ***since*** *and* ***as*** *in the following sentences.*

Mathematics is known ***as*** the most exact of all the sciences, ***since*** the proper use of its methods can provide only one correct answer to a specific problem.

Kinetics deals with the changes in motion ***as*** they are caused by forces not in equilibrium.

Aerodynamics is the study of fluid mechanics ***as*** it is related to motion between a fluid (air), and a solid.

XXI. *Study the typical expressions to be used in rendering. Use your dictionary. Say why they are typical of scientific literature in general:*

for the purpose of -ing
by the use of
in terms of
to solve problems
basis for
methods of treating problems
to reach conclusions
to discover relationship between
caused by
produced by
used in

XXII. *Suggest replacements for the italicized words. Refer to the text and/or use a monolingual dictionary:*

to *compute* quantities
is a *means* for finding
for the purpose of establishing
its *effects* upon bodies (NB: *upon* — formal style, *on* — informal style)

XXIII. *Start compiling your vocabulary. Register there everything you find useful for reading, translating, speaking and rendering of scientific literature. Mark all elements (pronunciation, spelling, prepositions, word-combinations, etc) which you are likely to confuse with Russian equivalents.*

Unit 2

Pronunciation

I. 1) *Pronounce final consonants without devoicing:*

instead made side as times years solid solve ways

2) *Prolong* [l, n] *at the end and before* [d]:

men one ten land called kinds

3) *Pronounce* [p, t, k] *before vowels with aspiration in stressed syllables:*

cube called calculate ten kind topic times county count continent

II. *Pronounce the following words with two stresses. Use your dictionary. Compare with Russian equivalents:*

fundamental computation mathematical numeration presentation observation astronomical operation

III. *Say how the -ed forms are pronounced:*

learned developed based used devised tripled worked applied called civilized added worked remained appeared

IV. *Say how -(e)s forms are pronounced. What is the rule?*

numbers solutions problems solves deals properties triangles surfaces cubes spheres branches sides provides peoples measures examples

V. *Say how these letters are pronounced:*

X, Y, Z, C, V, I, K, L

VI. *Say how the following signs, symbols and numbers are read:*

"+", "-", "=", x^2; x^3; 150; 5,000.

Grammar

VII. *Give the four forms of the verbs, spell and pronounce them:*

deal know learn make find use operate apply provide map

Text

MATHEMATICS — the Study of Numbers and Quantities

MATHEMATICS. The ability to count and measure and to deal with numbers and symbols is of great importance to civilized men. By the dawn of historic times, about 5,000 years ago, the fundamentals of arithmetic and geometry were known. Since then, men have learned much more about mathematics, and many new topics have been developed.

Arithmetic and Algebra

Arithmetic is based on a numeration system made up of symbols that are used to express numerical quantities. Many different numeration systems have been devised. Today, however, most civilized peoples use the decimal system. The numbers are represented by such symbols as 1, 5, 25, and 150.

Arithmetic is the science of operating with numbers to obtain solutions to problems. Addition and multiplication are examples of arithmetical operations.

Sometimes, facts about a number or quantity are known, but the value of the number or quantity must be found. Procedures used to solve such problems constitute *algebra*. For example, to find the number which when tripled and added to four is ten, solve the equation: $3x + 4 = 10$.

Geometry and Trigonometry

Geometry deals with the properties of plane figures and solid objects. *Plane geometry* deals with problems that can be worked out on flat surfaces. *Solid geometry* deals with objects in space such as cubes and spheres.

A special branch of geometry called *trigonometry* deals with the properties of triangles. If two angles of a triangle and the length of the side between them are known, the value of the remaining angle and sides can be calculated by using trigonometry.

Trigonometry applied to flat surfaces, such as the land within a county, is called *plane* trigonometry. *Spherical* trigonometry provides methods for dealing with problems on the surface of a sphere, such as the earth or what appears to be the "dome" of the sky. These methods can be used for mapping large areas such as continents, for navigation of ships and airplanes, and for astronomical observations.

Graphs and Analytic Geometry

One of the simplest ways to present many kinds of statistical or other facts is by the use of graphs. Graphs are a visual presentation of mathematical data.

Analytic geometry is based upon the fact that any geometric figure can be expressed in an algebraic equation. For example, the area of a square (y) or the volume of a cube (z) having x as one edge can be expressed as $y = x^2$ or $z = x^3$. Thus algebraic computation can be used instead of complicated geometric figures.

Development

VIII. *Spell the words pronounced as follows:*

[di:l] [kaunt] ['desim(ə)l] [ə'piə] [ðʌs] [im'pɔ:t(ə)ns] [gra:f] [əb'tein] ['saiəns] [i'kweiʒ(ə)n] [la:dʒ] ['figə] [ə'diʃ(ə)n]

[sʌtʃ] [hau'evə] [skweə] [edʒ] [ə'gəu] ['sɜ:fɪs] [said] ['deitə] ['vælju:] ['meʒə]

IX. *Use your dictionary to find the transcription for each pair of words:*

one — won, way — weigh, for — four, plane — plain

X. *Say what sound(s) distinguishes these words:*

ship — sheep, addition — edition, special — spatial, man — men, made — mate, this — these, walk — work

XI. *Pronounce linking r in these phrases:*

learned much more about mathematics
for astronomical observations
they are examples
when tripled and added to four is ten
for example
number or quantity

XII. *Read the following phrases pronouncing of as* [əv]:

on the surface of a sphere
the science of operating with numbers
of great importance
presentation of mathematical data
the area of a square

XIII. *Practice the pronunciation of weak forms of words in unstressed positions:* can [kən], must [məst], have [həv], and [ənd], be [bi]

can be 'calculated
must be 'found
'men have 'learned

the 'value of 'angle and 'size
ad'dition and ˌmultipli'cation

XIV. *Compare British and American variants:*

Br		Am
[gra:f]	graph	[græf]
[ɪg'za:mpl]	example	[ɪg'zæmpl]
one hundred and fifty	150	one hundred fifty

Grammar

XV. *What part of speech is* ***arithmetic*** *in the following sentence? How is it pronounced? Is there a different transcription for another part of speech? Consult your dictionary.*

Arithmetic is based on a numeration system...

XVI. *Can you think of related words for:*

solve develop present compute science apply express
able history long sphere algebra differ geometry

XVII. 1) *Identify the underlying grammatical construction, name its components:*

can be expressed as
can be used for -ing
are represented by
are used to express
can be used
must be found

2) *Is it possible to translate it into Russian in Active Voice? NB! Passive is used in scientific and technical writing to show objectivity and to avoid I(we).*

3) *What modal verbs are used in these expressions? What form of the verb comes after? Find more examples of such verbs in the text.*

XVIII. *What forms of the verb (I–IV), what parts of speech and what parts of the sentence are the italicized words?*

To find the number which when *tripled* and *added* to four is ten, solve the equation...
The ability *to count*
Trigonometry *applied* to flat surfaces is *called* plane trigonometry.
The area of a square (y) or the volume of a cube (z) *having* x as one edge can be *expressed* as ...

XIX. *What Tense is used in the following sentence? Is Past Indefinite possible here? Why (not)?*

Since then men have learned much more about mathematics.

Vocabulary

XX. *Observe the use of the word* ***such****:*

such as → such symbols as → to solve such problems

XXI. *Observe the modes of expressing the functions of science. What other variants do you remember from Text I?*

... is based on/upon the fact that provides methods for -ing

XXII. *Study the prepositions as compared with Russian. Which expressions can you use for rendering texts?*

instead *of*
is of great importance *to*
by (the dawn)
about 5,000 years ago
however
to obtain solutions *to* problems
to solve the equation
such problems

XXIII. *What is the meaning of the words* ***people*** *and* ***peoples****? Is the difference the same as, for example, between* ***number*** *and* ***numbers****? Is* ***people*** *singular or plural?*

XXIV. *Note down all the terms, words and phrases typical of scientific literature. Use your dictionary to check the pronunciation of the words you understand, as well as of the new ones.*

XXV. *Paraphrase the following phrases, suggest synonyms. Compare your variants with those from the text: are they formal or informal?*

is of great importance to civilized men
to obtain solutions to problems
provides methods for dealing with problems

Unit 3

Pronunciation

I. *Pronounce these words without devoicing final consonants:*

powers appears squared means edges cubed called raised side read above

II. *Pronounce* [p, t, k] *before a vowel in stressed syllables with aspiration:*

power cube called can appear tell positive ten

III. *Read the letters:*

a, e, x, v, s

IV. *Pronounce these phrases with linking r:*

the power of a number
to square a number
or any other power
there are
for example
the number itself

V. *Check in the dictionary the stress patterns of:*

understand multiplication algebraic represent

VI. *How is* ***close*** *pronounced as a verb and as an adjective?*

VII. *Spell and pronounce the four forms of the verbs:*

find read square see talk write tell show raise appear be mean understand divide

Text

Powers and Roots

The subject of *powers* is closely related to multiplication. The subject of *roots* is closely related to division.

POWERS. The algebraic formula for the area of a square is $A = s^2$. A represents *area* and s represents one *side* of the square. We read s^2 as 's (side) squared'; it means $s \times s$. In like manner, $3^2 = 3 \times 3 = 9$, and $10^2 = 10 \times 10 = 100$. To square a number, we simply multiply it by itself. The square of a number is called the *second power* of the number.

The formula for the volume of a cube is $V = e^3$. In this formula e represents the length of one edge of the cube. We read e^3 as 'e cubed'; it means $e \times e \times e$. In like manner $2^3 = 2 \times 2 \times 2 = 8$, and $5^3 = 5 \times 5 \times 5 = 125$. The cube of a number is the *third power* of the number.

In the same way we can find the fourth power, the fifth power, or any other power of a number. For example, 3^4 (3 to the fourth power)$=3 \times 3 \times 3 \times 3 = 81$; 10^5 (100 to the fifth power)$=10 \times 10 \times 10 \times 10 \times 10 = 100,000$. It will be seen that, except for very small numbers, the higher powers of a number are very large.

The first power of a number is simply the number itself. For example, $7^1 = 7$. We do not ordinarily talk about the first power of a number.

The power of a number is indicated by a small figure written a little above and to the right. This small figure is called the *exponent*. In 8^3, for example, the exponent is 3; it tells us that 8 is to be raised

to the third power. The exponent 1 is seldom written; if no exponent appears on a number, it is understood that the exponent is 1.

In algebra it is shown that any number with an exponent of 0 is equal to 1. Thus, $3^0 = 1$; $10^0 = 1$. It is also shown in algebra that exponents can be negative numbers. Any number with a negative exponent is equal to 1 divided by that number with a positive exponent. For example, $7^{-2} = \frac{1}{7^2} = \frac{1}{49}$.

ROOTS. The sign $\sqrt{\ }$ means 'square root of'. We know that $6^2 = 36$; the square root of 36 is 6, or $\sqrt{36} = 6$.

The sign $\sqrt[3]{\ }$ means "cube root of". Similarly there are 4th roots, 5th roots, 10th roots, and so on. Then the cube of 4 is 64; that is $4^3 = 64$. The cube root of 64 is 4; that is $\sqrt[3]{64} = 4$.

Development

VIII. *Spell the words pronounced as follows. Sometimes alternatives are possible:*

[ru:d] — [ru:t] [raid] — [rait] [si:n] — [sin] [leŋθ] [fɔ:θ] ['pauə] ['fɪgə] [skweə] ['ɔ:d(ə)nri] [ik'sept] [edʒ] ['ɪ:kwəl]

IX. *Practice the pronunciation of of* [əv]:

square root of
side of the square
edge of the cube
the cube of a number
an exponent of 0

X. *Practice the sentence stress:*

To 'square a 'number, we 'simply 'multiply it by it'self.
In the 'same 'way we can 'find the 'fourth 'power.
It will be 'seen that ex'cept for 'very 'small 'numbers, the 'higher 'powers of a 'number are 'very 'large.
If 'no ex'ponent ap'pears on a 'number, it is under'stood that the ex'ponent is '1.

Note down that articles, prepositions, auxiliary and modal verbs are not usually stressed in a sentence.

Grammar

XI. *Form Degrees of Comparison for the following words:*

high closely

XII. *Supply related words:*

related square represent length mean ordinary divide multiply

XIII. *What form of the verb (I–IV) is to square in the following sentence? Is it Active or Passive Voice? What part of the sentence is it?*

To square a number, we multiply it by itself.

XIV. *What type of verb is is (notional, auxiliary, link, modal) if it is followed by infinitive, e.g.*

... is to be raised to the third power.
Compare with: is raised to the third power.

Find in the text all examples of modal verbs. What types of infinitive are they followed by (Indefinite Infinitive Active, Indefinite Infinitive Passive)?

XV. 1) *Find Passive Voice of the verbs in the text.*

2) *Use Active Voice in Russian to translate Passive Voice in the following sentence:*

If no exponent appears on a number, it is understood that the exponent is 1.

3) *Do you think there is a stylistic reason for the use of Passive Voice in such texts? What is it?*

XVI. *Supply ordinal numbers from* 1 *to* 10, *e.g.* one — first.

XVII. *What does any mean in affirmative sentences?*

In algebra it is shown that *any* number with an exponent of 0 is equal to 1.
In the same way we can find *any* other power of a number.

Vocabulary

XVIII. *Observe the use of prepositions as compared with Russian:*

is equal to multiply by divided by

XIX. *Find in the text other modes of reading formulas. Register them in your vocabulary.*

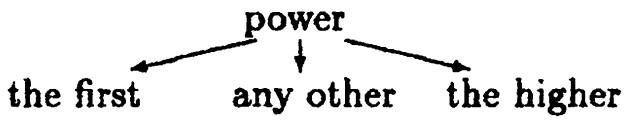
The sign ... means
"A" represents ...

XX. *Read the following signs. Check against the text.*

$\sqrt[3]{\ }$, $=$, $\times$, $\sqrt{36}$, 7^{-2}, $\frac{1}{7^2}$, $\frac{1}{49}$

XXI. *Study the combinations with power as compared with Russian. Learn to expand:*

power → the third power → to raise to the third power → is to be raised to the third power.



3^2 — three squared; e^3 — e cubed; 3^4 — 3 to the fourth power

XXII. *Note down similar means of expressing identical concepts:*
in like manner
in the same way
similarly

XXIII. *Study the typical expressions to be used in rendering scientific texts:*

and so on
that is
except (for)
The subject of ... is closely related to
It is shown that ... .

Writing

XXIV. *Read through the following paragraph to try to determine what the writer intended as the theme (main idea) of the paragraph. Either state it in your own words or find a sentence that expresses it.*

As you recall, the numbers used in multiplication are called factors. When the same factor is repeated more than once, a special shorthand, called exponential notation, can be used. In this notation, the repeated factor, called the base, is written only once. Above and to the right of the base is written another number, called the exponent or power of the base, which indicates how many times the base is repeated as a factor. For example,

$$\underbrace{5 \times 5 \times 5}_{\text{3 factors}} = 5^{3}$$

exponent or power

base

Unit 4

Pronunciation

I. 1) *Pronounce these words without devoicing final consonants:*

avoid above reasons fractions read and is hundred instead always as

2) *Pronounce initial consonants* [p,t,k] *before vowels with aspiration:*

point part ten common called come two time

II. *Practice the pronunciation of the following numerals:*

tenths
hundredths
thousandths
millionths

III. *Read the following with linking* r. *What is the rule?*

are easy there are for a long time power of ten the number is

IV. *Say how the -ed forms are pronounced:*

placed appeared said talked squared called used mixed

Text

Decimal Fractions

Numbers such as .4 and .07 are called *decimal fractions*, or simply *decimals*. The same numbers may be written as $\frac{4}{10}$ and $\frac{7}{100}$. They are then called *common fractions*, or simply *fractions*. Both are read in the same way: 'four tenths' and 'seven hundredths'.

In a common fraction, the number below the line is the *denominator*, and the number above the line is the *numerator*. In a decimal fraction we omit the denominator and place a dot, called a *decimal point*, in front of the numerator. The denominator of a common fraction may be any number. The unwritten denominator of a decimal fraction is always 10, 100, 1000, or some other power of 10.

Common fractions have been used for a longer time than have decimal fractions. In fact, decimal fractions did not appear until the latter part of the 16th century. Decimals are easier to write and to print than are common fractions. It is also easier to compute with them. For these reasons decimals have come to be widely used in business, science, and statistics.

How to Read Decimals

If there is only one figure to the right of the decimal point, we say 'tenths' when we read the decimal. For example, we read .1 as 'one tenths'.

If there are two figures to the right of the decimal point, we say 'hundredths'. We read .24 as 'twenty-four hundredths' and .06 as 'six hundredths'.

If there are three figures to the right of the decimal point, we say 'thousandths'. We read .256 as 'two hundred fifty-six thousandths', .075 as 'seventy-five thousandths', and .008 as 'eight thousandths'.

Four figures to the right of the decimal point are read as 'ten-thousandths'. We read .3852 as 'three thousand, eight hundred fifty-two ten-thousandths'.

After ten-thousandths there are hundred-thousandths, millionths and so on.

If a number has figures both to the left and to the right of the decimal point, the number is a *decimal mixed number*. The number 2.38 is read 'two and thirty-eight hundredths'. The word 'and' is used only where the decimal point appears in order to separate the whole number from the decimal fraction. To avoid confusion the business

practice for reading decimals is to say 'point' instead of 'and'. For example, the number 2.38 would be read 'two point three eight'.

Development

V. *Spell the words pronounced as follows:*

['ɔ:lwiz] [ə'piə] ['kɒmən] [ə'vɔid] [həul] [seim] ['sentʃəri] ['lætə] [be'ləu] [ə'bʌv] ['əunli] [weə] [in'sted] ['ri:z(ə)n] [wɜ:d] ['saiəns]

VI. *Say how the word* ***separate*** *is pronounced as a verb and as an adjective. Use your dictionary. What part of speech is used in the text (see the last paragraph).*

VII. *Say what sound distinguishes these words. Use your dictionary.*

latter — letter — later, to use — a use, place — plays, same — some, to read — are read, both — birth, wide — white, this — these, of — off, rid — to read

Does devoicing influence the meaning of words in Russian, e.g. ***кот*** *и* ***код*** [кот]?

VIII. *Practice the sentence stress. What kind of words are not stressed? Note down the unstressed variants of words:* ***can*** [kən], ***have*** [həv], ***and*** [ənd], ***be*** [bi], ***to*** [tə], ***for*** [fə].

If a 'number has 'figures 'both to the 'left and to the 'right of the 'decimal 'point, the 'number is a 'decimal 'mixed 'number.
It is 'also 'easier to com'pute with them.
For 'these 'reasons 'decimals have 'come to be 'widely 'used in 'business, 'science, and sta'tistics.

IX. *Say how each pair of words is pronounced. Use your dictionary if necessary.*

some — sum, right — write, two — too, whole — hole

What helps to distinguish them in speech? Give your reasons and examples.

Grammar

X. *Give the four forms of the following verbs, say how they are pronounced and spell them:*

write read see show mean come use be

XI. *Supply Degrees of Comparison. Be careful of changes to the spelling:*

easy long common simple simply widely

XII. *How is* ***any*** *translated in affirmative sentences?*

The denominator of a common fraction may be any number.

XIII. *What forms of the verb are* ***be written*** *and* ***be*** *which come after* ***may*** *in* ***may be written*** *and* ***may be****? What is the difference between them?*

XIV. *What Tense is used in the following sentence? What period of time does it cover as compared with Present Indefinite? What Tense is used in Russian to express the same idea? Find another example of this Tense in the text and analyze it.*

Common fractions have been used for a longer time than have decimal fractions.

XV. *What type of verb is* ***would*** *in the following sentence? What form of the verb is used after it?*

For example, the number 2.38 would be read ...

XVI. *Find in the text more examples of Passive Voice.*

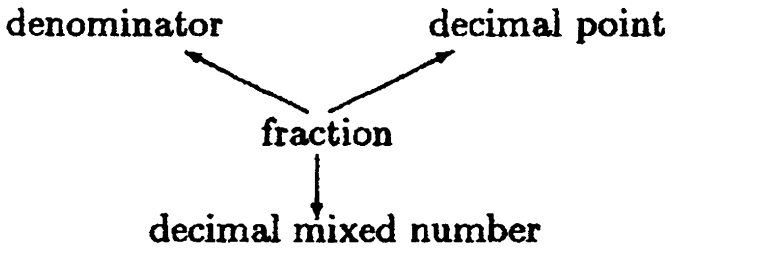
are called
may be written as
is read *(Find in the text the variant with Active Voice)*

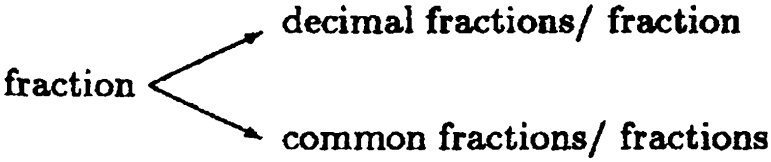
Vocabulary

XVII. *Study the prepositions as compared with Russian:*

to the right/left of
in front of

XVIII. *Study the following variants of terms. Compare with Russian equivalents. Note them down.*





XIX. *Study the typical expressions to be used in rendering. Find them in the sentences of the text.*

to avoid smth
in fact
for these reasons
for example
in order to

XX. *Read the second paragraph of the text and explain the difference between the use of the words* ***dot*** *and* ***point****.*

XXI. *What meanings of the word* ***figure*** *do you know? Find in your dictionary the meanings you may come across in your scientific literature.*

XXII. *What is the meaning of the word* ***science****? What branches studied at universities does it include? Consult your monolingual dictionary. How are such fields as philosophy and history called, unlike Russian? What are the Russian equivalents of the word* ***ученый****?*

XXIII. *Compare different ways of saying numbers:*

Br		Am
two hundred and fifty-six	256	two hundred fifty-six

Writing

XXIV. *The paragraph below is incomplete. Read it and think of a good topic sentence to unify it. Also, find the one sentence that is not relevant to the main idea of the paragraph. Be prepared to explain your decision.*

The numerator is placed to the right of a dot called a decimal point. The denominator is not actually written, but instead is determined in the following way: If the numerator ends one place to the right of the decimal point, the denominator is 10, if the numerator ends two places to the right of the decimal point, the denominator is 100, if the numerator ends three places to the right of the decimal point, the denominator is 1000; and so on. Numbers which consist of a whole number and a decimal fraction are called mixed decimals. Note, that to write $\frac{9}{1000}$ in this shorthand, we must use two zeros as place-holders so that the numerator ends the required three places to the right of the decimal point.

$$\frac{9}{1000} = .009.$$

Unit 5

Pronunciation

I. 1) *Prolong* [l, m, n] *at the end and before* [d, z]:

still stand end comes hold tend respond pull cold walls expand build called tell one depends ground kind line wind

2) *In which words are the initial* [p, t, k] *before vowels pronounced with aspiration?*

carry space pull cold statics turn torque come still pitcher stone push stars pound complex tiny stand kind pass

3) *Practice the pronunciation of final voiced consonants:*

stars hundred speed laws forces deals railroad sides structures made move occurs ceases

Text

Mechanics of Buildings, Machines and Motions

MECHANICS. A man can lift a 94-pound sack of cement fairly easily and even carry it. A strong man may push and tumble a rock weighing several hundred pounds across level ground. This is about the most a human being can do with his own strength.

With machinery and a motor or engine, however, men can move huge weights at high speed, even through the air. Without engines or

motor power, men can still move great weights by using a few simple devices. They can pry up large stones and other heavy weights by using a crowbar as a lever and then can roll away the weight easily on wheels. With a jack a boy can lift the end of a motorcar.

In all these operations, even to the most complex power-driven machinery used in manufacturing, transportation, and construction, certain general principles, or 'laws of nature', hold true. These principles make up the science of *mechanics.*

The principles of mechanics apply to all bodies in the universe from stars and planets to the tiny parts of an atom. They explain how an airplane flies and how a gyroscope behaves. Mechanics deals with the behavior of all kinds of matter under the influences of forces. The branch of mechanics which deals with bodies at rest is called statics, while that which deals with motion is called *dynamics.*

The Science of Keeping Objects in Place

Statics deals particularly with *preventing* undesired motion in structures such as buildings and bridges. These structures may seem motionless in their nature, but many forces act constantly to move them.

Basically, any structure must be able to stand up against the constant downward pull of gravity. At times, strong winds tend to push the structure over. Heat and cold make all parts expand and contract. People and loads shift about upon surfaces such as floors. Bridges must carry heavy, rapidly moving automobiles, trucks, and railroad trains. To offset these forces the designer must provide balancing forces strong enough to prevent too great a movement of any portion of the structure.

Ancient and Modern Bridging over Open Spaces

One means of solving many such problems is the arch. Since ancient times men have known how to use stone or brick arches for supporting weight above a passageway or other open spaces or for building a bridge over a river.

Arches built of stone or brick have one weakness. The wedge-shaped stones or bricks could be pushed outward at or near the supports. Early builders prevented this by providing thick walls at the sides of the arch and supports or by bracing the sides with buttresses.

Modern builders make an arch strong by using one piece of reinforced concrete. They also build more compact structures by using a latticework made of triangles, called a truss. Trusses are strong because triangles hold their shape firmly against bending, pulling, or

pressing until the material of which they are made is broken.

Center of Gravity and Support

In many mechanical situations, the weight of any solid object can be considered as concentrated at one point, called the *center of gravity.* Once the center is known, the support given to it will tell how the object will respond to various forces.

The center will remain at rest when the downward pull of gravity upon it is matched by equal and opposite supporting (upward) force. This supporting force may be supplied from below by a foundation or from above by a cable or wire which holds the weight. The center can also be held by a supported axle which permits the body to turn.

The result of combining forces can be learned from a diagram called a *parallelogram of forces.* The diagram shows how strong two supporting wires must be in order to hold up a bird feeder. This use of the diagram is called a *resolution* of forces because it proceeds from knowing what must be done (holding up the feeder) to telling how strong each supporting part must be. The same kind of diagram can be used for a *composition* of forces; that is, combining two or more forces acting in different directions to determine the combined effect (called a *resultant*).

Rotation and Status of Equilibrium

Some forces tend to make an object's center of gravity move along some line. Others may he exerted along a line which does not pass through the center of gravity. Any such force tends to make a body rotate upon some axis. The force, multiplied by the distance between the line of the force and the axis, is called a *torque.* A body cannot be completely at rest unless all torques, as well as forces which tend to move the center of gravity in some direction, are balanced.

Once a complete balance exists, the body is said to be in *equilibrium.* (The word is from Latin terms that mean "equal balance.") The most basic problem in designing structures such as buildings and bridges is to provide a state of equilibrium for all parts of the structure. This state must take into account various changes in the forces. The direction and strength of wind pressure upon a bridge or building, for example, may change at any moment; and these forces can be more troublesome than weight.

Some disturbances may tend to move a structure in one direction, as when an earthquake shifts a building bodily. Most disturbing forces, however (such as change in pressure or direction of wind), produce a

torque which tends to turn or tip over the body. What happens then depends upon the body's state of equilibrium when the disturbance occurs.

A body in equilibrium may be in any one of three states — *stable*, *unstable*, or *neutral*. It is in *stable* equilibrium if the force of gravity restores it to its original position, once the torque has disappeared. It is in *unstable* equilibrium if the force of gravity continues to turn it to a new position after the torque ceases to act. The body is in *neutral* equilibrium if it comes to rest wherever it may be, once the torque is removed.

Dynamics, the Science of Motion

When some force acting on a body is not balanced, the force produces a change in the motion of the body. The principles of dynamics explain how the planets move through space, why a kicked football takes a certain path, and why a pitcher can make a baseball curve. Dynamics provides foundation for developing rockets, guided missiles, and airplanes. An airplane autopilot utilizes the dynamics of gyroscopes.

Development

II. *Spell the words pronounced as follows:*

[spi:d] [eə] [lɔ:] [ik'splein] [sɜ:tn] [bi'heiv] [dai'næmiks] [di'zain] [a:tʃ] ['i:kw(ə)l] [ə'kɜ:] [θru:] [gaid] [həuld] [sə'pɔ:t] ['æksis] ['beisik] [ig'zist]

III. *Make -ed and/or -(e)s forms, spell and pronounce them*

push tumble move device apply explain fly behave influence force call structure surface bridge balance space shape side brace consider match change state space provide guide pass balance

Grammar

IV. *Provide related nouns:*

strong weigh behave hot weak disturb press produce occur high compose move

V. 1) *Which verbs from the list are irregular? Give three forms to illustrate:*

carry push do hold make roll fly move build give match supply occur come kick break tell mean

2) *What part of speech is the fourth form, e.g.* ***carrying****? What part of sentence can it be? Find examples in the text.*

3) *What other words in* ***-ing*** *are there in the text? What part of speech are they?*

VI. *What part of the sentence is the infinitive in:*

To offset these forces the designer must *provide* balancing forces strong enough *to prevent* too great a movement of any portion of the structure.

VII. *Find in the text examples of Indefinite Infinitive Active and Passive typically used after modal verbs, e.g.*

may push vs may be supplied

VIII. *Which of the modal verbs,* ***can*** *or* ***may*** *expresses* ***ability*** *and which expresses* ***probability*** *in the following sentences:*

With a jack a boy can lift the end of a motorcar.
A body in equilibrium may be in any of three states — stable, unstable, or neutral.

Find similar examples in the text. How are the same ideas expressed in Russian? Suggest variants.

IX. *What preposition is typically used with Present Perfect to mean* ***from a point in past until now; during the period after****? What other preposition is often used with Present Perfect which means during and covers the same period of time? What Tense do we use in Russian to express the same idea?*

Since ancient times men have known how to use stone or brick arches for supporting weight above a passageway or other open spaces or for building a bridge over a river.

X. *What does the word* ***that*** *stand for in the following sentence?*

The branch of mechanics which deals with bodies at rest is called statics, while *that* which deals with motion is called dynamics.

XI. *Identify grammatical components of Complex Subject italicized in the sentence. Give an adequate translation.*

Once a complete balance exists, the body *is said to be* in equilibrium.

Vocabulary

XII. *What meanings of the word* ***once*** *do you know? Use your dictionary to find the contextual meaning of* ***once*** *in the following sentences. What part of speech is it?*

Once the center is known the support given to it will tell how the object will respond to various forces.
The body is in neutral equilibrium if it comes to rest wherever it may be, *once* the torque is removed.

XIII. *Study the prepositions as compared with Russian. Which combination is idiomatic? What means are used in English — Russian dictionaries to help you find them quickly?*

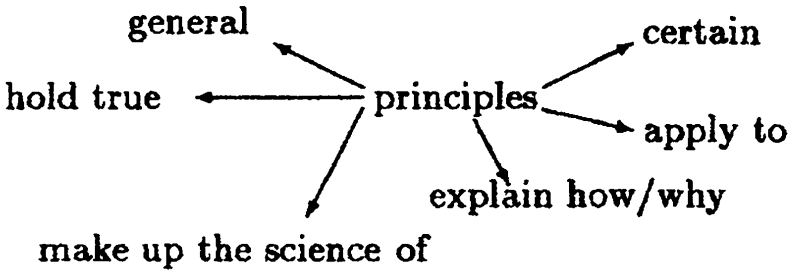
by using
under the influence
make up

apply to
bodies at rest

XIV. *Learn to expand:*

Mechanics deals with ⟶ statics deals particularly with -ing ⟶ the branch of ... which deals with ... is called

XV. *Observe the word trees for* ***principles*** *and* ***change****. Register as a diagram all combinations with the word* ***force*** *you can see in the text.*



to produce ⟵ a change ⟶ in the motion

XVI. *Find in the text words and phrases typical of scientific writing which you can use for rendering. Make a list of them and compare it with those of your classmates. Do you agree with what is on their lists? Why or why not?*

XVII. *Observe the difference in British and American spelling of the word* ***центр****:*

centre (Br) vs center (Am)

Writing

XVIII. *Read through the part of the text up to* ***The Science of Keeping Objects in Place****. Say why it is divided into four paragraphs. Identify the main idea of each paragraph and express it in your own words.*

XIX. *Read through the following paragraph and find the incomplete sentence. Complete it either by adding words or by combining it with another sentence. Combine other sentences, using a variety of connecting words and structures, so that there is a balance of short and long sentences.*

Dynamics is a field of classical mechanics. It is concerned with the study of the motion of material bodies. They are under the influence of forces. Newton's laws of motion form the basis of this study. Dynamics can be divided into kinetics and kinematics. Kinetics considers the relationships between force and motion. The effects of forces are studied. In kinematics motion is described without regard of its cause. Without considering the forces involved. Kinematics is, however, often treated as a separate field of classical mechanics. Dynamics and kinetics, then, are concerned with essentially the same subject matter. They may be considered synonymous. Statics deals with bodies in equilibrium under the action of forces.

Unit 6

Pronunciation

I. *Pronounce these words without devoicing final consonants:*

gave did laws had move change found could was aside

II. *Pronounce* [p, t, k] *before a vowel in stressed syllables with aspiration:*

case pupil contribution path time keep could mechanics Copernican undetectable support

III. *Say how these -ed and -(e)s forms are pronounced:*

discovered	inspired	moved	principles
supported	invented	acted	owes
established	followed	happened	inspires
included	devised	studied	essences
created	accounted	developed	establishes
changes	cases	views	devises
sciences	paths	includes	forces
disturbed			

Text

Galileo (1564–1642)

Modern physics owes its beginning to Galileo Galilei. He was the first astronomer to use a telescope. By discovering satellites of the planet Jupiter he gave men visual evidence that supported the Copernican theory. Galileo did as much as any one man to overthrow medieval thinking in science and to establish modern views.

Contributions to Mechanics

Galileo's specific contributions to the science of mechanics include the law of falling bodies, he fact that the path of a projectile is a parabola, the demonstration of the laws of equilibrium, and the principle of flotation. He devised a simple thermometer and inspired his pupil, Evangelista Torrichelli, to invent the barometer.

His great contribution to scientific thinking was the principle of *inertia*. Before his time everyone followed Aristotle's theory that when an object moved, something had to act continuously to keep it moving. The ancients invented undetectable 'essences' and 'principles' to support this view.

Galileo swept all this aside with the theory that if a body is moving freely in any direction, something must happen to stop it or to make it change direction. He found that in every case he studied he could account for the disturbing force. This created a firm basis for developing modern mechanics.

Development

IV. *Spell the words pronounced as follows. Alternatives are sometimes possible:*

[said] vs [sait] [mæn] vs [men] [ju:z] vs [ju:s] [greid] vs [greit] [hæd] vs [hæt] [ðiːz] vs [ðis] [it] vs [i:t] [fɔ:lz] vs [fɔ:ls] [lɔ:] ['ɒbdʒikt] ['mɒdn]

V. *What is the difference in the stress pattern of the following international words in English and in Russian? Compare the English and Russian meanings:*

contribution
demonstration

VI. *Practice the sentence stress. Compare strong (stressed) and weak (unstressed) variants of words.*

	strong	*weak*
had	[hæd]	[həd]
could	[kud]	[kəd]
to	[tu:]	[tə]
that	[ðæt]	[ðət]
an	[æn]	[ən]
for	[fɔ:]	[fə]

Be'fore his 'time 'everyone 'followed A'ristotle's 'theory that when an 'object 'moved, 'something had to 'act con'tiniously to 'keep it 'moving.

He 'found that in 'every 'case he 'studied he could a'ccount for the dis'turbing 'force.

Grammar

VII. 1) *Supply either the singular or the plural form, say how it is pronounced and spelt:*

men theory essence bodies basis

2) *Are the following words singular or plural? Can you think of other examples?*

physics
mechanics

VIII. 1) *Give the first form of the following words. Be careful of changes to the spelling:*

beginning inspired moving studied stopped

2) *What parts of speech are -ing forms used in the text?*

IX. *What type of verb (notional, auxiliary, link, modal) is* ***to have*** *if it is followed by infinitive? What is its specific meaning as compared with other verbs of the same type?*

Before his time everyone followed Aristotle's theory that when an object moved, something *had* to act continuously to keep it moving.

X. *Translate the sentence from ex.* IX *and the following one in accordance with the rule of Sequence of Tenses.*

He found that in every case he studied he could account for the disturbing force.

Vocabulary

XI. 1) *What preposition is used after* ***contribution*** *as compared with Russian?*

2) *Use your dictionary to choose the meaning of* ***to account*** *that fits. Is its combination with the preposition* ***for*** *an idiomatic one?*

he could account *for* the disturbing force

XII. *In what scientific context can you use these phrases?*

He devised
invented
was the first to use
This created a firm basis for

XIII. *What synonym for* ***law*** *is given in the text? Note them down together. Use your monolingual dictionary and study the text to see whether there is any difference between them.*

Writing

XIV. *Read the following sentences, which have been taken in random order from a paragraph describing Galileo's contribution to mechanics.*

Determine precisely what the central purpose or theme of the paragraph is, and then arrange these sentences into a logical order of development.

1. Galileo was not content to accept ideas without verifying them with experiments.

2. A blade of grass will fall more slowly than a stone only because it meets with more resistance from the air.

3. It was not until the early 1600s that long-established beliefs were challenged.

4. Disproving Aristotle's hypothesis, he determined that all bodies fall at equal rates, if you discount the air resistance.

5. He dropped various weights from a height and recorded the results.

Unit 7

Pronunciation

I. *Pronounce these words without devoicing final consonants. Can devoicing lead to misunderstanding? Give your examples of such typical mistakes of Russian learners of English:*

period pages others translated method faces credited chapters around provide principles

II. *Spell the words pronounced as follows:*

[met] — [mi:t] [stil] — [sti:l] [iz] — ['i:zi] [ɔv] — [ɔf] [ðis] — [ði:z] ['einʃ(ə)nt] [dju:] [ɪk'stent] [hens]

III. *Find in the text words with two stresses. Note them down in your vocabulary.*

IV. *Find in your dictionary how* ***-ed*** *is pronounced in* ***learned*** *in* ***was learned by the Europeans****. First say what part of speech it is. How is the adjective* ***learned*** *pronounced?*

V. *Check the pronunciation of* ***Arabic*** *in your dictionary. What mistakes are you likely to make because of the Russian language?*

Text

Hindu-Arabic and Roman Numeral Systems

The ancient Hindus are credited with discovering the decimal system of numeration we use today. This system was translated into Arabic prior to its introduction into Europe by traveling merchants around the 13th century. Hence it is also known as the *Hindu-Arabic system.*

Adoption of the Hindu-Arabic system met resistance due to the widespread use of the Roman numeral system during this period. Gradually, however, the superior Hindu-Arabic system was learned by the Europeans, and eventually it replaced the Roman system.

The Roman numerals are still used to a limited extent — on clock faces, for instance, and in books for numbering introductory pages and chapters.

The Roman system, like others that are not based on the principle of position, does not provide an efficient and easy method of computation.

Grammar

VI. *Supply related words:*

translate system introduce replace discover Europe numeral gradual

VII. *What part of speech are the following -ing forms?*

are credited with discovering
traveling merchants
during
are used for numbering pages

VIII. *Suggest two variants of translating the following sentence, using Active and Passive Voice:*

Gradually, however, the superior Hindu-Arabic system was learned by the Europeans.

Vocabulary

IX. *Study the prepositions with verbs as compared with Russian equivalents. Which expressions can be used for rendering scientific texts?*

translate into
prior to
introduction into
based on
to a limited extent
due to
gradually
eventually
for instance (What synonym do you know?)
hence
provides a method

X. *Suggest adjectives to be used with the following nouns. Then refer to the text. Register these combinations as word trees:*

system method

XI. *Read through the texts to see what Voice is used more often, Active or Passive? What characteristics of the style of scientific writing have you observed already? Adduce examples.*

XII. Compare British and American spelling

Br	Am
travelling	traveling

Writing

XIII. *Read the following text and put the linking words given below in the correct place.*

A numeral is a written sign depicting a number. In the most ancient times, numbers were denoted by straight-line strokes ('rods'): one rod

depicted unity, two rods, a two, ... This notation originated from the use of notches[1]. It still exists in the Roman numerals which denote the numbers 1, 2, 3.

This notation is inconvenient for writing large numbers ...special symbols were used to depict the number 10 ..., in some languages, the number 5 ...., symbols were invented for still larger numbers. These symbols exhibited a variety of forms in the different languages and underwent considerable modifications in the course of time. There was ...considerable variety of the systems of numeration, ..., modes of combining digits to form large numbers. ..., in most number systems the 10-scale was pre-eminent ...formed the basis of the decimal system of numeration.

(as well, also, and (2), that is, and so forth, however, and so, later)

[1] notch — a V-shaped cut in a surface or edge: He cut a notch in the stick with a sharp knife.

Unit 8

Pronunciation

I. *Read the following letters:*

G, H, O, Z, Y, S, C

II. *Pronounce the words without devoicing final consonants:*

crude symbols years systems childhood awkward five word as gives is those

III. *Prolong* [l, m, n] *at the end and before* [z, d]:

call called than ten come hand some still child second become

IV. *Pronounce* [p, t, k] *before a vowel in stressed syllables with aspiration:*

capture ten picture two combination common toe count become current

V. *Spell and pronounce the -ed and -(e)s forms of the following words. Do not devoice final consonants.*

record	divide	society
develop	include	language
picture	call	principle
require	symbolize	century
capture	inscribe	bush
influence		

VI. *How may stresses can an English word have as compared with Russian? Use your dictionary to pronounce the following words:*

exaggeration combination electronic numeration individual hieroglyphics

VII. *Look at these phrases. Mark the places where words are linked by r. What is the rule?*

for instance
there is little doubt
a picture of two flowers
the capture of prisoners
the number of fingers
in our own language

Text

Numeration Systems and Numbers

More than 5,000 years ago an Egyptian ruler recorded, perhaps with a bit of exaggeration, the capture of 120,000 prisoners, 400,000 oxen, and 1,422, 000 goats. This event was inscribed on a ceremonial mace which is now in a museum in Oxford, England.

The ancient Egyptians developed the art of counting to a high degree, but their system of numeration was very crude. For example, the number 1,000 was symbolized by a picture of a lotus flower and the number 2,000 was symbolized by a picture of two lotus flowers growing out of a bush. Although these symbols, called *hieroglyphics*, permitted the Egyptian to write large numbers, the numeration system was clumsy and awkward to work with. The number 999, for instance, required 27 individual marks.

In our system of numeration, we use ten symbols called digits — 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 — and combinations of these symbols. Our system of numeration is called *decimal*, or *base-ten, system*. There is little doubt that our ten fingers influenced the development of a numeration system based on ten digits.

Other numeration systems were developed in early cultures and societies. Two of the most common were the *base-five system*, related to the number of fingers on one hand and the *base-twenty system*, related to the number of fingers and toes.

In some languages the word for 'five' is the same as the word for 'hand', and the word for 'ten' is the same as the word for 'two hands'. In our language the word 'digit' is a synonym for the word 'finger' — that is, ten digits, ten fingers.

Still another early system of numeration was a *base-sixty system* developed by the Mesopotamians and used for centuries. These ancient people divided the year into 360 days (6 × 60); today we still divide the hour into 60 minutes and the minute to 60 seconds. Numeration systems of current interest include a *binary*, or *base-two, system* used in electronic computers and a *base-twelve*, or *duodecimal system.*

It is worthwhile to become familiar with the principles of the base-twelve system of numeration and with those of base-two, base-five, or other systems. Working with other bases gives you deeper insight into the decimal system you have used since childhood.

Development

VIII. *Spell the words pronounced as follows:*

[sins] ['didʒit] [sə'saiəti] [di'gri:] [daut] [ri'kwaiə] [a:t] [la:dʒ] [auə] ['pi:pl] ['minit] [i'vent] [di:p] [pə'hæps] [beis] [ɔ:l'ðəu] ['kɒmən] [hai] [wɜ:d]

IX. *Say what sound distinguishes the words in pairs. Use your dictionary:*

still — steel, bit — beat, write — ride, work — walk, were — war

Grammar

X. a) *What parts of speech of the word* ***use*** *do you know? What is the difference in the pronunciation? Compare the pronunciation of Past Indefinite of* ***to use*** *— использовать and* ***used to*** *— иметь обыкновение.*

b) *How many transcriptions are given in your dictionary for the word* ***record****? Say why.*

XI. *What part of speech are the* ***-ing*** *forms in the following examples?*

Working with other bases gives you deeper insight into the decimal system.

picture of two lotus flowers growing out of a bush

XII. *Supply Degrees of Comparison. Be careful of changes to the spelling:*

common early large little familiar clumsy deep high

What article is used with Superlative Degree? Say why.

XIII. *Give the plural form of the nouns:*

ox, basis, toe

XIV. *Why is* ***those*** *used in the following sentence?*

It is worthwhile to become familiar with the principles of the base-twelve system of numeration and with *those* of base-two, base-five, or other systems.

XV. *What Tense and why is used in the following phrase?*

the decimal system you have used since childhood

Vocabulary

XVI. *Observe the prepositions or the lack of them as compared with Russian equivalents:*

become familiar with
divide into *(When is this verb used with the preposition* ***by****?)*
to influence smth *(Is there a preposition with the noun* ***influence****?)*
synonym for

XVII. 1) *Study the various uses of the verb* ***develop****:*

They developed (the art)
systems were developed in (early societies)
by (them)

2) *Find in the text other combinations of* ***system*** *+ participle:*

system called
used in

XVIII. *Which of the two expressions is a free word-combination and which is an idiomatic one? Give Russian equivalents:*

(fingers) on one hand
On the one hand ...

XIX. *Explain the difference between the terms* ***number***, ***numeral*** *and* ***digit****. Refer to the text and/or use your monolingual dictionary. Which would you use in these phrases?*

Roman ... 666
numeration system based on ten ...
... of fingers on one hand

XX. *Study the typical expressions to be used in rendering. What expressions from this text have already been used before?*

there is little doubt that
still another system
although
perhaps

XXI. *Read all the numbers you can find in the text. What does a comma stand for in* ***5,000****?*

Writing

XXII. *Read each of the paragraphs. Identify the one sentence that best captures the main idea of the whole paragraph. Express in your own words the main idea and explain how the topic sentence serves its role. Note whether the sentence is at the beginning, middle, or end of the paragraph and attempt to explain why.*

Unit 9

Pronunciation

I. *Pronounce the following letters:*

F, M, A, P, B, W, C

II. *Pronounce the words without devoicing final consonants:*

speed third word as chairs pulls problems laws follows

III. *Pronounce* [p, t, k] *before a vowel in stressed syllables with aspiration:*

constant call continue particle keep tell take toward account calculation cannot pull

IV. *Prolong* [l, m, n] *at the end of words and before* [z, d]:

called tell tells compels second pull pulls world

V. *Say how -(e)s forms are pronounced. Be careful to the changes in spelling:*

body space change move particle impress force example take continue

VI. *Check the pronunciation of these international words. Mark the element (the sound or a stress pattern) which you are likely to confuse with Russian. Are there any* ***false friends of a translator?***

planet dynamics effect fundamental inertia proportional acceleration formula reaction calculation uniform

VII. *Read these phrases with linking r:*

are equal
as far as its inertia is concerned
or even worlds

Text

Inertia and Newton's Laws of Motion

Many problems in dynamics deal with bodies such as airplanes, bullets, and planets flying by themselves through space. Solutions for such problems are based upon Newton's three laws of motion.

The first law states a great fundamental property of matter called *inertia*, as follows:

1. Every body remains in a state of rest or of uniform motion (constant speed in a straight line) unless it is compelled by impressed forces to change that state.

Under this law a moving body is 'at rest' as far as its own inertia is concerned, as long as its motion continues at the same speed and in the same direction. Therefore particles (or even worlds) of matter will keep flying through empty space forever, without being driven by any force, until something compels them to change their motion.

Newton's second law tells how a force compels a change of motion, at a rate of change called an *acceleration*. Newton stated the law as follows:

2. Change of motion is proportional to the impressed force and takes place in the direction of the straight line in which that force is impressed.

This law can be stated much more simply as a formula, using letters for force, mass, and acceleration: $F = ma$. The *wording* of the law, however, makes clear how an impressed force acts. The force does not necessarily compel the affected matter to set off in the direction in

which the force is acting. It simply compels a change in the body's motion toward that direction.

Newton's third law is as follows:

3. Action and reaction are equal and opposite.

This law states a fact which can upset many calculations unless it is taken into account. It explains, for example, the saying that a man cannot lift himself by his bootstraps. Similarly, a man cannot lift himself by sitting in a chair and pulling up on the seat or rungs. As he pulls up on the chair, the effect reacts downward to the chair, and the chair pulls down on him. Action and reaction are equal and opposite. A striking modern example of action and reaction is jet propulsion.

Development

VIII. *Spell the words pronounced as follows:*

['mætə] [spi:d] ['bulit] [streit] [θru:] [seim] [tʃeindʒ] [dai'næmiks] [tʃeə] ['nesəs(ə)ri] ['i:kwəl] [sʌtʃ] [mæs] [flai] [di:l]

IX. *Say what sound distinguishes the words in pairs. Use your dictionary:*

affect — effect, word — world, sit — seat, raid — rate, place — plays, set — said, man — men, letter — latter

Grammar

X. *Pronounce and spell the four forms of the verbs:*

tell take set strike say deal fly concern pull make move change impress remain base state drive

XI. *Supply related words:*

space state act explain impress direct solve

XII. *Say what part of speech the -ing forms are:*

planets flying by themselves
a striking modern example
the force is acting
will keep flying
the wording of the law
It explains the saying that
cannot lift himself by pulling up on the seat

XIII. *Identify the italicized grammatical form, then translate the sentence.*

Therefore particles of matter will keep flying through empty space forever, without *being driven* by any force, until something compels them to change their motion.

Vocabulary

XIV. *Use your dictionary to find the meaning of the italicized words. What parts of speech are they?*

unless it is compelled to change that state
unless it is taken into account
as long as its motion continues
as he pulls up on the chair
until something compels them

XV. *Are these word-combinations free or idiomatic? What is an idiom?*

take place
take into account
to set off
as far as smth is concerned

XVI. *Study the prepositions as compared with Russian. Find other examples in the text:*

many problems deal with
solutions for ... are based upon
proportional to
at the same speed
explain to smb

XVII. *The Russian adjective* ***прямой*** *is translated into English as* ***straight*** *in one of its meanings. What is the English equivalent of the Russian noun* ***прямая*** *used as a term? Check against the text or use your dictionary.*

XVIII. *Note down as a diagram all combinations with the words* ***rest*** *and* ***change*** *you can find in the text.*

XIX. *Study the expressions to be used in stating the law. Find other variants in the text.*

The law states (a property) as follows
can be stated (more simply)
is as follows
explains
Under this law

XX. *What is the stylistic difference between* ***on*** *and* ***upon****?*

are based on/upon
depends on/upon

Writing

XXI. *Break the following run-on paragraph into at least three separate sentences. Add transition words, changing the sentence structure, or make stylistic or wording changes as necessary.*

The mass of any body is the amount of matter it contains and is measured by weighing; weight is not the same as 'mass', weight actually is the pull of gravity upon matter, and this difference can be visualized by considering a spaceship on a voyage to the moon.

Unit 10

Pronunciation

I. *Pronounce the letters of the English alphabet:*

D, E, I, T, C, P, W, U.

II. *Pronounce these words without devoicing final consonants:*

follows above positive corresponds numbers times thirds and geometers found because five squares decimals

III. *Say how these -ed forms are pronounced:*

pictured represented called consisted extended divided converted followed noticed included corresponded constructed designated discovered measured named stated

IV. *Compare the strong (stressed) and weak (unstressed) forms:*

can [kæn] be [bi:]	–	can [kən], be [bi] con'verted
as [æz]	–	as [əz] 'fractions
of [ɔv]	–	'set of [əv] 'points
and [ænd]	–	'positive and [ənd] 'negative
a [æ]	–	a [ə] 'circle
are [a:]	–	are [ə] 'called

V. *Compare the stress pattern of related words:*

represent — representation
Pythagoras — Pythagorean

VI. *Look at these international words you understand without a dictionary. Check their pronunciation. Mark the sound / stress / letter you are likely to confuse with Russian:*

hypotenuse theorem diagonal diameter

Grammar

VII. *Give the 3 forms of the verbs, pronounce and spell them:*

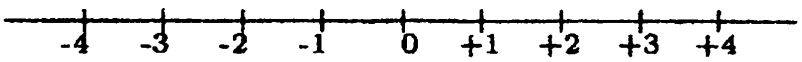
speak choose draw find show

Text

The Number Line and the Rational Numbers

The set of real numbers may be pictured as the set of points on a line, and we speak of the set of real numbers as the *number line*. A point on the line is chosen to represent the number 0 and other points are chosen for the numbers +1, +2, +3, +4, and so on.

The *set of positive integers* is called a *subset* of the set of real numbers and consists of all the positive numbers. The *set of negative integers* is also a *subset* of the set of real numbers and consists of all the negative numbers: -1, -2, -3, and so on.



The drawing of the number line may be extended to the right and to the left as necessary.

The *set of integers* consists of all the positive integers, all the negative integers, and zero.

When one integer is divided by another nonzero integer, the quotient is called a *rational number*. Rational numbers may be represented as fractions. For example, the fraction $+\frac{1}{2}$ represents the quotient of

+1 divided by +2. The symbol above the line is called the ***numerator*** of the fraction, and the symbol below the line is called the ***denominator*** of the fraction.

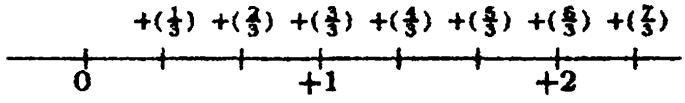
Rational numbers may also be represented as decimals. A fraction can be converted by division to the decimal representation as follows:

$$\frac{+1}{+2} = +.5 \qquad \begin{array}{r} .5 \\ \hline 2)1.0 \\ 10 \\ \hline 0 \end{array} \qquad \frac{-3}{+5} = -.6 \qquad \begin{array}{r} .6 \\ \hline 5)3.0 \\ 30 \\ \hline 0 \end{array}$$

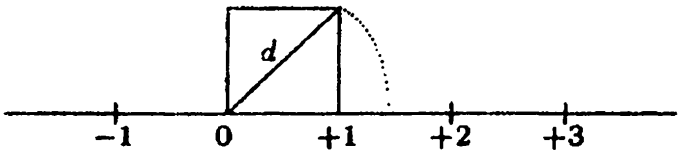
You may have noticed that the rational numbers include both positive and negative integers. For example, -4 is a rational number because $\frac{-4}{+1} = -4$.

The Irrational Numbers

In the real number system, every rational number corresponds to a point on the number line. For example, the point corresponding to $+(\frac{7}{3})$ may be found by dividing the segment between 0 and +1 into thirds and then constructing the segment 7 times as long as the segment from 0 to $+(\frac{1}{3})$.



However, not every point that can be shown on a real-number line designates a rational number. The ancient Greek geometers were the first to discover that there are some real numbers which are not rational. They showed, that if we construct a square measuring 1 unit by 1 unit the length of the diagonal (denoted by d in the drawing) is not a rational number.



The Pythagorean theorem, named after the Greek geometer Pythagoras, states that the square of the hypotenuse of a right triangle is equal to the sum of the squares of the legs. By this theorem,

$$d^2 = 1^2 + 1^2 = 1 + 1 = 2. \quad \text{So, } d = \sqrt{2}.$$

The real numbers which are not rational are called *irrational* numbers. Other irrational numbers are $\sqrt{3}$, $\sqrt{5}$, and π. (Say 'square root of three', 'square root of five', and 'pi'. Pi is the circumference of a circle whose diameter is 1 unit in length.)

Development

VIII. *Spell the words pronounced as follows:*

['sʌbset] ['intɪdʒə] ['kwəuʃ(ə)nt] [in'klu:d] ['einʃ(ə)nt] [skweə] [sə'kʌmf(ə)rəns] ['ʌðə] [sə:kl] ['fɒləu] ['sistəm] [leŋθ] ['drɔ:iŋ] ['nəutis] [ru:t] ['nesəs(ə)ri] ['ɔ:lsəu] ['zi(ə)rəu]

IX. *Read these phrases with of* [əv]:

we speak of the set
the set of positive integers
consists of all the negative numbers
the denominator of the fraction

X. *Say how each pair of words is pronounced. Use your dictionary if necessary:*

write — right, some — sum

XI. *Say what sound distinguishes these words. Use your dictionary:*

root — rude, right — ride, set — said, really — rarely

Grammar

XII. *Study the negative prefixes:*

regular — irregular
rational — irrational
zero — nonzero
equal — unequal

XIII. *Say what part of speech the -ed forms are:*

They showed that if we construct a square measuring 1 unit by I unit, the length of the diagonal (denoted by *d* in the drawing) is not a rational number.

... the quotient of +1 divided by +2

The Pythagorean theorem, named after the Greek geometer ...

XIV. *What part of the sentence is the noun number in these word-combinations? Give the Russian equivalents:*

number line
real number system

XV. 1) *Identify the grammatical components. Translate into Russian using both Active and Passive Voice. Find similar examples in the text:*

can be converted
may be represented
may be found
may have noticed

2) *Suggest your variants of translating may in combinations from the text. What Tense is used when translating Perfect Infinitive after may into Russian? Give your examples, like:*

You may have noticed

Vocabulary

XVI. *Study the following phrase. Is there a word-combination registered in one entry of the dictionary or is it enough to know the meaning of every word to understand the phrase?*

both positive and negative integers

XVII. 1) *Supply the right prepositions. Compare with Russian equivalents:*

consist ...
equal ...
correspond ...
may be extended ... the right
the theorem named ... the Greek geometer

2) *Which preposition after divide (into or by) fits in here?*

integer divided ... another integer
dividing the segment ... thirds

XVIII. *Complete the word tree for theorem.*

theorem
↙
by this

XIX. *Which expressions for rendering found in this text have you come across before?*

e.g. as follows
and so on

XX. *What is the opposite of:*

above≠
left≠

XXI. *Read all the numbers you can find in the text.*

Writing

XXII. *Complete the text about decimal fractions. Choose suitable linkers from the words in italics. (Note: some words may be used twice.)*

For example, in addition to, then, so that, besides, since, as well as, first, finally, in spite of, although, as, thus, and.

... you recall, one of the methods of comparing the values of fractions is to change the fractions to a common denominator, and ... compare the resulting numerators.

In order to apply this method to decimal fractions, use the following procedure:

To Compare Decimal Fractions: (1) Add zeroes to the right of the decimals ... all of them have the same number of decimal places (and ... the same denominator). (2) Compare the numbers to the right of the decimal points (the numerators of the decimal fractions).

..., to compare the decimal fractions .57, .413, ...6, ... add zeros to their right ... all of them are three-place decimals, having the same denominator, thousandths. ... compare their numerators by comparing the numbers to the right of the decimal point. ... 600 is the largest number, .6 is the largest decimal; ... 413 is the smallest number, .413 is the smallest decimal.

$.57 = .570 \quad .413 = .413 \quad .6 = .600$

Unit 11

Pronunciation

I. *Pronounce the letters:*

T, F, P, S, T, R, O, J, C, L

II. *Pronounce these words without devoicing final consonants:*

sled found hard would made hold dead world railroad around did rolls wheels systems is as

Text

Friction

Every machine or vehicle must overcome the resistance, called *friction*, which results when one body rolls or slides over another. Whenever a person pulls a sled or turns a crank, he must overcome not only the forces of inertia and gravity but friction as well.

This ever-present resistance is caused by the unevenness of surface found even in the hardest and best-polished objects if they are examined under a magnifying class. The smoother the surface, the less the friction. Hence in machines every effort is made to make the surfaces hard and smooth.

Lubricants also lessen friction. This is why automobiles and other machines are provided with elaborate oiling systems. Without oil the heat developed by friction would soon ruin the machines. Furthermore, rolling friction is less than sliding friction. This is why bicycle and

automobile wheels and roller skates are provided with ball and roller bearings. Friction is also reduced by bearings made of *antifriction* metals — various soft alloys which are at the same time hard enough to hold their form against pressure.

Because friction means resistance and never power, it sometimes is regarded as a nuisance and a dead loss. Yet a frictionless world would be a strange place. Friction makes it possible to transmit power by pulleys and stop trains by brakes. Without friction streetcar and railroad wheels would spin around without advancing. Friction in the wrong place is a dead loss; but in the physical world man would never get anywhere if he did not encounter resistance — friction — on the way.

Development

III. *Spell the words pronounced as follows:*

[hɑ:d]	vs	[hɑ:t]
[ded]		[det]
[meid]		[meit]
[feis]		['sɜ:fɪs]
[wi:l]		[wil]

[i'nʌf] ['pauə] ['efət] ['ve(ə)riəs] ['preʃə] [streindʒ] [rɒŋ]

IV. 1) *Words in -ate are pronounced in a different way as different parts of speech:* [-ət] *as nouns and adjectives,* [-eit] *as verbs. What part of speech is elaborate in this phrase? How is it pronounced?*

machines are provided with elaborate oiling systems.

2) *Find in the dictionary the pronunciation of the words* ***coordinate*** *and* ***delegate*** *for different parts of speech.*

V. *Say how -ed and -(e)s forms are pronounced:*

called	forced	examined	elaborated
provided	reduced	regarded	encountered
ruined	developed	stopped	advanced
pulled	caused	polished	turned
slides	forces	elaborates	surfaces
skates	reduces	provides	pulleys
brakes	machines	advances	causes
polishes			

VI. *Study these international words. Are they any* ***false friends of a translator****? What is the difference in their pronunciation as compared with Russian?*

machine inertia examine automobile object system

VII *Read these phrases with linking* ***r****:*

over another
whenever a person
they are examined
under a magnifying glass
are at the same time

Grammar

VIII. *Give the four forms of the verbs. Spell and pronounce them:*

come make hold mean get spin bear

IX. *What parts of speech can these forms of words be? Is there a difference in pronunciation in this case? Use your dictionary. What part of speech is used in the text?*

results forces encounter present cause means place heat skates object

X. *Give related words:*

resist reduce transmit develop lose

XI. 1) *Translate the sentence into Russian. Analyze the italicized components of the grammatical construction.*

The smoother the surface, *the less* the friction.

2) *Give Degrees of Comparison for:*

hard polished little soft good

XII. 1) *What meaning of the word* ***yet*** *do you know? Now consult your dictionary to find the contextual meaning of this word in the following sentence. Study the previous sentence to justify the use of the word.*

Yet a frictionless world would be a strange place.

2) *Analyze the idea of the sentence: is the action real as in Indicative Mood or is it unreal, a supposition, a hypothesis? What Mood is used here?*

3) *Study these sentences and analyze forms of the verbs used in this Mood.*

In the physical world man would never get anywhere if he did not encounter resistance on the way.

Without friction streetcar and railroad wheels would spin around without advancing.

Vocabulary

XIII. *Suggest replacements for* ***as well*** *in:*

not only the forces of inertia and gravity but friction as well

XIV. *What is the opposite of:*

possible anywhere ever evenness wrong with even

XV. *Supply prepositions. What are the Russian equivalents?*

are provided ... oiling systems
examine ... a magnifying glass
... the same time
hold their form ... pressure

XVI. *Study the typical expressions to be used in rendering:*

is regarded as
makes it possible to do smth

XVII. *What is the difference between* ***various*** *and* ***different****? Use your monolingual dictionary.*

XVIII. *Study the difference in British and American:*

1) *grammar*

Br	get	Am
get–got–got		get–got–gotten

2) *vocabulary*

car	–	automobile
tram	–	streetcar
railway	–	railroad

3) *pronunciation*

[glɑ:s]	glass	[glæs]
[əd'vɑ:ns]	advance	[əd'væns]
['nju:s(ə)ns]	nuisance	['nu:s(ə)ns]

Writing

XIX *In each of the following overly general sentences, add specific details that would support the theme or idea. Write one or two sentences.*

1. Friction means resistance.
2. Lubricants lessen friction.

Unit 12

Pronunciation

I. *Pronounce* [p,t,k] *before a vowel in stressed syllables with aspiration:*

tend top push two keep turn point call pendulum continue toy patent repeat purpose course part pilot tendency type conflict

Exception: [s]+[p,t,k] - stay stop space spin scan

II. *Pronounce the following letters:*

N, P, Y, V, L, H, U, R, C, J

III. *Make -ed forms and pronounce them. Be careful to the changes in spelling:*

call balance change trace head push disturb move turn explain carry roll pitch use install link inspire apply

IV. *Pronounce the linking r between words:*

there are
end over end
other effects
they are almost always

Grammar

V. *Give the four forms of the verbs. Spell and pronounce them. Be careful to the changes in spelling:*

get spin make swing be show have hold tell keep begin

Text

The Gyroscope — the Principles and Uses

Any wheel or body when rotating tends to stay in its plane of rotation. That is why your bicycle stops wobbling when you get up speed and why a spinning top stays upright. If you push the top when it is spinning fast, it will try to right itself. The heavy wheel, or rotor, of a gyroscope acts in the same way. This behavior makes the gyroscope useful for giving stability to many mechanisms.

There are two great gyroscopic principles which apply to every rotating body. First, it has *rigidity in space*, or *inertia*. This tends to keep its axis pointing continuously in the same direction. When this space rigidity is disturbed, the rotating body tends to turn so that points on its rim will be moving in the same direction as the disturbing force. This second principle is called *precession*.

This explains why spinning tops stay erect and planets or rifle bullets do not turn end over end in flight. It also explains how the earth, under the conflicting attraction of other heavenly bodies, wobbles slowly on its axis, producing among other effects what is called the *precession of the equinoxes*.

In 1851 Leon Foucault, a French physicist, demonstrated the earth's rotation by showing that a pendulum continued to swing in the same plane while the earth turned around. This inspired him to invent the gyroscope the next year. He named the device from the Greek words 'gyros', — 'revolution', and 'skopein' — 'to view' because he used it to 'view the earth's rotation'.

For many years the gyroscope was merely a scientific toy. It was not until the present century that practical use began to be made of it.

Gyrocompass

In 1911 Elmer A. Sperry, an American, patented his now famous gyrocompass. Almost every naval vessel and merchant ship today carries at least one master gyrocompass, installed in its own gyro room. A transmission system links the master gyrocompass to 'repeaters'. These are used on the ship for such purposes as steering, position finding, and course recording. Some ships have a gyropilot that steers the ship automatically more accurately than a human helmsman.

Other Uses of the Gyroscope

Well-balanced gyrowheels are sensitive to extremely small changes in position — hence their great value as automatic gauges and controls. A gyroscopic recorder aboard a speeding railway car will trace on a paper roll an accurate line showing every fault in the level of the tracks. On a ship it will record rolling and pitching. Large gyroscopes are no longer used to stabilize ships because they would have to be enormous to control the big ships of today. Instead, stabilizing fins, controlled by a gyroscope, counteract the tendency of a vessel to roll and pitch in heavy seas.

Aircraft compasses are almost always of the magnetic type, but in many airplanes they are gyrostabilized. Other gyroscopic instruments are part of the automatic pilot or are used for visual reference. The rate gyro — also called the turn-and-bank indicator — tells the pilot when he is starting to turn to the left or right, and about how fast. The horizon indicator, or gyro vertical, indicates the horizon without the pilot's having to look at the ground. When this is incorporated into the automatic pilot, it holds the airplane in a proper flight altitude. The directional gyro tells in what direction the aircraft is heading.

Gyroscopic instruments are used also in bomb sights, gunfire control systems, antiaircraft systems, and in the automatic pilots of guided missiles and long-range rockets.

Development

VI. *Spell the words pronounced as follows. Sometimes alternatives are possible:*

[ʃip]	vs	[ʃi:p]
[kɔ:z]	vs	[kɔ:s]
[ðæn]	vs	[ðen]
[li:st]	vs	[list]
[fɔ:s]	vs	[fɔ:θ]
[hæd]	[hed]	[hæt]

[ə'plai] [ɜ:θ] [miə] ['feimәs] ['pɜ:pәs] [i'nɔ:mәs] [flait]
[spi:d] [puʃ] [fɔ:lt] [taip] ['fizisist] [wi:l] ['ridʒid] [di'vais]

VII. *Look at these international words. Mark their peculiarities of pronunciation as compared with Russian. Are there any* ***false friends of a translator****?*

compass automatic control horizon accurate

VIII. *What parts of speech can these words be? Use your dictionary to see how they are pronounced in each case?*

record present

IX. *Compare the British and American spelling and pronunciation. Think of other examples. Keep a list of American words, pronunciation and spelling.*

Br.	vs	Am.
behaviour		behavior
['misail]	misile	['mis(ə)l]

Pronunciation

X. *Practice sentence stress:*

If you 'push the 'top| when it is 'spinning 'fast| it will 'try to 'right itself.

It was 'not until the 'present 'century| that 'practical 'use be'gan to be 'made of it.

'Large 'gyroscopes| are 'no 'longer 'used to 'stabilize 'ships| be'cause they would have to be e'normous| to con'trol the 'big 'ships of to'day.

Grammar

XI. *What is the plural of the following words? Be careful to the changes in spelling. Say how they are pronounced:*

body plane axis pendulum change trace recorder tendency sea missile view force device century

XII. *Say which noun in these noun+noun combinations is an atribute. Give Russian equivalents:*

space rigidity
rifle bullet
merchant ship
transmission system
paper roll
railway car
aircraft compass
gunfire control system
antiaircraft system
horizon indicator
flight altitude
bomb sight
gyro vertical

XIII. *Spell the infinitives for the following verbal forms:*

controlled giving wobbling spinning rotating producing tries carries having applies

XIV. *Say how the italicized words are translated and pronounced, what parts of speech they are:*

practical *use*
useful
are *used*

XV. *-ly is typical of adverbs, e.g.* ***automatically, accurately, merely.*** *What part of speech is* ***heavenly****, e.g. in* ***heavenly bodies****?*

XVI. 1) *Add* ***-able*** *to these words, spell and pronounce them:*

value trace

2) *What is the* ***-able*** *form for* ***explain****? Consult your dictionary.*

XVII. *What related words do you know?*

scientist explain act useful stable physics

XVIII. *Give Degrees of Comparison for the following words:*

accurately heavy great slowly practical sensitive long fast many good

XIX. *What does* ***any*** *mean in affirmative sentences, e.g.*

Any wheel or body when rotating tends to stay in its plane of rotation.

XX. *What Tense is used for the future after the conjunction* ***if*** *in the following sentence?*

If you push the top when it is spinning fast, it will try to right itself.

Learn other conjunctions used in the same way: ***when, after, until, unless, as soon as, provided, before.***

XXI. *Identify verbal forms in* ***would have to be****. What Mood is used in this clause?*

Large gyroscopes are no longer used to stabilize ships because they would have to be enormous to control the big ships of today.

XXII. *Study the following sentence from the text.*

It was not until the present century *that* practical use began to be made of it.

Compare it with:

Practical use began to be made of it in the present century.

What does the italicized construction help do? What other ways of emphasizing the idea do you know?

Vocabulary

XXIII. *Use the right prepositions. Compare with Russian equivalents:*

sensitive ...
... such purposes

XXIV. *Find in the text another mode of expressing the same idea:*

That is why

XXV. *Study the typical expressions to be used in rendering. Compare with Russian equivalents:*

for many years
no longer
instead
for such purposes as
principles which apply to

Writing

XXVI. *In each of the following overly general sentences, add specific details that would support the theme or idea. Write one or two sentences.*

1. The gyroscope is useful.
2. There are two gyroscopic principles.

Unit 13

Pronunciation

I. *Pronounce the following words without devoicing final consonants:*

wave(s) terms atoms move made bird(s) gold remains ways led patterns does as those kind(s) speed has hand(s) always outside outward

II. *Read the following with linking* **r**. *What is the rule?*

differ entirely
other optical devices
or on a wire
where energy will do

Text

The Modern Theory of Wave Mechanics

Wave mechanics or *quantum mechanics* was developed about 1925 by the theoretical physicists De Broglie, Schrödinger, and others. Electrons and other particles are shown to have wave properties, and the wave-particle theory applies to matter as well as to photons.

The heart of the theory can be stated in highly simplified terms as follows: both the units of *matter* (atoms, and the electrons, protons, and other particles which make up atoms) and the units of radiant or electromagnetic energy (quanta, or photons) behave like particles which move through space as though controlled by wavelike patterns.

A rough comparison can be made with swallows hunting insects in the air. The birds may be sitting motionless near their nests or on a wire. Suddenly the whole flock, swoops away in wavelike flight, seeking insects in the air. Each swallow remains an individual, like the photons in the theory; but the flock as a whole moves in waves, which are 'controlled' by the distribution of the insects.

The theories of wave mechanics differ, however, from the example of the swallows in many ways. One difference is that the 'control' which led the swallows into wavelike motion existed in space outside the birds; that is, in the distribution of insects in the air. On the other hand, the wave and particle natures of matter and of radiant energy do not have an independent existence. The waves originate where the particles are and they travel outward as the particles move.

Under this two-part theory, the wavelike pattens show where energy will go when it is travelling across space and when it encounters matter, as light does when it strikes mirrors, lenses, and other optical devices. But when energy penetrates atoms and makes them react, the quantized 'energy chunks' produce the reactions. Similarly, in electrical devices electrons act as particles. If a beam of electrons is sent through thin gold foil, however, the wave properties make the electrons show diffraction effects just like those shown by light and other kinds of wave motion in suitable experiments.

While the photons of radiant energy and the particles of matter (such as electrons, protons, and atoms) all have properties which are wavelike and particlelike, they differ entirely in many ways. For example, an electron or an atom can be made to go fast or slow, while the speed of a photon in air is always the same. An atom can be slowed down and weighed; a photon cannot because it has no rest mass.

Development

III. *Spell the words pronounced as follows. Sometimes alternatives are possible:*

[sit]	vs	[si:t]
[sik]	vs	[si:k]
[led]	vs	[li:d]
[send]	vs	[sent]
[seim]	vs	[sʌm]
[hɑ:d]	vs	[hɑ:t]

[wei] [nəu] [bai] [həul] [rʌf] [sʌtʃ] ['difə] ['sʌdnli] ['propəti] ['similə] [θru:] [speis] ['pɑ:tik(ə)l] [lait]

IV. *Make -ed and -(e)s forms and pronounce them according to the rule. Be careful to the changes in spelling:*

state	behave	differ	travel	slow
apply	remain	distribute	penetrate	weigh
simplify	move	exist	produce	
develop	control	originate	act	

theory space matter particle nature mirror

V. *Practice sentence stress. What kind of words are not stressed?*

... 'theory ap'plies to 'matter as 'well as to 'photons.

The 'heart of the 'theory can be 'stated as 'follows ...

The 'birds may be ' sitting 'motionless ...

... the 'flock as a 'whole 'moves in 'waves

... 'patterns 'show| where 'energy will 'go| when it is 'travelling ac'ross 'space.

...a 'photon can'not| because it has 'no 'rest 'mass.

VI. *How is* ***-able*** *pronounced in adjectives, like* ***suitable****? Compare with the adjective* ***able****.*

VII. *Give related words. Check their pronunciation in your dictionary:*

nature motion apply space compare theory atom energy weigh origin

Grammar

VIII. *Give three forms of the verbs:*

show sit have be wake go strike send fly seek lead

IX. *Find words for which* ***does*** *and* ***those*** *serve as substitutes.*

Under this two-part theory, the wavelike patterns show where energy will go when it is travelling across space and when it encounters matter, as light ***does*** when it strikes mirrors, lenses, and other optical devices.

If a beam of electrons is sent through thin gold foil, however, the wave properties make the electrons show diffraction effects just like ***those*** shown by light and other kinds of wave motion in suitable experiments.

X. *What infinitive and why is used after* ***may****? Analyze the context to answer the question.*

The birds may be sitting motionless near their nests or on a wire.

XI. *What part of the sentence are the italicized forms?*

shown by light
is travelling
which *led* the swallows
are controlled
can be made
is sent
will go

XII. *What are the elements of Complex Subject in the following sentence? Identify the verbal forms.*

Electrons and other particles are shown to have wave properties.

XIII. *What nouns in the following noun+noun combinations function as attributes? Compare these with Russian equivalents:*

wave mechanics
wave-particle theory
wave properties
rest mass
wave and particle nature
energy chunks
diffraction effects

Vocabulary

XIV. 1) *Use your dictionary to find the Russian equivalents of the following expressions:*

while
both ... and
about 1925

2) *Observe the use of as in these phrases. Translate them into Russian:*

electrons act as particles
as though controlled by wavelike patterns
the flock as a whole
The waves originate where the particles are and they travel outward as the particles move.

XV. *Use your dictionary to translate the idioms:*

make up
on the other hand

XVI. *What expressions for rendering can you find in the text?*

XVII. *Find in the text other combinations with the words* ***theory*** *and* ***differ****.*

theory

↙ ↘

was developed by *applies to*

differ from

XVIII. *Compare British and American*

1)*spelling*

Br		Am
	travel	
travelling		traveling
travelled		traveled

2)*pronunciation*

Br		Am
[fɑ:st]	fast	[fæst]

Writing

XIX. *Read the text to pick out the main points and note them. Add specific details that would support your notes.*

Unit 14

Pronunciation

I. *Read these words:*

1) *without devoicing final consonants. Can devoicing lead to misunderstanding? Give examples:*

side speed unchallenged moves falls reaches stays fluid toward said equalled varies miles wondered was

2) *prolonging* [l, m, n]. *What is the rule?*

tends held holds hand falls ground began balls second

3) *pronouncing the first consonant with aspiration. What is the rule?*

tends cork pebble case point push pull constant time terminal toward two

Text

Gravitation — The Force That Binds The Universe

Everything on earth tends to fall or to seek a lower position unless it is held up by something beneath it. Even balloons and corks are not the exceptions they seem to be. The air or water is heavier than the balloon or the cork. Thus it tends to push the lighter object upward and flow in to use the vacated space, so reaching a lower level. The force that causes bodies to fall to earth is called gravity. Gravity's pull

is always toward the center of the earth. A pebble dropped from a person's hand in the United States falls to the ground in just the way it would fall in Australia, on the opposite side of the earth. In both cases, the pebble falls toward the earth's center.

For thousands of years men have wondered about the workings of gravity. Early Greek philosophers thought of gravity as a force within an object that propelled it downward. 'Downward' they thought of as a single direction in space, for they had little idea that the earth was round and that 'down' meant toward its center. The great philosopher Aristotle thought the heavier an object was, the more of this force it possessed; and so, he said, a heavy object must fall more rapidly than a light object. Its rate of speed, he thought, must be proportional to its weight.

Law of Falling Bodies

For nearly 2,000 years this idea went unchallenged. Not until near the end of the 16th century did anyone try to test the truth of Aristotle's statement. At that time the Italian scientist Galileo Galilei began his experiments with falling bodies. He did much of this work in the city of Pisa.

Through experiments with balls on an inclined plane Galileo proved that falling bodies constantly acquire more speed as they fall. The farther an object falls, the faster it moves. This increase is called *acceleration due to gravity*, or *gravitational acceleration*. In science it is often designated by the letter *g*.

The physicist's formula for the Law of Falling Bodies is $s = \frac{1}{2}gt$. Here s is the total distance fallen, g is the acceleration due to gravity, and t is the time of fall in seconds. The velocity *(v)* of a falling body $= gt$. The difference of a second or two makes a tremendous difference in the speed and the resulting force of impact.

Terminal Velocity

Despite the Law of Falling Bodies, it is true in a sense that light bodies fall more slowly than heavy ones. It is obvious that a feather falls more slowly than a lead pellet. The fact is that the law holds for objects falling *in a vacuum* but not for objects falling through a fluid such as air or water.

Objects falling through a fluid are held back by the fluid. Resistance by the fluid exerts a force on the falling body opposite to the force of gravity. The resistance is proportional to the amount of sur-

face area the body has. In the same case of a feather, the amount of surface area is very great in proportion to its weight. Thus resistance of the air has a greater effect on a feather than it does upon a bit of lead with its small surface area.

Every object falling freely in a fluid eventually reaches a *terminal velocity*. At a certain point in its fall the object reaches its greatest speed and ceases to accelerate. From that point to the ground it falls at an even rate of speed because the resistance increases with the speed of the falling body and the force of gravity stays constant. Thus, a point is reached when the force of gravity, tending to accelerate the body, is exactly equalled by the resistance of the fluid, tending to slow it down. When the two forces are balanced, the body falls at a constant rate, which is its terminal velocity.

Terminal velocity varies according to the object and the fluid medium. In water even a stone falls only a few feet per second. A man falling through the air from an airplane may reach a terminal velocity as great as 220 miles an hour. This is the case if he reaches terminal velocity at 40,000 feet altitude. If he falls to the 5,000-foot level, where the air is denser and more resistant, his velocity will be decreased to about 130 miles an hour.

Development

II. *Spell the words pronounced as follows. Sometimes alternatives are possible:*

[led] — [let], [bit] — [bi:t], [ritʃ] — [ri:tʃ], [hæd] — [hæt], [sik] — [si:k];
[ɜ:ɵ] ['siŋg(ə)l] [pə' zes] [lɔ:] ['saiəns] [spi:d] [wɜ:k] [sens] ['obviəs] [ə' maunt] [keis] [i'fekt] [sləu] [fi'lɒsəfi]

III. *How many stresses are in these international words?*

gravitation acceleration

IV. *Pronounce strong vowels in unstressed syllables of the nouns* ***impact*** ['impækt] *and* ***increase*** ['inkri:s]. *How is the verb* ***increase*** *pronounced ?*

V. *What is the British spelling of the word* ***center****? Can you think of other examples of this kind?*

VI. *Say how* ***lead*** *is pronounced in the following examples. Use your dictionary:*

a lead pellet
a bit of lead

VII. *Practice sentence stress. What kind of words are not stressed?*

The 'fact is| that the 'law 'holds| for 'objects 'falling in a 'vacuum| but 'not for 'objects| falling through a 'fluid| such as 'air or 'water.

A 'man| 'falling 'through the 'air from an 'airplane| may 'reach a 'terminal ve'locity| as 'great as '2'20 'miles an 'hour.||

If he 'falls to the '5,000-'foot 'level| where the 'air is 'denser and 'more re'sistant| his ve'locity will be de'creased| to about '130 'miles an 'hour.

Grammar

VIII. 1) *Study the two examples of Comparative Degree in the following sentences. What parts of speech are used? Spell the initial form of* ***heavier****.*

The air or water is heavier than the balloon or the cork.

It is obvious that a feather falls more slowly than a lead pellet.

2) *Why is Comparative Degree of* ***dense*** *and* ***resistant*** *formed in a different way?*

denser vs more resistant

3) *Analyze the components of the Comparative Degree construction in these sentences. What is the Russian equivalent?*

The heavier an object was, the more of this force it possessed.

The farther an object falls, the faster it moves.

4) *Form Comparative Degree of:*

low rapidly light

IX. *What is the plural of foot? Can you think of other examples of this kind?*

X. *Which noun in these word-combinations is used as an attribute? Give Russian equivalents:*

surface area fluid medium at 40,000 feet altitude

XI. *What Tenses are used in these sentences and why? Find the difference between the period of time to answer the question.*

For thousands of years men have wondered about the workings of gravity.

For nearly 2,000 years this idea went unchallenged.

XII. *Observe the use of Past Indefinite in the subordinate clause. What rule applies here? Say why must stays the same?*

The great philosopher Aristotle thought that the heavier an object *was*, the more of this force it *possessed*; and so, he said, a heavy object *must* fall more rapidly than a light object.

'Downward' they thought of as a single direction in space, for they had little idea that the earth *was* round and that 'down' *meant* toward its center.

XIII. *Why is Present Indefinite used for the future in the following sentence?*

If he *falls* to the 5,000-foot level, where the air is denser and more resistant, his velocity will be decreased to about 130 miles an hour.

XIV. *Analyze the situation in the following sentence: is it real or imaginary? What Mood is used? Analyze its verbal forms.*

A pebble dropped from a person's hand in the United States falls to the ground in just the way it *would fall* in Australia, on the opposite side of the earth.

XV. *Identify two different functions of the verb* **do** *in these sentences:*

Not until near the end of the 16th century *did* anyone try to test the truth of Aristotle's statement.

Thus resistance of the air has a greater effect on a feather than it *does* upon a bit of lead with its small surface area.

Vocabulary

XVI. *Supply synonyms. Is there a stylistic difference between them. Consult your monolingual dictionary:*

seek	total	small	reach
idea	tremendous	eventually	
posses	obvious	cease	
increase	great	decrease	

XVII. *What is the opposite of:*

upward	true	heavy
increase	low	fast

XVIII. *What meaning of the word* **for** *do you know? Identify the part of speech of* **for** *in the following sentences. Use your dictionary.*

'Downward' they thought of as a single direction in space, *for* they had little idea that the earth was round.

For thousands of years men have wondered about the workings of gravity.

The physicist's formula *for* the Law of Falling Bodies is... .

XIX. 1) *Which of the three expressions is idiomatic? Use your dictionary:*

in the case of
in both cases
This is the case

2) *What is the meaning of the word* ***idea*** *in these sentences?*

For nearly 2,000 years this *idea* went unchallenged.

... they had little *idea* that the earth was round.

XX. *Supply prepositions. Compare with Russian equivalents:*

proportional ...
effect ... a feather
fall ... earth
the time of fall ... seconds
difference ... speed
difference ... a second or two
... a certain point
... constant rate

2) *Find verb+preposition combinations in the following phrases. Are there idiomatic ones?*

Everything on earth tends to fall or to seek a lower position unless it is held up by something beneath it.

'Downward' they thought of as a single direction in space ... .

a man falling through the air

Objects falling through a fluid are held back by the fluid.

XXI. *Find in the text other expressions for rendering:*

according to
despite
in a sense

Writing

XXII. *Read the text to pick out the main points and note them. Add specific details that would support your notes.*

Unit 15

Pronunciation

I. *Pronounce these words without devoicing final consonants:*

need was found as crystals these numbers led died lived

II. *Say how these -ed and -(e)s forms are pronounced:*

developed	called	studied	followed
satisfied	considered	assumed	worked
derived	recognized	designed	used

principles studies sciences branches properties consequences centuries structures theories

III. *Pronounce the phrases:*

1) *with lincking r*

for addition
our algebra

2) *with of* [əv]

algebra of real numbers	one of the earliest
a study of logic	development of the theory

Text

Modern Algebra

Our algebra of real numbers developed through the centuries from considerations of problems in arithmetic. The study of the algebra of real numbers and the recent recognition of the fundamental importance of the *basic principles* have led to the development of what is now called *modern algebra* or *abstract algebra.*

One of the earliest pioneers in this direction was the French genius Evariste Galois (1811–32). Although he lived a tragic life and died in a foolish duel at the age of 20, his work led to the development of the modern *theory of groups and fields.*

The concepts of modern algebra have been found to be extremely useful in other branches of mathematics, as well as in the physical and social sciences. A chemist may use modern algebra in a study of the structure of crystals; a physicist may use modern algebra in designing an electronic computer; a mathematician may use modern algebra in a study of logic.

In the algebra of real numbers we study the properties of addition and multiplication of real numbers, which follow as a consequence of certain basic principles. In modern algebra we may work with any set of objects. [We need not work just with real numbers.] We consider certain operations on these objects. [These operations need not be addition and multiplication.] We agree that certain basic principles are satisfied by these operations. [These basic principles need not be the same as our basic principles for addition and multiplication of real numbers.] Then we derive various properties which follow as consequences of the assumed basic principles.

Development

IV. Spell the words pronounced as follows:

[liv]	vs	[li:v]
[ful]		[fu:l]
[wə:k]		[wɔ:k]
[set]	[sed]	[sæd]
[let]		[led]

[im'pɔ:t(ə)nt] ['æbstræct] ['kɒnsept] [bra:ntʃ] ['kemist] [di'zain] [ə'gri:] [di'raiv] ['fizik(ə)l] ['ve(ə)rɪəs] [ɔ:l'ðəu] ['sætisfai]

V. *What is the stress pattern of the following words?*

mathematician multiplication recognition operation fundamental consideration

VI. *What should you note in the pronunciation of the word* ***basic*** *as compared with the Russian word?*

VII. *Practice sentence stress. What kind of words are not stressed?*

The 'concepts of 'modern 'algebra| have been 'found to be ex'tremely 'useful in 'other 'branches of ˌmathe'matics| as 'well as in the 'physical and 'social 'sciences.||

In the 'algebra of 'real 'numbers| we 'study the 'properties| of a'ddition and ˌmultipli'cation of real 'numbers| which 'follow as a 'consequence of 'certain 'basic 'principles.||

Grammar

VIII. *Give the four forms of the verbs:*

be lead have find

IX. *Spell the initial form of the adjective used below. What Degree of Comparison is used? What are its elements?*

one of the earliest pioneers

X. *Does* ***may*** *mean* ***to be able to*** *or* ***to be likely to*** *in the following sentence?*

A chemist may use modern algebra in a study of the structure of crystals; a physicist may use modern algebra in designing an electronic computer; a mathematician may use modern algebra in a study of logic.

XI. *What type of verb (notional, auxiliary, link or modal) is* ***need*** *in the following sentences? What form of the verb comes after it?* ***Need not*** *means* ***not necessary*** *— find at least two ways of translating it in the sentences below.*

We *need* not work just with real numbers.

These operations *need* not be addition and multiplication.

These basic principles *need* not be the same as our basic principles for addition and multiplication of real numbers.

XII. *Study the opening paragraph of the text to say why Present Perfect is used in the following sentence.*

The study of the algebra of real numbers and the recent recognition of the fundamental importance of the basic principles have led to the development of what is now called modern algebra.

XIII. *Identify the components of Complex Subject in the following sentence. Translate the sentence.*

The concepts of modern algebra have been found to be extremely useful in other branches of mathematics.

Vocabulary

XIV. *Find in the text nouns used with the following adjectives. Use a diagram to register them:*

basic certain modern fundamental

XV. *Can you think of synonyms for:*

basic extremely real modern

XVI. *What words and word-combinations from the text are often used in scientific texts?*

XVII. *Use your monolingual dictionary to find the difference between synonyms, e.g. compare* ***real*** *and* ***true***, ***modern*** *and* ***contemporary***. *Are they interchangeable in all word-combinations, is there a stylistic difference?*

Writing

XVIII. *Write a short paragraph explaining in your own words what abstract algebra deals with. Use expressions for rendering considered in previous texts.*

Unit 16

Pronunciation

I. *What is the pronunciation of final voiced consonants in English as compared with Russian?*

made added led should laws move method

II. *How are the -ed forms pronounced?*

developed married discovered seemed passed called changed formulated helped solved served stopped quarreled

III. *Spell the words pronounced as follows:*

[wait]	vs	[waid]
[hɜ:d]		[hɜ:t]
[pjuə]		[puə]
[sed]		[set]
[tɔ:d]		[tɔ:t]

[ə'tʃi:vmənt] ['si(ə)riəs] ['ɑ:gju:] [lait] ['pauə] [dis'kʌv(ə)ri] [di'said] [ə'trækt] [ik'splɔ:] [wʌns] [ə'gen] [fju:] [jet] ['kwestʃ(ə)n]

Text

Isaac Newton — Explorer of Nature's Laws

One of the greatest scientists who ever lived was Isaac Newton. He discovered the law of gravitation and the laws of light. He also developed differential calculus. Not until Einstein's theories came out were those of Newton even partially replaced.

In spite of his great achievements, Newton was a puzzling personality. Time and again he put aside his work in physics and mathematics to make long studies in alchemy. He lived to be 84 years old, but all his serious scientific work was done by the time he was 42. For the rest of his life he studied religion.

Newton never married, and he made few close friends. He lived for his work, scientific or religious. He hated to quarrel with fellow scientists, but once started, he hated to stop.

Great Discoveries

He made three of the greatest discoveries in the history of science.

Calculus deals with the rate of change and the amount of change in anything moving through a certain length of space or time. Newton called the method *fluxions*. He and the German scientists Gottfried W.Leibnitz seemed to have discovered it at about the same time. They argued for years over who should get the credit.

Newton's experiments with light led him to new facts about color. He passed white light through a prism, which broke it up into a wide color band, called spectrum. He passed the color band through another prism and restored it to white again. Next he passed a single color through a prism. It remained unchanged. From this he concluded that white light is a mixture of pure colored lights. He also formulated the *corpuscular* theory of light.

The idea of gravity came out of Newton's questions about the moon. What keeps the moon in its regular path as it turns around the earth? He decided that only the attraction of the earth and the moon for each other could account for it. From this observation grew the general law of gravitation.

In 1669 he was appointed professor of mathematics at Cambridge. Three years later he invented the reflecting telescope. In 1687 he published his famous 'Principia' ('Mathematical Principles of Natural Philosophy'), setting forth the theory of gravitation. He served a term in Parliament.

In 1696 he was appointed Warden of the Mint, and in 1699 he was made Master of the Mint. He was elected president of the Royal Society in 1703 and was knighted in 1705.

One factor that helped Newton to achieve greatness was his power of concentration. Once he fastened on a problem, he neither heard nor saw anything else until the problem was solved. Yet he was modest about his achievements. 'If I have seen further than most men, it is by standing on the shoulders of giants,' he said.

Development

IV. *How is the word close pronounced as a verb and as a noun? Use your dictionary if necessary.*

V. *Check the stress pattern of these words in your dictionary:*

observation scientific mathematics differential personality

VI. *Use your dictionary to say how each pair of words is pronounced. Can you think of other examples?*

night — knight, father — farther, a side — aside, a point — appoint, a round — around, fourth — forth

VII. *Find the difference in the pronunciation and meaning between the words in each of the following groups:*

once — ones, series — serious, laws — loss, should — shoot

VIII. *Practice sentence stress. What kind of words are not stressed?*

'What 'keeps the 'moon in its 'regular 'path| as it 'turns a'round the 'earth?

He de'cided| that 'only the a'ttraction of the 'earth and the 'moon for 'each 'other| could a'ccount for it.

If I have 'seen 'farther than 'most 'men| it is by 'standing on the 'shoulders of 'giants.

IX. 1) *What is the British spelling of the words* ***color*** *and* ***quarreled****. Think of other examples of this kind.*

2) *What is the British and American pronunciation of the words* ***neither****,* ***path****?*

Grammar

X. *What form of the verb (I–IV) is used? Give the three forms of the verbs.*

From this observation grew the general law of gravitation.

... which broke it up ...
he put aside his work
in anything moving through space
he neither heard nor saw anything
He published 'Principia', setting forth the theory ... .

XI. *What words with the same root do you know? What parts of speech are they?*

great regular decide conclude elect famous attract religion observe history

XII. *Read the sentence. How does the use of* ***not until*** *change the word order in the sentence? What word is used as a substitute for* ***theories****?*

Not until Einstein's theories came out were those of Newton even partially replaced.

XIII. *What type of verb (notional, auxiliary, link, or modal) is* ***should*** *in this sentence? Is it possible to use here any other verb of this type?*

They argued for years over who *should* get the credit.

XIV. *Study the use of Perfect Infinitive in Complex Subject. Suggest several variants of translating seem in the sentence into Russian.*

He and the German scientist Gottfried W.Leibnitz seemed to have discovered it at about the same time.

XV. *Why is is used here rather than was?*

From this he concluded that white light *is* a mixture of pure colored lights.

Vocabulary

XVI. *Use your dictionary to translate the following expressions. Which of them are idiomatic?*

neither ... nor
in spite of
time and again

XVII. *Choose one of the meanings of once and as to translate the following sentences:*

once	*as*
a) one time, on one occasion	a) because
b) some time ago	b) while, when
c) from the moment that	c) though

He hated to quarrel with fellow scientists, but *once* started, he hated to stop.

Once he fastened on a problem, he neither heard nor saw anything else until the problem was solved.

What keeps the moon in its regular path *as* it turns around the earth?

XVIII. *What meaning of the word fellow do you know? What does it mean in the following word-combination?*

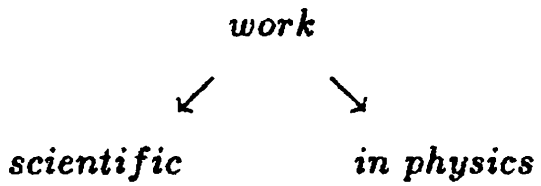
fellow scientists

XIX. *What is the difference between* ***solve*** *and* ***decide*** *as compared with Russian? Give examples of word-combinations. Use your monolingual dictionary if necessary.*

XX. *Find in the text other means of formulating similar statements about the achievements of a scientist.*

He discovered (the law)
developed (calculus)

XXI. 1) *Complete the word tree for* ***work*** *from the text:*



2) *Note down all combinations with* ***theory*** *and* ***law****. Use diagrams.*

Writing

XXII. *The formula of Newton's law of gravitation is as follows:*

$$F = G m_1 m_2 / d^2.$$

Write this law in words.

Unit 17

Pronunciation

I. *In which words are the initial sounds pronounced with aspiration?*

pass stop pace kept picked tire space turn peg cart carry step piece put time spoke

II. *Say what sound distinguishes these words:*

side — sight, card — cart, place — plays, a use — to use, since — sins, year — ear, made — mate, believe — belief, wheel — will

III. *How is the word in -ate separate pronounced as a verb and as an adjective?*

Text

Wheel

Without the wheel most of the world's work would stop. Yet no one knows when the wheel was invented or who invented it. The best guess is that this happened in Asia about 10,000 years ago. The oldest wheel known was discovered in Mesopotamia and is believed to date back 55 centuries. But this wheel was evidently the result of long development.

Early in history man found that a heavy load could he moved rather easily if a roller was put under it. He also discovered that placing runners under a load made it easier to drag. So the sledge was invented.

Combining the roller and the sledge for heavy loads is believed to have been the next step. After long use the sledge runners would wear grooves in a roller. Man soon learned that with a deeply grooved roller the sledge moved forward a longer distance before the roller needed to be shifted.

The next step was the change of the roller into a wheel. The wood between the grooves of the roller has been cut away to make an axle, and wooden pegs have been driven into the runners on each side of the axle. The runners can no longer roll forward. When the wheels turn, the axle revolved in the space between the pegs. This makes a primitive cart. Later in place of the pegs, holes for the axle were bored through the frame of the cart. Axle and wheels were now made separately.

By the time that wheels were made separately from the axle, the wheel idea was fully developed. What remained to be done was to improve the structure of the wheel itself.

A well-built wheel was composed of three essential elements — hub, spokes and rim. This type of wheel made its appearance in Egyptian chariots of about 2000 B.C. At this time, wheels for carrying heavy loads were still of the solid type. The spoked wheel was not strong enough until men learned to bind the rim and hold the fellies together with overlapping strips of metal serving as a tire. And many centuries passed before the spoked wheel reached its maximum strength with a tire made in one piece — a hoop of iron or steel, heated red-hot and shrunk on to the rim of the wheel as it cooled.

The Assyrians probably kept pace with the Egyptians in the use of the wheel. The Greeks picked the idea for wheels from Egypt and added a few improvements. The Romans developed the greatest variety of wheeled vehicles. Until the modern invention of pneumatic rubber tires and ball and roller bearings, there had been few improvements in the wheel itself since Roman days.

Development

IV. *Spell the words pronounced as follows. What mistakes of Russian learners of English may lead to misunderstanding?*

1)	[ges]	vs	[gæs]
	[bæk]		[bæg]
	[mæn]		[men]
	[ritʃ]		[ri:tʃ]
	[hit]		[hi:t]

2) [jiə] [di:p] [im'pru:v] ['sep(ə)rət] [i'senʃ(ə)l] [taip] ['vi:ik(ə)l] [bɔ:l] ['ɜ:li] [ə'piə] [i:tʃ] [i'nʌf]

V. *Say how each pair of words is pronounced:*

would — wood, knows — nose, bored — board, whole — hole, role — roll, peace — piece, where — wear

VI. *Study these international words. Check their pronunciation in your dictionary. Mark the element (the stress pattern, a sound) which you are likely to confuse with Russian:*

result history combination distance primitive structure element maximum modern pneumatic

VII. *Say how -ed and -(e)s forms are pronounced. Comment on the changes in spelling:*

discovered	changed	placed	developed	moved
dragged	grooved	turned	bored	remained
improved	structured	appeared	carried	spoked
composed	learned(!)	reached	passed	picked
revolved	served	overlapped	happened	believed

grooves centuries changes holes improves structures fellies reaches tires discoveries places

VIII. *Say how of is pronounced:*

a hoop of iron
the result of long development
most of the world's work

IX. *Say what words and why are not stressed in the following sentences.*

The best quess| is that this happened in Asia| about 10,000 years ago.

The spoked wheel was not strong enough| until men learned to bind the rim| and hold the fellies together| with overlapping stripes of metal| serving as a tire.

Early in history| man found| that a heavy load| can be moved rather easily| if a roller was put under it.

Grammar

X. *Give the three forms of the verbs:*

bind cut drive wear know find hold make do learn hold keep put build

XI. *Form Present Perfect of the verbs:*

bind cut drive wear

XII. *Can you think of related words? Check their pronunciation:*

invent develop discover combine long strong wood revolve improve serve vary

XIII. *Why is could used instead of can and made instead of makes in the following sentences? Compare with Russian.*

Early in history man found that a heavy load *could* be moved rather easily if a roller was put under it.

He also discovered that placing runners under a load *made* it easier to drag.

XIV. *Analyze the periods of time in the sentence to say why Past Perfect is used.*

Until the modern invention of pneumatic rubber tires and ball and roller bearings, there had been few improvements in the wheel itself since Roman days.

XV. *These sentences contain the verb* ***would****. In both cases it is used with 3d person and Indefinite Infinitive. Study the context (paragraphs 1 and 3) to find the difference in meaning.*

Without the wheel most of the world's work *would* stop.

After long use the sledge runners *would* wear grooves in a roller.

XVI. *Compare the elements of Complex Subject in these sentences. Explain the use of different types of infinitives.*

The oldest wheel ... is believed to date back 35 centuries.

Combining the roller and the sledge for heavy loads is believed to have been the next step.

Vocabulary

XVII. *Say what the italicized words mean:*

about 10,000 years ago

by the time that

XVIII. 1) *Find other verbs used in a similar context.*

Man found
discovered

2) *Find in the text phrases with the words* ***improve, develop*** *and related words. Note them down as diagrams.*

XIX. *Study the typical expressions for rendering. Find other examples in the text.*

So
No one knows
The next step was

Writing

XX. *Add specific details that would support the idea expressed in the first sentence of the text. Write 2 or 3 sentences.*

XXI. *Complete the text given below using suitable linkers.*

Gyroscope is a wheel spinning on a shaft and ... mounted ... it can rotate freely about any direction. It has two basic properties, either or both of which are used in a variety of instruments. ..., the spinning wheel tends to maintain the direction of its rotational axis in space; it is said to have gyroscopic inertia. ..., if a twisting force (a torque) is applied to the shaft ... to try to rotate the shaft about an axis perpendicular to the shaft, the resulting motion will be a precession, ... a rotation of the shaft about an axis that is perpendicular both to the shaft and to the axis of the torque.

Appendix: Summaries

I. *Analyze the summaries of books on mathematics to compile a list of expressions to be used in rendering.*

For example:

'The Lyapanov Matrix Equation in System Stability and Control' covers mathematical developments and applications while providing quick and easy references for solutions to engineering and mathematical problems.'

'This book is devoted to the related theory and practice of ends, dealing with manifolds and cw complexes in topology and chain complexes in algebra.'

Thus your list begins with:

This book	covers	(while) providing
	is devoted to	dealing with

developments and applications
references to

Continue in the same way.

1. 'This book describes the Inverse Galois Problem which brings together ideas from group theory, algebraic geometry and number theory, topology, and analysis. The author begins from the foundations and develops the necessary mathematical background to lead the reader to the research frontier.'

2. 'This book contains papers presented at the Canadian Mathematical Society Annual Seminar held in June 1994. Covering both expository, and research articles, 'Representation of Groups' offers the latest results on various aspects of representation theory of groups.'

II. *Analyze the summaries of books on mathematics to compile a list of expressions to be used in rendering.*

For example: 'The first half of this book is an expository account of the field explaining the main technical aspects. The second half of the book focuses on the definition of quantum cohomology. The authors give a new proof of the Ruan-Tian theorem of existence of the quantum cohomology ring, that is, that the quantum multiplication is associative on appropriate manifolds. They then describe the Jivental Kim calculation of the quantum cohomology of flag manifolds leading to quantum Chern classes and Witten's calculation for Grassmanians, which relates to the Verlinde algebra.'

Your list begins with:

The first/second half of this book	is an account of focuses on	explaining
The authors	give a (new) proof describe	

lead to
theorem on (existence)
relate to
that is
main aspects

Continue in the same way:

1. 'In this appealing and well written text, Richard Bronson gives readers a substructure for a firm understanding of the abstract concepts of linear algebra and its applications. The book includes ample exercises with answers and hints. With its inclusion of all the needed pedagogical features, this text will be a pleasure for teachers and students alike.'

2. 'Harmonic analysis plays an essential role in understanding of a host of engineering, mathematical, and scientific ideas. This book serves as a fundamental resource on the theories and applications of harmonic analysis.'

III. *Analyze the summaries of books on mathematics to compile a list of expressions to be used in rendering.*

For example: 'This book deals with the differential Galois theory of linear homogeneous differential equations, whose differential Galois

groups are algebraic matrix groups. In addition to providing a convenient path to Galois theory, this approach also leads to the constructive solution of the inverse problem of differential Galois theory for various classes of algebraic groups. Providing a self-contained development and many explicit examples, this book provides a unique approach to differential Galois theory and is suitable as a textbook at the advanced graduate level.'

Your list begins with:

This book	deals with provides (an approach) is suitable as

This approach ⟶ leads to

unique ↙ ↘ to (theory)

at the (advanced) level
in addition to +-ing (providing)

1. 'Probability theory is one of the most basic working tools for students of mathematics, theoretical statistics, and indeed any discipline that uses quantitative and analytic methods. Students and teachers will find in this textbook a truly extensive and modern approach to the subject, integrating measure theory as one of the essential foundations and bridging the gap between introductory courses and specialized topics.

The authors introduce the basic objects of probability theory (random variables, sigma fields, measures, expectations, distribution functions) at the same time developing concepts from measure theory as required. The book contains numerous examples and over 1000 exercises, many with solutions.'

2. 'The representation theory of groups and related structures is at the heart of this volume, which combines the modular representation theory of finite groups of R. Brauer and the representation theory of reductive groups of G. Lusztig. The former theory addresses all abstract finite groups, while the latter addresses paramount examples of finite groups. Both theories are regarded today as notable achievements in mathematics.'

IV. ***Analyze the summaries of books on mathematics to compile a list of expressions to be used in rendering.***

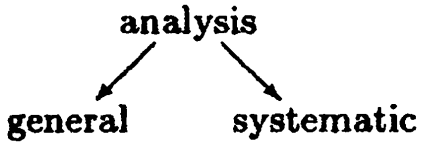
For example: 'This book gives a general systematic analysis of the notions of 'projectivity' and 'injectivity' in the context of Hilbert modules over operator algebras. In this work, Muhly and Solel introduce various notions of projective Hilbert modules and use them to investigate dilation and commutant lifting problems over certain infinite dimensional analogues of incidence algebras. The authors prove that commutant lifting holds for such an algebra if and only if the pattern indexing the algebra is a 'tree' in the sense of computer directories.'

Thus, your list begins with:

This book gives ...

In this work the authors — introduce / prove

(various) notions
use them to investigate
in the sense of
if and only if
hold for



1. 'Triangular algebras and nest algebras are two important classes of non-selfadjoint operator algebras. In this book, Orr uses the new depth of understanding which the similarity theory for nests has opened up to study ideals of nest algebras.

In particular, a unique largest diagonal-disjoint ideal is identified for each nest algebra. Using a construction proposed by Kodison and Singer, this ideal can be used to construct new maximal triangular algebras.'

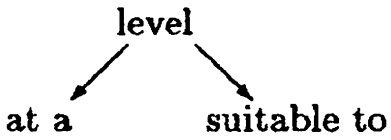
2. 'Cryptography is an outstanding book that covers all the major areas of cryptography in a readable, mathematically precise form. Several chapters deal with especially active areas of research and give the reader a quick introduction and overview of the basic results in the area.'

V. Analyze the summaries of books on mathematics to compile a list of expressions to be used in rendering.

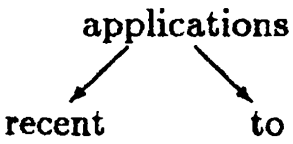
For example: 'This mathematics monograph, at a level suitable for graduate students at the beginning of their mathematical studies, is an introduction to the fascinating study of knots and provides insight into recent applications to such studies as DNA research and graph theory. The author clearly outlines what is known and what is not known about knots. There are numerous diagrams and exercises relating to the material.'

Thus, your list begins with:

This monograph | is an introduction to
provides insight into
The author (clearly) outlines



at the beginning



diagrams relating to (the material)

1. 'This text focuses on the physics of symmetries, developing symmetries and transformations through concrete physical examples and contexts rather than presenting the information axiomatically, mathematically, and abstractly. Readers are introduced gradually to advanced mathematical procedures, including the Wigner and Racah algebras and their applications to various symmetry groups. The book also includes some of the latest research on the use of non-invariance and non-compact groups in the consideration of relativistic and many-particle problems of atoms and nuclei.'

2. 'The book describes recent progress in the topological study of plane curves. Arnold describes applications to the geometry of caustics and of wavefronts in symplectic and contact geometry. These applications extend the classical four-vertex theorem of elementary plane geometry to estimates on the minimal number of cusps necessary for the reversion of a wavefront and to generalizations of the last geometrical theorem of Jacobi on conjugated points on convex surfaces.'

Е.Н. Егорова
под ред. Л.Н. Выгонской
English for Students of Mathematics and Mechanics
(Part one)
Учебное пособие

Оригинал-макет: *Н.Н. Андреев*
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