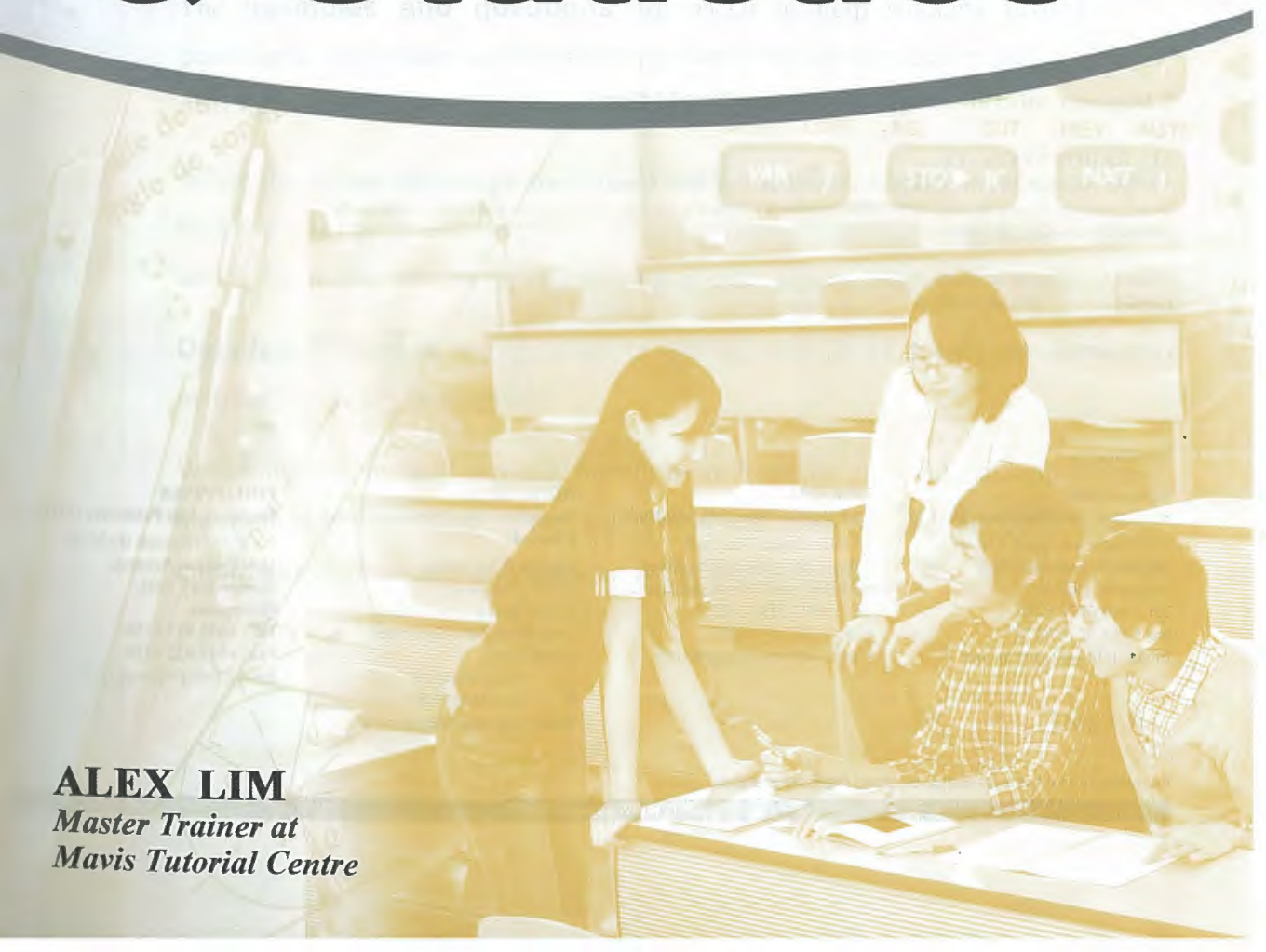




Lower Secondary

Geometry & Statistics

ALEX LIM
*Master Trainer at
Mavis Tutorial Centre*



Geometry

CONTENTS

1	Angles and Triangles	1
2	Polygons	37
3	Construction	65
4	Perimeter and Area	102
5	Surface Area and Volume	142
6	Pyramids	194
7	Cones	244
8	Spheres	279
9	Mensuration Combined	318
10	Congruence and Similarity	353
11	Pythagoras' Theorem	395
12	Trigonometric Ratios	431

Statistics

CONTENTS

13	Simple Statistics	473
14	Histograms	511
15	Dot Diagrams and Stem and Leaf Diagrams	559
16	Mean, Mode and Median	597
17	Probability	635

Solutions

S1 - S127

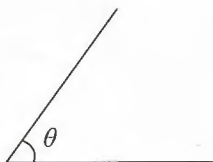
7

Angles and Triangles

Types of angles

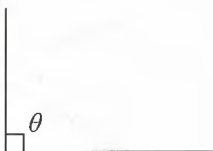
Acute angle

$$0^\circ < \theta < 90^\circ$$



Right angle

$$\theta = 90^\circ$$



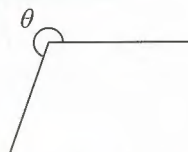
Obtuse angle

$$90^\circ < \theta < 180^\circ$$



Reflex angle

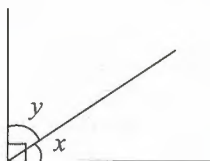
$$180^\circ < \theta < 360^\circ$$



Complementary angle

Complementary angles are angles which add up to 90° .

$$\angle x + \angle y = 90^\circ$$

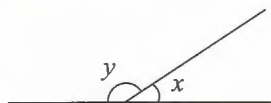


A clue to remember complementary angles: the letter "c" stands for the word "corner".

Supplementary angle

Supplementary angles are angles which add up to 180° .

$$\angle x + \angle y = 180^\circ$$



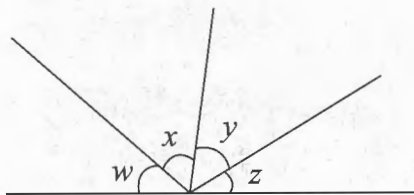
A clue to remember supplementary angles: the letter "s" stands for the word "straight".

Properties of angles

Angles on a straight line

$$\angle w + \angle x + \angle y + \angle z = 180^\circ$$

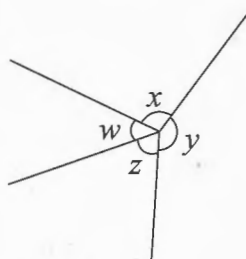
($\angle$ s on str. line)



Angles at a point

$$\angle w + \angle x + \angle y + \angle z = 360^\circ$$

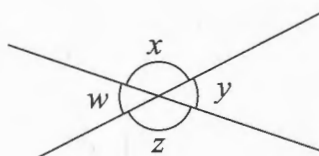
($\angle$ s at a pt.)



Vertically opposite angles

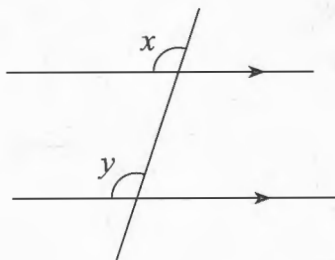
$$\angle w = \angle y \text{ (vert. opp. } \angle\text{s)}$$

$$\angle x = \angle z \text{ (vert. opp. } \angle\text{s)}$$



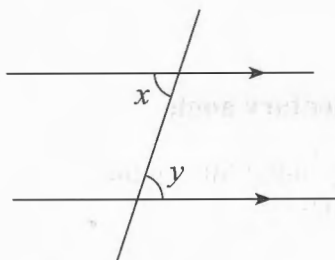
Corresponding angles

$$\angle x = \angle y \text{ (corr. } \angle\text{s)}$$



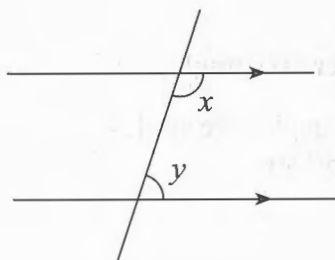
Alternate angles

$$\angle x = \angle y \text{ (alt. } \angle\text{s)}$$



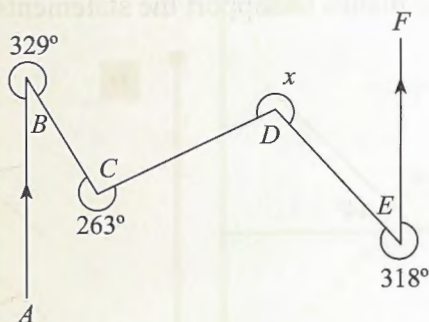
Interior angles

$$\angle x + \angle y = 180^\circ \text{ (int. } \angle\text{s)}$$



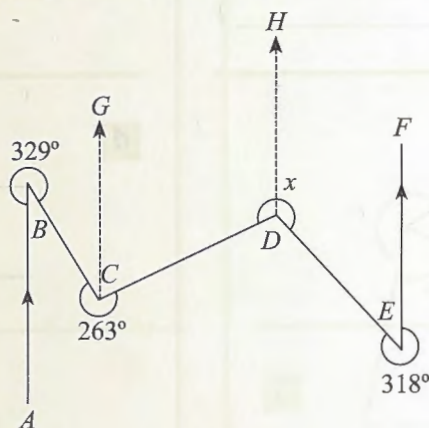
Example 1

Find the value of x .



Solutions:

In similar questions, we draw parallel lines to simplify the questions.



$$\begin{aligned}\angle ABC &= 360^\circ - 329^\circ \text{ (}\angle\text{s at a pt.)} \\ &= 31^\circ\end{aligned}$$

$$\angle BCG = 31^\circ \text{ (alt. } \angle\text{s)}$$

$$\begin{aligned}\angle GCD &= 360^\circ - 263^\circ - 31^\circ \text{ (}\angle\text{s at a pt.)} \\ &= 66^\circ\end{aligned}$$

$$\begin{aligned}\angle HDC &= 180^\circ - 66^\circ \text{ (int. } \angle\text{s)} \\ &= 114^\circ\end{aligned}$$

$$\begin{aligned}\angle FED &= 360^\circ - 318^\circ \text{ (}\angle\text{s at a pt.)} \\ &= 42^\circ\end{aligned}$$

$$\begin{aligned}\angle HDE &= 180^\circ - 42^\circ \text{ (int. } \angle\text{s)} \\ &= 138^\circ\end{aligned}$$

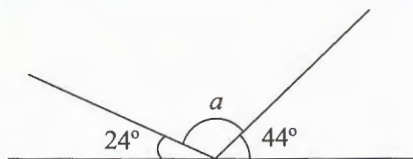
$$\begin{aligned}x &= \angle HDC + \angle HDE \text{ (adj. } \angle\text{s)} \\ &= 114^\circ + 138^\circ \\ &= 252^\circ\end{aligned}$$

Important to state reasons!

Let's Practise Properties of angles

1 Write the reasons in the blanks to support the statements.

a

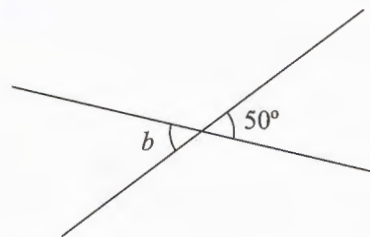


$$a + 44^\circ + 24^\circ = 180^\circ$$

$$a = 112^\circ$$

(_____)

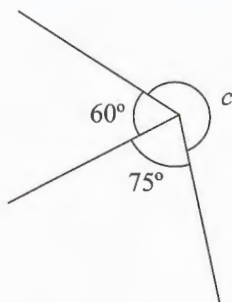
b



$$b = 50^\circ$$

(_____)

c

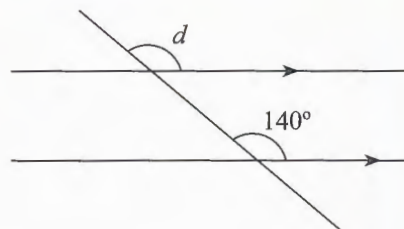


$$c + 60^\circ + 75^\circ = 360^\circ$$

$$c = 225^\circ$$

(_____)

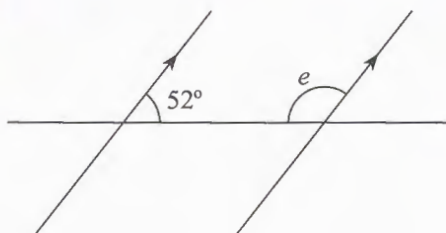
d



$$d = 140^\circ$$

(_____)

e



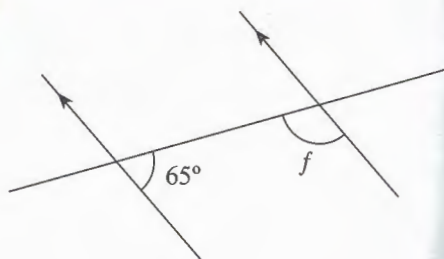
$$e + 52^\circ = 180^\circ$$

$$e = 180^\circ - 52^\circ$$

$$e = 128^\circ$$

(_____)

f



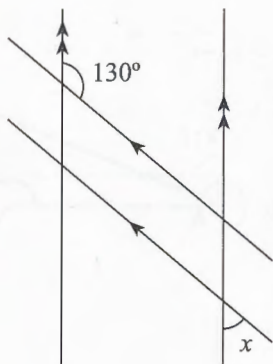
$$65^\circ + f = 180^\circ$$

$$f = 115^\circ$$

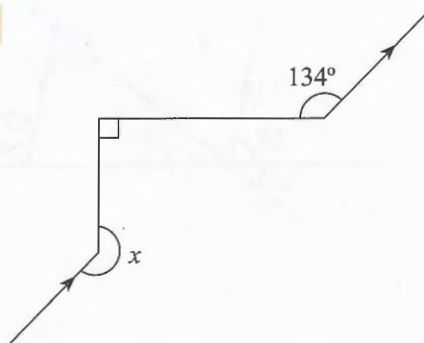
(_____)

2 Find the unknown angles, x and/or y .

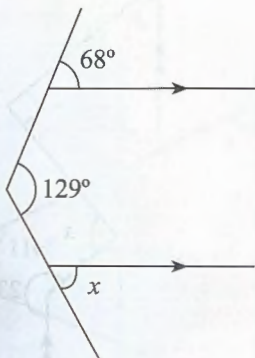
a



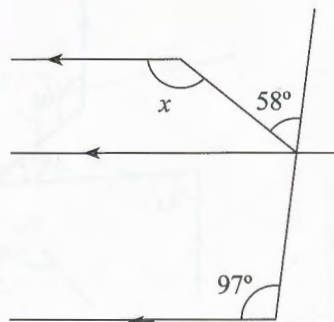
b



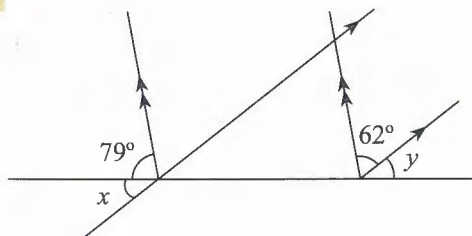
c



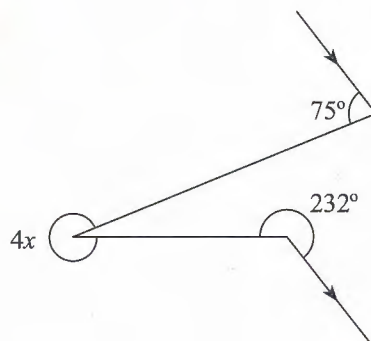
d



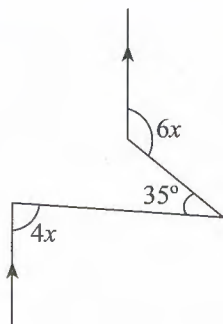
e



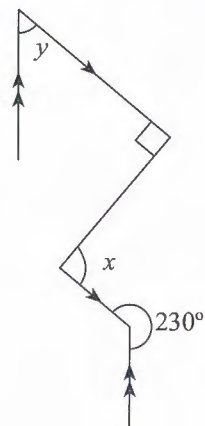
f

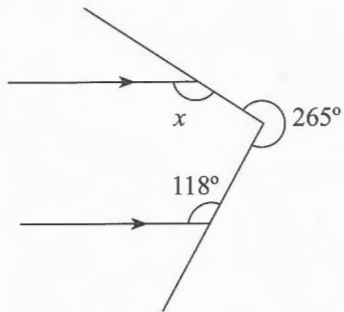
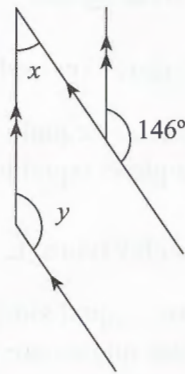
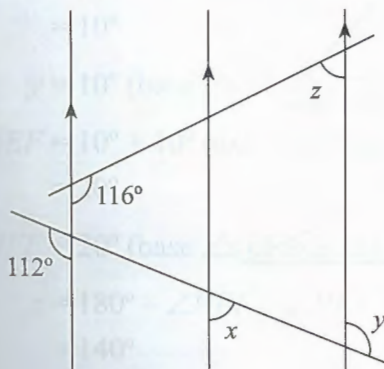
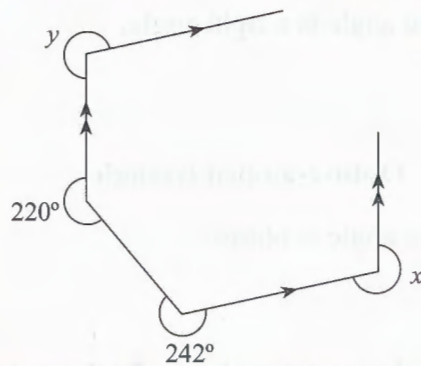


g



h

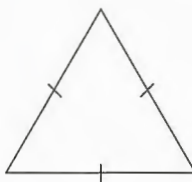


i**j***Solutions:***k****l**

Types of triangles

Equilateral triangle

- (a) All 3 sides are equal.
- (b) Every angle is equal to 60° .



Isosceles triangle

- (a) There are 2 equal sides.
- (b) The 2 base angles are equal.



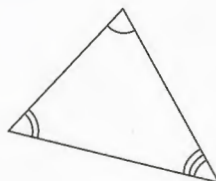
Scalene triangle

- (a) All sides are not equal.
- (b) All angles are not equal.



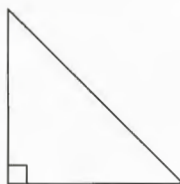
Acute-angled triangle

All 3 angles are acute.



Right-angled triangle

One angle is a right angle.



Obtuse-angled triangle

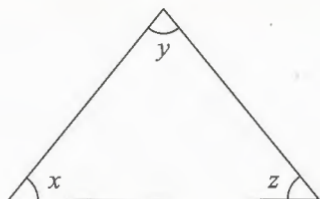
One angle is obtuse.



Angle properties of triangles

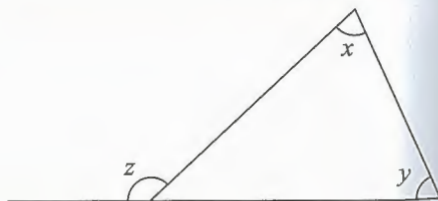
Sum of angles in a triangle

$$\angle x + \angle y + \angle z = 180^\circ \text{ (sum of } \angle\text{s in } \Delta\text{)}$$



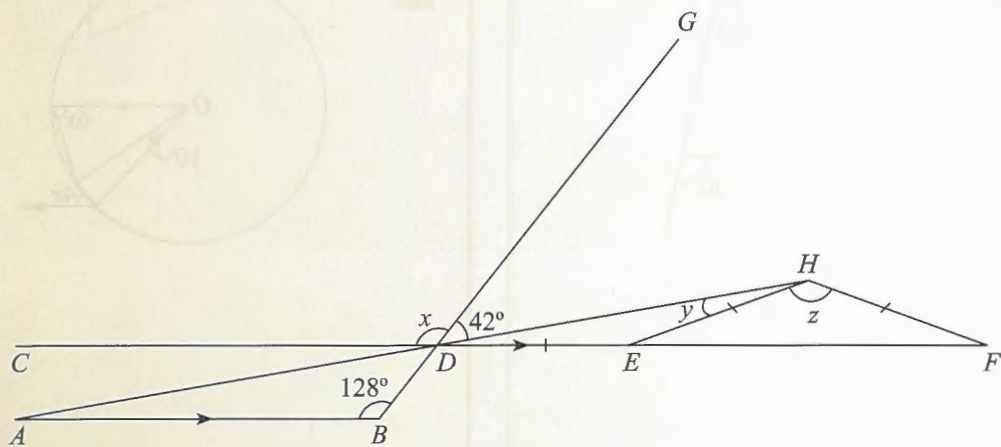
Exterior angles of a triangle

$$\angle x + \angle y = \angle z \text{ (ext. } \angle\text{s of } \Delta\text{)}$$



Example 2

In the diagram, AB is parallel to $CDEF$, $ED = EH = HF$, $\angle ABD = 128^\circ$ and $\angle GDH = 42^\circ$. Find the values of x , y and z .



Solutions:

$$x = 128^\circ \text{ (corr. } \angle\text{s)}$$

$$\begin{aligned}\angle HDE &= 180^\circ - 42^\circ - x \text{ (}\angle\text{s on str. line)} \\ &= 10^\circ\end{aligned}$$

$$y = 10^\circ \text{ (base } \angle\text{s of isos. } \Delta)$$

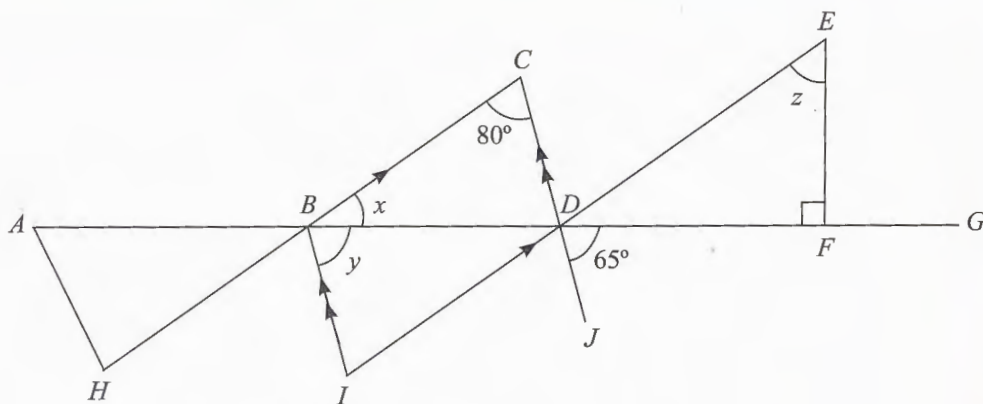
$$\begin{aligned}\angle HEF &= 10^\circ + 10^\circ \text{ (ext. } \angle\text{s of } \Delta) \\ &= 20^\circ\end{aligned}$$

$$\angle HFE = 20^\circ \text{ (base } \angle\text{s of isos. } \Delta)$$

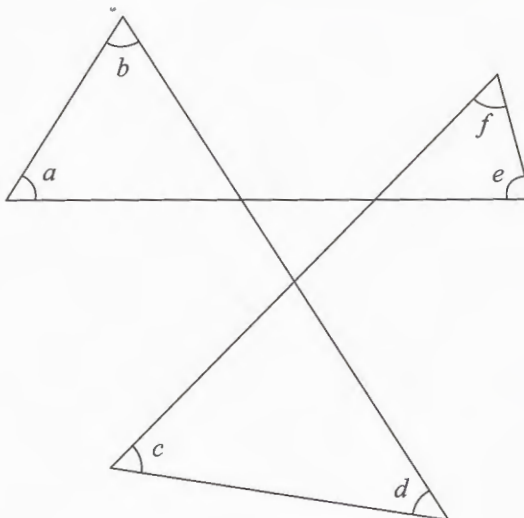
$$\begin{aligned}z &= 180^\circ - \angle HEF - \angle HFE \text{ (sum of } \angle\text{s in } \Delta) \\ &= 140^\circ\end{aligned}$$

Try These!

- 26 In the diagram below, CH is parallel to EI , BI is parallel to CJ and $ABDFG$ is a straight line. Find the values of x , y and z .



- 27 Find $\angle a + \angle b + \angle c + \angle d + \angle e + \angle f$.

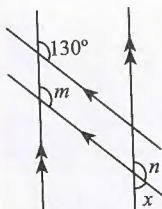


SOLUTIONS

TOPIC 1

1. (a) $\angle$ s on str. line
(b) vert. opp. $\angle$ s
(c) $\angle$ s at a pt.
(d) corr. $\angle$ s
(e) int. $\angle$ s
(f) int. $\angle$ s

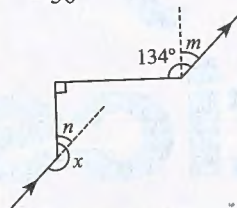
2. (a)



$$\begin{aligned} m &= 130^\circ \\ n &= 130^\circ \\ x &= 180^\circ - 130^\circ \\ &= 50^\circ \end{aligned}$$

(corr. $\angle$ s)
(corr. $\angle$ s)
($\angle$ s on str. line)

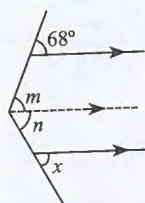
(b)



$$\begin{aligned} m &= 134^\circ - 90^\circ \\ &= 44^\circ \\ n &= 44^\circ \\ x &= 180^\circ - 44^\circ \\ &= 224^\circ \end{aligned}$$

(adj. $\angle$ s)
(corr. $\angle$ s)
(adj. $\angle$ s)

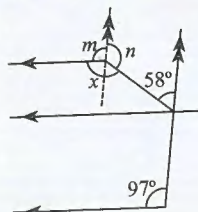
(c)



$$\begin{aligned} m &= 68^\circ \\ n &= 129^\circ - 68^\circ \\ &= 61^\circ \\ x &= 61^\circ \end{aligned}$$

(corr. $\angle$ s)
(adj. $\angle$ s)
(corr. $\angle$ s)

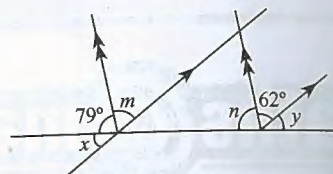
(d)



$$\begin{aligned} m &= 97^\circ \\ n &= 180^\circ - 58^\circ \\ &= 122^\circ \\ x &= 360^\circ - 97^\circ - 122^\circ \\ &= 141^\circ \end{aligned}$$

(corr. $\angle$ s)
(int. $\angle$ s)

(e)

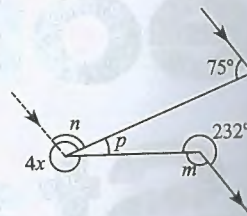


$$\begin{aligned} m &= 62^\circ \\ x &= 180^\circ - 79^\circ - 62^\circ \\ &= 39^\circ \\ n &= 79^\circ \\ y &= 180^\circ - 79^\circ - 62^\circ \\ &= 39^\circ \end{aligned}$$

(corr. $\angle$ s)
($\angle$ s on str. line)

(corr. $\angle$ s)
($\angle$ s on str. line)

(f)



$$\begin{aligned} m &= 360^\circ - 232^\circ \\ &= 128^\circ \\ n &= 180^\circ - 75^\circ \\ &= 105^\circ \\ p &= 128^\circ - 105^\circ \\ &= 23^\circ \\ 4x &= 360^\circ - 23^\circ \\ 4x &= 337^\circ \\ x &= 84.25^\circ \end{aligned}$$

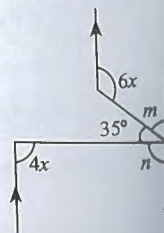
($\angle$ s at a pt.)

(int. $\angle$ s)

(adj. $\angle$ s)

($\angle$ s at a pt.)

(g)



$$\begin{aligned} m &= 180^\circ - 6x \\ n &= 180^\circ - 4x \\ m + n + 35^\circ &= 180^\circ \\ 180^\circ - 6x + 180^\circ - 4x + 35^\circ &= 180^\circ \\ 395^\circ - 10x &= 180^\circ \\ -10x &= -215^\circ \\ x &= 21.5^\circ \end{aligned}$$

(int. $\angle$ s)

(int. $\angle$ s)

($\angle$ s at a pt.)

($\angle$ s at a pt.)

($\angle$ s at a pt.)

($\angle$ s at a pt.)

($\angle$ s at a pt.)