Coimisiún na Scrúduithe Stáit
State Examinations Commission

MARKING SCHEME 2004

JUNIOR CERTIFICATE EXAMINATION

MATHEMATICS

HIGHER LEVEL

PAPER 1

GENERAL GUIDELINES FOR EXAMINERS

1. Penalties of three types are applied to candidates' work, as follows:
    *   Blunders   - mathematical errors / sign errors / omissions   (-3)
    *   Slips   - numerical errors   (-1)
    *   Misreadings (provided task is not oversimplified)   (-1)

    Frequently occurring errors to which these penalties must be applied are listed in the scheme. They are labelled as B1, B2, B3, ….. S1, S2, S3, ….. M1, M2, …. etc.

2. When awarding attempt marks, e.g. Att(3), it is essential to note that:
    *   any correct relevant step in a part of a question merits, at least, the attempt mark for that part
    *   if deductions result in a mark which is lower than the attempt mark, then the attempt mark must be awarded
    *   a mark between zero and the attempt mark is not awarded.

3. Worthless work must be awarded zero marks. Some examples of such work are listed in the scheme and they are labelled as W1, W2, …. etc.

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

5. 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.

6. Particular cases, verifications and answers derived from diagrams (unless requested) qualify for the attempt mark only.

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

8. ✍ Failure to show supporting work, will, in general, result in a Blunder (-3).

QUESTION 1

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

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

The area of a house covers 205 m^2.

The area of the site for the house covers 1025 m^2.

✍   What is the ratio of the area of the house to the

area of the site?

Give your answer in the form 1 : n, where $n \in$ **N**.

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

Ratio: $\dfrac{\text{House}}{\text{Site}}$ $=$ $\dfrac{205}{1025}$ $=$ $\dfrac{1}{5}$

Blunders (-3)

B1   Correct answer, but no work shown (✍).

B2   Ratio inverted, i.e. $\dfrac{1025}{205}$, and continues, but **note:** May incur other errors also.

B3   Not form 1 : n , e.g. stops at $\dfrac{205}{1025}$, but **note:** Stops at $\dfrac{1025}{205}$ incurs 2 blunders ➜   4 marks.

B4   Error in division / cancelling.

B5 $n \notin$ **N**.

B6   Adds or subtracts the 205 and continues.

Slips (-1)

S1   Numerical errors to a max of 3

Misreadings (-1)

M1   Reads as 250 m^2 or similar.

Attempts (3 marks)

A1   Gives a decimal answer, and no other work shown.

Worthless (0)

W1   Incorrect answer and no work.

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

(i)   Evaluate $(6 \cdot 3 \times 10^9) + (5 \cdot 8 \times 10^{10})$.

Express your answer in the form $a \times 10^n$, where $n \in \mathbf{N}$ and $1 \le a < 10$.

(ii)   John has a gross income per fortnight of €1750.
The standard rate of income tax is 20% and the higher rate is 42%.
He has tax credits of €105 per fortnight and his standard rate cut-off point is €1295 per fortnight.

✍   After tax is paid, what is John's net income per fortnight?

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

(i) $6 \cdot 43 \times 10^{10}$.

Blunders (-3)

B1   Not in scientific notation, e.g. $64 \cdot 3 \times 10^9$ or 64 300 000 000.

B2   Any decimal error.

B3   Any error in handling indices.

Misreadings (-1)

M1   Writes down $(6 \cdot 3 \times 10^9) \times (5 \cdot 8 \times 10^{10})$ to get $3 \cdot 654 \times 10^{20}$.

Attempts (2 marks)

A1   Indicates some knowledge of indices, e.g. gets 10^9.

A2   Arrives at $6 \cdot 43$ or $64 \cdot 3$ and stops or no correct use of indices.

A3   Converts either expression to a whole number and stops.

Worthless (0)

W1   Incorrect answer and no work.

W2   Attempts to add or subtract but shows no knowledge of indices, but **note:** A2 above.

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

(ii) Tax @ 20% on €1295	=	€259·00
Tax @ 42% on €455	=	€191·10
Total Tax	=	€450·10
Tax Credits	=	€105·00
Tax Due	=	€345·10
Net Income per fortnight	=	€1404·90

Gross + Credits	=	€1855·00
Tax @ 20% on €1295	=	€259·00
Tax @ 42% on €455	=	€191·10
Total Tax	=	€450·10
Net Income	=	€1404·90

*   Candidates may present other correct methods.

Blunders (-3)

B1   Correct answer, but no work shown (✍).

B2   Each error in decimal point.

B3   Mathematical error, e.g. 20% or 42% taken as some incorrect fraction – can incur 2 blunders.

B4   20% of some incorrect figure or 42% of some incorrect figure, but **note:** may incur 2 blunders.

B5   Incorrect total tax based on candidate's figure or no total tax.

B6   Mishandles the tax credit.

B7   Fails to calculate net income per fortnight.

B8   Stops at 450·10, but **note:** also incurs B6   ➔   9 marks.

Slips (-1)

S1   Numerical errors to max of 3.

Attempts (5 marks)

A1   Correct calculation of 20% or 42% and stops.

A2   Any correct relevant step, e.g. some correct calculation on candidate's figures.

Worthless (0)

W1   Incorrect answer and no work.

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

$$\frac{131 \cdot 5 - 1 \cdot 73 \times \sqrt{0 \cdot 64}}{35 \cdot 4 - (5 \cdot 1)^2}.$$

Then, evaluate $\dfrac{131 \cdot 5 - 1 \cdot 73 \times \sqrt{0 \cdot 64}}{35 \cdot 4 - (5 \cdot 1)^2}$, correct to two decimal places.

(ii)   ✍   Simplify $\left(\sqrt{12} + \dfrac{1}{\sqrt{12}} \right)\left(\sqrt{12} - \dfrac{1}{\sqrt{12}} \right)$, without the use of a calculator.

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

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

(i) $\dfrac{130}{10}$ =   13.

*   Accept rounding down / up of final answer.

Blunders (-3)

B1   Correct answer, but no work shown (✍).

B2   Each error in decimal point.

B3   Error in precedent.

Slips (-1)

S1   Numerical errors to max of 3

S2   Error in rounding to the nearest whole number, e.g. 131·5 rounds to 131.

Attempts (3 marks)

A1   Some correct rounding to nearest whole number.

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

(i)	$\dfrac{130\cdot116}{9\cdot39}$	$=$	$13\cdot8568$	$=$	$13\cdot86.$

*   Accept correct answer and no work.

*   Do not penalise same error if already penalise in **Estimate** above.

Blunders (-3)

B1   Each error in decimal point.

B2   Error in precedent.

Slips (-1)

S1   Numerical errors to max of 3.

S2   Failure to round off or incorrect rounding off.

Attempts (2 marks)

A1   Some correct calculation done.

Worthless (0)

W1   Incorrect answer and no work, but **note:** S2 above.

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

(ii)	$12-\dfrac{1}{12}$	$=$	$11\dfrac{11}{12}$	$=$	$\dfrac{143}{12}.$

Blunders (-3)

B1   Correct answer, but no work shown ($\cancel{}$).

B2   Each error in distributive law.

B3   Each error handling surds.

B4   Not in the form $\dfrac{a}{b}$, e.g. surds in answer, but **note:** S1 below.

Slips (-1)

S1   Not in the form $\dfrac{a}{b}$, i.e. leaves as $11\dfrac{11}{12}$.

Attempts (2 marks)

A1   Some effort at getting common denominator and stops.

A2   Shows some knowledge of handling surds.

Worthless (0)

W1   Uses calculator.

QUESTION 2

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

Part (a)	10 marks	Att 3

> ✍   Write 44 100 as a product of its prime factors.

(a)	10 marks	Att 3

$$44\,100 \quad = \quad 2^2 \times 3^2 \times 5^2 \times 7^2 \qquad \text{or} \qquad 2 \times 2 \times 3 \times 3 \times 5 \times 5 \times 7 \times 7$$

Blunders (-3)

B1   Some factors listed but with no prime numbers.

Slips (-1)

S1   Some factors listed containing prime numbers.

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

> **(i)**   ✍   The price of a playstation game is €59·99.
>
> In a sale the price of this playstation game is reduced to €49·99.
>
> What is the percentage reduction on the original price of the game in the sale?
> Give your answer correct to the nearest whole number.
>
> **(ii)**   ✍   Simplify $\dfrac{125^{\frac{1}{3}} \times 5^2}{5^3 \times 25^{\frac{5}{2}}}$ into the form 5^n, where $n \in \mathbf{Z}$.

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

> **(i)**   Reduction: =   €10
>
> % Reduction   = $\dfrac{10}{59·99} \times 100$ =   16.67   =   17%.

Blunders (-3)

B1   Correct answer, but no work shown (✍).

B2   Each error in decimal point.

B3   Failure to calculate the reduction.

B4   Uses $\dfrac{49·99}{59·99} \times 100$, but **note:** may also incur B3 above, e.g. 83% and stops.   ➔   4 marks.

B5   Uses $\dfrac{10}{49·99} \times 100$ and continues.

B6   Stops at $\dfrac{10}{59·99} \times 100$, but **note:** also incurs S2 below.   ➔   6 marks.

Slips (-1)

S1   Numerical errors to max of 3.

S2   Failure to round off or incorrect rounding off.

Attempts (3 marks)

A1   Gets correct reduction (€10) and stops.

A2   Gets $\dfrac{10}{59·99}$ and stops.

Worthless (0)

W1   Uses $\dfrac{49·99}{59·99}$ and no work with percentages.

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

(ii) $$\frac{5^1 \times 5^2}{5^3 \times 5^5} = 5^{-5}.$$

Blunders (-3)

B1   Correct answer, but no work shown (✍).

B2   Each different error in laws of indices.

B3   Error in sign – of index.

B4   Answer not given in form 5^n where $n \in Z$, but **note:** may incur other blunders also.
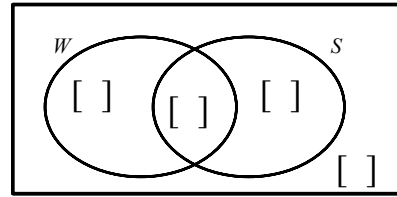
Slips (-1)

S1   Numerical errors to max of 3.

Attempts (3 marks)

A1   Some correct work with the indices.

Worthless (0)

W1   Uses calculator to get an answer of $0 \cdot 00032$ or similar, with no work.

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

(i) A leisure centre has 110 members. The weights room (W) is used by 82 members and the swimming pool (S) is used by 57 members. 15 members do not use either facility.

✍ Copy the Venn diagram into your answerbook and complete it to show the number of members in each part of each set.

(ii) U is the universal set and A and B are two subsets of U.

$\#U = u$ $\#A = a$ $\#B = b$ $\#(A \cap B) = x$ $\#((A \cup B)') = y$.

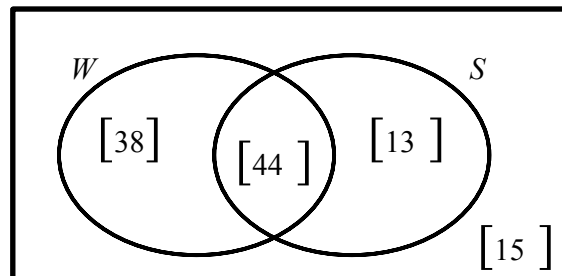✍ Represent this information on a Venn diagram and hence express u in terms of a, b, x and y.

✍ Show that if $a > b$, then the minimum possible value of u is $y + a$.

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

(i)

*   Accept diagram as above without any additional work.

Blunders (-3)

B1 $\#(W \setminus S) = 13$ and $\#(S \setminus W) = 38$

B2 $\#W \neq 82$.

B3 $\#S \neq 57$, but **note** candidate can incur B2 and B3.

B4 $\#(W \cup S) \neq 95$.

Attempts (3 marks)
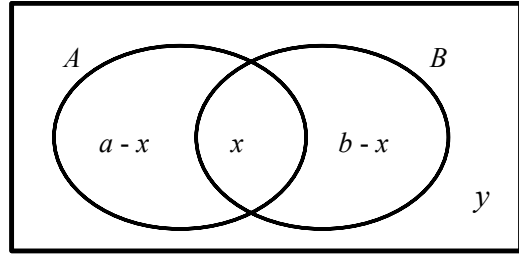
A1   Only one correct value filled in.

Worthless (0)

W1   Venn diagram but none of the required values filled in.

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

> **(ii)** u $=$ $a - x + x + b - x + y$
>
> $=$ $a + b - x + y.$

Blunders (-3)

B1 $\#(A \setminus B) = a.$

B2 $\#(B \setminus A) = b.$

Slips (-1)

S1   Failure to express u in terms of a, b, x and y, with a correct Venn diagram.

S2   Correct expression for u but no Venn diagram or incorrect Venn diagram.

Attempts (2 marks)

A1   Only one correct value filled in.

A2   Correctly labelled Venn diagram.

Worthless (0)

W1   Some incorrect expression for u and no Venn diagram.

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

> **(ii)**   If $a > b$ then Minimum when $b = x$
>
> u $=$ $a + y.$

Blunders (-3)

B1   Takes $b = 0$ and $x = 0$ to get $u = a + y.$

Attempts (2 marks)

A1   Uses values for u, a, b, x and $y.$

A2   States or shows that B is a subset of $A.$

QUESTION 3

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

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

✍   Solve $3(x-4) - 2(5x-3) = 8$.

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

$x = -2$

Blunders (-3)

B1   Correct answer, but no work shown (✍).

B2   Each different error in distributive law / sign.

B3   Each term omitted or incorrect.

B4   Each different error in transposition.

Slips (-1)

S1   Numerical slips to a max of 3.

Attempts (3 marks)

A1   Some correct relevant work, e.g. one correct multiplication.

Worthless (0)

W1   Incorrect answer and no work.

(i)   ✍   Evaluate $\dfrac{2x+1}{4} - \dfrac{3x-4}{3}$,   when $x = \dfrac{1}{2}$.

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

(ii)   ✍   Given that $2(2q - 7p) = q(3p - q)$, express p in terms of q.

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

(i) $\dfrac{-6x+19}{12} = \dfrac{-6\left(\frac{1}{2}\right)+19}{12} = \dfrac{4}{3}.$

or

$$\dfrac{2\left(\frac{1}{2}\right)+1}{4} - \dfrac{3\left(\frac{1}{2}\right)-4}{3} = \dfrac{2}{4} - \dfrac{-\frac{5}{2}}{3}$$

$$= \dfrac{1}{2} + \dfrac{5}{6} = \dfrac{8}{6} = \dfrac{4}{3}$$

*   Accept $\dfrac{16}{12}$ or similar for full marks.

Blunders (-3)

B1   Correct answer, but no work shown (✍).

B2   Not in the form $\dfrac{a}{b}$, e.g. decimals in answer (may incur other blunders), but **note:** S1 below.

B3   Each different error in distributive law / sign.

B4   Incorrect common denominator or mishandles common denominator.

Slips (-1)

S1   Not in the form $\dfrac{a}{b}$, i.e. leaves as $1\dfrac{1}{3}$.

Attempts (3 marks)

A1   Some correct relevant work, e.g. one correct substitution.

A2   Any term evaluated correctly.

A3   Correct common denominator and stops.

Worthless (0)

W1   Incorrect answer and no work.

(ii) $4q - 14p = 3pq - q^2$ $\rightarrow$ $p(14 + 3q) = q^2 + 4q$

$$p = \frac{q^2 + 4q}{14 + 3q}$$

* Accept $p = \dfrac{-q^2 - 4q}{-14 - 3q}$ or similar.

Blunders (-3)

B1 Correct answer, but no work shown ($\cancel{\mathscr{L}}$).

B2 Each different error in distributive law / sign.

B3 Each different transposition error or error with sign.

B4 Stops at $p(14 + 3q) = q^2 + 4q$,
but **note:** if stops at $-14p - 3pq = -4q - q^2$ also incurs B2 $\rightarrow$ 4 marks.

B5 Stops at $-p = \dfrac{-q^2 - 4q}{14 + 3q}$ or similar.

Attempts (3 marks)

A1 Some correct relevant work, e.g. one correct transposition or cross multiplication,
but **note:** B4.

A2 Stops at $4q - 14p = 3pq - q^2$.

A3 Attempts to solve for q.

A4 Incorrect cancelling leading to oversimplification.

Worthless (0)

W1 Incorrect answer and no work.

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

> **(i)** ✎ Solve the equation $x^2 - 8x + 11 = 0$ and give your answers correct to two decimal places.
>
> **(ii)** ✎ Hence, find the two values of $t \in \mathbf{R}$ for which
>
> $$\left(\frac{1}{t}\right)^2 - 8\left(\frac{1}{t}\right) + 11 = 0.$$
>
> Give your answers correct to two decimal places.

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

> **(i)** $x^2 - 8x + 11 = 0 \rightarrow x = \dfrac{8 \pm \sqrt{64 - 44}}{2} = \dfrac{8 \pm 4 \cdot 472}{2}$
>
> $\rightarrow x = 6 \cdot 236$ or $1 \cdot 7639 \rightarrow x = 6 \cdot 24$ or $1 \cdot 76$

Blunders (-3)

B1   Each error in formula, e.g. $+ b \pm \sqrt{}$ etc

B2   Each different incorrect substitution into formula,

but **note** b $=$ 8 ; c $= -11$ → 1 Blunder.

B3   Mathematical error in sign, e.g. $-4(1)(11) = +44$.

B4   Mathematical error in squaring, e.g. $8^2 = 16$ or similar.

B5   Mathematical error in tables (wrong page).

B6   Ignores a minus in square root, e.g. $\sqrt{-28}$ taken as $\sqrt{28}$.

B7   One solution where there should be two.

B8   Misplaced decimal.

Slips (-1)

S1   Failure to round off or rounds off incorrectly, once or twice.

S2   Numerical to max of 3.

Attempts (3 marks)

A1   Incorrect relevant formula with some correct substitution.

A2   Correct formula and stops.

A3   Stops at $\dfrac{8 \pm \sqrt{20}}{2}$ or $4 \pm \sqrt{5}$, [incurs **2 blunders** and **1 slip**].

A4   Some effort at completing the square.

Worthless (0)

W1   Some attempt at factorising.

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

(ii) $\dfrac{1}{t} = 6{\cdot}24$ or $1{\cdot}76$ $\rightarrow$ $t = 0{\cdot}16$ or $0{\cdot}57$

*   Accept candidates' values for x from **(c) (i)** above.

*   Accept quadratic in t multiplied out and mark blunders and slips as in **(c) (i)** above.

Blunders (-3)

B1   Correct answer, but no work shown (✍).

B2   Each different error in transposition.

B3   Deals with only one value of t, but if only one value of x in **(c) (i)** then no further penalty.

B4   Uses x values not consistent with those found in **(c) (i)** above.

B5   Stops at $t = \dfrac{1}{6{\cdot}24}$ or $t = \dfrac{1}{1{\cdot}76}$, but also incurs S1 below.

Slips (-1)

S1   Failure to round off or rounds off incorrectly, once or twice.

S2   Numerical to max of 3.

Attempts (3 marks)

A1 $x = \dfrac{1}{t}$ or $\dfrac{1}{6{\cdot}24}$ or similar and stops or $6{\cdot}24 = \dfrac{1}{t}$ or similar and stops.

Worthless (0)

W1 $t = 6{\cdot}24$ or $1{\cdot}76$.

QUESTION 4

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

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

✎   Divide $x^3 + x^2 - 12x$ by $x + 4$.

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

Division gives: $x^2 - 3x$

or

Factorising gives: $x(x^2 + x - 12) = x(x - 3)(x + 4)$ $\rightarrow$ $x(x - 3)$.

*   Accept correct answer by division or factorisation.

Blunders (-3)

B1   Correct answer, but no work shown (✎).

B2   Each error in index and sign.

B3   Each error in multiplication / subtraction when dividing.

B4   Stops at $x(x - 3)(x + 4)$ when factorising.

Attempts (3 marks)

A1   Some division to get x^2 or $-3x$.

A2   Sets up division correctly.

A3   Gets $x(x^2 + x - 12)$ and stops.

A4   Multiplies rather than divides – must have at least one correct term.

A5   Factorising results in factors without $(x + 4)$.

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

> **(i)**   Factorise $9x^2 - 64y^2$.
>
> **(ii)**   ✍   Factorise $3xy - 10x - 10b + 3by$.
>
> **(iii)**   Factorise $6x^2 - 7x - 24$.

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

> **(i)** $(3x - 8y)(3x + 8y)$

*   Accept correct answer and no work – **no** ✍ .

Blunders (-3)

B1   Errors in sign.

B2   Stops at $3x(3x + 8y) \; - \; 8y(3x + 8y)$.

B3   Incorrect factorisation of one term, e.g. $(9x - 8y)(9x + 8y)$.

B4   Answer given as $(3x - 8y) + (3x + 8y)$, but **note:** answer such as $(3x - 8y)$ *and* $(3x + 8y)$

merits 5 marks.

Attempts (2 marks)

A1   Any correct factors of $9x^2$ and / or $64y^2$.

A2 $(9x - 64y)(9x + 64y)$.

A3   Indicates some knowledge of the difference of two squares.

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

> **(ii)** $x(3y - 10) + b(3y - 10)$ $=$ $(3y - 10)\,(x + b)$.

Blunders (-3)

B1   Correct answer, but no work shown (✍).

B2   Each different error in sign.

B3   Stops after first step, i.e. $x(3y - 10) + b(3y - 10)$ or similar.

B4   Answer given as $(3y - 10) + (x + b)$,

but **note:** answer such as $(3y - 10)$ *and* $(x + b)$ merits 10 marks.

Attempts (3 marks)

A1   Some effort at factorising – groups off or pairs.

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

| (iii)   *Round Brackets:*

$(3x - 8)(2x + 3)$ | *Big 'X':*

$3x$ -8
$\diagdown\diagup$
$2x$ $+3$

$\rightarrow$
$(3x - 8)(2x + 3)$ | *Guide Number:*

GN $\rightarrow$ (6).(-24)   =   -144
Factors of $-144x$ that add to $-7x$ are:
      $-16x$ and $+9x$.
$6x^2 - 7x - 24 = 6x^2 - 16x + 9x - 24$
      = $3x(2x + 3)$ $-8(2x + 3)$
      = $(3x - 8)(2x + 3)$. |

*   Accept correct answer and no work – **no** ✍ .

*   Accept any correct method, e.g. using formula, big 'X', guide number etc. and mark slips and blunders.

Blunders (-3)

B1   Incorrect factors each time

        but **note:** incorrect factors containing $3x$ & $2x$ and -8 & 3 gives 1 Blunder .

B2   Each error in use of quadratic formula.

B3   Leaves answer as:

            $3x$ -8
            $\diagdown\diagup$
            $2x$ $+3$

B4   Stops at $3x(2x + 3) - 8(2x + 3)$.

B5   Uses formula to get $x = \dfrac{8}{3}$ and $x = -\dfrac{3}{2}$ but fails to form factors.

Attempts (2 marks)

A1   Any correct factors of $6x^2$ and / or 24.

A2   Some correct substitution into correct quadratic formula.

A3   Indicates correct guide (key) number and stops.

A4   Writes down correct quadratic formula and stops.

A youth club is organising an outing to a park. The total cost of entry for club members to the park is €42.

(i)   Taking x to be the number of club members, write an expression in x to represent the cost of entry per member.

If two club members decided not to go on the outing, the total cost of entry to the park would be €35.

(ii)   Write an expression in x to represent the cost of entry per member in this case.

The cost of entry per member, in this case, would be increased by €1.

(iii)   Write an equation in x to represent the above information.

(iv)   ✍   Solve this equation to find the number of members in the club.

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

(i) $\dfrac{42}{x}$

Blunders (-3)

B1   Cost of entry per member inverted, e.g. $\dfrac{x}{42}$.

Attempts (2 marks)

A1   Gives answer as $42 \cdot x$

A2   Any correct relevant step, e.g. trial and error – award once only i.e. in **(i)** & **(ii)**.

Worthless (0)

W1   Gives answer as $42 \pm x$.

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

(ii) $\dfrac{35}{x-2}$

Blunders (-3)

B1   Cost per seat inverted, e.g. $\dfrac{x-2}{35}$, but do not penalise if already blundered in **(i)** above.

B2   Uses $x+2$.

B3   Gives answer as $\dfrac{35}{x}$.

B4   Uses 42 instead of 35 to get $\dfrac{42}{x-2}$

Attempts (2 marks)

A1   Gives answer as $35 \cdot (x-2)$.

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

> **(iii)** $\dfrac{35}{x-2} - \dfrac{42}{x} = 1$, or equivalent.

*   Accept candidate's answer from **(i)** and **(ii)** above.

Blunders (-3)

B1   Sign error in setting up equation, e.g. $\dfrac{42}{x} - \dfrac{35}{x-2} = 1$.

B2   Expression not equal to 1, e.g. gets $\dfrac{35}{x-2} - \dfrac{42}{x} = 7$.

Attempts (2 marks)

A1   Incorrect expression but uses data from (i) & (ii), e.g. $\dfrac{42}{x-2} - \dfrac{42}{x} = 7$.

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

> **(iv)** $\dfrac{35}{x-2} - \dfrac{42}{x} = 1 \;\rightarrow\; \dfrac{35(x) - 42(x-2)}{(x)(x-2)} = 1$
>
> $35x - 42x + 84 = 1(x)(x-2)$
>
> $x^2 + 5x - 84 = 0 \;\rightarrow\; (x-7)(x+12) = 0 \;\rightarrow\; x = 7.$

Blunders (-3)

B1   Correct answer, but no work shown (✍).

B2   Each different error in distributive law.

B3   Errors in transposition.

B4   Mathematical / sign errors.

B5   One solution where there should be two, i.e. where there are 2 positive solutions.

B6   Correct factors and stops, i.e. failure to find the number of members in the club.

B7   Incorrect factors.

B8   Errors using quadratic formula.

Slips (-1)

S1   Numerical errors to a max of 3.

Attempts (2 marks)

A1   No quadratic due to previous errors, merits attempt at most.

QUESTION 5

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

Part (a)	10 marks	Att 3

✍   Graph on the number line the solution set of

$$-9 \leq 2x - 5 < 7, \quad x \in \mathbf{Z}.$$

(a)	10 marks	Att 3

$$-9 \leq 2x - 5 \quad \rightarrow \quad x \quad \geq \quad -2$$

$$2x - 5 < 7 \quad \rightarrow \quad x \quad < \quad 6$$

$$-9 + 5 \leq 2x < 7 + 5$$

$$-4 \leq 2x < 12$$

$$-2 \leq x < 6$$

$$\rightarrow \quad -2 \leq x < 6 \qquad \text{Plot on Number Line for } x \in \mathbf{Z}.$$
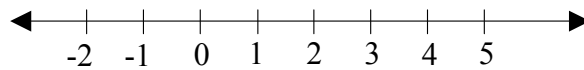
Blunders (-3)

B1   Correct answer, but no work shown (✍).

B2   Each different error in transposition.

B3   Mishandles inequality, e.g. $-2x \leq 4 \Rightarrow x \leq -2$

B4   No plotting or incorrect plotting, i.e. stops at $-2 \leq x < 6$ or plotted for $x \in \mathbf{R}$.

B5   Solves as two equations, but **note:** also incurs B4.

Slips (-1)

S1   Numerical errors to a max of 3.

Attempts (3 marks)

A1   Solves only one inequality.

A2   Tests for one correct value of *x* and stops.

A3   Any correct transposition and stops.

A4   Treats as one inequality, with some correct work.

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

> Marie has €25 made up of 20 cent coins and 50 cent coins. She has 104 coins in total.
>
> **(i)**   Taking x to be the number of 20 cent coins and y to be the number of 50 cent coins, write down two equations in x and y to represent this information.
>
> **(ii)**   ✍   Solve the equations to find the number of each type of coin Marie has.

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

> **(i)** $x + y = 104$ and $0{\cdot}2x + 0{\cdot}5y = 25$ **or** $20x + 50y = 2500$
>
> **(ii)**   Solving $\rightarrow$ $x = 90$ and $y = 14$
> $\rightarrow$ 90 twenty cent coins and 14 fifty cent coins.

Blunders (-3)

B1   One correct equation only. $\rightarrow$ **17 marks.**

B2   Forms part of either equation only, but also incurs B1 $\rightarrow$ **14 marks.**

Attempts (7 marks)

A1   Any other relevant equation.

A2 $x = 90$ **and** $y = 14$ without work.

Worthless (0)

W1 $x = 90$ **or** $y = 14$ without work.

W2   Invents value for 1 variable and continues, e.g $x = 50$ to get $y = 54$.

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

> Let f be the function $f : x \rightarrow x^2 + bx + c$, $x \in \mathbf{R}$ and $b, c \in \mathbf{Z}$.
>
> The points (2, -6) and (0, 6) lie on the graph of f.
>
> **(i)**   ✎   Find the value of b and the value of c.
>
> **(ii)**   ✎ k is a positive real number and $(k, -k)$ is a point on the graph.
>
>   Find the two possible values of k.

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

> **(i)** $f : 2 \rightarrow$ -6   and $f : 0 \rightarrow 6$
>
>   -6   = $4 + 2b + c$ and   6 = $0 + 0 + c$
>
> $\rightarrow$ $c = 6$ and $b =$ -8.

Blunders (-3)

B1   Correct answers, but no work shown (✎).

B2   Each different error in transposing or signs.

B3   Calculates the value of b **or** c correctly and stops.

Attempts (5 marks)

A1   Substitutes some correct value for x or $f(x)$.

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

> **(ii)** $f : k \rightarrow k^2 - 8k + 6$ $=$ -k $\rightarrow$ $k^2 - 7k + 6$ $= 0$
>
> $\rightarrow$ $k = 6$ or $k = 1$.

Blunders (-3)

B1   Correct answers, but no work shown (✎).

B2   Each different error in transposing or signs.

B3   Calculates one value of k correctly and stops.

Attempts (2 marks)

A1   Sets up equation, e.g. rewrites function with k for x.

QUESTION 6

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

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

> The perimeter of a rectangle is 14 m. The width of the rectangle is x m.
>
> **(a)**   ✎   Write an expression in x for the length of the rectangle.

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

> $$2x + 2l = 14 \qquad \rightarrow \qquad l = 7 - x$$

*   Accept $l = \dfrac{14 - 2x}{2}$ and stops.

Blunders (-3)

B1   Correct answer, but no work shown (✎).

B2   Gets $x + l = 7$ and stops.

B3   Uses $x + l = 14$ to get $l = 14 - x$.

B4   Errors in distributive law.

B5   Takes 14 as the area of the rectangle, i.e. gets $l = \dfrac{14}{x}$.

Attempts (3 marks)

A1   Uses some value for x and finds corresponding l.

Part (b)   **25 (5+20) marks**   **Att 2,7**

> **(i)**   ✎   Show that the area, in m^2, of the rectangle is $7x - x^2$.
>
> **(ii)**   ✎   Let f be the function $f : x \rightarrow 7x - x^2$.
>
>   Draw the graph of f for $0 \le x \le 7, \ x \in \mathbf{R}$.

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

> **(i)**   Area $= \quad x\,(7 - x) \quad = \quad 7x - x^2$.

*   Accept use of candidate's 'l' from **(a)** above, multiplied by x with or without further work.

*   Accept answer as $x\,(7 - x)$ without simplification since $7x - x^2$ given in question.

Blunders (-3)

B1   Incorrect use of '*l* 'from (**a**) above.

B2   Area given as $x \cdot x$ or $l \cdot l$.

Attempts (2 marks)

A1   States area is length by width.

A2   Correct factors of $7x - x^2$. [where $l \neq 7 - x$ in part (**a**)].

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

(ii) $f(x) = 7x - x^2$

$f(0) = 7(0) - (0)^2 = 0 - 0 = 0$ $f(4) = 7(4) - (4)^2 = 28 - 16 = 12$

$f(1) = 7(1) - (1)^2 = 7 - 1 = 6$ $f(5) = 7(5) - (5)^2 = 35 - 25 = 10$

$f(2) = 7(2) - (2)^2 = 14 - 4 = 10$ $f(6) = 7(6) - (6)^2 = 42 - 36 = 6$
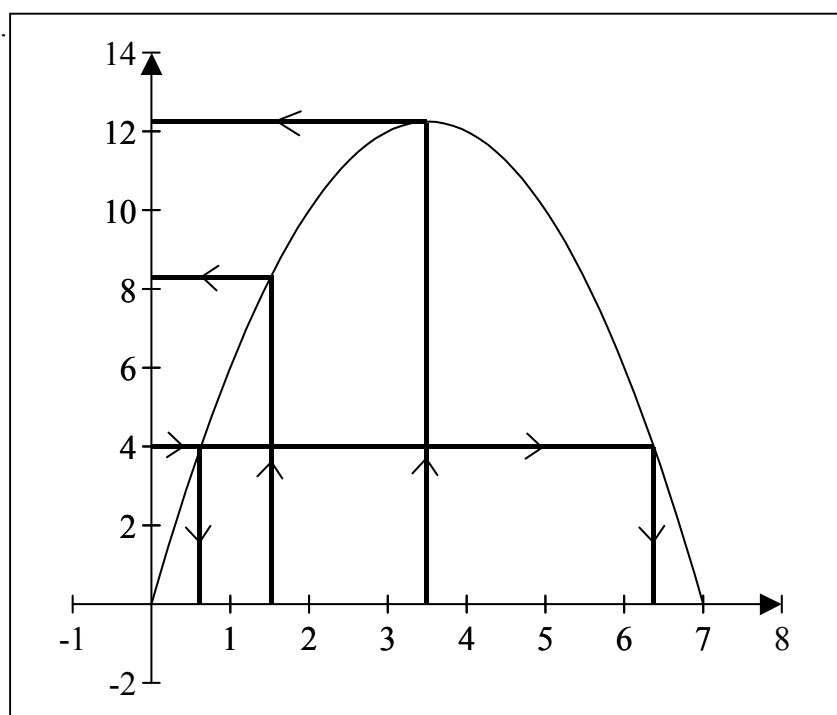
$f(3) = 7(3) - (3)^2 = 21 - 9 = 12$ $f(7) = 7(7) - (7)^2 = 49 - 49 = 0$

or

x	0	1	2	3	4	5	6	7
$-x^2$	0	-1	-4	-9	-16	-25	-36	-49
$+7x$	0	7	14	21	28	35	42	49
$f(x)$	0	6	10	12	12	10	6	0

Graph of $f : x \to 7x - x^2$.

Values for quadratic graph

Blunders (-3)

B1   Each incorrect $f(x)$ without work.

B2 x row added in, i.e. top row, or adds in extra row.

B3   Omits $7x$ row.

B4   Treating the domain as $0 < x < 7$, can incur 2 Blunders if both omitted.

B5   Each different blunder which yields an incorrect row (full or part), e.g. $(-x)^2$ for $-x^2$.

B6   Avoids square for some (not all) values.

B7   Mathematical errors in tots, e.g. $-36 + 42 = -6$, but apply once only.

B8   Uses graph of $f : x \rightarrow x^2 - 7x$.

B9   Function values given, but no work shown.

Slips (-1)

S1   Numerical slips to a max. of 3.

Attempts (7 marks)

A1   Omits $-x^2$ or does not treat as x^2 (Treats as linear expression).

A2   Correct or partly correct table / values but no graph drawn.

Plotting the quadratic graph

*   Accept candidate's values from the table.

Blunders (-3)

B1   Points not joined to form a reasonable graph.

B2 (x, y) plotted as (y, x), but apply once only, or reverses axes.

B3   Scale not reasonably uniform. 1 x (–3) each axis.

B4   Each different blunder in plotting points from candidate's table / values.

B5   Each point omitted, if graph does not go reasonably close to where point should be.

B6   Points joined with straight lines.

Attempts (7 marks)

A1   Scaled axis drawn.

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

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

(i)   ✍   the area of the rectangle when the width is $1 \cdot 5$ m

(ii)   ✍   the maximum possible area of the rectangle

(iii)   ✍   the two possible values of the width of the rectangle, when the area

is 4 m^2.

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

      (i) $f : 1 \cdot 5 \rightarrow$ $8 \cdot 25$

*   Accept answer consistent with candidate's curve (within tolerance of $\pm \, 0 \cdot 4$).

Blunders (-3)

B1   No indication on graph.

B2   Calculates area using $x = 1 \cdot 5$ in the function.

B3   Correct indication on graph, but no value given.

B4   Uses y or f(x) = $1 \cdot 5$

Slips (-1)

S1   Outside tolerance using candidate's graph.

Attempts (2 marks)

A1   Point indicated on graph only.

Worthless (0)

W1   Answer inconsistent with candidate's graph.

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

(ii) Max at $x = 3 \cdot 5$ $f : 3 \cdot 5 \to$ $12 \cdot 25$	

*   Accept answer consistent with candidate's graph.

Blunders (-3)

B1   No indication on graph.

B2   Calculates area using $x = 3 \cdot 5$ in the function.

B3   Correct indication on graph, but no value given.

B4   Max value of ≤ 12.

Attempts (2 marks)

A1   Point indicated on graph only.

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

(iii) $f : x \to 4$ $x = 0 \cdot 6$ or $6 \cdot 4$.	

*   Accept answer consistent with candidate's graph.

Blunders (-3)

B1   No indication on graph.

B2   Correct indication on graph, but no values given.

B3   Only one value given.