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GCSE MATHS

Geometry and measures

Edexcel 1MA1 | Subtopic collection Topic 42

Arcs and sectors

Higher tier

Answers and examiner comments

24	2003-2024	Higher
question groups	available papers	tier

Using this booklet

1. Answer numbers match the companion question booklet.
2. Follow the original question number on marking tables.
3. Examiner comments are included where available.

Name _____ **Date** _____

Some entries use full source marking material in an appendix. Any unavailable mark schemes are identified beside the relevant answer.

Original question 15

The full source mark scheme begins on page 43. Use the original paper code, tier and question number shown above.

Original question 18

No matching mark scheme was available in the supplied archive for this question.

Question		Working	Answer	Mark	Notes
24	(a)	$4x = 9-1$ $\frac{4x}{4}+\frac{1}{4}=\frac{9}{4}$	2	2	M1 for $4x = 9-1$ or $\frac{4x}{4}+\frac{1}{4}=\frac{9}{4}$ or a clear intention to either subtract 1 from both sides of the equation or to divide each term by 4 A1 for 2 (accept $\frac{8}{4}$)
	(b)	$2y = 12+1$ $\frac{2y}{2}-\frac{1}{2}=\frac{12}{2}$	6.5	2	M1 $2y = 12+1$ or $\frac{2y}{2}-\frac{1}{2}=\frac{12}{2}$ or a clear intention to either add 1 to both sides of the equation or divide each term by 2 A1 6.5 oe (accept $\frac{13}{2}$)

26	$\frac{40}{360}\times\pi\times8^2 - \frac{1}{2}\times8^2\times\sin 40^o$ = 22.34.... – 20.569... OR $\frac{40}{360}\times\pi\times8^2 -$ $8\times\sin 20^o\times8\times\cos 20^o$ = 22.34.... – 20.569...	1.77	5	M1 for $\frac{40}{360}$ oe seen or $0.1\dot{1}$ seen or ÷9 M1 for $\frac{40}{360}\times\pi\times8^2$ oe or sight of 22.3-22.35 M1 for $\frac{1}{2}\times8^2\times\sin 40^o$ or $8\times\sin\ 20\times8\times\cos 20$ or sight of 20.56-20.57 M1 (dep on at least one M1 scored) for the intention to find the difference between the area of triangle *OPS* and the area of sector *OPRS* A1 for 1.74 -1.78 [B3: RAD: ±1.50(340...) or GRAD: 3.53(108...)]

19		$\frac{30}{360} \times \pi \times 15^2$	58.8	2	M1 for a correct method to find the area of sector *OAB* A1 for answer in range 58.8 − 58.9125

1MA0_2H

20		$\pi 2^2 \times 2 = 8\pi$ $\pi 2^2 \times \frac{20}{360} \times 3 + \pi 2^2 \times \frac{340}{360} \times 2$ $8\pi : \frac{74}{9}\pi$: 72 : 74 Or $\frac{20}{360} \times 3 + \frac{340}{360} \times 2 = \frac{37}{18}$ $2: \frac{37}{18}$ 36:37	36:37	4	M1 method to find relative cost of design A e.g. $\pi 2^2$, $k \times \pi 2^2$ M1 for a complete method to find the relative cost of the watch face for design B e.g. $\pi 2^2 \times \frac{20}{360} \times \frac{3}{5} + \pi 2^2 \times \frac{340}{360} \times \frac{2}{5}$ M1 (dep on M1, M1) for the cost of design A: cost of design B A1 cao Or M1 for method to find fraction of the sectors in design B $\frac{20}{360}, \frac{340}{360}$ M1 for complete method to find the relative cost of the watch face for design B M1 (dep on M1,M1) for the cost of design A: cost of design B A1 cao

PAPER: 1MA0_2H

15			20.94	5	M1 for method to find circumference of circle, eg. $2\times\pi\times2.45$ or $\pi\times4.9$ (= 15.393....) M1 (dep) for $\frac{105}{360}\times$ "15.393 ... (= 4.4898...) M1 for "4.4898.." ÷ 1.75 (= 2.565...) or "4.9" ÷ 1.75 (= 2.8) oe or "9.3898…" ÷ 1.75 (=5.3656…) M1 for total cost = "6" × 3.49 (=20.94) or cost of arc or straight edges = "3" × 3.49 (=10.47) A1 cao

5MB3H_01 November 2015

PAPER: 1MA0_2H

Question		Working	Answer	Mark	Notes
22			28.9	3	M2 for $\frac{75}{360} \times 2 \times \pi \times 6$ oe + $\frac{75}{360} \times 2 \times \pi \times 10$ oe (= 7.85... + 13.08... = 20.94..) (M1 for $\frac{75}{360} \times 2 \times \pi \times 6$ oe or $\frac{75}{360} \times 2 \times \pi \times 10$ oe) A1 for 28.9 to 28.95

Question	Working	Answer	Mark	Notes
17		66.5	B1	for recognising an angle of 60 at *AOB*
			P1	for a process to find the area of the sector, e.g. $\frac{"60"}{360} \times \pi \times 11^2$ (= 63.3.. or $\frac{121\pi}{6}$)
			P1	for a process to find the area of the triangle, e.g. $\frac{1}{2} \times 7^2 \times \sin "60"$ (=21.2.. or $\frac{49\sqrt{3}}{4}$)
			P1	for a process to find the required percentage, eg. $\frac{"63.3.."-"21.2.."}{"63.3.."} \times 100$
			A1	for answer in the range 66.5 to 66.6

Question	Working	Answer	Mark	Notes
18	Note *DOC*=*DOA*, *ADO*=*CDO*	21.6	P1 P1 P1 P1 A1	Recognises that *OAD* or *OCD* is 90° or right angle for using trigonometry to set up an equation in *DOA* or *ADO* eg Cos *DOA* = $\frac{5}{9}$ for using inverse trigonometry to find *DOA* or *ADO* eg *DOA* = $\text{Cos}^{-1}\frac{5}{9}$ (= 56.25…) for a complete process to find arc length *ABC* or *AC* eg $\frac{360-2\times"56.25.."}{360}\times2\times\pi\times5$ (=21.598..) or $\frac{2\times"56.25.."}{360}\times2\times\pi\times5$ (=9.8174..) for answer in the range 21.5 to 21.65

Question	Working	Answer	Mark	Notes
20		68.5	B1	for angle $OAB = 90°$ or angle $OCB = 90°$, may be seen on diagram
			P1	for a process to find the length of AB or the length of CB ($= 10\sqrt{3}$ oe) eg $10 \times \tan 60°$ ($= 17.3...$) or the length of OB ($= 20$), eg $10 \div \cos 60°$
			P1	for a process (dep previous P1) to find the area of the triangle OAB ($= 50\sqrt{3}$ oe) or area of triangle OCB ($= 50\sqrt{3}$ oe) or area of kite $OABC$ ($= 100\sqrt{3}$ oe)
			P1	for a process to find the area of the sector OAC e.g. $\frac{1}{3} \times \pi \times 10^2$ ($= 104.7...$),accept rounded or truncated to 3 significant figures or more
			A1	for 68.4 − 68.6

Paper: 1MA1/2H

7	shown	C1 C1 C1 C1	for method to find area of semicircle, eg $\pi \times 10^2 \div 2$ (= 50π) for method to find area of quarter circle, for $\pi \times 20^2 \div 4$ (= 100π) for a complete method to find area shaded **and** area of square, eg $\pi \times 20^2 \div 4 - \pi \times 10^2 \div 2$ **and** 20×20 fully correct working leading to $\frac{\pi}{8}$	Can award first 3 marks if a value for π is used Working out to find the area of the shaded region **must** be shown

16	39.9	P1 P1 P1 P1 A1	for finding the length of the minor or major arc eg $\frac{220}{360}\pi\times12$ (= 23(.03834..)) for substituting into the sine or cosine rule to find *OD* eg 14 ÷ sin140 = *OD* ÷ sin 24 **or** (OD^2=) $6^2+14^2-2\times6\times14\times\cos24$ (=78.5....) for a complete process to find the length *OD* eg 14 ÷ sin140 × sin24 (=8.8(58778..)) for a complete process to find the perimeter eg "23(.03834..)" + 14+ "8.8(58778..)" – 6 for an answer in the range 39.8 to 40	Allow appropriate rounding if calculation seen in parts Must involve *OD* in the relationship but may be implied May be seen in multiple calculations If an answer in the range is seen in working and then incorrectly rounded award full marks.

Paper: 1MA1/3H

Question	Answer	Mark	Mark scheme	Additional guidance
12	25.4	P2	for finding the size of the angle eg $\frac{40\times360}{\pi\times7^2}$ (=93.5(4..)) **or** for working with proportion, eg $\frac{40}{49\pi}$ (=0.259(8…) or 0.26) **or** $\frac{49\pi}{40}$ (=3.84(8…) or 3.85)	
		(P1	for finding the area of the circle eg π × 7² (=153(.938..) or 154))	May be embedded
		P1	(dep on P2) for a process to find the arc length, eg $\frac{"93.5(4...)"}{360}$ × π × 2 × 7 (=11.4(28…)) **or** $\frac{40}{49\pi}$ × π × 2 × 7 (=11.4(28…)) **or** π × 2 × 7 ÷ $\frac{49\pi}{40}$ (=11.4(28…))	
		A1	for answer in the range 25 to 25.44	If an answer is shown in the range in working and then incorrectly rounded award full marks. Accept $\frac{178}{7}$

Paper: 1MA1/2H

23	264	P1 P1 P1 P1 A1	correct substitution into the volume formula, eg $56.8 = \frac{1}{3} \times \pi \times r^2 \times 3.6$ completes process to find base radius **or** the value of r^2, eg $r = \sqrt{\frac{56.8 \times 3}{\pi \times 3.6}}$ (=3.88158…) or $r^2 = \frac{56.8}{1.2\pi}$ (=15.066) Uses Pythagoras to find the sloping length, eg $\sqrt{"3.88\ldots"^2 + 3.6^2}$ (=5.29...…) process to find an equation in *AOB*, eg $\pi \times$ "3.88" $\times$ "5.29" $= \frac{AOB}{360} \times \pi \times$ "5.29"^{2} **or** $\frac{AOB}{360} \times \pi \times 2 \times$ "5.29" $= 2 \times \pi \times$ "3.88" **or** $\frac{AOB}{360} \times$ "5.29" = "3.88" answer in the range 263.9 to 264.1	*AOB* does not need to be the subject of the equation

Paper: 1MA1/3H

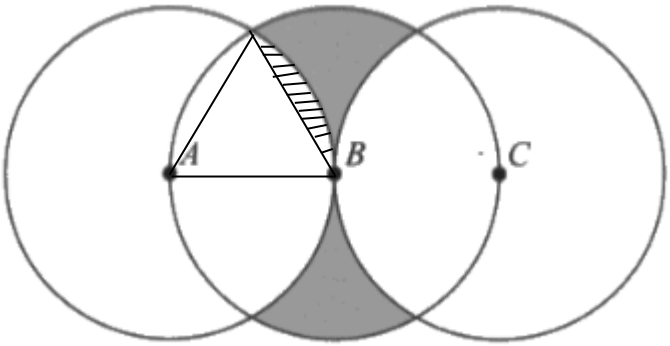
22	0.5	P1	derive an algebraic expression for the area of A eg $\frac{1}{8}\pi\,[\,(5x-1)^2-(3x-1)^2\,]$	
		P1	expand and simplify for either area A or area B eg $\frac{1}{8}\pi\,(16x^2-4x)$ **or** $\pi(x^2-2x+1)$	
		P1	(dep P2) equate and rearrange into a quadratic eqn of the form $ax^2 + bx + c = 0$ eg $2x^2 + 3x - 2 = 0$	
		P1	(dep P3) factorise eg $(2x-1)(x+2) = 0$ **or** use of formula eg $\frac{-3\pm\sqrt{3^2-4\times2\times-2}}{2\times2}$	
		A1	oe	Accept only the single value of 0.5 oe but award 0 marks for a correct answer with no supportive working

Paper: 1MA1/1H

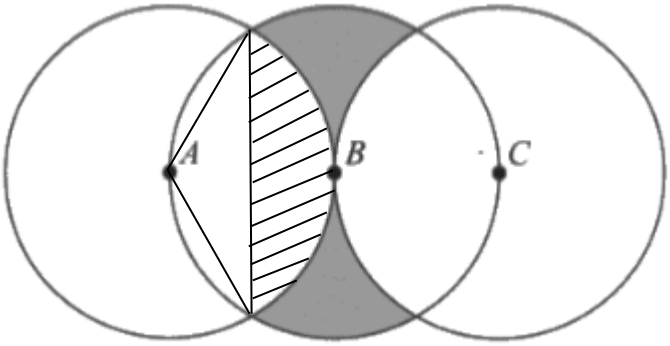
7	18.3	P1	for finding the area of the triangle eg $0.5 \times 8 \times 8$ (= 32)	Accept rounded or truncated figures
		P1	for finding the area of the circle $\pi \times 8 \times 8$ (= 201.06..)	
		P1	for finding the area of the sector eg $\frac{1}{4} \times \pi \times 8^2$ **or** "201.06.." ÷ 4 (= 50.26...)	
		A1	for an answer in the range 18.2 to 18.3	If the answer is given within the range but then rounded incorrectly award full marks.

Paper: 1MA1/1H

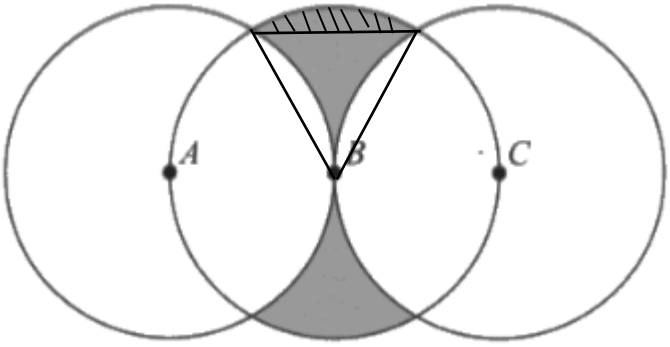
Question	Answer	Mark	Mark scheme	Additional guidance
21	$16\sqrt{3}-\frac{16\pi}{3}$	P1	for identifying an angle of 60 or 120	
		P1	for process to find the area of a sector of angle 60 or 120 eg $\pi 4^2\times\frac{60}{360}\left(=\frac{8\pi}{3}\right)$ or $\pi 4^2\times\frac{120}{360}\left(=\frac{16\pi}{3}\right)$	
		P1	for process to find the area of an equilateral triangle eg $\frac{1}{2}\times 4\times 4\times\sin 60\ (=4\sqrt{3})$ **or** $\frac{4\times\sqrt{4^2-2^2}}{2}\ (=2\sqrt{12}\text{ or }4\sqrt{3})$ **or** the area of an isosceles triangle **or** area of a right-angled triangle eg $\frac{1}{2}\times 4\times 4\times\sin 120\ (=4\sqrt{3})$ **or** $\frac{2\times\sqrt{4^2-2^2}}{2}\ (=\sqrt{12}\text{ or }2\sqrt{3})$	
		P1	for using area of sector – area of triangle to find area of a segment eg $\pi 4^2\times\frac{60}{360}-\frac{1}{2}\times 4\times 4\times\sin 60\ \left(=\frac{8\pi}{3}-4\sqrt{3}\right)$ **or** $\pi 4^2\times\frac{120}{360}-\frac{1}{2}\times 4\times 4\times\sin 120\ \left(=\frac{16\pi}{3}-4\sqrt{3}\right)$	
		A1	for $16\pi-4\left(\frac{16\pi}{6}-4\sqrt{3}+\frac{16\pi}{6}\right)$ or $16\sqrt{3}-\frac{16\pi}{3}$ oe	Does not need to be in simplest form



area of segment = area of sector centre A – area of equilateral triangle
Total shaded area = area of circle – 4 × area of sector – 4 × area of segment
or area of circle – 4 × area of triangle – 8 × area of segment



area of segment = area of sector centre A – area of isosceles triangle
Total shaded area = area of circle – 4 × area of segment



area of segment = area of sector centre B – area of equilateral triangle
Total shaded area = 2 × (area of sector – 2 × area of segment)
or 2 × (area of triangle – area of segment)

Modifications to the mark scheme for Modified Large Print (MLP) papers: 1MA1 1H

Only mark scheme amendments are shown where the enlargement or modification of the paper requires a change in the mark scheme. Notes apply to both MLP papers and Braille papers unless otherwise stated.

The following tolerances should be accepted on marking MLP papers, unless otherwise stated below:
Angles: ±5°
Measurements of length: ±5 mm

PAPER: 1MA1_1H			
Question		**Modification**	**Mark scheme notes**
5		Wording added 'Look at the diagram for Question 5 in the Diagram Booklet. It shows a regular hexagon and a regular pentagon which share a common side.'. Diagram enlarged. The angle moved outside of the angle arc and the angle arc made smaller. For Braille the diagram has hexagon ABCDEF and pentagon GHICB with *x* outside the angle arc. Wording now "The diagram is a regular hexagon, ABCDEF, and a regular pentagon, GHICB, joined at the common side, BC." "In the diagram, angle DCI is marked *x*."	Standard mark scheme
6	(a)	Wording added 'Complete the table below…'. The table turned vertical. Wording added 'There are four spaces to fill.' For Braille Add (i), (ii), (iii) & (iv) in the blank spaces and "Ans: (i) __ (ii) __ (iii) __ (iv) __"	Standard mark scheme
6	(b)	Wording added 'Look at the diagram for Question 6(b) in the Diagram Booklet. It shows a grid.' Diagram enlarged. Open headed arrows. Small squares removed. The axes labels moved to the top of the vertical axis and to the right of the horizontal axis.	Standard mark scheme
7		Wording added 'Look at the diagram for Question 7 in the Diagram Booklet. It shows cube A and cube B.' Wording added 'Cube A has sides of length 3 cm'; 'Cube B has sides of length 4 cm.' Diagram enlarged. The diagrams relabelled as 'cube A' and 'cube B'. Braille: have a model with the words "The models represent two cubes, A and B."	Standard mark scheme
8		Wording added 'Look at the table for Question 8 in the Diagram Booklet. It shows…'. The frequency column widened.	Standard mark scheme

PAPER: 1MA1_1H			
Question		**Modification**	**Mark scheme notes**
9		Wording added 'Look at the diagram for Question 9 in the Diagram Booklet. You may be provided with a model.' Wording added 'A cube is placed on top of a cuboid, to form a solid, as shown by the diagram and the model.' Diagram enlarged. The dashed lines made longer and thicker.	Standard mark scheme
10	(a)	Wording added 'Look at the table for Question 10 in the Diagram Booklet. It shows…'. The values changed so that the answers can be read on a grid line. 25 changed to 30. 30 changed to 15. 5 changed to 10. 15 changed to 20. Wording added 'Complete the cumulative frequency table below.' 'There are six spaces to fill.'	B1 for 10, 25, 55, 70, 80, 100
10	(b) (c) (d)	Wording added 'Look at the diagram for Question 10(b) in the Diagram Booklet. It shows a grid. Diagram enlarged. Small squares removed. Open headed arrows. Right axis labelled. The axes labels moved to the top of the vertical axis and to the left of the horizontal axis. Intermediates added at intervals of 5 on the *y* axis. The grid cut at 300 on the *x* axis.	(b) Standard mark scheme (c) B1 for answer of 40 **or** ft their graph (if possible) (d) M1 for finding the difference between readings taken from the profit axis at points from a cf of 25 and a cf of 75 ft their graph (if possible) A1 for answer in the range 120 to 130 **or** ft their graph (if possible)
11		Wording added 'Look at the information for Question 11 in the Diagram Booklet.	Standard mark scheme

PAPER: 1MA1_1H			
Question		**Modification**	**Mark scheme notes**
13		Wording added 'Look at the diagram for Question 13 in the Diagram Booklet.' Wording added 'three semicircular shaded'. Diagram enlarged. The right angle made more obvious. Shading changed. The regions labelled as 'region A', 'region B' and 'region C'.	Standard mark scheme
14		Wording added 'Look at the diagram for Question 14 in the Diagram Booklet. It shows…'. Diagram enlarged. Small squares removed. Open headed arrows. Right axis labelled. The axes labels moved to the top of the vertical axis and to the left of the horizontal axis.	Standard mark scheme with leeway in part (a)
21		Wording added 'Look at the diagram for Question 21 in the Diagram Booklet. It shows…'. Diagram enlarged. Shading changed. Labels A, B and C moved to the left.	Standard mark scheme

15	40	P1 P1 A1	for a start to the process, eg $\frac{x}{360}\times 2\times\pi\times 18\,(=4\pi)$ oe or $\frac{4\pi}{2\times\pi\times 18}\,(=\frac{x}{360})$ oe for a complete process to find x, eg $\frac{4\pi}{36\pi}\times 360$ oe cao	Any arrangement equivalent to this equation acceptable

Paper: 1MA1/1H

Question	Answer	Mark	Mark scheme	Additional guidance
4	186.15	P1	for correctly finding the area of at least three sections, eg 3 of 11×7 (= 77), **or** 9×7 (= 63), **or** $\frac{1}{2} \times 11 \times 9$ (= 49.5), **or** $\frac{1}{4} \times \pi \times 7^2$ (= 38.4845..)	Note a trapezium for the rectangle and triangle should be classed as two areas. Accept figures rounded or truncated to 1 dp or better throughout.
		P1	for a method to find the number of bags required for one area or a combination of areas eg "77" ÷ 14 (= 5.5) **or** "227.9845.." ÷ 14 (= 16.2846…)	
		P1	for method to work out the total area for all four sections eg "77" + "63" + "49.5" + "38.4845…" (= 227.9845…) or adding the exact number of bags per section for all four sections eg "5.5" + "4.5" + "3.53.." + "2.74.." (= 16.28...)	This mark is dependent upon correct processes seen for all four sections.
		P1	for method to find the cost, eg integer number of bags × 10.95	integer number of bags must come from area ÷ 14 rounded up
		A1	cao	

14	19.9	P1	for substituting into the cosine rule to find *OB*, eg $(OB^2) = 9^2 + 6^2 - 2 \times 9 \times 6 \times \cos 35$	
		P1	for using correct order of operations eg 81 + 36 – 88.46... (= 28.5...)	May be implied by *OB* = 5.34.... Values may be rounded or truncated.
		P1	for process to find the area of the sector, eg $\frac{80}{360} \times \pi \times$ "$5.34...^2$"	
		A1	for answer in the range 19.8 to 20	If a correct answer within the range is shown in working but incorrectly rounded award full marks.

Paper: 1MA1/3H

12	246	P1	for start of process to find angle inside sector eg $\frac{x}{360} \times \pi \times 6.2^2 = 82.6$ or $\frac{82.6}{\pi \times 6.2^2} \times 360$ **or** for an answer in the range 113 to 114	The size of the angle in the unshaded sector is 114
		A1	for answer in range 246 to 247	If an answer is shown in the range in working and then incorrectly rounded award full marks.

Paper: 1MA1/3H

Question	Answer	Mark	Mark scheme	Additional guidance
15	15π	P2	for process to find size of the angle eg $\frac{5\pi \times 360}{2 \times \pi \times 6}$ oe (= 150) or for working with proportion eg $\frac{5\pi}{12\pi}$ (= $\frac{5}{12}$) or $\frac{12\pi}{5\pi}$ (= $\frac{12}{5}$)	
		(P1	for a first step eg $\frac{x}{360} \times 2 \times \pi \times 6 = 5\pi$)	
		P1	(dep on P2) for process to find the area eg $\frac{"150"}{360} \times \pi \times 6^2$ **or** $\frac{5\pi}{12\pi} \times \pi \times 6^2$	
		A1	cao	

11	304	P1 P1 A1	for start of process to find the arc length eg $34.3 - 2 \times 4.7$ (= 24.9) **or** for forming a suitable equation eg $\frac{\angle AOB}{360} \times \pi \times 2 \times 4.7 + 2 \times 4.7 = 34.3$ for process to isolate the arc length in an equation eg $\frac{\angle AOB}{360} \times \pi \times 2 \times 4.7 = "24.9"$ **or** for complete process to find AOB eg $\angle AOB = \frac{"24.9" \times 360}{\pi \times 2 \times 4.7}$ answer in the range 303 to 304	Condone omission of the addition of 2 radii in the equation for this mark only eg $\frac{\angle AOB}{360} \times \pi \times 2 \times 4.7 = 34.3$ If an answer is given in the range in working and then rounded incorrectly award full marks

Paper: 1MA1/3H

GCSE

Mark Scheme

Mathematics A (1387)

June 2003

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NOTES ON MARKING PRINCIPLES

NOTES ON MARKING PRINCIPLES

1 Three types of mark are available

M marks - awarded for correct working seen or implied.
A marks - conditional accuracy marks which are awarded for accurate working following the award of M marks.
B marks - unconditional accuracy marks (independent of M).

2 Abbreviations

cao - correct answer only.
ft - follow through.
√ - Denotes a "follow through" answer.

SC - special case.
isw - ignore subsequent working.
oe - or equivalent (and appropriate).
NB: a candidate cannot benefit from both isw and ft.

3 If no working shown, then

correct answers normally score full marks
incorrect (even though nearly correct) answers score no marks.

4 Marking instructions

Misread loses A marks (and sometimes B marks) on that part but ft can be allowed on subsequent parts. M marks can still be earned. If in doubt contact your team leader.
If there is a wrong answer in the answer space DO CHECK the working in the body of the script.

- If it is clear from working that the "correct" answer has been obtained from incorrect working, award no marks. If in doubt contact your team leader.
- If there is a wrong answer in the answer space DO CHECK the working in the body of the script.
- If it is clear from working that the "correct" answer has been obtained from incorrect working, award no marks. If in doubt contact your team leader.

5 Style of marking

Answer correct: tick and write part mark in margin NEXT TO BRACKETED MARK.
Answer incorrect: cross, but show M, A or B marks if any earned in body of script and transfer the total of these to the margin next to the bracket mark.
Total for each double page at bottom right page (except for back if used), FINAL TOTAL IN RELEVANT BOX ON FRONT COVER.
Nought in margin for fully incorrect question or page AND FOR NO ATTEMPT.
Where no attempt has been made a line should be put in the answer space and zero in the margin next to the bracketed mark
CHOICE OF METHOD – No marks unless one answer is in answer space – then mark that.
CROSSED OUT WORK - if not replaced this should be marked (if legible).
There must always be a mark next to bracketed mark in the margin/

6 Follow Through Marks

Follow throughs are guided by two principles:

(a) Follow throughs which involve a single stage calculation can be awarded without working since you can check the answer yourself, but if ambiguous, do not award.
(b) Follow throughs which involve more than one stage of calculation can only be awarded on sight of the relevant working, even if it appears obvious that there is only one way you could get the answer given.

7 Probability

Probability answers must be given as fractions, percentages or decimals. If a candidate gives a decimal equivalent to a probability, this should be written to at least two decimal places (unless tenths).
Incorrect notation should lose the accuracy marks, but be awarded any implied method marks.

8 Linear Equations

Full marks can be gained if the solution alone is given on the answer line, or otherwise unambiguously indicated in working (without contradiction elsewhere). Where the correct solution only is shown substituted, but not identified as the solution, the accuracy mark is lost but any method marks can be awarded.

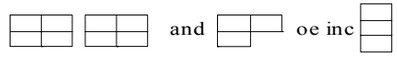
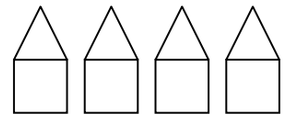
9 Parts of questions

Unless allowed by the mark scheme, the marks allocated to one part of the question CANNOT be awarded in another.

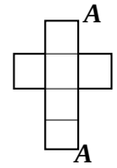
Paper 5501

No	Working	Answer	Mark	Notes
1 (a)		46	1	B1 cao
(b)		3.4	1	B1 oe
(c)		Arrow at 430	1	B1 allow ± half graduation
(d)		Arrow at 3.7	1	B1 allow ± half graduation Accept indications other than arrows as long as they are clear
2		1.60 2.05	2	B1) Condone B1) reversal
3 (a)	$\frac{18}{24}$ or $\frac{9}{12}$ or $\frac{6}{8}$	$\frac{3}{4}$	2	B2 for $\frac{3}{4}$ cao (B1 for $\frac{18}{24}$ or $\frac{9}{12}$ or $\frac{6}{8}$) SC B1 for $\frac{1}{4}$ only
(b)		16 squares shaded	1	B1 cao
4 (a)		line	1	B1 within overlay tolerance
(b)		midpoint	1	B1 within overlay tolerance ft from (a) ± 0.2cm
(c)		rectangle	1	B1 for rectangle 6 cm ± 0.2cm by 4 cm ± 0.2cm
5		kilograms, kg litre, *l* or cubic metres, m^3 inches, in	3	B1 B1 B1
6 (a)		parallel lines marked	1	B1
(b)		right angle marked	1	B1
(c)(i)		acute	1	B1
(ii)		reflex	1	B1

Paper 5501

No	Working	Answer	Mark	Notes
7 (i)		sphere	1	B1
(ii)		cylinder	1	B1 Accept circular prism
(iii)		pyramid	1	B1 Condone omission of "triangular" Accept tetrahedron
8 (a)(i)		40	2	B1 cao
(ii)		50		B1 cao
(b)		5 complete symbols	1	B1 cao
(c)		 and oe inc	1	B1
9 (i)		9, 37, 56, 59, 75	5	B1 cao
(ii)		0.067, 0.56, 0.6, 0.605, 0.65		B1 cao Ignore trailing zeros
(iii)		–10, –6, –4, 2, 5		B1 cao
(iv)		$\frac{2}{5}, \frac{1}{2}, \frac{2}{3}, \frac{3}{4}$		B2 for all 4 correct (B1 for any 3 in correct order) SC B1 for all 4 in reverse order (applies to(iv) only)
10 (a)			1	B1
(b)		Plotting (4, 24)	1	B1 ft from their matchsticks
(c)		60	1	B1 cao
(d)		$m = 6n$	2	B2 for $m = 6n$ oe (B1 for $6n$ oe or m = multiple of n except $m = n$)
11 (i)		6, 12	4	B1 cao
(ii)		4, 16		B1 cao
(iii)		3, 4, 6 or 3, 4, 6, 12		B1 Condone omission of 12
(iv)		8, 27		B1 cao

Paper 5501

No	Working	Answer	Mark	Notes
12		2.43	4	B1 for 36 or 0.36 B1 for 96 or 0.96 B1 for 125 or 1.25 If none of first 3 B1s awarded then SC B1 for four 24s and five 25s seen OR 4 × 24 and 5 × 25 seen B1 for 2.43 cao
13 (a)(i)		Edinburgh and Plymouth	3	B1 for Edinburgh or −7 B1 for Plymouth or 5
(ii)		12		B1ft from (i) if one positive and one negative
(b)		Cardiff and Belfast London and Plymouth	2	B1 for Cardiff and Belfast OR −6 and −4 B1 for London and Plymouth OR 3 and 5
14		5 9 8	3	B1 cao B1 cao B1 cao
15 (a)			2	✓ × 2 0 B2 1 0 B1 1 1 B1 2 1 B1
(b)	$2 \times 2 \times 2$	8	2	M1 for $2 \times 2 \times 2$ A1 for 8 cao
16 (a)		30	1	B1 cao
(b)		3	1	B1 cao
(c)	$2 \times 29 = 58$ $5 \times 30 = 150$ $2 \times 31 = 62$ $1 \times 32 = 32$ $\frac{302}{10} = 30.2$	30.2	3	M1 for freq × no pins M1 (dep on 1st M1) for totalling and ÷ 10 A1 for 30.2 cao

Paper 5501

No	Working	Answer	Mark	Notes
17		7 5 5 13 33 52 23	3	B3 all correct (B2 for 4, 5 or 6 correct B1 for 2 or 3 correct)
18 (a)(i) (ii) (iii) (iv) (b)		$4c$ p^4 $8g$ $10pr$ OR $10rp$ $10y - 15$	4 1	B1 oe B1 cao B1 oe B1 B1 cao Accept $10y + -15$
19		$\frac{2}{3}$	3	M1 for 3 rows (9 squares) shaded M1 for 2 columns (10 squares) shaded A1 for $\frac{2}{3}$
	$\frac{3}{5} = \frac{9}{15}$ $\frac{2}{3} = \frac{10}{15}$	$\frac{2}{3}$	3	M1 for $\frac{3}{5} = \frac{9}{15}$ M1 for $\frac{2}{3} = \frac{10}{15}$ A1 for $\frac{2}{3}$
	$\frac{3}{5} = 0.6$ $\frac{2}{3} = 0.66$ or 0.67 or better	$\frac{2}{3}$	3	M1 for $\frac{3}{5} = 0.6$) Accept M1 for $\frac{2}{3} = 0.66$ or 0.67 or better) percentages A1 for $\frac{2}{3}$

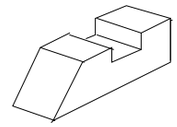
Paper 5501

No	Working	Answer	Mark	Notes
20 (a)	955 × 48 7640 38200 45840 OR 48 × 955 240 2400 43200 45840	458.40	3	M1 for complete correct method (condone one computational error) A2 for 458.40 cao (A1 for digits 4584 OR ft if M1 awarded)
(b)	14. 5 48 | 696. 0 48 216 192 24 0 24 0	14.50	3	M1 for 1 as first digit in answer and remainder 21 M1 (dep) 4 as second digit in answer A1 for 14.50 (Accept 14.5)
21 (a)		$12x$	1	B1 oe
(b)		$12x + 10y$	2	B2 oe ft from (a) (B1 $12x$ + multiple of y or $10y$ seen) SC B1 for $x = 12x + 10y$ OR $y = 12x + 10y$

Paper 5501

No	Working	Answer	Mark	Notes
22	$\frac{1}{3}+\frac{1}{4}=\frac{4}{12}+\frac{3}{12}=\frac{7}{12}$ $1-\frac{7}{12}=\frac{5}{12}$	$\frac{5}{12}$	3	M1 for $\frac{4}{12}$ **and** $\frac{3}{12}$ oe A2 for $\frac{5}{12}$ oe (A1 for $\frac{7}{12}$) B1 for 1–"$\left(\frac{1}{3}+\frac{1}{4}\right)$" correctly evaluated
	$1-\frac{1}{3}=\frac{2}{3}$, $1-\frac{1}{4}=\frac{3}{4}$ $\frac{8}{12}-\frac{3}{12}=\frac{5}{12}$ or $\frac{9}{12}-\frac{4}{12}=\frac{5}{12}$	$\frac{5}{12}$	3	B1 for $\frac{2}{3}$ or $\frac{3}{4}$ seen M1 for $\frac{8}{12}-\frac{3}{12}=\frac{5}{12}$ or $\frac{9}{12}-\frac{4}{12}=\frac{5}{12}$ A1 for $\frac{5}{12}$ oe
		$\frac{5}{12}$	3	M1 for 0.25 and 0.33 or better A1 for 0.58 or better A1 for $0.41\dot{6}$ or recurring
23 (a) (b)(i) (ii)	 180 – (54 + 54)	54 72 Reason	1 3	B1 cao M1 for 180 – (54 + 54) A1 ft from (a) if $x < 90$ B1 for mentioning isosceles and equal or base angles or equal sides and equal or base angles

Paper 5501

No	Working	Answer	Mark	Notes
24 (a)		Bryani	2	M1 for 4×9 or $4 \times 3 \times 3$ or $4 \times x \times x$ or square x first or square 3 first A1 SC 4×3^2 with Bryani scores B2
(b)		64	1	B1 cao
25 (a)		 dotted line may be solid	3	B2 for rectangle base 3 squares and height 4 squares (B1 for rectangle with one correct dimension) B1 for horizontal line 1 cm from top) SC B2 for completely correct elevation on its side
(b)			2	B2 for perspective drawing showing slant face and cutout B1 for perspective drawing with either slant face cutout omitted
26 (a)	20×2 or $\frac{20}{30} \times 60$ or $20 \div \frac{1}{2}$	40	2	M1 for 20×2 or $\frac{20}{30} \times 60$ or $20 \div \frac{1}{2}$ A1 cao
(b)	$\frac{20}{60}$ or $\frac{1}{3}$ or 20 minutes	line from (45, 20) to (65, 0)	2	M1 for $\frac{20}{60}$ or $\frac{1}{3}$ or 20 minutes seen A1 for correct line SC If M0, B1 for line from (45, 20) to (t, 0) where $t > 45$ or B1 for a line of the correct gradient.

Paper 5502

No	Working	Answer	Mark	Notes
1 (a)		$\frac{7}{100}$	1	B1 cao accept 0.07
(b)		0.18	1	B1 cao
(c)	20 in 100 oe	40	2	M1 for sight of 20 in 100 or 20 × 2 A1 cao
2 (a)		6cm	2	B1 for 6 ± 0.2 or 60 ± 2 B1 indep for cm or mm consistent with 1st B1
(b)		At centre	1	B1 within overlay
(c)		Circle drawn	1	B1 all within overlay
3		See diagram	3	B3 all correct – see separate sheet (B2 for 3 correct B1 for 2 correct)
4 (a)		$\frac{1}{4}$ oe	1	B1 cao
(b)		0.75	1	B1 cao
(c)		75%	1	B1 cao
(d)(i)		9	2	B1 accept answer in range 9 - 9.2
(ii)		15 - 16		B1 accept answers in range15 - 16
5 (a)		9:30	1	B1 cao
(b)		2hrs 45 min	2	B2 for 2hr 45 min or 2 $\frac{3}{4}$ hr or 165 minutes B1 2:45 or 2.45 or 165 or 45min + 1hr + 1hr oe
(c)		17	1	B1 cao
6 (a)	96 × 4	3.84	2	M1 for 96 × 4 or digits 384 A1 cao
(b)	3 × 96 + 40 = 328	(0).56	2	M1 for 3 × 96 + 40 or digits 328 or digits 56 A1 cao accept 56p

Paper 5502

No	Working	Answer	Mark	Notes
7 (a)		54 000	1	B1 cao accept 54 thousand
(b)		50 000	1	B1 (accept ten thousand or 10 000) oe
8 (a)		14	1	B1 cao
(b)		6	1	B1 cao
(c)		Correct reflection	2	B2 fully correct (B1 correct reflection in a line parallel to the mirror line or condoning 1 block error in shape or position of shape)
9 (a)		Missing horiz label 1 (and 6) missing on vertical scale	2	B1 B1
(b)		Correct graph	2	B1 for bar up to 4 for yellow B1 for bar up to 2 for green
(c)		Blue	1	B1 cao
(d)	3 + 5 + 4 + 2	14	1	B1 ft from (b)
(e)		$\frac{3}{14}$	1	B1 ft on '14'
10	Barry (8) because you double Kath (7) because you add, 1,2,3		2	B1 oe B1 oe SC: B1 for correct rules only
11 (a)		$2n$	1	B1 for $2n$ or $n + n$ OR $2 \times n$ OR $n \times 2$ OR $n2$
(b)		$2n + 15$	1	B1 for "$2n$" + 15 oe
(c)		20q	1	B1 cao
12 (a)	1 + 3 + 5 + 8 + 5	22	2	M1 add frequencies A1 cao
(b)		No, is>no of cups of coffee in the table	1	B1 'average cannot be bigger than 6' oe OR 'Average must be less than 6 oe'
13 (a)		Trapezium	1	B1 cao ignore spelling
(b)		(2, 3)	1	B1 cao
(c)		Isosceles	1	B1 cao ignore spelling
(d)		Q correct	1	B1 cao

Paper 5502

No	Working	Answer	Mark	Notes
14 (a)		250 000	1	B1 cao
(b)	$\frac{28}{4}$	7	2	M1 for $\frac{28}{4}$ oe or "250000" × 28 A1 cao **SC** B1 for 7 000 000
15 (a)		10	1	B1 cao
(b)		5.5	1	B1 ±0.3 pounds
(c)	$\frac{110}{22}$	50	3	M1 for use of graph at 11 or $\frac{110}{22}$ A1 for 5 A1 cao **SC** B2 for 49.5 – 50.6

Paper 5502

No	Working	Answer	Mark	Notes
16 (a)	$269.30 - 56.80 = 212.50$ $\frac{212.50}{42.50}$	6	2	M1 for $\frac{269.30 - 56.80}{42.50}$ or 5 seen A1 cao
(b)	5% of £269.30 £269.30 – "£13.465" OR $\frac{95}{100} \times 269.30$	255.83 or 255.84	3	M1 for $(5 \div 100) \times 269.30$ M1 for $269.30 -$ "13.465" A1 cao OR M2 for $\frac{95}{100} \times 269.30$ A1 cao **Alternative Method:** M1 for $\frac{5}{100} \times 56.80$ (= 2.84) and $\frac{5}{100} \times 42.50$ (=2.12(5)) (OR 53.96 AND 40.38 (40.375) seen M1 for $56.80 -$ "2.84" (= 53.96) $42.50 -$ "2.12(5)" (= 40.375 or 40.38) "5" × "40.375" + "53.96" A1 cao
17	$4.1^2 \times 1.07 = 16.81 \times 1.07$	17.9867	2	M1 for ("4.1") followed by squaring, or sight of 16.81 A1 cao SC: *B1 for 18 or better with no working*
18 (a)		60	1	B1 cao
(b)	$360 - 60 - 90 - 90$	120	2	M1 for $360 -$ " 60 " $- 90 - 90$ or $180 -$ "60" A1 cao
(c)	6×2	12	2	M1 for 6×2 A1 cao for 12

Paper 5502

No	Working	Answer	Mark	Notes
19 (a)(i)	$240 \times 5 = 1200$	1250	3	B1 cao 1250
(ii)	$\frac{50}{'1250'}$	$\frac{1}{25}$		M1 cao $\frac{50}{'1250'}$ A1 for $\frac{1}{25}$ in its simplest form
(b)	$\frac{60}{100} \times 1000 = 600$	12:5	3	M1 for $\frac{60}{100} \times 1000$ oe A1 for 600 A1 cao
20 (a)		$x + 2$	1	B1 accept $2 + x$ but not $x = x + 2$
(b)	$x + 5 + x + 5 + x + 2 + x + 2$	$4x + 14$	2	M1 adding 4 sides, two of which are '$x + 2$' (all sides to be linear expressions in x) **SC** $x + 5 + x + 2 \times 2$ gets M1 A1 for correct simplified answer or $(20 - 14) \div 4$ oe gets M1
(c)	'$4x + 14$' = 20	1.5 oe	2	M1 for equation A1 cao
21	$\sum f = 90$	Angles drawn, labelled	3	M1 for 1 person = 4°or one angle correct in table or pie chart A1 any 2 correctly drawn angles in pie chart A1 fully correct chart labelled
22 (a)		$2p - q$	2	B1 cao for $2p$ B1 cao for $-q$ accept $(-q + 2p)$, $2p - 1q$ and $2p + -q$
(b)	$5x = 3 + 4$	1.4	2	M1 for either (+3 or sight of 7) or (÷ 5 or sight of 0.8 and 0.6) A1 cao accept $\frac{7}{5}$ or $1\frac{2}{5}$

Paper 5502

No	Working	Answer	Mark	Notes
23 (a)		$\frac{4\times5}{2}$	1	B1 cao
(b)	$1+2+3+4+5+6+7+8$	$\frac{8\times9}{2}$	1	B1 cao
(c)	$\frac{100\times101}{2}$	5050	1	B1 cao
24	0 | 5 7 8 8 1 | 0 0 0 0 2 5 5 5 6 2 | 0 0 0 4 5 3 | 3 5 Key 1 | 2 = 12 (min)	See working	3	B1 for stem 0, 1, 2, 3 or 0, 10, 20, 30 B1 for accurate unordered leaves condone 1 error or omission B1 for key and ordered leaves all correct
25	$3.2\times2.8=8.96$ $2\times4.5\times2.8=25.2$ $2\times4.5\times28.8=28.8$ $\frac{62.96}{2.5}\times2.99$	£75.30	5	M1 for area of any face found correctly M1 for 2 areas found correctly A1 for 62.96 or 54 M1 for $\frac{'62.96'}{2.5}\times2.99$ Al cao Alternate method for candidates who round up $\frac{"62.92"}{2.5}$ M1 for "26" × 2.99 A1 for £77.74 cao **SC**: *for top included B2 for 71.92 m^2 seen or* B3 for £86.02 seen **SC** B4 for £64.58 or £65.78 seen
26	$2.5\times10\,000$	25 000	2	M1 for $2.5\times100\times100$ A1 cao

Paper 5503

No	Working	Answer	Mark	Notes
1 (a)(i)		$8g$	2	B1 oe
(ii)		$10rp$		B1 for $10pr$ or $10\ rp$
(b)		$10y - 15$	1	B1 cao accept $10y$ - + 15
(c)	$6x + 8 - 12x + 15$	$-6x + 23$	2	M1 for 3 correct terms out of 4 A1 cao
2		$m = 6n$	2	B2 for $m = 6n$ oe accept $6 \times n$, n 6 (B1 for $6n$ alone, or $6n$ +1 oe OR m = multiple of n except $m = n$)
3 (i)		0.067, 0.56, 0.6, 0.605, 0.65	1	B1 cao Ignore trailing zeros
(ii)		−10, −6, −4, 2, 5	1	B1 cao
(iii)		$\frac{2}{5}, \frac{1}{2}, \frac{2}{3}, \frac{3}{4}$	2	B2 all four correct (B1 any three in correct order) SC: B1 all 4 in reverse order
4		7 5 5 13 33 52 23	3	B3 all correct (B2 for 4, 5 or 6 correct entries) (B1 for 2, 3 correct entries)

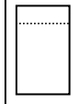
Paper 5503

No	Working	Answer	Mark	Notes
5		$\frac{2}{3}$	3	M1 for 3 rows (9 squares) shaded M1 for 2 columns (10 squares) shaded A1
	OR $\frac{3}{5}=\frac{9}{15}$ $\frac{2}{3}=\frac{10}{15}$ Therefore $\frac{2}{3}>\frac{3}{5}$	$\frac{2}{3}$		M1 for $\frac{3}{5}=\frac{9}{15}$ M1 for $\frac{2}{3}=\frac{10}{15}$ A1
	OR $\frac{3}{5}=0.6$ or percent $\frac{2}{3}=0.66$ or 0.67 or better Therefore $\frac{2}{3}>\frac{3}{5}$	$\frac{2}{3}$		M1 for $\frac{3}{5}=0.6$ or percent M1 for $\frac{2}{3}=0.66$ or 0.67 or better A1
6	$2\times 29=58$ $5\times 30=150$ $2\times 31=62$ $1\times 32=32$ $\frac{302}{10}=30.2$	30.2	3	M1 for freq × no. pins (at least 3) M1 for totalling and for ÷ 10 (dep on 1st M1) A1 cao
7 (a)			2	B1 for 180° rotation (wrong centre) B1 cao
(b)			3	B1 for any enlargement sf other than 1 B1 for all sides halved B1 for position

Paper 5503

No	Working	Answer	Mark	Notes
8 (a)		$12x$	1	B1 oe
(b)		$12x + 10y$	2	B2 oe or ft from (a) (B1 for $12x$ + a multiple of y or $10y$ seen) **SC** B1 for $x = 12x + 10y$ or $y = 12x + 10y$
9	$\frac{1}{3}+\frac{1}{4}=\frac{4}{12}+\frac{3}{12}=\frac{7}{12}$ $1-\frac{7}{12}=\frac{5}{12}$ OR $1-\frac{1}{3}=\frac{2}{3}, 1-\frac{1}{4}=\frac{3}{4}$ $\frac{9}{12}-\frac{4}{12}=\frac{5}{12}, \frac{8}{12}-\frac{3}{12}=\frac{5}{12}$	$\frac{5}{12}$	3	M1 for $\frac{4}{12}$ and $\frac{3}{12}$ oe A2 for $\frac{5}{12}$ oe (A1 for getting $\frac{7}{12}$) (B1 for $1 - \frac{"1}{3} + \frac{1"}{4}$ correctly evaluated) OR B1 for $\frac{2}{3}$ or $\frac{3}{4}$ seen M1 for $\frac{3}{4}-\frac{1}{3}=\frac{9}{12}-\frac{4}{12}$ or $\frac{2}{3}-\frac{1}{4}=\frac{8}{12}-\frac{3}{12}$ A1 for $\frac{5}{12}$ oe OR M1 0.25 and 0.33 or better A1 for 0.58 or better A1 for 0.416 *recurring*
10 (a)		54	1	B1 cao
(b)(i)	180 – (54 +54)	72	3	M1 for 180 – (“54” + “54”) A1 for 72° ft from (a) if $x < 90°$
(ii)				B1 for mentioning isosceles and equal or base angles or equal sides and equal or base angles

Paper 5503

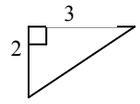
No	Working	Answer	Mark	Notes
11 (a)	Bryani was correct $4 \times 3^2 = 4 \times 9 = 36$	Bryani	2	M1 for 4×9 or $4 \times 3 \times 3$ or "square the three/x then multiply by four" A1 Bryani **SC** 4×3^2 with Bryani gets B2
(b)			1	B1 cao
12 (a)			3	B2 for rectangle height 4 squares, base 3 squares (B1 for rectangle with one correct dimension) B1for line 1 square from the top **SC** B2 for completely correct elevation on its side
(b)			2	B2 for perspective drawing showing slant face and cut out (B1 for perspective drawing with either slant face or cut out omitted or one aspect incorrect)
13 (a)	20×2 or $\frac{20}{30} \times 60$ or $20 \div \frac{1}{2}$	40	2	M1 for 20×2 or $\frac{20}{30} \times 60$ or $20 \div \frac{1}{2}$ A1 cao
(b)	$\frac{20}{60}$ or $\frac{1}{3}$ or 20 minutes seen	Line from (45, 20) to (65, 0)	2	M1 for $\frac{20}{60}$ or $\frac{1}{3}$ or 20 minutes seen A1 for correct line **SC** If M0, B1 for line from (45, 20) to (t, 0) where $t > 45$ or a line of the correct gradient
14 (i)		119.31	3	B1 cao
(ii)		119 310		B1 cao
(iii)		1.23		B1 cao

Paper 5503

No	Working	Answer	Mark	Notes
15	$\frac{10}{100}\times 12000$ 12 000 – 1200 = 10 800 $\frac{10800}{10}=1080$ 10 800 – 1080 = £9720	£9720	3	M1 for $\frac{10}{100}\times 12000$ or sight of 1200 or 2400 or 10 800 or 9600 M1 (dep) for $\frac{10}{100}\times(12\,000-\frac{10}{100}\times 12000)$ or sight of 1080 A1 cao Alternative mark scheme M2 for $12000\times(1-\frac{10}{100})^2$ (M1 for $12000\times(1-\frac{10}{100})$ A1 cao
16 (a)	$2p = 6$	$p = 3$	2	M1 for $7p - 5p = 8 - 2$ or $2p$ or 6 A1 cao
(b)	$7r - 5r = -20 - 2$	–11	2	M1 for $7r + 2 = 5r - 20$ or $\frac{7r}{5}+\frac{2}{5}=r-4$ or $7r-5r=20-2$ or $\frac{7r}{5}-r=-4-\frac{2}{5}$ A1 cao
17		$5n + 1$	2	B2 oe (B1 for $5n$ seen) NB: n = gets B1 max

Paper 5503

No	Working	Answer	Mark	Notes
18 (a)	–1, 0, 1		2	B2 for –1, 0, 1 (B1 for –1, 0 or 0,1 or –1,1 or –2, -1, 0, 1 only)
(b)	(–1, –1), (0, –1), (1, –1), (0, 0), (1, 0), (1, 1)		3	B3 for 6 points correct B2 for 3 points correct B1 for 1 point correct **NB** –B1 each additional point over six
19 (a)	Triangle with vertices at (0,0) (0,–2) and (3,0)		2	M1 for correct orientation A1 cao
(b)	Rotation, 180°, centre (0,1) Enlargement sf - 1 centre (0,1)		2	B2 for 180° 'rotation' centre (0, 1) B2 for Enlargement sf - 1 centre (0,1) (B1 for any two of the three parts) NB: B0 if additional transformation is included
20	Bisector of $\angle BAC$ Arc around A Region		3	B3 cao (B2 for either two correct boundaries, no shading/ wrong shading or one correct boundary, one incorrect boundary with valid shading) (B1 for either two incorrect boundaries but one drawn from A and one intersection, with valid shading or one correct boundary) Ignore shading outside the triangle
21		Length Volume Area	3	B1 for Length B1 for Volume B1 for Area
22 (a)	Unbiased question with choices		2	B1 for unbiased question B1 for at least 2 choices
(b)			2	Classification 1: A biased question Classification 2: A restricted sample of people Classification 3: Not specifying a range of foods Classification 4: Nothing to do with eating habits B2 reasons which satisfy 2 different classifications (B1 a reason which satisfies one classification)



Paper 5503

No	Working	Answer	Mark	Notes
23 (a)	$6 \times 10^2 \times 8 \times 10^4$ 48×10^6	4.8×10^7	3	M1 for $6 \times 10^a \times 8 \times 10^b$ oe, a and b integers including 0 A1 for 48×10^6 oe A1 cao
(b)	200 000 + 30 000	230000	2	B2 cao (B1 for sight of 200 000 or 30 000 or 2.3×10^5 or 23×10^4)
24 (i)		64	4	B1 cao
(ii)		3		B1 cao
(iii)	$\sqrt{16 \times 9} = \sqrt{144}$	12		B2 cao (B1 for sight of $\sqrt{2^4} \times \sqrt{9}$ or better, or 144 seen)
25 (i)	Tangent 90° to diameter /radius/ line from (through) centre	27°	4	B1 for 27° cao B1 for reason
(ii)	180 –(90+ "27") angle in semicircle (is 90°)/Alternate segments /angle at centre twice at circumference	63°		B1 ft for 90–"27" if not 63° B1 for reason
26 (a)(i)		152	2	B1 cao
(ii)		177		B1 cao
(b)			3	B1 for median marked at 167 B1 ft for postion of box with its ends at "152" and "177" B1 for position of whiskers with ends at 132 and 182 NB: For any points plotted between 141 and 149 give a tolerance of an extra ± 1 square
27	$x^2 + xy + xy + y^2$	$x^2 + 2xy + y^2$	2	M1 for at least 3 of the 4 terms correct A1 cao
		25	2	M1 for recognising 3.47 + 1.53 (= 5) A1 cao

Paper 5504

No	Working	Answer	Mark	Notes
1 (a)	$4.1^2 \times 1.07 = 16.81 \times 1.07$	17.9867	2	M1 for (4.1) followed by squaring, or sight of 16.81 A1 cao SC: B1 for 18 or better with no working
(b)		$(1.6 + 3.8 \times 2.4) \times 4.2$	1	B1 cao Allow additional brackets if they give an expression with value 45.024
2 (a)	269.30 – 56.80 = 212.50	6	2	M1 for $\frac{269.30 - 56.80}{42.50}$ or 5 seen A1 cao
(b)	5% of £269.30 £269.30 – "£13.465" OR $\frac{95}{100} \times 269.30$	255.83 or 255.84	3	M1 for (5 ÷ 100) × 269.30 M1 (dep) for 269.30 – "13.465" A1 cao OR M2 for $\frac{95}{100} \times 269.30$ A1 cao **Alternative Method:** M1 for $\frac{5}{100} \times 56.80$ (= 2.84) and $\frac{5}{100} \times 42.50$ (=2.12(5)) (OR 53.96 AND 40.38 (40.375) seen M1 for 56.80 – "2.84" (= 53.96) 42.50 – "2.12(5)" (= 40.375 or 40.38) "5" × "40.375" + "53.96" A1 cao

Paper 5504

No	Working	Answer	Mark	Notes
3 (a)		60	1	B1 cao
(b)	360 – 60 – 90 – 90	120	2	M1 for 360 – "60" – 90 – 90 or 180 – "60" A1 cao
(c)	6 × 2	12	2	M1 for 6 × 2 A1 cao 12
(d)		Correct drawing	2	B2 for triangle and construction lines (see overlay) (B1 for 1 line of length 4cm and correct arcs crossing OR for correct triangle with either no arcs or incorrect arcs) SC: B1 similar triangle drawn with construction lines
4 a(i)	240 × 5 = 1200	1250	3	B1 cao 1250
(ii)	$\frac{50}{1250}$	$\frac{1}{25}$		M1 $\frac{50}{"1250"}$ A1 oe in its simplest form
(b)	$\frac{60}{100} \times 1000 = 600$ 600: 250	12:5	3	M1 for $\frac{60}{100} \times 1000$ oe A1 for 600 A1 cao
5 (a)		$x + 2$	1	B1
(b)	$x + 5 + x + 5 + x + 2 + x + 2$	$4x + 14$	2	M1 adding 4 sides, two of which must be '$x + 2$' (all sides to be linear expressions in x) A1 for correct simplified answer
(c)	"$4x + 14$" = 20	1.5	2	M1 for equation "$4x + 14$" = 20 OR $\frac{20-14}{4}$ oe A1 cao

Paper 5504

No	Working	Answer	Mark	Notes
6 (a)		$2p - q$	2	B1 cao for $2p$ B1 cao for $-q$ accept $-q + 2p$ and $2p - 1q$
(b)	$5x = 3 + 4$	1.4	2	M1 for either (+3 or sight of 7) or (÷ 5 or sight of 0.8 and 0.6) A1 cao accept $\frac{7}{5}$ or $1\frac{2}{5}$
7 (a)		$\frac{4\times5}{2}$	1	B1 cao
(b)	$1 + 2 + 3 + 4 + 5 + 6 + 7 + 8$	$\frac{8\times9}{2}$	1	B1 cao
(c)	$\frac{100\times101}{2}$	5050	1	B1 cao
(d)		$\frac{n(n+1)}{2}$	2	B2 cao (B1 for any quadratic in n)
8	$3.2 \times 2.8 = 8.96$ $2 \times 4.5 \times 2.8 = 25.2$ $2 \times 4.5 \times 3.2 = 28.8$ $\frac{62.96}{2.5} \times 2.99$	75.30	5	M1 for area of any face found correctly M1 for 2 areas seen A1 for 62.96 or 54 M1 for $\frac{'62.96'}{2.5} \times 2.99$ A1 cao Alternate method for candidates who round up $\frac{"62.96"}{2.5}$ M1 for "26" x 2.99 A1 for £77.74 cao SC: for top included B2 for 71.92 m^2 seen or B3 for £86.02 or £86.71 SC: B4 for £64.58 or £65.78 seen

Paper 5504

No	Working	Answer	Mark	Notes
9	2.5×10000	25000	2	M1 for 2.5×10000 or $2.5 \times 100 \times 100$ A1 cao
10 (a)	$\sum f = 90$ (88), 144, 32, 96	Angles drawn, labelled	3	M1 for 1 person = 4° or one angle correct in table or pie chart A1 any 2 angles correctly drawn in pie chart A1 fully correct chart labelled
(b)	$0.38 + 0.27 + 0.15$	0.20	2	M1 1 – sum A1 cao
11	0 | 5 7 8 8 1 | 0 0 0 0 2 5 5 5 6 2 | 0 0 0 4 5 3 | 3 5 Key 1 | 3 = 13 (min)	See working column	3	B1 for stem 0, 1, 2, 3 or 0, 10, 20, 30 B1 for accurate unordered leaves condone 1 error or omission B1 for key and ordered leaves all correct
12 (a)	$V = \pi \times 4^2 \times 10$	502 – 503	2	M1 for $\pi \times 4^2 \times 10$ A1 502 – 503
(b)	$P^2 = 10^2 + 8^2$ $P = \sqrt{164}$	$\sqrt{164} < 13$	3	M1 for sight of a correct right-angled triangle M1 for $10^2 + 8^2$ A1 for conclusion based on a correct calculation or 12.8 seen
13 (a)	2×30	$2 \times 2 \times 3 \times 5$	4	M1 for systematic method, eg division, factor trees (at least one prime) A1 cao
	2×48	$2^5 \times 3$		M1 for systematic method, eg division, factor trees (at least one prime) A1 cao
(b)		12	1	B1 cao
(c)	$2^5 \times 3 \times 5$	480	2	B2 cao B1 for $2^5 \times 3 \times 5$ or any correct common multiple

Paper 5504

No	Working	Answer	Mark	Notes
14 (a)		$150 < C \leq 200$	2	M1 use of cum freq to find the cost of the 20th or 20.5^{th} car OR $\frac{1}{2}\Sigma f$ or $\frac{1}{2}(\Sigma f + 1)$ A1 eg 150 to 200
(b)		No, because the 21st value is in the same interval	1	B1 20.5^{th} or 21st in same interval or an alternative correct explanation
(c)	80% = 5200 $\frac{5200}{80} \times 100$	6500	3	M1 for (100 – 20) % = 5200 M1 for $\frac{5200}{"80"} \times 100$ A1 cao
15 (a)	$x^2(x + 1) = 230$	AG	2	M1 for $x \times x \times (x+1)$ or $x \times x \times x + 1$ oe A1 cao from $x \times x \times (x+1)$
(b)	'5 – 150 5.1 – 158.7 5.2 – 167.6 5.3 – 177.0 5.4 – 186.6 5.5 – 196.6 5.6 – 207.0 5.7 – 217.7 5.8 – 228.8 5.9 –240.2 5.85 – 234.4	5.8	4	B 2 for trial between 5.8 and 5.9 inclusive (B1 for different trial between 5 and 6 inclusive) B1 for different trial between 5.8 and 5.85 (not including 5.8) B1 (dep on at least one previous B1) cao for 5.8, 5.81, 5.811

Paper 5504

No	Working	Answer	Mark	Notes
16	$\pi \times \left(\frac{15}{2}\right)^2 = 176.715$	88.4cm^2	3	M1 for $\pi \times \left(\frac{15}{2}\right)^2$ A1 88.3 – 88.4 B1(ind) for cm²
17 (a)	$5 = 0.5x + 1$	8	2	M1 for $5 = 0.5x + 1$ A1 cao
(b)		$y = \frac{1}{2}x + c$	1	B1 $y = \frac{1}{2}x + c$, c ≠ 1, oe
(c)		$x = 2y - 2$ OR $x = 2(y - 1)$	2	M1 for correctly multiplying both sides by 2 or correctly isolating $\frac{x}{2}$ A1 for $x = 2(y - 1)$, $x = \frac{y-1}{0.5}$, $x = \frac{y-1}{\frac{1}{2}}$ oe SC: B1 for $x = 2y - 1$
18	$4x - 6y = 22$ $15x + 6y = 54$ $19x = 76$	$x = 4,\ y = -1$	4	M1 for coefficients of x or y the same followed by correct operation , one arithmetical error A1 cao M1(dep on previous M mark) for sub for other variable A1 cao Trial and improvement –0 unless both x and y correct values found

Paper 5504

No	Working	Answer	Mark	Notes
19 (a)	$SF = \frac{10}{6}$ $\frac{10}{6} \times 4.8 = 8$	8	2	M1 for sight of $\frac{10}{6}$ or $\frac{6}{10}$ or 1.67 or better or $\frac{CD}{10} = \frac{4.8}{6}$ A1 cao
(b)	$\frac{10}{6} \times 4.5 - 4.5 = 3$	19.8	2	M1 for use of SF from (a) to find *BC* or *AC* and adding 4 sides A1 cao
20	$\frac{6 \times 10^{15}}{3.2 \times 10^{8}}$ 1.875×10^{7}	4.3×10^{3}	3	B3 for 4.3×10^{3} to 4.34×10^{3} (B2 for 1.875×10^{7} oe or 4300 to 4340 or final answer of 1.9×10^{7}) (B1 for sight of 6×10^{15} oe or 3.2×10^{8} oe)
21	$8.5 \times \tan 38 = 8.5 \times 0.7813$	6.64	3	M1 for correct use of trig, eg $\tan 38 = \frac{opp}{8.5}$ M1 for 8.5 × tan38 A1 6.64 – 6.641

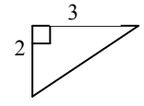
Paper 5504				
No	**Working**	**Answer**	**Mark**	**Notes**
22 (a)		No, as you would expect about 100. Yes, as it is possible to get 200 sixes with a fair dice	1	B1 for a consistent answer
(b)	$\frac{1}{6}, \frac{5}{6}$ + labels		3	B1 for $\frac{5}{6}$ on the red dice, *not six* branch B1 for a fully complete tree diagram with all branches labelled B1 for $\frac{1}{6}$, $\frac{5}{6}$ on all remaining branches as appropriate

Paper 5505

No	Working	Answer	Mark	Notes
1 (i) (ii) (iii)		119.31 119310 1.23	3	B1 cao B1 cao B1 cao
2	$\frac{10}{100}\times 12000 = 1200$ 12 000 – 1200 = 10 800 10 800 ÷ 10 =1080 10 800 – 1080 = £9720	9720	3	M1 for $\frac{10}{100}\times 12\,000$ or sight of 1200 or 2400 or 10 800 or 9600 M1 (dep) for $\frac{10}{100}\times(12\,000 - \frac{10}{100}\times 12\,000)$ or sight of 1080 A1 cao Alternative markscheme M2 for $12000\times\left(1-\frac{10}{100}\right)^2$ (M1 for $12000\times\left(1-\frac{10}{100}\right)$) A1 cao
3	$7r - 5r = -20 - 2$	–11	2	M1 for $7r + 2 = 5r - 20$ or $\frac{7r}{5} + \frac{2}{5} = r - 4$ or $7r - 5r = -20 - 2$ or $\frac{7r}{5} - r = -4 - \frac{2}{5}$ A1 cao

Paper 5505

No	Working	Answer	Mark	Notes
4 (a)		–1, 0, 1	2	B2 for –1, 0, 1 only (B1 for –1, 0 or 0,1 or –1, 1 or –2, -1, 0, 1 only)
(b)		(–1,–1)(0,–1) (1,–1) (0, 0) (1, 0) (1, 1)	3	B3 for 6 points correct (B2 for 3 points correct) (B1 for 1 point correct) *NB: –B1 for each additional point over six*
5		$5n + 1$	2	B2 oe (B1 for $5n$ seen) NB: n = gets B1 max
6 (a)	Triangle with vertices at (0,0) (0,–2) and (3,0)		2	M1 for correct orientation A1 cao
(b)	Rotation, 180°, centre (0,1) Enlargement sf –1 centre (0,1)		2	B2 for 180° 'rotation' centre (0, 1) or for Enlargement sf - 1 centre (0,1) (B1 for any two of the three parts) NB: B0 if additional transformation is included
7	Bisector of $\angle BAC$ Arc around A Region	See overlay	3	B3 cao (B2 for either two correct boundaries, no shading/ wrong shading or one correct boundary, one incorrect boundary with valid shading) (B1 for either two incorrect boundaries but one drawn from A and one intersection, with valid shading or one correct boundary) Ignore shading outside the triangle
8		Length Volume Area	3	B1 for Length B1 for Volume B1 for Area



Paper 5505

No		Working	Answer	Mark	Notes
9	(a)	Unbiased question with choices		2	B1 for unbiased question B1 for at least 2 choices
	(b)	Leading question and a restricted sample		2	Classification 1: A biased question Classification 2: A restricted sample of people Classification 3: Not specifying a range of foods Classification 4: Nothing to do with eating habits B2 reasons which satisfy 2 different classifications (B1 a reason which satisfies one classification)
10	(a)	$6 \times 10^2 \times 8 \times 10^4$ $48 \times 10^6 = 4.8 \times 10^7$	4.8×10^7	3	M1 for $6 \times 10^a \times 8 \times 10^b$ oe, a and b integers including 0 A1 for 48×10^6 oe A1 cao
	(b)	200 000 + 30 000 = 230 000	230 000	2	B2 cao (B1 for sight of 200 000 or 30 000 or 2.3×10^5 or 23×10^4)
11	(a)	$x^2 + xy + xy + y^2$	$x^2 + 2xy + y^2$	2	M1 for at least 3 of the 4 terms correct A1 cao
	(b)		25	2	M1 for recognising 3.47 + 1.53 (= 5) A1 cao
12	(i)	Tangent 90° to diameter /radius/ line from (through) centre	27°	4	B1 for 27° cao B1 for reason
	(ii)	180 –(90+ "27") angle in semicircle (is 90°)/Alternate segments /angle at centre twice at circumference	63°		B1 ft for 90–"27" if not 63° B1 for reason
13	(i)		p^9	1	B1 cao
	(ii)		$6q^6$	2	B2 for $6q^6$ (B1 for sight of $\frac{6q^9}{q^3}$ or $3q \times 2q^5$ or $3q^4 \times 2q^2$ or $6 \times q \times q \times q \times q \times q \times q$ or final answer of the form kq^6, $k > 0$)

Paper 5505

No	Working	Answer	Mark	Notes
14 (a)(i)		152	2	B1 cao
(ii)		177		B1 cao
(b)			3	B1 for median marked at 167 B1 ft for postion of box with its ends at "152" and "177" B1 for position of whiskers with ends at 132 and 182 NB: For any points plotted between 141 and 149 give a tolerance of an extra ± 1 square
15	(arc =) $\frac{40}{360} \times 2\pi \times 9$ $= 2\pi$	$2\pi + 18$	4	M1 for $\frac{40}{360} \times$ M1 for $2\pi \times 9$ M1 (dep) for $\frac{40}{360} \times 2\pi \times 9$ oe A1 for $\frac{18 \times \pi}{9} + 18$ oe exact form
16 (i)		1	1	B1 cao
(ii)		$\frac{1}{16}$	1	B1 cao accept 0.0625
(iii)		64	1	B1 cao condone ± 64

Paper 5505

No	Working	Answer	Mark	Notes
17 (a)	$F \propto 1/x^2$ $F = k/x^2$ $4 = k / 3^2$ $F = 36/x^2$	$F = \frac{36}{x^2}$	3	M1 for $F = k/x^2$ seen or implied. ($k \neq 1$) M1 (dep) for subst. or sight of $k = 36$ A1 for $F = 36/x^2$
(b)		9	1	B1 ft for 9 (ft on $F = kx^n$, $n \neq 0$)
(c)	$64 = \frac{36}{x^2}$ $x^2 = \frac{36}{64}$ $x = \pm\frac{3}{4}$	$\frac{6}{8}$	2	M1 for $x^2 = \frac{"36"}{64}$ A1 for $\frac{6}{8}$ oe (condone $\pm$) *SC: Use of $F = kx^2$ max M1 M1 A0 B1 ft M0 A0* *SC: Use of* $F = \frac{k}{\sqrt{x}}$ *max M1 M1 A0 B0 M1* ($\sqrt{x} = \frac{4\sqrt{3}}{64}$) *A0*
18	$(5+\sqrt{3})(5-\sqrt{3}) = 5\times5 - 5\sqrt{3} + 5\sqrt{3} - \sqrt{3}\sqrt{3}$ $= 5\times5 - 3$ $\frac{22}{\sqrt{22}} = \frac{22\sqrt{22}}{22}$	$\sqrt{22}$	3	B1 for correct expansion $25 - 5\sqrt{3} + 5\sqrt{3} - \sqrt{3}\ \sqrt{3}$ with 1st three terms reducing to 25 **without** any errors seen B1 (indep) for $\sqrt{3}\ \sqrt{3} = 3$ B1 for $\sqrt{22}$ coming from $\frac{22}{\sqrt{22}}$ (S.C $\frac{(5+\sqrt{3})(5-\sqrt{3})\sqrt{22}}{22}$ gets B1)

Paper 5505

No	Working	Answer	Mark	Notes
19 (a)		60 40	2	B1 cao B1 cao
(b)		correct bars	2	B1 for $30 < x \leq 40$ with an area of 2½ squares B1 for $40 < x \leq 70$ with an area of 3 squares *SC:* $\frac{0}{4}$ *give M1 if clearly using area or frequency density*
20 (a)	$6x + 8 - 12x + 15$	$-6x + 23$	2	M1 for 3 of the 4 terms $6x$, $+8$, $-12x$, $+15$ correct A1 cao
(b)		$32x^5y^{15}$	2	B2 cao (B1 for two of 32, x^5, y^{15})
(c)	$\frac{(n+1)(n-1)}{n+1} \times \frac{2}{n-2}$ $\frac{2(n-1)}{n-2}$	$\frac{2(n-1)}{n-2}$	3	M1 for $k(n + 1)(n - 1)$ M1 dep for $\frac{(n+1)(n-1)}{(n+1)} = n - 1$ A1 for $\frac{2(n-1)}{n-2}$
21	Vertices at $(-3, -1\frac{1}{2}), (-4\frac{1}{2}, -1\frac{1}{2}), (-3, -4\frac{1}{2})$		3	B1 for all sides $\times 1\frac{1}{2}$ B1 for correct orientation with 2 vertices almost correct B1 cao

Paper 5505

No	Working	Answer	Mark	Notes
22	Total = 3 + 5 + 2 (=10) $\frac{3}{10}\times\frac{3}{10}\times\frac{5}{10}\left(=\frac{45}{1000}\right), \frac{3}{10}\times\frac{3}{10}\times\frac{2}{10}\left(=\frac{18}{1000}\right)$ $\frac{5}{10}\times\frac{5}{10}\times\frac{3}{10}\left(=\frac{75}{1000}\right), \frac{5}{10}\times\frac{5}{10}\times\frac{2}{10}\left(=\frac{50}{1000}\right)$ $\frac{2}{10}\times\frac{2}{10}\times\frac{3}{10}\left(=\frac{12}{1000}\right), \frac{2}{10}\times\frac{2}{10}\times\frac{5}{10}\left(=\frac{20}{1000}\right)$ $3\times\left(\frac{"45"}{1000}+\frac{"18"}{1000}+\frac{"75"}{1000}+\frac{"50"}{1000}+\frac{"12"}{1000}+\frac{"20"}{1000}\right)$ $\frac{660}{1000}$	$\frac{660}{1000}$ oe	5	M3 for all six expressions seen OR their combined equivalents (M2 for four expressions seen OR their combined equivalents) (M1 for two expressions seen OR their combined equivalents) M1 sum of 18 relevant products condone 1 slip A1 for $\frac{660}{1000}$ oe *SC: without replacement maximum M4 A0* SC: Just 2 beads: Answer either $\frac{38}{100}$ oe OR $\frac{28}{90}$ oe B1

Paper 5505

No	Working	Answer	Mark	Notes
23 (a)(i)		$6\mathbf{b} - 6\mathbf{a}$	2	B1 for $6\mathbf{b} - 6\mathbf{a}$ oe
(ii)		$6\mathbf{a}$		B1 for $6\mathbf{a}$ oe
(b)	$\overrightarrow{EX} = \overrightarrow{EB} + \overrightarrow{BX}$ $= 12\mathbf{b} + \frac{1}{2}\overrightarrow{BC}$	$12\mathbf{b} - 3\mathbf{a}$	2	M1 for $\overrightarrow{EX} = \overrightarrow{EB} + \overrightarrow{BX}$ oe vector journey in a form ready for straightforward substitution A1 for $12\mathbf{b} - 3\mathbf{a}$ oe
(c)	$\overrightarrow{AY} = \frac{5}{3}\overrightarrow{AB}$ or $\overrightarrow{BY} = \frac{2}{3}\overrightarrow{AB}$ $\overrightarrow{EY} = 16\mathbf{b} - 4\mathbf{a}$ or $\overrightarrow{XY} = 4\mathbf{b} - \mathbf{a}$ $\overrightarrow{EY} = 4\overrightarrow{XY}$ or $\overrightarrow{EX} = 3\overrightarrow{XY}$ or $\overrightarrow{EY} = \frac{4}{3}\overrightarrow{EX}$	Printer Answer	3	B1 for either $\overrightarrow{AY} = \frac{5}{3}\overrightarrow{AB}$ or $\overrightarrow{BY} = \frac{2}{3}\overrightarrow{AB}$ oe B1 ft for either $\overrightarrow{EY} = 16\mathbf{b} - 4\mathbf{a}$ or $\overrightarrow{XY} = 4\mathbf{b} - \mathbf{a}$ ft only on parts (*a*) and (*b*) B1 for either $\overrightarrow{EY} = 4\overrightarrow{XY}$ or $\overrightarrow{EX} = 3\overrightarrow{XY}$ or $\overrightarrow{EY} = \frac{4}{3}\overrightarrow{EX}$ oe **plus** conclusion of *E*, *X*, *Y* on the same straight line
24 (a)(i)		$(5, -4)$	4	B1 cao
(ii)		$(2, -9)$		B1 cao
(iii)		$(2, 4)$		B1 cao
(iv)		$(1, -4)$		B1 cao
(b)		$(x-2)^2 - 4$	4	B4 for $(x-2)^2 - 4$ oe eg. $x^2 - 4x$ (B3 for $(x+2)^2 - 4$ or $(x-2)^2 + 4$) (B2 for $x^2 - 4$ or $(x-2)^2$ OR $x^2 + bx$, $b \neq 0$ OR $(x+2)^2 + 4$ OR $f(x-2) - 4$) (B1 for $x^2 + 4$ or $(x+2)^2$ or $ax^2 + bx$ or $x^2 + bx + c$ OR $x - 2 - 4$ or $x^2 - 2 - 4$, $a, b, c \neq 0$)

Paper 5506

No	Working	Answer	Mark	Notes
1 (a)	$V = \pi \times 4^2 \times 10$	502 – 503 cm^3	2	M1 for $\pi \times 4^2 \times 10$ A1 502 – 503
(b)	$P^2 = 10^2 + 8^2$ $P = \sqrt{164}$	$\sqrt{164} < 13$	3	M1 for sight of correct right angled triangle M1 for $10^2 + 8^2$ A1 for conclusion based on a correct calculation Or 12.8 seen
2 (a)(i)	2×30	$2 \times 2 \times 3 \times 5$	4	M1 for systematic method, eg division, factor trees (at least one prime) A1 cao
(ii)	2×48	$2^5 \times 3$		M1 for systematic method, division, factor trees (at least one prime) A1 cao
(b)		12	1	B1 cao
(c)	$2^5 \times 3 \times 5$	480	2	B2 cao B1 for $2^5 \times 3 \times 5$ or any correct common multiple

Paper 5506

No	Working	Answer	Mark	Notes
3 (a)		$150 < C \leq 200$	2	M1 use of cum freq to find the cost of the 20th or 20.5^{th} car OR $\frac{1}{2}\Sigma f$ th or $\frac{1}{2}(\Sigma f + 1)$ th car. A1 eg 150 to 200, 150 – 200
(b)		No, because the 21st value is in the same interval	1	B1 for 20.5^{th} or 21st value in the same internal consistent with 'a' OR Refers to the median value being low in the interval (statement to be mathematically correct) See additional sheet
(c)	80% = 5200 $\frac{5200}{80} \times 100$	6500	3	M1 for (100 – 20)% = 5200 M1 for $\frac{5200}{"80"} \times 100$ A1 cao

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No	Working	Answer	Mark	Notes
4 (a)	$x^2(x + 1) = 230$	AG	2	M1 for $x \times x \times (x+1)$ or $x \times x \times x + 1$ oe, $x^2(x+1)$, $x^2 \times x + 1$ A1 cao from $x \times x \times (x+1)$, no need to see 230
(b)	5 – 150 6 – 252 5.1 – 158.7 5.2 – 167.6 5.3 – 177.0 5.4 – 186.6 5.5 – 196.6 5.6 – 207.0 5.7 – 217.7 5.8 – 228.8 5.9 –240.2 5.85 – 234.4	5.8	4	B2 for trial between 5.8 and 5.9 inclusive evaluated (B1 for trial between 5 and 6 inclusive evaluated) B1 for different trial between 5.8 and 5.85 (not including 5.8) B1 dep on at least are previous B1 5.8, 5.81, 5.811
5	$\pi \times \left(\frac{15}{2}\right)^2 = 176.715$	88.4 cm^2	3	M1 for $\pi \times \left(\frac{15}{2}\right)^2$ seen A1 88.3 – 88.4 B1 for cm² (independent)

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No	Working	Answer	Mark	Notes
6 (a)	$5 = 0.5x + 1$	8	2	M1 for $5 = 0.5x + 1$ A1 cao
(b)		$y = \frac{1}{2}x + c$	1	B1for $y = \frac{1}{2}x + c$, $c \neq 1$, oe
(c)		$x = 2y - 2$ OR $x = 2(y - 1)$	2	M1for correctly multiplying both sides by 2 or correctly isolating $\frac{x}{2}$ A1 for $x = 2(y - 1)$, $x = \frac{y-1}{0.5}$, $\frac{y-1}{\frac{1}{2}}$ oe SC B1 for x= 2y -1
7	$4x - 6y = 22$ $15x + 6y = 54$ $19x = 76$	$x = 4$, $y = -1$	4	M1 for coefficients of x or y the same followed by correct operation, allow one arithmetical error A1 cao M1 (dep) for correct sub for other variable A1 cao Trial and improvement 0 marks unless both correct values of x and y found
8 (a)	SF = $\frac{10}{6}$ $\frac{10}{6} \times 4.8 = 8$	8	2	M1 for sight of $\frac{10}{6}$ or $\frac{6}{10}$ or 1.67 or better or $\frac{CD}{10} = \frac{4.8}{6}$ A1 cao
(b)	$\frac{10}{6} \times 4.5 - 4.5 = 3$	19.8	2	M1 for use of SF from "a" to find AC or BC or $\frac{BC}{4.5} = \frac{4}{6}$ and adding 4 sides A1 cao

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No	**Working**	**Answer**	**Mark**	**Notes**
9	$\frac{6\times10^{15}}{3.2\times10^{8}}$ 1.875×10^{7}	4.3×10^{3}	3	B3 for 4.3×10^{3} to 4.34×10^{3} (B2 for 1.875×10^{7} oe or 4300 to 4340, final answer of 1.9×10^{7} B1 for sight of 6×10^{15} oe or 3.2×10^{8} oe)
10	$8.5\times\tan38$ $=8.5\times0.7813$ $\frac{8.5}{\sin(90-38)}=\frac{AB}{\sin38}$ $AB=\frac{8.5\times\sin38}{\sin(90-38)}$ $=\frac{5.2331}{0.788}=6.64$	6.64	3	M1 for correct use of trig, eg $\tan 38=\frac{opp}{8.5}$ M1 for $8.5\times\tan38$ A1 6.64 – 6.641 OR M1 for correct substitution into the sine rule M1 (dep) for correct rearrangement for AB= A1 6.64 – 6.641
11 (a)		No, as you would expect about 100. Yes, as it is possible to get 200 sixes with a fair dice	1	B1 for a consistent answer See additional sheet

Paper 5506

No	Working	Answer	Mark	Notes
(b)	$\frac{1}{6}, \frac{5}{6}$ + labels		3	B1 for $\frac{5}{6}$ on the red dice, *not six* branch B1 for a fully complete tree diagram with all branches labelled B1 for $\frac{1}{6}$ and $\frac{5}{6}$ on all remaining branches as appropriate
(c)(i)	$\left(\frac{1}{6}\right)^2$	$\frac{1}{36}$	2	M1 $\left(\frac{1}{6}\right)^2$ or $\frac{1}{6}\times\frac{1}{6}$ only or 0.28 A1 $\frac{1}{36}$ or 0.03 or better
(ii)	$1-\left(\frac{5}{6}\right)^2$ OR $\frac{1}{6}\times\frac{5}{6}+\frac{5}{6}\times\frac{1}{6}+\frac{1}{6}\times\frac{1}{6}$	$\frac{11}{36}$	3	M2 for $1-\left(\frac{5}{6}\right)^2$ or $1-\frac{5}{6}\times\frac{5}{6}$ A1 cao OR M1 for $\frac{1}{6}\times\frac{5}{6}$ oe M1 for 2 or 3 only of $\frac{1}{6}\times\frac{5}{6}, \frac{5}{6}\times\frac{1}{6}$, "a" A1 for $\frac{11}{36}$ or 0.31 or better

Paper 5506

No	Working	Answer	Mark	Notes
12 (a)	$\pi \times 30 \times \frac{7.5^2}{3} - \pi \times 10 \times \frac{2.5^2}{3} = 1767 - 65$	1700	3	M1 for either $\pi \times 30 \times \frac{7.5^2}{3}$ or $\pi \times 10 \times \frac{2.5^2}{3}$ M1 (dep) for difference A1 1700 – 1702 **SC** B1 Using d instead of r, 6800 – 6808
(b)	$\frac{S}{2\pi d} = \sqrt{h^2 + d^2}$ $\left(\frac{S}{2\pi d}\right)^2 = h^2 + d^2$	$h = \sqrt{\frac{S^2 - 4\pi^2 d}{4\pi^2 d^2}}$	3	M1 for correctly isolating $\sqrt{h^2 + d^2}$ or $h^2 + d^2$ or $h + d$ or kh^2 or kh M1(indep) squaring both sides A1 $h = \sqrt{\frac{S^2 - 4\pi^2 d^4}{4\pi^2 d^2}}$, $h = \frac{\sqrt{S^2 - 4\pi^2 d^4}}{2\pi d}$ $h = \sqrt{\left(\frac{S}{2\pi d}\right)^2 - d^2}$
(c)	$\left(\frac{30}{20}\right)^2 \times 450$ or $450 \div \left(\frac{20}{30}\right)^2$	1012.5	2	M1 for sight of correct SF^2 including 4:9 A1 1010 to 1013

Paper 5506

No	Working	Answer	Mark	Notes
13 (a)	$\frac{2x(x+20)}{2} = 400$	As given	2	M1 $\frac{2x(x+20)}{2}$ or $\frac{2x \times x + 20}{2}$ or $2x(x + 20) = 800$ A1 cao following correct working, no need for = 400 *SC B1* $2x \times x + \frac{1}{2} \times 2x(10 - \frac{x}{2}) \times 2$
(b)	$\frac{-20 \pm \sqrt{20^2 - 4 \times 1 \times (-400)}}{2}$ $= \frac{-20 \pm 44.721}{2}$	12.361	3	M1 for correct sub, up to signs, in the quad formula A1 for 44.7 or $\sqrt{2000}$ A1 for 12.3606 – 12.361, ignore negative solution T.I B3 for 12.361 OR Completing the square M1 for $(x+10)^2$ seen A1 for $-10 \pm \sqrt{500}$ A1 for 12.3606 – 12.361 ignore negative solution

Paper 5506

No	Working	Answer	Mark	Notes
14 (a)	$0.5\times 8\times 15\times \sin 70^0$	56.4	2	M1 for correct sub into area formula A1 56.38 – 56.4
(b)	$AB^2 = 8^2 + 15^2 - 2\times 8\times 15\times \cos 70^0 = 206.9$ EITHER $0.5\times AB\times CX$ ='56.38' OR $\frac{\sin B}{8} = \frac{\sin 70}{\sqrt{'206.9'}}$ $B = 31.5$ 15 sin '31.5'	7.84	4	M1 for correct sub into cos rule A1 for 206.9 - 207 or 14.38 – 14.4 EITHER M1 for use of area rule to find CX A1 7.83 – 7.84 OR M1 for correct use of sine rule to find sin B or sin A and then sight of 15sin B *or* 8 sin A A1 7.83 – 7.84

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No	Working	Answer	Mark	Notes
15 (a)	$4a^2 - 4a + 1 - (4b^2 - 4b + 1) =$ $4(a^2 - b^2) - 4(a - b)$ $4(a - b)(a + b - 1)$ OR $((2a - 1) - (2b - 1))((2a - 1) + (2b - 1))$ $(2a - 2b)(2a + 2b - 2)$	AG	3	Expansion Method M1 for a correct expansion of any one of the three terms M1(dep) on an attempt to expand all 3 terms and show LHS = RHS A1 fully correct algebra RHS exp is $4\left(a^2 + ab - a - ba - b^2 + b\right)$ OR Factorisation Method M1 for attempt to use difference of 2 squares on LHS M1 for one bracket correctly simplified A1 fully correct
(b)	Any 2 odd square numbers have the above form If a and b are both even or odd then $a - b$ is even, so $4(a - b)$ is a multiple of 8 If one of a,b is odd, then $a + b - 1$ is even, so $4(a + b - 1)$ is a multiple of 8		3	B1 'any 2 square nos have the above form' (may be implied by sight of $(2a - 1)^2 - (2b - 1)^2$ in part (b)) B1 first reason B1 second reason SC B1 for $(2r + 1)^2 - (2r - 1)^2$ B1 for 8r
16 (a)	$g_L = \frac{2 \times 4.495}{1.35^2 \times \sin 30.5}$ $g_u = \frac{2 \times 4.505}{1.25^2 \times \sin 29.5}$	9.719 11.710	4	B2 for any 4 of 4.505, 1.25, 29.5, 4.495, 1.35, 30.5 seen (B1 for any two or three seen) B1 for 11.710 – 11.7103 B1 cao 9.719 – 9.71904
(b)	Round, until lower and upper bounds agree	10	1	B1 for 10 + reason " they agree to this level of accuracy"

Paper 5506

No	Working	Answer	Mark	Notes
17 (a)(i)		xy	3	B1 cao
(ii)		y^2		B1 for y^2 or $y \times y$
(iii)		$\frac{x}{2}$		B1 for $\frac{x}{2}$ or $0.5x$ or $2^{-1}x$
(b)	Divide to get $2y = 1$	$q = -1$	2	M1 for $2y = 1$ or $\frac{x}{2} = 32$ or $p + q = 5$ or $1 + p + 2q = 5$
		$p = 6$		A1 cao
18 (a)	$x^2 - 2mx + m^2 - k$	$k = m^2$	2	M1 for correct exp of $(x - m)^2$ or correct completion of the square eg $\left(x - \frac{2m}{2}\right)^2 - \left(\frac{2m}{2}\right)^2$
				A1 cao
				SC B1 for $k = -m^2$
(b)(i)	Min value is $-m^2$	$-m^2$	3	M1 for recognition that min value occurs when $(x - m)^2 = 0$ (either (b)(i) or (b)(ii) correct implies this M1)
(ii)	$x = m$	m		A1 ft on 'k', " $-k$" gets M1 A0
				A1 cao
19	$0.06 \times 0.05 = 0.003$	No	2	M1 for 0.06×0.05
				A1 correct conclusion based on 0.003 or 0.06 x 0.05 stated as $\neq 0.0011$
				OR M1 for statement that for the two events to be independent P (BL and CL) = P(BL) × P(CL)

Paper 5506				
No	**Working**	**Answer**	**Mark**	**Notes**
20		50 50 4	3	B1 50 or $\frac{100}{2}$ B1 for 50 or "a" B1 4 or $\frac{360}{90}$ oe

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Question 12

This question required students to be able to link the area and perimeter of sectors. There were two main routes through the problem. The most popular was to find the angle of the sector using the formula for the area of a sector, and then to apply this to the arc length of a sector. This left simply the need to add 2×7 to finish the problem. The other common method was to work with proportion, for example $\frac{40}{49\pi}$ and then find this proportion of the circumference. Both these methods were regularly seen and used well. There was a simple first mark that almost all were able to achieve, for finding the area of the circle. Quite a large number of students dropped the final mark for failing to add the 2×7 to the arc length to complete the perimeter. Several wrong responses started with the angle being 110°, presumably from measuring. Students need to be aware of that, unless stated, diagrams are not accurately drawn.

Question 23

This question was not attempted by all students. Those who did attempt the question often gained the first two marks for substituting into the volume formula and rearranging to find the radius. Many of these students then failed to realise that the slant height of the cone had to be found, using Pythagoras. For those that did find the slant height, a good proportion did not use this slant height as the radius of the sector OACB.

A small number of students did gain full marks for this question.

Question 20

When answers were attempted students often gained three marks by finding correct vectors for ZP and ZR. Very few of these students were then able to show the full process to show ZP and ZR in an appropriate ratio.

Others only gained two marks for correct vectors using the given ratios and finding a vector for OZ or XY.

A noticeable error was when students had YX correct as $a - b$ they did not reverse the whole vector to get XY, they simply used $-a-b$.

Summary

Based on their performance on this paper, students should:

- read questions carefully
- practice questions involving time, in different notations and also converting between hours and minutes
- recognise right angled triangles and non right angled triangles and know which trigonometry relationships are appropriate for the different style of triangles.
- always attempt questions as part marks are available for suitable starting points.

Question 22

This proved to be a challenging question and finding the value of x proved to be beyond most students. Although there were relatively few fully correct solutions a number of students did gain at least one mark. This was usually for expanding and simplifying an expression for the area of shape **B**. A common error was not applying π to all 3 terms of an expanded quadratic expression, omitting brackets and writing π only before the first term or after the last term. Students struggled to find an expression for the area of shape **A**. Even when students realised that they needed to subtract the area of the white sector from the area of the whole sector they often failed to find a correct expression. Some students used areas of whole circles, not areas of sectors, and some forgot to square the radii.

Question 7

This question was done well by a majority of students who were awarded all 4 marks. Some students found the area of the triangle and/or the area of the quadrant but could not complete the solution to get full marks. It was encouraging to see that nearly all students could recall how to find the area of a circle.

Question 21

This proved to be a challenging question with very few students showing any understanding of what was required to find the total area of the two shaded regions. Most students failed to find a successful strategy and working out was often messy and difficult for examiners to follow. Fully correct answers were seen only rarely but nevertheless it was pleasing to see some excellent solutions from the most able students taking this paper. The students who scored marks had generally drawn appropriate triangles on the diagram to help formulate their approach. Those who used $\frac{1}{2}ab\sin C$ to find the area of a triangle were usually able to recall the exact value of $\sin 60^o$ or $\sin 120^o$. Some students made a good start and gained the first two marks by finding either the area of a triangle or the area of a sector but often they did not find both and were unable to make any further progress. It was pleasing to see many students attempting this question but often they simply found the area of one circle as 16π or the area of three circles and then made incorrect assumptions about the proportion shaded in searching for a solution.

Summary

Based on their performance on this paper, students should:

- take care when carrying out arithmetic operations and check their working to avoid careless errors
- consider whether or not an answer is reasonable and of a sensible size
- read each question carefully and ensure that their final answer matches the question asked
- show their methods clearly when using graphs
- ensure that they know the difference between surface area and volume
- practise working out an estimate for the mean from a grouped frequency table
- practise answering probability questions that require the use of algebra and ratio

Question 15

This question was not answered as well as might have been expected and a large number of students failed to gain any marks at all with many not attempting the question. Many of those with some knowledge of sectors of circles went wrong at the first step, using πr^2 or πr instead of $2\pi r$ and gained no marks. A good proportion of those who did make a correct start went on to get full marks.

Question 4

This is the first AO3 question on the paper and required 3 main processes. The first of which was to find the total area, and there were two marks assigned to this, the first for correctly finding 3 areas and the second for finding all 4. The second process was to find the number of bags of grass seed that is needed. This could be gained for finding this for a single area or a combination. Finally, the candidates had to round the number of bags up to gain the number needed to buy, and multiply by £10.95 to find the total cost.

Almost all candidates were able to gain some marks, even if just for correct areas. This was as often seen for 2 rectangles and the quadrant, as it was for 2 rectangles and the triangle. Most were then able to gain the mark for dividing by 14. The two major causes of errors were learners not having all four areas correct, as this was needed to gain the 3rd mark. The other common error was for candidates to not round the number of bags up to the nearest integer and so found a cost that was inaccurate.

Question 14

Just under a half of students scored full marks for their responses to this question. However, many other students were able to gain some marks and the question was a good discriminator between students who could show a good understanding of the cosine rule and those who had little understanding of the application of trigonometry to non right-angled triangles. There were a significant proportion of students who could correctly write down an expression for OB^2 by using the cosine rule but then did not observe the correct order of operations and calculated 9 cos35° instead of $117 - 108\cos 35^\circ$. Students who made a good start to the problem were often able to complete it successfully, but some students used OB^2 rather than OB as the radius when finding the area of the sector. Other errors seen included using $\frac{1}{4}$ rather than $\frac{80}{360}$ when finding the area of the sector and assuming that the radius of the circle was 6 cm.

Question 12

About one third of students scored both marks on this question. Students who found the angle for the minor sector were awarded 1 mark. Some students used the formula for the circumference of a circle rather than the area. There were also some students who combined different measures, for example working out the area of the circle then subtracting it from $360^{(\circ)}$.

Question 15

This question was not answered as well as might have been expected and a surprising number of students failed to gain any marks at all. Many of those with some knowledge of sectors of circles went wrong at the first step, using πr^2 or πr instead of $2\pi r$ and gained no marks. A good proportion of those who did make a correct start went on to get full marks. Marks were often lost because of arithmetic errors or poor algebraic manipulation. Students who cancelled down fractions before multiplying worked more accurately than those who left cancelling until the end. Those who started by forming the equation $\frac{x}{360} \times 2 \times \pi \times 6 = 5\pi$ gained the first mark but rearranging the equation correctly to find the value of x was a problem for some. Students who worked with proportion and found that the arc length is $\frac{5}{12}$ of the circumference of the circle gained the first two marks. They could then complete the process to find the area of the sector by working out $\frac{5}{12} \times \pi \times 6^2$ although many chose to first work out the size of angle AOB. After gaining the first three marks for a complete process to find the area of the sector a significant number of students failed to get an answer of 15π because they could not evaluate $\frac{150}{360} \times \pi \times 6^2$ correctly. Those who used $\frac{5}{12} \times \pi \times 6^2$ made fewer arithmetic errors. Some students assumed that the sector was one third of a circle and worked with an angle of 120° and some measured the angle and used 130° in their calculations. These students gained no marks.

Question 11

Responses on this question showed quite a lot of confusion between area and perimeter as it was not uncommon for learners to equate the area of the sector to 34.3 or even 24.9. Of the learners that were most successful in answering this question, most started with a complete equation.