Aleksander KUBOT
Weronika MAĆKÓW

MATHEMATICS AND GRAPHS

VOCABULARY PRACTICE FOR ACADEMIC ENGLISH STUDIES

Publishing House
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Master your knowledge of English and it will repay you a hundredfold

– authors

INTRODUCTION

Imagine the following theoretical mathematical dilemma: your girlfriend or boyfriend (both of you are over 21) says she/he is willing to pay 50% for your first drink and then 50% of each consecutive amount that is left to be paid for your other drinks. The seemingly true question is then: "How many times will she/he have to pay for your drinks?" There is, of course, no definite answer to this absurd dilemma. Yet, it has still sounded intriguing as far as mathematics goes, has it not? Seriously speaking, mathematics is omnipresent and neglecting its existence in numerous aspects of our everyday life such as family issues, studying, business, industry, seems pointless. The need for English for mathematics and graphs arises when we settle down or begin working in English-speaking environment or simply want to become fully proficient in this global language.

Teaching notes

While teaching English at the Centre of Languages and Communication at Poznan University of Technology we have identified the basic mathematical terms, as well as the vocabulary and some grammatical aspects related to describing graphs, which would be helpful in learning and practice for students. However, this book is by no means intended to teach you mathematics. This book is intended to be used by learners at B1/B2 levels of the Common European Framework during their foreign language courses at universities in order to broaden their linguistic competence.

We would also recommend it as supplementary for those who need to take the ACERT exam (Academic Certificate of English). This is a certified exam at B2 level for full-time first-cycle university students who attend obligatory courses in English in academic language centers associated in SERMO (Association of Academic Foreign Language Centers).

In addition, this book is likely to be beneficial for students aiming at winning scholarships at universities where English is the lingua franca and graduates wanting to refresh their knowledge of English during their professional career. Finally, the scope of this book may not be adequate for students who specialize in mathematics or graduates needing advanced mathematical analysis and lexis in English. Those students are advised to make use of sources that deal with mathematics more extensively in addition to this book.

Components

Mathematics and Graphs – Vocabulary Practice for Academic English Studies is made of three independent parts with exercises such as TRANSLATION WORK marked ( ), which focuses on key vocabulary,

followed by READING (), MATCHING (), GAP-FILL (), SPEAKING – PAIR WORK (), TRUE/FALSE (), COMPREHENSION () or other miscellaneus exercises. There are also additional LISTENING exercises as well as exercises related to more advanced mathematics at the end of this book.

Finally, there is a short glossary at the end of this book, where words whose pronunciation is usually troublesome for learners are accompanied by their transcription.

We also focused on some mathematical problems and vocabulary terms which usually cause confusion or are frequently erroneously used by students (they are highlighted in the **notes** in each chapter). Since there is the key for all exercises included in this book, it can be used either in class or for self-study. Good luck and

Do not worry about your difficulties in Mathematics.
I can assure you mine are still greater.
– Albert Einstein

Acknowledgements

We are grateful to the following persons for their advice and support during the development of this book:
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PART 1

MATHEMATICS

God made natural numbers; all else is the work of man
– Leopold Kronecker

1. NUMBERS

TRANSLATION WORK:

number
numeral .....
numerical value of a .....
even number .....
odd number .....
natural number .....
rational number .....
irrational number .....
positive number .....
negative number .....
integer .....

READING

When reading numbers, students frequently find it difficult to read the combination of two letters: 'th'. Make sure you can read the following numbers accurately:
3 – three [θri:]
333 – three hundred (and) thirty three [θɜ:rti] [θri:]
3,333 – three thousand, three hundred (and) thirty three
3,003,333,333 – three billion, three million, three hundred thirty three thousand, three hundred (and) thirty three

PUZZLE:
If you took **th**ree **th**rushes* from under a **th**atched roof housing **th**irteen of **th**em, how many would you have?
*thrush – (PL) drozd

(See the bottom of page 13 for the answer)

MATCHING

Ex. 1 Match the terms (1, 2, 3…) with their definitions (a, b, c…):

1. a **number** [___]
2. a **numeral** [___]
3. an **odd** number [___]
4. an **even** number [___]
5. **natural** numbers [___]
6. a **positive** number [___]
7. a **negative** number [___]
8. **integers** [___]
9. an **irrational** number [___]
10. ordinal numbers [___]
11. a **numerical value** [___]
12. a **rational** number [___]

a. is a number that is less than 0 and with a – symbol in front of it
b. is an abstract entity that represents amount or measurement[1]
c. 1, 3, 5, 7, 9, 11, 13 …. – when divided by two, the result is a fraction
d. are the „whole" natural numbers, including negative ones
e. are the ordinary whole numbers that are used for counting (*There are 25 students in this class.*) or ordering (*This is the fifth tallest student...*)
f. i.e. nineteen, 19, XIX, represents a number
g. 2, 4, 6, 8, 10, 12, 14… – if it is a multiple of two
h. indicate the order in which objects appear in a well-ordered set, i.e. This is the fifth tallest student in [this particular set of students in] class
i. is a number that is greater than 0, it can be, but does not have to be written with a "+" symbol in front of it
j. is a real number regardless of its sign
k. any number that can be expressed as the quotient or fraction p/q of two integers, where $q \neq 0$
l. any real number that cannot be expressed as a ratio of integers, for instance $\sqrt{2}$, π, etc.

SPEAKING – PAIR WORK

Ex. 2 Student A: read the first 5 numbers, student B: listen and write them down. Then, students change roles for the remaining numbers 6 – 10.

[1] Krukiewicz-Gacek, Trzaska, 2010, p. 15.

1. 675
2. 37.89
3. 7,865
4. 908,076
5. 897.65
6. 1,209,398
7. 324,100,990
8. 77,543
9. 100,576,192,200
10. 509,489,099

TRUE/FALSE

Ex. 3 State whether the following sentences are true (T) or false (F):

1. A numeral represents a number. _____
2. When divided by two, an odd number gives a fraction. _____
3. Integers are the „whole" natural numbers, excluding negative ones. _____
4. An even number plus an even number gives an even number. _____
5. In English, we use a dot to refer to thousands and millions. _____
6. We use natural numbers for counting. _____
7. XIX represents a number and is a numeral. _____
8. *Nought* is usually used to refer to telephone numbers. _____

NOTE:

1. In Polish, the word *bilion* represents 10^{12} and the word *trylion* is equivalent to 10^{18}.

   English: 1,000,000,000 – one **billion (10^9)**
   1,000,000,000,000 – one **trillion** represents **10^{12}**

2. We say: three hundred (~~hundreds~~) soldiers, four thousand (~~thousands~~) children, thirty three million (~~millions~~) people, etc.
   But: hundreds of soldiers, thousands of children, tens of thousands of protesters, millions of people, etc.
3. Make sure you understand the use of a coma (i.e. 123,009) and a dot (i.e. 12.98 or 0.45), which is used to enumerate decimal fractions.
4. 0 – can be called ***zero***, or
   - ***nil*** (when it refers to numbers in sports games as in *Liverpool won the game three–nil.*),
   - ***nought / naught*** (esp US) in calculations and figures as in *GDP has decreased by nought point 25 per cent.*,
   - ***oh*** is used to refer to numbers such as telephone numbers: *7 oh 7 double 5 8 oh 7* (70755807).

2. ELEMENTS OF ALGEBRA, EQUATIONS AND SYMBOLS

TRANSLATION WORK:

the absolute value of a .....
the sum of .....
percent .....
per mil .....
equal to/not equal to .....
less/greater than or equal to .....
approximate (ly) .....
identical to .....
round, square brackets .....
parentheses .....
braces (also: curly brackets) .....
infinity .....
tends to .....
capital letter .....
subtraction .....
addition .....
division .....
multiplication .....
the sign of multiplication .....
quotient .....
product .....
rounding .....
ratio .....
directly proportional .....
variable .....
linear/quadratic/cubic equation .....
system of equations .....
solve an equation .....
solution/root of equation .....
unknown .....
substitute .....

READING

Read the text and do the exercise below (ex. 4).

Here are three useful reminders:

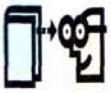
A. *Most mathematical operations: addition, subtraction, multiplication and division are normally performed in a particular order or sequence. Multiplication and division are done prior to addition and subtraction*[2].

B. Mathematical operations such as rounding a numerical value and solving an equation are very common. You ***round*** a numerical value when you replace the value with another that is ***approximately*** equal, i.e. $\sqrt{2} \approx 1.41$ (the square root of 2 is approximately equal to 1 point four one).

C. In order to **solve** this equation: $2\mathbf{x} - 4 = 10$

we can do the following:

1. **Transfer** the -4 from the left-hand side of the equation, to the right-hand side and change its sign:
   $2x = 10 + 4$
2. Since we can multiply or divide both sides of the equation, we divide it by 2 and **replace** our equation with an equivalent, simpler one:
   $2x : 2 = 14 : 2$
3. The **solution** (or **root**) of the equation is $x = 7$.



COMPREHENSION

Ex. 4 Choose the correct ending:

1. Multiplication and division are done
   a. before addition and subtraction
   b. after addition and subtraction
2. You ***round*** a numerical value when you replace the value with another that is
   a. identical to it.
   b. close to the exact value.
3. When you transfer a particular value from the left-hand side of the equation to the right-hand side
   a. you change its sign to the opposite.
   b. you always add the negative sign to it.

---

[2] Krukiewicz-Gacek, Trzaska, 2010, p. 27.

The answer to the puzzle from the READING exercise in chapter 1.1 is three.

4. A solution of an equation can be called
   a. the unknown.
   b. the root of the equation.

MATCHING

Ex. 5 Match the terms (1, 2, 3…) with their definitions (a, b, c…):

1. **addition** [___]
2. **subtraction** [___]
3. **multiplication** [___]
4. **product** [___]
5. **quotient** [___]
6. a **linear** equation [___]
7. **quadratic** equation [___]
8. **cubic** equation [___]
9. **system** of equations [___]
10. **division** [___]

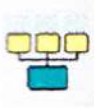
a. $f(x) = ax^3 + bx^2 + cx + d$
b. $a + b$
c. is the result of division
d. $a \times b$
e. $a : b$
f. is the result of multiplying
g. $y = 11 + x$
h. $a - b$
i. $ax^2 + bx + c = 0$
j. $\begin{cases} 3x + 2y = 19 \\ x - y = 3 \end{cases}$

GAP-FILL

Ex. 6 Complete the statements with the words given below:

less absolute capital in brackets equals variable braces greater directly proportional sum of a ratio much is not equal to square

1. Five minus four ..... 1.
2. The symbol $\propto$ (i.e. a $\propto$ b) means .....
3. Σ^{a}_{k} represents the ..... (sub) k
4. $\mathbf{X} \rightarrow \infty$ reads as follows: ..... x tends to infinity
5. 4:3 is the ..... of width to height in standard television
6. $2\mathbf{x} - 4 = 10$, in this equation, **x** is the ..... (or the unknown).
7. $|a| \geq 0$ is the ..... value of a is greater than or equal to 0
8. $X + 5 \neq X - 5$ reads as follows:
   capital X plus 5 ..... capital X minus 5
9. (a + b) reads as follows: a plus b .....
10. You can use {} – ....., where you cannot use either ( ) round or [ ] ..... brackets.
11. Other symbols are:
    < ..... than
    $\leq$ less than or equal to
    > ..... than
    $\geq$ greater than or equal to
    « ..... less than
    » much greater than



GAP-FILL

Ex. 7 Complete the statements below with the correct words:

1. Any number _____ by one is equal to the number itself.
2. A numerical value is _____ when the value is replaced by another that is approximately equal to it.
3. _____ by zero is impossible.
4. Multiplication and division are inverse _____.
5. We do not need any _____ to write the equation: $3 \times 5 - 2 \times 5 = 5$
6. _____ is the result of division.

MATCHING

Ex. 8 Match the symbols with their definitions

Symbols		Definitions
a. <	.....	1. is equal to / equals
b. =	.....	2. the absolute value of b
c. 0.	.....	3. infinity
d. {...}	.....	4. greater than or equal to
e. (...)	.....	5. not equal to
f. >	.....	6. less than or equal to
g. [...]	.....	7. divided by
h. +	.....	8. (in) brackets / parentheses
i. ÷	.....	9. approximately equal to
j. ≡	.....	10. (in) braces / curly brackets
k. –	.....	11. identical to
l. ≈	.....	12. plus
m. ≤	.....	13. the sum of (X values)
n. ∞	.....	14. (in) square brackets
o. →	.....	15. minus
p. ≥	.....	16. tends to
q. ≠	.....	17. decimal point
r. | b |	.....	18. greater than
s. ∑	.....	19. less than

NOTE:

% – **per cent** (also **percent** in US), **percentage – a percentage** in mathematics is defined as a **ratio** or **fraction** of 100, i.e. *20 per cent of 200 equals 40*. Other examples:

- 10 **percent** of school children are overweight.
- Tax is paid as **a percentage** of income.

‰ – **per mil** is defined as one part per thousand:

$1‰ = 10^{-3} = 0.001 = 0.1\%$

$1\% = 10‰$

Do not use the words: *smaller* or *bigger* to refer to < or >
Use *is equal **to** something* and *equal**s** something* accurately.
In English, we say: *open/close brackets*
In English *a **multiplied** by b* is equivalent to *a **times** b*,
× is the *sign of multiplication* or ***multiplication sign*** (**a × b**)
*a **divided** by b* is the same as *a **over** b*
: is the ***sign of division***

3. FRACTIONS

TRANSLATION WORK:

fraction .....
vulgar fraction .....
proper / improper fraction .....
numerator .....
denominator .....
common denominator .....
decimal fraction .....
repeating decimal .....
common factor .....
reduce to lowest terms .....
converting .....
add / subtract / multiply /divide fractions .....
reciprocal .....

READING

The cat's mystery

Here is a story of a tomcat. He was born on a sunny Sunday. He spent one third of his life enjoying the time on a pillow in a wealthy house. After another one sixth of his life, he hunted the first mouse. He escaped after the next two ninths of his life. He was found after the next two tenths of his life. It was then, when he brought a female cat with it back home. After another one sixth of a year, 4 kittens were born. They spent a subsequent year of the tomcat's life together. Unfortunately, the tomcat died in a car accident then.
How old was the cat when he died?
Clue:
In order to **add fractions**, you must first **convert** their **denominators** to a **common** one.

Should you need help, you will find the answer at the bottom of page 29.

MATCHING

Ex. 9 Match the terms (1, 2, 3…) with their definitions (a, b, c…):

1. **fraction** [___]
2. **vulgar (or a common) fraction** [___]
3. **proper fraction** [___]
4. **improper fraction** [___]
5. **decimal fraction** [___]
6. **repeating decimal (or recurring decimal)** [___]

a. consists of an integer numerator – 2/3 (2 is the numerator in this case) and a non-zero integer denominator 2/3 (3 is the denominator in this case)
b. (from Latin: *fractus* – broken) represents a part of a whole, i.e. ½, ¾, etc.
c. if the numerator is greater than the denominator, i.e. 8/5, 4/3, etc.
d. occurs when there is a finite sequence of digits that is repeated indefinitely, i.e. 2/3 = 0.666 – two thirds is equal to (nought) point six six six recurring
e. is a fraction written in the decimal numeral system and whose denominator is a power of ten
f. if the numerator is less than the denominator, i.e. ¼, ½, ¾, and if the absolute value of the fraction is less than 1

GAP-FILL

Ex. 10 Complete the statements below with the correct word(s):

1. In order to reduce a fraction to its lowest terms (to its more basic representation), you have to divide both the numerator and the denominator by the greatest common ……. .
2. In order to add fractions, you must first …….. their denominators to a common one.
3. Subtraction of fractions needs finding a …… …… .
4. In order to …….. a fraction by another fraction, you must multiply both the numerator and the denominator.
5. If you want to multiply a fraction by a whole number, you must convert the number to its equivalent …… fraction.
6. In order to divide a fraction by a fraction, you must multiply the fraction by the …… of the other.

MATCHING

Ex. 11 Match the terms (1, 2, 3…) with their definitions (a, b, c…):

1.	½	a.	is a reciprocal of 1/7
2.	0.45	b.	is an improper fraction
3.	8/7	c.	is a decimal fraction
4.	¼	d.	is the more basic representation of 4/8
5.	1/3	e.	is not a fraction
6.	7/1	f.	is a vulgar fraction
7.	2	g.	represents a recurring decimal 0.333

TRUE/FALSE

Ex. 12 State whether the following sentences are true (T) or false (F):

1. ¼ (a quarter) exemplifies an improper fraction. [___]
2. In order to divide a fraction by a fraction, one must multiply the fraction by their common denominator. [___]
3. A decimal fraction – is a fraction written in the decimal numeral system and whose denominator is a power of ten. [___]
4. In order to add fractions, one adds their numerators and denominators. [___]
5. Repeating decimal (or recurring decimal) occurs when there is a finite sequence of digits that is repeated indefinitely. [___]
6. A fraction represents a part of a whole. [___]
7. Subtraction of fractions is a reciprocal of addition of fractions. [___]
8. In order to reduce a fraction to its lowest terms, one has to divide both the numerator and the denominator by the smallest common factor. [___]
9. In ¾ , integer 3 represents the denominator. [___]

NOTE:

Here are some examples on how to write fractions in their word representations:

½ – **a half, one half**

⅓ – **a third / one third**

¼ – **a quarter / one quarter / one fourth**

⅛ – **an eighth / one eighth**

⅔ – **two thirds**

⅜ – **three eighths**

¾ – **three quarters / three fourths**

⅝ – **five eighths**

4¾ – four **and** three quarters/three fourths

11⅜ – eleven **and** three eighths

4. POWERS, LOGARITHMS AND ROOTS

TRANSLATION WORK:

power .....

raise a number to a power .....

square .....

squared .....

cubed .....

cubic .....

constant .....

logarithm .....

base .....

common logarithm .....

natural logarithm .....

superscript/subscript .....

root .....

to extract a root .....

READING

2 + 2 = 4, or else?

You might be wondering why there are so many mathematical operations and terms necessary for everyone to learn. Subtraction, addition, multiplication, division, raising numbers to powers, etc. make us wiser and civilized. In one case, we boastfully calculate a 15% discount off the price of the sweater we want to buy. In another case, we are proud when we explain to the less educated that a logarithm is not an abbreviation of low-ga-rhythm or that a square root has nothing to do with an ivy plant. We take mathematics and our skills for granted until we come across a mysterious discovery that 8 = 7.

Now, you have become intrigued. Read this[3]:
Let us assume that $x + y = z$,
Therefore $x = 8x - 7x$, $y = 8y - 7y$, and finally $z = 8z - 7z$
So, $8x - 7x + 8y - 7y = 8z - 7z$,
Next, $8x + 8y - 8z = 7x + 7y - 7z$
Then, $8(x + y - z) = 7(x + y - z)$
Finally, $8 = 7$ ☺

MATCHING

Ex. 13 Match the terms (1, 2, 3…) with their definitions (a, b, c…):

1. x^2 [___]
2. x^3 [___]
3. x^n [___]
4. x^{-n} [___]
5. **ln** [___]
6. $\log_b c$ [___]
7. $\sqrt{a} = x$ [___]
8. $\sqrt[n]{a} = x$ [___]
9. $\sqrt[3]{a} = x$ [___]

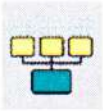
a. x to the power of n / x to the n-th power / x to the n-th
b. the natural logarithm, it has the constant *e* as its base, i.e. ln x (the logarithm of x to the base *e*, phonetically: [el en of eks])
c. the square root of a is/equals x
d. the cube/cubic root of a is /equals x
e. x cubed
f. x to the power of minus n / x to the minus n-th
g. the n^{th} root of a is /equals x
h. x squared
i. the logarithm of *c* to the base *b*

SPEAKING – PAIR WORK

Ex. 14 Student A: read out loudly the terms / equations 1-4;
Student B: write and confirm the correct versions. Next, Student B read out loudly the terms / equations 5 – 8 (p. 22) . Student A - write and confirm the correct versions.

1. 100^{-n}
2. k^3m^{4-c}
3. $\sqrt{x} = p : m$
4. $a^0 = 1$ (when $a \neq 0$)

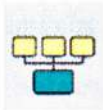
[3] Adapted from [www.ahajokes.com, 2013].



GAP-FILL

Ex. 15 Complete the following rules/definitions:

1. In x_q – q is called a _____ and is written slightly below the baseline.
2. Volume is given in _____ centimeters (cc), meters, etc.
3. Extracting a root is an inverse operation to _____ a number to a power, i.e. $\sqrt{\mathbf{a}} = \mathbf{x}$ and $\mathbf{x^2} = \mathbf{a}$.
4. In x^k – k can be called a _____ (or _____).
5. Any $a^0 = 1$, when a is not _____ to 0.
6. $x^m : x^n$ is equal to x^{m-n} (x to the _____ of m minus n).
7. You should add powers when you multiply numbers of the same _____.
8. The logarithm of a x to the base b ($\log_b x$) is the _____ to which the _____ must be raised to produce x.
9. If base b = 10, the logarithm is called _____ logarithm.
10. When we multiply numbers with the same base (i.e. $x^m \cdot x^n$), we _____ the powers (i.e. x^{m+n})



GAP-FILL

Ex. 16 Read this mathematical equation and fill in the blanks with the words given below. There are two extra words you do not need to use.

$$\{(x+y)^3 - \sqrt{a}\}^{-1} \; x^3 + \log_a x = \tfrac{2}{3}$$

a. **power**	b. **base**	c. **brackets**	d. **braces**	e. **root**
f. **cubed**	g. **over**	h. **multiplied**	i. **squared**	j. **thirds**
k. **times**				

X plus y in (1) _____ to the (2) _____ of three minus the square (3)_____ of a; all in (4) _____ and to the minus one. All this (5)_____ by x (6)_____ plus the logarithm of x to the (7) _____ a is equal to two (8) _____.

(Ex. 14) Student B:

5. $\log_b x$
6. $x^n - 9(n-1) = \sqrt[n]{b}$
7. $\sqrt[4]{x} = K$
8. $a^n = \frac{5}{8} + \sqrt{b} - b$

NOTE:

x^k – k can be called a superscript (or index)

x_q – q is called a subscript and is written slightly below the baseline

cc can mean the following:

- ***cubic centimetre(s) / centimeter(s)*** – for instance the cubic capacity of an engine
- or ***carbon copy*** – *used in a business letter or email to show that you are sending a copy to someone else*

$\sqrt[4]{a}$ is read the four**th,** $\sqrt[5]{a}$ – the fif**th**,$\sqrt[6]{a}$ – the six**th** etc. root of a

5. GEOMETRY

5.1. Two-dimensional geometry

A. Lines, angles, triangles

TRANSLATION WORK:

line .....

- solid .....
- broken .....
- dotted .....
- diagonal .....
- wavy .....
- straight .....
- curved .....
- parallel .....
- perpendicular .....
- intersecting .....

line segment .....

points/endpoints .....

vector .....

ray .....

angle .....

- acute .....

- obtuse .....
- right .....
- straight .....
- full .....

vertex .....

triangle .....

- acute .....
- obtuse .....
- equilateral .....
- isosceles .....
- scalene .....

MATCHING

Ex. 17 Match the names of lines (1, 2, 3…) with their equivalent representations (a, b, c…):

1.	dotted	[____]	a. 
2.	straight	[____]	b.
3.	curved	[____]	c. 
4.	perpendicular	[____]	d.
5.	intersecting	[____]	e. 
6.	diagonal	[____]	f. 
7.	broken	[____]	g. 
8.	parallel	[____]	h.
9.	vertical	[____]	i. 

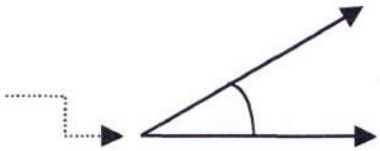
GAP-FILL

Ex. 18 Complete the following rules/definitions with the words given below:

full acute vertex segment obtuse extends right straight

1. a line _____ AB has two distinct endpoints: A and B
2. a ray/vector begins at its endpoint and _____ in one direction
3. an _____ angle measures between 0 and 90 degrees

4. a _____ angle is an angle measuring 90°
5. an _____ angle measures over 90° and less than 180°
6. a _____ angle = 180°
7. a _____ angle = 360°
8. the _____ of an angle *is the point where two rays that form the angle intersect*[4]



MATCHING

Ex. 19 Read the following definitions and match the triangles to their names (there is often more than one option possible).

a triangle is a three-sided polygon
an equilateral triangle has all three sides of equal length (all the angles measure 60°)
an isosceles triangle has at least two sides of equal length
a scalene triangle is a triangle having three sides of different length
an acute triangle has three acute angles
an obtuse triangle has one obtuse angle

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____

a. equilateral ___
b. isosceles ___
c. obtuse ___
d. right-angled ___
e. scalene ___
f. acute ___

[4] Kucharska-Raczunas, Maciejewska, 2010, p. 56.

SPEAKING – PAIR WORK

Ex. 20 Read / dictate and draw:

Student A: read the first description given below
Student B: follow the description and do the drawing on a separate sheet of paper. Then, change roles for the other description.

1. *There is a horizontal base line. On the line, there are 2 equal circles supporting one rectangular shape. In the middle of the rectangle, there is a square whose bottom and top sides come within the sides of the rectangle. On the left side of the rectangle and at its lower corner, there is an isosceles triangle whose base comes within the side of the rectangle and is approximately equal to 2/3 of its side. The vertex of the triangle is the center of another circle whose diameter equals 1/3 of the side of the triangle.*
2. *There is a vertical line which intersects a horizontal line. On the right side of the vertical line, there is a square whose one side comes within the vertical line. On the other side of the vertical line, there is a circle. There is another horizontal line which joins the center of the circle to the center of the square.*

GAP-FILL

Ex. 21 Complete the following sentences:

1. An _____ angle measures between 0 and 90 degrees.
2. A _____ angle measures 90 degrees.
3. A _____ triangle has three sides of different lengths.
4. An _____ angle measures between 90 and 180 degrees.
5. An _____ triangle is a triangle in which all 3 sides are equal.
6. A triangle is a _____-_____ polygon.
7. The point where two rays that form an angle intersect is called the _____ of the angle.
8. A line segments has two distinct _____.

B. Polygons

TRANSLATION WORK:

polygons .....
quadrilateral .....

square .....
rectangle .....
parallelogram .....
rhombus .....
trapezoid .....
pentagon .....
hexagon .....
heptagon .....
octagon .....
nonagon .....
decagon .....
circle .....
chord .....
circumference .....
diameter .....
radius .....

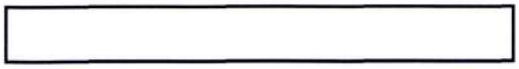
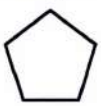
READING

Pentagon

The Pentagon, which is the Headquarters of the United States Department of Defense, takes its name after its design shape of a pentagon and is the biggest office building in the world. Hardly anybody knows that there is a central plaza inside it (also in the shape of a pentagon), which is informally known as *ground zero*[5].

How to make a pentagon?

In order to make a regular pentagon[6] (all edges of the same length), you need a rectangular strip of paper, yet it must be relatively long. For instance, it can be approximately 20 cm long and 3 cm wide.

Now, having a shape like this: 
make this: 

See the answer at the bottom of page 32.

[5] Wikipedia, The Pentagon, 2013.
[6] Adapted from [Steward, 2008, p. 34].

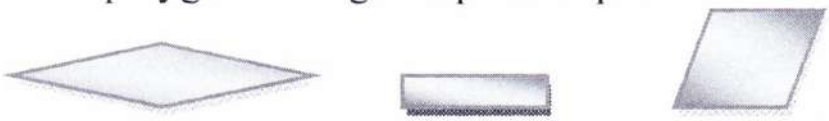
Polygons

Polygons can be **regular** (the sides are all of the same length and the angles are all the same) or **irregular/non-regular**

a square – a four-sided polygon having all sides of equal length

a rectangle – a four-sided polygon having all right angles

a parallelogram – a four-sided polygon having two pairs of parallel sides



a rhombus – a **quadrilateral** whose all sides are of the same length

a trapezoid – a four-sided polygon which has exactly one pair of parallel sides

a pentagon – a five-sided polygon

a hexagon – a six-sided polygon

a heptagon – a seven-sided polygon

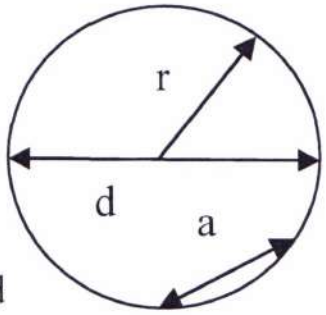
an octagon – an eight-sided polygon,

a nonagon – a nine-sided polygon

a decagon – a ten-sided polygon

Circle

r – radius c – ? (see TASK below)
d – diameter



a – chord

TASK: mark the circle's circumference in the picture of a circle,
circumference (c) $c = 2 \pi r$

TASK: True or false?
The mathematical constant **pi** (π) represents the ratio of a circle's circumference to its diameter. [____] (See the bottom of the page for the answer[7])

TRUE/FALSE

Ex. 22 State whether the following statements are true (T) or false (F)

1. The diagonals in a square intersect at a right angle. [____]
2. A hexagon is a seven-sided polygon. [____]
3. The sum of the angles of a rectangle is 360 degrees. [____]
4. The sides of a polygon intersect in exactly two places each. [____]
5. A trapezoid is a quadrilateral which has all sides of equal length. [____]
6. The point where two rays that form an angle intersect is called the bisector of the angle. [____]
7. A polygon can only be made of line segments. [____]

5.2. Three-dimensional geometric figures

TRANSLATION WORK:

cube .....
cuboid .....
cubical .....

---

[7] Yes.
Answer:
The cat lived 15 years, clue: x – cat's lifespan, so x/3 + x/6 + 2x/9 + 2x/10 + 1/6 + 1 = x

cone .....
cylinder .....
pyramid .....
sphere .....
hemisphere .....
tetrahedron .....
volume .....

READING

A spherical dilemma

The sphere is more important than the cube. This provocative thesis can be supported by countless arguments, and hands are raised when it comes to giving examples in favor of this statement. The arguments range from serious ones pointing to spherical planets, atoms, or lenses, to such touching ones showing the very first toy to be a spherical ball. Those in the minority then put forward quite a rational argument that the playing dice is cubical and so are the stairs. Finally, they claim that the brick, which is a basic building block most widely known to the human kind, is a cuboid. Of course, an intense scientific debate can be initiated emphasizing the fact that soap bubbles could never be cubical because their surface tension allows for spherical shapes exclusively. The discussion would continue. But does it really matter? ☺

MATCHING

Ex. 23 Match the following 3D figures to their names

a. 

b. 

c.

d. 

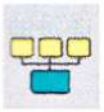
e. 

f. 

1. tetrahedron [____]
2. sphere [____]
3. cylinder [____]
4. pyramid [____]
5. cube [____]
6. cone [____]

TASK: Complete the table by writing the equivalent adjective, use the glossary at the end of the book:

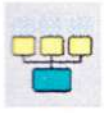
Noun	Adjective	Noun	Adjective
cone	.....	hemisphere	.....
cube	.....	cylinder	.....
sphere	.....	pyramid	.....



GAP-FILL

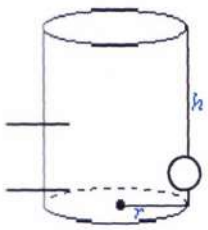
Ex. 24 Read the following descriptions and name the proper shape.

1. It is a three-dimensional figure which has six matching sides. [_____]
2. It is a three-dimensional shape having a circular base and a single vertex. [_____]
3. It is a three-dimensional shape having all of its points at the same distance from its center. [_____]
4. It is a four-sided three-dimensional shape, each face of which is a triangle. [_____]
5. It is a three-dimensional shape with a square base and 4 triangle sides. [_____]
6. It is a three-dimensional shape having two circular bases of the same shape and size that are parallel. [_____]



GAP-FILL

Ex. 25 Analyze this simple drawing of an electric boiler and complete the description below with the correct words.



A boiler is a (1) c _ _ _ _ _ _ _ with a (2) r _ _ _ _ _ ***r*** and the (3) h _ _ _ _ _ ***h***.

In order to calculate its surface area we need to add:

The area of the top and bottom (4) c _ _ _ _ _ _ $(2 \pi r^2)$ + the area of the side $(2\pi rh)$.

Therefore, the surface area (A) is (5) e _ _ _ _ to:

$A = 2 \pi r^2 + 2 \pi r h$

$A = 2 \pi r (r + h)$ A is equal to $2 \pi r$ times $r + h$ in (6) b_ _ _ _ _ _ _

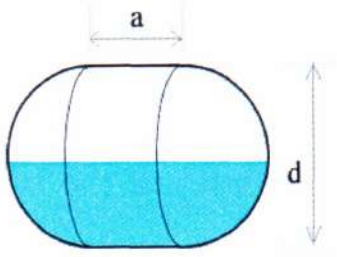
GAP-FILL

Ex. 26 Complete the following description of a pyramid and a sphere with the correct words.

The (1) v_ _ _ _ _ **V** of a **pyramid** is $V = 1/3\ Bh$, where ***B*** is the (2) a_ _ _ of the base and ***h*** is the (3) h_ _ _ _ _ (***h*** is (4) p_ _ _ _ _ _ _ _ _ _ _ _ _ to the plane of the base).
The base of a pyramid can be a regular (5) p_ _ _ _ _ _. If the base is circular, the pyramid becomes a (6) c _ _ _.
In classical geometry, the volume **V** of a **sphere** reads as follows:
$V = {}^4/_3 \pi r^3$ where $\mathbf{r^3}$ stands for (7) **r** _ _ _ _ _ to the (8) p_ _ _ _ of 3.

GAP-FILL

Ex. 27 How to calculate the volume V of a capsule tank[8]? Complete the description.



We treat a capsule as an object composed of a (1) s_ _ _ _ _ of diameter **d** split in half and separated by a (2) c_ _ _ _ _ _ _ of diameter **d** and (3) h_ _ _ _ _ **a**.

Therefore, the total volume $V = Vs + Vc$
$Vs = 4/3\pi\mathbf{r}^3$ where:

r is (4) r_ _ _ _ _ **r** = **d** : 2 **d** is (5) d_ _ _ _ _ _ by 2
$\mathbf{r}^3$ is **r** (6) c_ _ _ _
$Vc = \pi\, \mathbf{r}^2\mathbf{a}$, $\mathbf{r}^2$ is **r** (7) s _ _ _ _ _ _

NOTE:

a line in geometry **extends indefinitely** in both directions
a right angle = 90°, whereas a straight angle = 180°

---

[8] Adapted from: [www.calculatorsoup.com, 2012]
In order to make a pentagon, you must tie a knot (very carefully), and fold the ends:


[Steward, 2008, p. 269].

a 90-degree triangle is a right-angled triangle
an **equilateral** triangle – its sides are all of the same length
an **equiangular** triangle – its angles are all of the same measure
Remember the difference between solid vs straight lines.

Volume and capacity:
volume – volume is a measure of how much space a 3D shape takes up
capacity – a term in economics, management, engineering, etc., only similar to volume
half of a sphere is called a **hemisphere**

PART 2

GRAPHS

1. VISUAL AIDS

GAP-FILL EXERCISE

Ex. 28 Complete the definitions of different types of visual aids with the words from the box.

bar	diagram	flow	line graph	pie	table

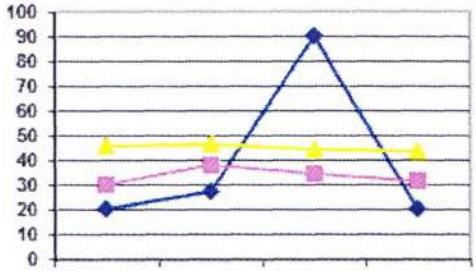
a. A _____ is a two-dimensional geometric symbolic representation of information according to some visualization technique.
b. A _____ chart is a type of diagram that represents an algorithm or process, showing the steps as boxes of various kinds, and their order by connecting them with arrows.
c. A _____ chart is divided into sectors, illustrating numerical proportion where the arc length of each sector (and consequently its central angle and area) is proportional to the quantity it represents.
d. A (vertical or horizontal) _____ chart is used to compare unlike items.
e. A _____ is often used to show a trend over a number of days or hours. It is plotted as a series of points, which are then joined with straight lines.
f. A _____ is a visual aid that presents scientific or mathematical data in an organized and uncomplicated way.[9]

MATCHING

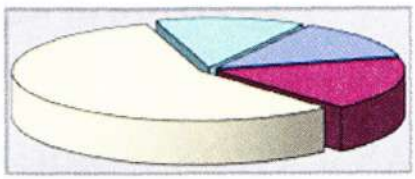
Ex. 29

A. Match the pictures with the types of visual aids from **exercise 28**.

1.

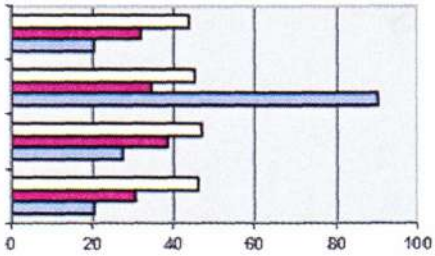


2.

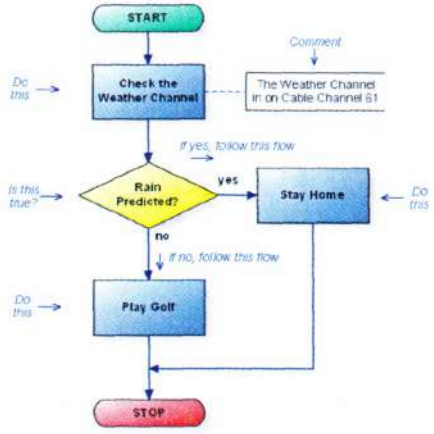


[9] Adapted from [Wikipedia, 2014].

3.



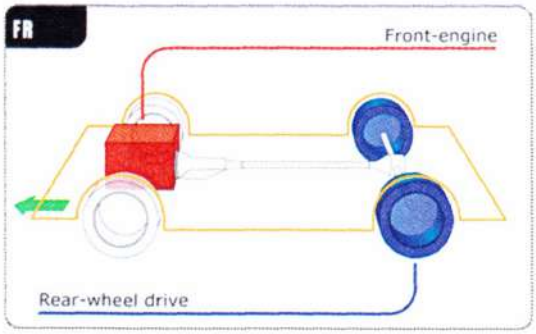
4.



5.

Force Out		Distance from Fulcrum		Force In
1000	=	10	X	100.00
1000	=	20	X	50.00
1000	=	30	X	33.33
1000	=	40	X	25.00
1000	=	50	X	20.00
1000	=	60	X	16.67
1000	=	70	X	14.29
1000	=	80	X	12.50

6.



B. Which of the above would you use to present the following information? Discuss in pairs.

1. monthly expenditure of a household on food, mortgage, clothing and entertainment
2. the process of water treatment step by step
3. changes in the average temperature over a period of one hundred years
4. data and variables in an experiment
5. GDP of three different countries

2. DESCRIBING CHANGES

2.1. Growth and fall – nouns and verbs

TRANSLATION WORK:

drop .....

plummet .....

fluctuation .....

soar .....

increase .....
slump .....
jump .....
fall .....
rocket .....
rise .....
level off .....
peak .....

MATCHING

Ex. 30 Match the phrases with the pictures. You can match several words/phrases with one picture.

upward trend
reach the lowest point
go up
reach the lowest point
decrease
fall
nosedive
decline
rocket
drop
downward trend

stay constant/stable
go down
fluctuate
grow
rise
level off
reach a peak
plummet
soar
increase

1.

2.

3.

4.

5.

6.

7.

8.

9.

Which of the words have the same noun and verb forms?

NOTE:

In English, some nouns and verbs have the same form. For example:

*I'd like a **refund** on this. (noun)*

*We'll **refund** you 50%. (verb)*

However, the pronunciation (i.e. syllable stress) is different. Where "refund" is used as a noun, the stress falls on the first syllable: re-found. But where "refund" is used as a verb, the stress is on the second syllable: re-fund . Here are some other examples:

an increase – to increase

a record – to record

a decrease – to decrease

READING

Ex. 31 Read the text and complete the table.

A considerable growth has been noticed in the sales of books in Japan in the last ten years which is a good sign both for publishers as for the authors. However, the future of paper books did not look that bright in the beginning of that period when the sales plunged and reached only 12.5 books per person. It meant that the publishing industry shrank by about 24% which was terrible news for the publishing companies. This drop was caused by the growing popularity of e-books which were cheaper and more convenient in use than bulky volumes. Fortunately for publishers, the sales made a spectacular recovery when the first craze for digital books passed and readers started feeling nostalgic about the traditional book. The sales plummeted three years ago but they picked up quite quickly. Therefore, this temporary drop did not affect the market much. In January 2011 the book sales jumped unexpectedly which is all in all good news for the industry.

Increase	Decrease

a. Look at the words in the table. Write *n* next to nouns and *v* next to verbs. What are the verb forms of the nouns?
b. The verb *pick up* is modified by the phrase *quite quickly*. Which three other words from the text modify the change? Do they modify verbs or nouns?

Ex. 32 Put the words from **exercise 30, 31** in the table below. Which verbs are irregular?

Nouns	Verbs

2.2. Degree and speed – adjectives and adverbs

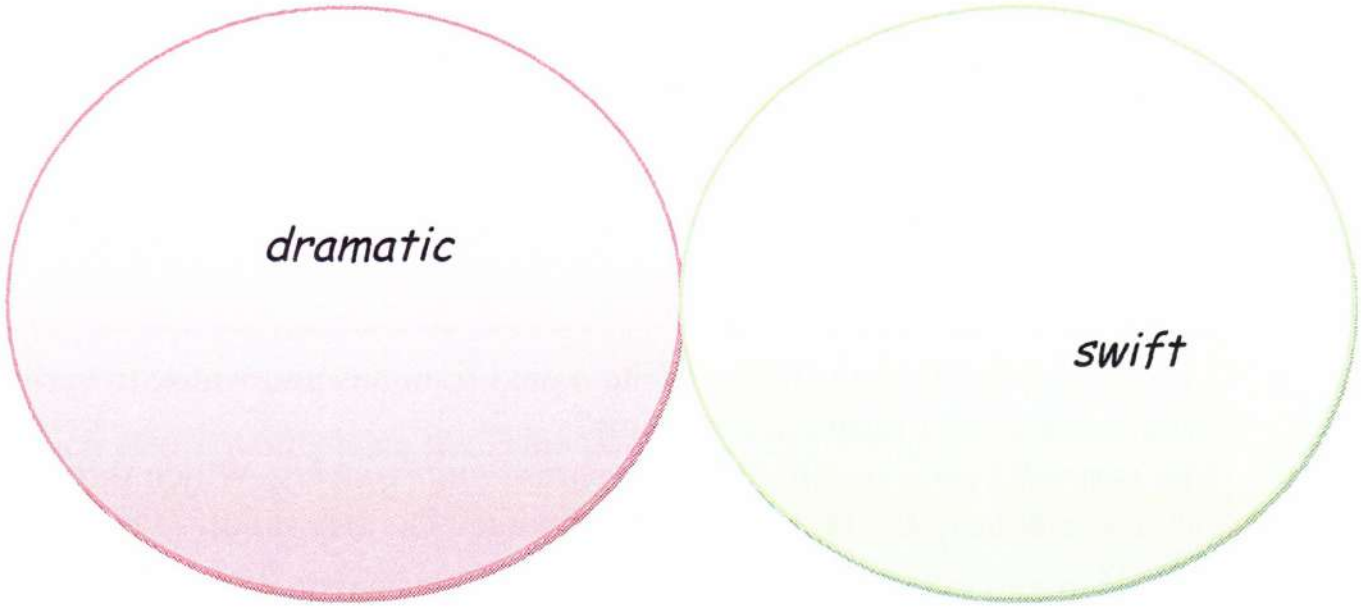
The description of a graph is more accurate when you use words which refer to the degree and speed of changes. By modifying verbs and nouns, the description is more detailed and clear. Here are some of the most popular adjectives you can use:

considerable, dramatic, gentle, gradual, moderate, rapid, significant, sharp, slight, slow, steady, swift, substantial, quick

If you do not know them, use a dictionary to help you.

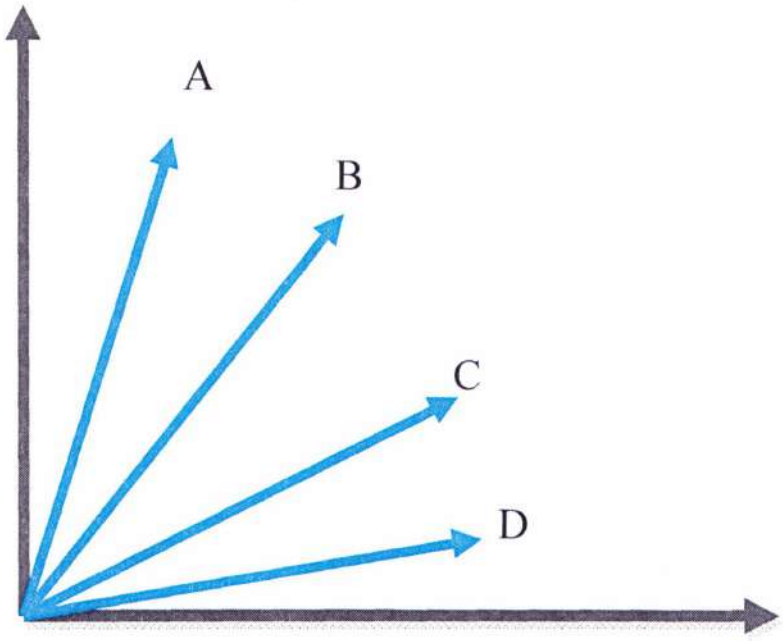
COMPREHENSION

Ex. 33 Put the above words in the correct bubble.



Can you think of any other words that you can use?

Ex. 34 The arrows in the two graphs below indicate the speed and degree of change. Use the words from **exercise 33** and label the arrows accordingly.



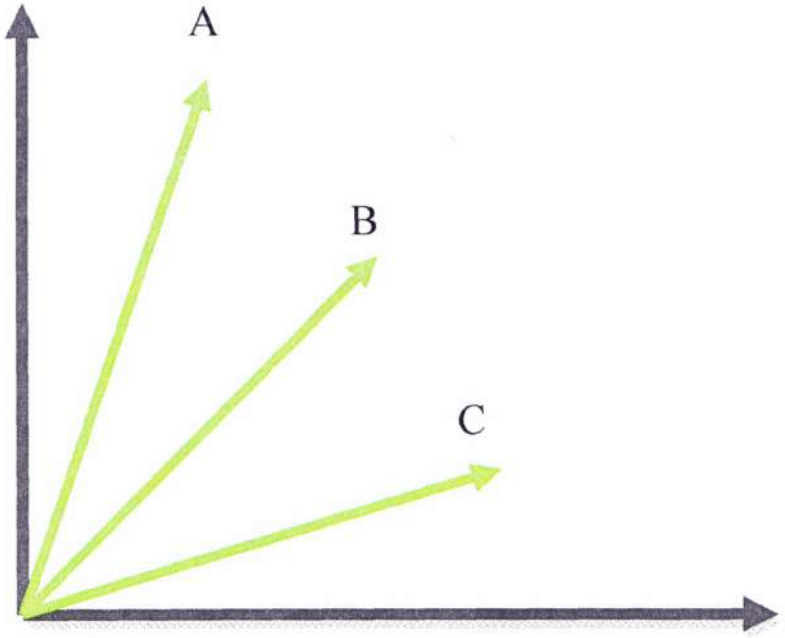
A. .....

B. .....

C. .....

D. .....

Degree of change



A. .....

B. .....

C. .....

Speed of change

Ex. 35 Write adverbs to the following adjectives.

slight –
sharp –
dramatic –
steady –

NOTE:

ADJECTIVES AND ADVERBS

Take a look at the following phrases and tick the correct answer:

A slow motion	*to move slowly*
a happy smile	*to smile happily*
a gradual decrease	*to decrease gradually*

- Adjectives modify *nouns/verbs* and they come *before/after* the word they describe.
- Adverbs modify *nouns/verbs* and they come *before/after* the word they describe.

In English, many adverbs are formed by adding –ly to the corresponding adjectives:

final – finally *immediate – immediately* *slow – slowly*

Spelling notes:

a. a final **y** changes into **i**: *happy – happily*
b. a final **e** is retained before –ly: *extreme – extremely*

Exceptions: *true – truly* *due – duly* *whole – wholly*

c. adjectives ending in a consonant +le drop the **e** and add **y**: *simple – simply*

Note: the adverb of **good** is **well**.

READING

Ex. 36 Read the text about the changes in the sales of books over a decade. Find one mistake in each of the lines and correct it. Some lines are correct[10].

The graph depicts the sales of books in the UK	1.....
between 2000 and 2010. At the beginning of this period	2.....
just over 10,000 copies were sold. Sales increased	3.....
substantial over the next two years, to peak at almost	4.....
60,000 in 2002. However, the sales fell rapid to well	5.....
under 30,000 in the following year and they went down	6.....

[10] Adapted from [www.eslflow.com, 2014].

gradually between 2003-2004. There was a steadily increase in sales over the next few years and by 2007 the sales rose gently to more than 10,000. However, after this the sales began to drop significantly once more to approximately 10,000 in 2009.

In the first six months of 2010, the sales fluctuated, although there was an moderate increase in the summer, reaching a peak of well over 15,000. A sharply decrease followed, with sales falling dramatically to around 10,000 in September. They remained steadily until November, when there was a slight increase.

7.....
8.....
9.....
10.....
11.....
12.....
13.....
14.....
15.....
16.....
17.....
18.....

2.3. Prepositions

In graph descriptions, the following prepositions can be used while referring to the amount and the topic: *by, to, of, in, from*. However, you need to be careful while using them. Take a look at the examples and rules below:

to .... from are used after a verb and between two amounts:
Cigarette prices increased from £1.30 to £1.50.

by goes after a verb and indicates how much the amount has changed:
Cigarette prices rose by 20 p.

of goes after a noun (or a noun phrase) and before the amount:
There was a price rise of 5%.

in goes after a noun (or a noun phrase) and before a topic:
There was a fall in the price of fruits.

Ex. 37 Describe the following changes where: ▼ means a downward trend and ▲means an upward trend.

Example: *bus tickets / prices / by 6% ▲*
Bus tickets prices increased by 6%.

1. Ikea chairs/ sales / of 34% ▼
2. car / export / 41% / by ▼
3. bananas / import / to / from $17 000 ($13 000) ▲
4. traffic / 8% / last year / by / since ▲
5. oil reserves / 35% / in the Gulf countries / in ▼

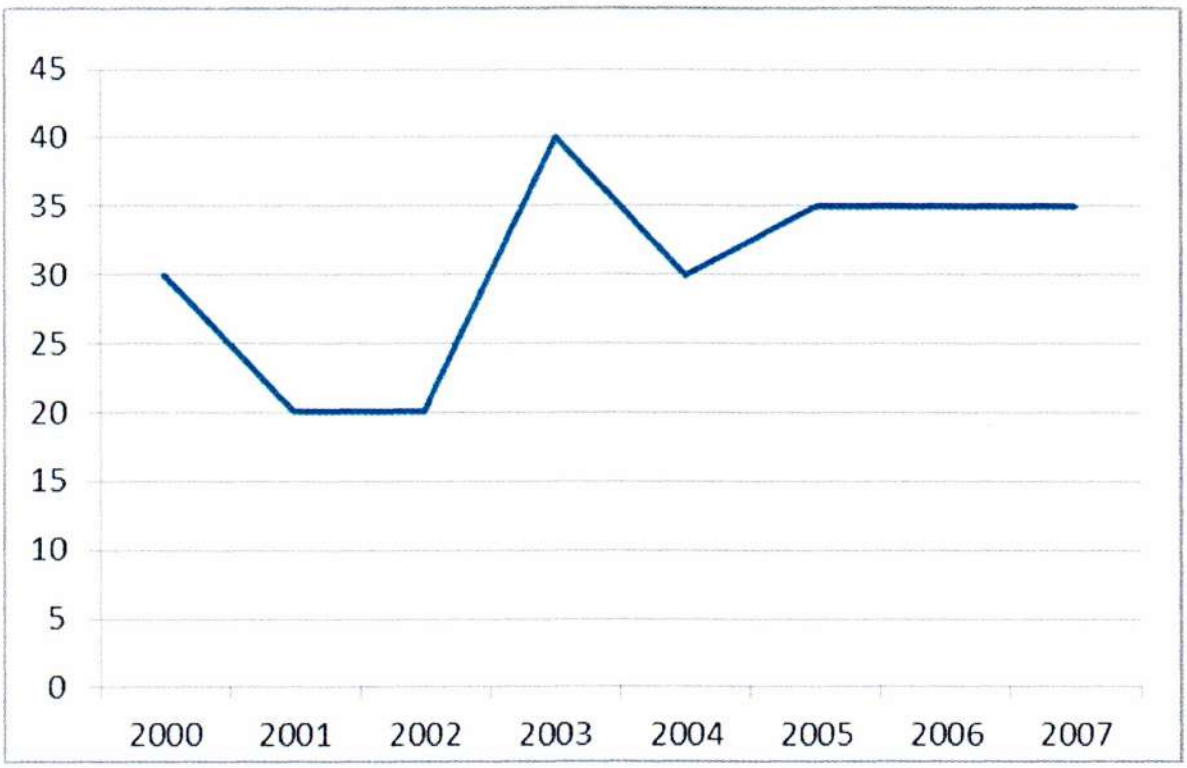
3. DESCRIBING TIMELINES

NOTE :

TENSES
While describing changes, the following tenses are used:
Past Simple
Sales **fell** between 2000 and 2003.
Sales **increased** during the spring months last year.
Present Perfect
Sales **have risen** since 2003.
Sales **have nosedived** this month.
Present Continuous
Sales **are improving** at the moment.
The sales figures **are getting** worse and worse.
will
Sales **will drop** next year.
Sales **won't improve** soon.

COMPREHENSION

Ex. 38 Look at the graph and complete the sentences below with ONE word in each blank. Use the words that you learned in section 2, *Describing graphs*.



1. Production _____ during 2000.
2. In 2001 production _____ _____.
3. Production _____ during 2002.
4. Production _____ _____ _____ at the beginning of 2003.
5. Over the next year there was a _____ in production.
6. Then there was a _____ in production in 2005.
7. During 2006 and 2007 production _____ off .

Ex. 39 Look at the graph again and fill the gaps with an appropriate preposition – *to*, *at*, *by*, or *of*.

1. At the beginning of 2000 production stood ____ 30,000 units.
2. Over the next 12 months production dropped ____ 20,000 units.
3. Production remained steady ____ 20,000 units during 2002.
4. At the beginning of 2003 it reached a peak ____ 40,000 units.
5. But then during 2004 it decreased ____ 10,000 units.
6. Then there was a rise ____ 5,000 units in 2005.

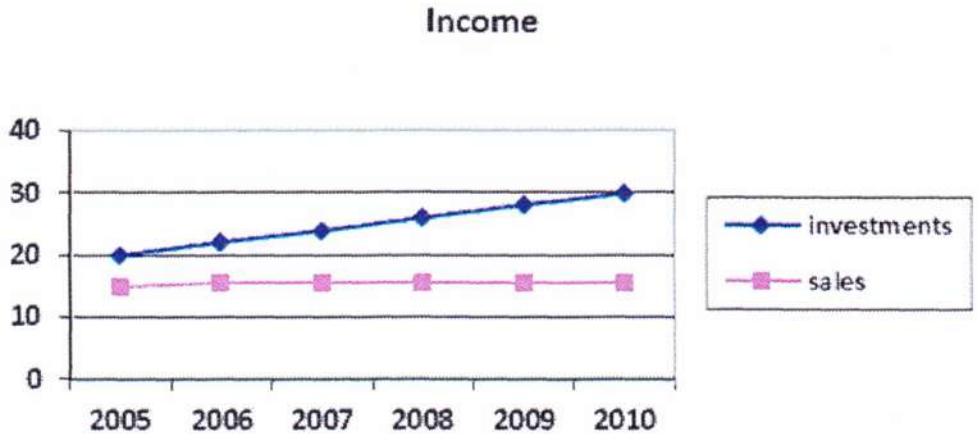
Ex. 40 Complete the extract from a business presentation with an appropriate verb form. Use Past Simple, Present Continuous, Present Perfect and Future Simple. Look at the graphs below to help you[11].

Although at the moment our company's sales 1)_____ (look) promising, the profit was not impressive earlier this year as our sales 2)_____ (fall) to 1300 units. During March profit 3)_____ (begin) to recover; however, it 4)_____ (decrease) again in May. It was probably due to seasonal factors. There was an improvement during the summer, but in the last few months the growth in sales 5)_____ (level off) and we probably 6) _____ (not/reach) our target of 2000 units by the end of this year.

Our market share 7)_____ (remain) stable at about 17% in spite of very aggressive competition.

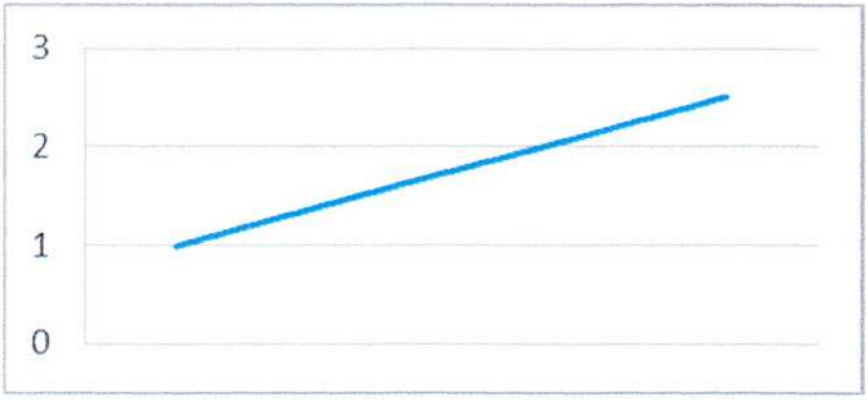
Unfortunately, while income from company investments 8)_____ (rise) at the moment, our income from sales 9)_____ (be) rather flat over recent years. Overall, we 10)_____ (now/make) progress but there is place for improvement.

[11] Adapted from [T. Trappe, Tullis, 2005, p.84].



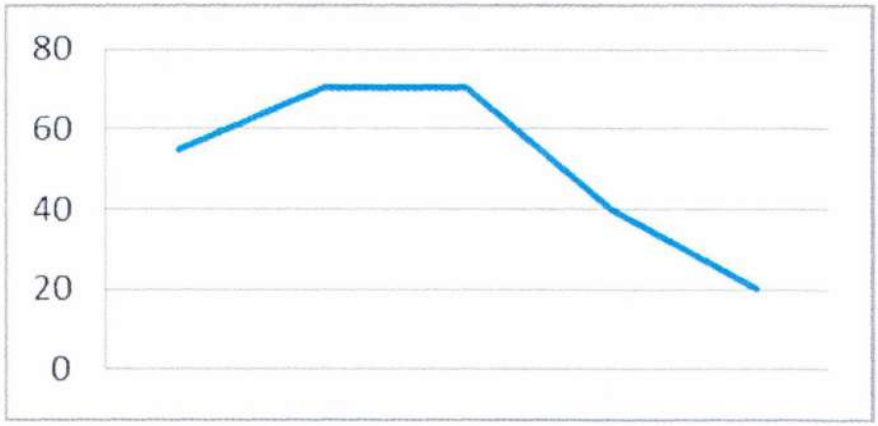
Ex. 41 Study the graphs below and fill in the gaps with suitable words and expressions.

Graph A



There has been a r_____ in production over the year.

Graph B

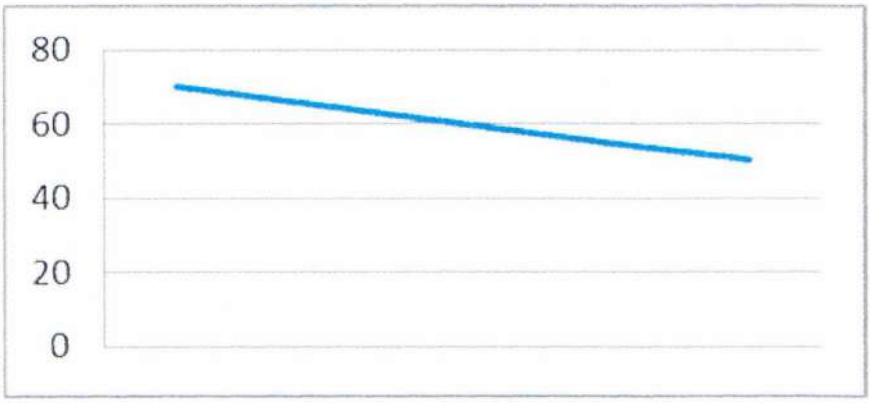


Production started climbing s_____ but leveled off around 70. Since then, it has f_____ .

Graph C

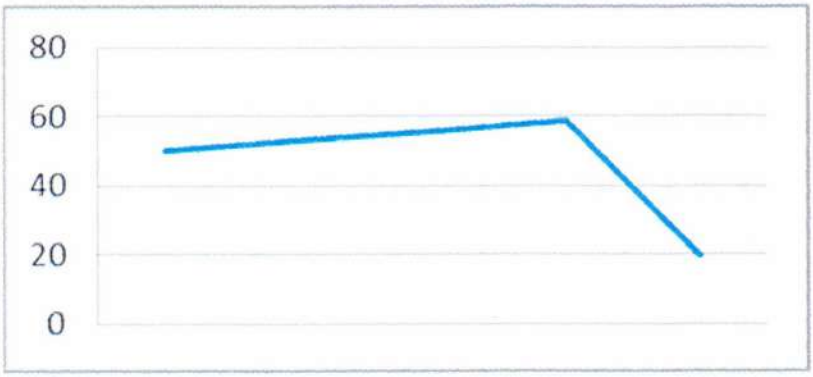
Production grew r_____ in the first quarter, but then levelled off at about 70. Since then it has r_____ more or less stable.

Graph D



Production has dropped slowly but s_____ over the year.

Graph E



Production showed a marginal i____ in the first three quarters, but then suffered a sharp d____.

4. DESCRIPTIONS

Ex. 42 Look at the graph which shows spending on advertising in three different types of med ia. Match the two descriptions with the appropriate line[12].

a. Advertising in press was more or less stable during the last years; however, a slight drop can be noticed, especially between 2000-2002. For the next 8 years the spending on advertising levelled off. There was

[12] Adapted from [www.ielts-exam.net, 2014].

a very gentle rise in 2004 but the spending circulated around $200 million. Since 2010 this number has gradually fallen.

b. The spending on advertisement in the Internet is booming. In 2000 it stood at $150 million which was the lowest number of all three. However, it rose spectacularly. In the first 8 years, spending on the Internet advertisement increased steadily but then the number rocketed and reached the peak of $245 million.

Ex. 43 Look at the graph again and complete the description about TV advertising with the words from the box.

decrease, fell, reached, recovered, significant, steadily, stood at

During the last 12 years the spending on TV advertising fluctuated. However, a minor **1**___ can be noticed in the overall trend. In 2000 the number **2**___ $200 million and it **3**___ by around $20 million reaching $180 million in 2002. In the next two years the spending on TV advertising **4**___ but from 2004 a **5**___ drop was observed. In 2008 the number **6**___ its lowest point of $160 million. From this point on, this number has risen **7**___.

Ex. 44 Read about changes in population in the USA and answer the questions[13].

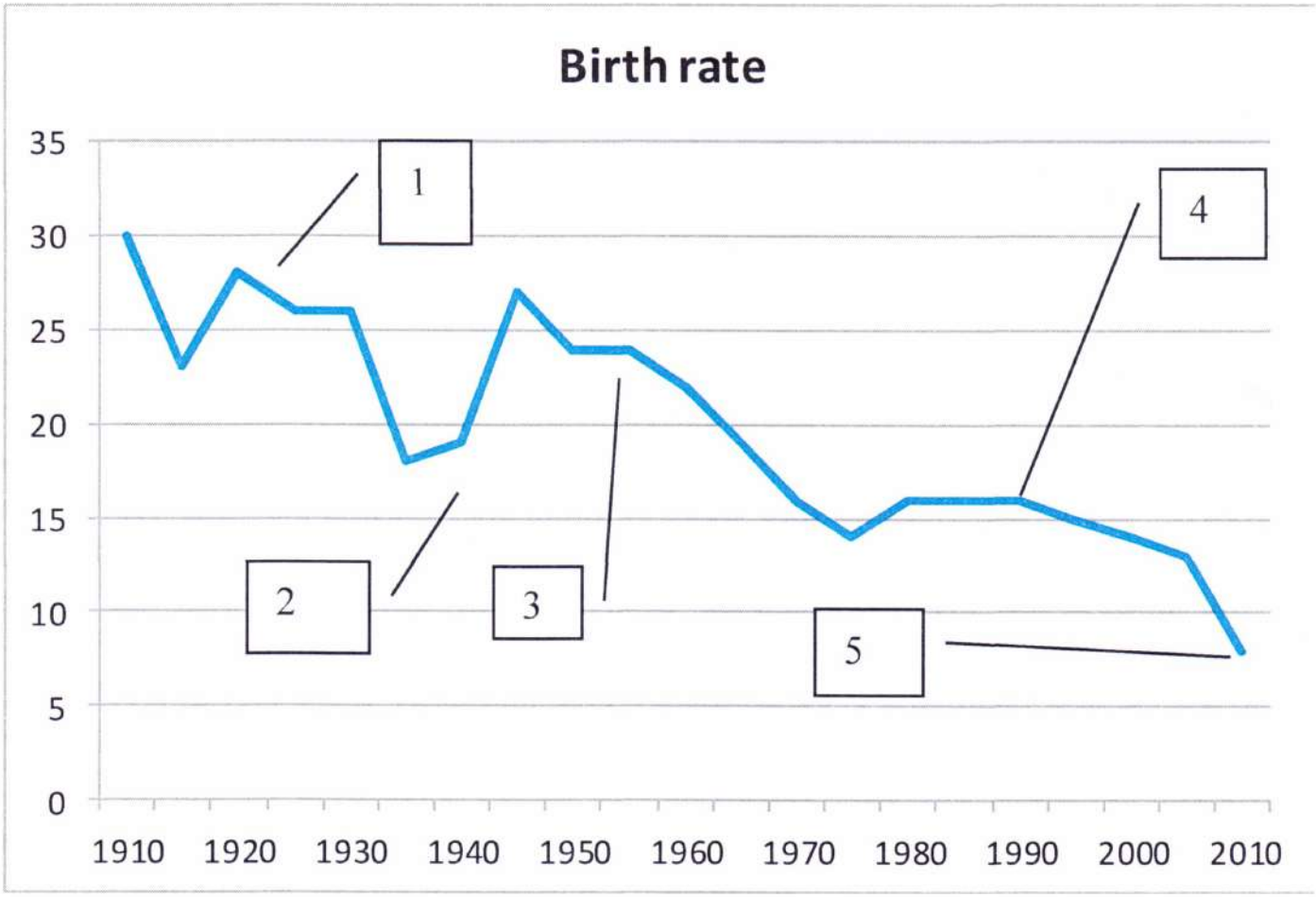
The graph shows demographic stability in the USA over one century. It can be seen clearly from the graph that although the birth rate fluctuated a great deal, a massive downward trend occurred between 1910 and 2010 and it continues to this day.

At the beginning of the period the number of babies born reached the peak of 30 babies per 1,000 people. During the first decade this number dropped slightly but in the 1920s a noticeable recovery can be observed, which is attributed to the period of economic stability and development the USA underwent during this time. However, from 1925 this number plummeted and hit a low of 18 newborns in the middle of the 1930s. This dramatic fall coincided with the Great Depression which influenced the American economy painfully. After the Depression, the birth rate rose gradually and just after the Second World War this number jumped suddenly. Children born at that time are called Baby Boomers. A slight decrease followed and in the beginning of the 1950s the number of babies stood at 24. The birth rate levelled off during this decade but from the 1960s it decreased substantially and in the 1970s it reached a lower level than during the Great Depression with 14 children per 1,000 people. Later

[13] Adapted from [www.ieltsbuddy.com, 2014].

a slight rise can be observed and the birth rate remained stable during the 1980s and 1990s. However, from 1995 the birth rate declined steadily and in 2008 it fell rapidly again. This decrease connected with the ongoing recession has a major influence on the US population which reached the lowest point since the beginning of the 20th century with only 13 children born per a thousand people. Overall, the graph depicts changes in the birth rate in the span of 100 years. It can be concluded that great events in the history and economy are responsible for the major shifts in the birth pattern. It is obvious that in the times of economic and social depression, fewer babies are born.

1. What is the purpose of the first paragraph?
2. What is the conclusion of the description?
3. What are the synonyms of the following words (from the text): *baby, accredit, coexist, impact*
4. Look at the graph to which the text refers. Put the headings in the corresponding gaps.
   1970s oil crisis, Baby Boom, the Great Depression, recession, the Roaring Twenties
   Which sentences in the text describe these events?



WRITING TIP

The first sentence of the description introduces the topic of the graph. In your descriptions, you can use the common phrases:

Introduction		Subject	Circumstances
This graph	**represents** **shows** **depicts** **outlines** **illustrates**	rates of economic growth changes in temperature fluctuations	over the past decade. between 1990 and 2000. in the developing world.

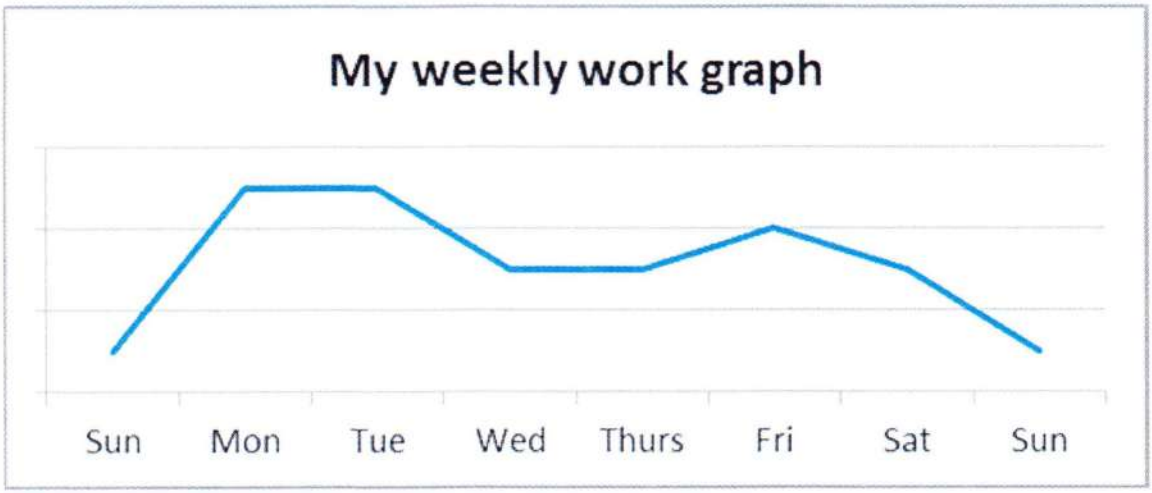
Ex. 45 In graph descriptions it is important to use a variety of different language structures. Rewrite the following sentences so that the meaning stays the same.

a. During this time, the birth rate fluctuated.
   There.....
b. Astronomers have noticed unexplained variations in the sun's activity since 1980.
   Unexplained variations.....
c. The birth rate rose gradually during that time.
   There was.....
d. There was a slow growth in the American economy in the second quarter.
   American economy.....
e. Electronic goods import from China to the EU increased by 250% in the first six months of 2012 compared with the same period in 2002.
   There was an .....
f. There was a fall in retail sales in October.
   Retail sales.....

Ex. 46 Look at the *My weekly work graph* below. Write 5 sentences about the graph using the prompts[14].

Example: *Monday / increase / sharp / two tests on Tuesday.*
On Monday my work increased sharply because I had two tests on Tuesday.

[14] Adapted from [www.eslflow.com, 2014].



Possible topics
free time,
sleep,
weight problems
money,
laziness

1. Wednesday / fall / rapidly / no classes.
2. Thursday / remain / stable / no classes.
3. Friday / rise / substantially / two classes / no tests.
4. Weekend / drop / gradual / free weekend / do housework.

Ex. 47 Look at the possible topics in **exercise 46** above. Choose one topic (or invent it yourself), draw a graph and describe it in 8 sentences. Remember to introduce the topic and connect the sentences with linking words.

LANGUAGE TIP LINKING WORDS

Cause/effect: *so, therefore, as a result/consequence, due to...*
Next step: *after, next, then, subsequently, finally...*

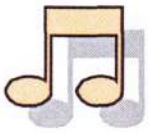
SPEAKING – PAIR WORK

Exe. 48 Work with your partner. Read your description and ask your partner to draw what he/she hears. Compare the two graphs. Change roles.

PART 3

ADDITIONAL EXERCISES

1. LISTENING EXERCISES



Listening 1

Ex. 49 Listen to the description of a graph which depicts the annual sales of umbrellas in the UK. Listen to the recording and state whether the following statements are **true** or **false**.

1. In the first six months there was a gradual decrease in the sales of umbrellas in the UK.
2. Due to bad weather, the sales of umbrellas jumped in June.
3. The number of umbrellas sold in September fell slightly.
4. In November, the sales decreased.

Ex. 50 Read the description of the graph in **exercise 49**. Put the words from the box in the appropriate gaps. There are three words you do not need to use! Listen again and check your answers.

dramatic, decreased, fall, fell, levelled, reached, rise, rocketed, slight, steadily

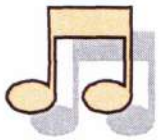
The graph presents the annual sales of umbrellas in the UK. It is shown clearly that the sales fell **1**___ in the first half of the year – that is from January to May – and hit the lowest level in June. This gradual **2**___ is attributed to the low level of precipitation that took place during that time. Next, a particularly rainy summer resulted in the **3**___ in sales. They **4**___ in July and **5**___ off in August. After rising significantly in September, they suffered a **6**___ decrease in October due to a spell of good weather in that month but then the sales made a spectacular recovery in November. However, the year ended with a 7___ downturn.

Therefore, the sales of umbrellas decreased in the first part of the year and then rose significantly in the second part which may be considered as a standard turnover for that particular product.

Listening 2

Ex. 51 Listen to the recording and state whether the following statements are **true** or **false**.

1. The graph depicts changes in unemployment pattern during three years.
2. In January 2010, the rate was slightly above 9%.
3. For a half year it decreased a bit.
4. The situation improved at the end of 2010 and the beginning of 2011 when fewer people were unemployed.
5. There was no change in the unemployment rate in February and March 2011.
6. Unemployment increased gradually from April until June.
7. The rate hit a low in December 2011.



Listening 3

Ex. 52 Listen to the recording and complete the notes.

Flight report MJN Air

April 2012

Route: Poznan to (1) .....

During the first 10 days 450 passengers used MJN Air. On the 4th Apr, the number (2)..... significantly and then (3)..... for 5 days.

Between the 12th and 15th April, there was a (4)..... rise.

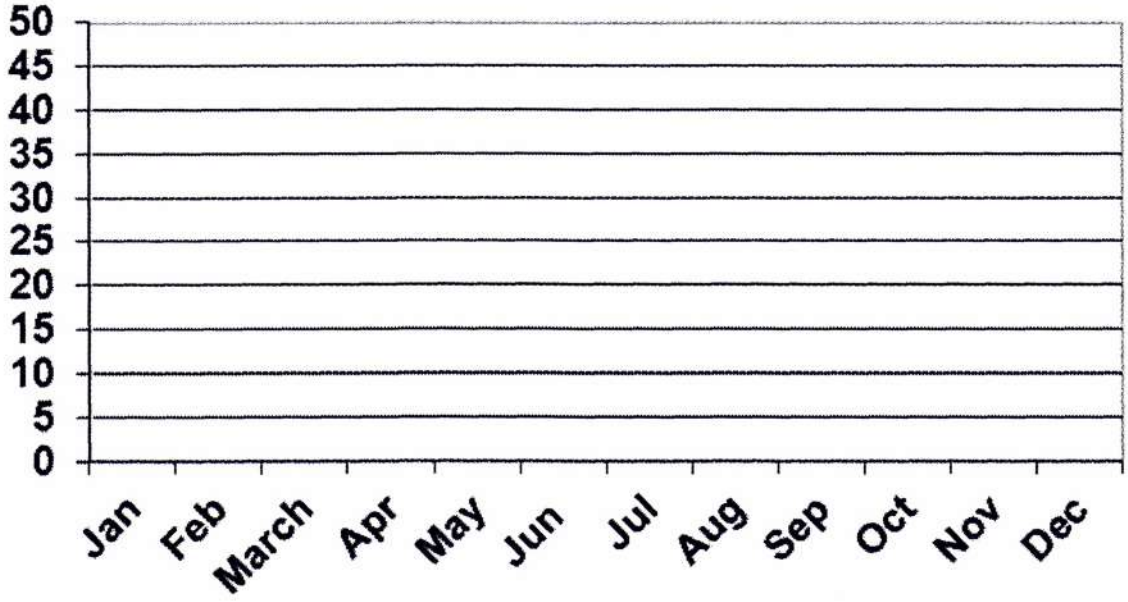
The number levelled off between (5)..... and the 18th. A sudden (6)..... followed – on the 19th 59 passengers used our service.

Next, the number fluctuated and on the 24th 60 passengers used MJN Air.

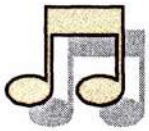
On the 27th, the number reached (7)..... . After that, there was a (8)..... (9)..... until the end of the month.

Listening 4

Ex. 53 Listen to the recording and draw the graph.



Now turn to the Key at the end of the book to check if you were right.



Listening 5

Ex. 54 Listen to the recording and answer the following questions.

1. What is the topic of the graph?
2. What happened with the number between 2000 and 2002?
3. What happened in 2005?
4. Why did the number reach the peak in 2006?
5. When did the number reach its lowest point?

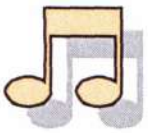
Ex. 55 Read the text and put the words from the box in the gaps. There are two words you do not need to use! Listen to the recording and check your answers[15].

decline, dramatic, dropping, fluctuations, peak, plummeted, remained, rose, steady

The line graph shows the sales of pickup trucks in the USA during one decade between 2000 and 2010. From 2000 to 2002, the number of sold vehicles remained **1**____ at the level of 200,000. After that the figure **2**____ steadily and reached 450,000 in 2004, before **3**____ slightly in 2005. Due to a high market

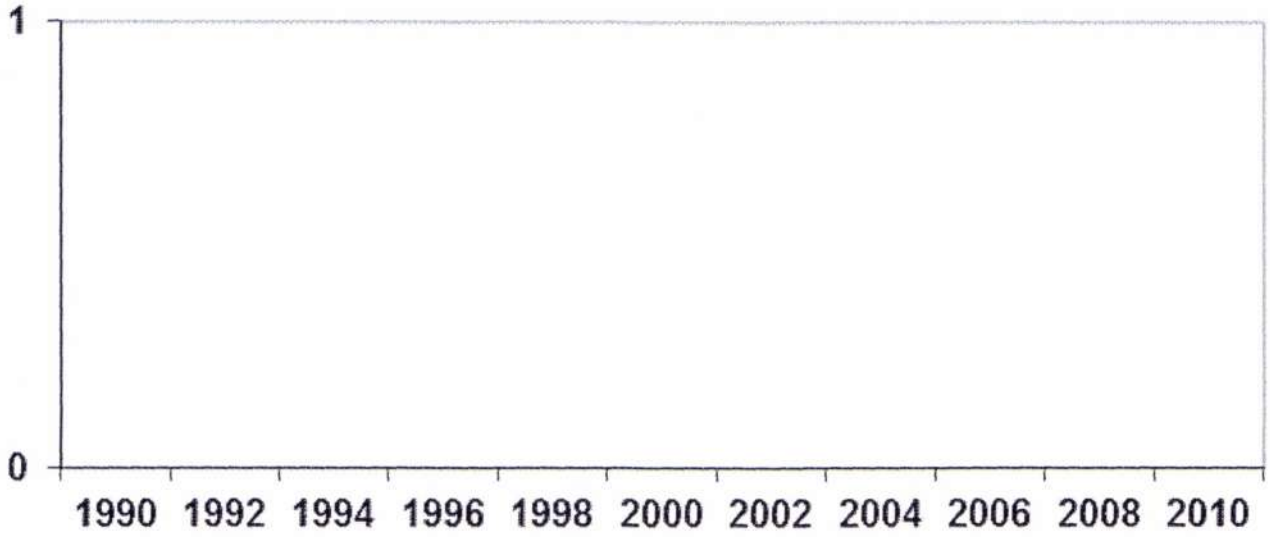
[15] Adapted from [www.eslflow.com, Oct 2014].

demand, a **4**____ increase was noticed and the sales reached a peak in 2006. As the demand decreased, a gradual **5**____ was observed during the next year when the figure went down to a lower level of 500,000 and **6**____ constant for two years. During the last year the sales **7**____ and reached the lowest point in 2010. This dramatic fall coincided with the beginning of the economic crisis in the USA.



Listening 6

Ex. 56 Listen to the recording and draw the graph[16].



Ex. 57 Read the text and put the words from the box in the gaps. <u>There are three words you do not need to use!</u> Listen to the recording and check your answers.

at, between, dropped, fluctuations, from, levelled off, gradually, reaching, rose by, rise, stood

The following graph shows **1**____ in the price of New Zealand meat from 1990 to 2010. It can be seen that within the span of 20 years the price fluctuated greatly.

In 1990, the price of New Zealand meat **2**____ at $1.98 per a kilogram. It then **3**____ 20 cents in 1992 before falling back **4**____ to $2.14 in 1996. There was a sharp increase over the next two years, with the price of meat **5**____ a

[16] Adapted from [www.eslflow.com, Oct 2014].

peak of $5.13 in 1998. This year was the best for New Zealand's export since the mid-1970s. From 1999 to 2004 the price fluctuated **6**___ a high of $3.20 and a low of $2.75, but then rose substantially to $4.60 in 2006. For the next two years, the price **7**___ gradually and reached $3.60 in 2008. Finally, the price **8**___ and at the end of the period amounted to $3.55.

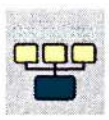
2. MISCELLANEOUS EXERCISES

MATCHING

Ex. 58 Match the words to their definitions:

1. Combinatorics
2. Probability
3. Matrix
4. Function
5. Calculus
6. Vector
7. Derivative
8. Abstract algebra

[___] a. a quantity, i.e. force that has a direction as well as size
[___] b. the mathematics of discretely structured problems
[___] c. a rectangular array of numbers with columns and rows
[___] d. is the measure of the likeliness that an event will occur
[___] e. a relation between a set of inputs and a set of permissible outputs where each input is related to exactly one output
[___] f. the part of mathematics that deals with changing quantities
[___] g. at a chosen input value, it is a linear approximation of a function near that input value
[___] h. the study of algebraic structures such as groups, rings, modules, etc.



GAP-FILL EXERCISE

Ex. 59 Complete the statements below with the correct words from the list[17]:

one-to-one **range** **inverse** **domain** **real** **inflection**

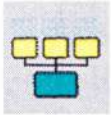
[17] Adapted from: [Krukiewicz-Gacek, Trzaska, 2010, p. 72-73].

1. A(n) _____ of the function is the set of all acceptable inputs.
2. A(n) _____ of the function is the set of all acceptable outputs.
3. A(n) _____ point is the point where the graph presenting the function changes concavity.
4. A(n) _____ function is a rule that assigns a unique real number to each number in a specified set of real numbers.
5. A(n) _____ function is one in which different elements in the domain should always give different values of f.
6. A(n) _____ function is a function that is derived from the given function by interchanging the two variables.

TRUE/FALSE

Ex. 60 State whether the following statements are true (T) or false (F):

1. A matrix is defined as a scalar. [___]
2. A matrix that has m rows and n columns is referred to as an $m \times n$ matrix. [___]
3. A square matrix is a unique matrix. [___]
4. Two matrices are equal if they have the same number of rows and column. [___]
5. Rows are matrix elements that appear horizontally. [___]
6. The inverse of a matrix exists when its determinant is nonzero. [___]



GAP-FILL EXERCISE

Ex. 61 Supply the missing preposition:

1. Multiply a row ___ a real number
2. Simplify a 4 × 4 matrix ___ to several 2 × 2 matrices
3. x times second derivative ___ y plus c
4. solve an equation ___ an unknown
5. substitute a certain value ___ the other equation
6. check the solution ___ substituting the values…

MATCHING

Ex. 62 Place the following words in the appropriate columns:
row reduction, composite, periodic, expand, continuous, linear, elements, odd/even, quadratic scalar, determinant, coefficient, derivative, triangular form

Matrices	Functions

MATCHING

Ex. 63 Match the following names of functions to their descriptions:

1. a continuous function [ ]
2. a monotone function [ ]
3. a quadratic function [ ]
4. a power function [ ]
5. a trigonometric function [ ]
6. an exponential function [ ]
7. a logarithmic function [ ]
8. an inverse trigonometric function [ ]

a. $y = \text{arc sin } x$
b. continuous at all points of its domain
c. $y = ax^2 + bx + c$
d. increasing: $f(x_2) \geq f(x_1)$ or decreasing: $f(x_2) \leq f(x_1)$
e. $y = ax^n$
f. $y = a^x$
g. $y = \sin x$
h. $y = \log_a x$

TRUE/FALSE

Ex. 64 State whether the following sentences are true:

Set theory

1. A set is well defined collection of objects. [___]
2. The objects that make up a set are called pieces. [___]
3. In order to specify the elements of a set one can use either an intentional or extensional definition. [___]
4. The extensional definition is denoted by square brackets. [___]
5. If a is a member of B, this is denoted by a $\in$ B. [___]
6. If set A is contained in B, then A is a subdivision of B. [___]
7. The relation between sets called inclusion (or containment) is represented by the sign $\subseteq$. [___]
8. The fundamental operations for constructing new sets from given sets are: unions, intersections and complements. [___]

3. TAPE SCRIPTS

Listening 1

The graph presents the annual sales of umbrellas in the UK. It is shown clearly that the sales fell steadily in the first half of the year – that is from January to May – and hit the lowest level in June. This gradual fall is attributed to the low level of precipitation that took place during that time. Next, a particularly rainy summer resulted in the rise in sales. They rocketed in July and levelled off in August. After rising significantly in September, they suffered a dramatic decrease in October due to a spell of good weather in that month but then the sales made a spectacular recovery in November. However, the year ended with a slight downturn.

Therefore, the sales of umbrellas decreased in the first part of the year and then rose significantly in the second part which may be considered as a standard turnover for that particular product.

Listening 2

The line graph shows the rate of unemployment in Poland between January 2010 and December 2011. It is clear from the chart that the rate of unemployment fluctuated a great deal during this time. At the beginning of the period, the unemployment rate stood at 9.1 per cent. The figure rose slightly for six consecutive months and from July until November 2010 it remained stable. From this point on there was a rapid downward trend and by January 2011 the rate had fallen to 5.9 per cent. This spectacular drop resulted from the government's new regulations concerning employment in the public sector. That rate remained constant for two months. From April 2011 onwards, there was a significant increase in the rate of unemployment in Poland. From April 2011 to June, the figure shot up and then remained stable for three months. However, due to the crisis in the Euro zone, the rate of unemployment increased sharply again, and reached a peak in December 2011.

Listening 3

This line graph illustrates the monthly fluctuation in the number of passengers who travelled from Poznan to Bristol with one of the leading low-cost airlines. It is clear from the graph that the busiest time for the airline was the beginning and the end of the month.

The number of passengers on the 1st and 2nd was low but then rose sharply on the 4th, and remained steady for 5 days. After that, the number of passengers decreased and reached the lowest point on the 11th. A slight increase can be observed between 12th and 15th. In the middle of the month the number of passengers levelled off for three days between the 16th and the 18th, to drop suddenly on the 19th. For the next 5 days the number of passengers fluctuated considerably and reached a similar level on the 24th as it had been on the 19th. Then the number rocketed and reached the highest point on the 27th. Following that spectacular rise, the number of passengers decreased gradually until the end of the month.

Listening 4

The graph shows the Facebook dollar share price from January to December 2011 which fluctuated markedly during the period within the $20 to $45 range, though there was an overall increase which started in January 2011 at about $21 and finished in December at roughly $28.

The first 3 months saw a rapid increase in the share price, from the abovementioned $21 to almost $30 in March 2011 due to a successful marketing campaign. Then the share price suffered a steady decline which continued until June with just under $25 per a share. However, the share price rocketed and reached a peak of $45 in July 2011. During the next two months the price

dropped to the level of $28 in September 2011 but then recovered again to over $35 in October 2011. It began to decline gradually again thereafter towards the end of the period.

Listening 5

The line graph shows the sales of pickup trucks in the USA during one decade between 2000 and 2010. From 2000 to 2002, the number of sold vehicles remained steady at the level of 200,000. After that the figure rose steadily and reached 450,000 in 2004, before dropping slightly in 2005. Due to a high market demand, a dramatic increase was noticed and the sales reached a peak in 2006. As the demand decreased, a gradual decline was observed during the next year when the figure went down to a lower level of 500,000 and remained constant for two years. During the last year the sales plummeted and reached the lowest point in 2010. This dramatic fall coincided with the beginning of the economic crisis in the USA.

Listening 6

The following graph shows fluctuations in the price of New Zealand meat from 1990 to 2010. It can be seen that within the span of 20 years the price fluctuated greatly.

In 1990, the price of New Zealand meat stood at $1.98 per a kilogram. It then rose by 20 cents in 1992 before falling back gradually to $2.14 in 1996. There was a sharp increase over the next two years, with the price of wool reaching a peak of $5.13 in 1998. This year was the best for New Zealand's export since the mid-1970s. From 1999 to 2004 the price fluctuated between a high of $3.20 and a low of $2.75, but then rose substantially to $4.60 in 2006. For the next two years, the price dropped gradually and reached $3.60 in 2008. Finally, the price levelled off and at the end of the period amounted to $3.55.

KEY

Ex. 1: 1b, 2f, 3c, 4g, 5e, 6i, 7a, 8d, 9l, 10h, 11j, 12k.

Ex. 2:

1. six hundred (and) seventy five
2. thirty seven point eighty nine
3. seven thousand, eight hundred (and) sixty five
4. nine hundred eight thousand, seventy six
5. eight hundred (and) ninety seven point sixty five
6. one million, two hundred nine thousand, three hundred (and) ninety four
7. three hundred twenty four million, one hundred thousand, nine hundred and ninety
8. seventy seven thousand, five hundred (and) forty three
9. one hundred billion, five hundred seventy six million, one hundred ninety two thousand, two hundred
10. five hundred nine million, four hundred eighty nine thousand, ninety nine.

Ex. 3: 1. T, 2. T, 3. F, 4. T, 5. F, 6. T, 7. T, 8. F.

Ex. 4: 1a, 2b, 3a, 4b.

Ex. 5: 1b, 2h, 3d, 4f, 5c, 6g, 7i, 8a, 9j, 10e.

Ex. 6: 1. equals, 2. directly proportional, 3. the sum of a, 4. capital, 5. ratio, 6. variable, 7. absolute, 8. is not equal to, 9. in brackets, 10. braces, square, 11. less, greater, much.

Ex. 7: 1. divided, 2. rounded, 3. division, 4. operations, 5. Parentheses / brackets, 6. quotient.

Ex. 8: a19, b1, c17, d10, e8, f18, g14, h12, i7, j11, k15, l9, m6, n3, o16, p4, q5, r2, s13.

Ex. 9: 1b, 2a, 3f, 4c, 5e, 6d.

Ex. 10: 1. factor, 2. convert, 3. common denominator, 4. multiply, 5. improper, 6. reciprocal.

Ex. 11: 1d, 2c, 3b, 4f, 5g, 6a, 7e.

Ex. 12: 1. F, 2. F, 3. T, 4. F, 5. T, 6. T, 7. F, 8. F, 9. F.

Ex. 13: 1h, 2d, 3a, 4e, 5b, 6i, 7c, 8g, 9d.

Ex. 14: Student B:

1. One hundred to the power of minus 1
2. k squared times/multiplied by m to the power of 4 minus c
3. The square root of x equals p over m (divided by m)
4. a to the power of zero equals 1 when a is not equal to zero
5. The logarithm of x to the base b

6. x to the n-th (the power of n) minus 9, open brackets n minus 1, close brackets is equal to the n-th root of b
7. The fourth root of x equals capital k
8. A to the power of n equals five eighths plus the square root of b minus b.

Ex. 15: 1. subscript, 2. cubic, 3. raising, 4. superscript, index, 5. equal, 6. power, 7. base, 8. power, base, 9. common, 10. add.

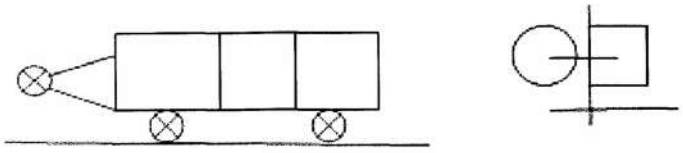
Ex. 16: 1c, 2a, 3e, 4d, 5h, 6.f, 7b, 8j.

Ex. 17: 1d, 2h, 3f, 4i, 5e, 6c, 7a, 8g, 9b.

Ex. 18: 1. segment, 2. extends, 3. acute, 4. right, 5. obtuse, 6.straight, 7. full, 8. vertex.

Ex. 19: a1, b3, c4/5, d2, e4/6, f3/6.

Ex. 20: exemplary drawings: student A and student B



Ex. 21: 1. acute, 2. right, 3. scalene, 4. obtuse, 5. equilateral, 6. three-sided, 7. vertex, 8. endpoints.

Ex. 22: 1. T, 2. F, 3. T, 4. T, 5. F, 6. F, 7. T.

Ex. 23: 1f, 2c, 3d, 4b, 5a, 6e.

Ex. 24: 1. cube, 2. cone, 3. sphere, 4. tetrahedron, 5. pyramid, 6. cylinder.

Ex. 25: 1. cylinder, 2. radius, 3. height, 4. circle, 5. equal, 6. brackets.

Ex. 26: 1. volume, 2. area, 3. height, 4. perpendicular, 5. polygon, 6. cone, 7. radius, 8. power.

Ex. 27: 1. sphere, 2. cylinder, 3. height, 4. radius, 5. divided, 6. cubed, 7. squared.

Ex. 28: a. diagram, b. flow, c. pie, d. bar, e. line graph, f. table.

Ex. 29:

A) 1. line graph, 2. pie chart, 3. flow chart, 4. bar chart, 5. table, 6. diagram

B) 1. pie chart, 2. flow chart, 3. line graph, 4.table, 5. bar chart.

Ex. 30: 1. level off, 2. Fluctuate, 3. stay constant / stable, 4. reach the lowest point, 5. reach a peak, 6. upward trend, go up, grow, increase, rise, 7. rocket, soar, 8. fall, decrease, decline, drop, downward trend, go down, 9. nosedive, plummet.

Ex. 31:

Increase	Decrease
growth *n*	plunge *v*
recovery *n*	shrink *v*
jump *v*	plummet *v*

a. growth – to grow
recovery – to recover
b. considerable growth; spectacular recovery; jumped unexpectedly
considerable and spectacular are adjectives and they modify nouns
unexpectedly is an adverb and it modifies a verb.

Ex. 32: nouns: increase, decrease, jump, rise, drop, fall, fluctuation, growth, decline, recovery, slump; verbs: decrease, increase, rise*, fall*, soar, jump, rocket, drop, plummet, slump, level off, fluctuate, stay constant / stable, reach, grow*, decline, go*, nosedive, recover, shrink*, plunge
*rise – rose – risen; fall – fell – fallen; grow – grew – grown; go – went – gone; shrink – shrank – shrunk.

Ex. 33: degree of change: considerable, dramatic, gentle, moderate, sharp, slight, substantial; speed of change: gradual, rapid, slow, steady, swift, quick; possible additional words: sudden, steep, pronounced, marked.

Ex. 34: degree: a. dramatic; b. considerable, significant, sharp, substantial; c. moderate; d. slight, gentle
speed: a. rapid, swift, quick; b. gradual, steady; c. slow.

Ex. 35: slight – slightly, sharp – sharply, dramatic – dramatically, steady – steadily
Adjectives and adverbs:
Adjectives modify nouns and they come before the word they describe.
Adverbs modify verbs and they come after the word they describe.

Ex. 36: 1, 2, 3. OK, 4. substantially, 5. rapidly, 6. OK, 7. steady, 8, 9, 10, 11, 12. OK, 13. a, 14. OK, 15. sharp, 16. OK, 17. steady, 18. OK

Ex. 37:

1. There was a drop / decrease / decline / fall of 34% in the sales of Ikea chairs.
2. Car export fell / decreased / dropped / declined by 41%.
3. The import of bananas rose / increased from $13,000 to $17,000.
4. Traffic has risen / increased by 8% since last year.
5. There was a decline / drop / decrease of 35% in oil reserves in the Gulf countries.

Ex. 38: 1. decreased/fell/declined/dropped/shrank, 2. remained steady, 3. soared/rocketed, 4. reached the peak, 5. drop/decline/decrease/fall, 6. rise, 7. leveled.

Ex. 39: 1. at; 2. to; 3. at; 4. of; 5. by; 6. of.

Ex. 40: 1. are looking, 2. fell, 3. began, 4. decreased, 5. has levelled off, 6. won't reach, 7. remains, 8. is rising, 9. has been, 10. are now making.

Ex. 41: A. rise, B. steadily, fallen, C. rapidly, remained, D. steadily, E. increase, decline/drop/decrease.

Ex. 42: 3 – press,
1 – Internet,
2 – TV.

Ex. 43: 1. decrease, 2. stood at, 3. fell, 4. recovered, 5. significant, 6. reached, 7. steadily.

Ex. 44: 1. to introduce the topic, 2. economy has an influence on birth rate, 3. newborn, attribute, coincide with, repercussion

1. the roaring twenties (*in the 1920s a noticeable recovery can be observed*); 2. The great depression (*this number plummeted and hit a low of 18 newborns in the middle of the 1930s*); 3. Baby boom (*the birth rate rose gradually but just after the Second World War the number jumped suddenly;*) 4. 1970s oil crisis (*The birth rate leveled off during this decade but from the 1960s it decreased substantially and in the 1970s it reached a lower level than during the Great Depression*); 5. recession (*from 1995 the birth rate declined steadily and in 2008 it fell rapidly again*).

Ex. 45: a. / There / was a fluctuation in the birth rate during this time; b. Unexplained variations in the sun's activity have been noticed by astronomers; c. There was a gradual rise in the birth rate during this time; d. American economy grew slowly in the second quarter; e. There was an increase of 250% in electronic goods import from China to the EU in the first six months of 2012 compared with the same period 2002; f. Retail sales fell in October.

Ex. 46: 1. On Wednesday my work fell rapidly because I had no classes. 2. On Thursday my work remained the same because I had no classes. 3. On Friday my work rose substantially because I had two classes but no testes. 4. During the weekend my work dropped gradually because I had a free weekend but I had to do housework.

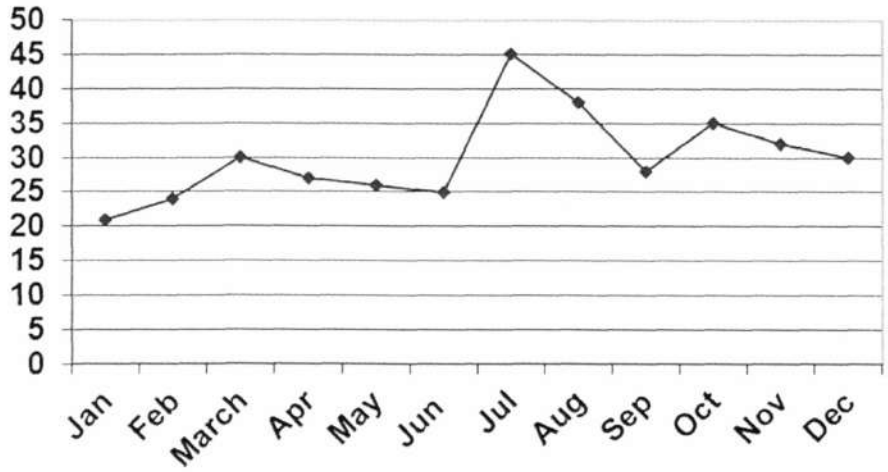
Ex. 49: 1. T; 2. T; 3. F; 4. F.

Ex. 50: 1. steadily, 2. fall, 3. rise, 4. rocketed, 5. levelled, 6. dramatic, 7. slight.

Ex. 51: 1. F – 2 years, 2. T; 3. F – it rose steadily, 4. T; 5. T; 6. F – it rose significantly, 7. F – it reached a peak.

Ex. 52: 1. Bristol; 2.rose; 3. remained steady; 4. slight; 5. the 16th; 6. drop; 7. the peak / the highest point; 8. gradual; 9. Decrease.

Ex. 53:

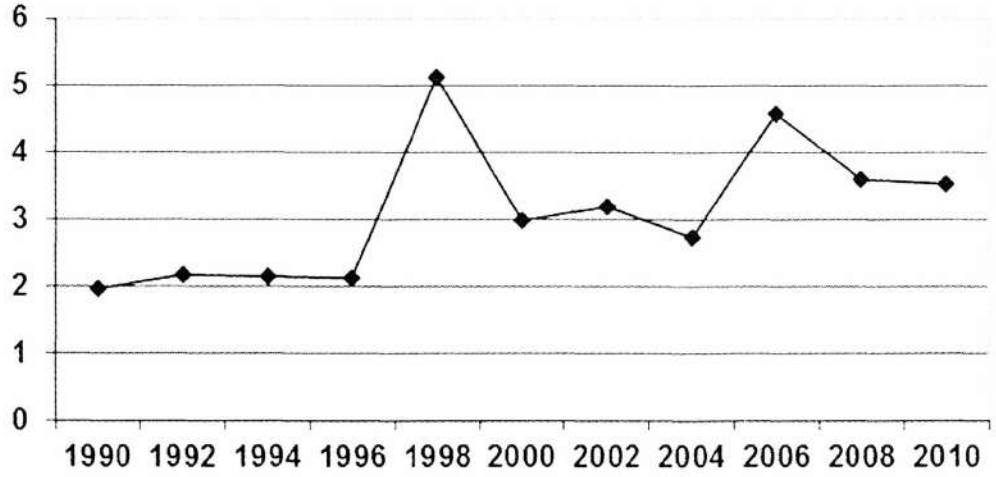


Ex. 54: 1. The sales of pickup trucks in the USA; 2. The number remained

steady at 200,000; 3. The number dropped slightly; 4. Due to high market demand; 5. In 2010.

Ex. 55: 1. steady; 2. rose; 3. dropping; 4. dramatic; 5. decline; 6. remained; 7. plummeted.

Ex. 56:



Ex. 57: 1. fluctuations; 2. stood; 3. rose by; 4. gradually; 5. reaching; 6. between; 7. dropped; 8. levelled off.

Ex. 58: 1b, 2d, 3c, 4e, 5f, 6a, 7g, 8h.

Ex. 59: 1. domain, 2. range, 3. inflection, 4. real, 5. one-to-one, 6. inverse.

Ex. 60: 1. F, 2. T, 3. F, 4. F, 5. T, 6. T.

Ex. 61: 1 by, 2 down, 3 of, 4 for, 5 into, 6 by.

Ex. 62: Matrices: row reduction, expand, scalar, determinant, coefficient, elements, triangular form.
Functions: composite, periodic, continuous, derivative, linear, odd/even, quadratic.

Ex. 63: 1b, 2d, 3c, 4e, 5g, 6f, 7h, 8a.

Ex. 64: 1. T, 2. F (elements or members), 3. T, 4. F (curly brackets or braces), 5. T, 6. F (A is a subset), 7. T, 8. T.

GLOSSARY

A

acute [əˈkjuːt] – ostry
acute angle – kąt ostry
add – dodać
addition – dodanie, dodawanie
algebraic substitution – podstawienie algebraiczne
amount – ilość
angle [ˈæŋgəl] – kąt
angle of intersection – kąt przecięcia
antiderivative – całka nieoznaczona, funkcja pierwotna
apply [əˈplaɪ] – zastosować
approximate(ly) – przybliżony, (w przybliżeniu)
area – obszar, powierzchnia
assumption – założenie, przypuszczenie
augmented [ɔːgmenˈtəd] matrix – macierz rozszerzona
axis – oś (geometryczna)

B

back-substitution – podstawianie
bar – słupek
base – podstawa
basic [ˈbeɪsɪk] – podstawowy
binary – dwójkowy
bounded from above / below – ograniczony z góry / z dołu

C

calculation – obliczenia, kalkulacja
chord [kɔːd] – cięciwa
circle [ˈsɜːkəl]– koło
circular – okrągły, kolisty
circumference [səˈkʌmferəns] – obwód
climb – wspinać się
coefficient – współczynnik
combine – połączyć, powiązać
common logarithm – logarytm zwykły / dziesiętny
concave [ˌkɒnˈkeɪv] – wklęsła
condition – warunek
congruent [ˈkɒngruənt] – przystawalny
coordinate – współrzędna
corner – róg, narożnik
considerable – znaczny
cosine – kosinus
constant – stały, niezmienny

cotangent – kotangens
cube – sześcian, kostka
cubic – sześcienny
cubic equation – równanie trzeciego stopnia
cuboid – prostopadłościan
curve(d) [kɜ:v] – krzywa (zakrzywiony)
cylinder – walec

D
decagon – dziesięciobok
decimal ['desıməl] – dziesiętny
decimal point – przecinek (w ułamku dziesiętnym)
decline – spadać, opadać
decrease – maleć, spadek
define [dı'faın] – definiować, określać
definite – określony
definition – definicja
degree – stopień
denominator – mianownik
depth ['depθ] – głębokość
derivative – pochodna
determinant – wyznacznik
diagram ['daıəgræm] – diagram
diameter [daı'æmətə] – średnica
differentiable [ˌdıfə'renʃəbəl] function – funkcja różniczkowalna
differentiation – różniczkowanie
digit – cyfra
dimension – wymiar
direction – kierunek
divide [də'vaıd] – dzielić
division – dzielenie
domain [də'meın] of a function – dziedzina funkcji
domain of a variable ['veəriəbəl] – dziedzina zmiennej
downward – w dół, ku dołowi
dramatic – dramatyczny
drop – spadać, zmniejszać się; spadek

E
elicit [ı'lısət] – uzyskać
equation – równanie
endpoint – punkt końcowy
equation – równanie
equiangular [ˌı:kwə'æŋgjələ] – równokątny
equilateral triangle – trójkąt równoboczny
error – błąd
even number – liczba parzysta
expand a matrix – rozłożyć macierz

explicit [ɪksˈplɪsət] function – funkcja jawna
expression – wyrażenie
exterior angle – kąt zewnętrzny
extract a root – wyciągać pierwiastek

F
factor – czynnik
factorial – silnia
fall – opaść, obniżyć się, spaść; upadek, spadek
flow (chart) – schemat blokowy
fluctuate [flʌkʃueɪt] – wahać się
fluctuation – wahanie
formula – wzór
fraction – ułamek
full angle – kąt pełny

G
gentle – łagodny
geometric / geometrical – geometryczny
gradual – stopniowo
graph – graf, wykres
greatest common factor /divisor – największy wspólny dzielnik
grow – rosnąć

H
height [haɪt] – wysokość
heptagon – siedmiokąt
hexagon – sześciokąt
horizontal – poziomy
hypotenuse [haɪˈpɒtənju:z] – przeciwprostokątna

I
identity [aɪˈdetətɪ] matrix – macierz jednostkowa
imaginary number – liczba urojona
implicit [ɪmˈplɪsət] function – funkcja zawiła / uwikłana
improper fraction – ułamek niewłaściwy
increase – wzrastać, rosnąć; wzrost
indefinite – nieoznaczona
index – wykładnik
inequality – nierówność
infinity – nieskończoność
initial side of an angle – ramię początkowe kąta
integer – liczba całkowita
integral – całka
integral sign – znak całkowania
integrand – funkcja podcałkowa
interior angle – kąt wewnętrzny

interval – przedział
invalid fraction – ułamek niewłaściwy
inverse matrix – macierz odwrotna
inverse number – liczba odwrotna
irrational number – liczba niewymierna
isosceles [aɪˌsɒsəliːz] triangle – trójkąt równoramienny

J
jump – skoczyć; skok

L
lateral face – wysokość ściany bocznej
LCD (the least common denominator) – najmniejszy wspólny mianownik (w ułamkach)
level off – stabilizować się
line segment – odcinek
linear ['lɪnɪə] equation – równanie liniowe

M
matrix (pl. matrices) – macierz
moderate – umiarkowany
multiple ['mʌltəpəl] – wielokrotność
multiplication – mnożenie
multiplier – mnożnik
multiply ['mʌltəplaɪ] – mnożyć

N
natural logarithm – logarytm naturalny
natural number – liczba naturalna
naught/nought [nɔːt] – zero
negative number – liczba ujemna
nonagon – dziewięciokąt
nosedive ['nəʊzdaɪv] – spadek (nieoczekiwany, nagły)
number – liczba
numeral – cyfra

O
obtuse [əb'tjuːz] angle – kąt rozwarty
octagon – ośmiokąt
odd numer – liczba nieparzysta
operation – działanie, operacja
opposite numer – liczba przeciwna
ordinal numer – liczba porządkowa
ordinate ['ɔːdəneɪt] – rzędna

P
paralel – równoległy
parallelogram – równoległobok

peak [pi:k] – szczyt, najwyższa wartość
pentagon – pięciokąt
perimiter [pəˈrɪmətə] – obwód
periodic function – funkcja okresowa
perpendicular [ˌpɜ:pənˈdɪkjʊlə] – prostopadły
pie (chart) – wykres kołowy
plane – płaszczyzna
plummet [ˈplʌmət] – gwałtownie spaść, pogorszyć się, obniżyć
positive numer – liczba dodatnia
prime [praɪm] numer – liczba pierwsza
prism – graniastosłup
product – iloczyn
proper fraction – ułamek właściwy
protractor – kątomierz
pyramid – ostrosłup
Pythagorean [ˌpəθəˈgɒriən] theorem – twierdzenie Pitagorasa

R

radius [ˈreɪdiəs] – promień
raise a number to a power – podnieść liczbę do potęgi
rapid – gwałtowny
ray – półprosta (*fiz.* promień)
real number – liczba rzeczywista
rectangle – prostokąt
rectangular [rekˈtæŋgjələ] – prostokątny
rectangular matrix – macierz prostokątna
recurring [ˌrɪˈkɜ:rɪŋ] decimal – ułamek dziesiętny okresowy
reduce to lower terms – skrócić (uprościć ułamek)
reflex angle – kąt wklęsły
regular polygon – wielokąt foremny
repeating decimal – ułamek dziesiętny okresowy
resolve a vector – rozkładać wektor na składowe
rhombus [ˈrɒmbəs] – romb
right angle – kąt prosty
rise – wzrastać, wzrost
rocket – gwałtownie podskoczyć
root – pierwiastek
round – zaokrąglić (np. liczbę)
round angle – kąt pełny

S

satisfy an equation – spełnić równanie
scalene [ˌskeɪli:n] triangle – trójkąt nierównoboczny
sector – wycinek koła
set equal to zero – przyrównać do zera
sharp – ostry, gwałtowny
shrink – kurczyć się, zmniejszać

side – bok
significant – znaczny
slight – niewielki
slump [slʌmp] – zapaść się, obniżyć; obniżka
simultaneous [ˌsɪməlˈteɪnɪəs] equations – równania, które tworzą układ równań
sine [saɪn] – sinus
sine wave – sinusoida
soar [sɔ:] – gwałtwonie wzrastać, powiększać
solid – bryła
solution – rozwiązanie
solve an equation – rozwiązać równanie
sphere [sfɪə] – sfera, kula
square – kwadrat
square matrix – macierz kwadratowa
square root – pierwiastek kwadratowy
stable – stabilny
steady – równy, spokojny
straight angle – kąt półpełny
subset – podzbiór
substitution – podstawienie
substantial – duży, poważny, pokaźny
summation [səˈmeɪʃən] sign – znak sumy
surface area – powierzchnia figury przestrzennej
sudden – nagły
swift – szybki, natychmniastowy
system of equations – układ równań

T

table – tabela
take a root – wyciągnąć pierwiastek
tangent [ˈtændʒənt] – tangens
tangent (to) – styczna (z)
tetrahedron – czworościan
tetrahedral – czworościenny
theorem [ˈθɪərəm] – twierdzenie
trapezoid [ˈtræpəzɔɪd] – trapez
triangle [ˈtraɪæŋgəl] – trójkąt
two-dimensional – dwuwymiarowy

U

union of sets – suma zbiorów
unknown [ˌʌnˈnəʊn] – niewiadoma
upward – w górę

V

variable [ˈveəriəbəl] – zmienna
vector – wektor

vertex (pl.vertices or vertexes) – wierzchołek
vertical – pionowy
volume – objętość
vulgar ['vʌlgə] fraction – ułamek zwykły

Z

zero angle – kąt zerowy
zero matrix – macierz zerowa

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