Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE

Centre Number	Candidate Number

Thursday 4 June 2020

Morning (Time: 2 hours) | Paper Reference **4MA1/2HR**

Mathematics A
Paper 2HR
Higher Tier

You must have:
Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.

Total Marks

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.

Turn over

P64693A

1/1/1/1/

P 6 4 6 9 3 A 0 1 2 8

Pearson

International GCSE Mathematics

Formulae sheet – Higher Tier

Arithmetic series

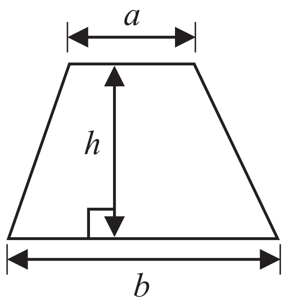
Sum to n terms, $S_n = \dfrac{n}{2}\,[2a + (n - 1)d]$

The quadratic equation

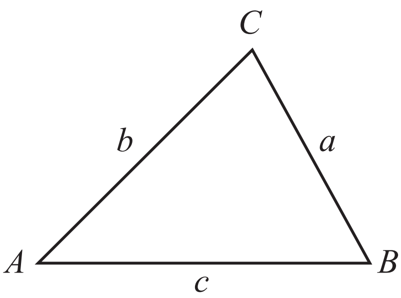
The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$ are given by:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Area of trapezium $= \dfrac{1}{2}(a + b)h$



Trigonometry



In any triangle *ABC*

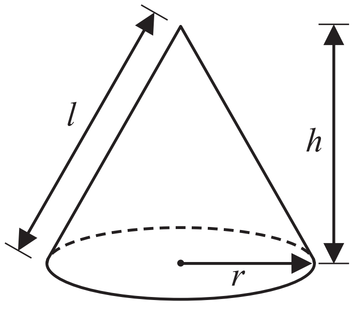
Sine Rule $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine Rule $a^2 = b^2 + c^2 - 2bc\cos A$

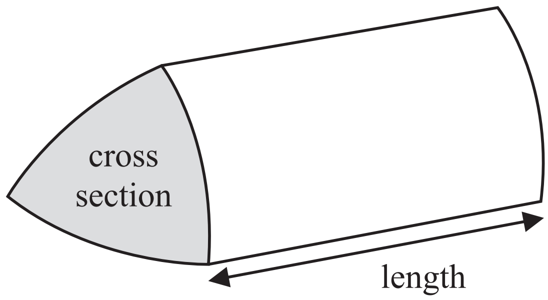
Area of triangle $= \dfrac{1}{2}ab\sin C$

Volume of cone $= \dfrac{1}{3}\pi r^2 h$

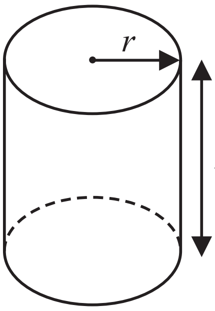
Curved surface area of cone $= \pi rl$



Volume of prism
= area of cross section × length

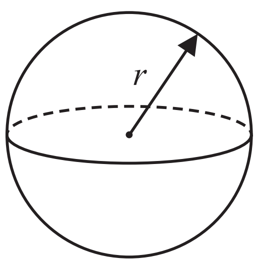


Volume of cylinder $= \pi r^2 h$
Curved surface area of cylinder $= 2\pi rh$



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

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



Answer ALL TWENTY SIX questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 The probability that a spinner will land on blue is 0.4

Rayyan is going to spin the spinner 280 times.
Work out an estimate for the number of times the spinner will land on blue.

0.4×280 1

$= 112$ times 1

112

(Total for Question 1 is 2 marks)

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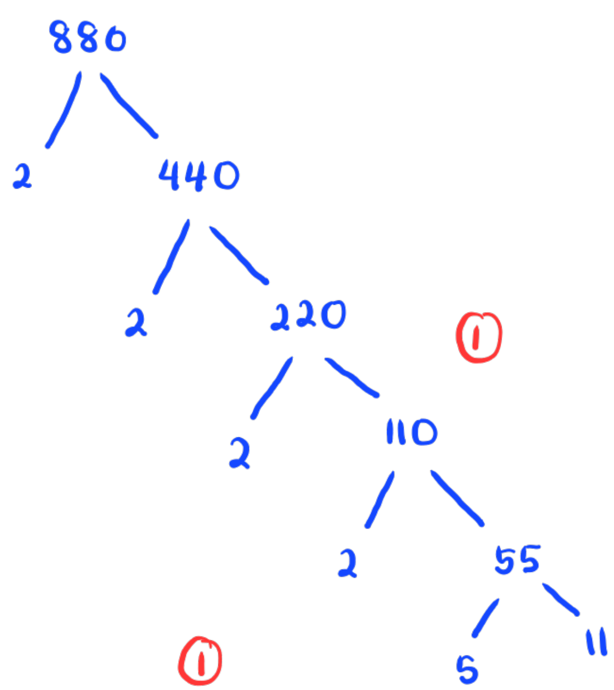
2 Write 880 as a product of powers of its prime factors.
Show your working clearly.



1

1

$2 \times 2 \times 2 \times 2 \times 5 \times 11 = 880$

$2^4 \times 5 \times 11 = 880$

1

$2^4 \times 5 \times 11$

(Total for Question 2 is 3 marks)

3 (a) Write 2.46×10^6 as an ordinary number.

2.460000 ← $\times 10$ six times

$= 2460\,000$ (1)

$2460\,000$

(1)

(b) Write 0.000 74 in standard form.

0.00074 ← 4 times

$= 7.4 \times 10^{-4}$ (1)

7.4×10^{-4}

(1)

(c) Work out $(5.6 \times 10^6) + (2.3 \times 10^5)$

$(5.6 \times 10^6) + (2.3 \times 10^5)$

$= (56 \times 10^5) + (2.3 \times 10^5)$ ← convert to 10^5

$= (56 + 2.3) \times 10^5$

$= 58.3 \times 10^5$ (1)

convert back to 10^6 for standard form

$= 5.83 \times 10^6$ (1)

5.83×10^6

(2)

(Total for Question 3 is 4 marks)

4 Alexa has five cards.
Each card has a number on it.

The table gives information about the numbers on the five cards.

Total	Median	Mode	Range
45	8	5	10

Using the information in the table, complete each card by writing its number on it.

Median : 8 (means two number smaller and two number larger than 8)

Mode : 5 (means appear the most . Since 8 is median, there are two 5s)

Range : 10 . (since 5 is the smallest number, largest number is 15)

total : 45 . The remaining card is 45 - 5 - 5 - 8 - 15 = 12

5	5	8	12	15

3

(Total for Question 4 is 3 marks)

---

5 The length of a book is 33.8 cm, correct to one decimal place.

(a) Write down the lower bound of the length of the book.

33.75 1 cm
(1)

(b) Write down the upper bound of the length of the book.

33.85 1 cm
(1)

(Total for Question 5 is 2 marks)

6 Nav has worked out $\frac{68.3 \times 42.8}{0.021}$ on his calculator.

His answer is 139 201.9048

Without using a calculator and using suitable approximations, check that his answer is sensible.
Show your working clearly.

For approximation :

let $68.3 = 70$ ← round up

$42.8 = 40$ ← round down

$0.021 = 0.02$

$$\frac{70 \times 40}{0.02} = \frac{2800}{0.02} = \frac{2800}{\frac{2}{100}}$$

$$= \frac{280000}{2}$$

$= 140\,000$. Yes his answer is sensible .

(Total for Question 6 is 2 marks)

7 Markus makes a steel framework.
The framework is in the shape of the right-angled triangle *ABC* shown in the diagram.

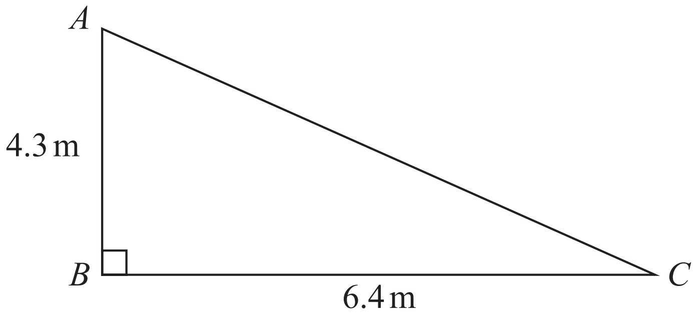


Diagram **NOT** accurately drawn

The steel that Markus uses costs $22 per metre.
The steel can **only** be bought in a length that is a whole number of metres.

Work out the total cost of the steel that Markus buys in order to make the framework.

Finding length AC using Pythagoras' Theorem :

$AC = \sqrt{4.3^2 + 6.4^2}$ 1

$= 7.71$ m 1

Finding total length of framework :

7.71 m + 4.3 m + 6.4 m = 18.4 m

∴ Since steel can only be bought in whole number of metres,
round up 18.4 m to 19 m.
cannot round down to 18 m. Not enough for total framework.

Total cost of steel : 19 × $22 1

= $418 1

$ 418

(Total for Question 7 is 4 marks)

8 Alison buys 2 boxes of strawberries, box **A** and box **B**.

Box **A** contains 15 strawberries.
The strawberries in box **A** have a mean weight of 24 grams.

$$\text{mean} = \frac{\text{total weight}}{\text{no. of strawberry}}$$

Box **B** contains 25 strawberries.
The strawberries in box **B** have a mean weight of 18 grams.

Alison puts all 40 strawberries into a bowl.
Work out the mean weight of the 40 strawberries.

Calculating total weight of box A :

$24 \times 15 = 360\text{ g}$

Calculating total weight of box B :

$18 \times 25 = 450\text{ g}$ 1

Calculating total weight of all strawberries :

$360 + 450 = 810\text{ g}$ 1

Mean weight of 40 strawberries :

$$\frac{810\text{ g}}{40} = 20.25\text{ g}$$ 1

20.25 grams

(Total for Question 8 is 3 marks)

9 (a) Factorise $x^2 - x - 42$

$(x+6)(x-7)$

(2)

$(x+6)(x-7)$

(2)

(b) Solve the inequality $3x + 15 < 8x + 3$

Show clear algebraic working.

$3x + 15 < 8x + 3$

$15 - 3 < 8x - 3x$ (1)

$12 < 5x$ (1)

$\frac{12}{5} < x$ (1)

$x > \frac{12}{5}$

(3)

(Total for Question 9 is 5 marks)

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10 Given that $150^x = 1$

(a) write down the value of x.

$x^0 = 1$

$x =$ 0 (1)

(1)

Given that $3^{-8} \div 3^{-6} = 3^n$

(b) find the value of n.

$\frac{3^{-8}}{3^{-6}} = 3^n$

$3^{(-8-(-6))} = 3^n$

$3^{-2} = 3^n$

$n = -2$

$a^m \times a^n = a^{m+n}$

$a^m \div a^n = a^{m-n}$

$n =$ -2 (1)

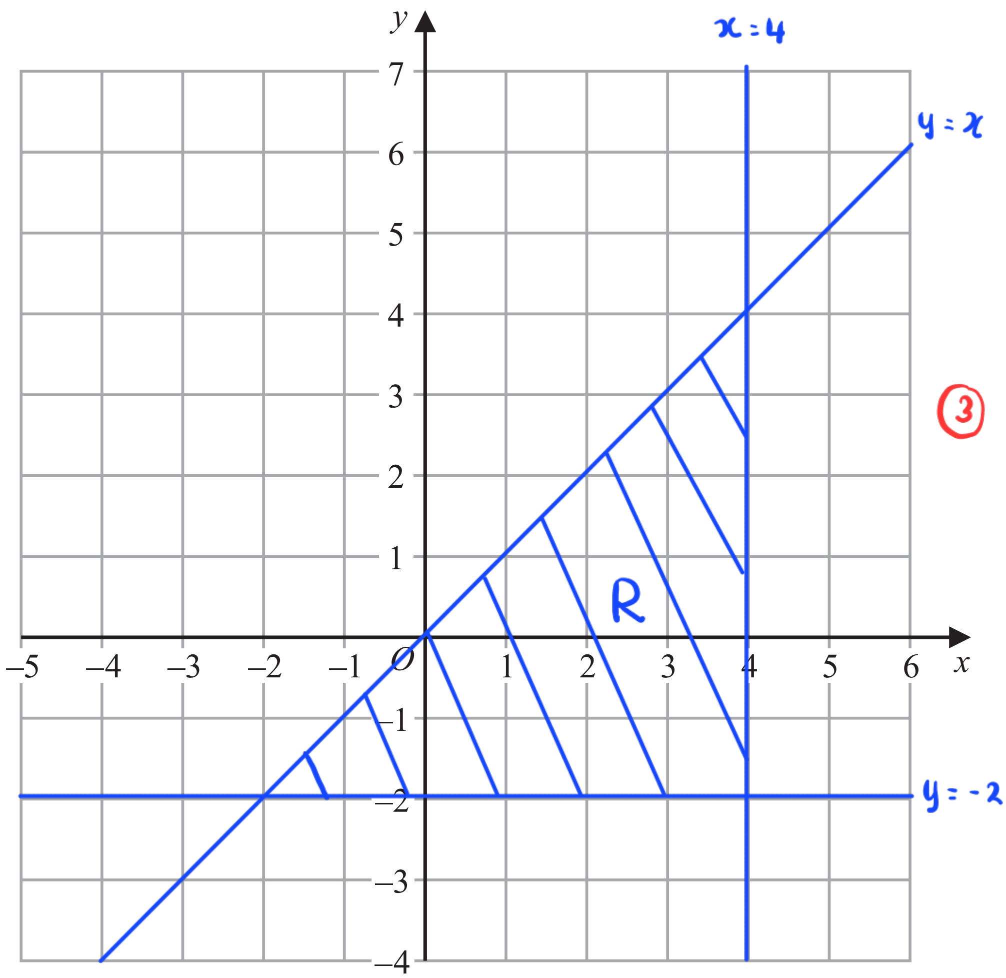
(1)

(Total for Question 10 is 2 marks)

11 Show, by shading on the grid, the region that satisfies all three of the inequalities

$$x \leqslant 4 \qquad \text{and} \qquad y \geqslant -2 \qquad \text{and} \qquad y \leqslant x$$

Label the region **R**.



③

(Total for Question 11 is 3 marks)

12 Find the gradient of the straight line with equation $5x + 2y = 7$

Equation of straight line : $y = mx + c$

Rearrange equation to $y = mx + c$

where m = gradient
c = y-intercept

$5x + 2y = 7$

$2y = -5x + 7$

$y = \boxed{-\frac{5}{2}}x + \frac{7}{2}$ ①

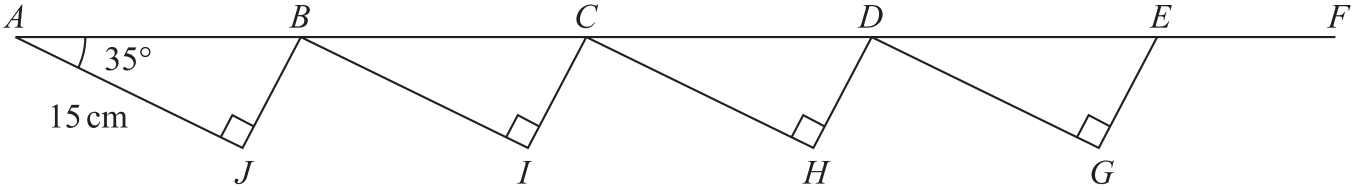
gradient, m

$-\frac{5}{2}$ ①

(Total for Question 12 is 2 marks)

13 The diagram shows four congruent right-angled triangles *ABJ*, *BCI*, *CDH* and *DEG*.
The diagram also shows the straight line *ABCDEF*.

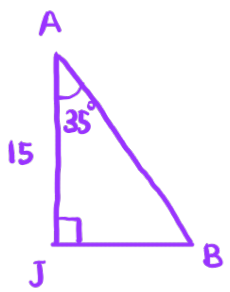
Diagram **NOT** accurately drawn



$AJ = 15$ cm
Angle $BAJ = 35°$

$AF = 80$ cm

Work out the length of *EF*.
Give your answer correct to 3 significant figures.



$\cos 35° = \frac{AJ}{AB}$

$AB = \frac{AJ}{\cos 35°}$

length $AB = \frac{15\text{ cm}}{\cos 35°}$ (1)

$= 18.3$ cm (1)

since all triangles are congruent :

length $AE = 4 \times 18.3$ cm

$= 73.2$ cm (1)

length $EF = AF - AE$

$= 80 - 73.2$ (1)

$= 6.75$ cm (1)

6.75 cm

(Total for Question 13 is 5 marks)

14 Sandeep sat 11 tests in January 2020
Each test was marked out of 60

Here are his test results.

45 41 35 44 38 47 47 39 37 43 42

(a) Find the interquartile range of these test results.
Show your working clearly.

arrange the data from smallest to largest

$$\underbrace{35 \quad 37 \quad \overset{Q_1}{38} \quad 39 \quad 41}_{\text{lower quartile}} \quad 42 \quad \underbrace{43 \quad 44 \quad \overset{Q_3}{45} \quad 47 \quad 47}_{\text{upper quartile}} \quad (1)$$

median

Median $= \frac{11+1}{2} = 6\text{th term}$

median of lower quartile, $Q_1 = 38$

median of upper quartile, $Q_3 = 45$ (1)

interquartile range $= Q_3 - Q_1$
$= 45 - 38$
$= 7$

7 (1)

(3)

Sandeep also sat some tests in May 2020
Each test was marked out of 60

The median of the May 2020 test results is 42
The interquartile range of the May 2020 test results is 12

(b) In which month, January or May, were Sandeep's test results more consistent?
Give a reason for your answer.

January. As the interquartile range is lower. (1)

(1)

(Total for Question 14 is 4 marks)

15 Platinum nuggets are in the shape of a solid cylinder.

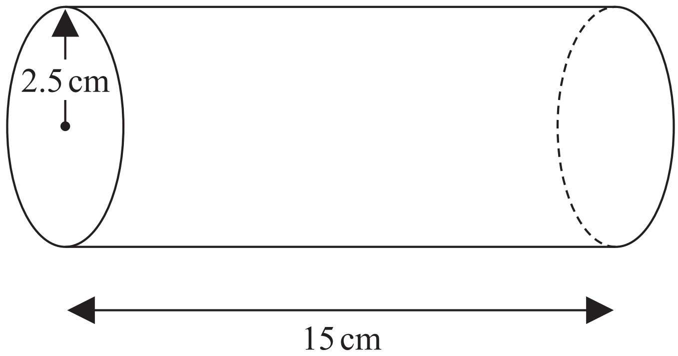


Diagram **NOT** accurately drawn

The radius of each cylinder is 2.5 cm.
The length of each cylinder is 15 cm.

The density of platinum is 21.5 g/cm^3

The greatest mass that Jacques can carry is 30 kg.

Can Jacques carry 5 platinum nuggets at the same time?
You must show all your working.

$\text{density} = \dfrac{\text{mass}}{\text{volume}}$

volume of cylinder $= \pi r^2 h$

Finding the volume of platinum nugget:

$\pi \times 2.5^2 \times 15 = 294.52\ cm^3$ 1

Finding mass of a platinum nugget:

$21.5\ g/cm^3 = \dfrac{\text{mass}}{294.52\ cm^3}$ 1

$kg \xrightarrow{\times 1000} g$, $g \xrightarrow{\div 1000} kg$

$\text{mass} = 294.52\ cm^3 \times 21.5\ g/cm^3$ 1

$= 6332.27\ g \div 1000$ ← convert g to kg

$= 6.33227\ kg$

Finding mass of 5 platinum nuggets:

$5 \times 6.33227\ kg = 31.661\ kg > 30\ kg$
1

$\therefore$ No. Jacques cannot carry 5 platinum nuggets at a time. 1

(Total for Question 15 is 5 marks)

16

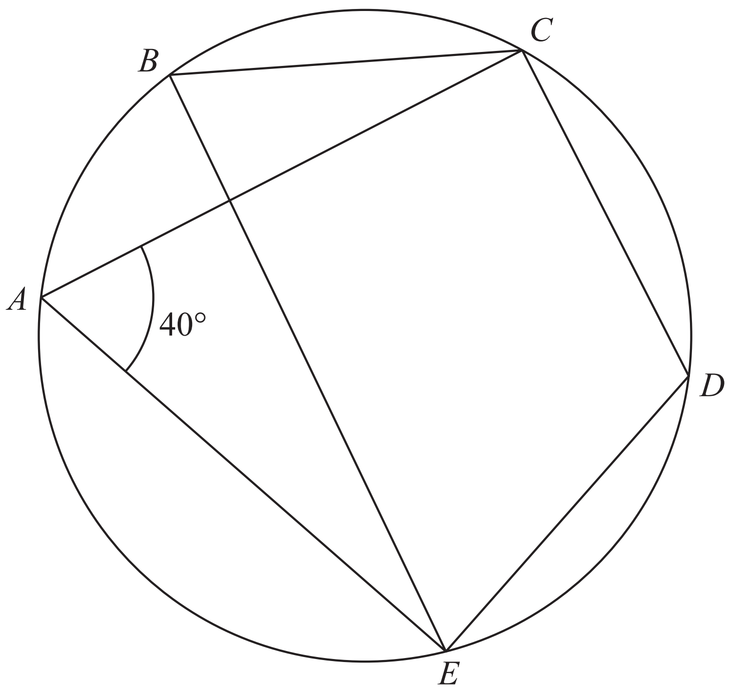


Diagram **NOT** accurately drawn

A, *B*, *C*, *D* and *E* are points on a circle.

Angle $EAC = 40°$

(a) (i) Write down the size of angle *EBC*.

angle EBC = angle EAC = 40°

40 (1) °

(1)

(ii) Give a reason for your answer.

Angles in the same segment are equal. (1)

(1)

(b) Find the size of angle *EDC*.

opposite angles in a cyclic quadrilateral sums up to 180°.

angle EDC = 180° − angle EAC

= 180° − 40°

= 140° (1)

140 °

(1)

(Total for Question 16 is 3 marks)

17 Given that $n > 0$

make n the subject of the formula $y = \dfrac{n^2 + d}{n^2}$

$$y = \frac{n^2 + d}{n^2}$$

$\times n^2$

$$yn^2 = n^2 + d \quad (1)$$

$- n^2$

$$yn^2 - n^2 = d \quad (1)$$

$$n^2(y-1) = d \quad (1)$$

$\div (y-1)$

$$n^2 = \frac{d}{y-1}$$

$\sqrt{}$

$$n = \sqrt{\frac{d}{y-1}} \quad (1)$$

$n = \sqrt{\dfrac{d}{y-1}}$

(Total for Question 17 is 4 marks)

18 (a) Complete the table of values for $y = \frac{1}{2}x^3 - 2x + 3$

x	–3	–2	–1	0	1	2	3
y	–4.5	3	4.5	3	1.5	3	10.5

2

when $x = -2$, $y = \frac{1}{2}(-2)^3 - 2(-2) + 3$

$= \frac{1}{2}(-8) + 4 + 3 = 3$

when $x = -1$, $y = \frac{1}{2}(-1)^3 - 2(-1) + 3$

$= \frac{1}{2}(-1) + 2 + 3 = 4.5$

when $x = 1$, $y = \frac{1}{2}(1)^3 - 2(1) + 3$

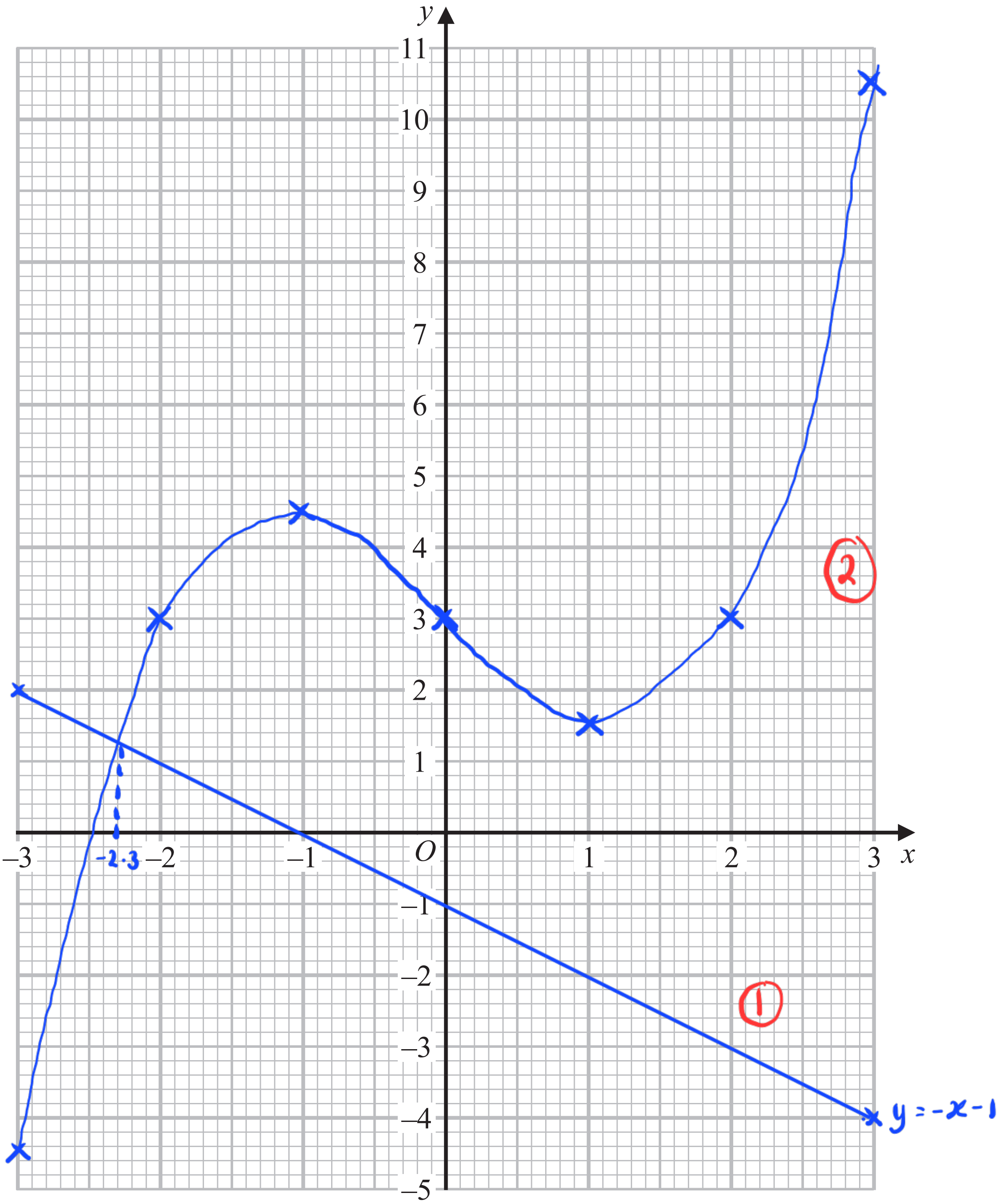
$= \frac{1}{2}(1) - 2 + 3 = 1.5$

when $x = 3$, $y = \frac{1}{2}(3)^3 - 2(3) + 3$

$= \frac{1}{2}(27) - 6 + 3 = 10.5$

(2)

(b) On the grid, draw the graph of $y = \frac{1}{2}x^3 - 2x + 3$ for $-3 \leqslant x \leqslant 3$



(2)

(c) By drawing a suitable straight line on the grid, find an estimate for the solution of the equation $\frac{1}{2}x^3 - x + 4 = 0$

$\frac{1}{2}x^3 - x + 4 = 0$ $\quad + (-x-1)$

$\frac{1}{2}x^3 - 2x + 3 = -x - 1$

$x =$ -2.3 (1)

(2)

(Total for Question 18 is 6 marks)

19

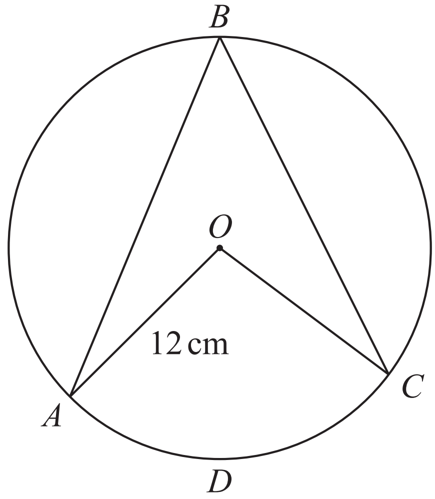


Diagram **NOT** accurately drawn

A, B, C and D are points on a circle with centre O and radius 12 cm.

The area of the sector $OADC$ of the circle is 100 cm^2

Work out the size of angle ABC.
Give your answer correct to 3 significant figures.

Finding angle AOC :

Area of sector OADC = 100 cm^2

$$100 = \pi \times 12^2 \times \frac{\angle AOC}{360} \quad (1)$$

$$\text{angle } AOC = \frac{100}{\pi \times 12^2} \times 360$$

$$= \frac{250}{\pi} \quad (1)$$

Finding angle ABC :

$$\text{angle } ABC = \frac{1}{2} \times \text{angle } AOC$$

$$= \frac{1}{2} \times \frac{250}{\pi} \ (1) = \frac{125}{\pi} = 39.8 \quad (1)$$

39.8 °

(Total for Question 19 is 4 marks)

20 T is inversely proportional to m^2

$T = 30$ when $m = 0.5$

(a) Find a formula for T in terms of m.

$T \propto \frac{1}{m^2}$

$T = \frac{k}{m^2}$, where k = constant (1)

when $T = 30$ and $m = 0.5$,

$30 = \frac{k}{(0.5)^2}$ (1)

$k = 30 \times (0.5)^2$

$= \frac{15}{2}$

$\therefore T = \frac{15}{2m^2}$ (1)

$T = \frac{15}{2m^2}$

(3)

(b) Work out the value of T when $m = 0.1$

when $m = 0.1$,

$T = \frac{15}{2(0.1)^2}$

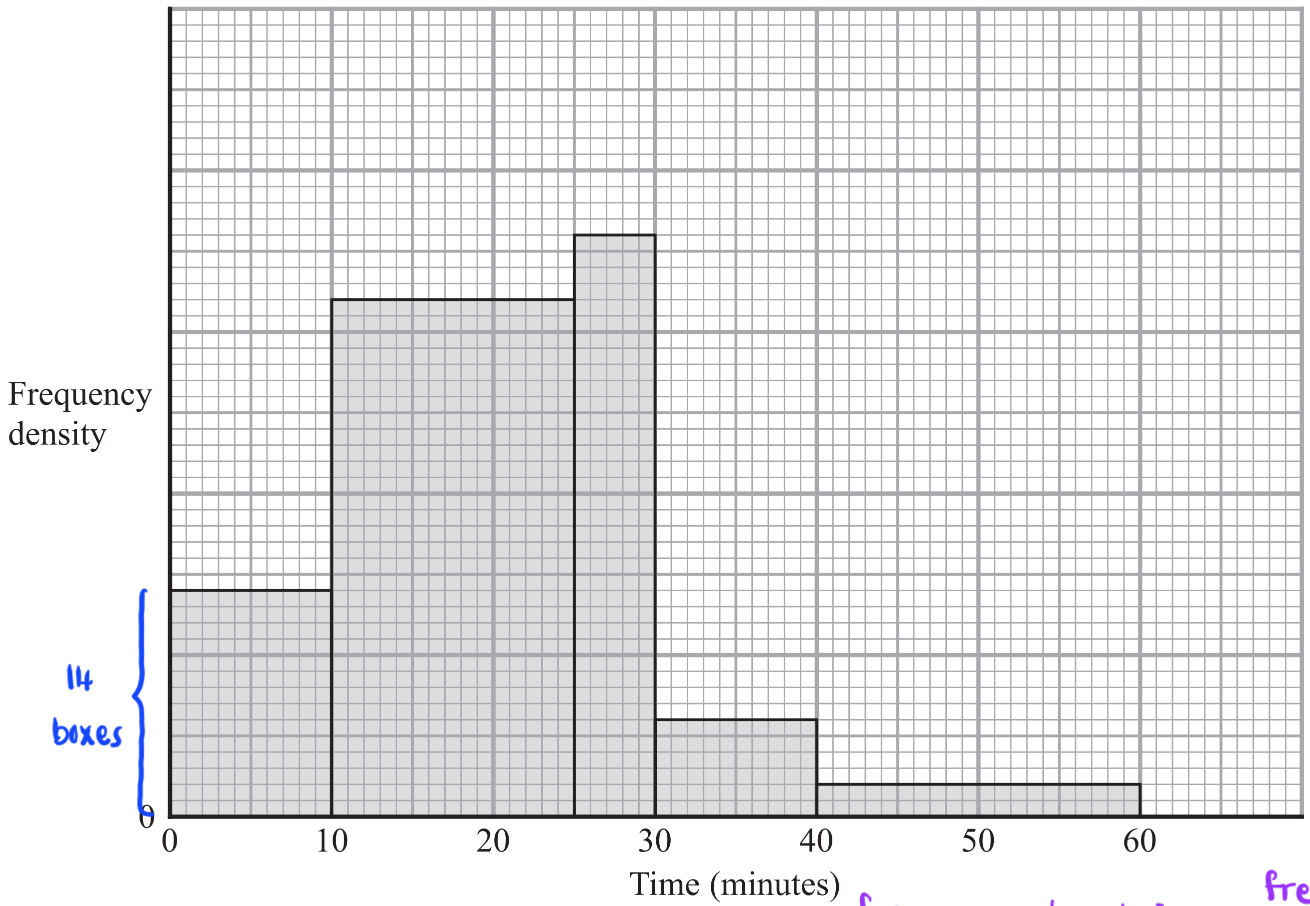
$= 750$ (1)

750

(1)

(Total for Question 20 is 4 marks)

21 The histogram gives information about the times, in minutes, some customers had to wait to be served in a restaurant.



frequency density $= \dfrac{\text{frequency}}{\text{class width}}$

14 customers had to wait less than 10 minutes to be served.

Work out the number of customers who had to wait less than 60 minutes to be served.

from 0 - 10 minutes : frequency density $= \dfrac{14 \text{ customers}}{10} = 1.4$ 1

$\therefore$ since there are 14 small boxes for this class, means one small box (vertically) = 0.1

from 10 - 25 : frequency $= 3.2 \times 15 = 48$

from 25 - 30 : frequency $= 3.6 \times 5 = 18$ 1

from 30 - 40 : frequency $= 0.6 \times 10 = 6$

from 40 - 60 : frequency $= 0.2 \times 20 = 4$

Total customers : $14 + 48 + 18 + 6 + 4$

$= 90$ 1

90

(Total for Question 21 is 3 marks)

22 The curve with equation $x^2 - x + y^2 = 10$ and the straight line with equation $x - y = -4$ intersect at the points A and B.

Work out the exact length of AB.

Show your working clearly and give your answer in the form $\frac{\sqrt{a}}{2}$ where a is an integer.

$x^2 - x + y^2 = 10$ — ①

$x - y = -4$ — ②

$x = y - 4$ — ③

substitute ③ into ①

$(y-4)^2 - (y-4) + y^2 = 10$ ①

$y^2 - 8y + 16 - y + 4 + y^2 = 10$

$2y^2 - 9y + 20 = 10$

$2y^2 - 9y + 10 = 0$ ①

$(2y-5)(y-2) = 0$ ①

$y = 2.5$ or $y = 2$

substitute y into ③

$x = -1.5$ or $x = -2$

$(-1.5, 2.5)$ and $(-2, 2)$ ①

length $= \sqrt{(-1.5-(-2))^2 + (2.5-2)^2}$ ①

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

$\frac{\sqrt{2}}{2}$

(Total for Question 22 is 6 marks)

23 P and Q are two points.

The coordinates of P are $(-1, 6)$

The coordinates of Q are $(5, -4)$

Midpoint of PQ

Find an equation of the perpendicular bisector of PQ.
Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.

Finding midpoint of PQ :

$$\left(\frac{-1+5}{2}, \frac{6+(-4)}{2}\right) = (2,1) \quad 1$$

Finding gradient of line PQ :

$$m = \frac{(-4-6)}{(5-(-1))} = \frac{-10}{6} = \frac{-5}{3} \quad 1$$

Finding gradient of perpendicular bisector :

$$m_{PB} = -\frac{1}{\frac{-5}{3}} = \frac{3}{5} \quad 1$$

Finding equation of perpendicular bisector :

known value : point $(2,1)$ and gradient $= \frac{3}{5}$

$$y = mx + c$$

$$1 = \frac{3}{5}(2) + c$$

$$c = 1 - \frac{6}{5}$$

$$= -\frac{1}{5} \quad 1$$

Equation : $y = \frac{3}{5}x - \frac{1}{5}$ 1

$\therefore 5y = 3x - 1$

$\therefore 3x - 5y - 1 = 0$

$3x - 5y - 1 = 0$ 1

(Total for Question 23 is 6 marks)

24 (a) Write $7 + 12x - 3x^2$ in the form $a + b(x + c)^2$ where a, b and c are integers.

$7 + 12x - 3x^2$

$= -3(x^2 - 4x) + 7$ (1)

$= -3[(x-2)^2 - 4] + 7$ (1)

$= -3(x-2)^2 + 12 + 7$ (1)

$= -3(x-2)^2 + 19$

Arrange in the form of $a + b(x+c)^2$

$= 19 - 3(x-2)^2$ (1) where $a = 19$

$b = -3$

$c = -2$

$19 - 3(x-2)^2$

(4)

The curve **C** has equation $y = 7 + 12x - 3x^2$
The point A is the turning point on **C**.

(b) Using your answer to part (a), write down the coordinates of A.

$y = 19 - 3(x-2)^2$

y-coordinate (when $x=2$, $y=19$)

x-coordinate ($x - 2 = 0 \rightarrow x = 2$)

(2 , 19) (1)

(1)

(Total for Question 24 is 5 marks)

25

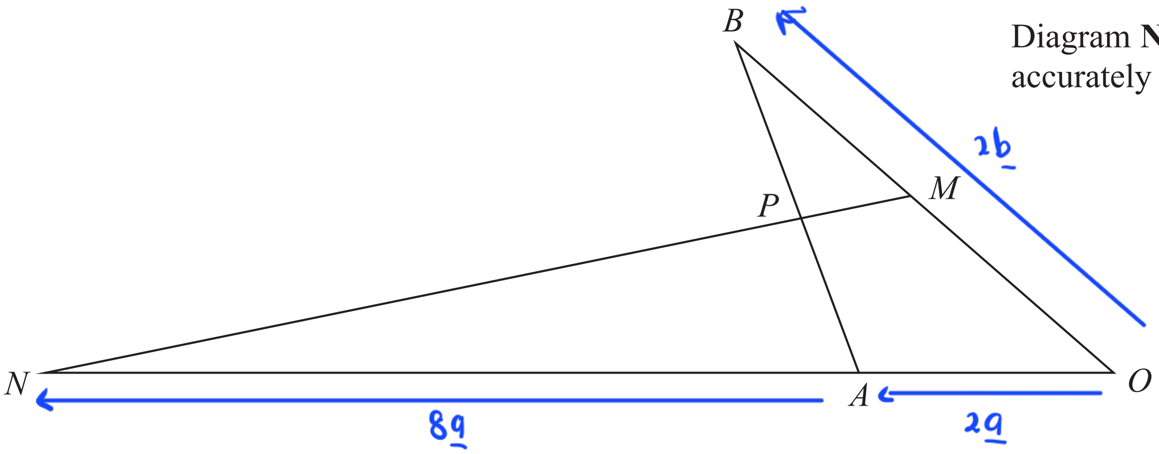


Diagram **NOT** accurately drawn

OAN, OMB, APB and MPN are straight lines.

$OA : AN = 1 : 4$

$OM : MB = 1 : 1$

$\overrightarrow{OA} = 2\mathbf{a}$ $\quad \overrightarrow{OB} = 2\mathbf{b}$

By using a vector method, find the ratio $AP : PB$
Give your answer in its simplest form.

$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$

$= -2\underline{a} + 2\underline{b}$ (1)

$\overrightarrow{NM} = \overrightarrow{NO} + \overrightarrow{OM}$

$= -10\underline{a} + \underline{b}$

Let X : fraction of NM

Y : fraction of AB

$\overrightarrow{AP} = \overrightarrow{AN} + \overrightarrow{NP}$

$= 8\underline{a} + X(-10\underline{a} + \underline{b})$ (1)

$\overrightarrow{AP} = Y(-2\underline{a} + 2\underline{b})$ (1)

$$\therefore \; 8\underline{a} + x(-10\underline{a} + \underline{b}) = y(-2\underline{a} + 2\underline{b})$$

$$8\underline{a} - 10\underline{a}x + \underline{b}x = -2\underline{a}y + 2\underline{b}y$$

$$8\underline{a} = 10\underline{a}x - 2\underline{a}y + 2\underline{b}y - \underline{b}x$$

$$8\underline{a} = \underline{a}(10x - 2y) + \underline{b}(2y - x)$$ (1)

$\underline{b}$ term : $0 = 2y - x$

$2y = x$ — (1)

$\underline{a}$ term : $8 = 10x - 2y$ — (2)

substitute (1) into (2)

$8 = 10(2y) - 2y$

$8 = 20y - 2y$

$y = \frac{8}{18} = \frac{4}{9}$

since y = fraction of AB,

$\overrightarrow{AP} = \frac{4}{9}\overrightarrow{AB}$

$AP = \frac{4}{9}$, hence $PB = \frac{5}{9}$

$AP : PB = 4 : 5$

4 : 5 (1)

(Total for Question 25 is 5 marks)

Turn over for Question 26

26 A, B, D and E are points on a circle.
ABC and EDC are straight lines.

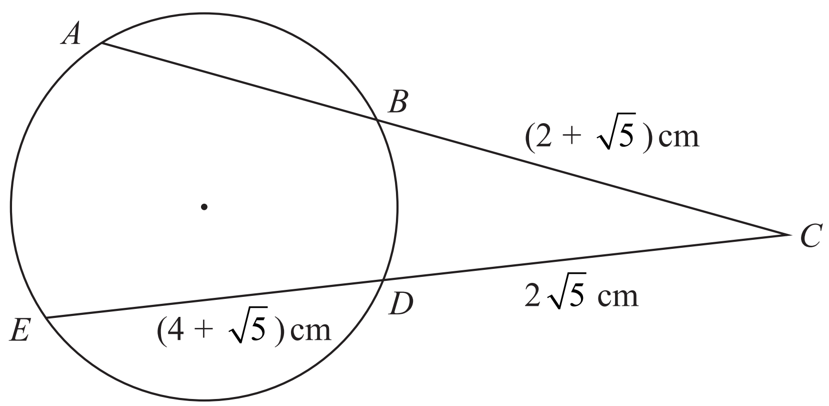


Diagram **NOT** accurately drawn

$BC = (2 + \sqrt{5})$ cm

$ED = (4 + \sqrt{5})$ cm

$DC = 2\sqrt{5}$ cm

Show that the length of AB is $(p\sqrt{5} + q)$ cm, where p and q are integers whose values are to be found.
Show your working clearly.

$$BC \times AC = CD \times EC$$

$$(2+\sqrt{5})(AB + 2+\sqrt{5}) = 2\sqrt{5}\,(4+\sqrt{5}+2\sqrt{5}) \quad 1$$

$$AB = \frac{2\sqrt{5}\,(4+\sqrt{5}+2\sqrt{5})}{2+\sqrt{5}} - (2+\sqrt{5}) \quad 1$$

$$= \frac{8\sqrt{5} + 2(5) + 4(5) - (4+4\sqrt{5}+5)}{2+\sqrt{5}}$$

$$= \frac{8\sqrt{5} - 4\sqrt{5} + 10 + 20 - 9}{2+\sqrt{5}}$$

$$= \frac{21+4\sqrt{5}}{2+\sqrt{5}} \times \frac{2-\sqrt{5}}{2-\sqrt{5}} \quad 1$$

$\downarrow$

$$= \frac{42 - 21\sqrt{5} + 8\sqrt{5} - 4(5)}{4 - 5}$$ 1

$$= \frac{22 - 13\sqrt{5}}{-1}$$

$$= -22 + 13\sqrt{5}$$

$= 13\sqrt{5} - 22$ 1 where $p = 13$

$q = 22$

(Total for Question 26 is 5 marks)

TOTAL FOR PAPER IS 100 MARKS

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