

8300

GCSE MATHEMATICS

Foundation and Higher tier – Questions by Topic – Mark Scheme

Algebra

Interpreting graphs of quadratic functions

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.

$(-3, 5)$

B1

[1]

Q2.

Alternative method 1

$a(-3)^2 + b(-3) + c = 0$ or $a(3)^2 + b(3) + c = 0$ oe

M1

any two of

$(-)6b = 0, c = 18$ and $9a + 18 = 0$ oe

M1dep

$y = 18 - 2x^2$ oe equation

A1

Alternative method 2

$y = 18 - 2x^2$

oe equation

B2 correct equation missing $y =$

eg $18 - 2x^2$

B1

equation of a quadratic curve that passes through $(-3, 0)$ or $(3, 0)$ or $(0, 18)$

condone missing $y =$

eg $(y =) 18 - x^2$ or $(y =) (3 + x)(3 - x)$

or $(y =) x^2 - 2x - 3$

or $(y =) (x + 3)(x - 3)$

Additional Guidance

Correct equations include

$y = 2(3 + x)(3 - x)$

$y = -2(x + 3)(x - 3)$

$y = (6 + 2x)(3 - x)$

For B3, B2 or B1 ignore incorrect expansion after correct equation or expression seen

[3]

Q3.

$4 = 0^2 + p \times 0 + r$ or $r = 4$

oe equation

may be implied

M1

$1^2 + p(\times 1) + \text{their } 4 = 3$ or $p = -2$

oe equation

allow their 4 to be r

M1

$8^2 + (\text{their } -2) \times 8 + \text{their } 4$ or $64 - 16 + 4$

oe

dep on M1M1

do not allow their 4 to be r

M1dep

52

A1

[4]

Q4.

$(x - -2)^2$ or $(x + 2)^2$ or $a = 2$

oe implied by $x^2 + 2x + 2x + 4 (+b)$

or $x^2 + 4x + 4 (+b)$

M1

$1 = (3 + 2)^2 + b$ *oe*

M1dep

-24 *accept $(-2, -24)$*

A1

Additional Guidance

$(x - 2)^2$

M0

$1 = (3 - 2)^2 + b$

M0

[3]

Q5.

5

B1

3

B1

Additional Guidance

Mark the answer lines only

Do not allow eg $(0, 5)$

[2]

Q6.

(a) -1 and 5 *either order*

B1

Additional Guidance

Ignore $x =$ written before answers

$(-1, 0)$ or $(5, 0)$

B0

(b) $(2, -9)$

B1 $x = 2$ or $(2, \dots)$ or $y = -9$ or $(\dots, -9)$ or $(x - 2)^2 - 9$

B1ft correct y-coordinate for their x-coordinate with $x \neq -1, 0$ or

5

SC1 $(-9, 2)$

B2

Additional Guidance

If answer line is blank, check diagram for indication of x or y values

$(3, -9)$

B1

$(3, -8)$

B1ft

$(1, -8)$

B1ft

$(2.5, -8.75)$

B1ft

$(0, -5)$

B0ft

[3]

Q7.

(a) 2 and 5

with no other roots

either order

B1 at least one correct root with up to one incorrect root

SC1 (2, 0) or (5, 0) or (2, 5) or (5, 2)

B2

Additional Guidance

$x = 2$ and $x = 5$

B2

2, 5 or 5, 2

B2

(2, 0) and (5, 0) and 2 and 5

SC1

(2, 0) and (5, 0) and -2 and -5

B0

2, 0 and 5, 0 (both pairs imply coordinates)

SC1

2, 0 or 5, 0 (one pair implies roots)

B1

(0, 2) and (0, 5)

B0

0, 2 and 0, 5 (both pairs imply coordinates)

B0

0, 2 or 0, 5 (one pair implies roots)

B1

Both answers embedded

$2^2 - 7 \times 2 + 10 = 0$ and $5^2 - 7 \times 5 + 10 = 0$

B1

$(x - 2)(x - 5)$

B0

(b) 3.5 oe

B1

Additional Guidance

$x = 3.5$

B1

3.5x

B0

Ignore any y-coordinate even with brackets omitted

eg (3.5, -2.25) or 3.5, -2 or $x = 3.5$ $y = -2.25$ or $x = 3.5$ $y = 2$

B1

(-2.25, 3.5)

B0

[3]

Q8.

1

B1

[1]

Q9.

(1, -6)

B1

[1]

Q10.

$$0 = 5^2 + 5b + c \text{ or } -10 = 0^2 + b(0) + c \text{ or } c = -10 \text{ oe}$$

M1

$$b = -3 \text{ or } x^2 - 3x + c \text{ or } (y =) x^2 - 3x - 10 \text{ oe}$$
$$(x - 5)(x + k) \text{ and } -5k = -10$$

M1dep

$$(x - 5)(x + 2)$$

$$\text{or } \frac{-(-3) \pm \sqrt{(-3)^2 - 4 \times 1 \times -10}}{2 \times 1} \text{ or } \frac{3 \pm \sqrt{49}}{2} \text{ or } (x - \frac{3}{2})^2 + \dots$$

$$\text{or } 2x - 3 = 0$$

$$\text{or } x\text{-coordinate of } P = -2$$

or two symmetrical coordinates

$$\text{e.g. } (1, -12) \text{ and } (2, -12) \text{ oe}$$

Correctly factorises the 3-term quadratic expression or
correctly substitutes into quadratic formula for the 3-term
quadratic

Dep on M1 M1

M1dep

$$1\frac{1}{2} \text{ or } \frac{3}{2} \text{ with no incorrect working}$$

oe

$$\text{Accept } (1.5, -12.25)$$

A1

[4]

Q11.

$$(x =) -2.2, 1.5$$

B1 at least one of -2.2 and 1.5 with at most one incorrect value

or

$$(-2.2, 0) \text{ and } (1.5, 0)$$

or

$$(-2.2, 1.5)$$

B2

Additional Guidance

$$(1.5, -2.2)$$

B0

$$(0, -2.2) \text{ and } (0, 1.5)$$

B0

[2]

Q12.

$$\frac{a+b}{2} \text{ oe eg } a + \left(\frac{b-a}{2}\right)$$

B1

[1]

Q13.

$$(a) \quad 15 = 3^2 + c \text{ or } (c =) 6 \text{ oe}$$

M1

$$7^2 + \text{their } 6 \text{ oe}$$

M1dep

$$55$$

A1

(b) It is impossible to tell

B1

[4]