

8300

GCSE MATHEMATICS

Foundation and Higher tier – Questions by Topic – Mark Scheme

Statistics

Interpreting frequency tables with grouped data

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.

- (a) 20 – 2 minutes 50 seconds
oe

M1

17 minutes 10 seconds
SC1 17.1 or 17.5

A1

Additional Guidance

SC is for those who understand range and calculation but do not work out the timing correctly.

- (b) Valid reason
eg Median is in $10 < t \leq 15$ class (so does not include 10 minutes)

B1

[3]

Q2.

- (a) 20 – 3 minutes 40 seconds
oe

M1

16 minutes 20 seconds

A1

- (b) Valid reason
eg Median is in $10 < t \leq 15$ class
(so does not include 10 minutes)

B1

[3]

Q3.

There is an overlap

oe

eg 20 can go in two rows

B1

There is no category above 50

oe

eg 53 can't go into the table

B1

Additional Guidance

Criticism of overlapping categories, eg
10 (or 20, 30 or 40) can go in two places

B1

20 (or 10 or 30 or 40) appears twice

B1

Should be 0-9, 10-19, 20-29 etc (minimal implied criticism)

B1

0-10; 11-20; 21-30 etc (no criticism)

B0

It doesn't give a clear number of cars

B0

Repeats the same number (could refer to the number of cars)

B0

Criticism of missing categories, eg
There is no row for the 53 (or 57)

B1

Doesn't go up high enough

B1

There's not space for all the numbers

B1

Some cars are left out

B1

She only put up to 50

B1

The last group is not big enough

B1

There should be another row (minimal implied criticism)

B1

There is a number over 50

B0

Cars go up to 57

B0

Add another frequency box

B0

Drawing another row to the table with no explanation

B0

[2]

Q4.

39

B1

[1]

Q5.

- (a) continuous grouped
both circled

B1

- (b) **Alternative method 1**

$$380 \div 2$$

or

$$(380 + 1) \div 2$$

or

$$381 \div 2$$

or

$$190 \text{ or } 190.5 \text{ or } 191$$

$$\text{oe e.g. } \frac{59 + 158 + 106 + 45 + 12}{2}$$

may be seen by the table

M1

$$2 < t \leq 4$$

with

$$190 \text{ or } 190.5 \text{ or } 191 \text{ seen}$$

A1

Alternative method 2

$$2 < t \leq 4$$

with

$$59 + 158 - 106 - 45 - 12 = 54 \text{ seen}$$

$$\text{oe calculation e.g. } 217 - 163 = 54$$

$$\text{B1 } 59 + 158 - 106 - 45 - 12 = 54 \text{ oe}$$

B2

Additional Guidance

$$2 < t \leq 4 \text{ with } 190 \text{ or } 190.5 \text{ or } 191 \text{ not seen}$$

M0A0

Condone 2 – 4 in both or one of the spaces on answer line if 190 or 190.5 or 191 seen

M1A1

Condone missing brackets if recovered

Alt 2 54 with calculation not seen

B0

Alt 2 $2 < t \leq 4$ and 54 with calculation not seen

B0

(c) $\frac{45+12}{380}$ or $\frac{57}{380}$ or $\frac{3}{20}$ or 0.15
 or $100 \div \frac{380}{57}$ or $57 \div 3.8$
oe proportion or calculation
must use 380

M1

15

A1

Additional Guidance

$1 - \frac{59+158+106}{380}$ or $1 - \frac{323}{380}$ or $1 - \frac{17}{20}$ or $1 - 0.85$

M1

Correct proportion seen even if not subsequently used

M1A0

Do not allow misreads of 380

Build-up

e.g. $10\% = 380 \div 10$ or 38

$5\% = 38 \div 2$ or 19

$38 + 19 = 57$

is M0A0 unless answer 15

[5]

Q6.

(a) $4 \leq t < 6$

B1

(b) **Alternative method 1**

$18 + 10 + 16 + 12$ or 56 and

60×0.9

or

$(18 + 10 + 16 + 12) \div 60 \times 100$ or 93.3... *oe*

M1

56 and 54 and Yes

or

93(.33)(%) and Yes

A1

Alternative method 2

4 and 60×0.1

or

$4 \div 60 \times 100$ or 6.66 *oe*

M1

4 and 6 and Yes

or

6(.66)(%) or 7(%) and Yes

A1

[3]

Q7.

(a) 13

B1

(b) Cannot tell

B1

(c) $20 < x \leq 30$

B1

[3]

Q8.

- (a) 2.5×12 or 30
and
 7.5×7 or 52.5
and
 $12.5 (\times 1)$
or
95

allow one incorrect midpoint

or

$[2, 3] \times 12$ and $[7, 8] \times 7$

and $[12, 13] (\times 1)$

ignore $t \geq 15$ row

$$\frac{\text{their } 30 + \text{their } 52.5 + \text{their } 12.5}{12 + 7 + 1}$$

M1

or $95 \div 20$

$t \geq 15$ product must be 0 if seen

condone bracket error seen eg $30 + 52.5 + 12.5 \div 20$

M1dep

4.75

*accept 4.8 or 5 if full working shown using **correct** midpoints*

A1

Additional Guidance

Two correct from 30, 52.5 and 12.5 implies the first mark and could be used to score up to M2

M1

Midpoints used in the ranges $[2, 3]$, $[7, 8]$ and $[12, 13]$ must be seen

eg

2.5×12 and 7×7 and $12 (\times 1)$

or 3×12 and 7×7 and $13 (\times 1)$

NB These could be used to score up to M2

M1

Correct products seen in the table but a different method shown in the working lines

eg $20 \div 4 = 5$

M0

- (b) Lower than part (a)

B1

[4]

Q9.

(a) Mid values seen

5, 15, 25
or 5.005, 15.005, 25.005
or 5.01, 15.01, 25.01

B1

$5 \times 18 (+) 15 \times 15 (+) 25 \times 7$

Accept use of mid values 5.005, 15.005, 25.005 or 5.01, 15.01, 25.01

Allow one error

eg one mid value incorrect or one calculation incorrect

M1

their $490 \div 40$

M1dep

12.25 or 12.26

SC2 for 7.25 or 7.26
or 17.25 or 17.26

A1

(b) Indicates lower

B1

Valid reason

eg (£)4.50 is less than (£)5 and (£)23.40 is less than (£)25

B1

[6]

Q10.

55×1 or 55
or 70×6 or 420
or 90×13 or 1170

M1

their 55 + their 420 + their 1170
or 1645

sum of fx

M1dep

their $1645 \div 20$ or 82.25

M1dep

82.25 and correct conclusion

oe

eg 82.25 and men were faster.

A1

Additional Guidance

$1645 \div 3 = 548.3333$

M1M1M0A0

[4]

Q11.

- (a) Midpoints seen or implied
5, 15, 25, 35, 45

B1their Σfx

This mark is for the sum of their midpoints $\times$ frequencies but condone one error

$$5 \times 5 + 15 \times 22 + 25 \times 28 + 35 \times 21 + 45 \times 4$$

$$\text{or } 25 + 330 + 700 + 735 + 180$$

$$\text{or } 1970$$

$$5 \times 5 = 25$$

$$15 \times 22 = 330$$

$$25 \times 28 = 700$$

$$35 \times 21 = 735$$

$$45 \times 4 = 180$$

M1their $\Sigma fx \div 80$

$$\text{their } 1970 \div 80$$

M1dep

$$24.6(\dots)$$

Accept 25 with working shown

A1

- (b) $5 + 22 + 28$ or 55

$$21 + 4 \text{ or } 25$$

M1

$$\frac{5 + 22 + 28}{80} \times 100$$

$$\frac{21 + 4}{80} \times 100$$

M1

$$68(\dots)(\%) \text{ or } 69 \text{ and No}$$

$$31(\dots)(\%) \text{ and no}$$

A1**Alternative Method**

$$5 + 22 + 28 \text{ or } 55$$

$$21 + 4 \text{ or } 25$$

M1

$$\frac{70}{100} \times 80 \text{ or } 56$$

$$\frac{30}{100} \times 80 \text{ or } 24$$

M1

$$55 \text{ and } 56 \text{ and No}$$

$$\text{or } 56 \text{ is in the } 30 - 40 \text{ group so No}$$

$$24 \text{ and } 25 \text{ and No}$$

A1**[7]**

Q12.

- (a) Mid values seen

5, 15, 25
 or 5.005, 15.005, 25.005
 or 5.01, 15.01, 25.01

B1

$$5 \times 42 + 15 \times 30 + 25 \times 8$$

Accept use of mid values 5.005, 15.005, 25.005 or 5.01, 15.01, 25.01

Allow one error

eg one mid value incorrect or one calculation incorrect

M1

$$\text{their } 860 \div 80$$

M1dep

$$10.75 \text{ or } 10.76\dots$$

SC2 for 5.75 or 5.76 or 15.75 or 15.76

A1

- (b) Indicates higher

B1

Valid reason

eg more people wait for 10 – 20 mins and 20 – 30 mins in the second group

B1**[6]****Q13.**

- (a)
- Alternative method 1**
- Works out best estimate of the percentage of employees with hourly rate more than £17

$$32 \div 2 \text{ or } 16$$

oe

implied by 41 or 82

M1

$$(15 + 10 + \text{their } 16) \div 123$$

$$\text{or } 41 \div 123$$

$$\text{or } \frac{1}{3} \text{ or } 0.33(\dots)$$

or

$$(66 + \text{their } 16) \div 123$$

$$\text{or } 82 \div 123$$

$$\text{or } \frac{2}{3} \text{ or } 0.66(\dots) \text{ or } 0.67$$

oe eg $(123 - 66 - \text{their } 16) \div 123$

or

$$13(.0\dots)(\%) + [12, 12.2](\%) + 8(.1\dots)(\%)$$

M1dep

$$33(.3\dots)(\%)$$

oe eg 0.33(3\dots) and 0.3

allow 33.2(%)

from 13(%) + 12.2(%) + 8(%)

SC3 37 (or 36.9) and explains that a minimum of 12 of 32 people earn more than £17

A1

Alternative method 2 Compares best estimate of the number of employees with hourly rate more than £17 with 30% of number of employees
 $32 \div 2$ or 16

oe
implied by 41 or 82

M1

0.3×123 or 36.9

or

0.7×123 or 86.1

oe
accept 36 or 37 for 36.9
accept 86 or 87 for 86.1

M1

41 and 36.9

or

82 and 86.1

accept 36 or 37 for 36.9
accept 86 or 87 for 86.1
SC3 37 (or 36.9) and explains that a minimum of 12 of 32 people earn more than £17

A1

Alternative method 3 Shows that a value of x gives a percentage $> 30\%$

$(15 + 10 + x) \div 123$

where $12 \leq x \leq 32$

oe eg $(25 + x) \div 123$
*must see 15 and 10 **or** 25*

M2

$(15 + 10 + x) \div 123$

where $12 \leq x \leq 32$

and

evaluates

$(15 + 10 + x) \div 123 \times 100$ correctly

evaluations rounded or truncated to nearest integer or better
SC3 37 (or 36.9) and explains that a minimum of 12 of 32 people earn more than £17

A1

Alternative method 4 Shows a number of employees that gives a percentage $> 30\%$

0.3×123 or 36.9

oe
accept 36 or 37 for 36.9

M1

$15 + 10 + x$ or $25 + x$

where $12 \leq x \leq 32$

*must see 15 and 10 **or** 25*

M1dep

36.9 and

evaluates $15 + 10 + x$ correctly

where $12 \leq x \leq 32$

accept 36 or 37 for 36.9
SC3 37 (or 36.9) and explains that a minimum of 12 of 32 people earn more than £17

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

16 may be seen by the table

Alt 1 67% needs further explanation to score A1

Ignore irrelevant working in an otherwise fully correct response

For the SC3, minimum of 12 may be implied by an explanation that

$10 + 15 + x$ is at least 37 or $25 + x$ is at least 37

Responses involving interpolation should be escalated

(b) Valid reason

eg all employees in the second interval may earn less than £17

B1

Additional Guidance

Fewer than 12 employees could earn more than £17 per hour

B1

Only 10 might get more than £17 in second class interval (10 could be replaced by any integer from 0 to 11 inclusive)

B1

More than 12 in group 2 earn less than £17

B0

Everyone in second group may earn 14 or 15 or 16

B1

21 people may earn between £14 and £17

(21 could be replaced by any integer from 22 to 32 inclusive)

B1

More people may earn between £14 and £17

B0

People in the 14 to 20 group aren't evenly distributed

B0

Not everyone in 14 – 20 earns more than £17

B0

Not many in second group may get more than £17

B0

Some of second group may get more than £17

B0

14 to 20 includes people who get less than £17

B0

2nd group includes some getting less than 17 and some getting more than 17

B0

We don't know what each person earns

B1

We don't know how many of 2nd group earn less than £17 per hour

B1

Under £17 isn't in the data

B1

Grouped data or it is only an estimate or using midpoints or data is wrong

B0

Ignore irrelevant working but do not ignore incorrect working

[1]

- (c) 12×66 or 792
 and
 17×32 or 544
 and
 30×15 or 450
 and
 70×10 or 700
 oe
implied by 2486
may be seen by the table
allow one product or fx value to be incorrect

M1

(their 792 + their 544 + their 450 + their 700) $\div$ 123
 or
 $2486 \div 123$

oe eg $\frac{792 + 544 + 450 + 700}{66 + 32 + 15 + 10}$
condone bracket error if working seen
eg $792 + 544 + 450 + 700 \div 123$

M1dep

20.2(1...)

allow 20.20 if M2 seen and no errors

A1

Additional Guidance

Four values with three correct from 792, 544, 450, 700 can score up to M2 if they add and divide by 123

Correct products or values seen but a different method used eg $123 \div 4$

M0M0

20.2(1...) in working with answer given as the interval $20 \leq p < 40$

M2A0

Ignore any references to statement B

eg £20.21 which makes B wrong

M2A1

Condone $20.\dot{2}$, $20.\dot{2}1$ etc for $20.\dot{2}113\bar{8}$

Do not allow rounding of any of their 4 values in the second mark

eg 792 544 450 700

M1

$(800 + 544 + 450 + 700) \div 123$

M0

- (d) Valid reason referring to the distribution
eg 98 employees earned below £20

B1

Additional Guidance

Less than a half earned more than £20

B1

Over a half earned between £10 and £14

B1

Lots earned 10 to 14

B0

Only 25 people were over £20

B1

25 people were over £20

B0

Not many earned more than the mean

B0

Most earned less than £20

B1

Some earned less than the mean, some earned more

B0

Mean is not a real amount of money

B0

Median is between £10 and £14

B1

Median is better or mode is better

B0

Modal class is $10 \leq p < 14$

B1

The mode is between £10 and £14 (condone mode as modal class)

B1

We don't know what each person earns

B0

Grouped data or it is only an estimate or using midpoints or data is wrong

B0

The range is large

B0

The data has extreme values or outliers or anomalous values

B1

The data is (positively) skewed

B1

The distribution is not symmetrical

B1

The distribution is not evenly spread

B1

Not representative

B0

Lots of low values or high values can make the mean inaccurate

B0

Ignore irrelevant working but do not ignore incorrect working

[8]

Q14.

(a) $2 \leq t < 4$

(b) **Alternative method 1**

$32 + 19 + 20$ or 71 and 80×0.9

or

$(32 + 19 + 20) \div 80 \times 100$ or 88.75
oe

B1

71 and 72 and No

or

$88(.75)(\%)$ or $89(\%)$ and No

Accept $88(.75)(\%)$ and Yes because it rounds to 90

M1

A1

Alternative method 2

$7 + 2$ or 9 and 80×0.1

or

$(7 + 2) \div 80 \times 100$ or 11.25
oe

M1

9 and 8 and No

or

$11(.25)(\%)$ or $12(\%)$ and No

A1

[3]

Q15.

(a)

B1

(b) 101×65 or 6565 or

64×75 or 4800 or

25×85 or 2125 or

10×95 or 950 or $14\,440$

Attempt at fx using one correct midpoint

3610 implies M1M0A0

M1

$(\text{their } 6565 + \text{their } 4800 + \text{their } 2125 + \text{their } 950) \div 200$

Condone missing brackets eg 13494.75 implies M1M1A0

M1dep

72.2

SC2 77.2 or 67.2

Accept 70 or 72 with fully correct working

A1

(c)

	101
	66
	29
	14

*B1 all frequencies correct
or
all tallies correct
or
two rows correct*

B2

(d) frequency polygon and histogram

B1

[7]

Q16.

(a) 21

B1

(b)

$\frac{55}{100}$ or $\frac{11}{20}$ or 0.55 or 55%
oe fraction, decimal or percentage

B1

Additional Guidance

Ignore incorrect simplification or conversion after correct answer seen

(c) $21 \div 5$ or 4.2

or

$24 \div 5$ or 4.8

or

$37 \div 10$ or 3.7

or

$18 \div 20$ or 0.9

implied by a correct bar

M1

At least three of 4.2 4.8 3.7 0.9

implied by at least three correct bars

M1dep

Fully correct histogram

$\frac{1}{\pm 2}$ small square
ignore frequency polygon if included

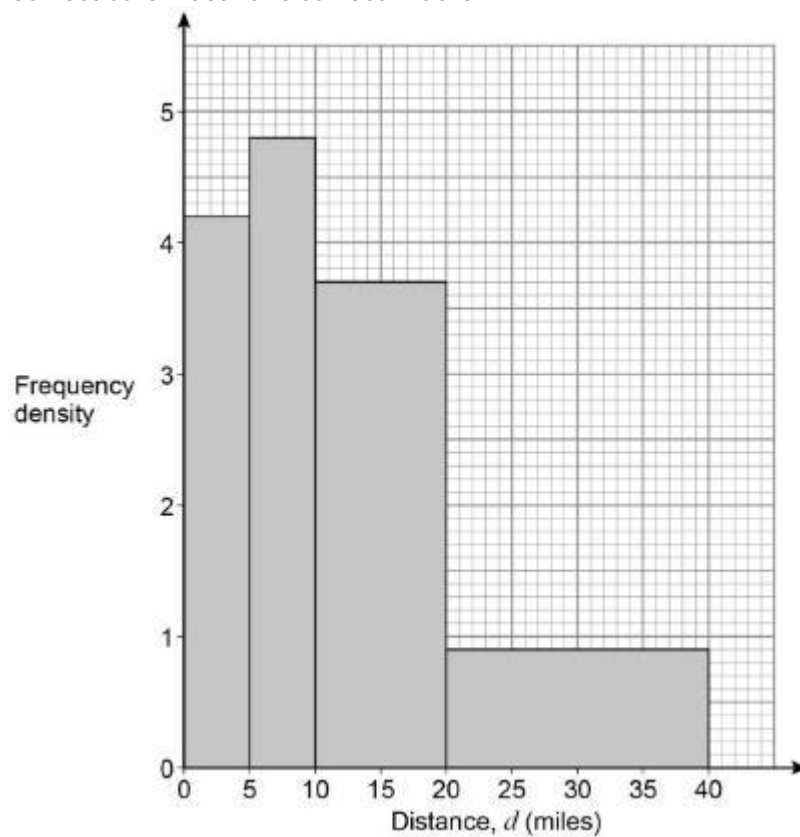
A1

Additional Guidance

Allow up to M2 even if not subsequently used or incorrectly plotted

Allow up to M2 for correct heights seen on a frequency polygon

Correct bars must have correct widths



M1M1A1

[5]

Q17.

(a) **Alternative method 1**

$$4 + 21 + 28 + [1, 34] \text{ or } [54, 87]$$

or

$$\frac{4}{5}$$

$$\times 35 \text{ or } 28$$

M1

$$8000 \times \frac{\text{their } 81}{100} \text{ or } 6480$$

oe

M1dep

$$233\,280$$

A1

Alternative method 2

$$\frac{8000}{100}$$

$$\times 4 \text{ or } 320$$

and

$$\frac{8000}{100}$$

$$\times 21 \text{ or } 1680$$

and

$$\frac{8000}{100}$$

$$\times 28 \text{ or } 2240$$

and

$$\frac{8000}{100}$$

$$\times [1, 34] \text{ or } [80, 2720]$$

M1

$$\frac{8000}{100} \times 4 + \frac{8000}{100} \times 21 + \frac{8000}{100} \times 28 + \frac{8000}{100} \times \text{their } 28$$

oe

M1dep

$$233\,280$$

A1

(b) Any appropriate explanation

eg1 this is only a sample

eg2 it may not reflect the whole population

eg3 it may be different on another day

B1

[4]