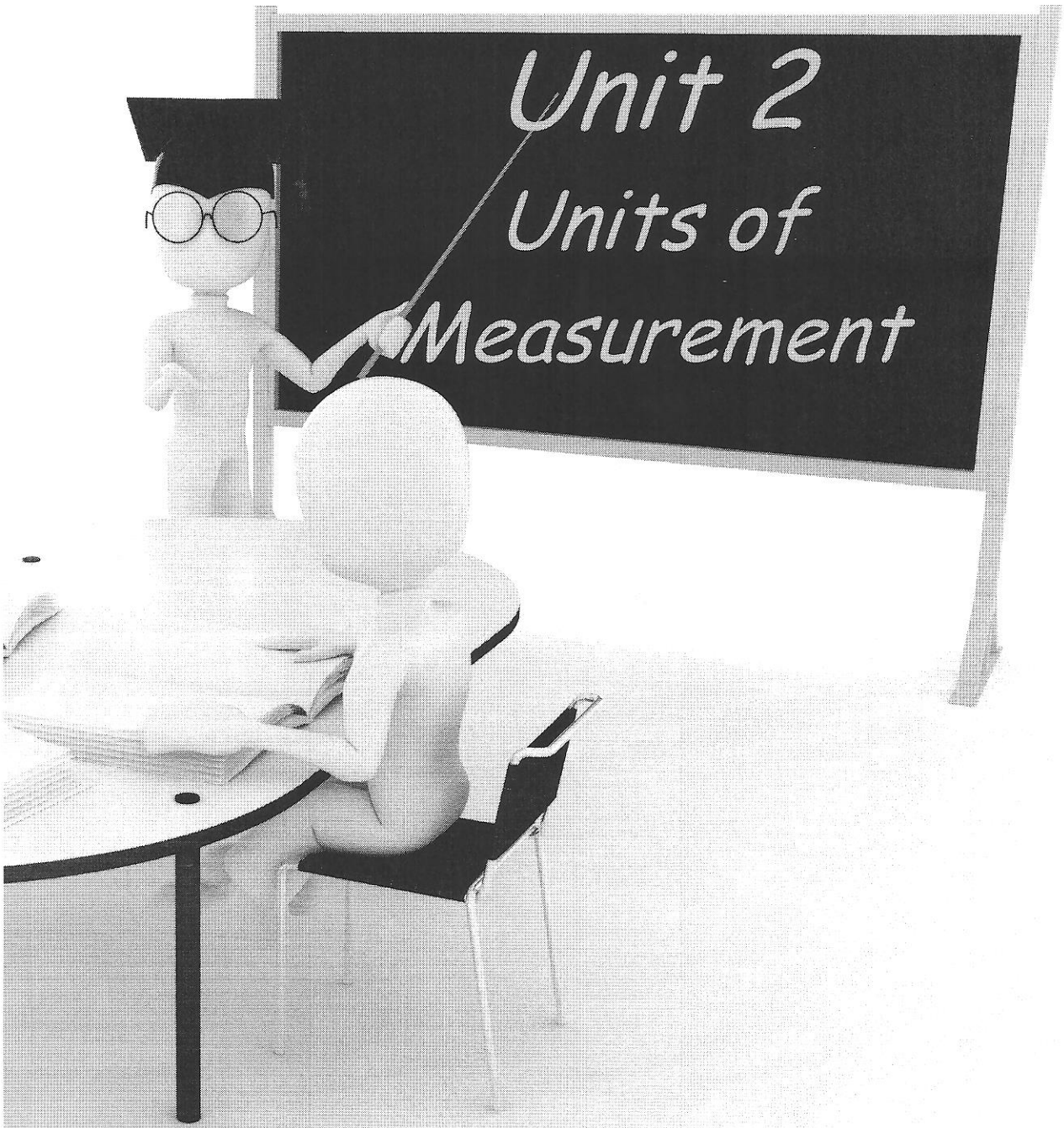


Stage 1 – Vocabulary

Units of Measurement

ampere ['æmpɛə] *n*
block [blɔk] *n*
caesium ['si:zjəm] *n*
candela [kæn'di:lə] *n*
coefficient [ˌkəuɪ'fɪʃ(ə)nt] *n*
committee [kə'mɪtɪ] *n*
contact ['kɔntækt] *n*
cube [kju:b] *n*
cubic(al) ['kju:bɪk(əl)] *a*
cylinder ['sɪlɪndə] *n*
distance ['dɪstəns] *n*
equator [ɪ'kweɪtə] *n*
fact [fækt] *n*
factor ['fæktə] *n*
gram [græm] *n*
kilogram ['kɪlə(u)græm]
milligram ['mɪlɪgræm]
inertia [ɪ'nə:ʃjə] *n*
international [ˌɪntə'næʃ(ə)nl] *a*
iridium [ɪ'rɪdɪəm] *n*
isotope ['aɪsə(u)təup] *n*
krypton ['krɪptɔn] *n*
logical ['lɔdʒɪk(ə)l] *a*
metre ['mɪ:tə] *n*
centimetre ['sentɪˌmi:tə]
kilometre ['kɪlə(u)ˌmi:tə]
millimetre ['mɪlɪˌmi:tə]
metric ['metrɪk] *a*
minute ['mɪnɪt] *n*
monotonous [mə'nɔtnəs] *a*
nation ['neɪʃ(ə)n] *n*
ohm [əum] *n*
platinum ['plætɪnəm] *n*
practically ['præktɪk(ə)lɪ] *adv*
prefix ['pri:fɪks] *n*
prototype ['prəutətaɪp] *n*
radian ['reɪdjən] *n*
scale [skeɪl] *n*
second ['sek(ə)nd] *n*
spectrum ['spektrəm] *n* (*pl* -ra)
standard ['stændəd] *n, a*
standardize ['stændədaɪz] *v*
steradian [stə'reɪdɪən] *n*
system ['sɪstɪm] *n*
vacuum ['vækjuəm] *n*

accept [ək'sept] *v* принимать
accuracy ['ækjurəsɪ] *n* точность; тщательность
adopt [ə'dɔpt] *v* принимать
agree [ə'gri:] *v* соглашаться
alloy ['ælɔɪ] *n* сплав
angle ['æŋg(ə)l] *n* угол;
solid angle – телесный угол
available [ə'veɪləbl] *a* 1) доступный; 2) (при)годный; 3) действительный
axis ['æksɪs] *n* (*pl* axes) ось
base [beɪs] *v* основывать, базировать
basic ['beɪsɪk] *a* основной
bureau [bju:ə'rəu] *n* (*pl* -eaux [-əuz]) бюро, отдел, управление, комитет
calculate ['kælkjuleɪt] *v* вычислять; подсчитывать
carbon ['kɑ:bən] *n хим.* углерод
carry out ['kærɪ] *v* выполнять, проводить
choice [tʃɔɪs] *n* выбор, отбор; альтернатива
choose [tʃu:z] *v* (chose, chosen) выбирать
coherent [kəu'hɪərənt] *a* согласованный
comma ['kɔmə] *n* запятая
complicated ['kɔmplɪkeɪtɪd] *a* сложный; запутанный
conductor [kən'dʌktə] *n* проводник
convert [kən'və:t] *v* преобразовывать
create [kri(:)'eɪt] *v* создавать, творить
current ['kʌrənt] *n* ток
decimal ['desɪməl] *a* десятичный
deference ['def(ə)r(ə)ns] *n* уважение;
in deference to – из уважения к
define [dɪ'faɪn] *v* определять
depth [depθ] *n* 1) глубина; 2) *геом.* длина
derive [dɪ'raɪv] *v* получать, извлекать
dimension [dɪ'menʃ(ə)n] *n* размер
division [dɪ'vɪʒ(ə)n] *n* деление
eminent ['emɪnənt] *a* 1) возвышенный; 2) выдающийся, видный, знаменитый
emit [ɪ'mi:t] *v* испускать, излучать
employ [ɪm'plɔɪ] *v* употреблять, применять
entirely [ɪn'taɪəlɪ] *adv* полностью, всецело, совершенно
expansion [ɪks'pænʃ(ə)n] *n* расширение;
coefficient of expansion – температурный коэффициент расширения
fairly ['fɛəlɪ] *adv* довольно
flux [flʌks] *n* поток
freeze [fri:z] *v* (froze, frozen) замерзать
frequency ['fri:kwənsɪ] *n* частота
hard [hɑ:d] *a* трудный, тяжелый
inch [intʃ] *n* дюйм
incidence ['ɪnsɪd(ə)ns] *n* падение;
angle of incidence – угол падения
intensity [ɪn'tensɪtɪ] *n* 1) интенсивность, напряженность; 2) сила света
involve [ɪn'vɔlv] *v* включать в себя, содержать
keep [ki:p] *v* (kept) 1) держать; 2) хранить
latent ['leɪtənt] *a* скрытый, латентный;
latent heat – скрытая теплота
length [leŋθ] *n* 1) длина; 2) расстояние

magnitude ['mægnɪtju:d] *n* величина, размер(ы)
major ['meɪdʒə] *a* более важный, бóльший
measurement ['meʒəmənt] *n* измерение
multiplication [ˌmʌltɪplɪ'keɪʃ(ə)n] *n мат.* умножение
multiply ['mʌltɪplaɪ] *v мат.* умножать
numerical [nju(:)'merɪk(ə)l] *a* числовой, цифровой
obtain [əb'teɪn] *v* получать
particular [pə'tɪkjulə] *a* 1) особый; 2) частный, отдельный
pendulum ['pendjuləm] *n* маятник
possess [pə'zes] *v* обладать, владеть
pound [paund] *n* фунт (*единица измерения*)
power ['pauə] *n мат.* степень
property ['prɔpətɪ] *n* свойство, качество
provide [prə'vaɪd] *v* обеспечивать, давать, предоставлять
purpose ['pə:pəs] *n* цель
ratio ['reɪʃɪəu] *n* (*pl* ratios) (со)отношение, пропорция, коэффициент
relationship [rɪ'leɪʃ(ə)nʃɪp] *n* отношение, взаимоотношение; связь
replace [rɪ'pleɪs] *v* заменять, замещать
represent [ˌreprɪ'zent] *v* представлять
require [rɪ'kwaɪə] *v* нуждаться, требовать
rotate [rə(u)'teɪt] *v* вращаться
shift [ʃɪft] *v* 1) сдвиг; 2) способ, средство
slightly ['slaɪtlɪ] *adv* слегка, немного
slow down ['sləu daun] *v* замедлять(ся); сбавлять (*скорость*)
specify ['spesɪfaɪ] *v* точно определять
stand for [stænd] *v* (stood) означать, символизировать
string [strɪŋ] *n* веревка, нитка
suitable ['sju:təbl] *a* подходящий, соответствующий, годный
supplementary [ˌsʌplɪ'mentərɪ] *a* дополнительный
travel ['trævl] *v* двигаться, передвигаться; перемещаться
unfortunately [ʌn'fɔ:tʃnɪtlɪ] *adv* к несчастью, к сожалению
unit ['ju:nɪt] *n* единица измерения
universal [ˌju:nɪ'və:s(ə)l] *a* всеобщий, всемирный
value ['vælju:] *n* 1) ценность; 2) значение, величина
wavelength ['weɪvleŋθ] *n* длина волны
width [wɪdθ] *n* ширина; расстояние

to be interrelated [ˌɪntərə'leɪtɪd] **with** – быть взаимосвязанным с
for instance – например
until recently – до недавнего времени
with a few exceptions – за небольшим исключением

Mathematical symbols[1]

symbols – символы:

\+ plus / added to
\- minus
× times / multiplied by
: divided by
= is / makes / equals / is equal to
≠ is not equal to / is unequal to
≈ is approximately equal to
∝ is proportional to
< is smaller / less than
> is larger / greater than
≡ is identical to / is equivalent to / is identically equal to

e.g.:

2 + 7 = 9 *Two plus seven is equal to nine.*
15 – 3 = 12 *Fifteen minus three makes twelve.*
3 × 6 = 18 *Three times six equals eighteen.*
20 : 5 = 4 *Twenty divided by five is four.*

fractions[2] – дроби:

0.25 – zero point two five / oh [əu] point two five / point two five / nought point two five
71.36 – seventy-one point three six
25.448 – twenty-five point double four eight
1/3 – one third / a third
2/3 – two thirds
3/7 – three sevenths

powers – степени:

8^5 – eight to the fifth (power)
8^{-5} – eight to the minus fifth (power)
8^2 – eight square / squared

roots – корни:

$\sqrt{a}$ – the square root of **a**
$\sqrt[3]{a}$ – the cube root of **a**
$\sqrt[n]{a}$ – the **n**-th root of **a**

and others:

a_1 – **a** sub **one**, **a** first
d_k – **d** sub **k**

[1] – A fuller list of mathematical symbols is given in '*Appendix 7*'.
[2] – In English writing a decimal **point** is used in decimal fractions (instead of a decimal **comma** in Russian writing).

Task I. Pay attention to …

I. Pay attention to the pronunciation of the following words.

a) calculate ['kælkjuleɪt] – calculation [ˌkælkju'leɪʃ(ə)n];
multiply ['mʌltɪplaɪ] – multiplication [ˌmʌltɪplɪ'keɪʃ(ə)n];
b) metre ['mɪːtə] – metric ['metrɪk]

II. Pay attention to the following derivatives. Read and translate them.

agreement ← **agree** → disagree;
↳disagreement ↵
approximate → approximately;
calculate → calculation;
conduct → conductor;
convert → conversion;
cube → cubic(al);
define – redefine;
direct → indirect;
divide → division;
equal → unequal;
except → exception;
expand → expansion;
fortunately ← **fortunate** → unfortunate;
↳unfortunately ↵
free → freely;
gravitation → gravitational → gravitationally;
measure → measurement;
metre → metric;
multiply → multiplication;
nation → national → international;
physicist ← **physics** → physical;
produce → reproduce → reproducible;
relationship ← relation ← **relate** → related → interrelated;
↓ ↓
interrelation relative → relativity;
rotate → rotation;
standard → standardize;
universe → universal → universally;
vary → varying → unvarying;
vibrate → vibration

Suffixes:
-ation/-(t)ion/ sion *v* → *n*
-al *n* → *a*
-ible *v* → *a*
-ic(al) *n* → *a*
-ist *n* → *n*
-ity *a* → *n*
-ive *v* → *a*
-ize *n* → *v*
-ly *a* → *adv*
-ment *v* → *n*
-or *v* → *n*
-ship *n* → *n*

Prefixes:
dis- *'the opposite of' / 'not'*
in- *'the opposite of' / 'not'*
inter- *'from one to another' / 'between'*
re- *'again'*
un- *'the opposite of' / 'not'*

A fuller list of affixes is given on pp 9-13.

III. Pay attention to the compounds. Read and translate them.

a: well + defined = well-defined
n: wave + length = wavelength; platinum + alloy = platinum alloy (*also* platinum-alloy)

*Pay attention to some other '**noun + noun**' combinations. Read and translate.*
the experiment results; the world nations; the system value; light waves; light intensity measurement; a platinum-alloy bar; a prototype mass; light waves vibrations; caesium atoms; the system (official) name

IV. Pay attention to the plural of the following nouns.

axis – ax**es**; bureau [bju:ə'rəu] – bureau**x** [bju:ə'rəuz]; foot – feet; spectrum – spectr**a**

Choose the correct form of the noun.

1. The second was originally defined in terms of the time required for the Earth to rotate about its (*axis / axes*).
2. The coordinate (*axis / axes*) cross this plane.
3. Two (*bureau / bureaux*) stood between the windows.
4. A (*bureau / bureaux*) is an office, organization, or government department that collects and distributes information.
5. One yard is equal to three (*foot / feet*). A (*foot / feet*) is equal to 12 inches.
6. The (*spectrum / spectra*) of caesium is used to define the second.
7. We call these (*spectrum / spectra*) continuous.

V. Pay attention the following international words. They are often called 'false friends of a translator' as they can be translated in different ways.

accuracy ['ækjurəsɪ] *n* 1) точность, правильность; 2) тщательность

distance ['dɪstəns] *n* расстояние, длина, дистанция

monotonous [mə'nɔtnəs] *a* монотонный; однообразный; скучный

nation ['neɪʃ(ə)n] *n* 1) народ, нация; народность; 2) государство, страна

period ['pɪ(ə)rɪəd] *n* 1) период, промежуток времени; 2) время, эпоха; 3) *мат., физ., астр.* период

second I ['sek(ə)nd] *num* второй

second II ['sek(ə)nd] *n* секунда

system ['sɪstɪm] *n* 1) система; метод; 2) устройство, система; 3) организм; 4) мир, вселенная

universal [ˌju:nɪ'və:s(ə)l] *a* 1) всеобщий, всемирный; 2) универсальный

vibrate [vaɪ'breɪt] *v* 1) вибрировать, дрожать (with – от); 2) качаться, колебаться; 3) трепетать; 4) звучать (*в памяти, в ушах*); 5) вызывать вибрацию; 6) сомневаться, колебаться, быть в нерешительности

Find the meaning that correctly explains the use of the words in bold and translate the sentences.

1. A well-defined, unvarying, reproducible, and **universally** available value of a quantity is accepted as a unit of that quantity.
2. The SI is based on seven basic units, each of which is defined with great **accuracy**.
3. Conversion of one unit into another is a **monotonous** job in the British **system**.
4. Nearly all the **nations** of the world use the SI Units.
5. The metre is a unit of **distance** in the SI.
6. In 1960 the metre was redefined as the **distance** travelled by light in a vacuum over a definite **period** of time.
7. The **second** fundamental unit of the SI is the **second**. It was redefined as the time required for a certain number of **vibrations** of the light waves emitted by caesium atoms.

VI. Pay attention the following easily confused words.

a) **accept** [ək'sept] *v* принимать
except [ɪk'sept] **1)** *v* исключать; **2)** *prep* исключая, кроме

b) **deference** ['def(ə)r(ə)ns] *n* уважение, почтительное отношение
difference ['dɪfrəns] *n* разница, различие

c) **high** [haɪ] *a* высокий, большой, сильный, интенсивный
height ['haɪt] *n* высота

d) **right I** [raɪt] *a* правильный, верный
right II [raɪt] *a* правый (*о стороне*); **right-hand** – правый (*о стороне*)
write [raɪt] *v* писать

e) **only** ['əunlɪ] *adv* только
the only [θɪ 'əunlɪ] *a* единственный

f) **hard** [hɑ:d] *adv* тяжело, с трудом
hardly ['hɑ:dlɪ] *adv* едва (ли); вряд ли

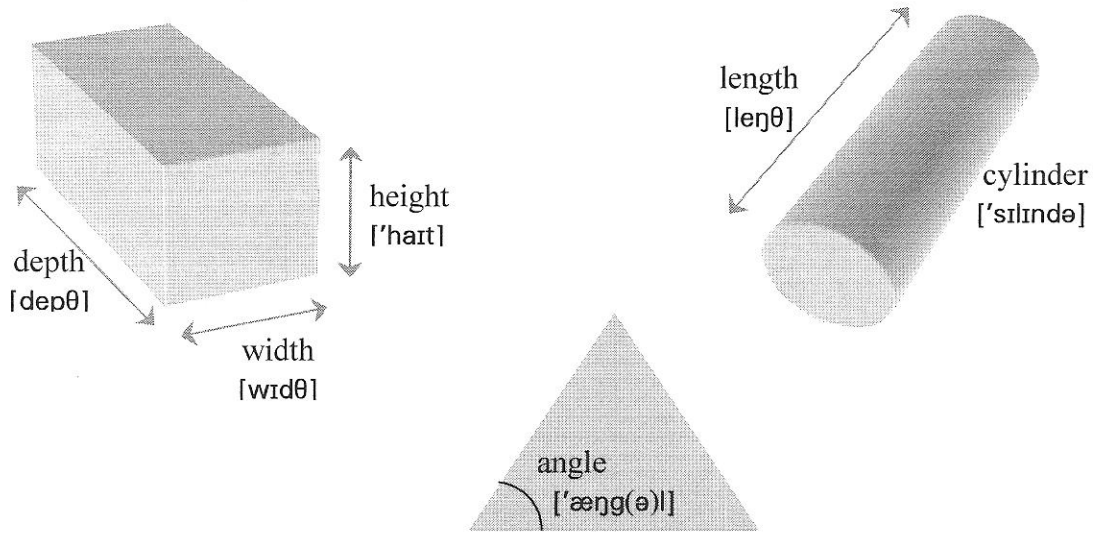
g) **near** [nɪə] *adv* близко, рядом
nearly ['nɪəlɪ] *adv* почти, приблизительно; около

h) **wide** [waɪd] широко – полностью; совершенно, абсолютно
widely [waɪd] широко – повсюду, во многих местах; в значительной степени

Choose the correct word to complete the meaning of the sentences.

1. (*Only /The only*) form of energy that can exist in the absence of matter is radiant one.
2. Each form of energy (*accept / except*) radiant one can be transformed into another form (*only / the only*) in the presence of matter.
3. With a few (*acceptances / exceptions*), (*near / nearly*) all the nations of the world have (*accepted / excepted*) the SI Units.
4. There was a (*deference / difference*) between London and Yorkshire units of measurement.
5. In (*deference / difference*) to France, the system official name is the Systèm International, or SI, meaning the International System.
6. To convert one unit into another is (*hard / hardly*) in the British system. It is (*hard / hardly*) surprising that it is not (*wide / widely*) used in the world.
7. The SI is based on seven basic units, each of which is defined with (*high / height*) accuracy.
8. Volume is width times (*high / height*) times depth.
9. And the last thing to do is to add the rest of the numbers in the (*right / write*)-hand row and (*right / write*) the sum. Whether you like to believe it or not, you will get the (*right / write*) answer.

VII. Pay attention to the geometric terms used in the unit.



Fun with Words

PLAY UPON WORDS
ИГРА СЛОВ

***

foot *n* 1) нога; 2) фут

He who thinks by* the inch and talks by* the yard deserves to be kicked by the foot.

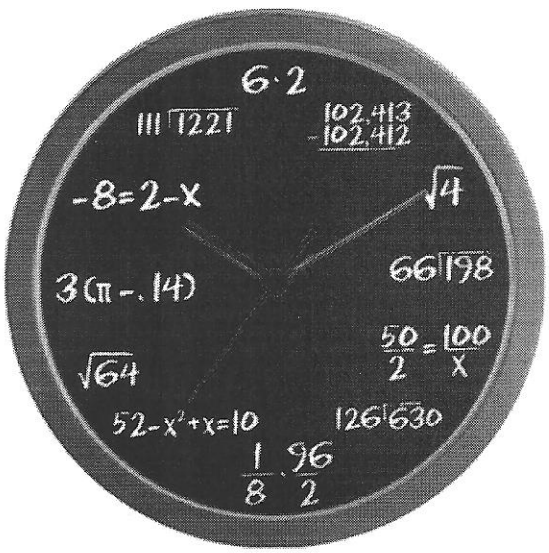
*by указывает на меру длины, по которой производится расчет

***

hand *n* 1) рука; 2) стрелка (часов)
to keep one's hand busy – заниматься делом, работой

Take a lesson from the clock – it passes time* by keeping its hand busy.

*passes time – *зд.* коротает время



***

to tell the time – 1) показывать время (*о часах*); 2) сказать, который час

- Does your watch tell the time?
- No, sir. You have to look at it.

***

to work oneself / smb to death – изводить работой, «заездить»

The best way to kill time is to work it to death.

***

Why is the third hand on the watch called the second hand?

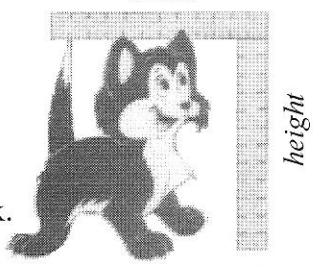
***

like 1) *adv* как, подобно; 2) *v* любить, нравиться
fly 1) *n* муха; **fruit fly** – плодовая мушка; 2) *v* летать

Time flies like an arrow. Fruit flies like a banana.

MNEMONIC DEVICES
МНЕМОНИЧЕСКИЕ ПРИЕМЫ

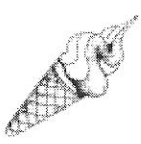
There are different types of mnemonic devices.
Some phrases help us to remember how to spell specific syllables, e.g.:



MEA**SURE**MENT
You should be **sure** of your mea**sure**ment before you start work.

There are phrase in which the initial letters of the words spell out a word which many people find rather difficult to spell.

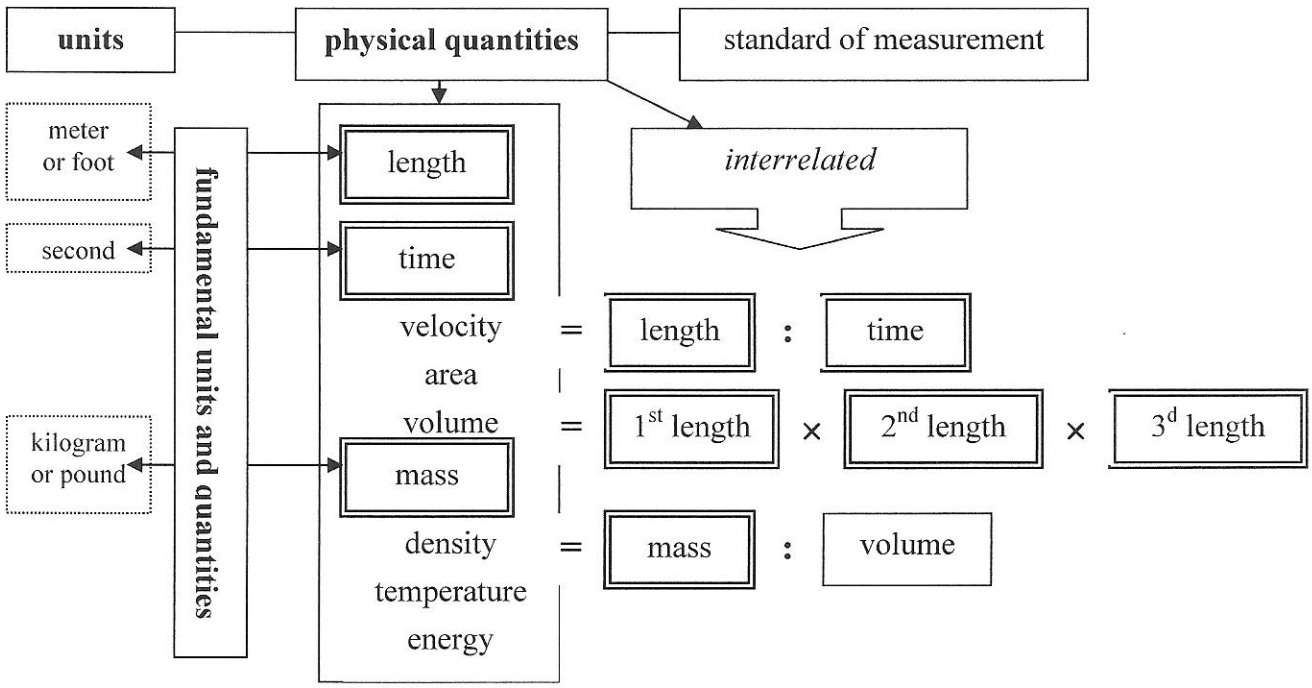
ARITHMETIC
A Rat **I**n **T**he **H**ouse **M**ay **E**at **T**he **I**ce **C**ream.



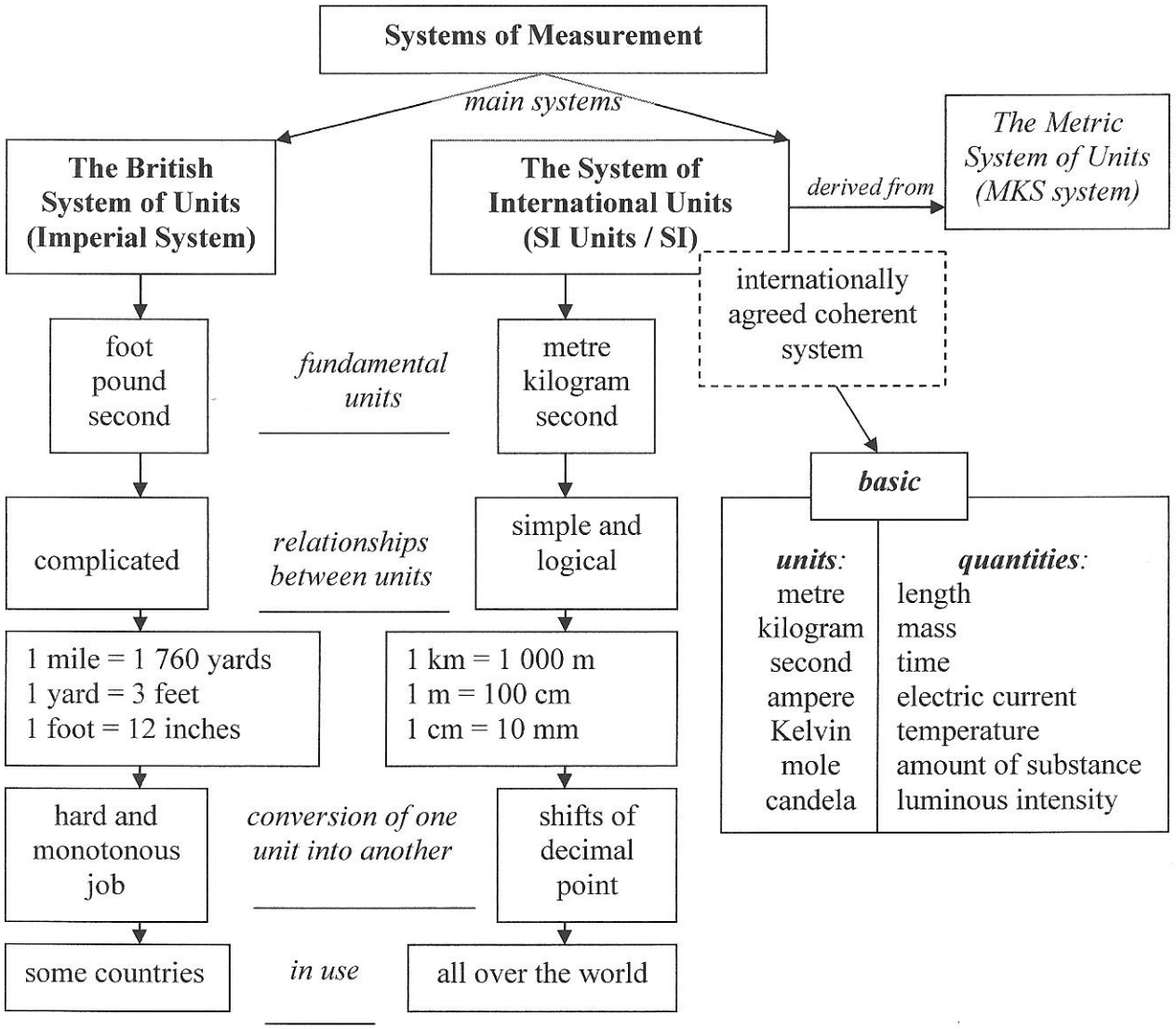
A fuller list of spelling mnemonics is given on page 16.

Stage 2 – Schemes

SCHEME 2.1



SCHEME 2.2



Task II. Use the schemes given on the left-hand page as a prompt to do the following exercises.

SCHEME 2.1

I. Complete the sentences:

1. A unit is a physical quantity adopted as a … … .
2. In physics we deal with measurement of physical quantities such as … , … , … , … , … , … , … , … , … .
3. Many of these quantities are … .
4. For example, velocity is length … … time. Volume equals … multiplied by … multiplied by … . Density … … … mass divided by … .
5. … , … , and … are the three fundamental quantities because most of the physical quantities are derived from them.
6. A unit of … is the metre or foot. A unit of time is the … . A unit of mass is the … or … .

II. Answer the questions:

1. What is a unit?
2. What physical quantities do you know?
3. Are these quantities interrelated?
4. What is velocity /volume /density / equal to?
5. What are the three fundamental quantities?
6. What is a unit of length /mass /time /?

III. Talk about the units of measurement using the scheme.

SCHEME 2.2

I. Agree or disagree with the following sentences (statements expressing agreements and disagreements are given on page 169):

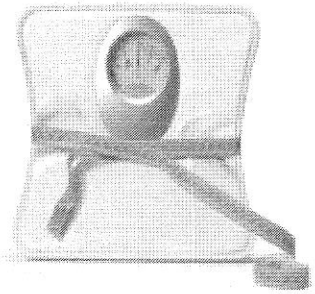
1. There are several systems of measurement and two of them are considered to be main.
2. The fundamental units of the British system are the metre, the kilogram and the second.
3. The fundamental units of the SI are the foot, the pound and the second.
4. A unit of length in the British system is the foot and in the SI is the metre.
5. The second is a unit of time in all the systems of measurement.
6. The British system is very complicated. For example, 1 mile is equal to 1 760 yards; 1 yard equals 3 feet; 1 foot is 12 inches.
7. The conversion of one unit into another is a simple job in the British system.
8. In the SI Units, the relationships between units are simple and logical. For example, 1 kilometre is equal to 1 000 metres, 1 metre equals 100 centimetres and 1 centimetre makes 10 millimetres.
9. The conversion of one unit into another is a hard and monotonous job in the SI Units.
10. In the SI converting one unit into another can be done by shifts of a decimal point.
11. The SI is widely used all over the world.
12. The SI is a system derived from the British system of units.
13. The SI is an internationally agreed coherent system of units.
14. The basic units of the SI are the metre, the kilogram, the second, the ampere, the Kelvin, the mole and the candela.
15. The basic quantities are velocity, area, density and resistance in the SI.

II. Answer the questions:

1. What are the main systems of measurement?
2. What are the fundamental units of the British system / SI Units?
3. What is the unit of length / time / mass / in the British system?
4. What is the unit of length / time / mass / in the SI Units?
5. Is the British system of units simple or complicated? Why?
6. In the British system converting one unit into another is a hard and monotonous job, isn't it?
7. Are the relationships between units of the SI simple and logical? (Prove it.)
8. How can we convert one unit into another in the SI?
9. Is the British system or the SI widely used all over the world?
10. What are the basic units and quantities in the SI Units?

III. Discuss the systems of measurement using the scheme.

Stage 3 – Text



Units of Measurement

Units were not standardized until fairly recently in history, but much of physics deals with measurements of physical quantities such as length, time, velocity, area, volume, mass, density, temperature or energy. So when the physicist Isaac Newton gave the result of an experiment with a pendulum, he had to specify not just that the string was 37 $^{7}/_{8}$ inches long but that it was '37 $^{7}/_{8}$ London inches long'. The inch as defined in Yorkshire would have been different. Even after the British Empire standardized its units, it was still very complicated to do calculations involving money, volume, distance, time, or weight, since converting one unit into another was a hard and monotonous job.

We define unit as a fixed quantity or dimension taken as a standard of measurement, *e.g.* the metre is a unit of length in the SI. Many of the quantities are interrelated. For instance, velocity is length divided by time. Density is mass divided by volume. Volume is width times height times depth, *i.e.* it is a length times a second length times a third length. Most of the physical quantities are related to length, time and mass, therefore all the systems of physical units are obtained from these three fundamental quantities.

Practically there are two main systems of measurement in use today: the British system of units and the System of International Units (SI Units / SI). With a few exceptions nearly all the nations of the world have accepted the SI Units. The value of this system is that it is entirely decimal. The wonderful thing about the SI which makes it great is that its various units possess simple and logical relationships among themselves. The conversion of one unit to another can be carried out by shifts of a decimal point (comma in Russian writing), while the British system has very complicated conversion factors, like 12 inches in a foot, 3 feet in a yard, and 1 760 yards in a mile.

In fact, the SI is an internationally agreed coherent system of units derived from the Metric system (or the MKS system based on the metre, kilogram and second). In 1960 it was adopted by an international committee as a basic system of units. It is replacing all the other systems. The SI is based on seven basic units, each of which is defined with great accuracy. These units are:

the metre (*m*)* – defined from a wavelength in the spectrum of krypton;
the second (*s*)* – defined from the frequency in the spectrum of caesium;
the kilogram (kg)* – defined from the mass of a prototype;
the ampere (*a*) – defined from a newton and a metre;
the Kelvin (*K*) – defined from the freezing point of water in contact with ice;
the mole (*mol*) – defined from the carbon-12 isotope;
the candela (*cd*) – the measurement of intensity of light.

1

***The metre**

The standard metre of the world was originally defined in terms of the distance from the North Pole to the equator. This distance is close to 10 000 kilometres or 10^7 metres. Fairly soon, a standard was created in the form of a platinum-alloy bar with two scratches on it. It is kept at the International Bureau of Weights and Measures in France. In 1960 the metre was redefined as the distance travelled by light in a vacuum over a definite period of time (1/2999792458 seconds). The square metre (m^2) is a unit of area while the cubic metre (m^3) is a unit used to measure volume.

* **The metre**, **the kilogram** and **the second** are the **fundamental** units of the SI.

All other units are derived from these basic units. Under system, each physical quantity has only one particular unit for its measurement, *e.g.* length is only measured in metres. If the number employed with a basic unit is very large, or very small, then one of the prefixes can be used. Each prefix stands for a power of ten. For example, the metre is a unit of distance. The prefix kilo- stands for 10^3, so we can use a kilometre (1 km) instead of a thousand metres (1000 m).
(See *Prefixes for the SI Units* in '*Appendix 8*').

***The second** 2

Until recently, the hour, minute, and second were defined in terms of the time required for the Earth to rotate about its axis. Unfortunately, the Earth's rotation is slowing down slightly. The second was therefore redefined as the time required for a certain number of vibrations of the light waves emitted by caesium atoms.

***The kilogram** 3

The third fundamental unit of the SI is the kilogram, a unit of mass. The standard kilogram is a mass of a prototype, a cylinder made of platinum alloy kept at the International Bureau of Weights and Measures in France. Mass can be defined gravitationally or in terms of inertia.

NOTES ON THE TEXT

Isaac Newton ['aɪzək 'nju:tn] – Исаак Ньютон

Yorkshire ['jɔ:kʃɪə] – Йоркшир

British Empire ['empaɪə] – Британская империя

the SI Units / the SI – 'The ***SI Units***' stands for the ***System of International Units***. The system is entirely decimal, thanks to the same eminently logical people who brought about the French Revolution. In deference to France, the system official name is the ***Système International***, or ***SI***, meaning the ***International System***. (The phrase 'the SI system' is therefore redundant.)

France ['frɑ:ns] – Франция

Units of some quantities of the SI			
Length [leŋθ]	1 metre (m) ['mɪ:tə]	1 centimetre (cm) ['sentɪ,mi:tə]	1 kilometre (km) ['kɪlə(u),mi:tə]
Area ['ɛərɪə]	1 square metre (m^2) [skwɛə]	1 square centimetre (cm^2)	1 square kilometre (km^2)
Volume ['vɔlju:m]	1 cubic metre (m^3) ['kju:bɪk]	1 cubic centimetre (cm^3)	–
Velocity [vɪ'lɔsɪtɪ]	1 metre per second (m/sec) [pə:]	–	1 kilometre per hour (km/h) [auə]
Mass [mæs]	1 kilogram (kg) ['kɪlə(u)græm]	1 gram (g) [græm]	1 ton [tʌn]
Density ['densɪtɪ]	1 kilogram per cubic metre (kg/m^3)	1 gram per cubic centimetre (g/cm^3)	–

Here are some differences between the SI and the British system:				
British System	1 inch	1 foot	1 yard	1 mile
SI Units	2.54 cm	30.48 cm	91.44 cm	1609 m

Task III. Read the text and then do the following exercises.

I. In the text, find the English equivalents for the words and phrases below:

- до сравнительно недавнего времени
- многое в физике
- преобразование одной единицы в другую
- например *(find 2 equivalents)*
- связаны с
- выводятся из *(find 2 equivalents)*
- ценность этой системы
- перемещениями десятичной точки
- очень сложные особенности преобразования, такие как
- в действительности / фактически
- с огромной точностью
- точка замерзания
- сила света
- степень десяти

(in the boxes)

- на основании расстояния
- расстояние составляет почти / близкò к
- довольно скоро
- брусок из платинового сплава
- цилиндр из платинового сплава
- пройденное расстояние
- за определенный период времени
- время, требуемое, чтобы земля обернулась вокруг своей оси

II. Choose the right variant.

1. Isaac Newton wrote that the pendulum string was 37 $^{7}/_{8}$ (*inches / London inches / Yorkshire inches*) long.
2. After the British Empire standardized its units, it was very (*simple / complicated*) to do calculations.
3. A unit is a (*quality / quantity*) used as a standard of measurement.
4. Length, time and mass are (*fundamental / derived*) quantities.
5. The foot is a unit of (*area / volume / length / mass*) in the British system of measurement.
6. Ten inches is (*less / more*) than one foot.
7. There are twelve (*yards / inches / pounds*) in one foot.
8. The kilogram is a unit of mass in (*all the systems / the English system / the SI Units*).
9. Velocity is length (*divided by / added to / multiplied by*) time.
10. The second is a unit measuring time in (*the SI Units only / the English system only / all the systems*).
11. (*Dimension / Division / Distribution*) is a mathematical operation.
12. The square metre is a unit of (*area / volume / length*).
13. 11,500 cubic feet is the measure of (*mass / area / volume*).
14. The official abbreviation for seconds is (*s / sec*) and for grams is (*g / gm*).
15. The prefix centi- stands for (10^{3} / 10^{-3} / 10^{2} / 10^{-2}).
16. The standard metre is the distance between two scratches made on a platinum-alloy (*bar / cylinder*).
17. The second was originally defined in terms of the time required for (*the Earth to rotate about its axis / a certain number of vibrations of light waves emitted by caesium atoms*).
18. The Kelvin is defined from the (*boiling / freezing*) point of water.

III. Fill in the gaps with the correct preposition.

1. Converting one unit … another can be carried … by shifts of a decimal point in the SI, while the British system has very complicated conversion factors, like 12 inches … a foot.
2. The SI is based … seven basic units, each of which is defined … great accuracy. All other units are derived … them.
3. Each prefix stands … a power of ten.
4. The standard metre of the world was originally defined … terms … the distance …. the North Pole … the equator. This distance is close … 10 000 kilometres or 10^{7} metres.
5. It is kept … the International Bureau of Weights and Measures in France.

IV. Solve the following problems and write down them in words.

1) $15 \times 29 =$ 2) $76 \times 38 =$
3) $94 \times 52 =$ 4) $63 \times 81 =$
5) $144 : 3 =$ 6) $330 : 22 =$
7) $210 : 15 =$ 8) $288 : 24 =$
9) $1\frac{2}{3} + 7\frac{1}{3} =$ 10) $23\frac{7}{8} - 19\frac{3}{4} =$
11) $67.34 + 932.66 =$
12) $8732.0336 - 32.0123$
13) $\sqrt{1156} =$ 14) $\sqrt[3]{4913} =$
15) $28^2 =$ 16) $2^{-4} =$

V. Use suitable forms of the words from the box instead of the underlined ones.

1. Unit is a quantity or dimension <u>taken</u> as a standard of measurement.
2. <u>Nearly</u> all the countries of the world have accepted the SI Units.
3. All the systems of measurement are based on the fundamental and basic quantities. All other units are <u>derived</u> from them.
4. For <u>example</u>, density, velocity, force and resistance are derived quantities
5. The metre is a unit of <u>length</u> in the SI.
6. The prefix 'centi-' <u>means</u> 10^{-2}.
7. The prefix 'centi-' is only <u>used</u> in the centimetre; a hundredth of a gram cannot be written as 1 cg but as 10 mg.

a) distance
b) instance
c) to adopt
d) to employ
e) to obtain
f) to stand for
g) almost

IN OTHER WORDS

- The metre is a unit of length.
  A unit of length is the metre.
  Length is measured in metres.
  We / They use the metre to measure length.
- The British system has very complicated conversion factors.
  The conversion of one unit to another is very complicated in the British system.
- The standard kilogram is a cylinder made of platinum alloy.
  The standard kilogram is a platinum-alloy cylinder.

VI. Rewrite each sentence using the words given.

1. The kilogram is a unit of mass. – *A unit* .....
2. The second is a unit of time. – *Time* .....
3. The ampere is a unit of electric current. – *We use* .....
4. The candela is a unit of luminous intensity. – *Luminous intensity* .....
5. The conversion of one unit to another is simple and logical in the SI. – *The SI has* .....
6. The standard metre is a platinum-alloy bar with two scratches on it. – *The standard metre is a bar* .....

VII. Change the following sentences from

a) active to passive: We use the metre to measure length. – *The metre is used to measure length.*

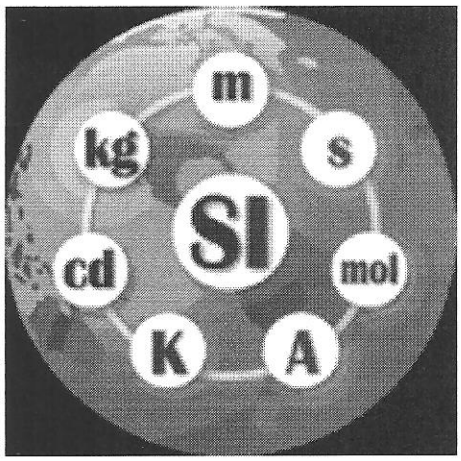
1. We define unit as a fixed quantity or dimension accepted as a standard of measurement.
2. Practically we use two main systems of measurement today.
3. They derived the SI Units from the Metric system.
4. We can derive all other units from the basic ones.
5. The physicist Isaac Newton gave the result of an experiment with a pendulum.

b) passive to active: Length is measured in metres. – *We / they measure length in metres.*

6. At present the standard metre is defined from a wavelength in the spectrum of krypton.
7. It was originally defined in terms of the distance from the North Pole to the equator.
8. The conversion of one unit to another can be carried out without difficulty.
9. Units were not standardized until fairly recently in history.
10. In 1960 the SI was adopted by an international committee as a basic system of units.

VIII. Answer the questions based on the text.

1. What does the text deal with?
2. What is a unit?
3. What are the three fundamental units?
4. What systems of measurements are widely in use all over the world nowadays?
5. Why is the SI widely in use all over the world?
6. What are the units of length / time, mass / in the SI Units?
7. What are the units of length / time, mass / in the British system?
8. Which units are considered to be basic ones in the System of International Units?
9. How was the standard metre / second / originally defined?



10. How is the standard metre / second, kilogram / defined now?
11. Where is the international prototype of the meter / kilogram / kept?
12. What standard unit is used for measuring area / volume /?
13. What prefixes for the SI Units do you know?
14. What does each prefix stand for?

IX. Annotate schemes 2.1 and 2.2 using the text "Units of Measurement" and then describe the schemes in your own words. While describing, make use of the following expressions:

1. The present paper refers to … Данная статья рассматривает …
2. At first the author ['ɔ:θə] notes that … Вначале автор отмечает, что
3. It should be emphasized ['emfəsaɪzd] that … Следует подчеркнуть, что …
4. It is interesting to point out that … Интересно отметить, что ...
5. It is known that … / … is known to V … Известно, что …
6. As the author emphasizes … Как подчеркивает автор, …
7. As mentioned ['menʃ(ə)nd] in the paper … Как упомянуто в статье …
8. As far as I know / remember … Насколько я знаю / помню …
9. In conclusion [kən'kluʒ(ə)n] it should be noted that … В заключение следует отметить, что
10. In my opinion the paper is … По моему мнению, статья …

You can find some more useful expressions on pages 167 – 168.

XI. Let's play the game 'Debate'. The instructions are given on page 176. You should answer the question 'Is the System of International Units the major one?'

Stage 4 – Definitions

From "Longman Dictionary of Scientific Usage"

measure To find the *value* (↓) of a property by comparing its *magnitude* (↓) with a *standard* (↓), *e.g.* **a)** to measure the volume of an object by comparing its magnitude with the *standard* (↓) of measurement, *i.e.* the cubic metre; **b)** to measure the electrical resistance of a metallic conductor by comparing its magnitude with the standard, *i.e.* the ohm.
measurement The result of measuring, *e.g.* a measurement of length.

magnitude A point on a scale represented by a number or ratio, *e.g.* the ratio of a mass m_1 to a specified mass m_0 (m_1/m_0) is the magnitude of mass. If the specified mass is a kilogram and the ratio is 2, then the measured mass is 2 kilograms, which is the magnitude of mass. Magnitudes are represented by numbers, on suitable scales, for all *quantities* (↓).

quantity Any *measurement* (↑) of matter or radiation, either direct or indirect, is a quantity. Examples of quantities are: mass, length, time, *velocity* (→)[1], electric current, latent heat, angle of incidence, magnetic flux, coefficient of expansion, atomic number, *wavelength* (→)[2], *intensity* (→)[3] of light, amount of substance, *etc.* Some quantities are measured in *units* (↓), other quantities are numbers, *e.g.* length is measured in metres, relative density is a number.

fundamental quantities These are mass, length and time. All other physical quantities can be related to these three fundamental quantities. In the physical world, we have no choice over these quantities.

basic quantities These are chosen quantities which are taken as independent measurements. In the SI Units the basic quantities are length, mass, time, electric current, temperature, amount of substance, and luminous *intensity* (→)[3].

derived quantities These quantities are measured in terms of the *fundamental* and *basic quantities* (↑), *e.g.* density, *velocity* (→)[1], force and resistance are derived quantities.

unit A well-defined, unvarying, reproducible, and universally available *value* (↓) of a *quantity* (↑) is accepted as a unit of that quantity. Units are usually agreed internationally. The ratio of any other value of the quantity to the accepted unit value is the *magnitude* (↑) of the quantity. For instance, there is a block of metal agreed as the international prototype of the kilogram; it is an unvarying universally available value of the quantity, mass. The magnitude of all other masses is measured as the ratio of their masses to the unit mass.

value The numerical part of a measurement of a *quantity* (↑), *e.g.* 6 metres is a measurement of the quantity, length; the metre is the *unit* (↑) of measurement and 6 is the numerical value. Temperatures of 30°C and 86°F each have different numerical values and different units, but both have the same *magnitude* (↑).

standard An object or substance chosen to provide the *unit* (↑) of *measurement* (↑) for a physical *quantity* (↑), *e.g.* **a)** the standard of mass is a piece of platinum-iridium alloy, *i.e.* an object of mass 1 kg; **b)** the standard of length is defined from the *wavelength* (→)[2] of a specified line in the spectrum of krypton-86 (a substance).

SI units An internationally agreed system of coherent units, based on seven *basic units* (↑): the metre (m), the kilogram (kg), the second (s), the kelvin (K), the ampere (A), *the candela (cd)* (→)[1], the mole (mol). The radian (rad) and *steradian (sr)* (→)[3] are supplementary measurements of angles. All other units are *derived* (↑) ones. The letters SI stand for Systèm International.

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[1] – see "KINEMATICS"
[2] – see "THEORIES OF LIGHT" (Set B)
[3] – see "PHOTOMETRY"

Task IV. Read the definitions of the terms from "Longman Dictionary of Scientific Usage" and do the following exercises.

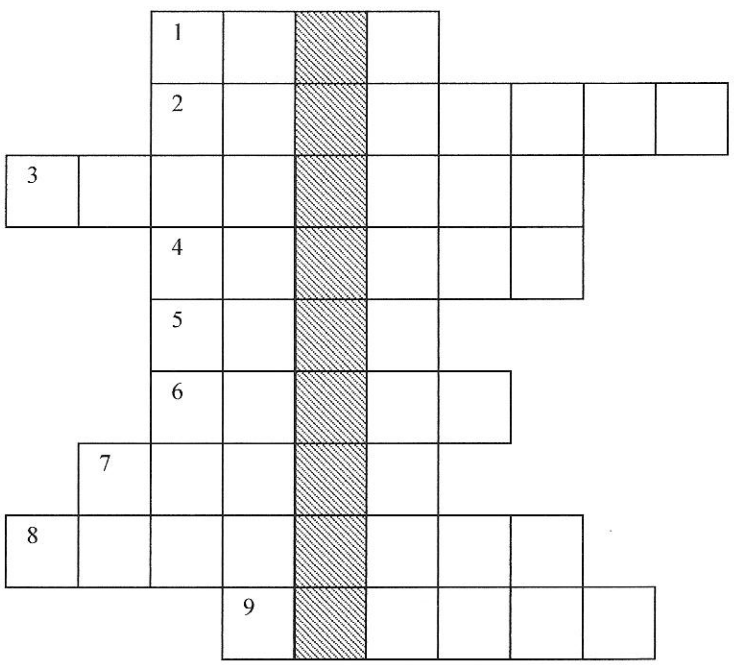
I. Complete the following sentences with the words from the box.

1. Mass is one of the three … quantities.
2. We measure the mass of an object by comparing its … with the standard of measurement.
3. The … of mass is a piece of platinum-iridium alloy.
4. 2 kilograms is a measurement of the …, mass; the kilogram is the … of measurement and 2 is the numerical … .
5. Temperature is the … quantity in the SI Units.
6. Area and volume are … quantities.
7. Lengths of 1609 m and 1 mile each have … numerical values and units, but both have … magnitude.

a) unit
b) quantity
c) standard
d) magnitude
e) value
f) the same
g) different
h) fundamental
i) basic
j) derived

II. **Diagram** *Place the terms into the diagram and a word appears in the shaded column reading down. In everyday English this word means "**greatness of size or importance**". What does this word mean in the language of science?*

1) one of the three fundamental quantities; a continuous measurable quantity from the past, through the present, and into the future;
2) any measurement of matter or radiation;
3) a unit for measuring mass in the SI Units;
4) one of the fundamental quantities; measurement or extent from one end to the other;
5) a value of a quantity taken as a standard of measurement;
6) a unit of length in the SI Units;
7) the numerical part of a measurement of a quantity;
8) an object or substance chosen to provide the unit of measurement for a physical quantity;
9) a unit for measuring time in all the systems.



Task V. You are going to play the game 'Research Conference'. You should choose the role of either Chairman or Speaker. (There must be one Chairman in the group). What else would you like to know about measurement? You could use the Internet or an encyclopedia to research one of the topics given below and write notes for your presentation. Themes of the conference are:

- **Units of Measurement**
- **Systems of Measurement**

The instructions for a chairman and speakers as well as for writing and discussing a research paper are given on pages 170 – 172.

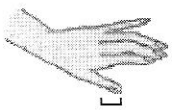
Stage 5 – In Addition

It is Interesting

1. An Interesting Way of Measuring Length

Read the following information and conduct ***Experiment 1 (Measuring the Classroom)*** *given below.*

Men took the first units of measuring length from their bodies.



one inch

The end of a man's thumb is about one inch long.
A tall man's foot is about twelve inches or one foot long.

twelve inches or one foot

A long step is about three feet or one yard long.
The simplest way of measuring a short distance is to step it.

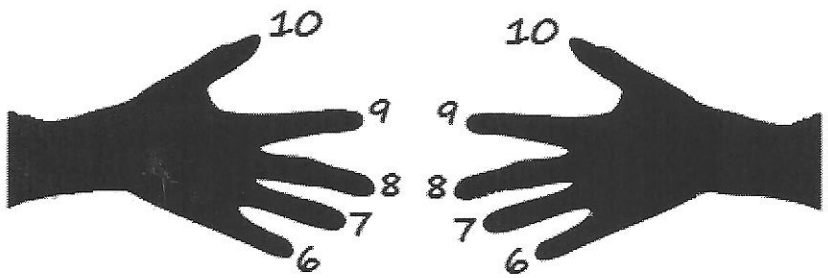
three feet or one yard

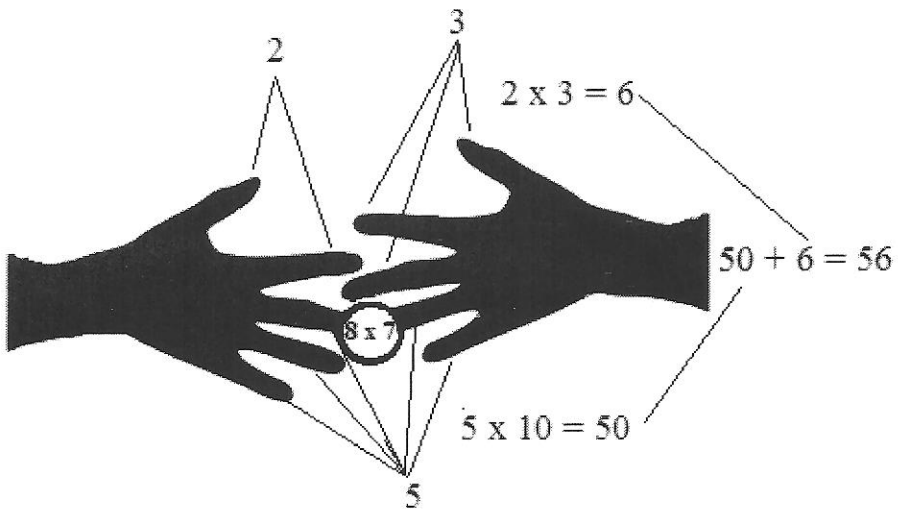
2. An Interesting Way of Multiplying Numbers

Here is an interesting way to multiply numbers from *6* to *10*. They used this method in some parts of old Russia because at that time poor people and their children could not go to school. If you want to try this method, you are to do the following.

You give numbers to your fingers from *6* to *10*, as you can see in the picture. If you want to multiply *8* by *7*, finger number *8* of one hand must touch finger number *7* on the other hand. Then these two fingers with together with all the fingers under them are tens. You have five tens, that is *50*.

Then you multiply the number of the other fingers on the left hand by the number of the fingers on your right hand. *2 x 3 = 6*. So *50 + 6 = 56*. This method always gives the right answer.



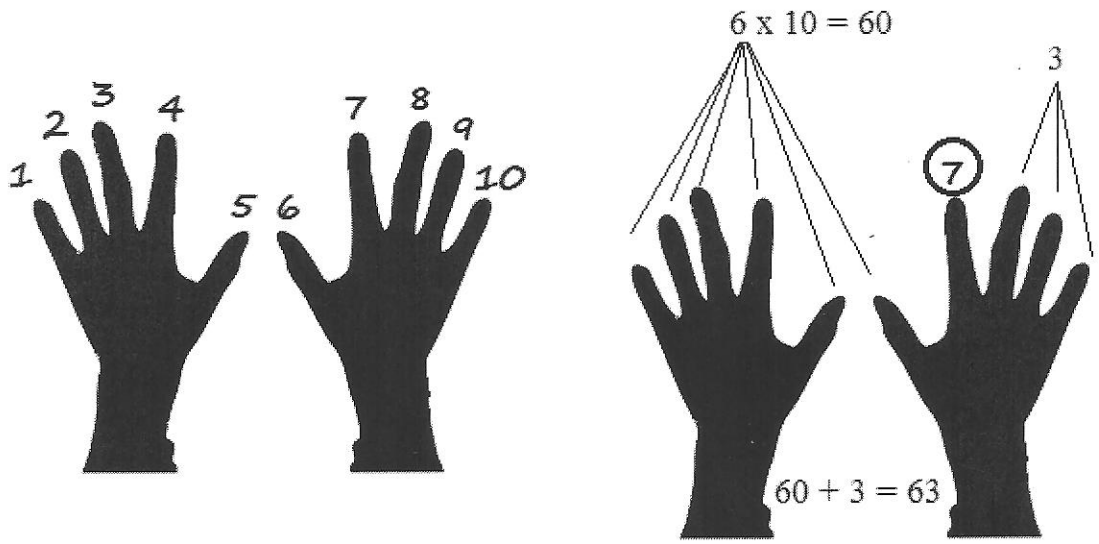


3. An Interesting Way of Multiplying by Ten

Describe this method of multiplication in English (first orally in class and then in pen at home).

Человеческая рука – это один из первых калькуляторов. Вот, например, способ умножения первых десяти чисел на *9*.

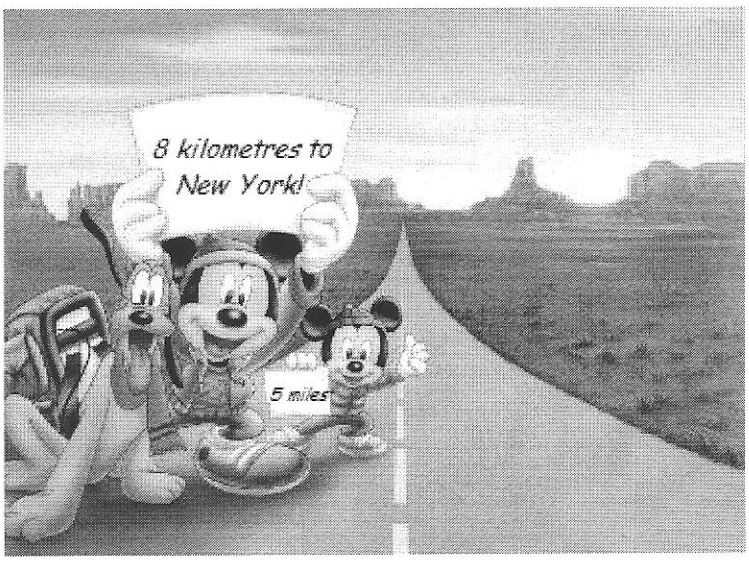
Положите обе руки на стол и пронумеруйте пальцы, как показано на рисунке. Если вам нужно умножить *7* на *9*, поднимите седьмой палец. Число пальцев, лежащих слева от поднятого пальца, будет числом десятков. В нашем случае их шесть, т.е. *60*. Число пальцев справа – количество единиц, т.е. *3*. В результате мы получаем *63*. Это метод работает безотказно!



4. An Interesting Way of Converting Miles into Kilometres

Converting miles into kilometres is easy by using *Fibonacci numbers*. Fibonacci numbers are an infinite series of numbers starting with 1, 2 and extending by adding the last two numbers to get the next (*i.e.* 1 + 2 = 3 and 2 + 3 = 5):

1, 2, 3, 5, 8, 13, 21, 34, 55, 89, *etc.*



The trick is that any two consecutive Fibonacci numbers give a fairly accurate 'mile' and 'kilometre' conversion. For example:

5 miles = 8 kilometres!
34 miles = 55 kilometres!

And vice versa:

3 kilometres = 2 miles!
89 kilometres = 55 miles!

Fibonacci numbers themselves do not have to be remembered – the series can easily be recreated on paper at any time to provide the conversion figures required. That is easier than having to memorise and multiply conversion formulas!

The Fibonacci method of approximate conversion is surprisingly accurate compared with calculations using proper conversion formulas. Compare the figures in the tables below:

1 mile = 1.609 kilometres		
miles	**km (Fibonacci)**	**km (exact)**
1	2	1.61
2	3	3.22
3	5	4.83
5	8	8.04
8	13	12.87
13	21	20.92
21	34	33.79
34	55	54.71
55	89	88.50
89	144	143.20

1 kilometre = 0.6214 miles		
km	**miles (Fibonacci)**	**miles (exact)**
2	1	1.24
3	2	1.86
5	3	3.11
8	5	4.97
13	8	8.08
21	13	13.05
34	21	21.13
55	34	34.18
89	55	55.30
144	89	89.48

The Fibonacci method can also be used to convert numbers that are not in series. Imagine we have to convert 40 miles into kilometers. First break down 40 into a combination of simple Fibonacci numbers, *i.e.* (13 x 3) + 1. Then any multiplication still required is relatively simple to perform, *e.g.*:

The Fibonacci method: 40 miles = (13 x 3) + 1 = (21 x 3) + 2 = 65 kilometres
The conversion formula: 40 miles = 40 x 1.609 = 64.36

The Fibonacci method: 40 kilometres = (13 x 3) + 1 = (8 x 3) + 0 = 25 miles
The conversion formula: 40 kilometres = 40 x 0.6214 = 24.86 miles

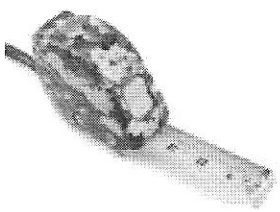
Lastly, if you get confused about which way round the conversions go, remember that distance in miles and kilometres are like the number of letters in each word: **fewer in miles** and **more in kilometres**.

Experiments

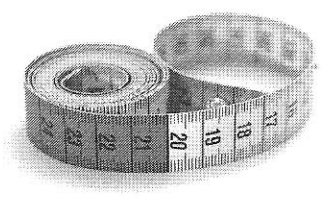
1. Measuring the Classroom.

*Read "**An Interesting Way of Measuring Length**" given above and make the following experiment. You are to measure the length of the classroom. In doing so follow these instructions:*

Experimenter:	Students:
1. Measure the length of the classroom with the help of a tape measure[1]. 2. Convert metres into yards (centimetres into feet and inches). 3. Collect your fellow students' data. 4. Compare students' results with yours and find the most precise student's measurement. 5. Call the student whose result is the most precise one and congratulate him or her.	1. Measure the length of your classroom with the help of your body. So you are to use units of length of the British System, *i.e.* yards, feet and inches. 2. Write down your measurements. 3. Give your data to the experimenter.



[1] **tape measure** ['teɪp meʒə] a narrow band of **cloth** or steel, marked with divisions of length, used for measuring; **cloth** ['klɔð] (a piece of) material made from wool, cotton, *etc. (from "Active Dictionary of English")*



Here are some tricks you can show your friends.

2. Quick Addition

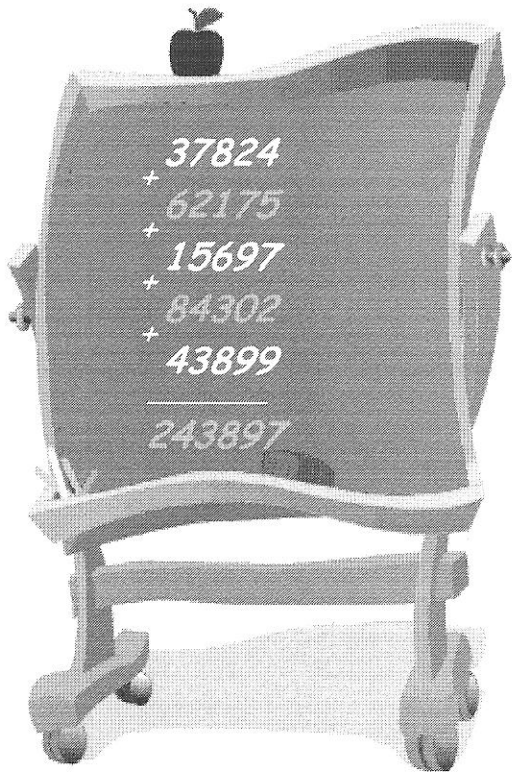
Anybody can learn to count fast if they know the secret of the following trick. Ask your friend to write any five-figure number on the blackboard. Then you write your five-figure number under it. You choose your figure so that each one with the figure above it will make *9*. For example:

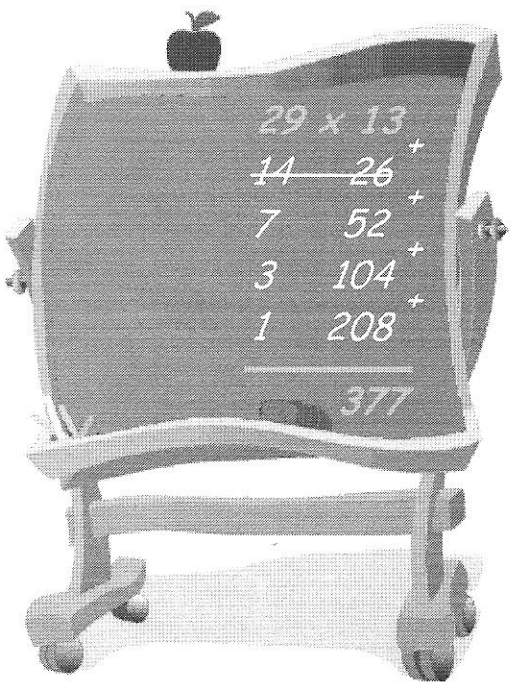
Their number: *37824*

Your number: *62175*

Tell your friend to put a third five-figure number under your number. Then you write a fourth five-figure number in the same way. After they have written the fifth number, you draw a line under it and quickly write the sum. You may even write it from left to right!

How do you do it? You subtract two from the fifth number and put *2* in front of your answer. For example: if the fifth number is *43899*, the sum will be *243897*.

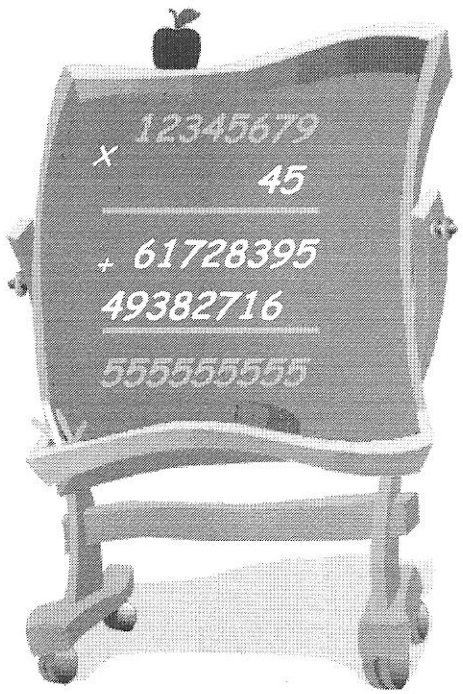




3. Strange Mathematics

There are many ways to multiply numbers of two or more figures. Here is one of the strangest. Let's multiply *29* by *13*. Half of *29* is *14.5*. Write only *14* under *29* as you can see in the picture. Half of *14* is *7*. Write it under *14*. Continue until you have *1*.

Now write numbers under *13*. But this time, multiply each number by *2* to write the number under it. Continue until you have a number on the same line as *1*. Then cross out any row that has an even number on the left. In our experiment there is only one even number – *14*. And the last thing to do is to add the rest of the numbers in the right-hand row. Believe it or not, you will get the right answer.



4. Magic Number

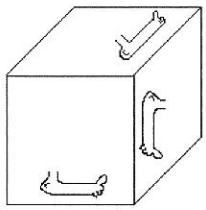
Here is an interesting trick you can show your friends. Write the magic number *12345679* on the blackboard or a piece of paper. It is easy to remember this number because there are all figures in it from *1* to *9* except *8*.

Then ask your friend to tell you their favourite figure from *1* to *9*. Multiply it by *9* in your head and write the answer under the magic number. For example, if they told you that their favourite figure was *5*, you write *45* under the magic number. Ask your friend to multiply these numbers. The answer will surprise them, because there will be only *5's* in it – it is their favourite figure! Try to find out whether this trick works with other figures.

Think and Guess

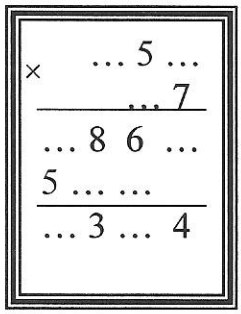
1. Funny Box

What is this?



2. Punch-card (Карточка с прорезями)

Find the punch –card that reconstitutes this multiplication sum and then write down this problem in words.



a

× 5□2
2□
3□□4
□54
9□0□

b

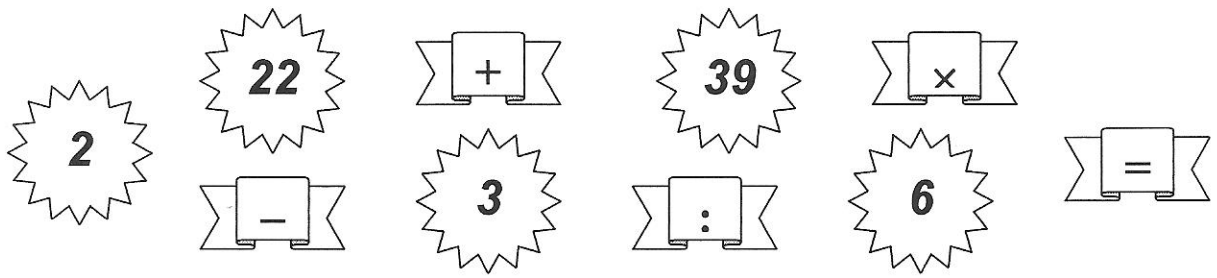
× 5□2
1□
3□□4
□52
9□8□

c

× 5□2
1□
3□□4
□12
8□8□

3. Sum Sign

By using each number and each sign, can you reach a total of **42***? Write down your solution in words.*



4. Rebuses

Try to solve these problems by using figures instead of letters and 'stars'. Each letter corresponds to a figure. The similar letters mean the similar figures and different letters mean different figures. 'Stars' are used instead of different figures. Write down your solution in words.

1

× ABC
BAC
* * * *
* * A
* * * B
* * * * * *

2

DO + RE = MI
FA + SI = LA
RE + SI + LA = SOL

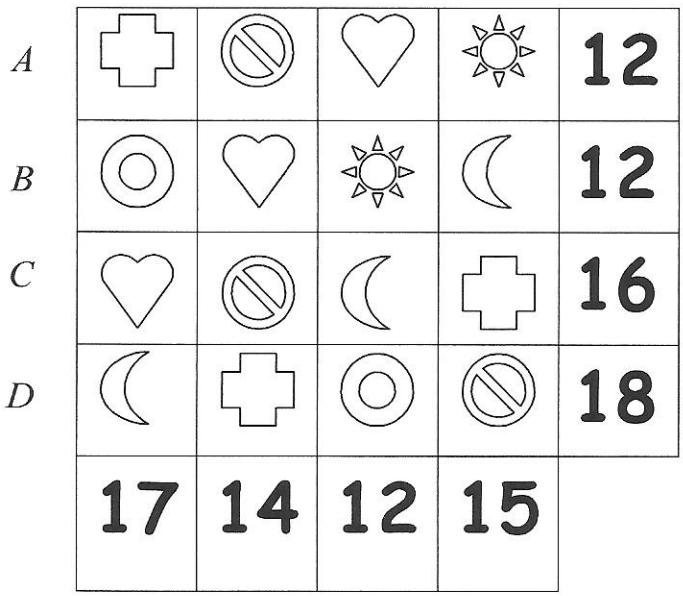
It has two solutions.

3

× ATOM
ATOM
* * * * *
* * * * *
* * * * *
* * * * *
* * * *ATOM

5. Sum Total

Can you solve these sums knowing that the same sign always equals the same number? If you can, write down all the sums in words.



6. Missing Words

Fill in the gaps with the most suitable missing word.

1	inch		yard	mile
2		minute	hour	day
3	length	mass		
4	milligram	gram	kilogram	
5	foot		second	
6		kilogram	second	
7	height	depth		
8	is		equals	is equal to
9	addition	subtraction		division
10		giga-	mega-	kilo-

Fun with Words

MNEMONIC DEVICES
МНЕМОНИЧЕСКИЕ ПРИЕМЫ

Dividing by fractions

Here is a mnemonic rhyme that explains the rule to apply whenever you are faced with the confusing task of having to divide a whole number by a fraction:

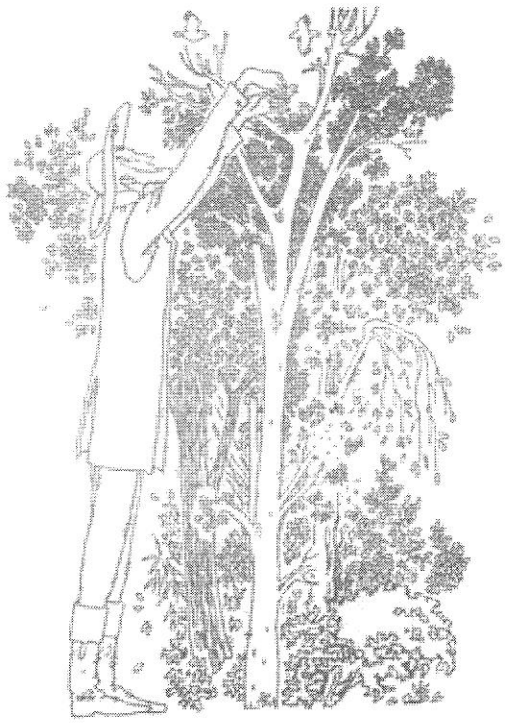
The number you're dividing by,
Turn upside-down and multiply.

For example: $5 : \frac{1}{2} = 5 \times \frac{2}{1} = 10$

TALL STORY
НЕБЫЛИЦА

Read the story and then fulfill the task given below.

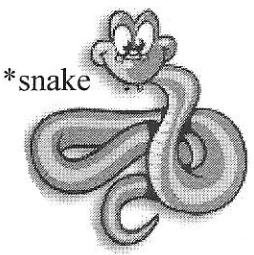
to run high – 1) подниматься (*о приливе*), вздыматься, волноваться (*о море*); 2) возрастать, крепнуть, разгораться (*о споре, надеждах и т.п.*)
word [wə:d] *n* 1) слово; 2) *pl* размолвка, ссора, спор



Two men were exchanging tall stories. Joe said that his grandfather had been 18 feet tall. Not to be outdone* Fred replied: "I suppose everything grows strongly in our country. I was going through the wood last night and saw a snake* 4 miles long."

His companion would not believe the story. Words were running high when a third party tried to break up the argument*.

"Well," said Fred, "I'm not one to quarrel* so if he takes 12 feet off his grandfather, I'll see what I can do with my snake."


*snake

*not to be outdone – не желая, чтобы его переспорили
*to break up the argument ['ɑ:gjumənt] – прекратить спор
*I'm not one to quarrel ['kwɔr(ə)l] – я не из тех, кто любит спорить

Choose the right variant.

1. Joe said that his grandfather had been … metres tall.
2. Fred said that he had seen a snake … kilometres long.
3. Fred asked Joe to take … metres off his grandfather.

a) about 5.5
b) about 3.5
c) about 6.5

Group Work Activity

a) Write the questions you will need to ask to find out the missing information.
b) Follow the teacher's instructions to obtain the missing information. (The instructions are given in the "Teacher's Book" on page 42.)

RECORD BREAKERS

1. How fast _____
   The fastest bird in the world is the cluck hawk*. It can fly at _____ .

2. How fast _____
   The fastest land animal in the world is the cheetah*. It can run at _____ .

3. How fast _____
   The fastest insect in the world is the gadfly*. It can fly at _____ .

4. How fast _____
   The biggest aeroplane in the world is the Boeing 747. It travels at _____ .

5. How fast _____
   The fastest aeroplane in the world is Concorde. It flies at _____ .

6. How fast _____
   The most accurate clock of its size in the world is that of "St. Stephen's Tower" (often called "Big Ben" by mistake). The minute hand of the clock travels at _____ .

7. How long _____
   It takes _____ to fly from London to New York by Concorde.

8. How long _____
   It takes _____ for light from the Sun to reach Pluto, the furthest planet in our Solar system.

9. How long _____
   It takes _____ for the Moon to travel around the Earth.

10. How long _____
    Men used to wind the clock of "St. Stephen's Tower" by hand until 1913. It took _____ to wind it.

11. How far _____
    The Sun is _____ from the Earth.

12. How far _____
    The moon is _____ from the Earth.

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cluck hawk ['klʌk 'hɔ:k] – кудахтающий ястреб
cheetah ['tʃi:tə] – гепард
gadfly ['gædflaɪ] – овод