



October/November 2020

1 Karel travelled from London to Johannesburg and then from Johannesburg to Windhoek.

Ⓚ

- (a) The flight from London to Johannesburg took 11 hours 10 minutes.  
The average speed was 813 km/h.  
Calculate the distance travelled from London to Johannesburg.  
Give your answer correct to the nearest 10 km.

$$11 \text{ h } 10' = 11 \frac{10}{60} \text{ h}$$

$$\text{distance} = 813 \times 11 \frac{10}{60} = 9078.5$$

.....2080..... km [3]

- (b) The total time for Karel's journey from London to Windhoek was 15 hours 42 minutes.  
The total distance travelled from London to Windhoek was 10 260 km.

- (i) Calculate the average speed for this journey.

$$15 \text{ h } 42' = 15 \frac{42}{60} \text{ h}$$

$$\text{speed} = \frac{10260}{15 \frac{42}{60}} \approx 654$$

.....6.54..... km/h [2]

- (ii) The cost of Karel's journey from London to Windhoek was \$470.

- (a) Calculate the distance travelled per dollar.

$$\begin{array}{r} 10260 \text{ km} \quad \$470 \\ \hline 10260 \text{ km} \quad \$1 \\ 470 \end{array}$$

.....21.8..... km per dollar [1]

- (b) Calculate the cost per 100 km of this journey.  
Give your answer correct to the nearest cent.

$$100 \text{ km} \quad \$ \frac{100 \times 470}{10260}$$

\$.....4.58.....per 100 km [2]

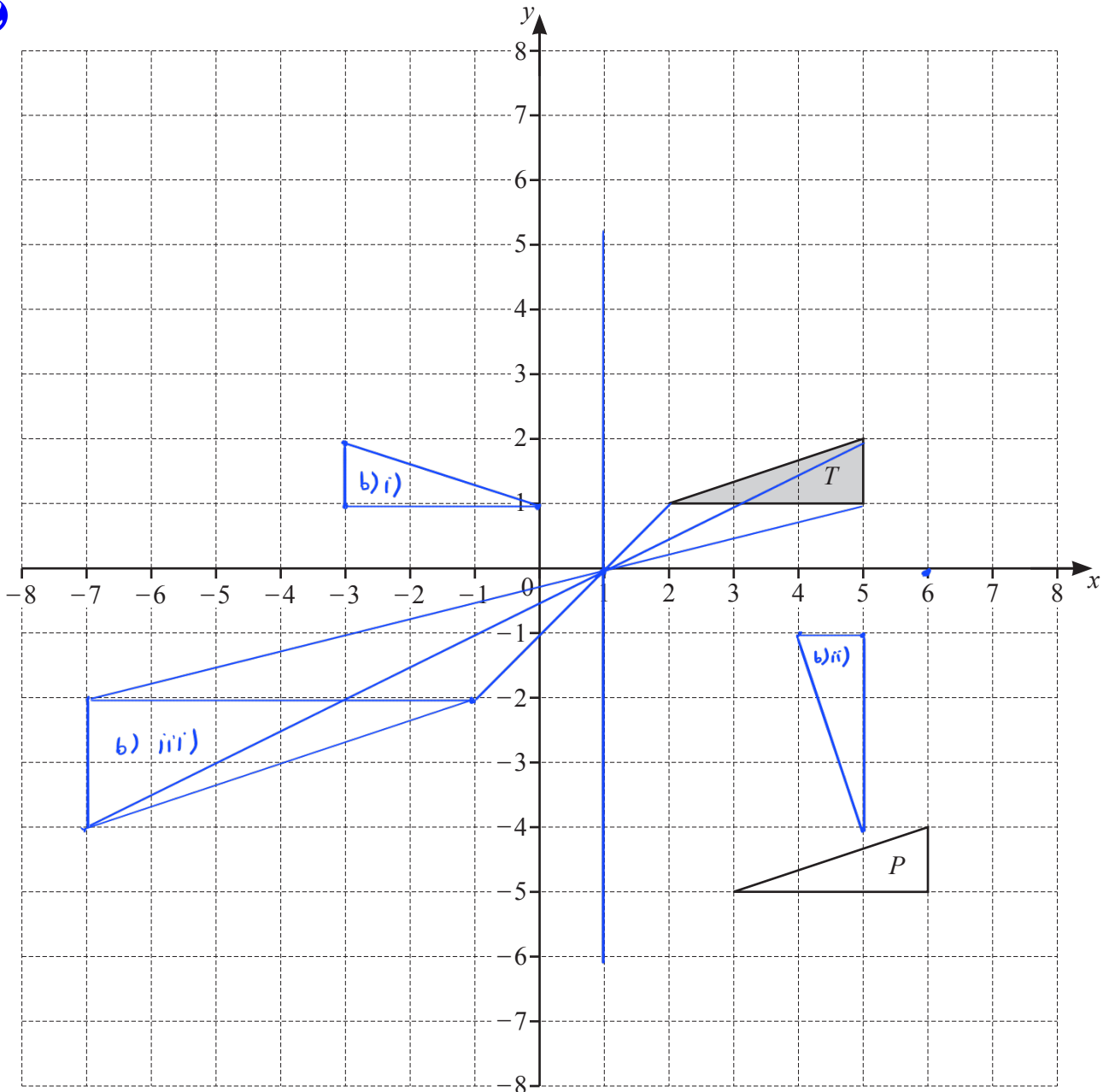
- (c) Karel changed \$300 into 3891 Namibian dollars.

Complete the statement.

$$\$1 = \frac{3891}{300} \text{ Namibian dollars}$$

\$1 = .....12.97..... Namibian dollars

[1]



- (a) Describe fully the **single** transformation that maps triangle  $T$  onto triangle  $P$ .

Translation by vector  $\begin{pmatrix} 1 \\ -6 \end{pmatrix}$

[2]

- (b) (i) Reflect triangle  $T$  in the line  $x = 1$ .

[2]

- (ii) Rotate triangle  $T$  through  $90^\circ$  anticlockwise about  $(6, 0)$ .

[2]

- (iii) Enlarge triangle  $T$  by a scale factor of  $-2$ , centre  $(1, 0)$ .

[2]

- 3 (a) Beth invests \$2000 at a rate of 2% per year compound interest.

7

- (i) Calculate the value of this investment at the end of 5 years.

$$2000 \left( 1 + \frac{2}{100} \right)^5 \approx 2208.2$$

\$ ..... 2210 ..... [2]

- (ii) Calculate the overall percentage increase in the value of Beth's investment at the end of 5 years.

$$\frac{2208.2 - 2000}{2000} \times 100 = 10.41$$

..... 10.4 ..... % [2]

- (iii) Calculate the minimum number of complete years it takes for the value of Beth's investment to increase from \$2000 to more than \$2500.

$$2000 \left( 1 + \frac{2}{100} \right)^t > 2500$$

use trial & error:

$$\text{When } t = 11: \quad 2000 \left( 1 + \frac{2}{100} \right)^{11} = 2487$$

$$\text{When } t = 12: \quad 2000 \left( 1 + \frac{2}{100} \right)^{12} = 2536$$

$$\Rightarrow t = 12$$

..... 12 ..... [3]

- (b) The population of a village decreases exponentially at a rate of 4% each year. The population is now 255.

Calculate the population 16 years ago.

$$P \left( 1 - \frac{4}{100} \right)^{16} = 255$$

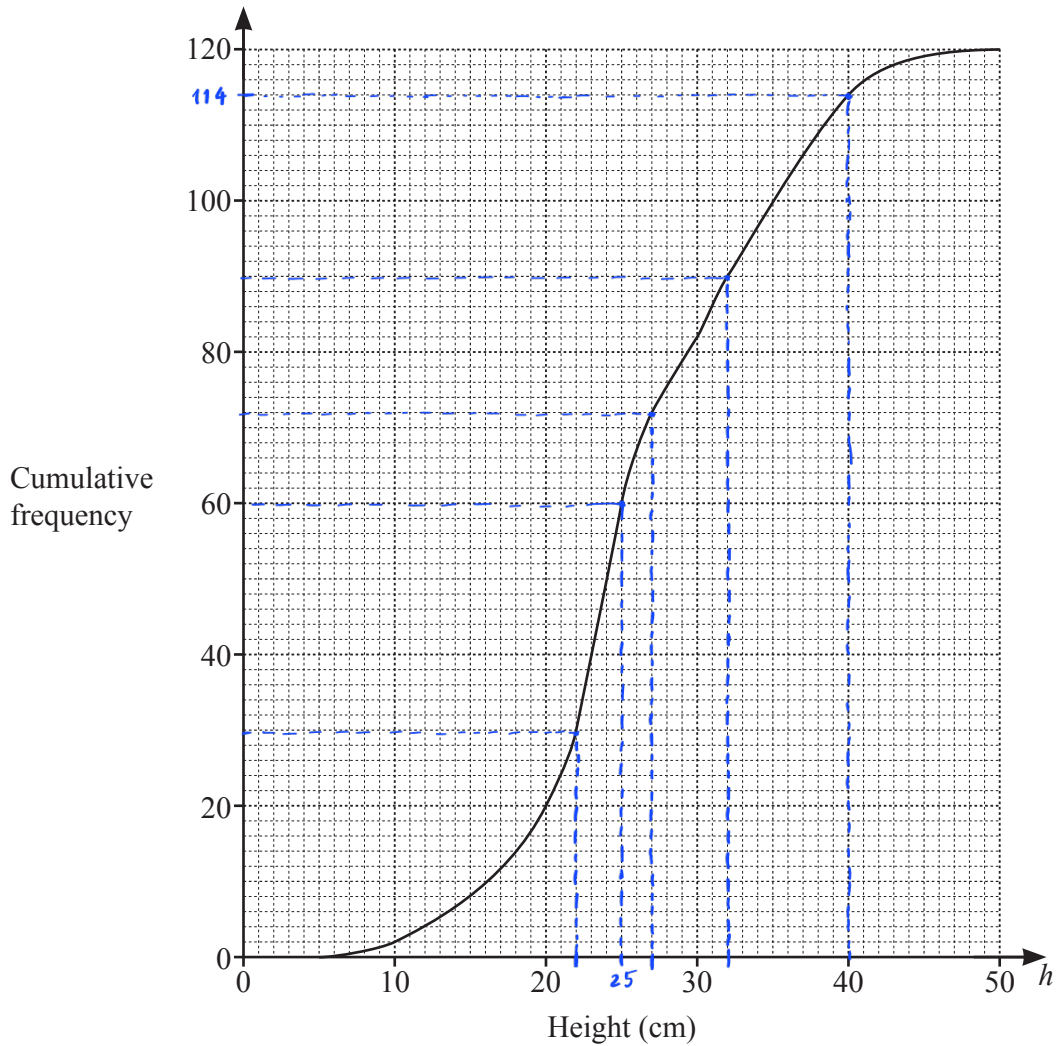
$$0.5204 P = 255$$

$$P \approx 490.08$$

because  $P$  is natural number so  $P = 490$

..... 490 ..... [3]

- 4 The height,  $h$  cm, of each of 120 plants is measured.  
 The cumulative frequency diagram shows this information.



(a) Use the cumulative frequency diagram to find an estimate of

(i) the median,

..... 2.5 ..... cm [1]

(ii) the interquartile range,

$$32 - 22 = 10$$

..... 10 ..... cm [2]

(iii) the 60th percentile,

..... 2.7 ..... cm [1]

(iv) the number of plants with a height greater than 40 cm.

$$120 - 114$$

..... 6 ..... [2]

(b) The information in the cumulative frequency diagram is shown in this frequency table.

Mid value	5	15	25	40
Height, $h$ cm	$0 < h \leq 10$	$10 < h \leq 20$	$20 < h \leq 30$	$30 < h \leq 50$
Frequency	2	18	62	38
Freq density		1.8		1.9

(i) Calculate an estimate of the mean height.

$$\frac{5 \times 2 + 15 \times 18 + 25 \times 62 + 40 \times 38}{120} \approx 27.9$$

..... 27.9 ..... cm [4]

(ii) A histogram is drawn to show the information in the frequency table.  
The height of the bar representing the interval  $10 < h \leq 20$  is 7.2 cm.

Calculate the height of the bar representing the interval  $30 < h \leq 50$ .

$$\begin{array}{ll} 1.8 & 7.2 \text{ cm} \\ 1.9 & ? \\ \hline \frac{1.9 \times 7.2}{1.8} & = 7.6 \end{array}$$

..... 7.6 ..... cm [2]

5 Ahmed sells different types of cake in his shop.

7

The cost of each cake depends on its type and its size.

Every small cake costs \$ $x$  and every large cake costs  $\$(2x + 1)$ .

(a) The total cost of 3 small lemon cakes and 2 large lemon cakes is \$12.36.

Find the cost of a small lemon cake.

$$3x + 2(2x + 1) = 12.36$$

$$3x + 4x + 2 = 12.36$$

$$7x = 10.36$$

$$x = \frac{10.36}{7}$$

\$ .....1.48..... [3]

(b) The cost of 18 small chocolate cakes is the same as the cost of 7 large chocolate cakes.

Find the cost of a small chocolate cake.

$$18x = 7(2x + 1)$$

$$18x = 14x + 7$$

$$4x = 7$$

$$x = 1.75$$

\$ .....1.75..... [3]

(c) The number of small cherry cakes that can be bought for \$4 is the same as the number of large cherry cakes that can be bought for \$13.

Find the cost of a small cherry cake.

$$\frac{4}{x} = \frac{13}{2x + 1}$$

$$4(2x + 1) = 13x$$

$$8x + 4 = 13x$$

$$4 = 5x$$

\$ .....0.8..... [3]

(d) Petra spends \$20 on small coffee cakes and \$10 on large coffee cakes.

The total number of cakes is 45.

Write an equation in terms of  $x$ .

Solve this equation to find the cost of a small coffee cake.

$$\frac{20}{x} + \frac{10}{2x + 1} = 45$$

$$\frac{20(2x + 1) + 10x}{x(2x + 1)} = 45$$

$$40x + 20 + 10x = 45(2x^2 + x)$$

$$90x^2 - 5x - 20 = 0$$

$$(9x + 4)(2x - 1) = 0$$

$$x = \frac{-4}{9} \text{ or } x = \frac{1}{2}$$

Because  $x > 0$  so  $x = \frac{1}{2}$  .....  $\frac{1}{2}$  ..... [7]

6



Red



Yellow



Blue



Blue



Yellow



Blue

The diagram shows six discs.  
Each disc has a colour and a number.

- (a) One disc is picked at random.

$$2 \times \frac{2}{6} \times \frac{1}{5} + \frac{2}{6} \times \frac{1}{5} \times 3$$

Write down the probability that

- (i) the disc has the number 4,

$$\frac{2}{6} \dots \dots \dots [1]$$

- (ii) the disc is red and has the number 3,

$$0 \dots \dots \dots [1]$$

- (iii) the disc is blue and has the number 4.

$$\frac{1}{6} \dots \dots \dots [1]$$

- (b) Two of the six discs are picked at random **without** replacement.

Find the probability that

- (i) both discs have the number 3,

$$\frac{2}{6} \times \frac{1}{5}$$

$$\frac{1}{15} \dots \dots \dots [2]$$

- (ii) both discs have the same colour.

$$(Y \cap Y) \text{ or } (B \cap B)$$

$$\frac{2}{6} \times \frac{1}{5} + \frac{3}{6} \times \frac{2}{5}$$

$$\frac{4}{15} \dots \dots \dots [3]$$

- (c) Two of the six discs are picked at random **with** replacement.

Find the probability that both discs have the same colour.

$$(R \cap R) \text{ or } (Y \cap Y) \text{ or } (B \cap B)$$

$$\frac{1}{6} \times \frac{1}{6} + \frac{2}{6} \times \frac{2}{6} + \frac{3}{6} \times \frac{3}{6}$$

$$\frac{7}{18} \dots \dots \dots [3]$$

7

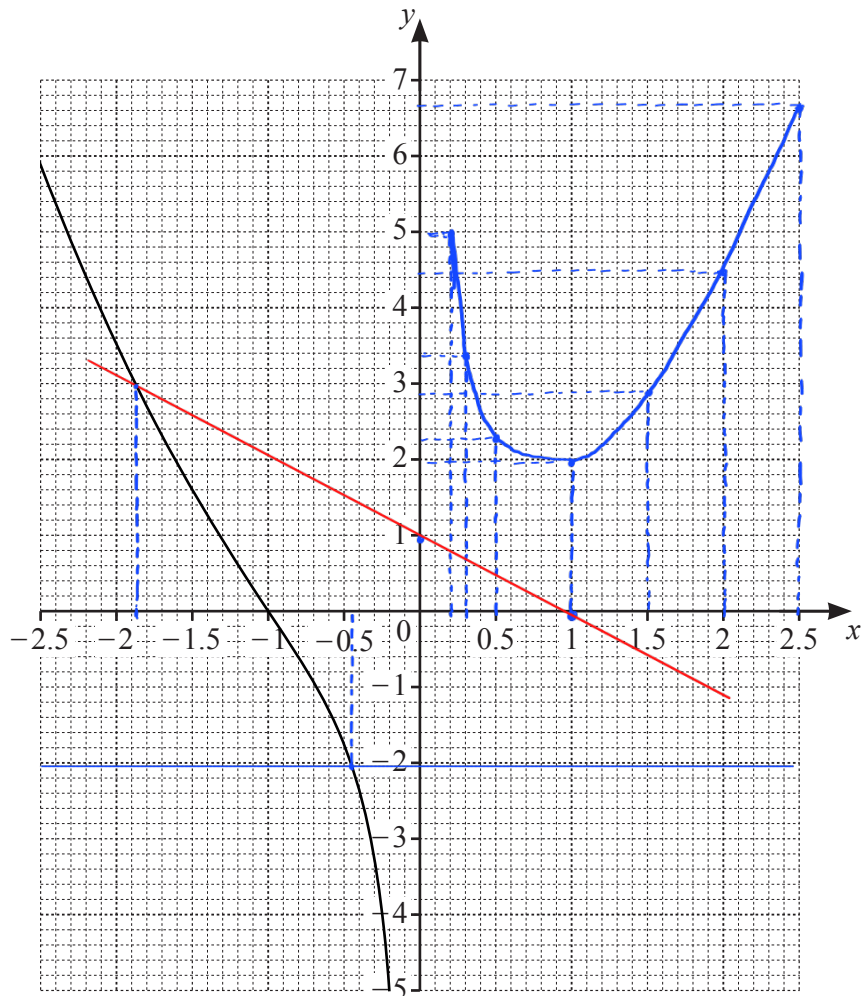
$$y = x^2 + \frac{1}{x}, \quad x \neq 0$$



(a) Complete the table.

$x$	0.2	0.3	0.5	1	1.5	2	2.5
$y$	5.0	3.4	2.3	2	2.9	4.5	6.7

[2]

(b) On the grid, draw the graph of  $y = x^2 + \frac{1}{x}$  for  $0.2 \leq x \leq 2.5$ .The graph of  $y = x^2 + \frac{1}{x}$  for  $-2.5 \leq x \leq -0.2$  has been drawn for you.

[4]

(c) By drawing suitable straight lines on the grid, solve the following equations.

(i)  $x^2 + \frac{1}{x} = -2$

$x = \dots -0.45 \dots$  [1]

(ii)  $x^2 + \frac{1}{x} + x - 1 = 0$


$$x^2 + \frac{1}{x} = -x + 1$$

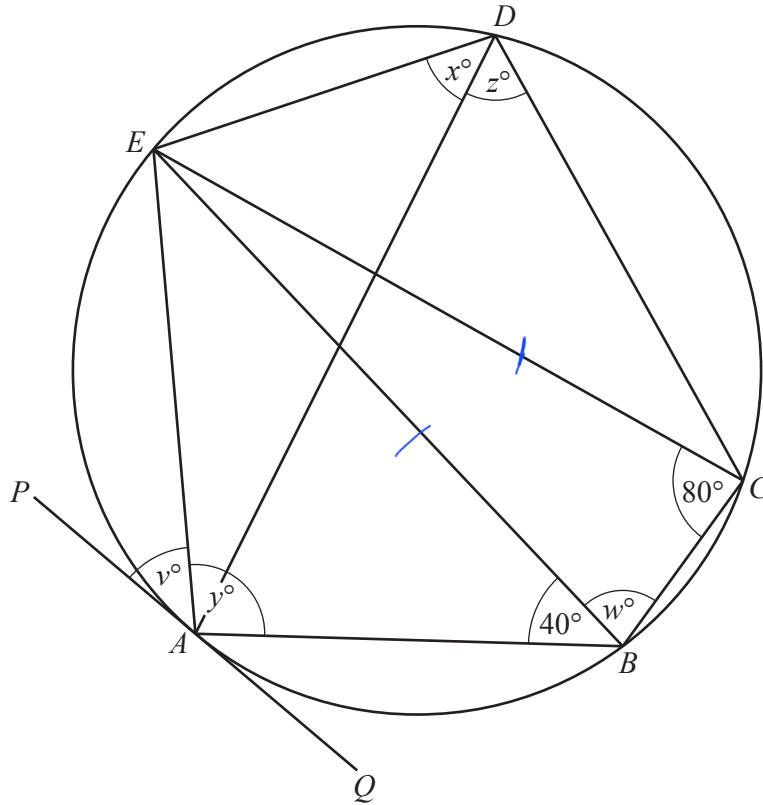
$x = \dots -1.87 \dots$  [2]

(d)  $k$  is an integer and the equation  $x^2 + \frac{1}{x} = k$  has three solutions.

Write down a possible value of  $k$ .

$k = \dots 3 \dots$  [1]

8 (a) 



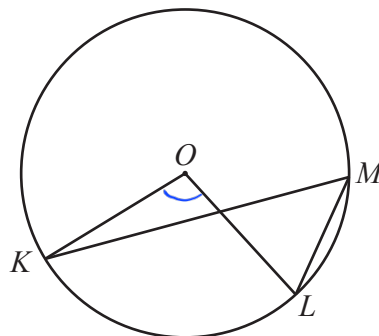
NOT TO SCALE

The points  $A, B, C, D$  and  $E$  lie on the circle.  
 $PAQ$  is a tangent to the circle at  $A$  and  $EC = EB$ .  
 Angle  $ECB = 80^\circ$  and angle  $ABE = 40^\circ$ .

Find the values of  $v, w, x, y$  and  $z$ .

$v = \dots 40 \dots$      $w = \dots 80 \dots$      $x = \dots 40 \dots$      $y = \dots 100 \dots$      $z = \dots 60 \dots$  [5]

(b)



NOT TO SCALE

In the diagram,  $K, L$  and  $M$  lie on the circle, centre  $O$ .  
 Angle  $KML = 2x^\circ$  and reflex angle  $KOL = 11x^\circ$ .

Find the value of  $x$ .

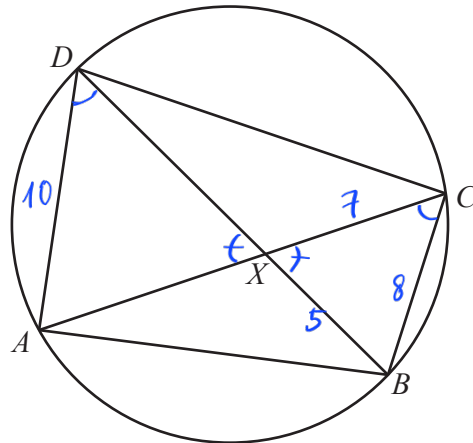
$$\widehat{KOL} = 360 - 11x = 2 \widehat{KML} = 2 \times 2x = 4x$$

$$\Rightarrow 360 = 15x$$

$$\Rightarrow x = \frac{360}{15}$$

$x = \dots 24 \dots$  [3]

(c)

NOT TO  
SCALE

The diagonals of the cyclic quadrilateral  $ABCD$  intersect at  $X$ .

- (i) Explain why triangle  $ADX$  is similar to triangle  $BCX$ .  
Give a reason for each statement you make.

$$\widehat{ADB} = \widehat{ACB} \text{ (subtend the same arc } \widehat{AB} \text{)}$$

$$\widehat{AXD} = \widehat{BXC} \text{ (vertically opposite)}$$

$$\widehat{DAC} = \widehat{DBC} \text{ (subtend the same arc } \widehat{CD} \text{)}$$

$$\Rightarrow \triangle ADX \sim \triangle BCX \quad [3]$$

- (ii)  $AD = 10$  cm,  $BC = 8$  cm,  $BX = 5$  cm and  $CX = 7$  cm.

- (a) Calculate  $DX$ .

$$\frac{AD}{BC} = \frac{DX}{CX} \Rightarrow \frac{10}{8} = \frac{DX}{7}$$

$$DX = \frac{10 \times 7}{8}$$

$$DX = 8.75 \text{ cm} \quad [2]$$

- (b) Calculate angle  $BXC$ .

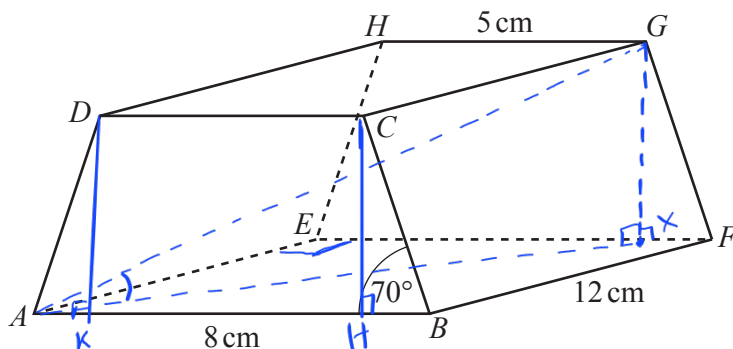
$$8^2 = 7^2 + 5^2 - 2 \times 7 \times 5 \cos \widehat{BXC}$$

$$-10 = -70 \cos \widehat{BXC}$$

$$\cos \widehat{BXC} = \frac{1}{7}$$

$$\widehat{BXC} = 81.8^\circ$$

$$\text{Angle } BXC = 81.8^\circ \quad [4]$$

NOT TO  
SCALE

The diagram shows a prism with a rectangular base,  $ABFE$ .  
The cross-section,  $ABCD$ , is a trapezium with  $AD = BC$ .  
 $AB = 8$  cm,  $GH = 5$  cm,  $BF = 12$  cm and angle  $ABC = 70^\circ$ .

(a) Calculate the total surface area of the prism.

$$HB = AK = \frac{AB - CD}{2} = \frac{8 - 5}{2} = 1.5$$

$$\tan 70^\circ = \frac{CH}{HB} \Rightarrow CH = 1.5 \tan 70^\circ \approx 4.1212$$

$$\cos 70^\circ = \frac{HB}{CB} \Rightarrow CB = \frac{1.5}{\cos 70^\circ} \approx 4.3857$$

$$\begin{aligned} \text{Total} &= A_{2 \text{ bases}} + A_{2 \text{ trapezium faces}} + A_{2 \text{ rectangular faces}} \\ &= 5 \times 12 + 8 \times 12 + 2 \times \frac{1}{2} (5 + 8) \times 4.1212 + 2 \times 12 \times 4.3857 \\ &= \dots\dots\dots 31.5 \dots\dots\dots \text{ cm}^2 \quad [6] \end{aligned}$$

(b) The perpendicular from  $G$  onto  $EF$  meets  $EF$  at  $X$ .

(i) Show that  $EX = 6.5$  cm.

$$EX = AH = AK + KH = 1.5 + 5 = 6.5$$

[1]

(ii) Calculate  $AX$ .

$\triangle AEX$  is a right-angled triangle

$$\Rightarrow AX^2 = AE^2 + EX^2$$

$$AX^2 = 12^2 + 6.5^2 = 186.25$$

$$AX = \sqrt{186.25}$$

$$AX = \dots\dots\dots 13.6 \dots\dots\dots \text{ cm} \quad [2]$$

(iii) Calculate the angle between the diagonal  $AG$  and the base  $ABFE$ .

$\triangle AXG$  is a right-angled triangle

$$\Rightarrow \tan \widehat{GAX} = \frac{GX}{AX} = \frac{CH}{AX} = \frac{4.1212}{\sqrt{186.25}} = 0.3020$$

$$\Rightarrow \widehat{GAX} = 16.8^\circ$$

$$\dots\dots\dots 16.8^\circ \dots\dots\dots [2]$$

10  $f(x) = x^2 + 1$        $g(x) = 1 - 2x$        $h(x) = \frac{1}{x}, x \neq 0$        $j(x) = 5^x$

**7** (a) Find the value of

(i)  $f(3)$ ,  $3^2 + 1$

.....  $10$  [1]

(ii)  $gf(3)$ .

$g f(3) = g(10) = 1 - 2 \times 10$

.....  $-19$  [1]

(b) Find  $g^{-1}(x)$ .

$x(-2) \rightarrow +1$

inverse:  $\therefore (-2) \leftarrow -1$

$g^{-1}(x) = \dots \frac{x-1}{-2} \dots$  [2]

(c) Find  $x$  when  $h(x) = 2$ .

$\frac{1}{x} = 2$

$x = \dots \frac{1}{2} \dots$  [1]

(d) Find  $g(x)g(x) - gg(x)$ , giving your answer in the form  $ax^2 + bx + c$ .

$(1-2x)(1-2x) - [1-2(1-2x)]$

$1 - 2x - 2x + 4x^2 - 1 + 2 - 4x$

$4x^2 - 8x + 2$

.....  $4x^2 - 8x + 2$  [4]

(e) Find  $hh(x)$ , giving your answer in its simplest form.

$$\frac{1}{\frac{1}{x}} = x$$

.....  $x$  ..... [1]

(f) Find  $j(5)$ .

$$5^5$$

.....  $3125$  ..... [1]

(g) Find  $x$  when  $j^{-1}(x) = 2$ .

$$5^2$$

$x =$  .....  $25$  ..... [1]

(h)  $j(x) = hg(-12)$

Find the value of  $x$ .

$$g(-12) = 1 - 2(-12) = 25$$

$$h(25) = \frac{1}{25}$$

$$5^x = \frac{1}{25} = \frac{1}{5^2} = 5^{-2}$$

$x =$  .....  $-2$  ..... [2]

11



Sequence	1st term	2nd term	3rd term	4th term	5th term	$n$ th term
A	13	9	5	1	$-3$	$17 - 4n$
B	0	7	26	63	$124$	$n^3 - 1$
C	$\frac{7}{8}$	$\frac{8}{16}$	$\frac{9}{32}$	$\frac{10}{64}$	$\frac{11}{128}$	$\frac{n+6}{2^{n+2}}$

(a) Complete the table for the three sequences.

(b) One term in Sequence C is  $\frac{p}{q}$ .

[10]

Write down the next term in Sequence C in terms of  $p$  and  $q$ .

.....  $\frac{p+1}{2q}$  ..... [2]