

8300

GCSE MATHEMATICS

Foundation tier – Questions by Topic – Mark Scheme

Probability

Probabilities of mutually exclusive events

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) $\frac{3}{5}$

oe

B1

(b) **Alternative method 1**

25 outcomes for 2 spins

Implied by a probability with denominator 25 or by a 5 by 5 possibility space diagram

M1

One way of attaining 8

eg in a possibility space diagram or sight of 4 + 4 or 1/5 seen twice

M1

$\frac{1}{25}$

A1

oe

Alternative method 2

$\frac{1}{5}, \frac{1}{5}$

oe

M1

$\frac{1}{5} \times \frac{1}{5}$

oe

M1

$\frac{1}{25}$

A1

oe

[4]

Q2.

(a) $\frac{1}{18}$

B1

(b) 0

B1

[2]

Q3.

(a) $\frac{1}{6}$ on '1' and $\frac{1}{3}$ or $\frac{2}{6}$ on '2 or 3'

and

$$\frac{1}{2}$$

on each of 'Odd' and 'Even'

oe fraction, decimal or percentage

B1

$$\frac{1}{6} \text{ on '1' and } \frac{1}{3} \text{ or } \frac{2}{6} \text{ on '2 or 3'}$$

or

$$\frac{1}{2} \text{ on each of 'Odd' and 'Even'}$$

or

all correct unsimplified probabilities with one or more simplification errors

e.g. $\frac{3}{6}$ on 'Odd' simplified to $\frac{1}{2}$

B2

Additional Guidance

Accept decimals or percentages rounded or truncated correctly to at least

2 significant figures

Only withhold a mark for simplification errors if B2 would otherwise be awarded

Ignore extra branches added

Ignore attempts to work out combined probabilities to the right of the tree diagram

If an answer line is blank, the student may have written their answer

elsewhere on the branch

(b) **Alternative method 1: $P(1) + P(4, 5 \text{ or } 6) \times P(\text{Odd})$**

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

oe

M1

$$\text{their } \frac{1}{4} + \text{their } \frac{1}{6}$$

oe

M1dep

$$(P(\text{win}) =) \frac{10}{24} \text{ or } \frac{5}{12}$$

oe ft their tree diagram

A1ft

$$\text{Lose (and } P(\text{Lose}) = \frac{14}{24} \text{ or } \frac{7}{12} \text{ oe)}$$

ft correct decision for their $\frac{5}{12}$ (and their $\frac{7}{12}$ with M2 scored

A1ft

Alternative method 2: $1 - P(2 \text{ or } 3) - P(4, 5 \text{ or } 6) \times P(\text{Even})$

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

oe

M1

$$\text{their } \frac{1}{4} + \text{their } \frac{1}{3}$$

oe

$$\text{or } P(\text{lose}) = \frac{7}{12}$$

ft their tree diagram

M1dep

$$(P(\text{win}) =) \frac{10}{24} \text{ or } \frac{5}{12}$$

oe ft their tree diagram

A1ft

$$\text{Lose (and } P(\text{Lose}) = \frac{14}{24} \text{ or } \frac{7}{12} \text{ oe)}$$

ft correct decision for their $\frac{5}{12}$ (and their $\frac{7}{12}$ with M2 scored

A1ft

Additional Guidance

Check the tree diagram for working

Any 'their' or ft probability must be > 0 and < 1 for marks to be awarded

For the second A1ft, the ft can be from an incorrect tree (which may score 4 marks) or an arithmetic error (which scores 3 marks, M1M1A0A1ft)

Accept equivalent fractions or decimals within calculations and

equivalent fractions, decimals or percentages for final probabilities

Accept decimals or percentages rounded or truncated correctly to at least 2 significant figures

Condone $\frac{1}{2} \times \text{their } \frac{1}{2}$ as part of a longer, incorrect multiplication

$$\text{e.g. } \frac{1}{2} \times \frac{1}{2} \times \frac{1}{6}$$

M1M0A0A0

Condone decimals used within fractions

$$\text{e.g. } P(\text{Win}) = \frac{2.5}{6}$$

at least M1M1A1

For the method marks, condone incorrect mathematical notation

$$\text{e.g. } \frac{1}{2} \times \frac{1}{2} = \frac{1}{4} + \frac{1}{6} = \dots$$

at least M1M1 (may go on to score 3 or 4 marks)

For the second A1ft, if the student gives a value for $P(\text{Lose})$, their $P(\text{Win}) +$ their $P(\text{Lose})$ must equal 1

However, allow a comparison to $\frac{1}{2}$ unless it is clearly an incorrect value for $P(\text{Lose})$

[6]

Q4.

(a) $\frac{1}{5}$

oe

B1

Alternative method 1

(b) 25 outcomes for 2 spins

Implied by a probability with denominator 25 or by a 5 by 5 possibility space diagram

M1

All 6 ways of getting a total of 4 identified

eg in a possibility space diagram or in a list

M1

$$\frac{6}{25}$$

oe

No incorrect totals should be seen for this mark

A1

Alternative method 2

$$\frac{2}{5} \times \frac{2}{5} \text{ or } \frac{1}{5} \times \frac{1}{5}$$

oe

M1

$$\frac{2}{5} \times \frac{2}{5} + \frac{1}{5} \times \frac{1}{5} + \frac{1}{5} \times \frac{1}{5}$$

oe

M1

$$\frac{6}{25}$$

oe

A1

[4]

Q5.

(a) $\frac{2}{17}$

B1

(b) $\frac{1}{17}$

B1

[2]

Q6.

Valid reason

eg sum of probabilities is not 1

B1

Additional Guidance

Ignore irrelevant statements alongside a correct statement

eg the sum of the probabilities is not 1 and the probabilities are not percentages

B1

Do not ignore incorrect statements alongside a correct statement

eg the sum of the probabilities is 0.11 not 1

B0

They add up to 1.1

B1

They add up to 110%

B1

It is 0.1 too much

B1

One of the probabilities is 0.1 too much

B1

It should be something like 0.1, 0.2, 0.3, 0.4

B1

B should be 0.4

B1

They don't add up correctly

B0

They add up to 0.11

B0

It's not a fair spinner

B0

[1]

Q7.

$(1 -) 0.1 + 0.2 + 0.3$ or 0.6

M1

0.4

A1

[2]

Q8.

$1 - 0.16$ or 0.84

or

0.16×3 or 0.48

M1

$1 - 0.16 - (3 \times 0.16)$

or their $0.84 - (3 \times 0.16)$

or $1 - 0.16 -$ their 0.48 or 0.36

M1

0.18

oe

A1

[3]

Q9.

(a)

$\frac{1}{5}$ (Green) and $\frac{4}{5}$ (Yellow)
for Bag A

oe fractions, decimals or percentages

B1

$\frac{3}{10}$ (Green) and $\frac{7}{10}$ (Yellow)
on both sections for Bag B

oe fractions, decimals or percentages

B1

(b)

their $\frac{1}{5}$ < their $\frac{3}{10}$

oe fractions or decimals

ft their tree diagram with

0 < both probabilities for Green < 1

M1

$\frac{3}{50}$ or 0.06 or 6%

oe

ft their tree diagram with

0 < both probabilities for Green < 1

A1ft

Additional Guidance

Ignore incorrect simplification or conversion after correct answer seen
3 out of 50 or 3 : 50 without working for M1

M0A0

[4]

Q10.

- (a) 0.2 on Jose not pass
 oe fraction, decimal or percentage

B1

0.4 on Maria test pass
 and
 0.6 on Maria test not pass twice
 oe fraction, decimal or percentage

B1

- (b) 0.32 or $\frac{32}{100}$ or $\frac{16}{50}$ or $\frac{8}{25}$ or 32%
 oe fraction, decimal or percentage

B1**Additional Guidance**

Ignore simplification or conversion if correct answer seen

eg1 $\frac{32}{100}$ seen Answer $\frac{3}{10}$

B1

eg2 $\frac{32}{100}$ seen Answer 3.2%

B1

Ignore words if correct answer seen

eg1 $\frac{32}{100}$ seen Answer 32 out of 100

B1

eg2 0.32, unlikely

B1

Answer given as ratio (even if correct answer also seen)

eg 32 : 100

B0

Answer only in words eg 32 out of 100

B0

Only 32 (without %)

B0**[3]**

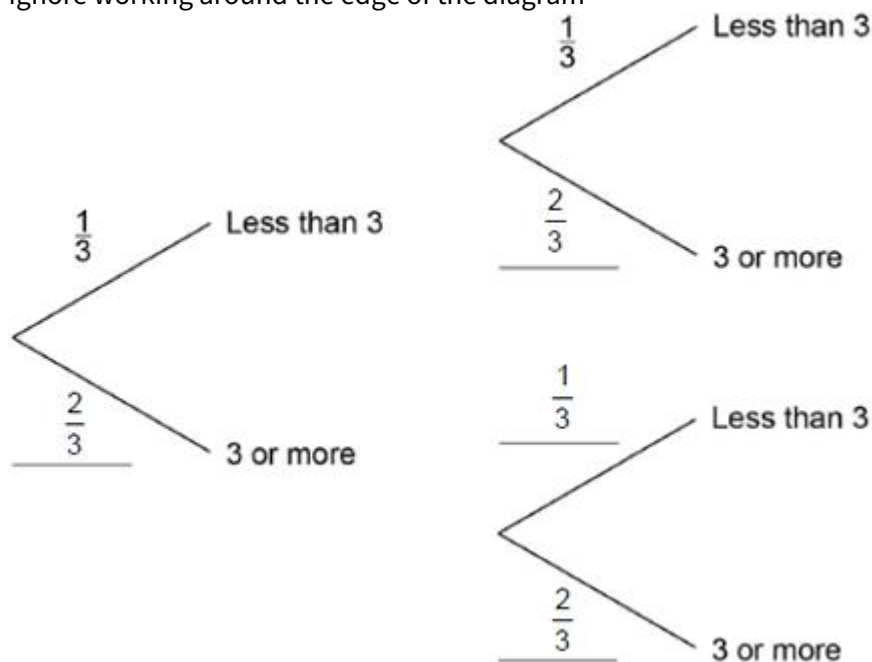
Q11.

- (a) $\frac{1}{3}$ or $\frac{2}{6}$ or 0.33... or 33.(...)% on each top branch
 and
 $\frac{2}{3}$ or $\frac{4}{6}$ or 0.66... or 0.67 or 66.(...)% or 67% on each bottom branch
accept any equivalent fraction, decimal or percentage

B1

Additional Guidance

Decimals must have at least 2 decimal places so do not accept 0.3 or 0.6 or 0.7
 Only accept the percentages shown, do not accept 30% or 60%
 Ignore working around the edge of the diagram



B1

- (b) $\frac{1}{9}$ or 0.11... or 11.(...)%

B1

Additional Guidance

Ignore probability words such as 'unlikely' or 'evens'

Accept equivalent answers eg $\frac{2}{18}$, $\frac{3}{27}$, 0.1

Do not accept 0.1 or 10%

[4]

Q12.

(a)

	1	2	7
4	4	4	7
5	5	5	7
8	8	8	8

B1 any row or column correct

B2

(b) 2 and 5 on spinner C

and

3 and 4 on spinner D

B1 2, 3, 4 and 5 used but in the wrong position

or

all sections completed so that at least three probabilities are correct

B2

[4]