Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE

General Certificate of Secondary Education

WJEC CBAC

CYD-BWYLLGOR ADDYSG CYMRU

Tystysgrif Gyffredinol Addysg Uwchradd

184/09

MATHEMATICS

HIGHER TIER PAPER 1

A.M. TUESDAY, 8 November 2005

(2 Hours)

**CALCULATORS ARE
NOT TO BE USED
FOR THIS PAPER**

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take π as 3·14.

INFORMATION FOR CANDIDATES

You should give details of your method of solution.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

Formula List

Volume of prism = area of cross-section × length
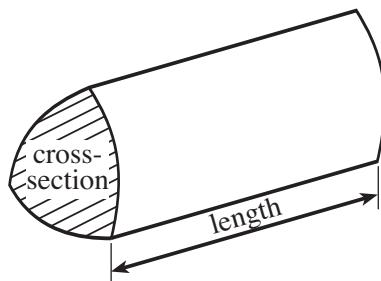
Volume of sphere = $\frac{4}{3} \pi r^3$

Surface area of sphere = $4\pi r^2$
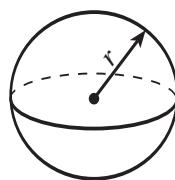
Volume of cone = $\frac{1}{3} \pi r^2 h$

Curved surface area of cone = $\pi r l$
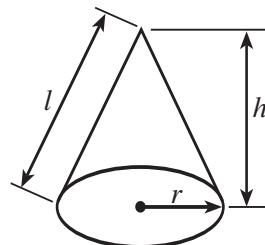
In any triangle *ABC*

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

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

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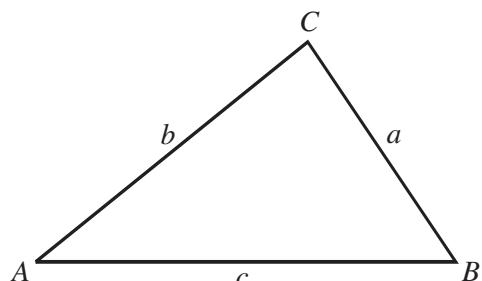
The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

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

Standard Deviation

Standard deviation for a set of numbers

$x_1, x_2, \ldots, x_n,$ having a mean of $\bar{x}$ is given by

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n}} \text{ or } s = \sqrt{\frac{\sum x^2}{n} - \left\{\frac{\sum x}{n}\right\}^2}$$

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1. Each of the exterior angles of a regular polygon is 30°. How many sides has the polygon?

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[2]

2. Change $4 \cdot 6 \, \text{m}^3$ into cm^3.

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[2]

3. *(a)* Express 750 as a product of prime numbers in index form.

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[3]

(b) Write down the least positive whole number that 750 must be multiplied by to make the result a perfect square.

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[1]

Turn over.

4. The table shows some of the values of $y = 3x^2 - 7x - 1$ for values of x from –2 to 4.

(a) Complete the table by finding the value of y for $x = 2$.

x	–2	–1	0	1	2	3	4
$y = 3x^2 - 7x - 1$	25	9	–1	–5		5	19

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[1]

(b) On the graph paper opposite, draw the graph of $y = 3x^2 - 7x - 1$ for values of x between –2 and 4.

[3]

(c) Draw the line $y = 8$ on your graph paper and write down the x-values of the points where your two graphs intersect.

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[2]

For use with question 4.

Turn over.
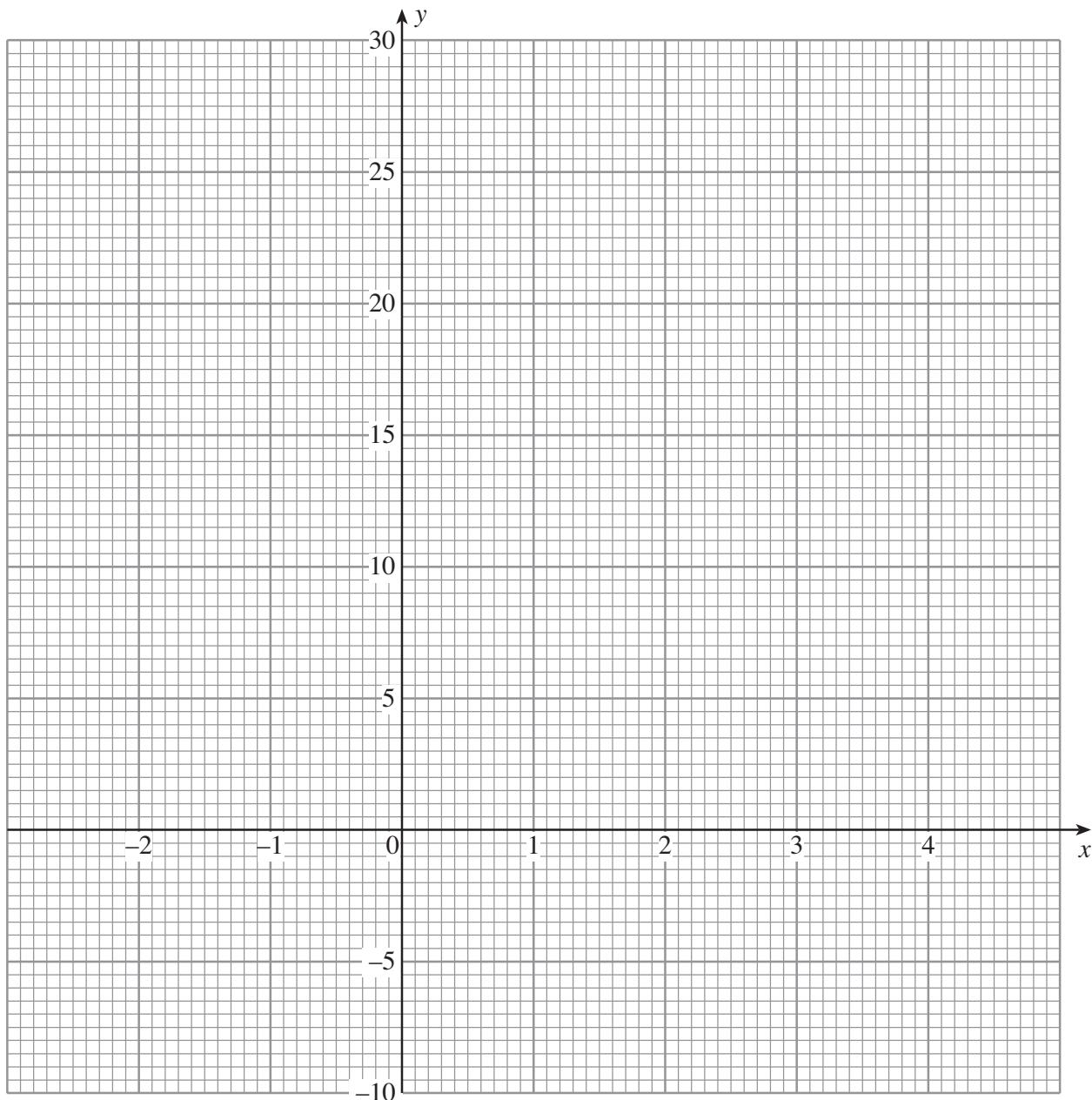
5. Below is a sketch of Treasure Island using a scale of 1cm to represent 10m. Captain Blood has buried the treasure using the following rules.

The treasure is
  (i)   more than 50m away from the straight line beach *AB*,
 (ii)   nearer to the tree at *X* than to the tree at *Y*,
(iii)   less than 40m away from the rock.

Clearly indicate the region in which the treasure has been buried.

[4]

Tree
Y ●

Rock
●

A

B
E
A
C
H

Sea

A

B

Tree
X ●
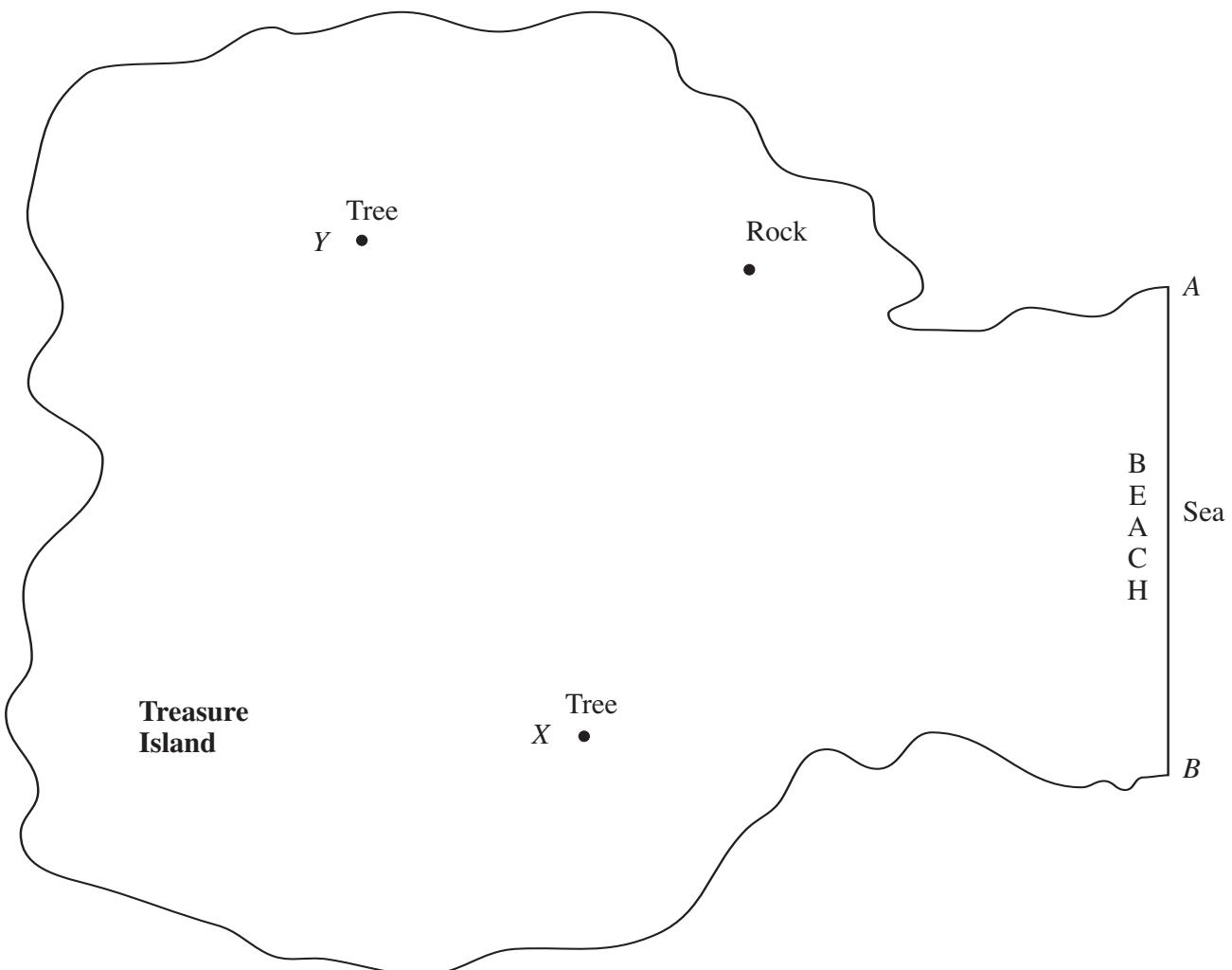
**Treasure
Island**

6. *(a)* Describe fully the transformation that transforms triangle *ABC* into triangle *PQR*.

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[2]

Turn over.
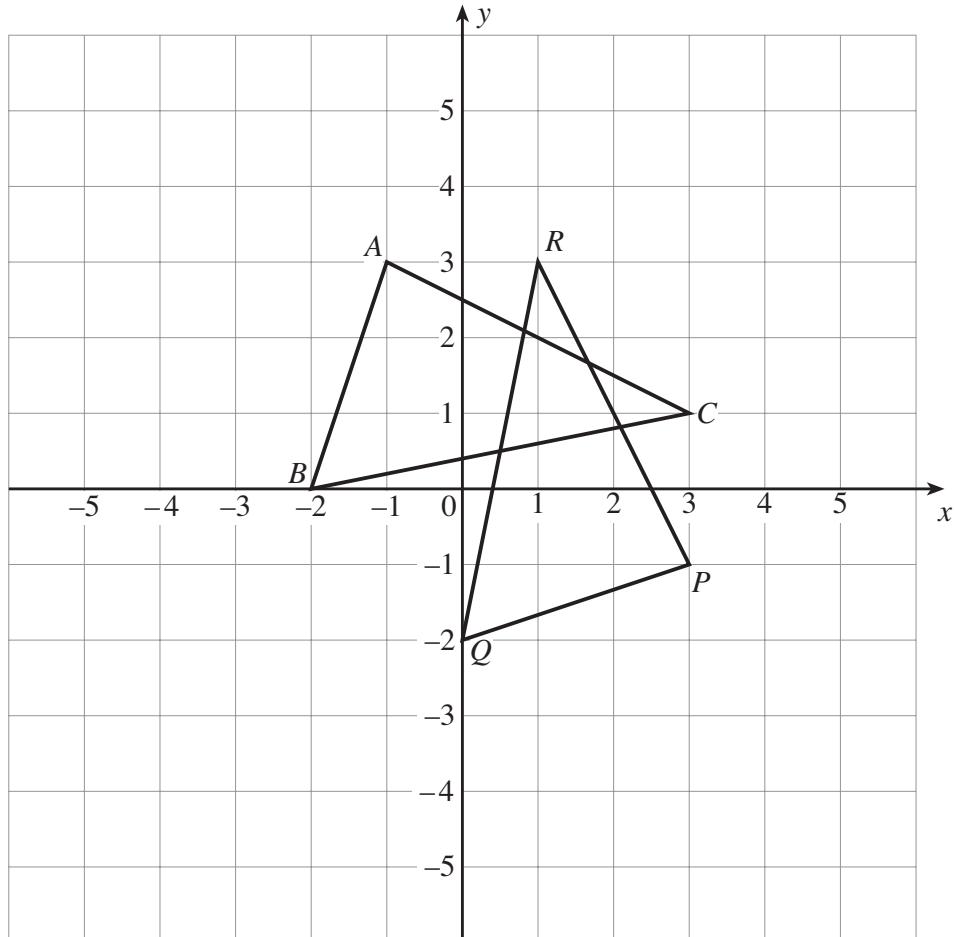
(b) Rotate the triangle **D** through 90° clockwise about the point (2, 1).
Label the image **E**.

[2]
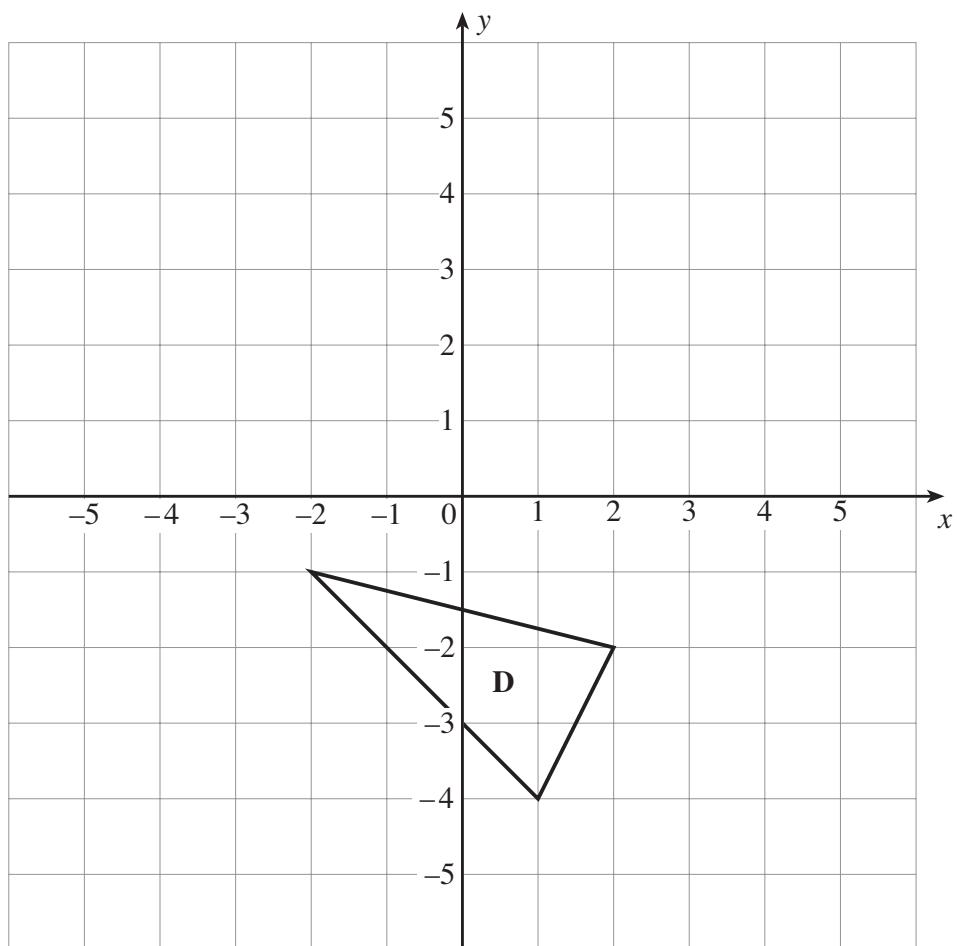
7. Concrete blocks have a mass of 15 kg measured to the nearest kg.

(a) Write down the least and greatest possible values of the mass of a concrete block.

Least mass .... kg   Greatest mass .... kg

[2]

(b) (i) Find the least and greatest possible values of the mass of 100 concrete blocks.

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Least mass .... kg   Greatest mass .... kg
of 100 blocks   of 100 blocks

[2]

(ii) Denver wishes to be sure that he puts no more than 1500 kg of blocks on his lorry. Find the greatest number of blocks Denver should put on his lorry in order to be sure that no more than 1500 kg is loaded.

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[3]

8. Each of the following quantities has a particular number of dimensions. Give the number of dimensions of **each** quantity. The first one has been done for you.

Quantity	Number of dimensions
The capacity of a bucket	3
The area of a rectangle	
The volume of a cone	
The distance between Wrexham and Pembroke	
The circumference of a circle	

[2]

Turn over.

9. Solve the following simultaneous equations by an algebraic (not graphical) method.
Show all your working.

$$5x + 3y = -1$$
$$3x + 4y = 6$$

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10. *(a)* Simplify the expression

$$4m^5n^2 \times 2m^3n.$$

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[2]

(b) Expand $(x - 4)(x - 5)$.

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[2]

11. *(a)* Solve the inequality

$$5x + 3 > 24 - 2x.$$

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[2]

(b) Write down the smallest whole number that satisfies this inequality.

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[1]

12. *(a)* Explain clearly why the following triangles are **NOT** similar.
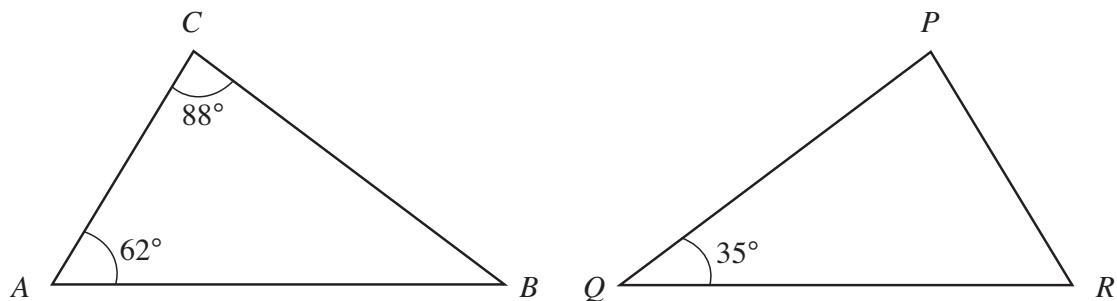
Diagrams not drawn to scale.

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[2]

(b) Triangles *DEF* and *XYZ* are similar. Their corresponding sides are in the ratio 4:3. Calculate the length of *YZ*.

Diagrams not drawn to scale.

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[2]

Turn over.
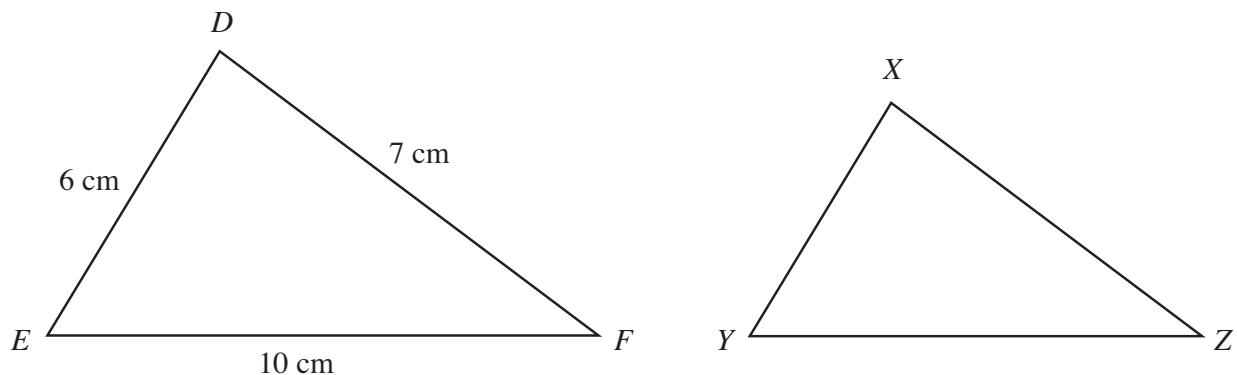
13. Class **X** and Class **Y** both have 30 pupils. The time taken by each pupil to perform a task is measured to the nearest second. The cumulative frequency polygons for the times taken by pupils in Class **X** and for those in Class **Y** are shown below.
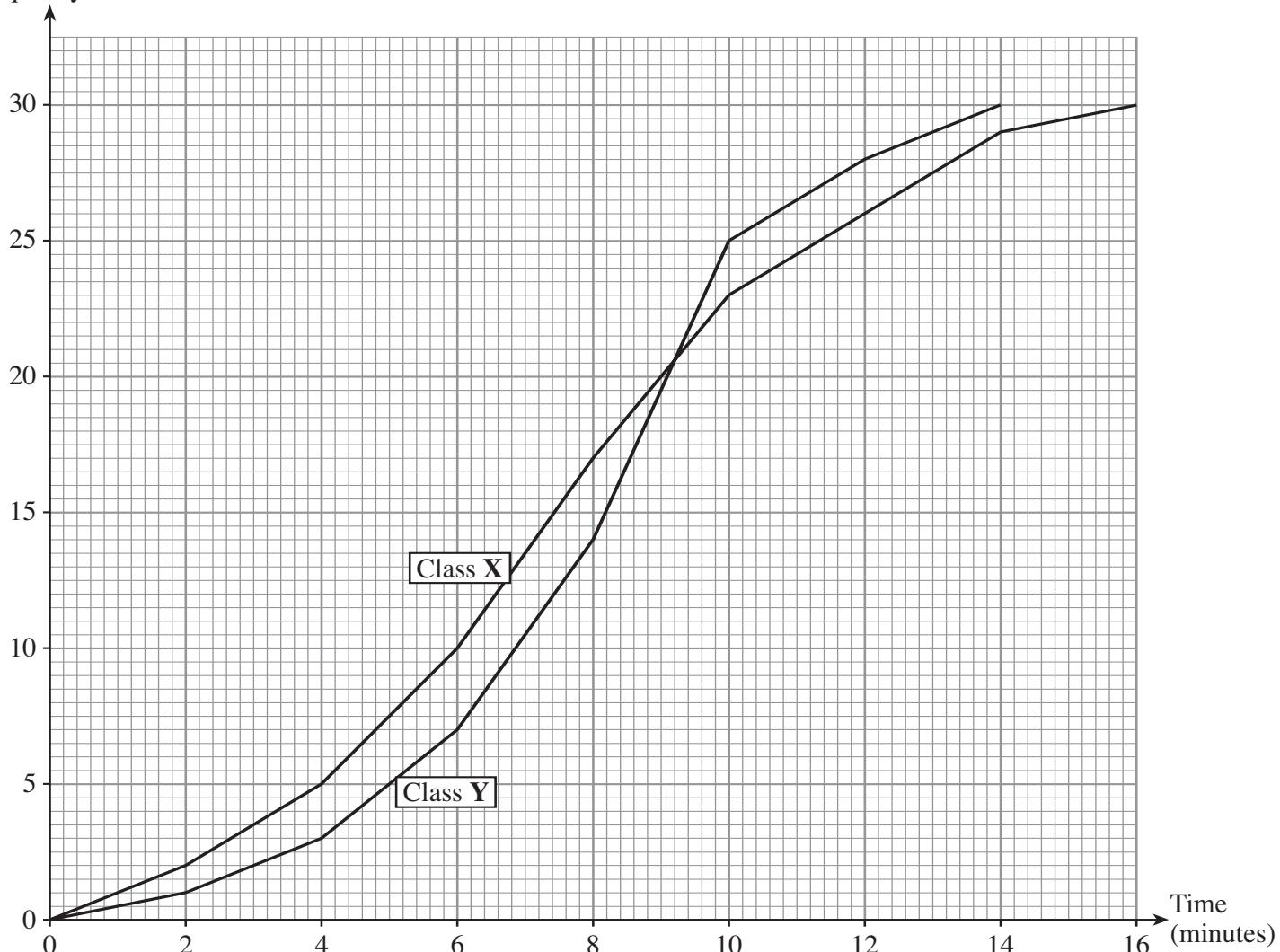
Use the cumulative frequency polygons to answer the following questions.

(a) Which class has the higher median time and by how much?

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[2]

(b) Which class had more pupils finishing the task between the 8th and 12th minute? Write down how many more pupils.

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(184/09)

[2]

14.
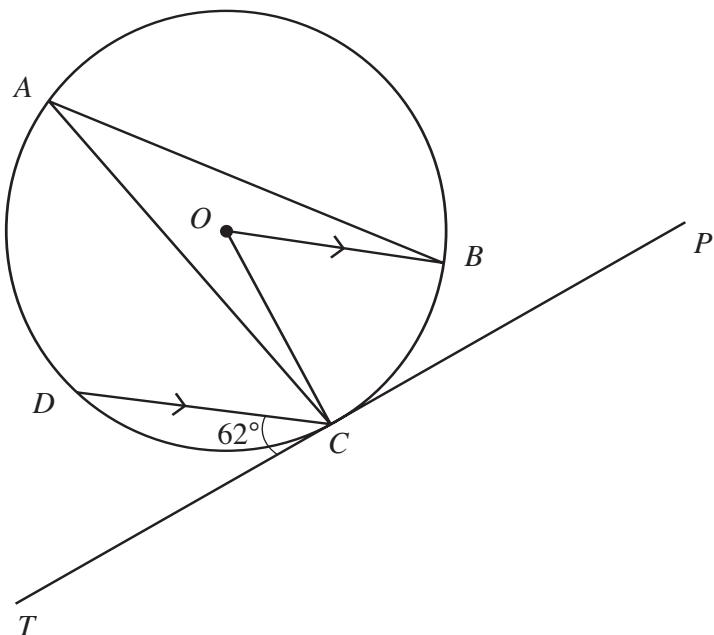
Diagram not drawn to scale.

Four points *A, B, C* and *D* lie on the circumference of the circle centre *O*.

The tangent *TP* touches the circle at *C* and the radius *OB* is parallel to *DC*.

Given that $D\hat{C}T = 62°$, find **each** of the following angles, giving reasons for your answers.

(a) $O\hat{C}D$

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[2]

(b) $B\hat{A}C$

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[2]

Turn over.

15. Make *f* the subject of the following formula.

$$2e + 3 = \frac{3f - 5d}{4f}$$

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[4]

16. On the graph paper provided, draw the region which satisfies **all** of the following inequalities.

$$x + y \leqslant 8$$
$$y \geqslant 5x + 2$$
$$x \geqslant -2$$

Make sure that you clearly indicate the region that represents your answer.

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[3]

Turn over.
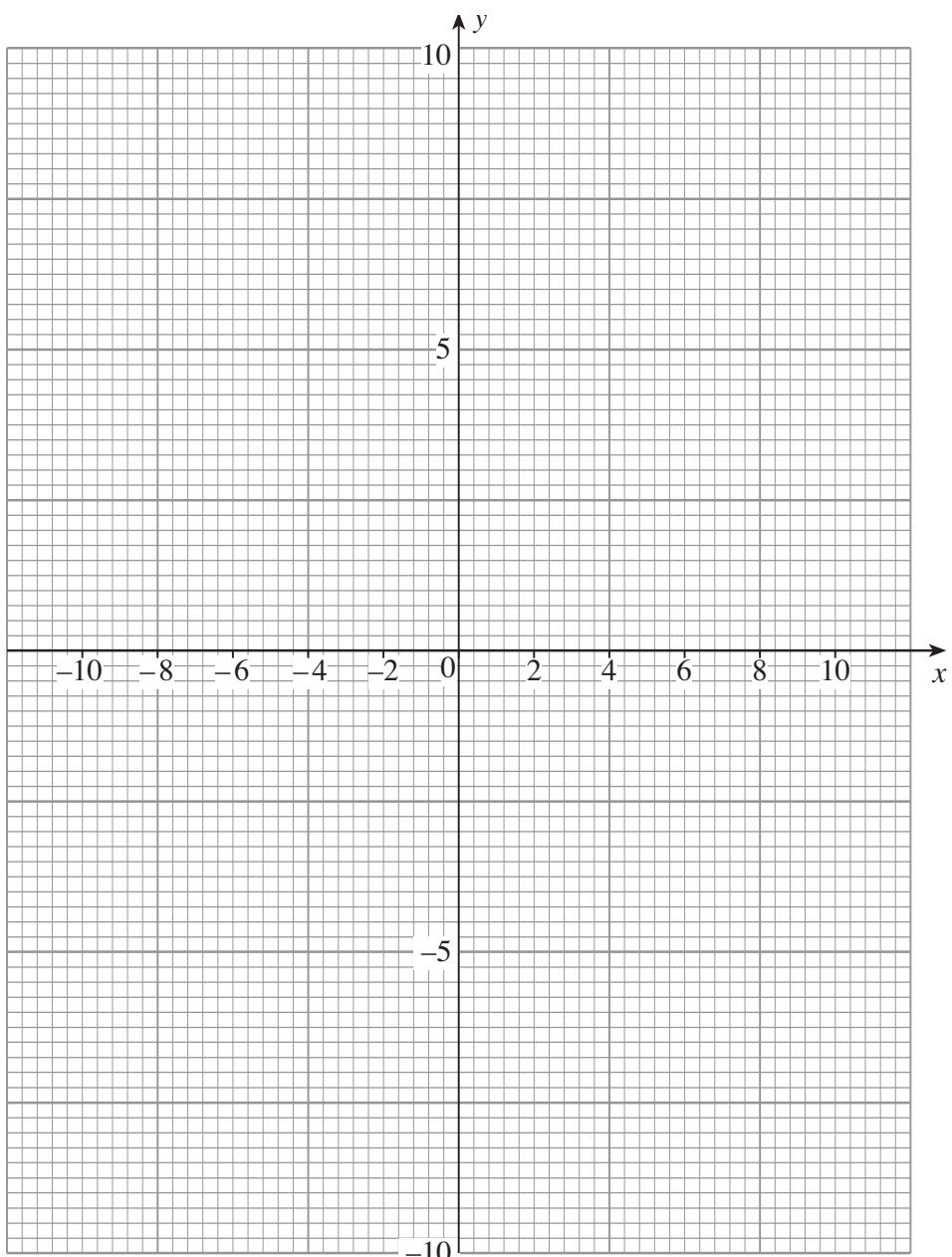
17. The graph of $y = x^2 - 3x - 7$ is given below.
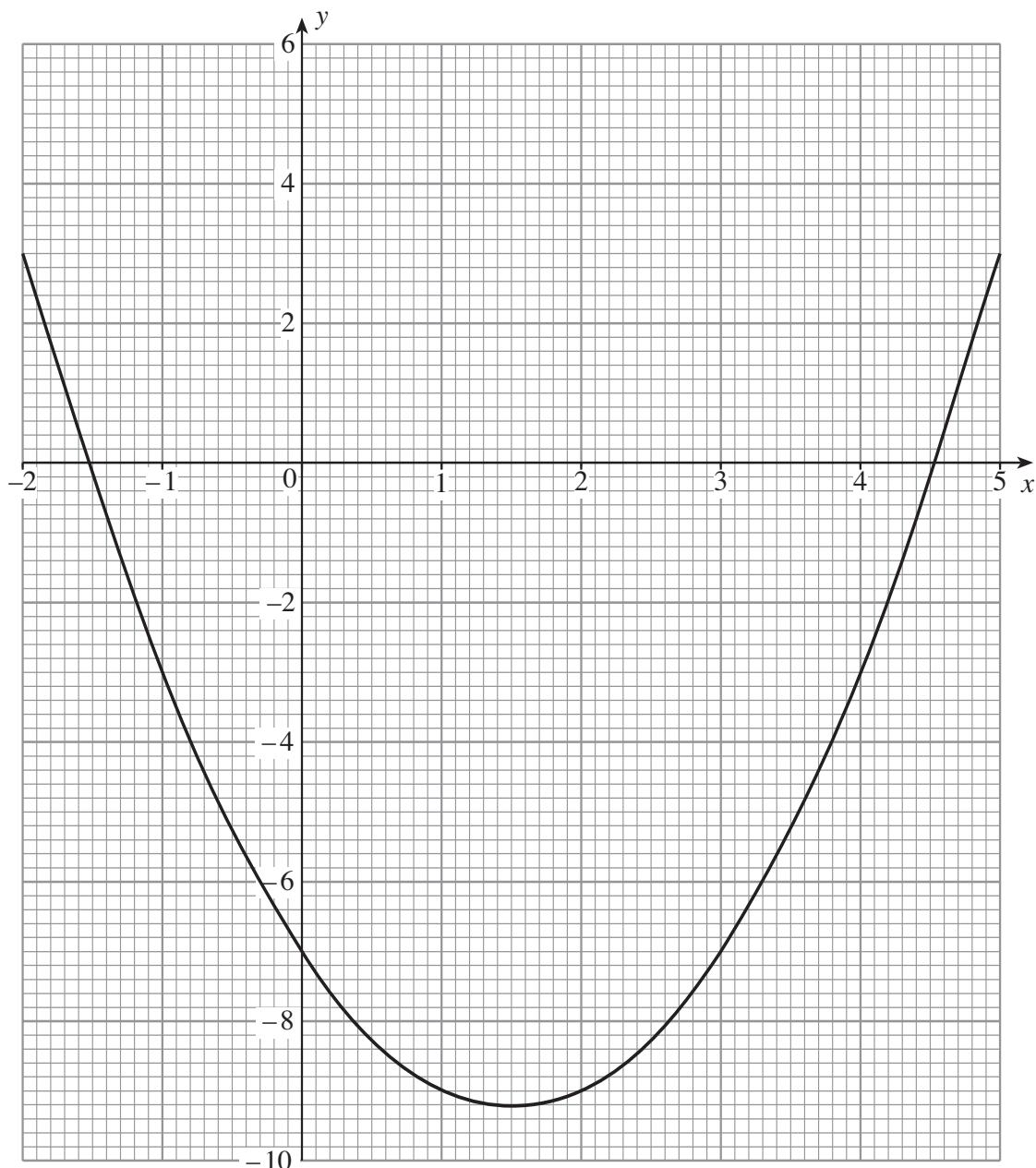
Use the graph of $y = x^2 - 3x - 7$ to find

(a) the value of x when the gradient of the curve is zero,

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[1]

(b) the gradient of the curve when $x = 0$.

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[3]

18. As part of an investigation, the time taken to undo three knots in a piece of string was measured for each pupil in a group of twelve year olds.
The histogram below illustrates the results obtained.

Times for the 12 year olds
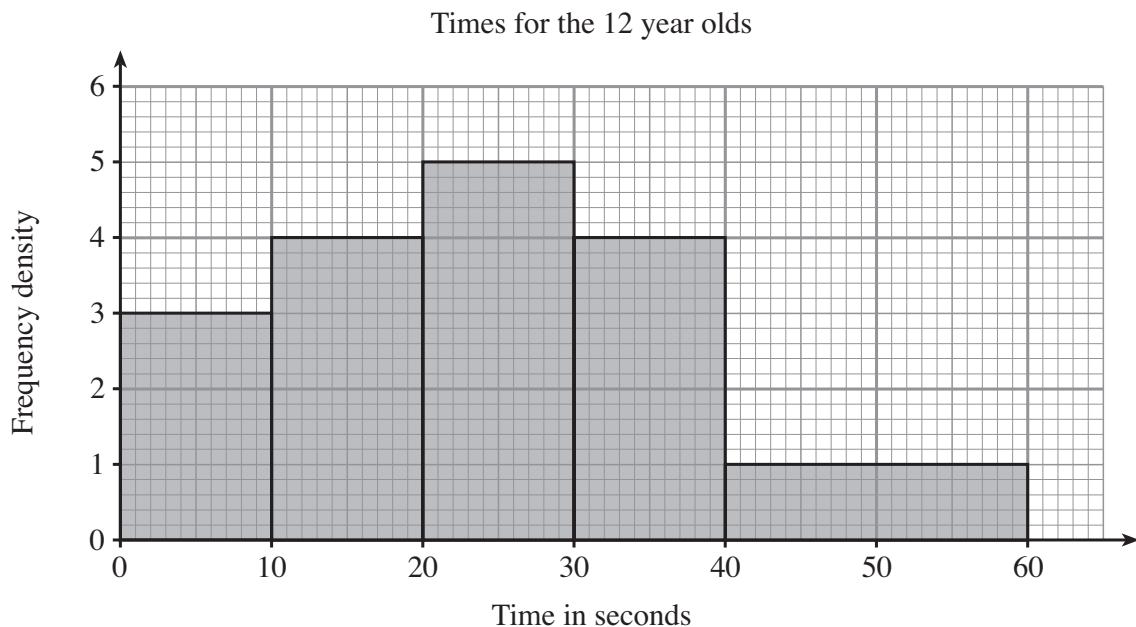
(a) Use the histogram to calculate the number of twelve year olds in this group.

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Turn over.

(b) The time taken to undo three knots in a piece of string was measured for each pupil in a group of 200 sixteen year olds.
The following grouped frequency distribution was obtained.

Time, t seconds	$0 < t \leqslant 10$	$10 < t \leqslant 20$	$20 < t \leqslant 30$	$30 < t \leqslant 40$	$40 < t \leqslant 60$
Number of people	45	55	60	30	10

(i) Find an estimate for the median of this distribution.

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[1]

(ii) Draw a histogram to illustrate the distribution on the graph paper below.

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[2]

Times for the 16 year olds

Frequency density

6
5
4
3
2
1
0

0   10   20   30   40   50   60

Time in seconds
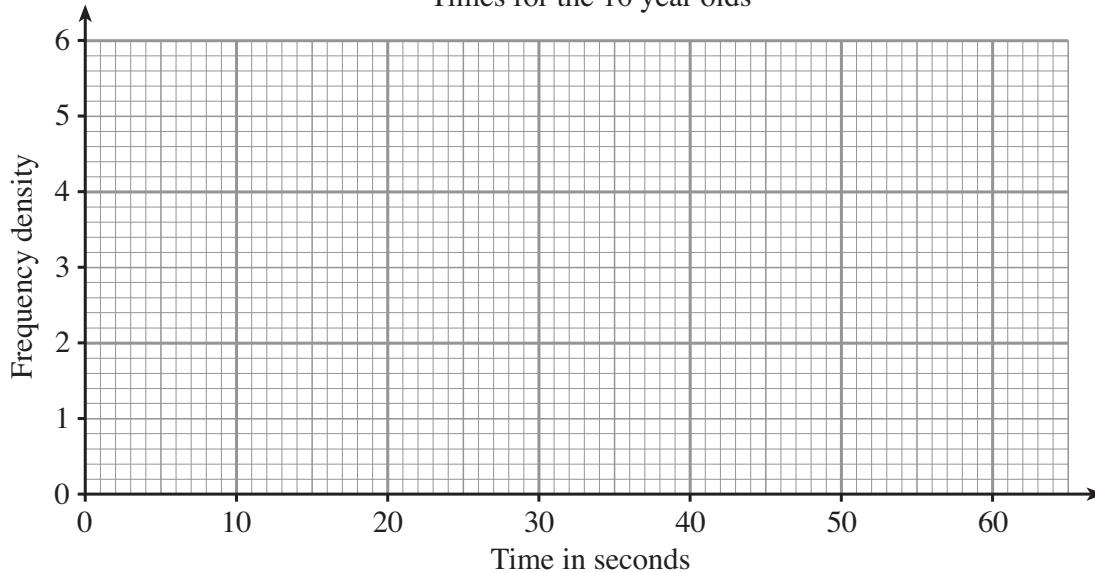
(c) State, with a reason, which of the two groups is the better, on average, at undoing knots.

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[1]

19. Express $0 \cdot 6\overset{..}{5}\overset{.}{2}$ as a fraction.

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[2]

Turn over.

20. A bag contains 25 wine gums. There are 3 green, 5 yellow, 8 black and 9 red wine gums in the bag. Two wine gums are selected at random from the bag.

(a) Calculate the probability that both selected wine gums are red.

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(b) Calculate the probability that at least one of the selected wine gums is yellow.

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[3]

21. *(a)* Factorise $15x^2 + 7x - 2$.

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(b) Simplify $\dfrac{15x^2 + 7x - 2}{6x^2 + 4x}$.

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22. *(a)* Write down a value of x (where $x > 1$) for which $x^{\frac{2}{3}}$ is rational.

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(b) Write down an irrational number whose square is rational.

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[1]

(c) Find the value of $\left(\sqrt{50} - \sqrt{2}\right)^2$.

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[2]

Turn over.

23. The diagram shows a quadrilateral *OABC*.
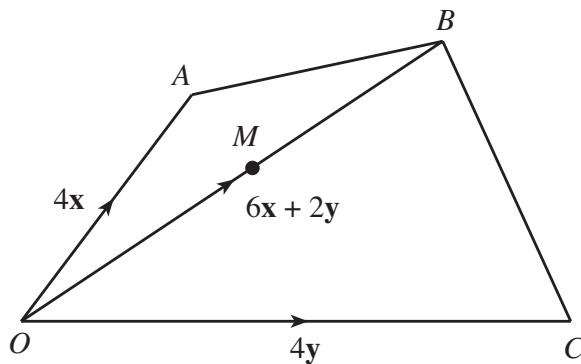
In the quadrilateral *OABC*, the vectors **OA**, **OB** and **OC** are given by
OA = 4**x**, **OB** = 6**x** + 2**y** and **OC** = 4**y**.

(a) Given that *M* is the mid-point of *OB*, express each of the following in terms of **x** and **y** in their simplest form.

(i) **AC**

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[1]

(ii) **OM**

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[1]

(iii) **AM**

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[1]

(b) Does *M* lie on the line *AC*? Give a reason for your answer.

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[1]

24. Express the following as a single fraction in its simplest form.

$$\frac{7}{2x + 3} - \frac{5}{5x + 2}$$

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[4]

Turn over.

25. The data in the table was recorded during an experiment. Results were recorded for the two variables x and y.

x	1	2	3	4	5
y	54	87	133	206	292

(a) On the graph paper plot the values of y against the values of x^2.

[2]
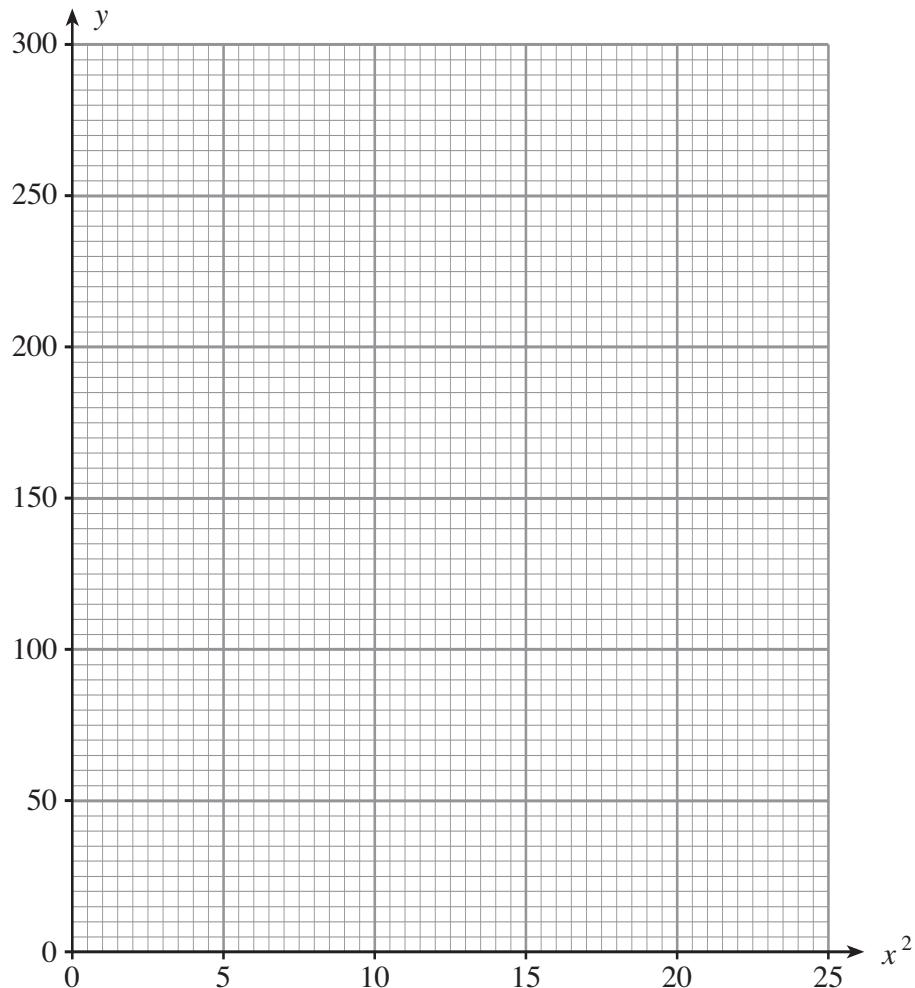
(b) It is known that y is approximately equal to $ax^2 + b$.
Use your graph to estimate the values of a and b.

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[3]