

GENERAL CERTIFICATE OF SECONDARY EDUCATION

MATHEMATICS A

Higher Paper 3

SPECIMEN

Candidates answer on the question paper.

Time: 2 hours

Additional Materials:

Geometrical instruments

Tracing paper (optional)

H J512/3



Candidate
Name

Centre
Number

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Candidate
Number

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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers on the dotted lines unless the question says otherwise.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- There is a space after most questions. Use it to do your working. In many questions marks will be given for a correct method even if the answer is incorrect.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- **WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.**

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is 100.

WARNING

You are not allowed to use a calculator in this paper.

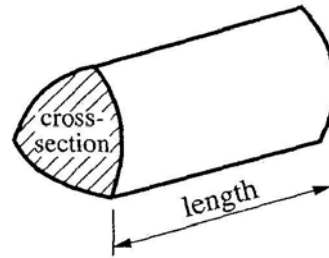
For Examiner's Use

Total	
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This document consists of **24** printed pages and **1** blank page.

FORMULAE SHEET

Volume of prism = (area of cross-section) x length

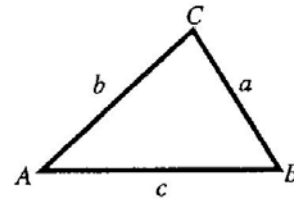


In any triangle ABC

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

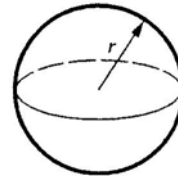
Cosine rule $a^2 = b^2 + c^2 - 2bc \cos A$

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



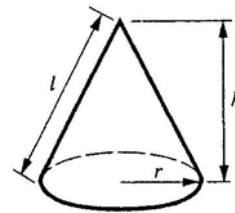
Volume of sphere = $\frac{4}{3} \pi r^3$

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



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

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

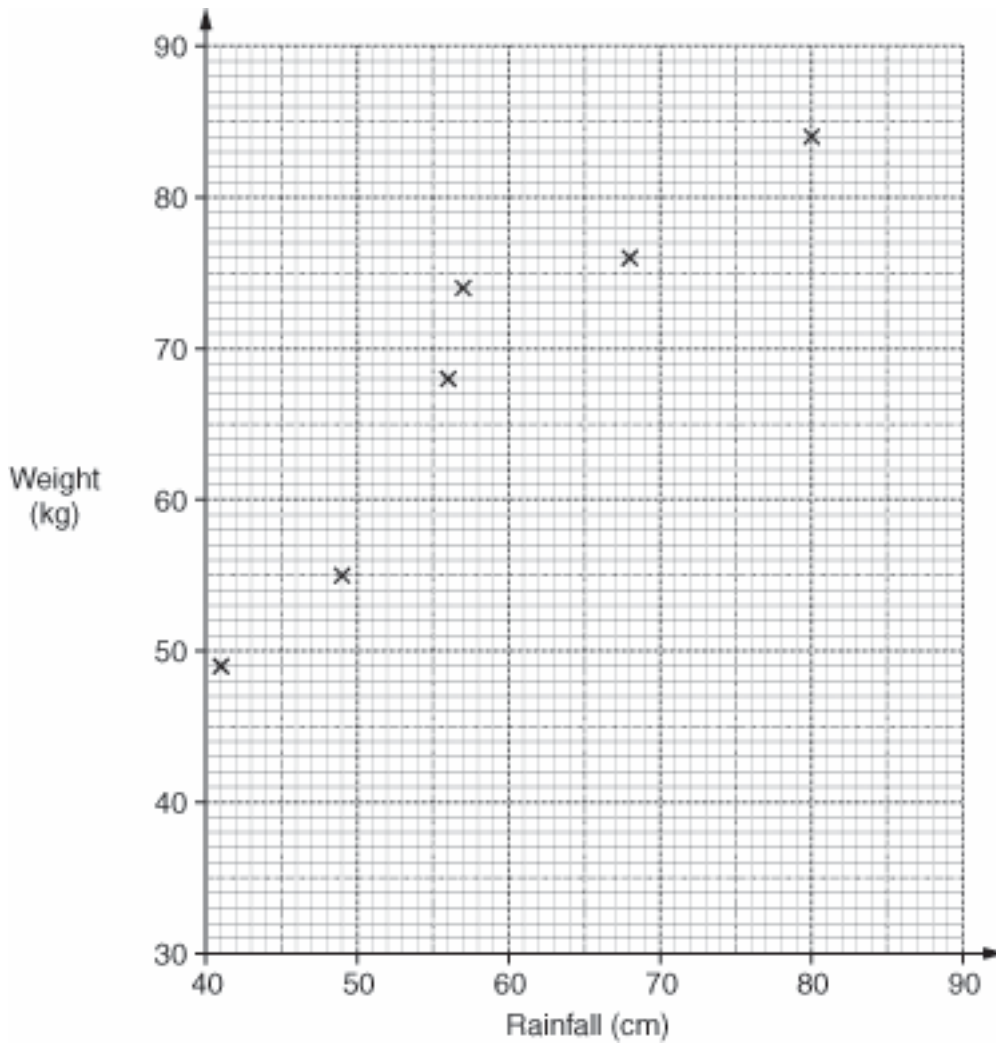


The Quadratic Equation

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 A gardener records the rainfall in the growing season and the weight of apples that his trees produce each year. The scatter diagram shows his results for six years.

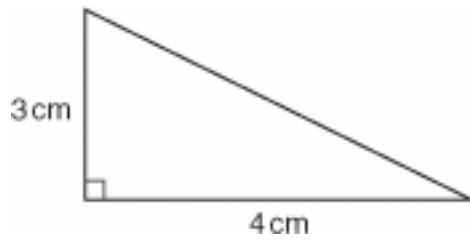


The information for two more years is given.

Rainfall (cm)	52	86
Weight of apples (kg)	60	88

- (a) Add this information to the diagram. [1]
- (b) (i) Draw a line of best fit on the diagram. [1]
- (ii) Describe the correlation. [1]
- (b)(ii) [1]
- (c) (i) In another year, 64 cm of rain fell in the growing season.
Estimate the weight of apples produced that year.
(c)(i)kg [1]
- (ii) Another year the trees produced 80 kg of apples.
Estimate the rainfall in that growing season.
(ii)cm [1]

- 2 (a) Calculate the area of this triangle.



NOT TO
SCALE

(a) cm^2 [1]

- (b) The triangle is the cross-section of a prism of length 10 cm.
Calculate the volume of the prism.
Give the units of your answer.

(b) [2]

3 Calculate.

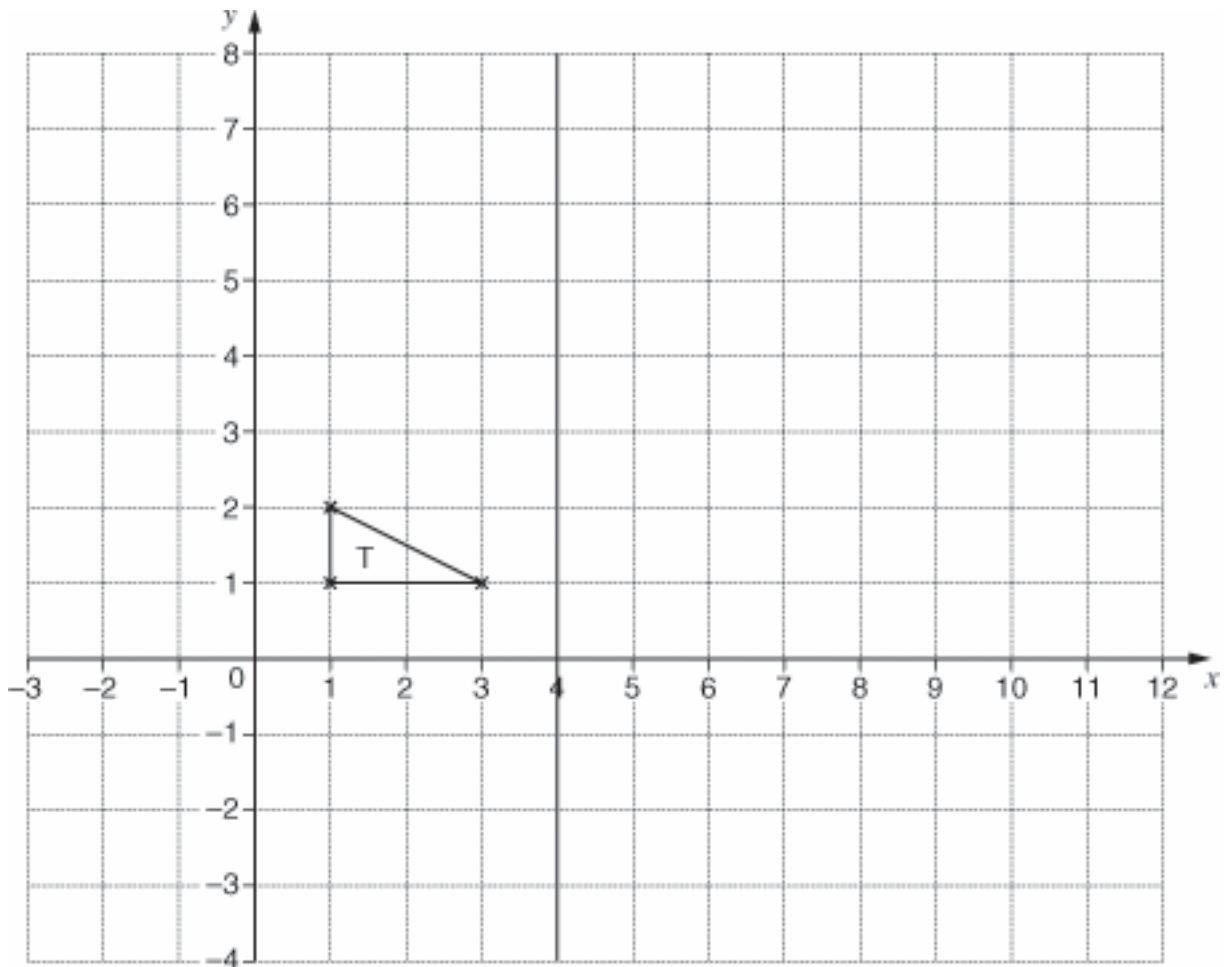
(a) $\frac{3}{5} - \frac{1}{4}$

(a) [2]

(b) $\frac{3}{5} + \frac{1}{2}$

(b) [2]

4



(a) Enlarge triangle T by scale factor 3, centre the origin.

Label the image A.

[3]

(b) Reflect triangle T in the line $x = 4$.

Label the image B.

[1]

- 5 (a) Some of the probabilities of obtaining the numbers on a biased, 6-sided die are shown in the table below.

Number	1	2	3	4	5	6
Probability	0.25	0.1	0.1		0.1	0.25

- (i) Work out the probability of obtaining a 4.

(a)(i) [2]

- (ii) Work out the probability of obtaining a 5 or a 6 when this die is thrown.

(ii) [1]

- (b) A bag contains red counters, blue counters and green counters.

The table shows the probability of each colour counter being taken at random from the bag.

Colour	red	blue	green
Probability	0.2	0.25	0.55

Tom thinks that there are 10 red counters in the bag. He is wrong.

Explain, using calculations, why he is wrong.

.....

 [3]

6 James grows sunflowers.

He measures the height in centimetres of 18 sunflowers.

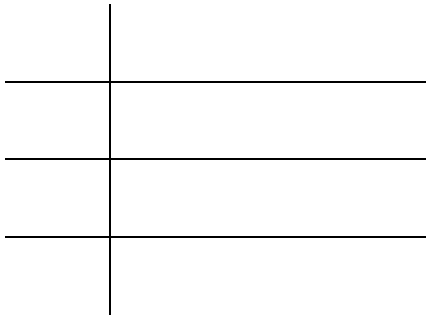
Here are the measurements.

149 169 154 156 161 153

166 172 163 167 173 175

159 170 164 158 168 167

(a) Show this information in an ordered stem and leaf diagram.



Key 14 | 9 represents 149 cm.

[3]

(b) Use your stem and leaf diagram to find the median.

Explain how you found your answer.

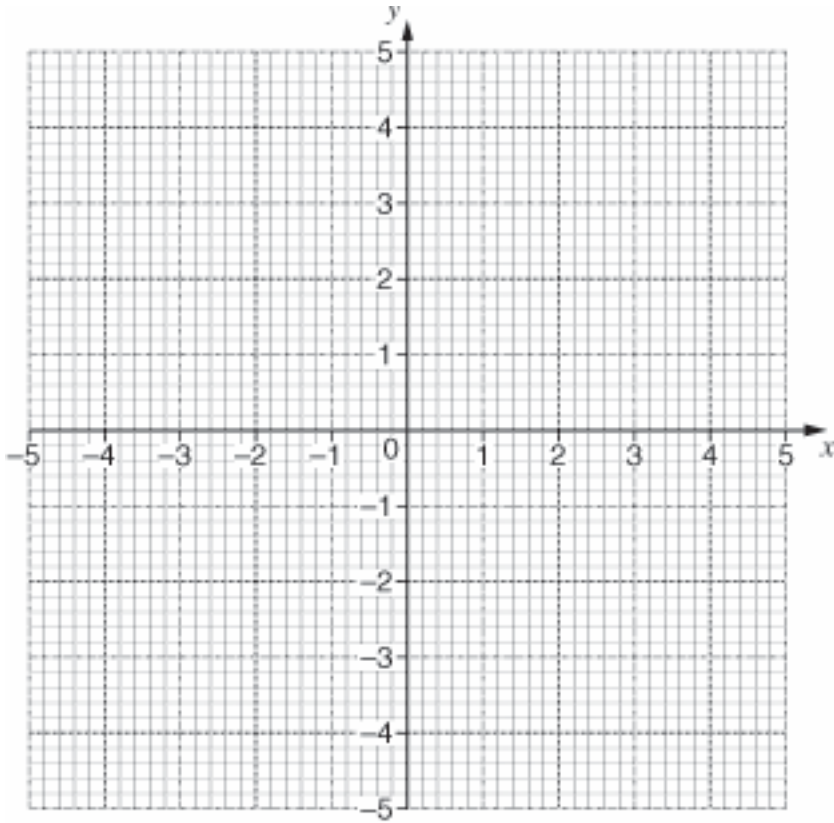
Median..... because

.....

.....

..... [2]

7 Draw the graph of $y = 2x - 1$.



[3]

8 Helen took six maths tests.

Her marks in the first four tests were 4, 6, 7 and 8.

When she had completed the six tests the mode of her marks was 8 and the mean of her marks was 7.

(a) Find her marks in the other two tests.

(a) and [3]

(b) What is the range of her marks?

(b) [1]

9 Rachael bought a tray of 60 plants.

The 60 plants each produced flowers of a single colour.

The plants produced red flowers, white flowers and blue flowers in the ratio 2 : 3 : 5.

How many plants produced white flowers?

..... [3]

10 20 can be expressed as a product of prime factors as

$$20 = 2^2 \times 5.$$

(a) Write 72 as a product of prime factors.

(a) [2]

(b) What is the highest common factor (HCF) of 20 and 72?

(b) [1]

(c) What is the lowest common multiple (LCM) of 20 and 72?

(c) [1]

11 (a) Solve.

$$7x - 1 < 20$$

(a) [2]

(b) In each part, give **one** example to show that the statement is **false**.

You must show your working.

(i) For every non-zero number y , $2y > y$.

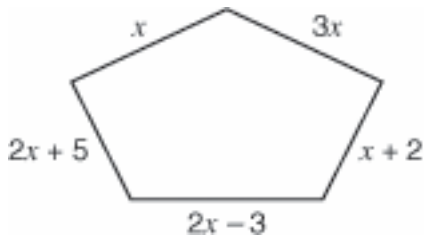
.....
..... [2]

(ii) For every non-zero number x , $x^2 > x$.

.....
..... [2]

12 The diagram shows a pentagon.

The length of each side is marked on the diagram.



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The perimeter of the pentagon is 40 cm.

(a) Show that $9x + 4 = 40$

[2]

(b) (i) Solve.

$$9x + 4 = 40$$

(b)(i) [2]

(ii) Find the length of the longest side of the pentagon.

(ii) [1]

13 (a) Rearrange this formula to make x the subject.

$$y = \frac{x^2}{5}$$

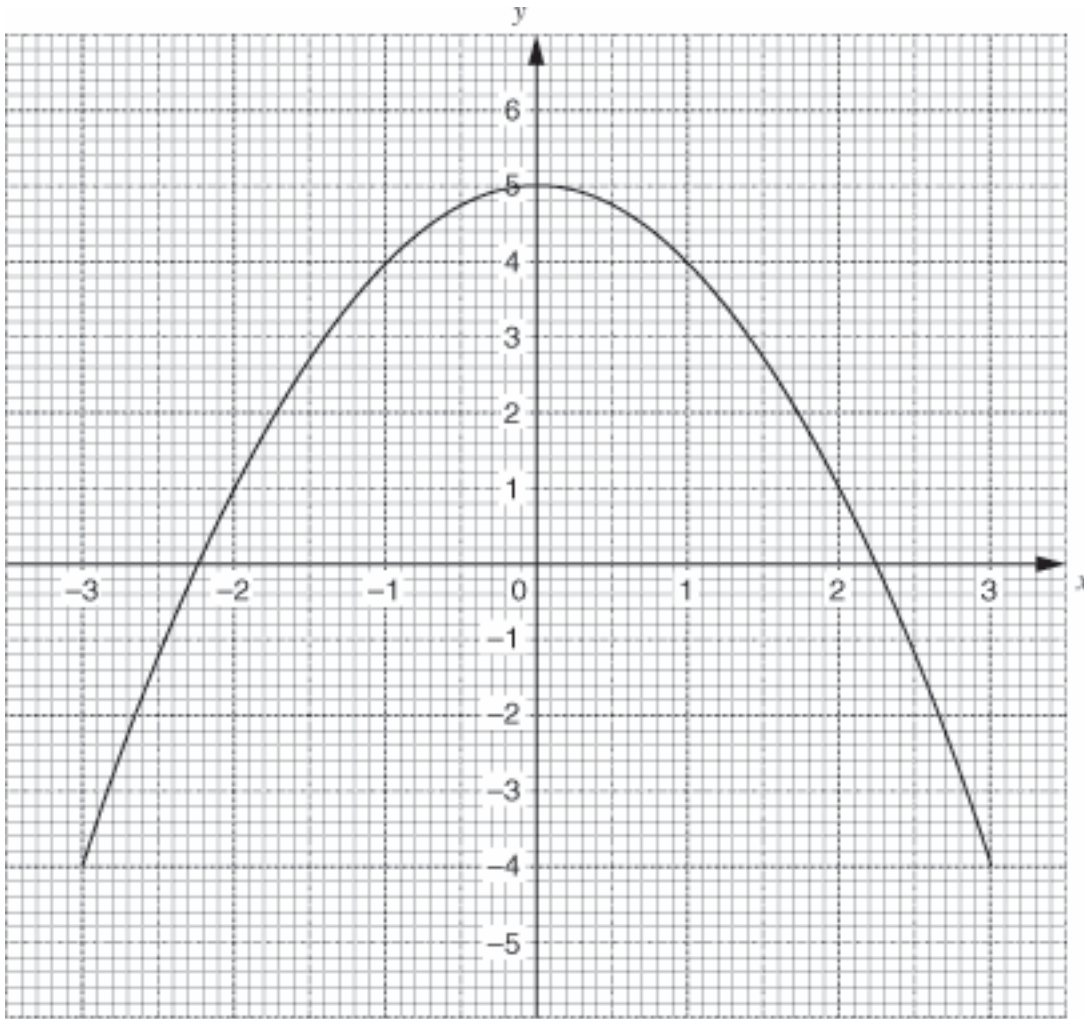
(a) [2]

(b) Solve algebraically these simultaneous equations.

$$\begin{aligned} 2x - 3y &= 7 \\ 8x + y &= 2 \end{aligned}$$

(b) $x = \dots\dots\dots y = \dots\dots\dots$ [3]

14 The diagram shows the graph of $y = 5 - x^2$.



(a) Use the graph to solve the equation $5 - x^2 = 0$.

(a) [2]

(b) By drawing a straight line on the graph, solve the equation $5 - x^2 = x$.

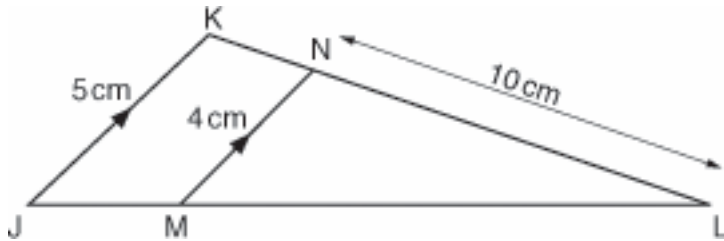
(b) [3]

15 JKL and MNL are similar triangles.

M lies on JL and N lies on KL.

MN is parallel to JK.

JK = 5 cm, MN = 4 cm, NL = 10 cm.



(a) Find length KN.

(a)cm [4]

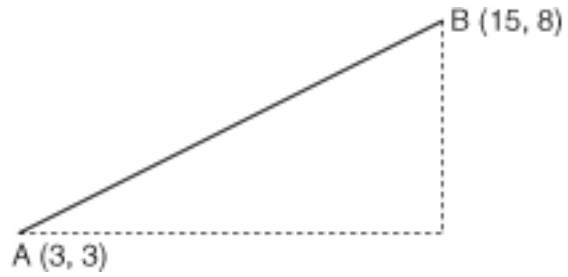
(b) Write down the ratio

Area of triangle MNL : Area of triangle JKL

(b) : [2]

16 A is the point (3, 3).

B is the point (15, 8).



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(a) Write down the coordinates of the midpoint of AB.

(a) [2]

(b) Calculate the length AB.

(b) [3]

17 y is proportional to x^2 when $y = 18$ and $x = 3$.

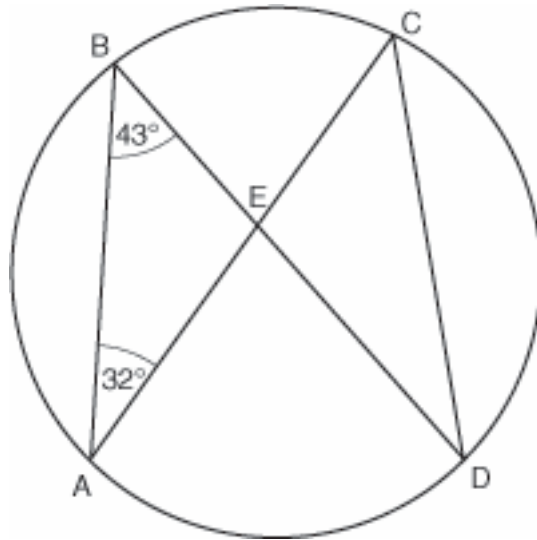
Find an equation for y in terms of x .

..... [3]

18 A, B, C and D are points on the circumference of a circle.

AC and BD intersect at E.

Angle ABD = 43° and angle BAC = 32° .



NOT TO SCALE

(a) Find the size of angle ACD.

Give a reason for your answer.

Angle ACD = $^\circ$ Reason

..... [2]

(b) Explain how you know that E is **not** the centre of the circle.

.....

.....

..... [2]

19 (a) Evaluate.

$$4^{0.5} \times 2^{-2}$$

(a) [3]

(b) Show that $(\sqrt{3} + \sqrt{12})^2 = 27$

(b) [2]

20 Jerome records the time it takes a snail to cross a step.

He finds that the snail travels a distance of 140 mm, correct to the nearest 10 mm, in a time of 3 minutes, correct to the nearest minute.

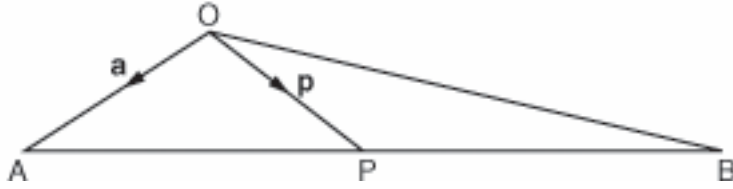
Calculate the maximum possible average speed, in mm per minute, of the snail.

.....mm/minute [4]

21 OAB is a triangle.

P is the midpoint of AB.

$$\vec{OA} = \mathbf{a} \quad \vec{OP} = \mathbf{p}$$



Find the following vectors in terms of \mathbf{a} and \mathbf{p} .

(a) \vec{AP}

(a) [2]

(b) \vec{OB}

(b) [2]

22 Solve.

$$\frac{3}{x+3} + \frac{2}{3x-1} = 1$$

..... [7]

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OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

MATHEMATICS A

Higher Paper 3

Specimen Mark Scheme

J512/3

The maximum mark for this paper is 100.

1 (a)	Two correct plots	B1		±1 mm
(b) (i)	Line of best fit for $45 < x < 80$ and +ve gradient	B1		Ruled with no more than 1 point on either side than the other
(ii)	Positive	B1		Ignore qualifiers
(c) (i)	$\sqrt{\quad}$ from graph	B1		±1 mm
(ii)	$\sqrt{\quad}$ from graph	B1	5	±1 mm
2 (a)	6	B1		
(b)	60 or (their 6) × 10 cm ³	B1 [√] U1	3	
3 (a)	$\frac{7}{20}$	B2		M1 for $\frac{12}{20}$ or $\frac{5}{20}$ seen
(b)	$1\frac{1}{10}$	B2	4	M1 for $\frac{6}{10}$ or $\frac{5}{10}$ seen
4 (a)	Correct enlargement	B3		B2 for two vertices correct or any enlargement s.f. 3 or SC1 for any enlargement centre O
(b)	Correct reflection	B1	4	
5 (a) (i)	0.2 oe	B2		M1 for $1 - (0.25 + \dots)$ soi by 0.47
(ii)	0.35 oe	B1		
(b)	total of 50 0.25 × 50 oe =12.5 & can't have half a counter	M1 M1 A1	6	
6 (a)	14 9 15 3 4 6 8 9 16 1 3 4 6 7 7 8 9 17 0 2 3 5	B3		B2 for one error or omission or B1 for two errors or omissions
(b)	165 between 9 th and 10 th values	B1 R1	5	
7	Straight line with +ve grad. or -ve intercept Ruled through (0, -1) for $-1 \leq x \leq 2$ Ruled with gradient 2 for $-1 \leq x \leq 2$	M1 A1 A1		3

8 (a)	8 uses total of marks 9	B1 M1 A1		
(b)	5 or their max. value – 4	B1 √	4	
9	$60 \div (2 + 3 + 5)$ multiply by 3 18	M1 DM1 A1	3	
10 (a)	$2^3 \times 3^2$	B2		M1 for at least two correct steps for factors
(b)	4	B1		
(c)	360	B1	4	
11 (a)	$(x) < 3$	2		M1 for correct first step $7x < 21$, or division by 7
(b) (i)	Negative value identified Correctly evaluated & conclusion	M1 A1		
(ii)	$0 < x \leq 1$ Correctly evaluated & conclusion	M1 A1	6	
12 (a)	$2x + 5 + 2x - 3 + x + 2 + 3x + x = 40$ $9x + 4 = 0$ correctly established	M1 E1		
(b) (i)	$(x =) 4$	B2		M1 for $9x = 40 - 4$ oe
(ii)	13	B1 √	5	√ for their (i) in $2x + 5$
13 (a)	$x = (\pm)\sqrt{5y}$	B2		M1 for multiplying by 5 or SC1 for $5\sqrt{y}$
(b)	$x = \frac{1}{2}, y = -2$ after correct algebra	B3		M1 for equating coeffs. Allow one error and A1 for $26x = 13$ or $-13x = 26$ oe or SC1 for both solutions with wrong or no working
			5	
14 (a)	$-2 \cdot 3$ to $-2 \cdot 2$ and $2 \cdot 2$ to $2 \cdot 3$	B2		B1 for one correct value
(b)	$-2 \cdot 9$ to $-2 \cdot 7$ and $1 \cdot 7$ to $1 \cdot 9$	B3		M1 for attempt to draw $y = x$ and B1 for one correct value
			5	
15 (a)	$2\frac{1}{2}$	B4		B3 for $KL = 12\frac{1}{2}$ or M2 for $KL = \frac{5}{4} \times NL$ or M1 for $KL:NL = 5:4$ oe
(b)	16:25 or 1:1.5625 or 0.64:1	B2	6	M1 (their s.f) ² seen

16 (a)	(9, 5½)	B2		B1 for either correct
(b)	13	B3	5	M2 for $\sqrt{(15-3)^2 + (8-3)^2}$ or M1 for any attempt at using Pythagoras eg. $AB^2 = (15-3)^2 + (8-3)^2$
17	$y = 2x^2$	B3	3	M1 for $y = kx^2, k \neq 1$ and M1 for substituting in $y = kx^2$ or $y = k\sqrt{x}$
18 (a)	43° angles in same segment oe	B1 R1		
(b)	angle AED = 75° seen angle AED \neq 2 × angle ABD	B1 B1	4	or EBA not an isosceles triangle oe
19 (a)	½ oe www	B3		B1 for $4^{0.5} = 2$ and B1 for $2^{-2} = \frac{1}{4}$ oe
(b)	$(\sqrt{3} + 2\sqrt{3})^2$ or $3 + 2\sqrt{36} + 12$ $(3\sqrt{3})^2$ or $3 + 12 + 12 = 27$	M1 E1	5	
20	135 or 145 or 2½ or 3½ seen 145 and 2½ used <i>their</i> 145 ÷ <i>their</i> 2½ 58 (mm/m)	M1 M1 M1 A1	4	Dep on first M1
21 (a)	$\mathbf{p} - \mathbf{a}$ oe	B2		M1 for $\overline{AP} = \overline{AO} + \overline{OP}$ oe seen
(b)	$2\mathbf{p} - \mathbf{a}$ oe	B2	4	M1 for $\overline{OB} = \overline{OA} + \overline{AB}$ or $\overline{OA} + 2\overline{AP}$ oe seen If consistent column vectors used, penalise only once
22	(x =) -1 and 2	7	7	M1 for multiplying by $x + 3$ soi by $2(x + 3)$ and M1 for mult. by $3x - 1$ soi by $3(3x - 1)$ and M1 for RHS = $(x + 3)(3x - 1)$ and B2 for $3x^2 + 8x - 3$ seen and M1 factorising their quadratic = 0 or use of formula or SC2 for both correct after wrong or no working

Assessment Objectives Grid

Question	AO2	AO3	AO4	Total
1			5	5
2		3		3
3	4			4
4		4		4
5			6	6
6			5	5
7	3			3
8			4	4
9	3			3
10	4			4
11	6			6
12	5			5
13	5			5
14	5			5
15		6		6
16		5		5
17	3			3
18		4		4
19	5			5
20	4			4
21		4		4
22	7			7
Totals	54	26	20	100