

**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)

**Friday 15 January 2010  
Morning**

**Duration: 2 hours**



|                    |  |                   |  |
|--------------------|--|-------------------|--|
| Candidate Forename |  | Candidate Surname |  |
|--------------------|--|-------------------|--|

|               |  |  |  |  |  |                  |  |  |  |  |
|---------------|--|--|--|--|--|------------------|--|--|--|--|
| Centre Number |  |  |  |  |  | Candidate Number |  |  |  |  |
|---------------|--|--|--|--|--|------------------|--|--|--|--|

**INSTRUCTIONS TO CANDIDATES**

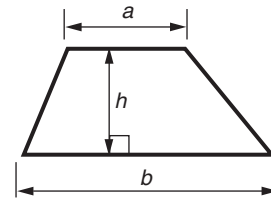
- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Show your working. 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**

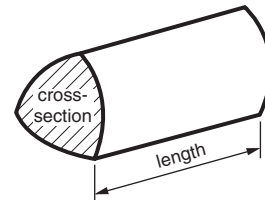
- The number of marks is given in brackets [ ] at the end of each question or part question.
- You are expected to use an electronic calculator for this paper.
- Use the  $\pi$  button on your calculator or take  $\pi$  to be 3.142 unless the question says otherwise.
- The total number of marks for this paper is **100**.
- This document consists of **20** pages. Any blank pages are indicated.

## Formulae Sheet: Higher Tier

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



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

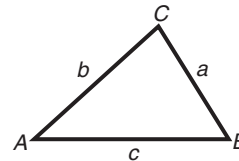


**In any triangle ABC**

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

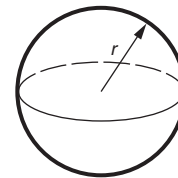
**Cosine rule**  $a^2 = b^2 + c^2 - 2bc \cos A$

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



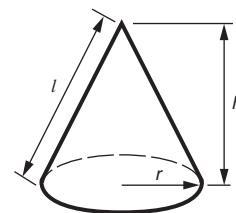
**Volume of sphere**  $= \frac{4}{3} \pi r^3$

**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

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

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1 Calculate.

(a)  $\frac{7.8 - 3.1}{1.2 + 6.9}$

.....  
 .....

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

(b)  $\sqrt{2.56^2 - 1.4^2}$

.....  
 .....

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

2 Jayne uses these ingredients to make play dough.

| Play dough for 2 children |                    |
|---------------------------|--------------------|
| Plain flour               | 225 g              |
| Oil                       | 2 tablespoons      |
| Water                     | $\frac{3}{4}$ pint |
| Salt                      | 140 g              |

(a) Jayne wants to make enough play dough for 10 children.

Work out the amount of water Jayne will need.

.....  
 .....

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

(b) Jayne has lots of oil and water, but only a 1.5 kg bag of plain flour and a 1 kg bag of salt.

What is the maximum number of children Jayne can make play dough for?  
 You must show your working.

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

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

- 3 (a) One question on the 2001 Census form was:

'How many cars are available for use by one or more members of your household?'

There was space on the form to write down who lived at that household. Jenna collects information about the number of people and the number of cars at each household from a sample of 100 Census forms.

In this sample there were no households where more than 5 people lived and none had more than 3 cars.

- (i) Design a two-way table for Jenna to use. [3]

- (ii) In Jenna's sample there are 14 households with 3 people and 2 cars.

Show this data in your table in part (a)(i). [1]

- (b) Jenna uses this question in a survey.

'How many bicycles are there in your household?'

None                       1 – 2                       More than 3

What mistake has Jenna made?

\_\_\_\_\_

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

4 (a) A parallelogram has angles as shown.



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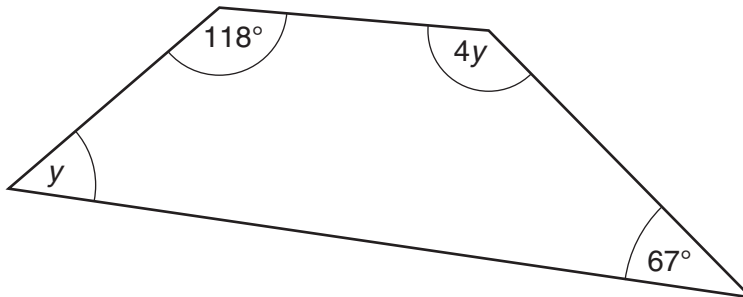
Work out angle  $x$ .  
Give a reason for your answer.

.....

$x =$  \_\_\_\_\_  $^{\circ}$  because \_\_\_\_\_

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

(b) A quadrilateral has angles as shown.



NOT TO SCALE

Work out angle  $y$ .

.....

.....

.....

.....

(b) \_\_\_\_\_  $^{\circ}$  [4]

- 5 Gary's dogs eat 6 tins of dog food between them each day.  
The tins are sold in boxes of 44.  
Gary normally buys one box of 44 tins for each week.

Explain, showing your calculations, why Gary does not have to buy a box for the 22nd week.

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[3]

- 6 (a) The  $n$ th term of a sequence is given by  $n^2 - 2$ .

Work out the first three terms of this sequence.

.....

.....

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

- (b) In another sequence of three numbers, the difference between each number and the next is 4.  
The total of the three numbers is 6.

What are the three numbers?

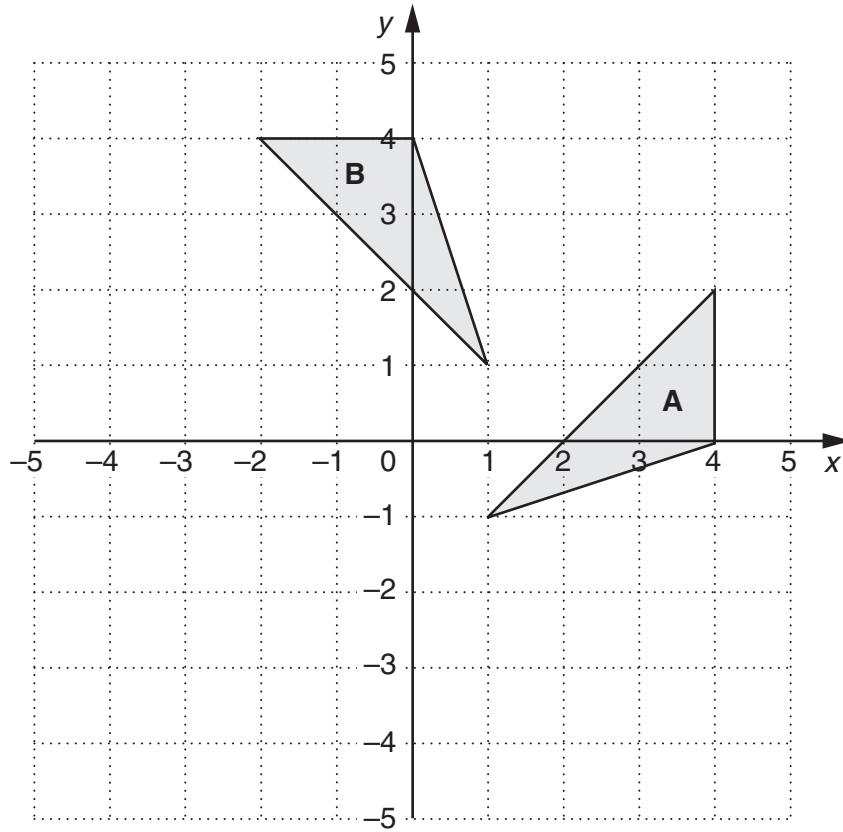
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(b) \_\_\_\_\_ [2]



- (a) Describe fully the **single** transformation that maps triangle **A** onto triangle **B**.

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[3]

- (b) Draw the reflection of triangle **A** in the  $x$ -axis.

[2]

- 8 Tom made an electronic dice which gave scores of 1, 2, 3, 4, 5 or 6. This table summarises 100 scores.

| Score | Frequency |
|-------|-----------|
| 1     | 17        |
| 2     | 19        |
| 3     | 15        |
| 4     | 17        |
| 5     | 18        |
| 6     | 14        |

- (a) Work out the mean score.

.....

.....

.....

.....

.....

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

- (b) Is the dice biased?  
Give a reason for your answer.

\_\_\_\_\_

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



9 Simplify.

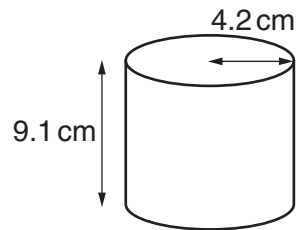
(a)  $d^7 \times d^4$

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

(b)  $\frac{d^9}{d^3}$

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

10 A cylindrical tin has radius 4.2 cm and height 9.1 cm.



Work out the curved surface area of the tin.  
 Give your answer to an appropriate degree of accuracy.

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

\_\_\_\_\_ cm<sup>2</sup> [4]

- 11 (a) Work out the integer values of  $n$  that satisfy this inequality.

$$7 < 4n \leq 20$$

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.....

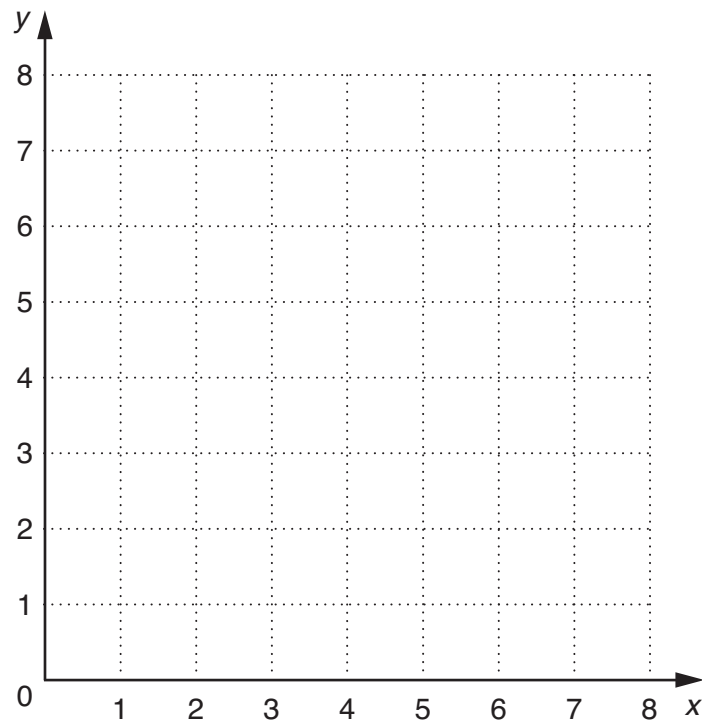
(a) \_\_\_\_\_ [3]

- (b) On the grid, indicate clearly the region that satisfies all these inequalities.

$$x \geq 2$$

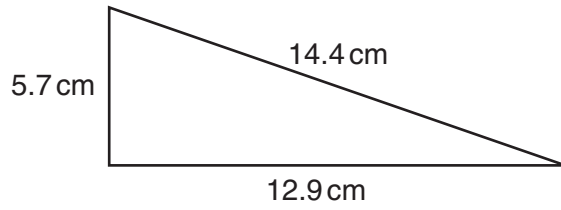
$$y \geq 3$$

$$x + y \leq 7$$



[3]

12



NOT TO SCALE

Is a triangle with these lengths right-angled?  
Explain your answer using calculations.

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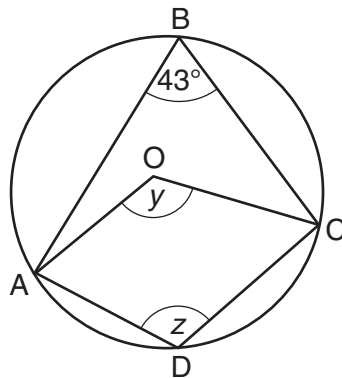
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[3]

13 The points A, B, C and D lie on the circumference of a circle, centre O.



NOT TO SCALE

Find the size of angle  $y$  and angle  $z$ .  
Give a reason for each answer.

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$y =$  \_\_\_\_\_  $^\circ$  because \_\_\_\_\_

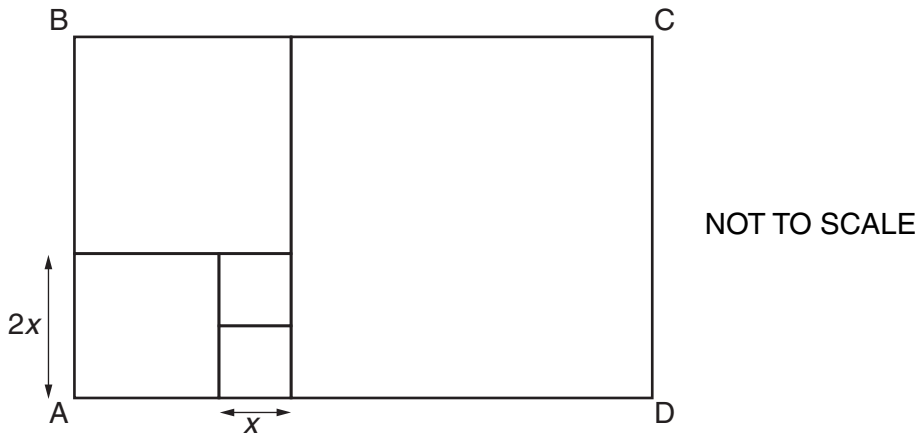
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$z =$  \_\_\_\_\_  $^\circ$  because \_\_\_\_\_

---

[4]

14 Rectangle ABCD is made from five squares.



The area of rectangle ABCD is  $810\text{ cm}^2$ .

Work out the value of  $x$ .  
Show all your working.

.....

.....

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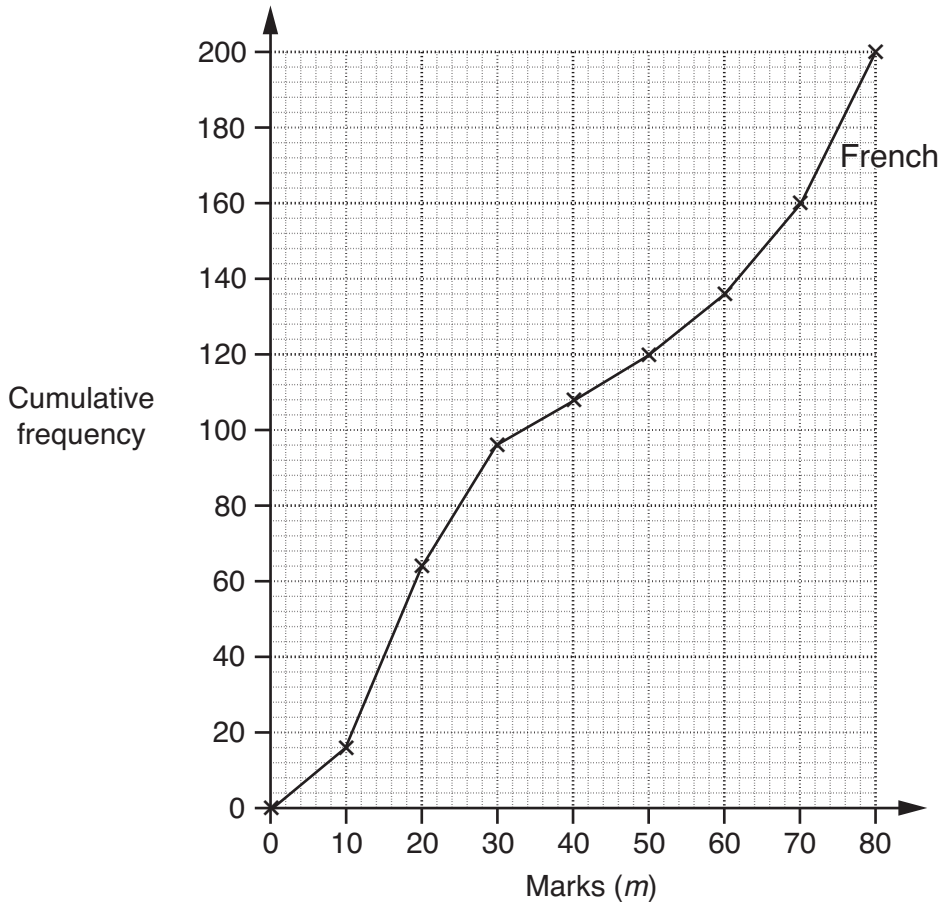
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\_\_\_\_\_ cm [5]

- 15 The cumulative frequency graph summarises the marks obtained in a French exam by 200 students.



The table gives the cumulative frequencies of marks obtained in a German exam by 120 students.

| Marks ( $m$ )        | $m \leq 10$ | $m \leq 20$ | $m \leq 30$ | $m \leq 40$ | $m \leq 50$ | $m \leq 60$ | $m \leq 70$ | $m \leq 80$ |
|----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Cumulative frequency | 4           | 20          | 36          | 60          | 84          | 104         | 112         | 120         |

- (a) On the grid, draw a cumulative frequency graph to summarise the marks obtained by the students in the German exam. [3]

- (b) In which exam, French or German, was the median mark higher, and by how much?

.....

.....

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

16 (a) Factorise.

(i)  $x^2 - 8x$

.....

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

(ii)  $6x^3 + 10xy^3$

.....

.....

(ii) \_\_\_\_\_ [2]

(iii)  $4x^2 - y^2$

.....

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

(b) Simplify.

$$\frac{x^2 + 3x}{3x^2}$$

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.....

.....

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

17 (a) Write 91 000 000 in standard form.

.....

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

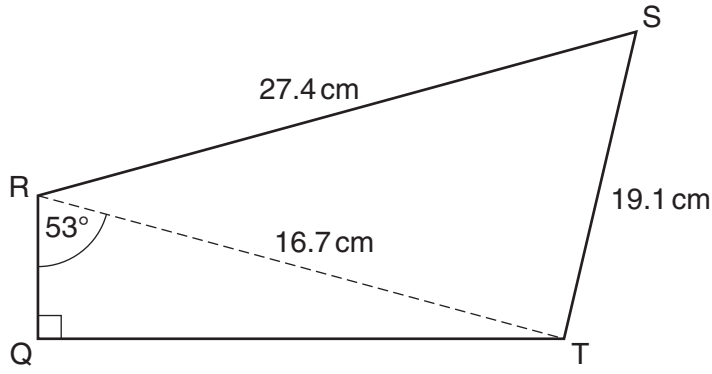
(b) A picometre is  $10^{-12}$  m.  
A nanometre is  $10^{-9}$  m.

How many picometres are there in a nanometre?

.....

.....

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



NOT TO SCALE

(a) Calculate length QT.

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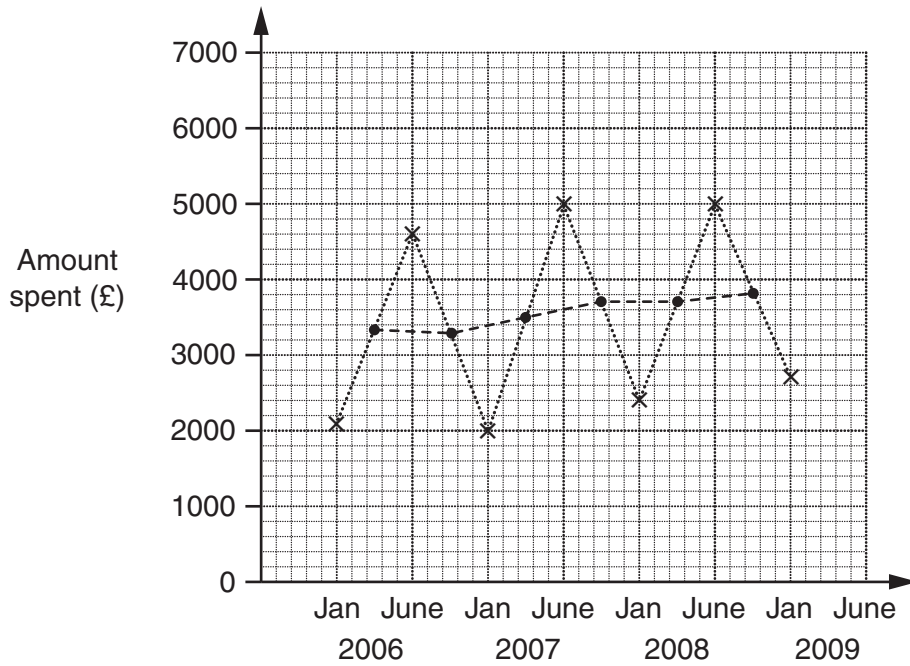
(a) \_\_\_\_\_ cm [3]

(b) Calculate angle RST.

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.....  
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(b) \_\_\_\_\_ ° [3]

- 19 The time series graph shows the amounts spent by a school on exams in January and in June each year. The two-point moving averages (●) are also shown.



- (a) Give a reason why it is appropriate to use a two-point moving average.

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[1]

- (b) Predict the next moving average and use this to work out an estimate of the amount spent on exams by the school in June 2009.

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(b) £ \_\_\_\_\_ [3]



**20** Use trial and improvement to solve  $7^x = 27$ .  
Give your answer correct to 2 decimal places.  
Show all your trials and their outcomes.

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\_\_\_\_\_ **[4]**

**21 (a)** Express  $\sqrt{45}$  in the form  $a\sqrt{b}$ , where  $a$  and  $b$  are integers and  $b$  is as small as possible.

.....

.....

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

**(b)** Rationalise the denominator of  $\frac{9}{\sqrt{6}}$ .  
Give your answer in its simplest form.

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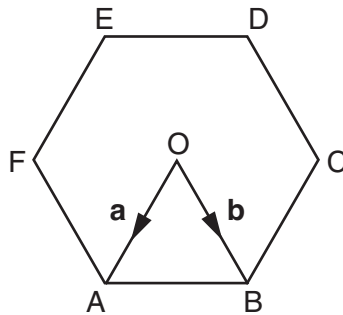
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**(b)** \_\_\_\_\_ **[2]**

22 ABCDEF is a regular hexagon, centre O.

$\vec{OA} = \mathbf{a}$ .       $\vec{OB} = \mathbf{b}$ .



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

(i)  $\vec{CB}$ ,

.....

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

(ii)  $\vec{DB}$ .

.....

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

(b) X lies on DB such that  $DX : XB = 1 : 2$ .

Find  $\vec{OX}$ , in terms of **a** and **b**.  
Give your answer in a simplified form.

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

23 (a) Explain why  $(x - y)^2 \geq 0$ .

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[2]

(b) Hence, show that  $x^2 + y^2 \geq 2xy$ .

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[1]

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