

**GENERAL CERTIFICATE OF SECONDARY EDUCATION  
MATHEMATICS SYLLABUS A**

**J512/04**

Paper 4  
(Higher Tier)

Candidates answer on the question paper

**OCR Supplied Materials:**

None

**Other Materials Required:**

- Electronic calculator
- Geometrical instruments
- Tracing paper (optional)

**Wednesday 14 January 2009  
Afternoon**

**Duration: 2 hours**



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Show your working. Marks may be given for a correct method even if the answer is incorrect.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

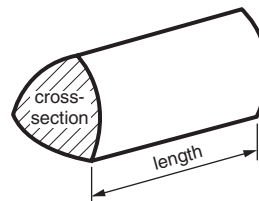
**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You are expected to use an electronic calculator for this paper.
- Use the  $\pi$  button on your calculator or take  $\pi$  to be 3.142 unless the question says otherwise.
- The total number of marks for this paper is **100**.
- This document consists of **16** pages. Any blank pages are indicated.

<b>FOR EXAMINER'S USE</b>

## Formulae Sheet: Higher Tier

**Volume of prism** = (area of cross-section)  $\times$  length

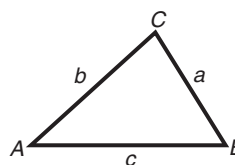


**In any triangle ABC**

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

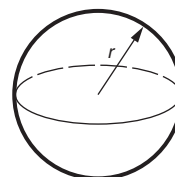
**Cosine rule**  $a^2 = b^2 + c^2 - 2bc \cos A$

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



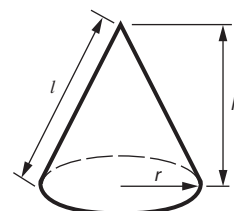
**Volume of sphere** =  $\frac{4}{3} \pi r^3$

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



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

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



**The Quadratic Equation**

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

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

1 Calculate.

(a)  $\frac{16.5}{8.25 + 5.15}$

Give your answer correct to 1 decimal place.

.....

.....

(a) \_\_\_\_\_ [2]

(b)  $\frac{45}{(0.3)^2}$

.....

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(b) \_\_\_\_\_ [2]

2 Josh painted his bedroom.

Complete his paint bill by working out the three missing values.

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.....

<b>Paint Bill</b>		
3 tins silk emulsion	@ £17.99 per tin	£ _____
_____ tins gloss	@ £11.99 per tin	£ _____
<b>Total cost</b>		<b>£ 77.95</b>

[4]

3 (a) Factorise.

(i)  $6x + 16$

(a)(i) \_\_\_\_\_ [1]

(ii)  $x^2 + 6x$

(ii) \_\_\_\_\_ [1]

(b) Solve.

(i)  $\frac{x}{12} = 6$

(b)(i) \_\_\_\_\_ [1]

(ii)  $6x + 1 = 11 + 4x$

.....  
 .....

(ii) \_\_\_\_\_ [3]

(iii)  $\frac{x}{6} + 2 = 9$

.....  
 .....

(iii) \_\_\_\_\_ [2]

(c) Rearrange the following to make  $x$  the subject.

$y = 6x - 7$

.....  
 .....

(c) \_\_\_\_\_ [2]

- 4 15 women each changed a car wheel.  
These are the times taken, in minutes.

22	15	13	17	22
8	16	21	7	10
12	33	9	18	22

- (a) Draw an ordered stem and leaf diagram to show these times.

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.....	
.....	
.....	
.....	
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.....	

Key: [3]

- (b) Work out the median and range of these times.

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.....

(b) Median = \_\_\_\_\_ minutes

Range = \_\_\_\_\_ minutes [2]

15 men each changed a car wheel.  
The median time taken by these men was 16 minutes.  
The range of their times was 33 minutes.

- (c) Write down one comparison between the times taken by these men and women.

\_\_\_\_\_

\_\_\_\_\_ [1]

- 5 (a) The  $n$ th term of a sequence is  $n^2 + 2$ .

Write down the first three terms of this sequence.

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(a) \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ [2]

- (b) Another sequence begins

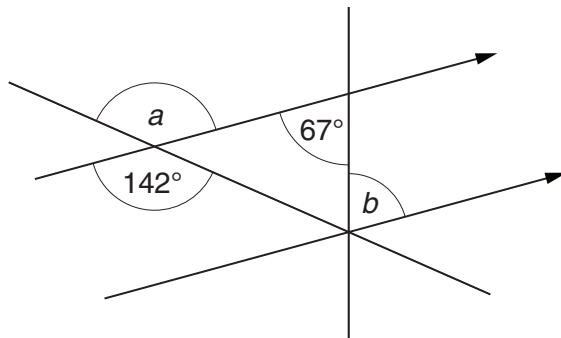
7, 11, 15, 19, .....

Write down the  $n$ th term of this sequence.

.....  
 .....

(b) \_\_\_\_\_ [2]

- 6 (a) Find the sizes of angle  $a$  and angle  $b$ .  
 Write down a reason for each answer.



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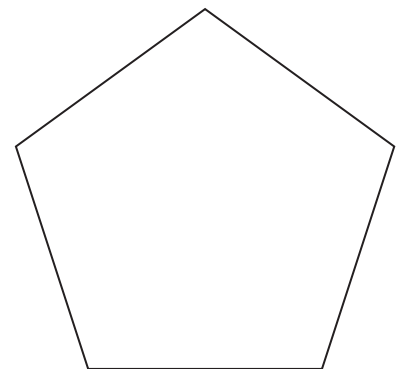
$a =$  \_\_\_\_\_  $^\circ$  Reason \_\_\_\_\_

$b =$  \_\_\_\_\_  $^\circ$  Reason \_\_\_\_\_ [4]

- (b) (i) The sum of the interior angles of a regular pentagon is  $540^\circ$ .

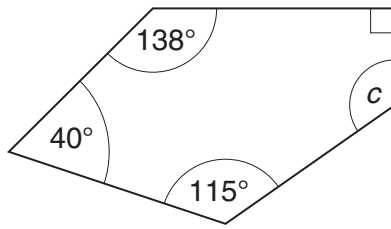
Without measuring any angles, explain why this is true.

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[3]

- (ii) This is an irregular pentagon.



NOT TO SCALE

Work out angle  $c$ .

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(b)(ii) \_\_\_\_\_  $^\circ$  [2]

- (iii) The area of another pentagon is  $4.5 \text{ cm}^2$ .

Change  $4.5 \text{ cm}^2$  into  $\text{mm}^2$ .

.....  
 .....

(iii) \_\_\_\_\_  $\text{mm}^2$  [2]

- (c) In the following expressions, the letters  $f$ ,  $g$ , and  $h$  represent lengths.

$$fgh$$

$$f^2(g + h)$$

$$2f(g + h)$$

Which one of these expressions could represent an area?

(c) \_\_\_\_\_ [1]

7 (a)  $5x^3 = 40$ .

Work out the value of  $x$ .

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.....

(a) \_\_\_\_\_ [2]

(b) Write 52 as a product of prime factors.

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(b) \_\_\_\_\_ [2]

(c) What is the LCM (least common multiple) of 27 and 33?

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(c) \_\_\_\_\_ [2]

(d) What is the HCF (highest common factor) of 96 and 144?

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(d) \_\_\_\_\_ [2]

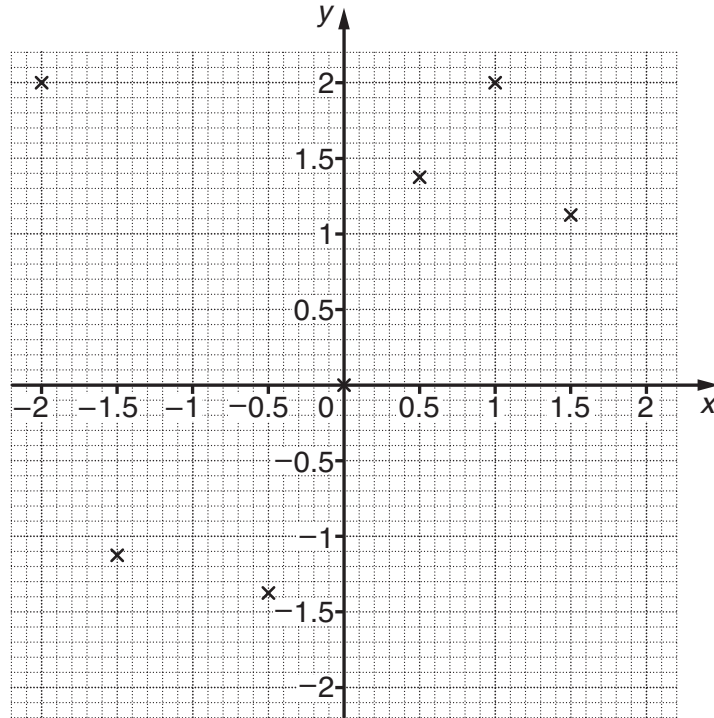


8 (a) Complete this table for  $y = 3x - x^3$ .

x	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
y	2	-1.125		-1.375	0	1.375	2	1.125	

[2]

(b) Complete the graph of  $y = 3x - x^3$  for  $-2 \leq x \leq 2$ .



[2]

(c) Use your graph to estimate the values of  $x$  when  $y = 1$ .

(c) \_\_\_\_\_ [2]

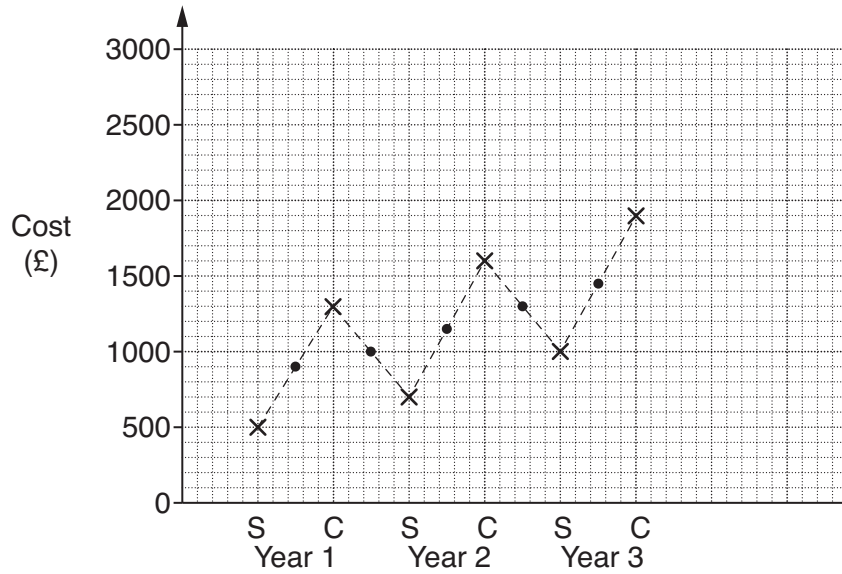
(d) Sam wants to use this graph to solve  $2x - x^3 = 0$ .

Find the equation of the line she should draw on the graph.

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(d) \_\_\_\_\_ [2]

- 9 Barney kept a record of the cost, in £, of his office Summer parties (S) and Christmas parties (C). The graph shows these costs (x) and the 2-point moving averages (•) for three years.



- (a) Explain why Barney used 2-point moving averages.

\_\_\_\_\_ [1]

- (b) Show how the first moving average has been calculated.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ [2]

- (c) The moving average calculated from the Year 3 Christmas and Year 4 Summer parties is £1420.

Calculate the cost of the Year 4 Summer party.

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(c) £ \_\_\_\_\_ [2]

- (d) 89 women and 31 men work for Barney.  
He wishes to take a representative sample, stratified by gender, of his staff.  
He decides on a sample of size 20.

How many women should Barney include in the sample?

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(d) \_\_\_\_\_ [2]

- 10 Evan invested £50 in a savings account for 4 years at 6% compound interest per year.

He wants to use this formula to work out the amount, in £, in the savings account at the end of the 4 years.

$$\text{Amount} = 50 \times c^d$$

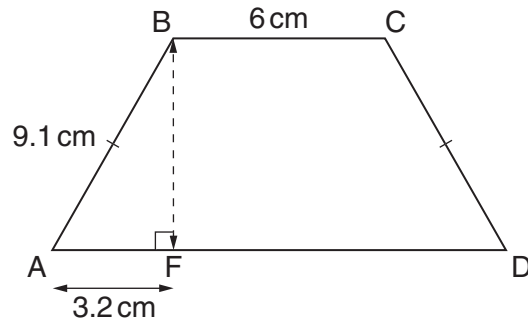
What values should he use for  $c$  and  $d$ ?

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$c =$  \_\_\_\_\_  $d =$  \_\_\_\_\_ [3]

- 11 (a) ABCD is an isosceles trapezium.  
BF is perpendicular to AD.



NOT TO SCALE

- (i) Calculate BF.

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(a)(i) \_\_\_\_\_ cm [3]

- (ii) Calculate the area of ABCD.

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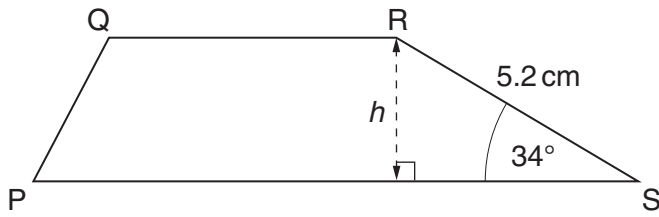
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(ii) \_\_\_\_\_ cm<sup>2</sup> [3]

(b) PQRS is a trapezium.



NOT TO SCALE

Calculate  $h$ .

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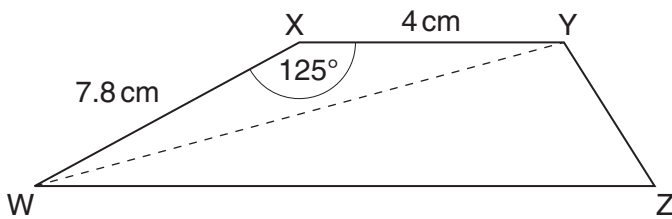
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(b) \_\_\_\_\_ cm [3]

(c) WXYZ is a trapezium.



NOT TO SCALE

Calculate WY.

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(c) \_\_\_\_\_ cm [3]

12 Simplify.

(a)  $t^2 \times t^7$

(a) \_\_\_\_\_ [1]

(b)  $\frac{s^3}{s^6}$

(b) \_\_\_\_\_ [1]

(c)  $s^3t^3 \times s^4t^2$

.....

(c) \_\_\_\_\_ [2]

(d)  $(s^3t)^4$

.....

(d) \_\_\_\_\_ [2]

13  $y$  is proportional to the square of  $x$ .  
 $y = 18$  when  $x = 6$ .

(a) Find an equation connecting  $y$  and  $x$ .

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(a) \_\_\_\_\_ [3]

(b) Find the values of  $x$  when  $y = 5$ .

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.....

(b) \_\_\_\_\_ [2]

- 14 A toy car travels 180 cm, correct to the nearest 10 cm.  
It takes 7 seconds, correct to the nearest second, to travel this distance.

Work out the greatest possible value of the average speed of the toy car.  
You must show all your working.

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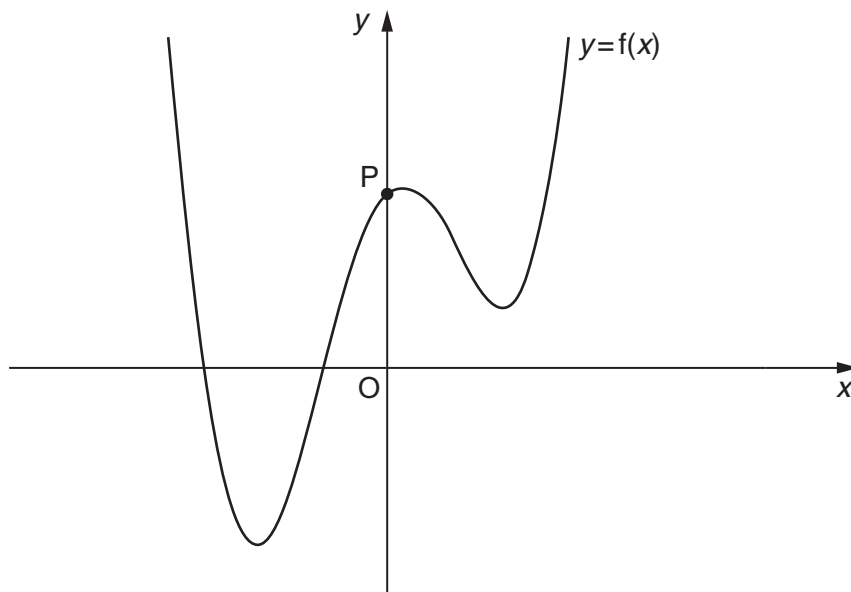
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\_\_\_\_\_ cm/s [4]

- 15 The diagram shows the graph of  $y = f(x)$ .



The graph passes through the point P (0, 2).

Write down the coordinates of the image of P when  $y = f(x)$  is transformed to

(a)  $y = f(x) - 3$ ,

(a) ( \_\_\_\_\_ , \_\_\_\_\_ ) [1]

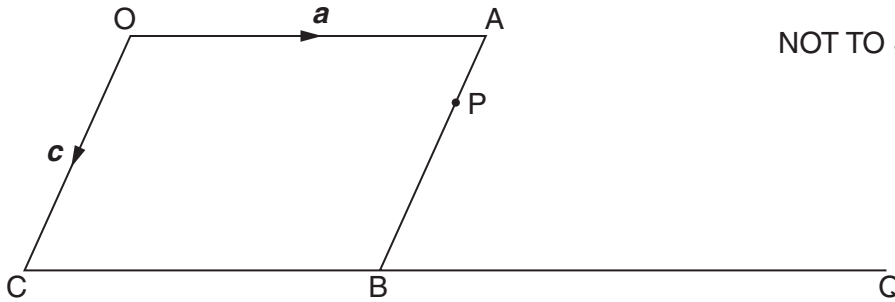
(b)  $y = f(x - 3)$ .

(b) ( \_\_\_\_\_ , \_\_\_\_\_ ) [1]

Turn over

16 OABC is a parallelogram.

$$\vec{OA} = \mathbf{a} \quad \vec{OC} = \mathbf{c}$$



NOT TO SCALE

P is the point on AB such that  $\vec{AP} = \frac{1}{4} \vec{AB}$ .

CBQ is a straight line such that  $CB : BQ = 1 : 3$ .

(a) Write down, in terms of  $\mathbf{a}$  and  $\mathbf{c}$ , the vectors

(i)  $\vec{AP}$ ,

(a)(i) \_\_\_\_\_ [1]

(ii)  $\vec{OP}$ ,

(ii) \_\_\_\_\_ [1]

(iii)  $\vec{BQ}$ ,

(iii) \_\_\_\_\_ [1]

(iv)  $\vec{OQ}$ .

(iv) \_\_\_\_\_ [1]

(b) Explain, using vectors, why O, P and Q lie on a straight line.

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(b) \_\_\_\_\_ [1]