Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

For Examiner's Use

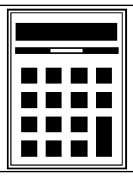
General Certificate of Secondary Education
November 2006

MATHEMATICS (SPECIFICATION A) **3301/2H**
Higher Tier
Paper 2 Calculator

H

Friday 10 November 2006 9.00 am to 11.00 am

For this paper you must have:
- a calculator
- mathematical instruments.



Time allowed: 2 hours

Instructions
- Use blue or black ink or ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Use a calculator where appropriate.
- Do all rough work in this book.
- If your calculator does not have a π button, take the value of π to be 3.14 unless another value is given in the question.

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You may ask for more answer paper, graph paper and tracing paper. They must be tagged securely to this answer booklet.

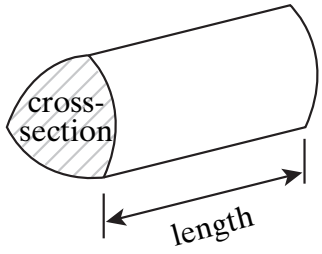
Advice
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Pages	Mark
3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
TOTAL	
Examiner's Initials	

Formulae Sheet: Higher Tier

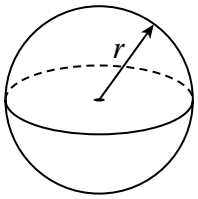
You may need to use the following formulae:

Volume of prism = area of cross-section × length



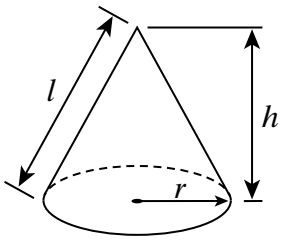
Volume of sphere = $\frac{4}{3}\pi r^3$

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



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

Curved surface area of cone = $\pi r l$

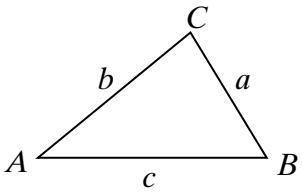


In any triangle ABC

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

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

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



The Quadratic Equation

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

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

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

1 Here are the nth terms of 3 sequences.

Sequence 1	nth term	$4n + 1$
Sequence 2	nth term	$3n + 3$
Sequence 3	nth term	$3n - 1$

For each sequence state whether the numbers in the sequence are

A Always multiples of 3
S Sometimes multiples of 3
N Never multiples of 3

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Answer Sequence 1 .....

Sequence 2 .....

Sequence 3 .....

(3 marks)

2 A car produces 2.78 kg of carbon dioxide per hour when driven in a city.
The car travels 30 miles in a city at an average speed of 20 mph.
How much carbon dioxide does the car produce during its journey?

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Answer ..... kg *(3 marks)*

6

3 Last year the Tate Modern Art Gallery in London had 5.2 million visitors.
The gallery was open every day of the year except for 24th, 25th and 26th of December.
The advertising department produces a poster.

Tate Modern
One of London's top attractions

Each day in 2005 there were, on average, over

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visitors.
Why not join them ?

Calculate an appropriate number to write in the box to show the average number of visitors each day.

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(2 marks)

4 (a) Solve the inequality $3(x - 2) \leqslant 9$

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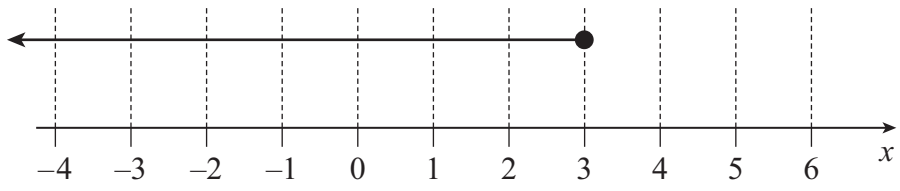
Answer ..... *(3 marks)*

(b) The inequality $x \leqslant 3$ is shown on the number line below.



Draw another inequality on the number line so that only the following integers satisfy both inequalities

$\{-2, -1, 0, 1, 2, 3\}$

(1 mark)

LEAVE MARGIN BLANK

5 A survey was taken of the amount of money spent at a supermarket by 100 shoppers on a Monday. The table shows the results.

Amount spent, *m*, (£)	**Frequency**
$0 < m \leqslant 40$	18
$40 < m \leqslant 80$	34
$80 < m \leqslant 120$	40
$120 < m \leqslant 160$	8

Which class interval contains the median?
You **must** show your working.

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Answer ..... $< m \leqslant$ ..... *(2 marks)*

Turn over for the next question

8

6 The table shows the consumption of water per person on average each day during various years.

Year	1960	1976	2004
Consumption (litres)		110	150

(a) Calculate the percentage increase in consumption from 1976 to 2004.

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Answer ..... % *(3 marks)*

(b) The consumption in 1976 was 20% more than the consumption in 1960.
Calculate the consumption in 1960.

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Answer ..... litres *(3 marks)*

7 A prism has the following properties.

Area of cross-section	$0.6\,m^2$
Mass	15 kg
Density	20 kg per m^3

Calculate the length of the prism.

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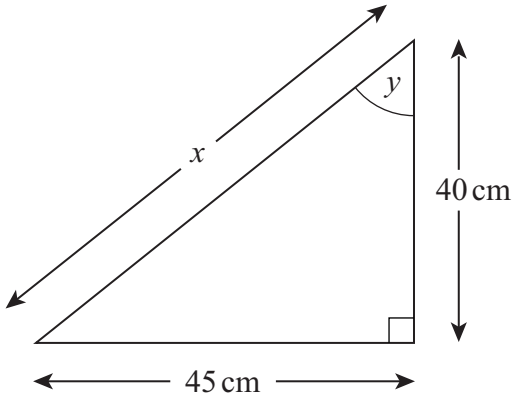
Answer ..... m *(4 marks)*

8 A right-angled triangle has the dimensions shown.



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(a) Calculate the length x.
Give your answer to a suitable degree of accuracy.

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Answer ..... cm *(4 marks)*

(b) Calculate the size of angle y.
Show your working.

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Answer ..... degrees *(3 marks)*

17

9 (a) In a primary school the ratio of boys to girls is 7 : 8

For each statement write down whether it is

D Definitely true
C Could be true
F False

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(i) The number of boys in the school is 49 .....

(ii) The fraction of boys in the school is $\frac{7}{8}$ .....

(iii) The fraction of girls in the school is $\frac{8}{15}$ .....

(3 marks)

(b) In a secondary school the ratio of boys to girls is 10 : 11
There are 830 boys in the school.
How many girls are there in the school?

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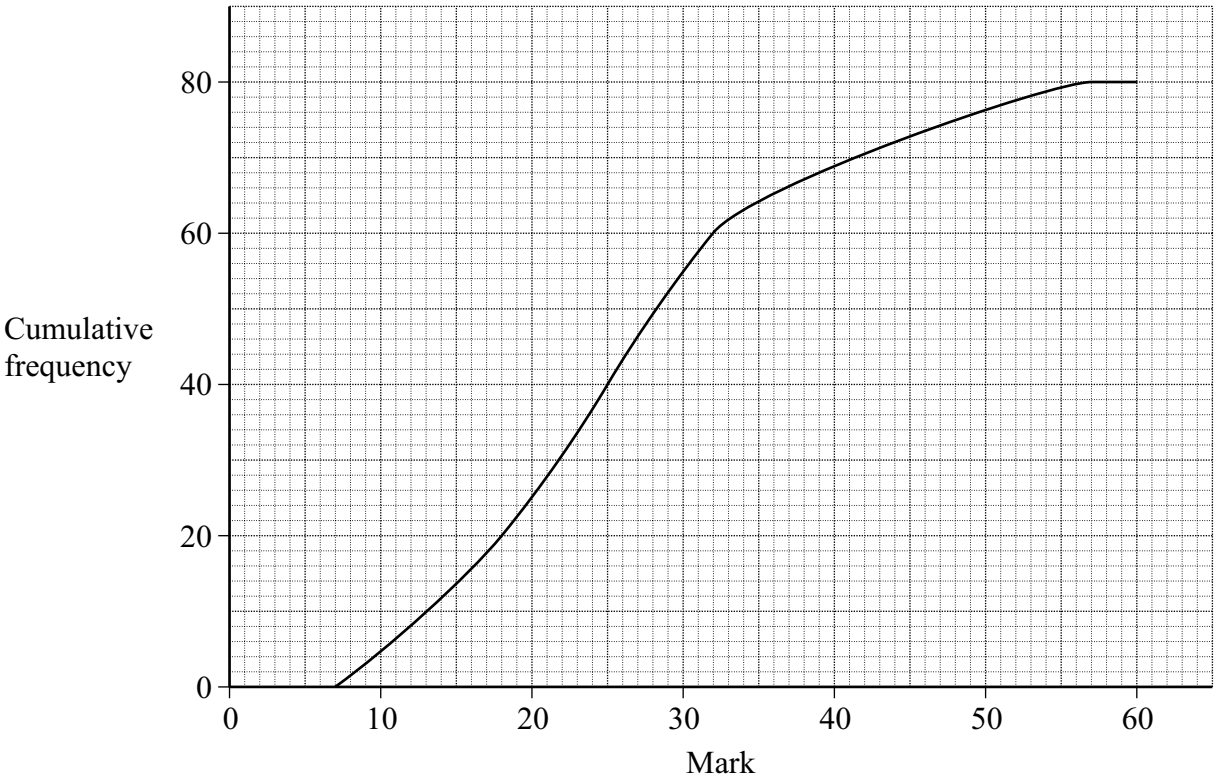
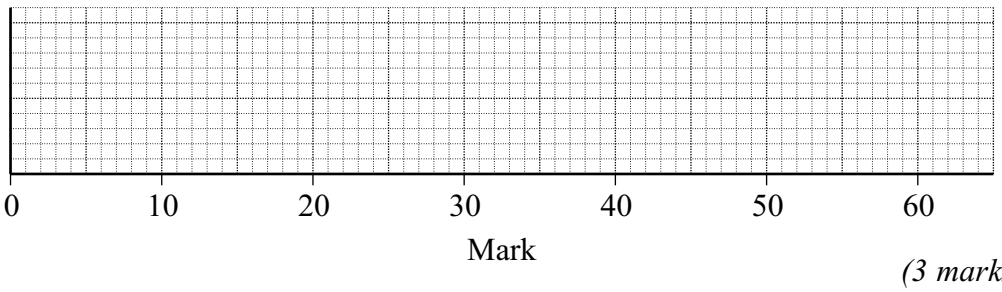
Answer ..... *(2 marks)*

10 The cumulative frequency diagram shows the distribution of marks for 80 students in a Geography examination.



(a) The lowest mark is 8.
The highest mark is 57.
Draw a box plot for this data.



(3 marks)

(b) What percentage of students scored less than the lower quartile mark?

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Answer ..... % *(1 mark)*

9

11 (a) Rearrange the expression $4(p + r) = 7r + 11$ to make p the subject.

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Answer $p =$ ..... *(3 marks)*

(b) Solve these simultaneous equations

$$3x + 5y = 4$$
$$6x + y = 26$$

You **must** show your working.
Do **not** use trial and improvement.

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Answer $x =$ ..... $y =$ ..... *(3 marks)*

12 (a) Show clearly that $(p + q)^2 \equiv p^2 + 2pq + q^2$

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(1 mark)

(b) Hence, or otherwise, write the expression below in the form $ax^2 + bx + c$

$$(2x + 3)^2 + 2(2x + 3)(x - 1) + (x - 1)^2$$

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Answer ..... *(3 marks)*

13 Expand fully $2y(2x - 1)(2x + 1)$

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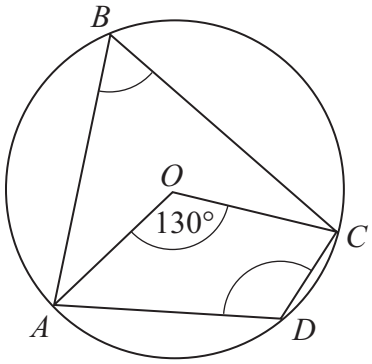
Answer ..... *(3 marks)*

13

14 (a) A, B, C and D are points on the circumference of a circle centre O.
$\angle AOC = 130°$



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Work out the size of angles ABC and ADC.

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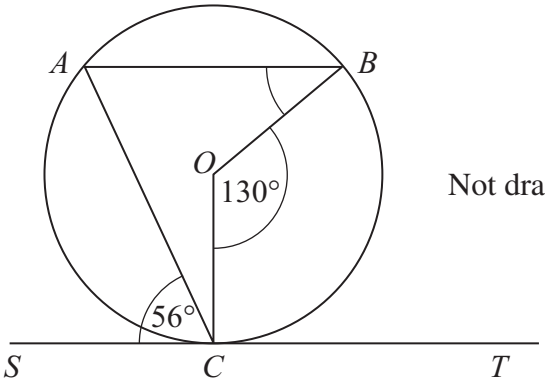
Answer Angle ABC ..... degrees *(1 mark)*

Angle ADC ..... degrees *(1 mark)*

(b) ABC are three points on the circumference of a circle centre O.
SCT is a tangent to the circle.
$\angle SCA = 56°$ $\angle COB = 130°$



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Find the size of angle OBA.

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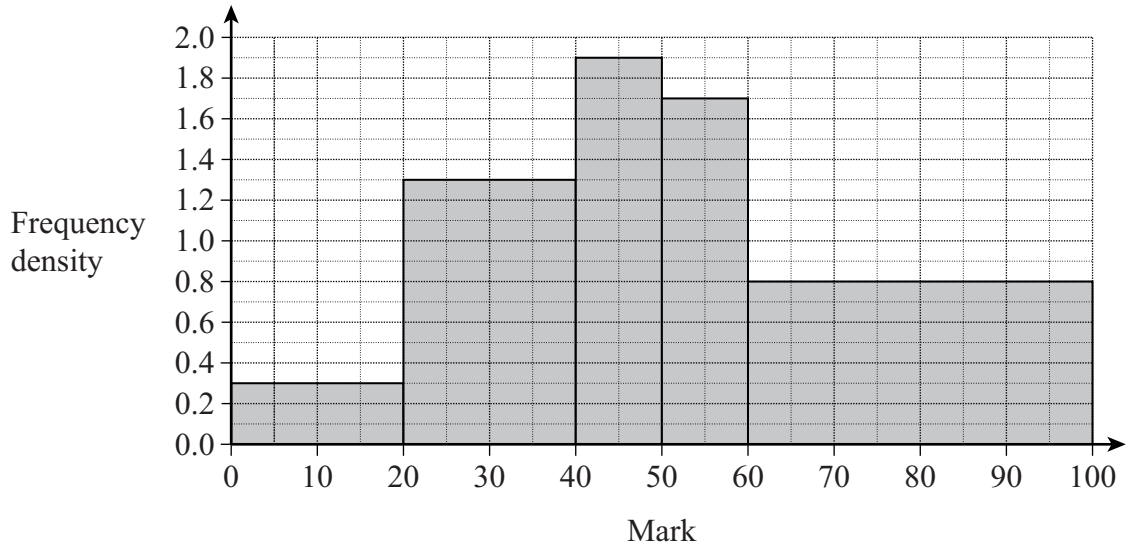
Answer Angle OBA = ... degrees *(3 marks)*

15 The histogram shows the distribution of student marks for an examination.



(a) How many students took the examination?

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Answer ..... *(3 marks)*

(b) Calculate an estimate of the mean mark.

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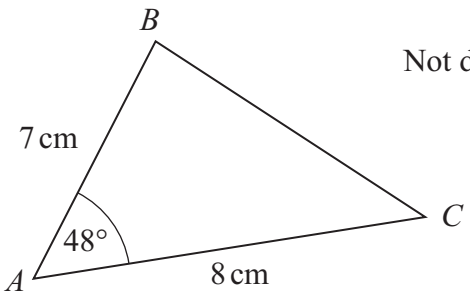
Answer ..... *(4 marks)*

12

16 *ABC* is a triangle.



(a) Calculate the length of side *BC*.

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Answer ..... cm *(3 marks)*

(b) Find the size of angle *BCA*.

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Answer ..... degrees *(3 marks)*

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17 The cost of circular mirrors is directly proportional to the square of the diameter.
A circular mirror with a diameter of 60 cm costs £50.

What is the cost of a circular mirror with a diameter of 90 cm?

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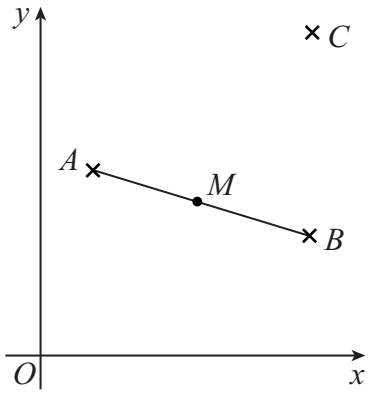
Answer £ ..... *(3 marks)*

18 *A* is the point (2, 9)
B is the point (8, 7)
M is the midpoint of *AB*
C is the point (8, 18)



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Is *MC* perpendicular to *AB*?
You must justify your answer.
Do **not** use graph paper to answer this question.

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(4 marks)

Turn over ▶

13

19 Rearrange the formula $3y + 2 = \frac{x + 3}{x}$ to make x the subject.

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Answer ..... *(4 marks)*

20 A broadband internet connection has a download speed of 60 Kilobytes per second, which is accurate to 1 significant figure.
A video file is 15 000 Kilobytes, accurate to 2 significant figures.

Calculate the greatest possible time needed to download this file.

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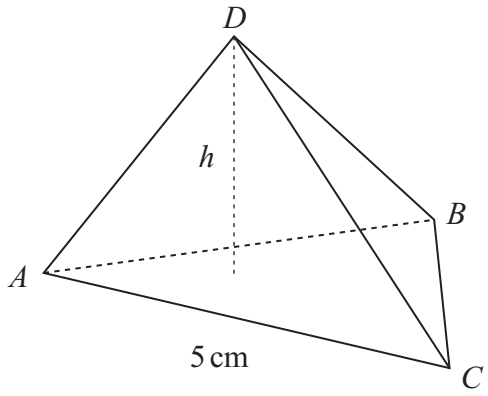
Answer ..... seconds *(4 marks)*

21 *ABCD* is a triangular based pyramid.
The base *ABC* is an equilateral triangle with side 5 cm.
The volume of the pyramid is 36 cm^3.



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Volume of a pyramid = $\frac{1}{3}$ × base area × perpendicular height

Calculate the perpendicular height, *h*, of the pyramid.

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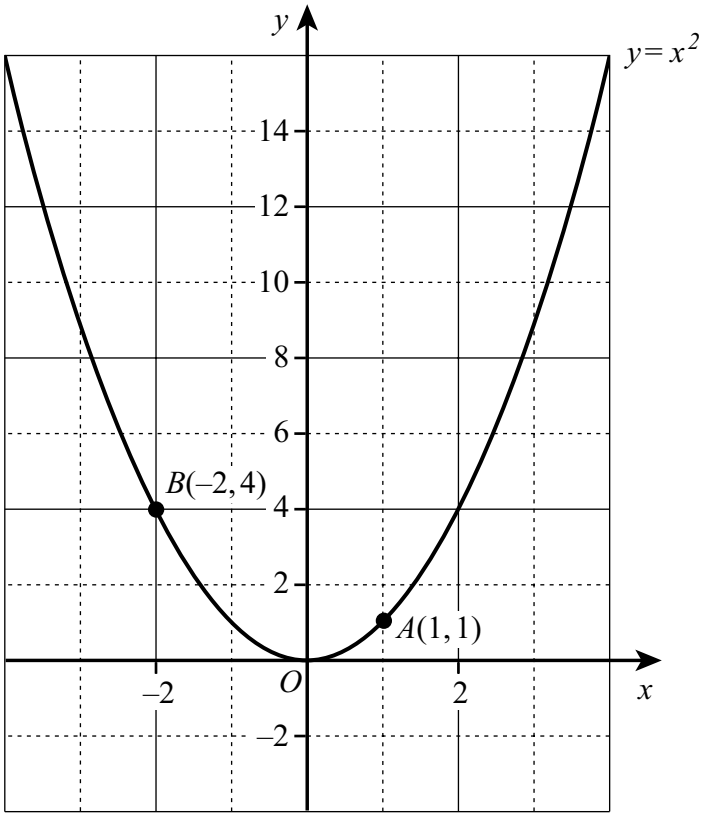
Answer *h* = ... cm *(4 marks)*

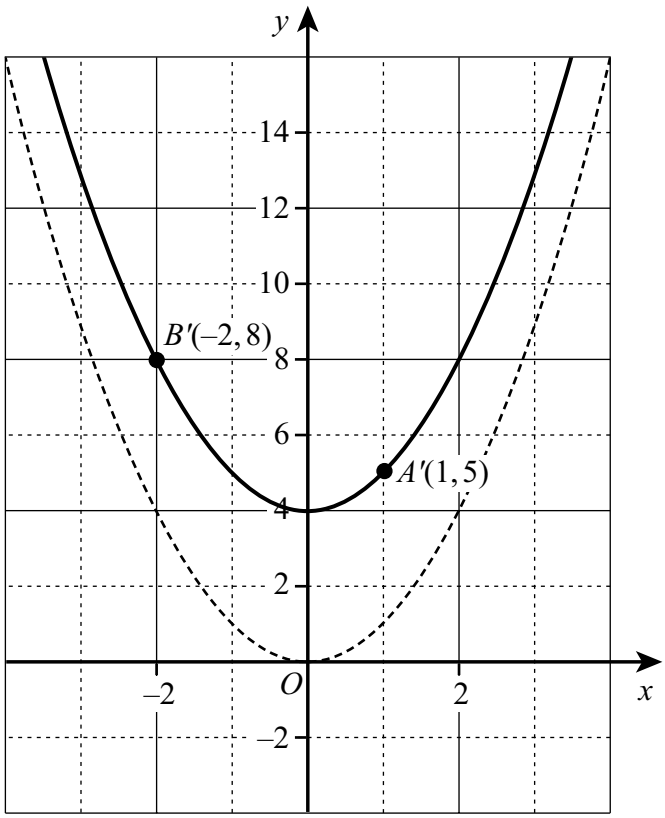
12

22 $A(1, 1)$ and $B(-2, 4)$ are two points on the graph of $y = x^2$



Here are three transformations of the graph $y = x^2$.
On each diagram the graph of $y = x^2$ is shown dotted.
The images A' and B' of A and B are shown.
Write down the equation of the transformed graph in each case.

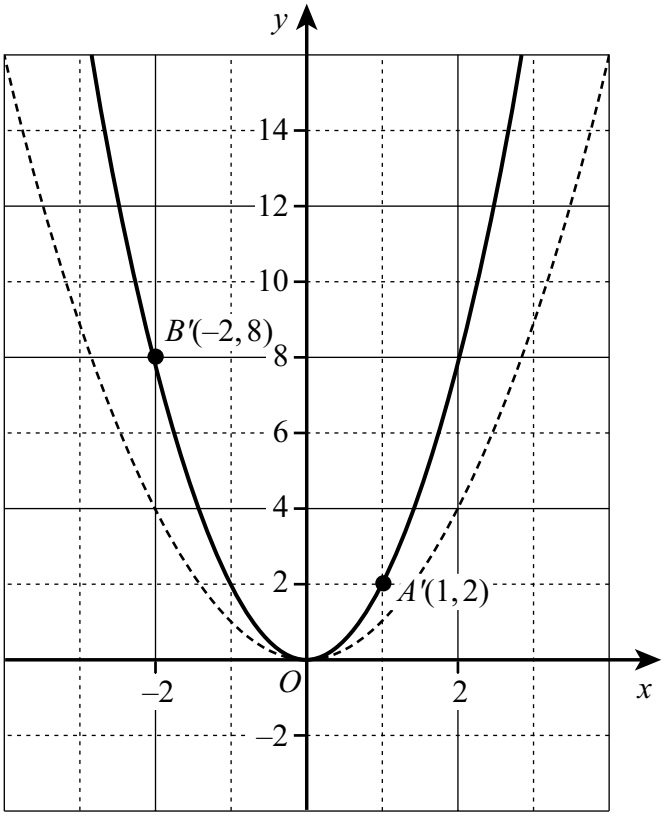
(a)



$y =$ .....

(1 mark)

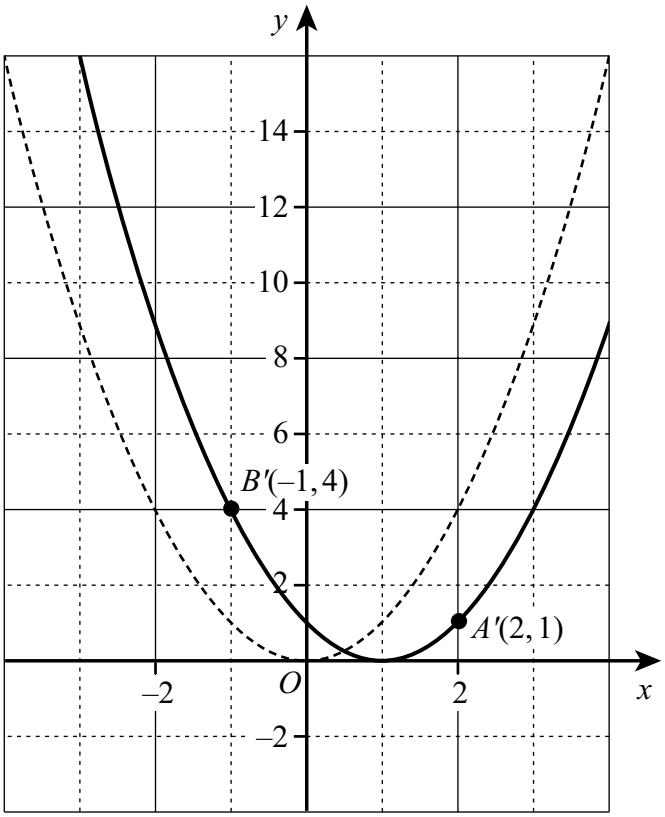
(b)



$y =$ .....

(1 mark)

(c)



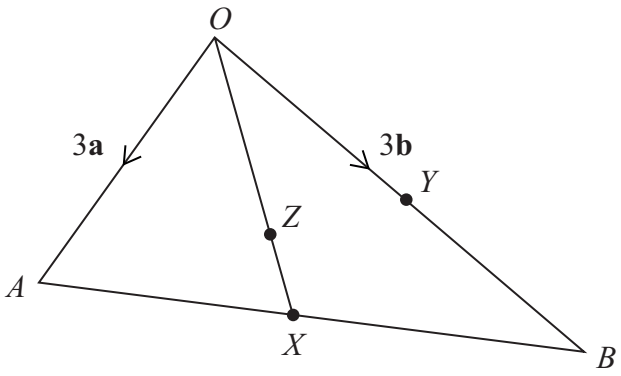
$y =$ .....

(1 mark)

3

23 OAB is a triangle.
X is the midpoint of AB.
Y is the midpoint of OB.
Z is the point on OX such that $OZ : ZX = 2 : 1$

$\overrightarrow{OA} = 3\mathbf{a}$, $\overrightarrow{OB} = 3\mathbf{b}$



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(a) Find, in terms of **a** and **b**, the vectors

(i) $\overrightarrow{AY}$

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Answer ..... *(1 mark)*

(ii) $\overrightarrow{OX}$

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Answer ..... *(2 marks)*

(iii) $\overrightarrow{AZ}$

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Answer ..... *(2 marks)*

(b) A, Z and Y are on a straight line.

Find the ratio $AZ:ZY$

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Answer ..... *(2 marks)*

END OF QUESTIONS

7

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