GCSE
MATHEMATICS
8300/3H

Higher Tier Paper 3 Calculator

Mark scheme

June 2024

Version: 1.1 Final

2 4 6 G 8 3 0 0 / 3 H / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

Further copies of this mark scheme are available from aqa.org.uk

Glossary for Mark Schemes

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

M	Method marks are awarded for a correct method which could lead to a correct answer.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
ft	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
SC	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
oe	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values $a \leqslant$ value $< b$
3.14 …	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
Use of brackets	It is not necessary to see the bracketed work to award the marks.

Examiners should consistently apply the following principles.

Diagrams

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

Responses which appear to come from incorrect methods

Whenever there is doubt as to whether a student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

Questions which ask students to show working

Instructions on marking will be given but usually marks are not awarded to students who show no working.

Questions which do not ask students to show working

As a general principle, a correct response is awarded full marks.

Misread or miscopy

Students often copy values from a question incorrectly. If the examiner thinks that the student has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

Further work

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

Choice

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

Work not replaced

Erased or crossed out work that is still legible should be marked.

Work replaced

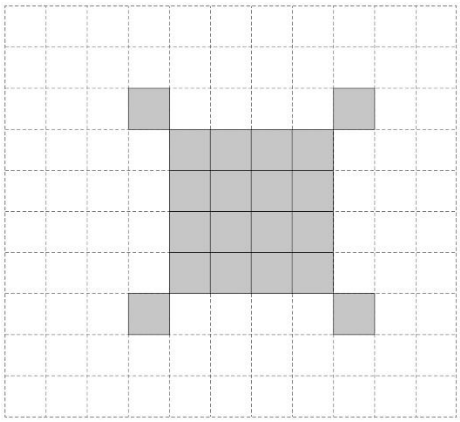
Erased or crossed out work that has been replaced is not awarded marks.

Premature approximation

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

Continental notation

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

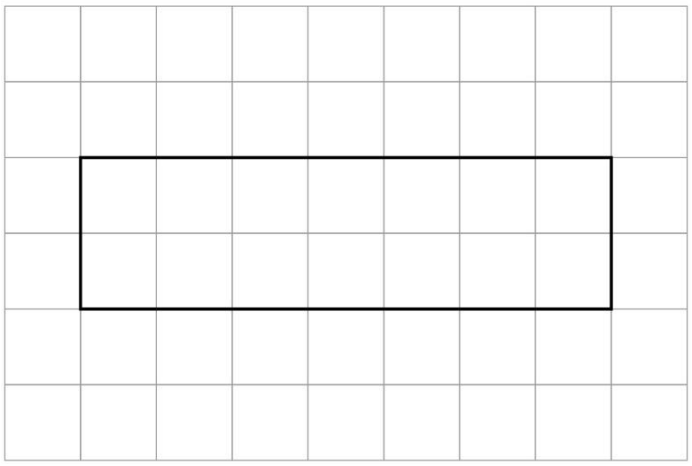
Q	Answer	Mark	Comments
1(a)		B1	
	Additional Guidance		
	Mark intention, condone missing interior lines		
	Shading not required		

Q	Answer	Mark	Comments
1(b)	23	B1	

Q	Answer	Mark	Comments
2	24^2 or 576 **and** 31^2 or 961 or 1537	M1	ignore units
	$\sqrt{24^2+31^2}$ or $\sqrt{576+961}$ or $\sqrt{1537}$	M1dep	
	39.2(…)	A1	accept 39 with 1537 seen or M2 awarded
	Additional Guidance		
	M1 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts		
	$31^2 - 24^2$		M1M0A0
	$\sqrt{385}$ without seeing 24^2 or 576 **and** 31^2 or 961		M0M0A0
	Answer only 39.2		M2A1
	Answer only 39		M0
	39.2 from only accurate drawing		M0M0A0
	39.2 from only trigonometry		M0M0A0
	39.2 from only cosine rule		M1M0A0

Q	Answer	Mark	Comments
3	This is not representative of all flats or He didn't take into account flats on the other floors	B1	oe
	Additional Guidance		
	Ignore incorrect or irrelevant statements or incorrect values alongside a correct reason, unless contradictory		
	Data is biased		B1
	Missing floor or Misses top 2 floors (ignore incorrect value)		B1
	There could be different results on the other 4 floors (ignore incorrect value)		B1
	Must have a flat from each floor, do another 27 (ignore irrelevant statement)		B1
	Only doing 5 out of the 8 floors		B1
	Not tested any on floor 7 or 8		B1
	Missing most of the other floors (ignore 'most of' as irrelevant)		B1
	Some floors might be different to others		B1
	Sample all floors, sample size too small (ignore incorrect statement)		B1
	Needs to sample them all (all may refer to all flats not floors)		B0
	Sample too small		B0
	Some flats might be different to others		B0
	Didn't test a third of the flats		B0

Q	Answer	Mark	Comments
4	It is true for **all** values of x	B1	

Q	Answer	Mark	Comments
5	42 ÷ (2 × 3) or 7 or rectangle with height 2 cm	M1	oe implied by rectangle with one side 7 cm
	Rectangle with height 2 cm and width 7 cm	A1	any position on the grid
	Additional Guidance		
	Mark intention, condone interior lines		
	Accept unruled lines		
	Side elevation 		M1A1
	Cuboid with rectangle height 2 cm and / or width 7 cm		M1A0

Q	Answer	Mark	Comments
6(a)	**Alternative method 1: working in metres per second or kilometres per second**		
	1500 (metres) or 0.05 (km)	B1	implied by 30 or 1200
	their 1500 ÷ 50 × 40 or 1.5 ÷ their 0.05 × 40 or 1200	M2	oe M1 their 1500 ÷ 50 or 30 oe or 50 ÷ 40 or 1.25 oe or 1.5 ÷ their 0.05 oe their 1500 must be using digits 15 (and zeros) their 0.05 must be using single digit 5 (and zeros)
	their 1200 ÷ 60	M1dep	oe dep on M2
	20	A1ft	ft their 1500 or their 0.05
	Alternative method 2: working in metres per minute or kilometres per minute		
	1500 (metres) or 0.05 (km)	B1	implied by 0.075
	40 ÷ 60 or $\frac{2}{3}$	M1	oe accept [0.66, 0.67]
	50 ÷ (40 ÷ 60) or 75 or $\frac{\text{their } 0.05}{(40 \div 60)}$ or 0.075 or their 1500 × (40 ÷ 60)	M1dep	oe calculation their 1500 must be using digits 15 (and zeros) their 0.05 must be using single digit 5 (and zeros)
	their 1500 ÷ their 75 or 1.5 ÷ their 0.075 or their 1500 × (40 ÷ 60) ÷ 50	M1dep	oe
	20	A1ft	ft their 1500 or their 0.05

Additional Guidance is on the next page

6(a) cont	**Additional Guidance**	
	1500 ÷ 1.25	B1M2
	1.5 ÷ 50 × 40 their 1500 must be using digits 15 (and zeros)	B0M2
	1.5 ÷ 0.5 × 40 their 0.05 must be using single digit 5 (and zeros)	B0M2
	150 ÷ 50 their 1500 must be using digits 15 (and zeros)	B0M1
	150 ÷ 1.25 = 120, 120 ÷ 60 = 2	B0M2M1A1ft

Q	Answer	Mark	Comments
6(b)	It is greater than the answer to part (a)	B1	

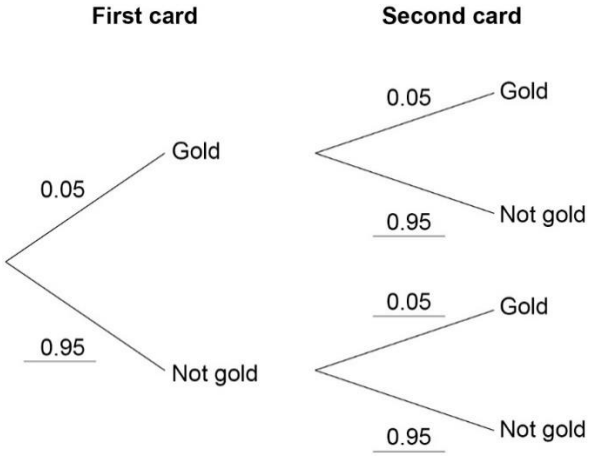
Q	Answer	Mark	Comments
7	Any two of (–2, 2) $\left(-1, 1\frac{1}{2}\right)$ (0, 1) $\left(1, \frac{1}{2}\right)$ (2, 0) $\left(3, -\frac{1}{2}\right)$ (4, –1) or other correct points	M1	may be seen in a table with values assigned to x and y implied by points plotted
	At least two of their points plotted	M1	$\pm\frac{1}{2}$ square implied by a line passing through two of their points
	Single straight line from (–2, 2) to (4, –1)	A1	$\pm\frac{1}{2}$ square ignore line beyond (–2, 2) and (4, –1)
	Additional Guidance		
	Ignore extra points listed or plotted if required line is drawn		
	M marks can be awarded even if incorrect line drawn		
	Correct line from (–2, 2) to (4, –1) within tolerance with no points plotted		M1M1A1

Q	Answer	Mark	Comments
8	(8 + 9 + 9 + 6 + 9 + 10) ÷ 6 or 51 ÷ 6 or 8.5	M1	oe implied by 34
	162 ÷ 360 × 100 or 45	M1	oe
	4 × their 8.5 + their 45 or 34 + 45	M1dep	oe dep on M2
	79	A1	SC2 53.5 or 57.5
	Additional Guidance		
	Check table and pie chart for working		
	34 + 45%		M1M1M1

Q	Answer	Mark	Comments
9	**Alternative method 1: population density of Town A**		
	84 000 ÷ (7 × 2.6) or [4615, 4616]	M2	oe M1 84 000 ÷ 7 or 12 000 oe or 7 × 2.6 or 18.2 oe
	Town B and [4615, 4616]	A1	
	Alternative method 2: comparing one square mile of population		
	84 000 ÷ 7 or 12 000	M1	oe
	4695 × 2.6 or 12 207	M1	oe
	Town B and 12 000 and 12 207	A1	
	Alternative method 3: comparing seven square miles of population		
	4695 × 2.6 × 7 or 85 449	M2	oe M1 4695 × 2.6 or 12 207 oe or 7 × 2.6 or 18.2 oe
	Town B and 85 449	A1	
	Alternative method 4: comparing areas with equal populations		
	7 × 2.6 or 18.2	M1	oe
	84 000 ÷ 4695 or [17.89, 17.9] or 18	M1	oe
	Town B **and** 18.2 **and** [17.89, 17.9] or 18	A1	

Q	Answer	Mark	Comments	
10	**Alternative method 1**			
	$1 - 0.38$ or 0.62	M1	oe	
	their 0.62×150	M1dep	oe implied by $\frac{93}{150}$	
	93	A1		
	Alternative method 2			
	0.38×150 or 57	M1	oe	
	$150 -$ their 57	M1dep	oe implied by $\frac{93}{150}$	
	93	A1		
	Additional Guidance			
	'93 out of 150' on answer line			M1M1A1
	Ignore attempt to simplify $\frac{93}{150}$			M1M1A0
	$\frac{93}{150}$ and 93 both on answer line			M1M1A0
	$\frac{57}{150}$			M1M0A0
	Do not allow a misread of any probability			

Q	Answer	Mark	Comments	
11	-1	B1		
	4π	B1		
	Additional Guidance			
	Do not allow use of a numerical value for π			

Q	Answer	Mark	Comments
12(a)	Fully correct diagram	B2	oe B1 0.95 seen once in correct position
	Additional Guidance		
			

Q	Answer	Mark	Comments
12(b)	0.05×0.05 or 0.0025 or 0.05×0.95 or 0.95×0.05 or 0.0475 or 0.95×0.95 or 0.9025	M1	oe ft their tree diagram in (a) if all probabilities are between 0 and 1
	$1 - 0.95 \times 0.95$ or $1 - 0.9025$ or $0.05 \times 0.05 + 2 \times 0.05 \times 0.95$ or $0.0025 + 2 \times 0.0475$ or $0.0025 + 0.095$	M1dep	oe ft their tree diagram in (a) if all probabilities are between 0 and 1
	0.0975 or 0.098	A1ft	oe eg $\frac{39}{400}$ or 9.75%
	Additional Guidance		
	Calculations or probabilities for part (b) may be seen on diagram in part (a)		
	If part (a) is incorrect full marks may be scored in part (b)		

Q	Answer	Mark	Comments
13	(x =) –2.2, 1.5	B2	B1 at least one of –2.2 and 1.5 with at most one incorrect value or (–2.2, 0) and (1.5, 0) or (–2.2, 1.5)
	Additional Guidance		
	(1.5, –2.2)		B0
	(0, –2.2) and (0, 1.5)		B0

Q	Answer	Mark	Comments
14	**Alternative method 1**		
	(a =) 45 ÷ 3 × 7 or 105	M1	oe may be on diagram
	(y =) $\frac{360 - 45 - \text{their}105}{4+1}$ or $\frac{210}{5}$ or 42	M1dep	oe may be on diagram
	(a =) 105 and (y =) 42 or 105 : 42 and (a : y =) 5 : 2 with M2 awarded	A1	
	Alternative method 2		
	(a =) 45 ÷ 3 × 7 or 105	M1	oe may be on diagram
	(y =) their 105 ÷ 5 × 2 or 42	M1dep	oe may be on diagram
	45 + 105 + 42 + 168 = 360 and 42 × 4 = 168 or 360 – 45 – 105 – 42 = 168 and 168 ÷ 4 = 42	A1	
	Additional Guidance		
	105 : 42		M1M1A0

Q	Answer	Mark	Comments
15(a)	Correct method for finding the difference between the x or y coordinates for line AC	M1	may be on diagram eg $9 - -7$ or 16 or $3 - -5$ or 8
	Correct method for finding the difference between the x or y coordinates for line AB or line BC	M1dep	may be on diagram eg $16 \div (1 + 3)$ or 4 or $8 \div (1 + 3)$ or 2 or $16 \times \frac{3}{(1+3)}$ or 12 or $8 \times \frac{3}{(1+3)}$ or 6
	$(-3, 5)$	A1	
	Additional Guidance		
	Up to M2 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts		
	Condone any missing minus signs if absolute values for the differences are correct		
	$(-3, \ldots)$ or $(\ldots, 5)$		M1M1A0

Q	Answer	Mark	Comments
15(b)	$(m_1=)\frac{-7-9}{3--5}$ or $(m_1=)\frac{9--7}{-5-3}$ or -2	M1	gradient of AC
	$-1 \div$ their -2 or $\frac{1}{2}$	M1	gradient of line perpendicular to AC their -2 must be identified as a gradient $\frac{1}{2}$ implies M1M1
	$-7 =$ their $\frac{1}{2} \times 3 + c$ or $(c=) -8.5$ or $y - -7 =$ their $\frac{1}{2}(x - 3)$	M1dep	oe condone any letter for c dep on 2nd M1
	$y = \frac{1}{2}x - 8.5$	A1	oe eg $2y = x - 17$
	Additional Guidance		
	Check part (a) for working for part (b)		

Q	Answer	Mark	Comments
16	$\frac{1}{6}$ or 0.16(6…) or 0.167 or 0.17	M1	oe theoretical probability
	$\frac{14}{72}$ or 0.19(4…)	M1	oe relative frequency
	Yes and both values in comparable formats	A1	eg $\frac{12}{72}$ and $\frac{14}{72}$ or $\frac{6}{36}$ and $\frac{7}{36}$ or 0.16(6…) or 0.167 or 0.17 **and** 0.19(4…) SC1 Yes and 12 seen

Q	Answer	Mark	Comments
17(a)	80	B3	B2 (200 =) $2^3 \times 5^2$ or $2^4 \times 5$ oe or 16×5 or $200 \times 2 \div 5$ B1 $a = 2$ and $b = 5$ or 2, 2, 2, 5, 5 seen on a factor tree or 25 or 8
	Additional Guidance		
	For B1, 25 or 8 must be chosen from any lists of square or cube numbers		
	$2 \times 2 \times 2 \times 5 \times 5$		B2
	$5^3 \times 2^2$		B0

Q	Answer	Mark	Comments
17(b)	$e = c^2d$	B1	

Q	Answer	Mark	Comments
18(a)	$\frac{\sin x}{11} = \frac{\sin 35}{7}$ or $\frac{11}{\sin x} = \frac{7}{\sin 35}$	M1	oe equation
	$\sin x = \frac{11\sin 35}{7}$ or $\sin x = 0.901...$ or $\sin^{-1}\frac{11\sin 35}{7}$ or $\sin^{-1} 0.901\ldots$	M1dep	oe equation with $\sin x$ as the subject
	[64.2, 64.4] with correct working seen	A1	
	Additional Guidance		
	0.901… may be seen as 0.9 for M marks		
	Only using $x = 64$ in sine rule		M0
	[64.2, 64.4] with no appropriate working		M0M0A0

Q	Answer	Mark	Comments
18(b)	No and correct reason indicating that 35° is a different angle or No and correct reason indicating that 7 cm is a different side	B1	oe eg correct reasons 35 is between 7 and 11 this time 35 is not opposite 7 A is SSA but B is SAS
	Additional Guidance		
	Ignore irrelevant reasons with a correct reason		
	'Yes' ticked		B0
	'No' ticked and states:		
	(A and B are) not congruent		B1
	This triangle is SAS but the other one is not		B1
	The sides are not opposite the same angles		B1
	35 is in a different position compared to the sides		B1
	35 is in a different position		B0
	7 is in a different position compared to the angles		B1
	7 is in a different position		B0
	7 was opposite 35 and is now adjacent		B1
	7 was opposite and is now adjacent		B0
	Sides and angles are in different places		B0
	Sides are in different places		B0
	There is no value opposite the 35		B0
	The angle is in a different position compared to the sides		B0
	It is a different size		B0
	It is a different shape		B0
	w is 72(.3…) or use of sine rule (question says 'without further calculation')		B0

Q	Answer	Mark	Comments
19(a)	**Alternative method 1**		
	$4 \times 6 - 7$ or $24 - 7$ or 17	M1	
	14	A1	
	Alternative method 2		
	$4x - 7 - 3$ or $4x - 10$	M1	
	14	A1	

Q	Answer	Mark	Comments
19(b)	$(x-3)^2 = 4x - 7$ or $x^2 - 6x + 9 = 4x - 7$	M1	oe equation
	$x^2 - 10x + 16$ (= 0)	M1dep	oe their 3-term quadratic equation with terms collected correctly
	$(x-2)(x-8)$ or $\frac{--10 \pm \sqrt{(-10)^2 - 4 \times 1 \times 16}}{2 \times 1}$ or $5 \pm \sqrt{9}$	M1	oe correct for their 3-term quadratic
	$x = 2$ and $x = 8$	A1	
	Additional Guidance		
	$(x-3)^2 = 4x - 7$ $x^2 + 9 = 4x - 7$ $x^2 - 4x + 16$ (= 0)		M1M1
	$(x-3)^2 = 4x - 7$ $x^2 + 9 = 4x - 7$ $x^2 - 4x + 2$ (= 0) $x = 2 \pm \sqrt{2}$ correct answers imply 3rd M		M1M0M1A0
	$(x-3)^2 = 4x - 7$ $x^2 + 9 = 4x - 7$ $x^2 - 4x + 2$ (= 0)		M1M0

Q	Answer	Mark	Comments
20	$P \propto Q$ or $P = kQ$ or $8 = k \times 2$ or $R \propto \frac{1}{Q^2}$ or $R = \frac{c}{Q^2}$ or $10 = \frac{c}{3^2}$	M1	oe
	$k = \frac{8}{2}$ or $k = 4$ or $c = 10 \times 3^2$ or $c = 90$	M1dep	oe implied by $P = 4Q$ implied by $R = \frac{90}{Q^2}$
	$P = 4Q$ and $R = \frac{90}{Q^2}$ or $k = 4$ and $c = 90$	A1	oe
	$Q = \frac{0.5}{\text{their } 4}$ and $R = \frac{\text{their } 90}{\left(\text{their } \frac{0.5}{4}\right)^2}$ or $R = \frac{\text{their } 90}{0.125^2}$	M1	oe eg $R = \frac{1440}{0.25}$ ft their equations of the form $P = kQ$ and $R = \frac{c}{Q^2}$ their 90 must not be 4
	5760	A1ft	ft their equations of the form $P = kQ$ and $R = \frac{c}{Q^2}$ with 3rd M1 scored
	Additional Guidance		
	Allow k and c to be any letters, including using both as k		
	Correctly using constants on the left side of their equations – follow the spirit of the mark scheme		
	5760 with no errors in working		5 marks
	$P \propto kQ$ or $R \propto \frac{c}{Q^2}$ is M0 unless recovered		

Q	Answer	Mark	Comments
21(a)	**Alternative method 1**		
	$\frac{4}{3}\pi r^3 = \pi r^2 h$	M1	
	$\frac{4}{3}r = h$ or $4r = 3h$	M1dep	oe equation with π and r^2 cancelled
	3 : 4 with M2 awarded	A1	oe ratio eg $\frac{3}{4}$: 1 or 1 : $\frac{4}{3}$ accept 1.33 or better for $\frac{4}{3}$
	Alternative method 2		
	$\frac{4}{3}\pi r^3 = \pi r^2 h$ or substitution of the same value of r into $\frac{4}{3}\pi r^3$ and $\pi r^2 h$	M1	the substitution must be shown
	Substitution of the same value of r into $\frac{4}{3}\pi r^3$ and $\pi r^2 h$ and correct value of h for their value of r	A1	the substitution must be shown their h should be exactly $\frac{4}{3}\times$ their r eg $r = 2$ and $h = \frac{8}{3}$ (oe fraction) do not allow rounded values
	3 : 4 with M1A1 awarded	A1	oe ratio eg $\frac{3}{4}$: 1 or 1 : $\frac{4}{3}$ accept 1.33 or better for $\frac{4}{3}$
	Additional Guidance		
	Accept h : r = 4 : 3 for final mark with M2 or M1A1 awarded		

Q	Answer	Mark	Comments
21(b)	$(\pi)(3r)^2(2h)$ or $3^2 \times 2$	M1	oe ft their formula for a cylinder from part (a) in the form $k\pi r^2 h$ with k as a positive constant
	18	A1	
	Additional Guidance		
	Answer 18 from choosing values for r and h eg $\pi \times 3^2 \times 4 = 36\pi$ and $\pi \times 9^2 \times 8 = 648\pi$ and $648\pi \div 36\pi = 18$		M1A1
	Answer 18 from rounding a decimal		M0A0

Q	Answer	Mark	Comments
22	5 (×) 4 (×) 3 (×) 2	M1	oe
	120 with no errors in working	A1	SC1 625 (allowing repeated digits)
	Additional Guidance		
	Ignore any listing of possible codes		
	Condone further working after 120 seen and M1 awarded eg answer as a probability $\frac{1}{120}$		M1A1
	5, 4, 3, 2		M1A0
	5, 4, 3, 2, 1 or $5 \times 4 \times 3 \times 2 \times 1 = 120$		M0A0

Q	Answer	Mark	Comments
23	2	B1	

Q	Answer	Mark	Comments
24	**Alternative method 1**		
	dx^2 or $2dex$ or de^2	M1	
	$dx^2 + 2dex + de^2 + f$	M1dep	
	$2(x-3)^2 - 11$ or $d = 2,\ e = -3,\ f = -11$	A1	SC2 $2(x-6)^2 - 29$ SC1 $2(x-6)^2 + k \quad k \neq -29$ SC1 $2(x+6)^2 - 29$ SC1 $2(x+3)^2 + k$ SC1 $(x-3)^2 - 2$
	Alternative method 2		
	$2(x^2 \ldots)$ or $d = 2$	M1	
	$2(x^2 - 6x + \frac{7}{2})$ or $2(x^2 - 6x) + 7$ or $2(x-3)^2 + k$	M1dep	$k \neq -11$
	$2(x-3)^2 - 11$ or $d = 2,\ e = -3,\ f = -11$	A1	SC2 $2(x-6)^2 - 29$ SC1 $2(x-6)^2 + k \quad k \neq -29$ SC1 $2(x+6)^2 - 29$ SC1 $2(x+3)^2 + k$ SC1 $(x-3)^2 - 2$