MARKING SCHEME
JUNIOR CERTIFICATE EXAMINATION 2007
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)	**20 marks**	**Att 7**
Part (c)	**20 marks**	**Att 8**

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

One lap of a running track measures 440 m. James runs 50 laps of that track.
What distance, in kilometres, does James run?

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

$440 \times 50 = 22{,}000\,\text{m}$

$$\frac{22000}{1000}$$

$= 22$ km

* Accept "," for decimal point if used throughout the paper.

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 multiplies.
B4 Decimal error

Slips (-1)

S1 Numerical slips to a maximum of -3
S2 Leaves answer as $\frac{22000}{1000}$

Attempts (3 marks)

A1 Some correct step with work
A2 Converts to kilometres correctly and stops e.g. 0.440 km
A3 States 1000m = 1km and stops
A4 Some correct effort at conversion e.g. $\frac{50}{1000}$.
A5 22000 without work and stops
A6 440×50 and stops

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

Part (b) **20 marks (10, 5, 5)** **Att 7 (3, 2, 2)**

Aoife books a flight from Cork to London. The plane is due to leave Cork at 18:25 and to arrive in London 1 hour and 20 minutes later.

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

At what time should the plane arrive in London?

$18:25+1:20=19:45$

* Accept answer in twelve hour clock format.

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation with work and continues.

B3 Correctly adds an arbitrary time to 18 : 25 with work.

B4 Incorrectly converts to a twelve hour format and continues.

Slips (-1)

S1 Numerical slips to a maximum of -3

S2 Leaves answer as $18:25+1:20$

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**

On the day of her flight the departure time was delayed by 25 minutes but the flight time was 6 minutes less than expected. At what time did the plane land in London?

$18 : 25 + 0 : 25 + 1 : 20 - 0 : 06 = 20 : 04$

Or

$19 : 45 + 0 : 25 - 0 : 06 = 20 : 04$

* Accept candidates answer in part (i)
* Accept answer in twelve hour clock format.

Blunders (-3)

B1 Correct answer without work 
B2 Incorrect mathematical operation with work and continues.
B3 Error in converting hours to minutes or no conversion (unless penalised in part (i)).

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

Attempts (2 marks)
A1 Some correct step with work e.g. $25 - 6 = 19$
A2 States 1 hour = 60 minutes and stops.

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

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

Aoife's fare for the flight was €48.
Excess hand baggage was charged at the rate of €3·50 per kg.
Aoife had 5·6 kg of excess hand baggage.
Find the total cost of Aoife's flight.

Cost of hand baggage = $5 \cdot 6 \times 3 \cdot 50 = €19 \cdot 60$

Total Cost = $48 + 19 \cdot 60$
= €67·60

Blunders (-3)

B1 Correct answer without work
B2 Incorrect mathematical operation with work and continues.
B3 Decimal error

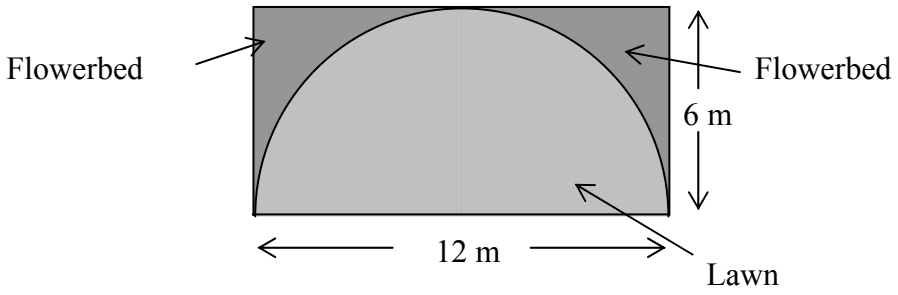
Slips (-1)
S1 Numerical slips to a maximum of -3
S2 Leaves as $48 + 19 \cdot 60$

Attempts (2 marks)
A1 Some correct step with work e.g. $5 \cdot 6 \times 3 \cdot 5$ and stops.
A2 Answer given as €48 and stops
A3 Answer given as 19·60 with or without work.

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

Part (c) **20 marks (5, 5, 5, 5)** **Att 8 (2, 2, 2, 2)**

A garden with a semicircular lawn and two flowerbeds has measurements as shown in the diagram.



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

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

Area = $6 \times 12 = 72\,m^2$

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation with work and continues

B3 Incorrect relevant formula e.g. $\frac{1}{2}(6 \times 12) = 36$

B4 Incorrect substitution and continues

B5 $6^2 \times 12^2 = 5184$

Slips (-1)

S1 Numerical slips to a maximum of -3

S2 Leaves answer as 6×12

Attempts (2 marks)

A1 Some correct step with work.

A2 Finds perimeter of part or whole correctly or incorrectly with work shown e.g. $6 + 6 = 12$

A3 Correct formula for area and stops e.g. Area = L × W

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

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

Taking π as 3·14, find the area of the lawn, in m^2.

$$\begin{aligned} \text{Area of lawn} &= \tfrac{1}{2} \times \pi r^2 \\ &= \tfrac{1}{2} \times 3 \cdot 14 \times 6 \times 6 \\ &= \tfrac{1}{2} \times 113 \cdot 04 \\ &= 56 \cdot 52 \ m^2 \end{aligned}$$

Blunders (-3)

B1 Correct answer without work

B2 Incorrect relevant formula and continues e.g. $2\pi r$ or πr^2

B3 Mathematical error e.g. $6^2 = 12$ and continues.

B4 Incorrect substitution and continues e.g. $r = 12$

B5 $\pi \neq 3 \cdot 14$ or answer given in terms of π

B6 Decimal error

Slips (-1)

S1 Numerical slips to a maximum of -3

S2 Leaves answer as $\tfrac{1}{2} \times 113 \cdot 04$

Attempts (2 marks)

A1 Some correct step with work.

A2 Product of two relevant numbers and stops

A3 Writes 6^2 and stops

A4 Correct formula for area of lawn and stops

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

W2 Incorrect formula without work

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

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

Area of flowerbeds $= 72 - 56 \cdot 52$
$= 15 \cdot 48\ m^2$

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

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation and continues.

B3 Decimal error

Slips (-1)

S1 Numerical slips to a maximum of -3

S2 Leaves answer as $72 - 56 \cdot 52$

Attempts (2 marks)

A1 Some correct step with work.

A2 Writes 72 and / or 56·52 and stops.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

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

Taking π as 3·14, find the total perimeter of the semicircular lawn, in m

$$\begin{aligned} \text{Total perimeter} &= 12 + \tfrac{1}{2} \times 2\pi r \\ &= 12 + \tfrac{1}{2} \times 2 \times 3 \cdot 14 \times 6 \\ &= 12 + 18 \cdot 84 \\ &= 30 \cdot 84 \text{ m} \end{aligned}$$

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation

B3 Decimal error

B4 Incorrect relevant formula and continues e.g. πr^2.

B5 $\pi \neq 3 \cdot 14$ or answer given in terms of π (unless penalised in (c)(ii)).

B6 Incorrect substitution and continues.

Slips (-1)

S1 Numerical slips to a maximum of -3

S2 Leaves answer as $12 + 18 \cdot 84$.

Attempts (2 marks)

A1 Some correct step with work.

A2 Correct formula for perimeter of semi-circle and stops

A3 Recognises 12 as part of the answer e.g. $12 + ...$ and stops or writes 12 on its own.

A4 A correct substitution and stops

A5 π omitted with some relevant work.

Worthless (0)

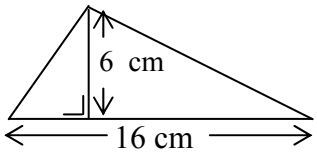
W1 Incorrect answer without work unless attempt mark applies.

QUESTION 2

Part (a)	**10 marks**	**Att 3**
Part (b)	**25 marks**	**Att 9**
Part (c)	**15 marks**	**Att 6**

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 = $\frac{1}{2} \times 16 \times 6 = 48\,cm^2$

Blunders (-3)

B1 Correct answer without work

B2 Incorrect substitution and continues correctly e.g. $\frac{1}{2} \times 6 \times 8 = 24$

B3 Mathematical error

B4 Incorrect relevant formula and continues e.g. $16 \times 6 = 96$

Slips (-1)

S1 Numerical slips to a maximum of -3

Attempts (3 marks)

A1 Some correct step with work and stops.

A2 Product of any two dimensions with the exception of 6 and 16.

A3 Area = $\frac{1}{2} \times base \times height$ or similar and stops.

A4 $\frac{1}{2} \times 16$ or $\frac{1}{2} \times 6$ and stops

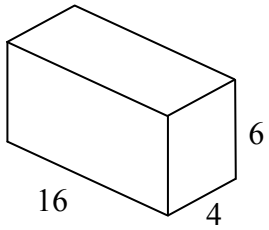
A5 Writes $16 + 6 = 22$

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

Part (b) **25 marks (15, 5, 5)** **Att 9 (5, 2, 2)**

A solid rectangular block of wood has length 16 cm, width 4 cm and height 6 cm.



(b)(i) **15 marks** **Att 5**

Find, in cm^3, the volume of the block of wood

Volume of block = $16 \times 4 \times 6 = 384\ cm^3$

Blunders (-3)

B1 Correct answer without work
B2 Incorrect substitution or omission or extra, each time and continues.
B3 Mathematical error
B4 Incorrect relevant formula and continues e.g. surface area and continues.
B5 Leaves answer as $16 \times 4 \times 6$

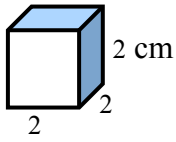
Slips (-1)
S1 Numerical slips to a maximum of -3

Attempts (5 marks)
A1 Some correct step with work and stops.
A2 Correct formula for volume of rectangular solid and stops
A3 Writes $16 + 4 + 6 = 26$

Worthless (0)
W1 Incorrect answer without work unless attempt mark applies.
W2 Use of formula involving π
W3 Writes $16 + 4 + 6$ and stops

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

Cubes with sides of length 2 cm, as shown, are made from the block of wood.
Find the number of cubes that can be made from the block of wood.



Volume of one cube	=	$2\times2\times2$	=	$8cm^3$
Volume of block			=	$384cm^3$
Number of cubes	=	$\frac{384}{8}$	=	48.

* Accept candidates answer from part (i).

Blunders (-3)

B1 Correct answer without work
B2 Incorrect substitution or omission or extra and continues.
B3 Mathematical error e.g. $2^3 = 6$
B4 Incorrect relevant formula and continues
B5 Incorrect mathematical operation e.g. 384×8

Slips (-1)
S1 Numerical slips to a maximum of -3
S2 Leaves answer as $\frac{384}{8}$

Attempts (2 marks)
A1 Some correct step with work and stops.
A2 Correct formula for volume of rectangular solid and stops
A3 Some correct substitution and stops
A4 Writes 384 or candidates answer from part (i) and stops
A5 Writes $2+2+2=6$ or $2\times2=4$ and stops

Worthless (0)
W1 Incorrect answer without work unless attempt mark applies.
W2 Use of formula involving π

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

Calculate, in cm^2, the surface area of the block of wood.

$$\begin{aligned} \text{Surface area} &= 2\times16\times4 + 2\times4\times6 + 2\times16\times6 \\ &= 128 + 48 + 192 \\ &= 368\ cm^2 \end{aligned}$$

Blunders (-3)

B1 Correct answer without work 
B2 Incorrect substitution or omission or extra and continues.
B3 Mathematical error
B4 Incorrect relevant formula and continues

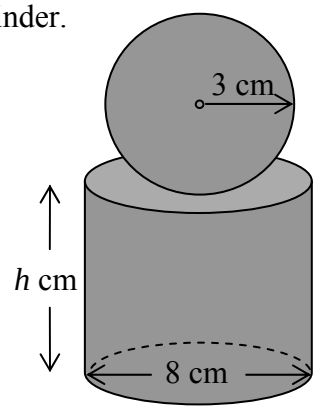
Slips (-1)
S1 Numerical slips to a maximum of -3
S2 Failure to add the three areas

Attempts (2 marks)
A1 Some correct step with work and stops e.g. 4×6
A2 Correct formula and stops
A3 Some correct substitution and stops
A4 Writes $16\times4\times6$ with or without an answer
A5 Finds surface area of the cube correctly with work

Worthless (0)
W1 Incorrect answer without work unless attempt mark applies
W2 Use of formula involving π

Part (c) **15 marks (5, 5, 5)** **Att 6 (2, 2, 2)**

A solid trophy, as shown, has a sphere mounted on top of a cylinder.
The radius of the sphere is 3 cm.



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

Find the volume of the sphere in terms of π.

$$\begin{aligned} \text{Volume} &= \tfrac{4}{3}\pi r^3 \\ &= \tfrac{4}{3}\times\pi\times 3\times 3\times 3 \\ &= 36\pi \text{ cm}^3 \end{aligned}$$

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

* Correct answer with no work merits full marks.

Blunders (-3)

B1 Incorrect substitution and continues.

B2 Mathematical error e.g. $r^3 = 9$

B3 Incorrect relevant formula and continues e.g. multiples of πr^3 or πr^2 with work

B4 Decimal error

Slips (-1)

S1 Numerical slips to a maximum of -3

S2 Answer not given in terms of π

Attempts (2 marks)

A1 Some correct step with work and stops.

A2 Product of two relevant numbers e.g. $3\cdot 14\times 3 = 9\cdot 42$

A3 Correct formula and stops

A4 Some correct substitution and stops.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

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

The cylinder in the trophy has a diameter of 8 cm and its volume is four times the volume of the sphere.
Find h, the height of cylinder in the trophy.

Volume of cylinder	=	$4 \times 36\pi$
$\pi r^2 h$	=	144π
$\pi \times 4 \times 4 \times h$	=	144π
$16h$	=	144
h	=	$\frac{144}{16}$
h	=	9 cm

* Accept candidates answer from part (i)

Blunders (-3)

B1 Correct answer without work
B2 Incorrect substitution and continues.
B3 Mathematical error
B4 Incorrect relevant formula and continues
B5 Decimal error

Slips (-1)
S1 Numerical slips to a maximum of -3
S2 $\frac{144}{16}$ and stops.

Attempts (2 marks)
A1 Some correct step with work and stops e.g. $4^2 = 16$ or $r = 4$
A2 Writes 36π or candidates answer from part (i) and stops.
A3 Correct formula and stops
A4 Some correct substitution and stops.
A5 Writes 144π or ($4\times$ candidates answer from part (i)) with or without work.

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

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

Find the total height of the trophy.

Total height = 9 + 6
= 15 cm

* Accept candidates answer from part (ii)

Blunders (-3)

B1 Correct answer without work

B2 Incorrect mathematical operation e.g. $9 \times 6 = 54$

B3 Uses radius instead of diameter for height of sphere

Slips (-1)

S1 Numerical slips to a maximum of -3

S2 $9 + 6$ and stops.

Attempts (2 marks)

A1 Some correct step with work and stops.

A2 Writes 9 or candidates answer from part (ii) or 6 without work.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

QUESTION 3

Part (a)	**5 marks**	**Att 2**
Part (b)	**25 marks**	**Att 8**
Part (c)	**20 marks**	**Att 7**

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

Find the mode of the numbers**:** 1, 4, 3, 4, 1, 4, 12, 4, 15, 4.

Mode = 4

* Accept correct answer without work.

Blunders (-3)

B1 Gives 5 as the mode

Attempts (2 marks)

A1 Writes "mode means most"

A2 Writes 1 + 4 + 3 + 4 + 1 + 4 + 12 + 4 + 15 + 4 and / or 52

A3 Writes $\frac{52}{10}$ and or 5·2

A4 Writes 10 or 5 and stops.

A5 Rearranges the numbers in order

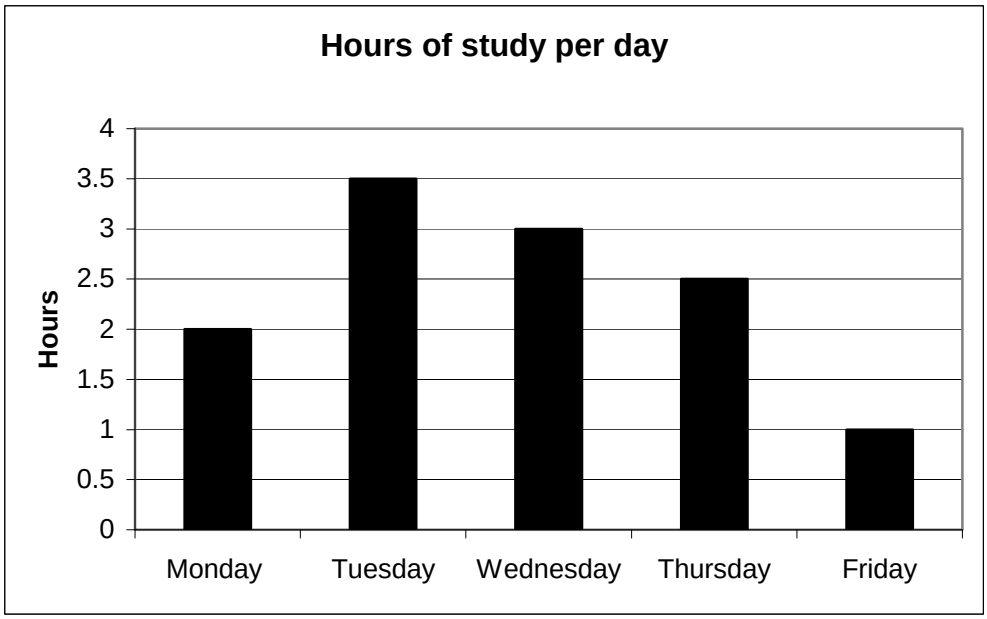
Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

W2 Just a list of numbers e.g. 4, 7, 5

Part (b) **25 marks (10, 10, 5)** **Att 8 (3, 3, 2)**

The bar chart shows the number of hours that Anne spent studying from Monday to Friday of a particular school week**.**



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

How many hours study did Anne do on the Monday of that week?

2 hours

* Accept correct answer without work.

Attempts (3 marks)
A1 Writes 3·5 or 3 or 2·5 or 1 as the answer

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

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

On what day of that week did Anne do the least study?

Friday

* Accept correct answer without work.

Attempts (3 marks)

A1 Tuesday

A2 Writes 3·5 or 1

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

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

Express the hours of study done by Anne on Wednesday as a percentage of her total hours of study for that week.

$2+3\cdot5+3+2\cdot5+1=12$

$\frac{3}{12}\times100=25\%$

Blunders (-3)

B1 Correct answer without work

B2 Omits the 100 or divides by the 100.

B3 Omits an entry or inserts an incorrect entry in the addition.

B4 Multiplies hours of study instead of adding them

B5 Leaves the answer as $\frac{3}{12}\times100$

Misreading (-1)

M1 Takes figure for a different day and continues e.g. $\frac{2}{12}\times100=16\frac{2}{3}\%$

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 any of the following numbers, 2, 3·5, 3, 2·5, 1, 12.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

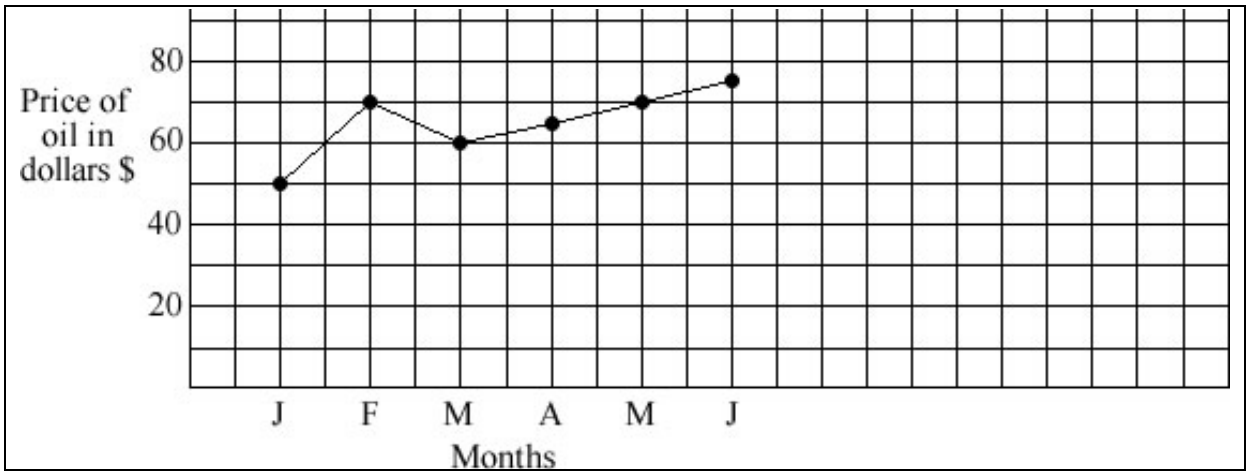
Part (c) **20 marks (10, 5, 5)** **Att 7 (3, 2, 2)**

The table shows the price in dollars of a barrel of crude oil for the first six months of 2006.

Month	January	February	March	April	May	June
Price	50	70	60	65	70	75

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

Draw a trend graph of the data, putting months on the horizontal axis.



* Accept correct graph with no labels.
* Be lenient with the plotting of points.

Blunders (-3)
B1 Axes not graduated uniformly (once).
B2 Points not joined or joined in incorrect order.
B3 Reorders months axis
B4 Axes reversed.
B5 Draws a bar or pie chart correctly.

Slips (-1)
S1 Each incorrect plot or point omitted

Attempts (3 marks)
A1 Graduated axis or axes or x and y axis only
A2 Plots only one point.

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

Calculate the mean price, in dollars, of a barrel of crude oil over this six-month period.

$$\frac{50+70+60+65+70+75}{6}=\frac{390}{6}=65$$

Blunders (-3)

B1 Correct answer without work

B2 Incorrect divisor

B3 Inverted fraction

B4 Multiplies instead of adding

Slips (-1)

S1 Numerical slips to a maximum of -3.

S2 $\frac{390}{6}$ and stops.

S3 Omits an entry or includes an incorrect entry in the addition (each time).

Attempts (2 marks)

A1 Some correct step with work and stops.

A2 Addition of data only

A3 Partial addition of data with work and stops

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

A5 States median is $67\cdot5$ or mode is 70 and stops.

A6 390 or 6 without work

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

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

The mean price of a barrel of crude oil for the first seven months of 2006 was 67 dollars.

Find the price of a barrel of such oil in July 2006.

✍

67×7	=	469		$390 + x$	=	469
65×6	=	390		x	=	$469 - 390$
					=	79
Price in July	=	$469 - 390$				
	=	79				

or

*Accept candidates answer from part (ii).

Blunders (-3)

B1 Correct answer without work ✍

B2 Incorrect mathematical operation

B3 Error in manipulation of equation

Slips (-1)

S1 Numerical slips to a maximum of -3.

S2 Omits an entry or includes an incorrect entry in the addition (each time).

S3 Writes $469 - 390$ and stops.

Attempts (2 marks)

A1 Some correct step with work and stops.

A2 Writes $50 + 70 + 60 + 65 + 70 + 75 + x$ and stops.

A3 Partial addition of data with work and stops

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

A5 Indicates subtraction i.e. $67 - 65 = 2$

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

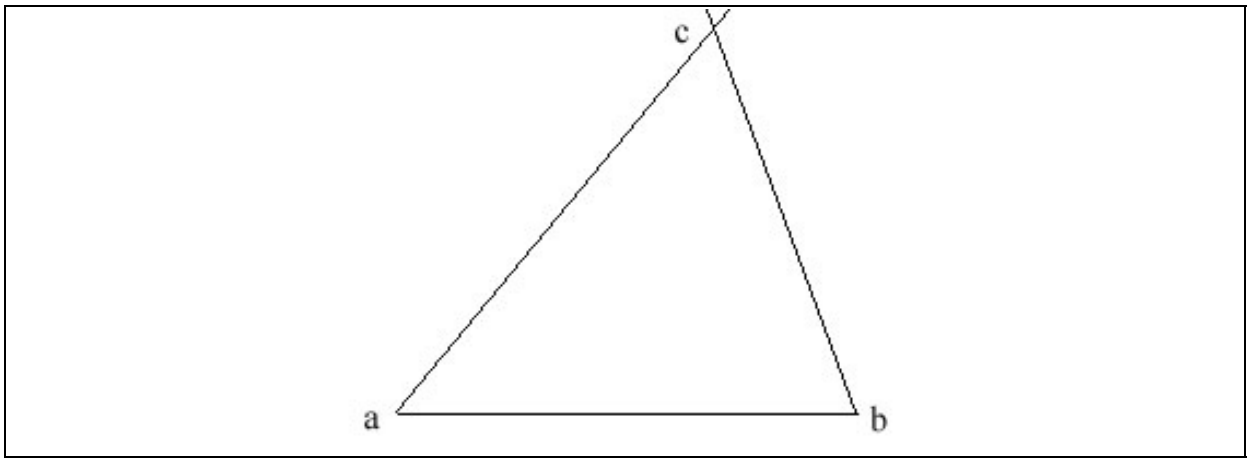
QUESTION 4

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

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

Construct a triangle *abc* with $|ab| = 6$ cm, $|\angle bac| = 50^o$ and $|\angle abc| = 70^o$

Label your diagram clearly.



* Accept base other than [ab]
* Tolerance of $\pm 2mm$ on the side and $\pm 5°$.
* Examiners must measure candidate's work.

Blunders (-3)

B1 Incorrect length of [*ab*] i.e. outside tolerance
B2 Each incorrect angle measurement i.e. outside tolerance
B3 Failure to complete the triangle

Slips (-1)

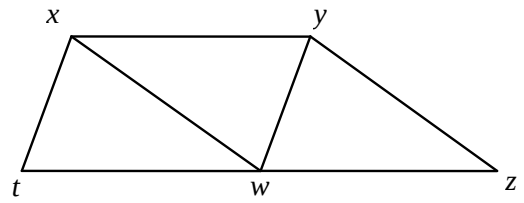
S1 No labels or incorrect labels on the diagram
S2 Units other than centimetres

Attempts (3 marks)

A1 Pilot diagram drawn
A2 Draws a line segment [*ab*] of 6 cm in length labelled or unlabelled **or** draws a labelled line segment [*ab*] of any length.
A3 Unlabelled angle of $50°$ or $70°$ drawn and stops

Part (b) **20 marks (5, 5, 5, 5)** **Att 8 (2, 2, 2, 2)**

xywt and *xyzw* are two parallelograms as shown in the diagram.



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

Name the image of the point *x* under the translation $\overrightarrow{tw}$.

Image of *x* = y

* Accept diagram with image point indicated
* Accept answer without work.

Misreading (-1)

M1 Image of x shown on an extended diagram under translation $\overrightarrow{wt}$

Attempts (2 marks)

A1 States $tw = xy$ or $tw \parallel xy$ or indicates either on a diagram.

A2 Shows some knowledge of the given translation and stops.

Worthless (0)

W1 Gives answer as *t* or *w* or *z* or *x*.

W2 Diagram reproduced without modification.

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

Name the image of [*wz*] under the translation $\overrightarrow{wx}$.

Image of [*wz*] = [*xy*]

* Accept line segment [*xy*] indicated on a diagram in appropriate answer box for this part.

* Accept the answer without work.

Blunders (-3)

B1 Line segment with either x or y correct e.g. [*xt*]

Misreading (-1)

M1 Image of [*wz*] shown on an extended diagram under the translation $\overrightarrow{xw}$.

Attempts (2 marks)

A1 Image of one point only found correctly.

A2 States *wz* || *xy* or $|wz| = |xy|$ or indicates either on a diagram reproduced for this part.

A3 Shows some knowledge of the given translation and stops.

Worthless (0)

W1 Gives answer as [*tw*]

W2 Diagram reproduced without modification.

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

Given that the area of $\Delta xtw = 5\ \text{cm}^2$, find the area of the figure *txyz*.

✍ Area = $3 \times 5 = 15\ \text{cm}^2$

Blunders (-3)

B1 Correct answer without work ✍

B2 Incorrect mathematical operation e.g. $5 + 3 = 8$

Slips (-1)

S1 Numerical slips to a maximum of -3.

S2 3×5 and stops.

Attempts (2 marks)

A1 Some correct step with work and stops

A2 States $\Delta xtw = \Delta xyw$ or similar.

A3 States the diagonal bisects the area of a parallelogram.

A4 Writes 5 in each of the triangles in the given diagram reproduced for this part and stops.

A5 Writes correct formula for area of triangle.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies.

W2 Diagram reproduced without modification.

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

Show that Δxyw and Δywz are congruent.

✍	$\lvert xy\rvert = \lvert wz\rvert$	or $\lvert\angle yxw\rvert = \lvert\angle yzw\rvert$	or $\lvert xy\rvert = \lvert wz\rvert$
	$\lvert yw\rvert = \lvert yw\rvert$ common side.	$\lvert xw\rvert = \lvert yz\rvert$	$\lvert\angle yxw\rvert = \lvert\angle yzw\rvert$
	$\lvert xw\rvert = \lvert yz\rvert$	$\lvert\angle ywx\rvert = \lvert\angle wyz\rvert$	$\lvert xw\rvert = \lvert yz\rvert$

* Accept correct answer marked or indicated on a diagram.

Blunders (-3)

B1 Each step omitted.

Attempts (2 marks)

A1 Some correct step.
A2 States same shape or SSS or ASA or SAS.
A3 States triangles fold onto each other.
A4 Clearly indicates the two required triangles in the answer box for this part.

Worthless (0)

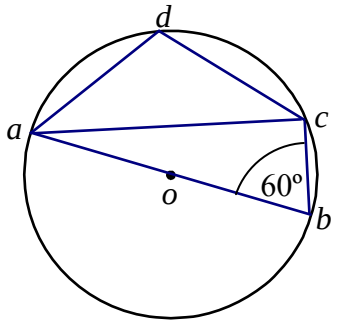
W1 Diagram reproduced without modification.

Part (c) **20 marks (5, 5, 5, 5)** **Att 8 (2, 2, 2, 2)**

[*ab*] is the diameter of a circle with centre *o*.

c and *d* are points on the circle.

$|\angle abc| = 60^o$.



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

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

$|\angle acb| = 90°$

Reason: Angle in a semi circle or an angle subtended by a diameter at the circumference

* Accept right angle marked or indicated on the diagram.

Slips (-1)

S1 Correct answer without a reason or with an incorrect reason.

Attempts (2 marks)

A1 States "angle at centre is twice the angle at circle standing on same arc" or similar and stops.

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

A3 States "sum of three angles in triangle = 180° " or similar.

A4 Clearly indicates $|\angle acb|$ on the diagram.

A5 Reason only given

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies e.g. $|\angle acb| = 30°$

W2 Diagram reproduced without modification.

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

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

$|\angle bac| = 30°$

Reason: The 3 angles in a triangle add up to $180°$ <u>or</u> $180 - 90 - 60 = 30°$

* Accept candidates answer from part (i).

Blunders (-3)

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

B2 Mathematical error.

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

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 Some correct step with work and stops.

A2 Writes down or indicates that $|\angle acb| = 90°$ for this part.

A3 Clearly indicates $\angle bac$ on diagram drawn in the answer box.

A4 States "sum of 3 angles in a triangle $= 180°$" or similar and stops.

A5 Writes $60 + 90$ and stops.

A6 $180 - 60$ or $180 - 90$ and stops.

A7 Reason only given.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies

W2 Diagram reproduced without modification.

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

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

$|\angle adc| = \quad 120°$

Reason: Opposite angles of a Cyclic quadrilateral add to 180°

or

$180 - 60 = 120°$

Blunders (-3)

B1 Use of $360°$ instead of $180°$.

B2 Mathematical error

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 Some correct step with work and stops.

A2 Reason only given.

A3 Clearly indicates $\angle adc$ on diagram reproduced in answer box.

A4 Some reference to $180°$ and stops.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies

W2 Diagram reproduced without modification.

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

Given that $|oa| = 2$ cm and $|bc| = 2$ cm, find $|ac|$.

Give your answer correct to one decimal place.

$\|ac\|^2 + \|cb\|^2$	=	$\|ab\|^2$
$\|ac\|^2 + 2^2$	=	4^2
$\|ac\|^2 + 4$	=	16
$\|ac\|^2$	=	12
$\|ac\|$	=	$\sqrt{12}$ or 3·46 = 3·5 cm

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

* Accept $|ac|$ found correctly by trigonometric ratio method for full marks.

Blunders (-3)

B1 Correct answer without work

B2 Mathematical error e.g. $4^2 = 8$

B3 Incorrect theorem of Pythagoras.

B4 Takes an arbitrary figure or 2 for $|ab|$ and continues.

B5 Error in manipulation of equation.

Slips (-1)

S1 Numerical slips to a maximum of -3.

S2 Fails to round off or rounds off incorrectly.

Attempts (2 marks)

A1 Some correct step with work and stops.

A2 States theorem of Pythagoras.

A3 States $|ab| = 4$ or indicates this on a reproduced diagram and stops.

A4 Marks $|bc| = 2$ and / or $|oa| = 2$ on a reproduced diagram and stops.

A5 2^2 and / or 4^2 and stops.

Worthless (0)

W1 Incorrect answer without work unless attempt mark applies e.g. 4

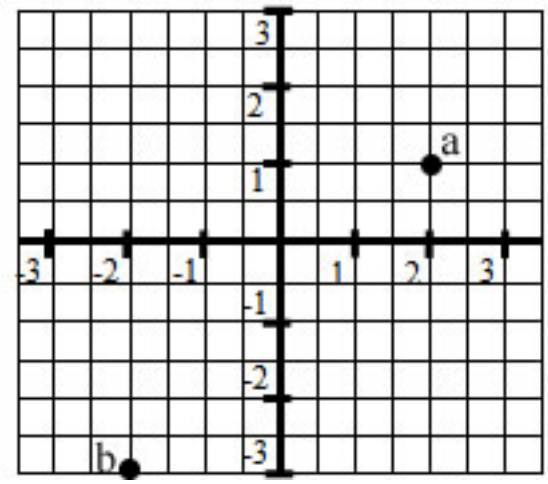
W2 $2 + 4 = 6$

QUESTION 5

Part (a)	**10 marks**	**Att 3**
Part (b)	**25 marks**	**Att 8**
Part (c)	**15 marks**	**Att 5**

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

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



* Accept correct answer without work.

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

Misreadings (-1)
M1 Plots (-2,3) or (2,-3) or similar.
M2 Plots (2,3) or similar. Penalise twice.

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

Attempts (3 marks)
A1 Some correct step and stops
A2 Plots (2,0) and / or (0,1) for point *a* or similar.
A3 Writes $x = 2$ and / or $y = 1$ for point *a* or similar.
A4 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 marks (10, 10, 5)** **Att 8 (3, 3, 2)**

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

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

the midpoint of $[pq]$

$$(\frac{3+5}{2},\frac{-3-1}{2})$$
$$=(\frac{8}{2},\frac{-4}{2})$$
$$=(4,-2)$$

* 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) and continues.

B4 Two or more signs incorrect in substitution and continues.

B5 Reversal of coordinates i.e. (-2,4) with work.

B6 One ordinate only worked out correctly.

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

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. $\left(\frac{-5+3}{2},\frac{-1-3}{2}\right)$ and continues

S4 Take (3,-3) as midpoint and finds extremity e.g. $(5,-1)\rightarrow(3,-3)\rightarrow(1,-5)$ or takes (5,-1) as midpoint and finds extremity e.g. $(3,-3)\rightarrow(5,-1)\rightarrow(7,1)$

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 Labels *p* and / or *q* with (x_1,y_1) and stops.

Worthless (0)

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

W2 Writes midpoint formula and stops.

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

(ii) the slope of *pq*

$\left(\frac{-3+1}{3-5}\right) = \frac{-2}{-2}$ or $\frac{2}{2}$ or 1

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

* Accept correct trigonometric method i.e. $\tan\theta = \frac{2}{2}$.

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) if not already penalised e.g. $\frac{3+3}{5+1}$ or $\frac{-3-3}{-1-5}$

B4 Mathematical error e.g. sign rules.

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

B6 Error in more than one sign when substituting.

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.

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

(iii) the equation of the line *pq*.

$(y+3) = 1(x-3)$ or $y+1 = 1(x-5)$ or $y+2 = 1(x-4)$

* Accept candidates slope from part (ii) and midpoint from part (i) if used.

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. $y - 3 = 1(x + 3)$

B4 Mathematical error.

B5 $y = 1(x + c)$ and stops

B6 Uses a point other than (3,-3) and (5,-1) or (4, -2) e.g. (0,0).

B7 $m \neq 1$

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 (2 marks)

A1 Some correct step with work.

A2 Writes $m = 1$ and stops.

A3 States $y = mx \pm c$ and stops

A4 $-1 + 3 = 1(5 - 3)$, substitutes both points.

Worthless (0 marks)

W1 Use of wrong formula

W2 States given formula only.

Note

$-3 - y_1 = 1(3 - x_1)$ or similar merits full marks.

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

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

K is the line $2x + 3y - 6 = 0$.
K cuts the *y*-axis at the point *r*.
By letting $x = 0$, find the co-ordinates of the point *r*.

$$2(0) + 3y - 6 = 0$$
$$3y = 6$$
$$y = \frac{6}{3}$$
$$y = 2$$

$r = (0,2)$

* Accept answer given as $y = 2$ 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.

Slips (-1)
S1 Numerical slips to a maximum of -3.
S2 $2(0) = 2$
S3 Stops at $\frac{6}{3}$ with work.

Attempts (3 marks)
A1 Some correct step with work and stops.
A2 Substitutes $x = 0$ and stops.
A3 Any correct manipulation of equation and stops e.g. $2x + 3y = 6$.
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.

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

Find the image of the point r under S_o,
the central symmetry in the origin, (0, 0).

$(0,2) \rightarrow (0,0) \rightarrow (0,-2)$

* Accept candidates answer from part (i)

Blunders (-3)

B1 Correct answer without work.

B2 Writes answer as (-2,0)

B3 Omits second ordinate.

Slips (-1)

S1 Numerical slips to a maximum of -3.

Attempts (2 marks)

A1 Some correct step with work and stops.

A2 Writes down (0,2) or candidates answer from part (i) and stops.

A3 Effort at finding graphically without naming image point.

A4 Plots (0,2) and / or (0,0) for this part.

A5 Effort at translation i.e. x remains unchanged, y goes down 4 or similar.

A6 Correctly finds only one ordinate.

Worthless (0)

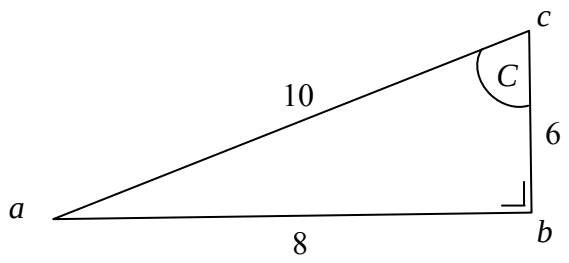
W1 Incorrect answer with no work unless attempt mark applies.

QUESTION 6

Part (a)	**15 marks**	**Att 5**
Part (b)	**20 marks**	**Att 7**
Part (c)	**15 marks**	**Att 5**

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

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



Part (a) (i) **10 Marks** **Att 3**

Write down the length of the hypotenuse of the Δabc.

Length of the hypotenuse of the $\Delta abc = 10$

* Correct answer with no work merits full marks.
* Indicates 10 only in diagram, or "h" or "hypotenuse", accept for 10 marks.

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

Attempts (3 marks)
A1 Any mention of a correct trigonometric ratio.
A2 Gives answer as 8 or 6

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

Part (a) (ii) **5 Marks** **Att 2**

Write down the value of cos C, as a fraction.

$\cos C = \frac{6}{10}$ or $\frac{3}{5}$

* Correct answer with no work merits full marks.
* Accept consistent error from part (i)
* Accept $\cos\frac{6}{10}$ for full marks.

Blunders (-3)

B1 Incorrect or inverted ratio e.g. $\cos C = \frac{10}{6}$.

B2 Gets $\cos \angle bac$ (check is not consistent error from (i)).

Slips (-1)

S1 Answer = 0.6 (answer not a fraction)

Attempts (2 marks)

A1 Any correct trigonometric ratio written down in answer box.

A2 Only gives answer = $53 \cdot 13°$ or rounded to $53°$ for this part.

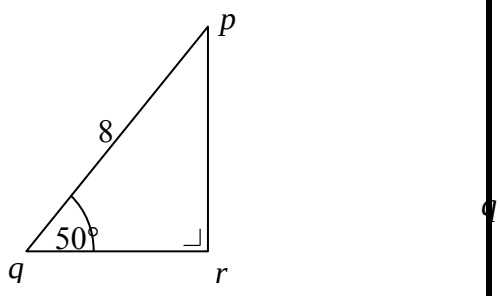
A3 Only gives answer = 0·9999 i.e. $\cos\frac{6}{10}$

Worthless (0)

W1 Incorrect answer with no work unless attempt mark applies.

Part (b) **20 marks (10, 5, 5)** **Att 7 (3, 2, 2)**

6(b) In the right-angled triangle pqr, $|pq| = 8$ and $|\angle pqr| = 50°$.



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

Find $|\angle qpr|$.

$|\angle qpr| = 180 - 90 - 50 = 40°$

* Correct answer with no work merits full marks.

Blunders (-3)

B1 Three angles of a triangle $\neq 180°$

B2 Fails to subtract one of the angles e.g. $180 - 50 = 130°$

B3 Mathematical error.

Slips (-1)

S1 Numerical slips to a maximum of -3.

Attempts (3 marks)

A1 Writes "3 angles in a triangle add up to 180" and stops.

A2 Writes $|\angle prq| = 90°$ or correctly writes the $90°$ angle on the diagram and stops.

A3 Any correct trigonometric ratio written down.

A4 Clearly indicates $\angle qpr$ on the diagram

Worthless (0)

W1 Incorrect answer with no work unless attempt mark applies.

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

(ii) Using your calculator, or otherwise, write down the value of $\sin |\angle qpr|$ correct to two decimal places.

$\sin |\angle qpr| = 0.64$

* Correct answer with no work merits full marks.
* Accept candidates answer from part (i).
* Accept sin 0·64 for full marks.

Blunders (-3)

B1 Writes $\sin 50 = 0 \cdot 77$ or 0·766 as the answer.

B2 Finds $\tan 40$ or $\cos 40$ and continues.

B3 $\sin 40 = \frac{qr}{8}$ and stops or $\frac{qr}{8}$ on it's own.

B4 Uses Radian or Grad mode on the calculator.

	RAD	GRAD
Sin 40	0·75	0·59

Slips (-1 marks)

S1 Failure to round off or rounds off incorrectly.

Attempts (2 marks)

A1 Writes $\sin 40 = \frac{qr}{qp}$ or $\frac{qr}{qp}$ and stops.

A2 Any correct trigonometric ratio written down.

A3 Correctly marks the hypotenuse or opposite or adjacent on a diagram reproduced and stops, for this part.

A4 $\cos 50 = 0 \cdot 71$ $\tan 50 = 1$ → Grad mode

<u>or</u>

$\cos 50 = 0 \cdot 96$ $\tan 50 = -0.27$ → Rad mode.

Worthless (0)

W1 Incorrect answer with no work unless attempt mark applies.

W2 0·71 or similar on its own (must be in format given in A4 to merit marks)

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

Hence, or otherwise, calculate $|qr|$ correct to one decimal place.

$\sin 40$	=	$\frac{qr}{8}$	**or**	0.64	=	$\frac{qr}{8}$
$8\sin 40$	=	qr		$8\times 0\cdot 64$	=	qr
$5\cdot 12$	=	qr		$5\cdot 12$	=	qr
$5\cdot 1$	=	qr		$5\cdot 1$	=	qr

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

Blunders (-3)

B1 Correct answer without work.

B2 Error in forming equation e.g. $\frac{8}{qr} = 0.64$ and continues

B3 Error in manipulation of equation.

B4 Writes $\frac{qr}{8} = 0\cdot 77$ and continues.

B5 Uses Radian or Grad mode on calculator.

	RAD	GRAD
Sin 40	0·75	0·59

Slips (-1 marks)

S1 Numerical slips to a maximum of -3.

S2 Failure to round off or rounds off incorrectly.

Attempts (2 marks)

A1 Any correct step with work and stops e.g. $\frac{x}{8}$ or $\frac{8}{x}$

A2 Correct scale diagram.

A3 $\sin 40$ or 0·64 or any trigonometric ratio.

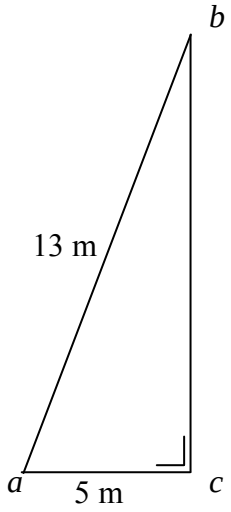
Worthless (0)

W1 Incorrect answer with no work unless attempt mark applies.

W2 Answer = 3·5 cm (measured from examination paper)

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

In the Δabc, $|\angle bca| = 90^{\circ}$, $|ab| = 13\,\text{m}$ and $|ac| = 5$ m.



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

(i) Find, in metres, $|bc|$.

$$|ab|^2 = |ac|^2 + |bc|^2$$
$$|13|^2 = |5|^2 + |bc|^2$$
$$169 = 25 + |bc|^2$$
$$144 = |bc|^2$$
$$\sqrt{144} \text{ or } 12 = |bc|$$

* Accept $|bc|$ 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. $5^2 = 10$

B4 Error in manipulation of equation.

B5 Stops at $|bc|^2 = 144$

Slips (-1 marks)

S1 Numerical slips to a maximum of -3.

Attempts (3 marks)

A1 Some correct step with work and stops e.g. 13^2.

A2 States theorem of Pythagoras and stops.

A3 Correct Sin, Cos or Tan ratio written down and stops.

Worthless (0)

W1 Incorrect answer with no work unless attempt mark applies e.g. 169.

W2 $5 + 13 = 18$ or $13 - 5 = 8$.

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

(**ii**) Find $|\angle bac|$, correct to the nearest degree.

$\sin \angle bac = \frac{12}{13}$ $\angle bac = 67 \cdot 38°$ or $67°22'$ $\angle bac = 67°$	$\cos \angle bac = \frac{5}{13}$ $\angle bac = 67 \cdot 38°$ or $67°22'$ $\angle bac = 67°$

* 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 $|\angle abc|$ 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 (2 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.

Worthless (0)

W1 Incorrect answer with no work unless attempt mark applies.