Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE

Centre Number | Candidate Number

Tuesday 7 January 2020

Morning (Time: 2 hours) | Paper Reference **4MA1/1H**

Mathematics A
Paper 1H
Higher Tier

You must have:
Ruler graduated in centimetres and millimetres, protractor, 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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1/1/1/

P 5 9 7 5 6 A 0 1 2 8

Pearson

International GCSE Mathematics

Formulae sheet – Higher Tier

Arithmetic series

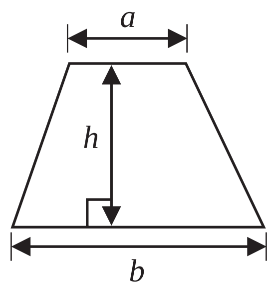
Sum to n terms, $S_n = \frac{n}{2}\,[2a + (n-1)d]$

The quadratic equation

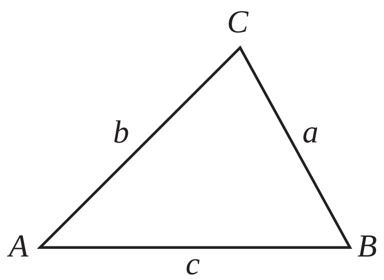
The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$ are given by:

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

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



Trigonometry



In any triangle ***ABC***

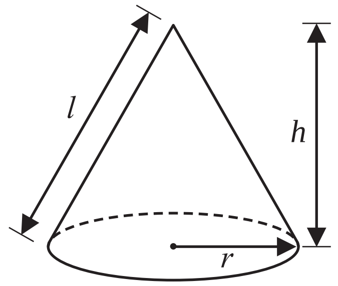
Sine Rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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

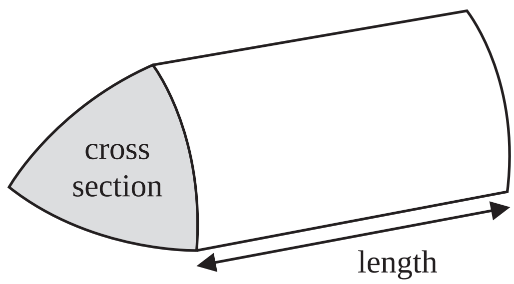
Area of triangle $= \frac{1}{2}ab\sin C$

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

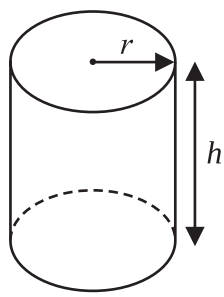
Curved surface area of cone $= \pi r l$



Volume of prism
= area of cross section × length

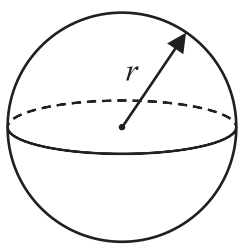


Volume of cylinder $= \pi r^2 h$
Curved surface area of cylinder $= 2\pi r h$



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

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



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Answer all TWENTY TWO questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 The point A has coordinates (5, −4)
The point B has coordinates (13, 1)

(a) Work out the coordinates of the midpoint of AB.

midpoint AB : $\left(\frac{5+13}{2}, \frac{-4+1}{2}\right)$ 1

$= (9, -1.5)$ 1

(9, −1.5)

(2)

Line **L** has equation $y = 2 - 3x$

(b) Write down the gradient of line **L**.

$y = \underline{-3}x + 2$

↑ m

−3 1

(1)

Line **L** has equation $y = 2 - 3x$

(c) Does the point with coordinates (100, −302) lie on line **L**?
You must give a reason for your answer.

$y + 3x = 2$

LHS : $-302 + 3(100) = -2$. No. The coordinate does not lie on line L.

1

(1)

(Total for Question 1 is 4 marks)

2 Find the lowest common multiple (LCM) of 28 and 105

Multiple of 28 : 28, 56, 84, 112, 140, 168, 196, 224, 252, 280, 308, 336, 364, 392, 420

(1)

Multiple of 105 : 105, 210, 315, 420

LCM of 28 and 105 is 420. (1)

420
....

(Total for Question 2 is 2 marks)

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3 The diagram shows a shape.

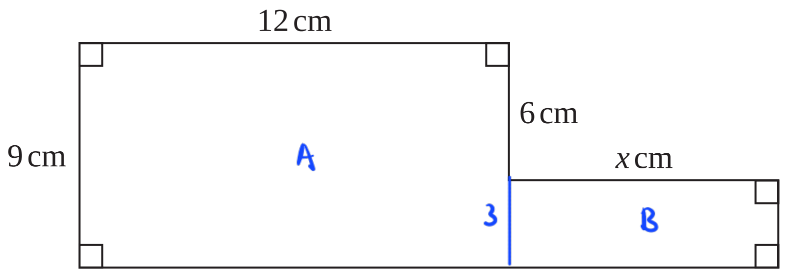

Diagram **NOT** accurately drawn

The shape has area 129 cm^2

Work out the value of x.

Total Area : Area of shape A + Area of shape B

$129 = (12 \times 9) + 3x$ (1)

$129 = 108 + 3x$ (1)

$3x = 129 - 108$

$3x = 21$

$x = \dfrac{21}{3}$ (1)

$= 7$ (1)

$x =$ 7

(Total for Question 3 is 4 marks)

4 The table shows information about the weights, in kilograms, of 40 babies.

Weight (w kg)	**Frequency**
$2 < w \leqslant 3$	12
$3 < w \leqslant 4$	16
$4 < w \leqslant 5$	9
$5 < w \leqslant 6$	2
$6 < w \leqslant 7$	1

(a) Write down the modal class.

modal class : class with highest frequency

$3 < w \leq 4$ (1)

....

(1)

(b) Work out an estimate for the mean weight of the 40 babies.

Estimated Total weight $= (12 \times 2.5) + (16 \times 3.5) + (9 \times 4.5) + (2 \times 5.5) + (1 \times 6.5)$ (1)

$= 30 + 56 + 40.5 + 11 + 6.5$ (1)

$= 144$

Mean $= \dfrac{144}{40}$ (1) $= 3.6$ kg (1)

3.6
.... kg

(4)

One of the 40 babies is going to be chosen at random.

(c) Find the probability that this baby has a weight of more than 5 kg.

Baby weight more than 5 kg $= \dfrac{2}{40} + \dfrac{1}{40}$ (1)

$= \dfrac{3}{40}$ (1)

$\dfrac{3}{40}$

....

(2)

(Total for Question 4 is 7 marks)

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5 120 children go on an activity holiday.
The ratio of the number of girls to the number of boys is 3 : 5

On Sunday, all the children either go sailing or go climbing.

$\frac{16}{25}$ of the boys go climbing.

Twice as many girls go sailing as go climbing.

Work out how many children go sailing on Sunday.

Total ratio : $3 + 5 = 8$

$\frac{120}{8} = 15$ (1)

Boys : $5 \times 15 = 75$
Girls : $3 \times 15 = 45$ (1)

Climbing

Boys : $\frac{16}{25} \times 75 = 48$ (1)

Girls : $\frac{1}{3} \times 45 = 15$ (1)

Sailing

Boys : $75 - 48 = 27$

Girls : $45 - 15 = 30$

Total sailing : $27 + 30$ (1)

$= 57$ (1)

57

(Total for Question 5 is 6 marks)

PMT

6 (a) Write 7.8×10^{-4} as an ordinary number.

0.00078

0.00078 ①

(1)

(b) Work out $\dfrac{5.6 \times 10^4 + 7 \times 10^3}{2.8 \times 10^{-3}}$

Give your answer in standard form.

$5.6 \times 10^4 \rightarrow 56 \times 10^3$

$\dfrac{56 \times 10^3 + 7 \times 10^3}{2.8 \times 10^{-3}}$ ①

$= \dfrac{63 \times 10^3}{2.8 \times 10^{-3}}$

$= 2.25 \times 10^7$ ①

2.25×10^7

(2)

(Total for Question 6 is 3 marks)

7 (a) Expand and simplify $(m - 8)(m + 5)$

$m^2 + 5m - 8m - 40$ ①

$= m^2 - 3m - 40$ ①

$m^2 - 3m - 40$

(2)

(b) Factorise fully $5y + 20y^2$

$5y + 20y^2$

$5(y + 4y^2)$

$= 5y(1 + 4y)$ ②

$5y(1+4y)$

(2)

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(c) Simplify $(p^2 + 3)^0$

$x^0 = 1$

1 (1)

(1)

(d) Solve $3(2x - 5) = \dfrac{9 - x}{2}$

Show clear algebraic working.

$3(2x-5) = \dfrac{9-x}{2}$

$6x - 15 = \dfrac{9-x}{2}$ (1)

$2(6x-15) = 9 - x$ (1)

$12x - 30 = 9 - x$

$12x + x = 9 + 30$ (1)

$13x = 39$

$x = \dfrac{39}{13}$

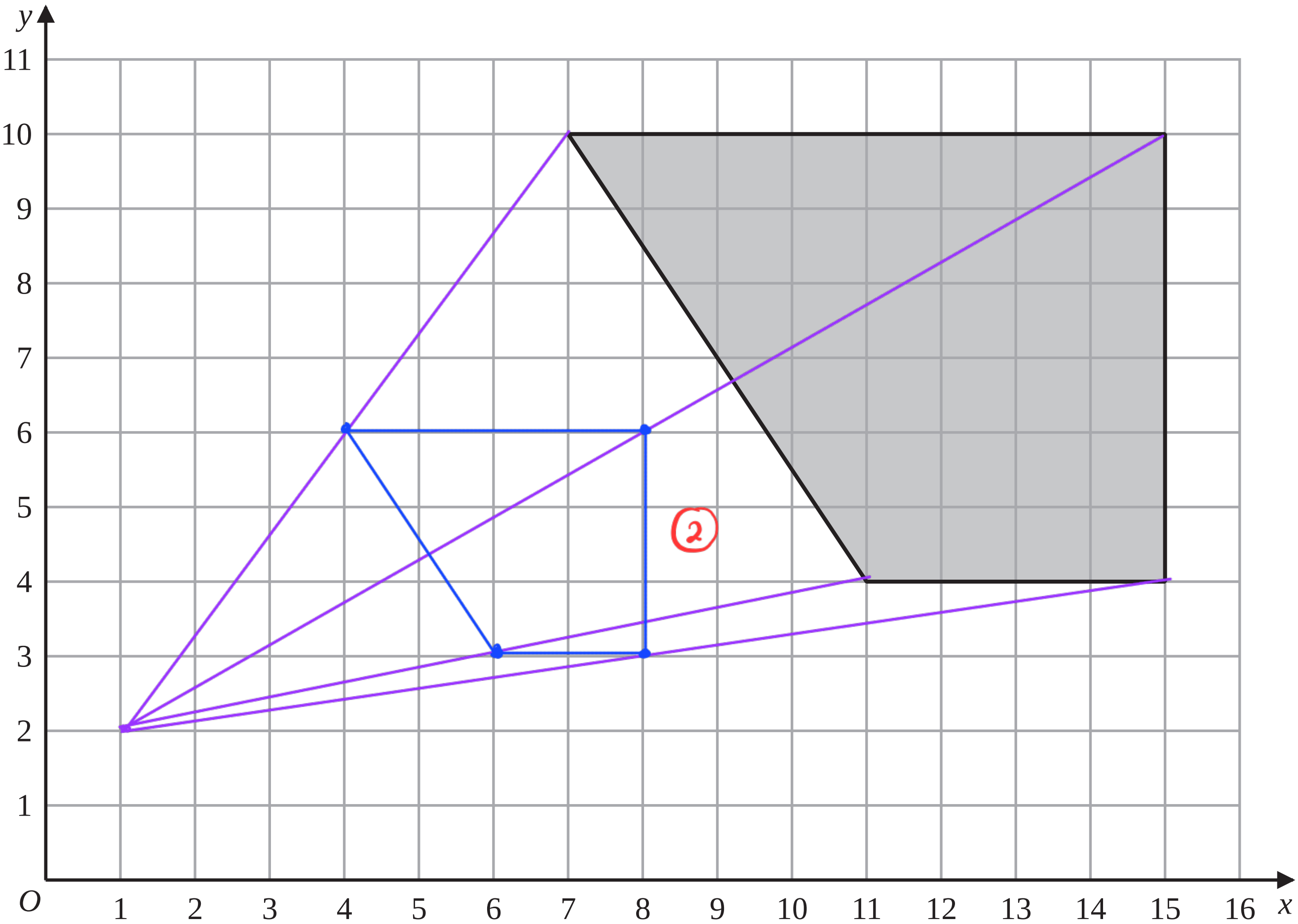
$= 3$ (1)

$x =$ 3

(4)

(Total for Question 7 is 9 marks)

8



On the grid, enlarge the shaded shape with scale factor $\frac{1}{2}$ and centre (1, 2)

(Total for Question 8 is 2 marks)

9 Here is a right-angled triangle.

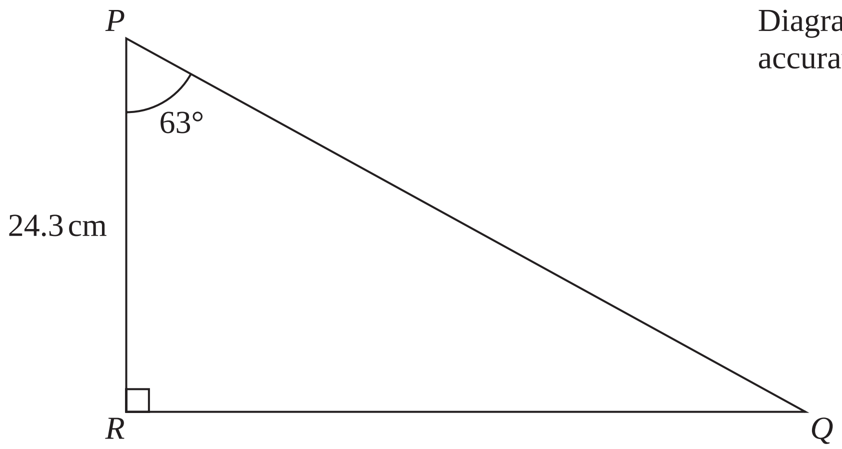


Diagram **NOT** accurately drawn

Calculate the length of PQ.
Give your answer correct to 3 significant figures.

$$\cos 63^\circ = \frac{PR}{PQ}$$

$$\cos 63^\circ = \frac{24.3}{PQ} \quad (1)$$

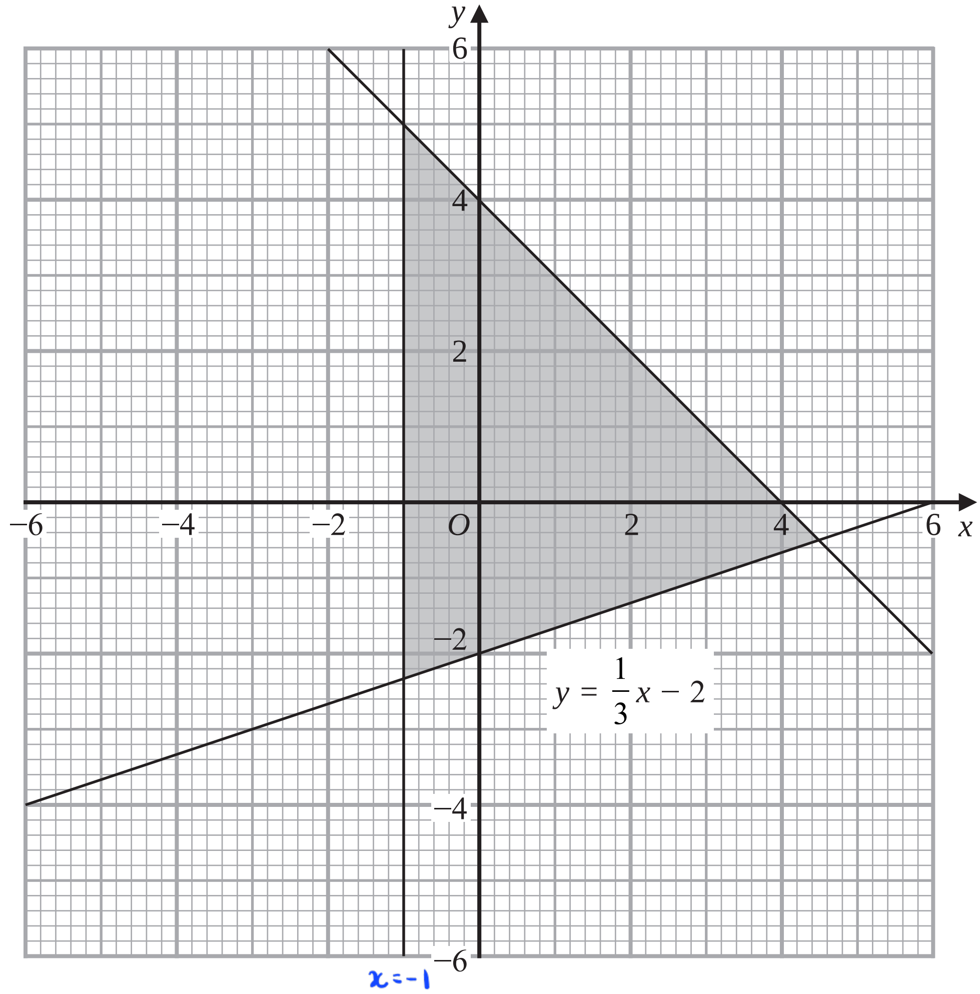
$$PQ = \frac{24.3}{\cos 63^\circ} \quad (1)$$

$$= 53.5 \text{ cm} \quad (1)$$

53.5 .... cm

(Total for Question 9 is 3 marks)

10 The shaded region in the diagram is bounded by three lines.
The equation of one of the lines is given.



Write down the three inequalities that define the shaded region.

$y \geqslant \frac{1}{3}x - 2$

$x \geqslant -1$

$y \leqslant -x + 4$ 3

(Total for Question 10 is 3 marks)

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11 Max invests \$6000 in a savings account for 3 years.
The account pays compound interest at a rate of 1.5% per year for the first 2 years.

The compound interest rate changes for the third year.
At the end of 3 years, there is a total of \$6311.16 in the account.

Work out the compound interest rate for the third year.
Give your answer correct to 1 decimal place.

First year : $6000 + \frac{1.5}{100} \times 6000 = 6090$

Second year : $6090 + \frac{1.5}{100} \times 6090 = 6181.35$ (1)

Third year : $6181.35 + \frac{x}{100} \times 6181.35 = 6311.16$

$\frac{x}{100} \times 6181.35 = 6311.16 - 6181.35$

$\frac{x}{100} \times 6181.35 = 129.81$ (1)

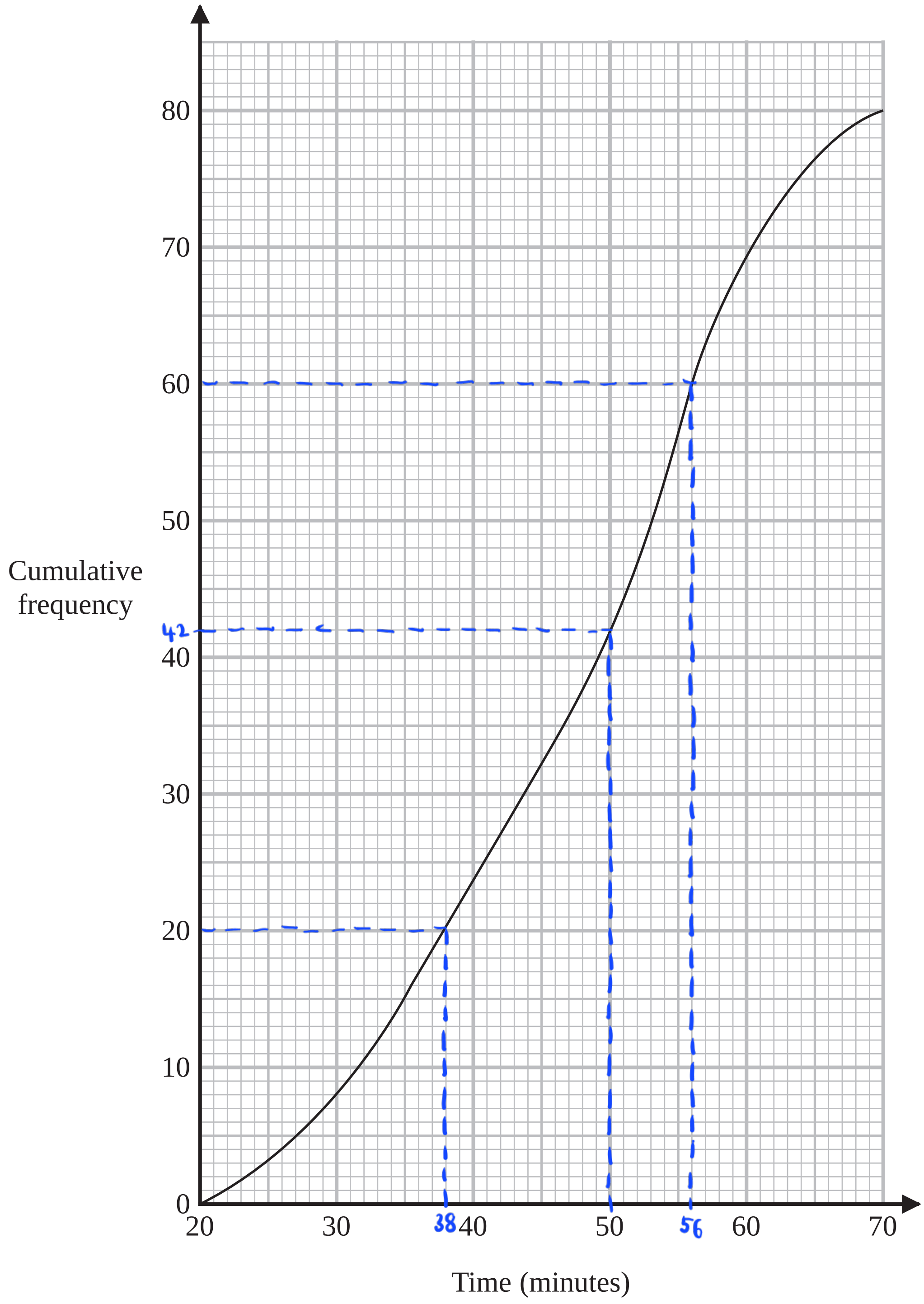
$x = \frac{129.81}{6181.35} \times 100$

$= 2.1\%$ (1)

2.1 .... %

(Total for Question 11 is 3 marks)

12 A total of 80 men and women took part in a race.
The cumulative frequency graph gives information about the times, in minutes, they took for the race.



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(a) Use the graph to find an estimate for the interquartile range.

$Q_1 = \frac{1}{4} \times 80 = 20$ $Q_3 = \frac{3}{4} \times 80 = 60$

$Q_1 = 38$ $Q_3 = 56$

Interquartile range $= 56 - 38$ 1

$= 18$ 1

18 .... minutes

(2)

60% of the men took 50 minutes or less for the race.
No women took 50 minutes or less for the race.

(b) Work out an estimate for the number of men who took part in the race.

From graph: 42 men took 50 minutes or less for the race. 1

$42 = 60\%$ of the men

Total men $= \frac{100}{60} \times 42$ 1

$= 70$ 1

70 ....

(3)

(Total for Question 12 is 5 marks)

13 The diagram shows a solid cube.
The cube is placed on a table so that the whole of one face of the cube is in contact with the table.

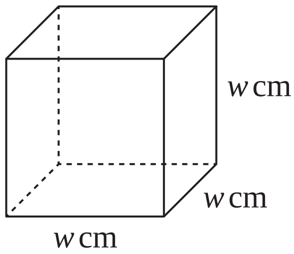

Diagram **NOT** accurately drawn

The cube exerts a force of 56 newtons on the table.
The pressure on the table due to the cube is 0.14 newtons/cm^2

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Work out the volume of the cube.

$0.14 \text{ N/cm}^2 = \frac{56 \text{ N}}{w^2}$ (1)

$w^2 = \frac{56}{0.14}$

$w^2 = 400$

$w = \sqrt{400}$

$= 20 \text{ cm}$ (1)

Volume of cube $= 20 \text{ cm} \times 20 \text{ cm} \times 20 \text{ cm}$ (1)

$= 8000 \text{ cm}^3$ (1)

8000 .... cm^3

(Total for Question 13 is 4 marks)

P 5 9 7 5 6 A 0 1 6 2 8

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14 The diagram shows parallelogram *EFGH*.

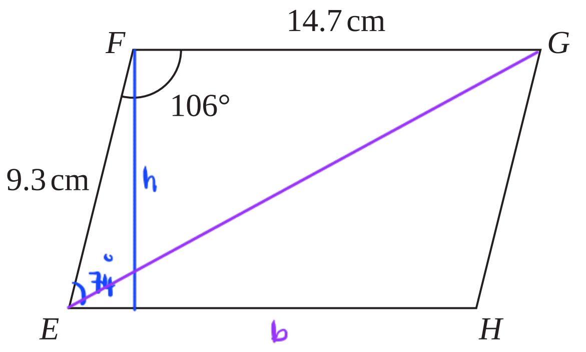

Diagram **NOT** accurately drawn

$EF = 9.3$ cm
$FG = 14.7$ cm
Angle $EFG = 106°$

Area of parallelogram : $b \times h$

(a) Work out the area of the parallelogram.
Give your answer correct to 3 significant figures.

angle FEH $= 180° - 106° = 74°$

$\sin 74° = \frac{h}{9.3}$

$h = 9.3 \sin 74°$ (1)

$= 8.94$ cm

Area of parallelogram : $8.94 \times 14.7 = 131 \text{ cm}^2$ (1)

131 .... cm²
(2)

(b) Work out the length of the diagonal *EG* of the parallelogram.
Give your answer correct to 3 significant figures.

By using cosine rule :

$EG^2 = EF^2 + FG^2 - 2 \times EF \times FG \times \cos 106°$

$= 9.3^2 + 14.7^2 - 2(9.3)(14.7) \cos 106°$ (1)

$= 86.49 + 216.09 + 75.36$

$= 377.94$ (1)

$EG = \sqrt{377.94}$

$= 19.4$ cm (1)

19.4 .... cm
(3)

(Total for Question 14 is 5 marks)

15

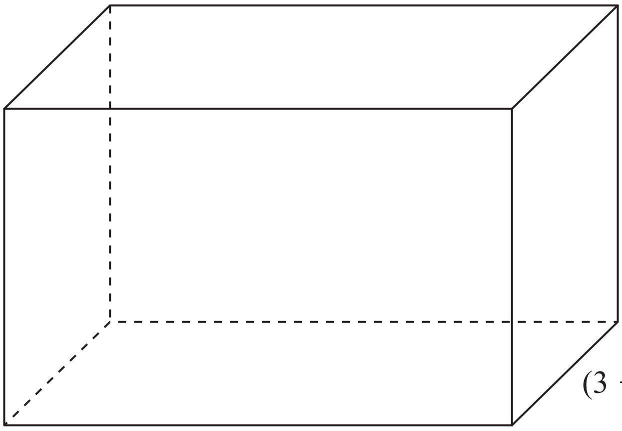

Diagram **NOT** accurately drawn

The diagram shows a cuboid of volume V cm^3

(a) Show that $V = 15 + 16x - x^2 - 2x^3$

$V =$ length $\times$ width $\times$ height

$= (2x+5)(3-x)(x+1)$

$= (6x - 2x^2 + 15 - 5x)(x+1)$

$= (-2x^2 + x + 15)(x+1)$ ①

$= -2x^3 - 2x^2 + x^2 + x + 15x + 15$ ①

$= -2x^3 - x^2 + 16x + 15$

①

$V = 15 + 16x - x^2 - 2x^3$ (shown)

(3)

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There is a value of x for which the volume of the cuboid is a maximum.

(b) Find this value of x.
Show your working clearly.
Give your answer correct to 3 significant figures.

Volume of cuboid is maximum when $\frac{dV}{dx} = 0$

$V = 15 + 16x - x^2 - 2x^3$

$\frac{dV}{dx} = 16 - 2x - 6x^2$ (1) (1)

$-6x^2 - 2x + 16 = 0$ (1)

By using quadratic equation:

$x = \frac{2 \pm \sqrt{(-2)^2 - 4(-6)(16)}}{2(-6)}$ (1)

$= \frac{2 \pm \sqrt{4 + 384}}{-12}$

$= \frac{2 \pm \sqrt{388}}{-12}$

$= \frac{2 + \sqrt{388}}{-12}$ or $\frac{2 - \sqrt{388}}{-12}$

$x = -1.81$ or $x = 1.47$

∴ x must be positive when cuboid is maximum. Hence,

$x = 1.47$ (1)

$x =$ 1.47

(5)

(Total for Question 15 is 8 marks)

P 5 9 7 5 6 A 0 1 9 2 8

16 $P = \dfrac{2a - c}{d}$

$a = 58.4$ correct to 3 significant figures.
$c = 20$ correct to 2 significant figures.
$d = 3.6$ correct to 2 significant figures.

Work out the upper bound for the value of P.
Show your working clearly.
Give your answer correct to 2 decimal places.

To get upper bound value of P :

we need upper bound of a , lower bound of c and lower bound of d .

upper bound of a : 58.45 1
lower bound of c : 19.5
lower bound of d : 3.55

upper bound value of $P = \dfrac{2(58.45) - 19.5}{3.55}$ 1

$= 27.44$ 1

27.44

(Total for Question 16 is 3 marks)

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17 (a) Show that $\left(6 + 2\sqrt{12}\right)^2 = 12\left(7 + 4\sqrt{3}\right)$

Show each stage of your working.

LHS : $(6+2\sqrt{12})(6+2\sqrt{12})$

$= 36 + 12\sqrt{12} + 12\sqrt{12} + 4(12)$ (1)

$= 36 + 24\sqrt{12} + 48$

$= 36 + 24\sqrt{4\times 3} + 48$

$= 36 + 24(2\sqrt{3}) + 48$ (1)

$= 36 + 48\sqrt{3} + 48$

$= 12(3 + 4\sqrt{3} + 4)$ (1)

$= 12(7 + 4\sqrt{3})$

(3)

(b) Simplify fully $\left(\dfrac{27a^{12}}{t^{15}}\right)^{-\frac{2}{3}}$

$\left(\dfrac{27a^{12}}{t^{15}}\right)^{-\frac{2}{3}} = \left(3^3 \times a^{12} \times t^{-15}\right)^{-\frac{2}{3}}$

$= (3^3)^{-\frac{2}{3}} \times (a^{12})^{-\frac{2}{3}} \times (t^{-15})^{-\frac{2}{3}}$ (1)

$= 3^{-2} \times a^{-8} \times t^{10}$ (1)

$= \dfrac{t^{10}}{9a^8}$ (1)

$\dfrac{t^{10}}{9a^8}$

(3)

(Total for Question 17 is 6 marks)

18 There are 16 sweets in a bowl.

4 of the sweets are blackcurrant. (B)
5 of the sweets are lemon. (L)
7 of the sweets are orange. (O)

Anna, Ravi and Sam each take at random one sweet from the bowl.

Work out the probability that the 5 lemon sweets are still in the bowl.

Scenario 1 : BBB

$\frac{4}{16} \times \frac{3}{15} \times \frac{2}{14} = \frac{1}{140}$ (1)

Scenario 2 : OOO

$\frac{7}{16} \times \frac{6}{15} \times \frac{5}{14} = \frac{1}{16}$

Scenario 3 : BBO

$\frac{4}{16} \times \frac{3}{15} \times \frac{7}{14} = \frac{1}{40}$ (1)

Scenario 4 : OOB

$\frac{7}{16} \times \frac{6}{15} \times \frac{4}{14} = \frac{1}{20}$

Scenario 5 : BOB

$\frac{4}{16} \times \frac{7}{15} \times \frac{3}{14} = \frac{1}{40}$

Scenario 6 : BOO

$\frac{4}{16} \times \frac{7}{15} \times \frac{6}{14} = \frac{1}{20}$

Scenario 7 : OBO

$\frac{7}{16} \times \frac{4}{15} \times \frac{6}{14} = \frac{1}{20}$

Scenario 8 : OBB

$\frac{7}{16} \times \frac{4}{15} \times \frac{3}{14} = \frac{1}{40}$

Total : $\frac{1}{140} + \frac{1}{16} + \frac{1}{40} + \frac{1}{20} + \frac{1}{40} + \frac{1}{20} + \frac{1}{20} + \frac{1}{40}$ (1)

$= \frac{33}{112}$ (1)

$\frac{33}{112}$

(Total for Question 18 is 4 marks)

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19 The diagram shows a cuboid *ABCDEFGH*.

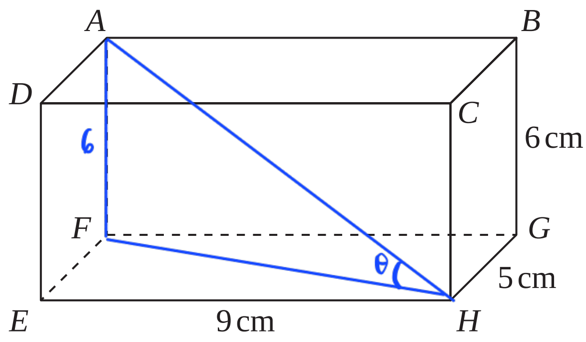


Diagram **NOT** accurately drawn

$EH = 9\text{ cm}$, $HG = 5\text{ cm}$ and $GB = 6\text{ cm}$.

Work out the size of the angle between *AH* and the plane *EFGH*.
Give your answer correct to 3 significant figures.

diagonal $FH = \sqrt{5^2 + 9^2}$

$= \sqrt{106}$ 1

$\tan\theta = \frac{AF}{FH}$

$\tan\theta = \frac{6}{\sqrt{106}}$ 1

$\theta = \tan^{-1}\frac{6}{\sqrt{106}}$ 1

$= 30.2°$ 1

30.2 °

(Total for Question 19 is 4 marks)

20 The curve **C** has equation $y = 4(x - 1)^2 - a$ where $a > 4$

Using the axes below, sketch the curve **C**.
On your sketch show clearly, in terms of a,

(i) the coordinates of any points of intersection of **C** with the coordinate axes,

(ii) the coordinates of the turning point.

When $x = 1$, $y = -a$ (1) — turning point

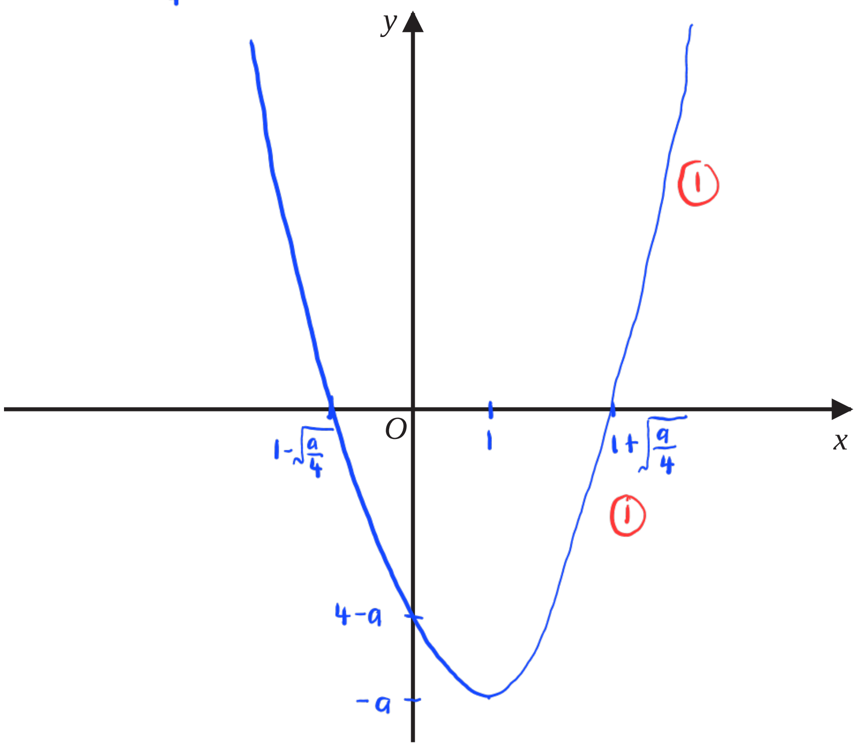
When $x = 0$, $y = 4 - a$ (1) — y-intercept

When $y = 0$, $0 = 4(x-1)^2 - a$ — x-intercept

$(x-1)^2 = \frac{a}{4}$

$(x-1) = \pm\sqrt{\frac{a}{4}}$

$x = 1 \pm \sqrt{\frac{a}{4}}$



(Total for Question 20 is 4 marks)

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21 The functions f and g are such that

$$f(x) = x^2 - 2x \qquad g(x) = x + 3$$

The function h is such that $h(x) = fg(x)$ for $x \geqslant -2$

Express the inverse function $h^{-1}(x)$ in the form $h^{-1}(x) = \ldots$

$fg(x) = (x+3)^2 - 2(x+3)$ (1)

$= x^2 + 6x + 9 - 2x - 6$

$fg(x) = x^2 + 4x + 3$ (1)

$(x+2)^2 - 4 + 3$

$fg(x) = (x+2)^2 - 1$

$fg(x) = h(x) = (x+2)^2 - 1$

Let $h(x) = y$

$y = (x+2)^2 - 1$ (1)

Find x in terms of y :

$y + 1 = (x+2)^2$

$\pm\sqrt{y+1} = x + 2$

$x = -2 \pm \sqrt{y+1}$ (1)

$\therefore h^{-1}(x) = -2 \pm \sqrt{x+1}$

equal to range of $h(x)$

since domain of $h^{-1}(x) \geq -2$,

$h^{-1}(x) = -2 + \sqrt{x+1}$ (1)

$h^{-1}(x) =$ $-2 + \sqrt{x+1}$

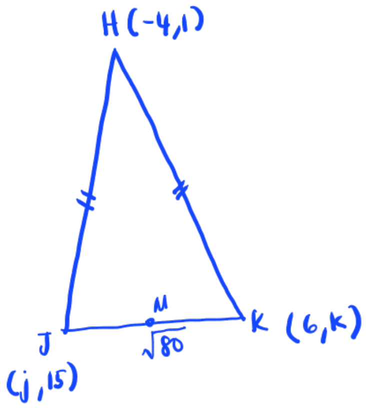
(Total for Question 21 is 5 marks)

22 Triangle HJK is isosceles with $HJ = HK$ and $JK = \sqrt{80}$

H is the point with coordinates $(-4, 1)$
J is the point with coordinates $(j, 15)$ where $j < 0$
K is the point with coordinates $(6, k)$

M is the midpoint of JK.
The gradient of HM is 2

Find the value of j and the value of k.



Given : gradient of HM = 2

gradient of JK $= \frac{-1}{2} = -\frac{1}{2}$ 1

$-\frac{1}{2} = \frac{(k-15)}{(6-j)}$

$-6 + j = 2k - 30$

$j = 2k - 24$ — 1 1

Given : length of JK $= \sqrt{80}$

$\sqrt{(6-j)^2 + (k-15)^2} = \sqrt{80}$

$(6-j)^2 + (k-15)^2 = 80$ 1

$j^2 - 12j + 36 + k^2 - 30k + 225 = 80$

$j^2 - 12j + k^2 - 30k = -181$ — 2

substitute 1 into 2 :

$(2k-24)^2 - 12(2k-24) + k^2 - 30k = -181$

$4k^2 - 96k + 576 - 24k + 288 + k^2 - 30k = -181$

$5k^2 - 150k + 1045 = 0$ 1

$k = \frac{150 \pm \sqrt{(-150)^2 - 4(5)(1045)}}{2(5)}$ 1

$= \frac{150 \pm \sqrt{1600}}{10}$

$= \frac{150 \pm 40}{10}$

$k = 19$ or 11

substitute k values into (1)

$j = 2(19) - 24$ or $j = 2(11) - 24$

$= 14$ or $j = -2$

since $j < 0$,

$\therefore$ $j = -2$ and $k = 11$ (1)

$j =$ -2

$k =$ 11

(Total for Question 22 is 6 marks)

TOTAL FOR PAPER IS 100 MARKS

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