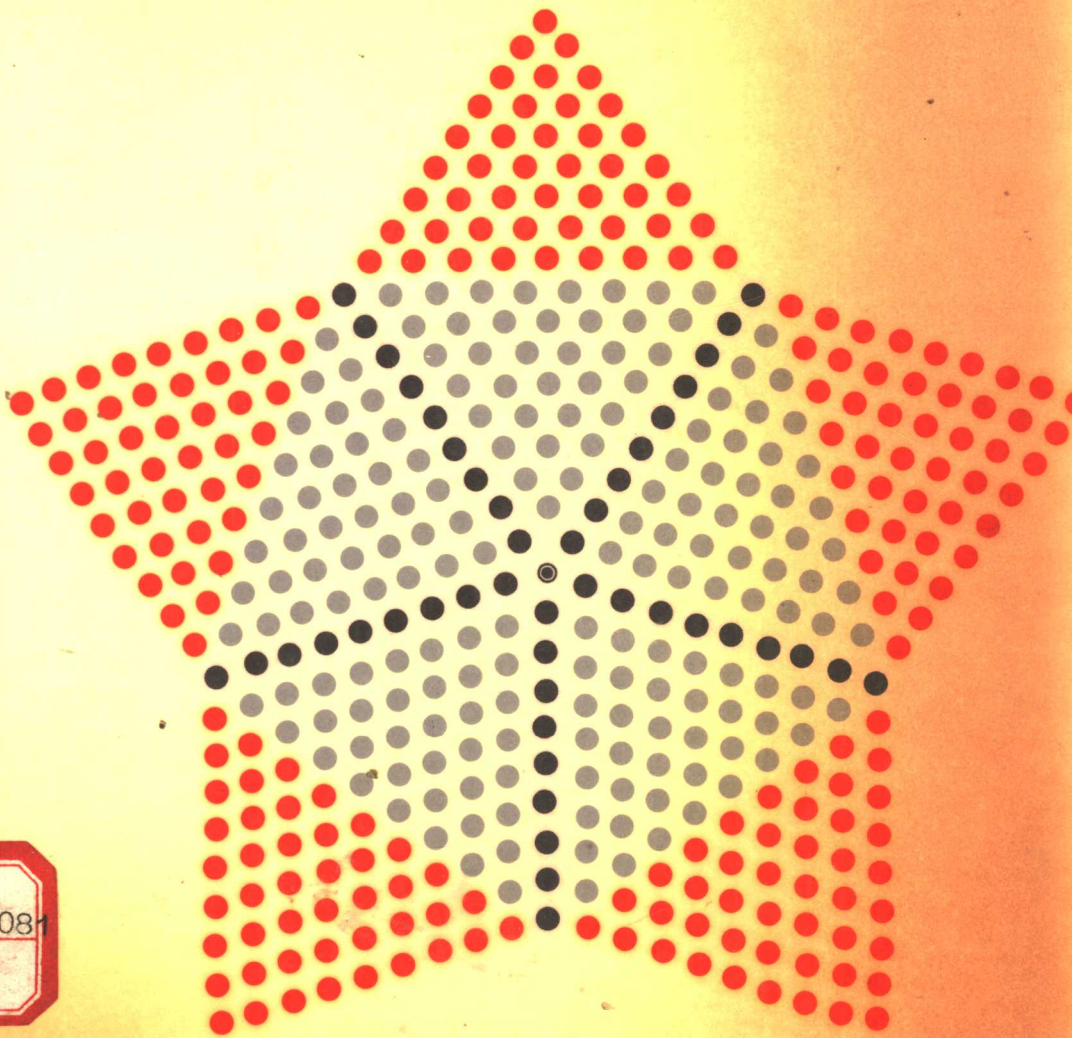
NUCLEUS

English for Science and Technology

MATHEMATICS

David Hall

with Tim Bowyer



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ENGLISH FOR SCIENCE AND TECHNOLOGY

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David Hall

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Tim Bowyer

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D.H.

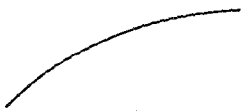
Contents

Unit 1 Properties and Shapes

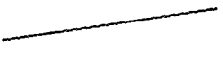
Section 1 Presentation

1. Look and read:

Lines



a curved line
a curve



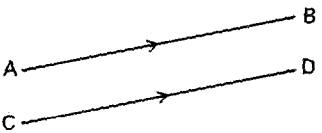
a straight line

a point

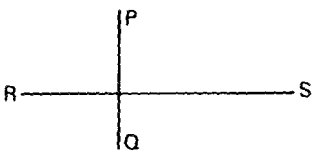
a vertical line

a horizontal line

an oblique line

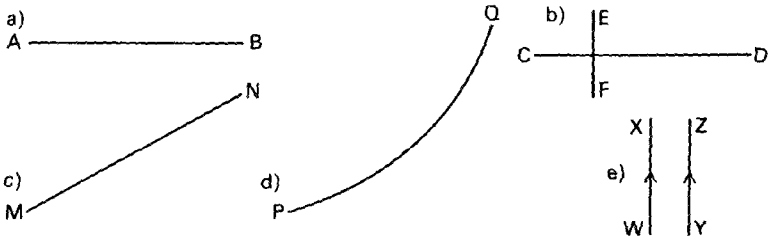


These are parallel lines.
AB is parallel to CD



These are perpendicular lines.
PQ is perpendicular to RS

Now describe the following lines:



2. Look at these Greek letters:

α	π	δ	β	θ	ϕ
alpha	pi	delta	beta	theta	phi

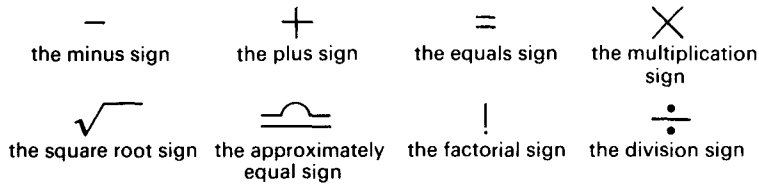
Now answer these questions:

a) Which letter has two parallel vertical lines and one horizontal line?
b) Which letter has one curved line and a horizontal line?
c) Which letter has one curved line and a vertical line?
d) Which letters have one curved line?
e) Which letter has one straight line and two curved lines?

3. Describe these capital letters:

a) H b) K c) O d) M e) U

4. Look at these mathematical signs:

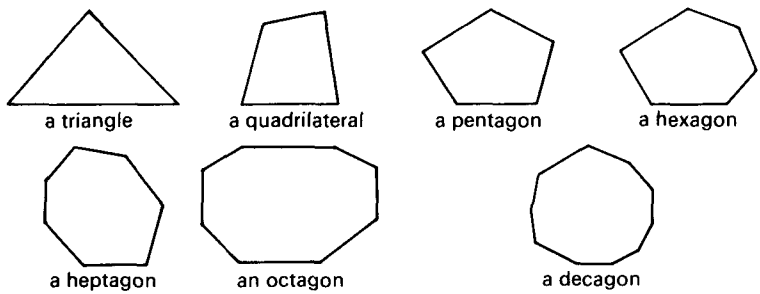


Write sentences about these signs:

Example: The minus sign has one horizontal line.

5. Look at these figures:

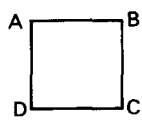
Plane figures



A triangle has three sides and three angles.
A triangle is a three-sided figure.

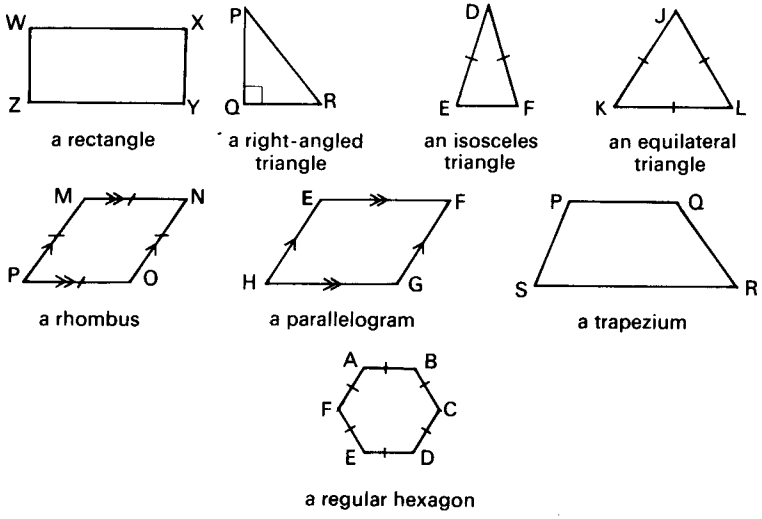
Now make similar statements about the other figures.

6. Look and read:



ABCD is a square.
It is a four-sided figure.
All its sides are equal.
All its angles are right angles.
Opposite sides are parallel.

Now describe these figures:



7. Look at these examples:

- A square is a kind of rectangle, but not all rectangles are squares.
- A right-angled triangle is a kind of triangle, but not all triangles are right-angled.

Now make similar statements about the following:

a) rhombus; parallelogram
b) parallelogram; trapezium
c) isosceles triangle; triangle
d) isosceles triangle; equilateral triangle
e) rectangle; plane figure

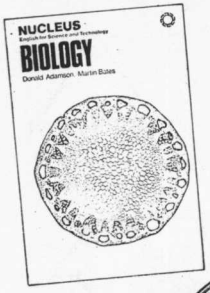
8. Look and read:

- All the sides of an equilateral triangle are equal, and so are those of a rhombus.
- Opposite sides of a parallelogram are parallel and so are those of a regular hexagon.

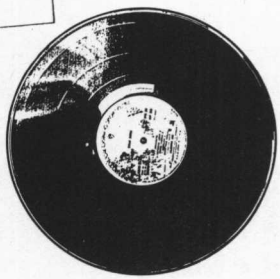
Now complete the following sentences:

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 the sides of a regular hexagon are equal, and so are .....
d) All the sides of an equilateral triangle .....
e) All the angles of an equilateral triangle .....

9. Look at these examples:



- The cover of this book is shaped like a rectangle. It is rectangular.

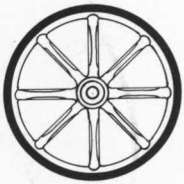


- A record is shaped like a circle. It is circular.

Now use this table to write sentences about the objects below:

circle	– circular	pentagon	– pentagonal
semi-circle	– semi-circular	hexagon	– hexagonal
triangle	– triangular	octagon	– octagonal
rectangle	– rectangular	heptagon	– heptagonal
square	– square		etc.

a)

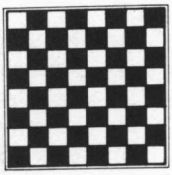


a wheel

b)

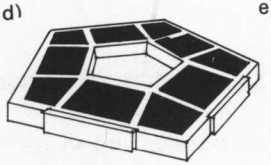
a road sign

c)



a chessboard

d)



The Pentagon in Washington

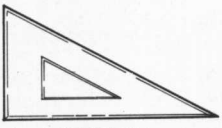
e)

a British 1p coin

f)

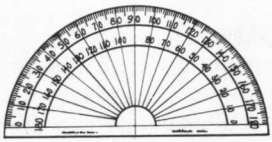
a British 50p coin

g)



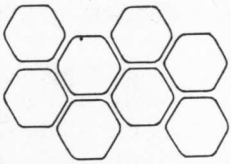
a setsquare

h)



a protractor

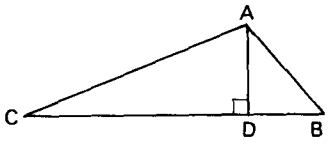
i)



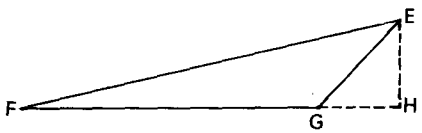
a honeycomb cell

Section 2 Development

10. Look and read:

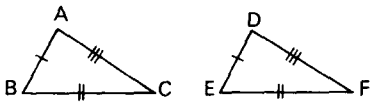


AD is an altitude of the triangle.
BC is the base.
What is the area of △ ABC?

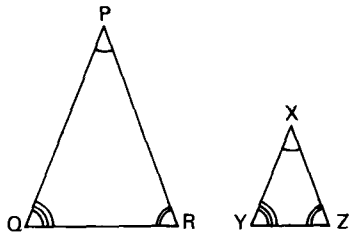


AD is equal to EH and BC is equal to FG.
The altitudes of the two triangles are equal and so are the bases.
Therefore the areas are the same.
△ ABC has the same area as △ EFG.

Now describe the following pairs of triangles:

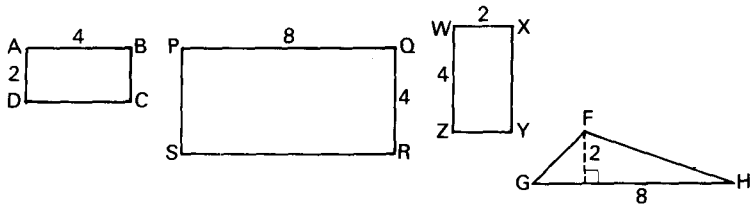


congruent triangles

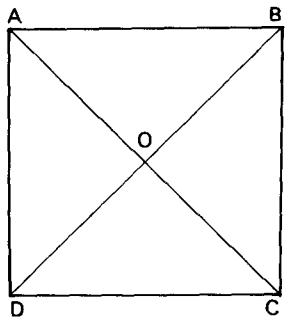


similar triangles

11. Compare these figures, saying whether they are congruent, similar or have the same area:



12. Look and read:



In square ABCD, the diagonals intersect at 0.

OA = OC and OD = OB. The diagonals bisect each other.

$\widehat{AOB} = 90°$. The diagonals intersect at right angles.

$\widehat{DAO} = \widehat{BAO}$. The diagonals bisect the angles.

AC = BD. The diagonals are equal.

AB = DC. The opposite sides are equal.

AB//DC. The opposite sides are parallel.

Now complete these tables:

	Opposite sides equal	Opposite sides parallel	Diagonals bisect each other	Diagonals bisect angles	Diagonals intersect at right angles	Diagonals equal
Square	✓	✓	✓	✓	✓	✓
Rhombus						
Parallelogram						
Trapezium						
Regular hexagon						

	Angles equal	Sides equal	Areas equal
Congruent figures			
Similar figures			

13. Look and read:

The opposite sides of a square are equal and parallel. The diagonals bisect each other at right angles and also bisect the angles. Also, the diagonals are equal.

Now write similar paragraphs about a rhombus, a parallelogram, a trapezium, a regular hexagon, and congruent and similar figures, using the information in the above table.

14. Look and read:

The diagonals of a rhombus are not equal unless the rhombus is a square.

Now complete the following sentences:

a) The diagonals of a parallelogram do not bisect the angles unless .....
b) The diagonals of a parallelogram are not equal unless .....
c) The diagonals of a trapezium do not bisect each other unless .....
d) The sides of two similar triangles are not equal unless .....

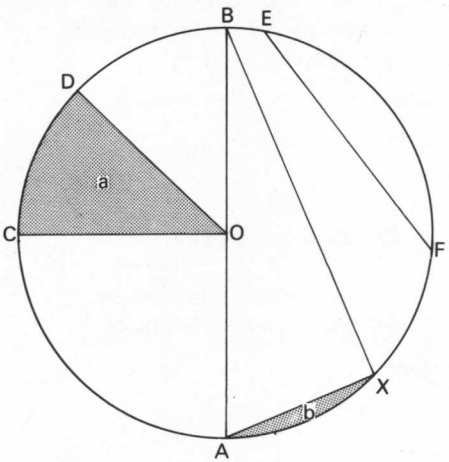
Section 3 Reading

15. Read this:

The circle

A circle is a plane geometric figure. The side of a circle is called the circumference. All the points on the circumference of a circle are equidistant from the centre. A straight line which is drawn from the centre of a circle to its circumference is called a radius. All the radii of a circle are equal. The area between two radii is called a sector. A straight line drawn between one part of the circumference and another is known as a chord. A chord separates a circle into two segments and the circumference into two arcs. A chord which passes through the centre of a circle is called a diameter.

Name the following parts of the diagram:



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

Now answer these questions:

h) What are the properties of any triangle ABX with AB as its base and X as a point on the circumference? (see diagram).
i) When is a sector also a segment?

16. Say whether the following statements are true or false. Correct the false statements.

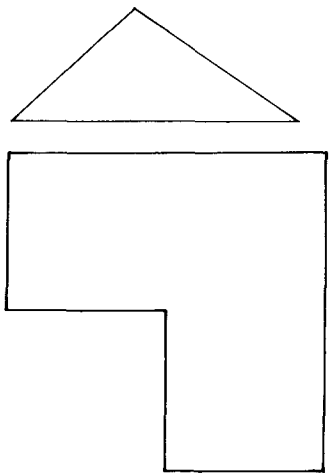
a) A chord is a curved line.
b) The radius of a circle is half the length of its diameter.
c) A closed curve where all points on the curve are equidistant from the centre is called a circle.
d) A sector has three sides – two chords and an arc.

Section 4 Listening

17. Listen to the passage and draw the diagram. Then answer the following questions:

a) Name three figures in the diagram which have the same area as ABCD.
b) How many right-angled triangles are there in the diagram?
c) How many pairs of non-congruent similar triangles are there in the diagram?
d) How many trapeziums are there in the diagram?
e) How many quadrilaterals which are neither parallelograms nor trapeziums are there in the diagram?
f) Which triangle has the same area as $\triangle ACD + \triangle DGF$?

18. PUZZLE



a) Divide this triangle into three figures with equal areas, using two straight lines.

b) Divide this figure into:
i) two congruent figures
ii) three congruent figures
iii) four congruent figures

Unit 2 Location

Section 1 Presentation

1. Look at this:

Angles

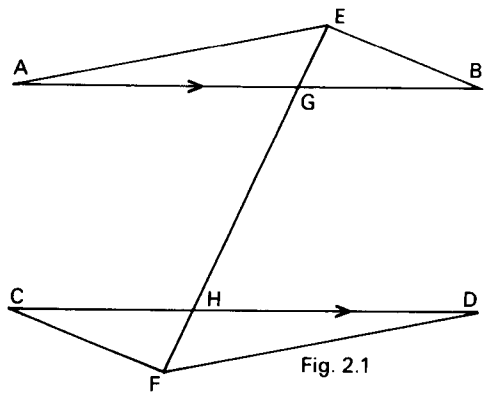


Fig. 2.1

Now describe Figure 2.1.

(**Note:** EF is called a transverse line)

2. Look and read:

$A\hat{G}H = E\hat{G}B$	They are *vertically opposite* angles. (Vert. opp. ∠s)
$A\hat{G}H = C\hat{H}F$	They are *corresponding angles.* (Corr. ∠s)
$A\hat{G}H = G\hat{H}D$	They are *alternate* angles. (Alt. ∠s)
$A\hat{G}H + A\hat{G}E = 180°$	They are *adjacent angles on a straight line.* (Adj. ∠s)
$A\hat{G}H + C\hat{H}G = 180°$	They are *interior angles on the same side of the transverse line.* (Int. ∠s)
$A\hat{G}H = E\hat{A}G + A\hat{E}G$	The *exterior angle* of a triangle equals the sum of the *interior opposite angles.* (Ext. ∠ of △)

Now make similar statements about $E\hat{G}B$:

Find other angles in the diagram which are equal and say why.
If EB is equal and parallel to CF, compare △CHF and △EGB.
Give reasons for what you say.

3. Look and read:

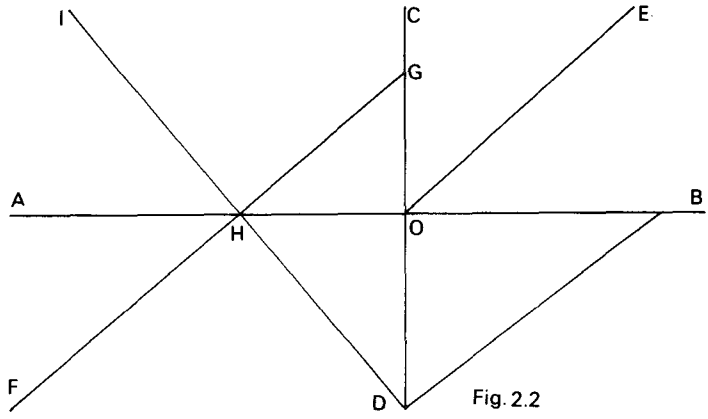


Fig. 2.2

In Figure 2.2, AB is perpendicular to CD
OE bisects $\widehat{COB}$
DI bisects $\widehat{OHF}$
FG//OE//DB

Look at these examples:

OE bisects $\widehat{COB}$ (Given)
$\therefore \widehat{COE} = 45°$
$\widehat{ODB} = \widehat{COE} = 45°$ (Corr. $\angle$s)

Now complete the following statements in the same way:

a) OE bisects $\widehat{COB}$ (_____) $\therefore \widehat{EOB}$ .....
b) $\widehat{OBD} = \widehat{EOB}$ .....
c) $\widehat{AHF} = \widehat{OBD}$ .....
d) $\widehat{OHF} + \widehat{AHF}$ .....
e) $\therefore \widehat{OHF} =$ _____
f) DI bisects $\widehat{OHF}$ _____
g) $\therefore \widehat{AHI} = \widehat{GHI} =$ _____
h) $\widehat{OHD} = \widehat{AHI}$ .....
i) $\widehat{AOD} =$ _____
j) $\therefore \widehat{ODH} =$ .....

4. Answer these questions about Figure 2.2:

a) Which triangles are similar?
b) How many isosceles triangles are there in the diagram?
c) Produce EO to meet DH at J. Describe $\triangle$OHJ.

5. Look and read:

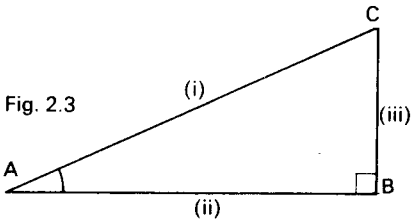


Fig. 2.3

In a right-angled triangle, the side opposite the right angle is called the hypotenuse.

a) Complete this statement of Pythagoras's Theorem.
The square of the ..... is equal to the sum of the .....
b) Label the three sides of △ABC in Figure 2.3, in relation to $\hat{CAB}$, using the words *hypotenuse*, *opposite* and *adjacent*.

Complete the following:

c) tangent = $\frac{\text{opposite}}{\text{adjacent}}$
d) $\tan CAB =$
e) sine =
f) $\sin CAB =$
g) cosine =
h) $\cos CAB =$

6. Look and read:

Inscribed and circumscribed figures

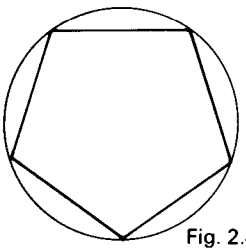


Fig. 2.4

Figure 2.4 shows a circle *circumscribed about* a pentagon. Each vertex of the pentagon lies on the circumference of the circle.

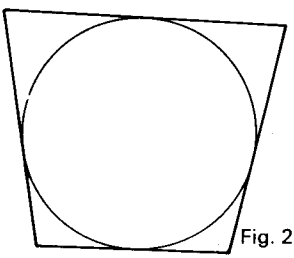


Fig. 2.5

Figure 2.5 shows a circle *inscribed in* a quadrilateral. Each side of the quadrilateral is a *tangent to* the circle.

Write correct sentences from the table:

A circle can be inscribed in	a quadrilateral	in all cases.
A circle can be circumscribed about	a triangle a trapezium	
A circle cannot be inscribed in	a rhombus	unless the sums of the opposite sides are equal.
	a rectangle	unless the sum of the opposite angles is 180°.
A circle cannot be circumscribed about	a square	unless the nonparallel sides are equal.

Section 2 Development

7. Look and read:

Simple matrices

Figure 2.6 shows a simple 5 × 5 matrix.
5 is in the top left-hand corner of the matrix.
15 is immediately below 33.
34 is immediately to the left of 16.
6 is immediately above 24.

$$\begin{pmatrix} 5 & 9 & 33 & 1 & 21 \\ 17 & 23 & 15 & 4 & 27 \\ 34 & 16 & 7 & 3 & 6 \\ 2 & 12 & 18 & 8 & 24 \\ 11 & 14 & 19 & 4 & 13 \end{pmatrix}$$

Fig. 2.6

Describe the position of the following numbers:

21; 6; 13; 7; 11; 23; 9

8. Look and read:

33 is the first element of the third column of the matrix. (Figure 2.6)
34 is the first element of the third row of the matrix.
5 and 33 are the first elements of the first and third columns respectively.
27 and 6 are the last elements of the second and third rows respectively.

Describe the position of these numbers in the same way:

2; 23; 14; 15 and 7; 8 and 4; 8 and 24.

9. Look and read:

$$A\begin{pmatrix}4 & 5\\ 1 & 2\end{pmatrix}$$

$$B\begin{pmatrix}3 & 1\\ 5 & 4\end{pmatrix}$$

Fig. 2.7

4 in matrix A corresponds to 3 in matrix B.

a) What are the other corresponding elements in the two matrices?
b) Explain how to add two matrices.
c) Explain how to multiply two matrices.

Section 3 Reading

10. Read this:

Angles

In plane geometry an angle is a figure which is 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.

Triangles are often named according to their angles. 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.

Now answer the questions:

What kind of angle does a clock make at

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

11. Name the kinds of angle shown in Figure 2.8:

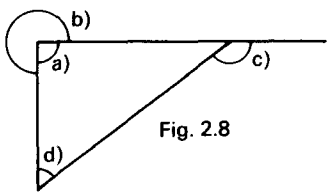


Fig. 2.8