

8300

GCSE MATHEMATICS

Foundation and Higher tier – Questions by Topic – Mark Scheme

Geometry

Angles – Angles on parallel lines

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

B1

[1]

Q2.

(a) 130

B1

(b) Vertically opposite
Strand (i)

Q1

[2]

Q3.

(a) 64

B1

(b) 116

B1

(c) Corresponding
Any unambiguous indication eg circles correct word

B1

[3]

Q4.

No ticked
and

appropriate working to show AB and CD are not parallel

B1 any correct angle on the diagram

eg 105 opposite the 105 given

eg 85 written next to the 95 given

or

any correct angle which assumes lines are parallel

eg 95 written opposite the 105 given

or

any correct angle evaluation seen in working

eg $180 - 105 = 75$

B2

Additional Guidance

Angles must be shown on diagram or clearly identified to score B2

Ignore any incorrect or irrelevant terminology alongside correct working

“No” may be implied

Condone an incorrect angle if not subsequently used

Crossed out angles on diagram may be used to support working

No and 95 should be 105

B2

No and 95 written opposite the given 95

and 95 is not equal to 105

B2

No and 105 opposite the given 105 and 85 next to the 95 and $105 + 85 = 190$ (or should be 180)

B2

No and 85 written next to the given 95 and 75 written next to the given 105 and $85 \neq 75$

B2

No and 75 written alongside 105 and 75 written underneath 95 and $95 + 75 = 170$ (or should be 180)

B2

No and 95 written opposite 105 and the other two angles 75 and $95 + 75 + 75 + 105 = 350$ (or should be 360)

B2

$95 + 105 = 200$ is not a correct angle evaluation

No and $95 + 105 = 200$ and if it is 180 they will be parallel

B0

[2]

Q5.

65°

B1

Corresponding

Strand (i)

If other explanations involving angles on a straight line,

interior, opposite, alternate angles etc. must be complete

eg 65 marked opposite 65 given and ‘Alternate, opposite’ is Q1

Q1

[2]

Q6.

b and c

B1

[1]

Q7.

(a) a and b

B1

(b) b and c

B1

(c) a and c

B1

[3]

Q8.

(a) 147

May be seen on diagram

B1

Corresponding

oe eg (y is) alternate and x is opposite

Check part (b)

Strand (i)

Q1

(b) 147

May be seen on diagram

ft their (a)

B1 ft

Alternate or (vertically) opposite

oe eg x is corresponding and y is opposite

Strand (i)

Q1

[4]

Q9.

Alternative method 1

angle $ACD = 180 - 78$ or 102

M1

angle $ECD = 360 - 115 - \text{their } 102$ or 143

angle $ECD = 143$ implies M1 M1

M1

$(143 + 32 =) 175$ and No

or

$143 + 32 \neq 180$ (and No)

oe

SC3 $32 + 78 = 110$ and No

or $32 + 78 \neq 115$ (and No)

A1

Alternative method 2

angle $ACD = 180 - 78$ or 102

M1

(Assumes CD is parallel to EF) angle $DCE = 180 - 32$ or 148

M1

$(102 + 148 + 115 =) 365$ and No

or

$102 + 148 + 115 \neq 360$ (and No)

oe

SC3 $32 + 78 = 110$ and No

or $32 + 78 \neq 115$ (and No)

A1

Alternative method 3

Extends DC to X

angle $XCA = 78$

X may be a different letter or not labelled

M1

angle $XCE = 115 - \text{their } 78$ or 37

angle $XCE = 37$ implies M1 M1

M1

37 and No

oe

SC3 $32 + 78 = 110$ and No

or $32 + 78 \neq 115$ (and No)

A1

Alternative method 4

Extends DC to X

angle $XCA = 78$

X may be a different letter or not labelled

M1

(Assumes CD is parallel to EF)

angle $XCE = 32$

M1

$(32 + 78 =) 110$ and No

or

$32 + 78 \neq 115$ (and No)

oe

SC3 $32 + 78 = 110$ and No

or $32 + 78 \neq 115$ (and No)

A1

Alternative method 5

Extends AC to meet EF at Y

angle $ECY = 180 - 115$ or 65

Y may be a different letter or not labelled

M1

angle $EYC = 180 - \text{their } 65 - 32$

or 83

angle $EYC = 83$ implies M1 M1

M1

83 and No

oe

SC3 $32 + 78 = 110$ and No

or $32 + 78 \neq 115$ (and No)

A1

Alternative method 6

Extends AC to meet EF at Y

angle $ECY = 180 - 115$ or 65

Y may be a different letter or not labelled

M1

(Assumes AB is parallel EF)

angle $EYC = 78$

M1

$(32 + 78 + 65 =) 175$ and No

or

$32 + 78 + 65 \neq 180$ (and No)

oe

SC3 $32 + 78 = 110$ and No

or $32 + 78 \neq 115$ (and No)

A1

Alternative method 7

Draws a line from X on AB to Y on EF passing through C with right angles marked at AXC and CYE (Assumes CD is parallel to EF)

angle $ACX = 180 - 90 - 78$ or 12

X and Y may be different letters or not labelled

M1

angle $ECY = 180 - 90 - 32$ or 58

M1

$(12 + 115 + 58 =)$ 185 and No

or

$12 + 115 + 58 \neq 180$ (and No)

oe

SC3 $32 + 78 = 110$ and No

or $32 + 78 \neq 115$ (and No)

A1

[3]

Q10.

(a) 108

B1

Corresponding

strand (i)

Mark is dependent on scoring B1

Q1

(b) $180 - 117$ oe

M1

63

A1

[4]

Q11.

Enough angles (at least 2) marked or stated to complete the proof with no incorrect angles marked or stated

$180 - (62 + 62)$

M1

56

A1

Complete method, showing 2 angles of 62 and subtraction from 180

Strand (ii)

Q1

Alternative method

AMQ and AML and PMB and NMB marked (stated) as 62

$(360 - 4 \times 62) \div 2$

M1

56

A1

Complete method, showing 4 angles of 62 and subtraction from 360 and division by 2

Strand (ii)

Q1

[3]

Q12.

Angle labelled as 72 for the correct interior angle of the triangle

or

angle labelled as 108 for a correct exterior angle of the triangle

or

$$3r + r + 72 = 180$$

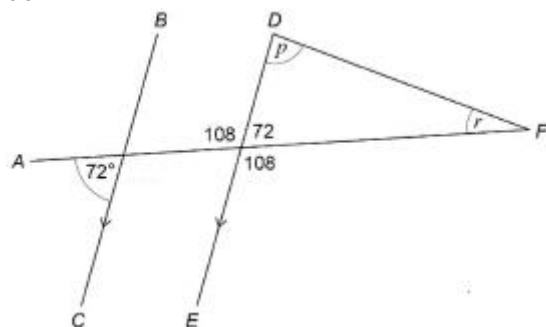
or

$$4r = 180 - 72$$

or

$$4r = 108$$

oe



M1

$$\frac{180 - 72}{3 + 1} \text{ or } \frac{108}{4} \text{ or } 27$$

or

$$108 \times \frac{3}{4}$$

or

$$\frac{4p}{3} = 108$$

oe

M1dep

81

A1

[3]

Q13.

$$x + 53 + 48 = 180$$

or

$$53 + 48 \text{ or } 101$$

or

$$180 - 53 \text{ or } 127$$

or

any correct angle marked as 53 or 127 on the diagram

oe equation in x

M1

$$180 - (53 + 48)$$

or

$$360 - 53 - 53 - (180 - 53) - 48$$

oe eg 180 - 101 or 127 - 48

M1dep

79

A1

Additional Guidance

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

Correct angle on diagram may be credited even if alongside other incorrectly marked angles or incorrect or no working in working lines

Correct method in the working lines may be credited even with incorrect angles on the diagram

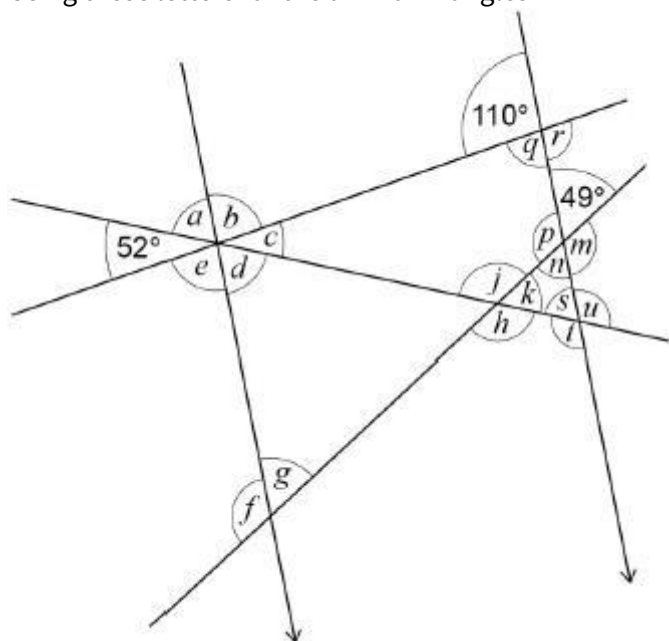
Method for 79 followed by further work to their 79

M1M1A0

[3]

Q14.

Using these letters for the unknown angles



73

B2 $180 - 110 + 52 - 49$ oe calculation

or

$h = 107$ or $j = 107$ or $k = 73$

or

$g = 49$ and $d = 58$

or

$g = 49$ and $e = 70$ or

$f = 131$ and $d = 58$

B1 any angle correct (others may be incorrect)

B3

Additional Guidance

Angles will usually be seen on the diagram

Angles must be unambiguously linked to the correct position

eg 131 seen in working but not on the diagram or in wrong position

B0

$a = 58$	$b = 70$	$c = 52$	$d = 58$	$e = 70$
$f = 131$	$g = 49$	$h = 107$	$j = 107$	$k = 73$
$m = 131$	$n = 49$	$p = 131$	$q = 70$	$r = 110$
$s = 58$	$t = 122$	$u = 122$		

[3]

Q15.

$$AED = 100 \text{ or } E = 100$$

$$\text{or } ADE = 40 \text{ or } D = 40$$

$$\text{or } DAE = 40 \text{ or } A = 40$$

May be on diagram in the correct place

B1

$$(BAD =) 180 - 117 \text{ or } 63 \text{ seen or implied}$$

oe

May be on diagram in the correct place

M1

$$103$$

A1**Additional Guidance**

Beware of contradictions between diagram and working shown

BAD shown as 63 on diagram in correct position

M1

180 – 117 with nothing marked on diagram and no contradiction

M1

180 – 117 = 63, 63 only marked at C on diagram

M0

Condone assumption for symmetry of trapezium $(360 - 2 \times 117) \div 2$

M1**[3]****Q16.**

(a) $x + y = 180$

oe

$$y = 180 - x$$

$$\text{or } x = 180 - y$$

$$\text{or } 2x + 2y = 360$$

B1

(b) $y = 1.5x$

oe

$$2y = 3x$$

$$\text{or } y = \frac{3}{2}x$$

$$\text{or } x = \frac{2}{3}y$$

$$\text{or } \frac{x}{y} = \frac{2}{3}$$

$$\text{or } \frac{y}{x} = \frac{3}{2}$$

B1**[2]**

Q17.

$$w + 40 = 72$$

May be on diagram

M1

$(w =) 32$ seen

A1

$$2w = 64 \text{ or } 2w = 2 \times \text{their } 32 \text{ or third angle} = 72$$

$$\text{or } 2w + t + 72 = 180 \text{ oe}$$

M1

$$180 - 72 - 64 \text{ or } 180 - 72 - \text{their } 32 \times 2$$

$$\text{oe } 108 - 64$$

M1

44

A1

[5]

Q18.

14

B3 correct equation

$$\text{eg } 2x + 5x + 6 + 5x + 6 = 180$$

$$\text{or } 5x + 6 = 90 - x$$

$$\text{or } 2x + 90 - x + 5x + 6 = 180$$

$$\text{or } 5x + 6 = 174 - 7x$$

B2 correct expressions for two angles

or

two different correct expressions for the same angle

B1 correct expression for one angle

B4

Additional Guidance

Correct expressions for angles (which may be seen on the diagram) include

angle $AQC = 2x$

angle $APQ = 5x + 6$

angle $AQP = 5x + 6$

$$\text{angle } APQ = \frac{180 - 2x}{2} \text{ or } 90 - x$$

$$\text{angle } AQP = \frac{180 - 2x}{2} \text{ or } 90 - x$$

$$\text{angle } APQ = 180 - 2x - (5x + 6) \text{ or } 174 - 7x$$

$$\text{angle } AQP = 180 - 2x - (5x + 6) \text{ or } 174 - 7x$$

$$\text{angle } QPB = 180 - (5x + 6) \text{ or } 174 - 5x$$

angle $ZPB = 5x + 6$ (Z is the end of line QP produced)

angle $ZPA = 180 - (5x + 6) \text{ or } 174 - 5x$ (Z is the end of line QP produced)

B2 may be awarded for the same expression for two different angles

eg angle $APQ = 5x + 6$ and angle $AQP = 5x + 6$

B2

Accept eg AQP for angle AQP

Do not accept eg (angle) P for angle APQ unless shown on the diagram

Ignore reasons

[4]

Q19.

(a) $2x + 10 = 3x - 20$

oe

$$180 - (2x + 10) + 3x - 20 = 180$$

M1

$$3x - 2x = 20 + 10 \text{ or } x = 30$$

oe

M1dep

$$2 \times \text{their } 30 + 10 \text{ or } 3 \times \text{their } 30 - 20 \text{ or } 70$$

oe

M1dep

$$110$$

A1

Additional Guidance

$$x = 30, y = 180 - 3(30) + 20 = 110$$

M1M1M1A1

$$x = 30, y = 180 - 3(30) - 20 = 110 \text{ recovered missing bracket}$$

M1M1M1A1

$$x = 30, y = 180 - 3(30) - 20 = 70 \text{ not recovered}$$

M1M1M0A0

$$2x + 10 = 3x - 20$$

$$3x - 2x = 20 + 10$$

$$x = 10$$

$$2 \times 10 + 10 (= 30)$$

M1M1M1A0

$$2x + 10 = 3x - 20$$

$$x = 10$$

$$2 \times 10 + 10 (= 30)$$

M1M0M0A0

$$y + 2x + 10 = 3x - 20 + y$$

M1M0M0A0

$$w = 3x - 20 \text{ seen or on diagram}$$

M0M0M0A0

$$w = 2x + 10 \text{ seen or on diagram}$$

M0M0M0A0

(b) $2x + 10 = 60$ or $2x = 60 - 10$ or $2x = 50$ or $x = 25$

M1

$3 \times \text{their } 25 - 20$ or 55 or $180 - 55$ or 125

oe

M1dep

$(y =) 125$ and bigger or $(y \text{ is}) 15$ bigger

oe

ft their (a)

A1ft

Additional Guidance

Note: A complete logical explanation of the effect of lines not being parallel

eg w is smaller so $2x + 10$ is smaller so x is smaller so $3x - 20$ is smaller so y is bigger

M1M1A1

$2 \times 25 + 10 = 60$

M1M0A0

y is bigger ticked but no valid working

M0M0A0

[7]

Q20.

(a) $x + y = 180$

oe

$$y = 180 - x$$

$$\text{or } x = 180 - y$$

$$\text{or } 2x + 2y = 360$$

B1

(b) $y = 1.5x$

oe

$$2y = 3x$$

$$\text{or } y = \frac{3}{2}x$$

$$\text{or } x = \frac{2}{3}y$$

$$\text{or } \frac{x}{y} = \frac{2}{3}$$

$$\text{or } \frac{y}{x} = \frac{3}{2}$$

B1

(c) $x + \text{their } 1.5x$ or $2.5x$

$$\text{or } y + \text{their } \frac{2}{3}y \text{ or } \frac{5}{3}y$$

$$\text{or } 180 \div 5 \text{ or } 36$$

M1

$$\text{their } 2.5x = 180$$

$$\text{or their } \frac{5}{3}y = 180$$

$$\text{or } 180 \div 2.5 \text{ or } 36 \times 2 \text{ or } 72$$

$$\text{or } 180 \div \frac{5}{3} \text{ or } 36 \times 3 \text{ or } 108$$

oe

M1dep

$$(x =) 72 \text{ and } (y =) 108$$

ft their (b)

A1ft

[5]

Q21.

(a) Third statement identified

B1

(b) (Angle $DEF =$)

$$180 - 144$$

$$\frac{360 - 288}{2}$$

or 2

oe

M1

(Angle $EDF =$)

$$180 - 36 - 108$$

$$\text{or } 36 + 36 + 108 = 180$$

oe

M1dep

36, 36, (108)

or state two angles equal

SC1 for 36 seen

Dependent on both method marks

A1

[4]