GCSE
MATHEMATICS
8300/1F

Foundation Tier Paper 1 Non-Calculator

Mark scheme

November 2019

Version: 1.0 Final

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.

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 $a \leq$ 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.

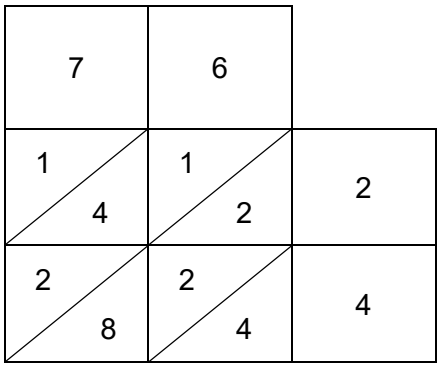
Premature approximation

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.

Question	Answer	Mark	Comments
1	$\frac{9}{10}$	B1	
2	$x = 2$	B1	
3	$0.3 > \frac{1}{4}$	B1	
4	7	B1	

Question	Answer	Mark	Comments
5	**Alternative method 1 – traditional method**		
	304 or 1520 with the 0 correct for the multiplication by 20 or 144 or 1680 with the 0 correct for the multiplication by 70	M1	values may be seen separately or in rows if 1520 or 1680 incorrect, placeholder 0, or equivalent must be present
	their 304 + their 1520 or their 144 + their 1680	M1dep	
	1824	A1	
	Alternative method 2 – grid method		
	At least three of 1400, 280, 120 and 24	M1	may not be in a grid
	their 1400 + their 280 + their 120 + their 24	M1dep	
	1824	A1	
	Alternative method 3 – Napier's bones		
		M1	oe at least three of the calculated values correct
	Attempt to total correctly four diagonals for their table with carrying figure seen	M1dep	
	1824	A1	
	Alternative method 4 and Additional Guidance are on the next page		

5 cont	**Alternative method 4 – breaking calculation down**		
	Calculation broken down correctly with a maximum of one calculation error	M1	eg 76 × 10 × 2 (+) 70 × 4 (+) 6 × 4 with at least two of 1520, 280 and 24 correct
	Addition of their parts	M1dep	eg 1520 + 280 + 24
	1824	A1	
	Additional Guidance		
	70 × 20 + 6 × 4 (= 1424)		M0M0A0
	Alt 1 304 + 152 = 456		M0M0A0
	Alt 1 If the 0 is missing, allow 0 to be replaced by x or a placeholder space (may be implied by their 4 in units column of their final answer)		
	Alt 3 Diagonal lines must slope consistently for M1 unless recovered		
	Alt 3 Diagonal lines missing is M0 unless recovered		
	Alt 3 For M1M1dep, a carrying figure must be seen or implied		
	Alt 3 Answer must be clearly stated and not left “around” the grid		

Question	Answer	Mark	Comments
6(a)	8	B1	
6(b)	16	B1	
6(c)	Physics and French	B1	either order mark intention eg accept P and F
	Additional Guidance		
	Condone incorrect spelling		
6(d)	All six of the following criteria correct: • width of bar • overall height of bar • correct gap from previous bar • bar split in half horizontally • appropriate shading/labelling • 'history' label correct and in correct place	B2	B1 any 5 of the criteria correct
	Additional Guidance		
	Apply a generous interpretation to their attempt to shade The shading for the boys needs to be darker than the shading for the girls (the part of the bar for the girls can be left unshaded)		
	Accept label(s) of 'boys' and/or 'girls' instead of shading		
	Ignore any numbers on bars, eg labelled 9 and 9		
7(a)	0.31	B1	oe eg .31
	Additional Guidance		
	Final answer 31 (even if 0.31 seen in working)		B0
7(b)	0.08	B1	oe eg .08

Question	Answer	Mark	Comments

8(a)	8.6 and 0.4	B1	either order	
	9(.0)	B1ft	ft their two numbers SC1 answer 9(.0), cards blank	
	Additional Guidance			
	Do not allow misreads of the card values in this question			
	8.6 and 0.27 Answer 8.87			B0B1ft
	8.6 and 6.3 Answer 14.9			B0B1ft
	0.27 and 6.3 Answer 6.57			B0B1ft
	0.27 and 0.4 Answer 0.67			B0B1ft
	6.3 and 0.4 Answer 6.7			B0B1ft
	8.6 + 0.27 = 8.87 Answer 9 (ignore rounding if correct decimal seen)			B0B1ft
	Cards take precedence, but if cards or answer line are blank, mark all other working and award the lowest mark unless their choice is unambiguously identified			

8(b)	8.6 and 0.27 in this order only	B1		
	8.33	B1ft	correct or ft their two numbers	
	Additional Guidance			
	Do not allow misreads of the cards in this question			
	Examples of follow through (there are many) 0.27 and 8.6 Answer –8.33 6.3 and 0.4 Answer 5.9			B0B1ft
	Cards take precedence, but if cards or answer line are blank, mark all other working and award the lowest mark unless their choice is unambiguously identified			

Question	Answer	Mark	Comments
9	Correct indication of mistake	B1	eg (6.10) should be 7(.00) or 2 × 3.5(0) (= 7.(00)) or cost of pens is wrong
	11.25	B1	
	Additional Guidance		
	Accept any correct indication of mistake eg two lots of 50p don't equal 10p		
	Condone (£) 11.25 p for second B1		
	Any reference to cost of rulers (words or calculations) being incorrect cannot score first B1		
	Response only references the decimal points not being lined up correctly		B0

Question	Answer	Mark	Comments
10	(A =) 2 000 000 and (B =) 500 000 and (C =) 400 000 and smallest answer C B largest answer A	B3	allow values or calculations instead of letters on answer lines B2 two of (A =) 2 000 000, (B =) 500 000, (C =) 400 000 B1 (A =) 2 000 000 or (B =) 500 000 or (C =) 400 000
	Additional Guidance		
	Answer line takes precedence over working		
	Any of the original value(s) misread or miscopied is max B2 for calculations		
	Once a correct evaluation has been seen, ignore further attempts to manipulate it for up to B2 eg 400,000 = 0.004 million, 0.5 million, 2 million, answer = CBA	B2	
	Accept values in words eg accept half a million for 500 000		
	Ordering of their values is irrelevant when awarding B2 or B1		
	Ignore (incorrect) spacings or any use of commas within numbers or continental notation eg 4 00000 50 0000 2,00000,0	B3	
	eg 40.0000 500.000 2.000.000	B3	
	C B A no correct calculations seen	B0	

Question	Answer	Mark	Comments

11(a)	0	B1	oe fraction, decimal or percentage
	Additional Guidance		
	zero or nought		B1
	0%		B1
	$\frac{0}{n}$; n is an integer > 0, eg $\frac{0}{200}$		B1
	With B1 scored, ignore probability words unless contradictory eg 0, impossible eg 0, unlikely		 B1 B0
	Zero chance		B0
	Nothing or nil		B0
	0 out of 200		B0
	0 in 200		B0
	No		B0
	No chance		B0
	Impossible		B0
	Not possible		B0
	Any of the B0 responses above, with a B1 answer		B1
	0 : 200 or 0 to 200 (even with B1 response, still scores B0)		B0

Question	Answer	Mark	Comments
11(b)	$200 - 79 - 90$ or 31 or $\frac{79}{200} + \frac{90}{200}$ or $1-\left(\frac{79}{200}+\frac{90}{200}\right)$ or $\frac{(200-79-90)}{200}$ or $\frac{169}{200}$	M1	oe eg $200 - (79 + 90)$ eg $0.395 + 0.45$ or 0.845
	$\frac{31}{200}$ or 0.155 or 15.5%	A1	accept 0.16 or 16% if no errors seen
	Additional Guidance		
	Ignore incorrect cancelling or incorrect conversion to a decimal or a percentage or incorrect rounding after correct answer seen eg $\frac{31}{200}$ seen, then answer $\frac{3}{20}$ eg 15.5% seen, then answer 15%	 M1A1 M1A1	
	Answer 0.16 or 16% with M1 work not seen	M1A1	
	31 : 200 or 31 : 169 or 31 out of 200 or 31 in 200	M1A0	
	Ignore probability words unless contradictory eg $\frac{31}{200}$ unlikely eg $\frac{31}{200}$ likely	 M1A1 M1A0	

Question	Answer	Mark	Comments
12	**Alternative method 1**		
	$x + x + 19 = 105$ or $\frac{105-19}{2}$ or $\frac{86}{2}$ or 43	M1	oe equation any letter may be implied by second mark
	$\frac{105-19}{2} + 19$ or 62	M1dep	oe 62 seen is M2 (unless clearly from incorrect working)
	$\frac{62}{105}$ or 0.59(0…) or 59.(0…)%	A1	oe SC2 $\frac{43}{105}$ or 0.41 or 41% or better
	Alternative method 2		
	$y + y - 19 = 105$	M1	oe equation any letter may be implied by second mark
	$\frac{105+19}{2}$ or $\frac{124}{2}$ or 62	M1dep	62 seen is M2 (unless clearly from incorrect working)
	$\frac{62}{105}$ or 0.59(0…) or 59.(0…)%	A1	oe SC2 $\frac{43}{105}$ or 0.41 or 41% or better
	Alternative method 3		
	$\frac{105}{2}$ and $\frac{19}{2}$ or 52.5 and 9.5	M1	
	their 52.5 + their 9.5 or 105 – (their 52.5 – their 9.5) or 62	M1dep	62 seen is M2 (unless clearly from incorrect working)
	$\frac{62}{105}$ or 0.59(0…) or 59.(0…)%	A1	oe SC2 $\frac{43}{105}$ or 0.41 or 41% or better
	Additional Guidance is on the next page		

	Additional Guidance	
Q12 cont	Ignore any attempts to simplify or convert a correct fraction	
	Trial and Improvement leading to 62 (may go on to score full marks)	at least M1M1
	Trial and Improvement not leading to 62 or the correct answer	M0M0A0
	$\frac{19}{105}$ or $\frac{86}{105}$	M0M0A0
	62 : 105 or 62 : 43 or 62% or 62 out of 105	M1M1A0

Question	Answer	Mark	Comments
13	(262 rounded to) 260 or (19.8 rounded to) 20 or 26 ÷ 2	M1	
	13	A1	
	Additional Guidance		
	13 embedded eg 260 ÷ 13 = 20		M1A0
	Beware, 13 may not get full marks eg 262 ÷ 20 = 13.1, answer 13		M1A0
	300 ÷ 20		M1A0

Question	Answer	Mark	Comments
14	10 + 2 + 10 + 2 or 24 or 10 + 6 + 10 + 6 or 32	M1	oe may be seen in a ratio
	10 + 2 + 10 + 2 or 24 and 10 + 6 + 10 + 6 or 32	A1	oe may be seen in a ratio
	3 : 4	B1ft	ft correct and full simplification of any unsimplified ratio except answer 4 : 3 with M1A1 scored SC2 6 : 7 SC1 12 : 14

Additional Guidance	
Ignore any units given	
Answer 3 : 4 with no incorrect working	M1A1B1
1 : 1.3$\dot{3}$	M1A1B0
Working with half perimeter consistently 12 : 16 = 3 : 4 answer 12 : 16 or 6 : 8	 M1A1B1 M1A1B0
24 and 32 then 32 : 24 = 4 : 3 cannot be awarded B1ft as this would be full marks for an incorrect final answer	M1A1B0
32 : 24	M1A1B0
24 : 42 = 4 : 7	M1A0B1ft
10 : 6 = 5 : 3	M0A0B1ft
20 : 12 = 10 : 6 (not fully simplified)	M0A0B0ft
20 : 60 = 1 : 3	M0A0B1ft
14 : 22 = 6 : 10 = 3 : 5 (6 : 10 is an error, then simplifying this to 3 : 5 is not B1ft)	M0A0B0ft

Question	Answer	Mark	Comments
15	**Alternative method 1**		
	5 : 1 or 1 : 5 or $\frac{5}{6}$ or $\frac{1}{6}$ or 6 (parts)	M1	may be implied by second mark may be seen on diagram
	180 ÷ 6 or 30	M1dep	
	150	A1	
	Alternative method 2		
	$5x + x = 180$ or $6x = 180$	M1	any letter may be implied by second mark
	180 ÷ 6 or 30	M1dep	
	150	A1	
	Additional Guidance		
	If Trial and Improvement used, 30 seen is M2 but 150 must be chosen as the answer for M2A1		
	360 ÷ 6		M1M0A0
16	125	B1	

Question	Answer	Mark	Comments
17	Any two of (–1, –4), (0, –1), (1, 2), (2, 5) and (3, 8) or other correct points	M1	may be seen in a table may be implied by points plotted
	At least two correct points plotted correctly or at least two of their points plotted correctly	M1	implied by correct line which does not have to extend from (–1, –4) to (3, 8) $\pm \frac{1}{2}$ small square
	Straight, ruled line from (–1, –4) to (3, 8)	A1	$\pm \frac{1}{2}$ small square ignore line beyond (–1, –4) and (3, 8)
	Additional Guidance		
	Ignore extra points listed or plotted		
	M marks can be scored even if wrong line drawn		
	M marks are independent, the second mark can be awarded for correct plotting of two of their points		
18(a)	$\frac{3}{5}$	B2	B1 $\frac{18}{30}$ or $\frac{9}{15}$ or $\frac{6}{10}$ or 0.6(0) or 60% SC1 $\frac{2}{5}$
	Additional Guidance		
	$\frac{18}{30}$ or $\frac{9}{15}$ or $\frac{6}{10}$ followed by incorrect simplification or any conversion		B1

Question	Answer	Mark	Comments
18(b)	$\frac{64}{100} \times (30 + 20)$	M1	oe eg 0.64×50 or $64 \div 2$ build up method must be complete
	32	A1	
	14 (out of 20)	A1ft	ft their 32 – 18 with M1A0 scored their 32 must be greater than 18 SC1 12.8 (or 13 after 12.8 is seen)
	Additional Guidance		
	$\frac{14}{20}$ or 70%		M1A1A0
	14 = 70% on answer line		M1A1A1
	Answer 32 or $\frac{32}{50}$		M1A1A0
	$64\% \times 50$ with no further work		M0
	$\frac{64}{100} \times 50 = 30$ Answer 12		M1A0A1ft
	<u>Example of complete build-up</u> (for 64% of 50) 10% = 5 (no working but correct) $6 \times 5 = 30$ (correct with working) 1% = 0.5 (no working but correct) $4 \times 0.5 = 0.20$ (incorrect but working shown so still on for M1) = 30.20 (implied correct addition) then 30.20 – 18 = 12.20 Answer 12.20 (condone decimal value for ft)		M1A0A1ft
	<u>Example of incomplete build-up</u> (for 64% of 50) 50% = 25 (no working but correct) 10% = 5 (no working but correct) 2% = 2 (incorrect and no working shown M0) …… (A0ft cannot award ft when M1 not awarded)		M0A0A0

Question	Answer	Mark	Comments
19(a)	Valid reason	B1	eg there might be 20 sheep or the number of sheep could be any multiple of 10 or the ratio may have been simplified or the numbers in the ratio do not have to be the actual numbers
	Additional Guidance		
	Ignore irrelevant statements but do not ignore contradictory statements		
	It doesn't mean 10 sheep it's just their ratio		B1
	The total number of animals is unknown		B1
	Could be 50 sheep		B1
	Could be 20 : 6		B1
	There are 10 sheep for every 3 cows we just don't know the exact number (of sheep/cows or total)		B1
	Could be 50 sheep and 18 cows (error seen)		B0
	Could be 50 : 15 = 10 : 3 = 2 : 1 (error seen)		B0
	It's only a ratio		B0
	There are 10 sheep for every 3 cows		B0
	There could be more than 10 sheep and more than 3 cows		B0
	There might be more than 10 sheep / might be more than 3 cows		B0

Question	Answer	Mark	Comments
19(b)	Yes and valid working	B1	eg Yes and (4 × 3 =) 12 oe or Yes and 4 × 3 is less than 13 oe or Yes and (13 ÷ 4 =) 3.25 oe or Yes and 13 ÷ 4 is more than 3 oe or Yes and (13 ÷ 3 =) 4.3… oe or Yes and 13 ÷ 3 is more than 4 oe
	Additional Guidance		
	'No' or 'Cannot tell' ticked		B0
	Ignore irrelevant statements but do not ignore contradictory statements		
	Allow correct reference to remainders or shortfalls in working eg Yes and 13 ÷ 4 = 3 with one (goat) left over eg Yes and 13 ÷ 4 = 3 r1 eg Yes and 13 ÷ 4 = 3.1		 B1 B1 B0
	Any evaluation must be fully correct or reference a remainder or shortfall eg Yes and 13 ÷ 4 = 3.2		 B0
	Any comparative statement must be true eg Yes and 13 ÷ 4 is less than 3		 B0

Question	Answer	Mark	Comments
20	☐ The number rolled is even ✓ The number rolled is greater than 1 ☐ The number rolled is less than 5 ☐ The number rolled is prime	B1	

21	$\pm 6x$ or ± 3 or $8x - 2x = 10 - 7$ or $7 - 10 = 2x - 8x$	M1	oe terms in x or constant terms collected
	$6x = 3$ or $-6x = -3$	A1	oe implied by correct answer
	0.5 or $\frac{1}{2}$	A1ft	oe eg $\frac{3}{6}$ ft any equation of form $6x = a$ or $-6x = a$ or $bx = 3$ or $bx = -3$
	Additional Guidance		
	$\frac{-3}{-6}$		M1A1A0
	Trial and Improvement scores 0 or 3		

Question	Answer	Mark	Comments
22	90 ÷ 5 or 18	M1	
	2 × their 18 or 36	M1dep	M2 $\frac{2}{5} \times 90$
	180 – 90 – their 36	M1dep	oe eg 90 – their 36
	90 36 54	A1	any order
	Additional Guidance		
	Beware of incorrect methods, eg dividing 180 by 5 180 ÷ 5 = 36 180 ÷ 2 = 90 180 – 90 – 36 = 54 Answer 90, 36, 54		M0M0M0A0
	Beware of 18 coming from wrong working 90 ÷ 2 = 45 90 ÷ 5 = 18 90 ÷ 7 = … However, it is not incorrect to work with 180 ÷ 10		M0M0M0A0
	Trial and Improvement scores 0 or 4		
23	number of pets	B1	

Question	Answer	Mark	Comments
24(a)	Says that the wrong line has been given or says that for the given reflection the image would be in the second quadrant (may be implied by sketch) or says that the given line is vertical or gives the coordinates of at least one image point under the given reflection or says that after the given reflection, a rotation 180° (centre (–1, –1)) or an enlargement, scale factor –1 (centre (–1, –1)) is needed	B1	eg the line should be $y = -1$ eg the triangle would move to the other side of the y-axis eg $x = -1$ is vertical eg (1, 1) would move to (–3, 1) (1, 3) would move to (–3, 3) (4, 1) would move to (–6, 1)
	Additional Guidance for this question is on the next page		

	Additional Guidance	
24(a) cont	It is the wrong line/axis (of reflection)	B1
	It's not $x = -1$	B1
	The line should be horizontal	B1
	$y = -1$	B1
	$x = -1$ line drawn with explanation that it is incorrect	B1
	Q should be to the left of P	B1
	Correct line drawn, with indication that it should be that line	B1
	Correct statement with irrelevant statement eg It's the wrong line and Q is in the wrong place	B1
	Correct line drawn, but no explanation or equation given	B0
	$x = -1$ line drawn with no explanation that it is incorrect	B0
	It should be reflected in the y-axis	B0
	It is not a reflection in $x = -1$	B0
	Should be rotation about $y = -1$	B0
	They are not an equal distance from each other	B0
	It should be the point $x = -1$	B0
	Q is in the wrong place	B0
	It is a reflection in the x-axis then a translation by $\begin{pmatrix} 0 \\ -2 \end{pmatrix}$	B0
	Correct statement with incorrect statement eg It's the wrong line, it should be $x = -2$	B0
	If more than one image point is given, they must all be correct	

Question	Answer	Mark	Comments

24(b)	Should say the centre of rotation (is O)	B1	oe statement accept 'axis of rotation' or 'point'
	Additional Guidance		
	Allow origin or (0, 0) for O		
	Should be about O		B1
	There is no centre		B1
	It should be around a point		B1
	It doesn't give the coordinates		B1
	Should/could be 270° clockwise about O		B1
	Should/could be 270° clockwise		B0
	Should be rotation through 90° clockwise about O		B0
	It is a reflection 90° anticlockwise with centre O		B0
	It's not reflected on a point		B0
	Doesn't say which line you're turning around		B0
	Correct statement with incorrect statement eg It should give a centre of rotation at (0, 1)		B0

25(a)	64	B1	accept 4^3
	Additional Guidance		
	4^3 and incorrect value given eg $4^3 = 32$		B0

Question	Answer	Mark	Comments
25(b)	–5 –13	B2	condone –13 –5 B1 –5 as first term or ft their first term – 8
26	60 × 4 or 4(a × 60) or 4a × 60 or $\frac{b}{a}$ = 60 or $\frac{4b}{b/60}$ or 4b = 240a or $\frac{240a}{a}$	M1	accept any multiplication signs
	240	A1	Condone $\frac{240}{1}$
	Additional Guidance		
	Correct answer found by substituting appropriate values for a and b	M1A1	
	Incorrect answer found by substituting appropriate values for a and b	M0A0	
	Award M1 for 60 × 4 or 240 in working, either as individual expressions or as part of longer expressions eg 4 × 60 = 240, answer 240b eg $\frac{4\times60\times a}{4b}$	 M1A0 M1A0	
	Do not award M1 for 240 within a list of multiples of 60 that continues beyond 240		

Question	Answer	Mark	Comments
27	(27 =) 3^3	M1	
	$((3^2)^7 =)\ 3^{2\times7}$ or $((3^2)^7 =)\ 3^{14}$	M1	
	3^{17}	A1ft	ft 3^a and 3^b then answer 3^{a+b} with M1M0 or M0M1 scored
	Additional Guidance		
	Answer 3^{17} with no incorrect working		M1M1A1
	3^{17} in working with 17 on the answer line or both 3^{17} and 17 on the answer line		M1M1A1
	$3^3 \times 3^9 = 3^{12}$		M1M0A1ft
	Evaluation of powers of 3 as values only		M0M0A0
	Answer 17 with no valid working		M0M0A0

Question	Answer	Mark	Comments
28	**Alternative method 1: working in terms of π**		
	π (×) 4^2 (×) 10 or 160π or [502, 503]	M1	oe accept 3 or better for π accept 480 or 496
	$\frac{2}{3}$ (×) π (×) 6^3 or 144π or [452, 453]	M1	oe accept 3 or better for π accept 0.66 or 0.67 or better for $\frac{2}{3}$ accept 432 or 446(.4)
	160π and 144π or [502, 503] and [452, 453]	A1	oe values accept 480 and 432 or 496 and 446(.4)
	160π and 144π and cylinder or [502, 503] and [452, 453] and cylinder or cylinder is 16π greater	A1ft	ft correct decision for their 160π and their 144π with M1M1 scored accept 480 and 432 and cylinder or 496 and 446(.4) and cylinder
	Alternative method 2: working without π		
	4^2 (×) 10 or 160	M1	oe
	$\frac{2}{3}$ (×) 6^3 or 144	M1	oe accept 0.66 or 0.67 or better for $\frac{2}{3}$
	160 and 144	A1	oe values
	160 and 144 and cylinder	A1ft	ft correct decision for their 160 and their 144 with M1M1 scored
	Additional Guidance for this question is on the next page		

	Additional Guidance	
28	Better than 3 for π could be 3.1, 3.14, 3.142 or $\frac{22}{7}$	
	160π with incorrect method for hemisphere	M1M0A0A0
	144π with incorrect method for cylinder	M0M1A0A0
	160π and 144π with incorrect decision or no decision	M1M1A1A0
	160 and 144 with incorrect or no decision	M1M1A1A0
	Accept values given as fractions for the first A mark, but for the second A mark, they must have a common denominator. eg 160π and $\frac{432\pi}{3}$ and cylinder eg $\frac{480}{3}$ and $\frac{432}{3}$ and cylinder	 M1M1A1A0 M1M1A1A1
	Working with π for one value but not the other can only score M1 eg 160π and 144 (with or without a decision)	 M1 only
	Do not allow M1 for a correct formula as part of an incorrect formula eg $\frac{1}{3} \times \pi \times 4^2 \times 10$	 M0

Question	Answer	Mark	Comments
29	**Alternative method 1: total amount of each colour (judgement accepted that ratio is not 4 : 3)**		
	60 ÷ (2 + 1) or 20 or 40	M1	
	80 + their 20 or 100	M1dep	
	28 + 2 × their 20 or 68	M1dep	dep on first M1 only
	100 and 68 and No	A1	
	Alternative method 2: total of red and how much white should have been added or how much there should have been originally or how much there should be now		
	60 ÷ (2 + 1) or 20 or 40	M1	
	80 + their 20 or 100	M1dep	
	their 100 ÷ 4 × 3 or 75	M1dep	dep on M2
	(75 – 2 × 20 =) 35 and No or 40 and (75 – 28 =) 47 and No or 75 and 68 and No	A1	comparing 35 to 28
	Alternative method 3: total of white and how much red should have been added or how much there should have been originally or how much there should be now		
	60 ÷ (2 + 1) or 20 or 40	M1	
	28 + 2 × their 20 or 68	M1dep	
	their 68 ÷ 3 × 4 or $90\frac{2}{3}$ or $\frac{272}{3}$	M1dep	dep on M2
	($90\frac{2}{3}$ – 20 =) $70\frac{2}{3}$ and No or 20 and ($90\frac{2}{3}$ – 80 =) $10\frac{2}{3}$ and No or $90\frac{2}{3}$ and 100 and No	A1	comparing $70\frac{2}{3}$ to 80
	The scheme for question 29 continues on the next page		

Question	Answer	Mark	Comments
29 cont	**Alternative method 4: total of red and what it should be for total amount of paint**		
	60 ÷ (2 + 1) or 20 or 40	M1	
	80 + their 20 or 100	M1dep	
	(60 + 80 + 28) ÷ (4 + 3) × 4 or 96	M1	
	100 and 96 and No	A1	
	Alternative method 5: total of white and what it should be for total amount of paint		
	60 ÷ (2 + 1) or 20 or 40	M1	
	28 + 2 × their 20 or 68	M1dep	
	(60 + 80 + 28) ÷ (4 + 3) × 3 or 72	M1	
	68 and 72 and No	A1	
	Additional Guidance		
	20 from 80 ÷ 4 is incorrect		
	With no incorrect working, 'He should have added 76 red and 32 white' implies full marks		M1M1M1A1
	'No' can be implied, eg on alt 1 accept 100 and 68 and 'He needs 7 more white'		M1M1M1A1
	Condone dubious notation eg 20 : 40 + 80 : 28 = 100 : 68, so No		M1M1M1A1
	Ignore further work if 100 and 68 and No are seen		M1M1M1A1
	Only works out the amounts of red and white there should be for the total amount of paint, eg, 168 ÷ 7 × 4 = 96 and 168 ÷ 7 × 3 = 72		M0M0M1A0

Question	Answer	Mark	Comments
30(a)	10^5 or 25 000	M1	oe correct value not in standard form eg 25×10^3
	2.5×10^4	A1	
	Additional Guidance		
	Condone $2.5 \cdot 10^4$		M1A1
	Condone different spacing or commas eg 2 5000 or 250,00		M1A0
30(b)	$c = 3$ and $d = -2$	B2	B1 $c = 3$ or $d = -2$ or $c = 10^3$ and/or $d = 10^{-2}$
	Additional Guidance		
	One or both of the values may be embedded for B1 only		
31	☐ V is directly proportional to H ✓ V is inversely proportional to H ✓ V is directly proportional to $\frac{1}{H}$ ☐ V is inversely proportional to $\frac{1}{H}$	B1	