Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Without sufficient working, correct answers may be awarded no marks.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- **Calculators may be used.**
- You must **NOT** write anything on the formulae page.
  Anything you write on the formulae page will gain NO credit.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.

Answer ALL TWENTY THREE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 The table gives information about the number of days that 100 cars were in an airport car park.

Number of days (d)	Frequency		
$0 < d \leqslant 4$	16	×2	= 32
$4 < d \leqslant 8$	18	×6	= 108
$8 < d \leqslant 12$	19	×10	= 190
$12 < d \leqslant 16$	27	×14	= 378
$16 < d \leqslant 20$	20	×18	= 360

(a) Write down the modal class.

$12 < d \leqslant 16$

(1)

(b) Work out an estimate for the mean number of days.

$$\frac{1068}{100}$$

10·68

days

(4)

(Total for Question 1 is 5 marks)

2 The diagram shows two solid toy bricks, Brick **A** and Brick **B**.

$r = 3$

6 cm

6 cm

6 cm

5 cm

5 cm

6 cm
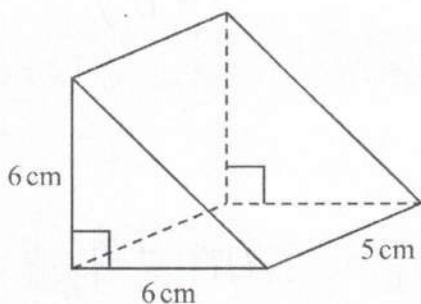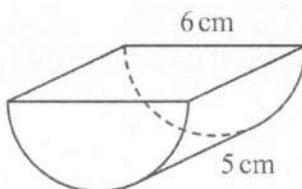
Diagram **NOT** accurately drawn

Brick **A**

Brick **B**

Brick **A** is a triangular prism of length 5 cm.
The cross section of Brick **A** is an isosceles right-angled triangle with equal sides of length 6 cm.

Brick **B** is half a cylinder of length 5 cm.
The semicircular cross section of Brick **B** has diameter 6 cm.

The volume of Brick **A** is greater than the volume of Brick **B**.

How much greater?
Give your answer correct to 1 decimal place.

$$A = \left(\frac{1}{2} \times 6 \times 6\right) \times 5 = 90 \text{ cm}^3$$

$$B = \left(\pi \times 3^2 \div 2\right) \times 5 = \frac{45}{2}\pi \text{ cm}^2$$

$$90 - \frac{45\pi}{2} = 19.3141\ldots$$

19.3

cm³

(Total for Question 2 is 4 marks)

3 Here are the first five terms of a number sequence S.

$+4$ 10   16   22   28   34 $(+6)$

(a) Find an expression, in terms of n, for the nth term of this sequence.

$6n$ 6   12

$6n + 4$

(2)

The nth term of a sequence T is given by $n^2 - 3$

There are numbers that are terms in both the sequence S and the sequence T.

(b) Find one of these numbers.

$$n^2 - 3 = 6n + 4$$
$$n^2 - 6n - 7 = 0$$
$$(n-7)(n+1) = 0$$
$$n = 7, \; n = -1$$

$7^2 - 3$
$= \underline{46}$

(2)

(Total for Question 3 is 4 marks)

4 On Saturday, Jacob walked 10 800 steps.
On Sunday, he walked 7% more steps than on Saturday.

Work out how many steps Jacob walked on Sunday.

$$10\,800 \times 1.07$$

11556

(Total for Question 4 is 3 marks)

5   The scale drawing shows the position of a hall and the position of a library.

N

)154

hall

N

library

$$\begin{bmatrix} 180 \\ -154 \end{bmatrix} = 26° \; acw$$

✗ P
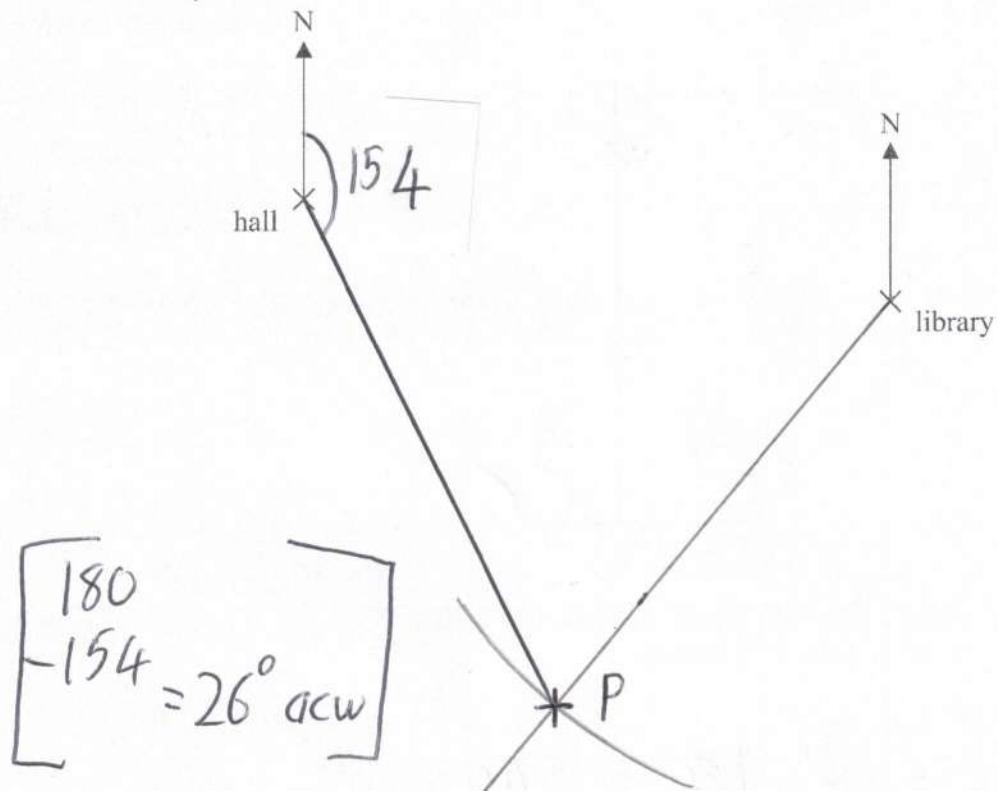
Scale: 1 cm represents 20 metres

A post box is 140 metres from the library on a bearing of 220°   = 7cm

(a) Show the position of the post box on the scale drawing.
    Mark the position with a cross (✗) and label it P.

(2)

(b) Use your scale drawing to find

    (i) the real distance, in metres, of the hall from the post box,

7.5cm   x 20   = 150 m

(ms: 150 → 158)

m

    (ii) the bearing of the hall from the post box.

360-26 =   334°

(ms: 330-334)

(2)

(Total for Question 5 is 4 marks)

6

P 5 9 0 2 4 A 0 6 2 4
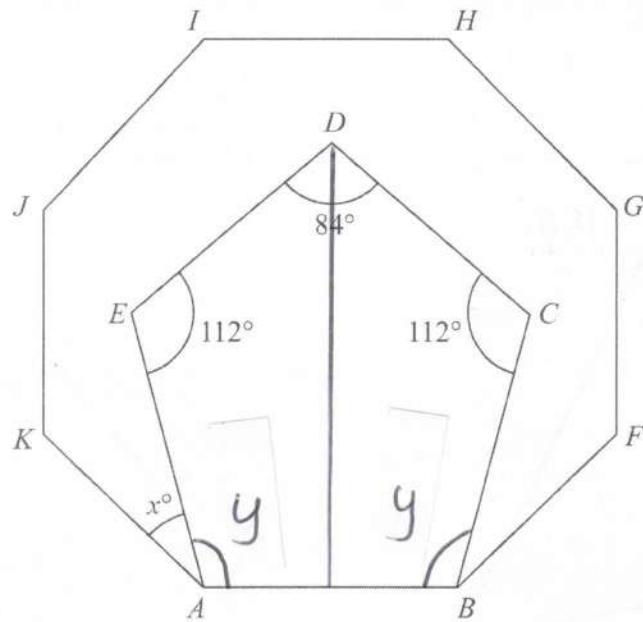
Diagram **NOT** accurately drawn


Pentagon *ABCDE* is drawn inside the regular octagon *ABFGHIJK*.
The pentagon has exactly one line of symmetry.

Work out the value of *x*.

$$\text{pentagon} = 3 \times 180 = 540$$

$$y = \frac{540 - 112 - 112 - 84}{2} = 116$$

$$\text{reg } 8\text{gon internal} = \frac{6 \times 180}{8} = 135$$

$$135 - 116$$

$$x = 19°$$

(Total for Question 6 is 4 marks)

P 5 9 0 2 4 A 0 7 2 4

7 The diagram shows a trapezium.

37 cm

125°

35°

15 cm

15

x

y cm

Diagram **NOT** accurately drawn
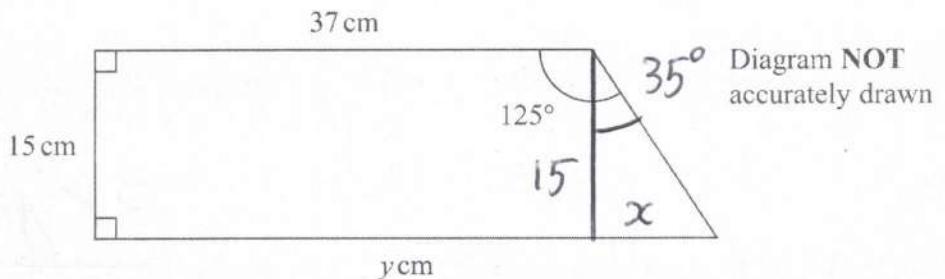
Work out the value of y.
Give your answer correct to 1 decimal place.

$x = \tan 35 \times 15 = 10.503...$

$37 + 10.5$

$y = 47.5$

(Total for Question 7 is 4 marks)

8 (a) Simplify fully $\dfrac{15k^4m^3}{5km^2}$

$$\underline{3K^3m}$$

(2)

(b) Solve the inequality $7 < 4x - 1 \leqslant 17$

$$8 < 4x \leqslant 18$$
$$2 < x \leqslant 4 \cdot 5$$

(3)

(Total for Question 8 is 5 marks)

9 Omar invests 6000 dirham for 4 years in a savings account.
   He will get 1.5% per year compound interest.

   Work out the total amount of interest Omar will have received by the end of 4 years.
   Give your answer correct to the nearest dirham.

$$6000 \times 1.015^4$$

$$= 6368.181$$

$$(-6000)$$

368 dirham

(Total for Question 9 is 3 marks)

10 (a) Simplify fully $(16x^8 y^6)^{\frac{1}{2}}$

$\sqrt{16} \qquad (x^8)^{\frac{1}{2}} \qquad (y^6)^{\frac{1}{2}} \qquad\qquad 4x^4 y^3$

(2)

(b) Solve $\dfrac{8-2x}{3} - \dfrac{2x-3}{2} = 4$ $\qquad$ (×6)

Show clear algebraic working.

$$2(8-2x) - 3(2x-3) = 24$$

$$16 - 4x - 6x + 9 = 24$$

$$-10x = -1$$

$$x = \frac{-1}{-10} \qquad = \frac{1}{10}$$

$x =$ $\qquad$ 0·1

(3)

(c) Make f the subject of $m = \sqrt{\dfrac{1}{3}ef}$

$$m^2 = \frac{ef}{3}$$

$$3m^2 = ef$$

so $\quad f = \dfrac{3m^2}{e}$

(2)

(Total for Question 10 is 7 marks)

11 The straight line L_1 has equation $x + 2y = 4$
The straight line L_2 passes through the points $(-1, -7)$ and $(7, 9)$

Michael says that the lines L_1 and L_2 are perpendicular.

Is Michael correct?
You must show clearly how you get your answer.

$L_1: \quad y = -\frac{1}{2}x + 2 \qquad$ so $m = -\frac{1}{2}$

$L_2: \quad m = \dfrac{9--7}{7--1} = \dfrac{16}{8} = 2$

$2 \times -\frac{1}{2} = -1 \qquad$ hence L_1 and L_2
are perpendicular
so YES

(Total for Question 11 is 3 marks)

12 Freddie recorded the number of runs he scored in each of 11 cricket matches.
Here are his results.

| 4 | 0 | 21 | 32 | 51 | 6 | 102 | 69 | 17 | 9 | 42 |

Find the interquartile range of his results.

0   4   ⑥   9   17   ㉑   32   42   �   69   102

Q_1 Q_2 Q_3

$$IQR = 51 - 6 = 45$$

(Total for Question 12 is 3 marks)

13 Carlos, Flavia and Tazia shared £861 between themselves.

The amount of money Flavia got is 65% of the amount of money Carlos got.
The amount of money Tazia got is 22% **more** than the amount of money Carlos got.

Work out how much money Carlos got.

C   F   T
100   65   122

$$C = \frac{100}{(100 + 65 + 122)} \times 861$$

£ 300

(Total for Question 13 is 3 marks)

14 (a) Given that $a = 3^x$ and $b = 3^y$

express in terms of a or b or a and b,

(i) 3^{2x}

$$= \left(3^x\right)^2 = a^2$$

(ii) 3^{x+4y}

$$= 3^x \times 3^{4y} = 3^x \times \left(3^y\right)^4 = ab^4$$

(iii) 3^{y-1}

$$= 3^y \times 3^{-1} = \frac{1}{3}b$$

(3)

$a = 3^x$ and $b = 3^y$

$ab = 2187$

$a^2b = 177\,147$

(b) Work out the value of x and the value of y.
Show your working clearly.

$$\frac{a^2b}{ab} = a = \frac{177147}{2187} = 81 = 3^x$$

$$81 \times b = 2187$$

$$b = 3^y = 27$$

$x = $ 4

$y = $ 3

(3)

(Total for Question 14 is 6 marks)

15 Barney has a biased coin.

When the coin is thrown once, the probability that the coin will land heads is 0.3

Barney throws the coin 4 times.

(a) Work out the probability that the coin will land heads exactly 3 times.

4 arrangements

so $\quad 4 \times (0.7 \times 0.3 \times 0.3 \times 0.3)$

$= 0.0756$

(3)

(b) Work out the probability that the coin will land heads at least once.

At least once $= 1 - $ no heads

$= 1 - 0.7^4$

$= 0.7599$

(2)

(Total for Question 15 is 5 marks)

16 **120** people who visited a sports centre were asked if they went swimming (*S*), played basketball (*B*) or used the gym (*G*).

Their answers showed that

28 people went swimming
16 people played basketball
27 people used the gym
3 people went swimming and played basketball
5 people played basketball and used the gym
7 people went swimming and used the gym
2 people went swimming, played basketball and used the gym

(a) Using this information, complete the Venn diagram to show the number of people in each region of the Venn diagram.
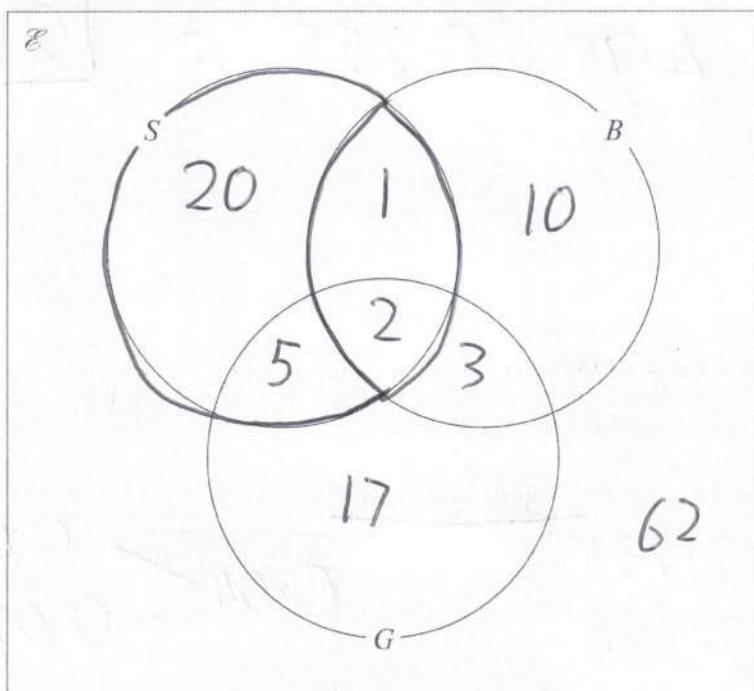
(3)

One of the people who went swimming is chosen at random.

(b) Find the probability that this person also played basketball.

$$\frac{3}{28}$$

(1)

(Total for Question 16 is 4 marks)

P 5 9 0 2 4 A 0 1 6 2 4

17 $P = ef$

$e = 4.8$ correct to 2 significant figures.
$f = 0.26$ correct to 2 significant figures.

(a) Work out the lower bound for the value of P.
Show your working clearly.
Give your answer correct to 3 significant figures.

$$4.8 < \begin{matrix} 4.85 \\ 4.75 \end{matrix} \qquad 0.26 < \begin{matrix} 0.265 \\ 0.255 \end{matrix}$$

$$LB = \downarrow e \times \downarrow f$$
$$= 4.75 \times 0.255 = \underline{1.21}$$

(2)

$Q = \dfrac{t}{w}$

$t = 2.73$ correct to 3 significant figures.
$w = 0.04$ correct to 1 significant figure.

(b) Work out the upper bound for the value of Q.
Show your working clearly.
Give your answer correct to 2 significant figures.

$$2.73 < \begin{matrix} 2.735 \\ 2.725 \end{matrix} \qquad 0.04 < \begin{matrix} 0.045 \\ 0.035 \end{matrix}$$

$$UB = \frac{t\uparrow}{w\downarrow} = \frac{2.735}{0.035} = \underline{78}$$

(2)

(Total for Question 17 is 4 marks)

18 Here is the graph of $y = \sin x°$ for $0 \leqslant x \leqslant 360$
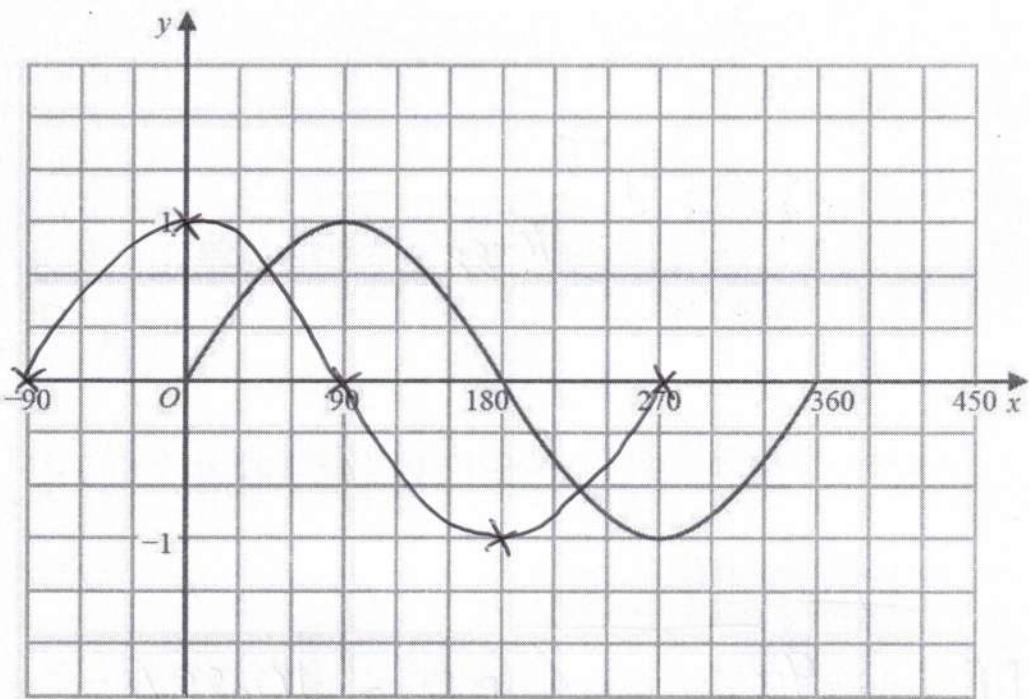
(a) On the grid above, sketch the graph of $y = \sin(x + 90)°$ for $0 \leqslant x \leqslant 360$

← 90°

(2)

In $0 \leqslant x \leqslant 360$, the graph of $y = \sin\left(\dfrac{x}{2}\right)° + 3$ has a maximum at the point A.

(b) Write down the coordinates of A.

stretch in
$sf = 2$

moves max ↑3

(doesn't affect
max pt y)

(180 , 4)

(2)

(Total for Question 18 is 4 marks)

18

19 *ABCD* is a quadrilateral.

A

9.3 cm   97°

Diagram **NOT**
accurately drawn

D   ) 25

10.88

58°
47°   B

11.2 cm

C
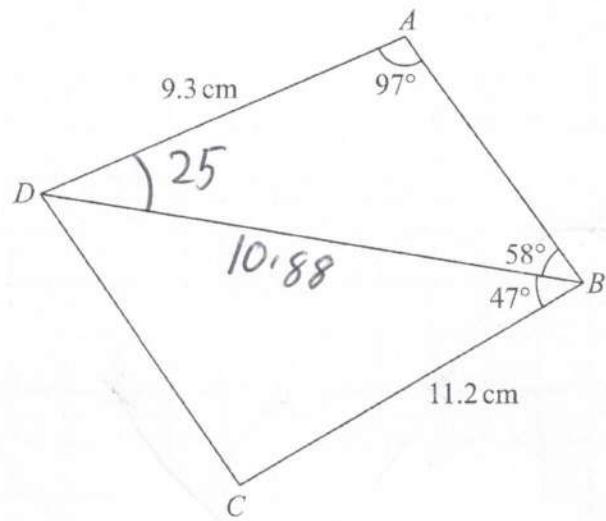
Find the area of quadrilateral *ABCD*.
Give your answer correct to 3 significant figures.

$$\frac{DB}{\sin 97} = \frac{9.3}{\sin 58} \qquad DB = 10.884...$$

$$\text{Area} = \left(\frac{1}{2} \times 9.3 \times 10.884 \times \sin 25\right)$$

$$+ \left(\frac{1}{2} \times 10.884 \times 11.2 \times \sin 47\right)$$

$$= 65.965...$$

$$= 66.0$$

cm²

(Total for Question 19 is 5 marks)

20 (a) Write $3x^2 - 12x + 7$ in the form $a(x + b)^2 + c$

$$3[x^2 - 4x] + 7$$

$$3[(x-2)^2 - 4] + 7$$

$$= 3(x-2)^2 - 12 + 7$$

$$= 3(x-2) - 5$$

(3)

The line **L** is the line of symmetry of the curve with equation $y = 3x^2 - 12x + 7$

(b) Using your answer to part (a) or otherwise, write down an equation of **L**.

$$x = 2$$

(1)

(Total for Question 20 is 4 marks)

21 The curve with equation $y = (10x - 3)(x + 1)$ and the line with equation $y - 6x = 0$ intersect at the points A and B.

Find the coordinates of the midpoint of AB.
Show your working clearly.

$$y = 6x$$

$$6x = (10x - 3)(x + 1)$$
$$6x = 10x^2 - 3x + 10x - 3$$
$$0 = 10x^2 + x - 3$$
$$0 = (5x + 3)(2x - 1)$$

$$x = -\frac{3}{5} \qquad\qquad x = \frac{1}{2}$$

$$y = 6\left(\frac{-3}{5}\right) \qquad\qquad y = 6\left(\frac{1}{2}\right)$$
$$= -3.6 \qquad\qquad = 3$$

$$\text{mid pt} = \left(\frac{-\frac{3}{5} + \frac{1}{2}}{2}, \frac{-3.6 + 3}{2}\right)$$

$$(-0.05, -0.3)$$

(Total for Question 21 is 6 marks)

$45° = \dfrac{1}{8}$
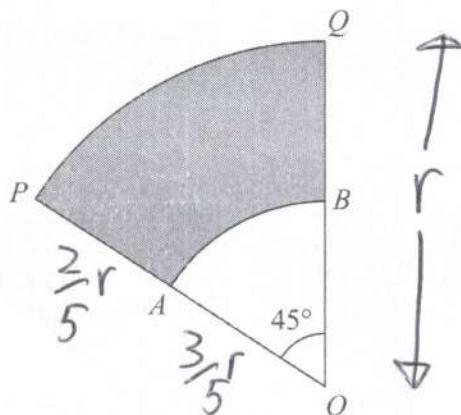
Diagram **NOT** accurately drawn

OPQ is a sector of a circle, centre *O*
OAB is a sector of a circle, centre *O*

A is the point on *OP* such that *OA* : *AP* = 3 : 2
B is the point on *OQ* such that *OB* : *BQ* = 3 : 2
Angle *POQ* = 45°

The area of the shaded region is $\dfrac{81}{2}\pi$ cm²

Work out the perimeter of the shaded region.
Give your answer in terms of π.

$$\frac{81}{2}\pi = \frac{1}{8}\pi r^2 - \frac{1}{8}\pi\left(\frac{3}{5}r\right)^2$$

$$324 = r^2 - \frac{9r^2}{25} = \frac{16r^2}{25}$$

$$r = 22.5 \quad \text{and} \therefore \tfrac{3}{5}r = 13.5, \tfrac{2}{5}r = 9$$

$$\text{Per} = 9 + 9 + \frac{1}{8}\left(2 \times \pi \times 13.5 + 2 \times \pi \times 22.5\right)$$

$$= \underline{18 + 9\pi \ \text{cm}}$$

23 The 10th term of an arithmetic series, S, is 66

The sum of the first 20 terms of S is 1290

Find the 5th term of S.

Show your working clearly.

$$t_{10} = a + 9d = 66 \qquad \boxed{\times 2}$$

$$S_{20} = \frac{20}{2}\left[2a + 19d\right] = 1290$$

$$2a + 19d = 129$$

$$\rightarrow \quad \underline{2a + 18d = 132}$$

$$\underline{d = -3}$$

$$a + 9(-3) = 66$$

$$a = 93$$

$$t_5 = a + 4d = 93 + 4(-3)$$

$$= 93 - 12$$

$$= \underline{\underline{81}}$$

(Total for Question 23 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS