

Coimisiún na Scrúduithe Stáit State Examinations Commission

Marking Scheme

JUNIOR CERTIFICATE EXAMINATION 2004 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, and 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.

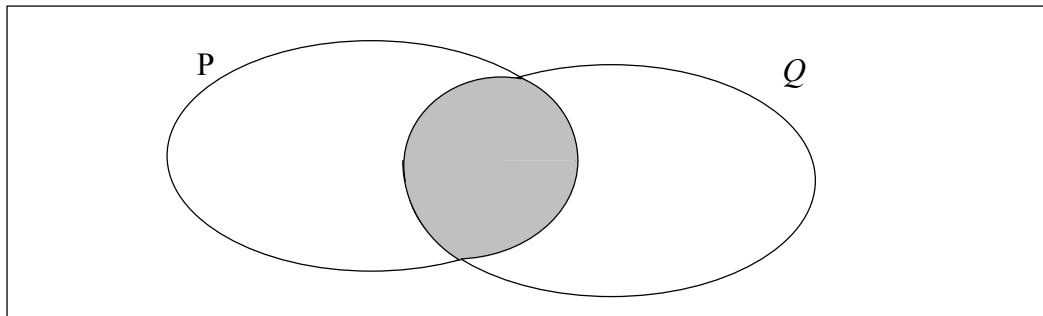
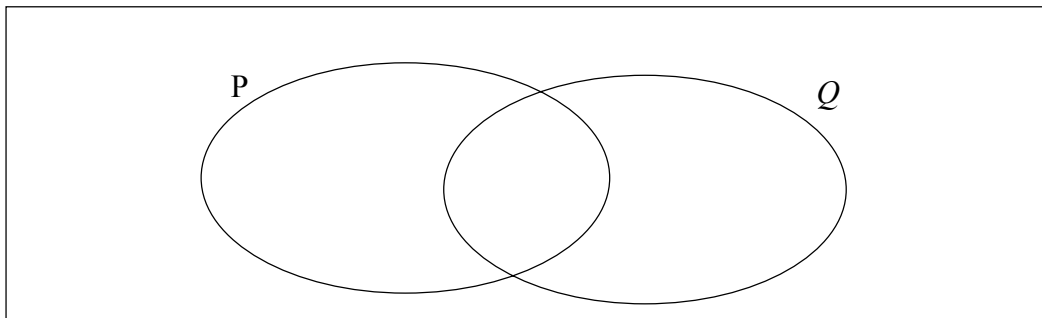
6. The phrase “and stops” means that no more work is shown by the candidate.

QUESTION 1

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

Part (a) (i) 5 marks Att 2

(i) Using the Venn diagram below, shade in the region that represents $P \cap Q$.



Blunders (-3)

B1 Any incorrect indication other than the misreading below.

Misreadings (-1)

M1 $P \cup Q$ indicated.

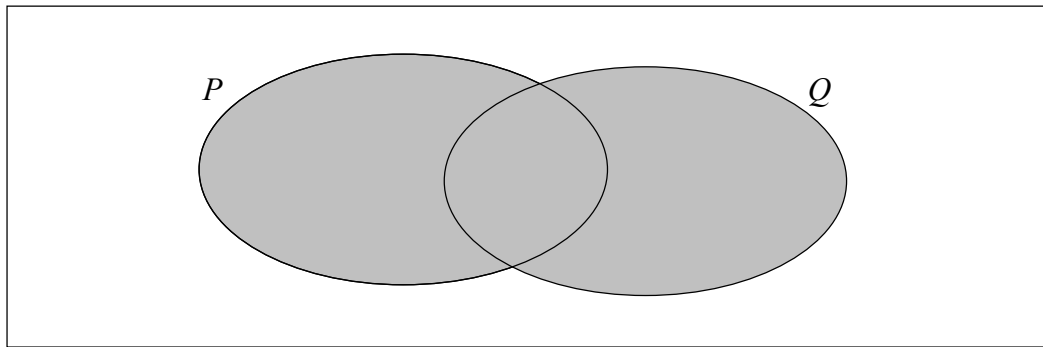
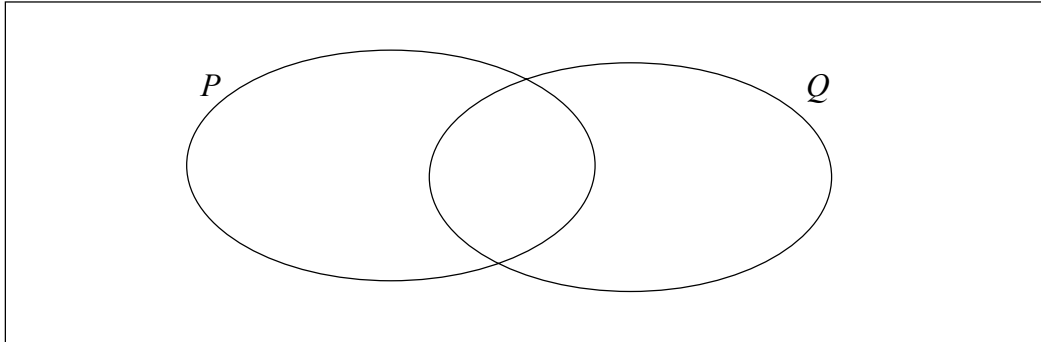
Part (a)

(ii)

5 marks

Att 2

(ii) Using the Venn diagram below, shade in the region that represents $P \cup Q$.



Blunders (-3)

B1 Any incorrect indication other than the misreading below.

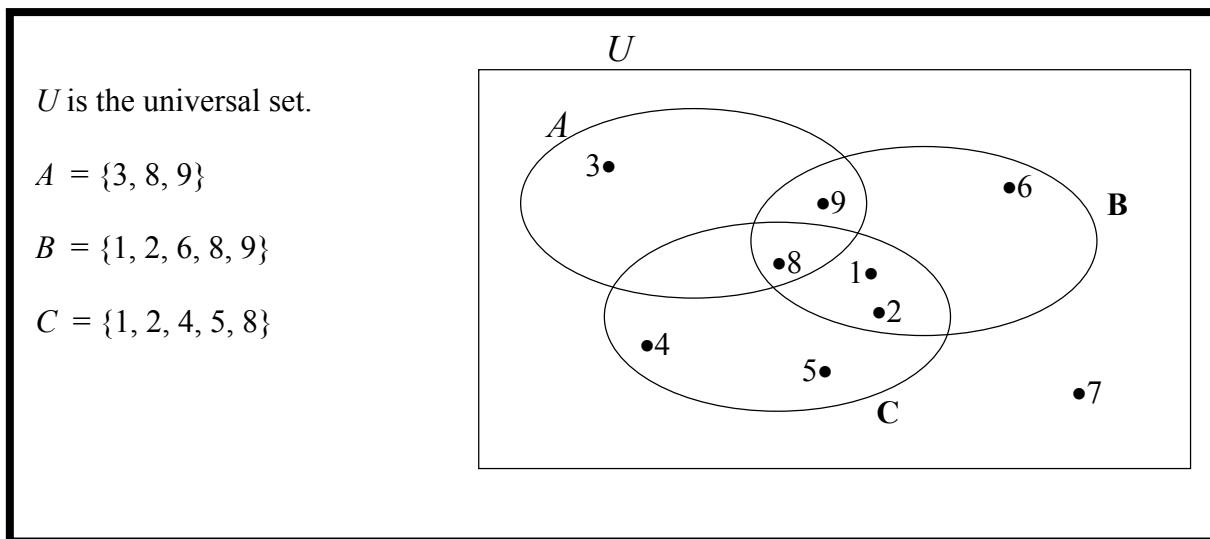
Misreadings (-1)

M1 $P \cap Q$ indicated.

Part (b)

20 marks

Att 2,2,2,2



Part (b) (i)

5 marks

Att 2

$$A \cup B = \{1, 2, 3, 6, 8, 9\}$$

Blunders(-3)

B1 Any incorrect set of the elements of A and B other than the misreading as below.

Misreadings(-1)

M1 $A \cap B$ giving $\{8, 9\}$.

Attempts

Att 4 or 5 or 7 appear in the answer.

Part (b) (ii)

5 marks

Att 2

$$B \setminus C = \{6, 9\}$$

Blunders(-3)

B1 Any incorrect set of the elements of B and C other than the misreading as below.

Misreadings(-1)

M1 $C \setminus B$ giving $\{4, 5\}$.

Attempts

Att 3 or 7 appear in the answer.

Part (b) (iii)

5 marks

Att 2

$$A' = \{1, 2, 4, 5, 6, 7\}$$

Slips(-1)

S1 Each correct element omitted and/or each incorrect element included.

Attempts

Att A or any proper subset of A .

Part (b) (iv)

5 marks

Att 2

$$A \cup (B \setminus C) = \{3, 8, 9\} \cup \{6, 9\} = \{3, 6, 8, 9\}$$

Blunders (-3)

B1 Any incorrect set of the elements of A and B and C other than the misreadings as below.

Misreadings (-1)

M1 $A \cap (B \setminus C)$ giving $\{9\}$.

M2 $A \cap$ {the candidate's answer to part (ii) above}.

Attempts

Att 7 appears in the answer.

Notes

N1 Accept $A \cup$ {the candidate's answer to part (ii) above}, if correct, for full marks.

Part (c) (i)

5 marks

Att 2

P is the set of prime numbers between 1 and 12.
List the elements of the set P.

$$P = \{2, 3, 5, 7, 11\}$$

Slips(-1)

S1 Each correct element omitted and/or each incorrect element included.

Worthless(0)

W1 No applicable prime number appears.

Part (c) (ii)

5 marks

Hit or Miss

$Q = \{1, 3, 5, 7, 9, 11\}$
Write down # Q.

$$\# Q = 6$$

Part (c) (iii)

5 marks

Att 2

$T = \{2, 4, 6, 8, 10, 12\}$.
Write down the elements of T that are multiples of 3.

$$6, 12.$$

Slips(-1)

S1 Each correct element omitted and/or each incorrect element included.

Worthless(0)

W1 No applicable multiple of 3 appears.

Part (c) (iv)

5 marks

Att 2

Express 12 as the product of three prime numbers

$$12 = 2 \times 2 \times 3.$$

$$12 = 2^2 \times 3.$$

Blunders(-3)

B1 Each correct prime factor omitted and/or each incorrect factor included, except the misreading below.

Misreading(-1)

M1 Product taken as sum e.g. $5 + 5 + 2$ or $7 + 3 + 2$.

Worthless (0)

W1 No applicable prime number appears.

QUESTION 2

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

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

€400 is shared between Mary and Tom in the ratio 7:3.
How much does each receive?

<p>7 parts : 3 parts $\Rightarrow 1 \text{ part} \equiv 40$ $\Rightarrow 7 \text{ parts} \equiv 280$ $\Rightarrow 3 \text{ parts} \equiv 120$</p>	<p><i>x</i> method $7x : 3x$ $\Rightarrow 10x = 400$ $\Rightarrow x = 40$ $\Rightarrow 7x = 280$ $\Rightarrow 3x = 120$</p>	<p>$7 + 3 = 10$ $\frac{1}{10} = 40 \Rightarrow \frac{7}{10} = 280 = \text{Mary's share}$ $\Rightarrow \frac{3}{10} = 120 = \text{Tom's share}$ or $400 - 280 = 120 = \text{Tom's share.}$</p>
Mary = €280		Tom = €120

Blunders (-3)

- B1 Fails to find second share.
- B2 Divisor $\neq 10$ and continues.
- B3 Incorrect multiplier.
- B4 Error in transposition. (*x* method)
- B5 Tom's share = $400 + 280 = 680$

Slips (-1)

- S1 Numerical errors (max -3).

Attempts

- Att Divisor $\neq 10$ e.g. $\frac{400}{7}$ and / or $\frac{400}{3}$ and stops.
- Att Indicates 10 parts or 7 parts or 3 parts or $\frac{7}{10}$ or $\frac{3}{10}$ or $7 + 3 = 10$ only and stops.
- Att 2800:1200 only.i.e. multiplies 400 by 7 and by 3.

Notes

- N1 correct answers without work $\Rightarrow 7$ marks. [But see B1]
- N2 $\frac{7}{3} \times 400 = 933.33$ and then $400 - 933.33 = -533.33 \Rightarrow 7$ marks (B2).
- N3 $\frac{3}{7} \times 400 = 171.43$ and then $400 - 171.43 = 228.57 \Rightarrow 7$ marks (B2).
- N4 40 and stops $\Rightarrow 4$ marks.
- N5 $\frac{7}{10}$ and $\frac{3}{10}$ and stops $\Rightarrow 4$ marks.
- N6 $\frac{7}{3} \times 400 = 933.33$ and stops and / or $\frac{3}{7} \times 400 = 171.43$ and stops. $\Rightarrow 4$ marks.
- N7 Incorrect answer without work $\Rightarrow 0$ marks.

Simplify $\frac{a^7 \times a^4}{a^3 \times a^2}$, giving your answer in the form a^n , where $n \in \mathbf{N}$.



$$\frac{a^7 \times a^4}{a^3 \times a^2} = \frac{a^{11}}{a^5} = a^6.$$

$$\frac{a \times a \times a \times a \times a \times a \times a \times a \times a \times a \times a}{a \times a \times a \times a \times a} = a \times a \times a \times a \times a \times a = a^6.$$

Blunders(-3)

- B1 Each error in calculation involving indices.
 B2 Each incorrect number of a 's in the extended form.
 B3 Each incorrect elimination in the extended form

Slips(-1)

- S1 $\frac{a^{11}}{a^5} = 6$ or $\frac{a^{11}}{a^5} = \frac{1}{a^{-6}}$ as final answers.
 S2 $a \times a \times a \times a \times a \times a$ as answer.

Attempts

Att Some manipulation of indices e.g. $a^7 \times a^4 = a^{28}$ only

Notes

- N1 $\frac{a^{11}}{a^5}$ and stops \Rightarrow 2 marks.
 N2 a^{11} and stops \Rightarrow 2 marks.
 N3 Correct answer without work \Rightarrow 2 marks.

By rounding each of these numbers to the nearest whole number, estimate the value of $\frac{66 \cdot 88 - 27 \cdot 36}{7 \cdot 6}$.

$\frac{66 \cdot 88 - 27 \cdot 36}{7 \cdot 6}$ is approximately equal to:

$$\frac{\boxed{67} - \boxed{27}}{\boxed{8}} = \frac{\boxed{40}}{\boxed{8}} = \boxed{5}$$

Blunders(-3)

- B1 Error in rounding off to the nearest whole number (each time)
 B2 Decimal point error in calculation of approximate value.
 B3 An arithmetical operation other than indicated.
 B4 $\frac{67}{8} - 27$ or $67 - \frac{27}{8}$ and continues.

Slips(-1)

- S1 Numerical errors in arithmetical operations.

Attempts

- Att Only one or two approximations made to the given numbers.

Worthless

- W1 No approximations made to given numbers.

Notes

- N1 $\frac{67 - 27}{8}$ and stops \Rightarrow 4 marks.
 N2 No penalty if the intermediate step between approximations and final answer not shown.
 e.g. $\frac{40}{8}$ not shown.

Part (b) (iii) Calculator

5 marks

Att 2

Using a calculator, or otherwise, find the exact value of $\frac{66 \cdot 88 - 27 \cdot 36}{7 \cdot 6}$.

5.2

Blunders(-3)

B1 *Otherwise*: Error(s) in decimal point.

B2 *Otherwise*: $\frac{66 \cdot 88}{7 \cdot 6} - 27 \cdot 36 = -18 \cdot 56$ or $66 \cdot 88 - \frac{27 \cdot 36}{7 \cdot 6} = 63 \cdot 28$.

B3 *Calculator*: Incorrect Answer.

Slips(-1)

S1 *Otherwise*: numerical errors in subtraction 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: $9^{\frac{1}{2}}$

3

Blunders(-3)

B1 Mishandles $9^{\frac{1}{2}}$ e.g. $9^{\frac{1}{2}} = 81$, $9^{\frac{1}{2}} = 4 \cdot 5$, $9^{\frac{1}{2}} = 9 \cdot 5$

B2 *Calculator*: Incorrect Answer.

B3 *Otherwise*: error in use of Maths. Tables e.g. $9 \cdot 487$ (wrong page)

Misreadings(-1)

M1 $9^{\frac{1}{2}} = \frac{1}{9^2} = \frac{1}{81} = 0 \cdot 012345679$.

M2 $9^{\frac{1}{2}} = \sqrt[3]{9} = 2 \cdot 08008$.

Attempts

Att $\sqrt{\quad}$ is mentioned.

Part (c) (ii)

5 marks

Att 2

Using a calculator, or otherwise, find the exact value of $(5 \cdot 32)^2$.

28.3024

Blunders(-3)

B1 $\sqrt{5 \cdot 32} = 2.306512519$ or $2 \cdot 307$ (from Maths. Tables)

B2 $5 \cdot 32 \times 2 = 10 \cdot 64$

B3 *Calculator*: Incorrect Answer.

B4 *Otherwise*: Decimal point error in multiplication or in use of Maths. Tables.

Slips(-1)

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

S2 *Maths. Tables*: $28 \cdot 3$.

S3 Rounded off to 28, $28 \cdot 3$, $28 \cdot 30$, $28 \cdot 302$.

Attempts

Att Some correct calculation done.

Hence, evaluate $9^{\frac{1}{2}} + (5 \cdot 32)^2 \times \frac{1}{0.625}$ and give your answer correct to two decimal places.



$$\begin{aligned} & 3 + 28.3024 \times 1.6 \\ & = 3 + 45.28384 \\ & 48.28384 \\ & 48.28 \end{aligned}$$

Blunders(-3)

- B1 Multiplies by 0.625 instead of $\frac{1}{0.625} \Rightarrow 20.689$ or 20.69 .
- B2 An arithmetical operation other than a given one e.g. + for \times :
 $3 + 28.3024 + 1.6 = 32.9024 = 32.90$.
- B3 $(9^{\frac{1}{2}}) \times \frac{1}{0.625} + (5 \cdot 32)^2 = 33.1024$ (breaking order). [Check candidate's calculations]
- B4 $(9^{\frac{1}{2}} + (5 \cdot 32)^2) \times \frac{1}{0.625} = 50.08384$ (breaking order). [Check candidate's calculations]
- B5 Error in decimal point.

Slips(-1)

- S1 Numerical errors in arithmetical operations.
- S2 An incorrect but relevant transfer of value from c (i) and /or c (ii).
- S3 Each rounding off which would effect the final rounded off answer (max -3). [Check candidate's calculations]
- S4 Fails to round off or incorrectly rounds off when giving final answer.

Attempts

- Att Candidate's c (i) and c (ii) added and stops.
- Att $\frac{1}{0.625} = 1.6$ and stops.
- Att Candidate's c (i) and c (ii) correctly transferred 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 $9 \cdot 5 + (5.32)^2 \times \frac{1}{0.625} = 54.78$.
- N3 Correct answer without work $\Rightarrow 7$ marks.

QUESTION 3

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) **10marks** **Att 3**

Anne bought 2 cans of cola. Each can cost 80c.
How much change did she get from a €10 note?



$$80c \times 2 = 160c = \text{€}1.60 \quad (7 \text{ m})$$

$$10.00 - 1.60 = 8.40 \quad (10\text{m})$$

$$\text{Change} = \text{€}8.40$$

$$10.00 - 0.80 = 9.20 \quad (7\text{m})$$

$$9.20 - 0.80 = 8.40 \quad (10\text{m})$$

$$\text{Change} = \text{€}8.40.$$

Blunders (-3)

- B1 Calculates the cost of the cans but fails to find the change.
- B2 Operation other than subtraction when finding the change.
- B3 $10.00 - 0.80 = 9.20$ and stops.
- B4 Error in decimal point (once only).
- B5 $\frac{10}{2} = 5 : 5 - 0.80 = 4.20$ and stops.

Slips (-1)

- S1 Numerical errors (to max -3).

Attempts

- Att Adds 0.80 to 10.00 and stops.
- Att $\frac{10}{2} = 5$ and stops.

Notes

- N1 Accept 840, 8.40 or 8.4 regardless of subsequent labelling or work.
- N2 Final subtraction step subject to maximum deduction of -3, e.g. 1.60 or $160 \Rightarrow 7$ marks: $9.20 \Rightarrow 7$ marks.
- N3 Correct answer without work $\Rightarrow 7$ marks.
- N4 Incorrect answer without work $\Rightarrow 0$ marks.

John's gross pay is €21 000. His tax credit is €2369. He pays income tax at the rate of 22%.
What is his take-home pay?

Gross Pay	€21 000
Tax @ 22%	€4620
Tax Credit	€2369
Tax Due	€2251
Take-home Pay	€18749

Method 1

$$\text{Tax} = \frac{21000}{100} \times 22 = 4620$$

$$\text{or Tax} = 21000 \times .22 = 4620$$

$$\text{Tax Due} = 4620 - 2369 = 2251.$$

$$\text{Take -Home Pay} = 21000 - 2251 = 18749$$

Method 2

$$\text{G.P.} - \text{Tax} + \text{T.C.}$$

$$= 21000 - 4620 + 2369$$

$$= 18749.$$

Method 3

$$(.78 \times 21000) = 16380$$

$$16380 + 2369$$

$$= 18749$$

Blunders (-3)

- B1 All blunders in calculating Tax. [Numerical slips to a max (-3)]
- B2 Misuse of Tax Credit in Method 1 when finding tax due e.g. $4620 + 2369 = 6989$ giving final answer 14011.
- B3 Misuse of Tax Credit in Method 2 when finding take-home pay e.g. $21000 - 4620 - 2369 = 14011$ as final answer.
- B4 Misuse of Tax Credit in Method 3 when finding take-home pay e.g. $16380 - 2369 = 14011$.
- B5 Misuse of Tax Amount in Methods 1 and 2 e.g. $21000 + 4620 \Rightarrow 25620$ as final answer.
- B6 Tax due and stops in Method 1.

3. Part (b) (i) contd.

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. [23369]

Notes

N1 Evidence of work done: 4620 and/ or 2251 and/or 16380, or similar from candidate's work, are written down.

N2 4620 and stops \Rightarrow 4 marks.

N3 2251 and stops \Rightarrow 7 marks.

N4 16380 and stops \Rightarrow 7 marks. [No use of Tax Credit]

N5 Correct answer without work \Rightarrow 7 marks.

N6 Incorrect answer without work \Rightarrow 0 marks.

VAT at 15% is added to a bill of €84.60.
Calculate the total bill



$$100\% = 84.60$$

$$1\% = \frac{84.60}{100}$$

$$115\% = \frac{84.60}{100} \times 115$$

$$= 97.29$$

$$100\% = 84.60$$

$$1\% = \frac{84.60}{100}$$

$$15\% = \frac{84.60}{100} \times 15 = 12.69$$

$$115\% = 84.60 + 12.69 = 97.29$$

$$15\% = \frac{15}{100}$$

$$VAT = \frac{15}{100} \times 84.60$$

$$Total\ bill = 84.60 + 12.69$$

$$= 97.29$$

$$84.60 \times 1.15 = 97.29$$

Blunders (-3)

B1 Inverts $\frac{115}{100}$ or $\frac{15}{100}$ and continues (giving 73.57 or 648.6).

B2 84.60 taken as 115%.

B3 $\frac{84.60}{100} \times 115$ and stops.

B4 No addition of VAT (as calculated by student) to the bill.

B5 Subtraction of VAT (as calculated by student) to the bill.

Slips(-1)

S1 Numerical errors (to a max-3).

Attempts

Att $\frac{15}{100}$ and stops.

Att $100\% = 84.60$ and stops.

Att $\frac{84.60}{100}$ and stops.

Att $100 \times \frac{15}{84.60}$ and stops.

Att $\frac{84.60}{15}$ and stops.

Att Use of any other percentage.

Notes

N1 Evaluation of 115% of 84.60 or 15% of 84.60 or 84.60×1.15 subject to max. deduction (-3).

N2 $84.60 \times \frac{15}{100}$ and stops \Rightarrow 4 marks.

N3 Correct answer without work \Rightarrow 7 marks.

N4 Incorrect answer without work \Rightarrow 0 marks.

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

€3000 is invested at 4% per annum.
What is the amount of the investment at the end of one year?

<p>1% = 30 4% = 120 Amount = €3120.</p>	$I = \frac{P.T.R}{100} = \frac{3000 \times 1 \times 4}{100} = 120$ <p>Amount = €3120.</p>	$(3000)(1.04) = €3120.$
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Blunders (-3)

- B1 Mishandles 4%, e.g. 3000×4 or $3000 \div 4$ (3000 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 3000 must be used].
 B6 Illegal cancellation in $\frac{3000 \times 1 \times 4}{100}$.
 B7 $3000 \times .04 = 120$ and stops.
 B8 $1 \cdot 04 = 1 \cdot 4$.

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. $4\% = \frac{4}{100}$ and stops.

Notes

- N1 €120 and stops \Rightarrow 7 marks.
 N2 $3000 \times 4 = 12000$ and stops \Rightarrow 4 marks (B1 + B3).
 N3 $3000 \times 4 = 12000 + 3000 = 15000 \Rightarrow$ 7 marks (B1).
 N4 Correct answer without work \Rightarrow 7 marks.
 N5 Incorrect answer without work \Rightarrow 0 marks.

€500 is withdrawn from this amount at the beginning of the second year.
 The interest rate for the second year is 3.6%.
 What is the amount of the investment at the end of that year?

$3120 - 500 = 2620$ $1\% = 26 \cdot 20$ ✍ $3 \cdot 6\% = 94 \cdot 32$ Amount = $2620 + 94 \cdot 32$ = €2714.32	$I = \frac{P.T.R.}{100} = \frac{2620 \times 1 \times 3 \cdot 6}{100} = 94 \cdot 32$ Amount = $2620 + 94 \cdot 32 = €2714 \cdot 32$	$(2620) \times (1.036)$ = €2714.32.
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Blunders (-3)

- B1 fails to subtract €500 and continues.
 B2 Adds €500 instead of subtracting €500 and continues.
 B3 Mishandles %, but no penalty if as in c (i).
 B4 Uses 4% instead of 3.6%.
 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 €3120 as principal to find amount and then subtracts €500.
 B10 €500 subtracted from €3000 and continues.
 B11 $2620 \times 0.036 = 94 \cdot 32$ and stops.
 B12 $1 \cdot 036 = 1 \cdot 36$.

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 subtracting €500.
 Att Calculates 3.6% of 500 but does not calculate 3.6% of 3120, stops or continues.
 Att €500 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)	10(5, 5) marks	Att 2,2
Part (b)	20(10, 10) marks	Att 3,3
Part (c)	20(10, 10) marks	Att 3,3

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

If $a = 2$ and $b = 7$ find the value of: $2a + b$



$$2a + b = 2(2) + 7 = 4 + 7 = 11$$

Blunders (-3)

- B1 Incorrect numerical substitution for a or for b and continues.
- B2 Leaves $2(2)$ in the answer.
- B3 Breaks order i.e. $[2(2 + 7) = 18]$.
- B4 $2(2)$ taken as 22.

Slips(-1)

- S1 Interchange of values of a and b .
- S2 Numerical errors.

Attempts

- Att Incomplete substitution and stops e.g. $2a + 7$, $4a + 7$.

Worthless

- W1 incorrect substitution for both a and b .

Notes

- N1 $4 + 7 \Rightarrow 4$ marks.
- N2 Correct answer without work $\Rightarrow 2$ marks.
- N3 Incorrect answer without work $\Rightarrow 0$ marks.
- N4 One substitution with an implied substitution leading to an answer of 11 e.g. $2a + 7 = 11 \Rightarrow 5$ marks.
- N5 $4a + 7 = 11 \Rightarrow 5$ marks.

Part (a) (ii)

5 marks

Att 2

If $a = 2$ and $b = 7$ find the value of: $3ab + 1$



$$3ab + 1 = 3(2)(7) + 1 = 42 + 1 = 43$$

Blunders (-3)

- B1 Incorrect numerical substitution for a or for b and continues.
- B2 Leaves $3(2)(7)$ in the answer or any incomplete evaluation of $3(2)(7)$.
- B3 Breaks order i.e. $[3(2)(7 + 1)] = 48$.
- B4 $3(2)(7)$ taken as 327 or $3(2)(7)$ taken as $3(27)$.
- B5 Ignores a multiplier e.g. $3(2)(7) = 14$.
- B6 An operator other than \times in evaluating $3(2)(7)$.

Slips(-1)

- S1 Numerical errors (to max -3).

Attempts

- Att Incomplete substitution and continues or stops.

Worthless

- W1 incorrect substitution for both a and b .

Notes

- N1 $42+1 \Rightarrow 4$ marks.
- N2 Correct answer without work $\Rightarrow 2$ marks.
- N3 Incorrect answer without work $\Rightarrow 0$ marks.

Part (b) (i)

10 marks

Att 3

Solve the equation

$$5(2x + 1) = 45.$$



$$5(2x + 1) = 45$$

$$10x + 5 = 45 \text{ (4m)}$$

$$10x = 40 \text{ (7m)}$$

$$x = 4 \text{ (10m)}$$

$$5(2x + 1) = 45$$

$$2x + 1 = 9 \text{ (4m)}$$

$$2x = 8 \text{ (7m)}$$

$$x = 4 \text{ (10m)}$$

Blunders (-3)

B1 Error in distributive law and continues, e.g. $10x + 1 = 45$ or $10x + 5 = 225$ (once only).

B2 Each error in transposition.

B3 Adds 'x's to 'numbers' and continues e.g. $2x + 1 = 3x$

Slips (-1)

S1 Error in division e.g. $x = \frac{40}{10} \Rightarrow x = 5$ (say).

S2 Errors in addition or multiplication (to max -3).

S3 $\frac{40}{10}$ and stops.

Attempts

Att $10x + 1 = 45$ and stops.

Att $10x + 5 = 225$ and stops.

Att $2x + 5 = 45$ and stops.

Att $2x + 1 = 45$ and stops.

Att $10x$ appears and stops.

Notes

N1 $x = \frac{40}{10} \Rightarrow 9$ marks.

N2 $2x + 1 = 45 - 5$ and continues attracts B2.

N3 $10x + 5 = 45$ and stops $\Rightarrow 4$ marks.

N4 Correct answer without work $\Rightarrow 7$ marks

N5 Incorrect answer without work $\Rightarrow 0$ marks

Part (b) (ii)

10 marks

Att 3

Write in its simplest form

$$(6x - y) - 3(x - 2y + 1)$$



$$\begin{aligned} 6x - y - 3x + 6y - 3 \\ = 3x + 5y - 3. \end{aligned}$$

Blunders (-3)

B1 Each incorrect term or each term omitted on multiplying out.

Slips (-1)

S1 Each incorrect term or each term omitted in final simple simplification.

Attempts

Att Any correct multiplication.

Att $(6x - y) = 6x - y$.

Worthless(0)

W1 Adding unlike terms and no attempt at multiplication.

Notes

N1 Stops after correct removal of brackets \Rightarrow 7 marks.

N2 Correct answer without work \Rightarrow 7 marks.

N3 Incorrect answer without work \Rightarrow 0 marks.

Part (c) (i)

10 (5, 5) marks

Att 2,2

The cost of five books and one magazine is €32.

The cost of eight books and three magazines is €54.

Let € x be the cost of a book and let € y be the cost of a magazine.

- (i) Write down two equations, each in x and y , to represent the above information.

Write down two equations

10 (5, 5) marks

Att2,2

First equation: $5x + y = 32$

Second equation: $8x + 3y = 54$

Apply to both equations

Slips(-1)

- S1 Incorrect coefficient of x (other than zero)
S2 Incorrect coefficient of y (other than zero)
S3 Incorrect constant.

Attempts

- Att Any effort at a linear equation in x only or a linear equation in y only.
Att $5x$ only or $8x$ only or $3y$ only appear.

(ii) Solve these equations to find the cost of a book and the cost of a magazine.

$$5x + y = 32$$

$$\underline{8x + 3y = 54}$$



$$15x - 3y = 96$$

$$\underline{8x + 3y = 54}$$

$$7x = 42$$

$$x = 6$$

$$y = 2$$

$$5x + y = 32$$

$$\underline{8x + 3y = 54}$$

$$40x + 8y = 256$$

$$\underline{40x + 15y = 270}$$

$$-7y = -14$$

$$y = 2$$

$$x = 6$$

$$y = 32 - 5x$$

$$8x + 3(32 - 5x) = 54$$

$$8x + 96 - 15x = 54$$

$$-7x = -42$$

$$x = 6$$

$$y = 2$$

Blunders (-3)

- B1 Error(s) in establishing the first equation in terms of x only [$7x = 42$] or the first equation in terms of y only [$-7y = -14$] 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).
- N3 If the candidate's equations in c(i) are such that they lead to an over simplification of the work intended in c(ii) then the Att mark (3) only.

QUESTION 5

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

Part (a) 10 marks Att 3

Find the values of x for which

$$2x + 1 \leq 7, x \in \mathbf{N}.$$



$$2x + 1 \leq 7$$

$$2x \leq 6$$

$$x \leq 3$$

$$\Rightarrow x = 0, 1, 2, 3.$$

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. $2x+1 = 3x$ (once only).

Slips (-1)

- S1 Numerical errors (to max -3).
S2 \leq is taken as $<$.
S3 incorrect listing or no listing given.

Attempts

- Att Gives $x = 3$ as answer with no listing or indication on number line of $\{0, 1, 2, 3\}$.
Att Attempts some substitution in an effort to test values.
Att Incorrect listing or indication on number line, without algebraic work. [Natural numbers]

Notes

- N1 $x \leq 3 \Rightarrow 9$ marks.
N2 Correct answer 0, 1, 2, 3 without algebraic work $\Rightarrow 7$ marks.
N3 If $x \geq 3$ as a result of error, 3,4,5 (and or more) as listing.

Part (b) (i)

5 marks

Att 2

Factorise $3x - 3y + ax - ay$.



$$3(x - y) + a(x - y)$$
$$(x - y)(3 + a)$$

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 e.g. $3(x - y) + a(x + y) = (x - y)(3 + a)$.

An instance of correct answer from incorrect work.

Slips(-1)

S1 $(x - y) \pm (3 + a)$.

Attempts

Att Pairing off, or indication of pairing off, and stops.

Att Correctly factorises any pair and stops

Part (b) (ii)

5 marks

Att 2

Factorise: $x^2 - 25$.

$$(x + 5)(x - 5)$$

Blunders (-3)

B1 Incorrect two term linear factors of $x^2 - 25$ formed from correct, but not applicable, factors of x^2 and ± 25

Slips (-1)

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

S2 Uses quadratic equation formula to find $x = 5$ and $x = -5$ and stops.

S3 $(x + 5) \pm (x - 5)$.

Attempts

Att Correct factors of x^2 only.

Att Correct factors of 25 or -25 only.

Att x or ± 5 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

$(x + 5)$ and $(x - 5)$. [The word **and** is written down.]

$(x + 5)$ or $(x - 5)$. [The word **or** is written down.]

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

Part (b) (iii)

5 marks

Att 2

Express $\frac{2}{3} - \frac{1}{9}$ as a single fraction.



$$\begin{aligned}\frac{2}{3} - \frac{1}{9} &= \frac{(2 \times 3) - 1}{9} \\ &= \frac{6 - 1}{9} \\ &= \frac{5}{9}\end{aligned}$$

Blunders (-3)

B1 Incorrect common denominator and continues.

B2 Misuse of common denominator e.g. $\frac{1-6}{9}$ (once only).

B3 Uses another arithmetical operator in place of the given operator and continues.

Slips (-1)

S1 Numerical errors (max-3).

Attempts

Att 9 appears.

Att $6 - 1 = 5$ and nothing else.

Notes

N1 $\frac{2}{3} - \frac{1}{9} = \frac{2-1}{3-9}$ or similar $\Rightarrow 0$ marks.

N2 Accept $\frac{15}{27}$ for full marks.

N3 Correct answer without work $\Rightarrow 2$ marks.

Part (b) (iv)

5 marks

Att 2

Express $\frac{x+7}{3} - \frac{x}{9}$ as a single fraction.

Give your answer in its simplest form.



$$\begin{aligned} & \frac{3(x+7) - x}{9} \\ &= \frac{3x + 21 - x}{9} = \frac{2x + 21}{9} \end{aligned}$$

Blunders(-3)

B1 Incorrect common denominator and continues.

B2 Incorrect numerator from candidate's common denominator. e.g. $\frac{(x+7) - 3x}{9}$.

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.

S3 Not in simplest form.

Attempts

Att 9 only or a multiple of 9 only appears.

Notes

N1 Subtracts numerators and then denominators i.e. $\frac{x+7}{3} - \frac{x}{9} = \frac{7}{-6} \Rightarrow 0$ marks.

N2 All blunders and slips in the simplification of the numerator subject to a max. deduction (-3).

N3 $\frac{3(x+7) - x}{9}$ and stops $\Rightarrow 2$ marks. [B3]

N4 $\frac{3x + 21 - x}{9}$ and stops $\Rightarrow 4$ marks. [S3]

N5 $\frac{6x + 63}{27} \Rightarrow 4$ marks. [S3]


N6 $6x + 63 \Rightarrow 3$ marks. [S1 and S3]

Worthless (0)

W1 $\left(\frac{x+7}{3}\right)\left(\frac{x}{9}\right)$ and stops.

W2 $\frac{7x}{3} - \frac{x}{9}$ and stops.

Part (c) (i)**10 marks****Att 3**Solve the equation $x^2 - 3x - 10 = 0$

	$(x-5)(x+2) = 0$	x	-5	$\Rightarrow (x-5)(x+2) = 0$
	$x-5 = 0$ or $x+2 = 0$	x	2	$\Rightarrow x = 5, x = -2.$
	$x = 5$ or $x = -2.$			

Blunders(-3)Factor Method

- B1 Incorrect two term linear factors of $x^2 - 3x - 10$ formed from correct, but not applicable, factors of x^2 and ± 10 .
- B2 Correct cross method but factors not shown and stops also incurs B4 \Rightarrow 4 marks (but see N1).
- B3 $x(x+2) - 5(x+2)$ or similar and stops also incurs B4 \Rightarrow 4 marks.
- B4 No roots given.
- B5 Error in transposition (once only) applies when both roots are incorrect or one root incorrect and the other is omitted.

Slips (-1)

- S1 One root omitted or a root incorrect provided a correct root has been found.

Attempts

- Att Some effort at factorising.
- Att Oversimplification as a result of losing terms or adding unlike terms e.g. non-quadratic equation.
- Att Some effort at substitution, correct or incorrect.

Notes

- N1 Correct cross method giving $x = 5$ and $x = -2 \Rightarrow$ 10 marks. [Factors need not be given.]

Formula MethodBlunders (-3)

- B1 Errors in a, b, c substitution into formula (once only).
- B2 Errors in signs in substituted formula (once only).
- B3 Error in square root or ignores root.
- B4 Leaving as $\frac{3 \pm 7}{2}$ or similar.
- B5 Incorrect quadratic formula.

Slips (-1)

- S1 One root omitted in final step.
- S2 Numerical errors (to max -3).
- S3 $x = \frac{10}{2}$.
- S4 $x = \frac{-4}{2}$.

Attempts

- Att Correct quadratic formula only or correctly substituted quadratic formula and stops.

Notes

- N1 Trial and error [correct or incorrect] \Rightarrow Att mark only.

$$x = \frac{3 \pm \sqrt{9+40}}{2}$$

$$x = \frac{3 \pm 7}{2} \Rightarrow x = \frac{10}{2} \text{ or } x = \frac{-4}{2}$$

$$\Rightarrow x = 5 \text{ or } x = -2.$$

Part (c) (ii)

10 marks

Att 3

Multiply $(x - 4)$ by $(x^2 + 3x - 1)$.
Give your answer in its simplest form.



$$\begin{aligned}(x - 4)(x^2 + 3x - 1) &= x(x^2 + 3x - 1) - 4(x^2 + 3x - 1) \\ &= x^3 + 3x^2 - x - 4x^2 - 12x + 4 \\ &= x^3 - x^2 - 13x + 4.\end{aligned}$$

Blunders (-3)

B1 Each incorrect term or each term omitted on multiplying out.

Slips (-1)

S1 Each incorrect term or each term omitted in final simplification. (to max -3).

Attempts

Att Any correct multiplication.

Att $x(x^2 + 3x - 1) - 4(x^2 + 3x - 1)$ and stops.

Att $x^2(x - 4) + 3x(x - 4) - 1(x - 4)$ and stops.

Worthless

W1 $(x - 4) \pm (x^2 + 3x - 1)$ stops or continues.

W2 Adding unlike terms and no attempt at multiplication.

Notes

N1 Correct answer without work \Rightarrow 7 marks.

N2 Incorrect answer without work \Rightarrow 0 marks.

QUESTION 6

Part (a)	10 (5, 5) marks	Att 2,2
Part (b)	30 (20, 10) marks	Att 7,3
Part (c)	10 (5, 5) marks	Att 2.2

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

$P = \{(1, 5), (2, 5), (3, 6), (4, 6)\}$.
Write out the domain of P.

Domain = $\{1, 2, 3, 4\}$

Slips(-1)

S1 Each correct element omitted and / or each incorrect element included other than the misreading below.

Misreadings (-1)

M1 Correct range $\{5, 6\}$ given.

Worthless(0)

W1 No element of the domain appears.

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

$P = \{(1, 5), (2, 5), (3, 6), (4, 6)\}$.
Write out the range of P.

Range = $\{5, 6\}$

Slips (-1)

S1 Each correct element omitted and/ or each incorrect element included other than the misreading below.

Misreadings (-1)

M1 Correct domain $\{1, 2, 3, 4\}$ given.

Worthless(0)

W1 No element of the range appears.

Note


N1 Accept $\{5, 5, 6, 6\}$ for full marks.

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

Draw the graph of the function

$$f: x \rightarrow x^2 - 4x + 2$$

in the domain $0 \leq x \leq 4$, where $x \in \mathbf{R}$.

 $f(0) = (0)^2 - 4(0) + 2 = 2$
 $f(1) = (1)^2 - 4(1) + 2 = -1$
 $f(2) = (2)^2 - 4(2) + 2 = -2$
 $f(3) = (3)^2 - 4(3) + 2 = -1$
 $f(4) = (4)^2 - 4(4) + 2 = 2$

or

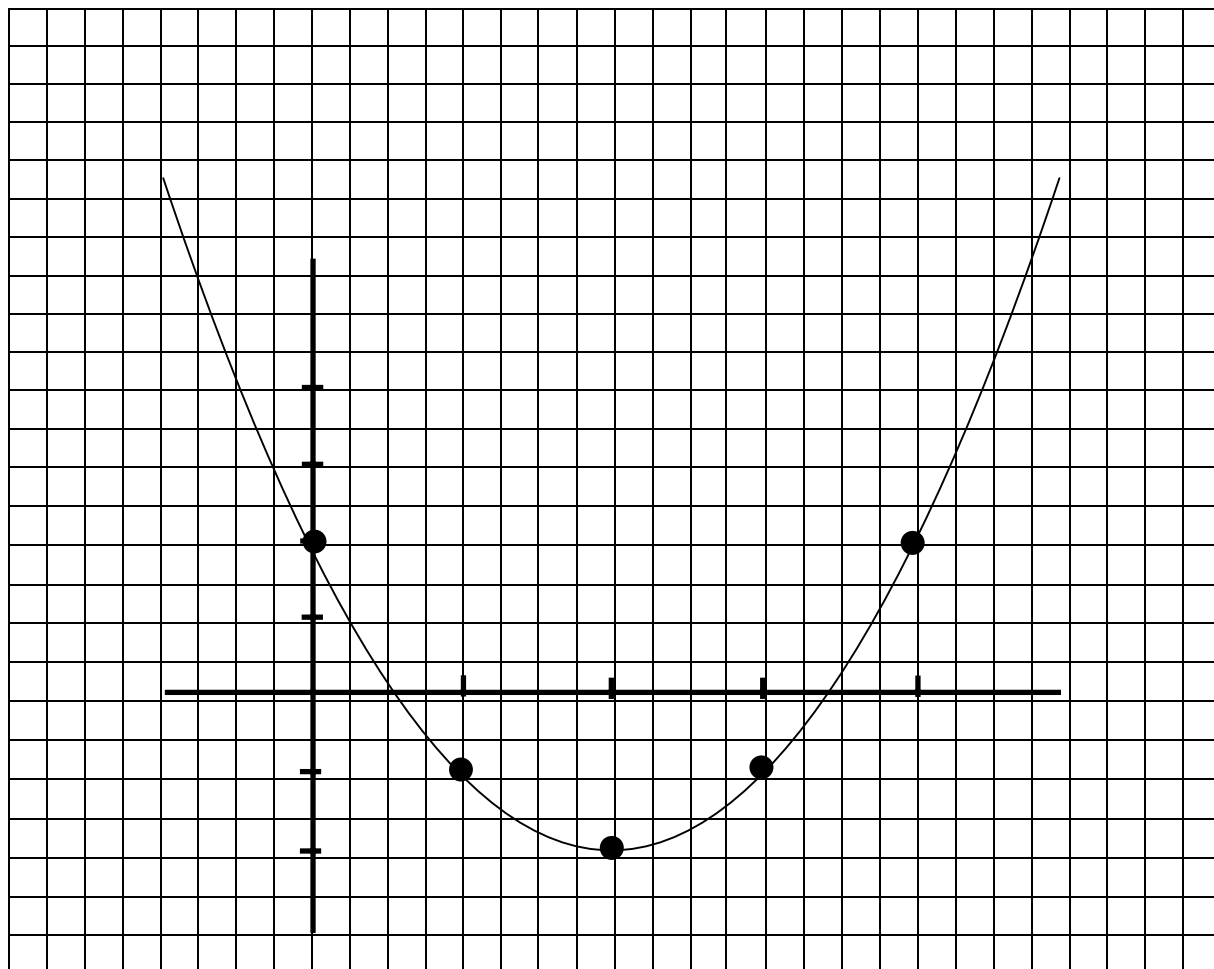
x	0	1	2	3	4
x^2	0	1	4	9	16
$-4x$	0	-4	-8	-12	-16
$+2$	2	2	2	2	2
$f(x)$	2	-1	-2	-1	2

Table**20 marks****Att 7**Blunders (-3)B1 x^2 taken as $2x$ all the way. [In row headed x^2 by candidate]B2 $-4x$ taken as -4 all the way. [In row headed $-4x$ by candidate]B3 $+2$ calculated as $2x$ all the way. [In row headed 2 by candidate]B4 Adds in top row when evaluating $f(x)$.B5 Omits $+2$ row or omits $-4x$ row.B6 Omits a value in the domain each time to max of -9 (4 values missing \Rightarrow Att 7).Slips (-1)S1 Numerical slips (to max -3) in any row other than $f(x)$ row.S2 Misreads $+2$ as -2 and places -2 in the table or $-4x$ as $4x$ and places $4x$ in the table.S3 Each incorrect $f(x)$ value calculated by addition within columns in student's table (no limit).
But note B4.AttemptsAtt Omits x^2 row from table or treats x^2 as x .Att Table with only $f(x) = x^2$.

Att Any effort at calculating point(s).

Att One point only calculated and nothing else.

NotesN1 Each individual error in the rows other than the $f(x)$ row, apart from blunders above, attracts a deduction of -1 subject to a maximum deduction of -3 per row. [$f(x)$ max(-5)]

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 \Rightarrow one point only calculated and graphed correctly.
 N2 Correct graph but no table \Rightarrow 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)

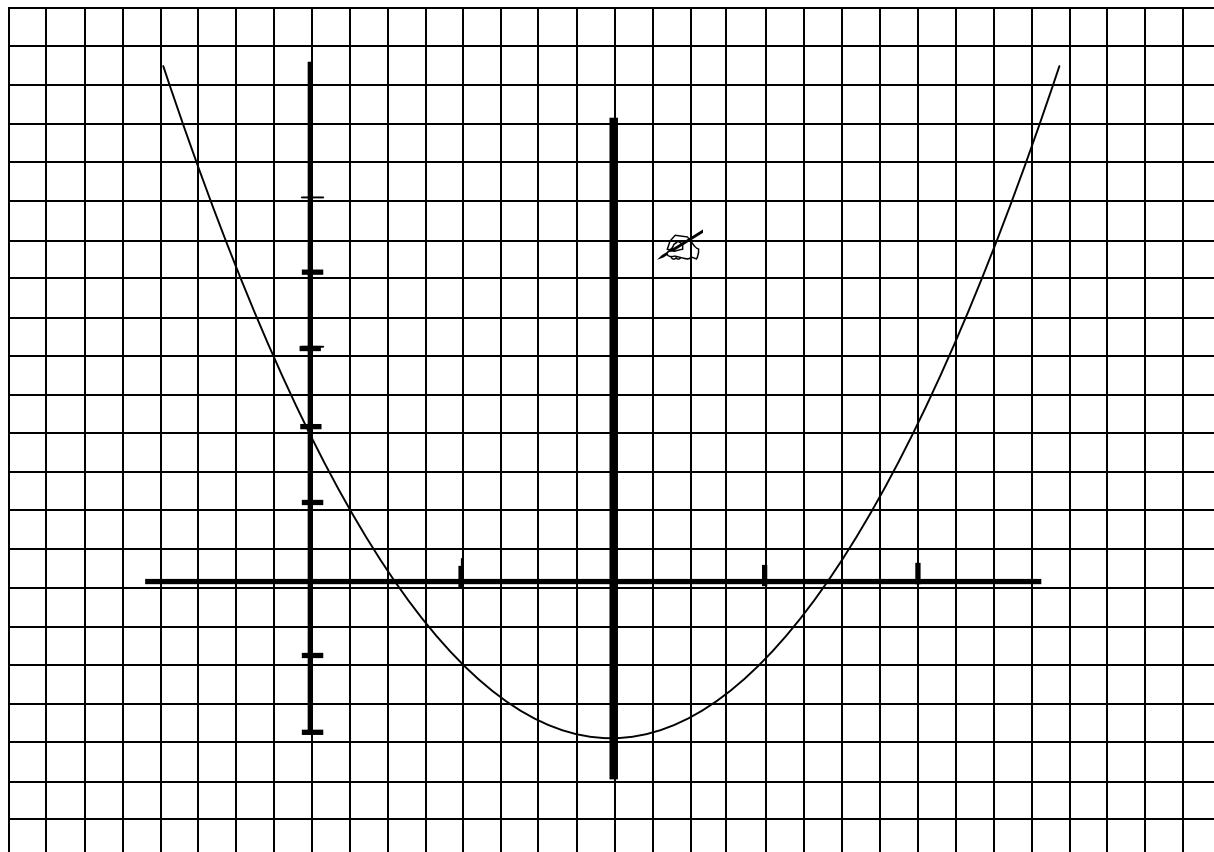
5 marks

Att 2

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

 Work to be shown on the graph.

$$x = 2$$



Blunders (-3)

- B1 any vertical line (parallel to candidate's y - axis) on diagram outside of tolerance. $[1.5 < x < 2.5]$.
- B2 marks 2 on x - axis and stops.
- B3 states $x = 2$ 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 $f(x)$.
- 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 $[1.5 < x < 2.5]$.
- 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

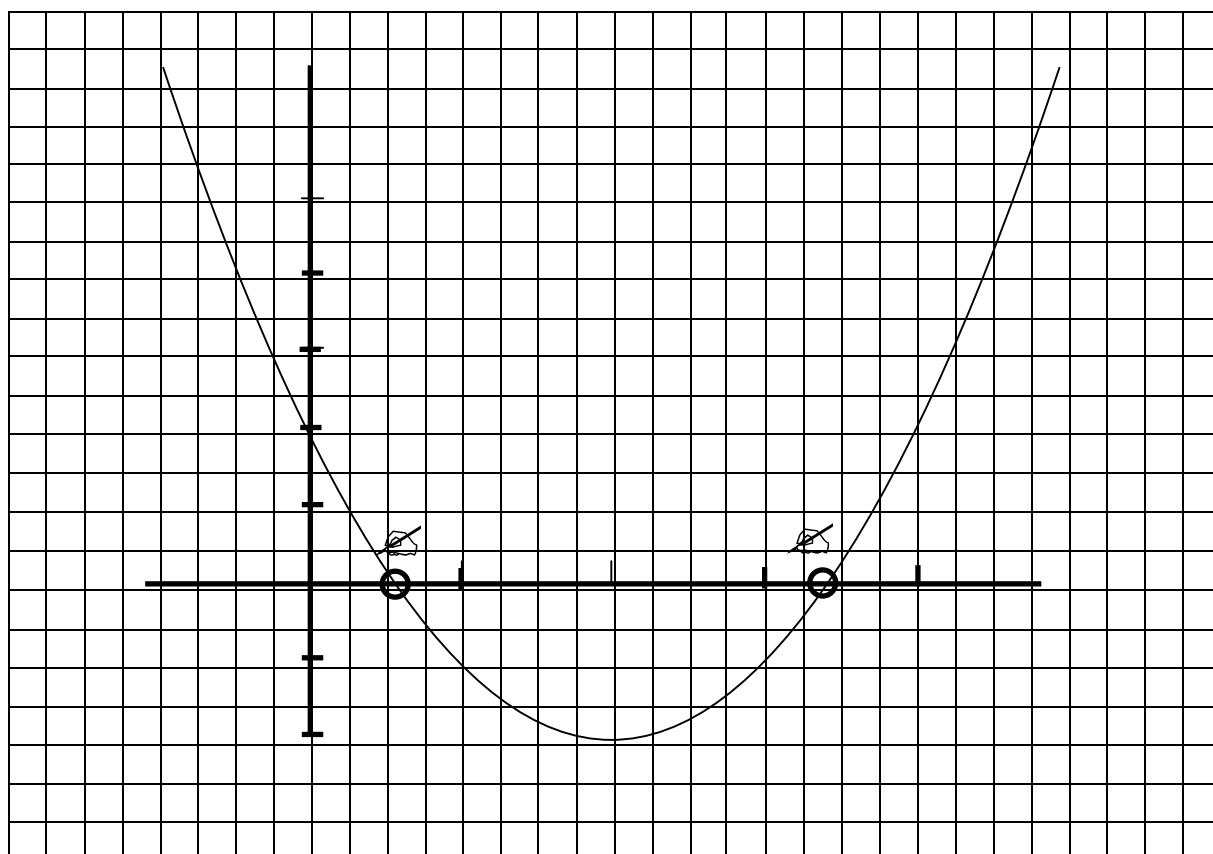
Att 2

Use the graph to estimate the value of x for which $f(x) = 0$.



Work to be shown on graph and answers written here

$x = 0.6$ or $x = 3.4$



Blunders (-3)

B1 Answer on diagram but outside of tolerance (± 0.25).

B2 Fails to write down the answers.

B3 Only one answer or indication.

Attempts

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 2 marks.

N2 A candidate's incorrect graph can earn up to full marks for this section.
[Use similar tolerances]