Write your name here:

Surname:	Other Names:

Mathematics
Predicted Paper 1
(Non Calculator)
Higher Tier
Time: 1 hour 30 minutes

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser

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.
- Answer the questions in the spaces provided
- there may be more space than you need.
- **Calculators may not be used.**
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- You must **show all your working out.**

Information

- The total mark for this paper is 80
- 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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

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Answer ALL questions.

Write your answers in the spaces provided.

You must write down all stages in your working.

You must NOT use a calculator.

1 (a) Work out $\dfrac{1}{7} \times \dfrac{2}{3}$

$\dfrac{2}{21}$

(1)

(b) Work out $\overset{3x}{\underset{3x}{}} \dfrac{3}{5} - \dfrac{1}{3} \overset{\times 5}{\underset{\times 5}{}}$

$\dfrac{9}{15} - \dfrac{5}{15} = \dfrac{4}{15}$

$\dfrac{4}{15}$

(2)

(Total for Question 1 is 3 marks)

2

<table>
<tr><td colspan="1">Competition

a prize every 2014 seconds</td></tr>
</table>

2000

In a competition, a prize is won every 2014 seconds.

Work out an estimate for the number of prizes won in 24 hours.
You must show your working.

20

$$20 \times 60 \times 60$$
$$\overline{}$$
$$2000$$

$$\frac{72000}{2000} = \frac{72}{2} = 36$$

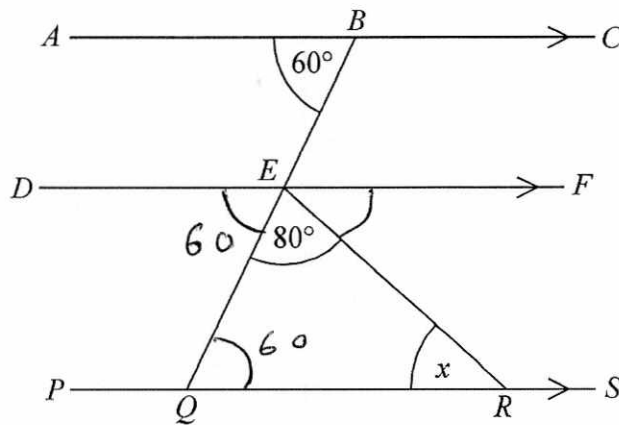Underestimate : rounded 24 down to 20.

(Total for Question 2 is 4 marks)

3

Diagram **NOT**
accurately drawn

ABC, *DEF* and *PQRS* are parallel lines.
BEQ is a straight line.

Angle *ABE* = 60°
Angle *QER* = 80°

Work out the size of the angle marked *x*.
Give reasons for each stage of your working.

$DEQ = 60°$ (corresponding angles are equal

$EQR = 60°$ (Alternate angles are equal)

$x = \underline{40°}$ (Angles in a triangle sum to 180°)

(Total for Question 3 is 4 marks)

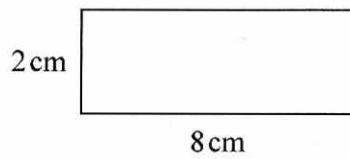**4** Here is a rectangle.

2 cm

8 cm

Diagram **NOT**
accurately drawn

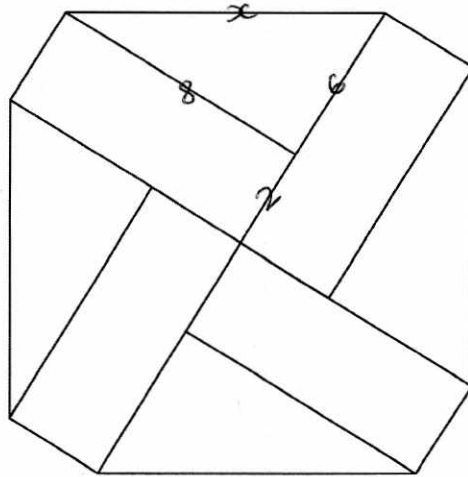The 8-sided shape below is made from 4 of these rectangles and 4 congruent right-angled triangles.

Diagram **NOT**
accurately drawn

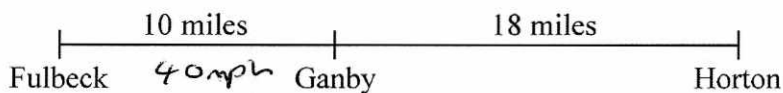Work out the perimeter of the 8-sided shape.
You must show all your working.

$$6^2 + 8^2 = x^2$$
$$36 + 64 = x^2$$
$$100 = x^2$$
$$x = 10$$

$$\text{Perimeter} = 4(10) + 4(2)$$
$$= 48 \text{ cm}$$

48 cm

(Total for Question 4 is 5 marks)

5 The distance from Fulbeck to Ganby is 10 miles.
The distance from Ganby to Horton is 18 miles.

```
   |——————10 miles——————|——————————18 miles——————————|
  Fulbeck      40mph     Ganby                        Horton
```

Raksha is going to drive from Fulbeck to Ganby.
Then she will drive from Ganby to Horton.

Raksha leaves Fulbeck at 10 00
She drives from Fulbeck to Ganby at an average speed of 40 mph.

Raksha wants to get to Horton at 10 35

Work out the average speed Raksha must drive at from Ganby to Horton.

FULBECK → GANBY

$$\text{Time} = \frac{Distance}{Speed}$$

$$= \frac{10}{40} = \frac{1}{4} \text{ (hours)} = 15 \text{ mins}$$

10:15 At Ganby

20 mins to get to Horton

$$\frac{20}{60} = \frac{1}{3} \text{ of an hour}$$

$$\text{Speed} = \frac{distance}{time}$$

$$= \frac{18}{\frac{1}{3}} = 18 \times 3 = 54$$

............**54**............ mph

(Total for Question 5 is 3 marks)

6 Adam, Ben and Charlie share some money.

Adam gets 1.5 times as much as Ben.
Ben gets 3 times as much as Charlie.

If they shared £68 in total, how much does Charlie have?

$$A : B \qquad B : C$$
$$\times 2 \; \frac{1.5 : 1}{3 : 2} \times 2 \qquad \times 2 \; \frac{3 : 1}{6 : 2} \times 2$$
$$\times 3 \; \frac{9 : 6}{} \times 3$$

~~6 : 4~~
~~9 : 6 : C~~
~~A : B :~~

$$A : B : C$$
$$9 : 6 : 2$$

17 PARTS

$$\frac{68}{17} = 4$$

Charlie $\quad 4 \times 2 = £8$

£8

(Total for Question 6 is 3 marks)

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7 Prove that the sum of the squares of 2 consecutive odd numbers is always 2 more than a multiple of 8.

$$(2n+1)^2 \quad + \quad (2n+3)^2$$

$$(2n+1)(2n+1) \quad + \quad (2n+3)(2n+3)$$

$$4n^2 + 2n + 2n + 1 \quad + \quad 4n^2 + 6n + 6n + 9$$

$$8n^2 + 16n + 10$$

$$8n^2 + 16n + 8 + 2$$

$$8(n^2 + 2n + 1) + 2$$

(Total for Question 7 is 3 marks)

8 The table shows information about the times taken by 100 people in a fun run.

Time (t minutes)	Frequency
$20 < t \leqslant 30$	4
$30 < t \leqslant 40$	16
$40 < t \leqslant 50$	36
$50 < t \leqslant 60$	24
$60 < t \leqslant 70$	14
$70 < t \leqslant 80$	6

(a) Complete the cumulative frequency table for this information.

Time (t minutes)	Cumulative frequency
$20 < t \leqslant 30$	4
$20 < t \leqslant 40$	20
$20 < t \leqslant 50$	56
$20 < t \leqslant 60$	80
$20 < t \leqslant 70$	94
$20 < t \leqslant 80$	100

(1)

(b) On the grid, draw a cumulative frequency graph for your table.

(2)
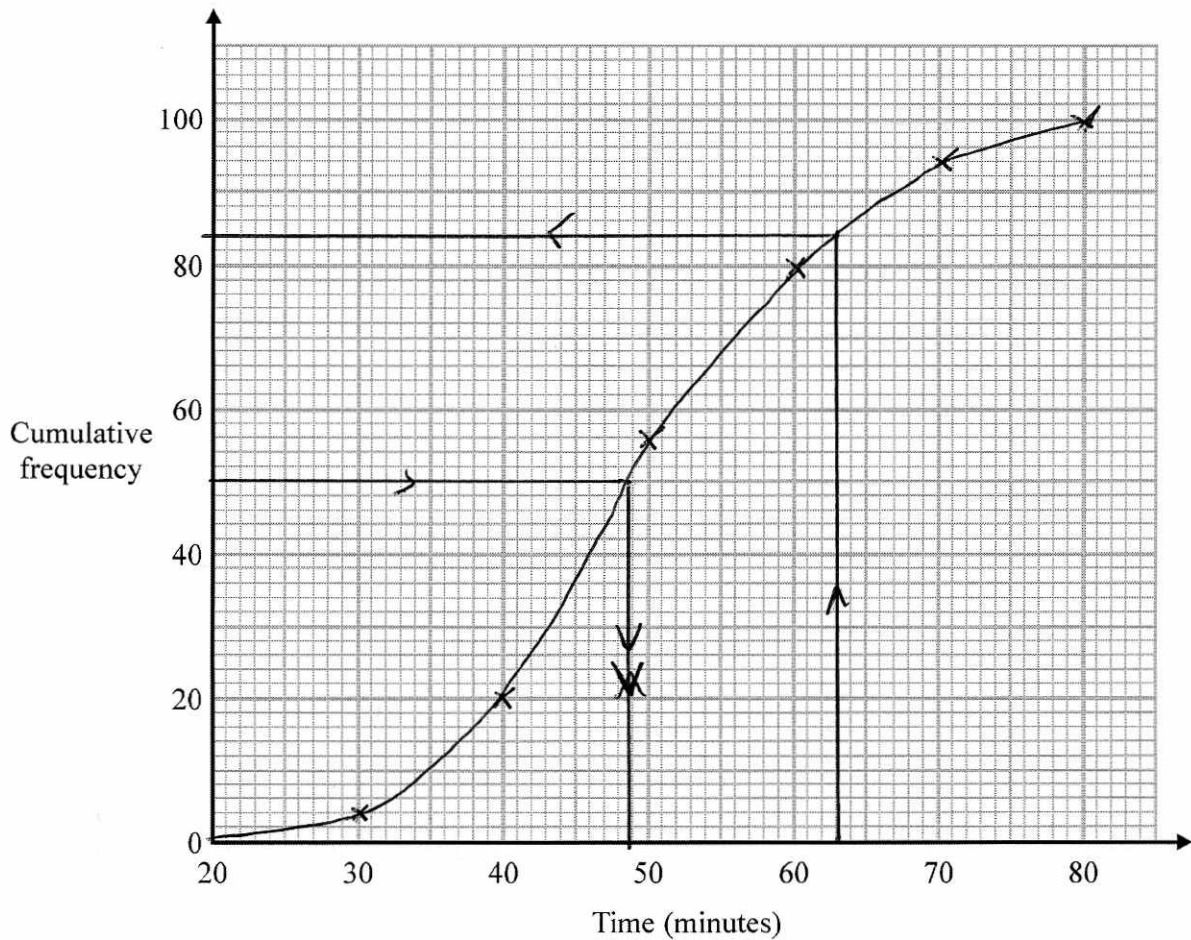
(c) Use your graph to find an estimate for the median time.

........49........ minutes

(1)

(d) Use your graph to find an estimate for the number of people who took longer than 63 minutes.

$100 - 84$

........16........

(2)

(Total for Question 8 is 6 marks)

9 (a) Factorise $24x^2y^2 + 12xy$

$$12xy(2xy + 1)$$

(2)

(b) Factorise $ef - 4e + 3f - 12$

$$(e + 3)(f - 4)$$

(2)

(c) Factorise $x^2 - 16$

$$(x + 4)(x - 4)$$

(1)

(Total for Question 9 is 5 marks)

10 $x = 0.0\dot{4}\dot{5}$

Prove algebraically that x can be written as $\dfrac{1}{22}$

$$0.0\dot{4}\dot{5} = x$$
$$0.\dot{4}\dot{5} = 10x$$
$$45.\dot{4}\dot{5} = 1000x$$
$$45 = 990x$$
$$x = \frac{45}{990}$$
$$= \frac{1}{22}$$

(Total for Question 10 is 3 marks)

11 $v^2 = u^2 + 2as$

(a) Find the value of s when $u = -4$, $v = 5$ and $a = 10$

$$(5)^2 = (-4)^2 + 2(10)(s)$$

$$25 = 16 + 20s$$

$$9 = 20s$$

$$s = \frac{9}{20}$$

$\frac{9}{20}$

(2)

$$f = \sqrt{\frac{g}{g+1}}$$

(b) Make g the subject of the formula.

$$f^2 = \frac{g}{g+1}$$

$$f^2(g+1) = g$$

$$f^2 g + f^2 = g$$

$$f^2 = g - f^2 g$$

$$f^2 = g(1 - f^2)$$

$$g = \frac{f^2}{1-f^2}$$

$g = \frac{f^2}{1-f^2}$

(3)

(Total for Question 11 is 5 marks)

12 f is inversely proportional to d.
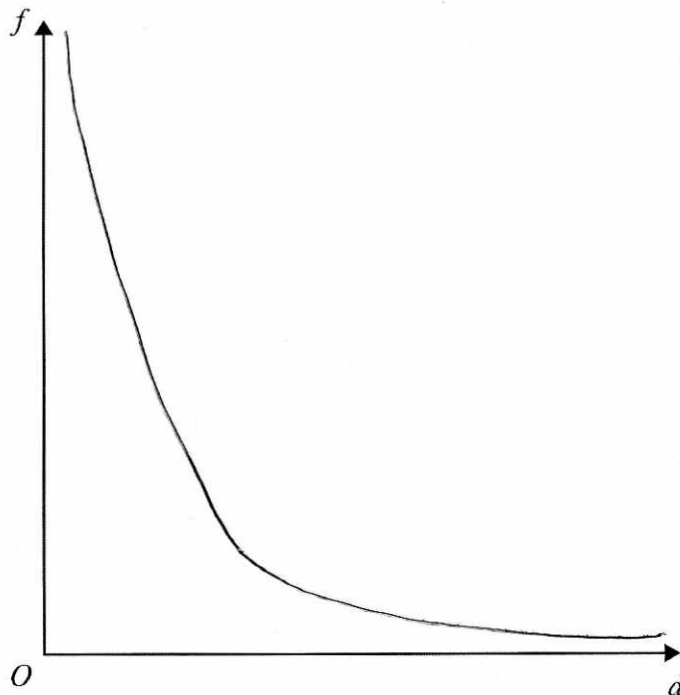
When $d = 20$, $f = 64$

(a) Find a formula for f in terms of d.

$$f = \frac{k}{d}$$
$$64 = \frac{k}{20}$$
$$k = 1280$$

$$f = \frac{1280}{d}$$

(3)

(b) Sketch the graph of f against d for positive values of d.

(1)

(Total for Question 12 is 4 marks)

13 (a) Simplify $\sqrt{3}\left(2\sqrt{3} + \dfrac{1}{\sqrt{3}}\right)$

$2\sqrt{9} + \dfrac{\sqrt{3}}{\sqrt{3}}$

$2(3) + 1$

$6 + 1$

................................7...........
(2)

(b) Rationalise the denominator of $\dfrac{15}{5 - \sqrt{7}}$

Give your answer in its simplest form.

$\dfrac{15}{(5-\sqrt{7})} \dfrac{(5+\sqrt{7})}{(5+\sqrt{7})}$

$\dfrac{75 + 15\sqrt{7}}{25 + 5\sqrt{7} - 5\sqrt{7} - 7}$

$\dfrac{75 + 15\sqrt{7}}{18}$

$\dfrac{25 + 5\sqrt{7}}{6}$

................$\dfrac{25+5\sqrt{7}}{6}$.............
(3)

(Total for Question 13 is 5 marks)

14 (a) Simplify fully $(3e)^0$

.... 1

(1)

(b) Simplify fully $\left(\dfrac{64x^6}{25y^2}\right)^{-\frac{1}{2}}$

$$\left(\frac{25y^2}{64x^6}\right)^{\frac{1}{2}}$$

$\dfrac{5y}{8x^3}$

(2)

(c) Write $\dfrac{5}{x-3} - \dfrac{4}{x+3}$ as a single fraction in its simplest form.

$$\frac{5(x+3)}{(x-3)(x+3)} - \frac{4(x-3)}{(x-3)(x+3)}$$

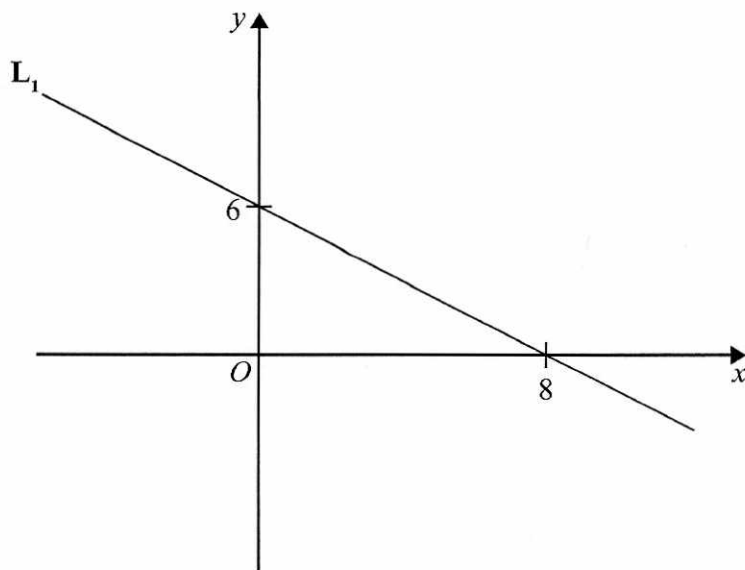$$\frac{5(x+3) - 4(x-3)}{(x-3)(x+3)}$$

$$\frac{5x+15-4x+12}{(x+3)(x-3)}$$

$$\frac{x+27}{(x+3)(x-3)}$$

$\dfrac{x+27}{(x+3)(x-3)}$

(3)

(Total for Question 14 is 6 marks)

15 The diagram shows a straight line L_1

The line L_2 is parallel to L_1 and passes through the point (2, 1).

(a) Find an equation of the line L_2
Give your answer in the form $y = mx + c$

$$L_1 \qquad m = \frac{-6}{8} = -\frac{3}{4}$$

$$L_2: \qquad y = -\frac{3}{4}x + c \qquad (2, 1)$$
$$\phantom{L_2: \qquad y = -\frac{3}{4}x + c \qquad} x \quad y$$

$$1 = -\frac{3}{4}(2) + c$$

$$1 = -1.5 + c$$

$$c = 2.5$$

...... $y = -3/4 x + 2.5$ ......

(2)

The line L_3 is perpendicular to L_1 and passes through the point $(0, -5)$.

(b) Find an equation of the line L_3

Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.

$$m = \frac{4}{3} \quad \text{(negative reciprocal)}$$

$$y = \frac{4}{3}x - 5$$

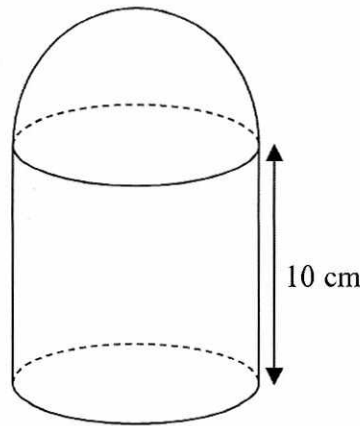$$3y = 4x - 15$$

$$4x - 3y - 15 = 0$$

$$4x - 3y - 15 = 0$$
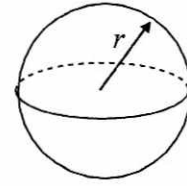$$y = \frac{4}{3}x - 5$$

(3)

(Total for Question 15 is 5 marks)

16 The diagram shows a solid shape.

$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$

$$\text{Surface area of sphere} = 4\pi r^2$$

The solid shape is made from a cylinder and a hemisphere.
The radius of the cylinder is equal to the radius of the hemisphere.

The cylinder has a height of 10 cm.
The curved surface area of the hemisphere is 32π cm².

Work out the total surface area of the solid shape.
Give your answer in terms of π.

Surface Area of Hemisphere $= 2\pi r^2$

$$\frac{32\pi}{2\pi} = \frac{2\pi r^2}{2\pi}$$

$$16 = r^2$$

$$r = 4$$

Area of circle $= \pi r^2$
$$= \pi (4)^2$$
$$\boxed{= 16\pi}$$

Circumference of circle $= 2\pi (r)$
$$= 2\pi (4)$$
$$= 8\pi$$

Area of curved part of cylinder
$$= 8\pi \times 10 = \boxed{80\pi}$$

32π
$+16\pi$
$+80\pi$

............128π............ cm²

(Total for Question 16 is 5 marks)

17 There are n sweets in a bag.
6 of the sweets are orange.
The rest of the sweets are yellow.

Hannah takes at random a sweet from the bag.
She eats the sweet.

Hannah then takes at random another sweet from the bag.
She eats the sweet.

The probability that Hannah eats two orange sweets is $\dfrac{1}{3}$

(a) Show that $n^2 - n - 90 = 0$

$$\frac{6}{n-1} \cdot 0 \quad \frac{5}{n-1} = 0$$

$$\frac{6}{n} \cdot 0 \qquad \frac{n-6}{n-1} y$$

$$\frac{6}{n-6} y \qquad \frac{6}{n-1} \cdot 0$$

$$\frac{n-6}{n} \qquad \frac{n-7}{n-7} y$$

$$\frac{6}{n} \times \frac{5}{n-1} = \frac{1}{3}$$

$$\frac{30}{n(n-1)} = \frac{1}{3}$$

$$30 = \frac{n(n-1)}{3}$$

$$90 = n(n-1)$$

$$90 = n^2 - n$$

$$0 = n^2 - n - 90$$

(3)

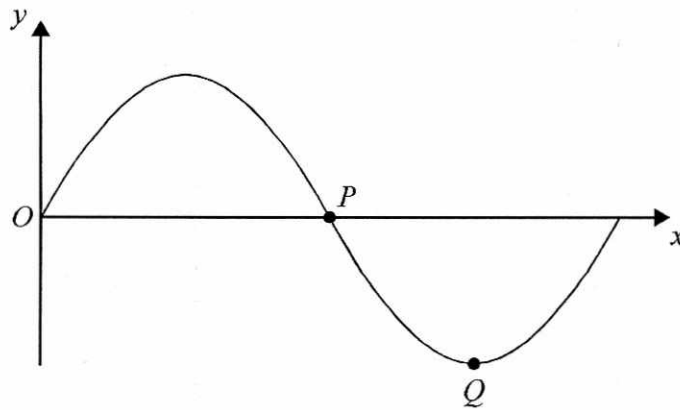(b) Solve $n^2 - n - 90 = 0$ to find the value of n.

$$(n - 10)(n + 9) = 0$$

$$n = 10 \qquad n = -9$$

n cannot be negative

10

(3)

(Total for Question 17 is 6 marks)

18 The diagram shows part of a sketch of the curve $y = \sin x°$.
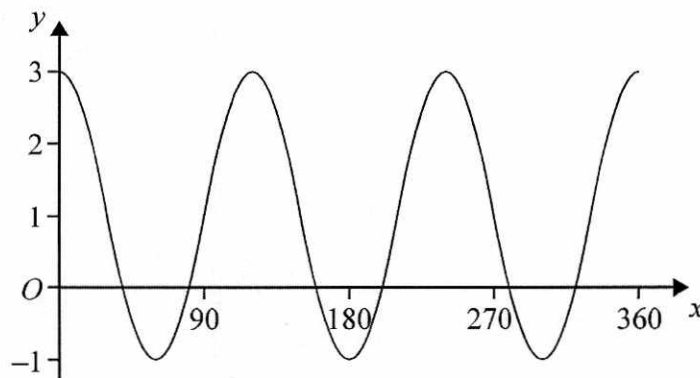

(a) Write down the coordinates of the point P.

(180   ,   0   )

(1)

(b) Write down the coordinates of the point Q.

(270   ,   −1   )

(1)

Here is a sketch of the curve $y = a\cos bx° + c$, $\quad 0 \leqslant x \leqslant 360$

(c) Find the values of a, b and c.

$a =$ 2

$b =$ 3

$c =$ 1

(3)

(Total for Question 18 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS