

Answer **all** the questions.

- 1 Work out $(2 \times 10^3) \times (4 \times 10^4)$, giving your answer in standard form.

$$8 \times 10^7$$



[2]

- 2 (a) Simplify fully.

$$\frac{3a^8 \times 2a^5}{a^2}$$

$$\frac{6a^{13}}{a^2}$$



(a)

$$6a^{11}$$



[3]

- (b) Solve.

$$\frac{6x - 10}{5} = 1$$

$$6x - 10 = 5$$



$$6x = 15$$



$$x = \frac{15}{6}$$

$$2\frac{1}{2}$$



(b) x =

[3]

- 3 Ed has a card shop.

- (a) He buys a particular card for £1.20 and sells it for £1.68.

→ 48p profit

Calculate his percentage profit on this card.

$$\frac{48}{120} \times 100 = \frac{480}{12}$$

✓ ✓

40 ✓

(a) % [3]

- (b) Ed's profit on "Good Luck" cards in 2018 was £360. This was a decrease of 20% on his profit in 2017.

Work out Ed's profit on "Good Luck" cards in 2017.

$$\begin{aligned} 47 &\Rightarrow 80\% = £360 \\ \textcircled{\div 4} & 20\% = £90 \\ \textcircled{\times 5} & 100\% = 450 \end{aligned}$$

✓
✓

450 ✓

(b) £ [3]

- 4 (a) A sunflower grows at a rate of 4 cm each day.

How many days does it take to grow from a height of 80 cm to more than 1.06 m?

$$80 + 28 = 1.08 \text{ m}$$

↓
7 × 4

✓ ✓

7 ✓

(a) [3]

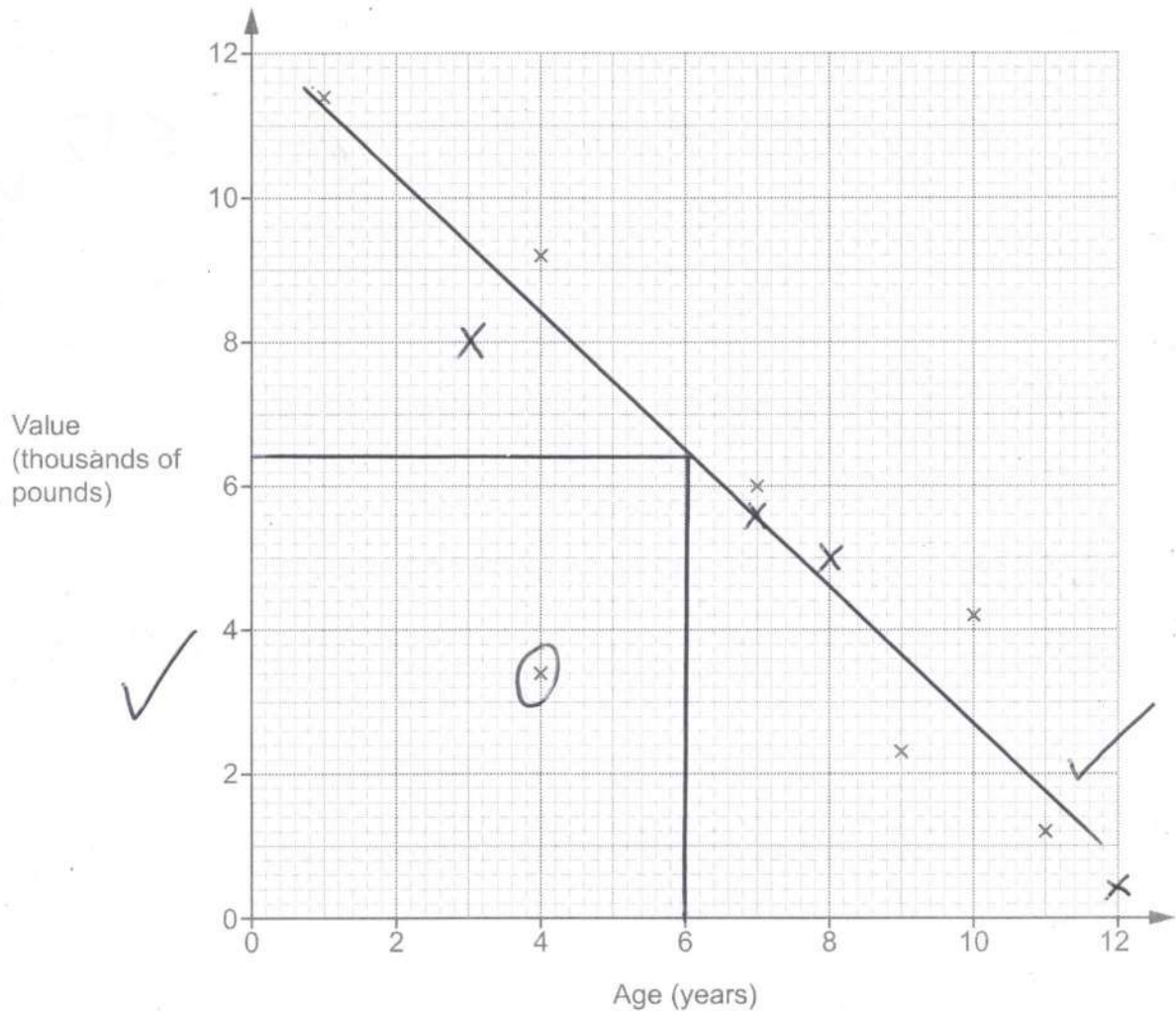
- (b) If the sunflower grows at a faster rate, how would this affect your answer to part (a)?

Fewer days ✓ [1]

- 5 The table shows the ages and values of 11 cars of the same model.

Age (years)	4	7	11	1	9	10	4	3	7	8	12
Value (thousands of pounds)	9.2	6.0	1.2	11.4	2.3	4.2	3.4	8.0	5.6	5.0	0.4

The points for the first 7 cars are plotted on the scatter diagram.



- (a) Plot the points for the remaining 4 cars.

✓₂ ✓₄

[2]

- (b) Describe the type and strength of the correlation shown in the completed scatter diagram.

Strong negative

✓✓

[2]

[moderate, medium ✓]
(not weak)

- (c) One car lost its value more quickly than the other cars.

On the scatter diagram, draw a circle around the point representing this car.

[1]

- (d) By drawing a line of best fit, estimate the value of a car that is 6 years old.

(d) £ [2]

6.4 ✓ ft

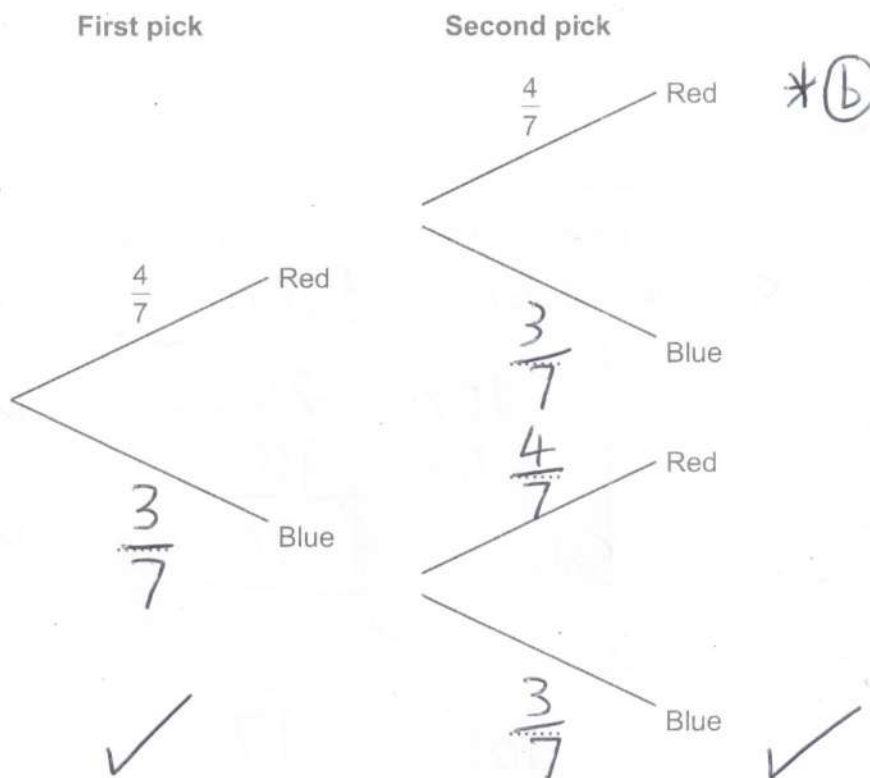
- (e) Explain the limitations of using the equation of the line of best fit to estimate the value of a car that is 16 years old.

Only have data for cars ≤ 12 ✓

[1]

- 6 A bag contains 4 red counters and 3 blue counters only. Jack picks a counter at random and then replaces it. Jack then picks a second counter at random.

(a) Complete the tree diagram.



[2]

(b) Work out the probability that Jack picks two red counters.

$$\frac{4}{7} \times \frac{4}{7} \quad \checkmark$$

$$\frac{16}{49} \quad \checkmark$$

(b) [2]

- 7 Adam buys some theatre tickets in a sale.

The normal prices are:

£80 for each adult
£40 for each child.

In the sale, the prices are reduced by 15%.

Adam buys 2 adult tickets and 1 child ticket at the sale price.

A 2% booking fee is then added to the total cost of the tickets.

Calculate the total amount that Adam must pay.



$$80 + 80 + 40 = \pounds 200 \quad \checkmark$$

$$10\% = 20 \quad \checkmark$$

$$5\% = \underline{10} \quad \checkmark$$

$$\text{Sale} = \underline{\underline{\pounds 170}} \quad \checkmark$$

$$10\% = 17 \quad \checkmark$$

$$1\% = 1.7 \quad \checkmark$$

$$2\% = 3.4 \quad \checkmark$$

$$170 + 3.4$$

$$\pounds \underline{173.40} \quad \checkmark \quad [6]$$

- 8 Mrs Mills buys 4 packs of treats for her cats, Fluff and Tigger.

She gives Fluff $\frac{1}{6}$ of a pack each day.

She gives Tigger $\frac{1}{5}$ of a pack each day.

For how many complete days will the 4 packs of treats last?

$$\frac{1}{6} + \frac{1}{5}$$

$$= \frac{5}{30} + \frac{6}{30}$$

$$= \frac{11}{30}$$

$$4 \div \frac{11}{30}$$

$$= \frac{4}{1} \times \frac{30}{11}$$

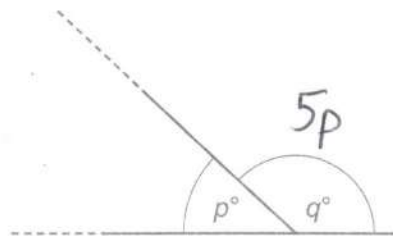
$$= \frac{120}{11}$$

$$= 10 \frac{10}{11}$$

10

[5]

- 9 An interior angle of an isosceles triangle is p° and an exterior angle is q° .



Not to scale

$$6p = 180$$

It is given that $q = 5p$.

- (a) Write the ratio $p : q$ in its simplest form.

$$30 : 150$$

$$3 : 15$$



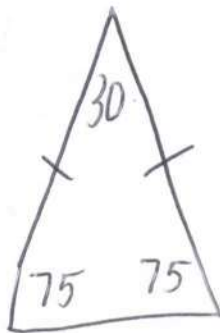
(a) : [2]

1

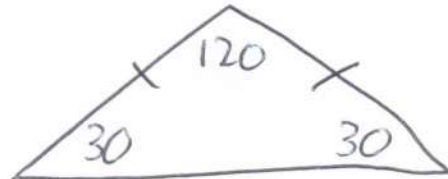
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- (b) Work out the two different possible sets of angles for the isosceles triangle.



$$p = 30$$



(b) Triangle 1: , , ✓

Triangle 2: , , ✓

[4]

- 10 (a) Write $\frac{1}{6}$ as a recurring decimal.

$$\begin{array}{r} 0.1666... \\ 6 \overline{) 1.0000} \end{array}$$

✓

$$0.1\dot{6}$$

✓

(a) [2]

- (b) Elsa divides a two-digit number by another two-digit number. She gets the answer 0.15.

She says that there is only one possible pair of numbers that will give this answer. Is she correct? Show how you decide.

$$\begin{array}{l} x = 0.15 \\ 10x = 1.5 \\ 100x = 15.5 \\ \hline 90x = 14 \end{array}$$

✓

$$x = \frac{14}{90}$$

✓

She is correct, $\frac{7}{45}$ then $\frac{21}{135}$ etc don't count.

[4]

- 11 (a) Simplify fully.

$$\sqrt{200}$$

$$\sqrt{100} \times \sqrt{2}$$

✓

$$10\sqrt{2}$$

✓

(a) [2]

- (b) Evaluate.

$$8^{\frac{1}{3}}$$

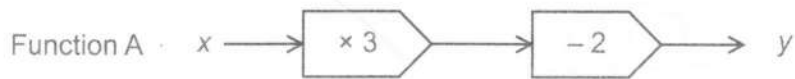
$$\sqrt[3]{8}$$

$$2$$

✓

(b) [1]

12 Here are two functions.



(a) Find an algebraic expression for the output of the inverse of function A when the input is x .

$x \quad (+2) \quad (\div 3)$

$$\frac{x+2}{3}$$

✓ OE

(a) [2]

(b) Here is a composite function C.



Find the value x when $z = 4x$.

$x \quad (\times 3) \quad (-2)$

$3x - 2$

✓

$3x - 2 \quad (+7) \quad (\times 2)$

$2(3x + 5)$

✓

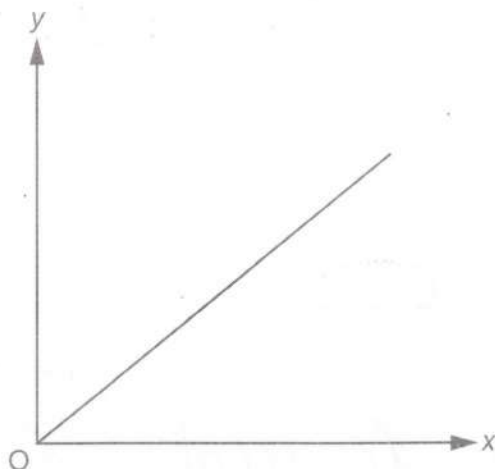
so $6x + 10 = 4x$
 $2x = -10$

✓
✓

(b) $x = -5$ [5]

Turn over

- 13 Shirley is asked to sketch a graph of $y = 5^x$ for $x \geq 0$. She produces the following.



The graph has two errors.

How should they be corrected?

1

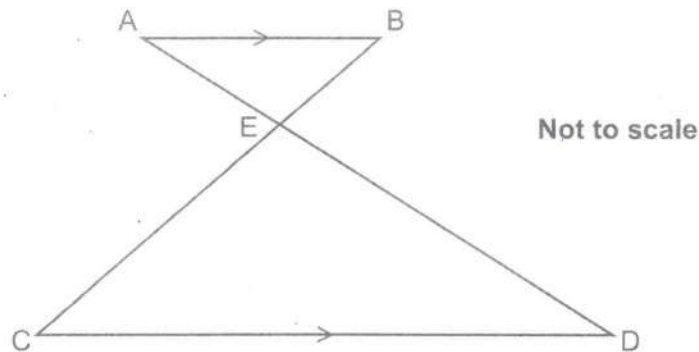
Should be curve with increasing gradient ✓

2

Should intercept y-axis at (0,1) ✓

[2]

- 14 In the diagram AB is parallel to CD.
AED and BEC are straight lines.



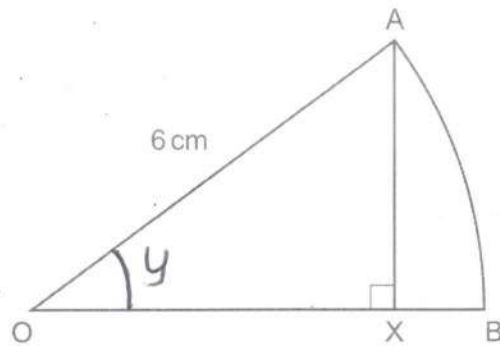
Prove that triangle ABE is similar to triangle CDE.

$\angle BAE = \angle EDC$ (alternate $\angle$ s are equal) ✓
 $\angle ABE = \angle ECD$ (alternate $\angle$ s are equal) ✓
 $\angle AEB = \angle CED$ (opposite $\angle$ s are equal)

AAA hence similar ✓

[3]

- 15 OAB is a sector of a circle, centre O.
OA = 6 cm and AX is perpendicular to OB.



The area of sector OAB is $6\pi \text{ cm}^2$.

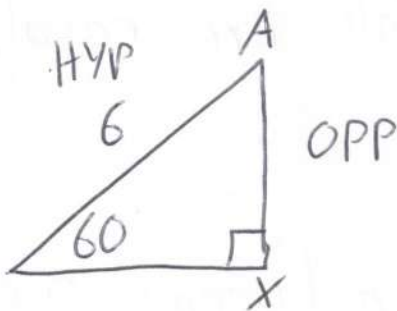
Show that $AX = 3\sqrt{3} \text{ cm}$.

[6]

$$\text{Sector Area} = \frac{\pi \times 6^2 \times y}{360} = 6\pi \quad \checkmark \checkmark$$

$$\frac{36y}{360} = 6$$

$$y = 60 \quad \checkmark$$



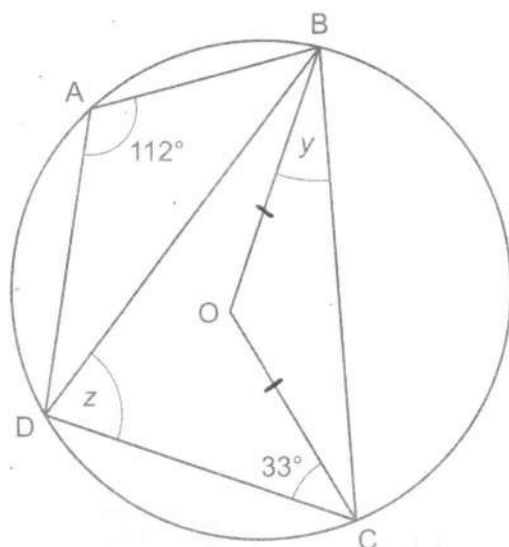
$$AX = \sin 60 \times 6 \quad \checkmark \checkmark$$

$$= \frac{\sqrt{3}}{2} \times 6$$

$$= 3\sqrt{3} \quad \checkmark$$

- 16 A, B, C and D are points on the circumference of a circle, centre O.

Angle $BAD = 112^\circ$ and angle $DCO = 33^\circ$.



Not to scale

- (a) Show that angle $y = 35^\circ$.
Give reasons for each stage of your working.

$$\angle DCB = 180 - 112 = 68 \quad (\text{opposite angles in a cyclic quadrilateral sum to } 180)$$

$$\angle OCB = 68 - 33 = 35$$

$$y = \angle OCB = 35 \quad (\text{base angles in isosceles triangle are equal})$$

- (b) Work out angle z .
Give reasons for your answer.

$$\begin{aligned} \angle BOC &= 180 - 35 - 35 \\ &= 110 \quad (\text{angles in a triangle sum to } 180) \end{aligned}$$

Angle $z = 55^\circ$ because angle at circumference (or arc) is half angle at centre.

[3]

- 17 (a) Write $x^2 + 8x + 3$ in the form $(x + a)^2 - b$.

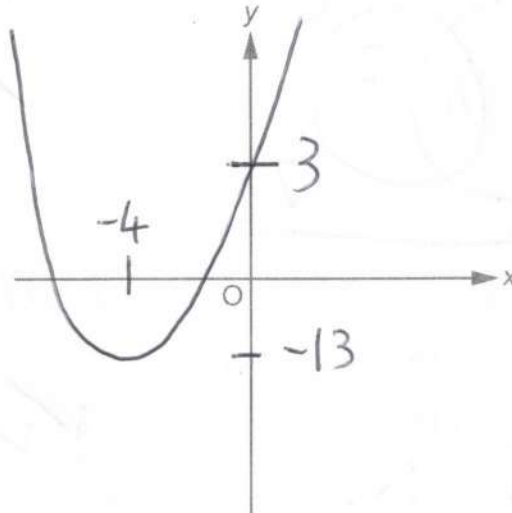
$$(x + 4)^2 - 16 + 3 \quad \checkmark$$

$$(x + 4)^2 - 13 \quad \checkmark \quad \checkmark$$

(a) [3]

- (b) Sketch the graph of $y = x^2 + 8x + 3$.

Show clearly the coordinates of any turning points and the y-intercept.



$$V(-4, -13)$$

$\checkmark$ U
 $\checkmark$ 3
 $\checkmark$ -4
 $\checkmark$ -13

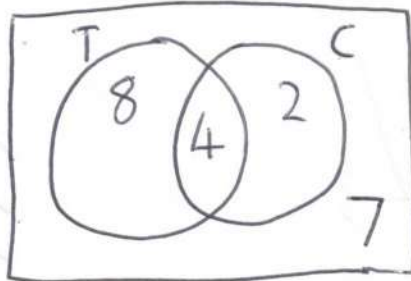
[4]

18 21 people travelled to a meeting.

- 12 used a train.
- 6 used a car.
- 7 did not use a train or a car.
- Some used a train and a car.

Two people are chosen at random from those who used a train. = 12

Find the probability that both these people also used a car.



✓✓✓

$$\frac{4}{12} \times \frac{3}{11}$$

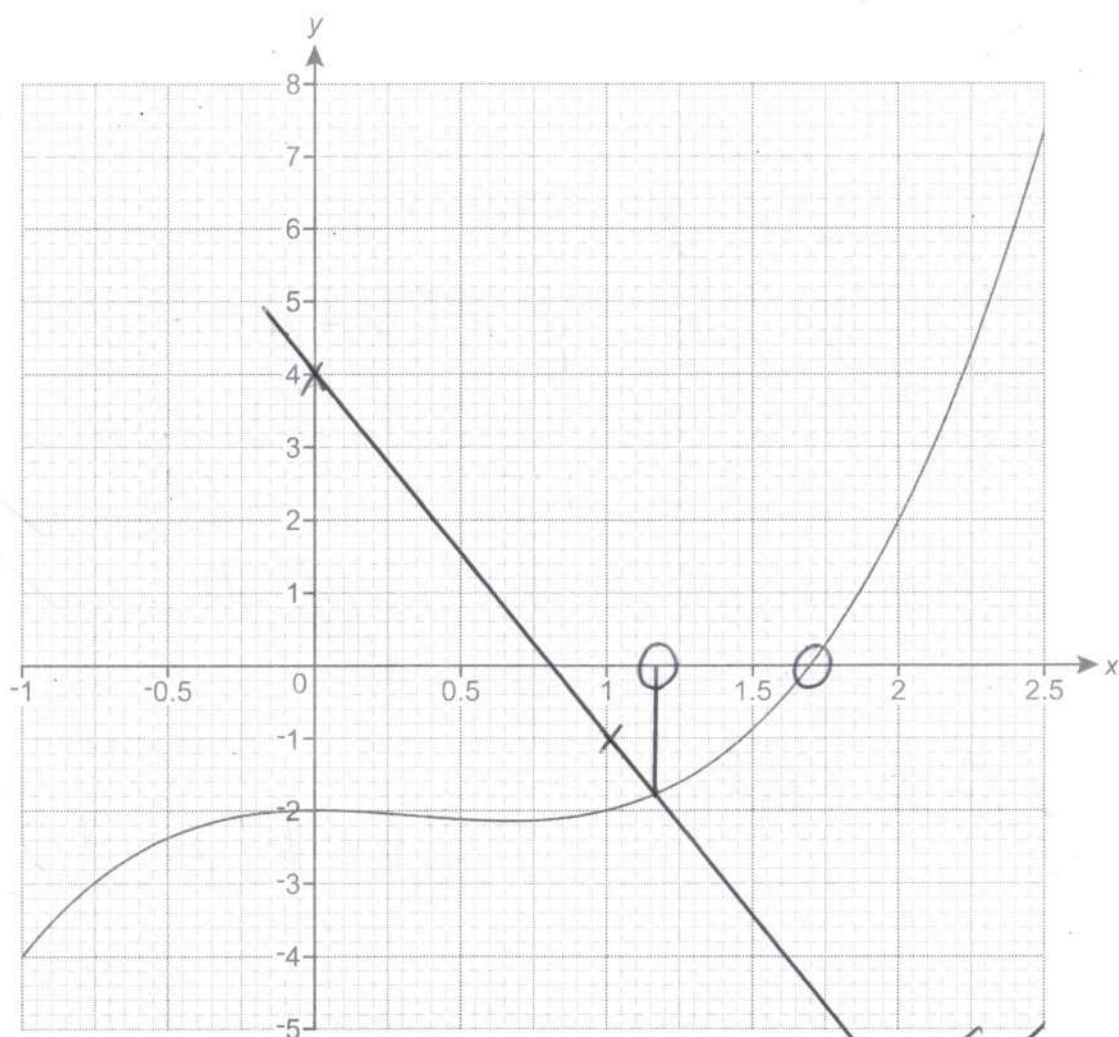
✓✓

$$\frac{12}{132}$$

✓OE

[6]

- 19 The graph of $y = x^3 - x^2 - 2$ is drawn on the grid.



- (a) Use the graph to solve $x^3 - x^2 - 2 = 0$.
Give your answer correct to 1 decimal place.

$x = \dots\dots\dots$ [1]

$$y = -5x + 4$$

- (b) The equation $x^3 - x^2 + 5x - 6 = 0$ can be solved by finding the intersection of the graph of $y = x^3 - x^2 - 2$ and the line $y = ax + b$.

(i) Find the value of a and the value of b .

$$x^3 - x^2 + 5x - 6 = 0$$

$$x^3 - x^2 - 6 = -5x$$

$$x^3 - x^2 - 2 = -5x + 4$$

(b)(i) $a = \frac{-5}{4}$ ✓
 $b = 4$ ✓ [2]

- (ii) Hence, **use the graph** to solve the equation $x^3 - x^2 + 5x - 6 = 0$.
 Give your answer correct to 1 decimal place.

(mine = 1.15)

[ms 1.1 or 1.2] ✓
 (ii) $x =$ [3]

END OF QUESTION PAPER