Coimisiún na Scrúduithe Stáit
State Examinations Commission

JUNIOR CERTIFICATE EXAMINATION

2010

MARKING SCHEMES

MATHEMATICS

HIGHER LEVEL

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MATHEMATICS HIGHER LEVEL PAPER 1

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MATHEMATICS - HIGHER LEVEL - PAPER 1

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

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

The price of a litre of petrol on the 1st of August was €1·20.
The price on the 1st September was €1·17.

✍ Calculate the percentage decrease over this period.

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

I

€1·20 - €1·17 = €0·03

$\frac{\cdot 03}{1\cdot 20} \times \frac{100}{1}$

Percentage decrease = 2·5%

or

II

3 cents

$\frac{3}{120} \times \frac{100}{1}$

Blunders (-3)

B1 Correct answer no work shown. ✍
B2 Decimal error
B3 Percentage of incorrect figure
B4 Inversion
B5 Mathematical error
B6 Sign error

Slips (-1)

S1 Numerical error, max -3

Misreadings (-1)

M1 Incorrect number written down, provided it doesn't oversimplify the question

Attempts (3 marks)

A1 Subtracts and stops
A2 Some mention of 100, 3 or ·03

Worthless (0)

W1 Adds €1·20 and €1·17 and stops
W2 Incorrect answer no work shown, except for numbers mentioned in A2.

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

(i) ✍ By rounding correct to the nearest whole number, estimate the value of

$$\frac{3.8}{4.23} + (2.97)^3 \div \sqrt{9 \cdot 16}$$

.

Then, evaluate $\frac{3.8}{4.23} + (2.97)^3 \div \sqrt{9 \cdot 16}$

correct to one decimal place.

(ii) ✍ By putting the largest number first, place the following numbers in order:

$$\frac{7}{6}, \quad \frac{\sqrt{6}}{2}, \quad (1{\cdot}11)^2, \quad \sqrt{1 \cdot 3456}$$

.

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

$\frac{4}{4} + 3^3 \div \sqrt{9} =$
$1 + 27 \div 3 =$
$1 + 9 =$
Estimate: 10

Blunders (-3)

B1 Correct answer no work shown. ✍
B2 Incorrect order *i.e.* precedent error
B3 Incorrect square root
B4 Incorrect use of indices
B5 Decimal error
B6 Mathematical errors
B7 Calculates first, then rounds (*e.g.* 9·6 with work, rounded to 10)

Slips (-1)

S1 Numerical errors
S2 Incorrect rounding, to a max of 3, if it affects answer

Misreadings (-1)

M1 Misreads a digit, provided it doesn't oversimplify the question

Attempts (3 marks)

A1 Some correct rounding
A2 Any correct step without rounding

Worthless (0)

W1 Incorrect answer no work shown
W2 9·6 without work

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

Evaluate

$$\frac{3.8}{4.23} + (2.97)^3 \div \sqrt{9 \cdot 16}$$

·898345153 + 26·198073 ÷ 3·02654919
·898345153 + 8·656086967
9·554432121
= 9·6

Blunders (-3)

B1 Correct answer no work shown.✍
B2 Incorrect order i.e. precedent error (e.g. 8·952908561 = 9·0 to one decimal place)
B3 Incorrect square root
B4 Incorrect use of indices
B5 Decimal error
B6 Mathematical errors

Slips (-1)

S1 Numerical errors
S2 Incorrect or no rounding, apply once if it affects answer

Misreadings (-1)

M1 Misreads a digit, provided it doesn't oversimplify the question

Attempts (3 marks)

A1 Any relevant correct step i.e. division, cubing, square root etc.

Worthless (0)

W1 Incorrect answer no work shown

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

1·2321, 1·224744871, 1·166666, 1·16 ***or***
1·23, 1·22, 1·17, 1·16

$(1{\cdot}11)^2$, $\frac{\sqrt{6}}{2}$, $\frac{7}{6}$, $\sqrt{1 \cdot 3456}$

* Accept correct decimals in order for full marks, at least 2 correct decimal places required. (Ignore rounding if it doesn't affect answer).
* Accept candidate's values when arranging

Blunders (-3)

B1 Correct answer no work shown.
B2 Incorrect order with relevant work shown, but note W1 and W2
B3 Mathematical or decimal error
B4 Square root error
B5 Indices error

Slips (-1)
S1 Reverses order
S2 Incorrect or early rounding which affects answer, max -3

Misreadings (-1)
M1 Incorrect reading of a digit provided it doesn't oversimplify the question

Attempts (2 marks)
A1 Finds decimal value of any given number and stops

Worthless (0)
W1 Incorrect answer no work or no work of merit
W2 Original list presented with no work of merit
W3 $\sqrt{9} = 4.5$, with otherwise no work of merit

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

(i) The standard rate of income tax is 20% and the higher rate is 41%.
The standard rate cut-off point is €36 500.
Aisling has a gross income of €47 500 and total tax credits of €1830.

✍ Calculate Aisling's net income.

(ii) The following year Aisling's gross income increases.
The tax rates, cut-off point and tax credits remain unchanged.
Her net tax now amounts to €15 105.

✍ What is her new gross income?

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

€47 500 – €36 500 = €11 000
€36 500 × 20% = € 7300
€11 000 × 41% = €4510
€7300 + €4510 = €11 810
€11 810 – €1830 = €9980
€47 500 – €9980
Net income = €37 520

* If candidate gets 41% of €36 500 and 20% of €11 000 and continues, this is one blunder only (€32 165)

Blunders (-3)

B1 Correct answer no work shown. ✍
B2 Decimal error
B3 20% of an incorrect figure, but note *
B4 41% of an incorrect figure, but note *
B5 Mishandling of tax credits leading to the wrong answer
B6 Fails to get total tax
B7 Fails to complete final step
B8 Mathematical blunder

Slips (-1)

S1 Numerical error to a max of 3

Misreadings (-1)

M1 Incorrect reading of a digit which does not oversimplify the question
M2 Uses 21%
M3 Uses 40% or 42%

Attempts (3 marks)

A1 Finds 20% or 41% of a number and stops, but note W1

A2 Writes 20% as $^{1}/_{5}$ or $^{20}/_{100}$ or ·2, without further work of merit

A3 Writes 41% as $^{41}/_{100}$ or ·41 without further work of merit

A4 Some knowledge of tax credits *eg. Tax payable=total tax – tax credits*

A5 Some knowledge of net income *eg. Net income = gross income – net tax*

A6 Any relevant step

A7 Any ***one*** of the following numbers without work €7,300 or €4,510 or €11,810 or €9,980

Worthless (0)

W1 Incorrect answer no work shown

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

I

€15 105 + €1830 = €16 935
€16 935 – € 7300 = € 9635
€9635 = 41%
€9635 ÷ 41 = €235
€235 = 1%
€235 × 100 = €23 500
€23 500 + €36 500 =
New gross income = €60 000

II

€15 105 – €9980 = €5125 Net tax – previous net tax
€5125 = 41% of increase
$^{€5,125}/_{41}$ = €125 = 1%
€125×100 = €12 500
€12 500 + €47 500 = €60 000 Increase + previous

III

x = Gross income

$\big(€7300 + (x - €36\,500)(·41)\big) - €1830 =$ Tax paid

€7300 + ·41x – €14 965 – €1830 = €15 105
·41x – €9495 = €15 105
·41x = €15 105 + €9495
·41x = €24 600
x = €24 600 ÷ ·41 = €60 000

***** Accept candidate's values from **(c) (i)** in **II** and **III**

Blunders (-3)

B1 Correct answer no work shown. ✍
B2 Uses 20% instead of 41%
B3 Incorrect use of tax credits
B4 Adds €7300 instead of subtracting in method **I**
B5 Divides by 100, and multiplies by 41
B6 Stops at €23 500 **I** or €12 500 **II** or €24 600 ÷ ·41 **III**
B7 Mathematical blunder

Slips (-1)

S1 Stops at €23 500 + €36 500 **I** or €12 500 + €47 500 **II**
S2 Numerical error, max -3

Misreadings (-1)

M1 Incorrect reading of a digit which does not oversimplify the question

Attempts (2 marks)

A1 Subtracts €7300 (as in Method **I)**
A2 Adds €1830 (as in Method **I**)
A3 Divides by 41
A4 Multiplies by 100
A5 Adds €36 500 to some relevant number
A6 Any relevant step

Worthless (0)

W1 Incorrect answer no work shown

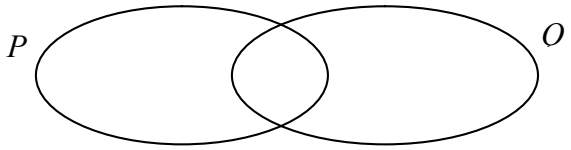
QUESTION 2

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

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

P is the set of divisors of 12. *Q* is the set of divisors of 9.

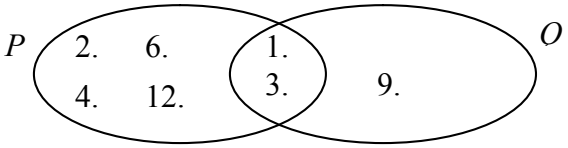
✍ Using this information copy and complete the Venn diagram.



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

Divisors of 12 = {1,2,3,4,6,12}
Divisors of 9 = {1,3,9}

Venn diagram



***** Ignore notation

Slips (-1)
S1 Each missing or incorrect or misplaced entry from the Venn Diagram

Attempts (3 marks)
A1 Any correct divisors of 12 or 9

Worthless (0)
W1 Copies diagram and stops

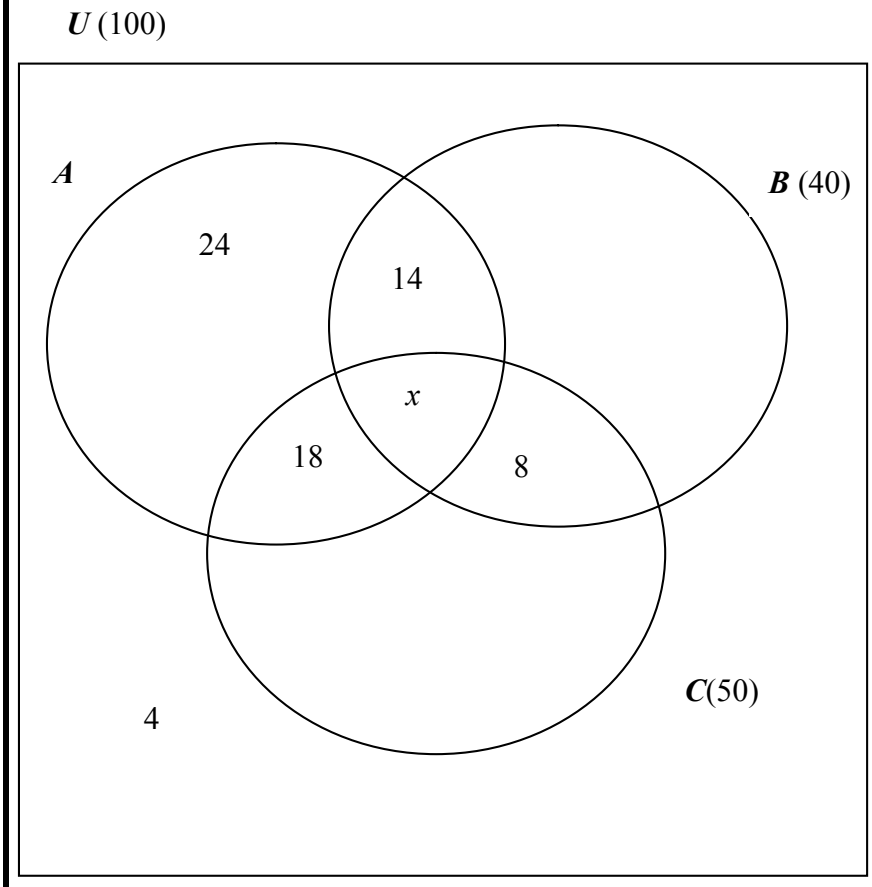
Part (b) **20 (5, 10, 5) marks** **Att (2, 3, 2)**

A group of 100 students were asked if they had a presence on particular social networking websites *A*, *B* and *C*.
24 students had a presence on *A* only, 40 had a presence on *B* and 50 had a presence on *C*.
14 students had a presence on *A* and *B* but not on *C*.
18 students had a presence on *A* and *C* but not on *B*.
8 students had a presence on *B* and *C* but not on *A*.
4 students stated that they did not have a presence on any of the websites

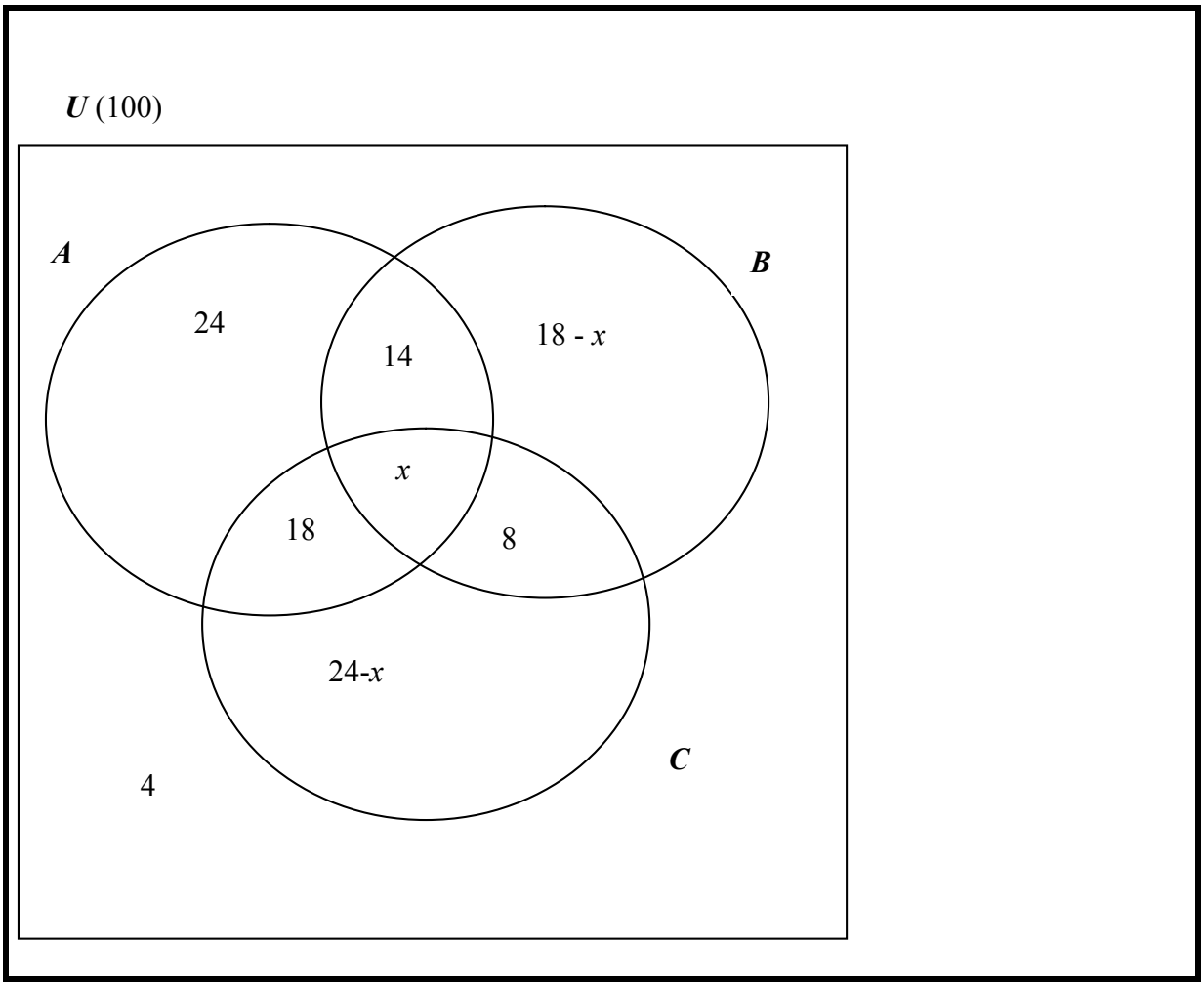
(i) ✍ Using x to represent the number of students who had a presence on all three websites, construct a Venn diagram and solve for x.

(ii) ✍ Hence, calculate the ratio of students with a presence on B only to the students with a presence on C only.

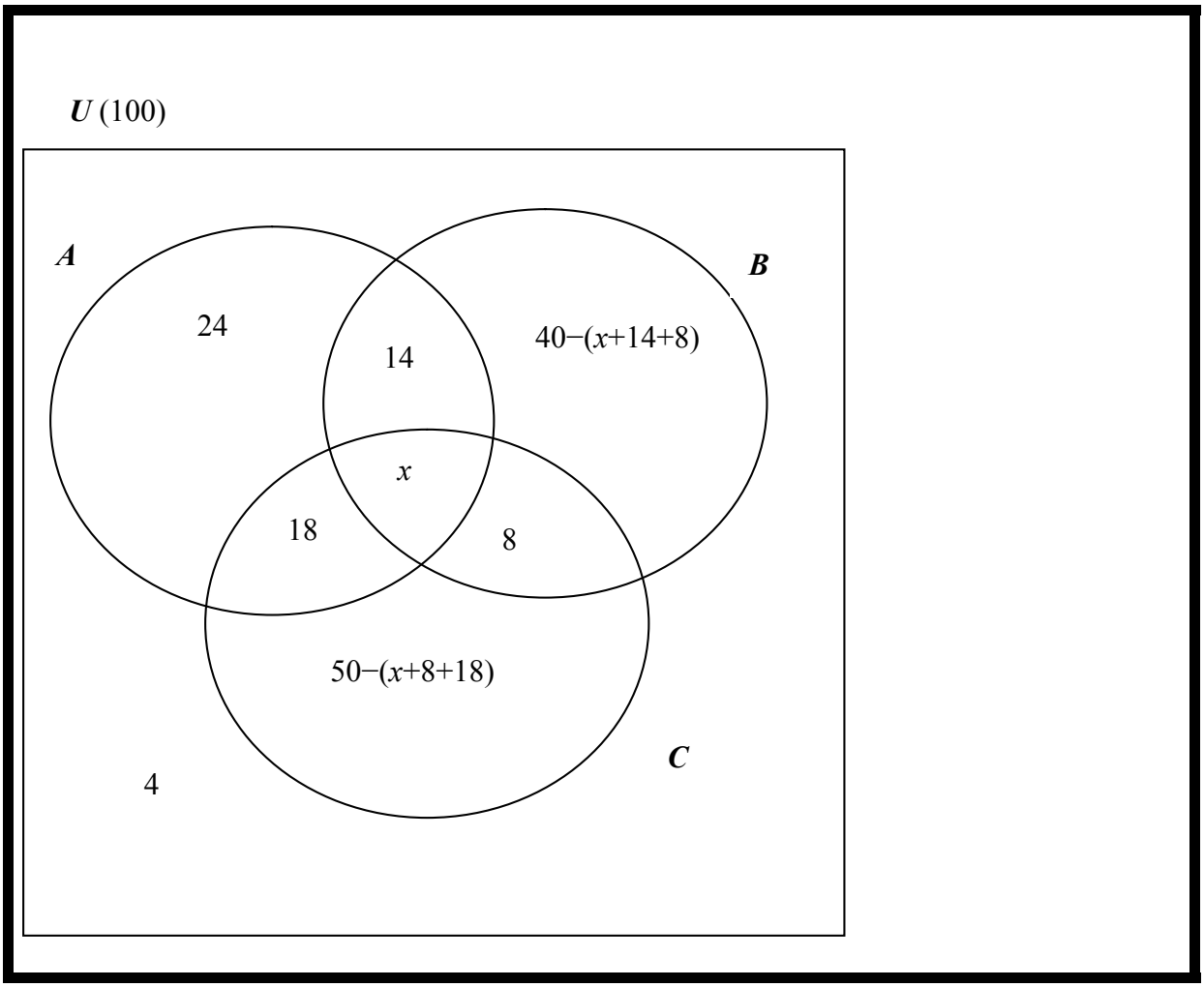
(b) (i) Venn diagram **5 marks** **Att 2**



or



or



Slips (-1)
S1 Each incorrect or misplaced or missing entry from the Venn Diagram, to a max of -3
S2 Universal box not drawn on diagram
S3 U = 100 not indicated on diagram

Attempts (2 marks)
A1 Any correct entry
A2 Draws a Venn Diagram of 3 intersecting circles and stops

Worthless (0)
W1 Diagram of one or two circles, but note A1

(b) (i) Value of x **10 marks** **Att 3**

I

$24 + 14 + 18 + x + 18 - x + 8 + 24 - x + 4 = 100$

$110 - x = 100$

$-x = -10$

$x = 10$

II

$24 + 14 + 18 + x + 18 - x + 8 + 24 - x = 96$

$106 - x = 96$

$-x = -10$

$x = 10$

*Accept candidate's work from previous part, provided it does not oversimplify the question

Blunders (-3)

B1 Correct answer, no work shown ✍

B2 Transposition error

B3 Mathematical error

B4 #U not equal to 100 in **I**

B5 Each missing or incorrect element from previous work in forming equation, to a max of 2; but if equation is oversimplified Att 3 applies

B6 Distribution error

Attempts (3 marks)

A1 Any correct term in forming equation and stops

A2 Any effort to combine terms from Venn Diagram

A3 Oversimplification (*e.g.* uses 40 and 50 to get $x = -46$ *etc.*)

Worthless (0)

W1 Incorrect answer, no work shown

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

Ratio B only: C only
$18 - x : 24 - x$
$18 - 10 : 24 - 10$
$8 : 14 = 4 : 7$

* Accept candidate's value of x from previous part
* Accept 8 : 14 (or equivalent) for full marks with work

Blunders (-3)

B1 Correct answer, no work shown ✍
B2 Value of x from previous part not used
B3 Mathematical error
B4 Fails to find ratio, stops at 18 – 10 : 24 – 10

Slips (-1)
S1 Finds ratio C only: B only (14 : 8 *or* 7:4)
S2 Numerical errors to a max of 3
S3 Two numbers correct in correct order, with no ratio sign

Attempts (2 marks)
A1 States $18 - x$ or $24 - x$ or candidate's equivalent from (b)(i) and stops
A2 Mention of 8 or 14 in this section, or candidate's equivalent. This may appear on the diagram
A3 Ratio of two numbers

Worthless (0)
W1 Produces the same diagram as in (b)(i) without relevant work

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

€2000 was invested at r% for 2 years compound interest.
A tax of 25% was deducted each year from the interest gained.
At the end of the first year the investment amounted to €2030, after tax was deducted.

(i) ✍ Calculate the rate of interest r%.

(ii) ✍ Find the amount of the investment at the end of 2 years, after tax has been deducted.

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

I

€2030 – €2000 = €30
€30 = 75%
$^{30}/_{75} = 0 \cdot 4 = 1\%$
$0 \cdot 4 \times 100 = €\ 40$ = Interest
$^{40}/_{2000} \times {}^{100}/_{1}$
Rate of interest $r = 2\%$

II

$€2000 \times {}^{r}/_{100} = 20r$
$20r \times {}^{25}/_{100} = {}^{500r}/_{100} = 5r$
$20r - 5r = 15r$ (*or* $20r \times {}^{75}/_{100} = 15r$)
$15r = 30$
$r = 2\ \%$

* Answer of $r = 1{\cdot}5\%$ with work is worth 4 marks
* Stops at $15r$ *or* at € 40 is worth 4 marks
* $^{40}/_{2000} \times {}^{100}/_{1}$ is worth 7 marks

Blunders (-3)

B1 Correct answer, no work shown ✍
B2 Mathematical error
B3 Incorrect operation
B4 Incorrect transposition
B5 Inverted fraction
B6 Expresses % as incorrect fraction and continues

Slips (-1)

S1 Numerical error to a max of 3

Attempts (3 marks)

A1 Finds 30 and stops
A2 Expresses 25% or 75% as a correct fraction and stops
A3 Any relevant step

Worthless (0)

W1 Incorrect answer, no work shown

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

€2030 × $^{2}/_{100}$ = €40·60 *Interest*
€40·60 × $^{25}/_{100}$ = €10·15 *Tax on interest*
€40·60 – €10·15 = €30·45 *Interest less tax* (*or* €40·60 × $^{75}/_{100}$ = €30·45)
€2030 + €30·45 = €2060·45 *Value of the investment*

* Accept candidate's *r* from previous part

Blunders (-3)

B1 Correct answer, no work shown ✍
B2 Mathematical error
B3 Decimal error
B4 Different value of *r* from previous part (unless worked out again in this part: mark on slip and blunder)
B5 Mishandles 25% or 75%
B6 Fails to finish

Slips (-1)

S1 Numerical error to a max of 3

Attempts (3 marks)

A1 Some correct effort to find interest before tax
A2 Some correct effort to simplify 25% or 75%
A3 Any relevant step

Worthless (0)

W1 Incorrect answer, no work shown

QUESTION 3

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**

✍ Write the reciprocal of 10 000 in the form 1×10^{n}, where $n \in \mathbf{Z}$.

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

$^{1}/_{10000} = {}^{1}/_{10^{4}}$ (*or* 0·0001)
$= 10^{-4}$
Answer $= 1 \times 10^{-4}$

Blunders (-3)

B1 Correct answer, no work shown ✍
B2 Not in form of $\mathbf{1} \times 10^{n}$, final answer left as 10^{-4} , with work
B3 Index error *e.g.* answer given as 1×10^{4} , with work
B4 Final answer given as $1 \times {}^{1}/_{10^{4}}$ *or* $1 \times 0{\cdot}0001$, with work
B5 Decimal error

Attempts (3 marks)

A1 Indicates knowledge of reciprocal
A2 10^{4} without work

Worthless (0)

W1 Incorrect answer, no work shown, but note A2

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

A builders' supplier sells two types of copper pipes.
One has a narrow diameter and costs €*x* per length.
The other has a wider diameter and costs €*y* per length.
Tony buys 14 lengths of the narrow diameter pipes and 10 lengths of the wider diameter pipes at a cost of €555.
Gerry buys 12 lengths of the narrow diameter pipes and 5 lengths of the wider diameter pipes at a cost of €390.

(i) Write two equations to represent the above information.

(ii) ✍ Solve these equations to find the cost of a length of each type of copper pipe.

(b) (i) **15(10, 5) marks** **Att(3, 2)**

$14x + 10y = 555$
$12x + 5y = 390$

* Two equations to mark in (**b) (i)**
* Each equation is marked independently of the other; the first is worth 10 marks, with Att 3 for any correct work, the second 5 marks, Att 2.

Blunders (-3)

B1 Incorrect term, once per equation

Attempts (3,2 marks)

A1 $14x$ or $10y$ or $12x$ or $5y$

A2 Effort at creating an equation equal to 555 or 390

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

I

$14x + 10y = 555$
$12x + 5y = 390$
(-2) **3 m**
$14x + 10y = 555$
$-24x - 10y = -780$
$-10x = -225$ **4m**
$x = €22{\cdot}50$ **7 m**

$14(22.5) + 10y = 555$
$315 + 10y = 555$
$10y = 240$
$y = €24$ **10 m**

II

$14x + 10y = 555$ $\times 6$
$12x + 5y = 390$ $\times -7$ **3m**

$86x + 60y = 3330$
$-84x - 35y = -2730$

$25y = 600$ **4m**
$y = €24{\cdot}00$ **7m**

$14x + 10(24) = 555$
$14x + 240 = 555$

$14x = 315$
$x = €22{\cdot}50$ **10m**

III

$14x + 10y = 555$
$12x + 5y = 390$

$14x = 555 - 10y$ **3m**

$x = \frac{555-10y}{14}$

$12\left(\frac{555-10y}{14}\right) + 5y = 390 \quad (\times 14)$

$6660 - 120y + 70y = 5460$
$-50y = -1200$ **4m**

$y =$ €24·00 **7m**

$x = \frac{555-10(24)}{14}$

$x =$ €22·50 **10m**

IV

$14x + 10y = 555$
$12x + 5y = 390$

$5y = 390 - 12x$ **3m**

$y = \frac{390-12x}{5}$

$14x + 10\left(\frac{390-12x}{5}\right) = 555 \quad (\times 5)$

$70x + 3900 - 120x = 2775$
$-50x = -1125$ **4m**

$x =$ €22·50 **7m**

$y = \frac{390-12(22.5)}{5}$
$y =$ €24·00 **10m**

Notes

* 1. Accept candidate's equations from part **(b)(i)** provided that it does not oversimplify
* 2. Apply only one blunder deduction in establishing the first equation in terms of x only or the first equation in terms of y only
*3. Finding the second variable is subject to a maximum deduction of 3 marks
*4. Correct values without algebraic work, **both verified** in **both equations** merits **10 marks**
*5. Correct values without algebraic work **not verified or not fully verified** merits attempt **3 marks**

Blunders (-3)

B1 Finds one variable only
B2 Distribution error
B3 Mathematical error
B4 Incorrect substitution when finding second variable, but note M1
B5 Transposition error in solving first variable
B6 Transposition errors in solving second variable
B7 Error(s) in establishing the first equation in terms of x only ($-10x = -225$) or the first equation in terms of y only ($25y = 600$) through elimination by cancellation (**I** and **II**)
B8 Error(s) in establishing the first equation in terms of x only ($-50x = -1125$) or the first equation in terms of y only ($-50y = -1200$) through elimination or by substitution (**III** and **IV**)

Misreadings (-1)

M1 Misreads digits, provided it doesn't oversimplify answer

Slips (-1)

S1 Numerical errors to a max of −3

Attempts (3 marks)

A1 Any correct manipulation of either given equation and stops
A2 Some correct partial substitution and stops

Worthless (0)

W1 Incorrect answer, no work shown
W2 Trial and error, but see *4 and *5 above

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

(i) ✍ Express in its simplest form:

$$\frac{3}{x+1} - \frac{2}{x+4}$$

(ii) ✍ Hence, or otherwise, solve the equation:

$$\frac{3}{x+1} - \frac{2}{x+4} = \frac{1}{3}$$

giving your answers in the form $a \pm \sqrt{b}$, where $a, b \in \mathbf{N}$.

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

$$\frac{3}{x+1} - \frac{2}{x+4}$$

$$\frac{3(x+4) - 2(x+1)}{(x+1)(x+4)}$$

$$\frac{3x + 12 - 2x - 2}{(x+1)(x+4)}$$

$$\frac{x+10}{(x+1)(x+4)}$$

$$\frac{x+10}{x^2+5x+4}$$

* Accept common denominator as $(x + 1)(x + 4)$. Penalise incorrect multiplication in part (c) (ii).

Blunders (-3)

B1 Correct answer but no work shown. ✍

B2 Incorrect denominator.

B3 Mishandles denominator.

B4 Mishandles numerator.

B5 Distribution error, once if consistent

B6 Mathematical error.

B7 Fails to combine like terms in final answer.

B8 Combining unlike terms and continues.

B9 Reads equation as $\frac{3}{x+1} + \frac{2}{x+4}$.

Continue to apply slips and blunders

Slips (-1)

S1 Numerical errors to a max of −3.

Attempts (2 marks)

A1 Identifies common denominator and stops.

A2 Any correct relevant step and stops.

A3 No denominator used

A4 Oversimplification

Worthless (0)

W1 Incorrect answer and no work shown.

W2 $\frac{3}{x+1} - \frac{2}{x+4} = \frac{1}{2x+5}$

W3 $\frac{3}{x+1} - \frac{2}{x+4} = \frac{1}{5}$ *or* $\frac{1}{3}$ *or* $\frac{1}{-3}$ *etc*

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

5 marks **Att2**	**5 marks** **Att2**
Establishing quadratic equation	**Solving quadratic equation**
I $\frac{x+10}{x^2+5x+4}=\frac{1}{3}$ $3(x+10) = 1(x+1)(x+4)$ $3x + 30 = x^2 + x + 4x + 4$ $x^2 + 2x - 26 = 0$ **5m** **II** $\frac{3}{x+1}-\frac{2}{x+4}=\frac{1}{3}$ $3(3)(x + 4) - 2(3)(x + 1) = (x + 1)(x + 4)$ $9x + 36 - 6x - 6 = x^2 + x + 4x + 4$ $x^2 + 2x - 26 = 0$ **5m**	$a = 1; b = 2; c = -26$ $x=\frac{-2\pm\sqrt{(2)^2-4(1)(-26)}}{2(1)}$ $x=\frac{-2\pm\sqrt{4+104}}{2}$ $x=\frac{-2\pm\sqrt{108}}{2}$ $x=\frac{-2\pm 6\sqrt{3}}{2}$ $-1 \pm 3\sqrt{3}$ *or* $1 \pm 3\sqrt{3}$ (see *) **5m**

* Due to a typographical error, "where $a, b \in N$" should have read "where $a, b \in Z$". Accordingly, accept candidate answers $-1 \pm 3\sqrt{3}$ *or* $1 \pm 3\sqrt{3}$ for full marks.

* Accept candidate's equation for solving, provided it doesn't oversimplify

Blunders (-3)

B1 Correct answer but no work shown. ✍
B2 Fails to group or groups incorrectly.
B3 Combines unlike terms and continues *e.g.* $3x + 30 = 33$
B4 Error in transposition.
B5 Error in quadratic formula (given in tables)
B6 Error in the application of the quadratic formula
B7 Finds only one solution.
B8 Stops at $x = \frac{-2 \pm 6\sqrt{3}}{2}$
B9 Mathematical error
B10 Distribution error

Slips (-1)

S1 Numerical errors to a max of −3.

Attempts (2 marks)

A1 Any correct multiplication and stops.
A2 Simplification to a linear equation may merit at most Att 2 marks.
A3 Solving a linear equation correctly for a single value may merit at most.Att 2 marks
A4 Quadratic formula with some correct substitution
A5 Any correct relevant step

Worthless (0)

W1 Incorrect answer and no work shown.

QUESTION 4

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

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

✍ Solve $3(x-2)-5(x-3) = 1$.

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

$3(x-2)-5(x-3) = 1$
$3x-6-5x+15 = 1$
$3x-5x = 1+6-15$
$-2x = -8$
$2x = 8$
$x = 4$

***** Accept $x = 4$ fully verified in equation for full marks

Blunders (-3)

B1 Correct answer but no work shown ✍
B2 Mathematical error
B3 Transposition error
B4 Distribution error

Slips (-1)

S1 Numerical errors to a max of −3.

Attempts (3 marks)

A1 Some correct relevant work.
A2 Tests any value in the equation and stops but note *

Worthless (0)

W1 Incorrect answer and no work shown.

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

(i) ✍ Simplify fully

$$(3x - 4)(2x^2 + 5x - 2).$$

(ii) ✍ List the elements of the solution set of

$$-5 \leq 3x - 2 < 7, \quad x \in \mathbf{Z}.$$

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

$(3x - 4)(2x^2 + 5x - 2)$

$3x(2x^2 + 5x - 2) - 4(2x^2 + 5x - 2)$ **3m**

$6x^3 + 15x^2 - 6x - 8x^2 - 20x + 8$ **7m**

$6x^3 + 7x^2 - 26x + 8$ **10m**

Blunders (-3)

B1 Correct answer but no work shown. ✍
B2 Mathematical error.
B3 Fails to group or groups incorrectly.
B4 Each incorrect or omitted term.
B5 Distribution error

Slips (-1)

S1 Numerical errors to a max of −3.

Attempts (3 marks)

A1 Some correct relevant work.
A2 Combining unlike terms merits at most attempt mark, subject to marks already secured

Worthless (0)

W1 Incorrect answer and no work shown.

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

I $-5 \leq 3x - 2 < 7$

$-5 + 2 \leq 3x < 7 + 2$

$-3 \leq 3x < 9$

$-1 \leq x < 3$ **7m**

$\{-1, 0, 1, 2\}$ **10m**

II $-5 \leq 3x - 2$

$-5 + 2 \leq 3x$

$-3 \leq 3x \rightarrow -1 \leq x$ **4m**

and $3x - 2 < 7$

$3x < 7 + 2$

$3x < 9 \rightarrow x < 3$ **7m**

$\{-1, 0, 1, 2\}$ **10m**

* One correct inequality with work is worth 4m (*i.e.* $-1 \leq x$ ***or*** $x < 3$)
Two correct inequalities with work is worth 7m (*i.e.* $-1 \leq x$ ***and*** $x < 3$ **or** $-1 \leq x < 3$)
Correct set or list and work is worth 10 marks

* Accept correct answers indicated on a number line, with work

Blunders (-3)

B1 Correct answer but no work shown ✍
B2 Mathematical error
B3 Mishandles inequality
B4 Transposition error
B5 Fails to list.
B6 Ignores the negative value in the original (*i.e.* $5 \leq 3x - 2 < 7$ and continues)
B7 Solves one inequality (B5 may also apply)
B8 $x \in \mathbf{R}$ indicated

Slips (-1)

S1 Numerical errors to a max of −3
S2 Includes the number 3 on the list, but note S3
S3 Each incorrect or missing number to a max of −3

Misreading (-1)

M1 Reverses one or both inequality signs
M2 Omits or includes "equals" incorrectly in inequality, apply once

Attempts (3 marks)

A1 Tests any value in the inequality and stops

Worthless (0)

W1 Number line drawn, no correct range or value indicated

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

Rectangular tiles are to be placed side by side on a wall.
Each tile has a length of x cm.
$\frac{300}{x}$ of these tiles are required.

(i) If each tile was 1 cm longer, write down an expression in x for the number of tiles that would now be required.

(ii) If the longer tiles were used, the number of tiles required would decrease by 10.

✍ Write an equation in x to represent this information.

(iii) ✍ Solve this equation to find the value of x.

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

$$\frac{300}{x+1}$$

Blunders (-3)
B1 Inversion
B2 $x + 1$ only

Attempts (2 marks)
A1 Effort to form relevant expression *e.g.* $\frac{300}{x} + 1$
A2 Uses $x + 1$

Worthless (0)
W1 $\frac{300}{x}$ *or* $\frac{300}{1x}$

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

$\frac{300}{x} - \frac{300}{x+1} = 10$ (or equivalent, based on **(c) (i)**)

* Accept candidate's answer from **(c) (i)** above

Blunders (-3)
B1 Error in setting up equation $\frac{300}{x} + \frac{300}{x+1} = 10$ *or* $\frac{300}{x+1} - \frac{300}{x} = 10$
B2 Writes correct expression with required terms but no equal sign

Attempts (2 marks)
A1 Must construct an equation or expression using at least two of the following:
10, answer (i), $\frac{300}{x}$

Worthless (0)
W1 $\frac{300}{x}$

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

$\frac{300(x+1)-300x}{(x)(x+1)} = 10$

$\frac{300x+300-300x}{(x)(x+1)} = 10$

$\frac{300}{(x)(x+1)} = 10$

$300 = 10(x)(x+1)$

$300 = 10(x^2+x)$ **2m**

$30 = x^2 + x$ ***or*** $x^2 + x - 30 = 0$ ***or*** $300 = 10x^2 + 10x$ **5m**

$x^2 + x - 30 = 0$

$(x + 6)(x - 5) = 0$

$x = -6, \ x = 5$ **4m**

Solution: $x = 5$. **5m**

*Mark in **two** parts : 5 marks for **equation** and 5 marks for **solving**

*Accept candidate's expression from **(c) (ii)** provided it doesn't oversimplify the question

Blunders (-3)

B1 Correct answer, no work shown ✍

B2 Mathematical error in forming equation

B3 Distribution error

B4 Transposition error

B5 Incorrect factors

B6 Correct factors and stops

B7 Errors using quadratic formula

Slips (-1)

S1 Numerical errors to a max of 3

S2 Stops at $x = -6$, $x = 5$ or concludes $x = -6$

Attempts (2 marks)

A1 Linear equation in x merits attempt at most

A2 Any correct relevant step

Worthless (0)

W1 Incorrect answer and no work shown

W2 ( )( )

QUESTION 5

Part (a)	**5 marks**	**Att 2**
Part (b)	**25(15, 10) marks**	**Att(5, 3)**
Part (c)	**20(5, 15) marks**	**Att(2, 5)**

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

✍ Given that $c = \sqrt{y - x}$, write x in terms of c and y.

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

$c^2 = y - x$
$c^2 - y = -x$
$x = y - c^2$.

Blunders (-3)

B1 Correct answer, no work shown ✍
B2 Transposition error
B3 Solves for y
B4 Square root error
B5 Mathematical error

Attempts (2 marks)

A1 Some correct relevant work *e.g.* effort at squaring or effort to isolate x.

Worthless (0)

W1 Incorrect answer and no work shown
W2 Interchanges x and c to get $x = \sqrt{y - c}$

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

(i) ✍ When $m = {}^{2}\!/_{5}$ and $n = {}^{5}\!/_{4}$, find the value of $\frac{1}{2m} - \frac{1}{3n}$.

Write your answer in the form $\frac{a}{b}$, where $a, b \in \mathbf{N}$.

(ii) ✍ Use factors to simplify

$$\frac{3x^2 - 19x - 14}{x^2 - 49}$$

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

I

$$\frac{1}{2m} = \frac{1}{2\left(\frac{2}{5}\right)} = \frac{1}{\frac{4}{5}} = \frac{5}{4}$$

$$\frac{1}{3n} = \frac{1}{3\left(\frac{5}{4}\right)} = \frac{1}{\frac{15}{4}} = \frac{4}{15}$$

$$\frac{5}{4} - \frac{4}{15} = \frac{75 - 16}{60} = \frac{59}{60}$$

II $\frac{1}{2m} - \frac{1}{3n} = \frac{13n-2m}{6mn} = \frac{3\left(\frac{5}{4}\right)-2\left(\frac{2}{5}\right)}{6\left(\frac{2}{5}\right)\left(\frac{5}{4}\right)} = \frac{\frac{15}{4}-\frac{4}{5}}{3} = \frac{\frac{59}{20}}{3} = \frac{59}{60}$

Blunders (-3)

B1 Correct answer, no work shown ✍

B2 Answer not in correct form ${}^{a}\!/_{b}$ (*e.g.*·9833333333 decimal answer). May also incur other blunders

B3 Incorrect denominator or mishandles denominator

B4 Error in multiplying fractions

B5 Error in subtracting fractions

B6 Error in dividing fractions

B7 Mathematical error

B8 Substitution error, but note M1

Misreading (-1)

M1 Swaps values of *m* and *n* when substituting

Slips (-1)

S1 Numerical errors to a max of 3

Attempts (5 marks)

A1 Finds common denominator and stops

A2 Some correct substitution

A3 Effort to subtract candidate's values of $\frac{1}{3n}$ from $\frac{1}{2m}$

Worthless (0)

W1 Incorrect answer and no work shown

W2 0·4 and/or 1·25, but note A2

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

I

$$\frac{3x^2 - 19x - 14}{x^2 - 49}$$

$$= \frac{(3x + 2)(x - 7)}{(x + 7)(x - 7)} = \frac{(3x + 2)}{(x + 7)}$$

II

$$\frac{3x^2 - 19x - 14}{x^2 - 49}$$

$$\frac{3x^2 - 21x + 2x - 14}{(x + 7)(x - 7)} = \frac{3x(x - 7) + 2(x - 7)}{(x + 7)(x - 7)}$$

$$= \frac{(3x + 2)(x - 7)}{(x + 7)(x - 7)} = \frac{(3x + 2)}{(x + 7)}$$

* 1 $\frac{(3x-2)(x+7)}{(x+7)(x-7)}$ and continues is one blunder

* 2 Candidate may use quadratic to solve numerator = 0. $x = 7$ and $x = -\frac{2}{3}$ $\Rightarrow$ $(x-7)(3x + 2)$ and continues.

Blunders (-3)

B1 Correct answer, no work shown ✍
B2 Incorrect factors of denominator
B3 Incorrect factors $3x^2$
B4 Incorrect factors of –14
B5 Incorrect factors, leading to an incorrect middle term
B6 Fails to finish
B7 Blunder in quadratic
B8 Substitution error in quadratic

Attempts (3 marks)

A1 Sets up factors or sets up quadratic, identifies *a*, *b* or *c*
A2 Finds guide number or a relevant number **II**
A3 Uses formula and stops at roots
A4 Mentions difference of 2 squares
A5 Any correct relevant step
A6 Quadratic with some correct substitution. (See *2)

Worthless (0)

W1 Incorrect answer and no work shown
W2 ( )( )

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

Let f be the function $f: x \rightarrow -x^2 - 4x + 5, \quad x \in \mathbf{R}$.

(i) ✍ Find the co-ordinates of the points where the graph of $f(x)$ cuts the x-axis.

(ii) ✍ Solve $f(x) = f(x + 1)$.

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

I $-x^2 - 4x + 5 = \mathbf{0}$

$(-x - 5)(x - 1) = 0$

$-x = 5 \qquad x - 1 = 0$

$x = -5 \qquad x = 1$

Cuts the x-axis at (-5, 0) and (1, 0).

II $-x^2 - 4x + 5 = \mathbf{0}$

$a = -1, b = -4, c = 5$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(-1)(5)}}{2(-1)} = \frac{4 \pm \sqrt{36}}{-2} = \frac{4 \pm 6}{-2} = -5 \text{ and } 1$$

Cuts the x-axis at (-5, 0) and (1, 0)

* Accept $x^2 + 4x - 5 = 0$ solved correctly using **I** or **II** for full marks

* The two correct x values verified fully by trial and error = full marks

* Accept graph with points of intersection indicated correctly, *with work*

Blunders (-3)

B1 Correct answer, no work shown ✍

B2 Incorrect factors of $-x^2$

B3 Incorrect factors of 5

B4 Incorrect factors leading to an incorrect middle term

B5 Transposition error

B6 Mathematical error

B7 Fails to find roots

B8 Graph showing correct points of intersection, no work otherwise

Slips (-1)

S1 Numerical errors to a max of 3

S2 Does not state co-ordinates, apply once

Attempts (2 marks)

A1 Some correct relevant work

A2 Tries to set up factors

A3 Quadratic with some correct substitution

A4 Correct x value(s) without algebraic work, not fully verified or not verified

A5 (0,5) or $y = 5$ stated (where graph cuts the y axis)

Worthless (0)
W1 Incorrect answer and no work shown
W2 Trial and error of x values other than $x = -5$ and $x = 1$
W3 States $x = 5$, no work
W4 ( )( )

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

$f(x) = -x^2 - 4x + 5$

$f(x + 1) = -(x + 1)^2 - 4(x + 1) + 5$

$-(x^2 + 2x + 1) - 4x - 4 + 5$
$-x^2 - 2x - 1 - 4x + 1$
$-x^2 - 6x$
$f(x) = f(x + 1)$
$-x^2 - 4x + 5 = -x^2 - 6x$
$-x^2 - 4x + 5 + x^2 + 6x = 0$
$2x + 5 = 0$
$2x = -5$
$x = -\frac{5}{2}$

*****Accept $x = -2{\cdot}5$ fully verified in $f(x) = f(x + 1)$ for full marks

Blunders (-3)
B1 Correct answer, no work shown ✍
B2 Mathematical error
B3 Substitution error, provided it does not oversimplify question
B4 Distribution error
B5 Error in squaring
B6 Transposition error

Slips (-1)
S1 Numerical errors to a max of 3

Attempts (5 marks)

A1 Some correct relevant substitution

Worthless (0)
W1 Incorrect answer and no work shown
W2 $f(x) = f(x + 1)$
W3 $x = x + 1$, even if continued

QUESTION 6

Part (a)	**5 marks**	**Att 2**
Part (b)	**30(10, 10, 5, 5) marks**	**Att(3, 3, 2, 2)**
Part (c)	**15(5, 5, 5) marks**	**Att(2, 2, 2)**

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

Let h be the function $h : x \to \sqrt{x+4}$.

✍ Show that $h(0) > h(-4)$.

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

$h(0) = \sqrt{0+4} \quad \sqrt{4} = 2$ **2m**

$h(-4) = \sqrt{-4+4} = \sqrt{0} = 0$ **2m**

$h(0) > h(-4)$ or $2>0$ **5m**

Blunders (-3)

B1 Correct answer *(i.e* **2 > 0**), no work shown ✍
B2 Incorrect $h(0)$
B3 Incorrect $h(-4)$
B4 $\sqrt{4} = -2$ leading to incorrect conclusion
B5 Fails to finish

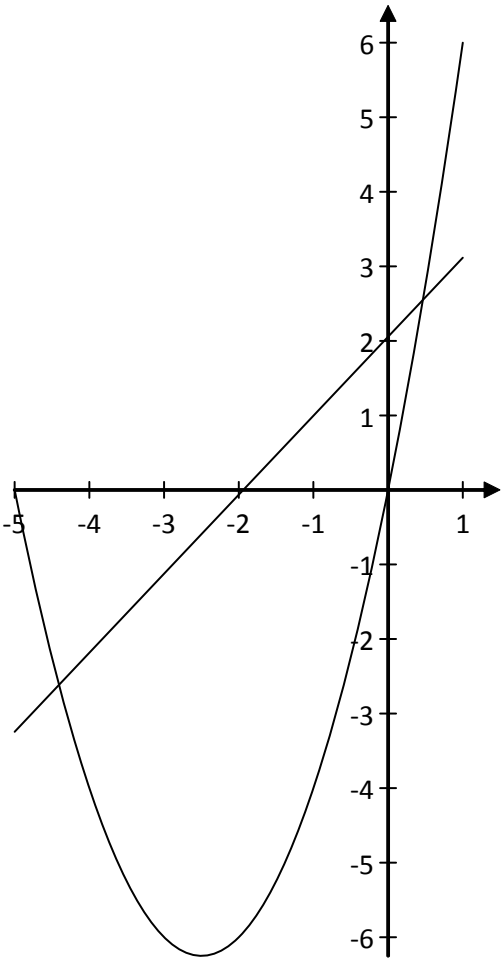
Attempts (2 marks)
A1 Some correct relevant substitution

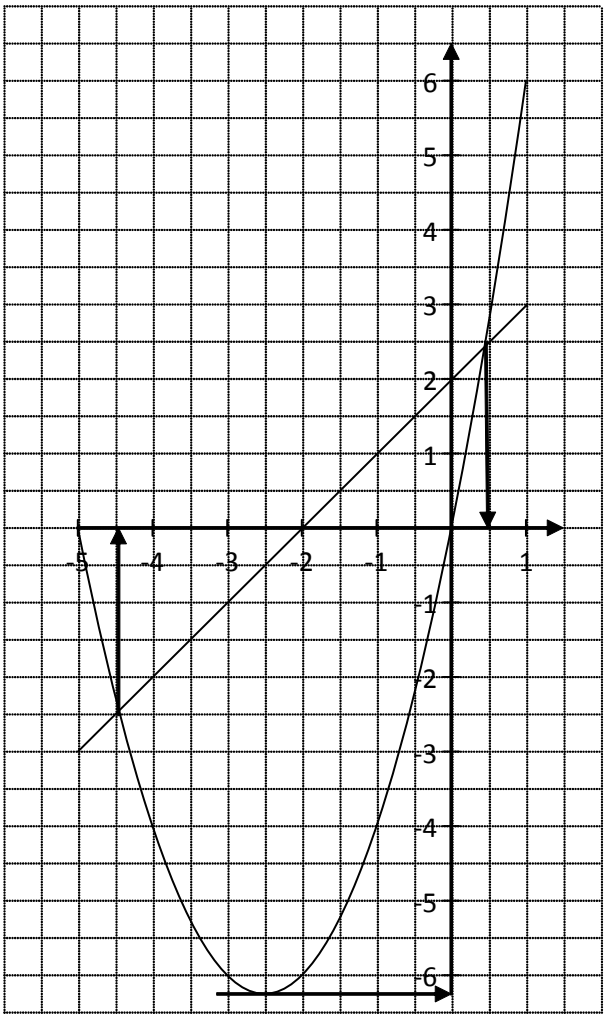
Worthless (0)
W1 Incorrect answer and no work of merit
W2 $h(0) > h(-4)$
W3 $0 > -4$ and no work of merit

Part (b) **30(10, 10, 5, 5) marks** **Att(3, 3, 2, 2)**

Let f be the function $f: x \to x^2 + 5x$ and let g be the function $g: x \to x + 2$.

✍ Using the same axes and scales, draw the graph of f and the graph of g, for $-5 \leq x \leq 1$, $x \in \mathbf{R}$.





or

(b) Function *f* **20 (10, 10) marks** **Att (3, 3)**

$f : x \to x^2 + 5x$

x	-5	-4	-3	-2	-1	0	1
x^2	25	16	9	4	1	0	1
$+5x$	-25	-20	-15	-10	-5	0	5
$f(x)$	0	-4	-6	-6	-4	0	6

* Table is worth 10 marks, graph is 10 marks
* Middle lines of table do not have to be shown
* Candidate may choose not to use a table.
* Points might not be listed, mark on position on graph
* Graph constitutes work in this question ✍

Blunders (-3)

B1 Error in calculating x^2, if consistent penalise once, but note A3
B2 Error in calculating $5x$, if consistent penalise once
B3 Error in calculating last line of table, once if consistent
B4 Each incorrect point without work
B5 Point plotted incorrectly, once only if consistent
B6 Incomplete domain
B7 Axes scaled incorrectly, once only
B8 Reversed axes
B9 No curve between (–3,–6) and (–2, –6) on graph

Slips (-1)

S1 Numerical errors to a max of 3

Attempts (3 ,3 marks)

A1 Some correct substitution
A2 Draws axes, with some indication of scaling
A3 Error leading to a linear graph

(b) Function *g* **10 (5, 5) marks** **Att (2, 2)**

$g: x \rightarrow x + 2$.

x	-5	-4	-3	-2	-1	0	1
+2	2	2	2	2	2	2	2
$g(x)$	-3	-2	-1	0	1	2	3

* Table is worth 5 marks, graph is 5 marks
* In g(x) function only 2 points are necessary in calculation; graph must be drawn from -5 to 1
* Middle lines of table do not have to be shown
* Candidate may choose not to use a table.
* Points might not be listed, mark on position on graph
* Graph constitutes work in this question ✍

Blunders (-3)

B1 Graphs not drawn on the same axes or scales (apply once only)
B1 Error in "*x"* line
B2 Error in "2" line
B3 Error in calculating last line of table, once if consistent
B4 Each incorrect point without work
B5 Point plotted incorrectly, once only if consistent
B6 Incomplete domain
B8 Axes scaled incorrectly
B9 Reversed axes, but if already blundered, do not penalise again

Slips (-1)

S1 Numerical errors to a max of 3

Attempts (2,2 marks)

A1 Some correct substitution
A2 Draws axes, with some indication of scaling

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

Use your graphs from part **(b)** to estimate:

(i) ✍ The minimum value of $f(x)$

(ii) ✍ The values of x for which $f(x) = g(x)$

(iii) The range of values of x for which $f(x) \leq g(x)$.

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

The minimum value of $f(x)$ = -6·25

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

$f(x) = g(x)$ at $x = 0{\cdot}5$ and x = -4·5

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

The range of values of x for which $f(x) \leq g(x)$.

$-4{\cdot}5 \leq x \leq 0{\cdot}5$

***** Apply marks to parts **(c) (i) (ii)** and **(iii)**

*****Accept "from –4·5 to ·5" for **(c) (iii)**

Blunders (-3)

B1 Value(s) not consistent with candidate's graph, tolerance ± ·2

B2 Fails to use graph

B3 y values given instead of x values **(ii)** and **(iii)**

B4 x value only given instead of $f(x)$ in **(c) (i)**

Slips (-1)

S1 In **(c) (i)** answer given as minimum point instead of minimum value

S2 In **(c) (iii) "<"** given instead of **""** or states "**between** –4·5 and ·5"

Misreading (-1)

M1 $f(x) \geq g(x)$

Attempts (2 marks)

A1 Some correct substitution

A2 Some correct indication of answer on graph

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

Coimisiún na Scrúduithe Stáit
State Examinations Commission

JUNIOR CERTIFICATE EXAMINATION

2010

MARKING SCHEME

MATHEMATICS HIGHER LEVEL PAPER 2

MARKING SCHEME
JUNIOR CERTIFICATE EXAMINATION 2010
MATHEMATICS - HIGHER 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.

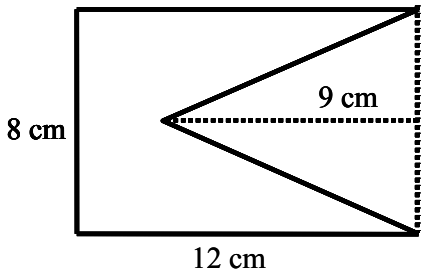
QUESTION 1

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

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

The diagram shows a rectangular piece of cardboard with a triangular section cut out.

✍ Calculate the area of the cardboard.



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

The area of the rectangle = $12 \times 8 = 96$ cm^2 Step 1

The area of the triangle = $\frac{1}{2}(8 \times 9) = 36$ cm^2 Step 2

$\therefore$ The area of the cardboard = $96 - 36 = 60$ cm^2 Step 3

or

Divide the cardboard into a rectangle of length 3, width 8 and two right angled triangles of base 4, height 9.

The area of the rectangle = $3 \times 8 = 24$ cm^2 Step 1

The area of the two triangles = $2.\frac{1}{2}(4 \times 9) = 36$ cm^2 Step 2

$\therefore$ The area of the cardboard = $24 + 36 = 60$ cm^2 Step 3

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect relevant formula
B3 Failure to subtract/add

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*

Attempts (3 marks)

A1 Area rectangle = $l \times b$

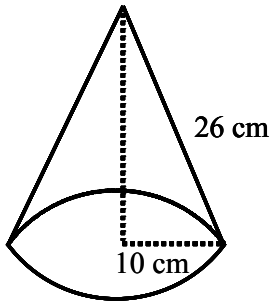
A2 Area triangle = $\frac{1}{2}$ base $\times$ perpendicular height , with some substitution

Worthless (0)

W1 Volume formula
W2 Perimeter formula

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

A cone has a slant height of 26 cm and a radius of 10 cm.



(i) ✍ Find the curved surface area of the cone, in terms of π.

The curved surface area of the cone is doubled, while the slant height remains the same.

(ii) ✍ Find the radius and hence the vertical height of this cone, correct to the nearest cm.

(iii) ✍ Show that the volume of this cone is more than double the volume of the cone part **(i)**.

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

$$\text{Curved surface area} = \pi rl$$
$$= \pi(10)(26)$$
$$= 260\pi \text{ cm}^2$$

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect relevant area formula
B3 $r \neq 10$
B4 $l \neq 26$

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*
S2 Answer not in terms of π

Attempts (2 marks)

A1 Correct formula with some substitution

Worthless (0)

W1 Volume of cone

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

$\text{Curved surface area} = 2(260\pi) = 520\pi$

$\Rightarrow \pi rl = 520\pi$

$\Rightarrow \pi r(26) = 520\pi$

$\Rightarrow r = 20$

$l^2 = h^2 + r^2$

$\Rightarrow 26^2 = h^2 + 20^2$

$\Rightarrow 676 = h^2 + 400$

$\Rightarrow h^2 = 276$

$\Rightarrow h = 16 \cdot 6 = 17 \text{ cm}$

* Accept candidate's answer from (b) (i)

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect substitution into correct formula
B3 Incorrect relevant formula
B4 Curved surface area ≠ 520π or candidate's equivalent
B5 $h^2 = 276$ and stops
B6 $\sqrt{276} \neq 16 \cdot 6$
B7 Incorrect squaring

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*
S2 Answer for *h* not rounded off or incorrectly rounded

Misreadings (-1)

M1 Slant height doubled and curved surface area the same

Attempts (2 marks)

A1 *r* only
A2 $l^2 = h^2 + r^2$
A3 Curved surface area = 520π or candidate's equivalent
A4 Correct formula with some substitution

Worthless (0)

W1 Volume formula

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

Original cone : $l^2 = h^2 + r^2$

$\Rightarrow 26^2 = h^2 + 10^2$

$\Rightarrow 676 = h^2 + 100$

$\Rightarrow h^2 = 576$

$\Rightarrow h = 24$

Volume of original cone $= \frac{1}{3}\pi r^2 h$

$= \frac{1}{3}\pi(10)^2(24)$

$= 800\pi \quad (2513 \cdot 27)\,\text{cm}^3$ Step 1

Volume of new cone $= \frac{1}{3}\pi r^2 h$

$= \frac{1}{3}\pi(20)^2(17)$ or $\frac{1}{3}\pi(20)^2(16 \cdot 6)$

$= 2266\frac{2}{3}\pi$ or $2213\frac{1}{3}\pi \quad (7120 \cdot 94 \text{ or } 6953 \cdot 39)$ Step 2

$2266\frac{2}{3}\pi > 2(800\pi)$ or $2213\frac{1}{3}\pi > 2(800\pi)$ **or** $2266\frac{2}{3} > 2(800)$ or $2213\frac{1}{3} > 2(800)$

$(7120 \cdot 94 / 6953 \cdot 39 > 2(2513 \cdot 27))$ Step 3

* Accept candidate's answer from (b) (ii)

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect relevant formula
B3 Incorrect *h* for either cone
B4 Incorrect *r* for either cone
B5 Incorrect squaring
B6 Volume of original cone not doubled or equivalent

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*
S2 No conclusion or incorrect conclusion

Attempts (3 marks)

A1 $l^2 = h^2 + r^2$
A2 *h* only
A3 Correct formula with some substitution

Worthless (0)

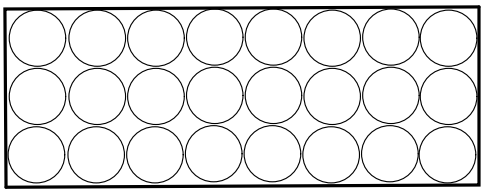
W1 Curved surface area

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

A vitamin capsule is in the shape of a cylinder with hemispherical ends. The length of the capsule is 20 mm and the diameter is 6 mm.

(i) ✍ Calculate the volume of the capsule, giving your answer correct to the nearest mm^3.

A course of these vitamins consists of 24 capsules. The capsules are stacked in three rows of eight in a box as shown in the diagram.



(ii) ✍ How much of the internal volume of the box is not occupied by the capsules.

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

Volume of cylindrical part $= \pi r^2 h$

$= \pi(3)^2(14)$

$= 126\pi$ or $395 \cdot 84\ \text{mm}^3$ Step 1

Volume of hemispherical ends $= 2\left(\frac{2}{3}\pi r^3\right)$

$= \frac{4}{3}\pi(3)^3$

$= 36\pi$ or $113 \cdot 10\ \text{mm}^3$ Step 2

Volume of capsule $= 126\pi + 36\pi$ or $295 \cdot 84 + 113 \cdot 10$

$= 162\pi = 508 \cdot 94$

$= 509\ \text{mm}^3$ Step 3

* Accept $\pi = 3 \cdot 14$ or $\frac{22}{7}$

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect substitution into correct formula
B3 Incorrect relevant volume formula
B4 Incorrect h
B5 Incorrect r
B6 Error in indices, once only
B7 Answer in terms of π
B8 Value of π which affects the accuracy of the answer

Slips (-1)
S1 Arithmetic slips to a maximum of *(-3)*
S2 Answer not rounded off or incorrectly rounded

Attempts (3 marks)
A1 Volume of hemisphere $= \frac{2}{3}\pi r^3$
A2 $r = 3$
A3 $h = 14$
A4 Effort at calculating the volume of either the cylinder or hemisphere/sphere

Worthless (0)
W1 Area formula for both the cylinder and hemisphere/sphere

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

Volume of box $= lbh$	
$= (48)(18)(20)$	
$= 17280\ \text{mm}^3$	Step 1
Volume of 24 capsules $= 24(509)$	
$= 12216\ \text{mm}^3$	Step 2
$\therefore$ Unoccupied volume $= 17280 - 12216 = 5064\ \text{mm}^3$	Step 3

* Accept candidate's answer from (c) (i)

Blunders (-3)
B1 Correct answer without work shown (✍)
B2 Incorrect relevant volume formula
B3 $l \neq 48$
B4 $b \neq 18$
B5 $h \neq 20$
B6 Failure to subtract

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

Attempts (3 marks)
A1 $l = 48$
A2 $b = 18$
A3 $h = 20$
A4 Volume $= l \times b \times h$
A5 Multiplication by 24

Worthless (0)
W1 Area of rectangle

QUESTION 2

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

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

M (-1, 2) is the midpoint of $[PQ]$ and P is the point (-2, -4).

✍ Find the co-ordinates of Q.

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

$P \to M = M \to Q$

$P(-2,-4) \to M(-1,2)$

$x : +1 \quad y : +6$

$M(-1,2) \to (0,8)$

$\therefore Q(0,8)$

or

Let $P = (x, y)$

$$M = \text{Midpoint}\,[PQ] = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

$$= \left(\frac{-2 + x}{2}, \frac{-4 + y}{2}\right)$$

$$\Rightarrow \frac{-2 + x}{2} = -1 \text{ and } \frac{-4 + y}{2} = 2$$

$\Rightarrow x = 0$ and $y = 8$

$\therefore Q(0,8)$

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect relevant formula
B3 Both x and y switched in substitution
B4 Error in translation
B5 Q taken as midpoint of $[MP]$
B6 One coordinate only
B7 Wrong translation

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*
S2 One incorrect substitution for x or y

Attempts (3 marks)

A1 Correct formula with some substitution
A2 Effort at translation
A3 Graphical solution or effort at graphical solution

Worthless (0)

W1 Incorrect formula with or without substitution

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

l is the line $2x - y + 6 = 0$.

(i) ✍ Find the slope of l.

(ii) ✍ Find the equation of the line m through (5, 1) perpendicular to the line l.

(iii) ✍ T is the point of intersection between l and m. Find the coordinates of T.

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

Slope of $l = -\frac{2}{-1} = 2$ **or** $2x - y + 6 = 0$, $\Rightarrow -y = -2x - 6$, $\Rightarrow y = 2x + 6$, $\therefore m = 2$ **or** (0,6) (–3,0) or other points, $m = \frac{0-6}{-3-0}$, $= 2$

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Error in transposition
B3 Incorrect relevant formula
B4 Incorrect point on the line

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*
S2 One incorrect substitution for x or y

Attempts (2 marks)

A1 Indication of $x = 0$ on the y axis and/or $y = 0$ on the x axis
A2 Attempt at finding a point on the line
A3 Correct formula with some substitution
A4 Slope $= -\frac{a}{b}$

Worthless (0)

W1 Incorrect formula with or without substitution

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

Slope of $m = -\frac{1}{2}$

Equation of m:

$y - y_1 = m(x - x_1)$

$y - 1 = -\frac{1}{2}(x - 5)$

$2y - 2 = -x + 5$

$x + 2y - 7 = 0$

* Accept candidate's answer from part (i)

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect relevant formula
B3 Switches both x and y in substitution
B4 Incorrect slope

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*
S2 One incorrect substitution for x or y

Attempts (3 marks)

A1 Indication that the product of the slopes of perpendicular lines is −1
A2 Correct formula with some substitution

Worthless (0)

W1 Incorrect formula with or without substitution

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

$2l : 4x - 2y = -12$

$m : x + 2y = 7$

$2l + m : 5x = -5$

$\Rightarrow x = -1$

Substitution for x into $m : -1 + 2y = 7$

$\Rightarrow 2y = 8$

$\Rightarrow y = 4$

$\therefore T(-1,4)$

or

$l : y = 2x + 6$

Substitution for y into $m : x + 2(2x + 6) = 7$

$5x + 12 = 7$

$5x = -5$

$x = -1$

Substitution for x into $m : -1 + 2y = 7$

$\Rightarrow 2y = 8$

$\Rightarrow y = 4$

$\therefore T(-1,4)$

* Accept candidate's answer from part (ii)

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Error in transposition
B3 Second value not found

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*

Misreadings (-1)

M1 One value found and incorrectly substituted

Attempts (2 marks)

A1 Any correct step
A2 Graphical solution or attempt at a graphical solution – e.g. let $x = 0$ and/or $y = 0$

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

A is the point (1, -3), B is the point (-2, 1), C is the point (4, -2).
D (2, -1) is a point on the line BC.

(i) ✍ Show that AD is perpendicular to BC.

(ii) ✍ Find $|BC|$.

(iii) ✍ Given that $|AD| = \sqrt{5}$, find the area of the triangle ABC.

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

Slope $AD = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{-1-(-3)}{2-1} = \dfrac{2}{1}$ or 2 Step 1

Slope $BC = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{-2-1}{4-(-2)} = \dfrac{-3}{6}$ or $-\dfrac{1}{2}$ Step 2

$2 \times -\dfrac{1}{2} = -1$ Step 3

$\therefore AD \perp BC$

or

$|AD| = \sqrt{(2-1)^2 + (-1-(-3))^2} = \sqrt{(1)^2 + (2)^2} = \sqrt{5}$ Step 1

$|CD| = \sqrt{(4-2)^2 + (-2-(-1))^2} = \sqrt{(2)^2 + (-1)^2} = \sqrt{5}$

$|AC| = \sqrt{(4-1)^2 + (-2-(-3))^2} = \sqrt{(3)^2 + (1)^2} = \sqrt{10}$ Step 2

$|AD|^2 + |CD|^2 = 5 + 5 = 10 = |AC|^2$ Step 3

$\Rightarrow \Delta ADC$ is right angled by Pythagoras' Theorem, with $AD \perp DC$

$\therefore AD \perp BC$

or

$|AD| = \sqrt{(2-1)^2 + (-1-(-3))^2} = \sqrt{(1)^2 + (2)^2} = \sqrt{5}$ Step 1

$|BD| = \sqrt{(2-(-2))^2 + (-1-1)^2} = \sqrt{(4)^2 + (-2)^2} = \sqrt{20}$

$|AB| = \sqrt{(-2-1)^2 + (1-(-3))^2} = \sqrt{(-3)^2 + (4)^2} = \sqrt{25}$ Step 2

$|AD|^2 + |BD|^2 = 5 + 20 = 25 = |AB|^2$ Step 3

$\Rightarrow \Delta ADB$ is right angled by Pythagoras' Theorem, with $AD \perp DB$

$\therefore AD \perp BC$

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect relevant formula
B3 Switches both x and y in substitution
B4 Incorrect squaring
B5 No conclusion or incorrect conclusion for product - i.e.$\neq -1$

Slips (-1)
S1 Arithmetic slips to a maximum of *(-3)*
S2 One sign incorrect having filled into formula correctly
S3 One incorrect substitution for x or y

Attempts (3 marks)
A1 Indication that the product of the slopes of perpendicular lines is -1
A2 Correct formula with some substitution
A3 Graphical solution or attempt at graphical solution

Worthless (0)
W1 Incorrect formula with or without substitution

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

$$|BC| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(4-(-2))^2 + (-2-1)^2}$$
$$= \sqrt{36+9}$$
$$= \sqrt{45} \text{ or } 3\sqrt{5} \text{ or } 6\cdot 71 \text{ or } 6\cdot 7$$

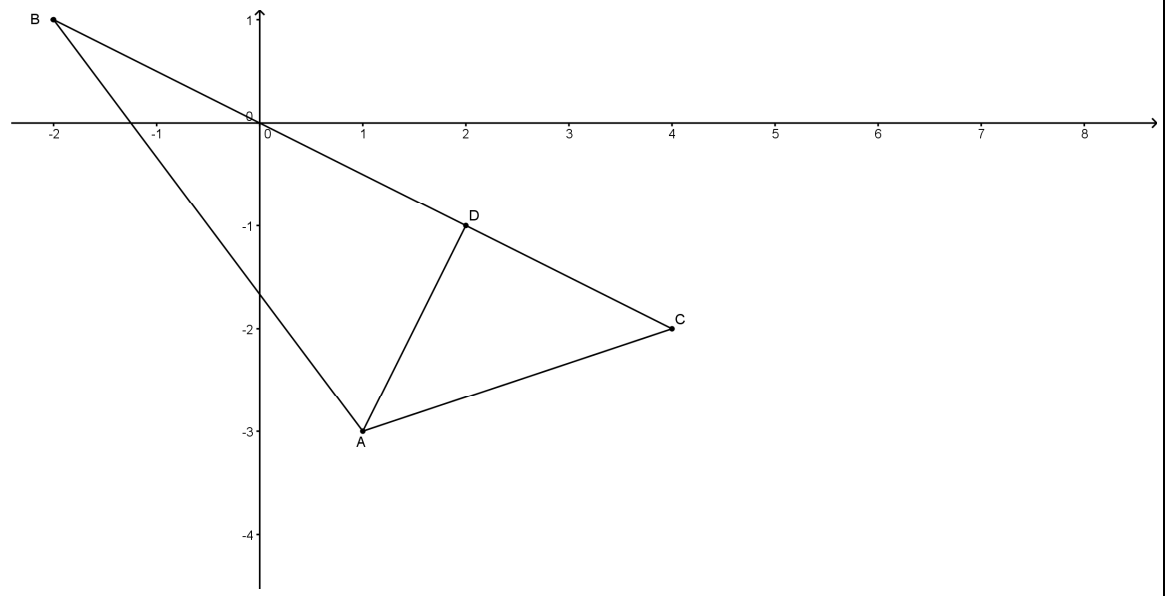
Blunders (-3)
B1 Correct answer without work shown (✍)
B2 Incorrect relevant formula
B3 Switches both x and y in substitution
B4 Incorrect squaring
B5 Answer not simplified
B6 Early rounding which affects the accuracy of the answer

Slips (-1)
S1 Arithmetic slips to a maximum of *(-3)*
S2 One incorrect substitution for x or y

Attempts (2 marks)
A1 Correct formula with some substitution
A2 Attempt at difference of x values and or/ difference of y values

Worthless (0)
W1 Incorrect formula with or without substitution

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



Area triangle $ABC = \frac{1}{2}|BC| \times |AD|$

$= \frac{1}{2}\sqrt{45} \times \sqrt{5}$

$= \frac{1}{2}\sqrt{225}$ or $\frac{15}{2}$ or 7.5 units^2

or

Area triangle $ABC = \frac{1}{2}|BC| \times |AD|$

$= \frac{1}{2}(6 \cdot 71)(2 \cdot 24)$

$= \frac{15 \cdot 034}{2}$ or $7 \cdot 5152$

* Accept candidates answer from part (ii)

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect relevant formula
B3 Answer not simplified
B4 Incorrect square root
B5 Early rounding which affects the accuracy of the answer

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*

Misreadings (-1)

M1 $\sqrt{5}$ misread as 5 or $\sqrt{45}$ misread as 45, but not both

Attempts (2 marks)

A1 Attempt at a graphical solution
A2 Correct area formula with some substitution

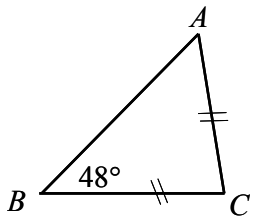
QUESTION 3

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

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

The triangle ABC shown in the diagram is isosceles, with $|AC| = |BC|$ and $\left|\angle ABC\right| = 48°$.

✍ Find $\left|\angle ACB\right|$.



(a) **15 marks** **Att 5**

$|AC| = |BC| \Rightarrow |\angle ABC| = |\angle BAC|$

$\therefore \left|\angle ACB\right| = 180^o - 2(48^o)$

$= 84^o$

* Accept work on diagram

Blunders (-3)

B1 Correct answer without work shown (✍)

B2 Sum of angles in a triangle $\neq 180^o$

B3 $\left|\angle BAC\right| \neq 48^o$

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*

Attempts (5 marks)

A1 Diagram from examination paper drawn with equal angles indicated

A2 $|\angle ABC| = |\angle BAC|$ stated

A3 Indication that angles opposite equal sides are equal in measure

A4 Indication that the sum of the angles in a triangle $= 180^o$

Worthless (0)

W1 Diagram from examination paper either partially or fully drawn

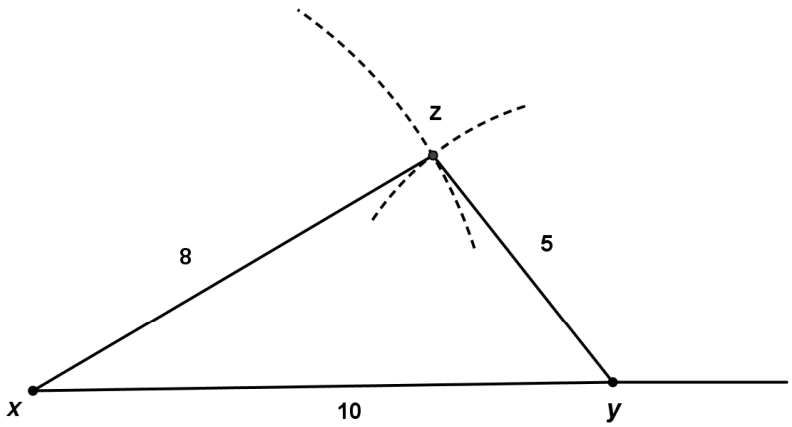
W2 $|\angle ACB| = 48^o$

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

(i) ✍ Show how to construct the triangle XYZ, with sides $|XY| = 10$ cm, $|XZ| = 8$ cm and $|YZ| = 5$ cm.

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

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



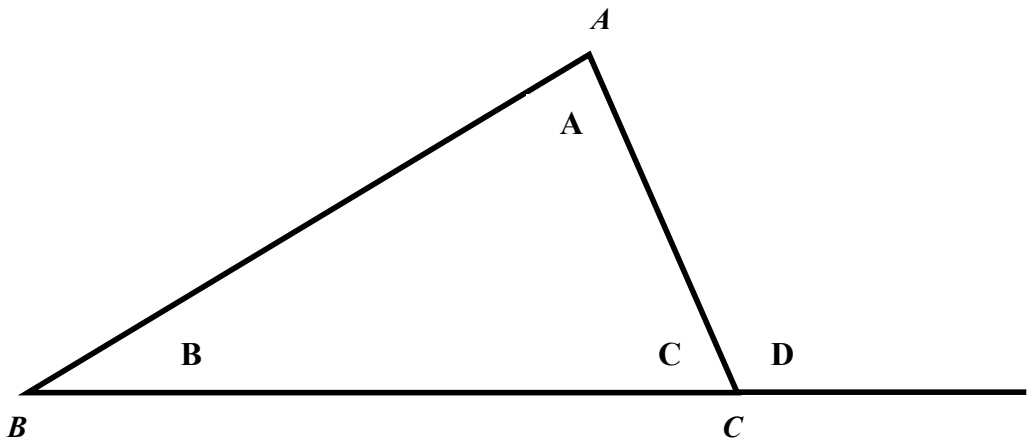
* Accept construction with tolerance of 2 mm

Blunders (-3)
B1 Each incorrect side
B2 Correct triangle but no construction lines
B3 Construction of a right angle between sides

Attempts (5 marks)
A1 No triangle but one correct length drawn
A2 One correct length drawn
A3 Rough diagram drawn with vertices and/or lengths indicated

Worthless (0)
W1 Triangle drawn with no correct length

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



Given: A triangle *ABC*, containing angles A, B and C, with the side [*BC*] extended, giving the exterior angle D.

To Prove**:** $|\angle D| = |\angle A| + |\angle B|$ Step 1

Proof**:**

$|\angle C| + |\angle D| = 180^\circ$ (straight angle)

$|\angle C| + |\angle A| + |\angle B| = 180^\circ$ (angles in a triangle add to 180°) Step 2

$\therefore \quad |\angle C| + |\angle D| = |\angle C| + |\angle A| + |\angle B|$ Step 3

$\therefore \quad |\angle D| = |\angle A| + |\angle B|$

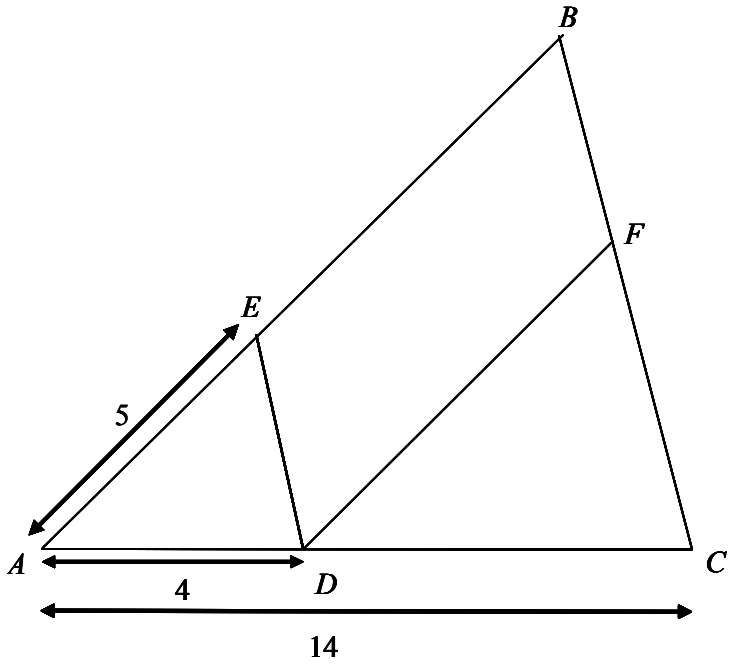
* Some steps may be partially indicated on diagram

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

Attempts (3 marks)
A1 Triangle with exterior angle drawn
A2 Indication that the sum of the angles in a triangle $= 180^\circ$
A3 Triangle drawn with vertices or angles indicated

Worthless (0)
W1 Unlabelled triangle drawn
W2 No diagram or no valid diagram
W3 Wrong theorem

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



In the triangle ABC, $[DE]$ is parallel to $[CB]$, $|AD| = 4$ cm, $|AC| = 14$ cm and $|AE| = 5$ cm.

(i) ✍ Find $|EB|$.

$[DF]$ is parallel to $[AB]$.

(ii) ✍ Find $\dfrac{\text{area } \Delta\ ADE}{\text{area } \Delta\ DCF}$ as a fraction in its simplest form.

[Hint: area of $\Delta = \dfrac{1}{2}ab\sin C$].

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

$$\frac{|AE|}{|AB|} = \frac{|AD|}{|AC|}$$

$$\Rightarrow \frac{5}{|AB|} = \frac{4}{14}$$

$$\Rightarrow |AB| = \frac{70}{4} = 17 \cdot 5$$

$$\Rightarrow |EB| = 17 \cdot 5 - 5 = 12 \cdot 5$$

or

$$\frac{|AE|}{|EB|} = \frac{|AD|}{|DC|}$$

$$\Rightarrow \frac{5}{|EB|} = \frac{4}{10}$$

$$\Rightarrow |EB| = \frac{50}{4} = 12 \cdot 5$$

or

$$\frac{|AC|}{|AD|} = \frac{14}{4} = 3 \cdot 5$$

$$\Rightarrow |AB| = 5 \times 3 \cdot 5$$

$$= 17 \cdot 5$$

$$\Rightarrow |EB| = 17 \cdot 5 - 5$$

$$= 12 \cdot 5$$

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Error in transposition
B3 $\frac{|AE|}{|EB|} = \frac{|AD|}{|AC|}$ or similar incorrect ratio

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*
S2 $|AB|$ found but not $|EB|$

Attempts (2 marks)

A1 Indication of equiangular triangles
A2 Indication of corresponding angles
A3 One correct relevant ratio
A4 Any use of 4 or 10 in a ratio
A5 10 written down without work or on diagram

Worthless (0)

W1 Diagram from examination paper either partially or fully drawn
W2 ΔAED treated as right-angled

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

$[DE]$ is parallel to $[CB]$ and $[DF]$ is parallel to $[AB]$
$\Rightarrow DEBF$ is a parallelogram

$\Rightarrow |DF| = |EB| = 12 \cdot 5$ **or** $\frac{|AB|}{|DF|} = \frac{|AC|}{|DC|} \Rightarrow \frac{17 \cdot 5}{|DF|} = \frac{14}{10}$

$\Rightarrow |DF| = 12 \cdot 5$

Also, $|\angle EAD| = |FDC| \left(|\angle ADE| = |DCF| \text{ and } |\angle AED| = |DFC|\right)$

$$\text{area}\Delta ADE = \tfrac{1}{2}|AE|.|AD|\sin\angle EAD$$
$$= \tfrac{1}{2}(5)(4)\sin\angle EAD$$
$$\text{area}\Delta DCF = \tfrac{1}{2}|DF|.|DC|\sin\angle FDC$$
$$= \tfrac{1}{2}(12 \cdot 5)(10)\sin\angle FDC$$
$$\Rightarrow \frac{\text{area}\Delta ADE}{\text{area}\Delta DCF} = \frac{\tfrac{1}{2}(5)(4)\sin\angle EAD}{\tfrac{1}{2}(12 \cdot 5)(10)\sin\angle FDC}$$
$$= \frac{4}{25}$$

or

$$\text{area } \Delta ADE = \frac{1}{2} \mid AD \mid . \mid DE \mid \sin \angle ADE$$

$$= \frac{1}{2}(4) \mid DE \mid \sin \angle ADE$$

$$= 2 \mid DE \mid \sin \angle ADE$$

$$\text{area } \Delta DCF = \frac{1}{2} \mid DC \mid . \mid FC \mid \sin \angle DCF$$

$$= \frac{1}{2}(10) \mid FC \mid \sin \angle DCF$$

$$= 5 \mid FC \mid \sin \angle DCF$$

$$\mid ED \mid : \mid BC \mid = 4 : 14 = 2 : 7$$

$$\mid ED \mid = \mid BF \mid \Rightarrow \mid ED \mid : \mid FC \mid = 2 : 5$$

$$\mid \angle ADE \mid = \mid \angle DCF \mid$$

$$\therefore \frac{\text{area } \Delta ADE}{\text{area } \Delta DCF} = \frac{2 \mid DE \mid \sin \angle ADE}{5 \mid FC \mid \sin \angle DCF}$$

$$= \frac{2}{5} . \frac{2}{5}$$

$$= \frac{4}{25}$$

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect relevant formula
B3 Ratio not indicated
B4 Ratio not simplified
B5 Error in transposition
B6 Incorrect substitution into correct formula
B7 Incorrect ratio
B8 Angle not specified, once only

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*
S2 Fraction not in simplest form

Attempts (2 marks)

A1 Correct formula with some substitution
A2 Indication of equiangular triangles
A3 One correct relevant ratio

Worthless (0)

W1 Diagram from examination paper either partially or fully drawn

QUESTION 4

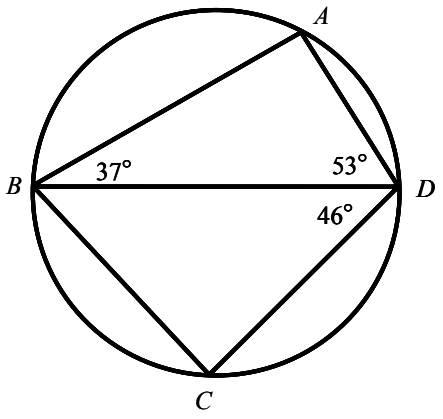
Part (a)	**10(5, 5) marks**	**Att(2, 2)**
Part (b)	**20 marks**	**Att 7**
Part (c)	**20(5, 5, 10) marks**	**Att(2, 2, 3)**

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

A, B, C and D are points on the circle as shown. $|\angle ABD| = 37°$ and $|\angle ADB| = 53°$.

(i) ✍ Explain why $[BD]$ is a diameter of the circle.

(ii) ✍ Given that $|\angle BDC| = 46°$, find $|\angle CBD|$.



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

$$|\angle BAD| = 180^\circ - (37^\circ + 53^\circ) = 90^\circ$$

$\therefore$ $[BD]$ is a diameter since the angle in a semi-circle is a right angle
or the angle at the circumference standing on a diameter is 90°.

* $|\angle BAD| = 90^\circ$ and no reason given gets 4 marks

Blunders (-3)

B1 Correct answer without work shown (✍)

B2 Sum of angles in a triangle $\neq 180^\circ$

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*

Attempts (2 marks)

A1 Indication that the sum of the angles in a triangle $= 180^\circ$

A2 Mention of angle in a semi-circle

A3 Mention of angle standing on a diameter

Worthless (0)

W1 Diagram from examination paper either partially or fully drawn

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

$|\angle BCD| = 90^o$ (angle standing on a diameter)

$\therefore |\angle CBD| = 90^o - 46^o$

$= 44^o$

or

$|\angle ABC| + |\angle ADC| = 180^o$

$\Rightarrow |\angle ABD| + |\angle CBD| + |\angle ADB| + |\angle CBD| = 180^o$

$\Rightarrow 37^o + |\angle CBD| + 53^o + 46^o = 180^o$

$\therefore |\angle CBD| = 180^o - 136^o$

$= 44^o$

Blunders (-3)

B1 Correct answer without work shown (✍)

B2 Sum of angles in a triangle $\neq 180^o$

B3 Sum of opposite angles in a cyclic quadrilateral $\neq 180^o$

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*

Attempts (2 marks)

A1 Indication that the sum of the angles in a triangle $= 180^o$

A2 $|\angle BCD| = 90^o$ or indication on diagram

A3 Mention of angle in a semi-circle

A4 Mention of angle standing on a diameter

A5 $|\angle CBD| = 62^o$

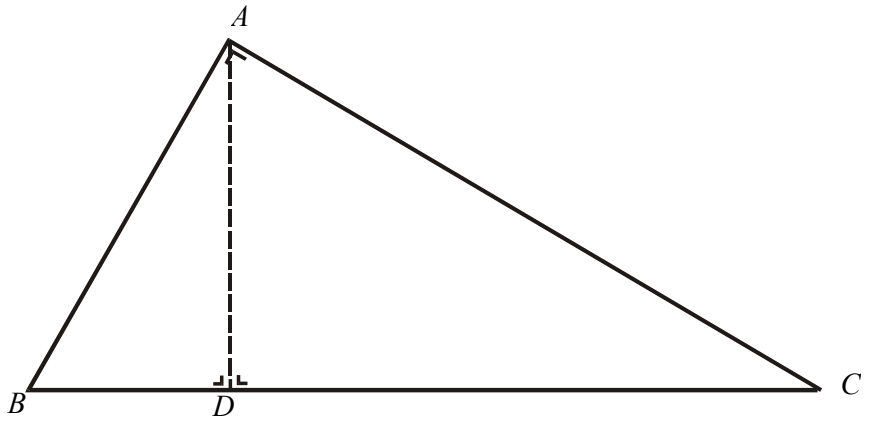
Worthless (0)

W1 Diagram from examination paper either partially or fully drawn

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.

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



Given:	ΔABC with $\lvert\angle BAC\rvert = 90^o$	
To Prove:	$\lvert BC\rvert^2 = \lvert AB\rvert^2 + \lvert AC\rvert^2$	Step 1
Construction:	Draw $AD \perp BC$	Step 2
Proof	Consider ΔABC and ΔABD	
	$\lvert\angle BAC\rvert = \lvert\angle BDA\rvert$ (both right angles)	
	$\lvert\angle ABC\rvert = \lvert\angle ABD\rvert$ (common angle)	
	$\lvert\angle BCA\rvert = \lvert\angle BAD\rvert$ (sum of angles in a triangle $= 180^o$)	
	$\therefore \Delta ABC$ and ΔABD are equiangular (similar)	Step 3
	$\Rightarrow \frac{\lvert AB\rvert}{\lvert BC\rvert} = \frac{\lvert BD\rvert}{\lvert AB\rvert}$	
	$\Rightarrow \lvert AB\rvert^2 = \lvert BC\rvert.\lvert BD\rvert$	Step 4
	Similarly, considering ΔABC and ΔADC	
	$\Rightarrow \lvert AC\rvert^2 = \lvert BC\rvert.\lvert DC\rvert$	
	$\therefore \lvert AB\rvert^2 + \lvert AC\rvert^2 = \lvert BC\rvert.\lvert BD\rvert + \lvert BC\rvert.\lvert DC\rvert$	Step 5
	$= \lvert BC\rvert\left(\lvert BD\rvert + \lvert DC\rvert\right)$	
	$= \lvert BC\rvert.\lvert BC\rvert$ or $\lvert BC\rvert^2$	Step 6

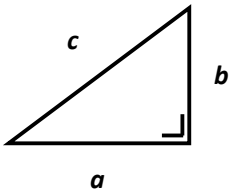
* Some steps may be partially indicated on diagram

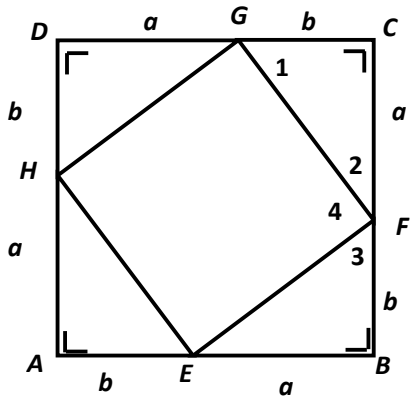
Blunders (-3)
B1 Each step incorrect or incomplete
B2 Each step omitted

Attempts (7 marks)
A1 Labelled right angled triangle
A2 Right angled triangle with perpendicular indicated

Worthless (0)
W1 No diagram or no valid diagram
W2 Wrong theorem

Alternative Proof





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

To Prove: $a^2 + b^2 = c^2$ Step 1

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

Proof: Each of the four inscribed triangles is congruent to the original triangle (S.A.S)
$\therefore$ Each side of the inner quadrilateral has length c Step 3

$|\angle 1| + |\angle 2| = 90^o$ (Sum of angles in a triangle = 180^o)

$|\angle 1| = |\angle 3|$ (Corresponding angles in congruent triangles)

$\therefore |\angle 2| + |\angle 3| = 90^o$

$\therefore |\angle 4| = 90^o$ (Straight angle) Step 4

$\therefore$ The inscribed quadrilateral is a square.
Area of square $ABCD$ = 4(area of one triangle) + area of inscribed square

$\Rightarrow (a+b)^2 = 4\left(\frac{1}{2}ab\right) + c^2$ Step 5

$\Rightarrow a^2 + 2ab + b^2 = 2ab + c^2$ Step 6

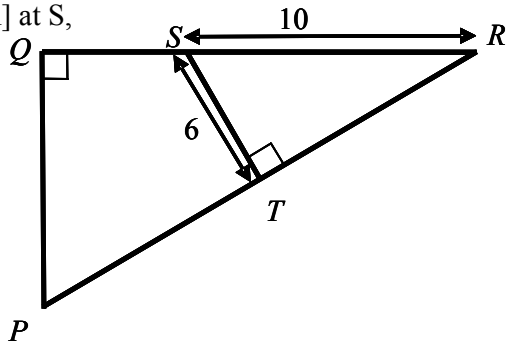
$\therefore a^2 + b^2 = c^2$

* Some steps may be indicated partially on diagram

Blunders (-3)
B1 Each step incorrect or incomplete
B2 Each step omitted
Attempts (7 marks)
A1 Labelled right angled triangle drawn
Worthless (0)
W1 No diagram or no valid diagram
W2 Wrong theorem

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

PQR is a right angled triangle.
T is the midpoint of [PR].
A line is drawn from T to meet [QR] at S, such that $|\angle RTS|$ is a right angle.
|ST| = 6 and |SR| = 10.



(i) ✍ Find |RT|.

(ii) ✍ Prove that $|\angle QPR| = |\angle TSR|$.

(iii) ✍ Find |PQ|.

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

$$|RS|^2 = |RT|^2 + |ST|^2$$
$$\Rightarrow 10^2 = |RT|^2 + 6^2$$
$$\Rightarrow |RT|^2 = 100 - 36 = 64$$
$$\Rightarrow |RT| = \sqrt{64} \text{ or } 8$$

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Error in Pythagoras' Theorem
B3 Error in transposition
B4 Incorrect squaring
B5 Incorrect square root

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

Attempts (2 marks)
A1 Indication of Pythagoras' Theorem

Worthless (0)
W1 Diagram from examination paper either partially or fully drawn

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

Consider ΔPQR and ΔSTR

$|\angle PQR| = |\angle STR| \ (90^o)$

$|\angle PRQ| = |\angle SRT|$ (common angle)

$\therefore |\angle QPR| = |\angle TSR|$ (sum of angles in a triangle $= 180^o$)

or

$\cos \angle TSR = \frac{6}{10} \Rightarrow |\angle TSR| = \cos^{-1} 0 \cdot 6 = 53 \cdot 13^o$

$\Rightarrow |\angle SRT| = 90^o - 53 \cdot 13^o = 36 \cdot 87^o$

In $\Delta PQR, |\angle QPR| = |\angle PQR| - |\angle PRQ|$

$= 90^o - 36 \cdot 87^o = 53 \cdot 13^o$

$\therefore |\angle QPR| = |\angle TSR|$

* Some steps may be indicated on diagram

Blunders (-3)

B1 Calculator in incorrect mode
B2 Incorrect ratio for cos function
B3 Incorrect use of calculator

Attempts (2 marks)

A1 Diagram drawn with equal angles indicated
A2 Indication that the sum of the angles in a triangle = 180^o
A3 Relevant triangles redrawn
A4 Correct trigonometric ratio with some substitution

Worthless (0)

W1 Diagram from examination paper either partially or fully drawn

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

ΔPQR and ΔSTR are equiangular

$\Rightarrow \frac{|PQ|}{|ST|} = \frac{|PR|}{|SR|}$

$\Rightarrow \frac{|PQ|}{6} = \frac{2(8)}{10}$

$\Rightarrow |PQ| = 9 \cdot 6$

or

$$\text{In } \Delta PQR, \sin \angle PRQ = \frac{|PQ|}{|PR|} = \frac{|PQ|}{2(8)} = \frac{|PQ|}{16}$$

$$\text{In } \Delta RST, \sin \angle SRT = \frac{|ST|}{|SR|} = \frac{6}{10}$$

$$\angle PRQ = \angle SRT \Rightarrow \frac{|PQ|}{16} = \frac{6}{10}$$

$$\Rightarrow |PQ| = \frac{96}{10} = 9 \cdot 6$$

or

$$\text{In } \Delta RST, \sin \angle SRT = \frac{6}{10} \Rightarrow \left|\angle SRT\right| = \sin^{-1} 0 \cdot 6 = 36 \cdot 87^{\circ}$$

$$\text{In } \Delta PQR, \sin 36 \cdot 87^{\circ} = \frac{|QP|}{16} \Rightarrow |QP| = 16 \sin 36 \cdot 87^{\circ} = 9 \cdot 6$$

* Some steps may be indicated on diagram

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect ratio
B3 Error in transposition
B4 Incorrect ratio for sin function
B5 Calculator in incorrect mode
B6 Early rounding which affects the accuracy of the answer
B7 $|PR| \neq 16$
B8 Incorrect use of calculator

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*

Attempts (3 marks)

A1 Indication that the lengths of corresponding sides in equiangular triangles are proportional
A2 Correct trigonometric ratio with some substitution
A3 One correct relevant ratio
A4 $|PT| = 8$ or $|PR| = 16$
A5 $|PQ|^2 + |QR|^2 = |PR|^2$ or equivalent

Worthless (0)

W1 Diagram from examination paper either partially or fully drawn

QUESTION 5

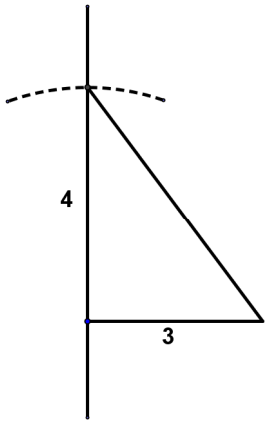
Part (a)	**10 marks**	**Att 3**
Part (b)	**20(10, 10) marks**	**Att(3, 3)**
Part (c)	**20(10, 10) marks**	**Att(3, 3)**

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

✍ Without using a calculator construct the angle A such that
$6 \tan A = 8, \quad 0° \leq A < 90°$.

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

$$6 \tan A = 8 \Rightarrow \tan A = \frac{8}{6} = \frac{4}{3}$$



* Accept construction with tolerance of 2 mm
* Measure sides to check ratio
* Measure for right angle – accept a tolerance of 2^o

Blunders (-3)
B1 Angle A not indicated
B2 Incorrect use of ratio
B3 Incorrect side
B4 Error in transposition

Attempts (3 marks)

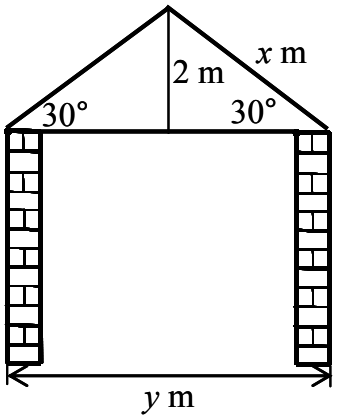
A1 One side of length 6 or 8 drawn (or equivalent)
A2 Indication of 8 as "opposite" and/or 6 as "adjacent" (or equivalent)
A3 Indication of hypotenuse = 10 - i.e. use of Pythagoras' Theorem (or equivalent)
A4 Rough right angled triangle drawn
A5 Angle of 53° constructed
A6 $\tan A = \frac{8}{6}$ or equivalent
A7 Non-right angled triangle drawn with lengths indicated and A opposite side 8
A8 Effort at isolating $\tan A$

Worthless (0)

W1 Non-right angled triangle drawn

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

A builder wants to construct a roof with pitch of 30°. The height of the apex above the ceiling level is 2 m, as shown in the diagram.



(i) ✍ Calculate x, the length of the rafter.

(ii) ✍ Calculate y, the length of the ceiling joist, correct to two decimal places.

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

$\sin 30^{\circ} = \frac{2}{x}$
$\Rightarrow x \sin 30^{\circ} = 2$
$\Rightarrow x = \frac{2}{\sin 30^{\circ}}$
$= \frac{2}{\frac{1}{2}}$
$= 4$

or

$\cos 60^{\circ} = \frac{2}{x}$
$\Rightarrow x \cos 60^{\circ} = 2$
$\Rightarrow x = \frac{2}{\cos 60^{\circ}}$
$= \frac{2}{\frac{1}{2}}$
$= 4$

or

$\frac{x}{\sin 90^{\circ}} = \frac{2}{\sin 30^{\circ}}$
$\Rightarrow x = \frac{2 \sin 90^{\circ}}{\sin 30^{\circ}}$
$= \frac{2(1)}{\frac{1}{2}}$
$= 4$

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect ratio for sin/cos function
B3 Error in transposition
B4 Calculator in incorrect mode
B5 Incorrect ratio for Sine Rule

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*

Attempts (3 marks)

A1 $\sin 30^{\circ}$
A2 $\frac{2}{x}$
A3 Sine Rule with some substitution
A4 Mention of 60°

Worthless (0)

W1 $\frac{x}{90} = \frac{2}{30}$
W2 Diagram from examination paper either partially or fully drawn

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

$4^2 = 2^2 + z^2, z = \frac{y}{2}$

$16 = 4 + z^2$

$z^2 = 12$

$z = \sqrt{12}$

$= 3 \cdot 464$

$y = 2(3 \cdot 464)$

$= 6 \cdot 9282$

$= 6 \cdot 93$

or

$4^2 = 2^2 + \left(\frac{y}{2}\right)^2$

$16 = 4 + \frac{y^2}{4}$

$64 = 16 + y^2$

$y^2 = 48$

$y = 6 \cdot 928$

$y = 6 \cdot 93\text{m}$

or

$\cos 30^\circ = \frac{z}{4}, z = \frac{y}{2}$

$\Rightarrow z = 4\cos 30^\circ$

$= 3 \cdot 464$

$\Rightarrow y = 2(3 \cdot 464)$

$= 6 \cdot 928$

$= 6 \cdot 93\text{m}$

or

$\sin 60^\circ = \frac{z}{4}, z = \frac{y}{2}$

$\Rightarrow z = 4\sin 60^\circ$

$= 3 \cdot 464$

$\Rightarrow y = 2(3 \cdot 464)$

$= 6 \cdot 928$

$= 6 \cdot 93\text{m}$

or

$\tan 60^\circ = \frac{z}{2}, z = \frac{y}{2}$

$\Rightarrow z = 2\tan 60^\circ$

$= 3 \cdot 464$

$\Rightarrow y = 2(3 \cdot 464)$

$= 6 \cdot 928$

$= 6 \cdot 93\text{m}$

or

$\tan 30^\circ = \frac{2}{z}, z = \frac{y}{2}$

$\Rightarrow z\tan 30^\circ = 2$

$\Rightarrow z = \frac{2}{\tan 30^\circ}$

$= 3.464$

$\Rightarrow y = 2(3 \cdot 464)$

$= 6 \cdot 928$

$= 6 \cdot 93\text{m}$

or

$\frac{y}{\sin 120^\circ} = \frac{4}{\sin 30^\circ}$

$\Rightarrow y = \frac{4\sin 120^\circ}{\sin 30^\circ}$

$= 6 \cdot 928$

$= 6 \cdot 93$

* Accept candidate's answer from (b) (i)

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Error in Pythagoras' Theorem
B3 Incorrect squaring
B4 Error in transposition
B5 Error in square root
B6 Incorrect ratio for sin/cos/tan function
B7 Incorrect ratio for Sine Rule
B8 Calculator in incorrect mode
B9 Early rounding which affects the accuracy of the answer

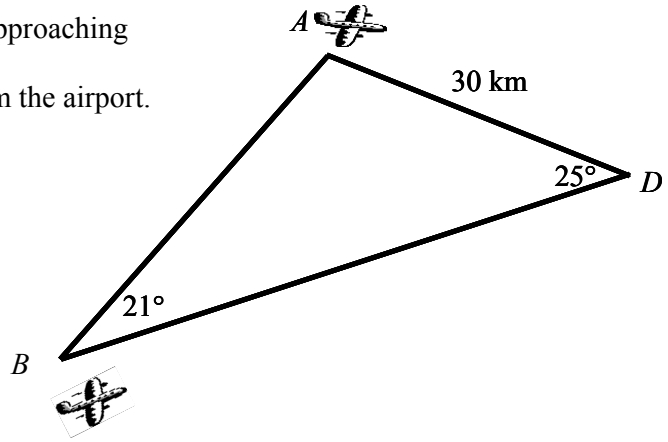
Slips (-1)
S1 Arithmetic slips to a maximum of *(-3)*
S2 Answer not rounded off or incorrectly rounded
S3 Failure to multiply by 2

Attempts (3 marks)
A1 Effort at Pythagoras' Theorem
A2 Mention of $\frac{y}{2}$ or half the length of the ceiling joist
A3 Sine Rule with some substitution
A4 Evaluation of sin/cos/tan of relevant angle
A5 Mention of 60^o or 120^o

Worthless (0)
W1 Diagram from examination paper either partially or fully drawn

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

Two planes, *A* and *B*, are approaching Dublin airport (*D*).
Plane *A* is 30 km from the airport.
$|\angle ABD| = 21°$ and
$|\angle ADB| = 25°$.



(i) ✍ Find the distance plane *B* is from the airport, giving your answer correct to the nearest km.

Both planes travel at an average speed of 400 km/h on their approach to the airport.

(ii) ✍ Calculate the time interval, in minutes, between the two planes landing.

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

$$|\angle BAD| = 180^o - (21^o + 25^o) = 134^o$$

$$\frac{|BD|}{\sin 134^o} = \frac{30}{\sin 21^o}$$

$$\Rightarrow |BD| = \frac{30 \sin 134^o}{\sin 21^o} = \frac{21 \cdot 5801}{0 \cdot 3584}$$

$$= 60 \cdot 2$$

$$= 60 \text{ km}$$

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect ratio for Sine Rule
B3 Error in transposition
B4 Calculator in incorrect mode
B5 Early rounding which affects the accuracy of the answer
B6 Sum of the angles in a triangle ≠ 180^o

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*
S2 Answer not rounded off or incorrect rounding

Misreadings (-1)

M1 $|AB|$ found

Attempts (3 marks)

A1 Sine Rule with some substitution
A2 Mention of 134^o
A3 Indication that the sum of the angles in a triangle = 180^o

Worthless (0)

W1 $\frac{|BD|}{134} = \frac{30}{21}$
W2 Triangle treated as right angled

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

$A: \text{time} = \dfrac{\text{distance}}{\text{speed}} = \dfrac{30}{400}$ or $\dfrac{3}{40}$ hr or $0 \cdot 075$ hr Step 1

$B: \text{time} = \dfrac{\text{distance}}{\text{speed}} = \dfrac{60}{400}$ or $\dfrac{3}{20}$ hr or $0 \cdot 15$ hr Step 2

$\text{Time interval} = 0 \cdot 15 - 0 \cdot 075 = 0 \cdot 075 \text{ hr}$

$= 0 \cdot 075 \times 60$

$= 4 \cdot 5 \text{ min}$ Step 3

* Accept candidate's answer from (c) (i)

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Error in Distance/Speed/Time formula, once only
B3 No conversion to minutes
B4 Incorrect conversion to minutes

Slips (-1)

S1 Arithmetic slips to a maximum of *(-3)*
S2 Addition instead of subtraction

Attempts (3 marks)

A1 Mention of Distance/Speed/Time formula
A2 Mention of 60

QUESTION 6

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

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

In Galway last year, there were 4320 small cars, 3780 medium cars and 1620 large cars sold.
Illustrate this information on a pie chart.

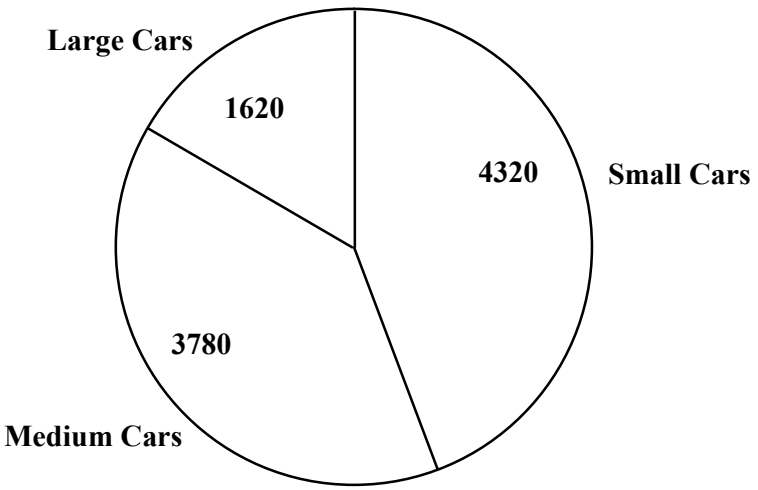
(a) **10 marks** **Att 3**

$$\text{Total number of cars} = 9720$$

$$\text{Small cars} : \frac{360}{9720} \times 4320 = 160^{o}$$

$$\text{Medium cars} : \frac{360}{9720} \times 3780 = 140^{o}$$

$$\text{Large cars} : \frac{360}{9720} \times 1620 = 60^{o}$$



* Allow for tolerance of 5^{o}

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Sum of angles $\neq 360^{o}$
B3 Incorrect fraction
B4 Incorrect labelling of sector or no labelling
B5 Angle outside tolerance

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

Attempts (3 marks)
A1 Indication of 360^{o}
A2 Circle drawn
A3 Angles correctly calculated but no pie chart drawn
A4 Total number of cars found

Worthless (0)
W1 Bar chart drawn

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

The braking distance in metres, i.e. the distance travelled from when the brake is applied to when a car stops, is recorded for 50 drivers.
The cumulative frequency table below shows the results obtained.

Braking distance (m)	< 10	< 20	< 28	< 34	< 40
Number of Drivers	2	30	40	46	50

(i) Copy and complete the following frequency table.

Braking distance (m)	0 – 10	10 – 20	20 – 28	28 – 34	34 – 40
Number of Drivers					

[Note: 10 – 20 means 10 or more but less than 20, etc.]

(ii) ✍ Taking mid-interval values, calculate the mean breaking distance, giving your answer correct to the nearest metre.

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

Braking distance (m)	0 – 10	10 – 20	20 – 28	28 – 34	34 – 40
Number of Drivers	2	28	10	6	4

Blunders (-3)

B1 Omission of a value

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

Attempts (2 marks)
A1 Any one value correctly filled into table
A2 Indication of subtraction of frequencies
A3 Addition of frequencies

Worthless (0)
W1 Table copied from examination paper
W2 Cumulative frequency curve drawn

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

The mid-interval values are: 5, 15, 24, 31, 37

$$\text{Mean} = \frac{(2)(5)+(28)(15)+(10)(24)+(6)(31)+(4)(37)}{2+28+10+6+4}$$
$$= \frac{10+420+240+186+148}{50}$$
$$= \frac{1004}{50} \text{ or } 20\cdot08$$
$$= 20$$

* Accept candidate's answer from (b) (i)

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Consistent incorrect mid-interval values
B3 Division by 5
B4 Division by sum of mid-interval values
B5 Mid-interval values added to frequencies instead of multiplied

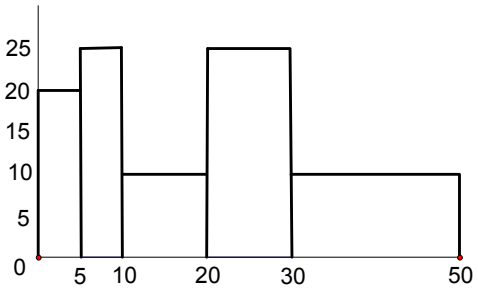
Slips (-1)
S1 Arithmetic slips to a maximum of *(-3)*
S2 Answer not rounded or incorrectly rounded

Attempts (5 marks)
A1 Step towards mid-interval values
A2 One correct multiplication in numerator
A3 Indication of division by 50

Worthless (0)
W1 Sum of frequencies divided by 5

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

An airline recorded the weight of each passenger's baggage on a particular flight. The results are shown in the histogram



(i) Copy and complete the following frequency table in your answer book.

Weight in kg	0 – 5	5 – 10	10 – 20	20 – 30	30 – 50
No. of passengers	20				

[Note: 5 – 10 means 5 or more but less than 10, etc.]

(ii) How many passengers were on the plane?
(iii) The airline charged an excess baggage fee of €8 for every kg over 25 kg. The airline collected €2880 from passengers in the 30 – 50 kg group.

✍ What was the average excess baggage fee paid per passenger in the 30 – 50 kg group?

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

Weight in kg	0 – 5	5 – 10	10 – 20	20 – 30	30 – 50
No. of passengers	20	25	20	50	40

Blunders (-3)
B1 Height taken as frequency
B2 Mishandling of base
B3 Omission of a value, each time

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

Attempts (3 marks)
A1 Indication of work with base

Worthless (0)
W1 Table copied from examination paper with no further entries

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

Number of passengers = 20 + 25 + 20 + 50+40 = 155

* Accept candidate's answer from (c) (i)
* Accept answer without work

Blunders (-3)
B1 Omission of each number

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

Attempts (2 marks)
A1 Indication of addition of number of passengers

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

Number of passengers in 30 – 50 kg group = 40
Average excess baggage fee per passenger = €2880 ÷ 40
= €72

or

Excess baggage = €2880 ÷ 8 = 360 kg
Average excess baggage per person = 360 ÷ 40 = 9kg
Average excess baggage fee per passenger = 9 × 8
= €72

* Accept candidate's answer from (c) (i)

Blunders (-3)

B1 Correct answer without work shown (✍)
B2 Incorrect number of passengers
B3 Multiplication by 40

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

Attempts (2 marks)
A1 Number of passengers = 40
A2 €2880 ÷ 8
A3 €2880 ÷5

Worthless (0)
W1 25 × 8

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