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H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

APPLICATIONS OF MATHEMATICS

A382/02

Applications of Mathematics 2 (Higher Tier)

A315610611

Candidates answer on the question paper.

OCR supplied materials:
None

Other materials required:
- Scientific or graphical calculator
- Geometrical instruments
- Tracing paper (optional)

Friday 10 June 2011
Morning

Duration: 2 hours

A382020

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Your answers should be supported with appropriate working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Answer **all** the questions.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- Your Quality of Written Communication is assessed in questions marked with an asterisk (*****).
- The total number of marks for this paper is **90**.
- This document consists of **20** pages. Any blank pages are indicated.

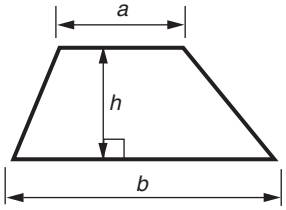
You are permitted to use a calculator for this paper

This paper has been pre modified for carrier language

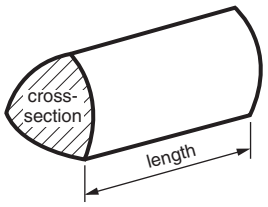
OCR is an exempt Charity

Formulae Sheet: Higher Tier

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



Volume of prism = (area of cross-section) × length

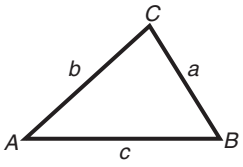


In any triangle *ABC*

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

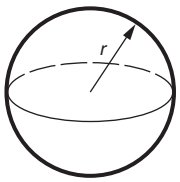
Cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$

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



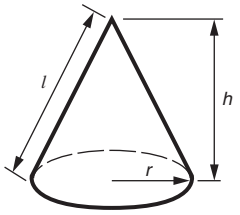
Volume of sphere $= \frac{4}{3}\pi r^3$

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



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

Curved surface area of cone $= \pi rl$



The Quadratic Equation

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

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

PLEASE DO NOT WRITE ON THIS PAGE

1 A group of 15 boys joined their local swimming club.
Their trainer recorded how long they took to swim 50 m freestyle.
The stem and leaf diagram shows their times.

5	3	4	7	9		
6	2	2	2	5	7	9
7	5	8	9			
8	1	3				

Key: 8 | 1 represents 81 seconds

(a) Find the range of these times.

(a) _____ s **[1]**

(b) The 15 boys trained for ten weeks. Their trainer then recorded how long they took to swim 50 m freestyle. These times are summarised below.

Fastest time	50 seconds
Range	30 seconds
Median	62 seconds

(i) After training, what was the slowest time?

(b)(i) _____ s **[1]**

(ii) Write down two comparisons between the boys' times before and after training.

(1) _____

_____

(2) _____

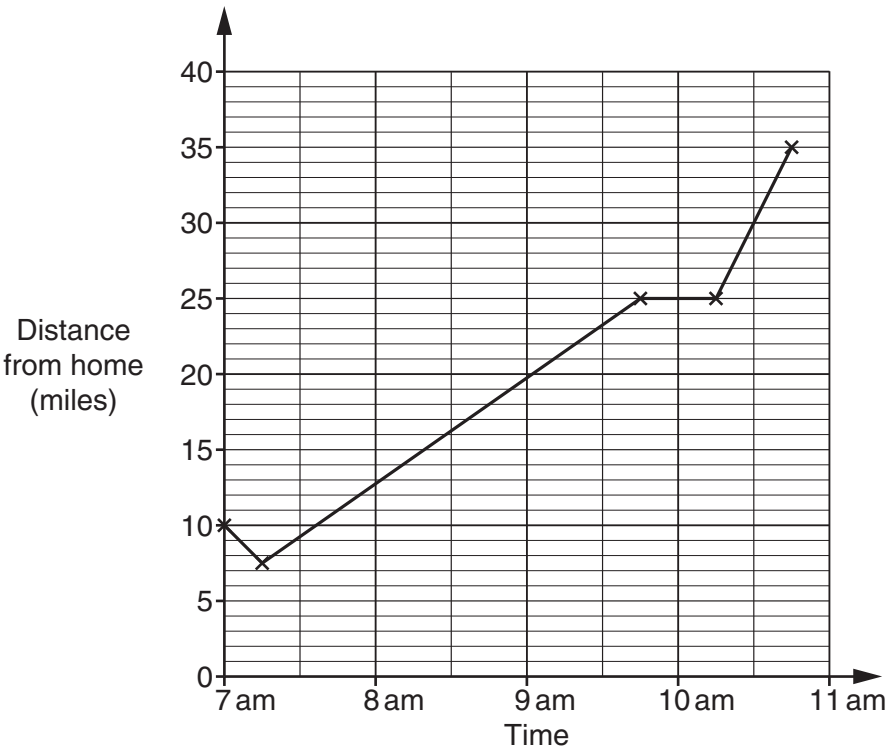
_____ **[2]**

(iii) Did all of the boys' times improve after the training?
Explain your answer.

_____

_____ **[1]**

2 Josh took part in a 'shopfront to seafront' cycling event with his local club.
He started outside the cycle shop at 7 am and finished at the seafront at 10.45 am.
The graph shows Josh's distance **from home** during the event.



(a) Josh stopped during the event.

For how long did he stop?

(a) _____ minutes **[1]**

(b) How many miles did Josh cycle during the event?

(b) _____ miles **[2]**

(c) Between which two times did Josh cycle at his greatest speed?
Explain how you decided.

_____ because _____

_____ **[2]**

3 Sarah is an Australian shopping in London.
She has some Australian dollars (AU$).
She wants to buy this handbag.
The price of the handbag is given in pounds and in euros.

Sarah can change her Australian dollars (AU$) at the following rates.

AU$1 = £0.611
AU$1 = €0.713

Which currency represents the lower price for the handbag?
Show calculations to support your answer.

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[5]**

4 The monthly salaries of the staff at a garden centre are summarised in the table.

Monthly salary, £m	Number of employees
$200 < m \leqslant 400$	24
$400 < m \leqslant 600$	18
$600 < m \leqslant 800$	10
$800 < m \leqslant 1000$	5

(a) Write down the modal class interval.

(a) £ _____ **[1]**

(b) Write down the class interval that contains the median.

(b) £ _____ **[1]**

(c) Work out an estimate of the mean monthly salary.

(c) £ _____ **[4]**

(d) The garden centre also employs one manager who is paid a monthly salary of £2400, and two assistant managers who are each paid a monthly salary of £1500.

Give a reason why the manager might want to include these salaries when he calculates the mean monthly salary for a pack sent out to job applicants.

_____

_____ **[1]**

5 **(a)** Gareth is making concrete for the base of a garden shed.
First he makes the dry concrete mix.
He mixes cement, sand and gravel in this ratio.

cement : sand : gravel = 1 : 3 : 4

Gareth has 80 kg of cement
225 kg of sand
310 kg of gravel

What is the maximum weight of dry concrete mix that Gareth can make?

(a) _____ kg **[4]**

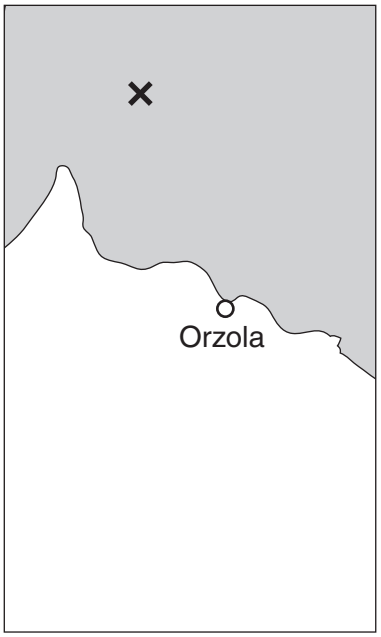
(b) Gareth makes 0.32 m^3 of concrete.
The depth of the concrete base for the shed will be 0.125 m.
The base will be a rectangle at least 1.5 m long and at least 1.2 m wide.

Work out possible dimensions for a base that uses all of Gareth's concrete.

(b) Length _____ m

Width _____ m **[4]**

6* The map shows part of the island of Lanzarote.



Scale:
1 cm represents 2 km

The furthest that a person standing at sea level can see is given by this formula

$d = \sqrt{13h}$ where d is the distance in kilometres
and h is the height, in metres, of their eyes above sea level.

Jayne is on the beach at Orzola. The height of her eyes above sea level is 1.55 m.
There is a boat, marked with a cross, out at sea.

Show whether or not Jayne is able to see the boat.

_____

_____

_____

_____

_____

_____ **[5]**

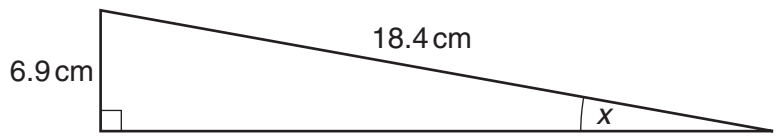
7 Use trial and improvement to solve this equation.

$x^3 + 4x = 29$

Give your answer correct to one decimal place.
Show all your trials and their outcomes.

_____ **[4]**

8 Calculate angle x.

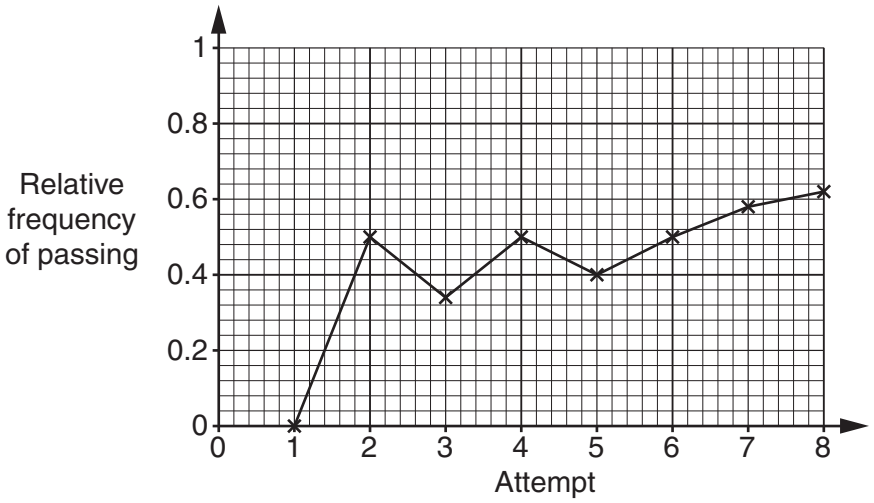


Not to scale

_____ ° **[3]**

9 Reuben practises the hazard section of the driving theory test.

This relative frequency diagram shows the proportion of times Reuben has passed the hazard section after each attempt.



(a) Explain how you can tell that Reuben failed the hazard section on his third attempt.

_____ **[1]**

Here are Reuben's scores for his first eight attempts.

Attempt	1	2	3	4	5	6	7	8
Score	42	53	43	47	41	44	45	55

(b) What was the fixed pass mark for the hazard section?
Explain how you found your answer.

_____

_____ **[2]**

(c) Reuben had 40 practice attempts at the hazard section.
Out of the 40 attempts he passed 30 times.
Out of the last 15 attempts he passed 12 times.

What is the best estimate of the probability that Reuben will pass the hazard section?
Give a reason for your answer.

_____

_____ **[2]**

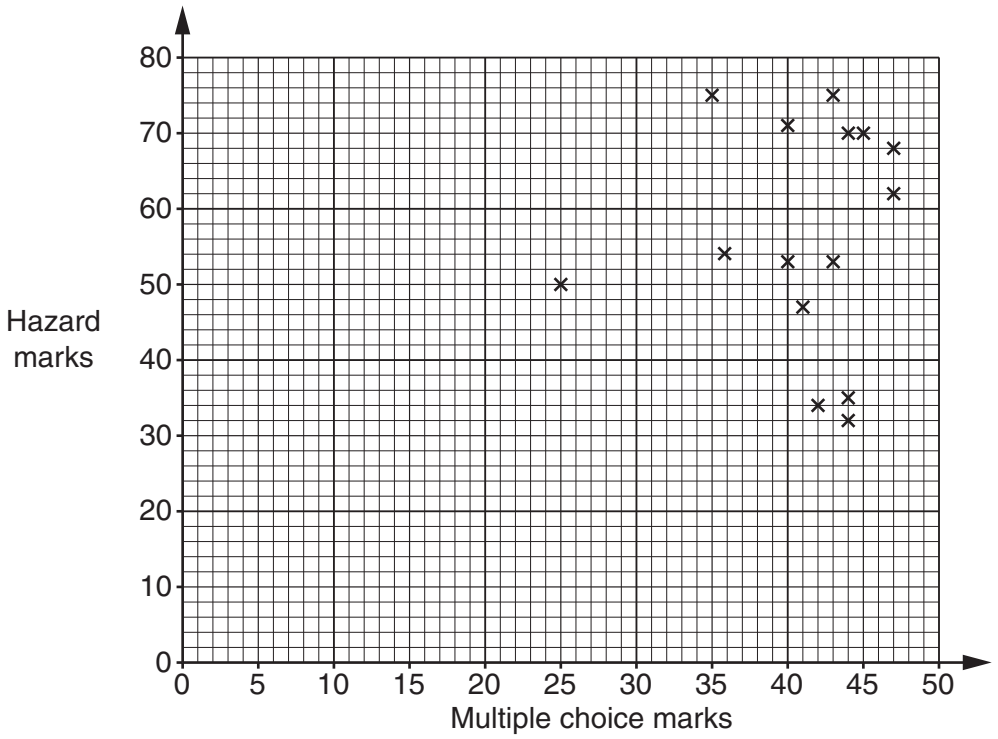
The full driving theory test consists of the hazard section and a multiple choice section.
The two sections have to be taken together, and both sections passed, for a candidate to pass the full test.

In his last 15 practice attempts at each test, Reuben passed the hazard section 12 times and he passed the multiple choice section 8 times.

(d) Use this information to calculate the probability that Reuben will pass the driving theory test.

(d) _____ **[2]**

(e) The scatter graph shows Reuben's 15 practice attempts at the full test.



(i) There is a fixed pass mark for each section of the test.

What is the fixed pass mark for the multiple choice section?

(e)(i) _____ **[1]**

(ii) Use the graph to comment on the accuracy of the probability you found in part **(d)**.

_____

_____

_____ **[2]**

10 Accurately construct the locus of points 3 cm from the L shape below.

[4]

11 Joni buys coffee and biscuits for her office.
She buys x jars of coffee and y packets of biscuits.

(a) She always buys at least one jar of coffee and more than two packets of biscuits at the same time. Which two of the following inequalities represent this information?

$x > 1$ $\quad$ $x \geqslant 1$ $\quad$ $y > 2$ $\quad$ $y \geqslant 2$

(a) _____ and _____ **[2]**

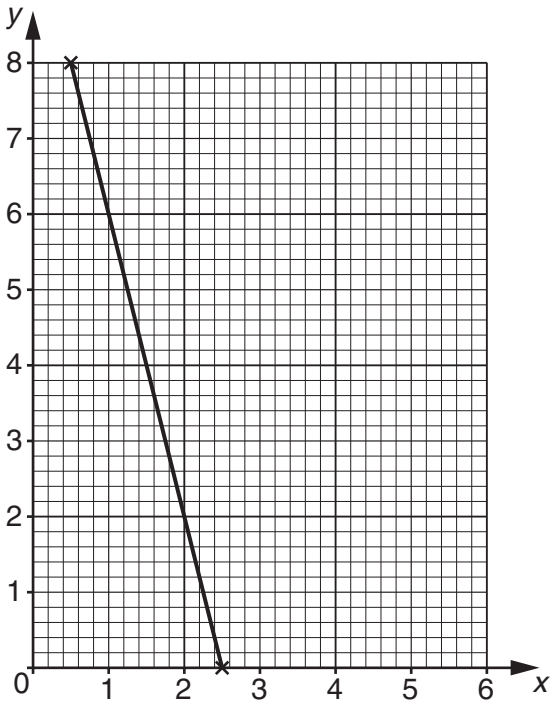
(b) A jar of coffee costs £2 and a packet of biscuits costs 50p.
Joni can spend at most £5 on coffee and biscuits.

Show that $4x + y \leqslant 10$.

_____ **[1]**

(c) The grid shows the line $4x + y = 10$.

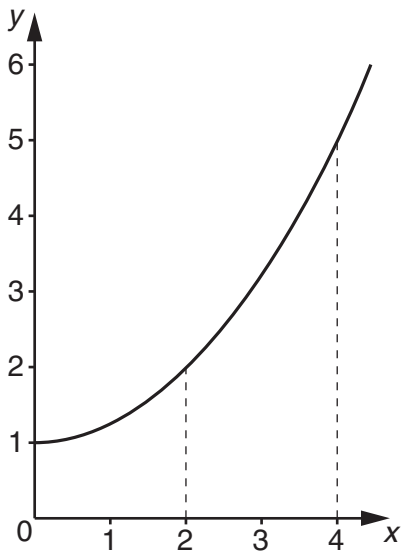
(i) On the grid shade the area satisfying the correct inequalities from part **(a)** and the inequality from part **(b)**.



[3]

(ii) Circle points on the graph to show all the possible combinations of coffee and biscuits that Joni can buy. **[2]**

12 The graph shows the curve $y = \frac{x^2}{4} + 1$ from $0 \leqslant x \leqslant 4$.



The area under the curve is split into two sections by the dotted lines.

(a) Treat each of the two areas under the curve as a trapezium.

Calculate an estimate of the total area between the curve, the x-axis, $x = 0$ and $x = 4$.
Show clearly the values you use for each trapezium.

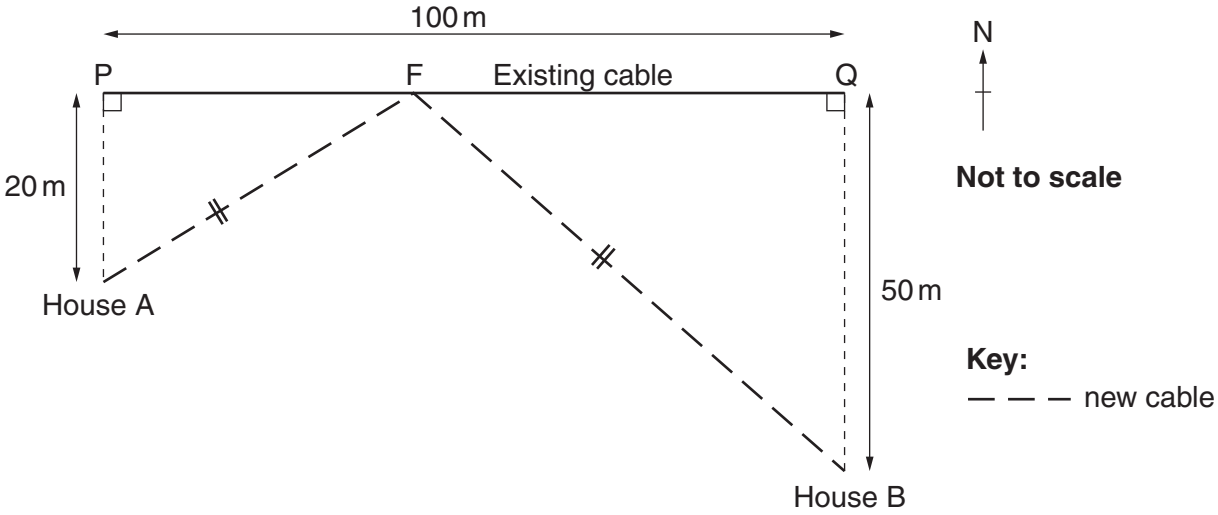
(a) _____ **[3]**

(b) Explain why your estimate of area in part **(a)** is an overestimate.

_____

_____ **[1]**

13 Cable is laid in a straight line along a road PQ.
Two houses, A and B, are on the same side of the road.
The distances between the houses and the road are shown.



New cable is to be added from **one** point, F, of the existing cable to each of the houses.

Work out where the new cable should be joined to the existing cable so that the length of each piece of new cable is the same.

_____ **[5]**

14 Hilary invested £20 000 in a five-year savings bond.
The bank gave her this information.

	Term	Gross	AER	Net
Interest capitalised annually and paid at maturity	5 years	4.86%	4.45%	3.89%

Rates correct at April 2010

(a) Use the AER to work out the gross interest received at the end of 5 years.
Give your answer correct to the nearest ten pounds.

(a) £ _____ **[3]**

(b) Use the figures in the table to show that the basic rate of income tax in April 2010 was 20%.

_____

_____ **[2]**

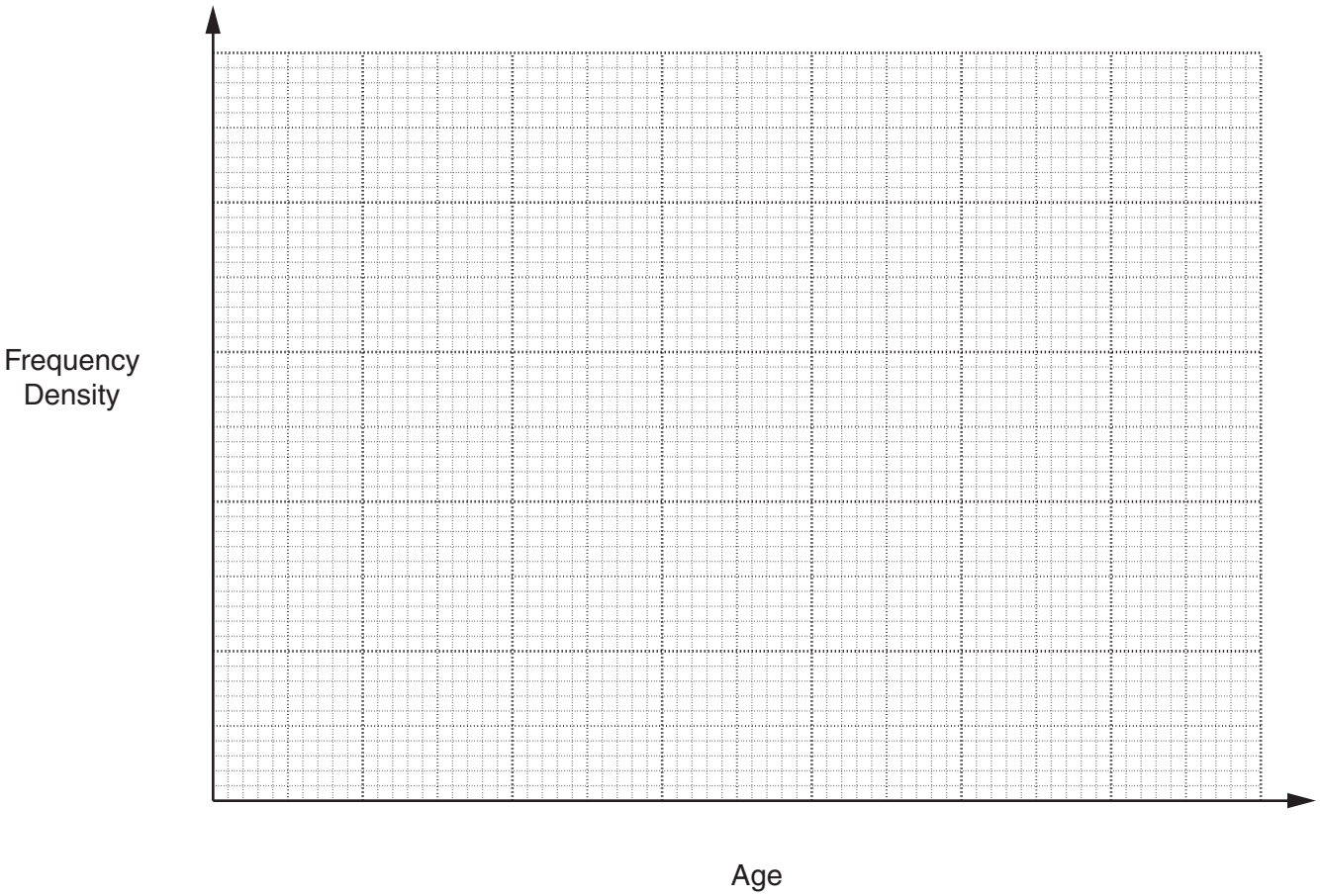
15 This table summarises the results of a survey in which smokers were asked the age at which they first started to smoke.

Age (years)	Frequency	Frequency density
10 – 15	132	
16 – 17	184	
18 – 19	120	
20 – 24	95	
25 and over	48	

(a) State what further information is needed in order to draw a histogram for these data and suggest a suitable value.

_____ **[1]**

(b) Using your value for the missing information, complete the frequency density column in the table and draw a histogram for these data.



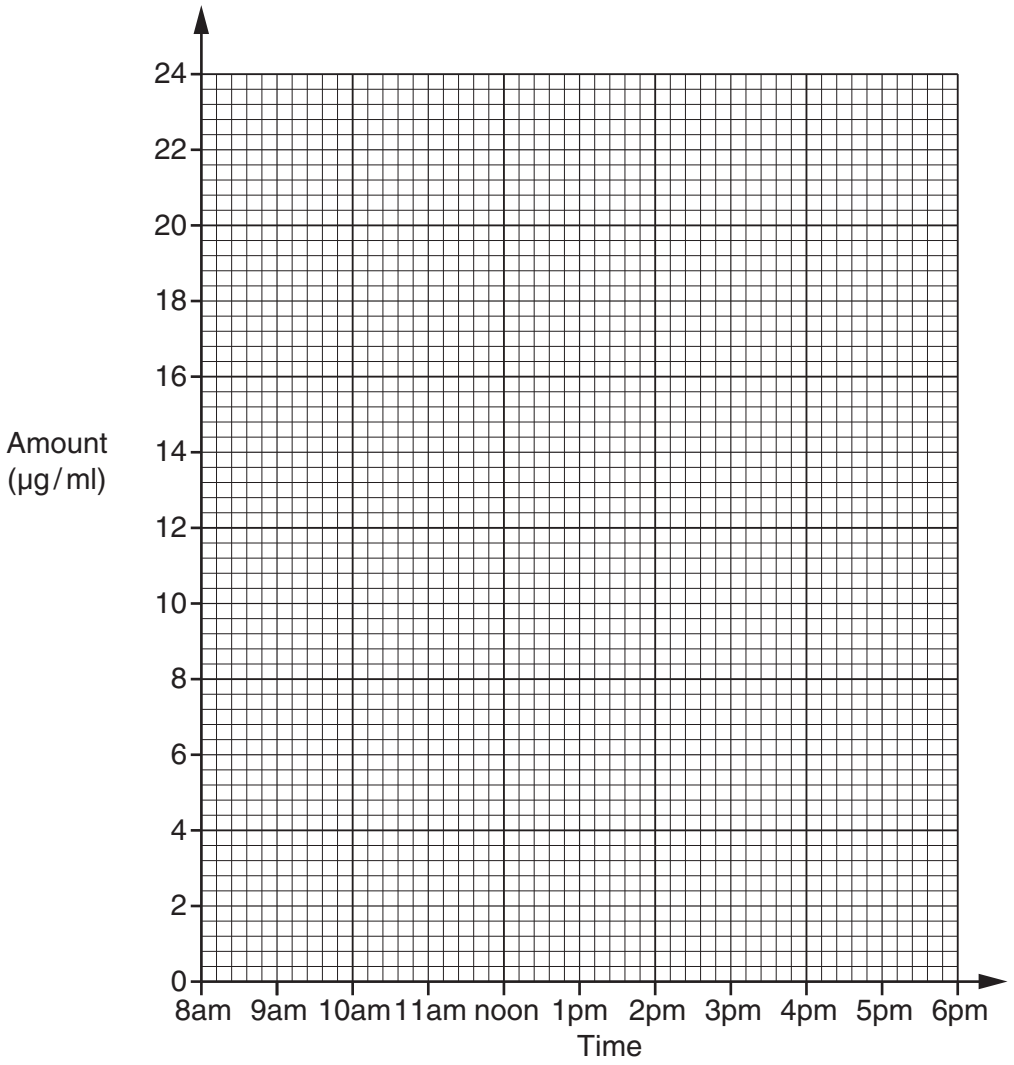
[6]

16 Each dose of a painkiller increases the amount of painkiller in the blood by 16 micrograms per millilitre (µg/ml).

Every two hours after each dose of painkiller is taken, the amount remaining in the blood is halved.

(a) Tom takes a single dose of this painkiller at 8 am.

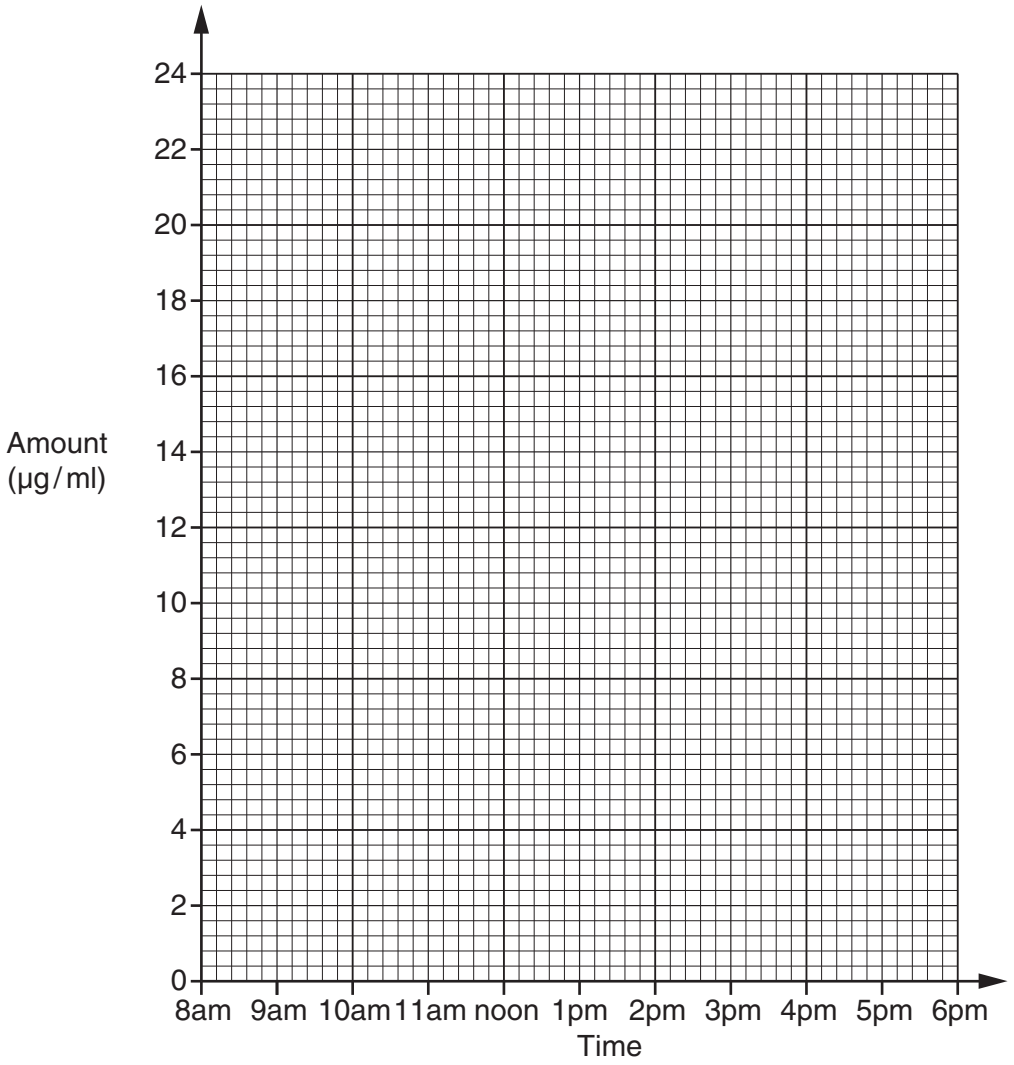
Draw a graph to show the amount of painkiller in Tom's blood from 8 am to 6 pm.



[3]

(b) Ollie takes a first dose of this painkiller at 8 am, a second dose at 12 noon and a third dose at 4 pm.

What is the amount of painkiller in Ollie's blood at 6 pm?



(b) _____ µg/ml **[2]**

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