

8300

GCSE MATHEMATICS

Foundation and Higher tier – Questions by Topic – Mark Scheme

Ratio, proportion and rates of change

Calculating with rates

v1.0

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 within the scheme 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. e.g. accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
3.14...	Allow answers which begin 3.14 e.g. 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.

Q1.

$$3206 \div 7$$

may be seen as a calculation attempted such as in the ‘bus stop’ method

$$458$$

M1

A1

Additional Guidance

7 $\div$ 3206 must be recovered eg by correct use in division sum

“Chunking” or build-up must convince that the equivalent to the full division is being attempted (ie reach or go beyond 3206)

Condone $3206 \div 420$ (working in seconds) for M1

$$\begin{array}{r} 3206 \\ 7 \end{array}$$

Accept $\begin{array}{r} 3206 \\ 7 \end{array}$ for M1 unless contradicted by further work

[2]

Q2.

(a) **Alternative method 1**

$$90 \div 10 \text{ or } 9$$

oe

M1

$$\text{their } 9 \times 15$$

oe

M1dep

$$135(.00)$$

A1

Alternative method 2

$$15 \div 10 \text{ or } 1.5$$

$$\begin{array}{r} 2 \\ 10 \div 15 \text{ or } 3 \end{array}$$

oe

M1

$$90 \times \text{their } 1.5$$

$$\begin{array}{r} 2 \\ \text{or } 90 \div \text{their } 3 \end{array}$$

oe

M1dep

$$135(.00)$$

A1

Alternative method 3

$$90 \div (10 \div (15 - 10)) \text{ or } 45$$

oe

M1

$$90 + \text{their } 45 \text{ or their } 45 \times 3$$

oe

M1dep

$$135(.00)$$

A1

Additional Guidance

Allow one error in a build-up method

- (b) **Alternative method 1: works out extra from hourly increase or totals (and compares to tax)**

$$15 \times (0.50) \text{ or } 15 \div 2$$

or

$$15 \times (\text{their } 9 + 0.5) - 15 \times \text{their } 9$$

$$\text{or } 142.5(0) - \text{their } 135$$

$$\text{or } 7.5(0)$$

oe

may be working in pence or pounds

M1

It is less than he expected

and

$$7.5(0)$$

correct or ft their hourly rate and/or their answer in (a)

A1ft

Alternative method 2: works out actual amount (and compares to expected amount)

$$15 \times (\text{their } 9 + 0.5) - 8.9(0)$$

or

$$142.5(0) - 8.9(0)$$

or

$$133.6(0)$$

oe

may be working in pence or pounds

M1

Correct box ticked for comparison with their (a)

and

$$133.6(0)$$

correct or ft their hourly rate and/or their answer in (a)

A1ft

Additional Guidance

It's 1.40 less with 135 in (a) (with no box ticked)

M1A1

Allow one error in a build-up method

Ignore further work after correct answer seen

[5]

Q3.

(a) 2×6 or 12

or

$$6 \times \frac{2}{3}$$

or

$$6 - \frac{1}{3} \times 6$$

oe

eg $6 \div 3 = 2$ followed by $6 - 2$

$6 \div 3 = 2$ followed by 2×2

M1

4

A1

Additional Guidance

Accept minutes for M1 even if units not given ie 2×360 or 720 etc

However, answer in minutes accepted only if units changed to minutes on answer line

(b) It takes less (time)

oe

B1

Additional Guidance

(It will be) quicker / faster

B1

(It will) now take less than (*their answer to part (a)*) hours

B1

Time will decrease

B1

It will not take as long

B1

It will not take long

B0

It will now take 2 hours (their answer in (a) was 3 hours)

B0

no comparison

The room will be painted at a faster rate

B0

repeats question

3rd person will finish quicker than the other 2

B0

[3]

Q4.

(a) **Alternative method 1**

$15 \div 2$ or 7.5

M1

(their $7.5 \times 3 =$) 22.5

or (their $7.5 \times 4 =$) 30

M1dep

4 chosen

A1

Alternative Method 2

25×2 or 50

M1

their $50 \div 15$ or 3.3

M1dep

4 chosen

A1

(b) $15 \times$ their 4 or 60

or $60 \div 25$

oe

M1

2.4

oe

ft their integer from part (a)

A1ft

[5]

Q5.

Alternative method 1: using different time periods

$450 \div 30$ or 15

or

$250 \div 10$ or 25

oe for any section of the basic rate or the overtime rate

$$\frac{450 - 150}{30 - 10}$$

eg

M1

15 and 25

implied by any ratio equivalent to 3 : 5

do not allow as a ratio in the wrong order eg 25 : 15

A1

3 : 5 or $\frac{3}{5} : 1$ or $1 : \frac{5}{3}$

oe fully simplified

ft full simplification of their two values

B1ft

Alternative method 2: using equal time periods

Four correct readings from equal time periods of at least 5 hours from the two sections of the graph

eg

at 5 and 10 hours and at 35 and 40 hours

if a reading from 30 is used, there may only be 3 readings

a reading of 0 from 0 may be implied

M1

15 and 25

or

correct totals for their equal time periods

eg 10 hours = 150 and 10 hours = 250

implied by any ratio equivalent to 3 : 5

must not be seen as a ratio in the wrong order eg 250 : 150

A1

3 : 5 or $\frac{3}{5} : 1$ or $1 : \frac{5}{3}$

oe fully simplified

ft full simplification of their two values

B1ft

Additional Guidance

In alt 2, only three readings are needed if a reading from 30 hours is included in both time periods or a reading of 0 is used

eg readings of 300 from 20, 450 from 30 and 700 from 40

M1

Readings from 10, 20, 30 and 40 should be 150, 300, 450 and 700

For readings from other numbers of hours not giving a multiple of £10 allow the multiple of 10 above or below the reading or any value between, which can then be used to score all three marks

eg allow [220, 230] for a reading at 15 hours

eg alt 1 readings of 70 at 5 hours, 380 at 25 hours, 450 at 30 hours and 700 at 40 hours, followed by hourly rates of 15.50 and 25 and an answer of 31 : 50

M1A1B1ft

eg alt 2 readings of 370 at 25 hours, 450 at 30 hours, 580 at 35 hours and 700 at 40 hours, followed by totals of 80 and 120 or hourly rates of 16 and 24 and an answer of 2 : 3

M1A1B1ft

For $1\frac{2}{3}$ allow 1.67 or better with correct rounding

450 : 250 = 45 : 25 does not get the mark for 25, but gets the final mark if simplified to 9 : 5

Ignore units throughout eg answer £3 : £5

M1A1B1

15 : 25

M1A1B0

25 : 15 or 25 : 10 not simplified

M1A0B0

25 : 15 with answer 5 : 3 or 25 : 10 with answer 5 : 2

M1A0B1ft

Answer 5 : 3 without working implies

M1A0B1ft

15 : 17.5

M1A0B0

15 : 17.5 followed by 6 : 7

M1A0B1ft

20 : 25

M1A0B0

20 : 25 followed by 4 : 5

M1A0B1ft

3 : 5 in working with answer 1.5 : 2.5

M1A1B0

30 : 10 = 3 : 1

M0A0B1ft

[3]

Q6.

$$h = 3n + 20$$

or

$$h = 20 + 3n$$

oe in the form $h =$

B2 correct equation not in the form $h =$

or $3n + 20$ or $20 + 3n$

or $h = 3n (+ k)$ (k is a number or letter)

or $h = (k +) 3n$ (k is a number or letter)

or $h = an + 20$ ($a \neq 0$)

or $h = 20 + an$ ($a \neq 0$)

B1 $3n (+ k)$ (k is a number or letter)

or $(k +) 3n$ (k is a number or letter)

or $an + 20$ ($a \neq 0$)

or $20 + an$ ($a \neq 0$)

SC1 $n = 3h + 20$

B3

Additional Guidance

Allow $h =$ in working but omitted on answer line

For an equation in the form $h =$ in working, but rearranged (correctly or incorrectly) for the answer line, award 1 mark less than the $h =$ form

Condone an unsimplified fraction for 3 if it has integer numerator and denominator

$$\frac{12}{4}$$

eg $h = \frac{12}{4}n + 20$

B3

An unsimplified fraction for 3 can still score marks if it does not have integer numerator and denominator

$$\frac{32 - 20}{4}$$

eg $h = \frac{32 - 20}{4}n + 20$

B2

Allow $3 \times n$ or $n \times 3$ for $3n$

Ignore units

Condone capital H or N , but for incorrect variable(s) award 1 mark less than correct variable(s) would get

eg1 $h = 3x + 20$ or $y = 3x + 20$

B2

eg2 $3x + 20$

B1

eg3 $3x$

B0

[3]

Q7.

15 litres

B1

[1]

Q8.

(a) 0.6 or $\frac{3}{5}$

oe fraction

Accept 36 m/s per min

B1

m/s^2

oe

Accept m/s per min only if their acceleration is 36 m/s per min

B1

(b) Chord from (0, 0) to (50, 30)

and

attempt at tangent to curve that is parallel to chord

M1

[11, 14]

Must see working on the graph

A1

[4]

Q9.

$\frac{2}{5} \times 240$ or 96

or

$\frac{3}{5} \times 240$ or 144

oe

M1

$\frac{2}{5} \times 240 \times 172$

or

96×172 or 16 512

oe

M1dep

$$\begin{array}{r} 29\,760 - 16\,512 \\ \hline 144 \end{array}$$

or

$$\begin{array}{r} 13\,248 \\ \hline 144 \end{array}$$

oe dep on M2

M1dep

92

A1

Additional Guidance

Up to M3 may be awarded for correct work, with no answer or incorrect answer, even if this is seen amongst multiple attempts

[4]

Q10.

- (a) $390 \div 37.5$ or 10.4
oe

M1

10.40

A1

- (b) No, their monthly pay is more
and $4 \times 7 = 28$
and not 31

oe

B1 for partial working

eg No, their monthly pay is more and $4 \times 7 = 28$

or More than 4 weeks in a month

B2

[4]

Q11.

Alternative method 1

$8400 \div 350$ or 24

oe method to work out 24

M1

their 24×175

M1dep

4200

A1

Alternative method 2

$8400 \div 3 \div 350$ or 8

oe method to work out 8

M1

their $8 \times 3 \times 175$

M1dep

4200

A1

[3]

Q12.

$$\pi \times 30^2 \times 160$$

$$452\,389\dots \text{ or } 144\,000\pi$$
$$[452\,160, 452\,389]$$

M1

$$\text{their } 452\,389 \div 1000$$

$$\text{or their } 452\,389 \div 1000 \div 0.1$$

$$452.3\dots \text{ or } 144\pi$$
$$[452.150, 452.389]$$
$$4523.8\dots$$
$$[4521.6, 4524]$$

M1

$$\text{their } 4523.89 \div 60 (\div 60)$$

$$\text{or } (60 \times 60 =) 3600$$

$$\text{or } 0.1 \times 60 \times 60 \text{ or } 360$$

$$75.398\dots \text{ or } 1.25\dots$$
$$[75.36, 75.4] \text{ or } [1.25, 1.0526]$$

M1dep

$$[75.36, 75.4] \text{ and Yes}$$

or

$$[1.25, 1.0526] \text{ and Yes}$$

or

$$3600 \text{ and } 4523.8\dots \text{ and Yes}$$

or

$$452.3\dots \text{ and } 360 \text{ and Yes}$$

oe

A1

[4]

Q13.

Alternative method 1 Words per minute or words per second

$$416 \div 8 \text{ or } 52$$

$$\text{oe eg } 416 \div (8 \times 60) \text{ or } 416 \div 480$$

$$\frac{13}{15} \text{ or } [0.86, 0.87] \text{ or } 0.9$$

M1

$$1534 \div \text{their } 52$$

or

$$(1534 - 416) \div \text{their } 52 + 8$$

or

$$\text{or } 29.5$$

$$\text{oe eg } 1534 \div \text{their } [0.86, 0.87]$$

or

$$(1534 - 416) \div \text{their } [0.86, 0.87] + 8 \times 60$$

$$\text{or } 1770$$

M1dep

$$29 \text{ minutes } 30 \text{ seconds}$$

$$\text{SC2 } 29 \text{ minutes } 50 \text{ seconds}$$

$$\text{or } 29 \text{ minutes } 5 \text{ seconds}$$

A1

Alternative method 2 Minutes per word or seconds per word

$8 \div 416$ or $\frac{1}{52}$
or [0.019, 0.019 231] or 0.02
oe eg $8 \times 60 \div 416$ or $480 \div 416$
 $\frac{15}{13}$ or [1.15, 1.154] or 1.2

M1

$1534 \times$ their [0.019, 0.019 231]
or
 $(1534 - 416) \times$
their [0.019, 0.019 231] + 8
or 29.5

oe eg $1534 \times$ their [1.15, 1.154]
or
 $(1534 - 416) \times$ their [1.15, 1.154]
+ 8×60
or 1770

M1dep

29 minutes 30 seconds
SC2 29 minutes 50 seconds
or 29 minutes 5 seconds

A1

Alternative method 3 Essay words $\div$ report words

$1534 \div 416$ or $\frac{59}{16}$
or [3.68, 3.69] or 3.7
or
 $(1534 - 416) \div 416$
or [2.68, 2.69] or 2.7 oe

M1

$8 \times$ their [3.68, 3.69]
or
 $8 \times$ their [2.68, 2.69] + 8
or 29.5

oe eg $8 \times 60 \times$ their [3.68, 3.69]
or
 $8 \times 60 \times$ their [2.68, 2.69] + 8×60
or 1770

M1dep

29 minutes 30 seconds
SC2 29 minutes 50 seconds
or 29 minutes 5 seconds

A1

Additional Guidance

M1 may be awarded for correct work with no, or incorrect answer, even if this is seen amongst multiple attempts

Answer 29.5 minutes 1770 seconds

M1M1A0

Build-up method must be a fully correct method that would lead to 29.5
If working with report words $\div$ essay words apply the principles of Alt 3

[3]

Q14.**(a) Alternative method 1**

$27\,576 \times 24$ or $661\,824$

M1

their $661\,824 \div 42\,600$ or $15.5\dots$

M1

15

A1

Alternative method 2

$42\,600 \div 27\,576$ or $1.54\dots$

M1

$24 \div$ their $1.54\dots$ or $15.5\dots$

M1

15

A1

Alternative method 3

$27\,576 \div 42\,600$ or $0.647\dots$

M1

their 0.647×24 or $15.5\dots$

M1

15

A1

(b) Alternative method 1

$27\,576 \div 60 \div 60$ or 7.66

M1

their 7.66×1000

M1dep

7660

A1

Alternative method 2

$27\,576 \times 1000$ or $27\,576\,000$

M1

their $27\,576\,000 \div 60 \div 60$

M1dep

7660

A1

Alternative method 3

$1000 \div (60 \times 60)$ or $0.277\dots$ or 0.28

M1

their $0.277\dots \times 27\,576$

M1dep

7660

A1

[6]

Q15.

Alternative method 1

$$5.88 \div 1.68 \text{ or } 3.5$$

or

$$1.68 \div 5.88 \text{ or } [0.285, 0.29]$$

or

$$5.88 \div 5.60 \text{ or } 1.05$$

$$\text{oe eg } \frac{7}{2} \text{ or } \frac{2}{7} \text{ or } \frac{21}{20}$$

or

$$5.6 \times 1.05 = 5.88$$

M1

$$5.6(0) \div (5.88 \div 1.68)$$

or

$$5.6(0) \times (1.68 \div 5.88)$$

or

$$1.68 \div (5.88 \div 5.60)$$

or

$$1.6$$

oe

$$\text{eg } 5.6(0) \div 3.5$$

or

$$5.6(0) \times [0.285, 0.29]$$

or

$$1.68 \div 1.05$$

M1dep

$$\text{their } 1.6 \div 1.68 \text{ or } [0.952, 0.9524]$$

$$\text{or } 1 - \text{their } 1.6 \div 1.68$$

$$\text{or } 1 - [0.952, 0.9524]$$

$$\text{or } [0.0476, 0.048]$$

$$\text{oe eg } \frac{20}{21} \text{ or } 1 - \frac{20}{21} \text{ or } \frac{1}{21}$$

$$5.6(0) \div 5.88 \text{ oe scores M3}$$

$$1 - 5.6(0) \div 5.88 \text{ oe scores M3}$$

M1dep

$$4.76$$

A1

Alternative method 2

5.88 ÷ 5.6(0) or 1.05

$$\text{oe eg } \frac{21}{20}$$

M1

1 ÷ their 1.05

$$\text{oe eg } 1 \div \frac{21}{20}$$

M1dep

[0.952, 0.9524]

or 1 – [0.952, 0.9524]

or [0.0476, 0.048]

$$\text{oe eg } \frac{20}{21} \text{ or } 1 - \frac{20}{21} \text{ or } \frac{1}{21}$$

5.6(0) ÷ 5.88 oe scores M3

1 – 5.6(0) ÷ 5.88 oe scores M3

M1dep

4.76

A1

Additional Guidance

Up to M3 may be awarded for correct work with no, or incorrect answer, even if this is seen amongst multiple attempts

0.28

5.60 = 0.05 is M0 unless 1.05 subsequently used

5.60 ÷ 1.68 with no further correct working

M0

Note that 1.6 seen may be from an incorrect method

eg 1.68 × 0.95 = 1.6 does not score because 1.68 × 0.95 is an incorrect method

and the actual value of 1.68 × 0.95 is 1.596

Any single calculation or set of calculations that lead to $\frac{20}{21}$ or $\frac{1}{21}$

M3

Some common oes for 1 – 5.6(0) ÷ 5.88 are

$$\frac{5.88 - 5.6(0)}{5.88} \text{ or } \frac{0.28}{5.88} \text{ and } \frac{1.68 - 1.6}{1.68} \text{ or } \frac{0.08}{1.68}$$

M3

3rd M1 oes include

[0.952, 0.9524] × 100 or [95.2, 95.24]%

100% – [0.952, 0.9524] × 100

[0.0476, 0.048] × 100 or (4.76, 4.8)%

Values that score marks may be seen in ratios

eg 5.88 : 1.68 (does not score at this stage)

3.50 : 1

M1

Allow working in pence eg 588 ÷ 1.68 or 350

M1

Allow working in grams eg 5.88 ÷ 1680 or 0.0035

M1

[4]

Q16.

Alternative method 1: works out concrete poured in 30 minutes

$$10.9 \times 30 \times 60 \div 1000 \quad \text{or} \quad 19.6(2)$$

or

$$10.9 \times 30 \times 60 \quad \text{or} \quad 19\,620$$

and

$$20 \times 1000 \quad \text{or} \quad 20\,000$$

oe full method

$$\text{eg } 10.9 \times 1800 \div 1000$$

$$\text{or } 30 \times 654 \div 1000$$

$$\text{or } 19\,620 \div 1000$$

M2 two correct steps

$$\text{eg } 10.9 \times 30 \times 60 \quad \text{or} \quad 19\,620$$

$$\text{or } 10.9 \times 30 \div 1000 \quad \text{or} \quad 0.327$$

$$\text{or } 10.9 \times 60 \div 1000 \quad \text{or} \quad 0.654$$

$$\text{or } 30 \times 60 \div 1000 \quad \text{or} \quad 1.8$$

M1 one correct step

$$\text{eg } 10.9 \times 30 \quad \text{or} \quad 327$$

$$\text{or } 10.9 \times 60 \quad \text{or} \quad 654$$

$$\text{or } 10.9 \div 1000 \quad \text{or} \quad 0.0109$$

$$\text{or } 30 \times 60 \quad \text{or} \quad 1800$$

$$\text{or } 30 \div 1000 \quad \text{or} \quad 0.03$$

$$\text{or } 60 \div 1000 \quad \text{or} \quad 0.06$$

$$\text{or } 20 \times 1000 \quad \text{or} \quad 20\,000$$

M3

19.6(2) and No

or

19 620 and 20 000 and No

oe eg 19.62 so it isn't

A1

Alternative method 2: works out time for 20 tonnes at given rate

$$20 \times 1000 \div 10.9 \div 60 \quad \text{or} \quad [30.5, 30.6]$$

or

$$20 \times 1000 \div 10.9 \quad \text{or} \quad [1834, 1835]$$

and

$$30 \times 60 \quad \text{or} \quad 1800$$

oe full method

$$\text{eg } 20\,000 \div 10.9 \div 60$$

$$\text{or } 20 \times [91.7, 91.74312] \div 60$$

$$\text{or } [1834, 1835] \div 60$$

M2 two correct steps

$$\text{eg } 20 \times 1000 \div 10.9 \quad \text{or} \quad [1834, 1835]$$

$$\text{or } 20 \times 1000 \div 60 \quad \text{or} \quad 333(\dots)$$

$$\text{or } 20 \div 10.9 \div 60 \quad \text{or} \quad [0.0305, 0.031]$$

$$\text{or } 1000 \div 10.9 \div 60 \quad \text{or} \quad [1.52, 1.53]$$

M1 one correct step

$$\text{eg } 20 \times 1000 \quad \text{or} \quad 20\,000$$

$$\text{or } 20 \div 10.9 \quad \text{or} \quad [1.83, 1.835]$$

$$\text{or } 20 \div 60 \quad \text{or} \quad 0.33(\dots)$$

$$\text{or } 1000 \div 10.9 \quad \text{or} \quad [91.7, 91.74312]$$

$$\text{or } 1000 \div 60 \quad \text{or} \quad [16.6, 16.7]$$

$$\text{or } 10.9 \times 60 \quad \text{or} \quad 654$$

$$\text{or } 30 \times 60 \quad \text{or} \quad 1800$$

M3

$$[30.5, 30.6] \quad \text{and} \quad \text{No}$$

or

$$[1834, 1835] \quad \text{and} \quad 1800 \quad \text{and} \quad \text{No}$$

*oe eg 30.6 so it isn't***A1****Additional Guidance**

Up to M2 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts

M3 or M2 will usually be seen in stages

$$\text{eg Alt 1 } 10.9 \times 30 = 327 \quad 327 \times 60 = 19\,620 \quad 19\,620 \div 1000$$

M3

M2 or M1 may be seen embedded in more than one step (extra steps could be incorrect)

No may be indicated by selecting the box or a statement in the working lines

No cannot be implied only by an inequality

A correct value is sufficient for showing working eg Alt 1 19.62 and No

M3A1

Ignore their units throughout

Other approaches are possible eg works out rate in kg per s for 20 tonnes in 30 minutes and compares to 10.9

[4]

Q17.

- (a) $1.2 \times 20 = 24$ and $40 - 24 = 16$
 oe eg $1.2 \times 20 = 24$ and $24 + 16 = 40$
 or $40 - 16 = 24$ and $24 \div 20 = 1.2$
 or $24 + 16 = 40$ and $24 \div 1.2 = 20$
 may be seen as one calculation
 eg $40 - 1.2 \times 20 = 16$
 or $16 + 1.2 \times 20 = 40$
 or $40 - 16 = 1.2 \times 20$

B1**Additional Guidance**

$40 - 24 = 16$ and $40 - 16 = 24$ and $24 + 16 = 40$ are equivalent
 $1.2 \times 20 = 24$ and $24 \div 1.2 = 20$ and $24 \div 20 = 1.2$ are equivalent
 $40 - 24 = 16$ or $16 + 24 = 40$ or $40 - 16 = 24$

B0

(20 minutes =) 24 litres leak out $40 - 24 = 16$

B0

$1.2 \times 20 = 24$ 16 litres left

B0

Allow unambiguous working in ml and/or seconds

For eg $40 - 24 = 16$ condone $24 - 40 = 16$ or $24 - 40 = -16$

Condone incorrect use of equals sign

eg $1.2 \times 20 = 24 + 16 = 40$ or $1.2 \times 20 = 24 - 40 = 16$

B1

Correct response with irrelevant work

B1

16 from two different ways with one way incorrect is choice

eg $1.2 \times 20 = 24$ and $40 - 24 = 16$ and $20 \div 1.2 = 16$

B0

(b) 3

B1

Correct method for gradient

$$\frac{40 - 16}{15 - \text{their } 3} \text{ or } \frac{24}{12}$$

eg $\frac{30 - 25}{10 - 7.5}$ or $\frac{10}{5}$ or $40 - 38$

M1

2

correct or ft their 3

A1ft

Additional Guidance

Note that their 3 can be used to work out the rate but does not have to be

Values seen on graph must be used correctly

eg 24 and 12 seen on the graph is M0 unless subsequently used correctly

in attempt to work out the gradient

A1ft answers must be to 1 dp or better

eg 3.5

B0

$$\frac{40 - 16}{15 - 3.5}$$

M1

2.1 (accept 2.08...)

A1ft

$$\frac{40 - 16}{15 - \text{their } 3}$$

After B0 the method may be implied (use $\frac{40 - 16}{15 - \text{their } 3}$ to check)

eg 6

B0

2.7 (accept 2.66...)

M1A1ft

If the report is blank, 3 and 2 must be unambiguously identified in working to be acceptable

Allow 2 to be written as $\frac{2}{1}$

[4]

Q18.

$80 \times x$ or $80x$ or $x \times 80$ or $x80$
teabags per hour

or

$x \div 60$ or $\frac{x}{60}$ or $\frac{1}{60}x$ or $x\frac{1}{60}$

or

$80 \div 60$ or $\frac{80}{60}$

boxes per minute

M1

$\frac{80x}{60} \left(= \frac{4x}{3} \right)$

or

$80 \div 60 \times x \left(= \frac{4x}{3} \right)$

oe showing 80 and 60 and x

eg $\frac{80 \times x}{60} \left(= \frac{4x}{3} \right)$ or $x\frac{80}{60} \left(= \frac{4x}{3} \right)$

or $\frac{80}{60} \times x \left(= \frac{4x}{3} \right)$ or $80x \div 60 \left(= \frac{4x}{3} \right)$

A1

Additional Guidance

M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts

Do not allow M1 if only seen embedded in an incorrect expression or calculation eg $80x \times 4 = 320x$

M0

$\frac{4x}{3}$

$60 \times \frac{4x}{3} = 80x$ (M1 allowed as $80x$ is not embedded in an incorrect expression or calculation, A0 because using the given answer)

M1A0

Condone $x = 80 \div 60$

M1A0

$\frac{80x}{60} \left(= \frac{4x}{3} \right)$

M1A1

$\frac{80}{60} = \frac{4}{3}$ and $\frac{4}{3} \times x \left(= \frac{4x}{3} \right)$

M1A1

$\frac{80}{60} = \frac{4}{3}$ and $\frac{4x}{3}$

M1A0

No equivalents allowed for M1

Ignore units

Condone 1.33(...) for $\frac{4}{3}$

Ignore non-contradictory working after M1A1 seen

[2]

Q19.

5×24.5 or 122.5
oe

M1

24.5×0.2 or 4.9
oe

M1

$24.5 - \text{their } 4.9$ or 19.6
oe
dep on 2nd M1
 24.5×0.8 oe is 2nd M1 and 3rd M1

M1dep

$(259.7 - \text{their } 122.5) \div \text{their } 19.6$
or
 $137.2 \div \text{their } 19.6$
oe
dep on 3rd M1
eg1 $7 \times 19.6 = 137.2$
eg2 $122.5 + 19.6 + 19.6 + 19.6 + 19.6 + 19.6 + 19.6 + 19.6 = 259.7$

M1dep

12 with 19.6 seen
or
12 with 122.5, 142.1, 161.7, 181.3, 200.9, 220.5, 240.1, 259.7

A1

Additional Guidance

Up to M3 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts

Build up attempts must be fully correct or show method

$122.5 + 19.6$

M1M1M1

122.5, 142.1, 161.7, 181.3, 200.9, 220.5, 240.1, 259.7 without 12

M1M0M0M0

[5]

Q20.

(a) Correct ruled straight line through (0, 0) and (20, 72)

$\pm \frac{1}{2}$ square

B1 any one correct coordinate plotted or seen in a table of values with $1 \leq x \leq 20$

eg (1, 3.6) (2, 7.2) (3, 10.8) (4, 14.4) (5, 18) (10, 36) (15, 54) or (20, 72)

B2

Additional Guidance

Ignore lines beyond (0, 0) to (20, 72)

Ignore incorrect points plotted

To award B1, points plotted cannot be implied by an incorrect line, there must be a coordinate plotted or values in a table

Correct ruled line but too short

B1

(b) 14

ft from their graph in part (a)

$$\pm \frac{1}{2} \text{ square}$$

B1ft

Additional Guidance

Answer must be a whole number

(c) **Alternative method 1** (using formula and conversion factor)

$$30 \times 3.6 \text{ or } 108$$

$$\text{or } 30 \div 1.61 \text{ or } [18.6, 18.64]$$

$$\text{or } 3.6 \div 1.61 \text{ or } [2.2, 2.24]$$

$$\text{or } 1.61 \div 3.6 \text{ or } [0.4, 0.45]$$

oe working in metres

$$\text{eg } 30 \times 60 \times 60 \text{ or } 108\,000$$

M1

$$\text{their } 108 \div 1.61$$

$$\text{or their } [18.6, 18.64] \times 3.6$$

$$\text{or their } [2.2, 2.24] \times 30$$

$$\text{or } 30 \div \text{their } [0.4, 0.45]$$

oe working in metres

$$\text{eg } 108\,000 \div 1610$$

M1dep

$$[67, 67.1]$$

$$[67, 67.1]$$

A1

Alternative method 2 (using graph and conversion factor)

Uses their graph to convert 30 m/s to km/h

or 108

$$\text{eg } 3 \times (\text{their } y \text{ at } x = 10)$$

or

$$(\text{their } y \text{ at } x = 10) + (\text{their } y \text{ at } x = 20)$$

$$\pm \frac{1}{2} \text{ square}$$

M1

$$\text{their } 108 \div 1.61$$

M1dep

$$[67, 67.1]$$

ft from their graph in part (a) and M2

A1ft

Additional Guidance

Alt 2 For A1ft answers may be rounded to the nearest integer or rounded to 1 decimal place

eg their graph used correctly gives 114 km/h

M1

$$114 \div 1.61$$

M1dep

$$[70.8, 71]$$

A1ft

[6]

Q21.

No and fully correct reason

eg No and it is (£)10 (per day after the first day)

or

No and it is (£)10.8(0) per day for five days

or

No and it would be (£)70 for five days

or

No and you pay more for the first day

B1 No and partially correct reason

eg No and (£)10.8(0)

or

fully correct reason with no decision or incorrect decision

eg it is (£)10 (per day after the first day)

B2

Additional Guidance

Equivalent values for (£)10.8(0) per day for five days

(£)11.(00) per day for four days

(£)11.33 per day for three days

(£)12.(00) per day for two days

Equivalent values for (£)70 for five days

(£)56 for four days

(£)42 for three days

(£)28 for two days

Do not ignore incorrect reasons with a correct reason for B2

Calculations must be correct for B2

Ignore irrelevant reasons with a correct reason

No, $24 - 14 = 10$

B2

No, as next would be 28

B2

No and $(C =) 10n + 4$

B2

Correct reason stated with decision yes

B1

No, it is £28 (partially correct reason)

B1

No, it is £12

B1

No, 5×14 is not 54

B1

States No with no reason

B0

States No with incorrect reason

B0

No, it does not go up by (£)14 per day

B0

[2]

Q22.

Alternative method 1 comparing with 7.5 minutes

$$180 \div 135 \text{ or } 180 \div 14$$

or

$$79.8 \div 14 \text{ or } 79.8 \div 135$$

oe or reciprocals

M1

$$\frac{14 \times 135}{180}$$

$$\text{or } 10.5$$

or

$$\frac{79.8 \times 180}{135}$$

$$\text{or } 106.4$$

oe or reciprocals

M1dep

$$\frac{79.8 \times 180}{14 \times 135}$$

$$\text{or } 7.6$$

oe eg 79.8 \div 10.5 or 106.4 \div 14

M1dep

No and 7.6 (and 7.5)

oe eg No and 7 minutes 36 seconds (and 7 minutes 30 seconds)

A1

Alternative method 2 comparing with 79.8 litres

$$135 \div 180 \text{ or } 14 \div 180$$

or

$$7.5 \times 14 \text{ or } 7.5 \div 180$$

oe or reciprocals

M1

$$\frac{14 \times 135}{180}$$

$$\text{or } 10.5$$

or

$$\frac{7.5 \times 135}{180}$$

$$\text{or } 5.625$$

oe or reciprocals

M1dep

$$\frac{7.5 \times 135 \times 14}{180}$$

$$\text{or } 78.75$$

oe eg 10.5 \times 7.5 or 5.625 \times 14

M1dep

No and 78.75

A1

Alternative method 3 comparing with 14 litres per minute

$$180 \div 135 \text{ or } 180 \div 7.5$$

or

$$79.8 \div 135 \text{ or } 79.8 \div 7.5$$

oe or reciprocals

M1

$$\frac{7.5 \times 135}{180}$$

$$\text{or } 5.625$$

or

$$\frac{79.8 \times 180}{135}$$

$$\text{or } 106.4$$

oe or reciprocals

M1dep

$$\frac{79.8 \times 180}{7.5 \times 135}$$

$$\text{or } [14.18, 14.19]$$

oe

M1dep

No and [14.18, 14.19]

A1

Alternative method 4 comparing new rate of flow with rate required

$$135 \div 180 \text{ or } 14 \div 180$$

oe or reciprocals

M1

$$\frac{14 \times 135}{180}$$

$$\text{or } 10.5$$

oe

M1dep

$$79.8 \div 7.5 \text{ or } 10.64$$

oe

M1

No and 10.5 and 10.64

A1

Alternative method 5 comparing with 135 degrees

$$180 \div 14 \text{ or } 180 \div 7.5$$

or

$$79.8 \div 14 \text{ or } 79.8 \div 7.5$$

oe or reciprocals

M1

$$180 \div 14 \text{ and } 79.8 \div 7.5$$

or

$$180 \div 7.5 \text{ and } 79.8 \div 14$$

oe or matching reciprocals

M1dep

$$\frac{79.8 \times 180}{7.5 \times 14}$$

$$\text{or } 136.8$$

dep on M2

M1dep

No and 136.8

A1

Additional Guidance

No may be implied eg It takes more

7.3(0) used for 7.5 may score up to M3

$7\frac{1}{2}$ minutes converted to 7.3(0) or 7 minutes 50 seconds

A0

Ignore incorrect conversion of 7.6 to minutes and seconds if 7.6 seen

Use the scheme that awards the most marks and ignore choice

$180 \div 14$ **and** $79.8 \div 7.5$

or

$79.8 \div 135$ or $79.8 \div 7.5$

oe or reciprocals

may be implied by (side length =) 35

or $4x + 5 = 10(x - 4)$

or $6x - 10 = 10(x - 4)$

oe

eg $4x + 5 + 6x - 10 = 2 \times 10(x - 4)$

condone $10x - 4$ for $10(x - 4)$

M1

$4x - 6x = -10 - 5$

or $-2x = -15$

or $4x = -10x = -40 - 5$

or $-6x = -45$

or $6x - 10x = -40 + 10$

or $-4x = -30$

oe collection of terms

eg $4x + 6x - 20x = -80 - 5 + 10$

or $-10x = -75$

condone $10x - 4$ for $10(x - 4)$

eg $4x - 10x = -4 - 5$

or $6x - 10x = -4 + 10$

$(x =) 7.5$

oe

may be implied by (side length =) 35

or (perimeter =) 105

A1

$(6 \times \text{their } 7.5 - 10) \times 3$

or

$(4 \times \text{their } 7.5 + 5) \times 3$

or

$10 \times (\text{their } 7.5 - 4) \times 3$

or

35×3

or

$6 \times \text{their } 7.5 - 10 + 4 \times \text{their } 7.5 + 5 + 10 \times (\text{their } 7.5 - 4)$

or

$20 \times \text{their } 7.5 - 45$

or

105

oe

dep on M1M1

condone $10x - 4$ for $10(x - 4)$

<i>condone $10x - 4$ for $10(x - 4)$ must show working if M1M1A0</i>		
105 and Yes		M1dep
<i>oe eg 1.05 and Yes</i>		
Additional Guidance		A1
$4x + 5 = 6x - 10 = 10(x - 4)$		
Condone $10x - 4$ for $10(x - 4)$ for up to M3		M1
		[4]
Q23.		
Alternative method 1		
37×0.25 or 9.25		
<i>must be working in £</i>		
		M1
312.65		
<i>condone £312.65p</i>		
		A1
Alternative method 2		
$303.4 \div 37 + 0.25$ or 8.45		
<i>must be working in £</i>		
		M1
312.65		
<i>condone £312.65p</i>		
		A1
Additional Guidance		
Working in pence must be recovered		
eg 1 $37 \times 25 = 925$		
		M0
eg 2 $37 \times 25 = 925$ and used as 9.25		
		M1
eg 3 $8.20 + 25 = 33.20$		
		M0
eg 4 $8.20 + 25 = 8.45$		
		M1
Do not accept 7 as a misread of 37		
		M0
		[2]

Q24.

Alternative method 1 Compares 70% of volume of hemisphere with volume of water

$$\frac{4}{3} \times \pi \times 12^3 \text{ or } 2304\pi$$

or [7216, 7239.2]

or

$$\frac{2}{3} \times \pi \times 12^3 \text{ or } 1152\pi$$

or [3581, 3638]

$$\text{oe eg } \frac{4}{3} \pi \times 1728$$

allow without any multiplication signs

$$\text{eg } \frac{4}{3} \pi 12^3$$

M1

$$0.7 \times \text{their } 1152\pi \text{ or } 806.4\pi$$

or [2506, 2547]

oe

$$0.7 \times \text{their } [3581, 3638] \text{ or } \frac{4032}{5} \pi$$

must be using volume of hemisphere

M1dep

$$325 \times 8 \text{ or } 2600$$

oe

M1

$$[2506, 2547] \text{ and } 2600 \text{ and Yes}$$

oe

A1

Alternative method 2 Works out volume of water as proportion of volume of hemisphere

$\frac{4}{3}$

$$\times \pi \times 12^3 \text{ or } 2304\pi$$

or [7216, 7239.2]

or

$\frac{2}{3}$

$$\times \pi \times 12^3 \text{ or } 1152\pi$$

or [3581, 3638]

$\frac{4}{3}$

$$\text{oe eg } \pi \times 1728$$

allow without any multiplication signs

$\frac{4}{3}$

$$\text{eg } \pi 12^3$$

M1

$$325 \times 8 \text{ or } 2600$$

oe

M1

their 2600 $\div$ their 1152 π

or [0.71, 0.73]

oe eg their 2600 $\div$ their [3581, 3638]

or 72%

dep on M2

must be using volume of hemisphere

M1dep

[71, 73](%) and Yes

oe eg 0.72 and 0.7 and Yes

A1

Alternative method 3 Works out time to fill 70% of volume of hemisphere

$$\frac{4}{3} \times \pi \times 12^3 \text{ or } 2304\pi$$

or [7216, 7239.2]

or

$$\frac{2}{3} \times \pi \times 12^3 \text{ or } 1152\pi$$

or [3581, 3638]

$$\frac{4}{3} \pi \times 1728$$

allow without any multiplication signs

$$\frac{4}{3} \pi 12^3$$

M1

$0.7 \times \text{their } 1152\pi \text{ or } 806.4\pi$

or [2506, 2547]

or

their $1152\pi \div 325$

or [11, 11.2]

oe

$$0.7 \times \text{their } [3581, 3638] \text{ or } \frac{4032}{5} \pi$$

or

their $[3581, 3638] \div 325$

must be using volume of hemisphere

M1dep

$0.7 \times \text{their } 1152\pi \div 325$

or $0.7 \times \text{their } [3581, 3638] \div 325$

or [7.7, 7.84]

oe

their $[2506, 2547] \div 325$

or $0.7 \times \text{their } [11, 11.2]$

M1dep

[7.7, 7.84] and Yes

oe

A1

Additional Guidance

Up to M3 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts

Allow 1.33(...) for $\frac{4}{3}$

Allow 0.66(...) or 0.67 for $\frac{2}{3}$

π may be seen as [3.14, 3.142] eg Alt 1 $\frac{2}{3} \times 3.14 \times 12^3$

M1

If a number (or calculation) in terms of π is seen but π is subsequently omitted, treat as a miscopy for M marks

eg Alt 1

1152 π

M1

$0.7 \times 1152 = 806.4$

M1dep

$325 \times 8 = 2600$ Yes

M1A0

Yes cannot be implied by inequalities

Alts 1 and 2

$325 \text{ cm}^3 \times 8$ seen is M1 even if evaluated incorrectly

$325^3 \times 8$ seen is M0 unless recovered to 2600

Do not allow misreads of the given formula unless recovered

eg1 using 12^2 instead of 12^3

eg2 using $\frac{3}{4}$ instead of $\frac{4}{3}$

For $0.7 \times$ their 1152π , do not accept $70\% \times$ their 1152π unless recovered

[4]

Q25.

Alternative method 1

280 ÷ 35 or 8

oe eg 80 ÷ 10

M1

(350 – 280) ÷ (40 – 35)

or

70 ÷ 5

or

14 *oe*

M1

6

A1

Alternative method 2

320

or

350 – 320 or 30

or

350 – 280 and 320 – 280

or

70 and 40

oe

M1

(350 – 320) ÷ 5

or

(70 – 40) ÷ 5

or

30 ÷ 5

oe

M1dep

6

A1

Additional Guidance

Do not allow a misread from the graph

Alt 2 40 must come from 320 – 280 and not 40 hours worked

[3]

Q26.

(a) $\pi \times 6^2$

or 3.14×6^2

or [113, 113.2]

May be embedded

oe

M1

$\pi \times 6^2 \times 15$

or $3.14 \times 6^2 \times 15$

or [113, 113.2] × 15

oe

M1dep

[1695, 1698] or 1700

or 540π

Ignore fw after 540π

A1

Additional Guidance

$$\pi \times 6^2 = \pi \times 12 \times 15$$

M1M1

$$\pi \times 6^2 \times 15 = \pi \times 12 \times 15$$

M1M1

$$\pi \times 6^2 \times 30$$

M1M0

$$2 \times \pi \times 6^2 \times 15$$

M1M0

$$\pi \times 6^2 = \pi \times 12$$

M1M0

$$\pi 6^2$$

M1

$$\pi \times 12$$

M0

$$\pi \times 12 \times 15$$

M0**(b) Alternative method 1**

$$45\,000 \div 1000 \text{ or } 45$$

M1

$$45 \div 0.75$$

$$\text{or } 45 \times 1.33\ldots$$

$$\text{or their } 45 \div 0.75$$

oe

$$\text{eg } 45 \div 3 \times 4$$

M1

$$60$$

A1

$$60 \text{ minutes or } 60 \text{ min(s)}$$

$$\text{or } 1 \text{ hour or } 1\text{h(r)}$$

*Strand (i) Correct notation***Q1****Alternative method 2**

$$0.75 \times 1000 \text{ or } 750$$

M1

$$45\,000 \div 750$$

$$\text{or } 45\,000 \div \text{their } 750$$

*oe***M1**

$$60$$

A1

$$60 \text{ minutes or } 60 \text{ min(s)}$$

$$\text{or } 1 \text{ hour or } 1\text{h(r)}$$

*Strand (i) Correct notation***Q1**

Additional Guidance

For the Q mark 60 minutes or 1 hour must not come from incorrect working

Ignore fw after 60 minutes or 1 hour

Digit 6 implies M0M1 eg 60 000, 6000, 600, 6 or 0.6

M0M1

$$750 \div 45\,000 = 0.016\dots \text{ (units would be minutes}^{-1}\text{)}$$

M1M0A0Q0

$$750 \div 45\,000 = 0.016\dots \text{ and } 0.016\dots \times 60 = 1 \text{ hour}$$

(method is incorrect)

M1M0A0Q0

Do not accept 60 m for the Q mark

M1M1A1Q0

[7]

Q27.

Alternative method 1

$$24 \times 48 \times 9.2 \text{ or } 10598.4(0)$$

M1

$$10598.4(0) \text{ and Yes}$$

A1

Alternative method 2

$$10\,000 \div 24 \div 48 \text{ or } 8.6(8\dots) \text{ or } 8.7$$

M1

$$8.6(8\dots) \text{ or } 8.7 \text{ and Yes}$$

A1

Alternative method 3

$$10\,000 \div 24 \div 9.2 \text{ or } 45.(...) \text{ or } 46$$

M1

$$45.(...) \text{ or } 46 \text{ and Yes}$$

A1

Alternative method 4

$$10\,000 \div 48 \div 9.2 \text{ or } 22.(...) \text{ or } 23$$

M1

$$22.(...) \text{ or } 23 \text{ and Yes}$$

A1

[2]

Q28.

$$2.5 \text{ cm/s}$$

B1

[1]

Q29.

(a) 8 cm

B1

(b) $\frac{21-13}{11-6}$

oe

M1

$\frac{8}{5}$ or 1.6

oe

A1

cm/s or cm s⁻¹

oe eg Centimetres per second

B1

[4]

Q30.

Alternative method 1 Working out time to fill the ball

$4 \div 3 \times 15^3 \times \pi$ or [4488, 4500] π

or [14 092, 14 139]

oe

allow 1.33 or better

M1

their [14 092, 14 139] – 5000

or [9092, 9139]

or

their [14 092, 14 139] $\div$ 160

or [88, 88.37]

oe

M1dep

(their [14 092, 14 139] – 5000) $\div$ 160

or [56, 57.12]

oe eg their [9092, 9139] $\div$ 160

or

their [88, 88.37] – 5000 $\div$ 160

M1dep

[56, 57.12] and Yes

A1

Alternative method 2 Comparing volume needed with volume that could be filled

$4 \div 3 \times 15^3 \times \pi$ or [4488, 4500] π

or [14 092, 14 139]

oe

allow 1.33 or better

M1

their [14 092, 14 139] – 5000

or [9092, 9139]

M1dep

[58, 60] $\times$ 160 or [9280, 9600]

oe

M1

[9092, 9139] and [9280, 9600] and Yes

A1

Alternative method 3 Volume of ball compared with volume that could be filled + 5000

$$4 \div 3 \times 15^3 \times \pi \text{ or } [4488, 4500]\pi$$

or [14 092, 14 139]

oe

allow 1.33 or better

M1

$$[58, 60] \times 160 \text{ or } [9280, 9600]$$

oe

M1

their [9280, 9600] + 5000

or [14 280, 14 600]

dep on 2nd M1

M1dep

[14 092, 14 139]

and [14 280, 14 600] and Yes

A1

Additional Guidance

$\frac{4}{3}$

Accept $\frac{4}{3}\pi 15^3$ without multiplication signs

Condone use of 1.3 for up to M3 if 1.3 shown

Up to M3 may be awarded for correct work, with no or incorrect answer, even if this is seen amongst multiple attempts

Using an incorrect power eg 15^2 , $15\pi^3$, $(15\pi)^3$ or omitting π unless recovered

1st M0

NB 56.(59...) or 56.6 or 57 coming from $5000 \div 88.35...$

M1M1M0

Yes can be implied eg Alt 1 $57 < 60$

M3A1

[4]

Q31.

(a) $240 \div 10$ or $120 \div 5$ or 24

or

240×6 or 120×12 or 1440

M1

24 litres per minute

or

1440 litres per hour

oe eg 24 l/min or 0.4 litres per second

A1

Additional Guidance

M1 may be awarded for correct work with no answer or incorrect answer, even if this is seen amongst multiple attempts

Units may be abbreviated but must be the correct units for their correct rate eg allow 0.4 l/s or 0.4 lps for 0.4 litres per second

M1A1

Do not ignore further incorrect attempts to change units eg 24 litres per minute and 0.4 litres/hour on the answer line

M1A0

(b) Horizontal line from (10, 240) to (30, 240)

$\pm \frac{1}{2}$ small square

B1

Straight line from their (30, 240) to (12 + their 30, 0)

$\pm \frac{1}{2}$ small square for (12 + their 30, 0)

B1ft

Additional Guidance

Mark intention

No horizontal line and straight line from (10, 240) to (22, 0)

B0B1ft

[4]

Q32.

Attempt to draw a tangent

M1

Attempt at slope of a tangent drawn at (10, 15)

tolerance $\pm \frac{1}{2}$ square

Must be an attempt at change in y divided by change in x

Accept positive or negative

M1dep

[0.6, 0.8] from tangent drawn at (10, 15)

Condone $-[0.6, 0.8]$ from tangent drawn at (10, 15)

ft from their tangent drawn at (10, 15)

A1ft

Additional Guidance

Tangent drawn at incorrect point

M1M0A0

No tangent

M0

Tangent drawn at (10, 15)

M1

$10 \div 15 = 0.6$

M0 A0

Misread of scale for tangent drawn at (10, 15) could score M1M1

[3]

Q33.

(a) [2.9, 3]

B1

(b) [1.4, 1.6]

B1

(c) $\frac{[4.55, 4.65] - 0}{3.5 - [1.5, 1.6]}$ or $\frac{[4.55, 4.65]}{[1.9, 2]}$
or $\frac{[4.55, 4.65] - 0}{[1.5, 1.6] - 3.5}$ or $\frac{[4.55, 4.65]}{[-2, -1.9]}$
or $[-2.45, -2.275]$
oe

M1

[2.275, 2.45]

A1

[4]

Q34.

Alternative method 1

1 mile per minute

or 60 miles per hour

or 0.15 (hours)

or 1.6 (hours) or $1\frac{36}{60}$ (hours)

B1

$9 \div 50$ or 0.18

oe

M1

$$70 \times 1\frac{36}{60}$$

or 70×1.6 or 112

oe

M1

their $112 \div 40$ or 2.8

Dep on 2nd M1

M1dep

2.98

or 2.8 and $(3 - 0.18 =) 2.82$

or 0.18 and $(3 - 2.8 =) 0.2$

Ignore fw

A1

Alternative method 2

1 mile per minute

or 60 miles per hour

or 0.15 (hours)

or 1.6 (hours) or $1\frac{36}{60}$ (hours)

B1

$9 \div 50$ or 0.18

oe

M1

$$70 \times 1\frac{36}{60} \text{ or } 112$$

or 70×1.6 or 112

M1

$40 \times (3 - \text{their } 0.18)$ or 112.8

Dep on 1st M1

M1dep

112.8 and 112

Ignore fw

A1

Alternative method 3

1 mile per minute
or 60 miles per hour
or 0.15 (hours)
or 1.6 (hours) or $1\frac{36}{60}$ (hours)

B1

$9 \div 50$ or 0.18

oe

M1

$70 \div 40$ or 1.75

M1

$70 \div 40 \times 1.6$ or 2.8

or their 1.75×1.6

oe

e.g. $1.75 + 0.875 + 0.175$

Dep on 2nd M1

M1dep

2.98

or 2.8 and $(3 - 0.18 =) 2.82$

or 0.18 and $(3 - 2.8 =) 0.2$

Ignore fw

A1

Additional Guidance

Key facts are :

First stage:

Distance travelled 9 miles (given)

Time taken 9 minutes (given) or 0.15 hours

Average speed 60 mph

Miles per gallon 50 mpg (given),

Amount of petrol $9 \div 50 = 0.18$ gallons

Second stage:

Distance travelled $70 \times 1.6 = 112$ miles

Time taken 1 hour 36 minutes (given) or 1.6 hours

Average speed 70 mph (given)

Miles per gallon 40 mpg (given),

Amount of petrol $112 \div 40 = 2.8$ gallons

An incorrect conversion of 1 hour 36 minutes to 1.36 can score: eg

$70 \times 1.36 = 95.2$, $95.2 \div 40 = 2.38$

B0M0M1M1A0

$70 \times 1.36 = 95.2$, $95.2 \div 40 = 2.38$, $0.18 + 2.38 = 2.56$

B1M1M1M1A0

$2.98 = 3$ (further work)

B1M1M1M1A1

$9 \div 50$

B1M1

[5]

Q35.

(a) 0.25 or $\frac{1}{4}$ or $\frac{2}{8}$

B1

$\frac{\text{m}}{\text{s}^2}$ or ms^{-2} or m/s/s or $\frac{\text{m}}{\text{s}^2}$

oe eg metres per second per second

SC2 acceleration and unit not in m/s^2 eg 25 cm/s^2 or 3240 km/h^2

B1

Additional Guidance

$\frac{2}{14-6}$ with no further simplification

(1st) B0

(b) **Alternative method 1**

$\frac{1}{2} \times 6 \times (v-2)$

or $\frac{1}{2} \times (14-6) \times (v+v-2)$

or $(14-6) \times (v-2)$

or $\frac{1}{2} \times (14-6) \times 2$ or 8

oe partial area

any letter

M1

$\frac{1}{2} \times 6 \times (v-2)$

+ $\frac{1}{2} \times (14-6) \times (v+v-2)$

or $3(v-2) + 8(v-2) + 8$

or $11v - 14$

oe

full area in one variable

eg $14 \times v - \frac{1}{2} \times 6 - (v-2)$

- $\frac{1}{2} \times 2 \times (6+14)$

implies M2

$\frac{1}{2} \times 6 \times (v-2)$

+ $\frac{1}{2} \times (14-6) \times (v+v-2) = 80$

or $94 \div 11$

oe

full area in one variable equated to 80

A1

$8.5(4\dots)$ or 8.55 or $\frac{94}{11}$ or $8\frac{6}{11}$

A1

Alternative method 2

$$\frac{1}{2} \times 6 \times x$$

$$\text{or } \frac{1}{2} \times (14 - 6) \times (x + x + 2)$$

$$\text{or } (14 - 6) \times x$$

$$\text{or } \frac{1}{2} \times (14 - 6) \times 2 \text{ or } 8$$

oe partial area

x is the speed at 6 seconds

any letter

M1

$$\frac{1}{2} \times 6 \times x$$

$$+ \frac{1}{2} \times (14 - 6) \times (x + x + 2)$$

$$\text{or } 3x + 8x + 8$$

$$\text{or } 11x + 8 \text{ oe full area in one variable}$$

$$\text{eg } 14 \times (x + 2) - \frac{1}{2} \times 6 \times x$$

$$- \frac{1}{2} \times 2 \times (6 + 14)$$

implies M2

M1dep

$$\frac{1}{2} \times 6 \times x$$

$$+ \frac{1}{2} \times (14 - 6) \times (x + x + 2) = 80$$

$$\text{or } 72 \div 11$$

$$\text{or } 6.5(4...) \text{ or } 6.55$$

$$\text{or } \frac{72}{11} \text{ or } 6\frac{6}{11}$$

oe full area in one variable equated to 80

A1

$$8.5(4...) \text{ or } 8.55 \text{ or } \frac{94}{11} \text{ or } 8\frac{6}{11}$$

A1

Additional Guidance

First M1 Do not allow 8 from $14 - 6$

Ignore units throughout

[6]

Q36.

(a) D

B1

(b) Draws tangent at $t = 10$

M1

$[0.3, 0.4]$

A1

Additional Guidance

For drawing of tangent mark intention

No tangent drawn

M0A0

[3]