

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Time 1 hour 30 minutes

Paper
reference

1MA1/3H

Mathematics

PAPER 3 (Calculator)

Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator, Formulae Sheet (enclosed). 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.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You must **show all your working**.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **Calculators may be used.**
- If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.



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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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P 6 8 7 2 5 A 0 1 2 4



Pearson

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1 Make a the subject of the formula $p = 3a - 9$

$$\begin{aligned} p &= 3a - 9 \\ +9 &\downarrow +9 \\ p+9 &= 3a \quad \textcircled{1} \\ \div 3 &\downarrow \div 3 \\ \frac{p+9}{3} &= a \end{aligned}$$

$$a = \frac{p+9}{3} \quad \textcircled{1}$$

(Total for Question 1 is 2 marks)

- 2 Rob has been asked to divide 120 in the ratio 3:5

Here is his working.

$$120 \div 3 = 40$$

$$120 \div 5 = 24$$

Rob's working is not correct.

Describe what Rob has done wrong.

Rob should have divided by 8 $\textcircled{1}$

$$\begin{aligned} \frac{120}{8} &= 15 & 15 \times 3 &= 45 \\ & & 15 \times 5 &= 75 \end{aligned}$$

(Total for Question 2 is 1 mark)

- 3 ^① 200 students chose one language to study.
Each student chose one language from French or Spanish or German.

Of the 200 students,

- ② 90 are boys and the rest of the students are girls
- ③ 70 chose Spanish
- ④ 60 of the 104 students who chose French are boys
- ⑤ 18 girls chose German.

Work out how many boys chose Spanish.

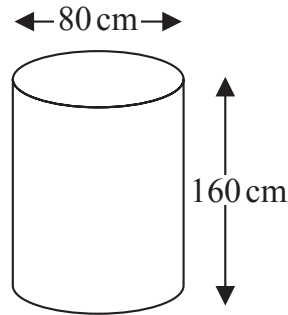
Always draw a two-way table!

	French	Spanish	German	Total
Boys	60 ^④	$90 - 60 - 8 = 22$ ^①	$26 - 18 = 8$	90 ^②
Girls	$104 - 60 = 44$ ^④		18 ^⑤	$200 - 90 = 110$ ^②
Total	104 ^④	70 ^③	$200 - 70 - 104 = 26$ ^①	200 ^①

^①
22

(Total for Question 3 is 3 marks)

- 4 Karina has 4 tanks on her tractor.
Each tank is a cylinder with diameter 80 cm and height 160 cm.



The 4 tanks are to be filled completely with a mixture of fertiliser and water.

The fertiliser has to be mixed with water in the ratio 1 : 100 by volume.
Karina has 32 litres of fertiliser.

$$1 \text{ litre} = 1000 \text{ cm}^3$$

Has Karina enough fertiliser for the 4 tanks?
You must show how you get your answer.

$$\text{Volume of the cylinder} = \pi r^2 h \quad \begin{array}{l} r = \text{radius} \\ h = \text{height} \end{array}$$

$$\text{we have } r = \frac{80}{2} = 40 \text{ cm}$$

$$h = 160 \text{ cm}$$

$$\therefore \text{volume is } \pi (40)^2 (160) = 256000\pi \text{ cm}^3 \quad \left. \begin{array}{l} \\ \end{array} \right\} \div 1000 \\ = 256\pi \text{ litres } \textcircled{1}$$

So four tanks have a volume
of $4 \times 256\pi = 1024\pi$ litres $\textcircled{1}$

we need fertiliser: water
1 : 100

$$1 + 100 = 101$$

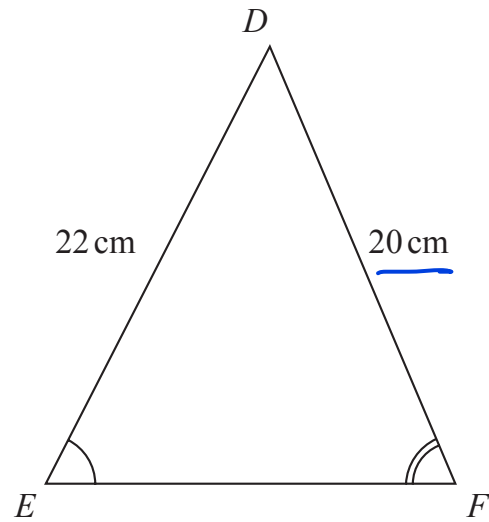
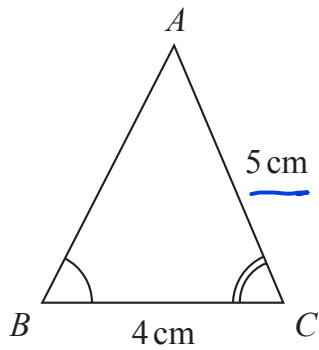
$$1024\pi \div 101 = 31.85\dots \textcircled{1}$$

So Karina needs at least 31.9
litres of fertiliser.

$32 > 31.9$ so $\textcircled{1}$
Karina has enough
fertiliser

(Total for Question 4 is 4 marks)

5 Triangle ABC and triangle DEF are similar.



(a) Work out the length of EF .

Find scale factor:

$$\frac{20\text{ cm}}{5\text{ cm}} = 4 \quad (1)$$

$$\begin{aligned} EF &= 4 BC \\ &= 4 \times 4 \\ &= 16 \end{aligned}$$

$$\begin{array}{r} \text{.....} \\ 16 \quad (1) \\ \text{.....} \\ (2) \end{array} \text{ cm}$$

(b) Work out the length of AB .

$$\begin{aligned} DE &= 4 AB \\ 22 &= 4 AB \\ AB &= \frac{22}{4} = 5.5 \quad (1) \end{aligned}$$

$$\begin{array}{r} \text{.....} \\ 5.5 \quad (1) \\ \text{.....} \\ (2) \end{array} \text{ cm}$$

(Total for Question 5 is 4 marks)

7 (a) Change 8000 cm^3 to m^3

$$\begin{aligned} 1\text{m} &= 10^2\text{cm} \\ 1\text{m}^2 &= 10^4\text{cm}^2 \\ 1\text{m}^3 &= 10^6\text{cm}^3 \end{aligned}$$

to get from cm^3 to m^3 ,
divide by 10^6

$$\frac{8000}{10^6} = 0.008$$

..... 0.008 m^3
(1)

(b) Change a speed of 180 km per hour to metres per second.

$$180\text{km} = 180,000\text{m} \quad (1)$$

$$1\text{hr} = 60 \times 60 = 3600\text{s}$$

$$\frac{180\text{km}}{1\text{hour}} = \frac{180,000\text{m}}{3600\text{s}} = 50\text{m/s} \quad (1)$$

..... 50 metres per second
(3)

(Total for Question 7 is 4 marks)

8 There are 30 women and 20 men at a gym.

The mean height of all 50 people is 167.6 cm

The mean height of the 20 men is 182 cm

Work out the mean height of the 30 women.

$$\begin{aligned} \text{Total of heights of all people} \\ &= 50 \times 167.6 = 8380\text{cm} \quad (1) \end{aligned}$$

$$\begin{aligned} \text{Total of heights of all men} \\ &= 20 \times 182 = 3640\text{cm} \end{aligned}$$

$$\begin{aligned} \text{Total height of all women} \\ &= 8380 - 3640 = 4740\text{cm} \end{aligned}$$

$$\begin{aligned} \text{mean height of the 30 women} \\ &= \frac{4740}{30} = 158\text{cm} \quad (1) \end{aligned}$$

..... 158 cm
(1)

(Total for Question 8 is 3 marks)

9 (a) Write 6.75×10^{-4} as an ordinary number.

$10^{-4} \Rightarrow$ move decimal place 4 places to the left

0.0006.75

$$6.75 \times 10^{-4} = 0.000675 \quad \textcircled{1}$$

(1)

(b) Work out $\frac{2.56 \times 10^6 \times 4.12 \times 10^{-3}}{1.6 \times 10^{-2}}$

Give your answer in standard form.

consider $2.56 \times 10^6 \times 4.12 \times 10^{-3}$

multiply front numbers, add powers of 10:

$$(2.56 \times 4.12) \times 10^{6-3}$$

$$10.5472 \times 10^3 \quad \textcircled{1}$$

now consider $\frac{10.5472 \times 10^3}{1.6 \times 10^{-2}}$

divide front numbers, subtract powers of 10

$$\left(\frac{10.5472}{1.6} \right) \times 10^{3-(-2)} = 6.592 \times 10^5$$

$$6.592 \times 10^5 \quad \textcircled{1}$$

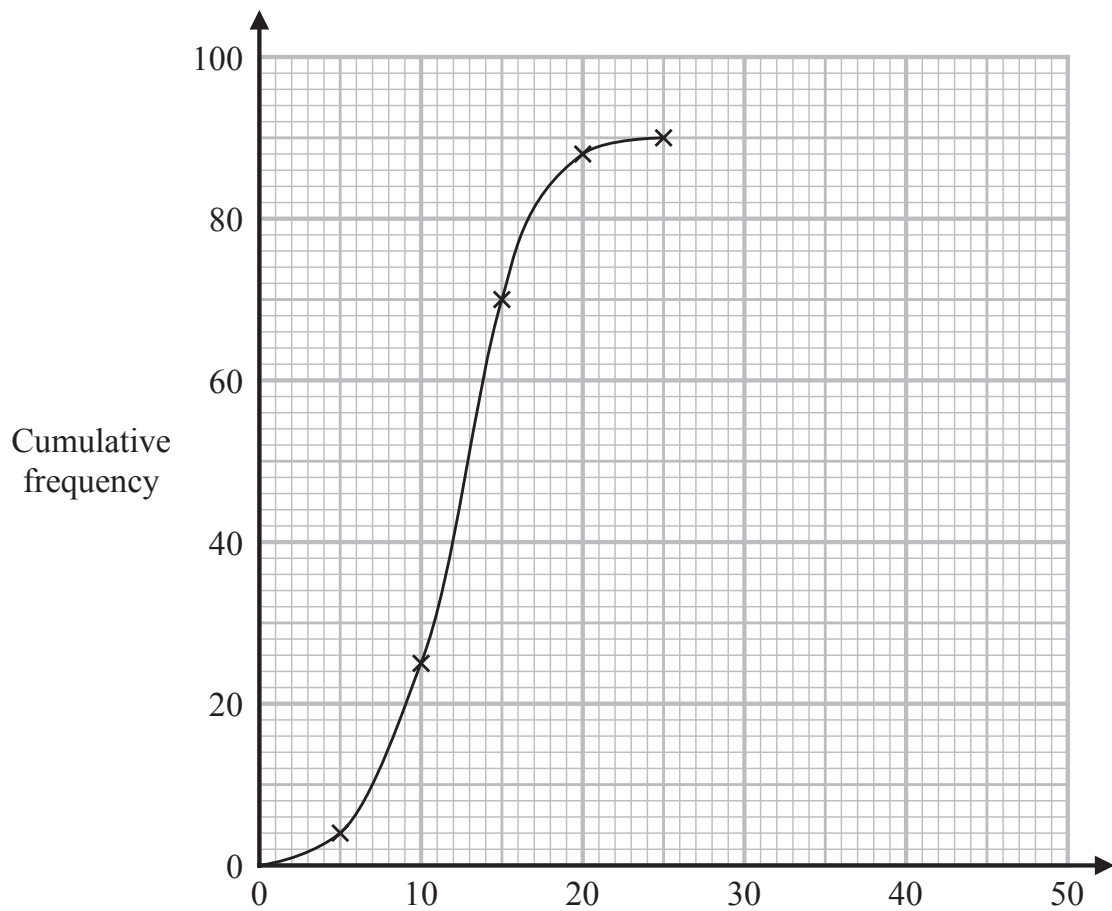
(2)

(Total for Question 9 is 3 marks)

- 13 Chen has this information about the time that it took an operator at a call centre to answer each of 90 calls.

Time (t seconds)	Cumulative frequency
$0 < t \leq 10$	4
$0 < t \leq 20$	25
$0 < t \leq 30$	70
$0 < t \leq 40$	88
$0 < t \leq 50$	90

Chen draws this cumulative frequency graph for the information in the table.



Write down two different things that are wrong with this graph.

- 1 The horizontal axis is not labelled. (1)
- 2 The graph has been plotted using midpoints instead of endpoints. (1)

(Total for Question 13 is 2 marks)

14 (a) Simplify fully $(3x^5y^6)^4$

$$(3x^5y^6)^4 = 3^4 x^{20} y^{24} = 81x^{20}y^{24} \quad (2)$$

Indices distribute
to terms multiplied together

$$\frac{81x^{20}y^{24}}{(2)}$$

(b) Expand and simplify $(x+2)(x-3)(x+4)$

consider

$$\begin{aligned} &(x-3)(x+4) \\ &= x^2 + 4x - 3x - 12 \\ &= x^2 + x - 12 \quad (1) \end{aligned}$$

$$\begin{aligned} &(x+2)(x^2+x-12) \\ &= x^3 + 2x^2 + x^2 + 2x - 12x - 24 \quad (1) \\ &= x^3 + 3x^2 - 10x - 24 \end{aligned}$$

$$\frac{x^3 + 3x^2 - 10x - 24}{(3)} \quad (1)$$

(Total for Question 14 is 5 marks)

15 A pet shop has

7 guppy fish
13 tetra fish
5 angel fish.

David is going to choose one of the following combinations of fish

- a guppy fish and an angel fish
- or a tetra fish and an angel fish
- or a guppy fish, a tetra fish and an angel fish.

Show that there are 555 different ways for David to choose his fish.

ways of
choosing:

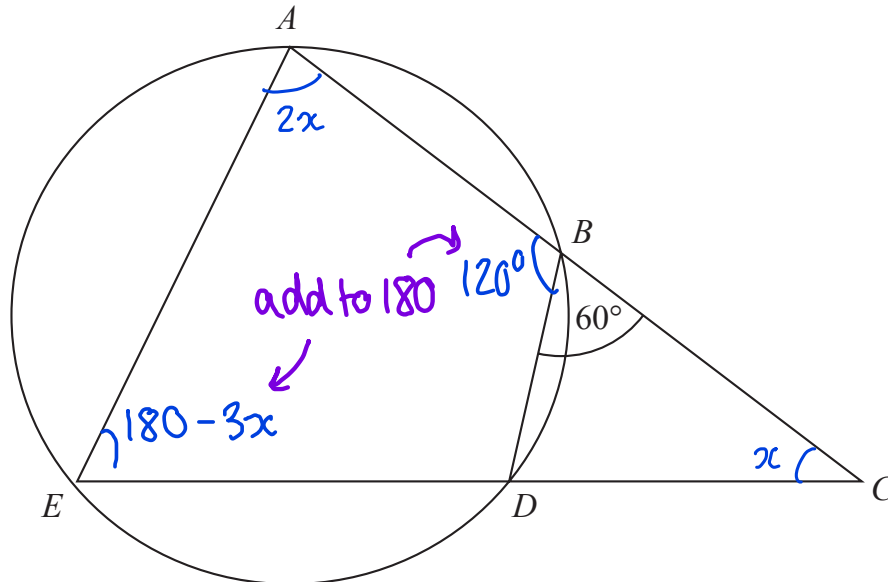
1. guppy and angel: $7 \times 5 = 35$ ①

2. tetra and angel: $13 \times 5 = 65$

3. guppy, tetra and angel: $7 \times 13 \times 5 = 455$

total number of ways = $35 + 65 + 455 = 555$ ①

(Total for Question 15 is 2 marks)



$ABDE$ is a cyclic quadrilateral.
 ABC and EDC are straight lines.
 Angle $DBC = 60^\circ$

Given that

$$\text{size of angle } EAB : \text{size of angle } BCD = 2 : 1$$

work out the size of angle BCD .
 You must show all your working.

$$\begin{aligned} \text{let } \angle BCD &= x \\ \text{then } \angle EAB &= 2x \quad \textcircled{1} \end{aligned}$$

From $\triangle ACE$,

$$\begin{aligned} \angle AEC &= 180 - (2x + x) \\ &= 180 - 3x \quad \textcircled{1} \end{aligned}$$

(angles in a \triangle add up to 180)

$$\begin{aligned} \angle ABD &= 180 - 60 = 120 \\ &\text{(angles on a straight line add to 180)} \end{aligned}$$

since $\square ABDE$ is cyclic,
 $\angle ABD + \angle AEC = 180^\circ \quad \textcircled{1}$

$$120 + 180 - 3x = 180^\circ$$

$$120 - 3x = 0$$

$$3x = 120$$

$$x = 120 \div 3$$

$$= 40 \quad \textcircled{1}$$

40°

(Total for Question 16 is 4 marks)

17 There are four boxes on a shelf, A, B, C and D.

- ① The total weight of A and B is 3 times the total weight of C and D.
- ② The weight of A is $\frac{2}{3}$ of the weight of B.
- ③ The weight of C is 75% of the weight of D.

Find the ratio

weight of A : weight of B : weight of C : weight of D

$$\textcircled{1} (A+B) = 3(C+D) \quad \textcircled{1}$$

$$\textcircled{2} A = \frac{2}{3} B \xrightarrow{\times 3} 3A = 2B \Rightarrow \begin{array}{l} A : B \\ 2 : 3 \end{array}$$

$$\textcircled{3} C = \frac{3}{4} D \xrightarrow{\times 4} 4C = 3D \Rightarrow \begin{array}{l} C : D \\ 3 : 4 \end{array} \quad \textcircled{1}$$

sub in $A = \frac{2}{3}B$ and $C = \frac{3}{4}D$
into $(A+B) = 3(C+D)$:

$$\frac{2}{3}B + B = 3\left(\frac{3}{4}D + D\right) \quad \textcircled{1}$$

$$\begin{array}{l} \times 12 \swarrow \quad \searrow \times 12 \\ \frac{5}{3}B = \frac{21}{4}D \end{array}$$

$$20B = 63D$$

$$B : D$$

$$63 : 20$$

$$\begin{array}{l} A : B \\ \times 21 \swarrow \quad \searrow \times 21 \\ 2 : 3 \\ 42 : 63 \\ \underline{\quad} \end{array}$$

$$\begin{array}{l} C : D \\ \times 5 \swarrow \quad \searrow \times 5 \\ 3 : 4 \\ 15 : 20 \\ \underline{\quad} \end{array}$$

$$\begin{array}{l} A : B : C : D \\ 42 : 63 : 15 : 20 \end{array}$$

$$42 : 63 : 15 : 20 \quad \textcircled{1}$$

(Total for Question 17 is 4 marks)

- 18 Shape **A** is reflected in the line with equation $x = 2$ to give shape **B**.
Shape **B** is reflected in the line with equation $x = 6$ to give shape **C**.

Describe fully the **single** transformation that maps shape **A** onto shape **C**.

the point (x, y) is transformed to $(2a - x, y)$ under reflection in the line $x = a$.

$$\text{so } (x, y) \xrightarrow{x=2} (4-x, y) \xrightarrow{x=6} (x+8, y)$$

Translation^① by vector $\begin{pmatrix} 8 \\ 0 \end{pmatrix}$ ^①

(Total for Question 18 is 2 marks)

- 19 There are only blue counters, red counters and green counters in a box.

The probability that a counter taken at random from the box will be blue is 0.4
The ratio of the number of red counters to the number of green counters is 7:8

Sameena takes at random a counter from the box.

$$7+8=15$$

She records its colour and puts the counter back in the box.

Sameena does this a total of 50 times.

Work out an estimate for the number of times she takes a green counter.

$$\text{Probability of red or green} = 1 - 0.4 = 0.6 \quad \text{①}$$

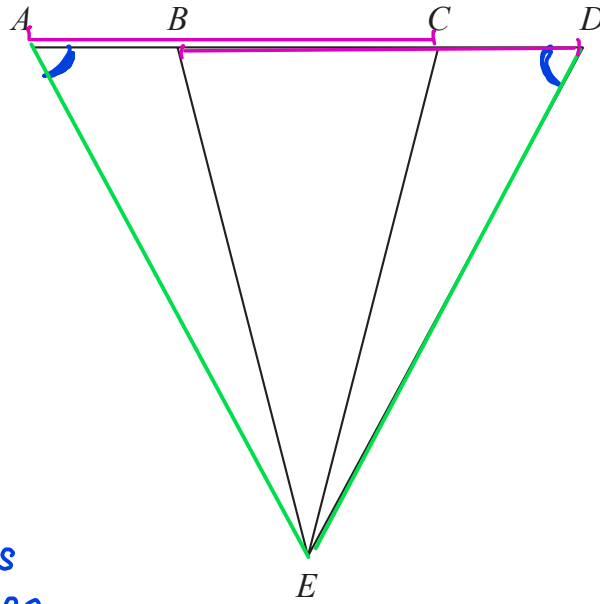
$$\text{Probability of green} = 0.6 \times \frac{8}{15} = 0.32$$

$$\text{Number of greens picked} = 0.32 \times 50 = 16 \quad \text{①}$$

16^①

(Total for Question 19 is 3 marks)

20 The diagram shows a triangle ADE .



$$AE = DE$$

$$AB:BC:CD = 1:2:1$$

Prove that triangle ACE is congruent to triangle DBE .

$$\angle CAE = \angle BDE \quad (\text{base isosceles angles are equal}) \quad \textcircled{1}$$

$$AE = DE \quad (\text{given}) \quad \textcircled{1}$$

$$\begin{array}{l} AB:BC:CD \\ 1:2:1 \end{array} \Rightarrow \begin{array}{l} AB+BC = BC+CD \\ AC = BD \end{array}$$

$$\text{SO } \triangle ACE = \triangle DBE \text{ by SAS } \textcircled{1}$$

(Total for Question 20 is 3 marks)

- 21 The equation of a curve is $y = 4x^2 - 56x$
The curve has one turning point.

By completing the square, show that the coordinates of the turning point are $(7, -196)$
You must show all your working.

$$\begin{aligned}y &= 4x^2 - 56x \\ &= 4[x^2 - 14x] \text{ ①} \\ &= 4[(x-7)^2 - 49] \text{ ②} \\ &= 4(x-7)^2 - 196\end{aligned}$$

hence the turning point is $(7, -196)$ ③

$$\begin{aligned}y &= a(x-b)^2 + c \\ &\text{has turning point } (b, c)\end{aligned}$$

(Total for Question 21 is 3 marks)

22 $\frac{2x+3}{x-5} + \frac{x-4}{x+5} - 3$ can be written in the form $\frac{ax+b}{x^2-25}$ where a and b are integers.

Work out the value of a and the value of b .
You must show all your working.

$$\frac{2x+3}{x-5} + \frac{x-4}{x+5} - 3$$

give fractions the same denominator

$$= \frac{(2x+3)(x+5)}{(x+5)(x-5)} + \frac{(x-4)(x-5)}{(x+5)(x-5)} - \frac{3(x+5)(x-5)}{(x+5)(x-5)}$$

$$= \frac{(2x+3)(x+5) + (x-4)(x-5) - 3(x+5)(x-5)}{(x+5)(x-5)}$$

combine onto one fraction

$$= \frac{2x^2 + 3x + 10x + 15 + x^2 - 4x - 5x + 20 - 3x^2 + 75}{x^2 - 25}$$

expand all brackets

$$= \frac{4x + 110}{x^2 - 25}$$

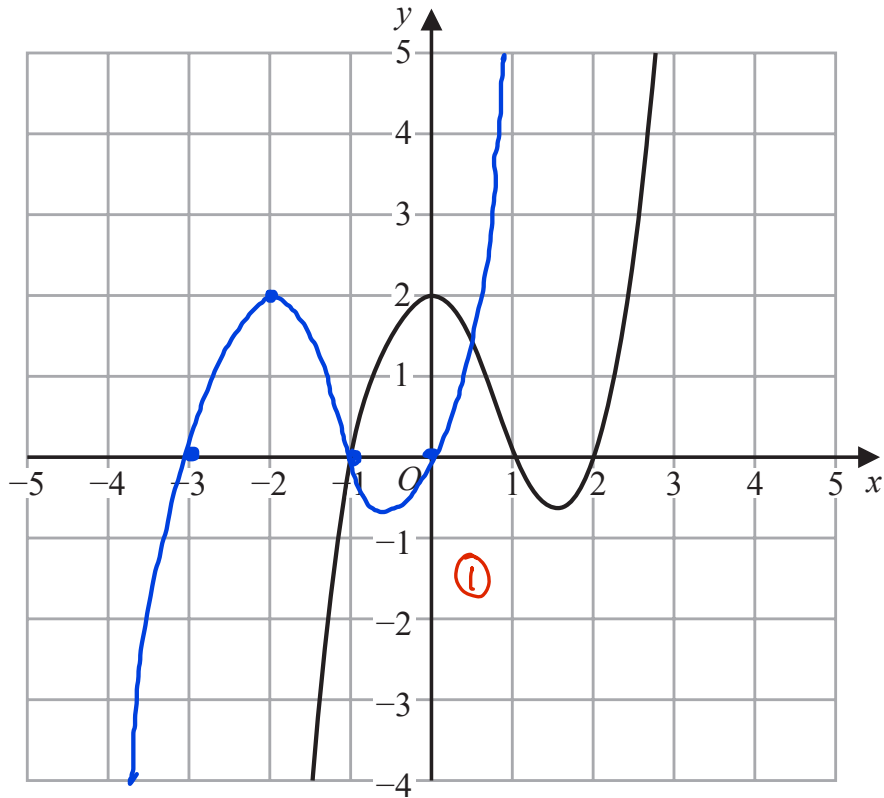
simplify

$$a = 4$$

$$b = 110$$

(Total for Question 22 is 3 marks)

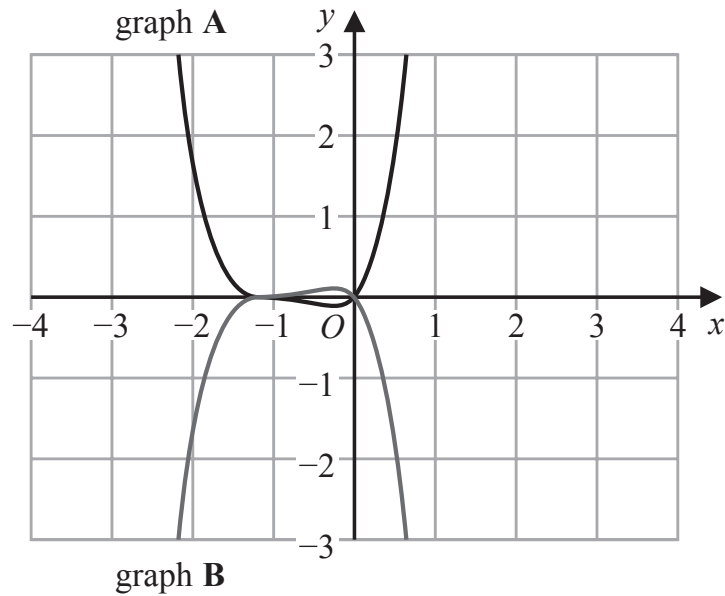
23 The graph of $y = f(x)$ is shown on the grid below.



(a) On the grid above, sketch the graph of $y = f(x + 2)$

translate by
vector $\begin{pmatrix} -2 \\ 0 \end{pmatrix}$

(1)



reflection in
 x -axis

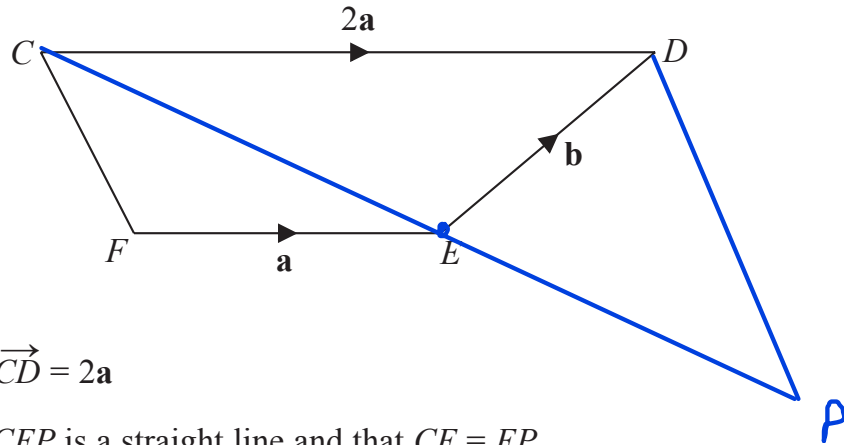
On this grid, graph A has been reflected to give graph B.
The equation of graph A is $y = g(x)$

(b) Write down an equation of graph B.

$y = -g(x)$ (1)

(Total for Question 23 is 2 marks)

24 $CDEF$ is a quadrilateral.



$$\vec{FE} = \mathbf{a} \quad \vec{ED} = \mathbf{b} \quad \vec{CD} = 2\mathbf{a}$$

The point P is such that CEP is a straight line and that $CE = EP$

Use a vector method to prove that CF is parallel to DP .

$$\begin{aligned} \vec{CF} &= \vec{CD} + \vec{DE} + \vec{EF} \\ &= 2\mathbf{a} - \mathbf{b} - \mathbf{a} \\ &= \mathbf{a} - \mathbf{b} \quad \textcircled{1} \end{aligned}$$

$$\begin{aligned} \vec{CE} &= \vec{CD} + \vec{DE} \\ &= 2\mathbf{a} - \mathbf{b} \quad \textcircled{1} \end{aligned}$$

$$\therefore \vec{EP} = 2\mathbf{a} - \mathbf{b} \quad \textcircled{1}$$

$$\begin{aligned} \vec{DP} &= \vec{DE} + \vec{EP} \\ &= -\mathbf{b} + (2\mathbf{a} - \mathbf{b}) \\ &= 2\mathbf{a} - 2\mathbf{b} \end{aligned}$$

$$\begin{aligned} &= 2(\mathbf{a} - \mathbf{b}) \quad \textcircled{1} \\ &= 2\vec{CF} \end{aligned}$$

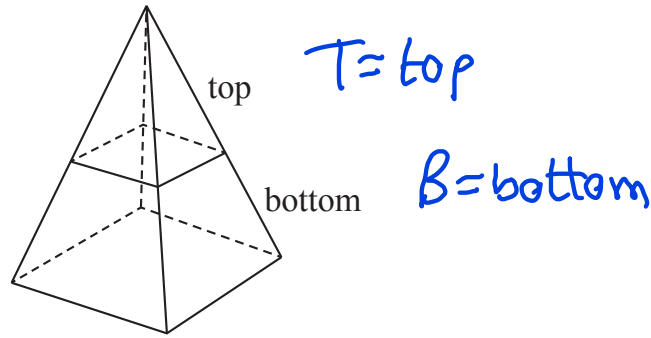
\therefore they are parallel

Method: find \vec{CF} and \vec{DP} and show that one is a multiple of the other.

(Total for Question 24 is 4 marks)

25 The pyramid **P** is formed from two parts made of different materials.

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



The top part of **P** has a mass of 92.8 g and is made from material with a density of 2.9 g/cm³

The bottom part of **P** has a mass of 972.8 g

The average density of **P** is 4.7 g/cm³

Calculate the volume of the top part of **P** as a percentage of the total volume of **P**.

Give your answer correct to 1 decimal place.

You must show all your working.

$$\text{volume T} = \frac{\text{mass}}{\text{density}} = \frac{92.8}{2.9} = 32 \text{ (1)}$$

$$\text{Total mass of P} = \overset{\text{mass T}}{92.8} + \overset{\text{mass B}}{972.8} = 1065.6 \text{ (1)}$$

$$\text{Total volume of P} = \frac{\text{mass of P}}{\text{density of P}}$$

$$= \frac{1065.6}{4.7} = 226.7234 \text{ (1)}$$

\therefore volume T as a percentage of volume P

$$= \frac{32}{226.7234} \times 100 = 14.114... \text{ (1)}$$

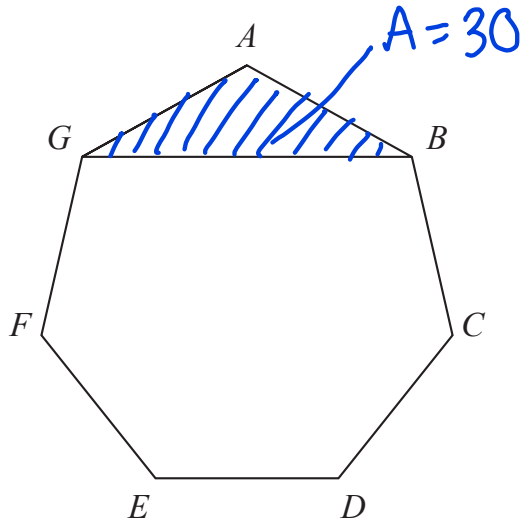
$$= 14.1 \text{ (1dp)}$$

..... 14.1 (1) %

(Total for Question 25 is 5 marks)

26 $ABCDEFG$ is a regular heptagon.

so $AG = AB$



The area of triangle ABG is 30 cm^2

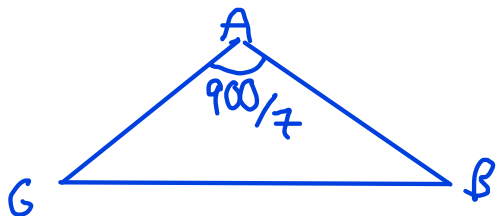
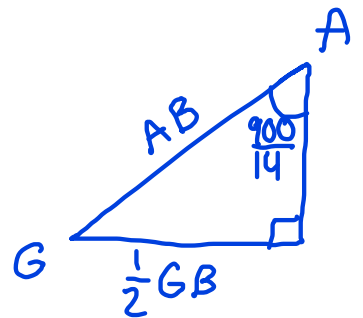
Calculate the length of GB .

Give your answer correct to 3 significant figures.

You must show all your working.

formula for interior angle = $\frac{180(n-2)}{n}$, $n = \#$ of sides
 heptagon has $n = 7$

$$\therefore \angle GAB = \frac{180 \times 5}{7} = \frac{900}{7} \text{ (1)}$$



$$\sin \frac{900}{14} = \frac{\frac{1}{2} GB}{AB} \text{ (1)}$$

using " $\frac{1}{2} ab \sin C$ " for area ABG

$$30 = \frac{1}{2} \times AB \times AG \times \sin \frac{900}{7} \text{ (1)}$$

$$\Rightarrow GB = \frac{\sin \frac{900}{14} \times AB}{\frac{1}{2}} \text{ (1)}$$

$$30 = \frac{1}{2} \times AB^2 \times \sin \frac{900}{7} \quad \left. \begin{array}{l} \downarrow AB = AG \\ \downarrow \text{rearrange for } AB \end{array} \right\}$$

$$= 15.7855 \dots$$

$$= 15.8 \text{ (3sf)} \text{ (1)}$$

$$AB = \sqrt{\frac{30}{\frac{1}{2} \times \sin \frac{900}{7}}} = 8.76 \dots$$

..... 15.8 cm

(Total for Question 26 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

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