

8300

GCSE MATHEMATICS

Foundation and Higher tier – Questions by Topic – Mark Scheme

Probability

Sample space diagrams (calculator)

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.

B H B T
G H G T
R H R T
W H W T

with no errors or repeats

any configuration

accept words

B1 five of B T G H G T R H R T
W H W T

B2

Additional Guidance

eg T B means B T so if both seen it is a repeat

Condone repeats or errors for B1 but not B2

Allow B H to be written again if list restarted

Do not count clear working as a repeat eg table used to work out combinations
and then separate list given as answer

[2]

Q2.

- (a) $\frac{1}{10}$ or 10% or 0.1
oe

B1

Additional Guidance

Ratio e.g. 1 : 10 or 1 : 9

B0

$\frac{1}{10}$ seen and answer 1 : 10

B1

Expressed only in words e.g. 1 out of 10

B0

1 out of 10 and $\frac{1}{10}$

B1

$\frac{1}{10}$ seen with change to incorrect decimal or incorrect percentage

e.g. $\frac{1}{10}$ and answer 0.01

B1

Ignore chance words if $\frac{1}{10}$ seen

e.g. $\frac{1}{10}$ and answer Unlikely

B1

- (b) $\frac{1}{4}$ or 0.25 or 25%
oe

B1

Additional Guidance

Ratio e.g. 1 : 4 or 1 : 3

B0

$\frac{1}{4}$ seen and answer 1 : 4

B1

Expressed only in words e.g. 1 out of 4

B0

1 out of 4 and $\frac{1}{4}$

B1

$\frac{1}{4}$ seen with change to incorrect decimal or incorrect percentage

e.g. $\frac{1}{4}$ and answer 0.4

B1

Ignore chance words if $\frac{1}{4}$ seen

e.g. $\frac{1}{4}$ and answer Likely

B1

[2]

Q3.

- (a) 1, 2, 3, 5, 6, 10, 15, 30

B1 for one, two or three omissions or incorrect numbers

B2

Additional Guidance

Accept factors as products e.g. 1×30

Accept factors as pairs in brackets e.g. (1,30)

Disregard any repeated factors or reversed factor pairs

Disregard any negative factor pairs -5×-6

1, 2, 3, 5, 6, 10, 15, 30 shown in working

1, 2, 3, 5, 6, 10, 15 on answer line (Allow transcription error)

B2

1, 2, 3, 4, 5, 6, 10, 12, 15

(one omission of 30 and two incorrect numbers in 4 and 12)

B1

- (b) $\frac{3}{8}$

oe fraction, decimal or percentage

ft their list in (a) with at least four numbers, at least one of which is two-digit

B1ft

Additional Guidance

$\frac{3}{8}$ is B1, if not $\frac{3}{8}$ refer to (a) for possible ft
0.375 or 37.5%

B1

Ignore further working with description of probability e.g. $\frac{3}{8}$ unlikely

B1

Ignore further working with attempts to convert to percentage or decimal

eg $\frac{3}{8} = 37\%$ or 38%

B1

3 : 8 in working with $\frac{3}{8}$ on answer line

B1

37% or 38% without $\frac{3}{8}$ or 37.5% in working

B0

3 : 8 on answer line

B0

3 out of 8 without $\frac{3}{8}$ in working

B0

[3]

Q4.

A in two sections

B1

B and C have equal number of sections
and

12 sections labelled using only A, B, C or D

$$P(B) = P(C) \neq 0$$

B1

D in twice as many sections as A

B1

Additional Guidance

2As, 3Bs, 3Cs, 4Ds

B1B1B1

2As, 5Bs, 5Cs

B and C have equal number of sections and 12 sections labelled using only A, B, C or D

B1B1B0

2As, 4Bs, 4Cs, 2Ds

B1B1B0

2As, 2Bs, 4Cs, 4Ds

B1B0B1

2As, 4Ds

B1B0B1

2As, 4Bs, 4Cs only 10 sections labelled

B1B0B0

2As, 3Bs, 4Cs, 3Ds

B1B0B0

1A, 2Bs, 2Cs, 7Ds

B0B1B0

1A, 2Bs, 2Cs, 3Ds only 8 sections labelled

B0B0B0

[3]

Q5.

(a)
$$\begin{array}{cccc} & & 9 & \\ & & 9 & 10 \\ & 9 & 10 & 11 \\ 9 & 10 & 11 & 12 \end{array}$$

B1

(b) 7

ft a completed table

B1ft

(c) Denominator of 36

or

Numerator of 5 (or their 5)

36 choices identified

M1

5

36 or 0.138(...) or 0.139

or 13.8(...) % or 13.9%

*correct or ft their 8s from a **complete** table*

A1ft

[4]

Q6.

All four correct combinations **and** scores (in any order)

W	D	L	Score
4	0	0	8
3	1	0	7
3	0	1	6
2	2	0	6
2	1	1	5
1	3	0	5

B2 for any 2 or 3 correct combinations (condone missing or incorrect scores)

B1 for any 1 correct combination (condone missing or incorrect score)

Rows may be in any order

B3

Additional Guidance

Accept blank as zero

Must have correct scores for B3

Beware 2, 1, 0 = 5 (doesn't add up to 4 games)

[3]

Q7.

- (a) (CB) CL CW *B2 for 5, 6 or 7 new combinations.*
 HB HL HW *B1 for 2, 3 or 4 new combinations.*
 PB PL PW *Accept any unambiguous representations of each sandwich or drink.*
For B1 and B2 ignore any repeats.

B3

- (b) $\frac{1}{9}$ oe *ft their combinations if at least 1 HW*

B1ft

[4]

Q8.

- (a) Symbol represents 10 members

B1

Correct number of symbols for one row

Basketball (1)

Netball $\left(1\frac{1}{2}\right)$ *Follow through from their key (not symbol =1)*

M1

Two correct rows

ft wrong key (not symbol = l)

A1 ft

- (b) Suitable headline reflecting data

Condone any valid statement about results eg

Most people do football

More do football than all the others in total

70 people go to sports clubs

B1

- (c) $40 \div 5 (= 8)$ or $40 \div 2 (= 20)$ or $2 \times 5 (= 10)$ oe

M1

4

A1

[6]

Q9.

Lists at least 4 different combinations

or $\frac{1}{2}$ or $\frac{1}{4}$ seen

1A, 1B, 1C, 1D, 2A, 2B, 2C, 2D

M1

Lists all 8 combinations

or 2×4 or 8 seen

or $\frac{1}{2} \times \frac{1}{4}$

Seen or implied eg 8 lines drawn from numbers to letters on diagram

eg 1 → A, 1 → B etc

M1dep

$\frac{1}{8}$

oe

A1

[3]

Q10.

(a) Lists at least 4 correct combinations from (SC), SB, SP

CJ, CF, BJ, BF, PJ, PF

$1 \times 3 + 3 \times 2$ or $3 + 6$ oe

M1

9 or 8 (more)

A1

(b) $\frac{3}{9}$ oe

ft their 3 and their 9 if probability > 0 and < 1

B1 ft

(c) $270 \times$ their $\frac{3}{9}$ oe

M1

90

ft their part (b) but must be > 0 and < 1
Must give integer answer

A1 ft

[5]

Q11.

(a) (MS) ML, MK, DS, DL, DK, WS, WL, WK

B2 at least five more of the eight possible options seen

B1 2 - 4 more of the eight possible options seen

B3

(b) their $\frac{1}{9}$

oe

B1 ft

[4]

Q12.

One correct pair

oe

B1

HH HT TH TT

Strand (ii)

oe

SC1 all four possible single toss outcomes

(10p H, 10p T, 2p H, 2p T)

Q1

[2]

Q13.

Alternative method 1

$4 \times 3 (\div 2)$ or $12 (\div 2)$ or 6

number of possible combinations

or

correct list of all possible combinations or all possible qualifying combinations

may be implied by the correct total for each combination

(5,10) (5,20) 5,50 (10,5) 10,20 10,50 (20,5) 20,10 20,50 50,5

50,10 50,20

or

(5,10) (5,20) 5,50 10,20 10,50 20,50

M1

$\frac{4}{6}$ or $\frac{8}{12}$

oe fraction, decimal or percentage with M1 awarded

A1

Alternative method 2

$\frac{1}{4} \times \frac{1}{3}$ or $\frac{1}{12}$

picking £5 first

and

$\frac{1}{4} \times \frac{2}{3} (\times 2)$ or $\frac{2}{12} (\times 2)$ or $\frac{4}{12}$

picking £10 first or £20 first

and

$\frac{1}{4} (\times 1)$ or $\frac{3}{12}$

picking £50 first

oe probabilities

M1

$\frac{4}{6}$ or $\frac{8}{12}$

oe fraction, decimal or percentage with M1 awarded

A1

Additional Guidance

Decimals or percentages should be rounded or truncated to 2dp or better

In Alt 1, combinations may be seen in a grid, table or other diagram

In Alt 1, do not accept repeat combinations or incorrect combinations for M1

[2]

Q14.

- (a) All values correct

B1 1 or 2 rows correct

B2

Additional Guidance

	1	2	3	4	5	6
2x	2	4	6	8	10	12
3x	3	6	9	12	15	18
x ²	1	4	9	16	25	36

- (b) $\frac{8}{18}$ or $\frac{4}{9}$ or 0.44(4...) or 44(.4...) %
oe fraction, decimal or percentage
ft their table with ≥ 12 values
must be using 18 for the total number of possible scores

B1ft

Additional Guidance

Ignore simplification or conversion attempt (not ratio) after correct probability seen

Ratio answer eg 8 : 18, even alongside a correct probability is B0

ft decimals or percentages must be correct to the same accuracy as in the scheme

eg 10 winning values in their table

$\frac{10}{18}$ or 0.55(5...) or 0.56 or 0.556 or 55(.5...) % or 56% or 55.6%

B1ft

- (c) $711 \times \text{their } \frac{8}{18}$ oe
ft their probability from (b)
or if no probability in (b), ft their table with ≥ 12 values
where $0 < \text{their probability} < 1$
probabilities, if rounded in (c), must be truncated or rounded to at least 2 sf

M1

316 SC2 395

A1

Additional Guidance

Answer 316

M1A1

$\frac{316}{711}$ on answer line

M1A0

Condone 316 out of 711

M1A1

Do not treat estimating by rounding as a misread

eg1 700 used instead of 711

M0A0

eg2 (b) 0.44 (c) 0.4×711 (rounded to 1sf in (c) for the probability)

M0A0

eg3 (b) 0.4 (c) 0.4×711 (follows through their (b))

M1A0

Do not allow ft for a ratio from (b) but may ft their (a) instead

For 0.44×711 , accept $44\% \times 711$ but do not accept 44% of 711 unless recovered

The method mark may be implied by a ft answer (decimal or truncated to the nearest integer or rounded up to the nearest integer)

eg1 (b) $\frac{7}{18}$

(c) 276.5 or 276 or 277 (correct ft method implied using (b))

M1A0

eg2 (a) completed table has 7 winning values (b) no probability shown

(c) 276.5 or 276 or 277 (correct ft method implied using (a))

M1A0

[5]

Q15.

(Outline of suitable table/sample space diagram and) begins to list outcomes
At least 5

M1

(shows all) 25 outcomes or indicates there are 25 outcomes
(eg sample space diagram)

Ignore any repeats or extras
Sight of 25 outcomes implies M2

M1

Identifies (the correct) 10 outcomes

No more than one repeat or error or omission unless recovered.

M1

$$\frac{10}{25}$$

oe eg 0.4

A1

Logical and organised approach

Q1

Strand (ii)

*Award if M3 given **and** a clear and organised approach is used*

Do not award if answer only given

Alternative method

$$\frac{1}{5} \times \frac{1}{5} \left(= \frac{1}{25} \right)$$

oe (for any outcome)

M1

$$\frac{1}{5} \times \frac{1}{5} \left(= \frac{2}{25} \right) \text{ or } \frac{1}{5} \times \frac{3}{5} \left(= \frac{3}{25} \right) \text{ or } \frac{1}{5} \times \frac{4}{5} \left(= \frac{4}{25} \right)$$

oe

M1

Their $\frac{1}{25}$ + their $\frac{2}{25}$ + their $\frac{3}{25}$ + their $\frac{4}{25}$
oe allow one error

M1

$$\frac{10}{25}$$

oe eg 0.4

A1

Logical and organised approach

Strand (ii)

*Award if M3 given **and** a clear and organised approach is used*

Do not award if answer only given

Q1

[5]

Q16.

Alternative method 1

All three of

1, 8 and 1, 2, 4, 8 and 1, 3, 5, 7, 9

or

all three of 2, 4 and 5

B1 any two correct

do not allow 2, 4 or 5 from an incorrect list of numbers

B2

their $2 \times$ their $4 \times$ their 5 or 40

working out the number of possible codes

ft their non-zero number of options for each digit

implied by $\frac{1}{\text{their } 2} \times \frac{1}{\text{their } 4} \times \frac{1}{\text{their } 5}$

M1

$$\frac{1}{40}$$

oe fraction, decimal or percentage

ft their non-zero number of options for each digit

A1ft

Alternative method 2

All three of

$$\frac{1}{2} \text{ and } \frac{1}{4} \text{ and } \frac{1}{5}$$

B1 any two correct

oe fractions, decimals or percentages

do not allow $\frac{1}{2}, \frac{1}{4}$ or $\frac{1}{5}$ from an incorrect list of numbers

B2

$$\text{their } \frac{1}{2} \times \text{their } \frac{1}{4} \times \text{their } \frac{1}{5}$$

oe fractions, decimals or percentages

allow their $\frac{1}{2}$ to be 1

their $\frac{1}{4}$ must be < 1

their $\frac{1}{5}$ must be < 1

M1

$$\frac{1}{40}$$

oe fraction, decimal or percentage

ft their probabilities

A1ft

Additional Guidance

If 0 is taken to be a cube number, $\frac{1}{3} \times \frac{1}{4} \times \frac{1}{5} = \frac{1}{60}$

B1M1A1ft

If they only have one cube number, $1 \times \frac{1}{4} \times \frac{1}{5} = \frac{1}{20}$

B1M1A1ft

8, 9 and 1, 2, 4, 8 and 1, 3, 5, 7, 9

$$\frac{1}{2} \times \frac{1}{4} \times \frac{1}{5} = \frac{1}{40}$$

B1M1A1ft

Ignore conversion attempt after correct answer seen

Allow $1^3, 2^3$ for 1, 8

[4]