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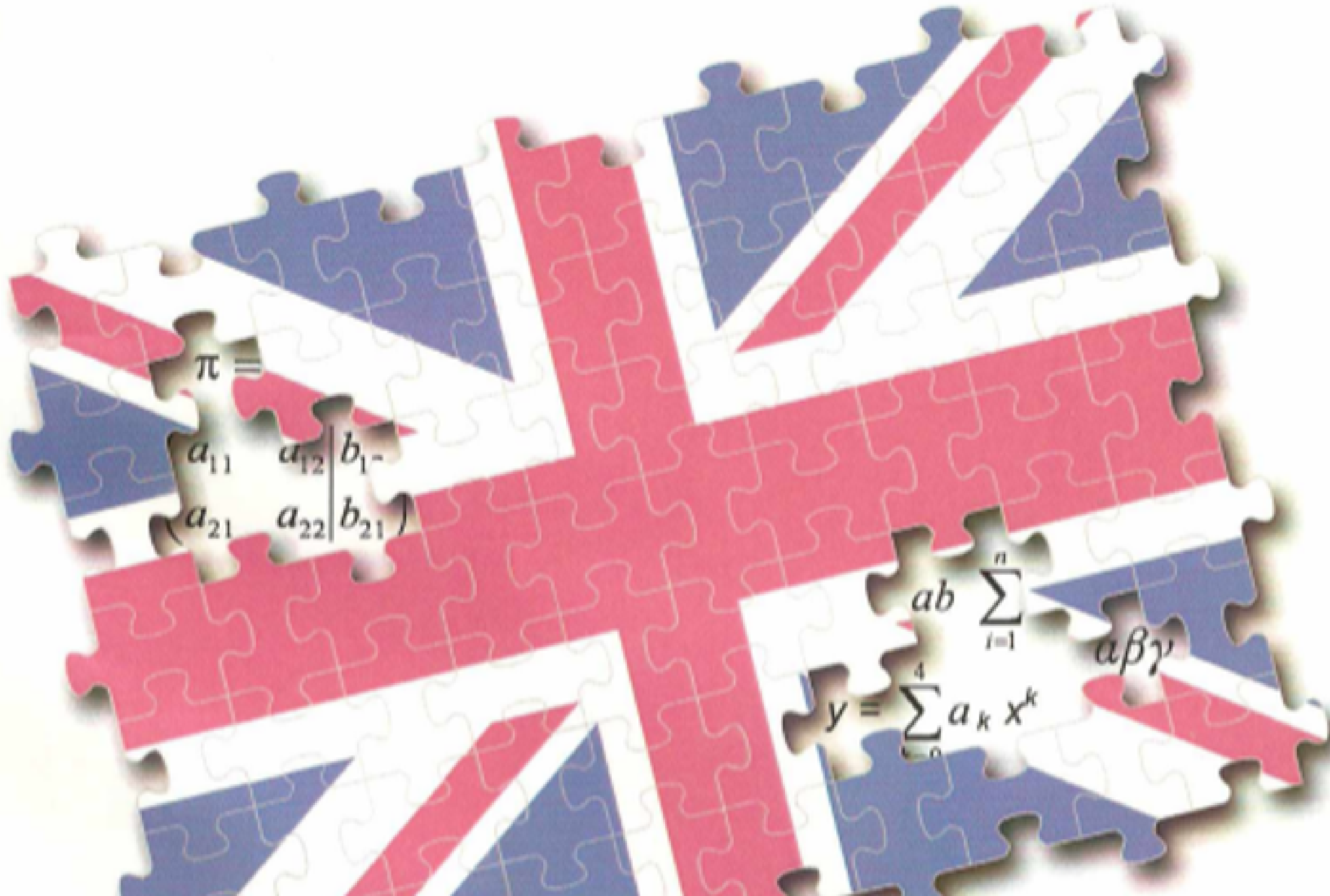
ANGLIČTINA PRO STUDENTY MFF UK



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VYDAVATELSTVÍ MATEMATICKO-FYZIKÁLNÍ FAKULTY
UNIVERZITY KARLOVY V PRAZE

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ÚVOD

Učebnice Angličtina pro studenty MFF UK není souhrnným pojednáním o charakteristikách odborného textu či snad diskursu matematické angličtiny. Jedná se o doplňkový materiál, který má studentům pomoci rozvíjet cizojazyčné řečové dovednosti (produktivní i receptivní) za použití textů z oblasti elementární a vyšší matematiky. Učebnice si rovněž klade za cíl seznámit studenty s vybranými oblastmi jazykového systému odborného matematického textu, zejména se specifiky anglické matematické terminologie a vybranými gramatickými jevy.

První část učebnice se věnuje jazyku akademickému. Každá lekce obsahuje úvodní texty, které byly excerpovány z autentických zdrojů a seznamují studenty s přirozenou povahou anglického matematického textu. Texty byly vybrány tak, aby studentům nečinila větší problémy jejich obsahová složka. Po osvojení příslušné terminologie by jim tedy měli porozumět a svou pozornost zaměřit na jazykové aspekty těchto textů. Gramatické jevy jsou doplněny podrobným výkladem s přihlédnutím ke specifikům matematického vyjadřování. Příkladové věty byly čerpány z řady autentických matematických textů. Výklad je vždy doplněn mluvnickými a lexikálními cvičeními tak, aby si studenti mohli učivo vždy řádně procvičit. V odborném diskursu není důležité vyjadřovat se jen srozumitelně a přiměřeně plynule, jak jsou studenti zvyklí z předchozích stupňů vzdělávání. Na vysoké škole si klademe cíle vyšší. Odborníci musí dbát na přesnost (accuracy) a vhodnost (appropriacy) vyjadřování. Přesnost, jasnost, jednoznačnost a relativní úplnost vyjádření jsou konstituující funkce odborného stylu. Studenti se budou muset k odborným tématům nejen „nějak" vyjádřit, ale budou muset své myšlenky formulovat dle zvyklostí profesionálů v daných oborech. To také znamená, že mnohdy budou muset potlačit některé své jazykové návyky (neformálnost vyjadřování) nebo emocionalitu sdělení.

Zvláštností učebnice je zejména skloubení různých metod a přístupů, které povedou k výše vytyčeným cílům. V každé lekci studenti naleznou cvičení čistě jazykové povahy, které se zaměřují na procvičení složek jazykového systému (mluvnice a lexika), ale zároveň cvičení povahy matematické. Jedná se například o slovní vyjádření symbolických matematických zápisů nebo dokonce řešení početních matematických úloh. Je nutno zde studentům připomenout, že účelem těchto cvičení není nalézt matematicky správné řešení takových cvičení. Je to samozřejmě žádoucí, nikoli však nezbytně nutné. Smyslem takových cvičení je si o matematických problémech povídat za použití cizího, v našem případě anglického jazyka. Pokud se tu a tam objeví v řešení chyba, lze ji využít k disputacím a k nácviku pro matematiky přirozené anglické konverzace. Apelujeme zde na studenty, aby v hodinách odborné angličtiny co nejvíce v cizím jazyce hovořili. I když jim to někdy možná připadá nedůležité a snad i zbytečné, nelze se jazyku bez aktivní mluvené produkce naučit (na rozdíl od matematiky, pro kterou je laboratoří především papír a pracovním nástrojem tužka).

Načrtnuté struktuře se vymyká pouze poslední sedmá lekce. Ta završuje první díl učebnice a studenti se v ní zaměří na rozvoj svých dovedností překladatelských. Účelem této lekce bude naučit se vyjadřovat vhodně v rámci komunikačních funkcí charakteristických pro odborný matematický diskurs, například správně formulovat definice, matematické věty a jejich důkazy. Úvodní text je proto doplněn svým zrcadlovým překladem. Studenti zde naleznou zásobník frází rozdělený dle výše zmíněných funkcí a jejich českých ekvivalentů. Všechna cvičení jsou v této kapitole založena na metodě kontrastivní, tedy na vzájemném srovnání češtiny a angličtiny. Zvláštní pozornost je věnována překladu gramatických kategorií, které pro češtinu nejsou typické, ale v anglickém textu se hojně objevují. Jedná se především o užití všudypřítomného pasíva a kondenzačních prostředků (infinitivu, gerundia a participia). Autoři učebnice věří, že studenti si uvědomí složitost procesu překládání a zároveň objeví i jeho krásu. V souladu s funkčním paradigmatem doporučujeme studentům, aby se v dalším studiu zbavili tyranie doslovného překladu. Je nutno mít na paměti, že při převodu cizojazyčného kódu nezachováváme nutně jen formu a obsah původního sdělení, ale především jeho komunikační funkci.

Druhá část učebnice se zaměřuje na jazykové prostředky, které by si studenti měli osvojit, pokud chtějí uspět na dnešním nekompromisně konkurenčním pracovním trhu. Tato část se zaměřuje na rozvoj praktických jazykových dovedností. Studenti se naučí psát životopis a průvodní dopis. Naleznou zde užitečné informace a četné rady k tvorbě prezentací v anglickém jazyce nebo pro popis grafů a statistik. V závěru učebnice studenti naleznou přehled matematické notace a její slovní vyjádření, důležité zkratky a akronyma, řeckou abecedu a anglosaský systém měr a vah.

Na závěr bychom rádi popřáli studentům, aby se jim s knihou dobře pracovalo. Věříme, že učebnice splní svůj účel a poskytne studentům dostatek příležitostí a impulzů tak, aby na Matematicko-fyzikální fakultě UK rozvinuli dostatečně své jazykové dovednosti a to i v oblasti natolik specifické, jakou je anglický matematický diskurs.

Autoři

CONTENTS

PART I
English for Academic Purposes

UNIT 1

FOCUS A

THE LONG ROAD TO CALCULUS

The origins of calculus go back over 2000 years to the work of the Greeks on areas and tangents. Archimedes (287-212 B.C.) found the area of a section of a parabola, an accomplishment that amounts in our terms to evaluating $\int_0^b x^2 dx$. He also found the area of an ellipse and both the surface area and the volume of a sphere. Apollonius (around 260-200 B.C.) wrote about tangents to ellipses, parabolas, and hyperbolas, and Archimedes discussed the tangents to a certain spiral-shaped curve. Little did they suspect that the "area" and "tangent" problems were to converge many centuries later. With the collapse of the Greek world, which had survived for a thousand years, it was the Arab world that preserved the works of Greek mathematicians. In its liberal atmosphere, Arab, Christian, and Jewish scholars worked together, translating and commenting on the old writings, occasionally adding their own embellishments.

It was not until the seventeenth century that several ideas came together to form calculus. In 1637, both Descartes (1596–1650) and Fermat (1601–1665) introduced analytic geometry. Descartes examined a given curve with the aid of algebra, while Fermat took the opposite tack, exploring the geometry hidden in a given equation. In this same period, Cavalieri (1598–1647) found the area under the curve $y = x^n$ for $n = 1, 2, 3, \dots, 9$ by a method the length of whose computations grew rapidly as the exponent increased. Stopping at $n = 9$, he conjectured that the pattern would continue for larger exponents. "What about the other exponents?" we may wonder. Before 1665 there were no other exponents. Nevertheless, it was possible to work with the function which we denote $y = x^{p/q}$ for positive integers p and q by describing it as the function y such that $y^q = x^p$. Wallis (1616–1703) found the area under the curve by a method that smacks more of magic than of mathematics. However, Fermat obtained the same result with the aid of an infinite geometric series.

The problem of determining tangents to curves was also in vogue in the first half of the seventeenth century. Descartes showed how to find a line perpendicular to a curve at a point P (by constructing a circle that meets the curve only at P); the tangent was then the line through P perpendicular to that line. Fermat found tangents in a way similar to ours and applied it to maximum-minimum problems. The stage was set for the union of the "tangent" and "area" techniques. Indeed, Barrow (1630–1677), Newton's teacher at Cambridge, obtained a result equivalent to the fundamental theorem of calculus, but it was not expressed in a useful form.

Newton (1642–1727) arrived in Cambridge in 1661, and during the two years 1665–1666, which he spent at his family's farm to avoid the plague, he developed the essential calculus – recognizing that finding tangents and calculating areas are inverse processes. The first integral table ever compiled is to be found in one of his manuscripts of this period. He also introduced negative and fractional exponents, thus demonstrating that such diverse operations as multiplying a number by itself several times, taking its reciprocal, and finding a root of some power of that number are just special cases of a single general exponential function a^x, where x is a positive integer, –1, or a fraction. Independently, however, Leibniz (1646–1716) also invented calculus. A lawyer, diplomat, and philosopher, for whom mathematics was a serious avocation, Leibnitz established his version in the years 1673–1676. To Leibnitz we owe the notation dx and dy, the terms "differential calculus" and "integral calculus", the integral sign, and the word "function".

It was to take two more centuries before calculus reached its present state of precision and rigor. The notion of a function gradually evolved from "curve" to "formula" to any rule that assigns one quantity to another. The great calculus text of Euler, published in 1748, emphasized the function concept by including not even one graph. In several texts of the 1820s, Cauchy (1789–1857) defined "limit" and "continuous function" much as we do today.

He also gave a definition of the definite integral, which with a slight change by Riemann (1826–1866) in 1854 became the definition standard today. So by the mid-nineteenth century the discoveries of Newton and Leibnitz were put on a solid foundation. In 1833, Liouville (1809–1882) demonstrated that the fundamental theorem could not be used to evaluate integrals of all elementary functions. In fact, he showed that the only values of the constant k for which $\int \sqrt{1-x^2}\ \sqrt{1-kx^2}\,dx$ is elementary are 0 and 1.

Still some basic questions remained, such as "What do we mean by area?" (For instance, does the set of points situated within some square and having both coordinates rational have an area? If so, what is this area?) It was as recently as 1887 that Peano (1858-1932) gave a precise definition of area – that quantity which earlier mathematicians had treated as intuitively given.

(From: Stein S. K.: *Calculus and Analytic Geometry*, pp. 218–219 - adapted)

Notice:

- the pronunciation and the stress of the words:
  infinite ['infinət] *definite* ['definət] *finite* ['fainait] *infinity* [in'finəti]
- the difference in meanings of the words *hypothesis* and *conjecture*:
  hypothesis [hai'poθisis] *(n)* – an idea or explanation for something based on known facts but not yet proved *(čes. hypotéza, předpoklad) – srov.: hypothesize* [hai'poθisaiz] *(v)*, *hypothetical* [ˌhaipəu'θetikəl] *(adj)*
  conjecture [kən'džekčə] *(n, v)* – a conclusion or opinion based on incomplete evidence, on the appearance of a situation rather than on proof *(čes. dohad, domněnka) – srov.: conjectural* [kən'džekčərəl] (adj)
- the difference in meanings of the words *ellipse* and *ellipsis*:
  ellipse (*pl.* ellipses) [i'lips/~iz] *(n)* – a term from geometry (*čes.* elipsa)
  ellipsis (*pl.* ellipses) [i'lipsiz/~i:z] *(n)* – a term from style, a series of dots that usually indicate an intentional omission of a word, sentence or whole section from the original text being quoted, an ellipsis can also be used to indicate an unfinished thought (...) (*čes.* v jazykovém a polygrafickém kontextu, elipsa, výpustka)
- inversion in "*Little did they suspect that the "area" and "tangent" problems were to converge many centuries later.*" (about inversion – see Unit 6)

Exercises

1. ***In the passage above find all the nouns which form their plurals irregularly and those that have only a singular or plural form. (Write their singular and plural forms if possible).***

2. ***Put into the singular form:***
   a) The experiments may confirm the hypotheses.
   b) Symmetric polyhedra are two polyhedra each of which is congruent to the mirror image of the other.
   c) Abscissae are horizontal coordinates in two-dimensional systems of rectangular coordinates.
   d) Rhombi are parallelograms with adjacent sides equal.
   e) DNA is stored in the nuclei of cells.
   f) The radii of these wheels are 30 cm.
   g) Students are writing their theses on black holes.
   h) The points where the axes (1) cut the ellipse are the vertices (2).
   i) Is the German language on the curricula at British schools?

3. *Choose the correct word for each of the following sentences and give the plural form. Each word may be used only once:*

(analysis, apex, crisis, criterion, formula, lemma, locus, maximum, medium, phenomenon)

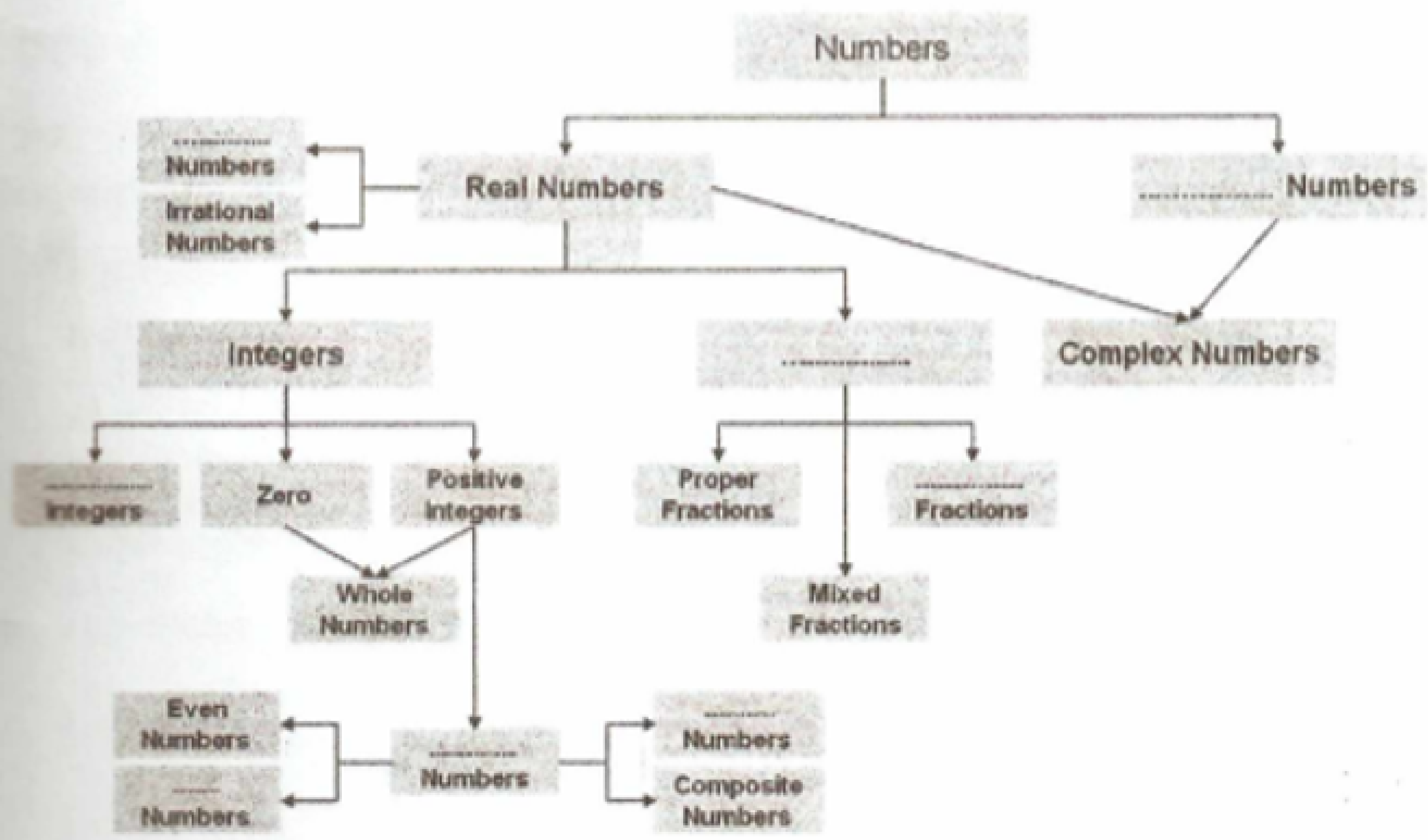
a) .... are the highest points relative to some lines or planes.
b) .... are observed events.
c) .... are decisive moments.
d) .... are channels of communication.
e) .... are theorems which are proved to be used in the proof of other theorems.
f) .... are standards or means of judging.
g) .... are general expressions for solving problems.
h) .... are separations of things into their parts or components.
i) .... of a set (as defined in set theory) are the greatest values in the set.
j) In geometry, ...are collections of points which share properties.

4. *Fill in a suitable expression in the correct form. Each form may be used only once:*

(crisis, criterion, datum, emphasis, focus, formula, matrix, nucleus, radius, spectrum)

a) Much ....has been given to the careful exposition of details.
b) We had to learn many chemical .... at school but I can only remember H_2O for water.
c) The .... was/were collected by various researchers.
d) The Health Service should not be judged by financial .... alone.
e) All the line segments extending from the centre of a circle are called ....
f) In the 17th century the word .... was introduced into optics, referring to the range of colours observed when white light was dispersed through a prism.
g) The sets of colours into which beams of light can be separated are called ....
h) I've passed several .... during my illness, but the fever's started to go down since yesterday.
i) Nuclear fission means the dividing of a .... (1) and nuclear fusion means the joining of the ....(2).
j) ....can only be added or subtracted if they have the same order.

5. *Complete the following diagram:*



State whether the following statements are true or false:

a) An integer is a rational number.
b) A rational is an integer.
c) A number is either a rational or an irrational, but not both.

Classify according to number type; some numbers may be of more than one type:

a) 0.45
b) 3.14159265358979323846264338327950288419716939937510...
c) 3.14159
d) 10
e) $^5/_3$
f) $1\,^2/_3$
g) –sqrt(81)
h) $^{-9}/_3$

6. ***Rewrite these expressions into mathematical symbols:***

a) *x* asterisk is approximately equal to point two one three
b) the modulus of *x* is less than or equal to *x* factorial
c) ten choose nine is equal to ten
d) *x* double-dashed is greater than *x* hat
e) binomial n over *k* does not equal the (*k* + 1)-th binomial coefficient of the (*n* + 1)-th degree

7. ***Read out the following notation (Fundamental Symbols and Combinatorics):***

a) $\left|\frac{a}{b}\right| = \frac{|a|}{|b|}$

b) $C_k(n) = \binom{n}{k} = \frac{n!}{k!(n-k)!}$

c) $a^* \geq \hat{a} \geq \tilde{a}$

d) $a \leq |a|$

e) $A = (5; +\infty)$

f) $a \approx 2.056$

g) $P(n) = n!$

h) $P'(k_1, k_2, k_3, \dots, k_n) = \frac{(k_1 + k_2 + k_3 + \dots + k_n)!}{k_1! \cdot k_2! \cdot k_3! \cdot \dots \cdot k_n!}$

i) $|a| - |b| \leq ||a| - |b|| \leq |a \pm b| \leq |a| + |b|$

j) $V_k(n) = \frac{n!}{(n-k)!}$

k) $|a| = |-a|$

l) $|x| > 5$

m) $x \leq 5$

n) $C'_k(n) = \binom{n+k-1}{k}$

8. ***Read the assignments below. Find solutions to the problems and explain the procedures:***

a) $\binom{10}{9} = ?$

b) $\binom{5}{0} = ?$

c) $V_3(5) = ?$

d) $P(3) = ?$

e) $C_2'(8) = ?$

9. ***Prove the following equalities:***

a) $\binom{n}{k} = \binom{n}{n-k}$

b) $\binom{n}{1} = n$

c) $\binom{n}{n} = \binom{n}{0} = 1$

d) $\binom{n}{k} + \binom{n}{k+1} = \binom{n+1}{k+1}$

e) $\binom{n}{k}\binom{k}{r} = \binom{n-r}{k-r}\binom{n}{r}$

f) $\binom{n+1}{k} = \dfrac{n+1}{n-k+1}\binom{n}{k}$

FOCUS B

GEOMETRY

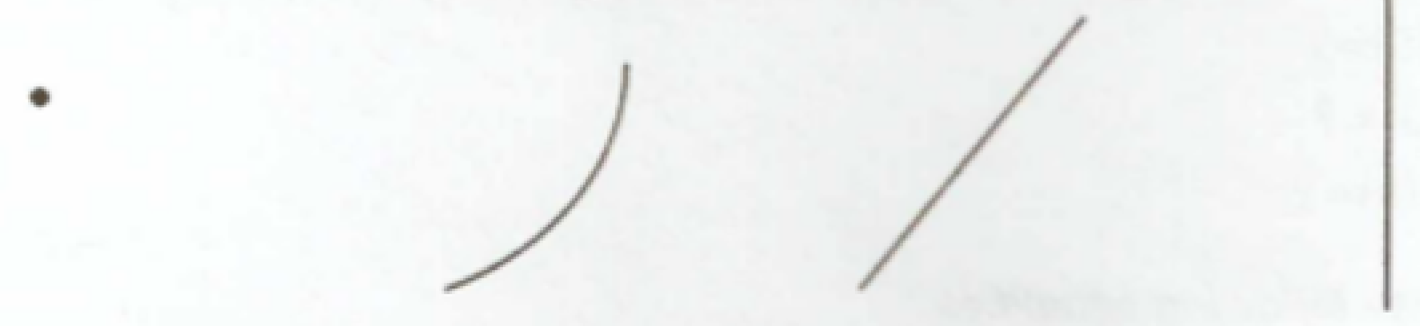
Fundamental signs:

$\parallel$	is parallel to
$\perp$	is perpendicular to
$\triangle$	a triangle
$\angle$	an angle
$\measuredangle$	a measured angle
$\sphericalangle$	a spherical angle
$\llcorner$	a right angle
$\circ$	a circle
$(\,.\,)$	coordinates
AB	a line
$\overrightarrow{AB}$	a ray
$\lvert x\text{-}y \rvert$	a distance
$^\circ$	a degree of an arc
$\cong$	is congruent to
$\approx$	is similar to
$\equiv$	is identical with
$'$	a minute
$''$	a second

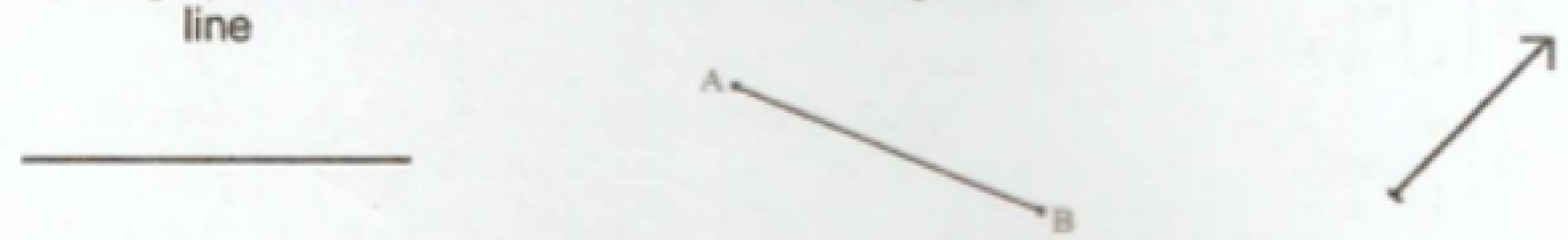
I. Lines

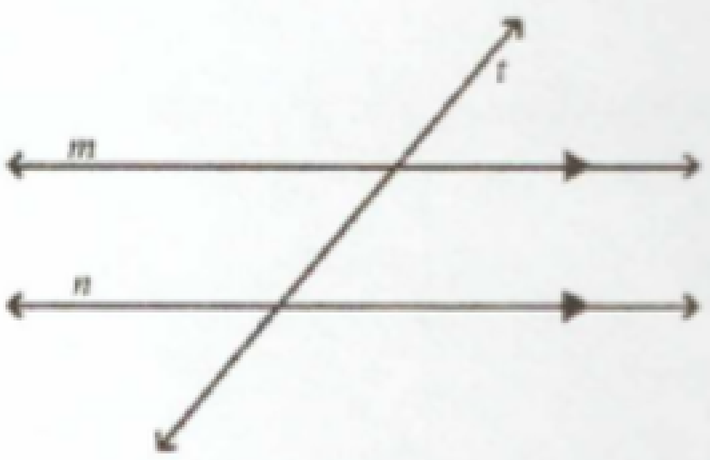
1. Look and read:

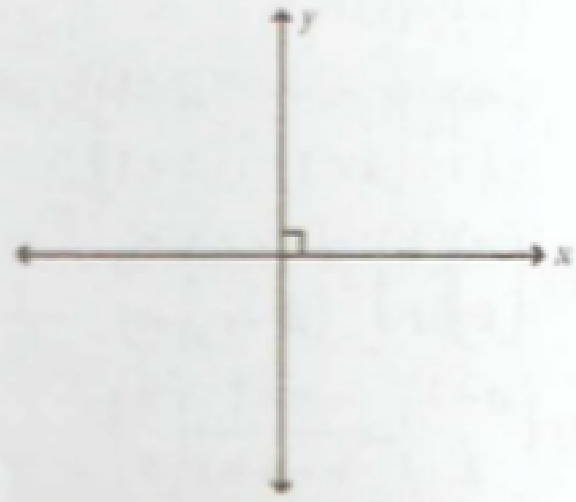
a *point* | a *curved* line (a *curve*) | an *oblique* line | a (straight) *vertical* line



a (straight) *horizontal* line | a *line segment* | a *ray*



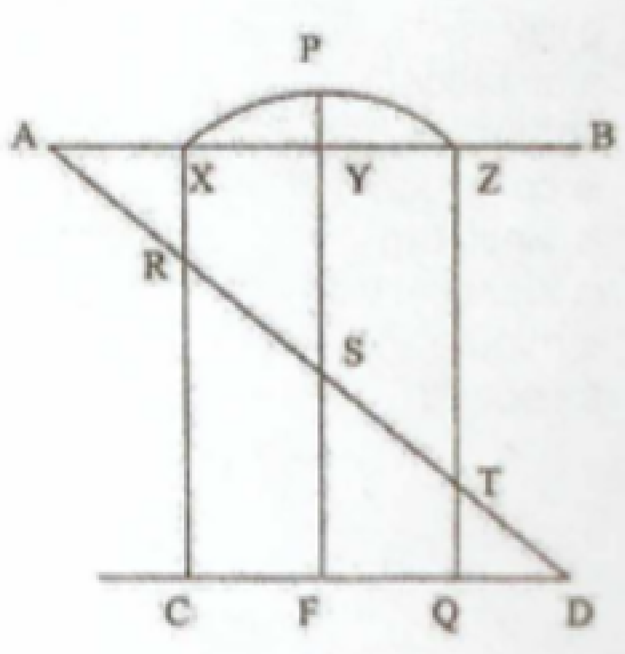




These are *parallel* lines; *m* is parallel to *n*. They are *equidistant*. A straight line drawn across a set of two or more parallel lines is called a *transversal*. Lines *n* and *t* *intersect* at the *point of intersection*.

These are *perpendicular* (*orthogonal*) lines; *y* is perpendicular to *x*. Perpendicular lines meet to form right angles. The symbol that makes a square in the corner where lines *x* and *y* meet indicates a right angle.

2. Look at the figure and say which lines are:



a) vertical
b) parallel
c) oblique
d) horizontal
e) curved
f) straight
g) perpendicular

3. *Which word (in capital letters) is being described below?*

First letter

One full-length vertical line is joined at the top and at its centre point by two parallel lines, the former slightly longer than the latter, extending to the right horizontally.

Second letter

A symmetrical, wedge-shaped figure: two straight but oblique lines slanting down to the base from a common point at the top; these are bisected by a single horizontal line.

Third letter

A long vertical line is connected at two points – at the top and halfway down – to a curved, semi-circular line running to the right. From the centre intersection a sloping line drops to the baseline at an angle 45 degrees to the perpendicular, again to the right.

4. *Using the words you have learned, describe the following capital letters:*

Example: **H** – Letter H has two parallel vertical lines and one horizontal line.

a) K	c) M	e) I	g) A	i) Z
b) B	d) E	f) L	h) X	j) O

5. *Complete the following sentences:*

a) Lines may be .... or curved. .... lines may be divided into three groups: vertical, ... and ....

b) Pairs of lines may be divided into two groups: those which .... and those which are .... at all points, which are called .... lines.

II. Angles

In plane geometry an angle is a figure formed by two straight lines which meet at a point. The lines of an angle are called the *sides*. The point where they meet is called the *vertex*. When the sides of an angle are *perpendicular* to each other, they form a *right angle*.

A right angle has ninety degrees. An angle of less than 90° is an *acute* angle, and an angle of more than 90° but less than 180° is an *obtuse* angle. An angle of more than 180° is a *reflex* angle.

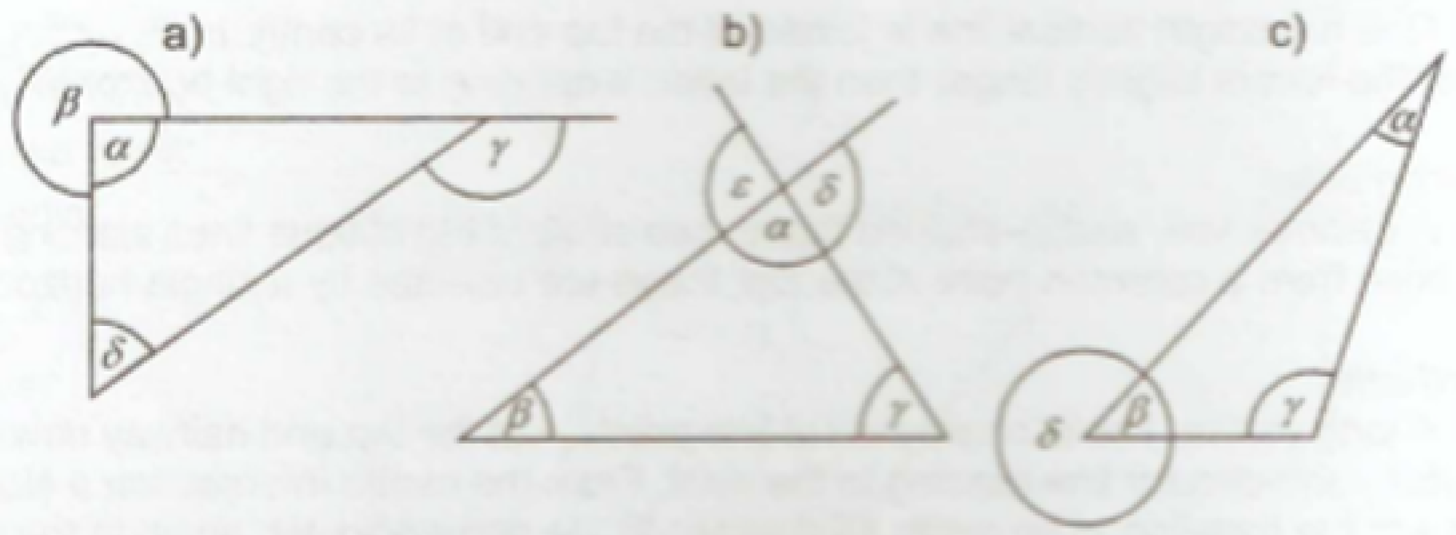
Classification of angles according to their *magnitude*:

acute ($0° < \alpha = <90°$) right ($\alpha = 90°$) btuse ($90° < \alpha = <180°$) straight ($\alpha = 180°$) reflex ($180° < \alpha = <360°$) complete rotation ($\alpha = 360°$)

1. *What kind of angle does a clock make at (clockwise orientation):*

a) two o'clock?
b) nine o'clock?
c) four o'clock?
d) twenty to ten?
e) twelve minutes past seven?
f) twenty-nine minutes past twelve?

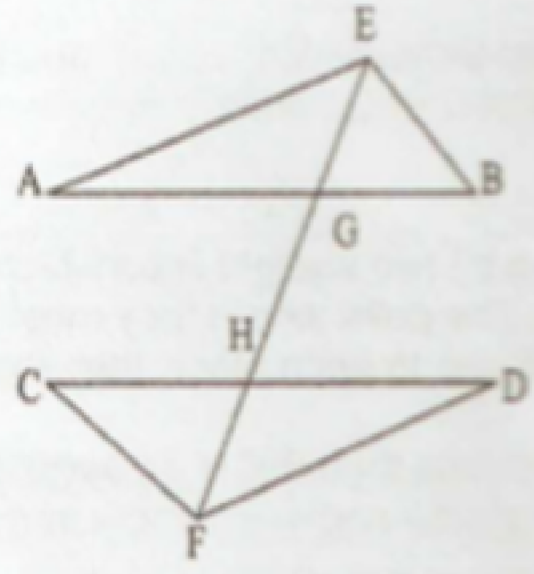
2. Name the kinds of angles shown in these figures:



3. Are the following statements true or false?

a) The exterior angles of a triangle are always obtuse.
b) Only two angles of a triangle can be obtuse.
c) The smallest angle of a triangle is opposite the shortest side.
d) The point where the sides of an angle meet is called the vertex.
e) A triangle with two obtuse angles is called an obtuse triangle.

4. Describe the figure:



5. Look at the figure above and read the following:

∡AGH = ∡EGB	They are *vertically opposite angles*. (Vert. opp. ∡s)
∡AGH = ∡CHF	They are *corresponding angles*. (Corr. ∡)
∡AGH = ∡GHD	They are *alternate angles*. (Alt. ∡s)
∡AGH + ∡AGE = 180°	They are *adjacent angles on a straight line*. (Adj. ∡s)
∡AGH + ∡CHG = 180°	They are *interior angles on the same side of the transverse line* (Int. ∡s)
∡AGH = ∡EAG + ∡AEG	The *exterior angle of a triangle* equals the sum of the *interior opposite angles* (Ext. ∡ of Δ)

- Now make similar statements about EGB.
- Find other angles in the diagram which are equal and say why. If EB is equal and parallel to CF, compare Δ CHF and Δ EGB. Give reasons for what you say.

6. ***Complementary and supplementary angles:***

- Two angles are *complementary* if the sum of their angles equals 90°. If one angle is known, its complementary angle can be found by subtracting the measure of its angle from 90°.
- Two angles are *supplementary* if the sum of their angles equals 180°. If one angle is known, its supplementary angle can be found by subtracting the measure of its angle from 180°.

Are the angles complementary, supplementary or neither?

99 degrees and 81 degrees?	....
34 degrees and 56 degrees?	....
25 degrees and 65 degrees?	....
3 degrees and 158 degrees?	....
143 degrees and 37 degrees?	....

FOCUS C

IRREGULAR PLURAL OF NOUNS: SPECIAL CASES

I. Nouns of Greek or Latin origin

Words which retain their original Greek or Latin forms make their plurals according to the rules of Greek or Latin. Some of them can have two plural forms, sometimes with different meanings.

1. –is → –es [-i:z]

singular		*plural*		
analysis	[ə'næləsis]	analyses	[ə'nælisi:z]	analýza
axis	['æksis]	axes	['æksi:z]	osa
basis	['beisis]	bases	[beisi:z]	základ
crisis	[kraisis]	crises	[kraisi:z]	krize
diagnosis	[daiəg'nəusis]	diagnoses	[daiəg'nəusi:z]	diagnóza
ellipsis	[i'lipsis]	ellipses	[i'lipsi:z]	elipsa (*gram.*)
emphasis	['emfəsis]	emphases	['emfəsi:z]	důraz
hypothesis	[hai'poθisis]	hypotheses	[hai'poθisi:z]	hypotéza
parenthesis	[pə'renθisis]	parentheses	[pə'renθisi:z]	kulatá závorka
synopsis	[si'nopsis]	synopses	[si'nopsi:z]	přehled, souhrn
synthesis	[sinθəsis]	syntheses	[sinθəsi:z]	syntéza
thesis	[θi:sis]	theses	[θi:si:z]	disertace

2. –on → –a [ə]

singular		*plural*		
criterion	[krai'tiəriən]	criteria	[krai'tiəriə]	kritérium
icosahedron	[aikəsə'hedrən]	icosahedra	[aikəsə'hedrə]	dvacetistěn
octahedron	[oktə'hedrən]	octahedra	[oktə'hedrə]	osmistěn
phenomenon	[fi'nominən]	phenomena	[fi'nominə]	jev, fenomén
polyhedron	[poli'hedrən]	polyhedra	[poli'hedrə]	mnohostěn
tetrahedron	[tetrə'hedrən]	tetrahedra	[tetrə'hedrə]	čtyřstěn

3. –a → –ae [-i:]

singular		*plural*		
abscissa	[æb'sisə]	abscissae	[æb'sisi:]	úsečka, souřadnice
alumna	[əl'amnə]	alumnae	[əl'amni:]	absolventka

antenna	[æn'tenə]	antennae	[æn'teni:]	anténa, tykadlo
formula	[fo:mjulə]	formulae	[fo:mjuli:]	formule, vzorec
minutia	[mai'njušiə]	munutiae	[mai'njušii:]	detail
nebula	[nebjulə]	nebulae	[nebjuli:]	mlhovina, nebula
persona	[pə'səunə]	personae	[pə'səuni:]	osoba, postava

4. –um → –a [-ə]

singular		*plural*		
addendum	[ə'dendəm]	addenda	[ə'dendə]	dodatek
colloquium	[kə'ləukwiəm]	colloquia	[kə'ləukwiə]	kolokvium, seminář
curriculum	[kə'rikjuləm]	curricula	[kə'rikjulə]	učební plán
datum	['deitəm]	data	[deitə]	údaj, fakt
dictum	['diktəm]	dicta	[diktə]	výrok, obecně platná věta
erratum	[ə'ra:təm]	errata	[ə'ra:tə]	tisková chyba
frustum	[frastəm]	frusta	[frastə]	kužel, komolý jehlan
maximum	[mæksiməm]	maxima	[mæksimə]	maximum
memorandum	[memə'rændəm]	memoranda	[memə'rændə]	memorandum
millennium	[mi'eniəm]	millennia	[mi'leniə]	milénium
minimum	[miniməm]	minima	[minimə]	minimum
optimum	[optiməm]	optima	[optimə]	optimum
pendulum	[pendjuləm]	pendula	[pendjulə]	kyvadlo
quantum	[kwontəm]	quanta	[kwontə]	kvantum, množství
spectrum	[spektrəm]	spectra	[spektrə]	spektrum
stratum	[stra:təm]	strata	[stra:tə]	vrstva
trapezium	[trə'pi:zjəm]	trapezia	[trə'pi:zjə]	lichoběžník

5. –ex / –ix → –ices [-isiz]

singular		*plural*		
apex	[eipeks]	apices	[eipisi:z]	vrchol, hrot
appendix	[ə'pendiks]	appendices	[ə'pendisi:z]	dodatek, rejstřík
		appendixes	[ə'pendiksiz]	slepé střevo
diretrix	[di'retriks/ dai'retriks]	directrices	[di'retrisi:z/ dai'retrisi:z]	řídicí přímka nebo křivka
index	[indeks]	indices	[indisi:z]	index, exponent
		indexes	[indeksiz]	rejstřík, seznam
matrix	[mætriks]	matrices	[mætrisi:z]	matice, matrix
radix	[reidiks]	radices	[reidisi:z]	kořen, základ číselné soustavy
vertex	[və:teks]	vertices	[və:tisi:z]	vrchol; zenit, nadhlavník
vortex	[vo:teks]	vorteces	[vo:tisi:z]	vír, víření

6. –us → –i [-ai]

singular		*plural*		
alumnus	[əl'amnəs]	alumni	[əl'amnai]	absolvent (*bývalý)*
annulus	[ænjuləs]	annuli	[ænjulai]	mezikruží
calculus	[kælkjuləs]	calculi	[kælkjulai]	počet, početní výkon
focus	[fəukəs]	foci	[fəusai]	ohnisko
locus	[ləukəs]	loci	[ləusai]	geometr. místo, těžiště
modulus	[modjuləs]	moduli	[modjulai]	modul, absolutní hodnota
nucleolus	[nju:klioləs]	nucleoli	[nju:kliolai]	jadérko
nucleus	[nju:kliəs]	nuclei	[nju:kliai]	jádro

radius	[reidiəs]	radii	[reidiai/ əsiz]	poloměr
rhombus	[rombəs]	rhombi	[rombai]	kosočtverec
stimulus	[stimjulə]	stimuli	[stimjulai]	podnět
syllabus	[siləbəs]	syllabi	[siləbai]	syllabus, program kurzu
torus	[to:rəs]	tori	[to:rai]	torus, anuloid (*geom.*)

7. ***–a → –ata*** [-atə]

singular		*plural*		
lemma	[lemə]	lemmata	[lemətə]	lemma, poučka
schema	[ski:mə]	schemata	[ski:mətə]	schéma

8. ***–us → –era/–ora*** [-ərə]

singular		*plural*		
genus	[dži:nəs]	genera	[dženərə]	(zool.) rod, třída, druh
corpus	[ko:pəs]	corpora	[ko:pərə]	korpus, soubor spisů / jevů

There is a tendency, particularly with fairly common Latin or Greek words, to make the plural according to the rules of English.

II. Nouns with singular and plural the same

1. Singular nouns with no plural:

advice	rada, rady	information	informace
business	záležitost, obchod	knowledge	znalosti, vědomosti
courage	odvaha	luggage	zavazadla
craft	lodi, plavidla	merchandise	zboží
despair	zoufalství	progress	pokrok
evidence	důkaz(y)	smallpox	neštovice
experience	zkušenost(i)	*and others*	
furniture	nábytek		
hair	vlasy		

Some of these words can have plural forms but having different meanings (e.g. hairs – chlupy, experiences – zážitky)

- A few names of fish and animals do not change in the plural: *sheep* (ovce), *trout* (pstruh), *deer* (vysoká zvěř), *fish* (ryba), *salmon* (pstruh), *cod* (treska), *grouse* (tetřívek). The regular plural is used to refer to particular animals or to types of animals.
- Some numbers and measurements do not change either: *hundred, thousand, million, billion, dozen (12), score (20), pound, foot,* when used with other numbers (*six hundred men, he is five foot eight tall*). But regular plurals are used with "of" (*hundreds of people*).

2. Plural nouns with no singular

annals	zprávy	means	prostředek (k čemu)
belongings	majetek, náležitosti	scissors	nůžky
bowels	vnitřnosti	series	řada
clothes	šaty, oděv	species	rod, druh
compasses (Br.)	kružítko	surroundings	okolí
earnings	výdělek	trousers	kalhoty
goods	zboží	vegetables	zelenina (a vegetable = jeden druh zeleniny)
headquarters	centrála, ústřední sídlo	*and others*	
italics	kurzíva		

- Some **nouns in the plural** take **verbs in singular** if they have a general meaning: *acoustics* (akustika), *athletics* (atletika), *economics* (ekonomika jako věda), *ethics* (etika jako věda), *mathematics* (matematika), *mechanics* (mechanika), *phonetics* (fonetika), *physics* (fyzika), *politics* (politika jako věda, praktická denní politika), *statistics* (statistika), *tactics* (taktika), and others.

  (e.g. *Mathematics* **is** *a science*. **but!** *His mathematics* **are** *weak*. – If there is a possessive pronoun or other attribute.)

Uncountable nouns can be made countable by adding expressions a piece, an item, an article, a lump etc. (e.g. a piece of furniture, a lump of sugar, an item / piece of news, many pieces of advice, many acts of kindness etc.)

UNIT 2

FOCUS A

QUANTIFIERS

When a statement contains more than one quantifier it is sometimes difficult to figure out what it means and whether it is true or false. It may be best in this case to think about the quantifiers one at a time, in order. For example, consider the statement $\forall x \exists y(x + y = 5)$, where the universe of discourse is the set of all real numbers. Thinking first about just the first quantifier expression $\forall x$, we see that the statement means that for every real number x, the statement $\exists y(x + y = 5)$ is true. We can worry later about what $\exists y(x + y = 5)$ means; thinking about two quantifiers at once is too confusing.

If we want to figure out whether or not the statement $\exists y(x + y = 5)$ is true for every value of x, it might help to try out a few values of x. For example, suppose $x = 2$. Then we must determine whether or not the statement $\exists y(2 + y = 5)$ is true. Now it is time to think about the next quantifier, $\exists y$. This statement says that there is at least one value of y for which the equation $2 + y = 5$ holds. In other words, the equation $2 + y = 5$ has at least one solution. Of course, this is true, because the equation has the solution $y = 5 - 2 = 3$. Thus, the statement $\exists y(2 + y = 5)$ is true.

Let us try one more value of x. If $x = 7$, then we are interested in the statement $\exists y(7 + y = 5)$, which says that the equation $7 + y = 5$ has at least one solution. Once again, this is true, since the solution is $y = 5 - 7 = -2$. In fact, you have probably realized by now that no matter what value we plug in for x, the equation $x + y = 5$ will always have the solution $y = 5 - x$, so the statement $\exists y(x + y = 5)$ will be true.

On the other hand, the statement $\exists y \forall x(x + y = 5)$ means something entirely different. This statement means that there is at least one value of y for which the statement $\forall x(x + y = 5)$ is true. Can we find such a value of y? Suppose, for example, we try $y = 4$. Then we must determine whether or not the statement $\forall x(x + 4 = 5)$ is true. This statement says that no matter what value we plug in for x, the equation $x + 4 = 5$ holds, and this is clearly false. In fact, no value of x other than $x = 1$ works in this equation. Thus, the statement $\forall x(x + 4 = 5)$ is false.

We have seen that when $y = 4$ the statement $\forall x(x + y = 5)$ is false, but maybe some other value of y will work. Remember, we are trying to determine whether or not there is *at least one* value of y that works. Let us try one more, say, $y = 9$. Then we must consider the statement $\forall x(x + 9 = 5)$, which says that no matter what x is, the equation $x + 9 = 5$ holds. Once again this is clearly false, since only $x = -4$ works in this equation. In fact, it should be clear by now that no matter what value we plug in for y, the equation $x + y = 5$ will be true for only one value of x, namely $x = 5 - y$, so the statement $\forall x(x + y = 5)$ will be false. Thus there are *no* values of y for which $\forall x(x + y = 5)$ is true, so the statement $\exists y \forall x(x + y = 5)$ is false.

Notice that we found that the statement $\forall x \exists y(x + y = 5)$ is true, but $\exists y \forall x(x + y = 5)$ is false. Apparently, the order of the quantifiers makes a difference! What is responsible for this difference? The first statement says that for every real number x, there is a real number y such that $x + y = 5$. For example, when we tried $x = 2$ we found that $y = 3$ worked in the equation $x + y = 5$, and with $x = 7$, $y = -2$ worked. Note that for different values of x, we had to use different values of y to make the equation come out true. You might think of this statement as saying that for each real number x there is a *corresponding* real number x such that $x + y = 5$. On the other hand, when we were analysing the statement $\exists y \forall x(x + y = 5)$ we found ourselves searching for a *single* value of y that made the equation $x + y = 5$ true for all values of x, and this turned out to be impossible. For each value of x there is a corresponding value of y that makes the equation true, but no single value of y works for every x.

(From: Velleman D. J.: *How To Prove It*, pp. 58–59 – adapted.)

Notice:

- *compare*: <u>*phrasal verbs*</u> - very common in informal style, their amount in formal style is relatively limited (see: to figure *out* – to calculate, to understand with difficulty; to try *out* – to test; to plug *in* – to supply, to fill; to come *out* – to appear, to reach a result; to turn *out* – to result, to develop, to end);

  <u>*verbs with prepositions*</u> – common both in formal and informal style, stylistically neutral (see: to think *about* – to have ideas or opinions in one's mind; to think *of* – to consider, to remember; to worry *about* – to have deep concern; to search *for* – to try very hard to find, to look for)
- *since* – frequently used in mathematical texts; means *because, as*
- *stylistic devices* used for the construction of explanation, see, especially, the separate words or the structures at the beginnings of the sentences: *thinking first, then, now it's time, in other words, of course, thus, let's try, once again, on the other hand, suppose, in fact, remember, notice, apparently, note*
- *compare: "whether" and "if" in reported speech where both can be used to introduce a question that does not have a question-word, e.g. "I'm not sure* ***whether / if*** *I'll have time"; in a structure "whether or not", when both sides of an alternative are given, "whether"* is more common, especially in formal style.

Exercises

1. ***What kinds of infinitives can you find in the text above?***

2. ***Replace the group of words in italics with an infinitive or an infinitive construction:***
   a) He proved the mathematical theorem and was very disappointed *when he found* that someone else had proved it first.
   b) There are a lot of examples *that need counting.*
   c) I was surprised *when I heard* that he had left the faculty.
   d) It is necessary *that everyone should know* the truth.
   e) There was no group *where we could participate.*
   f) He was the only one *who understood* the proof.
   g) It is often necessary *that we distinguish* the set {A} from the object A itself.
   h) There are some proof techniques *that need to be applied.*
   i) In the above proof we could have equally well chosen δ *which will be any positive number.*

3. ***Insert "to" where necessary before infinitives in brackets:***
   a) He made me (solve) …….. the equation again.
   b) I used (give) ……. lectures at Oxford University.
   c) You needn't (say) ……. anything. Just nod your head and they will understand.
   d) I want (visit) ……. the college where you live.
   e) May I (use) ……. your calculator?
   f) You had better (define) ……. the meaning of the measurement.
   g) Please let me (know) ……. your decision soon.
   h) Do I need (come) …….? I'd much rather (stay) ……. at the department.
   i) He was made (sign) ……. this disadvantageous agreement.
   j) I heard the door (open) ……. and saw our teacher (come) …….. .

4. ***Use the perfect infinitive of the verb in italics with the appropriate modal verb:***

a) I realized that our department was on fire. – That (*be*) a terrible moment.
b) I saw Leibniz last night. – You (*not see*) Leibniz; he died many years ago. You (*dream*) it.
c) I've had a headache for two days. – You (*go*) to the doctor when it started.
d) As I was standing in the hall I saw Prof. Porter. – It (*not be*) Prof. Porter; he left for Poland. It (*be*) his brother John.
e) I've brought my own notebook. – You (*not bring*) it. We could use mine.
f) The rector (*unveil*) the statue of Charles IV, but he is ill so his vice-rector is doing it instead.
g) He (*not catch*) the 7.45 bus because he didn't leave home till 8.00.
h) He said that censorship of news was absurd and it (*abolish*) years ago. (passive voice)
i) In the past people used to work much harder. – They (*have*) a lot of energy in those days.
j) We (*set*) out today, but the weather is so bad that we decided to postpone our start till tomorrow.

5. ***Read the following passage and then write the sentences using an appropriate infinitive form:***

Higgs Boson Discovery Has Been Confirmed

Two teams of physicists at the Cern laboratory near Geneva are preparing today to announce their latest efforts to discover the Higgs boson. The Higgs boson is the last undiscovered particle predicted to exist by the standard model of matter that scientists have been hunting for almost 50 years.
The elusive "God particle" has become the most sought-after particle in modern science. Its discovery would be proof of an invisible energy field that fills the vacuum of space, and excitement in the scientific community is at fever pitch.
Peter Higgs, the Edinburgh University physicist who proposed the idea of the particle in 1964, is flying in to Geneva, where the International Conference on High Energy Physics is being held.
There have been rumours, speculation, and, last night, even an apparent leak from the laboratory when a video announcing the discovery of a new particle was accidentally posted on its website.

a) Physicists at the Cern are reported (discover) .... the Higgs boson.
b) Two teams of physicists are said (prepare) ..... to announce the discovery.
c) Scientists are said (hunt) .... the Higgs boson for almost 50 years.
d) Peter Higgs is said (propose) .... the idea of the particle in 1964.
e) P. Higgs is said (fly)............. to Geneva.
f) The International Conference on High Energy Physics is reported (take place) .... in Geneva.
g) An apparent leak from the laboratory is said (occur) ...... last night.
h) A video announcing the discovery is reported (post) .... on the website.

6. ***Put in the right kind of infinitive:***

a) You ought (solve) the problem right now.
b) Your computer will (repair) by Friday.
c) I'd like (leave) for home early today.
d) I'd like (see) her face when she opened the letter.
e) She must (have) an argument with someone – I can hear her shouting at the top of her voice.
f) It's important (attend) the lectures on calculus regularly.

g) He hopes (choose) for the university exchange program.
h) Try (not be) arrogant to your teachers.
i) You should (tell) me you failed the exam.
j) She doesn't like (interrupt) while she's studying.

7. Rewrite these expressions into mathematical symbols:

a) *A* is a proper subset of *B* if and only if it holds for all elements *a* from *A* that they are elements of *B*.
b) The intersection of *A* and *B* equals the empty set.
c) If *A* is a subset of *B* and *B* is a subset of *A* then *A* equals *B*.
d) *X* and the negation of *Y* is equivalent to the negation of *X* or *Y*.
e) The open interval three five union the open interval four six does not equal the intersection of the closed interval one six and the closed interval three eight.

8. Read out the following notation (Logic and Sets):

a) $a \geq 0 \Leftrightarrow |a| = a$
b) $\operatorname{sgn} a = 1 \Leftrightarrow a > 0$
c) $|a| = 0 \Leftrightarrow a = 0$
d) $A \subseteq B \wedge B \subseteq C \Rightarrow A \subseteq C$
e) $A \subseteq B \Leftrightarrow B' \subseteq A'$
f) $\operatorname{sgn} a = -1 \Leftrightarrow a < 0$
g) $(u \vee v) \Rightarrow (\neg u \wedge \neg v)$
h) $A \cap B = \varnothing \Leftrightarrow A \subseteq B'$
i) $A \subseteq B \Leftrightarrow A \cup B = B$
j) $\neg u \wedge v$
k) $C \subseteq A \wedge C \subseteq B \Leftrightarrow C \subseteq (A \cap B)$
l) $\forall x, y, z \in \Re: (x < y \wedge y < z) \Rightarrow (x < z)$
m) $A = B \Leftrightarrow B = A$
n) $\forall x \in \Re_{-\{0\}} \exists -x \in \Re : x + (-x) = 0$
o) $A = B \wedge B = C \Rightarrow A = C$
p) $A \subseteq (A \cup B)$
q) $A \cap B = \varnothing \Leftrightarrow B \subseteq A'$
r) $\forall x \in \aleph : x > 0$
s) $A \subseteq C \wedge B \subseteq C \Leftrightarrow (A \cup B) \subseteq C$
t) $|a| > 0 \Leftrightarrow a \neq 0$
u) $a < 0 \Leftrightarrow |a| = -a$
v) $\operatorname{sgn} a = 0 \Leftrightarrow a = 0$
w) $A \cap B \subseteq A$
x) $\neg u \vee \neg v$
y) $A = A$

9. Read the following propositions. What are their truth values?

a) $x \vee \neg x$
b) $x \Leftrightarrow \neg(\neg x)$
c) $(\neg x \Rightarrow x) \Rightarrow x$
d) $\neg y \Rightarrow (x \Rightarrow y)$
e) $(x \Rightarrow y) \Leftrightarrow (\neg y \Rightarrow \neg x)$

10. Say whether the following equivalences are true or false? Draw pictures to demonstrate the equivalences:

a) $(A \cap B) \cup C = (A \cup C) \cap (B \cup C)$
b) $(A \cup B) \cap C = (A \cap C) \cup (B \cap C)$

FOCUS B

TRIANGLES

I. A triangle

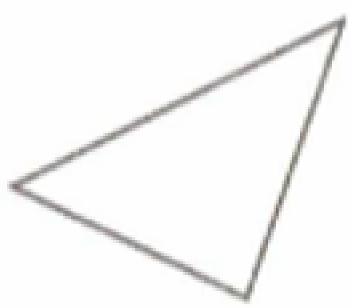
A triangle is a closed plane figure bounded by three straight lines meeting at three vertices. The vertex at the top of a triangle may be called the *apex*, and the line at the bottom may be called the *base*. The distance around a two-dimensional shape is a *perimeter. Area* is the amount of surface cover.

Triangles may be classified by their angles, or by their sides.

A right-angled triangle has one right angle and two acute angles. An obtuse triangle has one obtuse and two acute angles. An acute triangle has three acute angles.

Classification of triangles according to their ***angles:***

acute-angled

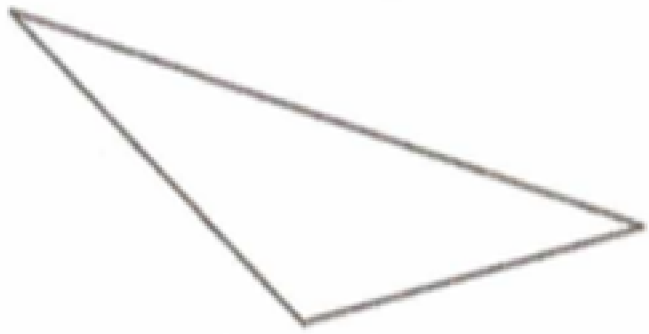


(all the interior angles are acute)

right-angled

(one interior angle is a right angle)

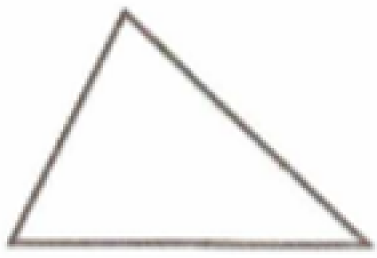
obtuse-angled



(one interior angle is obtuse)

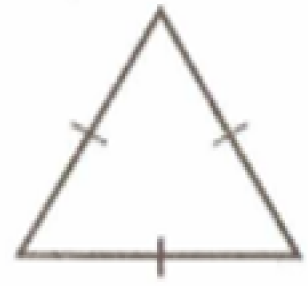
Classification of triangles according to their ***sides:***

scalene



(a Δ with no sides of equal length)

equilateral



(a Δ with all sides of equal length)

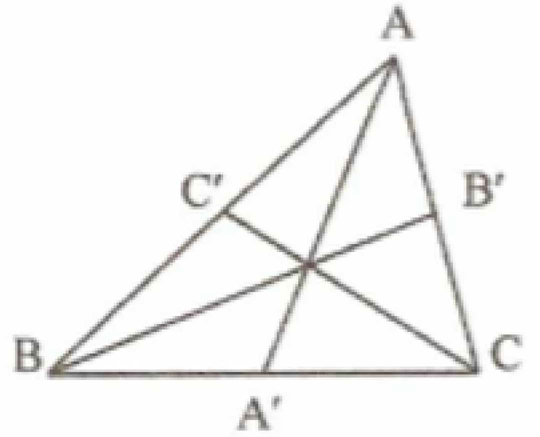
isosceles

(a Δ with two sides of equal length)

1. Complete the table with the correct name for each triangle:

Properties	Triangle
• has one right angle • can be isosceles	
• all three sides the same • all three angles the same size	
• two sides equal in length • angles opposite the equal sides are equal	
• no sides are the same • no angles are equal	

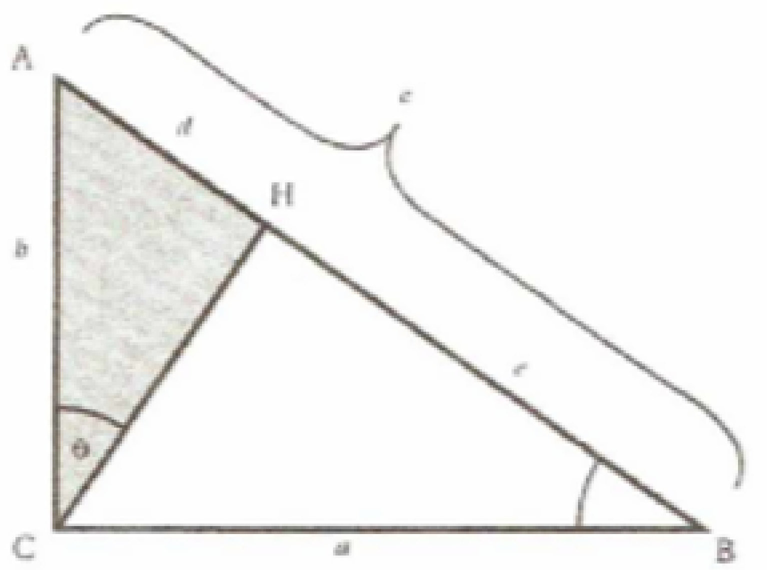
2. *Look and read, then fill in the missing expressions:*

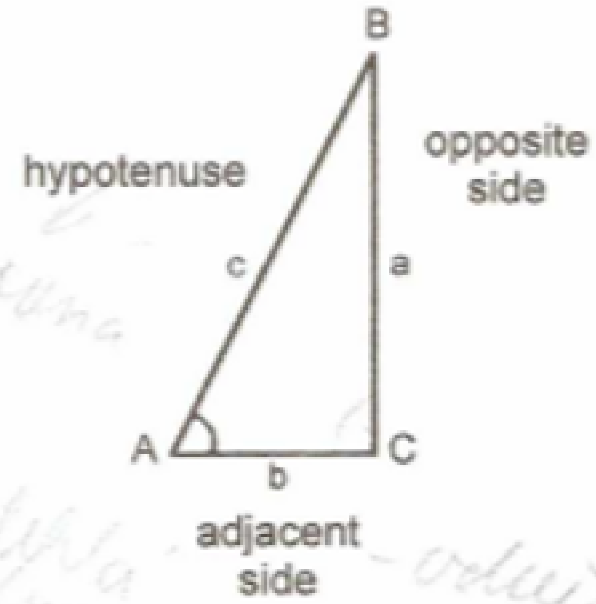


A straight line drawn from any ...vertex... of a triangle to the midpoint of the ...side... .... is known as a *median* of a triangle. The .... where they meet is called the *centroid*, or the *centre of gravity* of the triangle.

II. A right-angled triangle

3. Look and read:



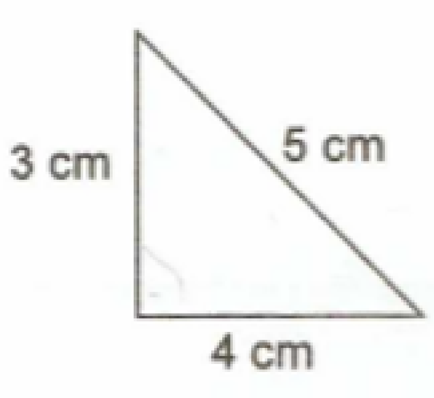


In a right-angled triangle the side *c* opposite the right angle is called the *hypotenuse*. *A*, *B* and *C* are *vertices* opposite the sides *a*, *b*, *c*. The side *a* is *opposite* the vertex A, and the side *b* is *adjacent to* the vertex *B*. The line leading from the vertex *C* perpendicular to the hypotenuse is called an *altitude* of the triangle.

4. Complete this statement of Pythagoras's Theorem:

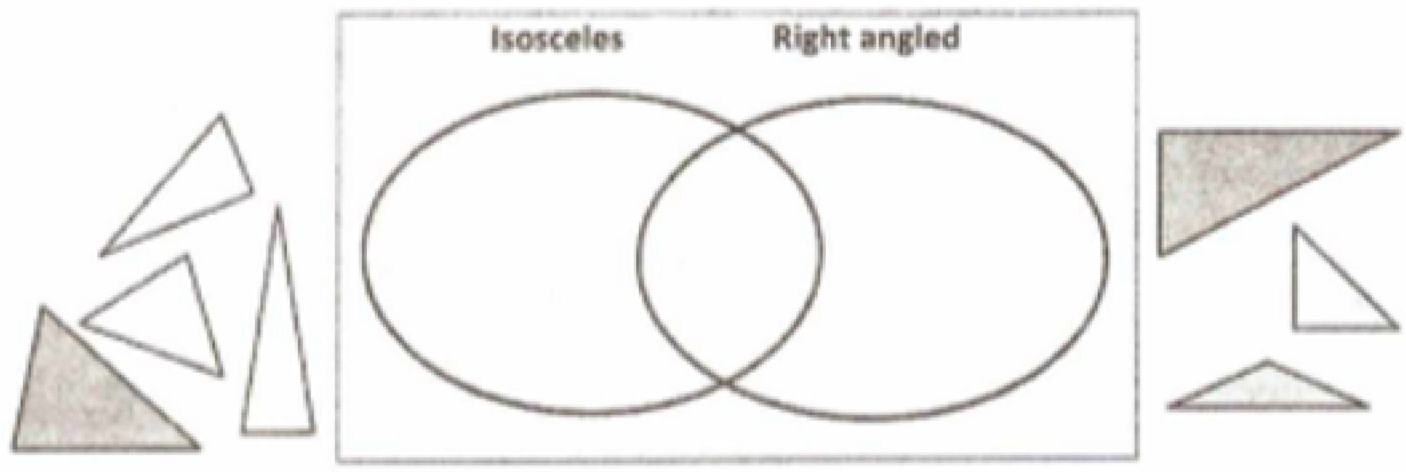
The square of the ...., known as the hypotenuse, is equal to the sum of the ....

5. Complete the following sentences and answer the question:



This is a ....scalene.... . Its sides are 3 cm and 4 cm .... The length of the .... is 5 cm.
What is its area?

6. Draw lines to join each triangle to the correct place on the Venn diagram:



7. Complete the following:

a) tangent = $\frac{opposite}{adjacent}$

b) sine = $\frac{\text{opposit}}{\text{hypotehus}}$

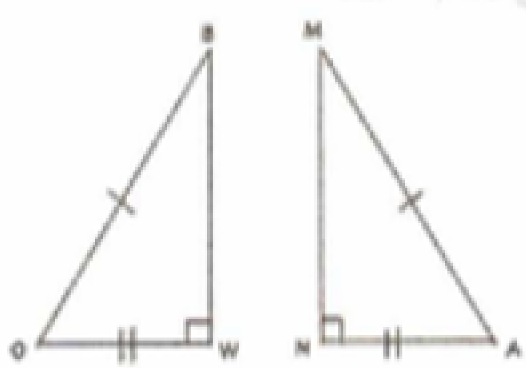
c) cosine = $\frac{\text{adyacent side}}{\text{hypothenus}}$

d) cotangent = $\frac{\text{adyacent}}{\text{opposite}}$

III. Congruence, similarity and symmetry

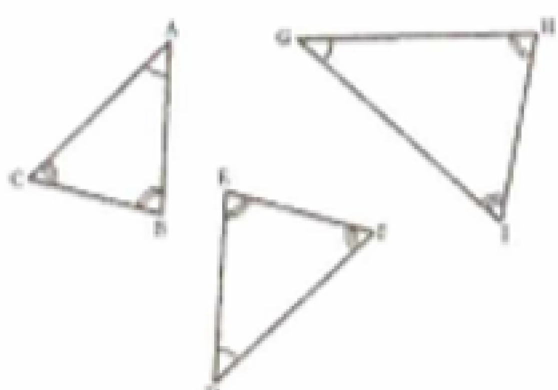
shoodnost

8. Read this: shochnost podobnost

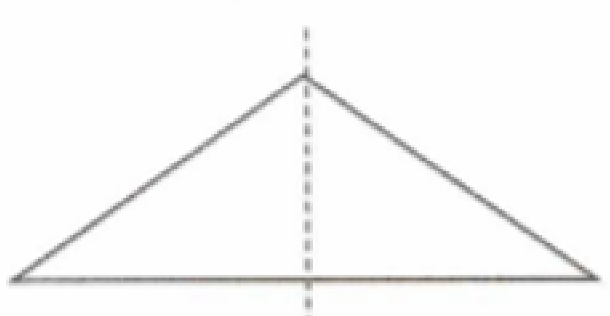


Two triangles are *congruent* if any of the following three sets of quantities are the same:

- the lengths of the three sides;
- the lengths of two sides and the angle between them; or
- the length of one side and the angles made with the other sides at their end.



If the three angles in one triangle equal those of another, then the triangles are *similar*.



These two triangles are *symmetrical*; they are on either side of an *axis of symmetry* (or *centre line*).

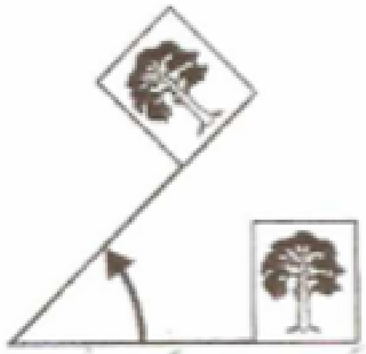
There are three basic types of symmetry. These are the ways in which we can transform an object while preserving its essential shape.

Moving shapes – language: Izoitladni

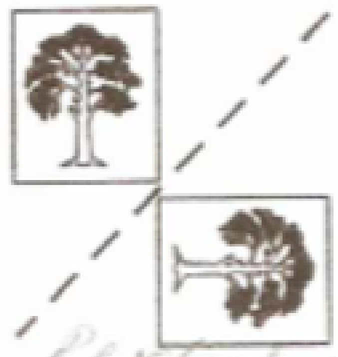
posun **Translation** – a move to left or right and/or up and down, with no turning or "flipping"
Reflection – a "flip over" movement in a mirror line
Rotation – a clockwise or anti-clockwise turn about a point

to force

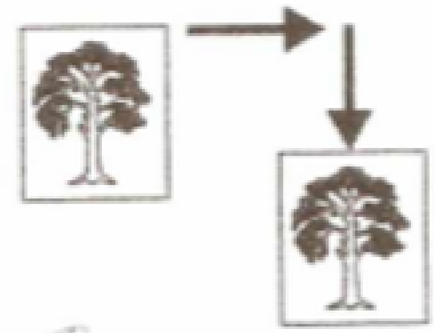
9. ***What type of transformation are these?***



a) Rotacion

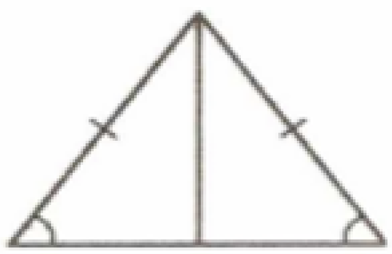


b) Reflection



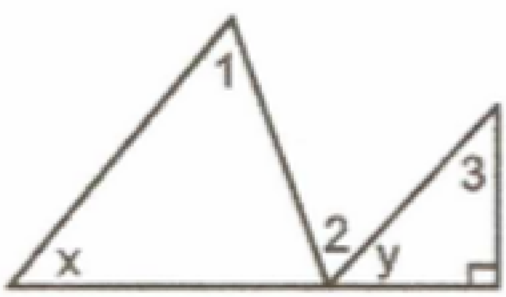
c) Translation

10. ***State whether or not each of the following triangle pairs is are congruent. If so, state a reason:***



11. ***Solve the problem:***

If $\angle 1 = 53°$, $\angle 2 = 65°$, and $\angle 3 = 43°$, find the measures of $\angle x$ and $\angle y$.



FOCUS C

INFINITIVE

I. Forms of infinitive

Forms	Simple Positive	Simple Negative	Progressive	Passive
Present	*to work*	*not to work*	*to be working*	*to be worked*
Perfect	*to have worked*	*not to have worked*	*to have been working*	*to have been worked*

II. Infinitive without "to" ("bare infinitive") after the following:

1. ***modal and auxiliary verbs (can, could, may, might, must, shall, should, will, would, do, dare)***

   You can work at home.

2. ***verbs of sensation if they are followed by a direct object + infinitive*** **(make, watch, see, hear, feel)**

   I saw him turn round the corner. (**But** after the passive: *He was seen* **to** *turn round the corner.)*

3. *verbs:* **let, make** ***followed by a direct object + infinitive,***

   You made me go there. (**But** after the passive: *I was made* ***to*** *go there.*)

4. ***expressions: would rather, had better, would sooner, rather than.***

   You had better define the equation.

III. Perfect infinitive

Perfect infinitives have the same kind of meanings as perfect or past tenses.

I am glad ***to have left school.*** *(= ... that I left school.)*
She was sorry ***not to have seen*** *Bill. (= ... that she had not seen Bill.)*
We hope ***to have finished*** *the job soon. (= ... that we will have finished ...)*

Perfect infinitives are often used with modal verbs to talk about **unreal past situations** that are the opposite of what really happened.

He ***should have helped*** *her. (= but he didn't)*
Joe ***must have gone*** *home. (= It seems certain that he has gone home.)*
They ***may not have arrived*** *yet. (= Perhaps they haven't arrived.)*
They ***can't have arrived*** *yet. (= They certainly haven't arrived.)*

IV. Use of infinitive in mathematical texts

1. ***To express purpose:***

   To make *this idea more precise, consider the diagram in Fig.9.59 … ...*
   To determine *whether a function has a local extremum at c, it is not enough to know …*
   To obtain a_1, *differentiate f(x) and get ….*

2. ***As the subject of the sentence:***

   To compromise *appears advisable.*
   To continue *seems impossible.*
   To say *that a and b are arbitrary integers* ***means*** *that...*
   To say *that an integer larger than 1 is not prime means that it can be written as a product of two smaller positive integers.*

3. ***In constructions with "too" and "enough":***

   … to prove that $y/2\pi$ *must be an integer, it is* ***enough to show*** *that ...*
   In some cases this assumption is not strong ***enough to make*** *the proof work.*
   The article is ***too*** *long* ***to be*** *translated.*
   It is not ***enough to know*** *that* $f'(c) = 0$.

4. ***In constructions like "we define A to be ...":***

   We ***find n to be*** *useful for ...*
   We ***may assume M to be*** *homogenous.*
   The completed plane often ***turns out to be*** *unsatisfactory as a stage for …*
   The work accomplished ***is defined to be*** $|F| \cos\theta \cdot |R|$…

5. ***In constructions like "A is allowed to be ...":***

   If the sets E_i *are* ***allowed to belong*** *to a larger class of subsets ...*
   The functions and sets are ***assumed to be*** *measurable.*
   Thus algebra might be ***employed to describe*** *symmetry ...*
   The real circle of radius k ***is said to have*** *a positive sense of direction if …*
   A pair of circles ***is said to be*** *orthogonal if* $\Delta_{12} = 0$ …
   A transformation $Z = \varphi(z)$ *of the z-plane onto the Z-plane* ***is said to be*** *isogonal at the point* z_0, *if …*

6. *After some adjectives:*

It is desirable to replace *the completed plane by another geometrical carrier of ...*
It is expedient to represent *the point (x, y) by the complex number ...*
It is necessary to complete *the ordinary complex number plane by adding to it ...*

7. *After "be":*

The obvious way of constructing E from M ***is to associate*** *with each f ....*
These ***were to be composed*** *of ...*
It ***was to take*** *two more centuries before calculus reached its present state of precision and rigor.*

8. *After nouns and superlatives, in the place of a relative clause:*

We cannot resist the ***opportunity to point out*** *that ...*
Proof by contradiction is a logical ***method to use****.*
He was ***the first to simplify*** *the proof.*

9. *In constructions like "for this to happen":*

For H^{0} to provide *a good description of H ...*
Now plug in 2 ***for n to get*** *the statement $(\forall k < 2P(k)) \rightarrow P(2)$.*

10. *Other constructions frequently used (after some verbs):*

We ***seem to have*** *come quite far ....*
Let *us* ***consider*** *the mid-range.*
If one of the resistances ***happens to be*** *zero, you will have ...*
... conditions that we ***wish to impose*** *....*
These functions ***tend to grow*** *in the worst possible way ...*
... a problem that ***appears to be*** *harder*
Theorem 1 ***enables us to find*** *what the coefficients a_0, a_1, a_2, ... must be.*

UNIT 3

FOCUS A

USING THE DERIVATIVE AND LIMITS WHEN GRAPHING A FUNCTION

The x and y *intercepts* are of aid in graphing, for they tell where the graph meets the x and y axes. Furthermore, horizontal and vertical *asymptotes* can be of use in sketching the graph for large $|x|$ and also near a number where the function becomes infinite (usually because a denominator is 0). For instance, the line $x = 1$ is a vertical asymptote of $1/(x-1)$; the line $y = 0$ is a horizontal asymptote of the same curve. The line $x = \pi/2$ is a vertical asymptote of the curve $y = \tan x$.

This section shows how to use the derivative and limits to help graph a function. Of particular interest will be these questions:
Where is the derivative equal to 0?
Where is the derivative positive? Negative?
How does the function behave for large $|x|$?
The answers will tell a good deal about the general shape of a particular graph; it will then not be necessary to plot so many specific points on the graph.
First, a few helpful definitions.

Definition *Critical number and critical point.* A number c at which $f'(c) = 0$ is called a **critical number** of the function f. The corresponding point $(c, f(c))$ on the graph of f is a **critical point** on the graph.

Definition *Relative maximum* (*local maximum*). The function f has a **relative maximum** (or **local maximum**) at the number c if there is an open interval (a, b) around c such that $f(c) \geq f(x)$ for all x in (a, b) that lie in the domain of f. A **local** or **relative minimum** is defined analogously.

Definition *Global maximum.* The function f has a **global maximum** (or **absolute maximum**) at the number c if $f(c) \geq f(x)$ for all x in the domain of f. A **global maximum** is defined analogously.

Note that a global maximum is necessarily a local maximum as well. A local maximum is like the summit of a single mountain; a global maximum corresponds to Mount Everest.

Figure 1 illustrates the notions of critical point, local maximum, global maximum, local minimum, and global minimum in the graph of a hypothetical function. Any given function may have none of these, or some, or all.

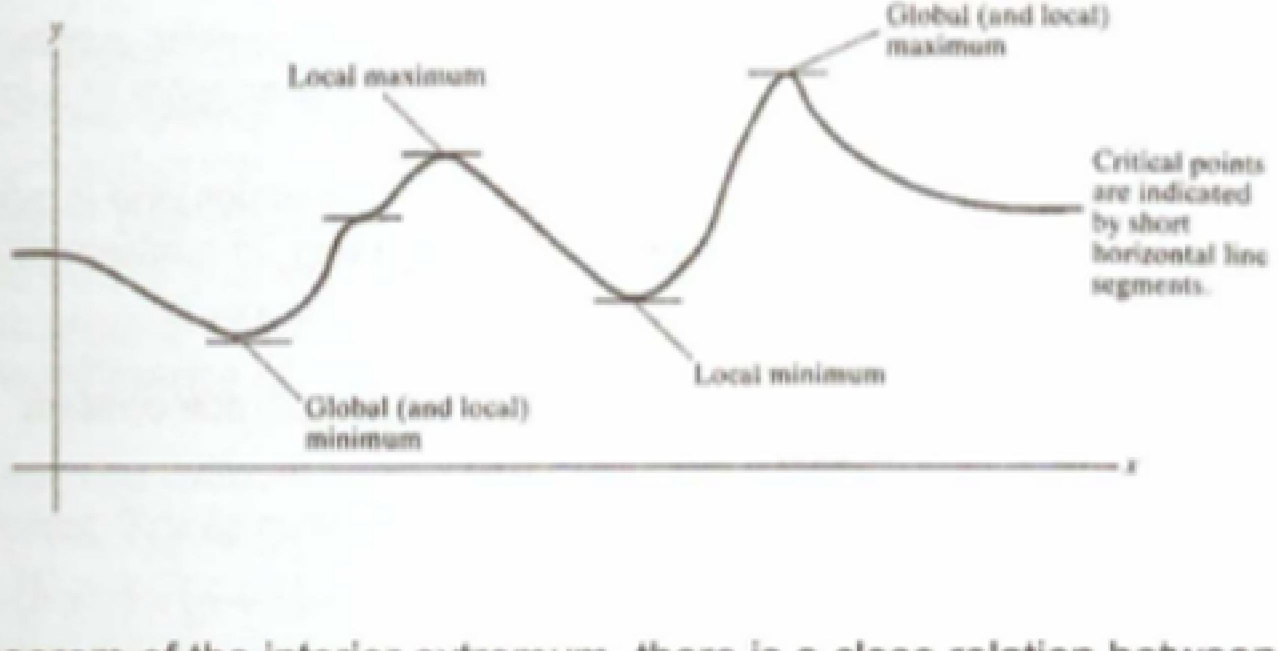


Figure 1

By the theorem of the interior extremum, there is a close relation between a local maximum (or minimum) and critical points for a differentiable function. If a local maximum occurs at a number c that lies within some open interval within the domain of f, then

$f'(c) = 0$. This means that c is a critical number. However, a critical point need not be a local extremum. This is illustrated by the function x^3, whose derivative $3x^2$ is 0 at 0. Thus $c = 0$ is a critical number of the function x^3. A glance at Figure 2 shows that x^3 has neither a local maximum nor a local minimum at 0.

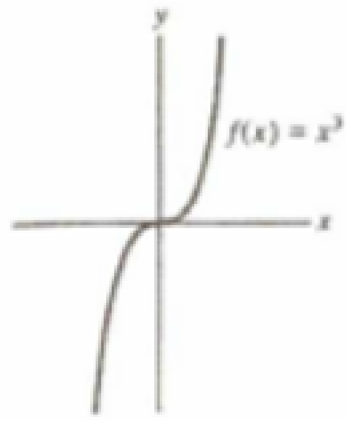


Figure 2

To determine whether a function has a local extremum at c, it is not enough to know that $f'(c) = 0$. It is also important to know how the derivative behaves for inputs near c.

A function may not be differentiable at a local extremum. For instance, consider $f(x) = x^{2/3}$, which is graphed in Figure 3.

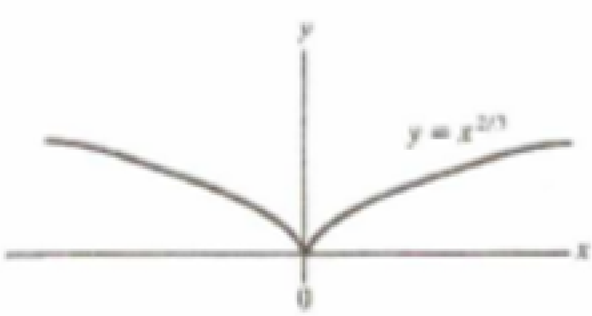


Figure 3

Clearly it has a local minimum at $x = 0$. However, $f'(x) = \frac{2}{3}x^{-1/3}$ is not defined at $x = 0$. [This is an unusual situation, but it should be kept in mind as a possibility when dealing with functions that are not differentiable throughout the domain of interest. The curve $y = x^{2/3}$ is said to have a cusp at (0,0).]

(From: Stein S. K.: *Calculus and Analytic Geometry*, pp. 133–135 – adapted)

Notice:

- *inversion* of the subject and a verb (typical of a very formal style) in a sentence: "*Of particular interest will be these questions:...*" (generally means putting the verb before the subject, *see* the explanation and exercises in Unit 6).
- "*neither ....nor*" (*čes. ani ... ani*) – the structure used to join two negative ideas (it is the opposite of *both ... and, čes. jak ... tak*) typical of a formal style.
- modal verbs followed by the infinitive without "to" in sentences: *"However, a critical point <u>need not be</u> a local extremum..."* and *"A function <u>may not be</u> differentiable at a local extremum."*
- **False friend** is a word or expression in one language which resembles one in another language. It is therefore wrongly taken to have the same meaning. In mathematics, you can also find false friends such as the following:

to differentiate [ˌdifəˈrenšieit] -	derivovat
differentiation [ˌdifərenšiˈeišən] -	derivace, derivování (proces, operace opačná k integrování)
differential [ˌdifəˈrenšəl] -	diferenciální, diferenciál
be differentiable [ˌdifəˈrenšəbl] -	mít derivaci
derivative [diˈrivətiv] -	derivace (1., 2. ... řádu)
to derive [diˈraiv] -	odvodit

derivation [ˌderiˈveišən] -	odvození, derivace množiny (množina hromadných bodů této množiny)

Exercises

1. ***In the text above find all the -ing forms and say what their grammatical meanings and positions in sentences are.***

2. ***Put the verbs in brackets into the correct form (-ing form or infinitive):***
   a) Imagine (cut) .... the tube along a direction parallel to *L* and then (lay) .... the tube flat.
   b) Would you mind (explain) .... the equation to me?
   c) Before (define) .... curvature in general, we should discuss the arc length *s* and the angle φ.
   d) After (hear) .... the conditions I decided (not enter) .... for the competition.
   e) He postponed (make) .... a decision till it was too late (do) anything.
   f) At first I enjoyed (listen) .... to him but after a while I got tired of (hear) .... the same presentation again and again.
   g) It is usually easier (learn) ...... a subject by (read) .... books than by (listen) .... to lectures.
   h) The author avoided terms (suggest) .... a special interpretation which he did not wish (emphasize) ....
   i) In conclusion, it is a pleasure (express) .... my gratitude to those mathematicians under whom I studied. I should like (mention) .... Professors I. James and P. Smith.
   j) The boy was ashamed of (tell) .... a lie.

3. ***Put the verbs in brackets into the correct form (-ing form or infinitive):***
   a) Let us try (use) ...... the area of the narrow curved part of the cylinder.
   b) I tried (persuade) .... him (agree) .... with your proposal.
   c) Stop (talk) .... ; I am trying (finish) .... an abstract.
   d) Please remember (write) .... a message before you leave for the conference.
   e) I will stop here (find) ...... the entrance to the university library.
   f) I regret (tell) .... him what happened yesterday, during the Department's meeting.
   g) When I came to the classroom I saw a professor (write) .... an equation on the board.
   h) You should stop (read) .... so much. It's bad for your eyes.
   i) We regret (inform) .... you that your article will be published later.
   j) I have never seen anyone (solve) .... the problem so quickly.

4. ***Rewrite these expressions into mathematical symbols:***
   a) ten over twenty is equal to five over ten which is equal to a half
   b) the fraction whose numerator is *x* over *y* and whose denominator is *t* over *u* equals *x* over *y*, that fraction times *u* over *t*
   c) the sum *a* plus *b* times the sum *c* plus *d* is equal to the sum of *ac*, *ad*, *bc* and *bd*
   d) the product of two over *d* and *d* over two is equal to one
   e) the difference of minus *a* and minus *a* equals zero

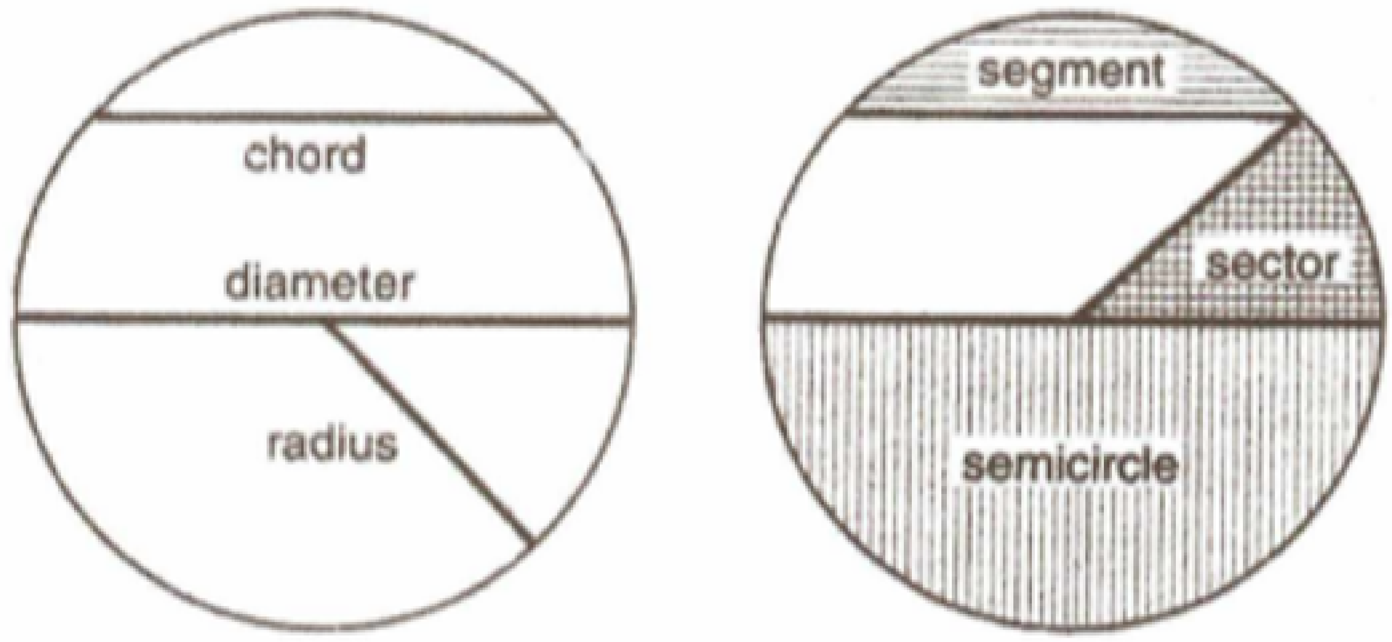
5. ***Read out the following notation (Addition, Subtraction, Multiplication, Division, Fractions). Try to read the expressions in various ways:***
   a) $a+(b+c)=(a+b)+c=a+b+c$
   b) $a+b=b+a$
   c) $a+0=0+a=a$

d) $(+a)+(+b)=+(a+b)=a+b$
e) $(-a)+(-b)=-(a+b)$
f) $(+a)+(-b)=+(a-b)=-(b-a)$
g) $-a+(+b)=-(a-b)=+(b-a)$
h) $(+a)-(+b)=(+a)+(-b)=a-b$
i) $(-a)-(-b)=(-a)+(+b)=b-a$
j) $(+a)-(-b)=(+a)+(+b)=a+b$
k) $(-a)-(+b)=(-a)+(-b)=-(a+b)$
l) $a+(b+c-d)=a+b+c-d$
m) $a-(b+c-d)=a-b-c+d$
n) $a(bc)=(ab)c=abc$
o) $ab=ba$
p) $a\cdot 1=1\cdot a=a$
q) $a\cdot 0=0\cdot a=0$
r) $a\cdot b=0 \Leftrightarrow a=0 \vee b=0$
s) $(+a)\cdot(+b)=+ab$
t) $(-a)\cdot(+b)=-ab$
u) $(+a)\cdot(-b)=-ab$
v) $(-a)\cdot(-b)=+ab$
w) $(a+b)\cdot c=c\cdot(a+b)=ac+bc$
x) $(a+b)\cdot(c+d)=ac+bc+ad+bd$
y) $\frac{a}{b}+\frac{c}{b}=\frac{a+c}{b}$
z) $\frac{a}{b}-\frac{c}{b}=\frac{a-c}{b}$
aa) $\frac{a}{be}+\frac{c}{de}=\frac{ad+cb}{bde}$
ab) $\frac{a}{b}\cdot c=\frac{ac}{b}$
ac) $c\cdot\frac{a}{b}=\frac{ca}{b}$
ad) $\frac{a}{b}:c=\frac{a}{b}\cdot\frac{1}{c}=\frac{a}{bc}$
ae) $a:\frac{b}{c}=a\cdot\frac{c}{b}=\frac{ac}{b}$
af) $\frac{a}{b}\cdot\frac{c}{d}=\frac{ac}{bd}$
ag) $\frac{a}{b}:\frac{c}{d}=\frac{ad}{bc}$
ah) $(a+b-c):m=\frac{a}{m}+\frac{b}{m}-\frac{c}{m}=\frac{(a+b-c)}{m}$

ai) $\dfrac{\frac{a}{b}}{\frac{c}{d}} = \dfrac{a}{b} : \dfrac{c}{d} = \dfrac{ad}{bc}$

FOCUS B

A CIRCLE



A circle is a plane figure. The length around a circle is called the *circumference*. A half circle is called a *semi-circle*. All points on the circumference of a circle are *equidistant* from the centre. A line segment which is drawn from centre to its circumference is called the *radius*. All the radii of a circle are equal. A line segment passing through the centre of a circle is called the *diameter*. A part of a circumference of a circle is called an *arc*. The straight line joining the ends of an arc is called a *chord*. A part of a circle enclosed by two radii and an arc is called a *sector* and a part enclosed by an arc and a chord is called a *segment*.

The *length of the circumference* C is related to the radius r and diameter d by: $C = 2\pi r = = \pi d$. The *area* A of the circle is defined by the equation $A = \pi r^2$.

1. Name the following:

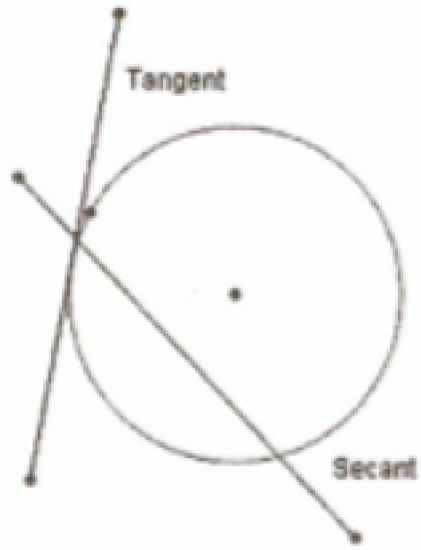
a) area a ....
b) area b ....
c) EF......................
d) XF......................
e) AB......................
f) OC and OD ....
g) O ....

2. Say whether the following statements are true or false. Correct the false statements:

a) A chord is a curved line.
b) The radius of a circle is half the length of its diameter.
c) A closed curve where all points on the curve are equidistant from the centre is called a circumference.
d) A sector has three sides, two chords and an arc.

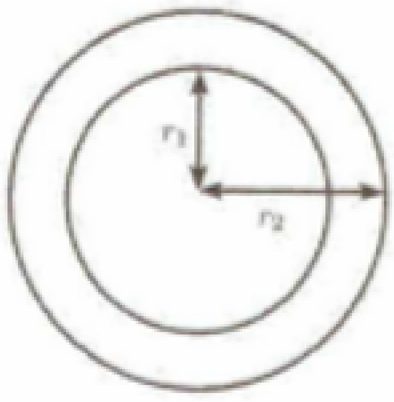
3. Look and read:

a)



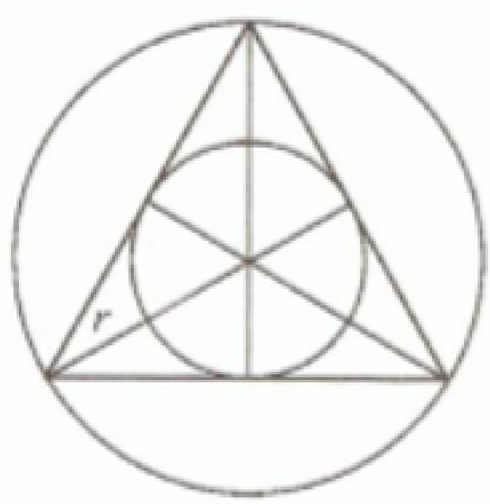
A line meeting the circumference but which does not intersect it is called a *tangent*.
A line which passes through a circle and intersects it at two points is called a *secant*.

b)



These circles have the same point of origin. They are *concentric*. An *annulus* is the region between two concentric circles.

c)



A circle which passes through the vertices of a triangle is called the *circumcircle* of the triangle, and its centre is called its *circumcentre*. The circle is *circumscribed* about (around) the triangle. A circle may also be *inscribed* in the triangle, then each side of the triangle is a tangent to the circle. The centre of an inscribed triangle is called its *incentre*.

4. Solve the problem:

A ______ is a line that intersects a given circle at two points.
a) tangent   b) chord   c) secant   d) diameter

5. Solve the problem:

A triangle inscribed in a semicircle is ______.
a) an equilateral triangle b) an acute triangle c) a right triangle d) an obtuse triangle

6. A circle has a radius of 3 cm. Calculate:

a) the diameter
b) the circumference

7. The circumference of a circle is approximately 15.7 cm. Calculate:

a) the approximate radius
b) the approximate diameter

8. Fill in the missing expressions:

a) If we draw the .... of a circle, the line divides the circle into two equal ....
b) A triangle has been .... if a circle passes through its ....
c) A .... is the area enclosed by an arc and two ...., while a .... is the area enclosed by an arc and a ....

FOCUS C

-ING FORMS

We can use -ing forms (e.g. writing, proving) not only as verbs, but also as adjectives, adverbs or nouns. When *-ing* forms are used as verbs, adjectives or adverbs, they are often called "present participles". When they are used more like nouns, they are often called "gerunds". However, the distinction is not really as simple as this, and some grammarians prefer to avoid the terms "participle" and "gerund".

FORMS	*Active*	*Passive*
Present	taking	being taken
Perfect (Past)	having taken	having been taken

- -ing forms often act like a verb and a noun at the same time. They can be followed by an object (e.g. *writing letters*, *introducing notation*), but they can also be the subject, object or a complement of a sentence:

  ***Thinking** about it took me almost a year.* (subject)
  *I hate **writing** letters.* (object)
  *One of the possible ways was **proving** the validity of a rule.* (complement)

- -ing forms can be used with a determiner, articles, possessive/ demonstrative pronouns, and adjectives. When used with an article, they do not usually take a direct object.

  *the rebuilding of **the** cathedral*
  *a questioning of **our** principles*
  *We denied all **this** useless arguing.*

- -ing forms are used after prepositions and phrasal verbs:

  You do it by starting at the top and filling in the pieces ...
  Similar things could be said about figuring out a proof.
  Give a step-by-step procedure for solving every proof problem.

- -ing forms can be used in compound nouns:

  a driving lesson
  a swimming pool
  bird-watching
  proof-writing techniques

I. Verbs + gerund

Verbs and structures followed by the gerund:

admit	detest	involve
anticipate	enjoy	keep (= continue)
avoid	excuse	mind (= object)
consider	fancy	miss
defer	finish	pardon
delay	forgive	postpone
deny	imagine	prevent

recollect	suggest	can't help (= prevent, avoid)
resist	understand	it's no use / no good
risk	can't stand (= endure)	worth *(adj)*
stop (= cease)		

II. Verbs + infinitive

Verbs and structures followed by the infinitive:

afford	learn	threaten
decide	manage	can't afford
fail	mean	should / shouldn't
forget	promise	like would / wouldn't
happen	refuse	like will do my best
hope	seem	
intend	tend	

III. Verb + -ing form or infinitive

1. Verbs followed by -ing form (gerund) or infinitive with very small differences in meaning:

advise	continue	love	require
agree	hate	mean	want
allow	intend	permit	
begin	leave	prefer	
can't bear	like	propose	

*He continued **working / to work** after everybody else had left the office.*

- like, love, hate, prefer + ***gerund*** – tend to refer to a general activity;
  + ***infinitive*** – tend to refer to a particular occasion; especially used in conditional structures.

  I like going to the cinema. (generally)
  I like to go to the cinema once a week. (particular occasion)

2. Verbs followed by –ing form or infinitive with important differences in meaning:

- forget, go on, regret, remember, stop, try.
  -ing form – refers to what happens / happened before the action of the main verb; ***infinitive*** – refers to what happens / happened after the action of the main verb;
- stop
  I stopped smoking. (I ceased to smoke; first I smoked, then I stopped.); *(čes.* Přestal jsem kouřit.)
  I stopped to smoke. (I didn't go on, because I wanted to smoke.); (*čes.* Zastavil jsem se, abych si zakouřil.)

- remember, forget, regret
  I still remember buying my first bicycle. (I certainly remember that I bought my first bicycle; first I bought a bicycle, then I remember the event – refers to the past); (*čes.* Vzpomínám si, že ...)
  Remember to lock the door tonight. (don't forget to lock the door – refers to the future); (*čes.* Nezapomeňte ...)
- try, mean, propose
  She tried writing with his pencil. (= to experiment); (*čes.* Zkusila si, jaké to je psát jeho tužkou.)

She tried to write with his pencil. (= to attempt to do something); (*čes.* pokusila se psát jeho tužkou, – ale nešlo to)

- verbs of sensation: see, hear, feel, watch, notice
  + ***-ing*** (activity in progress; more general)
  + ***infinitive without "to"*** (completed activity; special occasion)
    I saw him crossing the street. (I saw just a part of the action.)
    I saw him cross the street. (I saw the whole action.)

IV. Use of -ing form in mathematical texts

1. As the subject of a sentence (without an article):

***Thinking** about it took me a year.*
***Plugging** in different values for a free variable affects the meaning …*
***Knowing** that might be important in understanding a piece of reasoning.*

2. As an object of a sentence (without an article):

*Imagine **cutting** the tube along a parallel to L and then **laying** the tube flat.*

3. After prepositions:

*He solved the problem **by showing** that …*
*This is the formula **for computing** …*
*There are several reasons **for wanting** to make such an estimate.*
*We came quite far **without introducing** mathematical notion.*

4. After certain verbs (often with prepositions):

*He **starts by replacing** the entire phrase …*
*The solid of revolution **formed by revolving** R around L is shown in Fig.8.*
*When a set is **defined by listing** its elements …*
*This problem can be **defined by listing** a few elements with …*

5. Present participle modifying a noun:

*These factors contribute to the literal **fatigue resulting** from careful study.*
*Therefore the transformation **representing** the inversion can be inverted.*
*I received **an envelope** from Zürich, **containing** a paper published in 1919.*
*We can now state useful **laws involving** tautologies and contradictions.*

6. Present participle in a separate clause when the subjects of both the main and the subordinate clauses are the same:

***Using** these values, we could obtain our approximation …*
*We will use the letter t when **writing** the two preceding exponentials.*
***Corresponding** to each choice of V_1, there is a function Ψ_1 …*
***Looking** at Figure 6, we see that …*

UNIT 4

FOCUS A

THE PARABOLA

The locus of a point which moves so that its distance from a fixed point, S, is in a constant ratio, e, to its distance from a fixed line is called a **conic section**. If $e = 1$ this becomes the parabola.

The fixed point S is called the **focus**. The fixed line is called the **directrix**. The ratio e is called the **eccentricity**.

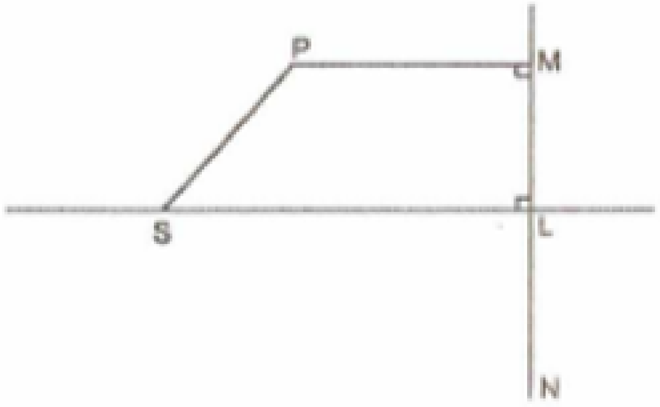


Figure 1

If in Figure 1 MN is the given line, S is the focus and P a general point, then the relationship is defined by SP = e PM. Clearly the locus is symmetrical about SL. The locus of P depends upon the value of e.

When $e = 1$, the curve is a **parabola**.
When $e < 1$, the curve is an **ellipse**.
When $e > 1$, the curve is a **hyperbola**.

Since the parabola is symmetrical about SL, we take the x-axis along LS. Clearly the curve will pass through the mid–point of LS and so we choose the y-axis perpendicular to LS through this point thus ensuring the curve will pass through the origin of coordinates, O. This is called the **vertex** of the parabola.

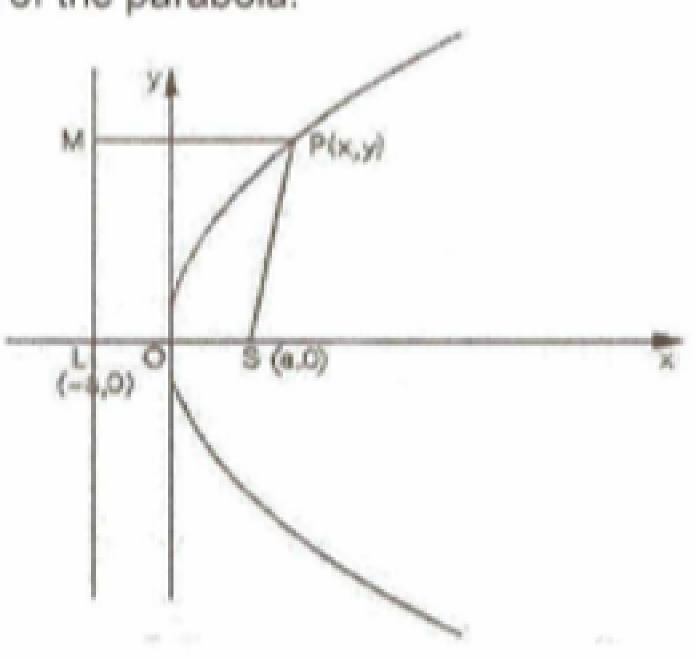


Figure 2

Let the distance of S from the origin be a, i.e. the focus is at the point $(a, 0)$. Let $P(x, y)$ be any point of the curve. From P draw PM parallel to SL to meet the line $x = -a$ (the directrix) at M. Join PS.

By definition SP = PM (since $e = 1$) giving $SP^2 = PM^2$.

$$(y - 0)^2 + (x - a)^2 = (x + a)^2$$
$$y^2 + x^2 - 2ax + a^2 = x^2 + 2ax + a^2$$
$$y^2 = 4ax$$

This is the **standard equation of a parabola**. When the equation is in this form it follows that:

(i) the focus S is the point $(a,0)$,
(ii) the directrix is the line $x = -a$,
(iii) the vertex is at the origin of coordinates,
(iv) the curve is symmetrical about the x-axis,
(v) the y-axis is a tangent at the vertex.

A line through the focus parallel to the y-axis is called the **latus rectum**. If the equation is in the form $y^2 = 4ax$, then the length of the latus rectum is $4a$.

(From: Parsons R. A., Dawson A. G.: *Pure and Applied Mathematics*, pp. 118–119 - adapted)

Notice:

- **latus rectum** (*pl.* latera recta) – the chord through a focus of a conic perpendicular to the major axis; its length is (1) $4a$ for the parabola, (2) $2a(1 - e^2)$ or $2b^2/a$ for the ellipse, and (3) $2a(e^2 - 1)$ or $2b^2/a$ for the hyperbola (*čes.* ohniskový parametr, ohnisková tětiva kuželosečky)
- the difference between: **ellipse** and **ellipsis –** see Unit 1 in *Notice*

Exercises

1. ***In the text above find all the nouns which form their plurals irregularly and write their plural forms.***

2. ***Analyse and discuss the ways articles are used or not used in the text above.***

3. ***Fill in the blanks with "a", "an" or "the" if necessary:***

Vectors can be multiplied in (1).....two ways, (2) .... first producing (3).........number (scalar) and is called (4).........scalar or (5).......... dot product and (6) ....second producing (7) ....vector and is called (8).......vector or (9)......cross product. Both (10)......products have (11)......important applications, especially in (12).......mechanics. (13).......study of (14)........their properties gives (15)......valuable insight into (16)......algebraic structure of (17) ......vectors and (18) ......mathematical structures in general. (19).......two-dimensional vectors are easy to represent and understand, while (20)......three-dimensional vectors are difficult to draw on (21)......plane paper and (22)......three-dimensional ideas difficult to convey. (23)......algebraic derivations are included to help (24)......understanding of three-dimensional work. (25)......many geometrical applications of (26)......vector methods are emphasized whenever possible. This also helps (27)......understanding and conveys (28)......idea of (29)......power and (30)......simplicity of (31).......working with (32)......vectors.

4. ***Fill in the blanks with "a", "an" or "the" in the following text if necessary:***

This book contains (1).... first-year graduate course in which (2).... basic techniques and (3).... theorems of (4).... analysis are presented in such (5).... way that (6).... intimate connections between its various branches are strongly emphasized. (7).... traditionally separate subjects of (8).... "real analysis" and (9).... "complex analysis" are thus united; some of (10).... basic ideas from (11).... functional analysis are also included.
Here are some examples of (12).... way in which these connections are demonstrated and exploited. (13).... Riesz representation theorem and (14).... Hahn-Banach theorem allow one to "guess" (15).... Poisson integral formula. They team up in (16)... proof of (17).... Runge's theorem. They combine with (18).... Blaschke's theorem on (19).... zeros of (20).... bounded holomorphic functions to give (21).... proof of (22).... Müntz-Szasz theorem, which concerns (23).... approximation on (24).... interval.

5. *Rewrite these expressions into mathematical symbols:*

a) the fifth root of *v* squared is equal to *v* to the power of two over five

b) *m* to the power of minus *n* all to the power of one over *n* is equal to one over *m* to the power of *n* squared

c) *a* raised to the fifth power all over *a* raised to the tenth power equals *a* raised to the power of minus five

d) the product of *a* plus *b* and *a* minus *b* is equal to the difference *a* squared minus *b* squared

e) *a* plus *b*, that sum cubed, is equal to *a* cubed plus three *a* squared times *b* plus three *a* times *b* squared plus *b* cubed

6. *Read out the following notation (Powers and Roots):*

a) $0^n = 0; n \in N$

b) $1^n = 1$

c) $(-1)^{2m} = 1; m \in N$

d) $(-1)^{2m+1} = -1$

e) $a^m b^m = (ab)^m$

f) $(a^m)^n = a^{mn}$

g) $a^{-n} = \dfrac{1}{a^n}; a \in R - \{0\}$

h) $a^0 = 1$

i) $a^k \cdot a^l = a^{k+l}; k, l \in Z$

j) $\dfrac{a^k}{a^l} = a^{k-l}$

k) $\sqrt[n]{0} = 0; n \in N$

l) $\sqrt[n]{1} = 1$

m) $\sqrt[1]{a} = a; a \in R_0^+$

n) $\sqrt[n]{(ab)} = (\sqrt[n]{a})\sqrt[n]{b}$

o) $\sqrt[n]{\dfrac{a}{b}} = \dfrac{\sqrt[n]{a}}{\sqrt[n]{b}}$

p) $(\sqrt[n]{a})^k = \sqrt[n]{a^k} = a^{\frac{k}{n}}$

q) $\sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a}$

r) $\sqrt[m]{a^m} = a$

s) $(\sqrt[n]{a})\sqrt[m]{a} = \sqrt[mn]{a^{m+n}}$

t) $\sqrt{a} + \sqrt{b} = \sqrt{\left[a + b + 2\sqrt{(ab)}\right]}; a, b \in R$

u) $\sqrt{a} - \sqrt{b} = \sqrt{\left[a + b - 2\sqrt{(ab)}\right]}; a \geq b$

v) $\sqrt{a \pm \sqrt{b}} = \sqrt{\dfrac{a + \sqrt{(a^2 - b)}}{2}} \pm \sqrt{\dfrac{a - \sqrt{(a^2 - b)}}{2}}; a^2 \geq b$

w) $\dfrac{1}{\sqrt{a} \pm \sqrt{b}} = \dfrac{\sqrt{a} \mp \sqrt{b}}{a - b}$

7. *Find solutions to the following problems and explain the procedure:*

a) $\dfrac{a^2+ab}{ab-b^2}\cdot\dfrac{a^2-b^2}{a+b}=?$

b) $\left(1+\dfrac{x}{1-x}\right):\dfrac{(1+x)^2}{1-x^2}=?$

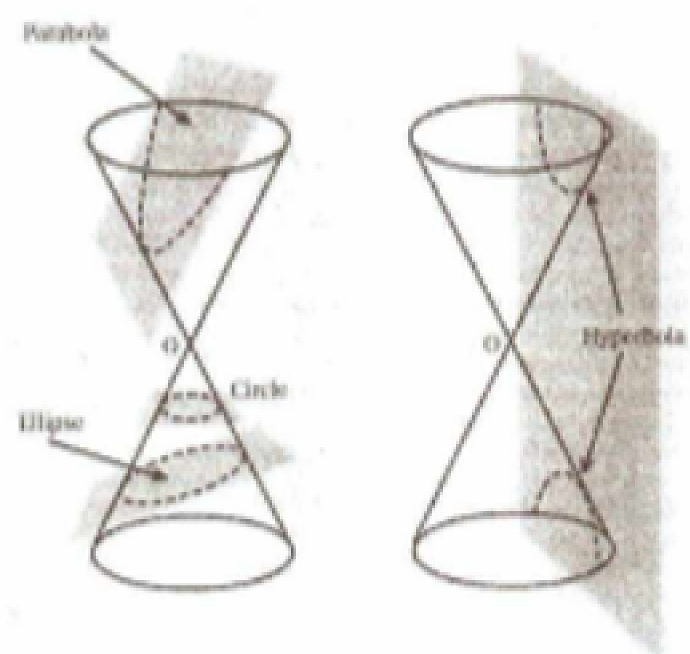
c) $\dfrac{\dfrac{a^3+b^3}{a^2b+ab^2}}{\dfrac{a}{b^2}+\dfrac{b}{a^2}}=?$

d) $\dfrac{1}{\sqrt{2}}-\dfrac{1}{2+\sqrt{2}}=?$

e) $\dfrac{1}{\sqrt[3]{\sqrt{3}-\sqrt{2}}}=?$

FOCUS B

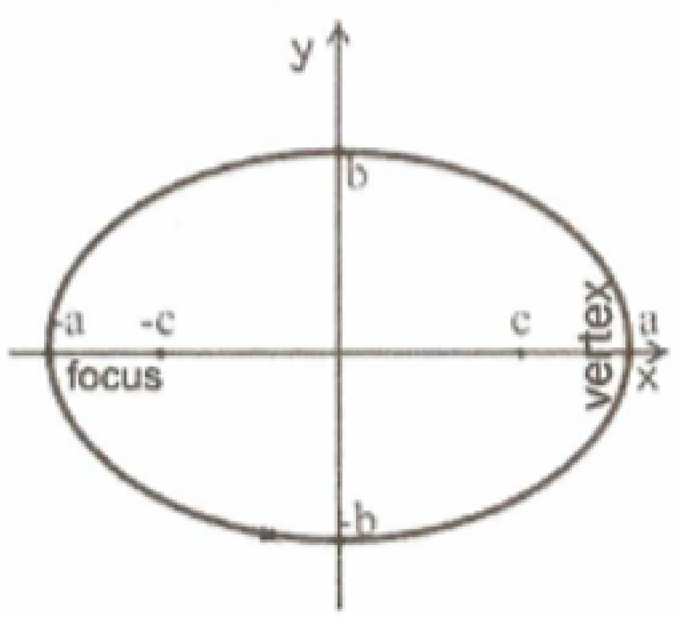
CONICS (CONIC SECTIONS)



The conic sections are curves obtained by the intersection of a right circular cone and a plane. According to the angle of intersection the conic is an ellipse, a parabola or a hyperbola. A circle is also a conic; it is a special case of an ellipse.

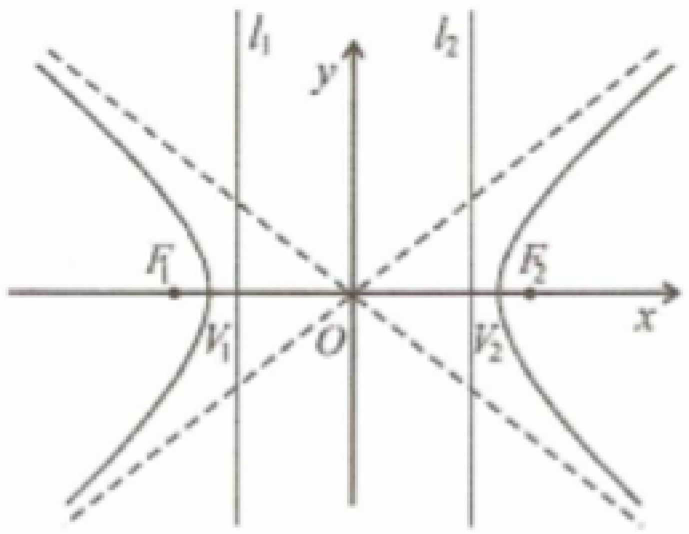
1. *Look and read:*

a) This is an *ellipse*. It is a closed curve which is symmetrical about both its axes.



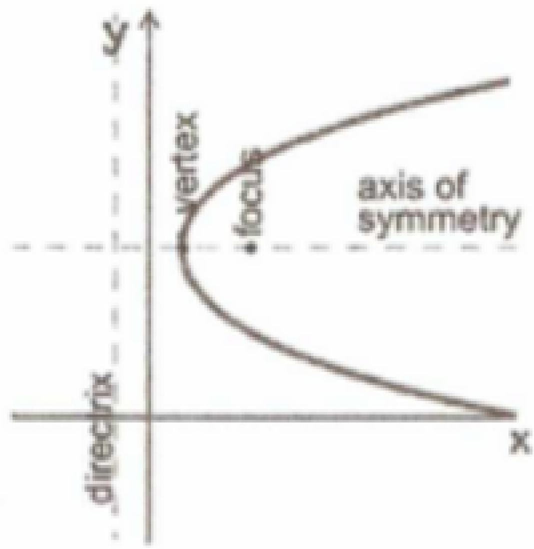
- Fixed points -*c* and *c* are called *foci* of an ellipse.
- The line through the foci is the *major axis (x)*. Perpendicular to the major axis through the centre is the *minor axis (y)*.
- The points where the axes cut the ellipse are the *vertices*.
- The midpoint of the vertices is the *centre* of the ellipse.

b) This is a *hyperbola*. It is a two-branched open curve.



- Fixed points F_1 and F_2 are called *foci* of a hyperbola.
- The line through the F_1 and F_2 is the *transverse axis* and the line through the centre perpendicular to the transverse axis is the *conjugate axis*.
- The points the transverse axis cuts the hyperbola are the *vertices*.
- The midpoint of the vertices is the *centre* of the hyperbola.
- The two separate parts of the hyperbola are the two *branches*.

c) This is a *parabola*. It is an open curve. It is the locus of a point that moves in a plane so as to be equidistant from a fixed line and a fixed point.



- The fixed line is called the *directrix*.
- The fixed point is the *focus*.
- The line through the focus perpendicular to the directrix is the *axis* of the parabola.
- The point where the axis cuts the parabola is the *vertex*. It is possible to take the vertex as the origin.

2. *Say whether the following statements are true or false:*

a) An ellipse is an open curve.
b) A transverse axis is a straight line through the foci.
c) The fixed points of conics are called the vertices.
d) A circle is a special case of a group of curves known as conic sections.
e) A parabola has two foci.
f) A parabola is a two-branched open curve.

3. *Fill in the gaps:*

a) A horizontal line through the centre of an ellipse is called ....
b) A parabola has a fixed point – ...., and a fixed line – ....
c) The two separate parts of a hyperbola are called ....
d) In an ellipse, the line through the centre perpendicular to the major axis is ....
e) A hyperbola has two axes: the horizontal one is called ...., and the vertical one is called ....
f) The points where the major axis cuts the ellipse are ....

FOCUS C

ARTICLES

Use of articles in mathematical texts

I. Use of the indefinite article (sg.: a, an; pl.: 0)

1. Instead of the number "one":

*... for **an** object to be an element of $A \cap B$, it must be ...*
*In **a** paper on "Spaces of Type $H \infty + C$" I learned ...*
*Prove that there is **a** positive number k and **a** closed interval F ...*

2. Meaning "member of a class of objects", "some", "one of":

*We introduced **a** family of linear operators which led to ...*
*Let $a_1, a_2, \dots$ be **a** sequence of real numbers.*

3. In definitions of classes of objects (when there are many objects with the given property):

*... the overall relationship of Y and X can represented roughly by **a** function whose graph is a straight line ...*
*Instead of using **a** goal that says what shouldn't be true, see if you can rephrase ...*
*A fundamental solution is **a** function satisfying ...*

4. In front of an adjective expressing "this particular quality":

*A finite Riemann surface is **a** connected open proper subset ...*
*Suppose that we have **a** metric space (X, d) ...*
*... which is obviously **an** increasing sequence.*

5. In the plural (when you are referring to each element of a class):

Students of mathematics often have trouble with mathematical proofs.
Mersenne primes are related to perfect numbers.
Open sets provide a simple characterization of continuity.

II. Use of the definite article (the)

1. Meaning "mentioned earlier":

***The** four conditions enumerated above are referred to as Peano's axioms for the natural numbers.*
*This we could do because **the** ideas we have been dealing with have been so simple.*
***The** above-mentioned classical theorems say that ...*

2. In the plural (if you are referring to all elements of a class):

*Most of **the** functions considered in topology are continuous.*
***The** harmonic numbers are the numbers H^n for $a \geq 1$ defined by the formula ...*
***The** Riemann sums of f, namely, **the** averages ...*

3. In front of a noun (or an adjective + a noun) referring to a uniquely determined object (as in definitions):

***The** concept of indexed family of subsets allows us to define the union or intersection of the aforementioned subsets.*
*Let D be **the** diagonal of U^n, ...*
*I defined **the** coset-ring of G to be the smallest family of sets...*

4. In the pattern: the + property + of + object:

***The existence of** inner functions was proved.*
***The continuity of** f follows from ...*
*The fourth condition is called **the principle of** mathematical induction.*

5. *In front of a cardinal number (if it includes all objects considered):*

This satisfies **the** *four properties enumerated in Definition 2.1.*
Each row represents one of **the** *four possible combinations of truth values ...*
Each of **the** *two products on the right side satisfies ...*

6. *In front of an ordinal number:*

In **the** *first step, we have listed ...*
... so **the** *fourth column contains ...*
The *first chapter is an informal discussion of set theory.*

7. *In front of surnames used attributively:*

... if this lies in **the** *Hardy space H^1, then ...*
This topological space satisfies **the** *Hausdorff axiom.*
The result is now known as **the** *Beurling-Rudin theorem.*
It allowed one to formulate **the** *Poisson integral formula.*

III. Use of no article (article omission)

1. *In front of nouns referring to activities (in patterns with "of" "the" can be used):*

It is possible to reach ***d****ifferentiation and* ***i****ntegration even more quickly by ...*
... the most elementary theorem on ***d****iophantine* ***a****pproximation ...*
We sometimes use this notation to restrict ***a****ttention to ...*

2. *In front of nouns referring to properties (if no particular object is mentioned):*

In ***c****alculus, the first occurrence of the word "continuity" is with reference to...*
... how proofs are constructed in ***d****etail.*
By ***d****efinition,* $A \cap B = \{ x / x \in A \text{ and } x \in B\}$.
In a context in which it is clear what the universe of ***d****iscourse U is ...*

3. *In front of numbered objects:*

By ***C****orollary 7.7, each equivalence class of metrically equivalent metric spaces is ...*
Quantifiers are introduced in ***C****hapter 2.*
...as indicated in ***F****igure 1...*
We immediately find that ***C****onjecture 1 is correct.*

4. *In front of surnames in the possessive:*

Schwarz's lemma
Runge's theorem
Cauchy's inequality
DeMorgan's law

5. *In front of the names of mathematical and other disciplines:*

About half of this course was devoted to ***a****lgebra and* ***t****opology.*
There is a parallel with ***c****omputer science here ...*
These chapters present the basics of ***s****et theory.*
The basic techniques and theorems of ***a****nalysis are presented here.*

6. *To avoid repetition:*

the basic techniques and ***t****heorems of analysis*
the order and ***s****ymbol of a distribution*
the inner and ***o****uter angles*

UNIT 5

FOCUS A

THE DOT PRODUCT OF TWO VECTORS

Consider a rock being pulled along level ground by a rope inclined at a fixed angle to the ground. Let the force applied to the rock be represented by the vector **F**. The force **F** can be expressed as the sum of a vertical force $\mathbf{F}_2$ and a horizontal force $\mathbf{F}_1$, as shown in Fig. 1.

Fig. 1

How much work is done by the force **F** in moving the rock along the ground? The physicist defines the work accomplished by a constant force **F** (whatever direction it may have) as follows. Say that the force **F**, as shown in Fig. 2, moves an object along a straight line from the tail to the head of **R**.

Fig. 2

The work accomplished is defined to be

$$\underbrace{|\mathbf{F}|\cos\theta}_{\substack{\text{Magnitude}\\ \text{of force in}\\ \text{direction}\\ \text{object is}\\ \text{moved}}} \cdot \underbrace{|\mathbf{R}|}_{\substack{\text{Distance}\\ \text{the object}\\ \text{is moved}}}$$

where θ is the angle between R and F. The angle θ can be anywhere in $[0, \pi]$.

(So, in case of the forces shown in Fig. 1, we see that $\mathbf{F}_2$ accomplishes no work. The work accomplished by **F** in pulling the rock is the same as that accomplished by $\mathbf{F}_1$.)

This important physical concept illustrates the **dot product of two vectors**, which will be introduced after the following definition.

Definition *Angle between two nonzero vectors.* Let **A** and **B** be two nonparallel and nonzero vectors. They determine a triangle and an angle θ, shown in Fig. 3.

The angle between two vectors

Fig. 3

The **angle between A and B** is θ. Note that $0 < \theta < \pi$. If **A** and **B** are parallel, the angle between them is 0 (if they have the same directions). The angle between **0** and any other vector is not defined.

The angle between **i** and **j** is $\pi/2$. The angle between $\mathbf{A} = -\mathbf{i} - \mathbf{j}$ and $\mathbf{B} = 3\mathbf{i}$ is $3\pi/4$, as Fig. 4 shows.

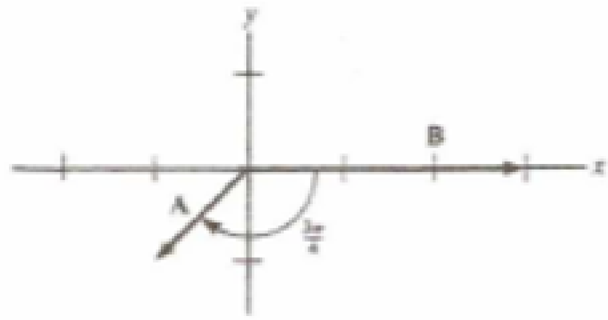


Fig. 4

The angle between **k** and **– k** is π; the angle between 2**i** + 2**j** + 2**k** and 5**i** + 5**j** + 5**k** is 0.
The dot product of vectors can now be defined.

Definition *Dot product.* Let **A** and **B** be two nonzero vectors. Their dot product is the number |**A**| |**B**| cos θ, where θ is the angle between **A** and **B**. If **A** or **B** is **0**, their dot product is 0. The dot product is denoted **A** · **B**. It is a scalar and is also called the **scalar product** of **A** and **B**.

(From: Stein S. K.: *Calculus and Analytic Geometry*, pp. 594–595 – adapted)

Notice:

- *imperatives* "consider" and "say", and "let" structures: "Let the force be represented", "Let A and B be two nonparallel and nonzero vectors", and "Let A and B be two nonzero vectors" – stylistic devices enabling the author to have the text very formal, clear, and pragmatic
- *non-* = *combining form* used to add the meaning 'not' or 'the opposite of' to adjectives and nouns, can be written both with a hyphen (*see* non-fiction, non-biological, non-existent, non-resident, non-profit etc.) and without a hyphen (nonsense, nonparallel, nonzero, non-profit etc.)
- *definition* [defi'nišən] (n) (*čes.* definice) – srov.: *define* [di'fain] (v), *definable* [di'fainəbl] (adj); compare with *hypothesis* and *conjecture* (*see* Unit 1)

Exercises

1. In the text above find all passives and say which form of passive they represent.

2. Complete the following sentences with the appropriate forms of the verbs from the box below:

see	make	pay	know	say	find	apply	forget	be	give

a) Subspace M of L^2 is .... to be translation invariant.
b) Elementary proofs may be .... in Chapter VII.
c) The result extends to L^2, as can be .... from Theorem 9.13.
d) An extremely short proof by P. J. Cohen is also ....
e) The functional analysis proof is .... to many analysts and has probably .... independently discovered several times in recent years.
f) Attention is ..... to the closeness of the approximation.
g) Lebesgue's theory of integration is .... to problems about holomorphic functions.
h) Part (b) was proved by Lebesgue but seems to have been ....
i) On earlier attempts that were ..... towards the construction of a satisfactory theory of integration.

3. Active or passive (past tense):

The first steam locomotive (1) (invent)...............by Richard Trevithick, a British inventor and mining engineer. Trevithick's steam locomotive (2) (build) .... in 1804 in Pen-y-Darren in South Wales for carrying cargo. Trevithick (3) (sell)........... the patents of the steam locomotive to Samuel Homfray. In one of the earliest public demonstrations, the locomotive successfully (4) (carry) .... an impressive load of 10 tons of iron, 5 wagons and 70 men 9.75 miles between Penydarren and Abercynon in 4 hours and 5 minutes. Trevithick (5) (continue) .... to work with steam locomotives for many more years until his death in April 1833. A full-scale working replica of his first steam locomotive (6) (build) .... in 1981 for the Welsh Industrial and Maritime Museum, later moving to the National Waterfront Museum in Swansea. The locomotive is run several times a year along a short length of rail outside the museum.

4. ***Make passive forms from the given phrases. Mind the tenses and forms in brackets:***
   a) computers – to replace (Past Progressive)
   b) the new computer chip – produce (Present Perfect)
   c) the road – to close (Conditional I)
   d) classrooms – to use (Past Perfect)
   e) inventions – to patent (Past Simple)
   f) houses – to build (Present Progressive)
   g) problems – to solve (Future Perfect)
   h) astronauts – to send to the Moon (will-future)
   i) a plan – not to accept ("going to" future)
   j) a lot of notebooks – to sell every day (Present Simple)

5. ***Rewrite the sentences starting with the words in brackets and use an infinitive or an infinitive construction:***
   a) It is expected that the dean will present a statement tonight. (The dean ......)
   b) It is likely that they will arrive before six. (They are ...)
   c) They say she was sitting at the meeting all day. (She is ......)
   d) They believe that he is one of the best Czech mathematicians. (He is ...)
   e) It is your duty to obey him. (You are supposed ...)
   f) People know that Albert Einstein worked for the Swiss Patent Office. (Albert Einstein is ...)
   g) We consider that she was the best physicist that Russia has ever produced. (She is ...)

6. ***Synonyms and antonyms. For each of the adjectives or verbs in A, write its opposite in B using a prefix. In column C, write a synonym for the words in B, choosing one of the words in the box:***

dispassionate	*reveal*	*breakdown*	*prohibited*	*ugly*
separate	*amateur*	*neglect*	*unfinished*	*careless*
~~sad~~	*anonymous*	*unspiritual*	*subvert*	*unscrupulous*
misinterpret	*misstate*	*vanish*	*deceitful*	*rare*
unbelievable	*halt*	*redundant*	*defective*	*lifeless*

A	B	C
happy	*unhappy*	*sad*
appear		
attractive		
carriage		
complete		
connect		
conscious		
continue		
cover		
credible		
emotional		

employed		
honest		
known		
legal		
moral		
perfect		
professional		
pronounce		
religious		
responsible		
stabilize		
treat		
understand		
usual		

7. ***Rewrite these expressions into mathematical symbols:***
   a) if the logarithm of the sum *a* plus *b* to the base *u* is equal to *v* then the exponential function of *v* with the base *u* is equal to the sum of *a* and *b*
   b) the fraction whose numerator is the exponential function of *x* with the base a, and whose denominator is the exponential function of *x* with the base *b* is equal to the exponential function of *x* with the base *a* over *b*
   c) the determinant of the upper-triangular matrix the first row of which is one and one, and the second row is zero and one equals one
   d) the transposed matrix of the two-by-two matrix whose first row is one and two, and whose second row is three and four is equal to the two-by-two matrix whose first row is one and three, and whose second row is two and four
   e) the fact that the exponential function of *x* with the base one third is less than the exponential function of *y* with the base one third implies that *x* is greater than *y*

8. ***Read out the following notation (Logarithms and exponential functions, Matrices and determinants):***
   a) $a^{\log_a a} = x$
   b) $\log_a a^y = y$
   c) $\ln x = y \Leftrightarrow x = e^y$
   d) $\log x = y \Leftrightarrow x = 10^y$
   e) $\log_b a = \frac{1}{\log_c b} \cdot \log_c a = \log_b c \cdot \log_c a$
   f) $\log_b \frac{a}{c} = \log_b a - \log_b c$
   g) $\log_b a^r = r \log_b a$
   h) $\log_b \sqrt[n]{a} = \frac{1}{n} \log_b a$

9. ***Find solutions to the following problems and explain the procedure:***
   a) $2 \cdot \log x = \log(x+6)$
   b) $\log(x-2) + \log 9 = 2 \cdot \log x$
   c) $\log^2 x - \log x^4 + 4 = 0$
   d) $\log_4(\log_3(\log_2 x)) = 0$

e) $\log x + \dfrac{16}{\log x} = -8$

f) $x^{-2+\log x} = 1000$

g) $\log_2(x+6) = \log_4 x^2$

h) $11^x < 11^{3x-2}$

i) $4^{2x-1} > 2$

j) $4^{1+x} + 4^{1-x} = 17$

k) $(0{,}5)^{-5} R (0{,}5)^8; R = \{<, >, =\}$

10. Consider the matrices A, B, C and D and read their notation. Find solutions to the following problems and explain the procedure:

$$A = \begin{pmatrix} -1 & 4 & 1 \\ 2 & -2 & -2 \\ 0 & 2 & 0 \end{pmatrix} \qquad C = \begin{pmatrix} 4 & -5 & 8 \\ 2 & 3 & 2 \end{pmatrix}$$

$$B = \begin{pmatrix} 2 & -3 \\ 1 & 2 \\ 9 & 0 \end{pmatrix} \qquad D = \begin{pmatrix} -3 & 1 \\ 3 & 4 \\ 2 & 1 \end{pmatrix}$$

a) $B + D = ?$

b) $A + C = ?$

c) $A \cdot B = ?$

d) $B \cdot C = ?$

e) $A \cdot C = ?$

f) $|A| = ?$

g) $|B| = ?$

h) $A_{13} = ?$

i) $A_{31} = ?$

j) $A^{-1} = ?$

k) $C^T = ?$

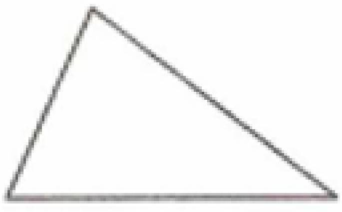
l) $D^T = ?$

FOCUS B

MORE 2-DIMENSIONAL FIGURES (PLANE FIGURES)

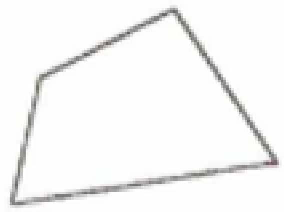
1. Look and read:

A triangle is a *polygon* with three sides and three angles.
A triangle is a three-sided figure.

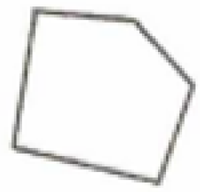


Note: A *polygon* is a figure with many sides. In a *regular* polygon all the sides have equal length and the interior angles have equal size; and the vertices lie on a circle. Specific polygons have names that indicate the number of sides, such as *triangle, quadrilateral, pentagon, hexagon, etc.*

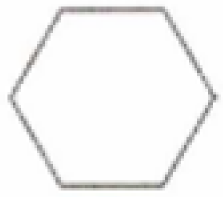
Now make similar statements about the other figures:



a trapezoid

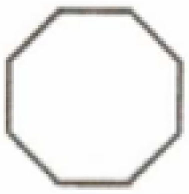


a pentagon



a regular hexagon

a heptagon



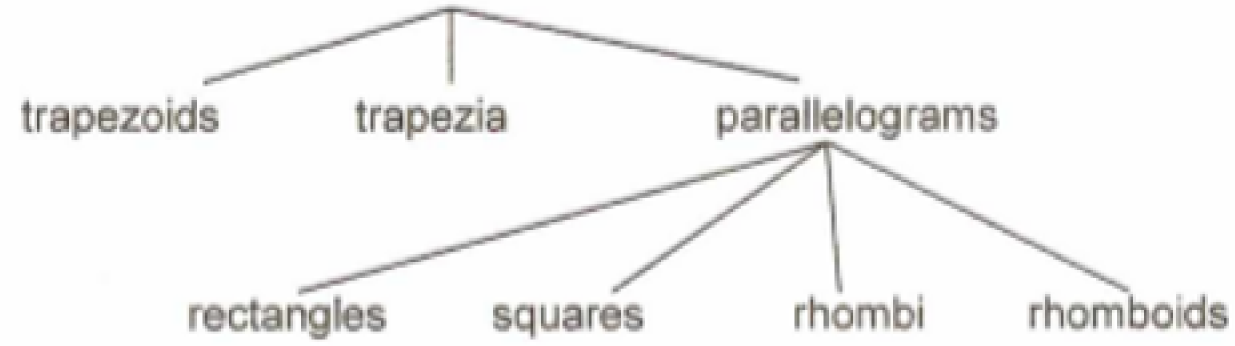
a regular octagon

a decagon

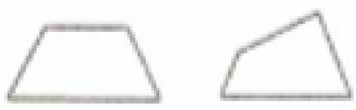
2. *Read this:*

A polygon with four straight sides and four vertices is called a *quadrilateral*.

Special types of convex quadrilaterals:

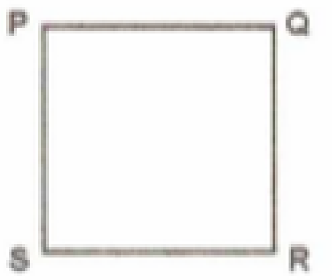


Note: **trapezium** (Br.)/ trapezoid (Am.): a quadrilateral with 2 parallel sides of unequal length;
trapezoid (Br.)/ trapezium (Am.): a quadrilateral with neither pair of sides parallel.



trapezium and **trapezoid** (Br.) or *vice versa* (Am.)

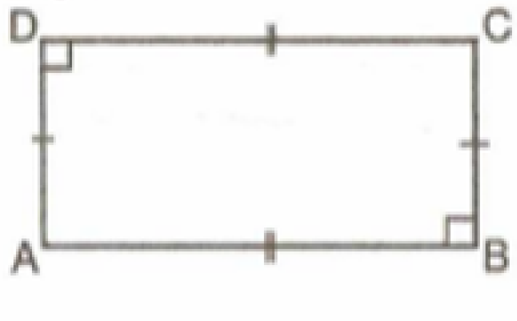
3. *Look and read:*



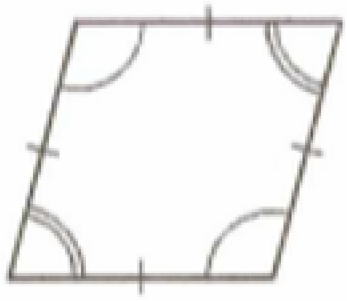
This is a square.
It is a four-sided figure.
Opposite sides are parallel.
All four sides are equal in length.
All angles are right angles.
A square is a regular quadrilateral.

Now describe these figures:

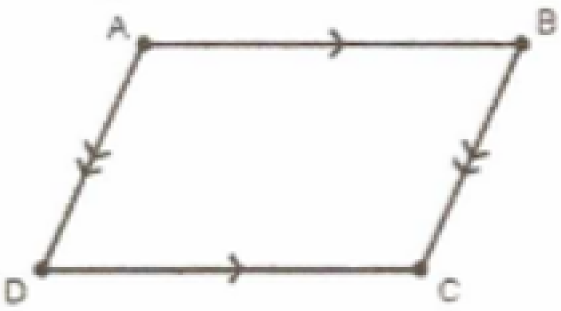
a) a rectangle



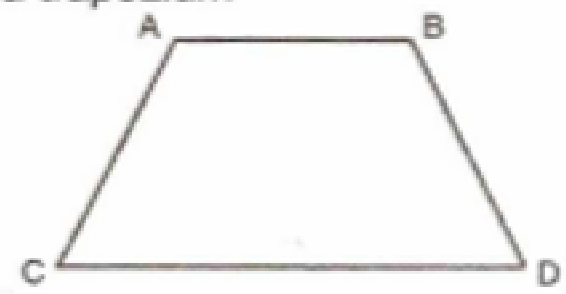
b) a rhombus



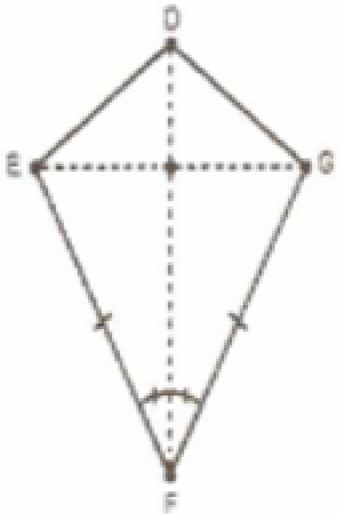
c) a parallelogram



d) a trapezium



4. Look and fill in the gaps:



This is a kite.
A *kite* is a convex quadrilateral with two distinct pairs of .... Each side of the pair is .... to the other and they are of equal length. The .... are equal where the pairs meet.
The diagonals (dashed lines) of a kite intersect at .... angles, and one of the diagonals bisects the other.

5. Fill in the missing expressions:

a) A .... is a .... with six sides.
b) A shape with five sides is called a ....
c) A four sided figure with two sides parallel is called a ....
d) A parallelogram has two ...... and .... sides and at least two angles of the same ....
e) If two .... of a parallelogram are vertical, the other two are ....
f) A figure with four equal .... but no right angles is called a ....

6. Which of the following is not enough information to prove that a quadrilateral is a parallelogram?

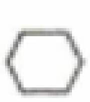
a) Both pairs of opposite angles are congruent.
b) One pair of opposite sides is both congruent and parallel.
c) The diagonals bisect each other.
d) Two pairs of sides are congruent.

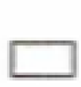
7. Describe the shapes by means of adjectives:

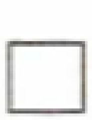
Example:  semicircular

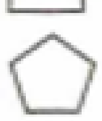
a)  ....

b)  ....

c)  ....

d)  ....

e)  ....

f)  ....

g)  ....

h)  ....

8. Complete the following sentences:

Example: All sides of an equilateral triangle are equal, and so are those of a rhombus.

a) Opposite sides of a rectangle are equal, and so are ....
b) All the angles of a square are right angles, and so are ....
c) All sides of a regular hexagon are equal, and so are ....
d) All sides of an equilateral triangle ....
e) All angles of an equilateral triangle ....

9. Puzzle

How many squares are on a chessboard?

Clues:
a) How many different sized squares can you find? ....
b) How many of the smallest squares can you find? ....
c) How many of the other sizes of squares can you find? ....

FOCUS C

PASSIVE VOICE

The passive of an active tense is formed by putting the verb *to be* into the same tense as the active verb and adding the *past participle* of the active verb. We usually prefer the passive when it is not important who or what performs the action. The object of an active sentence becomes a subject of the passive sentence. The passive is used much more in English than in Czech, in specialized mathematical texts in particular.

I. Forms of passive

Tense/ Verb form	Active Voice	Passive Voice
Simple Present	*keeps*	*is kept*
Present Progressive	*is keeping*	*is being kept*
Simple Past	*kept*	*was kept*
Past Progressive	*was keeping*	*was being kept*
Present Perfect	*has kept*	*has been kept*
Past Perfect	*had kept*	*had been kept*
Future	*will keep*	*will be kept*
Conditional	*would keep*	*would be kept*

II. The most frequent passive structures in mathematical texts

1. *"An object X is operated (by something) or acted upon (something)":*

The dot product of two vectors ***will be introduced****.*
Every one of spaces M ***is obtained*** *in this manner.*
The dot product ***is denoted*** *A • B.*
In Simpson's method the interval [a, b] ***is divided*** *into an even number of sections.*
The letter x ***will be needed*** *later for another purpose.*

2. *"An object X is proved (to be / to have etc.)":*

The work accomplished ***is defined to be*** *$|F| \cos\theta \bullet |R|$ where θ is the angle between R and F.*
... case (6) ***is*** *easily* ***proved to be*** *true ...*
... genus g ***is defined to be*** *the genus of R.*
The functions and sets ***are assumed to be*** *measurable.*
... subspace M of L^2 ***is said to be*** *translation invariant ...*

3. *"An object X is given a structure Y":*

... M ***can be given*** *a complex structure ...*

4. *"An object X to be proved / used etc." – with meaning "will be":*

... the subset turns out ***to be*** *totally* ***ordered****.*
... the discriminant ***is found to be*** *equal to ...*
... a paper that is important enough ***to be studied*** *by significant mathematicians.*

5. *"An object X can be proved /shown etc. "*

It ***can be shown*** *that $2 \cos \alpha = a$.*
It is ***readily seen*** *that the circle ...*
The solid ***may all be approximated*** *by concentric hollow pipes.*
The trigonometric functions ***can be expressed*** *in terms of ...*
F ***can be thought of*** *as ...*
Temperature ***may be recorded*** *hourly.*

FORMING OPPOSITES

We can form the opposite of many adjectives, verbs and nouns or give the negative meaning by adding a negative prefix. There is no fixed rule for adding one prefix or another, so students have to get familiar with these words and check a dictionary when in doubt in order to use them correctly.

a- (an-)	*without*	**a**moral, **a**political, **an**oxic, **an**hydrous
anti-	*against*	**anti**-clockwise, **anti**social
counter-	*against*	**counter**act, **counter**productive
de-	*opposite*	**de**stabilize, **de**magnetize
dis-	*opposite*	**dis**advantage, **dis**agree, **dis**respectful
il-	*not*	**il**legal, **il**logical *(before l)*
im-	*not*	**im**mature, **im**perfect, **im**possible *(before b, m, p)*
in-	*not*	**in**complete, **in**effective, **in**efficient

ir-	*not*	**ir**rational, **ir**relevant *(before r)*
mal-	*wrongly*	**mal**treat, **mal**formed
mis-	*wrongly*	**mis**understand, **mis**lead
non-	*not*	**non**sense, **non**-fiction, **non**-violant
un-	*not*	**un**fortunate, **un**fit

UNIT 6

FOCUS A

MANIPULATING POWER SERIES

In advanced calculus it is proved that within its interval of convergence a power series behaves in many ways like a polynomial. In particular, it can be differentiated term by term,

$$(a_0 + a_1x + a_2x^2 + a_3x^3 + \ldots)' = a_1 + 2a_2x + 3a_3x^2 + \cdots .$$

The sum of a *finite* number of functions can be differentiated term by term. The proof of this for power series is far more involved. In Theorem 1 the differentiation rule for power series in x is stated precisely. (A similar theorem holds for power series in $x - a$.)

Theorem 1 *Differentiating a power series.* Assume that $R > 0$ and that $\sum_{n=0}^{\infty} a_n x^n$ converges to $f(x)$ for $|x| < R$. Then for $|x| < R$, f is differentiable, $\sum_{n=1}^{\infty} na_n x^{n-1}$ converges, and

$$f'(x) = a_1 + 2a_2x + 3a_3x^2 + \cdots .$$

This theorem is *not* covered by the fact that the derivative of the sum of a *finite* number of functions is the sum of their derivatives.

EXAMPLE 1 Obtain a power series for the function $1/(1-x)^2$ from that for $1/(1-x)$.

SOLUTION From the formula for the sum of a geometric series, we know that

$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + \cdots \qquad \text{for } |x| < 1.$$

According to Theorem 1, if we differentiate both sides of this equation, we obtain a true equation, namely,

$$\frac{1}{(1-x)^2} = 0 + 1 + 2x + 3x^2 + \cdots \qquad \text{for } |x| < 1.$$

Thus

$$\frac{1}{(1-x)^2} = 1 + 2x + 3x^2 + \cdots = \sum_{n=0}^{\infty}(n+1)x^n \qquad \text{for } |x| < 1.$$

Suppose that $f(x)$ has a power-series representation $a_0 + a_1x + a_2x^2 + \ldots$; Theorem 1 enables us to find what the coefficients $a_0, a_1, a_2, \ldots$ must be. The formula for a_n appears in Theorem 2. In this theorem, $f^{(n)}$ denotes the nth derivative of f; $f^{(1)} = f'$, $f^{(0)}$ stands for f itself, and $0! = 1$.

Theorem 2 *Formula for a_n.* Let R be a positive number and suppose that $f(x)$ is represented by the power series $\sum_{n=0}^{\infty} a_n x^n$ for $|x| < R$, that is,

$$f(x) = a_0 + a_1x + \ldots + a_nx^n + \cdots \qquad \text{for } |x| < R.$$

Then

$$a_n = \frac{f^{(n)}(0)}{n!} \tag{1}$$

Proof When $x = 0$ we obtain $f(0) = a_0 + a_10 + a_20^2 + \cdots$. Hence

$$f(0) = a_0,$$

which is (1) for $n = 0$. To obtain a_1, differentiate $f(x)$ and get

$$f^{(1)}(x) = a_1 + 2a_2x + 3a_3x^2 + \cdots + na_nx^{n-1} + \cdots. \tag{2}$$

Set $x = 0$ in (2) and obtain $f^{(1)}(0) = a_1$.

This establishes (1) for $n = 1$.

To obtain a_2, differentiate (2) and get

$$f^{(2)}(x) = 2a_2 + 3 \cdot 2a_3x + \cdots + n(n-1)a_nn^{n-2} + \cdots. \tag{3}$$

Letting $x = 0$ gives $\quad f^{(2)}(0) = 2a_2$.

Hence $\quad a_2 = \frac{f^{(2)}(0)}{2}$,

and (1) is established for $n = 2$.

To obtain a_3, differentiate (3) as follows:

$$f^{(3)}(x) = 3 \cdot 2a_3 + 4 \cdot 3 \cdot 2a_4x + \cdots + n(n-1)(n-2)a_nx^{n-3} + \dots . \tag{4}$$

Set $x = 0$, obtaining $\quad f^{(3)}(0) = 3 \cdot 2a_3$,

or $\quad a_3 = \frac{f^{(3)}(0)}{3!}$.

This establishes (1) for $n = 3$ and also shows why the factorial appears in the denominator of (1). The reader should differentiate (4) and verify (1) for $n = 4$. The argument applies for all n and can be completed by induction.

(From: Stein S. K., *Calculus and Analytic Geometry*, pp. 529–531 – adapted)

Notice:

- *series* – both in singular and plural (*This series is … / These series are …*), *see* in the text above: "A power series behaves in many ways like a polynomial"; "series" as a noun (*see* "a power series", "a geometric series") and as an adjective (*see* "a power-series representation")
- related words with the same root: *prove* (v) – *proof* (n); *differentiate* (v) – *differentiation* (n) – *differentiable* (adj); *assume* (v) – *assumption* (n)
- stylistic devices typical for very formal, specialised mathematical texts, see **the sequence**: *assume – according to – thus – suppose – let R be - then – letting x = 0 gives – hence – to obtain – to establish*; **or structures**: *in particular – term by term – far more involved – stated precisely – a theorem holds – formula for a appears in … –$f^{(0)}$ stands for **f** itself – this shows why – the argument applies for all n and can be completed by induction*

Exercises:

1. ***Explain the difference in meanings of the words: proof, theorem, formula, assumption.***

2. ***Rewrite the sentences, using inversion instead of "if":***

   a) If I had known that you were coming I would have met you at the airport.
   b) If he had tried to leave the country he would have been stopped at the frontier.
   c) If I should find the name of the author I would tell you.
   d) If our documents had been in order we could have left at once.
   e) I shouldn't respect my opponent if he were rude.
   f) If they had found her earlier they might have saved her life.
   g) If I had had a map I wouldn't have been lost.
   h) If he had committed this crime he might have gone to prison.

3. ***Fill in the gaps using the words in the box:***

has – before – than – audience – then – was – started – will – can – did – so many – had

   a) Hardly ever .... an athlete won so many medals in such a short time.
   b) Little .... we realise what a social faux-pas we had committed.
   c) Scarcely .... the match started when the trouble began.
   d) Only by standing on tip-toe .... I able to see anything at all.
   e) Seldom can an .... have heard a better interpretation of this symphony.

f) Hardly had the controversial opera .... when people began to walk out.
g) Only if we leave now .... we be in time to catch the train.
h) Never have I seen .... people turn out for this event.
i) Rarely .... a remark have been more ill-judged.
j) Only .... did it become clear what the extent of the damage was.
k) Barely had we had time to pack up the picnic things .... the heavens opened.
l) No sooner had we asked for a quieter room .... we were given one.

4. *Fill in the missing British equivalents of the American words (compare lexical differences in a – k and spelling differences in l – v):*

a) area code ....
b) billion ....
c) collect call..............................
d) cookie.....................................
e) fall..
f) flashlight ....
g) math ....
h) resumé ....
i) schedule ....
j) secretary.................................
k) stove.......................................
l) rigor ....
m) meter ....
n) defense ....
o) inquire ....
p) dialog ....
q) ..program ....
r) modeling ....
s) color ....
t) theater ....
u) license ....
v) catalog ....

5. *Match the British words in column A with the American ones in column B:*

A	B
a) shop	1) reserve
b) quote	2) railroad
c) tube	3) apartment
d) trousers	4) conductor
e) railway	5) vacation
f) guard	6) mail
g) solicitor	7) subway
h) book	8) store
i) flat	9) pants
j) holiday	10) attorney
k) post	11) cite

6. *Rewrite these expressions into mathematical symbols:*

a) the integral of *x* squared plus two *x* plus one over *x* with respect to *x* is equal to *x* cubed over three plus *x* squared plus the natural logarithm of *x* plus a constant
b) the definite integral from *a* to *b* of the *f* of *x* with respect to *x* is equal to minus the definite integral from *b* to *a* of the *f* of *x* with respect to *x*
c) if *y* is equal to the natural logarithm of the *f* of *x* then the first derivative of *y* is equal to the fraction the first derivative of the *f* of *x* over the *f* of *x*
d) the first derivative of the sum *u* plus or minus *v* equals the first derivative of *u* plus or minus the first derivative of *v*
e) if the *f* of *x* is equal to the tangent of *x* then the first derivative of the *f* of *x* is equal to one over the cosine squared of *x*

7. *Read out the following notation (Calculus, Trigonometric functions, Equations):*

a) $\lim\limits_{n\to\infty} \alpha^n = 0; |\alpha| < 1, n \in N$

b) $\lim\limits_{n\to\infty} \frac{n!}{n^n} = 0$

c) $\lim_{n\to\infty}\sqrt[n]{\frac{1}{n!}}=0$

d) $\lim_{x\to\pm\infty}\left(1+\frac{1}{x}\right)^x=e$

e) $\lim_{x\to+\infty}a^x=+\infty;0<a<1$

f) $y=x^n\Rightarrow y'=nx^{n-1}$

g) $y=a^x\Rightarrow y'=a^x\ln a;x>0,a\in R$

h) $y=\sqrt[n]{x}\Rightarrow y'=\frac{1}{n\sqrt[n]{x^{n-1}}}$

i) $y=\log_a x\Rightarrow y'=\frac{1}{x\ln a};x>0,\ a>0,a\neq 1$

j) $y=x^n\Rightarrow y^{(n)}=n!$

k) $y=e^x\Rightarrow y^{(n)}=e^x$

l) $y=a^{kx}\Rightarrow y^{(n)}=(k\ln a)^n a^{kx};a>0,k\in R$

m) $\frac{d(v\pm u)}{dt}=\frac{dv}{dt}\pm\frac{du}{dt}$

n) $\frac{d(vu)}{dt}=\frac{dv}{dt}u+v\frac{du}{dt}$

o) $\int a^x dx=\frac{a^x}{\ln a}+c;a>0,a\neq 1$

p) $\int\frac{dx}{x}=\ln|x|+c;x\neq 0$

q) $\int\frac{dx}{x^2-1}=\frac{1}{2}\ln\left|\frac{x-1}{x+1}\right|+c;|x|\neq 1$

r) $\int\frac{xdx}{ax+b}=\frac{x}{a}-\frac{b}{a^2}\ln|ax+b|$

s) $\int(ax+b)^r dx=\frac{1}{(r+1)a}(ax+b)^{r+1};a\neq 0,b\neq 0,r\in R-\{-1\}$

t) $\sin(\alpha\pm\beta)=\sin\alpha\cos\beta\pm\cos\alpha\sin\beta$

u) $\tan(\alpha\pm\beta)=\frac{\tan\alpha\pm\tan\beta}{1\mp\tan\alpha\cdot\tan\beta}$

v) $\sin\alpha=2\sin\frac{\alpha}{2}\cos\frac{\alpha}{2}$

w) $\cos\alpha=\cos^2\frac{\alpha}{2}-\sin^2\frac{\alpha}{2}=1-\sin^2\frac{\alpha}{2}=2\cos^2\frac{\alpha}{2}-1$

x) $\cos(n\alpha)=\cos^n\alpha-\binom{n}{2}\sin^2\alpha\cos^{n-2}\alpha+\binom{n}{4}\sin^4\alpha\cos^{n-4}\alpha-\ldots$

y) $\cos\alpha+\cos\beta=2\cos\frac{\alpha+\beta}{2}\cos\frac{\alpha-\beta}{2}$

z) $\tan(4\alpha)=\frac{4\tan\alpha-4\tan^3\alpha}{1-6\tan^2\alpha+\tan^4\alpha}$

8. *Find the solution to the following problems and describe the procedure:*

a) $\int \frac{x^2 - 2x}{x^4} dx = ?$

b) $\int e^{-3x} dx = ?$

c) $\int (e^x + e^{-x})^2 dx = ?$

9. *Find extrema of the function f(x) and sketch its graph:*

$f(x) = 3x - x^3 = ?$

10. *Find the definite integral:*

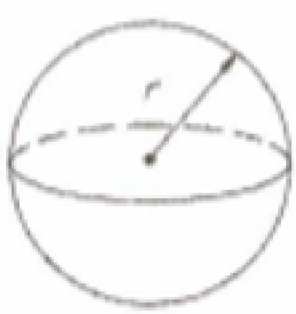
$\int_1^4 \sqrt{x} dx = ?$

FOCUS B

3-DIMENSIONAL FIGURES (SOLID FIGURES)

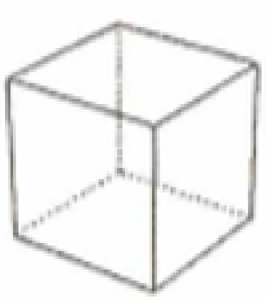
1. *Look and read:*

a)



This is a *sphere*. It is a locus of all points whose distance from the centre is equal to its radius.

b)



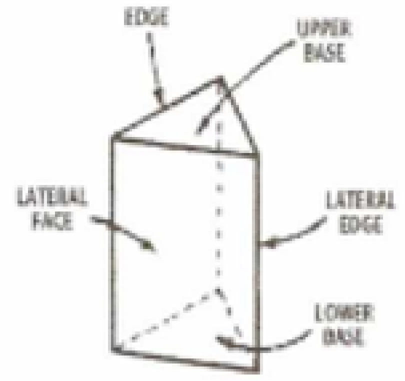
This is a *cube*. It has six square *faces*. It has eight vertices and twelve *edges*.

c) ***Polyhedra***

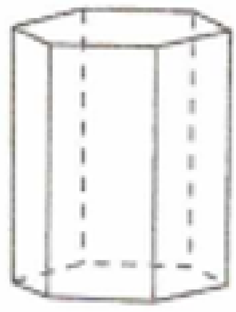
A *polyhedron* is a solid figure bounded by four or more polygonal faces. Each edge of the polyhedron joins two vertices and each edge is the common edge of two faces.
A convex polyhedron is *regular* if all its faces are alike and all its vertices are alike.

Only five kinds of *regular* convex polyhedra exist: *a tetrahedron* (with four faces, four vertices and six edges, each face is an equilateral triangle), *a hexahedron (a cube), an icosahedron, an octahedron* and *a dodecahedron*.

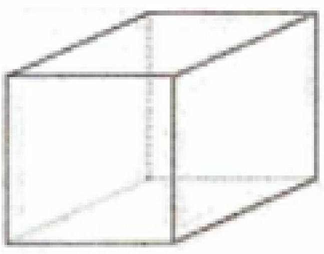
These shapes are called *prisms*.



a triangular prism



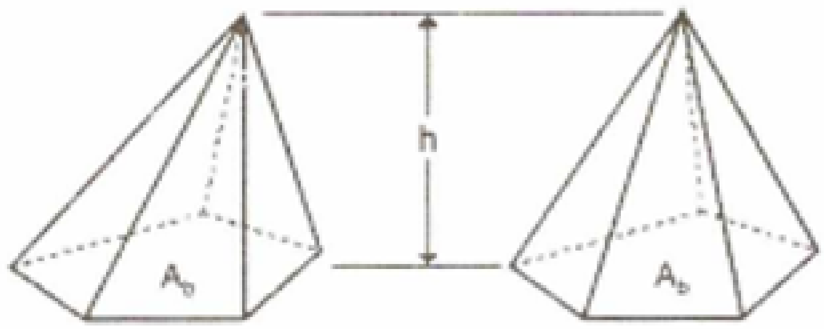
a hexagonal prism



a rectangular prism
(a cuboid)

A *prism* is a convex polyhedron with *two faces* that are congruent convex polygons. These are called the *bases* of the prism. They lie in parallel planes in such a way that, with *edges* joining corresponding vertices, the remaining faces are parallelograms. All faces of a regular polyhedron are congruent with each other.

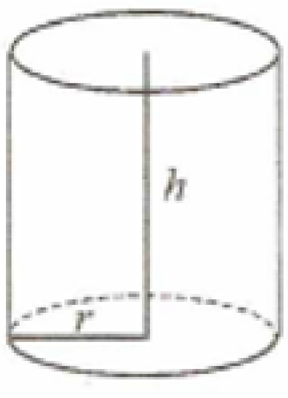
These shapes are *pyramids*.



an oblique pyramid. a right pyramid

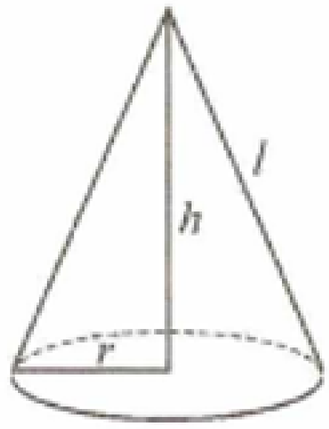
A *pyramid* is a convex polyhedron with *one polygonal face* (the *base*), and other faces (*lateral faces)* triangular with a common vertex (the *apex*). The vertices of the base are joined by *edges*.

d)



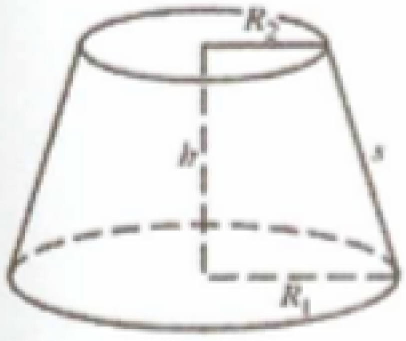
This is a *cylinder*. It consists of the *circular base* and the *curved surface* formed by the vertical line segments joining them.

e)

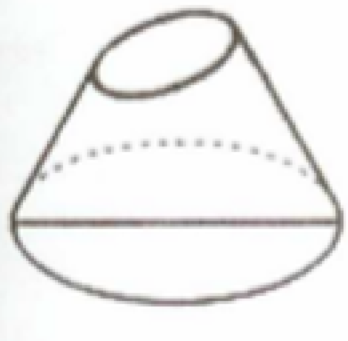


This is a right *cone*. It consists of a circle as the *base*, a *vertex* lying directly above the centre of the circle, and the *curved surface* formed by the line segments joining the vertex to the points of the circle.

f)

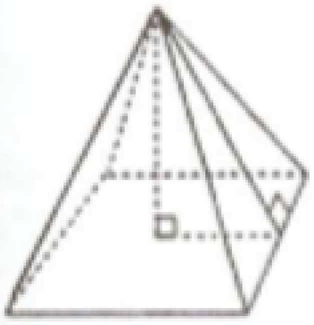


This is a *frustum of a* (right circular) *cone* (*conical frustum*). A frustum is a part of a solid such as a cone or pyramid lying between the base and a plane parallel to the base that intersects with the solid.



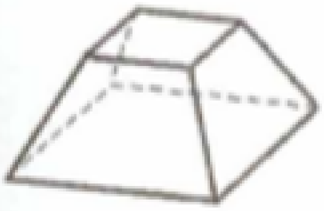
Truncated cone (pyramid, cylinder or prism) has its apex cut off by an intersecting plane, which may be either *oblique* or *parallel* to the base. (If the truncating plane is parallel to the base the figure is called a frustum.)

2. *Look and read:*



This is a right square pyramid. It is *made up of five faces.* The *bottom* face is a square. Each lateral face is a *triangle with two sides equal.* The point where the lateral sides meet is called the *apex.*

Now complete the sentences describing the figure using the words given:



a) This is ....

b) .... made up of ....

c) .... lateral faces .... shaped ....

d) .... squares.

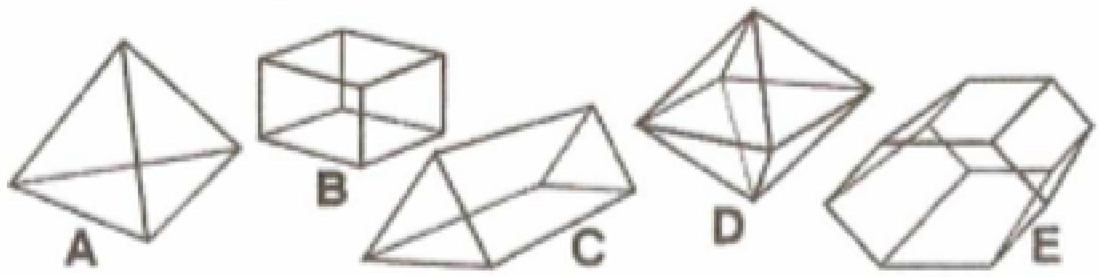
e) .... parallel.

3. *Complete this table:*

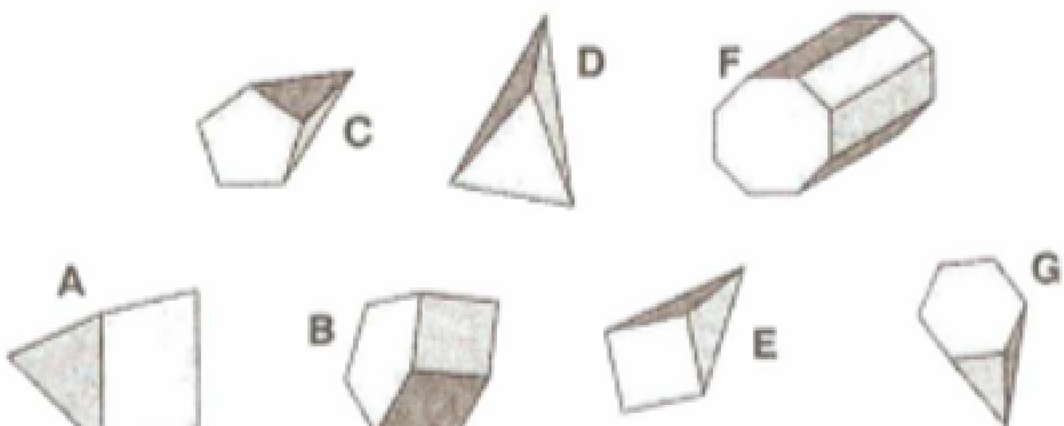
Solid figure	Edges	Faces	Vertices
Tetrahedron	6	4	4
Cube			
Octahedron			
Dodecahedron			
Icosahedron			
Square pyramid			
Truncated square pyramid			
Pentagonal prism			

The relationship between edges, faces and vertices is a constant. Give this constant in a formula. It is known as Euler's formula.

4. Which shape has 3 edges less than shape D?



5. Complete the table for these 3-D shapes:



	A	B	C	D	E	F	G
prisms							
pyramids							

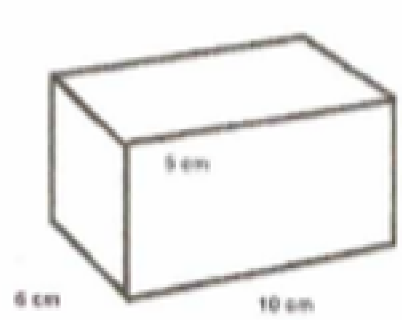
6. Dimensions:

Solid figures have three dimensions, i.e. they are ***three-dimensional.***

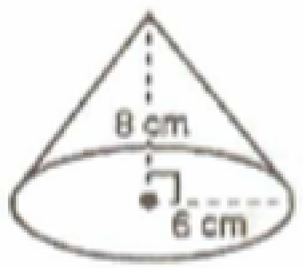
Complete this table:

Question	*Answer*
How *high* is the pyramid?	The .... of the pyramid is 12 cm.
How *long* is the line segment?	Its .... is 9 cm.
How *wide* is the rectangle?	It has a .... of 5 cm.

7. Complete the following sentences and answer the questions:



a) This solid figure is a .... Its .... is 10 cm, its .... is 6 cm and its .... is 5 cm. What is its surface area and its volume?



b) This solid figure is a .... with the .... of 6 cm and the ....of 8 cm.
What is its volume?

c) This is a .... It is 12 cm .... and its .... is 4cm.
What is its surface area?

8. *Describe the shapes and the dimensions of the following:*

a) a book
b) an orange
c) a television
d) a classroom

FOCUS C

INVERSION

Generally means putting the verb before the subject. In ordinary spoken English, inversion is common only in questions, and after *here, there, neither, nor* and *so*; other uses of inversion are found mainly in written English or in a very formal style of speaking (for instance, in lectures and public speeches).

Main uses of inversion:

1. *In conditional sentences instead of "if":*

Had we chosen *φ for the tangent line at P_0 initially to be, say, π, then, as we transverse the circle once, φ would increase to 3π.(= If we had chosen ...)*

Were I younger, *I would travel. (= If I were younger ....)*

Did I know of *Plancherel's paper, I would probably be discouraged from tackling this problem. (= If I knew Plancherel's paper ....)*

Should he come *after all, I would be pleased. (= If he should come after all ....)*

(* <u>Conditional</u> can be used in conditional sentences in the if-clause if you want to express that the action is unlikely though possible.)

2. *After certain adverbs and adverbial phrases* *(hardly, not only, seldom, rarely, never etc.)* ***at the beginning of the sentence:***

Under no circumstances ***can we accept*** *cheques.*

Hardly ***had I arrived*** *when a quarrel broke out.*

Seldom ***had I seen*** *such a remarkable mathematician.*

Never ***have I felt*** *better.*

Not only ***did it rain****, but it snowed as well.*

Little ***did they suspect*** *that the 'area' and 'tangent' problems were to converge many centuries later.*

3. *After adverbial of place and direction with verbs of motion or "to be":*

On the bed ***lay an old man****.*

There ***goes the Prime Minister****!*

Round the corner ***walked a large policeman****.*

In the bus ***were three children****.*
I don't want to go there. – ***Neither does he****.*
...x^2 is a continuous function. – ***So is 1/x.***

AMERICAN ENGLISH

The history of English language in America began in 1607 with the first successful English settlement in Virginia. Since then the English language has developed under different historical, social, geopolitical and other conditions and as a result it differs from British English in all areas of the language (pronunciation, spelling, grammar, vocabulary).

I. Some differences in spelling

	Am.		Br.	
a)	***-or***	*color, flavor, labor, rigor*	***-our***	*colour, flavour, labour, rigour*
b)	***-er***	*incenter*, meter, *theater*	***-re***	*incentre, metre, theatre*
c)	***-ense***	*defense, offense*	***-ence***	*defence, offence*
d)	***in-***	*inquire, inclose*	***en-***	*enquire, enclose*

e) words in American English tend to be spelled more simply or more like the way they are pronounced:
dialog, catalog — *dialogue, catalogue*
NOTICE: *PC program* (Br., Am.), but *theater program* (Am.) and *theatre programme* (Br.)

f) the consonant does not double in American English after the unstressed syllable:
modeling, marvelous, traveled — *modelling, marvellous, travelled*

II. Some differences in vocabulary

Compare the following American words and expressions with their British equivalents:

American	British
fall	autumn
check	bill
cookie	biscuit
(to) reserve	(to) book
French fries	chips
dormitory	hall of residence
stove	cooker
potato chips	crisps (= a cold snack)
resumé	curriculum vitae (CV)
area code	dialling code
driver's licence	driving licence
garbage	litter
flashlight	electric torch
second floor	first floor
apartment	flat
overpass	flyover
conductor	guard
vacation	holiday
elevator	lift
truck	lorry
math	maths
billion	milliard
secretary	minister
licence plate	number plate
gasoline, gas	petrol

(to) mail	(to) post
zip code	postcode, postal code
mailman	postman
baby carriage	pram
cite	quote
railroad	railway
collect call	reverse charge call
store	shop
attorney	solicitor
phone book	telephone directory
schedule	time-table
rest room	toilet
streetcar	tram
pants	trousers
long distance call	trunk call
subway	underground, tube

UNIT 7

FOCUS A

INTEGRATION OF RATIONAL FUNCTIONS BY PARTIAL FRACTIONS

The algebraic technique known as partial fractions makes it possible to integrate any rational function. For instance, later in this section it will be shown how to compute the integral

$$\int \frac{x^4 + x^3 - 3x + 5}{x^3 + 2x^2 + 2x + 1} dx \qquad (1)$$

[No integral table lists a form that covers (1).] The technique of partial fractions is also used in differential equations.

This section, which is purely algebraic, depends on this result from advanced algebra: Every rational function can be expressed as a sum of a polynomial (which may be 0) and constant multiples of three types of functions:

$$\frac{1}{(ax+b)^n}, \frac{1}{(ax^2+bx+c)^n}, \text{ and } \frac{x}{(ax^2+bx+c)^n}. \qquad (2)$$

(Moreover, the representation is unique.)

Since any polynomial and each of the three types of rational functions in (2) can be integrated, any rational function can be integrated. The only new question of interest is "What is the method for expressing a rational function as a sum of these four types of simpler functions?" A general method is presented in this section. The resulting expression is called the partial-fraction representation of the rational function.

To express *A*/*B*, where *A* and *B* are polynomials, as the sum of partial fractions, follow these steps:

Step 1 If the degree of *A* is *equal to or greater than* the degree of *B*, divide *B* into *A* to obtain a quotient and a remainder: *A* =

INTEGRACE RACIONÁLNÍ FUNKCE ROZKLADEM NA PARCIÁLNÍ ZLOMKY

Algebraická technika rozkladu racionální funkce na parciální zlomky nám umožňuje integrovat jakoukoliv racionální funkci. V příkladu dále ukážeme, jak lze počítat integrál

$$\int \frac{x^4 + x^3 - 3x + 5}{x^3 + 2x^2 + 2x + 1} dx \qquad (1)$$

[V tabulce integrálů není vzorec, pomocí kterého bychom mohli (1) vyjádřit.] Technika parciálních zlomků se používá také v diferenciálních rovnicích.

Tento čistě algebraický odstavec je založen na následujícím výsledku z vyšší algebry: každou racionální funkci lze vyjádřit jako součet polynomu a konstantních násobků funkcí následujících tří typů:

$$\frac{1}{(ax+b)^n}, \frac{1}{(ax^2+bx+c)^n}, \text{ a } \frac{x}{(ax^2+bx+c)^n}. \qquad (2)$$

(Navíc je toto vyjádření jednoznačně určeno.)

Protože lze každý polynom a každou z racionálních funkcí daných (2) integrovat, lze integrovat jakoukoliv racionální funkci. Otázka, kterou se budeme zabývat, je „Jak postupovat při vyjadřování racionální funkce ve tvaru součtu těchto čtyř typů jednodušších funkcí?" Obecnou metodu postupu ukazujeme v tomto oddíle. Výsledný výraz nazýváme rozkladem racionální funkce na součet parciálních zlomků.

Chceme-li vyjádřit *A*/*B*, kde *A* a *B* jsou polynomy, ve tvaru součtu polynomu a parciálních zlomků, postupujeme následujícím způsobem:

1. krok: Je-li stupeň *A větší nebo roven* stupni *B*, vydělíme se zbytkem polynom *A* polynomem *B*: *A* = *QB* + *R*, kde stupeň *R* je

= QB + R, where the degree of R is less than the degree of B or else $R = 0$. Then

$$A/B = Q + R/B.$$

Apply the remaining steps to R/B.

Step 2 If the degree of A is *less* than the degree of B, then express B as the product of polynomials of degree 1 or 2, where the second-degree factors are *irreducible*. (It can be proved that this is possible.) *No irreducible factor should simply be a constant times another irreducible factor.*

Step 3 If $px + q$ appears exactly n times in the factorization of B, form the sum

$$\frac{k_1}{px+q}+\frac{k_2}{(px+q)^2}+\ldots+\frac{k_n}{(px+q)^n},$$

where the constants $k_1, k_2, \ldots, k_n$ are to be determined later.

Step 4 If $ax^2 + bx + c$ appears exactly m times in the factorization of B, then form the sum

$$\frac{c_1x+d_1}{ax^2+bx+c}+\frac{c_2x+d_2}{(ax^2+bx+c)^2}+\ldots+$$
$$+\frac{c_mx+d_m}{(ax^2+bx+c)^m}$$

where the constants $c_1, c_2, \ldots, c_m$ and $d_1, d_2, \ldots, d_m$ are to be determined later.

Step 5 Determine the appropriate *k*'s, *c*'s, and *d*'s defined in steps 3 and 4, such that A/B is equal to the sum of all the terms formed in steps 3 and 4 for all factors of B defined in step 2.

menší než stupeň B nebo $R = 0$. Pak

$$A/B = Q + R/B.$$

Zbývající postup aplikujeme na R/B.

2. krok: Je-li stupeň A *menší* než stupeň B, vyjádříme B jako součin polynomů 1. a 2. stupně, přičemž faktory druhého stupně jsou dále (v R) *nerozložitelné*. (Lze dokázat, že je to vždy možné.) *V tomto vyjádření není žádný nerozložitelný činitel konstantním násobkem jiného nerozložitelného činitele.*

3. krok: Jestliže se dvojčlen $px + q$ vyskytuje právě n-krát v rozkladu B, napíšeme součet

$$\frac{k_1}{px+q}+\frac{k_2}{(px+q)^2}+\ldots+\frac{k_n}{(px+q)^n},$$

kde konstanty $k_1, k_2, \ldots, k_n$ určíme později.

4. krok: Jestliže se trojčlen $ax^2 + bx + c$ vyskytuje právě m-krát ve faktorizaci B, utvoříme součet

$$\frac{c_1x+d_1}{ax^2+bx+c}+\frac{c_2x+d_2}{(ax^2+bx+c)^2}+\ldots+$$
$$+\frac{c_mx+d_m}{(ax^2+bx+c)^m}$$

kde konstanty $c_1, c_2, \ldots, c_m$ a $d_1, d_2, \ldots, d_m$ opět určíme později.

5. krok: Určíme (vhodné) konstanty k, c a d definované ve 3. a 4. kroku tak, aby A/B bylo rovno součtu všech výrazů sestavených v těchto krocích pro všechny faktory B definované ve 2. kroku.

(From: Stein S. K., *Calculus and Analytic Geometry*, pp. 336–339 - adapted)

Phrases and linking expressions used in mathematical texts:

Definition	**Definice**
A group is (called) commutative if ...	Grupa je komutativní, jestliže ...
A group is said to be commutative if ...	Grupa se nazývá komutativní, jestliže ...
Define $f = kx$, where k is ...	Nechť / Budiž $f = kx$, kde k je ...
Let $f = kx$, where k is ...	Nechť / Budiž $f = kx$, kde k je ...

We obtain what will be referred to as ...	Získáváme / Dostáváme ..., což budeme dále označovat jako ...
We obtain what we shall call ...	Získáváme / Dostáváme ..., což budeme dále nazývat jako ...
We obtain what is known as ...	Získáváme / Dostáváme ..., známé jako ...
An augmented matrix is a matrix obtained by ...	Rozšířená matice soustavy je matice, kterou získáme ...
Notation	**Symbolický zápis**
Let us denote by *f* the map ...	Označme *f* zobrazení ...
Let *f* denote the map ...	Nechť *f* označuje zobrazení ...
The augmented matrix will be denoted by A_r.	Rozšířenou matici soustavy budeme značit A_r.
Here A_r denotes the matrix ...	A_r zde označuje matici ...
Here A_r stands for the matrix ...	A_r zde označuje matici ...
We abbreviate exp to *e*.	*Exp* budeme krátce psát jako *e*.
We denote it briefly by *e*.	Jednoduše budeme označovat / zapisovat písmenem *e*.
We write it *e* for short.	Krátce označujeme / zapisujeme písmenem *e*.
We write it *e* for brevity.	Krátce označujeme / zapisujeme písmenem *e*.
Property	**Vlastnost**
The element *k* such that ...	Prvek / element *k* takový, že ...
The element *k* with the property that ...	Prvek / element *k* s vlastností / jehož vlastností je ...
The element *k* satisfying ...	Prvek *k*, který splňuje / splňující ...
The element *k* so small that ...	Prvek *k*, který je tak malý, že ...
The constant *k* being independent of ...	Konstanta *k*, která je nezávislá na / nezávislá na ...
Assumption and condition	**Předpoklad a podmínka**
Our basic assumption is the following.	Naším základním předpokladem je ...
We will make the following assumptions: ...	Nyní vyslovíme / uvedeme následující předpoklady: ...
We assume *k* to be ...	Předpokládáme, že *k* je ...
It is necessary to put some restrictions on *k*.	Vlastnosti *k* je nutno omezit.
It is assumed that ...	Předpokládáme, že ... / Předpokládá se, že ...
It is required that ...	Je nutné, aby ... / Požaduje se, aby ...
F satisfies the condition that $F(x) = 0$.	*F* splňuje podmínku $F(x) = 0$.
This involves no loss of generality.	Tento postup lze použít bez újmy na obecnosti.
There exists a unique ... / ... one and only one ...	Existuje právě jedno ...
Given a positive *x* ...	Předpokládejme / Mějme kladné *x* ...

Theorem	**Věta**
The theorem states that ...	Věta říká, že ...
The theorem asserts that ...	Věta říká, že ...
The theorem shows that ...	Věta ukazuje, že ...
The theorem is an extension of ...	Věta je rozšířením ...
The theorem is a generalization of ...	Věta je zobecněním ...
The theorem is a refinement of ...	Věta je upřesněním ...
The theorem is a reformulation of ...	Věta je jiným vyjádřením ...
An equivalent formulation of (*a*) is: ...	Ekvivalentní formulací (*a*) je: ...
If ..., then ...	Jestliže ..., pak ...
Let *k* be ... Then ..., provided ...	Nechť *k* je ... Potom ..., za předpokladu ...
Let *k* satisfy ... Then ...	Nechť *k* splňuje ... Potom ...
Suppose that ... Then ..., unless ...	Předpokládejme, že ... Potom ..., pokud ...
Assume that ... Then ...	Předpokládejme, že ... Potom ...
... if and only if ...	... tehdy a jen tehdy ... / právě tehdy, když ...

Proof	**Důkaz**
direct proof	přímý důkaz
indirect proof	nepřímý důkaz
proof by induction	důkaz indukcí
proof by contradiction	důkaz sporem
We first prove that ...	Nejprve dokážeme, že ...
We prove this as follows.	To dokážeme následujícím způsobem.
Suppose the assertion is false.	Předpokládejme, že toto tvrzení je chybné.
Assume the formula holds for k; we will prove it for $k + 1$.	Předpokládáme, že vzorec platí pro k a jeho platnost dokážeme pro $k + 1$.
It follows that $a = b$.	Z toho vyplývá, že $a = b$.
This gives $a = b$.	To nám dává (rovnost) $a = b$.
The result is $a = b$.	Výsledkem je (rovnost) $a = b$.
We thus get $a = b$.	Tímto dostáváme (rovnost) $a = b$.
... and so $a = b$.	... a tedy $a = b$.
... and consequently $a = b$.	... v důsledku čehož platí $a = b$.
... which gives $a = b$.	... což nám dává $a = b$.
... which yields $a = b$.	... což nám dává $a = b$.
... which implies $a = b$.	... což implikuje $a = b$.
The equality implies that ...	Rovnost implikuje, že ...
As x is positive, we have $ax > 0$.	Protože x je kladné, dostáváme $ax > 0$.
But $ax > 0$ since x is positive.	Ale $ax > 0$, protože x je kladné.
We conclude from (a) that ..., and finally that ...	Z (*a*) vyplývá, že ... a nakonec také ...
The same conclusion can be drawn for ...	Stejný závěr lze učinit pro ...
In the same manner we can see that ...	Stejným způsobem lze ukázat, že ...
Consider ...	Uvažujte ...
Choose ...	Zvolte ...
Define ...	Definujte ...
Let ...	Nechť / Budiž ...
Set ...	Položte / Stanovte ...
Let us suppose ...	*Předpokládejme* ...
Let us assume ...	Předpokládejme ...
Let us regard *k* as ...	Uvažujme *k* takové, že ...

Let us compute ...	Vypočítejme ...
Adding *a* to the right-hand side yields ...	Připočtením *a* k pravé straně dostáváme ...
Adding *a* to the right-hand side gives ...	Připočtením *a* k pravé straně dostáváme ...
Subtracting (2) from (1), we obtain ...	Odečtením (2) od (1) získáváme ...
Subtracting (2) from (1), we get ...	Odečtením (2) od (1) získáváme ...
Subtracting (2) from (1), we have ...	Odečtením (2) od (1) získáváme ...
It suffices to show that ...	Postačí dokázat, že ...
It is sufficient to show that ...	Postačí dokázat, že ...
We need only consider two cases: ...	Musíme zvážit dva případy: ...
We only need to show that ...	Musíme ukázat, že ...
The proof is completed by showing that ...	Ukážeme, že ... a tím bude důkaz proveden.
It is clear that ...	Je zřejmé, že ...
It is evident that ...	Je zřejmé, že ...
It is easily seen that ...	Snadno vidíme / nahlédneme, že ...
A trivial verification shows that ...	Jednoduché ověření ukáže, že ...
A trivial verification makes it obvious that ...	Jednoduché ověření ukáže, že ...
..., which completes the proof.	..., a tím je důkaz proveden.
..., which proves the theorem.	..., a tím je důkaz proveden.
..., which is our claim.	..., což jsme požadovali.
..., which is our assertion.	..., což odpovídá našemu tvrzení.
..., which is the desired conclusion.	..., což je požadovaný závěr.
..., and the proof is complete.	..., a tím je důkaz dokončen.
This contradicts our assumption.	To je v rozporu s naším předpokladem.
..., contrary to (*a*).	..., což je v rozporu s (*a*). / na rozdíl od (*a*).
..., which contradicts our assumptions.	..., což je v rozporu s našimi předpoklady.
..., which is impossible.	..., což není možné. / ..., což je spor.

Conjunctions and prepositional phrases	**Spojky a předložková spojení**
Therefore ...	Proto / tedy / z tohoto důvodu ...
Thus ...	A tak / tak / takto / tedy ...
Hence ...	Proto / z tohoto důvodu / tudíž ...
Here and subsequently, ...	Níže / dále ...
Throughout the proof, ...	Během důkazu ...
In what follows, ...	V následující části ...
From now on, ...	Od nynějška / níže / dále ...
In this way, ...	Takto / tímto způsobem ...
For simplicity of notation, ...	Stručně / jednoduše (budeme zapisovat) ...
For abbreviation, ...	Stručně / jednoduše (budeme zapisovat) ...
... for brevity.	Stručně / jednoduše (budeme zapisovat) ...
... for short.	Stručně / jednoduše (budeme zapisovat) ...
Both *X* and *Y* are countable.	Jak množina *X* tak množina *Y* jsou spočitatelné.
Neither *X* nor *Y* is countable.	Ani množina *X* ani množina *Y* nejsou spočitatelné.
Neither of them is countable.	Ani jedna z nich *(ze dvou)* není spočitatelná.

None of the sets A_i is countable.	Žádná z množin A_i *(více než dvou)* není spočitatelná.
Without loss of generality ...	Bez újmy na obecnosti ...
Under the above assumptions, ...	Na základě výše uvedených předpokladů ...
Under the conditions stated above, ...	Na základě podmínek uvedených výše ...
Under the assumptions of Theorem 5, ...	Na základě předpokladů uvedených ve větě 5 ...
Under the hypotheses of Theorem 5, ...	Na základě hypotéz uvedených ve větě 5 ...
By definition, ...	Z definice ...
By the above, ...	Na základě výše uvedeného ...
By Cauchy's theorem, ...	Dle Cauchyho věty ...
By assumption, ...	Dle předpokladů ...
Other phrases	**Další fráze**
It is immaterial which k we choose.	Lze zvolit libovolné k. / Můžeme zvolit libovolné k.
We now turn to ...	Nyní se budeme zabývat ...
We continue in this fashion to obtain ...	Abychom získali ..., budeme pokračovat stejným způsobem.
Roughly speaking, ...	Zhruba řečeno ...
Loosely speaking, ...	Zjednodušeně řečeno ...
Of course, ...	Samozřejmě / Jistě ...
Clearly, ...	(Zcela) jasně / zřejmě / zřetelně ...
Obviously, ...	(Zcela) jasně / zřejmě / zřetelně ...

Exercises

1. ***Translate the underlined Czech phrases. The number of words to be inserted should correspond to the number of gaps to be filled in:***

   a) *Dospěli jsme k požadovanému výsledku, který může být vyjádřen následujícím způsobem:* ...
   This is the desired result, which can __________ __________ __________ __________: ...

   b) *Nechť A je lineární operátor zobrazující prostor X do prostoru Y.*
   __________ *A* __________ a linear operator __________ the space *X* into the space *Y*.

   c) *Spektrem, které budeme značit S, rozumíme množinu prvků, u které se předpokládá:* ...
   __________ __________ __________, __________ __________ S, we mean any set of points, where __________ __________ __________: ...

   d) *Ze vzorců (22) a (23) vyplývá, že operace definované v části 6.71 odpovídají obvyklému pojetí aditivní a multiplikativní operace u polynomů.*
   __________ __________ __________ __________ (22) and (23) that the operations __________ in Sec. 6.71 correspond to the usual operations of addition and multiplication of polynomials.

   e) *Říkáme, že vektor délky 1 je jednotkovým vektorem.*
   A vector x of length 1 __________ __________ __________ be a unit vector.

   f) *Jestliže jsou nenulové vektory $x_1, x_2, \ldots, x_k$ ortogonální, potom jsou lineárně nezávislé.*

__________ the nonzero vectors $x_1, x_2, \ldots, x_k$ __________ orthogonal, __________ __________ __________ linearly independent.

g) *V části 8.6 se budeme zabývat praktickou metodou sestavení takové ortogonální báze.*
In Sec. 8.6 __________ __________ __________ a practical method __________ __________ such an orthogonal basis.

h) *Předpokládejme, že větu o ortogonalizaci použijeme na systém funkcí v Eukleidovském prostoru. Podprostor je poté zjevně množinou polynomů stupně $n < k$.*
__________ __________ __________ the orthogonalization theorem _____ the system of functions in the Euclidean space. __________ the subspace __________ __________ the set of all polynomials of degree $n < k$.

i) *Tuto větu lze také dokázat přímo.*
__________ __________ __________ direct proofs of this theorem.

j) *Je patrné, že matice nulového operátoru se skládá pouze z nul.*
__________ __________ __________ that the matrix of the zero operator __________ __________ __________ zeros.

k) *Funkce obvykle označujeme malými písmeny, například f.*
Functions __________ __________ __________ by small letters, such as f.

l) *Existuje právě jedno y takové, že (x, y) je prvkem podmnožiny.*
There is exactly__________ __________ __________ __________ y __________ __________ (x, y) is in the subset.

m) *Nechť jsou dány množiny X a Y. Kartézský součin množiny X a Y, zapisujeme X × Y, a definujeme jako množinu všech uspořádaných dvojic takových, že první člen dvojice je prvkem množiny X a druhý člen dvojice je prvkem množiny Y.*
__________ two sets X and Y we __________ the cartesian product of X and Y, __________ $X \times Y$, __________ __________ the set of all ordered pairs the first member of which is in X, the second in Y.

n) *Pro stručnost budeme dále říkat, že na uzavřeném intervalu lze funkci integrovat (místo Riemannovsky integrovat) a budeme hovořit o integrálu (místo Riemannovu integrálu).*
In the future, __________ __________, __________ __________ __________ that a function is integrable on a closed interval, __________ __________ Riemann integrable, and speak of its integral __________ __________ its Riemann integral.

o) *Taylorův teorém je možné formulovat poněkud šířeji a získat tak zobecnění věty o střední hodnotě.*
However it is not difficult __________ __________ a somewhat more long-winded statement of Taylor's theorem which is an authentic __________ of the mean value theorem.

p) *Mějme funkci více proměnných takovou, že každé dvě její proměnné jsou navzájem nezávislé.*
__________ __________ __________ __________ __________ of more variables where the variables are all __________ __________ one another.

q) *Pro soustavu diferenčních rovnic typu $x_t = Ax_{t-1}$, kde A je čtvercová matice typu (2×2) platí, že jejich fázové diagramy se podobají diagramu sestavenému pro soustavu obyčejných diferenciálních rovnic.*
For a system of difference equations $x_t = Ax_{t-1}$ with A __________ a (2×2) square matrix, its phase diagrams resemble the one constructed for a system of ordinary differential equations.

2. *Translate the following sentences paying particular attention to the underlined phrases:*

a) Důkaz provedeme matematickou indukcí podle *n*.
b) Nechť tvrzení věty platí pro *k*.
c) Ukážeme, že množina *M* generuje prostor *L*.
d) Tato Stainitzova věta má řadu důsledků, které uvedeme v následujících větách.
e) Kdyby prvky množiny *N* byly lineárně závislé, tak podle věty 4.2 lze alespoň jeden z nich psát jako lineární kombinaci ostatních.
f) Můžeme zvolit libovolný prvek z množiny *M*.
g) Mějme lineární vektorový prostor *U*.
h) *L* je monomorphismus právě tehdy, když *Ker* $L = 0$.
i) Důkazy dalších dvou tvrzení jsou zřejmé.
j) Položme $h_3 = t_2$.
k) Lineární vektorový prostor nad tělesem reálných čísel se skalárním součinem se nazývá euklidovský prostor.
l) Normu vektoru *x* značíme $|x|$.
m) V dalším budeme za normu v prostoru se skalárním součinem vždy uvažovat normu indukovanou skalárním součinem.
n) Matematickou indukcí jsme ukázali, že z prvků báze umíme vytvořit ortogonální bázi.
o) Označme $b_1, b_2, \ldots, b_k$ bázi podprostoru *L*.
p) Tím jsme dokázali následující větu.
q) Určeme rozklad následujících polynomů na kořenové činitele.
r) Tato věta je zobecněním věty 8.12.
s) Věta bude dokázána v kapitole o lineárním zobrazení.
t) Zvolte libovolné *k* z množiny *K*.
u) Předpokládáme, že operace je komutativní.
v) Je zřejmé, že jsme tímto krokem dospěli ke sporu.
w) Nyní se budeme zabývat operacemi s maticemi.
x) Abychom získali ortogonální bázi, budeme postupovat stejným způsobem.
y) Tímto krokem jsem dospěli k závěru, který je v rozporu s našimi předpoklady.
z) K provedení důkazu postačuje ukázat, že *x* není kladné číslo.
aa) Přirozený logaritmus budeme stručně zapisovat *ln*.
bb) Bez újmy na obecnosti můžeme *b* považovat za záporné číslo.
cc) Odečtením *x* od obou stran rovnice získáváme rovnost.
dd) Věta 2.1 říká, že každé složené číslo lze rozložit na součin prvočísel.
ee) Důkaz Cauchy-Schwarzovy nerovnosti provedeme následujícím způsobem.
ff) Získali jsme matici, kterou budeme nadále nazývat maticí trojúhelníkovou.
gg) Relace splňuje podmínku reflexivity.
hh) $|A|$ označuje determinant matice *A*.
ii) Ekvivalentní formulaci věty o střední hodnotě naleznete v následujícícm oddílu.

FOCUS B

BASIC RULES FOR TRANSLATING *PASSIVE, INFINITIVE* AND *GERUND* INTO CZECH

I. Passive (Trpný rod)

1. opisným tvarem trpným:

*The solution **has** thus **been found**. – Řešení tak **bylo nalezeno**.*

This ***is illustrated*** *in Figure 22. – To* ***je ilustrováno*** *v Obrázku 22.*
Corollary 2 is false, if the compactness condition ***is omitted****. – Důsledek 2 je nepravdivý,* ***je-li vynecháno*** *kritérium kompaktnosti.*

2. zvratnou podobou slovesa:

This algorithm ***is used*** *repeatedly. – Tento algoritmus* ***se užívá*** *opakovaně.*
The function f ***is usually defined*** *on R. - Funkce f* ***se obvykle definuje*** *na množině R.*

3. činným rodem *(zejména je-li původce děje vyjádřen neurčitým podmětem)****:***

We must show that if a ***is contained*** *in A, then it* ***is contained*** *in the union of A and B. – Je nutno ukázat, že* ***obsahuje-li*** *množina A prvek a, potom sjednocení množin A a B tento prvek rovněž* ***obsahuje****.*

If p ***is held*** *fixed and e varies, then the smaller we take e, the smaller d will usually be. – Pokud p* ***zůstává*** *konstantní a e mění svou hodnotu, potom čím menší e uvažujeme, tím menší bude d.*

The previous proposition ***can be combined*** *with the lemma to give many examples of continuous real-valued functions. – Předchozí větu* ***lze zkombinovat*** *s naším lematem a získat tak příklady spojitých reálných funkcí.*

V angličtině se trpného rodu rodu užívá častěji a v některých případech i jinak než v češtině. (Slovesa pojící se s dvěma předměty mohou mít v podmětu trpné vazby nepřímý předmět, což je v češtině nemožné: ***I*** *was told something else. – Bylo mi řečeno něco jiného.*)

Exercises

1. Translate the following sentences into Czech:

a) This surface may be defined in the following manner.

b) The formula (5.6.7) also will be used in the numerical solution of boundary-value problems governed by certain second-order differential equations.

c) The operational methods which are illustrated supply only the formulae themselves and do not furnish the relevant error terms, which therefore must be obtained independently.

d) In all the operators except *D*, the spacing *h* is implied.

e) Positive integral powers of the operators are defined by iteration.

f) When a more explicit notation is needed, the spacing may be indicated as a subscript.

g) It is easily verified that the seven operators defined here possess the commutative, distributive and associative properties shared by real numbers.

h) In the present chapter, we will be concerned principally with applying the theorem.

i) In addition to the truncation errors, for which certain analytical expressions have been given, the effects of roundoff errors in the given data, and in the computation, must be taken into account.

j) Suppose that a rectangular plot is to be fenced off with one side along a river where no fencing is needed. What are the dimensions of the maximum area that can be fenced in with 100 feet of fencing?

k) The problems we can tackle with elementary calculus are oversimplified and therefore unrealistic. The numbers we shall use are also unrealistic; they have been deliberately chosen to minimize the arithmetic.

l) The continuity of φ can be deduced from what has already been proved.

m) It may be seen that the concept of significant figures is related more intimately to the relative error than to the error (or the absolute error) itself.

n) $\overline{N}$ may be said to approximate N to n significant figures.

o) The derivatives of the other five trigonometric functions are readily obtained.

p) Let us remind ourselves first of the behaviour of the function $y = \cos x$, which is shown in Fig. 10-5.

q) All functions will be defined on the real line.

r) Analogous work has been done for various other systems of functions.

s) You must have been given the paper that was meant for the advanced candidates.

t) My final results were very similar to the best that were known in basic mathematical literature.

u) Had I known of Plancherel's paper, I would probably have been discouraged from tackling this problem.

v) Similar things could be said about the process of figuring out a proof.

w) Many of these problems can be viewed from the general standpoint of geometrical transformations.

2. *Put the verbs in brackets in their correct forms (active or passive) and then translate the texts:*

Text A

The definition .... (may, reformulate) by saying that f is continuous at p if, given any open ball in E' of centre $f(p_0)$, there .... (exist) an open ball in E' of a centre whose image under f .... (contain) in the former ball. Another reformulation is that f is continuous at p_0 if, given any open subset of E' that .... (contain) $f(p_0)$, there .... (exist) an open subset of E that .... (contain) p_0 whose image under f .... (contain) in the former open subset. If E and E' are both subsets of R (so that we have a real-valued function of a real variable) the original definition .... (say) that f is continuous at p_0 if, given any $\varepsilon > 0$, there .... (exist) a $\delta > 0$ such that $|f(p) - f(p_0)| < \varepsilon$ whenever $p \in E$ and $|p - p_0| < \delta$. This .... (illustrate) in Figure 17.

Text B

The numbers 1, 1 + 1 = 2, 2 + 1 = 3, etc. .... (say) to be natural; it .... (assume) that none of these numbers is zero. By the integers in a field K we .... (mean) the set of all natural numbers together with their negatives and the number zero. By the rational numbers in a field K we .... (mean) the set of all quotients p/q, where p and q are integers and $q \neq 0$.

Text C

Thus $R_n(b,a) = \dfrac{f^{(n+1)}(c)}{(n+1)!}(b-a)^{n+1}$ as was .... (prove). Note that the case $n = 0$ of this theorem is essentially the mean-value theorem. There is a little more generality here in that it .... (assume) that $a < b$, but the assumption that f is differentiable on an open interval containing a and b is considerably more stringent than the analogous condition in the mean value theorem, where f .... (assume) differentiable only between a and b. However it is not difficult to get a somewhat more long-winded statement of Taylor's theorem which is an authentic generalization of the mean value theorem. The term "Taylor's theorem" that .... (attach) to the above result is a conventional misnomer. Taylor's original statement was much weaker.

Text D

Let *U*, *V* be as in the conclusion of the theorem. Without loss of generality it .... (may, assume) that *U*, *V* are open balls in E_m, E_n respectively, with centres *a*,*b*, respectively, for otherwise *V* .... (may replace) by an open ball of centre *b* that .... (entirely, contain) in *V* and *U* replaced by any open ball of centre *a* of sufficiently small radius.

Text E

Use .... (can, make) of (10.11.4) to predict in advance the probable number of correct digits in each iterate. For, since here f''/f' has a value of about 2 when $x = z_0 = 1.3$, it .... (may, expect) that the coefficient of $(\alpha - z_k)^2$ in (10.11.4) .... (have) a value approximating –1, so that the error ε_k in the *k*th iterate .... (be) of magnitude approximately the square of that of the preceding iterate and .... (be) of negative sign, if the iteration converges to α. If convergence is assumed, and if initially it .... (know) that the true value .... (lie) between 1.3 and 1.4 and hence that z_0 is in error by less than 0.1, it .... (can, predict) that z_1 .... (be) in error by less than about 0.01, so that three places .... (would retain).

Text F

In addition to the processes so far considered, a great variety of other iterative methods for the purpose of approximating the zeros of functions .... (devise) and .... (study). In particular, families of processes of higher order (integral or nonintegral) are available for computation. Although very often it is true that the theoretical advantages of such formulae are more than offset by the additional time and/or effort per iteration required by their use, this is not always the case. Accordingly, a few interrelated examples .... (consider) briefly in this section; throughout the section it .... (assume) that the required zero .... (not repeat), so that $f'(\alpha) \neq 0$.

Text G

The fact that the proof of a theorem .... (consist) in the application of certain simple rules of logic .... (not dispose) of the creative element in mathematics, which lies in the choice of the possibilities .... (examine). The question of the origin of the hypothesis (5) .... (belong) to a domain in which no very general rule .... (can, give); experiment, analogy, and constructive intuition .... (play) their part here. But once the correct hypothesis .... (formulate), the principle of mathematical induction is often sufficient .... (provide) the proof. Inasmuch as such a proof .... (not give) a clue to the act of discovery, it .... (might, call) a verification.

II. Infinitive (Infinitiv)

Do češtiny lze doslovně překládat pouze prostý infinitiv přítomný činný (*to give* dát) a trpný (*to be given* dostat). Ostatní infinitivy musíme vyjádřit opisem v rámci věty.

We now show how ***to calculate*** *the rank and find a minor of a given matrix A. – Nyní si ukážeme, jak vypočítat hodnost a najít subdeterminant dané matice A.*

The polynomial $Q_0(\lambda)$ is said ***to generate*** *the ideal I. – Říká se/ Říkáme, že polynom $Q_0(\lambda)$ generuje ideál I.*

It is easy ***to see*** *that the operator B so defined is also a linear operator mapping X into Y. – Snadno si uvědomíme/ nahlédneme, že takto definovaný operátor B je lineární operátor zobrazující X do Y.*

It should ***be noted*** *that for the product P = AB* ***to make sense****, the number of columns in A must equal the number of rows in B. – Měli bychom upozornit, že aby součin matic AB dával smysl, počet sloupců matice A musí být roven počtu řádků matice B.*

The result of the calculation is expected ***to be deducted*** *from the coefficient a. – Předpokládáme, že výsledek tohoto výpočtu bude odečten od koeficientu a.*

Prof. Novák is supposed ***to have made*** *a mistake in the proof. – Předpokládá se, že profesor Novák udělal chybu v důkazu.*

The procedure of the calculation is said ***to have been developed*** *by Cardano. – Uvádí se, že tento početní postup vyvinul Cardano.*

It makes sense ***to be proceeding*** *in this way to approximate the roots of the polynomial. – Je rozumné, abychom kořeny polynomu aproximovali tímto způsobem.*

Dr. Doughnut appears ***to have been solving*** *the problem for months. – Zdá se, že dr. Doughnut řeší tu úlohu už měsíce.*

Exercises

1. Translate the following sentences into Czech:

a) To obtain formulae for such purposes, we designate the shifting operator relative to the new spacing by E_1.

b) As a matter of fact, Fermat, who was one of the first to develop the calculus method of finding relative maxima and minima of functions, used this problem to show that the method works.

c) Let the given base be *AB*.

d) Now *x* takes on only positive integral values but it is convenient mathematically to think of *x* as varying continuously through all positive real values and to take the nearest integral value as the practical answer if the mathematical answer should be a fraction or an irrational number.

e) The important point to see now is that the larger we make *n*, which means that Δx becomes smaller and smaller, the closer does the sum S_n approach the area under the curve.

f) It is desirable to distinguish between a sequence and a function.

g) This fact is rather easy to establish.

h) This point is of practical importance only in that it illustrates the fact that, no matter how accurately a calculation is to be effected, the result of rounding the calculated value to *n* digits cannot be guaranteed in advance to possess *n* correct digits but may differ from the rounded true value by one unit in the last digit.

i) In order to exhibit the relationship more specifically, it is useful to define N^* and *r* such that $N = N^* \times 10^r$ where $1 \le N^* < 10$.

j) Making this assumption, we first show how to reconstruct the coefficients of a polynomial from a knowledge of its values.

k) Now that we have the derived function in (15), the chain rule enables us to handle more complicated sine functions.

l) To obtain the derivative of $y = \cos x$, we can go through the method of increments, but it is easier to obtain it from (17).
m) They use many methods to try to find answers to mathematical questions.
n) It may help you read and understand proofs written by other people.
o) Try to determine how much of the page is really sharp and clear.
p) Your eyes would have to start at the left of the first line.
q) In order to keep the individual values clearly in mind, we place the serial number of the observation as a subscript.
r) Using this, it is easy to see that if $1/2 < \alpha < 1$ and ...
s) The points *P* and *P'* are said to be inverse points.
t) It remains to prove statement (d).

III. Gerund (Gerundium)

Do češtiny překládáme:

1. Podstatným jménem slovesným:

*By **comparing** coefficients at the same time we obtain the following equation. – **Porovnáním** koeficientů dostáváme následující rovnici.*

*By **applying** theorems 1.4 and 1.5 find primitives of the following functions. – **Použitím** vět 1.4 a 1.5 nalezněte k následujícím funkcím jejich primitivní funkce.*

2. Infinitivem:

***Computing** effectively is **computing** with speed and no mistakes. – **Počítat** dobře znamená **počítat** rychle a bez chyb.*

3. Vedlejší větou (nejčastěji):

*I do not understand the professor's **solving** the problem in this particular way. – Nerozumím, proč pan profesor řeší ten příklad zrovna takto.*

*After **presenting** a few technical facts about the trigonometric functions, we shall consider a few of these applications. – **Poté, co jsme si ukázali některé vlastnosti trigonometrických funkcí**, se podíváme na několik následujících aplikací.*

4. Podstatným jménem:

*Prof. King objects to **proceeding** like this. – Prof. King nesouhlasí s tímto **postupem**.*

5. Přechodníkem v psaných textech:

Gerundium může mít shodnou funkci s českým přechodníkem. V současné češtině se však přechodníky běžně nepoužívají, proto při překladu do češtiny raději použijeme některou z předchozích možností.

*We can find the solution without **substituting** the variable. – Úlohu můžeme vyřešit **nesubstituujíce** proměnou. / ... **bez substituce** proměnné. / ... **bez použití substituce** proměnné. / ..., **aniž bychom substituovali** proměnnou.*

Exercises

1. Translate the following sentences into Czech:

a) Before proceeding with the detailed discussion of congruences, the reader should observe the following statements are equivalent.
b) Now we shall solve the problem of bisecting a given arc *AB* of a circle with the given centre O.

c) However, the result of applying the expanded form of the third relation in (5.2.14) to any arbitrarily chosen function (say a constant) shows that the former alternative is the proper one, so that we are justified in writing $E^{1/2} = \ldots$ when we deal only with polynomials.

d) The method of determining the circle inverse to the line joining two given points permits an immediate solution of problem 4.

e) The first really difficult figure is the circular region. The Greeks solved the problem of finding its area by taking a very natural step. First, they approximated the area by inscribing a square.

f) We can generalize somewhat our method of finding the area under a curve.

g) Hence what matters in forming the sequence of sums of rectangles is not that the Δx's in each subdivision of (a, b) be equal but that the Δx's approach 0 in size as n, the number of subintervals, increases.

h) In integrating trigonometric functions we should keep in mind that the numerous identities of trigonometry often aid in transforming a given function into one which is identical in its values to the given one but more amenable to integration.

i) A similar thing could be said about the process of figuring out a proof.

j) Before continuing with the proofs of the other parts, we give a brief commentary on the proof just given.

k) Although this function explodes at 0, this does not prevent it from being a continuous function.

l) The key to being continuous is that the function is continuous at each number in its domain.

m) No ambiguity can arise by eliminating the designations above and below the sigma.

2. ***Put the verbs in brackets in their correct forms (infinitives or gerunds, active or passive) and then translate the texts:***

Text A

The considerations .... (lead) to definition (1) might seem .... (be) without practical value. One problem has been replaced by another: instead of .... (ask) .... (find) the slope of the tangent to a curve $y = f(x)$ at a point, we are asked .... (evaluate) a limit which at first sight appears equally difficult. But as soon as we leave the domain of generalities and consider specific functions $f(x)$ we shall .... (obtain) a tangible result.

Text B

The errors introduced in the rounding of a large set of numbers, which are .... (combine) in a certain way, usually (but not always) tend .... (be) equally often positive or negative, so that their effects often tend .... (cancel). The slight favouring of even numbers is prompted by the fact that any subsequent operations on the rounded numbers are then somewhat less likely .... (necessitate) additional roundoffs.

Text C

The left-hand integral calls for .... (find) the indefinite integral of the function represented by y and then .... (subtract) the result of .... (substitute) b in this indefinite integral from the result of .... (subtract) a. The right-hand integral calls for the same indefinite integral and then .... (subtract) the result of .... (substitute) a from the result of .... (substitute) b.

Text D

If we should try .... (pass) to the limit directly in numerator and denominator, we should .... (obtain) the meaningless expression 0/0, But we can .... (avoid) this impasse by .... (rewrite) the difference quotient and .... (cancel), before .... (pass) to the limit, the disturbing factor $x_1 - x$. In .... (evaluate) the limit of the difference quotient we consider only values $x_1 \neq x$, so that this is permissible.

Text E

In quite a different way mathematical induction is used .... (establish) the truth of a mathematical theorem for an infinite sequence of cases, the first, the second, the third, and so on without exception. Let us .... (denote) by *A* a statement that involves an arbitrary integer *n*. For example, *A* may .... (be) the statement, "The sum of the angles in a convex polygon of $n + 2$ sides is n times 180 degrees." Or *A'* may .... (be) the assertion, "By .... (draw) n lines in a plane we cannot .... (divide) the plane into more than 2^n parts." .... (prove) such a theorem for every integer n it does not suffice .... (prove) it separately for the first 10 or 100 or even 1000 values of *n*. Instead, we must .... (use) a method of strictly mathematical and non-empirical .... (reason) whose character will .... (indicate) by the following proofs for the special examples *A* and *A'*.

3. Translate into English:

a) Jsou-li obě premisy pravdivé, potom si můžeme být jisti, že závěr je rovněž pravdivý.
b) Budeme pokračovat v používání písmen namísto výroků, ale pouze pro nedvojznačné výroky, které jsou buď pravdivé, nebo nepravdivé.
c) Tato kniha obsahuje látku z matematické analýzy pro přednášky ve vyšších ročnících univerzitního studia.
d) Výklad základních metod a vět analýzy je podán tak, že výrazně vynikají těsné souvislosti mezi jejími jednotlivými oblastmi.
e) Tradičně oddělované disciplíny „reálná analýza" a „komplexní analýza" zde tedy představují jediný celek.
f) Několik následujících příkladů ukazuje, jak jsou zmíněné souvislosti vykládány a jak se jich využívá.
g) Pro studium této knihy se předpokládá znalost látky ze základní přednášky z analýzy.
h) Toto vydání obsahuje dvě podstatné změny.
i) Téměř všechny tyto zásady vyšly z podnětu studentů, kolegů a dalších přátel.

FOCUS C

SYMBOLIC EXPRESSIONS - HOW TO AVOID AMBIGUITY

When expressing symbolic expressions in words, one can meet many ambiguities. The following two expressions can be read as "*a* minus *b* plus *c*".

$$(a-b)+c=a-b+c$$
$$a-(b+c)=a-b-c$$

Without explicitly stating where the parentheses are placed in the expressions, one cannot differentiate the two expressions, the results of which are different.

Ambiguity can be avoided by the following means:

1. use of additional general words such as "all", "out of", "the/ that (whole) quantity", etc.

   $a-b-(c-d)$

   a minus b minus the quantity c minus d

   $(a+b)^2$

   a plus b all squared
   a plus b that quantity squared

2. specifying the result of a particular operation as a whole (*sum, product, difference, quotient*)

   $a-b-(c-d)$

   a minus b minus the difference c minus d

   $(a+b)^2$

   a plus b that sum squared

3. fronting (*the sum of … and …*)

   $a^m a^n$

   the product of a to the m-th power and a to the n-th power

4. saying all necessary expressions (parentheses, fraction bars, etc.)

   $a-b-(c-d)$

   a minus b minus open parenthesis c minus d close parenthesis

   $$\frac{\frac{a}{b}}{\frac{c}{d}}$$

   the fraction, the numerator of which is the fraction a over b, the denominator of which is the fraction c over d

5. by means of prosody (making pauses where necessary)

6. combinations of 1. to 5.

Exercises

Read the following expressions and try to avoid ambiguity:

a) $a(b+c)$
b) $a(b+c)+d$
c) $a[b+c-e(f-g)]$
d) $\frac{a+b}{d}$
e) $a+\frac{b}{c}$

f) $a+\dfrac{b}{c+d}$

g) $\dfrac{a+b}{c}+d$

h) $a+\dfrac{b}{c}+d$

i) $\dfrac{a}{b}+\dfrac{c}{d}$

j) $\dfrac{a}{b+\dfrac{c}{d}}$

k) $\dfrac{\dfrac{a}{b}}{\dfrac{c}{d}}$

l) $\dfrac{\dfrac{a+b}{c}}{d}$

m) $\dfrac{c}{d}(a+b)$

n) $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$

2. *Fill in the missing expressions:*

a) An .... of a triangle is a line segment connecting a vertex to the line containing the opposite side and perpendicular to that side.
b) If angle A is an acute angle in a right triangle, the .... of A is the length of the side adjacent to angle A, divided by the length of the hypotenuse of the triangle.
c) A .... is the portion of a line lying strictly between two points. It has a finite length and no width.
d) A .... is a polygon with exactly four sides.
e) A .... triangle is a triangle with no sides equal.
f) .... triangles are triangles that have the same shape but possibly different size. In particular, corresponding angles are congruent, and corresponding sides are in proportion.
g) The .... is the point where the three medians of a triangle intersect. (A median of a triangle is a line segment joining a vertex to the midpoint of the opposite side.)
h) The .... of a circle is the length around it.
i) A line that links two points on a circle is called a ....
j) A truncated cone has its apex cut off by an intersecting plane, which may be either .... or .... to the base.

3. *State whether the statements are true or false:*

a) A concave polygon is any polygon that has one or more interior angles less than 180°.
b) A circle's diameter is a segment that passes through the centre and has its endpoints on the circle.
c) An isosceles triangle is a triangle with three equal sides.
d) A transversal is a line that passes through (transverses) two other lines.
e) The centroid of a triangle is the point where the three medians (line segments joining a vertex to the midpoint of the opposite side) intersect.
f) The circumference of a circle is a segment that passes through it.
g) A chord of a circle divides the circle into two regions, which are called the segments of the circle.
h) A polygon is a closed figure made of line segments each of which intersects with exactly two other line segments.
i) In an isosceles triangle, the apex is the point where the sides meet.

PART II
English for Occupational Purposes

JOB APPLICATION

When you are applying for a job, it is important to know how the job application process works. Most companies seeking suitable candidates for employment require your curriculum vitae (CV)/ resume and a covering/ cover, letter.

The CV should be a match for the job you are applying for. It should include your contact details, a summary of your educational and academic background, teaching and research experience, publications, presentations, awards, affiliations, and other details. It should be clear, concise, complete, and up-to-date. A CV is often all a prospective employer has to judge you on, so creating the right first impression is absolutely vital.

The most relevant skills or experience specific to the job should be identified in a covering letter. The following provides the layout and phrases that are usually found in a standard covering letter. By using these phrases, you can give a professional tone to your English formal letter.

Another integral part of the process is the interview. The text on interviews will give an idea of what you should expect, what you should avoid, and how you should prepare yourself for success.

CURRICULUM VITAE / RESUME

This is a relatively standard document which should enable a prospective employer to quickly find certain key pieces of information.

Heading

At the top put contact information:

- your name
- your address (permanent and/or postal)
- your phone number (mobile phone number)
- your email address

Then information should be listed in order of importance to the reader. Generally, new graduates list education first, while those who have some years of work experience start with employment history. However, both are listed in ***reverse chronological order.***

Education

Include dates, specializations, and details of degrees, training and certification.

- the dates of your studies
- the name and location of the institution
- the field of studies
- the degree (spelled out: Bachelor of ....) and the date you completed the degree
- title of your thesis

Honours and Awards

- May also be listed with your education. Keep in mind that the reader probably will not recognize abbreviations and may not know what the award was for. Provide concise explanations.

Work Experience/ Employment History/ Career Summary

- the dates of employment
- job title
- the name and location (city, state) of the employer
- position held

Publications and Conference Papers

If the list of publication is too long, it is recommended to submit them on a separate sheet.

Skills

- computer skills
- language skills
- other relevant skills (e.g. driving licence, typing certificate, etc.)

Interests

e.g. travelling, cycling, photography

Example of CV

Matrin Ross

Spálená 18, 120 00 Prague 2, Czech Republic
Tel: (+420) 123456789
E-mail: mross@seznam.cz

Education

2007-2010	PhD studies – Physics, Faculty of Mathematics and Physics, Charles University in Prague, Czech Rep. Specialization: Physics of Nanostructures PhD Thesis Title: *Motion of Vortices in Type II Superconductors*
2010	PhD degree
2005 – 2007	Master studies – Faculty of Mathematics and Physics, Charles University in Prague, Czech Rep. Specialization: Physics of Condensed Matter Master Thesis Title: *Structure and Magnetism of Transition Metal-Based Nanoparticles*
2007	Master degree (Mgr.)
2002 – 2005	Bachelor studies – Faculty of Maths and Physics, Charles University in Prague, Czech Rep. Specialization: General Physics Bachelor Thesis Title: *Nanocomposite Materials: Structure and Magnetic Properties*
2005	Bachelor degree (Bc.)
1996 - 2002	Grammar School of Ch. Doppler, Zborovská 45, Prague 5, Czech Rep. (mathematics and physics branch of study)
2002	leaving exams: Czech, English, Maths, Physics

Employment

2010 – today	Research Assistant, Dept. of Low Temperature Physics , Faculty of Mathematics and Physics, Charles University in Prague
2007-2010	During my PhD I also led seminars and supervised undergraduates in the laboratory.

Conferences, Presentations and Courses Attended

September 2010	ICFPM Uppsala, Sveden (poster presentation)
May 2010	3rd ICC Osaka, Japan (poster presentation)
November 2007	Modern Problems of NMR spectroscopy, Pec pod Snezkou, Czech Rep.

Awards, Fellowships and Grants

2010 – 2012	Potential Oxide – Diluted Magnetic Semiconductors Nanostructures (Charles University Granting Agency, project num. 23698)
May 2009	Experiments at ANKA synchrotron, Forschungzentrum Karlsruhe, Germany (Research Bursary)
2001	Olympiad in Physics – A cathegory – National Round; 2 place

Publications/ Conference papers (*see the attached appendix*)

Skills

***Computing Skills*:** Applications: Microsoft Office Suite, Internet Explorer, Paint Shop Pro
Programming Languages: C#, Java, and HTML
Operating Systems: Windows Vista, Windows XP

***Teaching Skills*:** Have lead several seminars for undergraduates in the Department of Low Temperature Physics

***Other skills*:** Languages: Czech (native), English (advanced), French (intermediate)
Driving licence – group A, B

Professional Memberships

Student member of the Union of Czech Mathematicians and Physicists

References (available upon request)

Useful advice

1. ***What to do:***

- write briefly, keep your CV simple and focus on about content;
- layout is very important (divide text into paragraphs);
- show a clear match between your skills and abilities and a job's requirements, focus on most important details;
- get the spelling and the grammar right;
- use either British or American English standard in all the submitted documents (be consistent).

2. ***What to avoid:***

- submitting more than 2 pages;
- writing the title "CV, Curriculum Vitae, Résumé" (It should be plainly obvious that the document is your CV);
- writing at great length;
- poor spelling and bad grammar;
- giving irrelevant information;
- personal information concerning your race, age, marital status, children, sex or religion (those should not determine whether or not you can do a job properly);
- including unnecessary copies of documents, letters etc.;
- referring to your distant past (parents, elementary school ...);
- giving false information.

COVERING LETTER

There are a number of conventions that should be used when writing a covering letter. The letter of application should follow the general guidelines for all business letters; it should have an introduction, a body and a conclusion. It should be written as simply and clearly as possible.

Do not use informal language like contractions.

Layout

British style:

15 Clifton Court
Manchester
MR3 5PY
e-mail: chrispar@.......

sender's address

recipient's address

Ms Sara Green
Manager
Suntrek Fabrics
36 St. James Avenue
Bournemouth
HB3 4LN

22 January 2011

date, given in full

opening greeting; salutation

Dear Ms Green,

Re: Administrator Vacancy

subject of the letter

opening

I learned of the position of *Administrator* in your advertisement in the 19th January edition of the Daily Times and I believe that I have the necessary credentials for this role.

body of the letter

I have considerable experience working as an *Administrator* and enclose the following relevant documents to support my application: *Curriculum Vitae*
Reference from current employer

I would welcome the opportunity to discuss my suitability for this position in person. Please let me know if I can provide you with any further information. Thank you for your kind consideration.

close

I look forward to hearing from you.

Yours sincerely,

closing phrase; complimentary ending

signature - hand written

Chris Parker

Chris Parker (Ms)

Enc.: 2

writer's full name – typed

American style:

Ken's Cheese House
25 Chatley Ave.
Seattle
WA 98765

22 January 2011

Personnal Manager
Suntrek Specialists Inc.
456 Green Road
Rockville, IL.

Subject: **Administrator Vacancy**

Dear Sir or Madam:

I learned of the position of *Administrator* in your advertisement in the 19th January edition of the Daily Times and I believe that I have the necessary credentials for this role.

I have considerable experience working as an *Administrator* and enclose the following relevant documents to support my applic*ation: Curriculum Vitae*
Reference from current employer

I would welcome the opportunity to discuss my suitability for this position in person. Please let me know if I can provide you with any further information. Thank you for your kind consideration.

I look forward to hearing from you.

Very truly yours,

Chris Parker

Chris Parker (Ms)

Enc.: 1

sender's address

date, given in full

recipient's address

subject of the letter

opening greeting; salutation

opening

body of the letter

close

closing phrase; complimentary ending

signature - hand written

writer's full name - typed

General guide

1. ***Addresses:***

   The sender's address should be written at the top, on the right or in the middle of the letter. The recipient's address should be written on the left, starting below the sender's address. (Br.)
   The sender's address is left-justified. The recipient's address should be written on the left, starting below the date. (Am.)
   You may also give your telephone number and e-mail address here.

2. ***Date:***

   The date is written on the right, one line below the sender's address. (Br.)

The date is written on the left on the line below the sender's address. (Am.)
Write a month as a word: *July 18, 2010* or *18 July 2010*
Most months can be written in an abbreviated short form: Jan, Feb, Mar, Apr, Jun, Jul, Aug, Sept, Oct, Nov, Dec.

Do not write the date as numbers only. Notice the differences between British and American styles, which can lead to confusion!

(*Br.*) 11/7/99	DAY - MONTH - YEAR
(*Am.*) 7/11/99	MONTH - DAY- YEAR

3. ***How to start and end a letter:***

You write to	Salutation	Closing Phrase
an unknown person / firm	Dear Sir/ Madam (Br.) (Am.) Dear Sir or Madam (Br.) (Am.) To whom it may concern	Yours faithfully (Br.) Yours truly (Am.) Truly yours (Am.)
a person whose name you know	Dear Mr/ Mrs/ Miss/ Dr Green	Yours sincerely (Br.) Very truly yours (Am.) Sincerely (yours) (Am.)

Nowadays, however, people tend to use "Yours sincerely" in all the cases.

If you are writing to a woman and do not know if she uses Mrs or Miss, you can use Ms.
Punctuation: (Br.) Dear Sir or Madam - (no punctuation or comma)
(Am.) Dear Sir: (use a colon)
Mr/ Ms/ Mrs are usually spelled without a full stop in British English, but with a full stop (Mr./ Mrs./ Ms.) in American English.

4. ***A subject line:***

A subject line is not really necessary. You may want to use one, however, so that the reader immediately knows what your letter is about. There are three common methods to distinguish the subject line from the body of the letter:

- Use "Re:" or "Subject:"
- Type the subject in bold letters
- Type the subject in capital letters

(Br.) The subject line is usually placed between the salutation and the body of the letter.
(Am.) The subject line can be placed between the recipient's address and the salutation.

5. ***Body of the letter:***

First paragraph:
In the 1st paragraph give the reason for writing; how you learnt of the position. Keep it short (if there are several posts advertised you must say which one you are applying for.)

Useful phrases:
Referring to your advertisement in the Times Union I would like to apply for the programmer position.
With reference to the advertisement in the Times of May 14, 2011, I wish to apply for the post of .....
I have seen the advertisement in the Sun of April 6, 2011 and I am interested in applying for ...
I have read the advertisement on the faculty web site and would like to apply for ...
I am interested in applying for the post of .... advertised in ....
I am writing to apply for .....

I wish to apply for the post of …………, which you advertised in yesterday's Times.
I am applying for the sales position posted on Boston.Monster.com.
I am writing to express my interest in the …… position listed on monster.com

Middle paragraphs:
Give the reasons why you are interested in working for the company and why you wish to be considered for that particular position. State your relevant qualification and experience, as well as your personal qualities that make you a suitable candidate.

Useful phrases:
As you can see from the enclosed CV I have many years' experience in ……..
As mentioned below I have worked in ……..
In my last (previous) job the organizational (language, financial) aspect (side) was very important and I used to work with computers (worked frequently with…, was used to dealing with people, learnt to work with …).
Although I am happy (satisfied) in my present position, I would now prefer (would appreciate) a post offering …….

Last paragraph:
In the last paragraph state what you would like the recipient to do as a result of the letter and thank them.

Useful phrases:
Please let me know if there is any further information you require.
More (further) details (references) are available upon request.
Should you need more information do not hesitate to contact me.
I am available for an interview at any time suitable to you.
I can be reached any time via email at ggeorge@email.com or my mobile phone 321654987.
Thank you for your time and consideration. I look forward to speaking with you about this employment opportunity.

6. ***Signature:***

   Sign your name, then print it underneath the signature, given name first, family name last. If you have a foreign name it is useful to put your title (Mr/ Ms) in brackets after your name.

7. ***Enclosures:***

   Indicate that one or more documents are enclosed by writing "Encs: 2" (for 2 documents, for example).

E-mail CV and covering letters

If you are sending an e-mail CV and covering letter you should follow the employer's instructions. Some employers do not accept attachments. In these cases, paste your CV and covering letter into your e-mail message. If the job posting says to include your CV and covering letter as an attachment, attach Microsoft Word or adobe PDF files to your message.
The ***subject line*** of your message should include the position you are applying for.
Do not forget to include your name with your contact information, so it is easy for the hiring manager to contact you.

INTERVIEWS

Your covering letter and CV have made a good impression and the employer has called you in for an interview. Properly preparing for your interview really helps to alleviate nerves and dramatically increases your chance of success.

The interview is usually divided into groups of questions, the sequence of which is not always the same:

- education and languages
- work experience
- reasons to change a job
- career prospects and motivation
- interests and hobbies

Preparation for an interview includes three important parts:

- information about the potential employer (*external sources* such as the company website, press and other public information channels and *internal sources,* e.g. staff of potential employer);
- interview preparation (to know what questions will be asked and how to answer);
- applicant presentation (presentation, behaviour and image of an applicant are an integral part of evaluation).

Top 10 Interview Blunders:

1. arriving late
2. not being prepared
3. lying
4. failure to research the company
5. criticising your past boss and co-workers
6. dressing inappropriately
7. not listening
8. not asking meaningful questions
9. lack of confidence and enthusiasm
10. asking about benefits, vacation time, or salary

PRACTICAL USAGE

1. Read the following sentences and correct the mistakes:

a) My name is Petr Sova and I was born 23 of January 1986 in Brno.
b) My mother is a accountant and my father works in a hospital.
c) My sister is 22 years and she studies at the Faculty of Medicine.
d) I was study from 2000 to 2004 in high school.
e) I made my school leaving exams in 2004.
f) I was accepted on the department of mathematics.
g) I finished university in 2009, I graduated from mathematics.
h) From 2011 I am a postgraduate student of the Faculty of Mathematics and Physics.

2. Study the following expressions concerning your education:

grammar school	anglická střední škola gymnaziálního typu
high school (Am.)	střední škola
science stream	přírodovědná větev (střední škola)
go to / attend university	jít / chodit na VŠ
1^{st} year student / freshman (Am.)	student 1. ročníku
2^{nd} year student / (Am.) sophomore	student 2. ročníku
3^{rd} / 4^{th} year student/ junior (Am.) senior	student 3. / 4. ročníku
(Am.)	student vyššího ročníku
school-leaving exams	maturitní zkoušky
university entrance exams (written, oral)	přijímací zkoušky (písemné, ústní)
take an exam in mathematics	dělat zkoušku z matematiky
sit for the finals	dělat závěrečné zkoušky
pass	udělat zkoušku
fail (in); fail sb.	propadnout (z); nechat někoho propadnout
to write / put in / submit an application	podat přihlášku (ne *give*!)
apply for a place to study maths	žádat o přijetí na obor matematika
admit to sth. (Oxford University)	přijmout na něco
accept at (a place)	přijmout někde
enrol at university / to be enrolled at ...	zapsat na universitě
subject	obor studia
branch of study, line of study, specialization	větev, odvětví, zaměření
major in / minor in (Am.)	studovat jako hlavní / vedlejší obor
study (for an exam)	učit se (na zkoušku)
learn maths (– *always with an object*)	učit se matematiku
take / do / follow a course in sth.	zapsat si, chodit na přednášku z ...
distance learning study	dálkové stadium
course is designed	kurz je určený
content / subject matter	náplň studia
work on a dissertation	pracovat na disertaci
practical / practical course	praktikum
exempt from ...	prominout zkoušku
required core courses	povinné předměty
optional / elective core courses	předměty povinně volitelné
optional / elective courses	předměty volitelné
lecture on	přednáška z
to give / hold a seminar	konat seminář
seminar on ...	seminář z čeho
obtain / gain / earn a credit	získat zápočet
degree	hodnost (vědecká)
study for a degree in (physics)	studovat k získání hodnosti z (fyziky)
receive a degree	získat hodnost

award a degree	udělit hodnost
thesis / theses (pl.); dissertation	disertace
degree thesis on sth.	závěrečná diplomová práce z (čeho)
doctoral thesis	doktorská disertace
assessment of a doctoral student	hodnocení doktoranda
to write a paper on ...	psát referát o ...
to set / assign a topic	zadat téma
to work on one's thesis	pracovat na ...
graduate in mathematics	promovat z (Am. = maturovat)
graduate from	promovat kde
defence of thesis	obhajoba disertace
fellowship	stáž, nadační stipendium
research project	výzkumný úkol
supervise	dohlížet, vést, řídit
bursary covered from a subsidy	stipendium hrazené z dotace

3. *Fill in suitable prepositions (if necessary):*

a) Kellogg College, which works closely .... the Department for Continuing Education places special emphasis .... part-time study.
b) Students successful in early examinations are rewarded .... their colleges .... scholarships.
c) To enter .... Oxford you must satisfy the university entrance requirements.
d) .... Oxford students sit .... their finals in June.
e) Registration opens one week .... the beginning of the semester and ends two weeks ...... the beginning.
f) Earning 4 credits ..... physics fulfils the science requirement.
g) Cooperation with a teacher in preparation ...... the bachelor's thesis is very important.
h) Courses passed during previous studies are usually accepted ..... assignation of credits.
i) Study plans are only advised and students sign ..... for courses ...... their own discretion.
j) The student must enrol ...... the course ..... Mathematical Modelling.
k) The Faculty lecturers are interested ...... teaching and keen to pass ..... their knowledge.
l) The average student in England now graduates ...... university .... debts of around £ 12,000.

4. *Fill in the missing expressions (sometimes more than one word):*

Dear Sir or Madam,

I (a) .... for the (b) .... of Editorial Assistant (c) .... in the official Dallas News (d) .... 2nd April.

I am now enrolled (e) .... The University of Texas at Dallas as a sophomore, with a dual major (f) ...... English literature and journalism. As the enclosed (g) .... shows, I have (h) .... on the university newspaper for two years, and I have published articles in my hometown papers. I believe my educational background and my work (i) .... qualify me for the opening you have.

I am (j) .... for an (k) .... at any time (l) .... to you. I would be happy to send you samples of my newspaper work.

Yours (m) .... ,

John M. Green

Please see (n) ....

5. *Formal letter phrases: Rewrite the sentences below. Change the word or words that are underlined with a word or phrase from the box:*

received	appropriate	complete	request
a refund	enclosed	replacement	
satisfied	concerning	returned	

a) I got your letter about my bank account.
b) I have put in a cheque for £158.
c) Please send me the right form to fill in.
d) I took back the sweater and asked for my money back.
e) I want a new one.
f) I am not happy with the repairs to my car.

6. *There are mistakes in grammar, spelling, punctuation, in the order of the paragraphs, and also in the layout. See how many mistakes you can find!*

26 whitby road
York Y03 0ET

Tower Hotel
Bournemouth
Hampshire HP4 PMT

The nineteenth of January

Dear Jane Berman,

I am interesting in the job of waitress advertised on "Metro" this morning and I am enclosing my CV.

I hope you will consider my application carefully and I look forward to hear from you.

I am working as waitress in my country since four years before I came here and my former employer can provide you with a referee.

I imagine that you cater mainly for foreign tourists so I belief my language skills would be usefull. In addition to speak german and english, I also can understand spanish.

Yours faithfully,

Anna Bauer
Anna Bauer

PRESENTATIONS

INTRODUCTION

Preparation and knowledge are the pre-requisites for a successful presentation, but confidence and control are just as important. A good oral presentation is well structured; this makes it easier for the listener to follow. Most presentations are organized in three parts:

1. introduction
2. body
3. conclusion

The ***introduction*** prepares the audience for what you will say in the body of the talk. It should be brief and to the point. The purpose of it is to capture the attention of the audience and to arouse their interest. It is often a good idea to begin a talk with a question, a short story, an interesting fact about your topic or an unusual visual aid. Many speakers follow this with visuals that show the title, aim and outline of the talk.
In a good introduction you should:

- *get people's attention, welcome your audience, introduce yourself*
- *explain the purpose of the talk*
- *outline the structure of your presentation*
- *give instructions about questions*

The ***body*** is the "real" presentation. It must be presented in a logical order that is easy for the audience to follow and natural to the topic. Divide your content into sections and make sure that the audience knows where they are at any time during your talk. It is often a good idea to pause between main sections of your talk. You can sum up the point or explain what the next point will be. This technique is called "**signposting**". If you have visuals (overhead transparencies, slides, computer ...) with an outline of your talk on it, you can put this on the projector briefly and point to the next section. Examples, details and visual aids add interest to a presentation and help you get your message through. But the visuals are not the presentation, their purpose is simply to summarise or illustrate your main points.
In the main body, you should:

- *give details of your topic in a logical order*
- *use anecdotes and examples to illustrate your points*
- *tell the audience how this information applies to them*
- *back up all the claims that you made at the start*

The ***conclusion*** should end the presentation on a positive note and make the audience feel that they have used their time well listening to you. In a good conclusion you should:

- *sum up*
- *give recommendations if appropriate*
- *thank your audience*
- *invite questions*

Questions

Many speakers worry about questions from the audience. However, questions show that the audience is interested in what you have to say and can make the talk more lively and interactive. One way of handling questions is to point to questions you would like to discuss as you are talking. You can control questions better if you leave pauses during your talk and ask for questions. It is important not to let question and answer sessions during the talk go on too long, however. Answer briefly or say you will deal with the question at the end.

Body language

Do not underestimate the power of body language. Your body is speaking to your audience even before you open your mouth. Your clothes, your walk, your haircut, your expression – it is from these that people form their first impression. How you sit, stand or project your voice can reinforce or sabotage your message. If you are using strong, powerful words but your body is communicating that you are weak and unsure, your audience will not accept what you are saying as well as if you were using strong body language.

Below are just a few examples of both positive and negative body language:

Positive body language

- stand up straight and face the audience
- make proper eye contact
- smile
- use natural, conversational gestures
- move forward or nod your head to emphasize
- move to one side to indicate a transition
- use a pen or pointer to indicate a part or a place (on a transparency)

Negative body language

- loss of eye contact: looking at notes, looking at the screen, at the board, at the floor
- staring, or looking blankly into people's eyes
- swaying back and forth like a pendulum
- turning back to the audience
- nervous tics
- hands in pockets
- crossing your arms or legs
- fidgeting; scratching your nose, rubbing an eye, nose or ear, jiggling things in your pocket or shuffling from foot to foot
- pointing at anyone in your audience, even when you invite them to answer a question

Voice

It is important that your audience be able to hear you clearly throughout your speech. In brief, pay attention to the following points:

- speed – you can speak at normal speed, you can speak faster or more slowly; you can pause. This is a good technique for gaining attention.
- intonation – you can change the pitch of your voice
- volume – speak up with sufficient volume to fill the room, but do not speak in the same, flat monotonous voice throughout your presentation
- speak clearly - clear articulation is essential

ORAL PRESENTATION

I. INTRODUCTION

1. Greeting the audience, calling for attention, introducing people:

Good morning. Well, everybody, can we begin? I'd like to introduce myself. My name is Peter Brown and I am a student at ....

OK, everyone, shall I begin? Let me introduce myself first. I'm Peter Brown and I am a researcher from ....

Good afternoon. If I could have everybody's attention. My name is Peter Brown. I am responsible for .....

Good morning, ladies and gentlemen. On behalf of .... I'd like to welcome you.

Good afternoon everyone. If everybody's ready, I think we can begin.

Good afternoon everybody. Perhaps we should begin? For those of you who don't know me, my name's Peter Brown.

OK, everyone. Let's get started.

Ladies and gentlemen. Thank you for coming today. I'm Peter Brown and I work for ......

Good, ladies and gentlemen, let me start now. Before I begin, let me tell you a little about myself. I'm .....

Ladies and gentlemen. Good morning. It's a pleasure to be here with you today. I'm a research engineer with the French National Centre for Scientific Research Marketing Manager. My name is ....

2. Introducing your subject:

I am going to talk today about ....

What I am going to talk about today is ....

The topic (theme) of my presentation today is ....

My objective today is to outline ...

I'm here today to tell you a few words about ...

What I intend to do this afternoon is to ...

This morning I'd like to present our new processor.

What I want to do is to give you the essential background information on ... What I want to do today is to analyse ......

My main aim this morning / afternoon is to tell you a few words about the present situation.

The purpose of this presentation is to introduce our new range of ...

My talk today will deal with ...

I've been asked to ...

My target is to ...

This afternoon, I'd like to cover two topics of interest to the automobile industry ...

The purpose of my presentation is to introduce our new range of ...

3. Outlining your structure:

- To make an overview, choose a sequencer:

Beginning	***Going further***	***Concluding***
First of all	Next	Finally
To begin with	(And) then	Last of all
To start with	Later	In the final part
First(ly)	Subsequently	To finish off
Let's start with	After that	In short / in brief
For a start	Second(ly) / third(ly)	To conclude /in summary

- Select a verb that reflects the approach you intend to use:

analyse	examine	present
consider	explain	speak about
concentrate on	go over	show
describe	look at	talk about
discuss	mention	

To start with I'll describe the progress made this year / I suggest looking at ...
First of all, I'll *talk about* ... and *then* I'll *explain* ..., *finally* ...
Let's start / begin with ...
Firstly, I'd like to *look* / let me *look* briefly *at* the progress made this year. *Secondly*, I intend to *concentrate on* ... / I want to *analyse*
The main points I will be *talking about* are *firstly* ..., *secondly* ..., *next* ., *finally* ... we are going to *concentrate on* ...

Then I'll *mention* some problems we've encountered and how we overcame them.
Next I'll be *talking about* the possibilities which are open to us.
Thirdly, I'll *consider* the possibilities for further growth next year.
After that I'm going to *show* you/ *present* some possible options.
Later I shall be recommending a global strategy for the following year.

Finally, I'd like to propose some new ideas for our future development strategy.
In the final part, we'll try to forecast the evolution of ... in the coming years.

4. Giving instructions about questions:

Do feel free to interrupt me if you have any questions.
I'll try to answer all of your questions after the presentation.
I plan to keep some time for questions after the presentation.
There will be plenty of time for questions at the end.
Perhaps we can leave any questions you have until the end?
If you have any questions, I'll be happy to answer them as we go along.

II. BODY

The body is the "real" presentation. If the introduction was well prepared and delivered, you will now be relaxed and confident. Do not forget these key points while delivering your presentation:

- do not hurry
- give time on visuals
- maintain eye contact
- look friendly
- keep your structure
- use your notes
- signpost throughout

1. Signposting phrases to guide your presentation:

- ***Finishing a section:***

That's all I have to say about ...
We've looked at ...
So, I've told you about ...
So much for ...

- ***Starting a new section:***
  - *When you want to make your next point, you "**move on**".*
    Moving on now to ...
    I'd like to move on to ...
    Well, moving on to ...
    Right, was that clear? So I'll move on to ...
    Now we'll move on to ...

  - *When you want to change to a completely different topic, you "**turn to**".*
    I'd like to turn to ...
    Let's turn now to ...
    Now, turning to ...
    Let me now turn to ...
    Turning to ...

  - *When you want to give more details about a topic you "**expand**" or "**elaborate**".*
    I'd like to expand more on this problem we have had in New York.
    Would you like me to expand a little more on that?
    I don't want to elaborate any more on that as I'm short of time.

  - *When you want to talk about something which is off the topic of your presentation, you "**digress**".*
    I'd like to/ let me digress here for a moment and just say ...
    Digressing for a moment, I'd like to say a few words about ...
    I feel I should digress here ...

  - *When you want to refer back to an earlier point, you "**go back**" or "**backtrack**".*
    Going back to something I said earlier, the situation in New York is serious.
    I'd like to go back to something Peter said in his presentation.
    And let me now go back to my main point/ what I was talking about.
    Let's backtrack to ...

  - *To just give the outline of a point, you "**summarize**" or "**sum up**".*
    If I could just summarize a few points from Peter's report.
    I don't have a lot of time left so I'm going to summarize the next few points.
    To sum up ...
    Right, let's sum up, shall we?
    Let's summarise briefly what we've looked at...
    If I can just sum up the main points ...

  - *To repeat the main points of what you have said, you "**recap**".*
    I'd like to quickly recap the main points of my presentation.
    Recapping quickly on what was said before lunch, ...
    Let's just recap ...
    I'd like now to recap ...

  - *For your final remarks, you "**conclude**".*
    I'd like to conclude by leaving you with this thought ...
    I'd like to conclude by saying ...
    To conclude my presentation, I would like to say ...
    In conclusion, ...
    Unfortunately, I seem to have run out of time, so I'll conclude very briefly by saying that ...

2. ***Analysing a point and giving recommendations:***

Where does that lead us?
Let's consider this in more detail ...
What does this mean for ...?
Translated into real terms ...
Why is this important?
The significance of this is ...

3. ***Giving examples:***

For example/ For instance, ...
A good example of this is ...
As an illustration, ...
To give you an example, ...
To illustrate this point ...
By providing ... such as/like ...

4. ***Paraphrasing and clarifying:***

Simply put ...
In other words ...
So what I'm saying is ...
To put it more simply ...
To put it another way ...

5. ***Linking words and phrases*:**

Indicating addition or similarity: also, ... / besides, ... / in addition, ... / furthermore, ... / as well as... / similarly, ... / likewise ...
Indicating contrast and comparison: however, ... / nevertheless, ... / on the other hand, ... / in contrast / while/ although/ even though / in spite of the fact that / despite the fact that / while / on the contrary / instead ... / rather... / yet ...
Giving a reason: for this reason, ... / because ... / because of ... / due to ...
Indicating result: therefore, ... / thus, ... / as a result, ... / consequently, ...
Reformulating an idea: in other words, ... / to put it simply, ... / that is ...

6. ***Verbal transitions – dividing your presentation into sections:***

Now that we have seen ... let's look at ...
Now that we have an idea of ... let's turn our attention to ....
Before going on to the next part which deals with ... I'd like to stress ...
To sum up then, we've examined ... , we've also analysed ... I'd now like to focus on ....
In addition to ..., what other factors contribute to ...?
Before we go on to the next section, let me briefly restate ...
As I explained / said / mentioned before, discussing ... is serious / urgent.
The next issue / topic / area I'd like to focus on is ...

7. ***Referring to common knowledge:***

As you all may well know ...
It is generally accepted that ...
As you are probably aware (of) ...

8. ***Expressing opinion:***

We believe (that) ...
I think (that) ...

I would say that ...
My opinion is ...
It seems (to us) that ...
It's our view ...
We (tend to) feel ...
I am convinced that ...
It is my firm belief that ...
According to Professor Ross ...
In Mr Peter Brown's opinion ...
It is commonly thought that ...
According to conventional wisdom ...

9. Expressing disagreement:

I'm afraid we disagree (strongly) with you on this point.
I'm afraid we cannot agree.
I don't quite agree.
We regret to say that we really cannot agree.
We'd like to express our disagreement.
I don't think we are in agreement on that, I'm afraid.
I agree with you on the whole, but we tend to be more optimistic than you.
To a certain extent I agree with you, but we are inclined to be more optimistic than you.
We are not sure (enough) about your recommendation.

10. Giving a warning:

If our company does not cut costs, profits will continue to fall.
Unless we cut costs ...
We suggest cutting down costs; otherwise profits will continue to fall.
Provided that our company cuts costs, profits will stop falling.

11. Emphasizing:

And what is more we must accept ...
What is very significant is ...
What is important to remember ...
I'd like to emphasize the fact that ...
I'd like to stress the importance of ...
We did see a noticeable difference.
In addition to this, ...
Furthermore, ...
Moreover, ...
But above all, ...

12. Getting to the point:

What I'm saying is that ...
What I'm trying to explain here is that ...
What I'm getting at is that ...
My theory is that ...

13. Using numbers

In a written paper, the reader's eye takes in numbers and their size and automatically makes approximations. Large or complicated numbers are much more difficult to assimilate orally (and long to pronounce.) Give your listener approximations instead. But signal that it's an approximation.

approximately	The greatest number of discrepancies occurs at approximately 6 Pascals. (5.92)
nearly	Nearly 5,000 cases were examined in this study. (4,679)
roughly	Roughly half the cases were found in the past three years. (4,250/9000)
over	Over a third of the respondents said they preferred instant coffee. (34.7 %)
more than	More than 12 million people live in Tokyo. (12,790,456)

14. *Presenting calculations:*

The sums show that ...
We estimate that ...
Our figures show that ...
According to our calculations it is obvious that ...

15. *Using rhetorical questions:*

So, how bad is the situation? I'll tell you how bad it is. It's absolutely catastrophic!
The obvious question is: are we able to achieve better results by the year 2012? Of course, we are.
So, who was responsible? I can explain.
How accurately can we predict future energy needs?
So, where did we go wrong? I'll tell you where. ...
What can be done about that?
What does this imply for you, as a consumer?

16. *Expressing hypothesis:*

If we chose A, we would / should / could sell ...
What would happen if we selected ...
Let's suppose we choose ...

17. *Giving a reason:*

Due to the rise in oil prices, the inflation rate rose by 1.30 %.
Due to the fact that oil prices have risen, the inflation rate has gone up by 1.30 %.
Owing to the demand, we are unable to supply all items within 2 weeks.
Owing to the fact that the workers have gone on strike, the company has been unable to fill all its orders.
Because the company is expanding, we need to hire more staff.
Because of bad weather, the football match was postponed.
Since the company is expanding, we need to hire more staff.
As the company is expanding, we need to hire more staff.

18. *Giving a result:*

Therefore, ...
Consequently, ...
This means that ...
As a result, ...
So, ...
The company are expanding. Therefore / So / Consequently / As a result / So, they are taking on extra staff.

19. *Contrasting ideas:*

but
however
although / even though
despite / despite the fact that
in spite of / in spite of the fact
that nevertheless
nonetheless
while
whereas
unlike
in theory ... in practice ...

He works hard, *but* he doesn't earn much.
He works hard. *However*, he doesn't earn much.
Although it was cold, she went out in shorts.
In spite of the cold, she went out in shorts.
Despite the fact (in spite of the fact) that the company was doing badly, they took on extra employees.
The company is doing well. *Nonetheless*, they aren't going to expand this year.
Taxes have gone up, *whereas* social security contributions have gone down.

20. *How to predict/ forecast:*

The company experts predict / expect / forecast that
... Our forecasts show that ...
Our company should / ought to ...
Our company may / might ...
We can / could ...
We must / have to ...

21. *Explaining decisions:*

As a result of a rise in demand we have increased our output.
Because of ...
Owing to ...
Since there is ...
Demand is up. For this reason ... / That's why we ...

22. *Eliminating alternatives:*

We have eliminated option A because of the ...
We have decided against option A because we want ...
We reject option A because ...
We accept option A because ...
We have chosen option A because ...
We would like to implement option A because ...

23. *To talk about different trends we use the following tenses:*

- The **Present Continuous –** to describe trends and changes that are happening now.
  Sales *are increasing* at the moment.

- The **Present Perfect** and **Present Perfect Continuous –** to describe trends that started in the past and have not finished yet:
  Sales *have decreased* **since** 2011.
  Sales *have decreased* **by** 30 % **in** 3 years.
  Sales *have been falling* **for** 3 years.
  The international role of the euro *has increased* gradually **since** 1999.

- The **Simple Past –** to describe events that happened in the past and are now finished:
  Sales *increased* between 2009 and 2012.

- The **Past Perfect** and **Past Perfect Continuous –** to describe trends that had already happened before another event in the past:
  Employee turnover *had decreased* when we introduced the new programme in 2011.
  Employee turnover *had been decreasing* before we introduced the new programme in 2011.

- The **Future form "will" –** to predict future trends:
  Sales *will increase* next year.

VERBS OF

INCREASE	DECREASE	STABILITY	UP and DOWN
increase	decrease	stabilize	fluctuate
go up	go down	stagnate	zigzag
rise	fall	level off/out	flutter
accelerate	plunge	flatten out/ off	undulate
peak	bottom out	hover around	oscillate
grow	plummet	hold steady	
take off	slump	stay the same	
soar	decline	remain constant/ stable	
shoot up	drop		

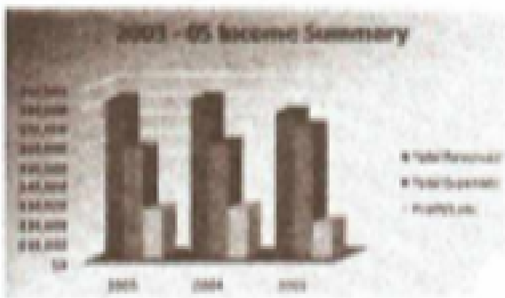
24. Commenting on visuals:

I'd like to illustrate this by showing you this diagram / graph / bar graph / flow chart / pie chart / scheme / table ...
Let me now show you this ...
And now have a look at this ...
This bar chart represents ...
If you look at the graph ...
This chart compares ...
If you look at the graph ...
The figures in this table show ...

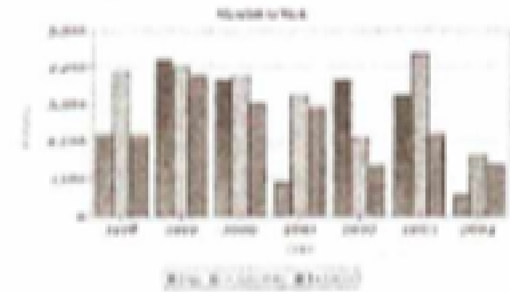
25. Types of graphs/ charts:

The main difference between charts and graphs is that charts are circular and represent 100% of a category; therefore each segment or piece of the pie is a percentage of the whole. Graphs show values that are related although different for two or more items or subjects and comparisons can be easily made such as the shortest and tallest.

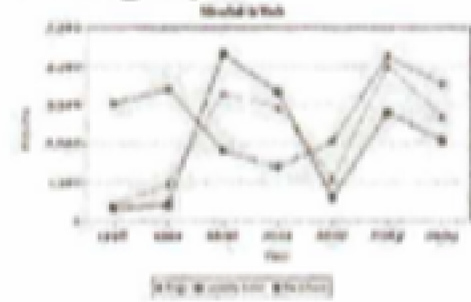
Column graph



Bar graph



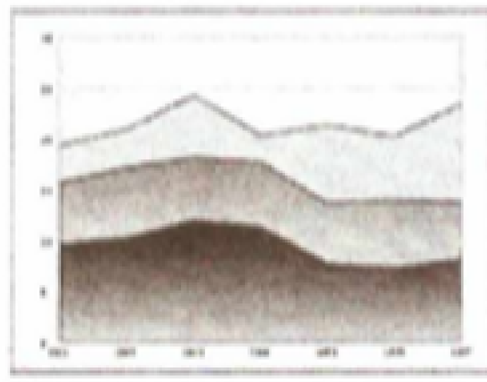
Line graph



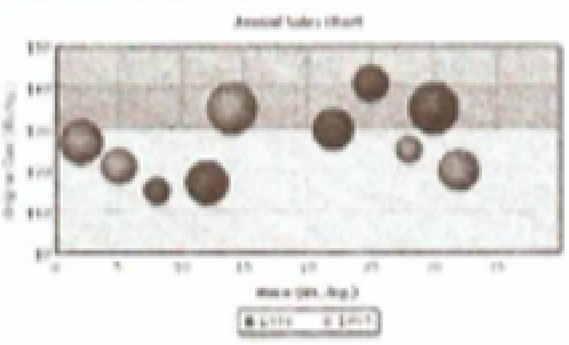
Pie/Cirle chart

Doughnut chart

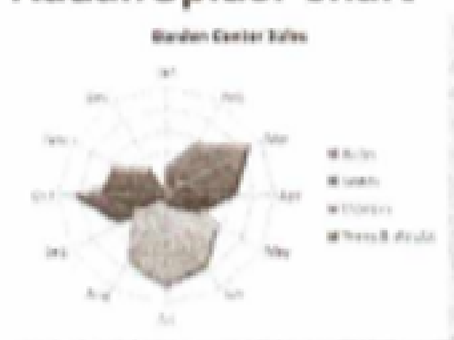
Area chart



Bubble chart



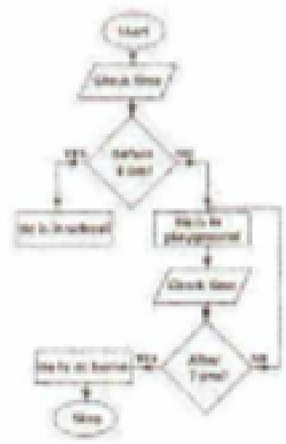
Radar/Spider chart



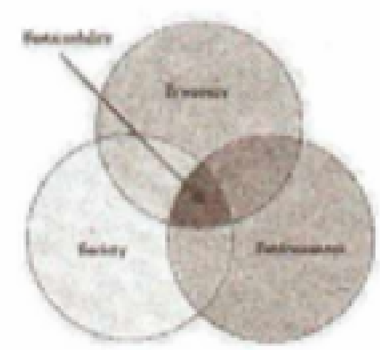
Surface chart

Table

Flow chart



Venn diagram



26. *Referring to graphs and charts:*

Figure 1 *shows* sales of mobile phones per month.
As *shown* in Figure 1, ...
... creating an ever-widening gap between the richest and poorest nations, as *can be seen from* the graph in Figure 1.
A typical apparatus used in the measurement of atomic spectra *is indicated* in Fig. 1.
Table 2.6 *illustrates* clearly ...
Table 4.2 *gives* an example of an engineering curriculum.
The next graph *demonstrates* that ...

27. *How to identify parts of diagrams:*

The vertical (y-axis) represents ...
The horizontal (x-axis) shows ...
The solid line represents ...
The broken line ...
The dotted line ...
The dash and dotted line ...

The marked part indicates ...
The dark section shows ...
The shaded segment ...
The unshaded quadrant ...
The dotted column ...
The coloured bar ...
The blue / red / yellow area ...

28. How to describe and explain graphs:

verbs *(learn the past tenses!)*	**nouns**	**adjectives**	**adverbs**
boom	boom	considerable	considerably
climb	climb	dramatic	dramatically
decline	decline	enormous	enormously
decrease	decrease	gradual	gradually
dip	dip	huge	hugely
fall	fall	marked	markedly
fluctuate	fluctuation	minimal	minimally
go up		moderate	moderately
grow	growth	quick	quickly
increase	increase	rapid	rapidly
level out	levelling out	sharp	sharply
peak	(reach) a peak (at)	significant	significantly
plummet	slump	slight	slightly
recover	recovery	slow	slowly
reduce	reduction	small	
remain stable at		steady	steadily
remain steady at		steep	steeply
rise	rise	substantial	substantially
settle		sudden	suddenly
soar / shoot up			
stay			

There was a *sudden fall* in the price of shares last year.
The price of shares *fell suddenly* last year.
After this / that sales *levelled out.*
Notice / observe how *the increase* has had an effect on the ...

- ***Verbs / nouns + prepositions:***

to fall ***by*** 25 % last month ***from*** 200 ***to*** 250
an increase ***of*** 8 % ***over*** last month
There was a 15 % drop ***in*** sales last year.
The exchange rate peaked ***at*** £ 3.52 in April.
In May it fell ***to*** £ 2.49.
In 2011 the price fell ***by*** almost £ 3.52.
There was a fall ***of*** £ 3.52 ***in*** the price of shares.
The price has now settled ***at*** £ 3.52.
between 2010 and 2012

III. CONCLUSION

1. Concluding and summarizing:

To conclude, (firstly,) our company has to reduce its production costs and, (secondly), become more market-oriented.
To summarise (my main point) ...
To recapitulate then – ...
So let me now summarise it all – ...
I'd like to sum up/recap now what I have said.
Now, to sum up ...
In conclusion, ...
Finally, may I/let me remind you of some of the main points we have considered.
I'd like to conclude by reminding you of ...
Let me end (here) by reminding you of ...
I'm going to conclude by ... saying that/inviting you to/quoting ...
So where does this leave us? Well we need to: ...
We can agree that ...
Our main point is that: ...
We have raised the following questions: ...
Our study has proved that: ...

2. Giving recommendations:

In conclusion, my recommendations are...
I therefore suggest / propose / recommend the following strategy.
We think that ... should be ...
I wonder if we shouldn't think of ...
We think you should/ ought to ...
Our point of view is that ...

3. Thanking your audience:

Thank you very much for your attention / your precious time / listening.
May I thank you all for being such an attentive audience.

4. Inviting questions:

Now I'll try to answer any questions you may have.
Now I'd like to invite any questions you may have.
Finally, I'll be happy to answer your questions.
Can I answer any questions?
You no doubt have some questions; I'd be pleased to answer them now.
I'm sure you have some questions; I'll do my best to deal with them.
If there are any questions, don't hesitate to ask.
Do you have any questions? I'd be happy to answer them.
Are there any final questions? I'll try to answer them satisfactorily.
If you have any questions, I'd be happy to answer them.
If you have any questions, I'll do my best to answer them.

If the question is aggressive, you can put the question off:

I'm afraid we don't have enough time to go into that now, but I'd be glad to send you some documents on that point.
That's an interesting point, but I'm afraid it concerns few of us here.
I'd be glad to talk to you during the break or at the end of the session.
Your question leads to an area which could be the subject of another paper. Perhaps we could continue this discussion during the lunch break.

***If you don't know the answer*:**

I wish I could answer that, but I can't. I'd have to go back to my lab for more data.

I wish I knew the answer to your question. We're working on that aspect right now.

Thank you ... it's a good question and one we are trying to address in our follow up studies.

Ah yes. That occurred to us too. We tried to account for it by ...

Ah ... I'm afraid I don't have that information with me now. If I can get your email address after this session, I'll mail it to you.

PRACTICAL USAGE

1. Complete the dialogue:

If I could have everybody's ...... ? .... morning. Thanks .... coming. On .... of Viva Travel I would like to .... you all here this morning. My name's Peter Green and I'm .... for customer service. ...... I want to do this morning is to .... to you ..... our new packages for travel agents. If you have any ...... you'd like to ask, I'd be happy to ...... them after the presentation.

To ..... with I'll describe the progress made this year. ...... I'll mention some problems we've encountered and how we overcame them. .... I'll summarize my presentation.

2. Complete the sentences with the words below:

turn	digressing	turn	move on	expand	
going back	elaborate	expand	digress		moving on

a) I'd like to .... to something completely different.
b) .... for a moment, I'd like to say a few words about China.
c) I'd like to .... to the next point if there are no further questions.
d) .... to something I said earlier, the situation in China is serious.
e) I don't want to .... any more on that because I'm short of time.
f) I'd like to......... here for a moment and say a word of thanks to Robert.
g) I'd like to...... more on this problem in China.
h) Let's ...... now to our plans for the future.
i) .... to the next point.
j) Would you like me to .... a little more on that?

3. For each sentence, choose the best word to complete the gap:

a) The number of students in A class has ...constant since the beginning of October.
A retained B replayed C remained D relayed

b) After the economic slump in the UK, unemployment reached a new peak ... a million.
A over B up C for D of

c) After two weeks of cold weather, the temperature suddenly rose ... a little over 14 degrees.
A through B for C to D at

d) Between April ... June, the number of students attending classes of physics fluctuated slightly.
A and B to C through D from

e) In the first three months of 2012, the price of eggs shot up ... .
A slightly B dramatically C gradually D a little

f) The number of students attending conversation class suddenly ... from 10 to 35 in November.
A rose up B rocketed up C grew up D jumped up

g) Since the year 2009, there has been a continued ... in the number of accidents in Prague.
A grow B growing C growth D growing up

h) Between 2008 and 2011 there was a ... rise of 0.4 % in the number of burglaries in Salisbury.
A slight B substantial C dramatic D major

i) There has been a ... increase in the number of students bringing their own notebooks.
A drama B dramatic C dramatical D dramatically

4. Complete the sentences with the words from the box:

draw	think	point	look	mention
refers	turn	include	focus	

a) Let's ..... now on what these figures mean.
b) I'd like us to ...... our attention to this part of the chart.
c) I'd like to ...... out the small difference in these figures.
d) This figure doesn't .... any adjustment for fluctuations in exchange rates.
e) We need to .... about how our company can improve this figure.
f) I would like to ...... the significance of these numbers.
g) I'd like to ...... your attention to this chart.
h) This figure ..... only to returns during the last year.
i) Now, let's .... in more detail at the red segment of this chart.

5. Complete the sentences with the verbs in brackets in the correct grammatical form:

a) The number of grievances of the employees (go up) .... at the moment.
b) Between 2009 and 2010 the average number of work related accidents (decrease) ....
c) The minimum wage in the car industry (increase) .... since 2009.
d) The number of employees in foreign companies (drop) .... next year.
e) According to the survey the employee satisfaction (grow) .... before the company increased the wages.

6. Look at some expressions used in giving a talk. Decide on the best description of the words in bold :

a) **I'm going to tell you about** the activities we have.
1. describing 2. explaining 3. introducing the topic

b) **First I'm going to talk about** activities for the over-50s, **then I'm going to talk about** the after-school clubs.
1. adding ideas describing 2. contrasting ideas 3. sequencing ideas

c) **As far as** prices are concerned, we are very reasonable.
1. adding ideas 2. contrasting ideas 3. starting a new idea

d) **Following this,** I'd like to talk about the Chinese market.
1. adding ideas 2. starting a new idea 3. sequencing ideas

e) We'd like to encourage young people to come along and take part. **On the other hand,** we have a maximum of 15 at any one session.
1. adding ideas 2. contrasting ideas 3. describing

PART III
Appendices

APPENDIX 1

GREEK ALPHABET

Letters		*Name*	*Pronun.*
Capital	*Small*		
Α	α	alpha	'ælfə
Β	β	beta	'bi:tə
Γ	γ	gamma	'gæmə
Δ	δ	delta	'deltə
Ε	ε	epsilon	'epsilən
Ζ	ζ	zeta	'zi:tə
Η	η	eta	'i:tə
Θ	θ	theta	'θi:tə
Ι	ι	iota	ai'əutə
Κ	κ	kappa	'kæpə
Λ	λ	lambda	'læmbdə
Μ	μ	mu	mju:

Letters		*Name*	*Pronun.*
Capital	*Small*		
Ν	ν	nu	nju:
Ξ	ξ	xi	ksai
Ο	ο	omicron	'əumikrən
Π	π	pi	pai
Ρ	ρ	rho	rəu
Σ	σ	sigma	'sigmə
Τ	τ	tau	tau
Υ	υ	upsilon	'jupsilən
Φ	φ	phi	fai
Χ	χ	chi	kai
Ψ	ψ	psi	psai
Ω	ω	omega	'əumigə

HOW TO READ MATHEMATICAL EXPRESSIONS

Fundamental symbols

$=$	equals; is equal to
$\neq$	is not equal to; does not equal
$\equiv$	is identical with; is always equal to
$\cong$; $\approx$	is approximately equal to; approximately equals
$>$	is greater than
$<$	is less than
$\leq$	is less than or equal to; is not greater than
$\geq$	is greater than or equal to; is not less than; is more than or equal to
$!$	factorial ($a!$ – *a* factorial; factorial *a*)
$\sim$; $\propto$	is (directly) proportional to; varies as
m_a	*ma*; *m* sub (script) *a*
x_{ij}	*x ij*; *x* with the indices *ij*
x'	*x* prime; *x* dashed
x''	*x* double-prime; *x* double-dashed
x^*	*x* star; *x* asterisk
$\bar{a}$	*a* bar
$\tilde{a}$	*a* tilde
$\hat{a}$	*a* hat; *a* roof
$\ddot{a}$	*a* double dot
$\lvert a \rvert$	the absolute value of *a*; modulus *a*
%	per cent
∞	infinity
( )	parentheses; round brackets
[ ]	brackets; square brackets
{ }	braces; curly brackets
⟨ ⟩	angle brackets
( ]	hybrid brackets

$(x; y)$	(the) ordered pair $(x; y)$

Combinatorics

$V_k(n)$	k variations of n things/ objects/ entities
$C_k(n)$	k combinations of n things/ objects/ entities
$P(n)$	n permutations
$V'_k(n)$	k variations of n things/ objects/ entities with repetition
$C'_k(n)$	k combinations of n things/ objects/ entities with repetition
$P'(k_1, k_2, k_3, \ldots, k_n)$	multiset permutation; multinomial coefficient
$\binom{n}{k}$	n choose k; binomial n over k; the kth binomial coefficient of the nth degree

Mathematical Logic

$X \wedge Y$	X and Y (conjunction of statements X and Y)
$X \vee Y$	X or Y (alternative of statements X and Y)
$X \Rightarrow Y$	X implies Y (implication) Y follows from X if X holds then Y also holds X is the sufficient condition for Y Y is the necessary condition for X
$X \Leftrightarrow Y$	X is equivalent to Y (equivalence) X holds if and only if Y holds X is the necessary and sufficient condition for Y
$\forall$	for all; the universal quantifier ($\forall x \in I : V(x)$ – for each $x \in I$ the statement $V(x)$ holds)
$\exists$	there exists; the existential quantifier ($\exists x \in I : V(x)$ – there exists $x \in I$ such that the statement $V(x)$ holds
$\therefore$	therefore
$\because$	because
$\neg X$	(the) negation (of) X
X'	(the) negation (of) X
1, 0	truth value; logical value
1	true
T	true
0	false
$\perp$	false

Sets

$x \in A$	x is an element of A; x lies in A x belongs to A x is a member of A
$x \notin A$	x is not an element of A; x does not lie in A x does not belong to A x is not a member of A
$A = \{a,b,c\}$	A is the set with the elements a, b, c
$A \subset B$	A is included in B A is contained in B A is a (proper) subset of B

$A = \varnothing$	*A* is an empty set *A* is a null set
$A \cup B$	the union of *A* and *B*; *A* union *B*
$A \cap B$	the intersection of *A* and *B*; *A* intersection *B*
$A \subseteq B$	*A* is a subset of *B*
$A \sim B$	*A* and *B* are equivalent to each other
(a, b)	the open interval *a b*/ with the end points *a*, *b*
$[a, b]; \langle a, b \rangle$	the closed interval *a b*
$(a, b]; (a, b\rangle$	half-open/ semi-open interval *a b*, open on the left and closed on the right
$X = (-\infty, +\infty)$	Capital *X* equals the open interval minus infinity, plus infinity.
$\bigcup_{\alpha \in A} S_\alpha$	(the) union of all sets *M* sub α; $\alpha \in A$
$\bigcap_{\alpha \in A} S_\alpha$	(the) intersection of all sets *M* sub α; $\alpha \in A$
$A \times B$	the Cartesian product of *A* and *B*; *A* cross *B*
A'_B	the relative complement of (a set) *A* with respect to (a set) *B*
$A \backslash B$	the (set-theoretic) difference of *A* and *B*

Addition

summands
sčítance

sum
součet

4 + 7 = 11

Four plus seven equals eleven.
Four plus seven is equal to eleven.
Four added to seven makes eleven.
Four and seven is/ are eleven.
Eleven is the sum of four and seven.
(or almost any combination of these, e.g.: Four and seven equals eleven.)

$a + b = c$ — *a* plus *b* equals *c*.
$a_1 + a_2 = s$ — *a* one plus *a* two equals *s*.

Subtraction

minuend
menšenec

subtrahend
menšitel

difference
rozdíl

11 − 4 = 7

Eleven minus four equals seven.
Four from eleven leaves seven.
Eleven diminished by four is equal to seven.
Seven is the difference of eleven and four.

$a - b = c$ — *a* minus *b* equals *c*.

Multiplication

factors
činitelé

product
součin

$$1 \times 1 = 1$$

$1 \times 1 = 1$	One times one is one.
	Once one is one.
$2 \times 2 = 4$	Twice two is four.
$3 \times 3 = 9$	Three threes are nine.
	Three times three is nine.
$4 \,.\, 4 = 16$	Four (multiplied) by four equals sixteen.
$ab = c$	*ab* equals/ is equal to *c*.
	a multiplied by *b* equals *c*.
$\prod\limits_{a=1}^{n}$	The product from *a* equals 1 to *n*.

Division

dividend
dělenec

divisor
dělitel

quotient
podíl

$$25 : 5 = 5$$

$25 : 5 = 5$	Twenty-five divided by five equals five.
$a \div b = c$	*a* divided by *b* equals *c*.

Fractions

Common (vulgar) fractions:

numerator
čitatel

denominator
jmenovatel

quotient
podíl

$$\frac{a}{b} = c$$

$\frac{1}{2}$	one half (a half)
1/3	one third (a third)
2/9	two ninths
$4\frac{5}{8}$	four and five eighths
$\frac{a}{b}$	*a* over *b*.
$\frac{a+b}{a-b} = \frac{c+d}{c-d}$	*a* plus *b* over *a* minus *b* equals *c* plus *d* over *c* minus *d*.

(You should avoid saying this except where it was visible to the listener: if you had to say it "unseen", you should pause to avoid ambiguity. – *a* plus *b* over (*pause*) *a* minus *b* equals *c* plus *d* over (*pause*) *c* minus *d*.

Decimal fractions:

0.523	nought point five two three
	zero point five two three
	point five two three
	oh [əu] point five two three
23.25	twenty-three point two five
0.002	oh point oh oh two
	point two ohs two
	point double-oh-two
	point nought nought two
2.6666666666	two point six recurring
2.612361236123	two point six one two three recurring

Powers / Exponentiations

base
základ

power/ exponent
mocnitel

a^n = power
mocnina

value of a power
výsledek mocnění

$$a^n = b$$

a to the *n* equals *b*.
a to the *n*th equals *b*.
a to the *n*th (or *n*-th) power is equal to *b*.
a (raised) to the power (of) *n* is equal to *b*.
The *n*th power of *a* is equal to *b*.

3^2	three squared (square)
	three (raised) to the second power
	three to the power of two
	the second power of three
5^3	five cubed (cube)
	the cube of five
	five (raised) to the third power
	five to the power of three
	the third power of five
10^7	ten to the seven
	ten to the seventh power
10^{-7}	ten to the minus seven
a^{-10}	*a* to the minus tenth; to the power minus ten
a^2	*a* squared; the square of *a*
a^n	*a* to the (power) *n* ; to the *n*th (power); the *n*th power of *a*
$(x + y)^2$	*x* plus *y* all squared

Roots

root sign (radical sign)
odmocnítko

$\sqrt[n]{c}$ = radical
odmocnina

$$\sqrt[n]{c} = b$$

(The) *n*th root of *c* is equal to *b*.

$\sqrt{4}=2$	The (square) root (of) four is two.
$\sqrt{a}$	root *a;* the square root *a*; the square root of *a*
$\sqrt[3]{a}$	the cube root (of) *a*
$\sqrt[4]{16}$	the fourth root (of) sixteen
$\sqrt[5]{a^7}$	the fifth root out of *a* to the power seven
$\sqrt[n]{a}$	the *n*th root of *a*
$\sqrt[n]{c^m}$	the *n*th root of *c* to the *m*th

Logarithms

$\boldsymbol{log_b\, c = n}$

base
základ

$log_b c$ = logarithmic expression
logaritmický výraz

The logarithm to the base *b* of *c* is equal to *n*.
The logarithm (of) *c* to/ with the base *b* is equal to *n*.

$ln\ c$	the natural logarithm of *c*
$log\ c$; $lg\ c$	the (common) logarithm of *c*; log-ten *c*
$log_2\ a$	the logarithm (of) *a* to the base two
$log\ x_1 x_2$	the logarithm (of) *x* one *x* two
$log\ x^n$	the logarithm (of) *x* to the power *n*

Matrices and Determinants

$A_{m,n}$	*m* by *n* matrix
$A_{[m,n]}$	*m* by *n* matrix
A^T	the transpose of a matrix A
$\begin{pmatrix} a & b \\ c & d \end{pmatrix}$	a two-by-two matrix, the first row is *a*, *b*, the second row is *c*, *d*
$\left(\begin{array}{cc\|c} a_{11} & a_{12} & b_{12} \\ a_{21} & a_{22} & b_{21} \end{array}\right)$	two-by-three matrix
$A=\begin{pmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{pmatrix}$	upper-triangular three-by-three matrix
$\|A\|=1$	the determinant of *A* equals 1
$M_{12}=\begin{vmatrix} 0 & 1 \\ 0 & 1 \end{vmatrix}$	the minor of the entry a_{12}
$A_{12}=(-1)^{1+2}M_{12}$	the cofactor of the entry a_{12}; the (*i,j*)th cofactor of *A*

Calculus

D_f	the defintition domain of (the function) *f*

R_f	the range of (the function) *f*
$g(f(x))$	the composition of (the functions) *g* and *f*; *g* composed with *f*
$g \circ f$	the composition of (the functions) *g* and *f*; *g* composed with
$x \to a+$	f *x* approaches *a* from the right
$U_\delta(x_0)$	the δ neighbourhood of *x* sub 0
$U_\delta^+(x_0)$	the right-hand δ neighbourhood of *x* sub 0
$P_\delta^+(x_0)$	the reduced right-hand δ neighbourhood of *x* sub 0
$\lvert x \rvert$	the entire part of *x*
$\operatorname{sgn} x$	the sign of *x*
$f(A)$	the image of *A* under *f*
$f_{-1}(A)$	the inverse image of *A* under *f*
$f: X \to Y$	*f* is a mapping of *X* into *Y*; *f* maps *X* into *Y*
$f: X \xrightarrow{onto} Y$	*f* is a mapping of *X* onto *Y*; *f* maps *X* onto *Y*
$x \to x_0$	*x* approaches *x* nought *x* tends to *x* nought
$\lim\limits_{x \to x_1} f(x) = L$	As *x* tends to one, *f* of *x* tends to *L*. The limit of *f* of *x* as *x* tends to *x* one is capital *L*.
$\lim\limits_{a \to \infty} a_n = 0$	The limit of *a* sub *n* is zero as *a* tends to/ approaches infinity.
$\sum\limits_{i=1}^{n}$	the sum from *i* equals one to *n*
$y = \sum\limits_{k=0}^{4} a_k x^k$	*y* equals the sum of *a* (sub) *k*, *x* to the power of *k*, (taken) from (or over) (*k* equal to) zero to (*k* equal to) four.
$\int$	the (indefinite) integral
$\iint$	the double integral
$\iiint$	the triple integral
$\int\limits_a^b$	the integral from *a* to *b* the (definite) integral between the values *a* and *b*
$\int f(x)\,dx$	the integral of (small/ function) *f* of *x* d *x*
d	the differential
d *f*	the differential of function *f*
$y = f(x)$	*y* is equal to *f* of *x*. *y* is equal to *fx*. *y* is equal to the function *f* of *x*.
$f'(x)$	*f* prime of *x*. the (first) derivative of (function) *f* with respect to *x*
$f''(x)$	*f* double-prime of *x*. the second derivative of *f* with respect to *x*
$f'''(x)$	*f* triple-prime of *x*. *f* treble-dash *x*. the third derivative of f with respect to x

$f^{(4)}(x)$	*f* four of *x* the derivative of the fourth order of function *f* the fourth derivative of *f* with respect to *x*
$\frac{\partial v}{\partial \theta}$	the partial derivative of *v* with respect to θ
$\frac{\partial^2 v}{\partial \theta^2}$	*d* two *v* by *d* theta squared the second partial derivative of *v* with respect to θ *squared*

Trigonometric functions

$y = \sin x$	*y* equals sine *x*; *y* equals the sine of *x*.
$y = \cos x$	*y* equals cos *x*; *y* equals the cosine of *x*.
$y = \tan x$	*y* equals tan *x*; *y* equals the tangent of *x*.
$y = \cot x$	*y* equals cot *x*; *y* equals the cotangent of *x*.
$y = \arcsin x$	*y* equals the inverse sine of *x*. *y* equals the arc sine of *x*. *y* equals the angle whose sine is *x*.

Equations

$x + 7 = 3 - x$	a linear equation
x	unknown
$x = 5$	the solution/ the root of the equation
$ax^2 + bx + c = 0$	a quadratic equation; the standard form of the quadratic equation
$D = b^2 - 4\,ac$	a discriminant
$ax^3 + bx^3 + cx + d = 0$	a cubic equation
$x + y = 2$; $2x - y = 5$	a system of two (linear) equations
$x + 2 \geq 5 + 2x$	an inequality for the unknown *x*/ involving the unknown *x*
$\pi < 5$	an inequality

$\begin{array}{l} x+y=2 \\ x+y=4 \end{array}$	inconsistent system of two linear equations in two unknowns
$\begin{array}{l} x+y=2 \\ x+2y=4 \end{array}$	consistent system of two linear equations in two unknowns
$\begin{array}{l} x+y=2 \\ x+2y=4 \\ 2x+y=1 \end{array}$	overdetermined system of linear equations
$\begin{array}{l} x+y+z=2 \\ x+y+z=4 \end{array}$	underdetermined system of linear equations

APPENDIX 2

WEIGHTS AND MEASURES

BRITISH CONVERSION FACTORS

Weight

1 grain	=	0.065	g
1 drachm	=	1.77	g
1 ounce (oz)	=	28.35	g
1 pound (lb) = 16 oz	=	453.6	g
1 stone = 14 lb	=	6.35	kg
1 hundredweight (cwt) = 112 lb	=	50.8	kg
1 ton = 20 cwt	=	1.016	tonne

Liquid measure

1 minim	=	0.059	ml
1 fluid drachm	=	3.55	ml
1 fluid ounce (vol. of 1 oz water)	=	28.40	ml
1 pint (pt) = 20 fl oz	=	568.00	ml
1 quart (qt) = 2 pt	=	1.14	l
1 gallon = 8 pt	=	4.55	l
		(1.201 U.S. gallon)	

Length

1 inch (in)	=	2.54	cm
1 foot (ft) = 12 in	=	0.305	m
1 yard (yd) = 3 ft	=	0.9144	m
1 mile = 1760 yd	=	1.61	km
1 nautical mile (6080 ft)	=	1.85	km

Area

1 square inch (in^2)	=	6.452	cm^2
1 square foot (ft^2)	=	0.093	m^2
1 square yard (yd^2)	=	0.836	m^2
1 acre = 4840 yd^2	=	0.404	hectare

Volume

1 cubic inch (in^3)	=	16.39	cm^3
1 cubic foot (ft^3)	=	0.0283	m^3
1 cubic yard (yd^3)	=	0.765	m^3

Speed and M.P.G.

60 miles/ hour (m.p.h.) = 88 ft/ sec	=	96.6	km/h
1 knot = 1 nautical mile/ hour	=	1.85	km/h
30 miles/ gallon	=	10.6	km/litre
		(9.4 litre / 100 km)	

Thermometer

Fahrenheit	*Centigrade*
212	100
194	90
176	80
158	70
140	60
122	50
113	45
107.6	42
105.8	41
104.0	40
102.2	39
100.4	38
98.6	37
96.8	36
95	35
86	30
77	25
68	20
59	15
50	10
41	5
32	0
23	−5
14	−10

APPENDIX 3

ABBREVIATIONS

ab init. (ab initio)	– from the beginning
abbr.	– abbreviate; abbreviation
ad inf. (ad infinitum)	– to infinity
adj	– adjugate of a matrix
alt	– altitude
an. (ante)	– before
app.	– appendix
approx.	– approximate(ly)
arg	– argument
at. ppm	– atomic parts per million
atm	– atmosphere
AU	– astronomical unit
c. / cca (circa)	– about, around, approximately
c.c.	– complex conjugate
calc	– calculated (in subscript)
Card	– cardinality of a set
cdf	– cumulative distribution function
cf. (conferre)	– compare to, see also
Cl	– topological closure
cm^3	– cubic centimetre
cod / codom	– codomain
coeff	– coefficient (in subscript)
colog	– cologarithm
const	– constant
cu	– cubic
curl / rot	– curl of a vector field
dB, dBm	– decibel
defn	– definition
deg	– degree
det	– determinant
dev	– deviation
diam	– diameter
dim	– dimension of a vector space
div	– divergence
DNE	– a solution for an expression does not exist, or is undefined. Generally used with limits and integrals.
dom	– domain of a function
dtto (detto)	– the same

e, exp	– exponential
e.g. (exempli gratia)	– for example
e.u.	– electron unit
emf, EMF	– electromotive force
Eq. (pl. – Eqs)/Eqn	– equation
et al. (et alii)	– and the others
etc. (et cetera)	– and so on
eu	– entropy unit
expr	– expression
ext	– exterior
F	– Faraday constant
f. (pl. – ff.)	– following
fcn	– function
Fig. (pl. – Figs.)	– figure
FOL	– first-order logic
G	– gauss
G	– gravitational constant
gcd	– greatest common divisor of two numbers
glb	– greatest lower bound
grad	– gradient of a scalar field
h	– Planck constant
hcf	– highest common factor of two numbers
i.d.	– inside diameter
i.e. (id est)	– that is, in other words
ib., ibid. (ibidem)	– in the same place
iff	– if and only if
Im	– *either* image of a function *or* imaginary part of a complex number
inc.	– included, including
ineq	– inequality
inf	– infimum of a set
int	– interior
iq (idem quod)	– the same as
ir, IR	– infrared
K	– degrees Kelvin
kbar	– kilobar
Ker	– kernel
l.c./ loc. cit. (loco citato)	– in the passage quoted
lb	– pound
lcm	– lowest common multiple of two numbers
lg	– common or binary logarithm

LHS	–	left-hand side of an equation
Li	–	offset logarithmic integral function
li	–	logarithmic integral function or linearly independent
lim	–	limit of a sequence, or of a function
lim inf	–	limit inferior
lim sup	–	limit superior
ln	–	natural logarithm
log	–	logarithm
logh	–	natural logarithm
lub/ sup	–	least upper bound
max	–	maximum of a set
min	–	minimum
min	–	minute
min	–	minimum of a set
mod	–	modulo
mol	–	mole
mx	–	matrix
No (numero)	–	number
NOR	–	not-or in logic
o.d.	–	outside diameter
op. cit. (opere citato)	–	in the work cited
opn	–	operation
ord	–	ordinal number
p.a. / pa / per an. per annum)	–	yearly
p.c. (per cent)	–	percent
pf	–	proof
ppm	–	parts per million
Pr	–	probability of an event
pro tem. (pro tempore)	–	for the time being
psi	–	pounds per square inch
q.v. (quod vide)	–	which see, go and look it up if you are interested
qe (quod est)	–	which is
QED (Quod erat demonstradum)	–	used at the end of a definitive proof
QEF (Quod erat faciendum)	–	used at the end of a construction
ran	–	range of a function
Re	–	real part
Re	–	real part of a complex number
resp	–	respectively
RHS	–	right-hand side of an equation
Rk	–	rank
rms	–	root-mean-square

rpm	– revolutions per minute
RTP	– required to prove
s, sec	– second
Soln	– solution
Sp	– linear span of a set of vectors
sq	– square
st	– such that or so that
STP	– (it is) sufficient to prove
sup	– supremum of a set
TFAE	– the following are equivalent
Thm / thm	– theorem
tot	– total (in subscript)
TP	– temperature-pressure
u	– atomic mass unit
v. (vide)	– see
v.s. (vide supra)	– see above
v.v. (vice versa)	– vice versa/ in the opposite order
viz (videlicet)	– namely, that is to say
vs. (versus)	– against, in contrast to
walog	– without any loss of generality
wff	– well-formed formula
wlog	– without loss of generality
WMA	– we may assume
WO	– well-ordered set
wrt	– with respect to/ with regard to
WTP	– want to prove
WTS	– want to show
XOR	– exclusive or (in logic)

APPENDIX 4

ENGLISH - CZECH DICTIONARY

A		
abscissa (pl. absissae)	[æb'sisə/ əb'sisi:]	úsečka; souřadnice
add	[æd]	přičíst
addition	[ə'dišən]	sčítání
adjacent	[ə,džeisənt]	přilehlý
algebra	[ældžibrə]	algebra
algebraic	[ældži'breik]	algebraický
altitude	[æltitju:d]	výška Δ
analogous	[ənæləgəs]	analogický; obdobný
angle: acute	[æŋgl]: [ə'kju:t]	úhel: ostrý
adjacent	[ə'džeisənt]	přilehlý
alteranate	[o:l'tə:nət]	střídavý, protilehlý
corresponding	[kori'spondiŋ]	shodný, souhlasný
complementary	[,kompli'mentəri]	doplňkový
exterior	[ek'stiəriə]	vnější
fixed (to the ground)	[fikst]	pevný; konstantní
interior	[in'tiəriə]	vnitřní
obtuse	[əb'tju:s]	tupý (>90°, >180°)
opposite	[opəzit]	protilehlý
reflex	[rifleks]	tupý (>180°)
supplementary	[,sapli'mentəri]	výplňkový
angular	[æŋgjulə]	úhlový
annulus (pl. annuli)	[ænjuləs/ ænjulai]	mezikruží
apex (pl. apices)	[eipeks/ eipisi:z]	vrchol Δ; špička
arc	[a:k]	oblouk
area	[eəriə]	obsah
arithmetic mean	[ə'riθmetic mi:n]	aritmetický průměr
arithmetic progression	[ə'riθmetic prəu'grešən]	aritmetická posloupnost
assertion	[ə'sə:ršən]	tvrzení
assignment	[ə'sainmənt]	převedení; převod; připsání
assume	[ə'sju:m]	domnívat se
assumption	[ə'sampšən]	domněnka
asymptote	[æsimptəut]	asymptota
average	[ævəridž]	průměr; průměrný, střední
axis (pl. axes)	[æksis/ æksi:s]	osa
B		
base	[beiz]	základna
braces	[breisiz]	závorky
C		
calculate	[kælkjuleit]	vypočítávat, vykalkulovat
calculation	[kælkju'lejšən]	kalkulace; výpočet
calculus	[kælkjuləs]	infinitezimální počet (integrální a diferenciální počet)

cell	[sel]	buňka
centre of gravity		těžiště
centroid	[sentroid]	těžiště
chord	[ko:d]	tětiva
circle	[sə:kl]	kružnice, kruh
circumference	[sə'kəmfərəns]	obvod kružnice
circumscribe	[sə:kəmskraib]	opsat kružnici, křivku
coefficient	[kəui'fišənt]	součinitel; koeficient
compasses	[kampəsiz]	kružítko
conclusion	[kən'klu:žən]	závěr
cone	[kəun]	kužel
congruence	[koŋgruəns]	shoda
congruent	[koŋgruənt]	shodný, souhlasný
conic section	[konik sekšən]	kuželosečka
conjectural	[kən'džekčərəl]	konjekturální
conjecture	[kən'džekčə]	dohad
consequence	[konsikwəns]	důsledek
constant	[konstənt]	konstanta; konstantní, stálý
continuity	[konti'njuəti]	spojitost
continuous	[kən'tinjuəs]	spojitý;
converge	[kən'və:dž]	sbíhat se, konvergovat
convergence	[kən'və:džəns]	konvergence
convex	[kon'veks]	konvexní
convexity	[kon'veksəti]	konvexita; vypuklina
coordinate	[kəu'o:dnət]	souřadnice
corollary	[kə'roləri]	důsledek; výsledná věta
cosec	[kəusek]	kosekant (zkr.)
cosecant	[kəu'si:kənt]	kosekant
cosine	[kəusain]	kosinus
cot	[kot]	kotangens
cotangent	[kəu'tændžənt]	kotangens
counterexample	[kauntəig'za:mpl]	protipříklad
cube	[kju:b]	krychle
curvature	[kə:vəčə]	zakřivení
curve	[kə:v]	křivka
cylinder	[silində]	válec
cylindrical	[si'lidrikəl]	válcový, válcovitý
D		
decagon	[dekəgən]	desetiúhelník
decimal point	[desiml point]	desetinná tečka
deductive	[di'daktiv]	deduktivní; co lze odvodit
definite	['definət]	určitý; definitní
definition	[defi'nišən]	definice
denominator	[di'nomineitə]	jmenovatel
– reduce to a common denominator		– převést na společného jmenovatele
derivation	[deri'veišən]	odvození; derivace množiny

derivative	[di'rivətiv]	derivace (1., 2. ... řádu)
derive (from)	[di'raiv]	odvodit (z)
determine	[di'tə:min]	určit
diagonal	[dai'ægənəl]	úhlopříčka
diameter	[dai'æmitə]	průměr
difference	[difərəns]	rozdíl
differential	[difə'renšəl]	diferenciální, diferenciál
differentiable: be ~	[difə'renšiəbl]	mít derivaci
differentiate	[difə'renšieit]	derivovat
differentiation	[difərenši'eišən]	derivace (opak integrování)
dimension	[di'menšən]	rozměr
diminish from	[diminiš]	odečíst od
diophantine approximation	[daiə'fæntin əproksi'meišən]	diofantická aproximace
direction	[di'rekšətn/ dai' rekšətn]	směr
directrix	[di'rektris/ dai' rektris]	řídicí přímka
discourse	[dis'ko:s/ disko:s]	výklad; přednáška; diskurz
distance	[distəns]	vzdálenost
distinct	[distinkt]	odlišný
dividend	[dividend]	dělenec
divisibility	[divizi'biləti]	dělitelnost
division	[di'vižən]	dělení
divisor	[di'vaizə]	dělitel
dodecahedron (pl. dodecahedra)	[dəudikə'hedrən/ dəudikə'hedrə]	dvanáctistěn, dodekaedr
domain	[də'mein]	definiční obor
E		
eccentricity	[eksən'trisəti]	excentricita; výstřednost
ellipse	[i'lips]	elipsa (v geometrii)
ellipsis (pl. ellipses)	[i'lipsiz/~i:z]	elipsa, výpustka (v jazyce)
equation	[i'kweišən/ i'kweižən]	rovnice
equidistant (from)	[i:kwi'distənt]	stejně vzdálený (od)
equilateral	[i:kwi'lætərəl]	rovnostranný
evaluate	[i'væljueit]	vyčíslit
evolution	[i:və'lu:šən]	odmocňování
example	[ig'za:mpl]	příklad
experiment	[ik'sperimənt]	pokus
experimentation	[eksperimen'tejšən]	experimentování; zkoušení
exponent	[ek'spəunənt]	exponent, mocnitel
expression	[ik'sprešən]	výraz; vyjádření
extremum (pl. extrema)	[ek'streməm]	extrém
local ~	[ləukəl ~]	lokální
~ problem	[ek'streməm probləm]	úloha o extrémech
F		
face	[feis]	stěna, strana (geom.)
factor	[fæktə]	činitel (mat.)
factorial	[fæk'to:riəl]	faktoriál; faktoriálový
factorization	[fæktərai'zeišən]	rozkládání v součin

finite	[fainait]	konečný
focus	[fəukəs]	ohnisko
force: constant ~	[fo:s konstənt]	síla: stálá; konstantní
horizontal ~	[hori'zontl]	horizontální
vertical ~	[və:tikl]	vertikální
formula (pl. formulae; -as)	[fo:mjulə/ ~li:/ ~ləs]	vzorec
fraction: decimal ~	[frækšən: desiməl	desetinné číslo
fraction: parcial ~	[frækšən pa:šəl]	zlomek parciální
proper ~/ improper ~	[propə/ im'propə]	pravý / nepravý
vulgar ~	[valgə]	obyčejný
friction	[frikšən]	tření
function: bounded	[fankšən: baundid]	funkce: omezená
convex	[kon'veks]	konvexní, vypuklá
rational	[ræšənəl]	racionální
continuous	[kən'tinjuəs]	spojitá
differentiable	[difə'renšiəbl]	mající derivaci
G		
geometry	[dži'omitri]	geometrie
graph	[græf]	graf; diagram; grafické znázornění
gravity	[grævəty]	přitažlivost (zem.); gravitace
guesswork	[geswə:k]	hádání (ve snaze uhodnout)
H		
heptagon	[heptəgən]	sedmiúhelník
hexagon	[heksəgən]	šestiúhelník
hexahedron (pl. hexahedra)	[heksə'hedrən/~rə]	šestistěn
hold (for sth)	[həuld]	platit (pro co)
honeycomb	[hanikəum]	plástev medu
hypothesis (pl. hypotheses)	[hai'poθisis/~si:z]	hypotéza; předpoklad
hypothesize [hai'poθisaiz]	[hai'poθisaiz]	formulovat předpoklad
hypothetical	[,haipəu'θetikəl]	hypotetický
I		
icosahedron (pl. icosahedra)	[aikəsə'herən/~rə]	dvacetistěn, ikosaed
incentre	[insentə]	střed kružnice vepsané
induction	[in'dakšən]	indukce
infinite	['infinət]	nekonečný
infinity	[in'finiti]	nekonečno
integer: positive	[inti:džə: pozətiv]	celé číslo: kladné
integral	[intigrəl]	integrál
intercept	[intəsept]	souřadnice průsečíků grafu funkce s osami soustavy souřadnic
intersect	[intə'sekt]	protínat
intersection	[intə'sekšən]	průnik; průsečík
interval: closed	[intəvəl: kləuzd]	interval uzavřený
open	[əupən]	otevřený
unit	[ju:nit]	jednotkový
involution	[invə'lu:šən]	umocňování
isosceles	[ai'sosili:z]	rovnoramenný

K		
kite	[kait]	deltoid
L		
lateral	[lætərəl]	postranní
line: horizontal	[lain: hori'zontl]	přímka: vodorovná
parallel	[pærəlel]	rovnoběžná, souběžná
real	[riəl]	reálná
slanting	[sla:ntiŋ]	šikmá
straight	[streit]	přímka
vertical	[və:tikl]	svislá, vertikální
locus	[ləukəs]	geometrické místo
M		
magnitude	[mægnitju:d]	velikost
mathematical	[mæθi'mætikəl]	matematický
mathematician	[mæθimə'tišən]	matematik
mathematics/ maths	[mæθi'mætiks/ mæθs]	matematika
mean	[mi:n]	průměr; střední hodnota
median	[mi:djən]	těžnice; středový, střední
minuend	[minjuənd]	menšenec
multiple	[maltipl]	násobek
multiply	[maltiplai]	násobit
N		
notion	[nəušən]	pojem
nought	[no:t]	nula
nucleous (pl. nucleoli)	[nju:kliolәs/ nju:kliolai]	jadérko
number: complex	[kompleks]	číslo: komplexní
composite	[kompəzit]	složené
even	[i:vn]	sudé
finite	[fainait]	konečné
irrational	[i'ræšənəl]	iracionální
odd	[od]	liché
natural	[næčərəl]	přirozené
negative	[negətiv]	záporné
positive	[pozətiv]	kladné
rational	[ræšənəl]	racionální
real	[riəl]	reálné
serial	[siəriəl]	řadové
numerator	[nju:məreitə]	čitatel
O		
oblique line	[ə'bli:k lain]	křivka
obtuse	[əb'tju:s]	tupý
octagon	[oktəgən]	osmiúhelník
octahedron (pl. octrahedra)	[oktə'hedrən/ oktə'hedrə]	osmistěn
one-variable setting		jedna proměnná
opposite	[opəzit]	protilehlý
orthogonal	[o:'θogənəl]	kolmý, pravoúhlý
P		
parallelogram [pærə'leləgræm]		rovnoběžník
parenthesis (pl. parantheses)	[pə'renθisis/~si:z]	kulaté závorky

pentagon	[pentəgən]	pětiúhelník
perimeter	[pə'rimi:tə]	obvod, délka obvodu
period	[piəriəd]	perioda
perpendicular (to)	[pə:pən'dikjulə]	kolmý (k), svislý
physicist	[fizisist]	fyzik
physics	[fiziks]	fyzika
plane (geometry)	[plein]	rovinná, v rovině
point	[point	bod; desetinná tečka
~ of origin	[əv oridžin]	střed kružnice
~ of intersection	[əv intəsekšən]	průsečík
corresponding ~	[kori'spondiŋ]	odpovídající
critical ~	[kritikəl]	kritický; nulový
polygon	[poligən]	mnohoúhelník, polygon
polyhedron (pl. polyhedra)	[poli'hedrən/ ~rə]	mnohostěn
polynomial	[poli'nəumiəl]	mnohočlen, polynom
positive integer	[pozətiv inti:džə]	přirozené číslo
power	[pauə]	mocnina
power exponent	[pauə 'eksponent]	mocnítko
premise	[premis]	předpoklad; premisa
prime	[praim]	prvočíslo
principle	[prinsəpl]	zásada; pravidlo; princip
prism	[prizm]	hranol, prizma
prismatic	[prizmætik]	hranolovitý
procedure	[prə'si:džə]	postup; pochod; způsob práce
proceed	[prə'si:d]	postupovat (dále)
product	[prodəkt]	součin; průnik
proof	[pru:f]	důkaz
proportional	[prə'po:šənl]	úměrný
protractor	[prə'træktə]	úhloměr
prove	[pru:v]	dokázat
pyramid	[pirəmid]	jehlan
Q		
quadrilateral	[kwodri'lætərəl]	čtyřúhelník; čtyřstěn
quantifier	[kwontifaiə]	kvantifikátor
quantify	[kwontifai]	měřit; vyjadřovat kvantitativně
quantity	[kwontəti]	množství, veličina
quotient	[kwəušənt]	podíl, kvocient
R		
radical	[rædikəl]	odmocnina
radicand	[rædikənd]	základ odmocniny, odmocněnec
radius (pl. radii)	[reidjəs/ reidiai]	poloměr
rapidity	[rə'pidəti]	rychlost
ratio	[reišiəu]	poměr, úměra
ray	[rei]	polopřímka; paprsek
rectangle	[rek'tæŋgəl]	obdélník, pravoúhlý čtyřúhelník

reflection	[ri'flekšən]	osová souměrnost; obraz,
remainder	[ri'meində]	zbytek
resistance: air ~	[ri'zistəns]	odpor vzduchu
rhombic	[rombik]	kosočtvercový, kosodélníkový
rhomboid	[romboid]	kosočtvercový, kosodélníkový
rhomboidal	[rom'boidəl]	kosočtvercový, kosodélníkový
rhombus (pl. rhombi)	[rombəs/ rombai]	kosočtverec
root	[ru:t]	odmocnina
root sign	[ru:t sain]	odmocnítko
rotation	[rəu'teišən]	rotace, otáčení
rule	[ru:l]	pravidlo; předpis
S		
scalar	[skeilər]	skalár
secant	[si:kənt]	sečna; sekans
sector	[sektə]	výseč
segment	[segmənt]	úsečka; kruhová úseč; část
semi-circle	[semi'sə:kl]	půlkruh
sequence	[si:kwens]	posloupnost
series (sg. and pl.)	[si: əri:z]	řada
set	[set]	množina
sine	[sain]	sinus
sphere	[sfiə]	koule
spheric harmonics	[sferik ha:'moniks]	sférické harmoniky / sférické harmonické funkce
spherical	[sferikəl]	kulatý, kulovitý, sférický
square	[skweə]	čtverec, druhá mocnina
subscript	[səb'skript]	dolní index
subsequence	[sabsikwəns]	podposloupnost
subset	[səbset]	podmnožina
substitute	[sabstitju:t]	nahradit
subtract from	[səb'trækt]	odečíst od
subtraction	[səb'trækšən]	odčítání
subtrahend	[sabtrəhend]	menšitel
sum	[sam]	součet, suma
summand	[səma:nd]	sčítanec
superscript	[sju:pəskript]	horní index
T		
tangent	[tændžənt]	tečna; tangens
technique	[tek'ni:k]	postup
tetrahedron (pl. tetrahedra)	[tetrə'hedrən/ tetrə'hedrə]	čtyřstěn, traedr
theorem	[θiərəm]	věta; teorém; rovnice; vzorec
transform	[træns'fo:m]	transformovat, zobrazit
translation	[træns'leišən]	translace, posunutí
transversal	[trænz'və:səl]	příčka, transversála
trapezium	[trə'pi:zjəm]	různoběžník
trial	[traiəl]	zkouška; pokus

trial-and-error method	['trailənd'erə'meθəd]	metoda pokusů a chyb
trigonomeric	[traigənə'metrik]	trigonometrický
truncated	[traŋ'keitəd]	komolý, seříznutý
U		
union (of sets)	[juniən]	sjednocení (množin)
uniqueness	[ju:'ni:knis]	jedinečnost
unit interval	[ju:nit intəvəl]	jednotkový interval
unknown	[an'noun]	neznámá
V		
variable	[veəriəbl]	proměnná
vector	[vektə]	vektor
verify	[verifai]	ověřit; verifikovat
vertex (pl. vertices)	[və:teks/ və:tisi:z]	vrchol
volume	[voljum]	objem
vortex (pl. vortices)	[vo:teks/ vo:tisi:z]	vír, víření
Z		
zero	[ziərə]	nula