

8300

GCSE MATHEMATICS

Foundation and Higher tier – Questions by Topic – Mark Scheme

Geometry

Circles – Finding the area of circles

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.

$$\pi \times 11.5^2$$

oe

accept [3.14, 3.142] for π

M1

$$[415, 416] \text{ or } \frac{529}{4} \pi \text{ or } 132.25 \pi$$

oe

A1

Additional Guidance

Accept $\frac{529}{4} \times \pi$ or $132.25 \times \pi$ or $\pi \times \frac{529}{4}$ or $\pi \times 132.25$

M1A1

Condone $\pi \frac{529}{4}$ or $\pi 132.25$

M1A1

[2]

Q2.

$$\pi \times 3.5 \times 3.5 \text{ or } 3.14 \dots \times 3.5 \times 3.5 \text{ oe}$$
$$\text{or } \pi \times 3.5^2 \text{ or } 3.14 \dots \times 3.5^2$$

M1

$$38.4(8 \dots) \text{ or } 38.4(6 \dots)$$

$$\frac{49}{4}$$

$$\pi \text{ or } 12.25\pi \text{ or } 12.3\pi$$

A1

$$38.5$$

ft their answer of 2 d.p. or more

B1 ft

[3]

Q3.

$$\pi \times 6^2$$

M1

$$113.(...) \text{ or } 36\pi$$

A1

[2]

Q4.

(a) $(5 \times 5 =) 25$
or $(5^2 =) 25$

M1

$$78.5(\dots)$$

Accept 79 with working seen

A1

(b) Divide by 3.14 or π
Square root

B1 for reversed order

or one step only in correct position

B2

[4]

Q5.

$$\sqrt{64} \text{ or } 8 \text{ or } 64 = 8 \times 8$$

Implied by a diameter or side length of 8 stated or shown on the diagram, or radius of 4 stated or used or shown on the diagram

M1

$$\pi \times (\text{their } 8 \div 2)^2 \text{ or } \pi \times 4^2 \text{ or } \pi 4^2 \text{ or } [50.24, 50.272]$$

oe

Allow [3.14, 3.142] for π

M1dep

$$16\pi$$

Condone $16 \times \pi$ or $\pi \times 16$ or $\pi 16$

A1

Additional Guidance

$$64 - 16\pi$$

M1M1A0

Beware of incorrect methods which lead to the correct answer

eg

$$r = 8, 2 \times \pi \times 8 = 16\pi$$

M0M0A0

$$\sqrt{64} = 8, 8^2 = 16, 16\pi$$

M1M0A0

[3]

Q6.

$$\left(\frac{1}{2}\right) \times \pi \times 6 \times 6$$

oe

M1

$$\left(\frac{1}{2}\right) \times \pi \times 6 \times 6 \div 4$$

oe

M1dep

$$4.5\pi$$

oe

A1

[3]

Q7.

$$11 \times 2.5 \text{ or } 27.5$$

or $3.1 \times 3^2 \text{ or } 27.9 \text{ or } 9\pi$

Allow 3.14×3^2

Accept 27.5^2 as meaning 27.5 cm^2

M1

$$27.5 \text{ and } 27.9 \text{ or } 28.26$$

Do not accept 9π at this stage as comparison of values cannot be made without evaluation to a number.

A1

Correct conclusion based on both their areas using correct methods with at least one correct area

Strand (iii)

Ignore any incorrect subtraction of

$27.9 - 27.5$

Q1

Additional Guidance

Indication of which is bigger shape can be done by the name, the value or the calculation.

$$11 \times 2.5 = 22.5$$

$$3.1 \times 3^2 = 27.9$$

Circle

Both methods, one value incorrect, correct conclusion using name of shape

M1, A0, Q1

$$11 \times 2.5 = 27.5$$

$$3.1 \times 3^2 = 3.1 \times 6 = 18.6$$

$$11 \times 2.5$$

Both methods, one value incorrect, correct conclusion using calculation

M1, A0, Q1

$$11 \times 2.5 = 22.5$$

$$3.1 \times 3^2 = 18.6$$

Rectangle

Both methods, correct conclusion but Q0 as both values incorrect.

M1, A0, Q0

$$11 \times 2.5 = 27.5$$

$$2 \times 3.1 \times 3 = 3.1 \times 6 = 18.6$$

$$27.5$$

One method correct, Q0 as one method wrong, therefore one value wrong.

M1, A0, Q0

$$11 \times 2.5 = 27.5$$

$$3.1 \times 3 \times 3 = 3.1 \times 9 = 27.9$$

Circle bigger by 0.3

Fully correct, ignore wrong subtraction.

M1, A1, Q1

[3]

Q8.

Any side chosen for square and squared, eg $10^2 = 100$

M2 is for both square and circle areas attempted with correct numerical values (eg if 10 chosen for side of square, then 5 must be used as radius of circle, or if 4 chosen as radius then 8 used as side of square)

M1 if both square and circle area attempted with one incorrect numerical value (eg if 10 chosen for side of square, then 10 used as radius of circle, or if 4 chosen as radius then 4 used as side of square)

Half the side squared and multiplied by π , eg $\pi \times 25$

π must be [3.1, 3.142] or $\frac{22}{7}$

M2 is for both square and circle areas attempted with correct numerical values (eg if 10 chosen for side of square, then 5 must be used as radius of circle, or if 4 chosen as radius then 8 used as side of square)

M1 if both square and circle area attempted with one incorrect numerical value (eg if 10 chosen for side of square, then 10 used as radius of circle, or if 4 chosen as radius then 4 used as side of square)

M2

Work out 75% of their square and a correct calculation of the circle area, **or** works out what percentage the circle area is of the square area

This can be awarded even if only M1 awarded.

Allow π used if a clear comparison, eg $\pi \times 25 > 3 \times 25$

A1

A method mark gained and correct conclusion based on 75% of their square with their circle

Strand (ii).

Do not award if their circle area > square area, eg $78.5 > 25$

Q1

Alternative Method

$2r$ length of side of square giving $4r^2$ as area

M2 is for both square and circle area attempted with correct

numerical values (eg if r chosen for side of square, then $\frac{r}{2}$ must be used as radius of circle, or if r chosen as radius then $2r$ used as side of square)

M1 if both square and circle area attempted with one incorrect numerical value (eg if x chosen for side of square, then x used as radius of circle, or if x chosen as radius then x used as side of square)

r as radius of circle giving πr^2 as area of circle

M2 is for both square and circle area attempted with correct

numerical values (eg if r chosen for side of square, then $\frac{r}{2}$ must be used as radius of circle, or if r chosen as radius then $2r$ used as side of square)

M1 if both square and circle area attempted with one incorrect numerical value (eg if x chosen for side of square, then x used as radius of circle, or if x chosen as radius then x used as side of square)

M2

75% of their square ($= 3r^2$) and correct expression for area of circle with their chosen radius

A1

A method mark gained and correct conclusion based on 75% of their square with their circle. eg $\pi > 3$

Strand (ii). Do not award if their circle area $>$ square area, eg $\pi r^2 > r^2$

Q1

[4]

Q9.

Please note, *actual measurements may have changed slightly on export/printing.*

Radius = 3 [2.9, 3.1]

or diameter = 6 [5.9 to 6.1]

Radius = 30 [29, 31]

or diameter = 60 [59, 61]

B1

$\pi \times (\text{their radius})^2$

or $\pi \times \left(\frac{1}{2} \text{ their diameter}\right)^2$

or $\pi \times (\text{any length but 6 if no diameter or radius seen})^2$

M1

9π or $\pi 9$ or $9 \times \pi$ or $\pi \times 9$ or $\frac{198}{7}$

or answer in range [27.9, 28.3]

900 π or $\pi 900$ or $900 \times \pi$ or $\pi \times 900$ or answer in range [2790, 2830]

SC1 if only 3, 6, 30 or 60 seen

A1

cm^2

mm^2 Accept units if seen in working but not stated on answer line

B1

[4]

Q10.

$12 \div 4$ or 3

oe

may be on the diagram

may be seen in a ratio

M1

$\pi \times \text{their } 3 \times \text{their } 3$ or 9π

or [28.2, 28.3]

oe

M1dep

$\pi \times 12 \times 12$ or 144π

or [452.1, 452.45]

oe

M1

135π

SC2 135

A1

Additional Guidance

Condone eg $\pi 9$ for 9π

$\frac{22}{7}$

Condone use of $\frac{22}{7}$ or 3.1 or better for π up to M3

Answer 135 with 135π in working

M1M1M1A0

Answer 135 without 135π in working

SC2

Answer [423.8, 424.3]

M1M1M1A0

[4]

Q11.**Alternative method 1**radius = $12 \div 4$ or 3or diameter = $12 \div 2$ or 6or 12×6 or 72**M1** $\pi \times \text{their } 3^2$ or 9π **M1** $2 \times \pi \times \text{their } 3^2$ or 18π **M1dep** $72 - 18\pi$ *Ignore attempts at factorisation
Do not ignore further work***A1****Alternative method 2**radius = $12 \div 4$ or 3or diameter = $12 \div 2$ or 6or 6×6 or 36**M1** $\pi \times \text{their } 3^2$ or 9π **M1** $36 - 9\pi$ **M1dep** $2(36 - 9\pi)$ *Ignore attempts at expansion
Do not ignore further work***A1****Additional Guidance** $72 - 18\pi = 54\pi$ **M1M1M1A0** $72 - 18\pi = 9(8 - 3\pi)$ (error in factorisation)**M1M1M1A1**Accept 3.14 or better for π for method marks

[4]

Q12.

Alternative method 1

radius = $12 \div 4$ or 3
or diameter = $12 \div 2$ or 6
or 12×12 or 144

M1

$\pi \times \text{their } 3^2$ or 9π

M1

$4 \times \pi \times \text{their } 3^2$ or 36π

M1dep

$144 - 36\pi$

Ignore attempts at factorisation
Do not ignore further work

A1

Alternative method 2

radius = $12 \div 4$ or 3
or diameter = $12 \div 2$ or 6
or 6×6 or 36

M1

$\pi \times \text{their } 3^2$ or 9π

M1

$36 - 9\pi$

M1dep

$4(36 - 9\pi)$

Ignore attempts at expansion
Do not ignore further work

A1

Additional Guidance

$144 - 36\pi = 108\pi$

M1M1M1A0

$144 - 36\pi = 12(12 - 4\pi)$ (error in factorisation)

M1M1M1A1

Accept 3.14 or better for π for method marks

[4]

Q13.

Side of square = 10 cm seen or implied
eg 10×10 or 100

B1

$\pi \times 5^2$
or 25π
or [78.4, 78.6]

oe

M1

$10 \times 10 - \pi \times 5^2$
or $100 - [78.4, 78.6]$

oe

M1dep

[21.4, 21.6] or $100 - 25\pi$

A1

[4]

Q14.

diameter = 10 (cm) seen or implied

or

width of rectangle = 10 (cm) seen or implied

*May be on diagram***B1**

radius = 5 (cm) seen or implied

*May be on diagram***B1dep** 10×10 or 100or 20×10 or 200

oe

M1 $\pi \times 5^2$ or 25π or [78.5, 78.6] or 79or $2 \times \pi \times 5^2$ or 50π or [157, 157.2]

or 158

oe

M1100 – their 25π or [21.4, 21.5]or $200 - 2 \times$ their 25π

oe

*Dependent on M1 M1***M1dep**

[42.8, 43]

or $200 - 50\pi$ or $50(4 - \pi)$

or 42

oe

A1**Additional Guidance** $200 - 50\pi = 150\pi$ does not score final A mark**5 marks** 20×10 or 200 implies**B1M1** $2 \times \pi \times 5$ implies**B1B1** $\pi d = 10\pi$ implies**B1** 10π on its own**B0**

[6]

Q15.

(a) $\pi \times 6^2$
or $\pi \times 36$

oe

M1

[113, 113.2] or 36π

A1

Additional Guidance

$\pi 36$

M1A0

(b) 20×50 or 1000

oe

M1

their 1000 – their [113, 113.2]

oe

M1dep

[886.8, 887] or $1000 - 36\pi$
ft their part (a)

A1ft

Additional Guidance

Do not ignore incorrect further working for the A mark,
eg $1000 - 36\pi = 964\pi$

M1M1A0

[5]

Q16.

$12 \div 2$ or 6

M1

$12 \div 4$

or $6 \div 2$

or 3

M1dep

$\pi \times 3 \times 3$

oe

M1dep

9π or [28.2, 28.3] or 28

SC2 for 36π or [113, 113.2]

A1

[4]

Q17.

(a) $\frac{1}{2} \times (40 + 24) \times 16$
oe

M1

512

A1

(b) $\pi \times 4 \times 4$
oe

M1

[50.2, 50.3] **or** 16π

A1

(c) $\frac{\text{their [50.2, 50.3]}}{\text{their 512}}$
(= [0.098, 0.0982422])

M1

[9.8, 9.82422]

*ft their 512 and their [50.2, 50.3]
Allow 10 with correct method seen
SC1 [90.18, 90.2]*

A1ft

[6]

Q18.

(a) $\pi \times 4.5^2$

M1

[63.58, 63.63]

Accept 63 or 64 after M1 awarded

A1

63.6

ft their answer if ≥ 4 sf and M1 awarded. eg $\pi \times 4.5^2 = 199.85 \approx 200$

Incorrect further work after an answer of [63.5, 63.63] then do not award B1

B1ft

(b) $2\pi r = 93$ or $\pi d = 93$

M1

$r = 93 \div 2\pi$

$d = 93 \div \pi$ **and** $d \div 2$

M1Dep

[14.79, 14.81]

$93 \div (2 \times 3.14) = 14 \frac{127}{157}$ on some calculator displays

$\pi = \frac{22}{7}$ gives $14 \frac{35}{44}$

Check if fractional answers are in range

15 with working

Non-contradictory further work such as working out the area can be ignored

T&I is MO unless answer given in range

A1

[6]

Q19.

- (a) $6.4 \times 4.5 (+) 4 \times 2.3$ **or**
 $4.5 \times 2.4 (+) 4 \times 6.8$
 oe eg 28.8 (+) 9.2 **or**
 10.8 (+) 27.2
- M1**
- 38
- A1**
- SC1 28.8 **and** 9.2 or 10.8 **and** 27.2
 or 5.4 **and** 5.4 **and** 27.2
- Alternative**
- $6.4 \times 6.8 (-) 2.3 \times 2.4$
 oe eg 43.52 (-) 5.52
- M1**
- 38
- A1**
- SC1 43.52 **and** 5.52
- (b) $\pi \times 1.7 \times 1.7$
 oe
- M1**
- [9, 9.1] **or** 2.89π
 oe
- A1**
- SC1 [2.268, 2.3]
- A1**
- their [9, 9.1]
- (c) their 38 ($\times 100$)
 oe eg their [9, 9.1] $\div 0.38$
- M1**
- [0.236, 0.24] **or** [23.6, 24]
 ft from their areas in (a) and (b)
- A1ft**
- [0.236, 0.24] **and** Yes
or
 [23.6, 24] **and** Yes
- Q1ft**
- Strand (iii) Must have M1
 Correct ft decision based on their decimal or their percentage
 ft from their areas in (a) and (b)
- Alternative 1**
- $0.25 \times \text{their } 38$
 oe
- M1**
- 9.5
- A1ft**
- ft from their area in (a)
- 9.5 **and** Yes
- Q1ft**
- Strand (iii) Must have M1
 Correct ft decision based on their 9.5 and their area in (b)
 ft from their areas in (a) and (b)

Alternative 2

their $[9, 9.1] \times 4$

M1

$[36, 36.4]$

ft from their area in (b)

A1ft

$[36, 36.4]$ **and** Yes

Strand (iii) Must have M1

*Correct ft decision based on their $[36, 36.4]$ and their area in (a)
ft from their areas in (a) and (b)*

Q1ft

[7]

Q20.

$8 \div 2 (= 4)$ oe

M1

$\pi \times \text{their } 4 \times \text{their } 4$ oe

Allow 3.14 or better for π

M1dep

$[50.2, 50.3]$ or 16π

Condone $[13.7, 13.8]$ or $64 - 16\pi$ as fw

A1

[3]

Q21.

Side of square = 14 cm seen or implied

eg 14×14 or 196

B1

$\pi \times 7^2$

or 49π

or $[153.8, 154]$

oe

M1

$14 \times 14 - \pi \times 7^2$

or $196 - [153.8, 154]$

oe

M1dep

$[42, 42.2]$ or $196 - 49\pi$

A1

[4]