

Surname					Other Names				
Centre Number					Candidate Number				
Candidate Signature									

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General Certificate of Secondary Education
November 2004



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

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Tuesday 9 November 2004 9.00 am to 11.00 am

<p>In addition to this paper you will require:</p> <ul style="list-style-type: none"> • a calculator • mathematical instruments. 	
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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	
22 – 23	
TOTAL	
Examiner's Initials	

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 in the spaces provided.
- Do all rough work in this booklet.
- If your calculator does not have a π button, take the value of π to be 3.14 unless otherwise instructed in the question.

Information

- The maximum mark for this paper is 100.
- Mark allocations are shown in brackets.
- Additional answer paper, graph paper and tracing paper will be issued on request and must be tagged securely to this answer booklet.
- You are expected to use a calculator where appropriate.

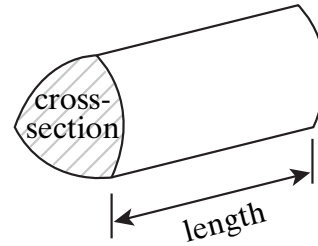
Advice

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

Formulae Sheet: Higher Tier

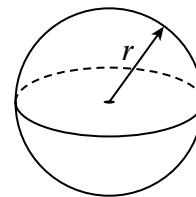
You may need to use the following formulae:

Volume of prism = area of cross-section \times length



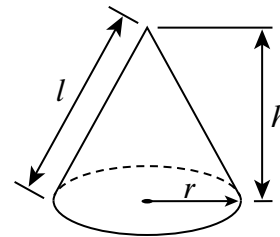
Volume of sphere = $\frac{4}{3} \pi r^3$

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



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

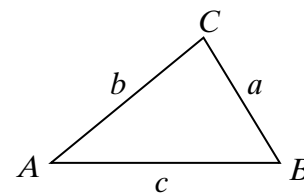
Curved surface area of cone = $\pi r l$



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

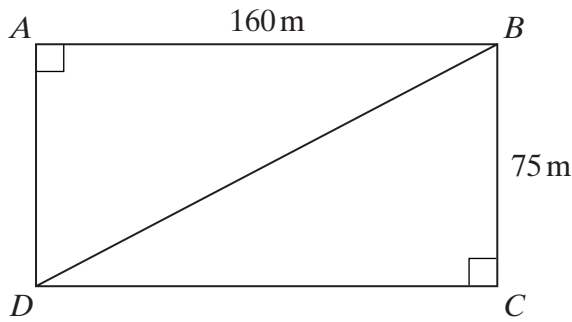
The Quadratic Equation

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 A rectangular field $ABCD$ is shown.
The length of the field, $AB = 160$ m.
The width of the field, $BC = 75$ m.



Not to scale

Calculate the length of the diagonal BD .

Give your answer to a suitable degree of accuracy.

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Answer m (4 marks)

- 2 A cylinder has a radius of 5 cm and a volume of 250 cm^3 .
Calculate the height of the cylinder.

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Answer cm (3 marks)



Turn over

- 3 In year 9 there are 30 students who study both French and Spanish.
Their National Curriculum levels in these subjects are shown in the two-way table.

		Level in Spanish					
		1	2	3	4	5	6
Level in French	1	0	0	0	0	0	0
	2	1	0	0	0	0	0
	3	2	1	1	0	0	0
	4	0	3	4	1	0	0
	5	0	1	2	3	2	0
	6	0	0	3	3	2	1

- (a) What is the modal level for French?

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Answer (1 mark)

- (b) What is the median level for French?
Show clearly how you obtained your answer.

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Answer (2 marks)

- (c) What is the mean level for Spanish?
Show clearly how you obtained your answer.

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Answer (3 marks)

- (d) The teacher claims that the students are better at French than at Spanish.
How can you tell from the table that this is true?

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(1 mark)

TURN OVER FOR THE NEXT QUESTION



Turn over ▶

4 Solve the equations

(a) $\frac{20}{x} = 4$

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Answer $x =$ (2 marks)

(b) $\frac{y}{3} + 5 = 9$

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Answer $y =$ (2 marks)5 P is a prime number. Q is an odd number.

State whether each of the following is always odd or always even or could be either odd or even.

Tick the appropriate box.

(a) $P(Q + 1)$

.....

Always odd

Always even

Could be either
odd or even

(1 mark)

(b) $Q - P$

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Always odd

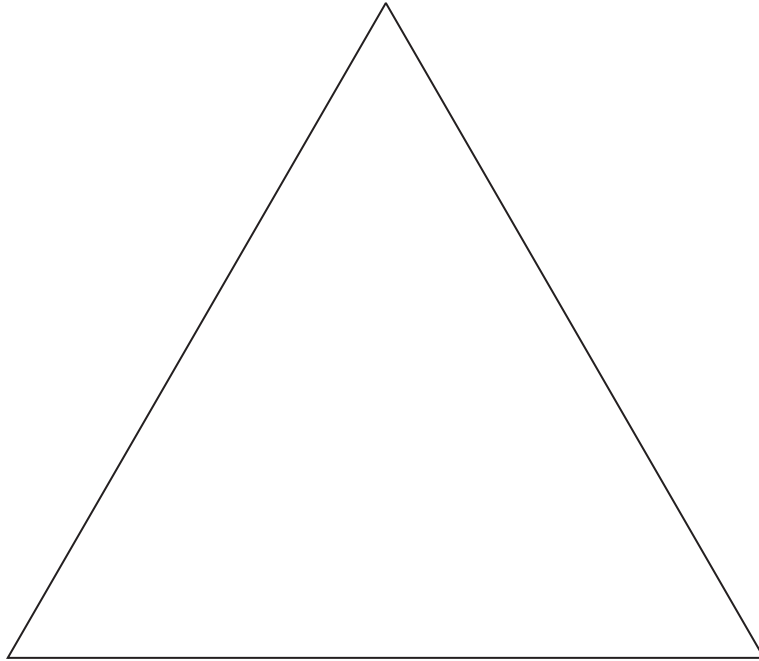
Always even

Could be either
odd or even

(1 mark)

6 In this question, you should use a ruler and compasses.

The diagram shows an equilateral triangle of side 10 cm.



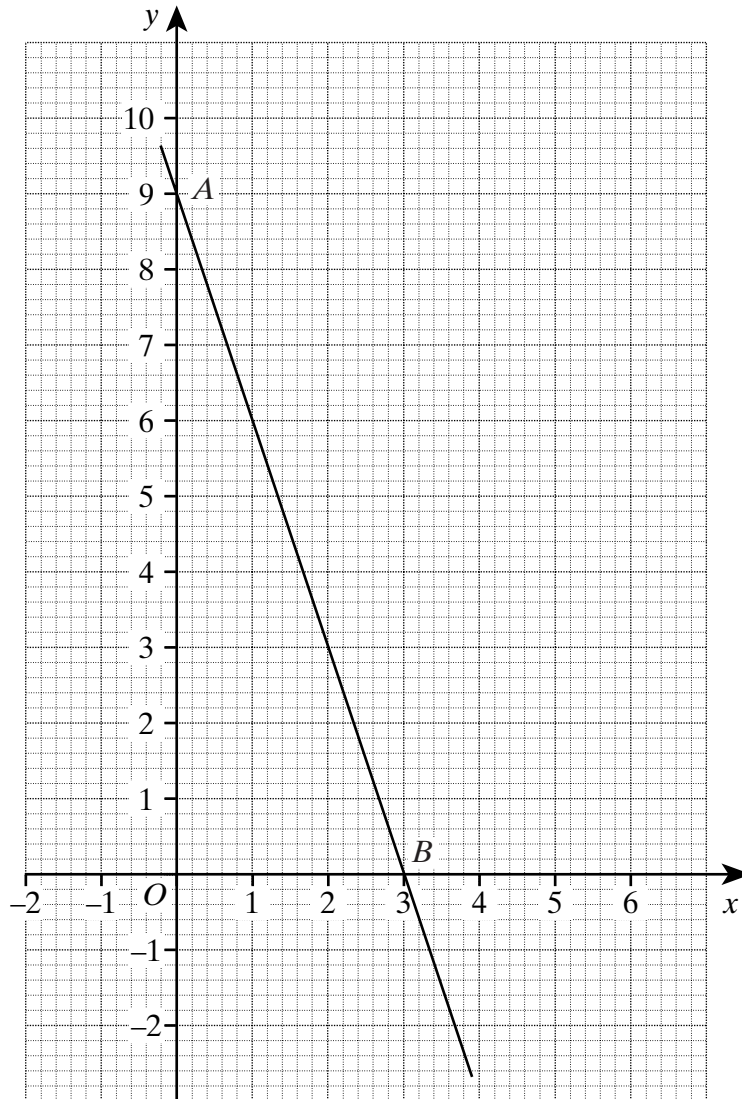
Show on the diagram all the points inside the triangle that are more than 5 cm from each vertex of the triangle.

You **must** show clearly all your construction arcs.

(3 marks)

Turn over ►

7 (a) Find the equation of the line AB .



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Answer (3 marks)

(b) Give the y -coordinate of the point on the line with an x -coordinate of 6.

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Answer (2 marks)

(c) Write down the gradient of a line perpendicular to AB .

Answer (1 mark)

- 8 The Earth is approximately a sphere of radius 6400 km.
The surface area of a sphere is given by the formula $A = 4\pi r^2$.
Calculate the approximate surface area of the Earth.
Give your answer in standard form.

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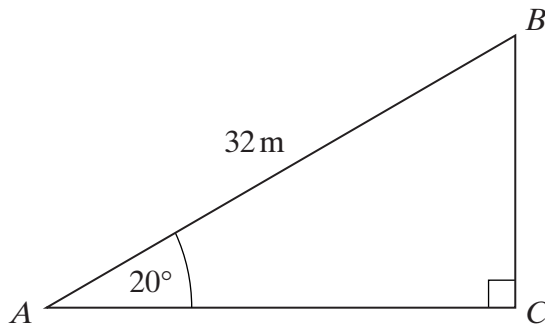
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Answer km² (3 marks)

- 9 The diagram shows a triangle ABC .
Angle $A = 20^\circ$ and angle $C = 90^\circ$
 $AB = 32$ m



Not drawn accurately

Calculate the height BC .

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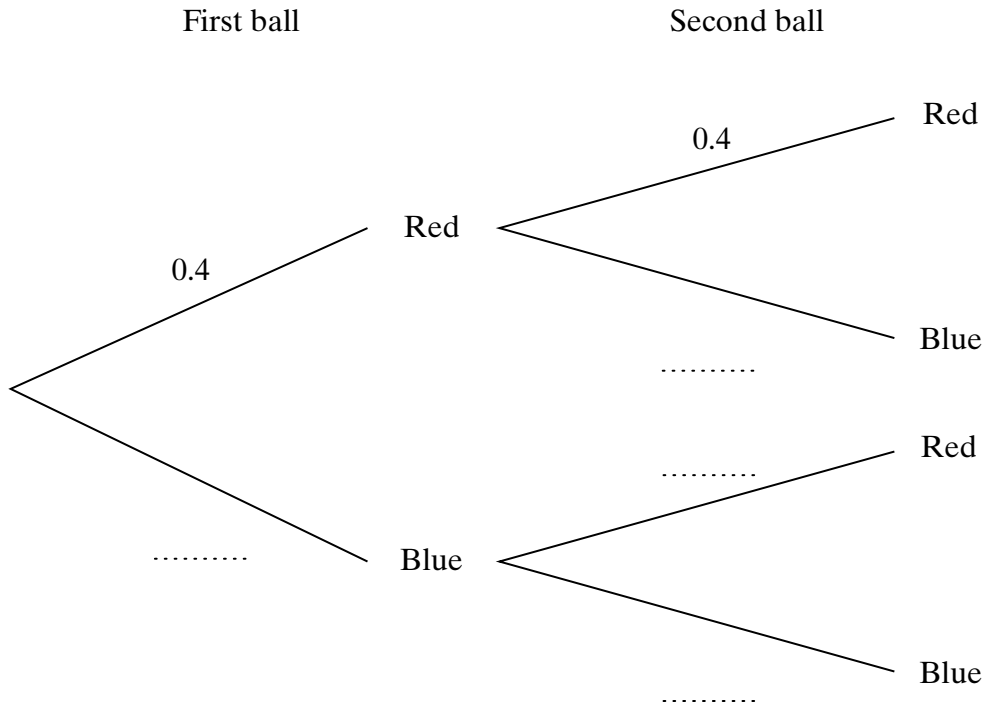
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Answer m (3 marks)

- 10** A bag contains 4 red balls and 6 blue balls.
A ball is taken from the bag at random and replaced.
Another ball is then taken from the bag at random.

(a) Complete the tree diagram.



(1 mark)

- (b) What is the probability that both balls are the same colour?

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Answer (3 marks)

11 On the grid below, indicate clearly the region defined by the three inequalities

$$y \leq 4$$

$$x \geq -3$$

$$y \geq x + 2$$

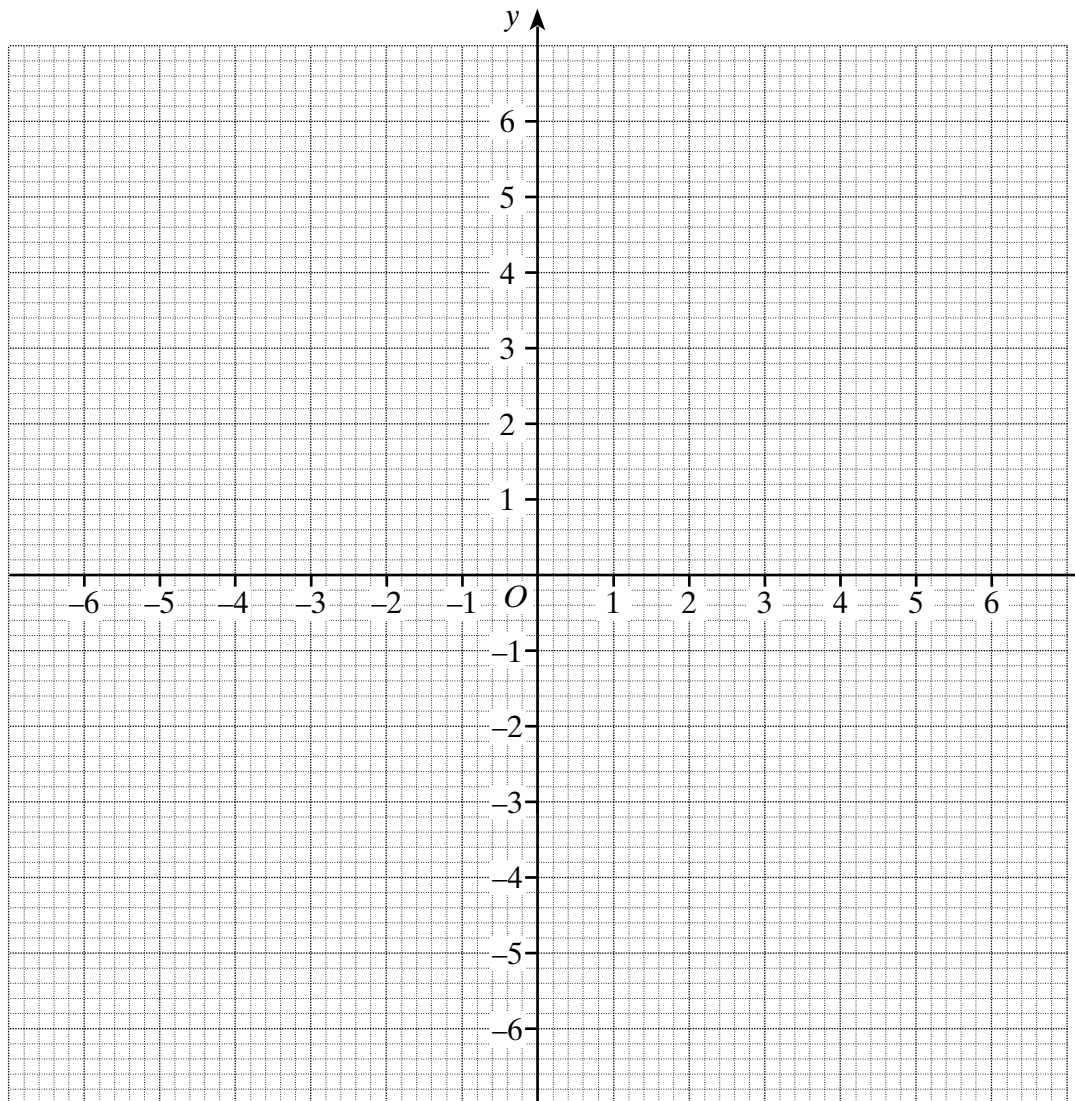
Mark the region with an *R*.

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(3 marks)

Turn over ►

- 12** (a) During 2003 the average wage earned by some factory workers in Barnsley rose from £350 to £372.
What was the percentage increase?

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Answer % (3 marks)

- (b) During 2003 the number of people out of work in Barnsley fell by 8%.
At the end of the year there were 2576 people out of work in Barnsley.
How many people were out of work at the beginning of the year?

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Answer (3 marks)

13 (a) Make c the subject of the formula

$$E = mc^2$$

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Answer (2 marks)

(b) Make m the subject of the formula

$$E = mgh + \frac{1}{2}mv^2$$

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Answer (2 marks)

14 Annie, Bert and Charu are investigating the number sequence

$$21, 40, 65, 96, 133, \dots$$

(a) Annie has found the following pattern.

1st term	$1 \times 2 + 3^2 + 2 \times 5 = 21$
2nd term	$2 \times 3 + 4^2 + 3 \times 6 = 40$
3rd term	$3 \times 4 + 5^2 + 4 \times 7 = 65$
4th term	$4 \times 5 + 6^2 + 5 \times 8 = 96$
5th term	$5 \times 6 + 7^2 + 6 \times 9 = 133$

Complete the n th term for Annie's pattern.

n th term $n \times (n + 1) + \dots + \dots \times \dots$
(2 marks)

(b) Bert has found this formula for the n th term

$$(3n + 1)(n + 3) + 5$$

Charu has found this formula for the n th term

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

Prove that these two formulae are equivalent.

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(3 marks)

15 Find values of a and b such that

$$(2 + \sqrt{3})(4 - \sqrt{3}) = a + b\sqrt{3}$$

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Answer $a =$ $b =$ (2 marks)

16 Solve the equation

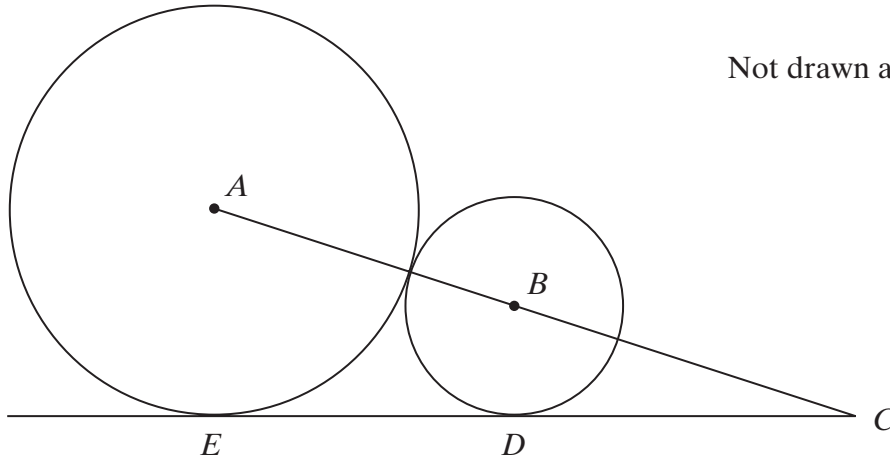
$$x^2 - 2x - 5 = 0$$

giving your answers to 3 significant figures.

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Answer (3 marks)

- 19 Two circles, centres A and B , with radii 4 cm and 1 cm touch each other.
 ABC is a straight line.
 EDC is a common tangent to the circles.



Not drawn accurately

Calculate the length AC .

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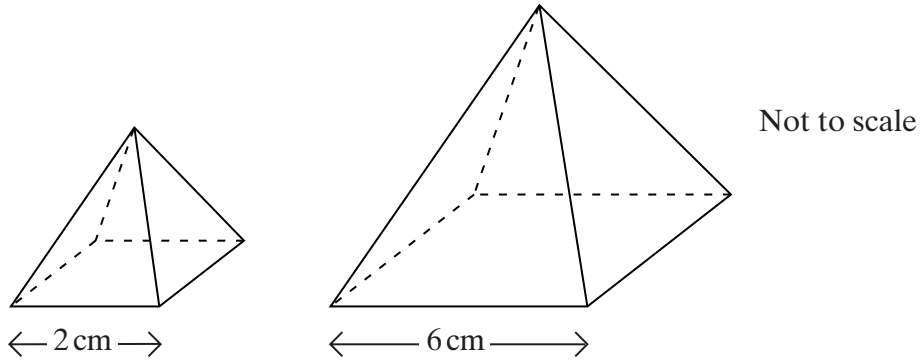
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Answer cm (4 marks)

- 20 A square-based pyramid with a base of side 2 cm has a volume of 2.75 cm^3 .



What is the volume of a similar square-based pyramid with a base of side 6 cm?

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Answer cm^3 (2 marks)

- 21 $a = 1.7$ measured to 2 significant figures.
 $b = 3.0$ measured to 2 significant figures.
 $c = 1.32$ measured to 3 significant figures.
 Calculate the upper limit of V .

$$V = ab - c^2$$

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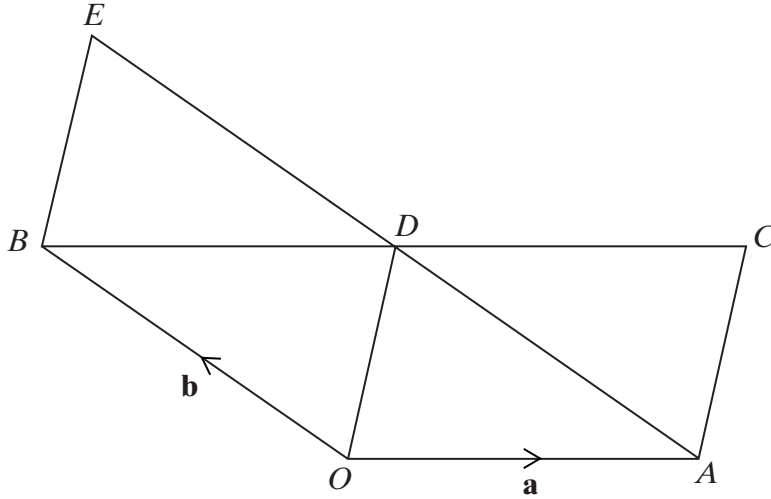
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Answer (5 marks)

22 In the diagram $OACD$, $OADB$ and $ODEB$ are parallelograms.

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



(a) Express, in terms of \mathbf{a} and \mathbf{b} , the following vectors.
Give your answers in their simplest form.

(i) \vec{OD}

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Answer (1 mark)

(ii) \vec{OC}

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Answer (1 mark)

(iii) \vec{AB}

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Answer (1 mark)

(b) The point F is such that $OCFE$ is a parallelogram.

Write the vector \vec{CF} in terms of \mathbf{a} and \mathbf{b} .

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Answer (2 marks)

(c) What geometrical relationship is there between the points O, D and F ?

Justify your answer.

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(2 marks)

23 Simplify fully

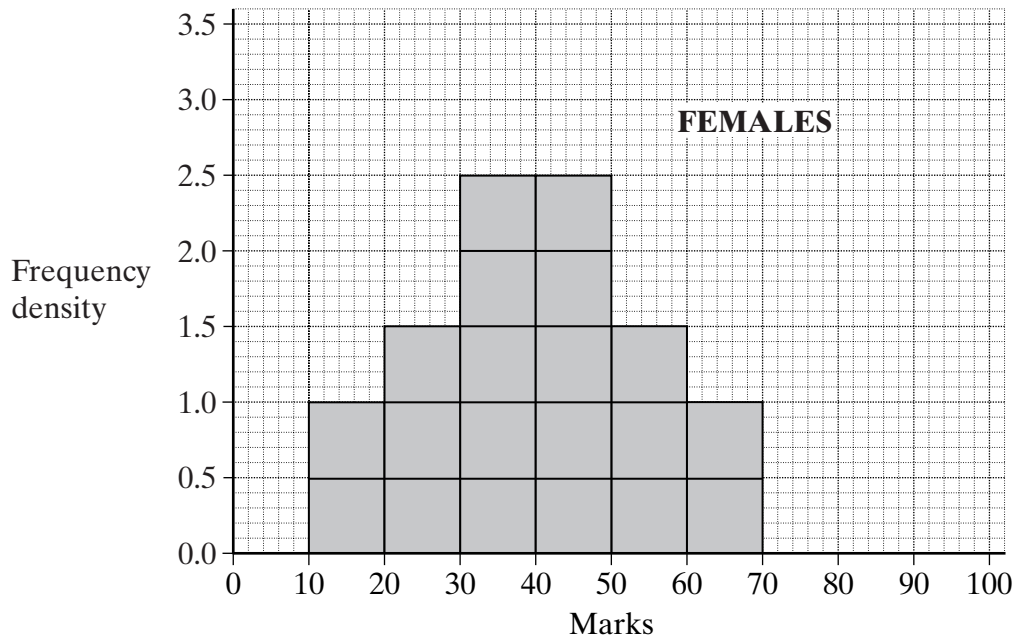
$$\frac{2x^2 + 5x - 3}{x^2 + 2x - 3}$$

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Answer (4 marks)

Turn over 

24 (a) This histogram shows the test scores of 100 female students.



(i) What is the median score?

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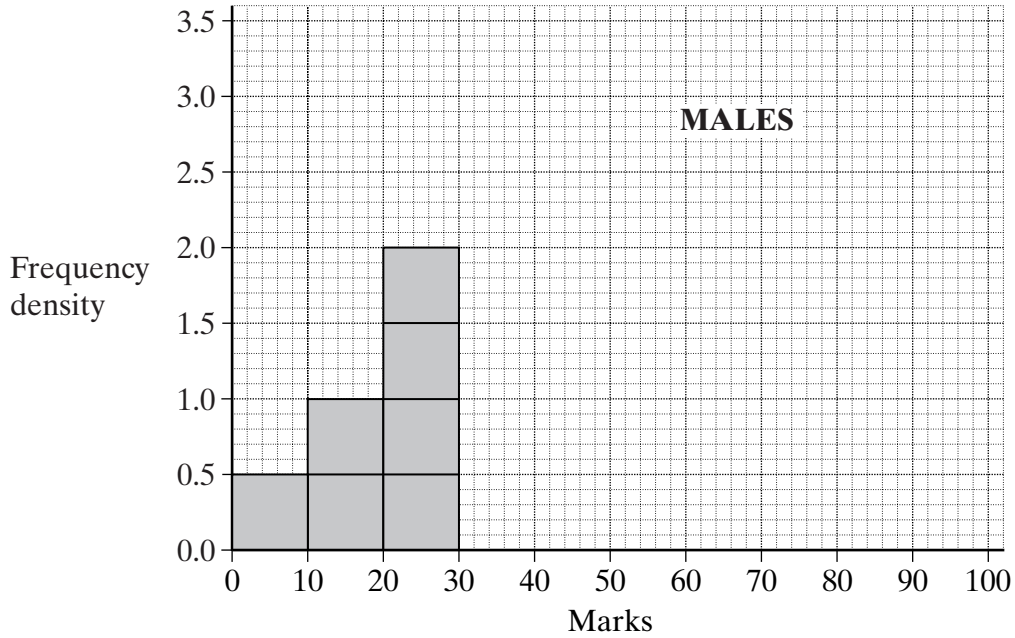
Answer (1 mark)

(ii) What is the interquartile range?

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Answer (1 mark)

- (b) This histogram is incomplete.
It shows some of the test scores for 100 male students.
The median test score for males is the same as for females.
The upper quartile for the males is 50.



- (i) What is the lower quartile for the male students?

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Answer (1 mark)

- (ii) Complete a possible histogram.

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(3 marks)

END OF QUESTIONS

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE