Coimisiún na Scrúduithe Stáit
State Examinations Commission

JUNIOR CERTIFICATE EXAMINATION 2006
MATHEMATICS - HIGHER LEVEL - PAPER 2
MARKING SCHEME

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

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

The height and the diameter of a solid cylinder are both 9 cm in length.

✍ Find the volume of the cylinder correct to one decimal place.

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

(a) Volume of cylinder $= \pi r^2 \; h = \pi\,(4.5)^2 .9 = 182.25\pi \approx 572{\cdot}6 \text{ cm}^3$

Blunders (-3)
B1 Correct answer with no work shown (hand)
B2 Incorrect substitution into correct formula
B3 Incorrect squaring
B4 Incorrect relevant volume formula or inappropriate value of π
B5 Answer in terms of π

Slips (-1)
S1 Arithmetic slips
S2 Answer not in required form

Attempts (3)
A1 Correct formula with some substitution
A2 Correct radius

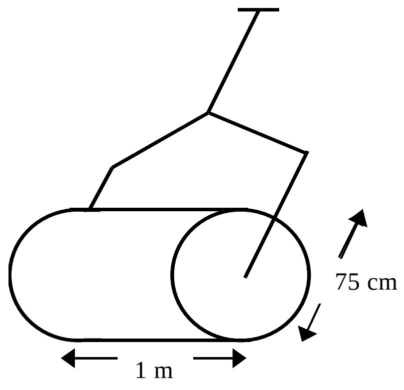
Worthless (0)
W1 Surface area(s)

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

(i) The perimeter of a square lawn is 96 m.

✍ Find the area of the lawn in m^2.

(ii) A garden roller, in the shape of a cylinder, has a diameter of 75 cm and is 1 m wide as shown in the diagram.



Calculate the curved surface area of the roller in m^2 correct to one decimal place.

(iii) ✍ What percentage of the lawn will be rolled when the roller has completed 9 revolutions?

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

(i) Length of side: $\frac{96}{4} = 24\text{m}$

Area of lawn $= 24^2 = 576 \text{ m}^2$.

Blunders (-3)

B1 Correct answer with no work shown (hand)
B2 Incorrect relevant area formula
B3 Perimeter divided by 4 neither indicated nor implied
B4 Incorrect squaring

Slips (-1)

S1 Arithmetic slips

Attempts (2)

A1 Length of one side of square only
A2 Correct area formula but no substitution

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

(ii) Curved Surface Area = 2π x $(0\cdot375)$ x $(1) = 2\cdot356 \approx 2\cdot4$ m^2.

Blunders (-3)
B1 Correct answer with no work shown (hand)
B2 Incorrect substitution into correct formula
B3 Incorrect relevant area formula
B4 Measurements not converted to same units
B5 Answer in terms of π or inappropriate value of π
Slips (-1)
S1 Arithmetic errors
S2 Answer not in required form
S3 Incorrect round off/ failure to round off

Attempts (2)
A1 Correct radius indicated
A2 1 m = 100 cm and/or 75 cm = .75 m

Worthless (0)
W1 Volume of cylinder

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

(iii) % completed $= \dfrac{9\times 2\cdot 4}{576}\times 100 = 3\cdot75\%$

* Accept candidates answers from (i) and (ii) for (iii)

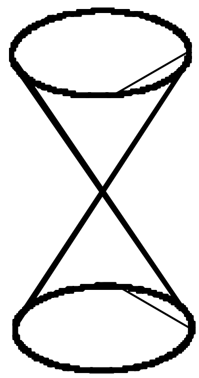
Blunders (-3)
B1 Correct answer with no work shown (hand)
B2 Calculations for one revolution only
B3 Calculations inverted
B4 Fraction calculated as a decimal, but percentage not found

Slips (-1)
S1 Arithmetic errors

Attempts (3)
A1 CSA x 9

(c)	**20 (10,10) marks**	**Att (3,3)**

(c) An egg-timer consists of two identical cones of height 6 cm and base radius 4 cm. Sand occupies half the volume of one cone and flows from one to the other at a rate of $\frac{4\pi}{45}$ cm^3 per second.



(i) ✍ Calculate the volume of each cone in terms of π .

(ii) ✍ Calculate the length of time it takes for the sand to flow from one cone into the other.

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

(i) Volume each cone $= \frac{1}{3}\pi r^2 h \quad = \frac{1}{3}\pi\, 4^2 6 \quad = \quad 32\pi$ cm^3

Blunders (-3)
B1 Correct answer with no work shown (hand)
B2 Incorrect substitution into correct formula
B3 Incorrect relevant formula
B4 Incorrect squaring

Misreading(-1)
M1 h = 3

Slips (-1)
S1 Arithmetic slips

Attempts (3)
A1 Correct formula with some substitution
A2 Diagram with r and/ or h shown correctly

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

(ii)	Time =	$\dfrac{16\pi}{\dfrac{4\pi}{45}}$	=	180 s

Blunders (-3)
B1 Correct answer with no work shown (hand)
B2: Ratio not simplified
B3 Ratio inverted
B4 Use of 32π or answer not halved from (c)(i)

Slips (-1)
S1 Arithmetic slips

Attempts (3)
A1 Identifies half the volume of one cone

QUESTION 2

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

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

(a) *a* (4, -6) and *b* (6, -2) are two points.

✍ Write |*ab*| in surd form.

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

$|ab| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$= \sqrt{(6-4)^2 + (-2--6)^2}$

$\sqrt{2^2 + 4^2}$

$= \sqrt{4+16}$ $\sqrt{20}$

Blunders (-3)
B1 Correct answer with no work shown (hand)
B2 Incorrect relevant formula
B3 Mixes both x and y in substitution
B4 Squares incorrectly

Slips (-1)
S1 Arithmetic slips
S2 One incorrect substitution into x or y

Attempts (3)
A1 Correct formula and stops
A2 Some attempt at difference of y's and /or difference of x's

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

p (-1, 2) and *r* (3, 4) are two points.

(i) ✍ Find *m*, the midpoint of [*pr*].

(ii) ✍ Find the slope of *pr*.

(iii) ✍ Find the equation of the line *L*, the perpendicular bisector of [*pr*].

(iv) The equation of the line *K* is $x - 2y = 0$.

✍ Find *n*, the point of intersection of *L* and *K*.

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

(i) $m = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right) = \left(\frac{-1+3}{2}, \frac{2+4}{2}\right) = \left(\frac{2}{2}, \frac{6}{2}\right) = (1, 3)$

Blunders (-3)
B1 Correct answer with no work shown (✍)
B2 Incorrect midpoint formula and continues
B3 Mixes both x and y in substitution
B4 Substitutes correctly but midpoint not found
Slips (-1)
S1 One incorrect sign after substitution
S2 One incorrect substitution
S3 Arithmetic errors
Attempts (2)
A1 Writes midpoint formula with or without some substitution
A2 Correct graphical solution

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

(ii) slope of *pr* $= \frac{y_2 - y_1}{x_2 - x_1} = \frac{4-2}{3--1} = \frac{2}{4}$ or $\frac{1}{2}$

Blunders (-3)
B1 Correct answer with no work shown (✍)
B2 Incorrect slope formula and continues
B3 Mixes both *x* and *y* in substitution
B4 Substitutes correctly but slope not found
Slips (-1)
S1 One incorrect sign after substitution
S2 One incorrect substitution
S3 Arithmetic errors
Attempts (2)
A1 Writes slope formula with or without some substitution
A2 Some attempt at difference of *y*'s and /or difference of *x*'s

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

(iii)	Equation of *L*	$y-3=-2(x-1)$

* Accept candidates answers from b(i) and b(ii)

Blunders (-3)

B1 Correct answer with no work shown (✍)
B2 Incorrect relevant formula and continues
B3 Switches both x and y in substitution
B4 Substitutes correctly for x and y but no slope
B5 Use of incorrect point and/or incorrect slope

Slips (-1)

S1 Arithmetic errors
S2 One incorrect substitution of *x* or *y*

Attempts (2)

A1 Correct line formula

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

(iv) $y-3=-2x+2 \Rightarrow 2x+y=5$

$$2x+y=5 \Rightarrow \quad 4x+2y=10$$
$$\underline{\quad x-2y=0}$$
$$5x \qquad\quad =10 \;\Rightarrow x=2$$

$$2-2y=0 \Rightarrow y=1$$

* (2,1) without work Att 3 subject to below
* Accept (2,1) $\in$ L and (2,1) $\in$ K shown in each case.

Blunders (-3)

B1 Error in manipulation of equations
B2 Transposition error
B3 No substitution for second value

Slips (-1)

S1 Arithmetic slips

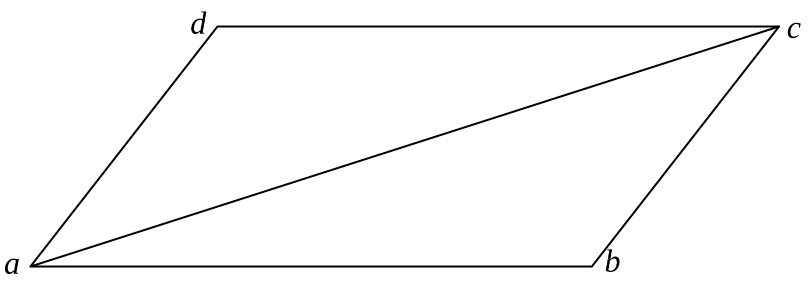
Attempts (3)

A1 Any correct step and stops
A2 Graphical solution correct

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

> ✍ Prove that the opposite sides and opposite angles of a parallelogram are respectively equal in measure.

(c) **15 marks** **Att 5**



Given: ▱ *abcd*

To prove: (i) $|\angle bad| = |\angle bcd|$ and $|\angle adc| = |\angle abc|$

(ii) $|ab| = |dc|$ and $|ad| = |bc|$ Step 1

Construction: Join ac Step2

Proof: Taking triangles *adc* and *abc*

$|\angle dac| = |\angle acb|$ (alternate angles since *ad* parallel to *bc*)

$|\angle dca| = |\angle bac|$ (alternate angles since *ab* parallel to *dc*) Step 3

ac common to both triangles

$\Rightarrow$ ASA $\Rightarrow$ Both triangles are congruent Step 4

$\Rightarrow$ (i) $|ab| = |dc|$ *and* $|ad| = |bc|$ corresponding sides

(ii) $|\angle dac| + |\angle bac| = |\angle acb| + |\angle dca|$

$\Rightarrow |\angle bad| = |\angle bcd|$. Similarly $|\angle adc| = |\angle abc|$ Step 5

or $|\angle adc| = |\angle abc|$. Similarly $|\angle bad| = |\angle bcd|$

* Some steps may be partially indicated on diagram

Blunders (-3)

B1 Each step incorrect or omitted

B2 Each step incomplete

Attempts (5)

A1 Diagram with parallelogram drawn, and diagonal indicated

Worthless (0)

W1 Wrong Theorem

W2 Parallelogram and nothing else

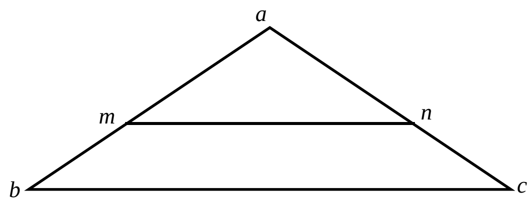
QUESTION 3

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

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

(a) The triangle *abc* has $|ab| = |ac|$.
The line *mn* is parallel to *bc*
and $|\angle nmb| = 115°$

✍ Find $|\angle abc|$ and $|\angle bac|$.



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

(a) $|\angle nma| = 180^0 - 115^0 = 65°$

$|\angle abc| = |\angle nma| = 65°$ or $|\angle abc| + |\angle nmb| = 180^0 \Rightarrow |\angle abc| = 65°$

Blunders (-3)

B1 Correct answer with no work shown (✍)

B2 Use of 360° instead of 180^0

Slips (-1)

S1 Arithmetic slip

Attempts (2)

A1 Indicates $|\angle nmb| + |\angle nma| = 180°$

A2 115^0 correctly marked in diagram

Worthless (0)

W1 Use of 90° instead of 180°

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

$\|ab\| = \|ac\| \Rightarrow \|\angle abc\| = \|\angle acb\|$
$\|\angle bac\| = 180° - (65° + 65°) = 50°$

* Accept answer from above for this section

Blunders (-3)

B1 Correct answer with no work shown (✍)

B2 Sum of angles in triangle $\neq 180°$

Slips (-1)

S1 Arithmetic slip

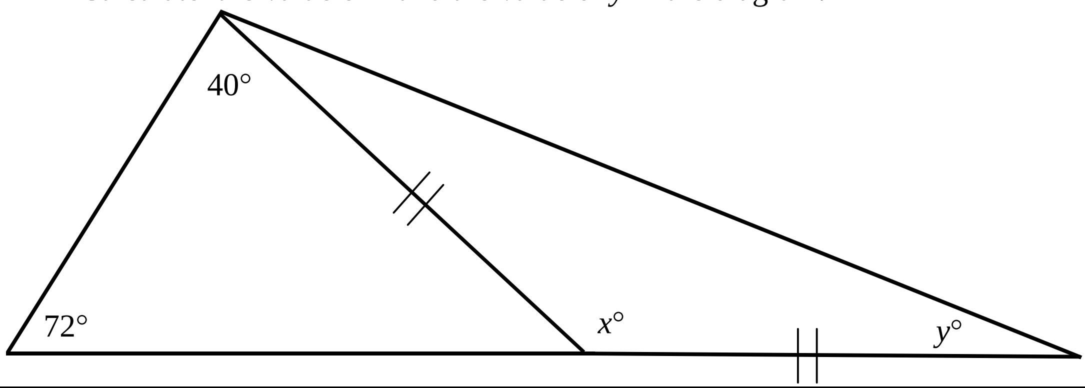
Worthless(0)

W1 Assuming Δ *abc* right angled triangle

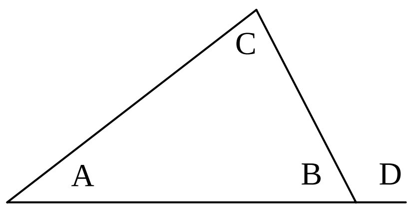
Part (b) **20 marks (10,10)** **Att (3,3)**

(i) ✍ Prove that an exterior angle of a triangle equals the sum of the two interior opposite angles in measure.

(ii) ✍ Calculate the value of x and the value of y in the diagram.



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



Given: Triangle with angles A, B, C. and one side extended with exterior angle D

To prove : $|\angle A| + |\angle C| = |\angle D|$ Step 1

Proof: $|<A| + |<B| + |\angle C| = 180^\circ$ (Angles in triangle sum to 180°)

$|\angle B| + |\angle D| = 180^\circ$ (Angles on straight line) Step2

$|<A| + |<B| + |\angle C| = |\angle B| + |\angle D|$ Step3

$\Rightarrow |\angle A| + |\angle C| = |\angle D|$

Blunders (-3)

B1 Each step incorrect or omitted

B2 Each step incomplete

Attempts (3)

A1 Triangle with exterior angle drawn

A2 Indicates sum of angles in a triangle equals 180^0

(b)(ii)	**10 (5,5) marks**	**Att (2,2)**

(ii) $x° = 40° + 72°$	$y° + y° + x° = 2y° + x° = 180°$	
$x° = 112°$	$\Rightarrow 2y° + 112° = 180° \Rightarrow 2y° = 68° \Rightarrow y = 34°$	

Blunders (-3)

B1 Correct answer with no work shown (✍)

B2 $x = 68°$

B3 Sum of angles in triangle ≠180°

B4 Incorrectly indicates equal angles in isosceles triangle

Slips (-1)

S1 Arithmetic slips

Attempts (2)

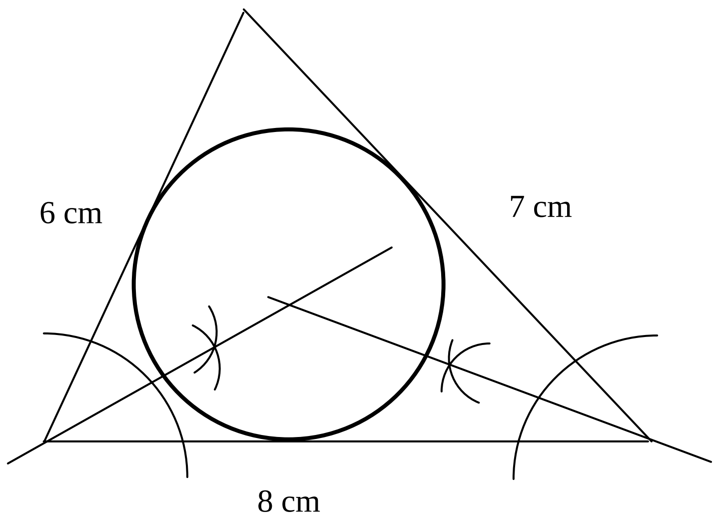
A1 Indicates sum of angles in triangle equals 180° once only

A2 Recognition of equal angles in isosceles triangle

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

(i)	✍	Construct a triangle of sides 8 cm, 7 cm and 6 cm.
(ii)	✍	Construct the incircle of the triangle.
		All construction lines must be clearly shown in each case.

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



* Accept constructions with tolerance of 2 mm

Blunders (-3)
B1 Each incorrect side
B2 Inserting right angles between two sides
B3 Correct triangle but no construction lines

*Attempts(*3)

A1 No triangle but one correct length drawn

Worthless (0)

W1 Triangle drawn with no correct length

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

(ii)	Incircle

* Accept constructions with tolerance of 2mm

* If candidate draws a separate correct triangle for (c)(ii), then accept this for construction of incircle.

* 4 marks: One angle bisected correctly
* 7 marks: Two angles correctly bisected

Blunders (-3)
B1 Incentre indicated but incircle not drawn

Attempts (3)
A1 Effort at bisecting any angle
A2 Triangle and incircle drawn with no construction shown
A3 Circumcircle drawn with construction lines shown

QUESTION 4

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

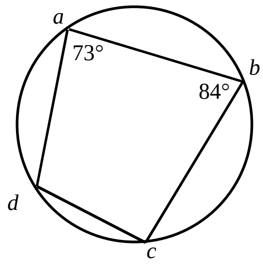
Part (a) **10 marks** **Att 3**

abcd is a cyclic quadrilateral.

✍ Given that $|\angle dab| = 73°$ and

$|\angle abc| = 84°$,

find $|\angle adc|$ and $|\angle bcd|$.



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

(a)	$|\angle adc| + 84°$	$= 180°$			
	$|\angle adc|$	$= 96°$	$|\angle bcd|$	$=$	$107°$

Blunders (-3)

B1 Correct answer with no work shown (✍)
B2 Uses 360° instead of 180°
B3 Sum of opposite angles = 90°
B4 One angle found only

Slips (-1)

S1 Arithmetic error

Attempts (3)

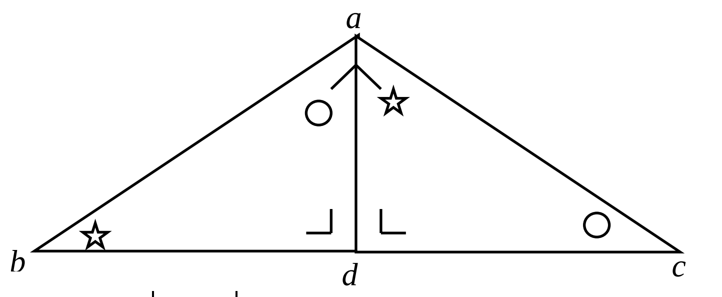
A1 Indicates sum of angles in cyclic quadrilateral = 360°
A2 Indicates sum of opposite angles in cyclic quadrilateral = 180° in measure

Worthless (0)

W1 $|\angle adc| = 84°$ or $73°$

Part (b) **20 marks** **Att 7**

✍ Prove that in a right-angled triangle, the square of the length of the side opposite to the right angle is equal to the sum of the squares of the lengths of the other two sides.



Given:	$\Delta\, abc$, with $\vert\angle bac\vert = 90°$	
To Prove:	$\vert bc\vert^2 = \vert ab\vert^2 + \vert ac\vert^2$	Step 1
Construction:	Draw $ad \perp bc$	Step 2
Proof:	Taking $\Delta\, abc$ and $\Delta\, abd$	
	$\vert\angle bac\vert = \vert\angle bda\vert$ (both right angles)	
	$\vert\angle abc\vert = \vert\angle abd\vert$ (same angle)	
	$\vert\angle bad\vert = \vert\angle bca\vert$ (Sum of angles in a triangle = 180^0)	
	$\Rightarrow$ triangles equiangular or triangles similar	Step 3
	$\Rightarrow \dfrac{\vert ab\vert}{\vert bc\vert} = \dfrac{\vert bd\vert}{\vert ab\vert}$	
	$\Rightarrow \vert ab\vert^2 = \vert bc\vert . \vert bd\vert$	Step 4

Similarly taking $\Delta\, abc$ and $\Delta\, adc$

$$|ac|^2 = |bc||dc|$$

Therefore $|ab|^2 + |ac|^2 = |bc|.|bd| + |bc|.|dc|$ Step 5

$$= |bc|(|bd| + |dc|)$$

$$= |bc|.|bc|$$ Step 6

* Some steps may be partially indicated on diagram

Blunders (-3)

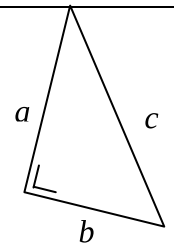
B1 Each step incorrect or omitted

B2 Each step incomplete

Attempts (7)

A1 Diagram with perpendicular indicated

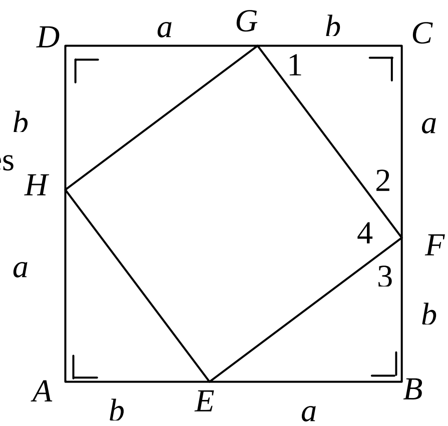
Alternative Proof



Given: Right-angled triangle with length of sides a, b, c, where c is the hypotenuse.

RTP: $a^2 + b^2 = c^2$. Step 1

Construction: Construct a square $ABCD$ of side $a + b$.
Construct the point E on $[AB]$ such that $|AE| = a$ (and hence $|EB| = b$).
Similarly construct points F, G and H on the other sides as shown.
Join E, F, G and H to divide the square $ABCD$ into a quadrilateral and four triangles, as shown.
Label the angles 1, 2, 3 and 4 as shown.



Step 2

Proof:
Each of the four inscribed triangles is congruent to the original triangle …….*SAS*

$\therefore$ Each side of the inner quadrilateral has length c. Step 3

$|\angle 1| + |\angle 2| = 90°$ …*Angle sum of triangle*

$|\angle 1| = |\angle 3|$ …*Corresponding parts in congruent triangles*

$\therefore$ $|\angle 2| + |\angle 3| = 90°$

$\therefore$ $|\angle 4| = 90°$ …*Straight angle* Step 4

$\therefore$ the inscribed quadrilateral is a square

Area of large square = $(a + b)^2 = 4(\text{area of one triangle}) + c^2$

$(a + b)^2 = 4(\tfrac{1}{2}\ ab) + c^2$ Step 5

$a^2 + 2ab + b^2 = 2ab + c^2$

$\therefore a^2 + b^2 = c^2$ Step 6

* Some steps may be indicated partially on diagram

Blunders(-3)
B1 Each step incorrect or omitted
B2 Each step incomplete

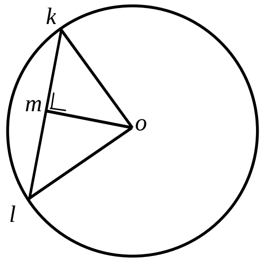
Attempts(7)
A1 Diagram only

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

A circle, centre *o*, has a radius of length 17.

[*lk*] is a chord of length 30.

m is a point on [*lk*] and *lk* is perpendicular to *mo*.



(i) ✍ Write down the length of [*km*], giving a reason for your answer.

(ii) ✍ Calculate |*om*|.

(iii) ✍ Find the area of the triangle *klo*.

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

(i) $|km| = \frac{1}{2}|kl| = 15$

Diameter/radius/line through centre/*om* perpendicular to chord bisects the chord

Blunders (-3)

B1 Correct answer with no work shown (✍)
B2 Reason not given

Slips (-1)
S1 Arithmetic slip

Attempts (2)

A1 Some use of $\frac{1}{2}$

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

(ii) $17^2 = 15^2 + |om|^2 \Rightarrow |om|^2 = 64 \Rightarrow |om| = 8$

Blunders (-3)

B1 Correct answer with no work shown (✍)
B2 Pythagoras incorrect
B3 Incorrect squaring
B4 $|om|^2 = 64$ and stops
B5 Use of 30 rather than 15

Slips (-1)
S1 Arithmetic slip
Attempts (2)
A1 Pythagoras indicated

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

(iii)	Area $= \frac{1}{2}\,|kl|\;|om| \;=\; \frac{1}{2}.30.8 = 120$

Blunders (-3)

B1 Correct answer with no work shown (✍)
B2 Incorrect relevant formula
B3 Incorrect substitution into correct formula

Slips (-1)

S1 Arithmetic slips

Attempts (3)

A1 Correct formula with some substitution

Worthless (0)

W1 Assuming angle at centre = 90°

QUESTION 5

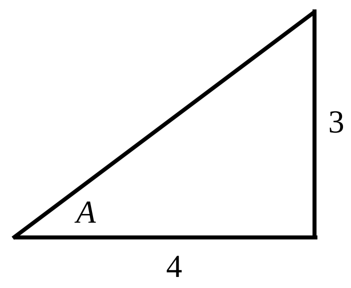
Part (a)	**10 marks**	**Att 3**
Part (b)	**20 (5,15) marks**	**Att (2,5)**
Part (c)	**20 (10,10) marks**	**Att (3,3)**

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

✍ Without using a calculator or the tables, construct the angle *A* such that

$$\tan A = \frac{3}{4}.$$

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



* Tolerance of 2mm

* Measure each side to check ratio
* Measure for right angle (need not be specifically marked)
* Check that relevant angle marked A

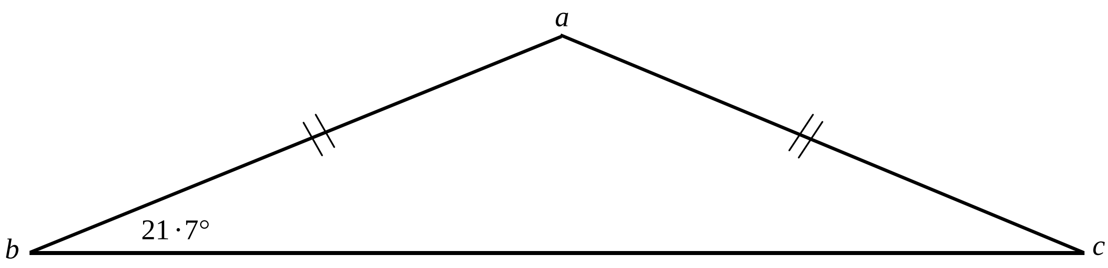
Blunders (-3)
B1 Angle A not indicated
B2 Incorrect use of ratio

Attempts (3)
A1 Draws one side of length 3 or 4
A2 Indicates 3 as ‘opposite’ and /or 4 as ‘adjacent’
A3 Indicates hypotenuse = 5
A4 States any correct trig. Ratio
A5 Pilot diagram

Worthless (0)
W1 Triangle with no length indicated

Part (b) **20 (5, 15) marks** **Att (2,5)**

abc is an isosceles triangle with $|ab| = |ac| = 9$.



✍ Given that $|\angle abc| = 21\cdot7°$, calculate the area of the triangle *abc*,

giving your answer correct to two decimal places.

(b) **20 (5,15)marks** **Att(2,5)**

First 5 marks

$|\angle bac| = 180° - (21{\cdot}7° + 21{\cdot}7°) = 136{\cdot}6°$

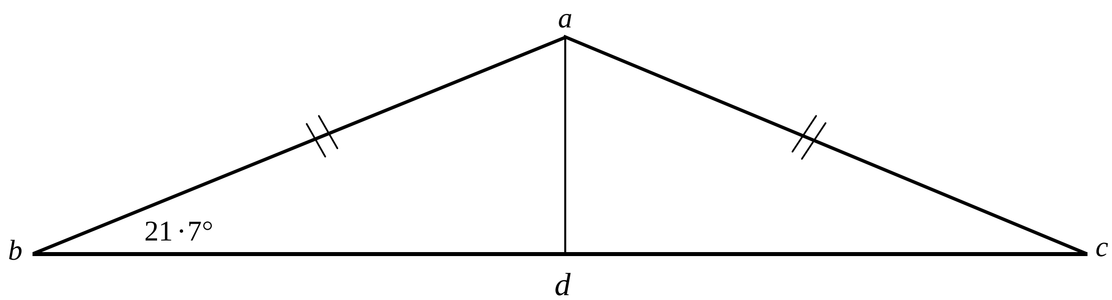
Second 15 marks

Area of triangle = $\frac{1}{2} \times 9 \times \sin 136\cdot6°$

$= 27{\cdot}827$

$\approx 27{\cdot}83$

OR



First 5 marks

$ad \perp bc$

$Sin\ 21\cdot7° = \frac{|ad|}{9} \Rightarrow |ad| = 3\cdot328$

Second 15 marks

$|bd|^2 = 81 - 11\cdot076$

$|bd| = 8\cdot362$

$Area = 8\cdot362 \times 3\cdot328 = 27\cdot828 \approx 27\cdot83$

Blunders (-3)

B1 Correct answer with no work shown (✍)
B2 $|\angle bac|$ not obtuse
B3 Incorrect substitution into correct formula
B4 Incorrect relevant formula
B5 Reads tables incorrectly or uses calculator in incorrect mode
B6 Early rounding off which affects answer
B7 Incorrect ratio for Sine function

Slips (-1)

S1 Arithmetic slips
S2 Slip reading tables (e.g. wrong column)
S3 Fails to distinguish between degrees and minutes and degrees in decimal format
S4 Not rounded off

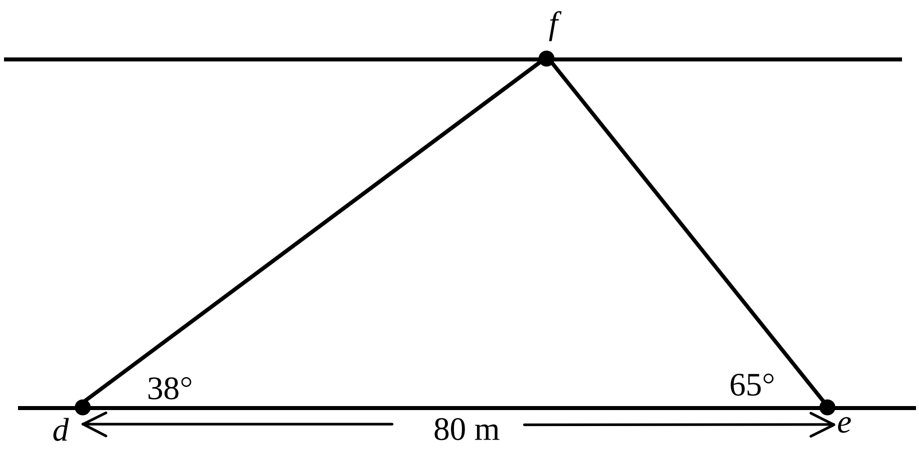
Attempts (2,5)

A1 Sum of angles in triangle equals 180°
A2 Correct formula with some substitution

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

d and *e* are points on a river bank 80 m apart and *f* is a point on the opposite bank as shown in the diagram.

$|\angle fde| = 38°$ and $|\angle fed| = 65°$.



(i) ✍ Find $|ef|$, correct to the nearest metre.

(ii) ✍ Find the width of the river, as measured from *f*, correct to the nearest metre.

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

(i) $|\angle dfe| = 77^0$

$$\frac{Sin77^0}{80} = \frac{Sin38^0}{|ef|} \Rightarrow |ef| = \frac{80Sin38^0}{Sin77} = \frac{80(0.61566)}{0.97437}$$

$$|ef| = 50 \cdot 5 \approx 51\text{m}$$

Blunders (-3)

B1 Correct answer with no work shown (✍)
B2 Incorrect ratio in use of Sine Rule
B3 Error in cross multiplication
B4 Reads wrong page of tables or uses calculator in incorrect mode
B5 Early rounding off which affects answer

Misreading(-1)
M1 $|df|$ found

Slips (-1)
S1 Arithmetic slips
S2 Slip reading tables (e.g. wrong column)

Attempts (3)
A1 Sine Rule substituted
A2 $|\angle dfe| = 77^0$
A3 Indicates sum of angles of triangle = 180^0

Worthless (0)
W1 Treats triangle as right angled

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

(ii) Let h be the width

$$Sin65 = \frac{h}{51} \Rightarrow h = 51\ Sin65 = 51(0.9063)$$

$$h = 46 \cdot 2 \approx 46\text{m}$$

* Accept candidates answer from (c)(i)

Blunders (-3)

B1 Correct answer with no work shown (✍)
B2 Incorrect ratio for *Sin* function
B3 Error in cross multiplication
B4 Reads wrong page of tables or uses calculator in incorrect mode
B5 Incorrect ratio for Sine Rule

Slips (-1)

S1 Arithmetic slips
S2 Slip reading tables (e.g. wrong column)

Attempts (3)

A1 Indicates use of *h* in a ratio
A2 Indicates use of (c)(i) answer in a ratio
A3 Indicates use of h in a right angled triangle
A4 Finds value of another acute angle and stops
A5 Any correct trig. Ratio or states Pythagoras

QUESTION 6

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

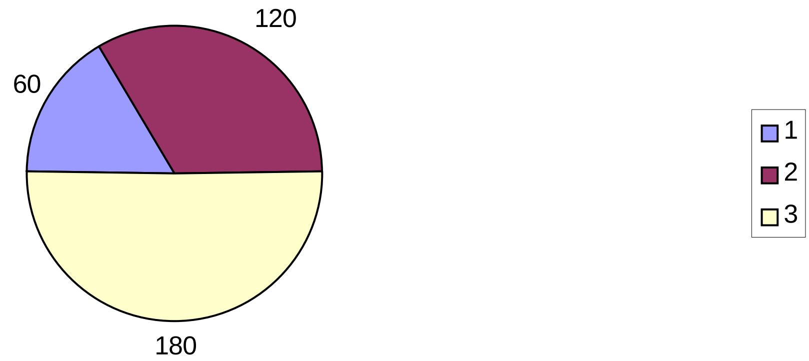
Part (a) **10 marks** **Att 3**

✍ Draw a pie chart to indicate how a lottery prize could be divided in the ratio of 3 : 2 : 1.

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

3 : 2 : 1

Pie Chart angles: 180°, 120°, 60°



* Allow a tolerance of 5° in chart

Blunders (-3)

B1 Correct answer with no work shown (✍)
B2 Sum of angles ≠ 360°
B3 Divisor other than 6
B4 Each incorrect plot

Slips (-1)

S1 Arithmetic slips

Attempts (3)

A1 Use of 360 indicated or implied
A2 Circle drawn

Worthless (0)

W1 Bar chart

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

The marks obtained by 25 candidates in an exam are as follows:

25	85	55	74	60
54	48	41	79	81
88	74	38	57	65
76	98	42	50	59
68	79	20	64	45

(i) Complete the following frequency table.

Marks	0 - 40	40 60	60 - 80	80 - 100
Number of Students				

[Note: 40 – 60 means 40 or more but less than 60, etc.]

(ii) ✍ Taking mid-interval values, calculate the student mean mark

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

(i)

Marks	0 - 40	40 - 60	60 - 80	80 - 100
Number of Students	**3**	**9**	**9**	**4**

Blunders (-3)
B1 Omits any number
B2 Cumulative frequencies

Attempts (3)
A1 One entry correct
A2 No entry correct but sum of entries = 25

Worthless(0)
W1 No correct entry and sum of entries ≠ 25

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

(ii)	Mean	=	$\dfrac{20\times3+50\times9+70\times9+90\times4}{25}$	=	60

* Accept candidates work from (b) (i)

Blunders (-3)

B1 Correct answer with no work shown (✍)
B2 Division by 4
B3 Division by sum of mid interval
B4 Use of value other than mid interval values
B5 Consistently adds mid interval value to frequency instead of multiplying

Slips (-1)

S1 Arithmetic slips to max of –3

Attempts (3)

A1 Some or all mid intervals identified
A2 One correct multiplication in numerator
A3 Indicates division by 25
A4 Sum of frequencies divided by 4 or sum of mid intervals divided by 4

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

The cumulative frequency table below shows the times in minutes that 100 Olympic athletes completed the marathon after the winner crossed the line.

Time in Minutes	< 2	< 5	< 7	< 9	< 11
Number of Athletes	10	25	55	70	100

(i) Complete the following frequency table.

Time in Minutes	0-2	2-5	5-7	7-9	9-12
Number of Athletes	1				

[Note: 2 – 5 means 2 or more but less than 5, etc.]

(ii) Draw a histogram to illustrate the data in the frequency table.

(iii) ✍ In which class interval does the 63rd athlete to finish lie?

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

(i)

Time in Minutes	0-2	2-5	5-7	7-9	9-12
Number of Athletes	**10**	**15**	**30**	**15**	**30**

Attempts (2)

A1 Any one value filled correctly into table

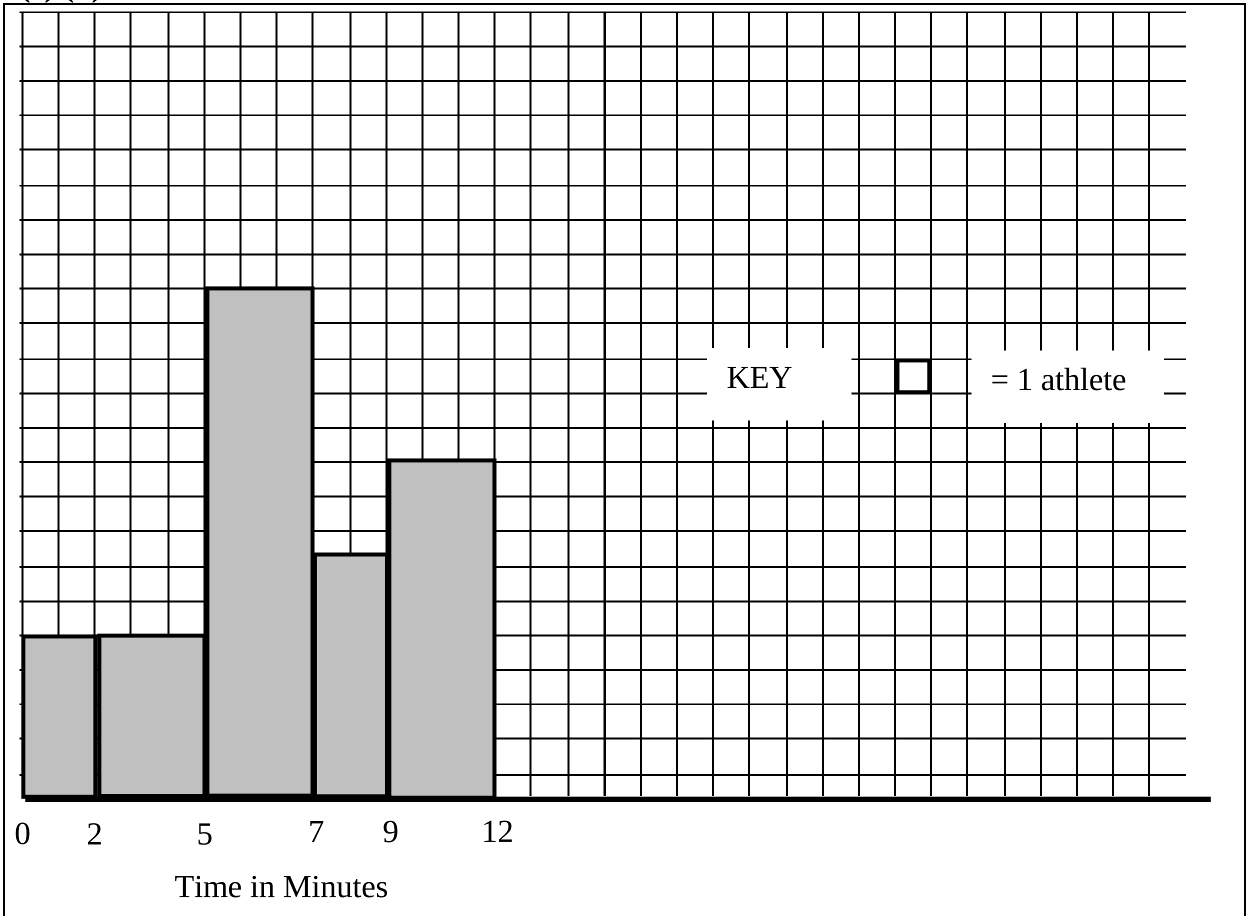
A2 Any indication of subtraction of frequencies

A3 Cumulative ‘cumulative ‘ table

Worthless (0)

W1 Copies table and stops

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



* Accept candidate's work from (c)(i)
* No penalty for vertical scale instead of area scale

Blunders(-3)

B1 Incorrect base scale
B2 Incorrect transfer of frequency to histogram
B3 Draws a trend graph from (c) (i)
B4 Each rectangle omitted

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

(iii) 10 + 15 + 30 = 55 Thus 55th athlete in the 5-7 interval
10+ 15+ 30+ 15 =7 0 Thus 70th athlete in 7-9 interval
$\Rightarrow$ 63rd athlete in the **7 – 9** class interval.

* Accept answer consistent with candidate's work
* Accept answer clearly identified on graph

Blunders (-3)

B1 Correct answer with no work shown (✍)
B2 Chooses incorrect interval with work

Attempts (2)

A1 Adds a number of frequencies