Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE

Monday 3 June 2024

Morning (Time: 2 hours)

Paper reference **4MA1/2H**

Mathematics A

PAPER 2H

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 ▶

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P 7 3 9 9 4 A 0 1 2 8

Pearson

International GCSE Mathematics

Formulae sheet – Higher Tier

Arithmetic series

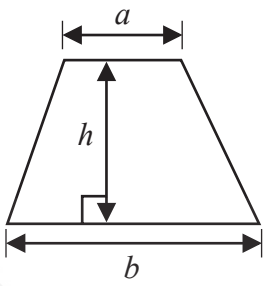
Sum to n terms, $S_n = \frac{n}{2}[2a + (n-1)d]$

The quadratic equation

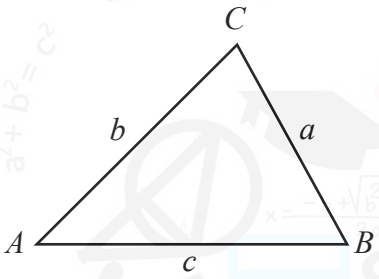
The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$ are given by:

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

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



Trigonometry



In any triangle ABC

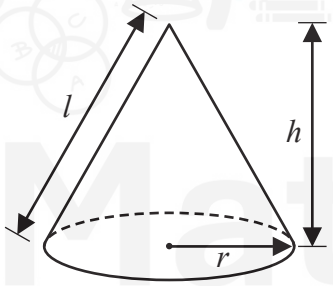
Sine Rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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

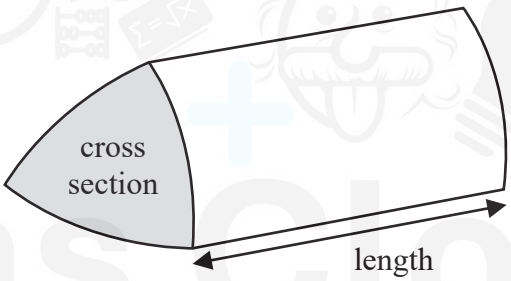
Area of triangle $= \frac{1}{2}ab\sin C$

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

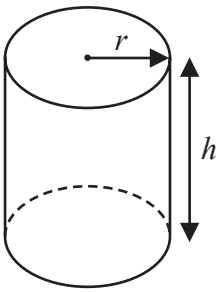
Curved surface area of cone $= \pi r l$



Volume of prism
= area of cross section × length

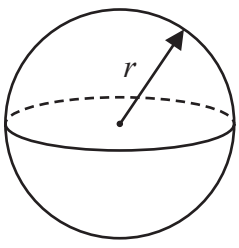


Volume of cylinder $= \pi r^2 h$
Curved surface area of cylinder $= 2\pi r h$



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

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



Answer ALL TWENTY FIVE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 Here are eight numbers written in order of size

h 6 7 8 j 16 k k

where h, j and k are integers.

The median of the eight numbers is 10

The mode of the eight numbers is 18

The range of the eight numbers is 13

Work out the value of h, the value of j and the value of k

Median is the middle value.
So $\frac{8+j}{2} = 10$

$8 + j = 20$
$j = 12$

mode is the one that appears the most.
we have 2 k's, no other number currently appears more than once,
so $k = 18$

range is difference between highest and lowest value:
$18 - h = 13$
$h = 5$

$h =$ 5

$j =$ 12

$k =$ 18

(Total for Question 1 is 3 marks)

2 (a) On the grid, draw the straight line with equation

(i) $y = 2$

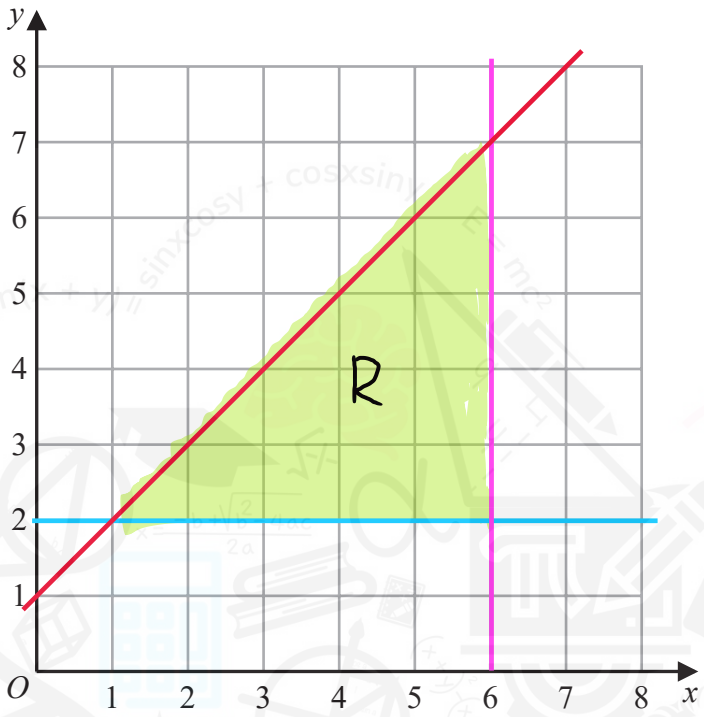
(ii) $x = 6$

(iii) $y = x + 1$

for $y = x + 1$:

x	0	1	2	3	4	5	6	7	8
y	1	2	3	4	5	6	7	8	9

Label each line with its equation.



(3)

(b) Show, by shading on the grid, the region that satisfies all three of the inequalities

$y \geqslant 2$ $x \leqslant 6$ $y \leqslant x + 1$

Label the region **R**

(1)

(Total for Question 2 is 4 marks)

3 A plane takes 9 hours 36 minutes to fly from New Delhi to Perth.

The plane flies at an average speed of 820 km/h.

Work out the total distance the plane flies.

9 hours 36 mins = $9\frac{36}{60}$ hours

↑ number minutes in an hour

we convert into hrs as speed is in km/h, so the time measures match

distance = speed × time

$= 820 \times 9\frac{36}{60}$

$= 7872$ km

7872 km

(Total for Question 3 is 3 marks)

4 Show that $2\frac{4}{7} \times 3\frac{1}{9} = 8$

$2 = \frac{7}{7} \times 2 = \frac{14}{7}$

$\frac{14}{7} + \frac{4}{7} = \frac{18}{7}$

$3 = \frac{9}{9} \times 3 = \frac{27}{9}$

$\frac{27}{9} + \frac{1}{9} = \frac{28}{9}$

$\frac{18}{7} \times \frac{28}{9}$

$= \frac{504}{63}$

$= 8$ as required

(Total for Question 4 is 3 marks)

5 The diagram shows triangle ABC

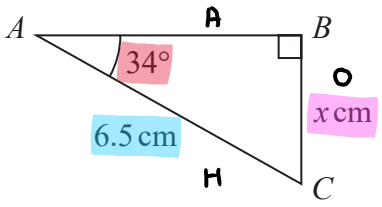


Diagram **NOT** accurately drawn

Work out the value of x
Give your answer correct to one decimal place.

we have opposite and hypotenuse so use Sin.

$\sin(34) = \frac{x}{6.5}$

$x = \sin(34) \times 6.5$

$x = 3.6$ To one decimal place

$x =$ 3.6

(Total for Question 5 is 3 marks)

6 Change a speed of w metres per second to a speed in kilometres per hour.
Give your answer in terms of w in its simplest form.

1 km = 1000 m
m -> km, so ÷
$w \div 1000 = \frac{w}{1000}$
1 hr = 3600 s
s -> hr, so ×
$\frac{w}{1000} \times 3600 = 3.6w$

3.6 kilometres per hour

(Total for Question 6 is 3 marks)

7 The diagram shows a 6-sided shape *ABCDEF*

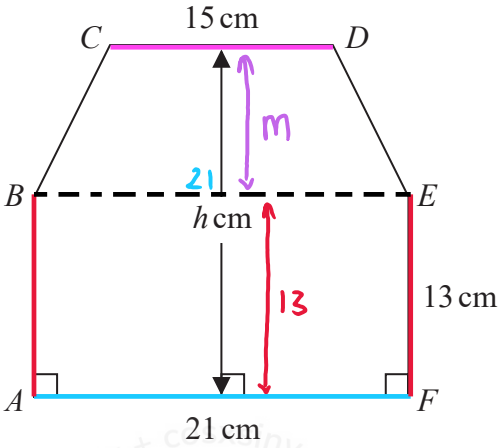


Diagram **NOT** accurately drawn

$AF = 21$ cm $CD = 15$ cm $AB = FE = 13$ cm

The perpendicular height of the shape is h cm
CD is parallel to AF

The area of the shape is 390 cm^2

Work out the value of h

Area rectangle : $21 \times 13 = 273$

Area trapezium : $390 - 273 = 117$

$$\frac{CD + BE}{2} \times m = 117$$

$$\frac{15 + 21}{2} \times m = 117$$

$$18m = 117$$

$$m = 6.5$$

$$h = 6.5 + 13$$

$$h = 19.5$$

$h =$ 19.5

(Total for Question 7 is 4 marks)

8 Ishir plants 600 bulbs in a garden.
He plants tulip bulbs, crocus bulbs and daffodil bulbs so that

number of tulip bulbs : number of crocus bulbs : number of daffodil bulbs = 9 : 4 : 2

45% of the tulip bulbs are for yellow flowers.

$\frac{5}{8}$ of the crocus bulbs are for yellow flowers.

All of the daffodil bulbs are for yellow flowers.

Work out the number of bulbs that are for yellow flowers.

$9 + 4 + 2 = 15$ shares

$600 \div 15 = 40$

$9 \times 40 : 4 \times 40 : 2 \times 40$

$360 : 160 : 80$

Bulbs for yellow flowers:

$(360 \times 0.45) + (160 \times \frac{5}{8}) + 80$

$162 + 100 + 80 = 342$

342

(Total for Question 8 is 5 marks)

9 Giovanni invests 4500 koruna in a savings account for 4 years.
He gets 2.4% per year compound interest.

Work out how much money Giovanni will have in the savings account at the end of 4 years.
Give your answer correct to the nearest koruna.

Initial amount = I
% multiplier = M
Years = y

I = 4500
M = 1 + 2·4%
= 1 · 0·024 = 1·024
y = 4

formula : $I \times M^y$

$= 4500 \times 1{\cdot}024^4$

$= 4948$ To the nearest koruna

4948 koruna

(Total for Question 9 is 3 marks)

10 Solve the simultaneous equations

$$6x + 4y = 1$$
$$3x + 5y = 8$$

Same sign, so we subtract

We want to make either both y or x's to be the same, so they cancel out when subtracting, allowing us to solve for the other. In this case, we'll make the y values the same.

Show clear algebraic working.

$6x + 4y = 1$ ×5
$3x + 5y = 8$ ×4

$30x + 20y = 5$ −
$12x + 20y = 32$

$18x = -27$
$x = -1.5$

plug back in to find y

$6x + 4y = 1$
$6(-1.5) + 4y = 1$
$-9 + 4y = 1$
$4y = 10$
$y = 2.5$

$x =$ −1.5

$y =$ 2.5

(Total for Question 10 is 3 marks)

11 (i) Factorise $x^2 + 9x - 22$

multiply to get −22

add to get 9

Consider −2 and +11

$(x - 2)(x + 11)$

$(x - 2)(x + 11)$

(2)

(ii) Hence, solve $x^2 + 9x - 22 = 0$

$(x-2)(x+11) = 0$

$x - 2 = 0$ | $x + 11 = 0$
$x = 2$ | $x = -11$

$x = 2, \ x = -11$

(1)

(Total for Question 11 is 3 marks)

12 Ali uses a fitness tracker to count the number of steps he walks each day for 7 days.

For the first 4 days, his mean number of steps is 11 800 (1)
For the next 3 days, his mean number of steps is 13 207 (2)

Work out his mean number of steps for the 7 days.

To calculate the mean, we divide the total number of steps and divide by the number of days.

Need to find the totals for (1) and (2) then ÷ by 7.

Let total = T

for (1): $\frac{T}{4} = 1180$

$T = 4720$

for (2): $\frac{T}{3} = 13207$

$T = 39621$

$\frac{47200 + 39621}{7} = 12403$

12403

(Total for Question 12 is 3 marks)

13 The table gives information about the distances, in km, that 70 teachers travel to school.

Distance (d km)	Frequency
$0 < d \leqslant 10$	7
$10 < d \leqslant 20$	17
$20 < d \leqslant 30$	18
$30 < d \leqslant 40$	14
$40 < d \leqslant 50$	10
$50 < d \leqslant 60$	4

(a) Complete the cumulative frequency table.

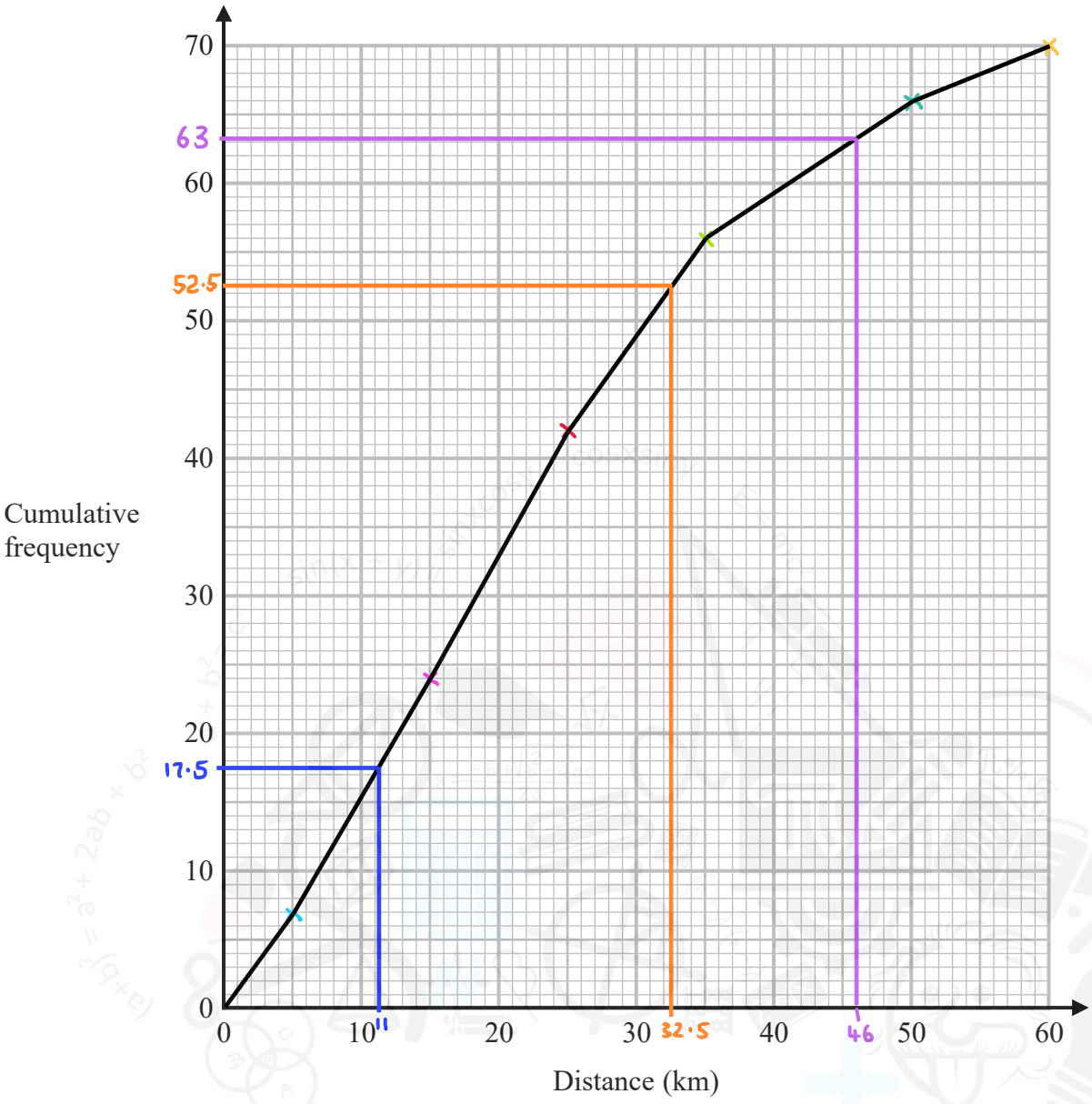
Distance (d km)	Cumulative frequency
$0 < d \leqslant 10$	7
$0 < d \leqslant 20$	24
$0 < d \leqslant 30$	42
$0 < d \leqslant 40$	56
$0 < d \leqslant 50$	66
$0 < d \leqslant 60$	70

7 + 17
24 + 18
42 + 14
56 + 10
66 + 4

(1)

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

(2)



(c) Use your graph to find an estimate for the interquartile range of the distances.

IQR = Upper 75% - Lower 25%.

70 × 0·75 = 52·5

70 × 0·25 = 17·5

From graph, approximately:

32·5 − 11 = 21·5 (18-22 will be accepted)

21·5 km

(2)

(d) Use your graph to find an estimate for the number of teachers who travel more than 46 km.

70 − 63 = 7

(6 or 7 or 8 or 9 accepted)

7

(2)

(Total for Question 13 is 7 marks)

14 (a) Show that $3y(2y + 5)(y + 7)$ can be written in the form $ay^3 + by^2 + cy$ where a, b and c are integers.

Expand one at a time

	$2y$	5
$3y$	$6y^2$	$15y$

	y	7
$6y^2$	$6y^3$	$42y^2$
$15y$	$15y^2$	$105y$

$= 6y^3 + 57y^2 + 105y$

(3)

(b) Solve $\frac{2x + 3}{5} + \frac{6x - 5}{4} = \frac{163}{100}$

Show clear algebraic working.

$(2x + 3)(4)(100) + (6x - 5)(5)(100) = 163(5)(4)$

$(8x + 12)(100) + (30x - 25)(100) = (815)(4)$

$800x + 1200 + 3000x - 2500 = 3260$

$3800x - 1300 = 3260$

$3800x = 4560$

$x = 1.2$

$x =$ 1.2

(4)

(Total for Question 14 is 7 marks)

15 (a) Make g the subject of $e = \sqrt{\dfrac{7g + 5}{11 + 2g}}$

Square both sides

$e^2 = \dfrac{7g + 5}{11 + 2g}$

× by $11 + 2g$

$e^2(11 + 2g) = 7g + 5$

expand brackets

$11e^2 + 2ge^2 = 7g + 5$

get g terms 1 side

$11e^2 + 2ge^2 - 7g = 5$

$2ge^2 - 7g = 5 - 11e^2$

factorise g

$g(2e^2 - 7) = 5 - 11e^2$

$\div 2e^2 - 7$

$g = \dfrac{5 - 11e^2}{2e - 7}$

$g = \dfrac{5 - 11e^2}{2e^2 - 7}$

(4)

(b) Solve the inequality $3y^2 + 4y - 32 > 0$

Show your working clearly.

$a = 3 \quad b = 4 \quad c = -32$

quadratic formula:

$y = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$y = \dfrac{-4 \pm \sqrt{(4)^2 - 4(3)(-32)}}{2(3)}$

+ve sqrt ↓ $y = 8/3$ or -ve sqrt ↓ $y = -4$

so $y > -4$, $y < 8/3$

$y < -4, \quad y > 8/3$

(3)

(Total for Question 15 is 7 marks)

16 60 art students were asked if they would like to attend workshops for knitting (K), for photography (P) or for embroidery (E)

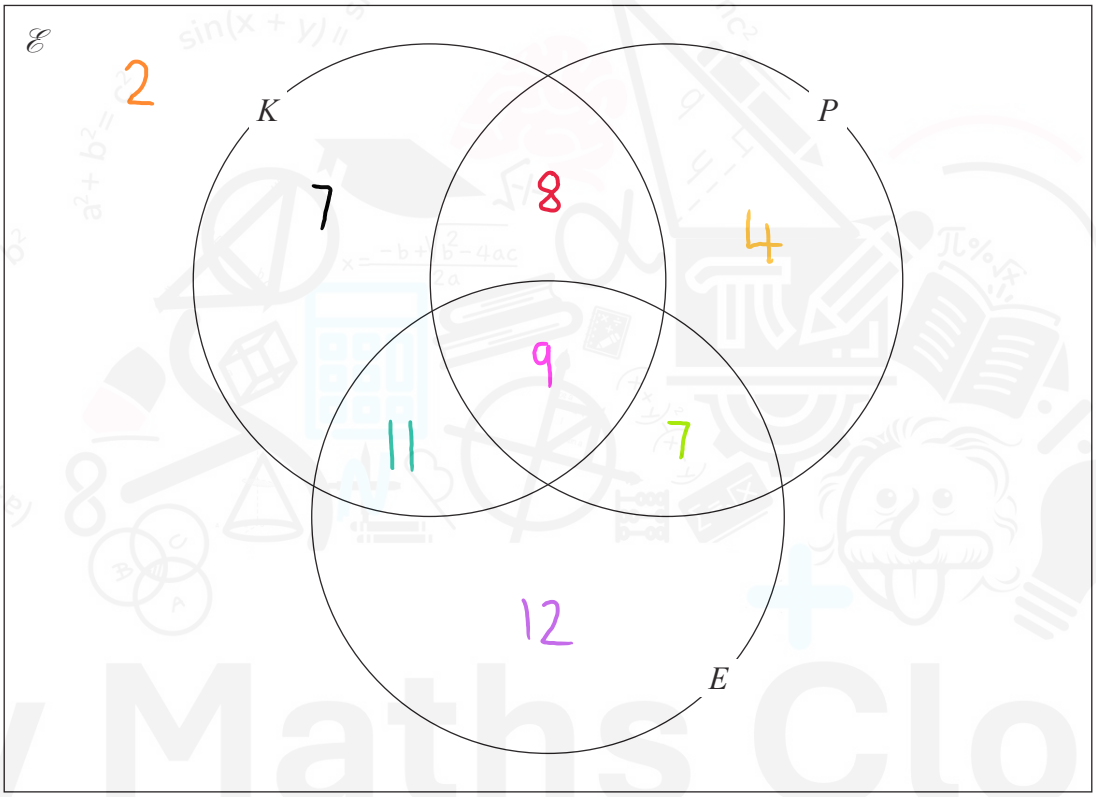
work from the inside out.

Of these students

9 chose knitting, photography and embroidery
17 chose knitting and photography; 17 - 9 = 8
16 chose photography and embroidery; 16 - 9 = 7
20 chose knitting and embroidery; 20 - 9 = 11
28 chose photography; 28 - 8 - 9 - 7 = 4
39 chose embroidery; 39 - 11 - 9 - 7 = 12
2 chose none of the workshops

just knitting:
60 - (8 + 4 + 7 + 11 + 12 + 9 + 2)
60 - 53 = 7

(a) Using this information, complete the Venn diagram to show the numbers of students in each subset.



(3)

One of the students is chosen at random.

Given that this student chose photography,

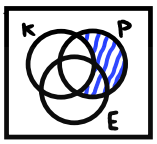
(b) find the probability that this student also chose knitting.

$\frac{9+8}{28} = \frac{17}{28}$

17/28

(2)

(c) Find $n(P \cap K')$



$= 4 + 7 = 11$

11

(1)

(d) Find $n([P \cup E] \cap K)$

$= 11 + 9 + 8 = 28$

28

(1)

(Total for Question 16 is 7 marks)

17 Q is directly proportional to the square root of d

$Q = 4.5$ when $d = 324$

Find a formula for Q in terms of d

$Q = k\sqrt{d}$

given $Q = 4.5$ $d = 324$

$4.5 = k\sqrt{324}$

$k = \frac{4.5}{\sqrt{324}}$

$k = 0.25$

so formula:

$Q = 0.25\sqrt{d}$

$Q = 0.25\sqrt{d}$

(Total for Question 17 is 3 marks)

18 The straight line **P** has equation $5y + 2x = 7$

Find the gradient of a straight line that is perpendicular to **P**

equation of line : $y = mx + c$

we have : $5y + 2x = 7$

rearange to get in same form

$-2x$

$5y = -2x + 7$

$\div 5$

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

given gradient = m

$m = -215$

perpendicular : $m_1 \times m_2 = -1$

$-215 \times m_2 = -1$

$m_2 = 5/2$

5/2

(Total for Question 18 is 2 marks)

19 $G = \dfrac{c}{2f - 3h}$

$c = 8$ correct to the nearest whole number

$f = 6.62$ correct to 2 decimal places

$h = 1.2$ correct to 1 decimal place

Bounds:

1 decimal place (± 0.5)

3 decimal places (± 0.005)

2 decimal places (± 0.05)

Work out the lower bound for the value of G

Give your answer correct to 3 decimal places.

Show your working clearly.

To get the lower bound, we want : $\dfrac{\text{Lowest value}}{\text{Highest value}}$

So we have : $\dfrac{7.5}{2(6.625) - 3(1.15)}$

$= 0.765$ To 3 decimal places

0.765

(Total for Question 19 is 3 marks)

20 Given that $k = x - y$ and $x = \frac{1}{4y}$

express $\frac{5k}{x+2}$ in the form $\frac{a - by^2}{c + dy}$ where a, b, c and d are integers.

Work by plugging in values one at a time.

$$\frac{5(x-y)}{x+y}$$

$$\frac{5x-5y}{x+y}$$

Now plug in $x = \frac{1}{4y}$

$$\frac{5\left(\frac{1}{4y}\right)-5y}{\frac{1}{4y}+y}$$

Multiply by $4y$ to remove the fractions. But there's $\times 2$ $\frac{1}{4y}$'s, so all terms get multiplied by $4y$.

$$\frac{\frac{5}{4y}\times 4y - 5y \times 4y}{\frac{1}{4y}\times 4y + 2 \times 4y}$$

$$\frac{5-20y^2}{\frac{4y}{1+8y}}$$
$$4y$$

$4y$'s cancel:

$$\frac{5-20y^2}{1+8y}$$

$\frac{5-20y^2}{1+8y}$

(Total for Question 20 is 3 marks)

21 The diagram shows a square $ABCD$ and a circle.

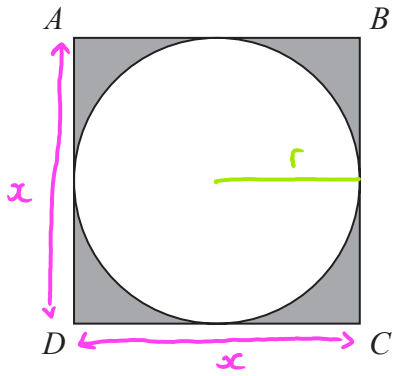


Diagram **NOT** accurately drawn

The sides of the square are tangents to the circle.

The total area of the shaded regions is $80\,cm^2$

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

Area square - area circle = 80

$2x^2 - \pi r^2 = 80$

$r = \frac{1}{2}x$ (r is half length of a side)

$\times 2 \left(2x^2 - \pi(\frac{1}{2}x)^2 = 80 \right.$

$4x^2 - \pi x^2 = 80$

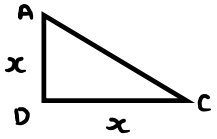
$x^2(4 - \pi) = 80$

$x^2 = \frac{80}{4 - \pi}$

$x = \sqrt{\frac{80}{4 - \pi}}$

$x = 9.65...$

Using pythagoras:



$AC = \sqrt{AD^2 + DC^2}$

$AC = \sqrt{2x^2 + 2x^2}$

$AC = \sqrt{2(9.65...)^2 + 2(9.65...)^2}$

$AC = 27.3\,cm$ to 3 significant figures

27.3 cm

(Total for Question 21 is 5 marks)

Turn over for Question 22

22 The straight line **L** has equation $x + y = 5$ (1)

The curve **C** has equation $2x^2 + 3y^2 = 210$ (2)

Find the coordinates of the points where **L** and **C** intersect.
Show clear algebraic working.

Intersect, so rearrange (1) to get x or y on it's own and plug into (2):

$x + y = 5$

$x = 5 - y$

$2(5-y)^2 + 3y^2 = 210$

	5	-y
5	25	-5y
-y	-5y	y^2

$2(y^2 - 10y + 25) + 3y^2 = 210$) expand

$2y^2 - 20y + 50 + 3y^2 = 210$) collect like terms

$5y^2 - 20y + 50 = 210$) -210

$5y^2 - 20y - 160 = 0$) ÷5

$y^2 - 4y - 32 = 0$) factorise

$(y-8)(y+4) = 0$

$y = 8$, $y = -4$

given (1):

$x + y = 5$

plug in $y = 8$, $y = -4$

$x + 8 = 5$ | $x - 4 = 5$

$x = -3$ | $x = 9$

so we have:
$(-3, 8)$, $(9, -4)$

(9 , -4) (-3 , 8)

(Total for Question 22 is 5 marks)

23 Simplify $\dfrac{30 \times 25^{2x+7}}{\sqrt{180} \times (\sqrt{5})^{4x+9}}$

Give your answer in the form 5^w where w is an expression in terms of x
Show each stage of your working clearly.

Consider each term individually, manipulating into forms which allow us to cancel and simplify

$30 = 5 \times 3 \times 2$

$25 = 5^2$, $25^{2x+7} = 5^{2(2x+7)} = 5^{4x+14}$

$\sqrt{180} = 6\sqrt{5} = 3 \times 2 \times \sqrt{5}$

$\sqrt{5} = 5^{1/2}$, $(\sqrt{5})^{4x+9} = (5^{1/2})^{4x+9}$

So we have:

$$\frac{5 \times 3 \times 2 \times 5^{4x+14}}{3 \times 2 \times \sqrt{5} \times (5^{1/2})^{4x+9}}$$

$$\frac{5^1 \times 5^{4x+14}}{5^{1/2} \times 5^{2x+4.5}}$$

when multiplying, we + indices

$$\frac{5^{4x+15}}{5^{2x+5}}$$

when dividing, we - indices

5^{2x+10}

5^{2x+10}

(Total for Question 23 is 3 marks)

Turn over for Question 24

24

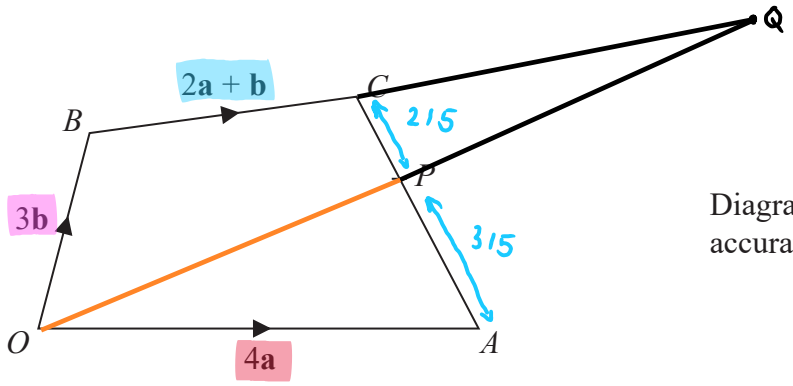


Diagram **NOT** accurately drawn

The diagram shows a quadrilateral $OACB$ in which

$\overrightarrow{OA} = 4\mathbf{a}$ $\overrightarrow{OB} = 3\mathbf{b}$ $\overrightarrow{BC} = 2\mathbf{a} + \mathbf{b}$

(a) Find $\overrightarrow{AC}$ in terms of **a** and **b**
Give your answer in its simplest form.

$\overrightarrow{AC} = \overrightarrow{AO} + \overrightarrow{OB} + \overrightarrow{BC}$

$= -4\underline{a} + 3\underline{b} + 2\underline{a} + \underline{b}$

$= 4\underline{b} - 2\underline{a}$

Note: we make 4a -ve as we travel in the opposite direction of O to A instead of A to O.

$\overrightarrow{AC} =$ $4\underline{b} - 2\underline{a}$

(2)

The point P lies on AC such that $AP : PC = 3 : 2$

The point Q is such that OPQ and BCQ are straight lines.

we don't know the length of the lines, so use some scalars λ, μ.

(b) Using a vector method, find $\overrightarrow{OQ}$ in terms of **a** and **b**
Give your answer in its simplest form.
Show your working clearly.

$\overrightarrow{OP} = 4\underline{a} + \frac{3}{5}(4\underline{b} - 2\underline{a})$

$= \frac{14}{5}\underline{a} + \frac{12}{5}\underline{b}$

$\overrightarrow{OQ} = 3\underline{b} + \lambda(2\underline{a} + \underline{b}) = 3\underline{b} + 2\lambda\underline{a} + \lambda\underline{b}$

we know that $\overrightarrow{OQ} = \mu\overrightarrow{OP}$

Compare: $= \frac{14}{5}\mu\underline{a} + \frac{12}{15}\mu\underline{b}$ (3)

$= 3\underline{b} + 2\lambda\underline{a} + \lambda\underline{b}$

so $3 + \lambda = \frac{12}{5}\mu$ (2)

$2\lambda = \frac{14}{5}\mu$

$\lambda = \frac{7}{5}\mu$ (1)

plug (1) into (2)

$3 + \frac{7}{5}\mu = \frac{12}{5}\mu$

$\mu = 3$

plug into (3)

$= \frac{14}{5}(3)\underline{a} + \frac{12}{5}(3)\underline{b}$

$= \frac{42}{5}\underline{a} + \frac{36}{5}\underline{b}$

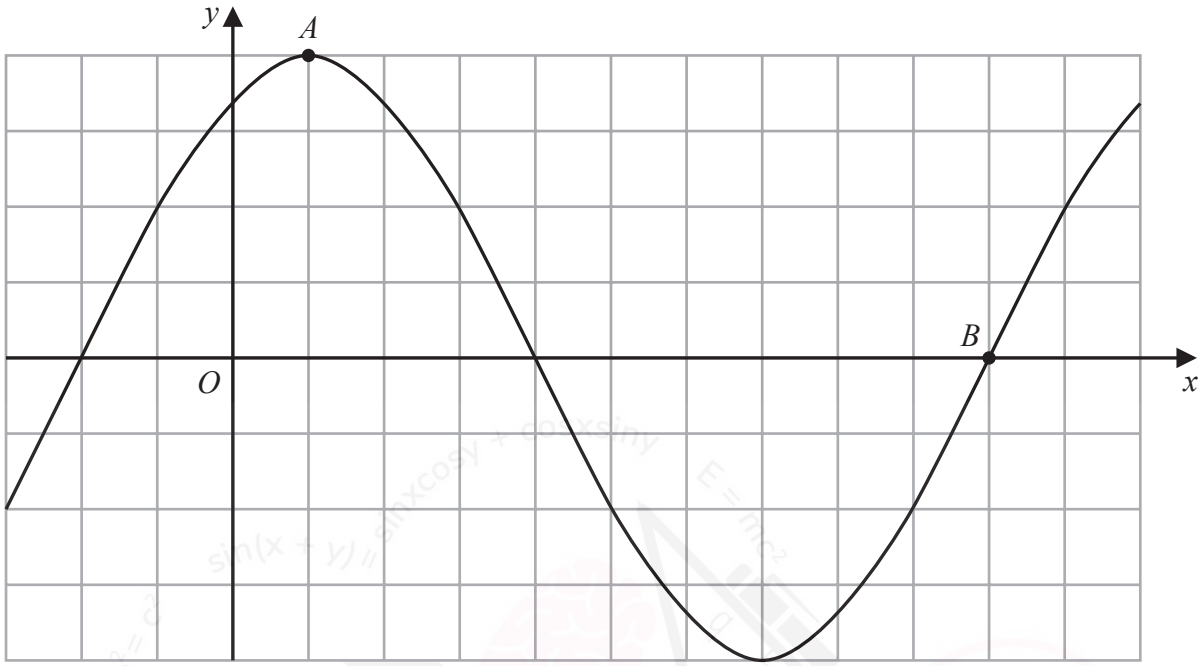
$\overrightarrow{OQ} = \frac{42}{5}\underline{a} + \frac{36}{5}\underline{b}$

(4)

(Total for Question 24 is 6 marks)

Turn over for Question 25

25 The diagram shows a sketch of the graph of $y = 2\sin(x + 60)°$



(i) Find the coordinates of the point A

$y = 2\sin(x + 60°)$

"x, inside, opposite"

typically: 1

$x = 90 - 60 = 30$

"y outside expect"

$y = 1 \times 2 = 2$

(30 , 2)

(1)

(ii) Find the coordinates of the point B

$y = 0$ (read off from graph)

Same process:

$x = 360 - 60 = 300$

(300 , 0)

(1)

(Total for Question 25 is 2 marks)

TOTAL FOR PAPER IS 100 MARKS

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