Coimisiún na Scrúduithe Stáit
State Examinations Commission

JUNIOR CERTIFICATE EXAMINATION

2009

MARKING SCHEME

MATHEMATICS ORDINARY LEVEL PAPER 2

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MATHEMATICS - ORDINARY LEVEL - PAPER 2

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: B1, B2, B3,…, S1, S2,…, M1, M2,…etc. These lists are not exhaustive.

2. When awarding attempt marks, e.g. Att(3), 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 phrase "hit or miss" means that partial marks are not awarded – the candidate receives all of the relevant marks or none.

5. The phrase "and stops" means that no more work is shown by the candidate.

6. Special notes relating to the marking of a particular part of a question are indicated by an asterisk. These notes immediately follow the box containing the relevant solution.

7. The sample solutions for each question are not intended to be exhaustive lists – there may be other correct solutions.

8. Unless otherwise indicated in the scheme, accept the best of two or more attempts – even when attempts have been cancelled.

9. The *same* error in the *same* section of a question is penalised *once* only.

10. Particular cases, verifications and answers derived from diagrams (unless requested) qualify for attempt marks at most.

11. A serious blunder, omission or misreading results in the attempt mark at most.

12. Do not penalise the use of a comma for a decimal point, e.g. €5.50 may be written as €5,50.

QUESTION 1

Part (a)	**10 marks**	**Att 3**
Part (b)	**25(10,5,10) marks**	**Att 3,2,3**
Part (c)	**15 (5,5,5)marks**	**Att 2,2,2**

Part (a) **10 marks** **Att 3**

Subtract 430 m from 6780 m and give your answer in km.

(a) **10 marks** **Att 3**

$6780 - 430$
$= 6350\text{m}$
$= \frac{6350}{1000}$
$= 6.35\text{km}$

Blunders (-3)

B1 Correct answer without work
B2 Incorrect conversion or no conversion
B3 Incorrect mathematical operation with work and continues correctly e.g. adds instead of subtracts.
B4 Decimal error
B5 6780 – 430 = 6350 = 6 km 350 m and stops.

Slips (-1)

S1 Numerical slips to a maximum of -3
S2 Leaves answer as $\frac{6350}{1000}$

Attempts (3 marks)

A1 Some correct step with work.
A2 Converts one or both to kilometres correctly and stops e.g. 6.78 km
A3 States 1000m = 1km and stops.
A4 Some correct effort at conversion and stops e.g. $\frac{430}{1000}$.
A5 6350 or 6km 350 m without work and stops
A6 $6780 - 430$ and stops.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

Part (b) **25 marks (10, 5, 10)** **Att 3, 2, 3**

Tara went by car from Dublin to Wexford, a journey of 150 kilometres.
Tara took 2 hours and 30 minutes to complete the journey.

(b)(i) **10 marks** **Att 3**

Tara left Dublin at 10:15. At what time did she arrive in Wexford?

(b)(i) **10 marks** **Att 3**

10:15 + 2:30

= 12:45

* Do not penalise the same error twice in part (b)

Blunders (-3)

B1 Correct answer without work
B2 Incorrect mathematical operation with work and continues.
B3 Error in converting hours / minutes or no conversion.
B4 Leaves answer as 10:15 + 2:30

Slips (-1)
S1 Numerical slips to a maximum of -3

Attempts (3 marks)
A1 Some correct step with work
A2 States 1 hour = 60 minutes and stops.

Worthless (0)
W1 Incorrect answer without work unless attempt mark applies.

(b)(ii) **5 marks** **Att 2**

Calculate the average speed, in km/h, for Tara's journey.

(b)(ii) **5 marks** **Att 2**

2h 30m = 2.5h

$$\text{Average Speed} = \frac{D}{T}$$

$$= \frac{150}{2.5}$$

$$= 60 \text{ km/h}$$

OR

2h 30m = 150 mins

$$\text{Average Speed} = \frac{D}{T}$$

$$= \frac{150}{150} \times 60$$

$$= 60 \text{ km/h}$$

* Accept ratio method.

Blunders (-3)

B1 Correct answer without work

B2 Incorrect relevant formula.

B3 Error in converting hours / minutes or no conversion (unless penalised in part (i)).

B4 No division.

B5 Decimal error

Slips (-1)

S1 Numerical slips to a maximum of -3

Attempts (2 marks)

A1 Some correct step with work e.g. 2 hours 30 minutes = 2.5 hours

A2 States 1 hour = 60 minutes and stops.

A3 Correct formula and stops.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

(b)(iii) **10 marks** **Att 3**

Tara's car emitted 19 500 grammes of carbon dioxide gas in travelling from Dublin to Wexford.
How many grammes of carbon dioxide did Tara's car emit for every kilometre travelled?

(b)(iii) **10 marks** **Att 3**

$$\frac{19500}{150}$$
$$= 130g$$

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation with work and continues.

B3 Leaves answer as $\frac{19500}{150}$

B4 Inverts fraction and continues.

Slips (-1)

S1 Numerical slips to a maximum of -3

Attempts (3 marks)

A1 Some correct step with work

A2 States 150 kilometres travelled.

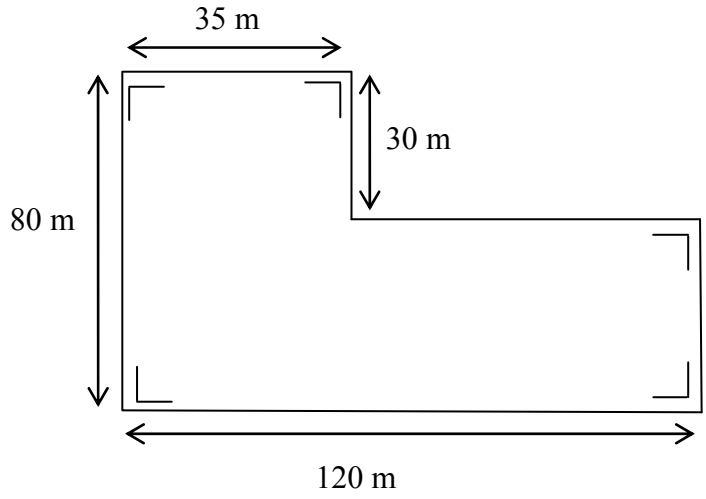
A3 Incorrect divisor e.g. $\frac{19500}{60}$, complete or incomplete.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

Part (c) **15 marks (5, 5, 5)** **Att (2, 2, 2)**

(c) A field has shape and measurements as shown in the diagram.



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

Find, in metres, the length of the perimeter of the field.

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

80 – 30 = 50; 120 – 35 = 85

P = 80 + 120 +50 + 85 +30 + 35 = 400 m

OR

2(80 + 120) = 400m

*Do not penalise the same error twice in part (c)

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation with work..

B3 Each measurement omitted or incorrect.

Slips (-1)

S1 Numerical slips to a maximum of -3.

S2 Leaves answer as 80 + 120 +50 + 85 +30 + 35

Attempts (2 marks)

A1 Some correct step with work and stops.

A2 Finds 50 and / or 85 and stops.

A3 Adds two of the given numbers correctly.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

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

Find, in m^2, the area of the field.

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

Small rectangle = $35 \times 30 = 1050$		$80 \times 120 = 9600$		$35 \times 80 = 2800$
Big rectangle = $50 \times 120 = 6000$	***OR***	$30 \times 85 = 2550$	***OR***	$85 \times 50 = 4250$
Total Area = $1050 + 6000$		$9600 - 2550$		$2800 + 4250$
$= 7050\ m^2$		$= 7050\ m^2$		$= 7050\ m^2$

* Accept candidates dimensions from part (i)

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation and continues.

Slips (-1)

S1 Numerical slips to a maximum of -3.

S2 Leaves answer as 1050 + 6000 or 2800 + 4250

Attempts (2 marks)

A1 Some correct step with work.

A2 Product of two relevant numbers and stops.

A3 Gets 1050 and/or 6000 with or without work and stops.

A4 Gets 9600 and/or 2550 with or without work and stops.

A5 Gets 2800 and / or 4250 with or without work and stops.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

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

Tim bought the field at a cost of €41 000 per hectare.
How much did Tim pay for the field?
[1 hectare = 10 000 m^2]

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

$7050\ m^2 = \frac{7050}{10000}\ ha$

$= .705$

cost = $.705 \times 41000$

= €28 905

* Accept candidates answer from part (ii).

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation and continues.

B3 Decimal error.

B4 Fails to convert to hectares or converts incorrectly.

Slips (-1)

S1 Numerical slips to a maximum of -3

S2 Early round off.

Attempts (2 marks)

A1 Some correct step with work.

A2 Gets 0.705 and stops.

A3 Writes 7050 and stops.

Worthless (0)

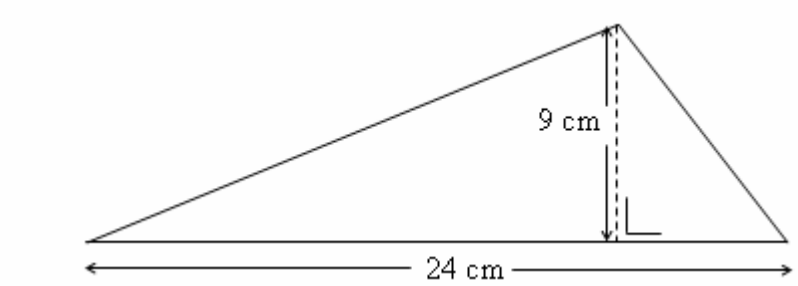
W1 Incorrect answer without work unless attempt mark applies.

QUESTION 2

Part (a)	**10 marks**	**Att 3**
Part (b)	**25(10,10,5) marks**	**Att 3,3,2**
Part (c)	**15(5,10) marks**	**Att 2,3**

Part (a) **10 marks** **Att 3**

A triangle has measurements as shown in the diagram.



Find, in cm^2, the area of the triangle

(a) **10 marks** **Att 3**

Area = $\frac{1}{2}$ base.height

$= \frac{1}{2} \times 24 \times 9$

$= 108 \text{ cm}^2$

Blunders (-3)

B1 Correct answer without work

B2 Incorrect substitution and continues correctly

B3 Mathematical error

B4 Incorrect relevant formula and continues e.g. $24 \times 9 = 216$

Slips (-1)

S1 Numerical slips to a maximum of -3

Attempts (3 marks)

A1 Some correct step with work and stops

A2 Area = $\frac{1}{2}$ base.height or similar and stops.

A3 Writes $\frac{1}{2} \times 24$ or $\frac{1}{2} \times 9$ and stops.

A4 Writes 24 + 9 = 33.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

Part (b) **25(10,10,5) marks** **Att 3, 3, 2**

A bicycle wheel has a diameter of 60 cm. .

(b)(i) **10 marks** **Att 3**

Calculate, in cm, the radius of the bicycle wheel.

(b)(i) **10 marks** **Att 3**

Radius $= \frac{1}{2} \times 60$

$= 30\,\text{cm}$

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation and continues.

Slips (-1)

S1 Numerical slips to a maximum of -3

Attempts (3 marks)

A1 Some correct step with work and stops.

A2 Writes Radius = $\frac{1}{2}$ of diameter and stops.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

(b)(ii) **10 marks** **Att 3**

Taking π as 3·142 calculate, in cm, the circumference of the bicycle wheel.

(b)(ii) **10 marks** **Att 3**

Circumference $= 2\pi r$

$= 2 \times 3.142 \times 30$

$= 188.52$ cm

* Accept candidates answer from part (i).

Blunders (-3)

B1 Correct answer without work

B2 Mathematical error

B3 Incorrect relevant formula and continues e.g πr^2 or πr

B4 Incorrect mathematical operation and continues

B5 Decimal error.

B6 $\pi \neq 3.142$ or answer in terms of π

Slips (-1)

S1 Numerical slips to a maximum of -3

Attempts (3 marks)

A1 Some correct step with work and stops.

A2 Correct formula and stops.

A3 Product of two relevant numbers and stops.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

(b)(iii) **5 marks** **Att 2**

How far does the bicycle travel when the wheel makes 340 complete turns?
Give your answer to the nearest metre.

(b)(iii) **5 marks** **Att 2**

Distance Travelled = 188.52×340

$= 64096.8$ cm

$= \frac{64096.8}{100}$

$= 640.968$ m

$= 641$ m

* Accept candidates answer from part (ii).

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation and continues .

B3 Decimal error

B4 Fails to convert to metres.

Slips (-1)

S1 Numerical slips to a maximum of -3

S2 Early round off

S3 Fails to round off to nearest metre.

Attempts (2 marks)

A1 Some correct step with work and stops.

A2 Writes 340×188.52 and stops.

A3 Converts 188.52 to metres and stops.

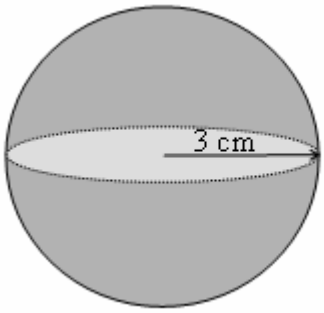
A4 Writes 100cm = 1m and stops

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

Part (c) **15(5,10) marks** **Att 2, 3**

A solid metal sphere has a radius 3 cm



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

Taking π as 3·142 find, in cm^3, the volume of the solid metal sphere.

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

$$\text{Volume} = \frac{4}{3}\pi r^3$$
$$= \frac{4}{3} \times 3.142 \times 3^3$$
$$= \frac{4}{3} \times 3.142 \times 27$$
$$= 113.112 \text{ cm}^3$$

*Accept $\frac{4}{8}\pi r^3$ for volume of sphere.

Blunders (-3)

B1 Correct answer without work

B2 Incorrect substitution and continues.

B3 Mathematical error e.g. $3^3 = 9$

B4 Incorrect relevant formula and continues e.g. multiples of πr^3 or πr^2 .

B5 Decimal error.

B6 $\pi \neq 3.142$ or answer in terms of π

Slips (-1)

S1 Numerical slips to a maximum of -3

Attempts (2 marks)

A1 Some correct step with work and stops e.g. correct formula

A2 π omitted with or without work.

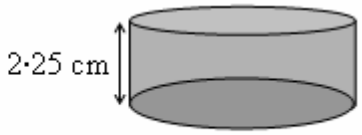
A3 Product of two relevant numbers and stops e.g. $3.142 \times 3 = 9.426$

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

(c)(ii) **10 marks** **Att 3**

The solid metal sphere was melted down and a quarter of the metal was recast to form a cylinder of height 2·25 cm. Taking π as 3·142 calculate, in cm, the radius of this cylinder.



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

✍	$\frac{1}{4}\times 113.112$	=	28.278
	$\pi r^2 h$	=	28.278
	$3.142r^2 \times 2.25$	=	28.278
	r^2	=	$\frac{28.278}{3.142\times 2.25}$
	r^2	=	4
	r	=	2 cm or $\sqrt{4}$

* Accept candidates answer from part (i)

Blunders (-3)

B1 Correct answer without work ✍
B2 Incorrect mathematical operation and continues e.g $4\times 113.112 = 452.448$
B3 Incorrect substitution and continues.
B4 Incorrect relevant formula and continues.
B5 Decimal error.
B6 $\pi \neq 3.142$
B7 Incorrect or no square root.

Slips (-1)
S1 Numerical slips to a maximum of -3
S2 Early round off.

Attempts (3 marks)
A1 Some correct step with work and stops
A2 Writes 113.112 or candidates answer from part (i).
A3 Correct formula and stops.
A4 Writes 28.278 or $\frac{1}{4}\times$ the candidates answer from part (i) with or without work.

Worthless (0)
W1 Incorrect answer without work unless attempt mark applies.

QUESTION 3

Part (a)	**10 marks**	**Att 3**
Part (b)	**20(10, 5, 5) marks**	**Att 3,2,2**
Part (c)	**20 (5,10,5)marks**	**Att 2,3,2**

Part (a) **10 marks** **Att 3**

Find the mean of the numbers 0·2, 4·6, 8·3, 10·2 and 11·7

Part (a) **10 marks** **Att 3**

$0.2 + 4.6 + 8.3 + 10.2 + 11.7 = 35$

$$\frac{0\cdot2 + 4\cdot6 + 8\cdot3 + 10\cdot2 + 11\cdot7}{5}$$

$$= \frac{35}{5}$$

Mean $= 7$

Blunders (-3)

B1 Correct answer without work

B2 Multiplies instead of adds.

B3 Decimal error.

B4 Incorrect divisor.

B5 Omits a value each time.

B6 Inverted fraction.

Slips (-1)

S1 Numerical slips to a maximum of -3

S2 $\frac{35}{5}$ and stops.

Attempts (3 marks)

A1 Some correct step and stops.

A2 Writes 0.2 + 4.6 + 8.3 + 10.2 + 11.7 and stops

A3 Partial addition with work and stops.

A4 Idea of mean indicated e.g. $\frac{\sum x}{n}$ or a verbal description.

A5 States median is 8.3 and stops

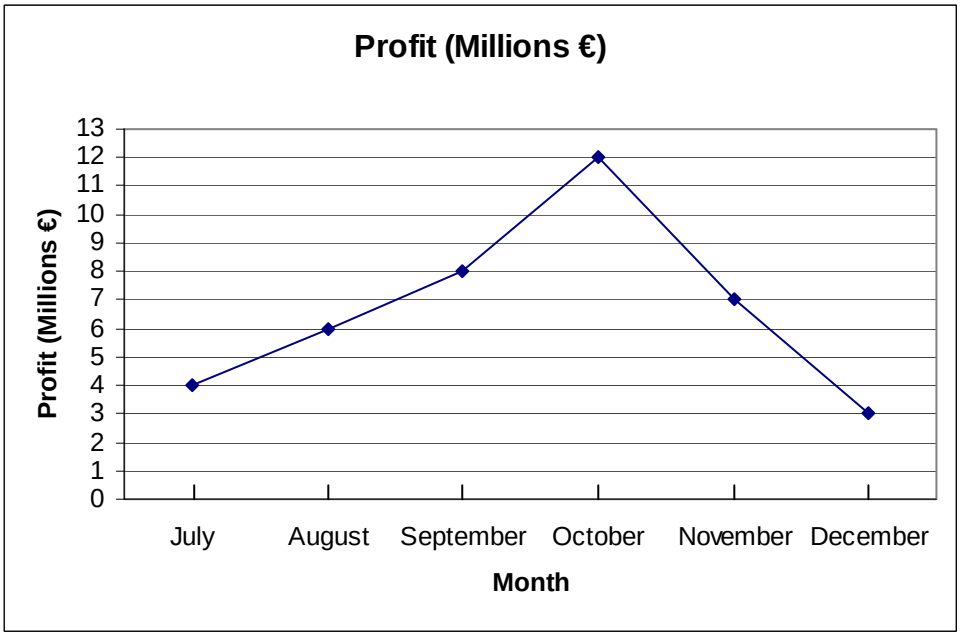
A6 35 or 5 without work.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

Part (b) **20 (10, 5, 5)marks** **Att 3, 2, 2**

The trend graph shows the profit, in millions of euro, made by a company during the last six months of last year



Use the trend graph to answer the following questions

(b)(i) **10 marks** **Att 3**

In which month did the company make the lowest profit?

(b)(i) **10 marks** **Att 3**

December

* Accept correct answer without work.

Attempts (3 marks)

A1 Writes July, August, September, October or November.

A2 Writes 3 as the answer.

(b)(ii) **5 marks** **Att 2**

What was the total profit, in millions of euro, made by the company in the given six months?

4 + 6 + 8 + 12 + 7 + 3

= 40 *or* €40 million

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation.

Slips (-1)
S1 Numerical slips to a maximum of -3
S2 Omits an entry or includes an incorrect entry in the addition (each time).

Attempts (2 marks)
A1 Some correct step and stops.
A2 Writes one of the relevant figures and stops.

Worthless (0)
W1 Incorrect answer without work unless attempt mark applies.

(b)(iii) **5 marks** **Att 2**

What percentage of the overall profit was made in July?

(b)(iii) **5 marks** **Att 2**

July = 4

$$\frac{4}{40}$$

$$\Rightarrow \frac{4}{40} \times 100$$

$$= 10\%$$

* Accept candidates answer in part (ii)

Blunders (-3)

B1 Correct answer without work
B2 Omits the 100 or divides by the 100
B3 Leaves answer as $\frac{4}{40} \times 100$
B4 Inverts the fraction.

Misreading (-1)
M1 Takes a correct profit for another month and continues.

Slips (-1)
S1 Numerical slips to a maximum of -3.

Attempts (2 marks)
A1 Some correct step with work and stops e.g. indicates the 100.
A2 Writes 4, 6, 8, 12, 7, 3, 0r 40 and stops.

Worthless (0)
W1 Incorrect answer without work unless attempt mark applies.

Part (c) **20(5,10,5) marks** **Att 2, 3, 2**

The highest temperatures, in degrees Centigrade,
of each of the days in June, 2006, were:

18°C	18°C	20°C	19°C	20°C	19°C
19°C	18°C	18°C	19°C	18°C	21°C
20°C	22°C	20°C	22°C	21°C	20°C
18°C	19°C	19°C	20°C	22°C	19°C
18°C	18°C	19°C	18°C	22°C	21°C

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

Complete the following frequency table:

Temperature °C	18	19	20	21	22
Number of Days					

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

Temperature °C	18	19	20	21	22
Number of Days	**9**	**8**	**6**	**3**	**4**

* Accept correct answer with no work shown
* Hit or miss; 1mark per correct entry.

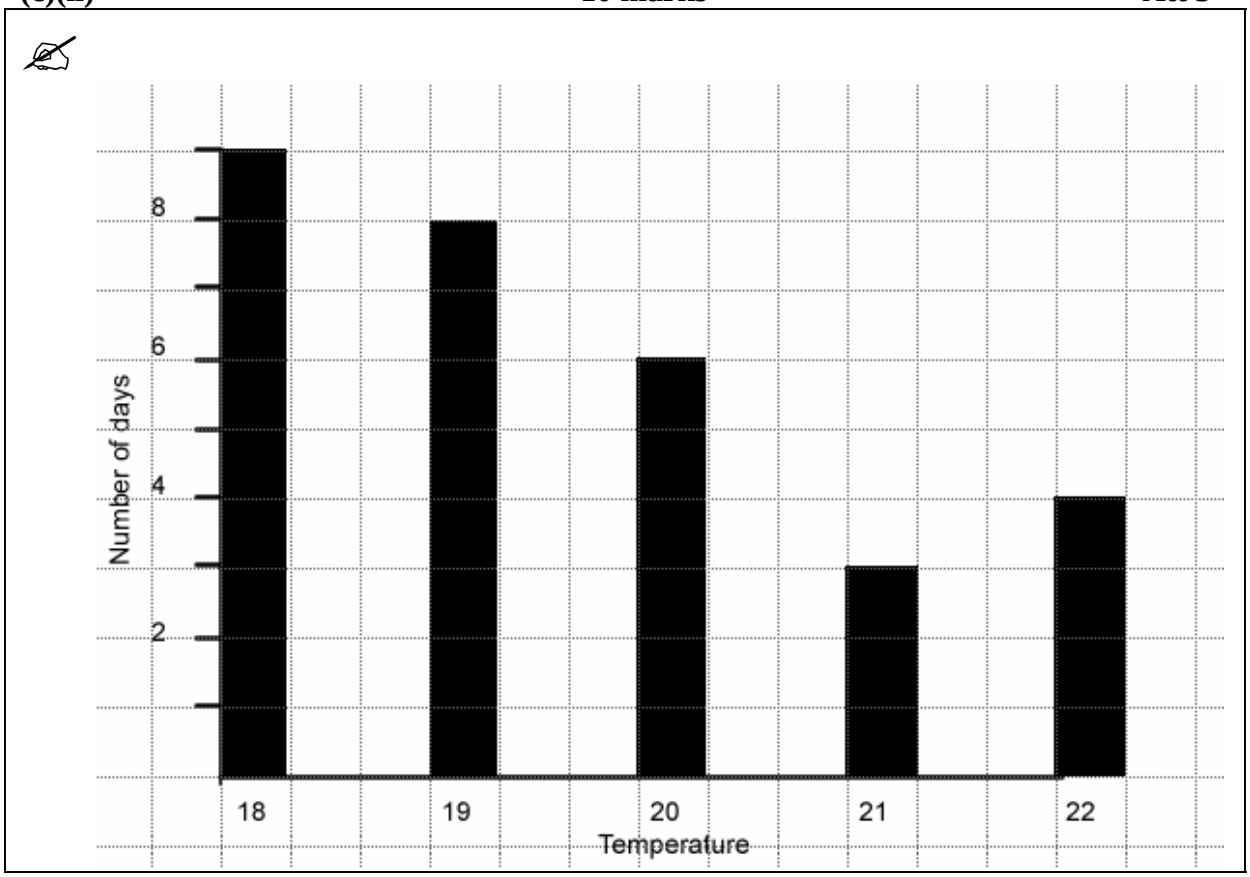
Attempts (2 marks)
A1 One correct entry only

Worthless (0)
W1 Table in question reproduced merits zero marks.

(c)(ii) **10 marks** **Att 3**

Draw a bar chart of the data

(c)(ii) **10 marks** **Att 3**



* Accept correct graph with no labels.
* Accept horizontal or vertical bar chart
* Accept bars of unequal widths or bars joined as a histogram
* Accept lines as bars

Blunders (-3)
B1 Axis with number of days not graduated uniformly.
B2 Reverse variable and frequency when drawn.
B3 Draws a trend graph or pie chart.

Slips (-1)
S1 Each incorrect bar or bar omitted to a max of -3.

Attempts (3 marks)
A1 Graduated axis or axes only.

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

Calculate the mean daily temperature for the month of June, 2006

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$= \frac{(18\times 9)+(19\times 8)+(20\times 6)+(21\times 3)+(22\times 4)}{9+8+6+3+4}$$

$$= \frac{162+152+120+63+88}{30}$$

$$= \frac{585}{30}$$

$$= 19.5$$

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation in numerator or denominator.

B3 Incorrect denominator or no denominator e.g. $\frac{585}{10}$

B4 Inverted fraction.

B5 Frequencies omitted in numerator

B6 Omits 2 or more values in numerator.

Slips (-1)

S1 Numerical slips to a maximum of -3.

S2 $\frac{585}{30}$ and stops.

S3 Omits one value in numerator with work.

Attempts (2 marks)

A1 Some correct step with work and stops e.g. $9+8+6+3+4$ and/or 30.

A2 Mean = $\frac{\sum fx}{\sum f}$ and stops.

A3 A relevant multiplication and stops.

A4 Average of the frequencies e.g. $\frac{9+8+6+3+4}{5}=\frac{30}{5}$

A5 $\frac{18+19+20+21+22}{5}=\frac{100}{5}$.

A6 585 or 30 without work.

A7 Indicates addition of any numbers from data in part (i) e.g. 18 + 18

Worthless (0)

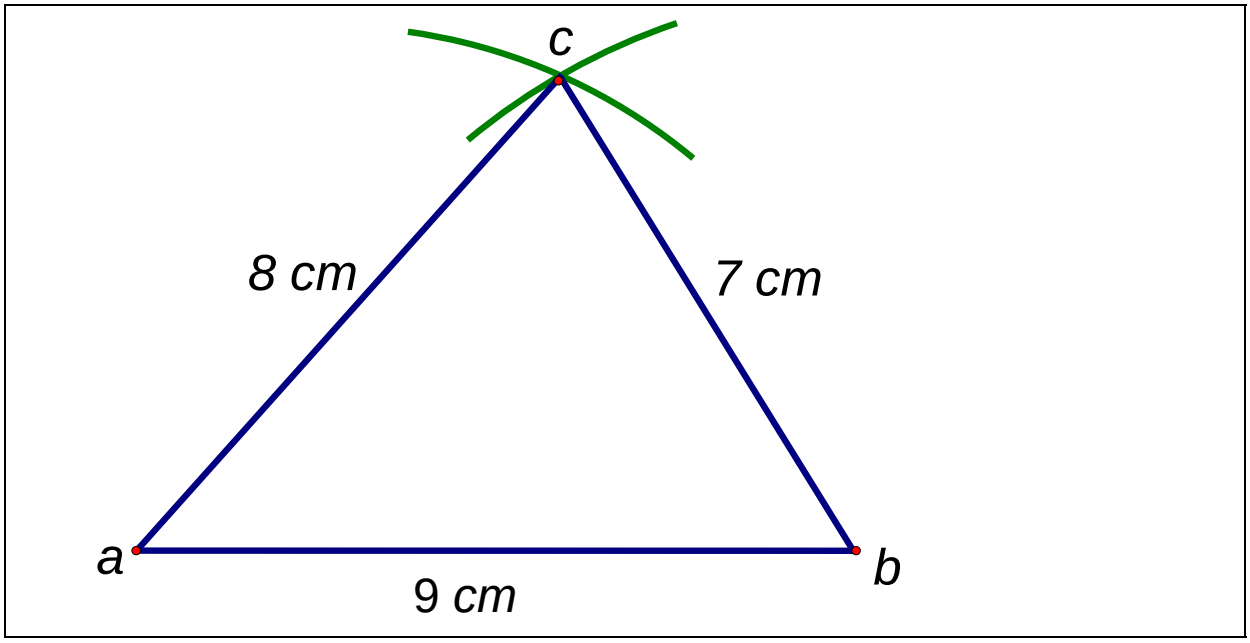
W1 Incorrect answer without work unless attempt mark applies.

QUESTION 4

Part (a)	**10 marks**	**Att 3**
Part (b)	**15(5, 5, 5) marks**	**Att 2,2,2**
Part (c)	**25(5,10,10) marks**	**Att 2,3,3**

Part (a) **10 marks** **Att 3**

Construct a triangle *abc* with $|ab| = 9$ cm, $|ac| = 8$ cm and $|bc| = 7$ cm.
Label your diagram clearly



* Accept base other than [ab]
* Tolerance of ± 2 mm on each side.
*Examiners must measure candidates work.

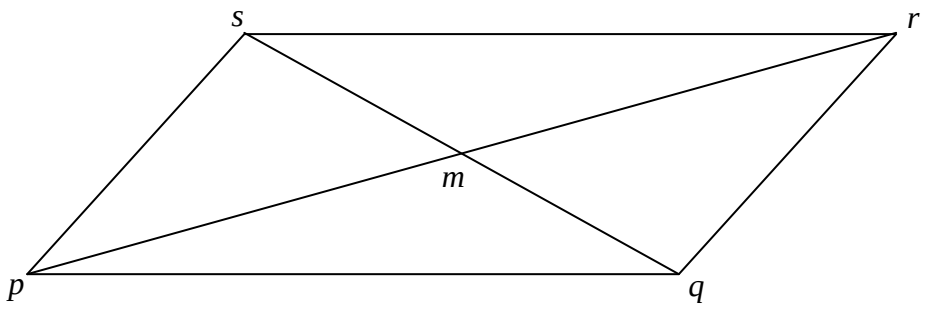
Blunders (-3)
B1 Incorrect length of first two sides drawn each time.
B2 Failure to complete the triangle.

Slips (-1)
S1 No labels or incorrect labels on the diagram.
S2 Units other than centimetres
.

Attempts (3 marks)
A1 Pilot diagram drawn
A2 Draws a line segment of the correct length, labelled or unlabelled.
A3 Draws a labelled line segment [ab] or [ac] or [bc] of any length.

Part (b) **15(5, 5, 5) marks** **Att 2, 2, 2**

pqrs is a parallelogram.
The diagonals [*sq*] and [*pr*] intersect at *m*



(b)(i) **5 marks** **Att 2**

The Δpqr has area 18 cm^2

Write down the area of the parallelogram *pqrs*

Give a reason for your answer

(b)(i) **5 marks** **Att 2**

Area of the parallelogram *pqrs* = 36 cm^2

Reason: Diagonal bisects area of parallelogram

* Accept correct answer without work

Blunders (-3)

B1 Area = $n \times 18, n \neq 2$ e.g. $4 \times 18 = 72$ or $\frac{1}{2} \times 18 = 9$

Slips (-1)

S1 Numerical slips to a maximum of -3.
S2 Correct answer without a reason or with an incorrect reason.

Attempts (2 marks)

A1 Reason only given
A2 Correct area formula for triangle or parallelogram.
A3 States opposite sides / angles of a parallelogram are equal in measure.

Worthless (0)

W1 Incorrect answer without work unless attempt mark or B1 applies.
W2 Diagram reproduced without modification.

(b)(ii) **5 marks** **Att 2**

Given that $|pr| = 10{\cdot}6$ cm, find $|mr|$.

Give a reason for your answer.

(b)(ii) **5 marks** **Att 2**

$$|mr| = \frac{10.6}{2} = 5.3 \text{ cm}$$

Reason: Diagonals of a parallelogram bisect each other.

* Accept correct answer marked / indicated on a diagram
* Accept correct answer without work

Blunders (-3)

B1 $|mr| = \frac{10.6}{n}, n \neq 2$

B2 Incorrect Mathematical operation

Slips (-1)

S1 Numerical slips to a maximum of -3.

S2 Correct answer without a reason or with an incorrect reason

Attempts (2 marks)

A1 Reason only

A2 Any mention of congruence.

A3 Writes $|pm| = |mr|$ and stops.

A4 Writes $|mr| = \frac{1}{2}|pr|$

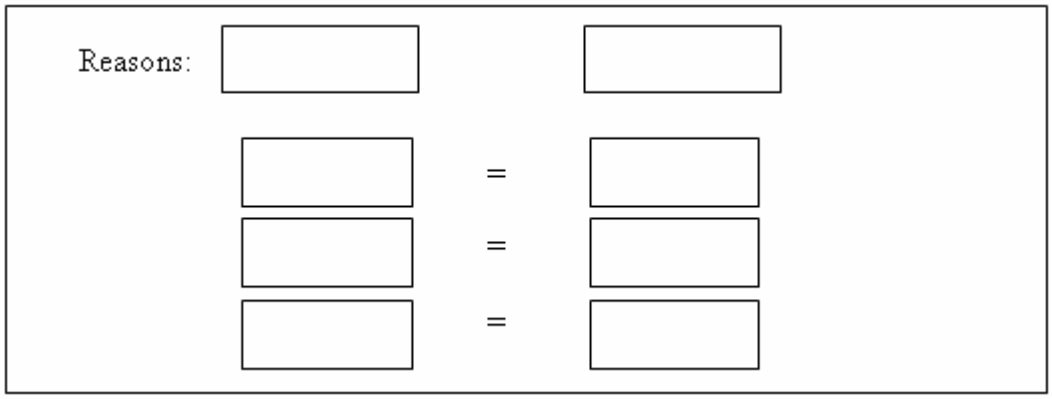
Worthless (0)

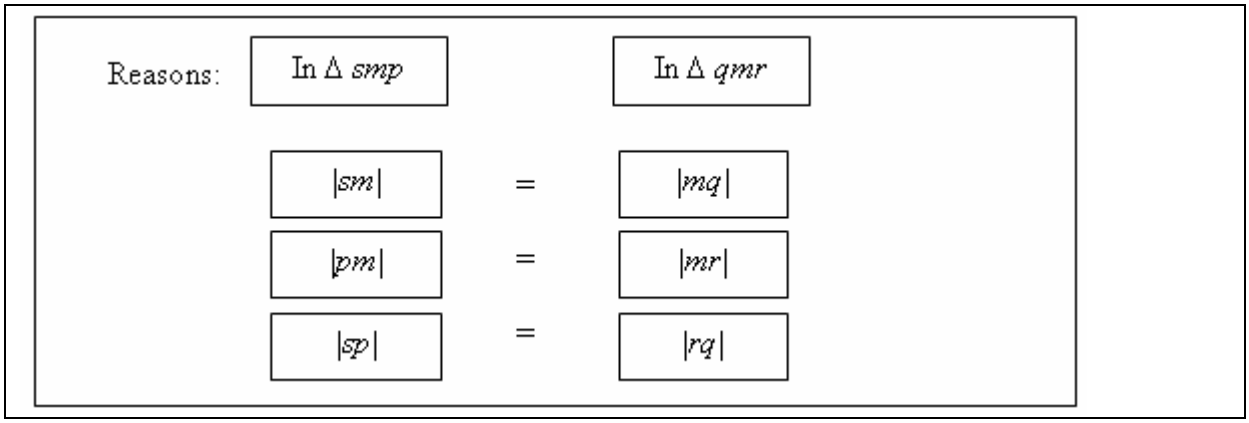
W1 Incorrect answer without work unless attempt mark or B1 applies.

W2 Diagram reproduced without modification.

(b)(iii) **5 marks** **Att 2**

Complete the following reasons for the fact that the triangles
$\Delta\ smp$ and $\Delta\ qmr$ are congruent





*Accept correct answer marked or indicated on a diagram
*Accept other correct reasons

Blunders (-3)
B1 Each step omitted

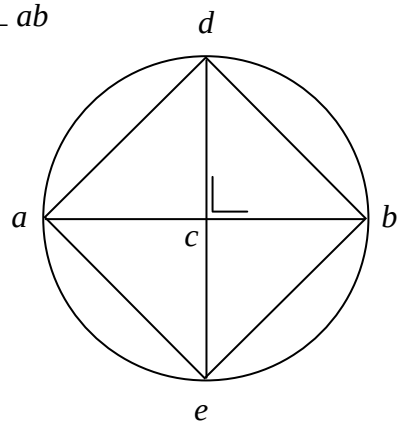
Attempts (2 marks)
A1 Some correct step with work and stops .
A2 States same shape or SSS or ASA or SAS.
A3 States triangles fold onto each other.
A4 Clearly indicates the two required triangle in the answer box for this part.

Worthless (0)
W1 Incorrect answer without work unless attempt mark applies.
W2 Diagram reproduced without modification.

Part (c) **25 (5,10,10)marks** **Att 2, 3, 3**

[*ab*] and [*de*] are diameters of a circle with centre c. $de \perp ab$

.



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

Name the image of the Δ *dbc* under S_c, the central symmetry in the point *c*

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

Δace

* Accept Δace with points in any order.
* Accept $d \to e$, $b \to a$ and $c \to c$.
* Accept diagram with correct indication / shading.

Blunders (-3)
B1 Each point whose image is not found (or incorrectly found).

Attempts (2 marks)
A1 Some correct step with work and stops.
A2 Shows some knowledge of central symmetry and stops.
A3 States that the image is a triangle.
A4 Finds the image of one or two points correctly e.g. $d \to e$ or $bc \to ac$
A5 If *a*, *c* or *e* appears in any group of letters.

Worthless (0)
W1 Diagram reproduced without modification.

(c)(ii) **10 marks** **Att 3**

Write down $|\angle cdb|$. Give a reason for your answer.

(c)(ii) **10 marks** **Att 3**

$|\angle cdb| = 45°$

Reason: Δcdb isosceles or $|cb| = |cd|$

or $|\angle cdb| = |\angle cbd|$

*Accept correct answer without work.

* Accept correct answer marked or indicated on a diagram.

Blunders (-3)

B1 Sum of angles in a triangle $\neq 180°$

B2 Transposition error.

B3 Takes an arbitrary angle for $|\angle cbd|$ and continues.

Slips (-1)

S1 Numerical slips to a maximum of -3.

S2 Correct answer without a reason or with an incorrect reason.

Attempts (3 marks)

A1 Some correct step with work and stops.

A2 Writes down $|\angle dcb| = 90°$.

A3 Writes down Δcbd is isosceles.

A4 Writes down $|cb| = |cd|$ and / or $|\angle cdb| = |\angle cbd|$

A5 Reason only given.

A6 States *"sum of the three angles in a triangle = 180"* or similar and stops.

A7 180 – 90 = 90 and stops.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies

W2 Diagram reproduced without modification.

(c)(iii) **10 marks** **Att 3**

Given that $|ab|$ = 10 cm, use the Theorem of Pythagoras to find $|db|$

(c)(iii) **10 marks** **Att 3**

$|ab| = 10 \Rightarrow |cb|$ and $|cd| = 5$

$\|cb\|^2 + \|cd\|^2 = \|db\|^2$	or	$\|ab\|^2 = \|ad\|^2 + \|db\|^2$
$5^2 + 5^2 = \|db\|^2$		$100 = \|db\|^2 + \|db\|^2$
$50 = \|db\|^2$		$50 = \|db\|^2$
7.07 or $\sqrt{50} = \|db\|$		7.07 or $\sqrt{50} = \|db\|$

* Accept correct answer without work

Blunders (-3)

B1 Mathematical error $5^2 = 10$

B2 Incorrect Theorem of Pythagoras.

B3 Error in manipulation of equation.

B4 Takes an arbitrary figure for $|ad|$ or similar and continues.

B5 Takes $|cb|$ or $|cd|$ as 10

Slips (-1)

S1 Numerical slips to a maximum of -3.

S2 Fails to write $\sqrt{50}$ and gives answer as 7.

Attempts (3 marks)

A1 Some correct step with work and stops.

A2 States Theorem of Pythagoras.

A3 States $|cb| = 5$ and stops.

A4 5^2 or 10^2 and stops.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies

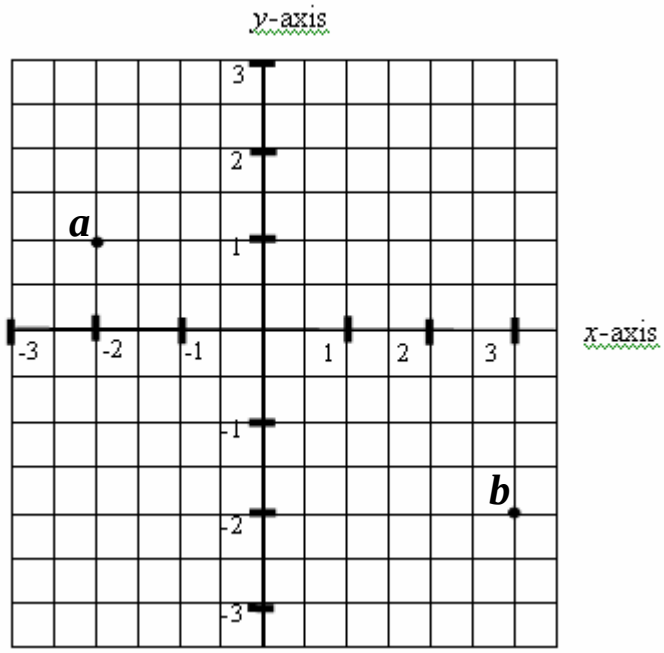
QUESTION 5

Part (a)	**10 marks**	**Att 3**
Part (b)	**25(10,10,5) marks**	**Att 3,3,2**
Part (c)	**15(10,5) marks**	**Att 3,2**

Part (a) **10 marks** **Att 3**

a is the point (-2, 1)
b is the point (3, -2)
Plot the points *a* and *b.*

(a) **10 marks** **Att 3**



* Accept correct answer without work.

Blunders (-3)
B1 Correctly plots and labels one point.
B2 Plots incorrect order of both couples – penalise once

Misreading (-1 marks)
M1 Each sign incorrect

Slips (-1)
S1 Fails to label points (each time)

Attempts (3 marks)
A1 Some correct step and stops e.g. Writes $x = -2$ and / or $y = 1$ for point *a* or similar.
A2 Plots (-2,0) and / or (0,1) for point *a* or similar.
A3 Picks a random point and plots it correctly

Worthless (0)
W1 Random point selected and plotted incorrectly.
W2 Diagram reproduced without modification.

Part (b) **25 (10, 10, 5)marks** **Att 3, 3, 2**

p is the point (5, 3) and *q* is the point (-3, 1). Find each of the following

(b)(i) **10 marks** **Att 3**

the slope of *pq*

(b)(i) **10 marks** **Att 3**

$\left(\frac{3-1}{5--3}\right)=\frac{2}{8}$ or $\frac{1}{4}$ or 0.25 **OR** $\left(\frac{1-3}{-3-5}\right)=\frac{-2}{-8}$ or $\frac{1}{4}$ or 0.25

* Accept candidates midpoint as a point for finding the slope.

* Accept correct trigonometric method i.e. $\tan\theta=\frac{1}{4}$.

Blunders (-3)

B1 Correct answer without work .

B2 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 $\frac{x_1-y_1}{x_2-y_2}$ or $\frac{horizontal}{vertical}$ or $\tan\theta=\frac{adjacent}{opposite}$ and continues.

B3 Incorrectly treats couples as (x_1,x_2) and (y_1,y_2)

B4 Mathematical error e.g. sign rules.

B5 Uses one of the given points and some arbitrary point e.g. (5,3) and (0,0) and continues.

B6 Error in more than one sign when substituting.

Misreading (-1)

M1 Use of points in part (a)

Slips (-1)

S1 Numerical slips 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 for substituting.

Attempts (3 marks)

A1 Some correct step with work and stops.

A2 $\tan\theta=\frac{opposite}{adjacent}$ or $m=\frac{vertical}{horizontal}$ and stops.

A3 Some correct substitution into formula with x_2-x_1 and / or y_2-y_1

A4 Points p and / or q plotted reasonably well for this part.

A5 Identifies (x_1,y_1) and / or (x_2,y_2) in this part.

Worthless (0)

W1 Use wrong formula e.g. midpoint formula.

W2 States given formula only.

(b) (ii) **10 marks** **Att 3**

(ii) the midpoint of $[pq]$

(b) (ii) **10 marks** **Att 3**

$(\frac{5-3}{2}, \frac{3+1}{2})$

$= (\frac{2}{2}, \frac{4}{2})$

$= (1,2)$

* Accept translation method.

* No penalty on brackets.

Blunders (-3)

B1 Correct answer without work

B2 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 $\left(\frac{x_1 + x_2}{2} + \frac{y_1 + y_2}{2}\right)$ or omits the divisor 2 and continues.

B3 Incorrectly treats couples as (x_1, x_2) and (y_1, y_2) if not already penalised.

B4 Two or more signs incorrect in substitution and continues.

B5 Reversal of coordinates i.e. (2,1) with work.

B6 One ordinate only worked out correctly.

B7 Uses one of the given points and some arbitrary point e.g. (5,3) and (0,0) and continues.

B8 Mathematical error e.g. sign rules

Slips (-1)

S1 Numerical slips to a maximum of -3.

S2 Error in one sign in midpoint formula and continues.

S3 One incorrect substitution or sign when substituting e.g. $\left(\frac{5-3}{2}, \frac{3-1}{2}\right)$ and continues

S4 Takes (5,3) as midpoint and finds extremity e.g. $(-3,1) \rightarrow (5,3) \rightarrow (13,5)$ or takes (-3,1) as midpoint and finds extremity e.g. $(5,3) \rightarrow (-3,1) \rightarrow (-11,-1)$

Attempts (3 marks)

A1 Some correct substitution

A2 Correct midpoint indicated on graph and not named (if named B1 applies)

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

A4 Identifies (x_1, y_1) and/or (x_2, y_2) (for this part).

Worthless (0)

W1 Use wrong formula e.g. slope or distance formula.

W2 Writes midpoint formula and stops.

(b) (iii) **5 marks** **Att 2**

✍ **(iii)** the length of $[pq]$

(b) (iii) **5 marks** **Att 2**

$\lvert pq\rvert$	=	$\sqrt{(5--3)^2+(3-1)^2}$	$\lvert pq\rvert$	=	$\sqrt{(-3-5)^2+(1-3)^2}$
	=	$\sqrt{(8)^2+(2)^2}$		=	$\sqrt{(-8)^2+(-2)^2}$
	=	$\sqrt{(64+4)}$		=	$\sqrt{(64+4)}$
	=	$\sqrt{68}$ or 8.24		=	$\sqrt{68}$ or 8.24

* Accept correct use of Pythagoras.

Blunders (-3)

B1 Correct answer without work. ✍

B2 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 square root sign or squares and continues.

B3 Incorrectly treats couples as (x_1, x_2) and (y_1, y_2) if not already penalised.

B4 Mathematical error e.g. $8^2 = 16$

B5 Two or more signs in substitution.

B6 No square root included with substitution and continues correctly to get 68.

Slips (-1)

S1 Numerical slips 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.

S4 If the square root sign is included with the substitution and omitted in the answer of 68.

Attempts (2 marks)

A1 Some correct step with work.

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

A3 States theorem of Pythagoras and stops.

A4 Point p and or q plotted reasonably well (for this part)

A5 Identifies (x_1, y_1) and/or (x_2, y_2) (for this part).

Worthless (0 marks)

W1 Use of wrong formula e.g. midpoint formula.

W2 Incorrect answer without work unless attempt mark applies .

Part (c) **15(10, 5) marks** **Att 3, 2**

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

The line *K* contains the point (-1, 6)
K has a slope of 2.
Find the equation of K.

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

$y - y_1 = m(x - x_1)$
$y - 6 = 2(x - -1)$

* $6 - y = 2(-1 - x)$ or similar merits full marks.

Blunders (-3)

B1 Correct answer without work.
B2 Incorrect formula e.g. $y + y_1 = m(x + x_1)$ or $(x - x_1) = m(y - y_1)$ and continues.
B3 Switches *x* and *y* e.g. $y - -1 = 2(x - 6)$
B4 Mathematical error.
B5 $y = 2(x + c)$ and stops
B6 Uses a point other than (-1,6) e.g. (0,0).
B7 $m \neq 2$

Slips (-1)
S1 Numerical slips to a maximum of -3.
S2 Error in one sign in formula.
S3 One incorrect substitution or sign when substituting.

Attempts (3 marks)
A1 Some correct step with work.
A2 Writes $m = 2$ and stops.
A3 States $y = mx \pm c$ and stops
.

Worthless (0 marks)
W1 Use of wrong formula
W2 States given formula only.

Note: If an error is made while attempting to simplify this equation, penalise in part (ii)

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

By letting $x = 0$, find the coordinates of *s,* the point of intersection of the line *K* and the *y*-axis.

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

$$\begin{aligned} y-6 &= 2(x+1) \\ y-6 &= 2(1) \\ y-6 &= 2 \\ y &= 2+6 \\ y &= 8 \end{aligned}$$

$s = (0,8)$

* Accept candidates answer from part (i)

* Accept answer given as $y = 8$ with work shown for full marks.

Blunders (-3)

B1 Correct answer without work.

B2 Substitutes $y = 0$ and continues.

B3 Mathematical error.

B4 Incorrect substitution and continues.

B5 Transposition error

Slips (-1)

S1 Numerical slips to a maximum of -3.

Attempts (2 marks)

A1 Some correct step with work and stops.

A2 Substitutes $y = 0$ and stops.

A3 Writes $y - 6 = 2(x + 1)$ and stops.

A4 Writes answer as (*0,y*) without work where *y* is an arbitrary number subject to B1.

Worthless (0)

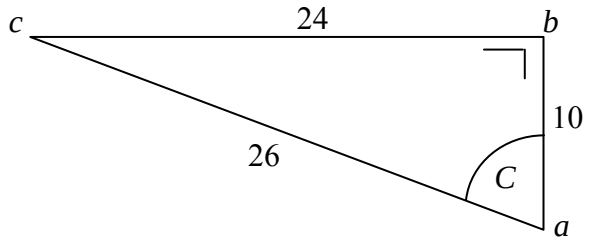
W1 Incorrect answer with no work unless attempt mark applies.

QUESTION 6

Part (a)	**15(10,5) marks**	**Att 3,2**
Part (b)	**20(5,10,5) marks**	**Att 2,3,2**
Part (c)	**15(5,10) marks**	**Att 2,3**

Part (a) **15(10,5) marks** **Att 3, 2**

The right-angled triangle *abc* has measurements as shown.



(a) (i) **10 marks** **Att 3**

Write down the length of the side opposite to the angle C

(a) (i) **10 marks** **Att 3**

Length of the side opposite to the angle C = 24

* Correct answer with no work merits full marks.
* Indicates 24 only in diagram, accept for 10 marks.

Blunders (-3 marks)
B1 Gives answer as [*bc*].

Attempts (3 marks)
A1 Any mention of a correct trigonometric ratio.
A2 Gives answer as 26 or 10.

Worthless (0)
W1 Incorrect answer with no work unless attempt mark applies.
W2 Gives more than one answer.
W3 Answer measured from examination paper.

(a) (ii) **5 marks** **Att 2**

Write down the value of tan C, as a fraction

(a) (ii) **5 marks** **Att 2**

$$\text{Tan C} = \frac{24}{10}$$

* Correct answer with no work merits full marks.
* Accept consistent error from part (i)
* Accept $\tan\frac{24}{10}$ for full marks.

Blunders (-3)

B1 Inverted or incorrect ratio e.g. $\tan C = \frac{10}{24}$ or $\frac{24}{26}$ or $\frac{10}{26}$

B2 Gets $\tan \angle acb$ (check is not consistent error from (i)).

Slips (-1)

S1 Answer = 2.4 (answer not a fraction)

Attempts (2 marks)

A1 Any correct trigonometric ratio written down in answer box.

A2 Only gives answer = $67.38°$ or rounded to $67°$ for this part.

A3 Only gives answer = 0.0419 i.e. $\tan\frac{24}{10}$

Worthless (0)

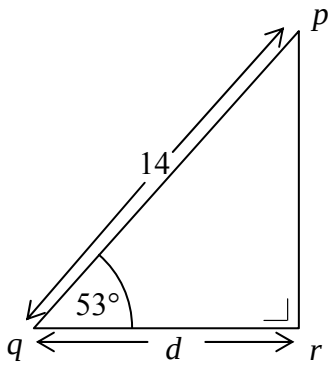
W1 Incorrect answer with no work unless attempt mark applies.

W2 Answer given as $\frac{26}{24}$ or $\frac{26}{10}$.

Part (b) **20 (5, 10, 5)marks** **Att 2, 3, 2**

6(b) In the right-angled triangle pqr,
$|pq| = 14$ and $|\angle pqr| = 53°$.

Let $|qr| = d$.



(b) (i) **5 marks** **Att 2**

Using the diagram write down the value of cos 53°, as a fraction

(b) (i) **5 marks** **Att 2**

$$\frac{d}{14}$$

* Correct answer with no work merits full marks.

* Accept $\cos\frac{d}{14}$ for full marks

Blunders (-3)

B1 Inverts the answer

B2 Gives the answer as 0.6018

B3 Correct sin or tan ratio given.

Attempts (2 marks)

A1 Writes $\frac{qr}{pq}$

A2 Any correct trigonometric ratio written down.

Worthless (0)

W1 Incorrect answer with no work unless attempt mark applies.

(b) (ii) **10 marks** **Att 3**

Using your calculator, or otherwise, write down the value of cos 53° correct to one decimal place.

(b) (ii) **10 marks** **Att 3**

$\cos 53° = 0.6018 = 0.6$

* Correct answer with no work merits full marks.

* Accept cos 0.6 for full marks.

Blunders (-3)

B1 Writes $\cos 37 = 0.7986$ as the answer.

B2 Finds $\sin 53$ or $\tan 53$ and continues.

B3 $\cos 53 = \frac{d}{14}$ and stops or $\frac{d}{14}$ on it's own.

B4 Uses Radian or Grad mode on the calculator.

	RAD	GRAD
Cos 53	-0.9182	0.6730

Slips (-1 marks)

S1 Failure to round off or rounds off incorrectly.

Attempts (3 marks)

A1 Writes $\cos 53 = \frac{qr}{pq}$ or $\frac{qr}{pq}$ and stops.

A2 Any correct trigonometric ratio written down.

A3 $\sin 37 = 0.549$ $\tan 37 = 0.6568$ → Grad mode

or

$\sin 37 = -0.6435$ $\tan 37 = -0.8407$ → Rad mode.

Worthless (0)

W1 Incorrect answer with no work unless attempt mark applies.

W2 0.549 or similar on its own (must be in format given in A3 to merit marks)

(b) (iii) **5 marks** **Att 2**

Hence find d, the value of $|qr|$

(b) (iii) **5 marks** **Att 2**

$$\frac{d}{14} = 0.6 \Rightarrow$$
$$d = 14 \times 0.6$$
$$= 8.4$$

* Accept candidates answers from parts (i) and (ii).

Blunders (-3)

B1 Correct answer without work.

B2 Error in forming equation e.g. $\frac{14}{d} = 0.6$ and continues

B3 Error in manipulation of equation.

B4 Writes $\frac{d}{14} = 0.7986$ or 0.8 and continues i.e. $\cos 37$

	RAD	GRAD
Cos 53	-0.9182	0.6730

B5 Uses Radian or Grad mode on calculator unless already penalised in part (ii).

Slips (-1 marks)

S1 Numerical slips to a maximum of -3.

Attempts (2 marks)

A1 Any correct step with work and stops e.g. $\frac{x}{14}$ or $\frac{14}{x}$

A2 Correct scale diagram.

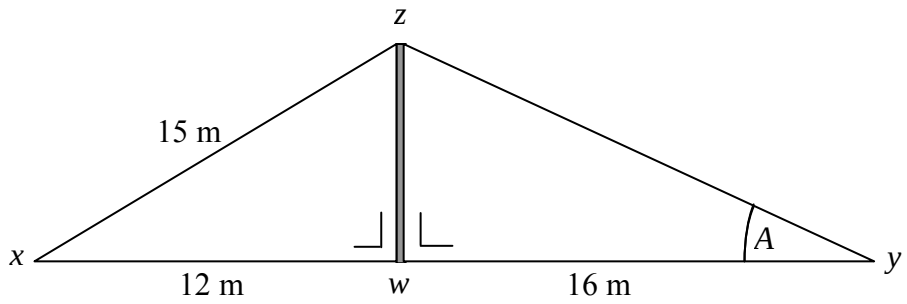
A3 $\cos 53$ or 0.6 or any trigonometric ratio.

Worthless (0)

W1 Incorrect answer with no work unless attempt mark applies.

W2 Answer = 3.5cm (measured from examination paper)

Part (c) **15 (5, 10)marks** **Att 2, 3**



$[zw]$ is a vertical television aerial mast
$[zx]$ and $[zy]$ are supporting cables.
$|zx| = 15$ m, $|xw| = 12$ m and $|wy| = 16$ m

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

(i) In $\Delta\, xwz$, use the Theorem of Pythagoras, to find $|zw|$
the height of the television aerial mast.

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

$(12)^2 + |wz|^2 = (15)^2$

$144 + |wz|^2 = 225$

$|wz|^2 = 225 - 144$
$= 81$
$|wz| = 9$ or $\sqrt{81}$

* Accept $|wz|$ found correctly using a correct trigonometric ratio method for full marks.

Blunders (-3)

B1 Correct answer without work
B2 Incorrect theorem of Pythagoras and continues.
B3 Mathematical error e.g. $12^2 = 24$
B4 Error in manipulation of equation.
B5 Stops at $|wz|^2 = 81$

Slips (-1 marks)
S1 Numerical slips to a maximum of -3.

Attempts (2 marks)
A1 Some correct step with work and stops e.g. 12^2 or writes 90° for $\angle W$ on diagram.
A2 States theorem of Pythagoras and stops.
A3 Correct Sin, Cos or Tan ratio written down and stops.
A4 Labels correctly the hypotenuse e.g. h=15.

Worthless (0)
W1 Incorrect answer with no work unless attempt mark applies e.g. 144.
W2 $15 - 12 = 3$ or $15 + 12 = 27$.
W3 Answer = 2.8cm (measured from examination paper)

(c) (ii) **10 marks** **Att 3**

Hence find the measure of the angle marked A in the diagram correct to the nearest degree

(c) (ii) **10 marks** **Att 3**

$$\tan A = \frac{9}{16}$$
$$= 0.5625$$
$$A = 29.357°$$
$$A = 29°$$

* Accept candidates answer from part (i).

Blunders (-3)

B1 Correct answer without work
B2 Incorrect trigonometric ratio.
B3 Decimal error.
B4 Mathematical error.
B5 Uses radian or grad mode on calculator.
B6 Error in manipulation of equation.

Misreading (-1 marks)

M1 Finds $|\angle yzw|$ correctly.

Slips (-1 marks)

S1 Numerical slips 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 Some correct step with work and stops e.g. Sine rule stated.
A2 Any correct trigonometric ratio written down.
A3 Correct scale diagram.
A4 States 180 with or without work.

Worthless (0)

W1 Incorrect answer with no work unless attempt mark applies.

BONUS MARKS FOR ANSWERING THROUGH IRISH

Bonus marks are applied separately to each paper as follows:

If the mark achieved is 225 or less, the bonus is 5% of the mark obtained, rounded ***down***.
(e.g. 198 marks × 5% = 9.9 ⇒ bonus = 9 marks.)

If the mark awarded is above 225, the following table applies:

Bunmharc (Marks obtained)	Marc Bónais (Bonus Mark)	Bunmharc (Marks obtained)	Marc Bónais (Bonus Mark)
226	11	261 – 266	5
227 – 233	10	267 – 273	4
234 – 240	9	274 – 280	3
241 – 246	8	281 – 286	2
247 – 253	7	287 – 293	1
254 – 260	6	294 – 300	0