



Coimisiún na Scrúduithe Stáit State Examinations Commission

MARKING SCHEME

JUNIOR CERTIFICATE EXAMINATION 2003


MATHEMATICS – ORDINARY LEVEL – PAPER 2 (300 marks)

GENERAL GUIDELINES FOR EXAMINERS

1. Penalties of three types are applied to candidates' work as follows:

- Blunders - mathematical errors/omissions (-3)
- Slips - numerical errors (-1)
- Misreadings (provided task is not oversimplified) (-1).

Frequently occurring errors to which these penalties must be applied are listed in the scheme. They are labelled as B1, B2, B3,....., S1, S2, S3,....., M1, M2, etc. Note that these lists are not exhaustive.

2. When awarding attempt marks, e.g. Att(3), it is essential to note that
- any correct relevant step in a part of a question merits *at least* the attempt mark for that part
 - if deductions result in a mark which is lower than the attempt mark, then the attempt mark must be awarded
 - a mark between zero and the attempt mark is never awarded.
3. Worthless work is awarded zero marks. Some examples of such work are listed in the scheme and they are labelled as W1, W2...etc.
4. The *same* error in the *same* section of a question is penalised *once* only.
5. Particular cases, verifications and answers derived from diagrams (unless requested) qualify for attempt marks only.
6. The phrase “and stops” means that no more work is shown by the candidate.
7. Special notes relating to the marking of a particular part of a question or question with  symbol are indicated by an asterisk * under solution box.

QUESTION 1

Part (a)	10 marks	Att 3
Part (b)	20 marks	Att 7
Part (c)	20 marks	Att 7

Part (a)	10 marks	Att 3
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A ribbon of length 2.5 m is cut into two pieces. One piece measures 97 cm.
What is the length of the other piece?



$$\begin{aligned}2.5 \text{ m} &= 250 \text{ cm} \\ \text{Length} &= 250 - 97 \\ &= 153 \text{ cm}\end{aligned}$$

or

$$\begin{aligned}97 \text{ cm} &= 0.97 \text{ m} \\ \text{Length} &= 2.5 - 0.97 \\ &= 1.53 \text{ m}\end{aligned}$$

- * Correct answer without work merits 7 marks
- * Answer = 94.5 without work merits 4 marks

Blunders (-3)

- B1 Incorrect conversion m \rightarrow cm or cm \rightarrow m or no conversion
- B2 Divides 2.5m by 2 and continues
- B3 Adds instead of subtracts

Slips (-1)

- S1 Numerical slips to a maximum of -3
- S2 Leaves as 250 - 97 or 2.5 - 0.97

Misreadings (-1)

- M1 Takes 2.5m as ratio 2:5 and continues

Attempts (3 marks)

- A1 Converts units and stops
- A2 Divides either number by 2 and stops

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)
- W2 Multiplies or divides both numbers

- Notes:*
- 99.5 with work merits 4 marks (B1 + B3)
 - 99.5 without work merits 0 marks

A person travels 48 km to work in the morning and returns home by the same route in the evening.
It takes 45 minutes to travel to work. Calculate the average speed in km/hr.



$$\begin{aligned} \text{Speed} &= \frac{D}{T} \\ &= \frac{48}{\frac{3}{4}} \quad \text{or} \quad \frac{48}{0.75} \\ &= 64 \text{ km/hr} \end{aligned}$$

or

$$\begin{aligned} \text{Speed} &= \frac{D}{T} \\ &= \frac{48}{45} \quad \text{or} \quad 1.0\dot{6} \text{ km/min} \\ &= 64 \text{ km/hr} \end{aligned}$$

- * Correct answer without work merits 2 marks
- * May use ratio method
- * Do not penalise same error twice in section (b)

Blunders (-3)

- B1 Incorrect relevant formula
- B2 No division
- B3 Mathematical error
- B4 Error in converting hr/min or no conversion

Slips (-1)

- S1 Numerical slips to a maximum of -3
- S2 $\frac{96}{45}$

Attempts (2 marks)

- A1 Converts min/hr or km/m and stops
- A2 Correct formula only and stops
- A3 Any relevant work

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

The person returns home at an average speed of 72 km/hr.
How many minutes does the journey home take?



$$\begin{aligned} \text{Time} &= \frac{D}{S} \\ &= \frac{48}{72} \quad \text{or} \quad 0.\dot{6} \text{ hr} \quad \text{or} \quad \frac{2}{3} \text{ hr} \\ &= 40 \text{ mins} \end{aligned}$$

- * Correct answer without work merits 2 marks
- * Accept candidate's answer from part (i)
- * Accept ratio method

Blunders (-3)

- B1 Incorrect formula
- B2 No division
- B3 Mathematical error
- B4 Error in converting hr/min or no conversion, unless B4 applied in part (i)

Slips (-1)

- S1 Numerical slips to a maximum of -3

Attempts (2 marks)

- A1 States 1hr = 60 mins and stops
- A2 Correct formula only and stops
- A3 Divides by 48

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

At what time should the person leave work in order to arrive home at 20:15?



$$\begin{aligned} \text{Time} &= 20:15 - 0:40 \\ &= 19:35 \end{aligned}$$

or

$$\begin{aligned} &= 19:75 - 0:40 \\ &= 19:35 \end{aligned}$$

- * Correct answer without work merits 7 marks
- * Accept candidate's answer from part (ii)
- * Accept answer in 12 hr clock format

Blunders (-3)

- B1 Adds instead of subtracts
- B2 Error in converting hr/min or no conversion, unless B4 applied in part (i)
- B3 Correctly subtracts arbitrary time other than answer (b) (ii)

Slips (-1)

- S1 Numerical slips to a maximum of -3

Attempts (3 marks)

- A1 Converts hr/min and stops

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

Part (c) (i)**10 marks****Att 3**

A small pizza has diameter 20 cm. A large pizza has diameter 30 cm.

What is the area of the base of a small pizza, to the nearest cm^2 .



$$\begin{aligned}\text{Area} &= \pi r^2 \\ &= 3.14 \times 10^2 \\ &= 314 \text{ cm}^2\end{aligned}$$

- * Correct answer without work merits 7 marks
- * Do not penalise same error twice in part (c)

Blunders (-3)

- B1 Incorrect relevant formula e.g. $2\pi r^2$, $2\pi r$
- B2 Incorrect substitution
- B3 Mathematical error e.g. $10^2 = 20$
- B4 Value of π which does not give correct answer when rounded off

Slips (-1)

- S1 Numerical errors to a maximum of -3
- S2 Incorrect round off or no round off

Attempts(3)

- A1 Some correct step and stops e.g. $r = 10$
- A2 Product of two dimensions

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

Notes 20 x 20, or 20 x 30 merit attempt mark
 400 or 600 without work merit 0 marks

What is the area of the base of a large pizza, to the nearest cm^2 .



$$\begin{aligned}\text{Area} &= \pi r^2 \\ &= 3.14 \times 15^2 \\ &= 706.5 \\ &\approx 707 \text{ cm}^2\end{aligned}$$

* Correct answer without work merits 2 marks

Blunders (-3)

- B1 Incorrect relevant formula
- B2 Incorrect substitution
- B3 Mathematical error e.g. $15^2 = 30$
- B4 Value of π which does not give correct answer when rounded off

Slips (-1)

- S1 Numerical errors to a maximum of -3
- S2 Incorrect round off or no round off

Attempts(2)

- A1 Some correct step and stops
- A2 Product of two dimensions

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

What is the difference in area between one large pizza and two small pizzas?



$$\begin{aligned}1 \text{ large} &= 707 \\2 \text{ small} &= 2 \times 314 = 628 \\ \text{Difference} &= 707 - 628 = 79 \text{ cm}^2\end{aligned}$$

- * Correct answer without work merits 2 marks
- * Accept answers from previous parts

Blunders (-3)

B1 Adds instead of subtracts

Slips (-1)

S1 Numerical slips to a maximum of -3

S2 Uses area for 1 small pizza or 2 large pizzas

Attempts (2 marks)

A1 Indicates subtraction

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

QUESTION 2

Part (a)	10 marks	Att 3
Part (b)	20 marks	Att 6
Part (c)	20 marks	Att 7

Part (a)	10 marks	Att 3
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A ball, in the shape of a sphere, has radius 7 cm.

Taking π as $\frac{22}{7}$, calculate the surface area of the ball.



$$\begin{aligned}\text{Area} &= 4\pi r^2 \\ &= 4 \times \frac{22}{7} \times 7^2 \\ &= 616 \text{ cm}^2\end{aligned}$$

* Correct answer without work merits 7 marks

Blunders (-3)

- B1 Incorrect relevant formula e.g. $2\pi r^2$
- B2 Incorrect substitution
- B3 Mathematical error e.g. $7^2 = 14$
- B4 $\pi \neq \frac{22}{7}$

Slips (-1)

- S1 Numerical errors to a maximum of -3

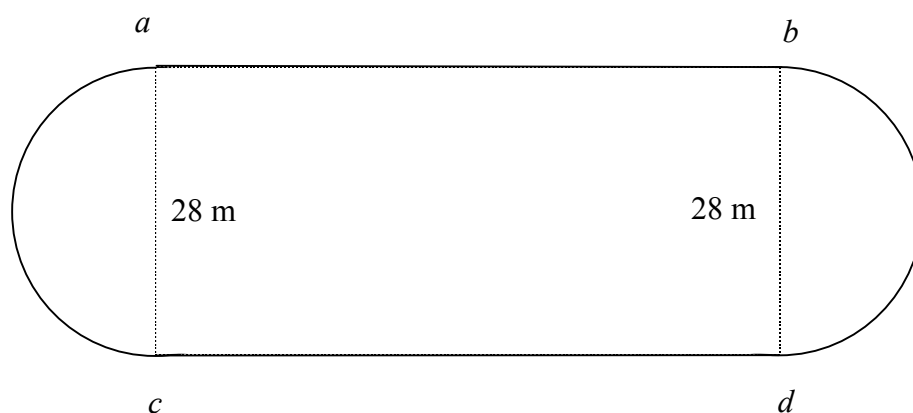
Attempts (3 marks)

- A1 Some correct step and stops
- A2 Correct formula only and stops
- A3 Relevant addition to a diagram e.g. r shown on diagram

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

An athletics track has a total length of 400 m. The track is made up of two parallel sides, $[ab]$ and $[cd]$, and two semi-circular ends as shown. The diameters of the ends, $[ac]$ and $[bd]$, measure 28 m each.



Taking π as $\frac{22}{7}$, calculate the length of one of the semi-circular ends.



$$\begin{aligned} \text{Length} &= \pi r \\ &= \frac{22}{7} \times 14 \\ &= 44 \text{ m} \end{aligned}$$

- * Correct answer without work merits 7 marks
- * Do not penalise same error twice in part (b)
- * If answer in part (i) > 400 accept order of subtraction in part (ii)

Blunders (-3)

- B1 Incorrect relevant formula
- B2 Incorrect substitution
- B3 Mathematical errors e.g. fraction
- B4 $\pi \neq \frac{22}{7}$

Slips (-1)

- S1 Numerical slips to a maximum of -3

Attempts (3 marks)

- A1 Some correct step
- A2 $r = 14$ only and stops
- A3 Correct formula only and stops

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

Calculate the length of the side $[ab]$.



$$2 \text{ ends} = 44 \times 2 = 88$$

$$2 |ab| = 400 - 88 = 312$$

$$|ab| = \frac{312}{2} \text{ or } 156 \text{ m}$$

- * Correct answer without work merits 7 marks
- * Accept answer from part (i)

Blunders (-3)

- B1 Adds instead of subtracts
- B2 Omits division by 2
- B3 Uses one length only
- B4 Uses 28 instead of answer (i) and continues

Slips (-1)

- S1 Numerical slips to a maximum of -3

Attempts (3 marks)

- A1 Some subtraction from 400
- A2 Division by 2 or multiplication by 2
- A3 Any correct step
- A4 Writes 200 and stops

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

- Notes*
- 400 – 28 and stops merits attempt mark
 - 400 – 28 and finishes correctly merits 4 marks

Part (c) (i)

5 marks

Att 2

A rectangular carton full of fruit juice measures 12 cm by 6 cm by 33 cm.
Find the volume of juice in the carton.



$$\begin{aligned}\text{Volume} &= l \times b \times h \\ &= 12 \times 6 \times 33 \\ &= 2376 \text{ cm}^3\end{aligned}$$

* Correct answer without work merits 4 marks. Special case

Blunders (-3)

- B1 Incorrect relevant formula
- B2 Incorrect substitution
- B3 Mathematical error

Slips (-1)

- S1 Numerical slips to a maximum of -3

Attempts (2 marks)

- A1 Correct formula and stops
- A2 Some correct substitution and stops
- A3 Volume = l + b + h and continues i.e $12 + 6 + 33 = 51$

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)
- W2 Answer = 51 without work shown

Notes: $12^3 = 1728$ or $6^3 = 216$ or $33^3 = 35937$ merit 2 marks

Part (c) (ii)

5 marks

Att 2

The juice fills 18 cylindrical glasses exactly. Find the volume of each glass.



$$\text{Volume} = \frac{2376}{18} \text{ or } 132 \text{ cm}^3$$

- * Accept correct answer without work for full marks. Special case.
- * Accept candidate's answer from part (i)

Blunders (-3)

B1 Multiplies instead of divides

Slips (-1)

S1 Numerical slips to a maximum of -3

Attempts (2 marks)

A1 2376 ± 18

A2 Writes down answer from (i) and stops

Worthless (0)

W1 Incorrect answer without work e.g. 2394 or 2358

The radius of each glass is 3 cm. Calculate the height of each glass, correct to the nearest cm.



$$\begin{aligned} \text{Volume} &= \pi r^2 h & \text{or} & \text{Volume} = 132 & \text{or} & \pi r^2 h = 132 \\ 3 \cdot 14 \times (3)^2 \times h &= 132 \\ h &= \frac{132}{3 \cdot 14 \times 9} = 4 \cdot 67 \approx 5 \text{ cm} \end{aligned}$$

- * Correct answer without work merits 7 marks
- * Accept candidate's answer from part (ii)

Blunders (-3)

- B1 Incorrect relevant cylinder formula
- B2 Incorrect substitution
- B3 Mathematical error
- B4 Transposing error
- B5 Value of π which does not give correct answer when rounded off

Slips (-1)

- S1 Numerical slips to a maximum of -3
- S2 Incorrect round off or no round off

Attempts (3 marks)

- A1 A correct substitution and stops e.g. $3 \cdot 14 \times 3^2 \times h$
- A2 Uses answer from (ii) e.g. $\frac{132}{3}$

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

QUESTION 3

Part (a)	10 marks	Att 3
Part (b)	20 marks	Att 8
Part (c)	20 marks	Att 7

Part (a)	10 marks	Att 3
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Three children are aged 2, 5 and 11 years. Calculate their average age.



$$\begin{aligned}\text{Average} &= \frac{\Sigma x}{n} \\ &= \frac{2+5+11}{3} \\ &= \frac{18}{3} \text{ or } 6\end{aligned}$$

* Correct answer without work merits 9 marks. Special case.

Blunders (-3)

- B1 Multiplies instead of adds e.g. $\frac{110}{3}$
B2 Incorrect divisor
B3 Omits a variable
B4 Inverted fraction

Slips (-1)

- S1 Numerical errors to a maximum of -3

Attempts (3 marks)

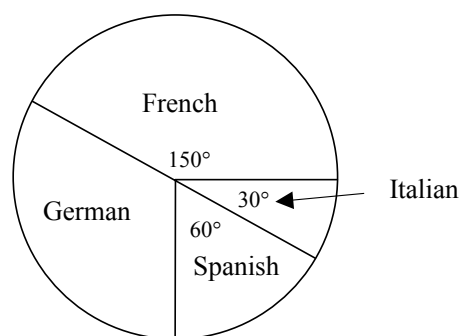
- A1 Writes 18 only and stops
A2 Partial addition and stops
A3 Idea of mean indicated e.g. $\frac{\Sigma x}{n}$
A4 "Median is 5" and stops

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

- Notes* Writes $\frac{3}{18} = 6$ merits 7 marks (B4)
Writes $\frac{3}{18}$ only merits attempt mark

Each student in a class studies one of the four languages: French, German, Spanish and Italian. The pie-chart represents the number of students that study each language.



What is the measure of the angle for German?

$$\text{Angle for German} \quad (150^\circ + 60^\circ + 30^\circ) \text{ or } 240^\circ \Rightarrow 360^\circ - 240^\circ = 120^\circ$$

$$\text{or} \quad 180^\circ - 60^\circ = 120^\circ$$

- * Accept correct answer with no work
- * Do not penalise same error twice in part (b)

Blunders (-3)

- B1 Angle centre of circle $\neq 360^\circ$
- B2 No subtraction
- B3 Straight line angle $\neq 180^\circ$

Slips (-1)

- S1 Numerical slips to a maximum of -3
- S2 Each angle omitted to a maximum of -3
- S3 Indicates subtraction i.e. $360^\circ - 240^\circ$

Attempts (2 marks)

- A1 Some addition
- A2 States "Angle sum in triangle = 180° " or similar
- A3 States "Angle centre of circle = 360° " or similar
- A4 States "Straight line angle = 180° " or similar
- A5 Writes 60° or 30° or 150° and stops

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

Part (b) (ii)

5 marks

Att 2

10 students study French. How many students study Italian?

$$\text{Number studying Italian} = \frac{1}{5} \times 10 = 2$$

$$\text{or} \quad 150^\circ = 10 \quad \text{or} \quad 150^\circ = 10$$

$$1^\circ = \frac{10}{150}$$

$$30^\circ = \frac{10}{150} \times 30 = 2 \quad 30^\circ = 2$$

* Accept correct answer with no work shown

Blunders (-3)

B1 Error in ratio method

B2 Mathematical error

Slips (-1)

S1 Numerical slips to a maximum of -3

Attempts (2 marks)

A1 Some use of relevant data

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

How many students are in the class?

Number of students in the class	$10, 2, 4, 8 \Rightarrow$	$10 + 2 + 4 + 8 = 24$	
or	$150^\circ =$	$\frac{10}{150}$	or $30^\circ = 2$
	$1^\circ =$	$\frac{10}{150}$	$1^\circ = \frac{2}{30}$
	$360^\circ =$	$\frac{10}{150} \times 360$	$360^\circ = \frac{2}{30} \times 360$
	$=$	24	$= 24$

- * Accept correct answer with no work shown
- * Accept candidate's answer from previous parts

Blunders (-3)

- B1 Incorrect ratio method
- B2 Mathematical error
- B3 Omits more than one entry in addition

Slips (-1)

- S1 Numerical errors to a maximum of -3
- S2 Omits one entry in addition or one incorrect entry

Attempts (2 marks)

- A1 Some addition

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

How many students do not study Spanish?

Number of students not studying Spanish	4	\Rightarrow	$24 - 4 = 20$
or	360°	=	24
	60°	=	4
Not Spanish		=	20

- * Accept any correct ratio method
- * Accept correct answer with no work shown
- * Accept candidate's answer from previous parts

Blunders (-3)

- B1 Incorrect ratio method
- B2 Gives answer for number studying Spanish

Attempts (2 marks)

- A1 Any correct step
- A2 Any relevant angle within scheme

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

Part (c) (i)

10 marks

Att 3

The following gives the number of days that each of 30 pupils was absent during May:

1 0 2 3 1 0 0 4 5 5
6 5 3 2 0 5 1 0 4 5
3 2 3 6 5 4 3 6 6 0

Complete the following distribution table:

Number of days absent	0	1	2	3	4	5	6
Number of pupils	6	3	3	5	3	6	4

Slips (-1)

S1 Each incorrect or omitted frequency

Calculate the mean number of days absent per pupil during May.



$$\begin{aligned} \text{Mean} &= \frac{\sum fx}{\sum f} \\ &= \frac{(6 \times 0) + (3 \times 1) + (3 \times 2) + (5 \times 3) + (4 \times 3) + (6 \times 5) + (4 \times 6)}{6 + 3 + 3 + 5 + 3 + 6 + 4} \\ \text{or} &= \frac{0 + 3 + 6 + 15 + 12 + 30 + 24}{30} \\ &= \frac{90}{30} \text{ or } 3 \end{aligned}$$

* Correct answer without work merits 2 marks

* Accept candidate's values from table

Blunders (-3)

B1 Multiplies instead of adds in denominator e.g. $\frac{90}{19440}$

B2 Adds instead of multiplies in numerator e.g. $\frac{51}{30}$

B3 Incorrect denominator or no denominator e.g. $\frac{90}{7}$

B4 Inverted fraction

B5 Frequencies omitted in numerator e.g. $\frac{0+1+2+3+4+5+6}{30} = \frac{21}{30}$

B6 Omits two or more values in numerator

B3 + B5 $\frac{0+1+2+3+4+5+6}{7}$

Slips (-1)

S1 Numerical slips to a maximum of -3

S2 $6(0) = 6$

S3 Omits one value in numerator

Attempts (2 marks)

A1 Mean = $\frac{\sum fx}{\sum f}$ and stops

A2 A relevant multiplication and stops

A3 Some correct work e.g. $\sum f$

A4 Average of frequencies e.g. $\frac{6+3+3+5+3+6+4}{7} = \frac{30}{7} = 4.3$

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

What percentage of the pupils were absent for three days or more?



* Correct answer without work merits 2 marks

* Accept candidate's values from table

Blunders (-3)

B1 More than 3 days e.g. 13 \Rightarrow 43.3%

B2 Exactly 3 days e.g. 5 \Rightarrow 16.7%

B3 Less than 3 days e.g. 12 \Rightarrow 40%

B4 Not more than 3 days e.g. 17 \Rightarrow 56.7%

B5 Omits the 100 or divides by 100

B6 Multiplies by $\frac{30}{100}$ e.g. 5.4%

Slips (-1)

S1 Numerical errors to a maximum of -3

Attempts (2 marks)

A1 Any correct step e.g. indicates x 100

Worthless (0)

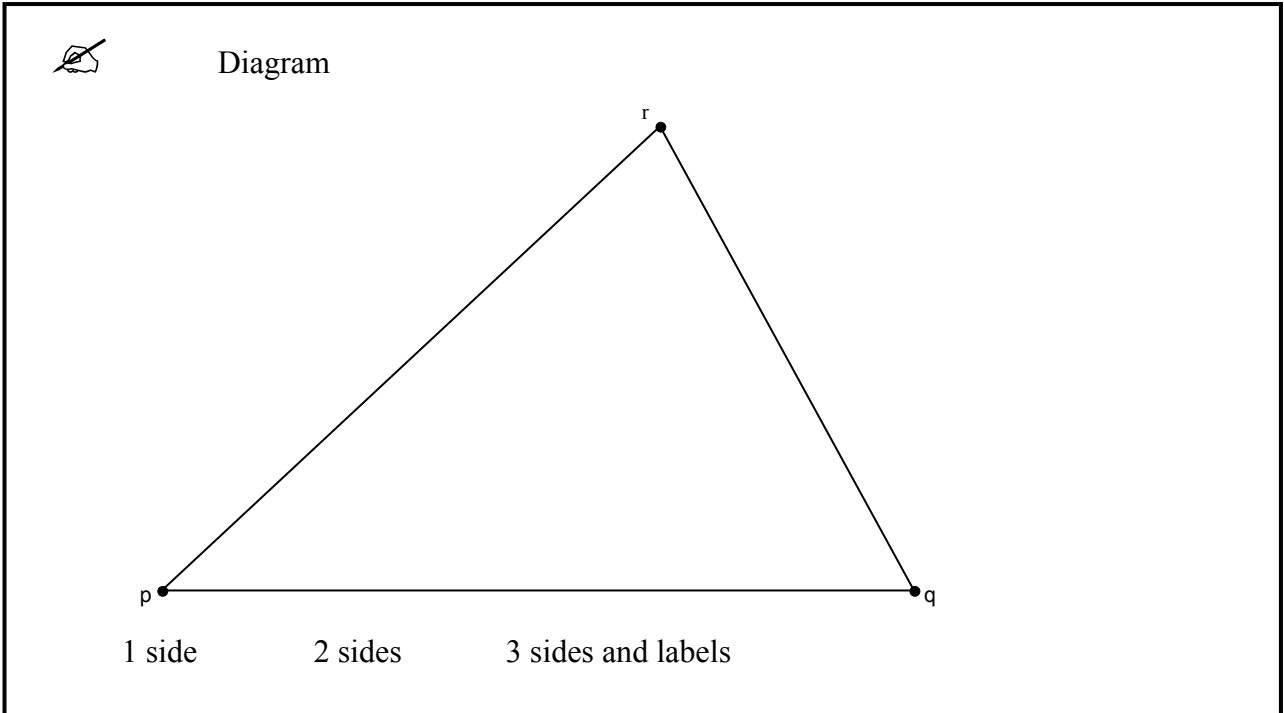
W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

QUESTION 4

Part (a)	10 marks	Att 3
Part (b)	20 marks	Att 8
Part (c)	20 marks	Att 8

Part (a)	10 marks	Att 3
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Construct a triangle pqr with $|pq| = 10$ cm, $|pr| = 9$ cm and $|qr| = 7$ cm.
Label your diagram clearly.



- * Accept base other than [pq]
- * Tolerance of ± 2 mm on sides
- * Examiners must measure candidate's work

Blunders (-3)

- B1 Each incorrect length i.e. outside tolerance
- B2 Failure to complete triangle

Slips (-1)

- S1 No labels on diagram
- S2 Units other than cm

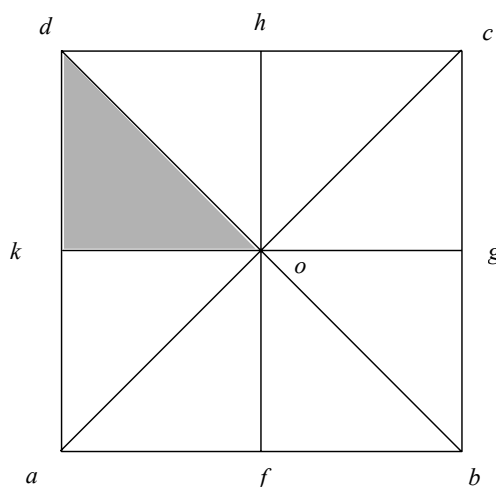
Attempts (3 marks)

- A1 Pilot diagram drawn

Notes: One side correct with labels merits 4 marks

$abcd$ is a square. The midpoints of the sides are f, g, h and k as shown.

The diagonals intersect at o .



Name the image of Δdko under:

S_o , the central symmetry in the point o

Δdko

\rightarrow

Δbgo

- * Accept Δbgo with points in any order
- * Accept $d \rightarrow b, k \rightarrow g, o \rightarrow o$
- * Accept diagram with correct indication/shading

Blunders (-3)

- B1 Each point whose image is not found or incorrectly found but note B2, B3, B4
- B2 Correct image of Δdko under some other central symmetry (even on extended diagram)
- B3 Correct image of Δdko under some axial symmetry or translation
- B4 Correct image of some other Δ under S_o

Attempts (2 marks)

- A1 Shows some knowledge of central symmetry and stops
- A2 A central symmetry not related to diagram or question
- A3 Correct axial symmetry or translation on some other Δ
- A4 States that image is a Δ

Worthless (0)

- W1 Diagram reproduced without modification

Name the image of Δdko under:
 S_{hf} , the axial symmetry in the line hf

$\Delta dko \rightarrow \Delta cgo$

- * Accept Δcgo with points in any order
- * Accept $d \rightarrow c, k \rightarrow g, o \rightarrow o$
- * Accept diagram with correct indication/shading

Blunders (-3)

- B1 Each point whose image is not found (or incorrectly found) but note B2, B3, B4
- B2 Correct image of Δdko under some other axial symmetry (even on extended diagram)
- B3 Correct image of Δdko under some central symmetry or translation
- B4 Correct image of some other Δ under S_{hf} , unless S1 applies

Slips (-1)

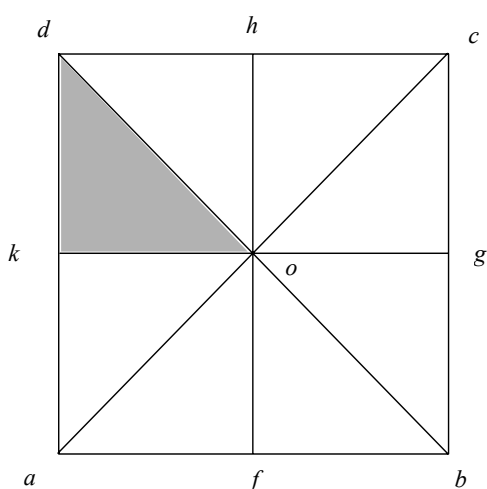
- S1 Names image of answer part (i)

Attempts (2 marks)

- A1 Shows some knowledge of axial symmetry and stops
- A2 An axial symmetry not related to diagram or question
- A3 Correct central symmetry or translation on some other Δ
- A4 States that image is a Δ

Worthless (0)

- W1 Diagram reproduced without modification



Notes:

- S1
 - (ii) gives image of answer (b) (i) \Rightarrow 4 marks
 - (iii) gives image of answer (b) (ii) \Rightarrow 5 marks [Do not penalise twice]
 - (iv) gives image of answer (b) (iii) \Rightarrow 5 marks [Do not penalise twice]

Part (b) (iii)

5 marks

Att 2

Name the image of Δdko under:
 S_{db} , the axial symmetry in the line db



Δdko



Δdho

- * Accept Δdho with points in any order
- * Accept $d \rightarrow d, k \rightarrow h, o \rightarrow o$
- * Accept diagram with correct indication/shading

Blunders (-3)

- B1 Each point whose image is not found (or incorrectly found) but note B2, B3, B4
- B2 Correct image of Δdko under some other axial symmetry (even on extended diagram)
- B3 Correct image of Δdko under some central symmetry or translation
- B4 Correct image of some other Δ under S_{db} , unless S1 applies

Slips (-1)

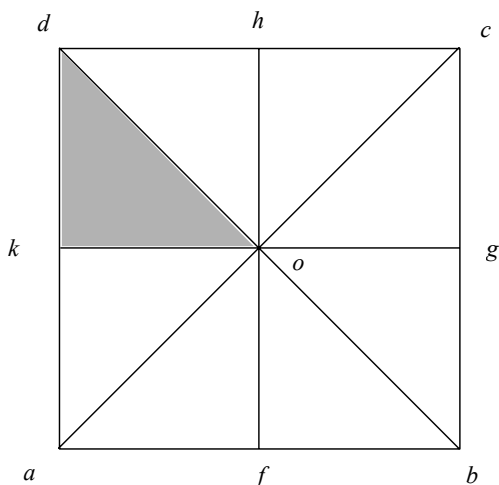
- S1 Names the image of answer part (ii)

Attempts (2 marks)

- A1 Shows some knowledge of axial symmetry and stops
- A2 An axial symmetry not related to diagram or question
- A3 Correct central symmetry or translation on some other Δ
- A4 States that image is a Δ

Worthless (0)

- W1 Diagram reproduced without modification
- W2 Answer given as ac



Name the image of Δdko under:
 S_{ac} , the axial symmetry in the line ac .

 Δdko  Δbfo

- * Accept Δbfo with points in any order
- * Accept $d \rightarrow b$, $k \rightarrow f$, $o \rightarrow o$
- * Accept diagram with correct indication/shading

Blunders (-3)

- B1 Each point whose image is not found (or incorrectly found) but note B2, B3, B4
 B2 Correct image of Δdko under some other axial symmetry (even on extended diagram)
 B3 Correct image of Δdko under some central symmetry or translation
 B4 Correct image of some other Δ under S_{ac} , unless S1 applies

Slips (-1)

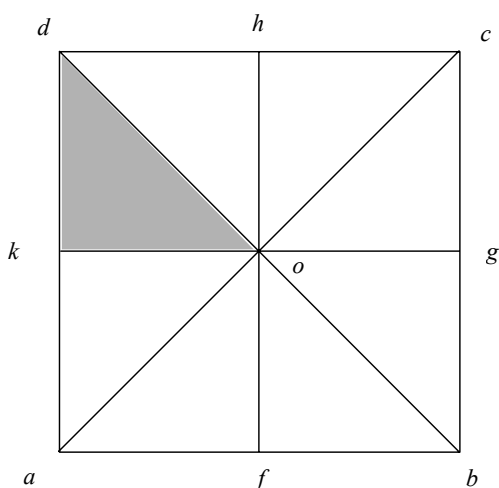
- S1 Names the image of answer part (iii)

Attempts (2 marks)

- A1 Shows some knowledge of axial symmetry and stops
 A2 An axial symmetry not related to diagram or question
 A3 Correct central symmetry or translation on some other Δ
 A4 States that image is a Δ

Worthless (0)

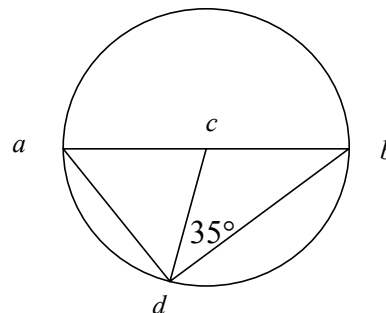
- W1 Diagram reproduced without modification



Notes: Answer = db merits 2 marks as b is correct (* accept any order)

Part (c) (i)**5 marks****Att 2**

$[ab]$ is a diameter of the circle with centre c .
 d is a point on the circle as shown.



Write down $|\angle adb|$, and give a reason for your answer.

$|\angle adb| = 90^\circ$

Reason: Angle in semi-circle or similar

* Accept right angle marked/indicated on diagram

Slips (-1)

S1 Correct answer without reason or incorrect reason

S2 Fills 55° on diagram as $\angle adc$ and stops

Attempts (2 marks)

A1 States "Angle at centre = twice angle at circle standing on same arc" or similar and stops

A2 States "Straight line angle = 180° " or similar and stops

A3 States "Angle sum in $\Delta = 180^\circ$ " or similar

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

W2 Diagram reproduced without modification

Part (c) (ii)**5 marks****Att 2**

Given that $|\angle bdc| = 35^\circ$, name another angle of 35° , and give a reason for your answer.

Name of angle: $\angle cbd$ or $\angle abd$

Reason: Isosceles triangle or similar

* Accept angle marked/indicated on diagram

Blunders (-3)

B1 Names two other angles equal in measure

B2 Names $|\angle dcb| = 35^\circ$

Slips (-1)

S1 Correct answer without reason or incorrect reason

Attempts (2 marks)

A1 Reason only

Worthless (0)

W1 Names $|\angle acd| = 35^\circ$

Part (c) (iii)**5 marks****Att 2**

Write down $|\angle acd|$, and give a reason for your answer.

$$|\angle acd| = 70^\circ$$

Reason: $|\angle dcb| = 110^\circ$ and straight line = 180°

- * Accept correct answer marked/indicated on a diagram
- * Accept correct answer and no work
- * Accept candidate's answer from part (ii) but note W2

Blunders (-3)

- B1 Shows $|\angle dcb| = 110^\circ$ and stops
- B2 States $|\angle acd| = 2|\angle bdc|$ or $2|\angle cbd|$ and stops
- B3 Sum of angles in $\Delta \neq 180^\circ$
- B4 Error in transposition
- B5 Uses $|\angle dcb| = 35^\circ$ and continues

Slips (-1)

- S1 Numerical errors to a maximum of -3
- S2 Correct answer with no reason or incorrect reason

Attempts (2 marks)

- A1 States "straight line angle = 180° " or similar
- A2 States "angle sum of $\Delta = 180^\circ$ " or similar
- A3 Any mention of isosceles Δ or exterior angle

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)
- W2 Gives $|\angle acd| = 35^\circ$ in part (ii) and repeats answer in (iii)

Write down $|\angle cad|$, and give a reason for your answer.

$$|\angle cad| = 55^\circ$$

Reason: $180^\circ - 70^\circ = 110^\circ$

$$110^\circ \div 2 = 55^\circ$$

- * Accept correct answer marked/indicated on a diagram
- * Accept correct answer and no work
- * Accept candidate's answers from previous parts

Blunders (-3)

- B1 Shows $|\angle dcb| = 110^\circ$ and stops
- B2 States $|\angle acd| = 2|\angle bdc|$ or $2|\angle cbd|$ and stops
- B3 Sum of angles in $\Delta \neq 180^\circ$
- B4 Error in transposition
- B5 Uses $|\angle dcb| = 35^\circ$ and continues

Slips (-1)

- S1 Numerical errors to a maximum of -3
- S1 Correct answer with no reason or incorrect reason

Attempts (2 marks)

- A1 States "straight line angle = 180° "
- A2 States "angle sum of $\Delta = 180^\circ$ "
- A3 Any mention of isosceles Δ or exterior angle

Worthless (0)

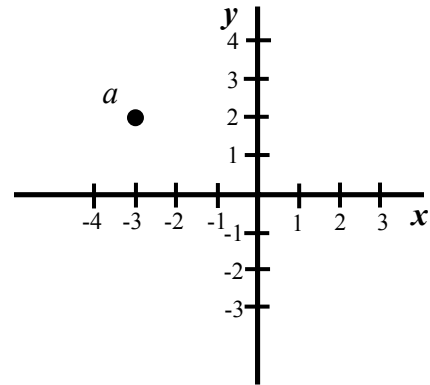
- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

QUESTION 5

Part (a)	10 marks	Att 3
Part (b)	20 marks	Att 7
Part (c)	20 marks	Att 6

Part (a)	10 marks	Att 3
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Write down the coordinates of the point a .



Part (a)	10 marks	Att 3
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$a (-3, 2)$

- * No penalty on brackets e.g. $-3,2$
- * Accept $x = -3$ and $y = 2$ written separately for full marks

Blunders (-3)

- B1 Incorrect order in couple, $(2,-3)$
- B2 Incorrect x ordinate if not sign error, subject to B1
- B3 Incorrect y ordinate if not sign error, subject to B1
- B4 $x = -3$ and stops or $y = 2$ and stops

Slips (-1)

- S1 Sign error x ordinate
- S2 Sign error y ordinate


Attempts (3 marks)

- A1 Draws line or segment through -3 and/or 2

Notes:

(-3,3): B3	(3,-2): S1, S2	(2,3): B2, B3
(-3,0): B3	(3,0): S1, B3	(-2,-3): B2, B3
(3,2): S1	(3,-2): S1, S2	(4,4): B2, B3

p is the point (3, 4) and q is the point (-1, 1). Find each of the following:
the slope of pq

 the slope of pq or $= \frac{\text{vertical}}{\text{horizontal}}$

$$= \frac{1-4}{-1-3} \quad \text{or} \quad = \frac{4-1}{3--1} \quad \text{or vertical} = 3 \quad \text{horizontal} = 4$$

$$= \frac{-3}{-4} \quad \text{or} \quad \frac{3}{4} \quad = \frac{3}{4} \quad = \frac{3}{4}$$

* Correct answer without work merits 7 marks

* Accept correct trigonometric method (i.e. $\tan \theta = \frac{3}{4}$)

Blunders (-3)

B1 Incorrect slope formula e.g. $\frac{x_2 - x_1}{y_2 - y_1}$ or $\frac{y_2 + y_1}{x_2 + x_1}$ or $\frac{y_2 - y_1}{x_1 - x_2}$ or $\frac{\text{horizontal}}{\text{vertical}}$

or $\tan \theta = \frac{\text{adjacent}}{\text{opposite}}$ and continues

B2 Incorrectly treats couples as (x_1, x_2) and (y_1, y_2) e.g. $\frac{1--1}{4-3}$ or $\frac{4-3}{1--1}$

B3 Mathematical error e.g. sign rules or $\frac{1}{-1} \pm \frac{4}{-3}$

B4x2 Uses $\frac{x_1 - y_1}{x_2 - y_2}$ and continues

B5 Gets the slope of op or oq correctly

B6 Error in more than one sign when substituting e.g. $\frac{1+4}{-1+3}$ or $\frac{4+1}{3+-1}$

Slips(-1)

S1 Numerical errors to a maximum of -3

S2 Error in one sign in slope formula e.g. $\frac{y_2 - y_1}{x_2 + x_1}$

S3 One incorrect substitution or sign when substituting e.g. $\frac{1+4}{-1-3}$

Attempts (3 marks)

A1 $\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$ or $m = \frac{\text{vertical}}{\text{horizontal}}$ and stops

A2 Some correct substitution into formula with $x_2 - x_1$ and/or $y_2 - y_1$

A3 Point p and/or q plotted reasonably well for this part

Worthless (0)

W1 Uses wrong formula e.g. midpoint formula

W2 Correct formula only

the midpoint of $[pq]$

$$\begin{aligned} \text{the midpoint of } [pq] &= \left(\frac{-1+3}{2}, \frac{1+4}{2} \right) & \text{or} & = \left(\frac{3+-1}{2}, \frac{4+1}{2} \right) \\ &= \left(\frac{2}{2}, \frac{5}{2} \right) \text{ or } (1, 2\frac{1}{2}) & & = \left(\frac{2}{2}, \frac{5}{2} \right) \text{ or } (1, 2\frac{1}{2}) \end{aligned}$$

- * Correct answer without work merits 2 marks
- * Accept translation method
- * No penalty on brackets e.g. $1, 2\frac{1}{2}$ is acceptable

Blunders (-3)

- B1 Incorrect formula e.g. error in both signs $\left(\frac{x_1 - x_2}{2}, \frac{y_1 - y_2}{2} \right)$ or $\left(\frac{x_1 + y_1}{2}, \frac{x_2 + y_2}{2} \right)$
or omits divisor 2
- B2 Incorrectly treats couples as (x_1, x_2) and (y_1, y_2) if not already penalised
- B3 Mathematical error e.g. sign rules or incorrect cancellation
- B4 Two or more signs incorrect in substitution
- B5 Reversal of coordinates i.e. $(2\frac{1}{2}, 1)$
- B6 One coordinate only worked out
- B7 Uses one of the points given and some arbitrary point e.g. $(3,4)$ and $(0,0)$

Slips (-1)

- S1 Numerical errors to a maximum of -3
- S2 Error in one sign in midpoint formula
- S3 One incorrect substitution or sign when substituting e.g. $\left(\frac{-1-3}{2}, \frac{1+4}{2} \right)$
- S4 Takes $(-1,1)$ as midpoint and finds extremity e.g. $(3,4) \rightarrow (-1,1) \rightarrow (-5,-2)$ or takes $(3,4)$ as midpoint and finds extremity e.g. $(-1,1) \rightarrow (3,4) \rightarrow (7,7)$

Attempts (2 marks)

- A1 Some correct substitution
- A2 Correct midpoint indicated on graph named or not
- A3 Point p and/or q plotted reasonably well for this part

Worthless (0)

- W1 Uses wrong formula e.g. slope or distance formula

Notes: Answer = $\left(\frac{2}{2} + \frac{5}{2} \right)$ with work shown merits 4 marks: (S2)

the length of $[pq]$

$$\begin{aligned} \text{the length of } [pq] &= \sqrt{(-1-3)^2 + (1-4)^2} & \text{or} & = \sqrt{(3--1)^2 + (4-1)^2} \\ & & & \text{or } \sqrt{(3+1)^2 + (4-1)^2} \\ & \text{or } \sqrt{(-4)^2 + (-3)^2} & & \text{or } \sqrt{(4)^2 + (3)^2} \\ & = \sqrt{16+9} = \sqrt{25} \text{ or } 5 & & = \sqrt{16+9} = \sqrt{25} \text{ or } 5 \end{aligned}$$

- * Correct answer without work merits 2 marks
- * Accept correct use of Pythagoras

Blunders (-3)

- B1 Incorrect formula e.g. $\sqrt{(x_2 - x_1)^2 - (y_2 - y_1)^2}$ or $\sqrt{(x_2 + x_1)^2 + (y_2 + y_1)^2}$ or omits $\sqrt{\quad}$ or omits squares
- B2 Incorrectly treats couples as (x_1, x_2) and (y_1, y_2) if not already penalised
- B3 Mathematical error e.g. sign rules or $(4)^2 = 8$
- B4 Two or more signs incorrect in substitution

Slips (-1)

- S1 Numerical errors to a maximum of -3
- S2 Error in one sign in $(x_2 - x_1)$ or $(y_2 - y_1)$ in formula
- S3 One incorrect substitution or sign when substituting

Attempts (2 marks)

- A1 Some correct substitution into formula with $x_2 - x_1$ and/or $y_2 - y_1$
- A2 Point p and/or q plotted reasonably well for this part
- A3 States Theorem of Pythagoras and stops
- A4 Correct graphical solution

Worthless (0)

- W1 Uses wrong formula e.g. midpoint formula

The point $(3, k)$ is on the line $2x - 3y + 6 = 0$. Find the value of k .



Find the value k

$$2(3) - 3(k) + 6 = 0$$

$$[6 - 3k + 6 = 0]$$

$$-3k = -12$$

$$k = \frac{-12}{-3} \text{ or } 4$$

- * Correct answer without work merits 7 marks
- * Accept answer given as $y = 4$ with work shown

Blunders (-3)

- B1 Substitutes $x = k$ and $y = 3 \Rightarrow k = \frac{3}{2}$
- B2 Mathematical error e.g. sign rules
- B3 Incorrect transposition e.g. $k = \frac{-12}{3}$

Slips (-1)

- S1 Numerical errors to a maximum of -3
- S2 Reads as $2x + 3y + 6 = 0$ and continues

Attempts (3 marks)

- A1 Substitutes one value and stops
- A2 Draws a line $x = 3$ or states $x = 3$ and/or $y = k$ and stops
- A3 Some statement similar to “substituting in will satisfy the equation”
- A4 Use of arbitrary value e.g. $x = 0$ or $y = 0$ with some correct work
- A5 Any correct transposition of equation and stops e.g. $2x - 3y = -6$

Worthless (0)

- W1 Incorrect answer and no work shown

The line M has slope -2 and contains the point $(2, -3)$. Find the equation of M .



Equation of M $y - (-3) = -2(x - 2)$ or $y + 3 = -2(x - 2)$ or $2x + y - 1 = 0$

Blunders (-3)

- B1 Incorrect formula e.g. $y + y_1 = m(x + x_1)$ or $x - x_1 = m(y - y_1)$
- B2 Switches x and y e.g. $y - 2 = -2(x - (-3))$
- B3 Mathematical error e.g. sign rules
- B4 Omits brackets e.g. $y + 3 = -2x - 2$ with no work shown
- B5 $y = -2x + c$ and stops
- B6 Uses a point other than $(2, -3)$ e.g. $(0, 0)$
- B7 $m \neq -2$

Slips (-1)

- S1 Numerical errors to a maximum of -3
- S2 Error in one sign in formula
- S3 One incorrect sign in substitution

Attempts (3 marks)

- A1 Writes $m = -2$ and stops
- A2 States $y = mx \pm c$ and stops

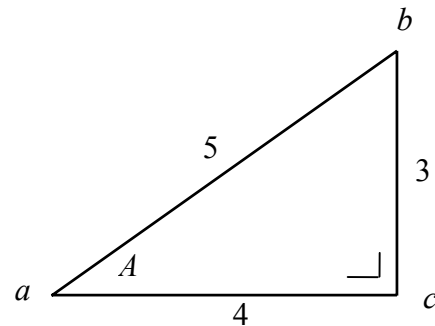
Notes: $-3 - y_1 = -2(2 - x_1)$ merits full marks
 Say $7 - (-3) = -2(5 - 2)$ merits attempt mark

QUESTION 6

Part (a)	10 marks	Att 4
Part (b)	20 marks	Att 6
Part (c)	20 marks	Att 6

Part (a) (i) 5 marks Att 2

The triangle abc has measurements as shown.



Write down the value of $\cos A$.

$$\cos A = \frac{4}{5} \quad \text{or} \quad 0.8$$

* Accept $\cos \frac{4}{5}$ for full marks

Blunders (-3)

B1 Incorrect or inverted ratio e.g. $\cos A = \frac{5}{4}$

B2 Gets cos of top angle

Attempts (2 marks)

A1 Any correct trigonometric ratio written down

A2 Gives answer = 37° exactly or rounded to 37°

A3 Gives answer = 0.9999025

A4 States relevant geometry e.g. 180°

A5 Answer = 0.81915 or $\cos 35^\circ = 0.81915$

Part (a) (ii)

5 marks

Att 2

Write down the value of $\tan A$.

$$\tan A = \frac{3}{4} \quad \text{or} \quad 0.75$$

* Accept consistent error from (i)

Blunders (-3)

B1 Incorrect or inverted ratio e.g. $\tan A = \frac{5}{4}$

B2 Gets tan of top angle

Attempts (2 marks)

A1 Any correct trigonometric ratio written down

A2 Gives answer = 37° exactly or rounded to 37° for this part

A3 Gives answer = 0.0130907

A4 States relevant geometry e.g. 180°

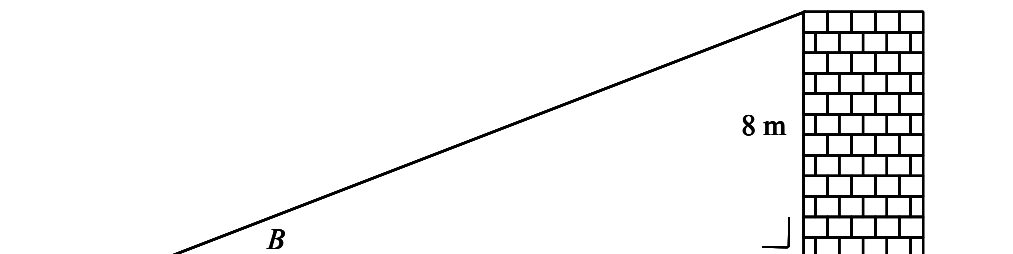
A5 Answer = 0.7002 or $\tan 35^\circ = 0.7002$

Part (b) (i)

10 marks

Att 3

A vertical building is 8 m high. It casts a shadow three times its height on horizontal ground.



Write down the length of the shadow.

$$l = 3 \times 8 \text{ or } 24 \text{ m}$$

Blunders (-3)

B1 $l = n \times 8, n \neq 3$

B2 $l = n \times 3, n \neq 8$

Slips (-1)

S1 Numerical slips to a maximum of -3

Attempts (3 marks)

A1 Multiples of 8 or 3 without work other than correct answer

A2 Answer = $2\frac{2}{3}$ without work

A3 Correct trigonometric ratio involving 8

A4 8 ± 3

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

W2 11 or 5 without work

Find B , the angle of elevation of the sun, correct to the nearest degree.



$$\begin{aligned}\tan B &= \frac{\textit{opposite}}{\textit{adjacent}} \\ &= \frac{8}{24} \quad \text{or} \quad 0.\dot{3} \\ B &= 18.43^\circ \approx 18^\circ\end{aligned}$$

- * Correct answer without work merits 7 marks
- * Accept candidate's answer from part (i)

Blunders (-3)

- B1 Incorrect trigonometric ratios but note W3 below
- B2 No decimal point or misplaced decimal point
- B3 Incorrectly uses radian or grad mode
- B4 Incorrect manipulation of fraction
- B5 Error in handling minutes \rightarrow degrees if top angle found first

Slips (-1)

- S1 Numerical errors to a maximum of -3
- S2 Fails to round off or rounds off incorrectly
- S3 Obvious slip in reading tables or calculator

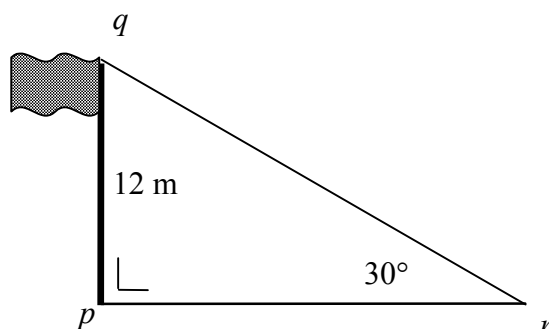
Attempts (3 marks)

- A1 Any correct trigonometric ratio written down
- A2 States theorem of Pythagoras or uses it to find length of third side and stops


Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)
- W2 Diagram reproduced with no modifications
- W3 Angle measured with protractor
- W4 Value of Sin or Cos > 1

A vertical flagpole $[pq]$, 12 m high, is supported by a cable $[qr]$ as shown in the diagram.



Given that $|\angle qrp| = 30^\circ$, find the length of the cable $[qr]$.

 Length of cable $[qr]$ $\frac{|pq|}{|qr|} = \sin \angle prq$
 $\frac{12}{|qr|} = \sin 30^\circ$
 $|qr| = 24 \text{ m}$

* Correct answer without work merits 7 marks

Blunders (-3)

B1 Incorrect trigonometric ratios

B2 No decimal point or misplaced decimal point

B3 Incorrectly uses radian or grad mode

B4 Incorrect manipulation of fraction or incorrect transposition

B5 Error in handling minutes \rightarrow degrees if top angle found first

Slips (-1)

S1 Numerical errors to a maximum of -3

S2 Obvious slip in reading tables or calculator

S3 Calculates $|pr|$ correctly

Attempts (3 marks)


A1 Any correct trigonometric ratio written down

A2 Some use of Sin/Cos/Tan

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)

How far is r from p , the foot of the flagpole?
Give your answer correct to one decimal place.

	Length $ pr $ $\frac{ pq }{ pr } = \tan 30^\circ$	or	$ pr ^2 + pq ^2 = qr ^2$
	$\frac{12}{ pr } = \tan 30^\circ$		$ pr ^2 + 12^2 = 24^2$
	$ pr = 20.784 \approx 20.8\text{m}$		$ pr = 20.784 \approx 20.8$

- * Correct answer without work merits 7 marks
- * Accept other trigonometric ratios

Blunders (-3)

- B1 Incorrect trigonometric ratios
- B2 No decimal point or misplaced decimal point
- B3 Incorrectly uses radian or grad mode
- B4 Mathematical error e.g. $12^2 = 24$
- B5 Incorrect transposition
- B6 Incorrect use of Pythagoras

Slips (-1)

- S1 Numerical errors to a maximum of -3
- S2 Fails to round off or rounds off incorrectly
- S3 Obvious slip in reading tables or calculator
- S4 Calculates $|qr|$ correctly

Attempts (3 marks)

- A1 Any correct trigonometric ratio written down
- A2 Some use of Sin/Cos/Tan
- A3 States theorem of Pythagoras and stops

Worthless (0)

- W1 Incorrect answer without work unless attempt mark applies (answer relevant to scheme)
- W2 Diagram reproduced with no modifications