Coimisiún na Scrúduithe Stáit
State Examinations Commission

Marking Scheme

JUNIOR CERTIFICATE EXAMINATION 2003
MATHEMATICS
ORDINARY 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 as B1, B2, B3,....., S1, S2, S3,...., M1, M2, etc. Note that these lists are not exhaustive.

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

5. Particular cases, verifications and answers derived from diagrams (unless requested) qualify for attempt marks only.

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

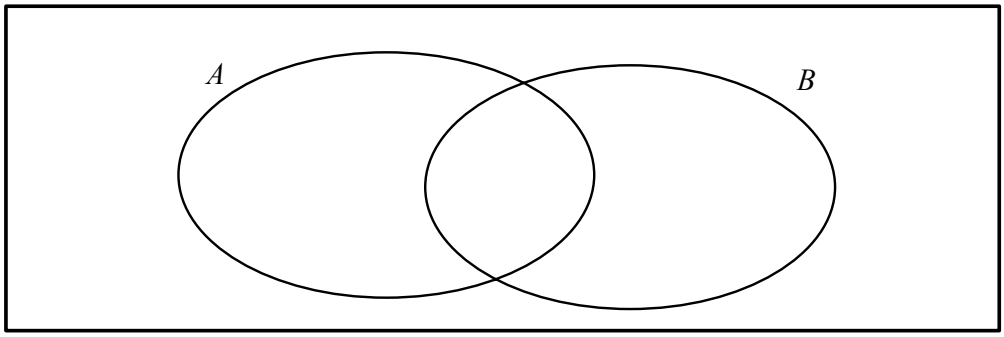
QUESTION 1

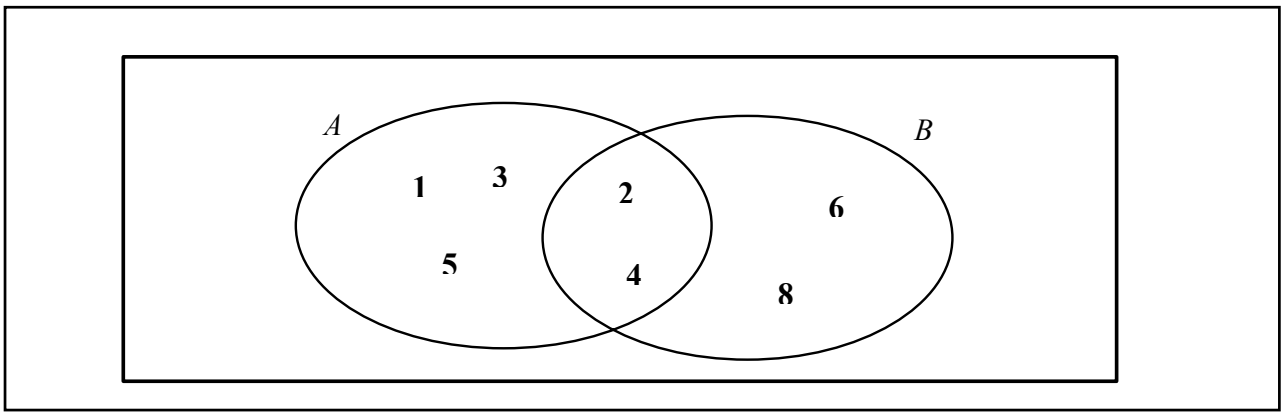
Part (a)	**10 marks**	**Att 3**
Part (b)	**20 marks**	**Att 2,2,2,2**
Part (c)	**20 marks**	**Att 2,2,2,2**

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

$A = \{1, 2, 3, 4, 5\}$ $B = \{2, 4, 6, 8\}$

Fill the elements of A and B into the following Venn diagram:





Slips (–1)

S1 Each element incorrectly filled into the diagram.

S2 Each element omitted from the diagram.

Attempts

Att Totally incorrect filling of the Venn diagram.

Worthless

W1 No filling of the Venn diagram.

Notes

N1 Only one element correctly placed in Venn diagram $\Rightarrow$ 4 marks.

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

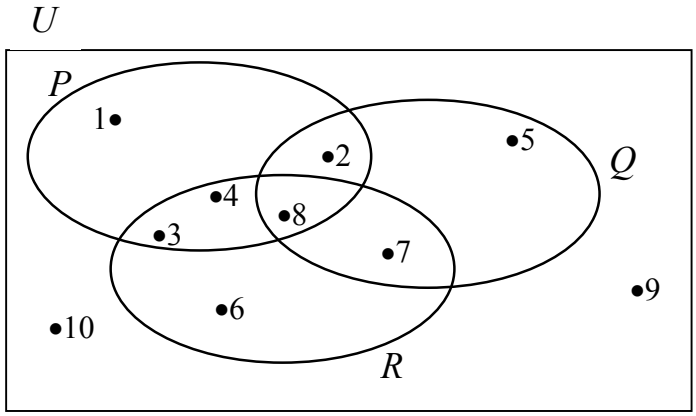
U is the universal set.

$P = \{1, 2, 3, 4, 8\}$

$Q = \{2, 5, 7, 8\}$

$R = \{3, 4, 6, 7, 8\}$

List the elements of:



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

$P \cap Q$ = {2, 8}

Blunders(−3)
B1 Any incorrect set of the elements of P and Q other than the misreading as below.
Misreadings(−1)
M1 P ∪ Q giving {1,2,3,4,5,7,8}.
Attempts
Att 6 or 9 or 10 appear in the answer.

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

$R \setminus Q$ = {3, 4, 6}

Blunders(−3)
B1 Any incorrect set of the elements of R and Q other than the misreading as below.
Misreadings(−1)
M1 Q\R giving {2,5}.
Attempts
Att 1 or 9 or 10 appear in the answer.

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

Q' = {1, 3, 4, 6, 9, 10}

Slips(−1)
S1 Each correct element omitted and/or each incorrect element included.
Attempts
Att: Q or any proper subset of Q.

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

$P \setminus (Q \cup R) \quad = \quad \{1\}$

Blunders(−3)
B1 Any incorrect set of the elements of P and Q and R other than the misreadings as below.

Misreadings(−1)
M1 (Q∪R)\P giving {5,6,7}.
M2 P\(Q∩R) giving {1,2,3,4}.

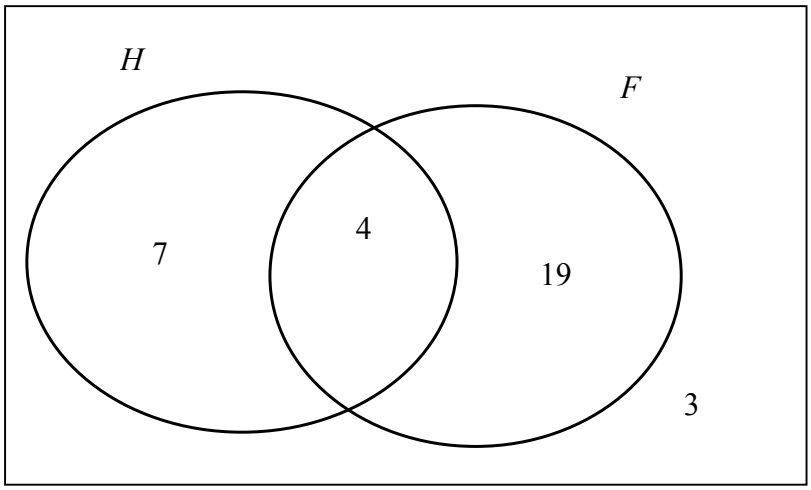
Attempts
Att 9 or 10 appear in the answer.

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

There are 33 students in a class. 11 play hurling (H) and 23 play football (F).

4 play both sports.

Using the Venn diagram below, or otherwise, answer the following questions:



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

How many play hurling but not football?

7

Blunders(−3)

B1 Incorrect Venn diagram.[See S1].

B2 Any incorrect use of the given numbers or the numbers from the candidate's incorrect Venn diagram, other than the misreading as below.

Misreadings(−1)

M1 F\H.

Slips(−1)

S1 Numerical errors where work is clearly shown.

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

How many play football but not hurling?

19

Blunders(−3)

B1 Incorrect Venn diagram, but do not penalise if already penalised in (i).

B2 Any incorrect use of the given numbers, or the numbers from the candidate's incorrect Venn diagram other than the misreading as below.

Misreadings(−1)

M1 H\F.

Slips(−1)

S1 Numerical errors where work is clearly shown.

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

How many play neither football nor hurling?
3

Blunders(−3)

B1 Incorrect Venn diagram, but do not penalise if already penalised in (i) or (ii). [See N1]

B2 Any incorrect use of the given numbers or the numbers from the candidate's incorrect Venn diagram.

Slips(−1)

S1 Numerical errors where work is clearly shown.

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

How many play exactly one of the two sports?
26

Blunders(−3)

B1 Incorrect Venn diagram, but do not penalise if already penalised in (i), (ii) or (iii).

B2 Any incorrect use of the given numbers or the numbers from the candidate's incorrect Venn diagram.

Slips(−1)

S1 Numerical errors where work is clearly shown.

Notes

N1 A correct answer written in space provided takes precedence over an incorrect Venn diagram.

N2 A fully correct Venn diagram and stops $\Rightarrow$Att 2 +Att 2 + Att 2 + 0 i.e. 6 marks.

QUESTION 2

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

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

€2400 is shared between John, Mary and Anne. John gets $\frac{1}{2}$ of the money. Mary gets $\frac{1}{3}$ of the money. How much does Anne get?

John = $\frac{1}{2}(2400) = 1200$
Mary = $\frac{1}{3}(2400) = 800$
Anne = 2400–(1200+800)
= 2400–2000 = 400.

John + Mary = $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$
Anne = $1 - \frac{5}{6} = \frac{1}{6}$
Anne = $\frac{1}{6}(2400) = 400$

Blunders(–3)
B1 Subtracts 800 from 1200 and continues.
B2 Adds 1200 and 800 and stops.
B3 Gets $\frac{1}{3}$ of John's share as Mary's share and continues giving 1200 for John, 400 for Mary and 800 for Anne.
B4 $\frac{1}{6}$ as answer and stops.
B5 $\frac{1}{2} + \frac{1}{3}$ incorrect and continues.
B6 Anne's share = 2000+2400.
B7 Error in decimal point. (once only).

Slips(–1)
S1 Numerical errors in division, addition or subtraction.

Attempts
Att $\frac{1}{2}$ of 2400 or $\frac{1}{3}$ of 2400 and stops.
Att $\frac{1}{2} + \frac{1}{3}$ and stops.
Att Any mention of 6 parts.
Att $\frac{1}{2} : \frac{1}{3}$ appears.
Att divides the money equally between them.

Notes
N1 1200,800 found but not added ⇒ 4 marks.
N2 $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$ and stops ⇒ 4 marks.
N3 Correct answer without work ⇒ 7 marks.
N4 Incorrect answer without work ⇒ 0 marks.

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

1 euro = 120 Japanese yen. Change 3000 yen to euro.

	120 yen	=	€1	→	1 yen	=	$€\frac{1}{120}$
	3000 yen	=	$€3000\times\frac{1}{120}$	=	$€\frac{3000}{120}$	=	€25

Blunders(−3)

B1 $3000\times 120 = 360000$.

B2 $\frac{120}{3000}$ or $\frac{120}{3000} = .04$.

B3 Decimal point error in evaluating $\frac{3000}{120}$.

B4 $\frac{3000}{120}$ and stops.

Slips(−1)

S1 numerical errors in division.

Attempts

Att 1 yen = $€\frac{1}{120}$ or $\frac{1}{120}$ and no more work.

Worthless

W1 Adds or subtracts 3000 and 120.

Notes

N1 Correct answer without work ⇒ 7 marks.

N2 Incorrect answer without work ⇒ 0 marks.

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

Show how to estimate the value of $\frac{5\cdot 89\times 12\cdot 42}{8\cdot 74}$.

$\frac{5\cdot 89\times 12\cdot 42}{8\cdot 74}$ is approximately equal to:

$$\frac{\boxed{6}\times\boxed{12}}{\boxed{9}} = \frac{\boxed{72}}{\boxed{9}} = \boxed{8}$$

Accept candidate's consistent method of approximation that would lead to estimation E where $6 \le E \le 10$.

Blunders(−3)
B1 Candidate's method would lead to an estimation E, outside $6 \le E \le 10$.
B2 Inconsistent relevant approximating(once only)
B3 Decimal point error in calculation of approximate value.
B4 Illegal cancellation in calculation of approximate value.
B5 An arithmetical operation other than indicated.

Slips(−1)
S1 Numerical errors in arithmetical operations.

Attempts
Att Only one or two approximations made to the given numbers.
Att Inconsistent and not relevant approximation

Worthless
W1 No approximations made to given numbers.

Notes
N1 $\frac{6\times 12}{9}$ or candidate's equivalent and stops $\Rightarrow$ 4 marks.
N2 No penalty if the intermediate step between approximations and final answer not shown.
e.g. $\frac{72}{9}$ not shown.

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

Using a calculator, or otherwise, find the exact value of $\frac{5 \cdot 89 \times 12 \cdot 42}{8 \cdot 74}$.

8·37

Blunders(−3)
B1 *Otherwise:* Error(s) in decimal point.
B2 *Calculator:* Incorrect Answer.
Slips(−1)
S1 *Otherwise:* numerical errors in multiplication or division.

Attempts
Att Some correct calculation done.

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

Using a calculator, or otherwise, find the exact value of $(6 \cdot 54)^2$

42·7716

Blunders(−3)

B1 $\sqrt{6.54} = 2.5573424$.

B2 $6.54 \times 2 = 13.08$.

B3 *Otherwise:* Decimal point error in multiplication or in use of Maths. Tables.

B4 *Calculator:* Incorrect Answer.

Slips(−1)

S1 *Otherwise:* numerical errors in multiplication to a max. of −3.

S2 *Maths. Tables:* 42.77.

Attempts

Att Some correct calculation done.

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

Using a calculator, or otherwise, find the exact value of $\sqrt{94 \cdot 09}$

9·7

Blunders(−3)

B1 $(94.09)^2 = 8852.9281$.

B2 $\sqrt[3]{94.09} = 4.5482866$.

B3 *Calculator:* Incorrect Answer.

B4 $\frac{94.09}{2}$ and continues.

Notes

N1 Maths. Tables give 9.7

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

Hence, evaluate $(6\cdot54)^2 \times \sqrt{94\cdot09} - \frac{1}{3\cdot76}$ and give your answer correct to two decimal places.

$42\cdot7716 \times 9\cdot7$	=	$414\cdot88452$		
$\frac{1}{3\cdot76}$	=	$0\cdot26596$		
$\Rightarrow$		$414\cdot61856$	=	$414\cdot62$

Blunders(−3)

B1 Subtracts 3.76 instead of 1 / 3.76

B2 An arithmetical operation other than a given one e.g. $+$ for $\times$:
$42.7716 + 9.7 - .26596 = 52.20564 = 52.21.$

B3 $\sqrt{94.09}$ - (1 / 3.76 × (6.54) ²) = -1.68 (breaking order).

B4 $\sqrt{94.09}$ - 1 / 3.76 = 9.434 × (6.54) ² = 403.51(breaking order).

B5 (6.54) ² - 1 / 3.76 = 42.5056 × $\sqrt{94.09}$ = 412.3(breaking order).

B6 (6.54) ² - 1 / 3.76 × $\sqrt{\ }$ 94.09 = 40.19(breaking order).

B7 Error in decimal point.

Slips(−1)

S1 Numerical errors in arithmetical operations.

S2 Maths. Tables give $\frac{1}{3.76} = .266$.

S3 An incorrect but relevant transfer of value from c (i) and /or c (ii).

S4 Each rounding off during the evaluation of the unrounded off answer (max −3).

S5 Fails to round off or incorrectly rounds off when giving final answer.

Attempts

Att Adds only.

Att Evaluates $\frac{1}{3.76}$ and stops.

Att *Calculator*: incorrect answer.

Notes

N1 Accept the use of candidate's incorrect answers from c (i) and c (ii) in c (iii).

N2 Correct answer without work $\Rightarrow$ 2 marks.

QUESTION 3

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

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

A shopkeeper bought a table for €120 and sold it for €162.
Calculate the profit as a percentage of the cost price.

Profit:

€42

Percentage of cost price:

$$\frac{42}{120}\times 100 \quad = \quad 35\%$$

Profit: (5 marks)

Blunders(−3)

B1 Adds €120 to €162.

Slips(−1)

S1 Numerical errors in arithmetical operations.

Attempts

Att Some indication of subtraction.

Notes

N1 Correct answer without work ⇒ 5 marks.

Percentage of cost price: (5 marks)

Blunders(−3)

B1 As percentage of selling price.

B2 Mishandles the calculation of profit as a percentage.

B5 Illegal cancellation in correct method of calculation of profit as a percentage.

B6 Error in decimal point in correct method of calculation of profit as a percentage.

Slips(−1)

S1 Numerical errors in arithmetical operations.

Attempts

Att Some use of 100 or of the given data or the calculated profit

Att $\text{Profit}/\text{Costprice}$ or $\text{Profit}/\text{Costprice}\times 100$ and stops.

Notes

N1 Correct answer without work ⇒ 2 marks.

N2 Incorrect answer without work ⇒ 0 marks.

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

Carla's gross pay is €24 000. Her tax credit is €2500. She pays income tax at the rate of 22%. What is her take-home pay?

Gross Pay	€24 000
Tax @ 22%	**€5280**
Tax Credit	€2500
Tax Due	**€2780**
Take-home Pay	**21,220**

Method 1

$\text{Tax} = \frac{24000}{100} \times 22 = 5280$

or $\text{Tax} = 24000 \times .22 = 5280$

Tax Due = 5280 – 2500 = 2780.

Take –Home Pay = 24000 –2780
= 21220

Method 2

G.P.–Tax + T.C.
=24000– 5280 +2500
=21220.

Method 3

$(.78 \times 24000) = 18720$

$18720 + 2500$

$= 21220$

Blunders (–3)

B1 Mishandles 22% /78% of 24000 e.g. 24000×22 only or $\frac{24000}{22}$. [All methods].

B2 Error in decimal point in calculation of chosen %. [All methods].

B3 illegal cancellation in $\frac{24000 \times 22}{100}$ [Methods1/2] or $\frac{24000 \times 78}{100}$ [Method 3].

B4 Misuse of Tax Credit in Method 1 when finding tax due e.g. $5280 + 2500 = 7780$ giving final answer 16220.

B5 Misuse of Tax Credit in Method 2 when finding take-home pay e.g. $24000 - 5280 - 2500 = 16220$ as final answer.

B6 Misuse of Tax Credit in Method 3 when finding take-home pay e.g. $18720 - 2500 = 16220$.

B7 Misuse of Tax Amount in Methods1 and 2 e.g. $24000 + 5280 \Rightarrow 26780$ as final answer.

B8 Tax due and stops in Method 1.

Slips(−1)

S1 Numerical errors in arithmetical operations.

Attempts

Att Some use of 100 when calculating either 22% or 78%.

Att Tax credit + gross pay and stops. [26500]

Notes

N1 Evidence of work done: 5280 and/ or 2780 and/or 18720, or similar from candidate's work, Are written down.

N2 5280 and stops ⇒ 4 marks.

N3 2780 and stops ⇒ 7 marks.

N4 18720 and stops ⇒ 7 marks [No use of Tax Credit]

N5 Correct answer without work ⇒ 7 marks.

N6 Incorrect answer without work ⇒ 0 marks.

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

The train fare from Cork to Dublin is €44·40 for an adult and €19·00 for a child.

How much does it cost one adult and two children to travel from Cork to Dublin?

44·40 + 2 (19·00) = 44.4 + 38 = €82·40

44.4 + 19 + 19 = €82.40

Blunders(–3)

B1 Fails to multiply 19 by 2 and continues to get 63.4.

B2 Does not add to find total cost.

B3 subtracts rather than adds.

B4 Error in decimal point.

B5 $\frac{19}{2}$ or $\frac{19}{2} = 9.5$ and continues.

Slips(–1)

S1 Finds the cost of 2 adults and 1 child getting 107.8 .

S2 Numerical errors in multiplication and addition.

S3 44 instead of 44.4.

Attempts

Att $\frac{19}{2}$ or 9.5 and stops.

Notes

N1 Correct answer without work $\Rightarrow$ 7 marks.

N2 Incorrect answer without work $\Rightarrow$ 0 marks.

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

€4000 is invested at 3% per annum.
What is the amount of the investment at the end of one year?

1% = 40
3% = 120
Amount = €4120

$I = \frac{P.T.R}{100} = \frac{4000 \times 1 \times 3}{100} = 120$
Amount = €4120

(4000)(1.03)
= 4120.

Blunders (–3)
B1 Mishandles 3%, e.g. 4000×3 or $4000 \div 3$ (4000 must be used).
B2 Error in decimal point (once only).
B3 Stops at interest i.e. fails to calculate amount.
B4 Subtracts to calculate amount.
B5 Incorrect substitution into formula and continues. [say T = 2: but 4000 must be used].
B6 Illegal cancellation in $\frac{4000 \times 1 \times 3}{100}$.
B7 $4000 \times .03 = 120$ and stops.
B8 1.03 = 1.3.
Slips (–1)
S1 numerical errors (to max–3).

Attempt
Att correct formula with or without substitution and stops.
Att some use of 100 in attempt to find percentage e.g. $3\% = \frac{3}{100}$ and stops.

Notes
N1 €120 and stops $\Rightarrow$ 7 marks.
N2 $4000 \times 3 = 12000$ and stops $\Rightarrow$ 4 marks (B1 + B3).
N3 $4000 \times 3 = 12000$ + 4000 = 16000 $\Rightarrow$ 7 marks (B1).
N4 Correct answer without work $\Rightarrow$ 7 marks.
N5 Incorrect answer without work $\Rightarrow$ 0 marks.

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

€1000 is added to this amount at the beginning of the second year.

The interest rate for the second year is $2 \cdot 5\,\%$ per annum.

What is the amount of the investment at the end of that year?

4120 + 1000 = 5120
1% = 51.20
2.5% = 128
Amount = 5248

$$I = \frac{P.T.R.}{100} = \frac{5120 \times 1 \times 2.5}{100} = 128$$
Amount = 5248

(5120)(1.025)
= 5248.

Blunders (–3)

B1 fails to add €1000 and continues.
B2 Subtracts €1000 instead of adding €1000 and continues.
B3 Mishandles %, but no penalty if as in c (i).
B4 Uses 3% instead of 2.5%.
B5 Error in decimal point (once only).
B6 Stops at interest i.e. fails to calculate amount.
B7 Subtracts to calculate amount.
B8 incorrect substitution into correct formula and continues but no penalty if as above e.g. T = 2 used in both parts.
B9 uses €4120 as principal to find amount and then adds €1000.
B10 €1000 added to €4000 and continues.
B11 $5120 \times .025 = 128$ and stops.
B12 $1.025 = 1.25$.

Slips (–1)

S1 numerical errors (to max–3).

Attempt

Att correct formula with or without substitution and stops.
Att some use of 100 in attempt to find percentage.
Att stops after adding €1000.
Att Calculates 2.5% of 1000 but does not calculate 2.5% of 4120, stops or continues.
Att €1000 used as the principal, stops or continues.

Notes

N1 €120 recalculated $\Rightarrow$ 3 marks.
N2 $P_1 = P_2 \Rightarrow$ Att.
N3 120×2 or $120 \times 2 = 240 \Rightarrow$ Att.
N4 Correct answer without work $\Rightarrow$7 marks.
N5 Incorrect answer without work $\Rightarrow$ 0 marks.

QUESTION 4

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

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

If $x = 3$, find the value of $x^2 - 2x + 5$.

$(3)^2 - 2(3) + 5 \quad = \quad 9 - 6 + 5 \quad = \quad 8$

Blunders (–3)

B1 Incorrect numerical substitution and continues.
B2 Mishandles $(3)^2$ i.e. $(3)^2 = 6$ or leaves $(3)^2$ in answer.
B3 Mishandles $-2(3)$ i.e. $= 6$ or leaves $-2(3)$ in answer.
B4 Breaks order i.e. $[9 - 2(3) = 7(3) = 21]$ (once only).
B5 $-2(3)$ taken as $-2 + 3$.
B6 –2(3) clearly taken as –23.

Slips(–1)

S1 Numerical errors (to max –3).

Attempts

Att Incomplete substitution and continues or stops.
Att $3x$ substituted for x in both terms with x and continues or stops

Notes

N1 $(3)^2 - 2(3) + 5 \Rightarrow 5$ marks.
N2 $9 - 6 + 5 \Rightarrow 12$ marks.
N3 $3 + 5 \Rightarrow 14$ marks.
N4 Correct answer without work $\Rightarrow 12$ marks.
N5 Incorrect answer without work $\Rightarrow 0$ marks.

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

Multiply $(2x+1)$ by $(3x-5)$ and write your answer in its simplest form.

$(2x+1)(3x-5) = 6x^2 - 10x + 3x - 5$ (7 mks.)

$= 6x^2 - 7x - 5$ (10 mks.)

Blunders (–3)
B1 Errors in indices when multiplying (once only).
B2 Only one omission in multiplication (more than one omission $\Rightarrow$ Att only).
B3 Adding unlike terms.
B4 Errors in sign when multiplying (once only).

Slips (–1)
S1 Numerical error(s) in multiplication (to max –3).
S2 Numerical error(s) in addition or subtraction (to max –3).

Attempts
Att Any correct multiplication.
Att $2x(3x-5)+1(3x-5)$ and stops.
Att $3x(2x+1)-5(2x+1)$ and stops.

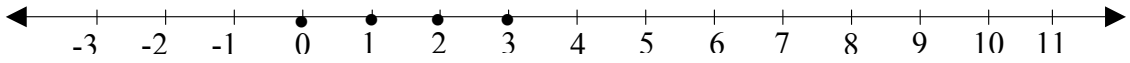
Worthless
W1 $(2x+1) \pm (3x-5)$.

Notes
N1 Correct answer without work $\Rightarrow$ 7 marks.
N2 Incorrect answer without work $\Rightarrow$ 0 marks.

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

Graph on the number line the solution set of $5x - 1 \leq 14, x \in \mathbf{N}$.

$$5x - 1 \leq 14$$
$$5x \leq 15$$
$$x \leq 3$$



Blunders (–3)

B1 Each error in transposition.

B2 Mishandling direction of inequality e.g. $-3 \leq -x \Rightarrow 3 \leq x$.

B3 Adds "x's" and "numbers" e.g. $5x-1 = 4x$ (once only).

B4 No indication on number line or incorrect indication on number line [but see S2, N4]

Slips (–1)

S1 Numerical errors (to max –3).

S2 $\leq$ is taken as $<$.

Attempts

Att Treats as an equation and continues but fully correct indication of candidate's answer as an inequality on number line takes precedence.

Att Attempts some substitution in an effort to test values.

Att Incorrect indication, without algebraic work.

Notes

N1 $x \leq 3 \Rightarrow$ 7 marks.

N2 Correct answer properly indicated on number line, without algebraic work $\Rightarrow$ 7 marks.

N3 If $x \geq 3$ as a result of error, 3,4,5 and or more as the indication on number line.

N4 Accept $x \in \mathbf{R}$ or $x \in \mathbf{N_0}$ or $x \in \mathbf{Z}$ for full marks.

N5 Correct answer without work i.e. no algebraic work or indication on number line $\Rightarrow$ 4marks.

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

Write $\frac{x+2}{3}-\frac{x-3}{5}$ as a single fraction and give your answer in its simplest form.

$$\frac{x+2}{3}-\frac{x-3}{5}$$
$$=\frac{5(x+2)-3(x-3)}{15}$$
$$=\frac{5x+10-3x+9}{15}$$
$$=\frac{2x+19}{15}$$

Blunders (–3)

B1 Incorrect common denominator and continues.
B2 Incorrect numerator from candidate's common denominator.
B3 No simplification of numerator.
B4 Errors in distributive law. [See N2].
B5 Errors in sign when multiplying.[See N2].

Slips (–1)

S1 Correct common denominator implied.
S2 Numerical errors in arithmetical operations.

Attempts

Att 15 only or a multiple of 15 only appears.
Att $\left(\frac{x+2}{3}\right)\left(\frac{x-3}{5}\right)$ and stops.

Notes

N1 Subtracts numerators and then denominators i.e. $\frac{x+2}{3}-\frac{x-3}{5}=\frac{5}{-2}\Rightarrow$ 0 marks.
N2 All blunders and slips in simplification of numerator (Max –3)

N3 $\frac{5(x+2)-3(x-3)}{15}$ and/or $\frac{5x+10-3x+9}{15}$ and stops $\Rightarrow$ 2 marks.

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

Solve for x and for y:

$$2x - 3y = 9$$
$$5x + 2y = 13$$

$2x - 3y = 9$
$5x + 2y = 13$
$4x - 6y = 18$
$15x + 6y = 39$
$19x = 57$
$x = 3$
$y = -1$

$2x - 3y = 9$
$5x + 2y = 13$
$10x - 15y = 45$
$10x + 4y = 26$
$-19y = 19$
$y = -1$
$x = 3$

$y = \frac{2x - 9}{3}$
$5x + \frac{2(2x - 9)}{3} = 13$
$15x + 4x - 18 = 39$
$19x = 57$
$x = 3$
$y = -1$

Blunders (–3)

B1 Error(s) in establishing the first equation in terms of x only [$19x = 57$] or the first equation in terms of y only [$-19y = 19$] through elimination by cancellation.

B2 Error(s) in establishing the first equation in terms of x only or the first equation in terms of y only through elimination by substitution.

B3 Errors in transposition in solving the first one variable equation.

B4 Errors in transposition when finding second variable.

B5 Incorrect substitution when finding second variable.

B6 Finds one variable only.

Slips (–1)

S1 Numerical errors (max –3) in solving first one variable equation and when finding second variable.

Attempts

Att Attempt at transposition and stops.

Att Multiplies either equation by some number and stops.

Att Correct answers without algebraic work.

Notes

N1 Apply only one blunder deduction (B1 or B2) to any error(s) in establishing the first equation in terms of x only or the first equation in terms of y only.

N2 Finding the second variable is subject to a maximum deduction (–3).

QUESTION 5

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

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

Solve the equation $3(x - 1) = 12$.

$3x - 3 = 12$ (4 mks.)
$3x = 15$ (7 mks.)
$x = 5$ (10 mks.)

$3(x-1)=12$
$x-1=4$ (7 mks.)
$x=5$ (10 mks)

Blunders (–3)
B1 Error in distributive law and continues, e.g. $3x - 1 = 12$ or $3x - 3 = 36$ (once only).
B2 Each error in transposition.
B3 Adds 'x's to 'numbers' and continues e.g. $3x - 1 = 2x$ or $3(x-1) = 3(-x) = -3x$

Slips (–1)
S1 Error in division e.g. $x = \frac{15}{3} \Rightarrow x = 6$ (say).
S2 Errors in addition or multiplication (to max –3).
S3 $\frac{15}{3}$ and stops.

.
Attempts
Att $3x - 1 = 12$ and stops.
Att $3x - 3 = 36$ and stops.
Att $x - 3 = 12$ and stops.
Att $x - 1 = 12 \Rightarrow x = 13$.
Att $3x$ appears and stops.

Notes
N1 $x = \frac{15}{3} \Rightarrow$ 9 marks.
N2 $x - 1 = 12 - 3$ and continues attracts B2.
N3 $3x - 3 = 12$ and stops $\Rightarrow$ 4 marks.
N4 Correct answer without work $\Rightarrow$ 7 marks
N5 Incorrect answer without work $\Rightarrow$ 0 marks

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

Factorise: $2xy - 4xw$

$2xy - 4xw = 2x\,(y - 2w)$

Blunders(–3)
B1 An incorrect common factor.
B2 Errors in sign.
B3 Stops after some correct effort at factorisation e.g. $2x(y) - 2x(2w)$ or similar.

Slips(–1)
S1 Numerical errors when taking out a factor e.g. $2x(y - 3w)$.

Attempts
Att $2(xy)$ and /or $\pm 4(xw)$ or effort at brackets.

Notes
N1 Accept $2(xy - 2xw)$ or $x(2y - 4w)$ for 5 marks.

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

Factorise: $ab - 2ac + 3b - 6c$

$ab - 2ac + 3b - 6c = a\,(b - 2c) + 3\,(b - 2c)$
$= (a + 3)\,(b - 2c)$

Blunders (–3)
B1 Stops after first line of correct factorisation.
B2 Error(s) in factorising any pair of terms.
B3 Incorrect common factor and continues.

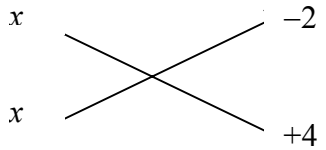
Slips(–1)
S1 $(a + 3) \pm (b - 2c)$.

Attempts
Att Pairing off, or indication of pairing off, and stops.
Att Correctly factorises any pair and stops.

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

Factorise: $x^2 + 2x - 8$

$x^2 + 2x - 8$
$= x^2 + 4x - 2x - 8$
$= x(x + 4) - 2(x + 4)$
$= (x - 2)(x + 4)$



$= (x - 2)(x + 4)$

Blunders (–3)

B1 Incorrect two term linear factors of $x^2 + 2x - 8$ formed from correct, but not applicable, factors of x^2 and ± 8.

B2 Correct cross method but factors not written.

B3 $x(x - 2) + 4(x - 2)$ or $x(x + 4) - 2(x + 4)$ and stops.

B4 Incorrect common factor and continues (applies to guide number method).

Slips (–1)

S1 Uses quadratic equation formula, but has wrong signs in factors (once only).

S2 Uses quadratic equation formula to find $x = -4$ and $x = 2$ and stops.

S3 $(x + 4) \pm (x - 2)$.

Attempts

Att Correct factors of x^2 only.

Att Correct factors of –8 or +8 only.

Att $-2x + 4x$ only appears.

Att Correct quadratic equation formula with or without substitution and stops.

Notes

N1 Quadratic equation formula method is subject to slips and blunders.

N2 Accept (with or without brackets) for 5 marks any of the following
$(x + 4)$ and $(x - 2)$. [The word **and** is written down.]
$(x + 4)$ or $(x - 2)$. [The word **or** is written down.]

N3 Accept $(x + 4), (x - 2)$ for 5 marks.

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

Factorise: $36 - y^2$

$36 - y^2 \quad = \quad (6 - y)\,(6 + y)$

Blunders (–3)

B1 Incorrect two term linear factors of $36 - y^2$ formed from correct, but not applicable, factors of y^2 and ± 36.

Slips (–1)

S1 Uses quadratic equation formula, but has wrong signs in factors (once only).

S2 Uses quadratic equation formula to find $y = 6$ and $y = -6$ and stops

S3 $(6 + y) \pm (6 - y)$.

Attempts

Att Correct factors of y^2 only.

Att Correct factors of 36 or -36 only.

Att Correct quadratic equation formula with or without substitution and stops.

Notes

N1 Quadratic equation formula method is subject to slips and blunders.

N2 Accept (with or without brackets) for 5 marks any of the following

$(6 + y)$ and $(6 - y)$. [The word **and** is written down.]

$(6 + y)$ or $(6 - y)$. [The word **or** is written down.]

N3 Accept $(6 + y), (6 - y)$ for 5 marks.

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

x is a number. A second number is 5 greater than x. Write down the second number in terms of x.

Second number = $x + 5$

5 c (i), 5c (ii) and 5 c (iii): Algebraic work is required to earn marks.

Blunders(–3)
B1 Incorrect second number in x other than the misreadings below.

Misreadings(–1)
M1 $5x$ instead of $x + 5$.
M2 $x - 5$ instead of x.

Attempts
Att Second number = y only, but do not apply if $y = x + 5$ appears in subsequent work.
Worthless
W1 Second number is a constant.
W2 An inequality appears.

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

Twice the first number added to three times the second number is equal to 35. Write down an equation in x to represent this information.

$2x + 3\,(x + 5)$ = 35

Blunders(–3)
B1 $3x + 2(x + 5)$
B2 $2x - 3(x + 5)$
B3 $2(\bullet) + 3(*) = 35$ incorrect when using candidate's values from previous part.

Attempts
Att A single equation in x and y.
Att x^2 instead of $2x$.
Att $2x$ only.
Notes
N1 Accept candidate's answer to c (i) for use in this section.

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

Solve your equation for x and state what the two numbers are.

	$2x + 3x + 15$	=	35
	$5x$	=	20
	x	=	4
	First number	=	4
	Second number	=	9

Blunders (–3)
B1 Errors in Distributive Law.
B2 Errors in transposition.
B3 Adds 'x's to 'numbers' and continues ($5x + 15 = 20x$).
Slips (–1)
S1 Error in division e.g. $x = \frac{20}{5} \Rightarrow x = 6$ (say).
S2 Errors in addition (to max –3).
S3 $\frac{20}{5}$ and stops. Also attracts S4.
S4 Second number not given.
Attempts
Att $5x+15 = 35$and stops.
Notes
N1 $x = \frac{20}{5}$ and stops $\Rightarrow$ 3 marks.
N2 Accept correctly worked simultaneous equations.
N3 Correct answer without work $\Rightarrow$ 2 marks.

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

Verify your result.

$2(4) + 3(9) = 8 + 27 = 35$

Blunders(–3)
B1 $3(A_1) + 2(A_2)$
Slips(–1)
S1 $2(A_1) + 3(A_2)$ correctly worked out but no statement re verification.
Attempts
Att $2(A_1) + 3(A_2)$ and stops.
Att $2(A_1) + 3(A_2) \neq 35$ but simply stated to be = 35.
Notes
N1 Accept candidate's answers to c (iii) for use in this section.
N2 Accept verification through substituting 4 for x in $2x + 3(x + 5) = 35$.

QUESTION 6

Part (a)	**10 marks**	**Att 2,2**
Part (b)	**30 marks**	**Att 7,3**
Part (c)	**10 marks**	**Att 2.2**

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

$f(x) = 3x - 5$. Find: $f(2)$

✍ $f(2) = 3(2) - 5 = 1$

Function concept correct:
$f(2) = 3(2) - 5$ or $f(2) = 6 - 5$ *i.e. multiplication of 2 by 3 is clearly indicated or is implied by subsequent work.*

Completion of $f(2)$ *subject to maximum deduction of –3.*

Blunders (–3)
B1 $f(2)$ incorrect: misunderstanding of the concept of a function.
B2 Error in sign when multiplying (once only).

Misreading (–1)
M1 $f(-2)$ instead of $f(2)$.

Slips (–1)
S1 Numerical errors (to max –3).

Attempts
Att Treats as equation and continues or stops.

Notes
N1 Correct function concept i.e. $3(2) - 5$ and stops $\Rightarrow$ 2 marks.
N2 Ignores x giving $3–5 = –2 \Rightarrow$ 0 marks.
N3 $2[f(x)] = 6x - 10 \Rightarrow$ 0 marks.
N4 Correct answer without work $\Rightarrow$ 2 marks.

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

$f(x) = 3x - 5$. Find: $f(-1)$

$f(-1) = 3(-1) - 5 = -8$

Function concept correct:
$f(-1) = 3(-1) - 5$ or $f(-1) = -3 - 5$ *i.e. multiplication of –1 by 3 is clearly indicated or is implied by subsequent work.*

Completion of $f(-1)$ *subject to maximum deduction of –3.*

Blunders (–3)
B1 $f(-1)$ incorrect: misunderstanding of the concept of a function.
B2 Error in sign when multiplying (once only).

Misreading (–1)
M1 $f(1)$ instead of $f(-1)$.

Slips (–1)
S1 Numerical errors (to max –3).

Attempts
Att Treats as equation and continues or stops.

Notes
N1 Correct function concept i.e. $3(-1) - 5$ and stops $\Rightarrow$ 2 marks.
N2 Ignores x giving $3–5 = –2 \Rightarrow$ 0 marks.
N3 $-1[f(x)] = -3x + 5 \Rightarrow$ 0 marks.
N4 Correct answer without work $\Rightarrow$ 2 marks.

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

Draw the graph of the function

$$g : x \to x^2 - 2x - 2$$

in the domain $-1 \le x \le 3$, where $x \in \mathbf{R}$.

$g(-1) = (-1)^2 - 2(-1) - 2 = 1$
$g(0) = (0)^2 - 2(0) - 2 = -2$
$g(1) = (1)^2 - 2(1) - 2 = -3$
$g(2) = (2)^2 - 2(2) - 2 = -2$
$g(3) = (3)^2 - 2(3) - 2 = 1$

or

x	-1	0	1	2	3
x^2	1	0	1	4	9
$-2x$	2	0	-2	-4	-6
-2	-2	-2	-2	-2	-2
$g(x)$	**1**	**-2**	**-3**	**-2**	**1**

Table **20 marks** **Att 7**

Blunders (–3)

B1 x^2 taken as $2x$ all the way. [In row headed x^2 by candidate]
B2 $-2x$ taken as -2 all the way. [In row headed $-2x$ by candidate]
B3 -2 calculated as $-x$ all the way. [In row headed -2 by candidate]
B4 Adds in top row when evaluating $g(x)$.
B5 Omits '–2' row or omits '–2x' row.
B6 Omits a value in the domain each time to max of –9 (4 values missing ⇒ Att 7).

Slips (–1)

S1 Numerical slips (to max –3) in any row other than $g(x)$ row.
S2 Misreads '–2' as '2' and places '2' in the table or '–2x' as '2x' and places '2x' in the table.
S3 Each incorrect $g(x)$ value calculated by addition within columns in student's table (to max –5). But note B4.

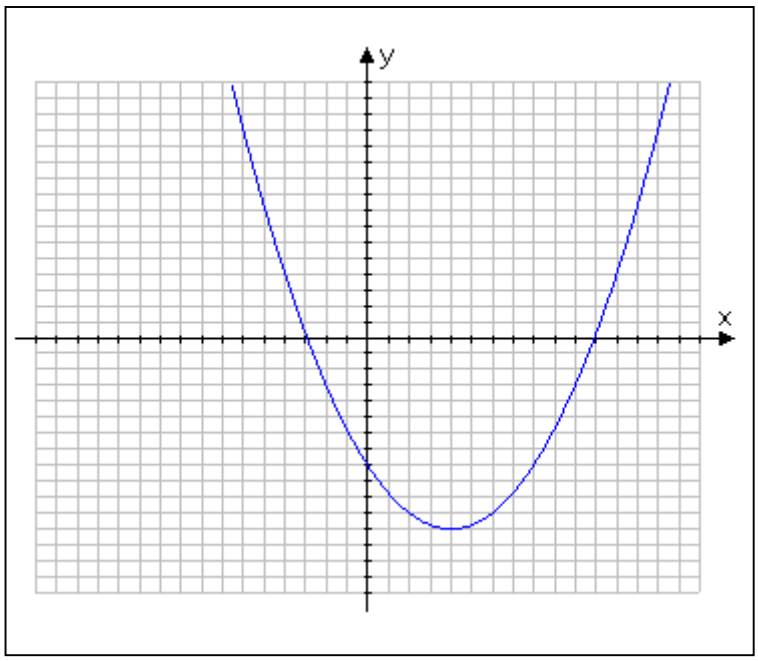
Attempts

Att Omits x^2 row from table or treats x^2 as x.
Att Table with only $g(x) = x^2$.
Att Any effort at calculating point(s).
Att One point only calculated and nothing else.

Notes

N1 Each individual error in the rows other than the $g(x)$ row, apart from blunders above, attracts a deduction of –1 subject to a maximum deduction of –3 per row. [g(x) max(–5)]

Graph **10 Marks** **Att3**



Blunders (–3)

B1 Reversed co-ordinates plotted against non-reversed axes (once only) [SeeN3].
B2 Axes not graduated uniformly (once only).
B3 Points not joined or joined in incorrect order (once only).

Slips (–1)

S1 Each point of candidate graphed incorrectly.
S2 Each point from table not graphed (subject to N1).

Attempts

Att Graduated axes only (need not be labelled).

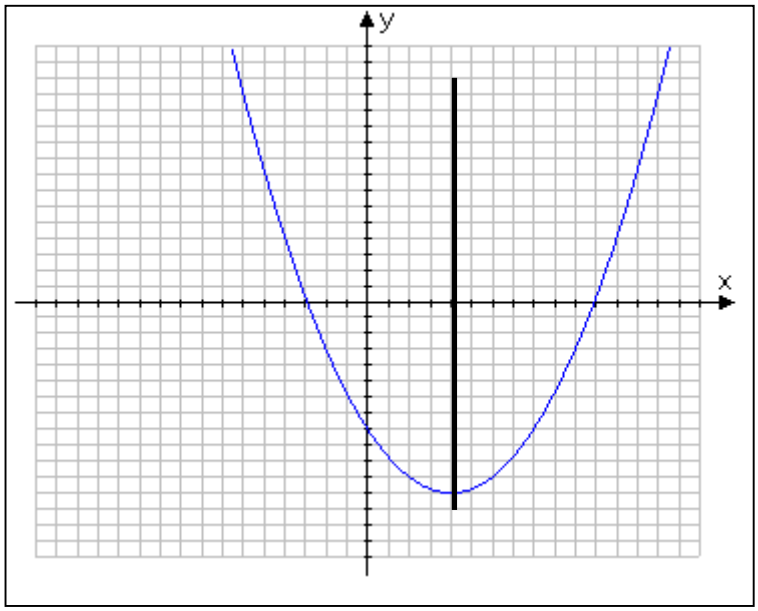
Notes

N1 Att 7 + Att 3 ⇒ one point only calculated and graphed correctly.
N2 Correct graph but no table ⇒ full marks, i.e. 30 marks.
N3 Accept reversed co-ordinates (i) if axes not labelled or (ii) if axes are reversed to compensate (see B1 above).

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

Draw the axis of symmetry of the graph drawn in **(b)** above.

Axis of Symmetry $x = 1$



Blunders (–3)

B1 any vertical line (parallel to candidate's *y*- axis) on diagram outside of tolerance. [$.5 < x < 1.5$].

B2 marks 1 on x - axis and stops.

B3 states $x = 1$ but line not indicated on graph.

Attempts

Att any non-vertical line (line not parallel to candidate's *y*-axis)

Att any attempt at axial symmetry or central symmetry of $g(x)$.

Att y-axis as the axis of symmetry.[See B1]

Notes

N1 Accept any vertical line (parallel to candidate's *y*- axis) in the interval [$.5 < x < 1.5$.]

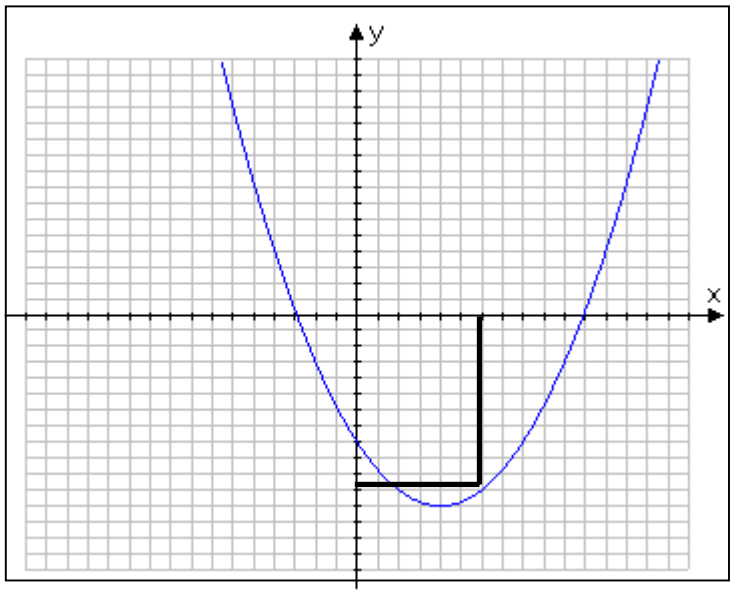
N2 a student's incorrect graph can earn up to full marks for this section. Mark using a similar tolerance.

N3 The minimum point highlighted in the candidate's graph $\Rightarrow$ 2 marks.

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

Use the graph to estimate the value of $x^2 - 2x - 2$ when $x = 1{\cdot}5$.

$g\,(1{\cdot}5) =$ $-2{\cdot}75$



Blunders (–3)

B1 Answer on diagram but outside of tolerance ($-3.0 \le x \le -2.5$) [refers to horizontal indication].

B2 Takes 1.5 on y-axis and indicates or reads answer on x-axis (one indication sufficient).

B3 If $x \neq 1.5$ (be lenient: accept as correct a value of x in the interval $(1.25 \le x \le 1.75)$.

B4 Incorrect sign for $g\,(1.5)$ [Within tolerance]

Attempts

Att Marks 1.5 (in any way) on x-axis or y-axis and nothing else.

Att Algebraic evaluation or calculator.

Worthless(0)

W1 Answers outside of tolerance without graphical indication.

Notes

N1 Correct answer (clearly consistent with graph) inside tolerance without graphical indication $\Rightarrow$ 5 marks.

N2 Accept reasonable indication on y - axis (it is not necessary to write down the answer, indication on graph is sufficient).

N3 Graph takes precedence even if incorrect answer is stated.

N4 A candidate's incorrect graph can earn up to full marks for this section. [Use similar tolerances]