Answer **all** the questions.

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

8×10^7 **[2]**

2 **(a)** Simplify fully.

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

(a) $6a^{11}$ **[3]**

(b) Solve.

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

$\Rightarrow 6x - 10 = 5$

$\Rightarrow 6x = 15$

$\Rightarrow x =$

(b) $x =$ 2.5 **[3]**

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3 Ed has a card shop.

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

Calculate his percentage profit on this card.

$\frac{1.68-1.2}{1.2} \times 100 =$

(a) 40 % **[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.

$\frac{360}{0.8} =$

(b) £ 450 **[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?

1.06m = 106cm.

$\frac{106-80}{4} = 6.5 \rightarrow 7$

(a) [redacted] 7 **[3]**

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

It would take fewer days. **[1]**

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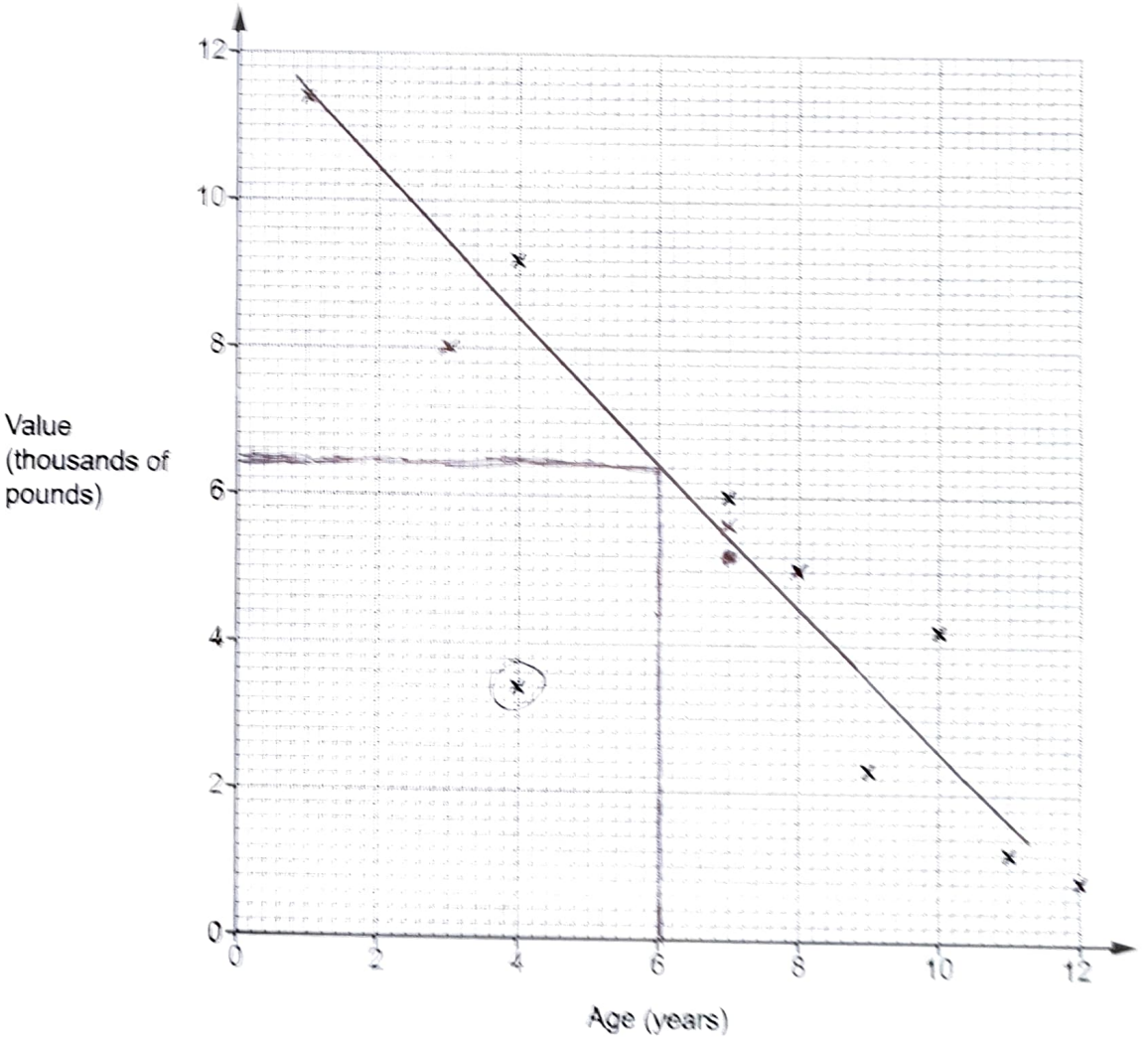
5 The table shows the ages and values of 11 cars of the same model.

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]**

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

Strong negative **[2]**

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(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) £ 6400 **[2]**

(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.

Since the data only extends to cars up to 12 years old, we could suggest that the trend may not continue. **[1]**

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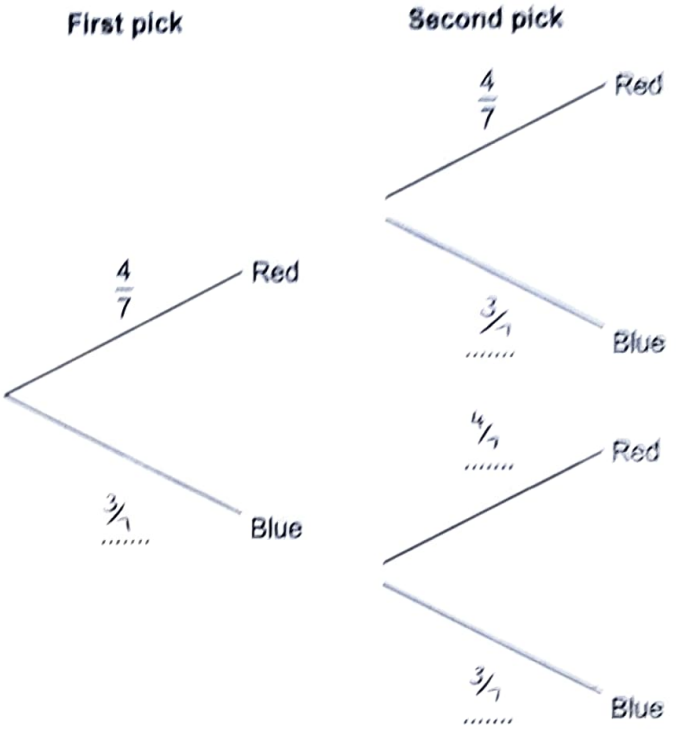
6 A bag contains 4 red counters and 3 blue counters only.
Jack picks a counter at random and then replaces it.
Jack then picks a second counter at random.

(a) Complete the tree diagram.



[2]

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

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

$\frac{16}{49}$

(b) ..... **[2]**

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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 = £200.

200 × 0.85 = 170

170 × 1.02 =

£ 173.40 [6]

Turn over

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6 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?

$\frac{1}{6} + \frac{1}{5} = \frac{5}{30} + \frac{6}{30} = \frac{11}{30}$ pack per day

$\frac{4}{(11/30)} = \frac{120}{11}$

$\frac{120}{11}$ ..... [5]

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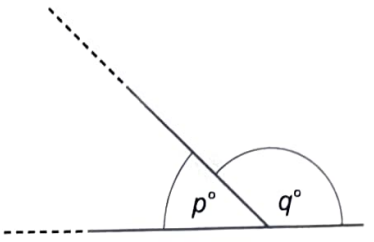
9 An interior angle of an isosceles triangle is $p°$ and an exterior angle is $q°$.



Not to scale

It is given that $q = 5p$.

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

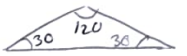
(a) ..... 1 ..... : ..... 5 ..... **[2]**

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

$5p + p = 180$

$\Rightarrow 6p = 180$

$\Rightarrow p = 30.$



or

(b) Triangle 1: ..... 30 ..... °, ... 30 ..... °, ... 120 ..... °

Triangle 2: ..... 30 ..... °, ... 75 ..... °, ... 75 ..... °

[4]

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

(a) ..... $0.1\dot{6}$ ..... **[2]**

(b) Elsa divides a two-digit number by another two-digit number.
She gets the answer $0.1\dot{5}$.

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

$x = 0.1\dot{5}$

$10x = 1.5\dot{5}$

$\Rightarrow 9x = 1.4$.

$\Rightarrow x = \frac{1.4}{9} = \frac{14}{90}$. There are no equivalent fractions where the numerator and denominator have two digits.

..... Yes, she is correct. ..... **[4]**

11 **(a)** Simplify fully.

$\sqrt{200}$

$\sqrt{2\times100} = \sqrt{2}\sqrt{100} = 10\sqrt{2}$

(a) ..... $10\sqrt{2}$ ..... **[2]**

(b) Evaluate.

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

(b) ..... 2 ..... **[1]**

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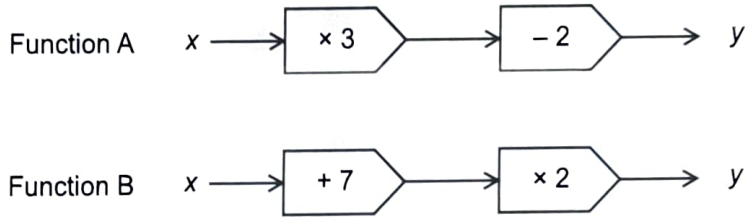
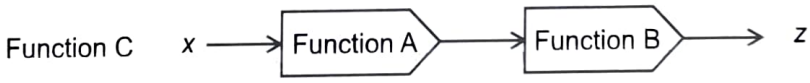
12 Here are two functions.



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

(a) $\frac{x+2}{3}$ **[2]**

(b) Here is a composite function C.



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

$x \xrightarrow{A} 3x - 2.$

$3x - 2 \xrightarrow{B} 2(3x + 5) = 6x + 10.$

$6x + 10 = 4x$

$\Rightarrow 2x = -10$

$\Rightarrow x = -5$

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

Turn over

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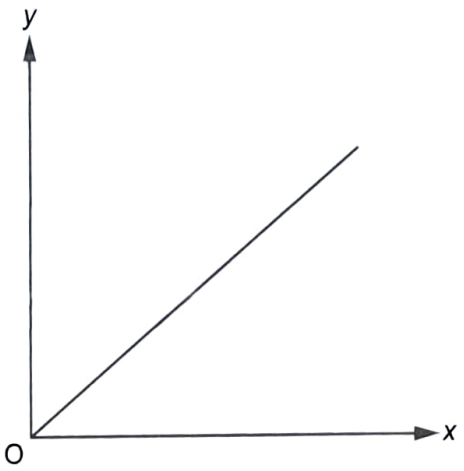
13 Shirley is asked to sketch a graph of $y = 5^x$ for $x \geqslant 0$.
She produces the following.



The graph has two errors.

How should they be corrected?

1 The graph should go through (0, 1)

2 The gradient should be increasing for all x.
(It should be a curve, not a line). **[2]**

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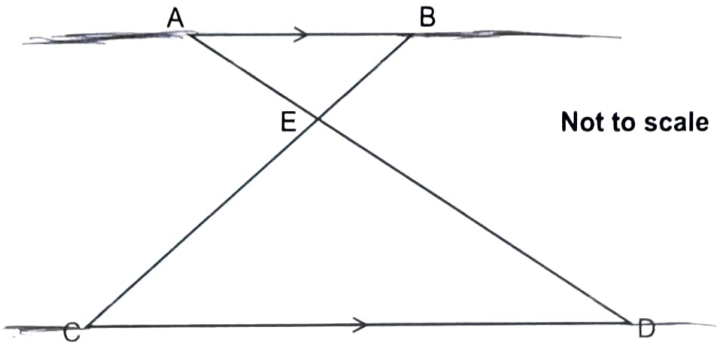
14 In the diagram AB is parallel to CD.
AED and BEC are straight lines.



Prove that triangle ABE is similar to triangle CDE.

Angle AEB = Angle CED (as they are opposite angles).

Angle ABE = Angle DCE (as they are alternate angles)

Angle BAE = Angle CDE (as they are alternate angles).

All corresponding angles are equal so they are similar. [3]

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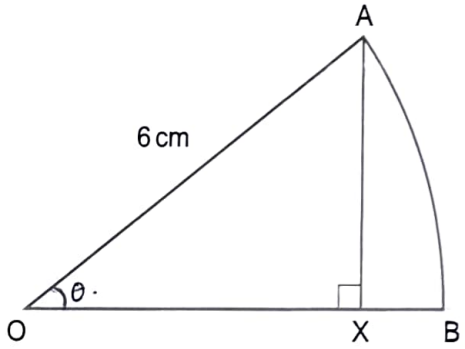
15 OAB is a sector of a circle, centre O.
OA = 6 cm and AX is perpendicular to OB.



Not to scale

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

Show that $AX = 3\sqrt{3}\,\text{cm}$. **[6]**

$$\frac{\theta}{360} \times 6^2 \times \pi = 6\pi \quad \Rightarrow \quad \frac{\theta}{60} = 1.$$

$$\Rightarrow \theta = 60^\circ.$$

$$6\sin 60^\circ = AX = 6 \times \frac{\sqrt{3}}{2}$$

$$= 3\sqrt{3}\ \text{cm}.$$

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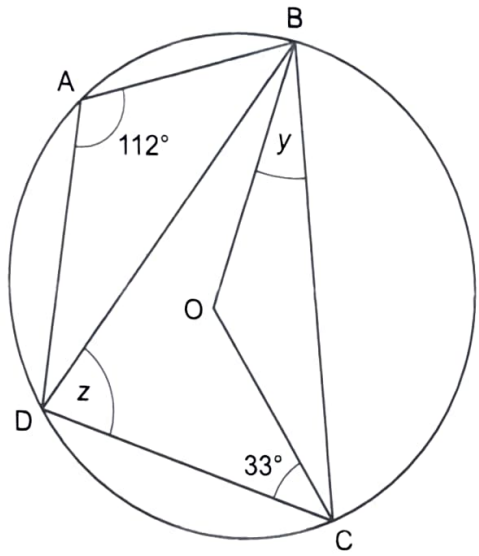
16 A, B, C and D are points on the circumference of a circle, centre O.

Angle BAD = 112° and angle DCO = 33°.



Not to scale

(a) Show that angle $y = 35°$.
Give reasons for each stage of your working. **[4]**

ABCD is a cyclic quadrilateral, so $\angle BCD = 180 - \angle BAD$

$= 180 - 112 = 68°$.

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

OBC is an isosceles triangle, so $y = 35°$.

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

$\angle BOC = 110°$ $(180 - 35 - 35)$

$\angle BDC = \frac{110°}{2} = 55°$

Angle z = 55 ° because angle at circumference is half of the angle at the centre. **[3]**

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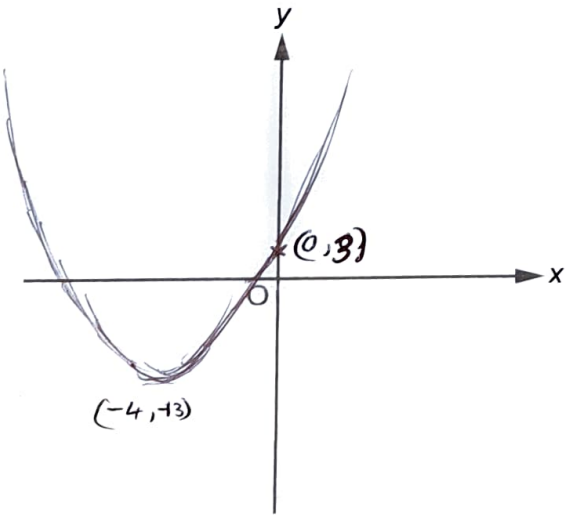
17 **(a)** Write $x^2 + 8x + 3$ in the form $(x + a)^2 - b$.

$(x+4)^2 - 16 + 3$

(a) $(x+4)^2 - 13$ **[3]**

(b) Sketch the graph of $y = x^2 + 8x + 3$.
Show clearly the coordinates of any turning points and the y-intercept.



[4]

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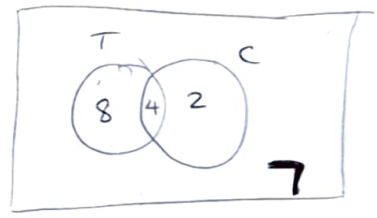
18 21 people travelled to a meeting.

- 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.

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

	T	No T	
C	4	2	6
No C	8	7	15
	12	9	21



$\frac{4}{12} \times \frac{3}{11} = \frac{12}{12 \times 11} = \frac{1}{11}$

.....$\frac{1}{11}$..... **[6]**

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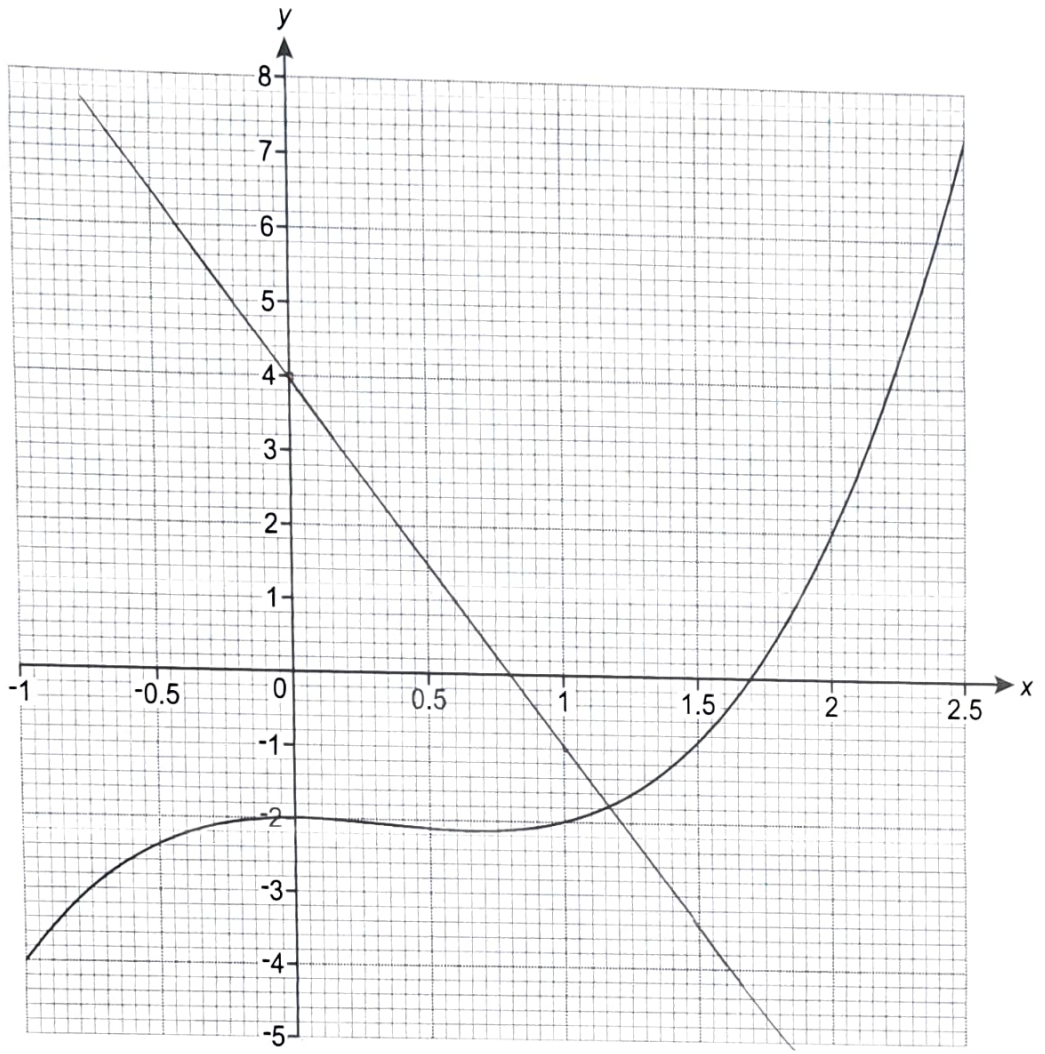
19 The graph of $y = x^3 - x^2 - 2$ is drawn on the grid.



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

$x =$ 1.7 **[1]**

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(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.

$0 = x^3 - x^2 + 5x - 6 = (x^3 - x^2 - 2) + (5x - 4)$

$\Rightarrow \quad x^3 - x^2 - 2 = 4 - 5x$

(b)(i) $a =$ ..... -5 .....

$b =$ ..... 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.

(ii) $x =$ ..... 1.2 ..... **[3]**

END OF QUESTION PAPER

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