Coimisiún na Scrúduithe Stáit
State Examinations Commission

JUNIOR CERTIFICATE EXAMINATION 2006
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: B1, B2, B3,…, S1, S2,…, M1, M2,…etc. These lists are not exhaustive.

2. When awarding attempt marks, e.g. Att(3), note that
   - any *correct, relevant* step in a part of a question merits at least the attempt mark for that part
   - if deductions result in a mark which is lower than the attempt mark, then the attempt mark must be awarded
   - a mark between zero and the attempt mark is never awarded.

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

4. The phrase "hit or miss" means that partial marks are not awarded – the candidate receives all of the relevant marks or none.

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

6. Special notes relating to the marking of a particular part of a question are indicated by an asterisk. These notes immediately follow the box containing the relevant solution.

7. The sample solutions for each question are not intended to be exhaustive lists – there may be other correct solutions.

8. Unless otherwise indicated in the scheme, accept the best of two or more attempts – even when attempts have been cancelled.

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

10. Particular cases, verifications and answers derived from diagrams (unless requested) qualify for attempt marks at most.

11. A serious blunder, omission or misreading results in the attempt mark at most.

12. Do not penalise the use of a comma for a decimal point, e.g. €5.50 may be written as €5,50.
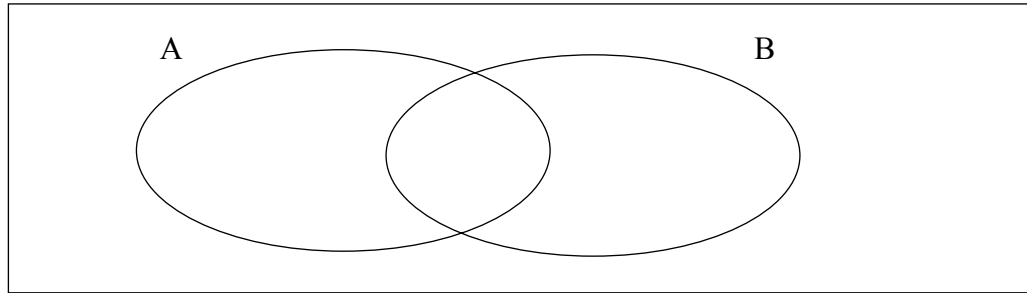
QUESTION 1

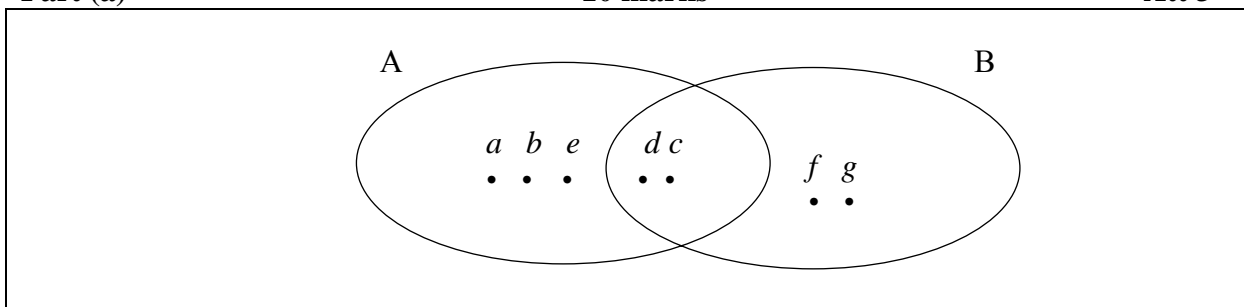| Part (a)	10 marks	Att 3
Part (b)	20(5, 5, 5, 5) marks	Att (2, 2, 2, 2)
Part (c)	20(5, 5, 5, 5) marks	Att (2, 2, 2, 2)

Part (a)	10 marks	Att 3

(a) $A = \{a, b, c, d, e\}$ $B = \{c, d, f, g\}$

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

Part (a)	10 marks	Att 3

* Only **one** correct element correctly placed in the Venn diagram merits **4 marks**.
* • Not necessary

Slips (-1)
S1   Each element incorrectly filled into the diagram.
S2   Each element omitted from the diagram.

Attempts (3 marks)
A1   Totally incorrect filling of the Venn diagram

Worthless (0)
W1   No filling of the Venn diagram.

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

1(b) U is the universal set.

P = {1, 4, 5, 7}

Q = {4, 6, 7, 9, 10}

R = {1, 7, 8, 10}

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

(i)   List the elements of $Q \cup R$.

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

$Q \cup R$ = {1, 4, 6, 7, 8, 9, 10}

Blunders (-3)
B1   Any incorrect set of the elements of Q and R other than the misreading as below.

Misreadings (-1)
M1 $Q \cap R$ giving {7, 10}.

Attempts (2 marks)
A1   2 or 5 or 3 appear in the answer.

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

(ii) List the elements of $Q \setminus (P \cup R)$.

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

$Q \setminus (P \cup R)$.= {6, 9}

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

Misreadings (-1)
M1 $(P \cup R) \setminus Q$ giving {1, 5, 8}. $Q \setminus (P \cap R)$ giving {4,6,9,10} or $(P \cap R) \setminus Q$ giving{1}.

Attempts (2 marks)
A1   2 or 3 appear in the answer.

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

(iii) List the elements of *P′*, the complement of the set *P*.

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

P′ = {2,3,6,8,9,10}

Slips (-1)
S1   Each correct element omitted and/or each incorrect element included. (Max -3)

Attempts (2 marks)
A1   P or any proper subset of P.

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

(iv)   Write down   # *R*.

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

4

Blunders (-3)
B1   Incorrect #R $\leq$ 10. (See M2)

Misreadings (-1)
M1   R= {1, 7, 8, 10}
M2   #R' = 6.

Attempts (2 marks)
A1   Uses phrase "number of elements" or "cardinal number".
A2   #R = 26 or 560.

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

1(c)   There are 30 students in a class.
                             21 own a mobile phone (*M*) and 12 own a computer (*C*).
                             7 own both a mobile phone and a computer.
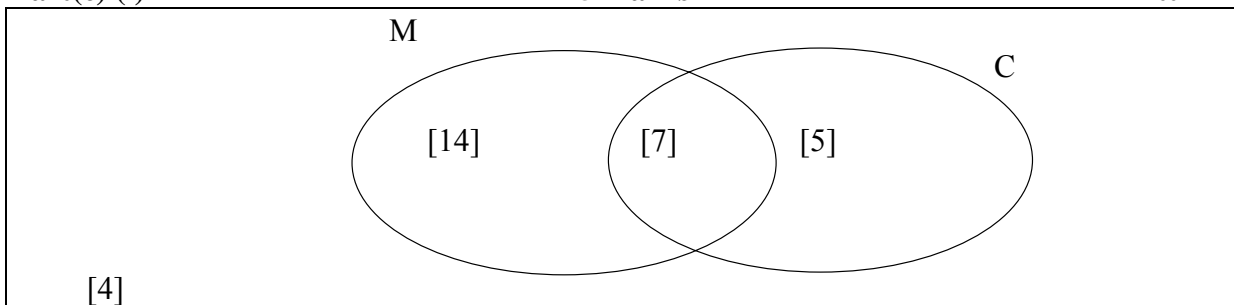
Part(c) (i)   **5 marks**   **Att 2**

   (i)   Represent this information in the Venn diagram below.

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

M

C

[14]   [7]   [5]

[4]

Blunders (-3)
B1   Incorrect Venn diagram subject to S1 below.

Slips (-1)
S1   Numerical errors where work is clearly shown.

Attempts (2 marks)
A1   Any one correct/relevant entry.

Part(c) (ii)	**5 marks**	**Att 2**
(ii) How many students own a mobile phone but not a computer?		

Part(c) (ii)	**5 marks**	**Att 2**
14		

* A correct answer written in the space provided takes precedence over an incorrect Venn diagram.
* Accept candidates work from previous part c (i).
* If no work appears here, award 2 marks if correct answer appears in Venn Diagram.

Blunders (-3)
B1 Any incorrect use of the given numbers or the numbers from the candidates incorrect Venn diagram. [Subject to S1].

Slips (-1)
S1 Numerical errors where work is clearly shown.

Misreadings (-1)
M1 C\M

Part(c) (iii)	**5 marks**	**Att 2**
(iii) How many students own neither a mobile phone nor a computer?		

Part(c) (iii)	**5 marks**	**Att 2**
4		

* A correct answer written in the space provided takes precedence over an incorrect Venn diagram.
* Accept candidates work from previous parts (c) (i), (c) (ii).
* If no work appears here, award 2marks if correct answer appears in Venn Diagram.

Blunders (-3)
B1 Incorrect Venn diagram.[Subject to Second *above].
B2 Any incorrect use of the given numbers or numbers from the previous work.
[Subject to Second *above].

Slips (-1)
S1 Numerical errors where work is clearly shown.

Part(c) (iv)	**5 marks**	**Att2**
(iv) How many students do not own a mobile phone?		

Part(c) (iv)	**5 marks**	**Att2**
9		

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

*   Accept candidates work from previous parts (c) (i), (c) (ii), and (c) (iii).

Blunders (-3)

B1   Incorrect Venn diagram. [Subject to Second *above].

B2   Any incorrect use of the given numbers or numbers from the previous work. [Subject to Second * above].

Slips (-1)

S1   Numerical errors where work is clearly shown

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

(a) In a school of 646 pupils the ratio of girls to boys is 9:8.
Find the number of girls and the number of boys in the school.

Part (a)	10 marks	Att 3

$9\,parts : 8\,parts$

$\Rightarrow \dfrac{646}{17} = 38$

$Girls = 38 \times 9 = 342$

✍ $Boys = 38 \times 8 = 304$

$9x : 8x$

$\Rightarrow 17x = 646$

$\Rightarrow x = 38$

$\Rightarrow 9x = 342$

$\Rightarrow 8x = 304$

$9 + 8 = 17$

$\dfrac{1}{17} = 38$

$\Rightarrow \dfrac{9}{17} = 342(Girls)$

$\Rightarrow 646 - 342 = 304(Boys).$

Blunders (-3)

B1   Correct answers without work. ✍
B2   Divisor = 8 or 9 only and continues.
B3   Incorrect multiplier or fails to multiply. (each time)
B4   Error in transposition (x method).
B5   Fails to find second number. (Number of boys or girls only).
B6   Adds instead of subtracting e.g. 646 + 342 = 988.

Slips (-1)

S1   Numerical errors to a max of 3
.

Attempts (3 marks)

A1   Divisor $\neq$ 17 e.g. $\dfrac{646}{9}$ and/or $\dfrac{646}{8}$ and stops.

A2   Indicates 17 parts or 9 parts or 8 parts or $^{9}/_{17}$ or $^{8}/_{17}$ or 9+8=17 only and stops.
A3   5814:5168 only. i.e. multiplies 646 by 9 and by 8.
A4   Divide by 2 and stops or continues. (Oversimplification).
A5   Both answers added to equal 646. (If no work shown).

Worthless (0)

W1   Incorrect answer without work.

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

2(b) (i)   On a day when $€1 = \$1 \cdot 21$, find the value in euro of \$6655.

Part (b) (i)   **5 marks**   **Att2**

$€1 = \$1.21$

$€? = \$6655$

$? = \dfrac{6655}{1.21} = €5500$

$\$1.21 = €1$

$\Rightarrow \$1 = € \dfrac{1}{1.21}$

$\Rightarrow \$6655 = 6655 \times \dfrac{1}{1.21} = €5500$

*   No penalty for the omission of € or \$ symbols.

Blunders (-3)

B1   Correct answer without work. ✍

B2   Incorrect multiplier i.e. $6655 \times 1.21 = 8052.55$

B3   Incorrect ratio $\dfrac{1.21}{6655}$ or $\dfrac{121}{665500}$.

B4   Decimal error.

B5   Fails to finish, leaves as $\dfrac{6655}{1.21}$ and stops.

Slips (-1)

S1   Numerical errors to a max of 3.

S2   Rounds off too early. i.e. (0.83).

Attempts (2 marks)

A1 $\$1 = € \dfrac{1}{1.21}$ and stops.

Worthless (0)

W1   Adds or subtracts 6655 and 1.21.

W2   Incorrect answer without work.

2 (b) (ii)   By rounding each of these numbers to the nearest whole number, estimate the value of $\dfrac{4 \cdot 368 + 10 \cdot 92}{3 \cdot 12}$.

✍ $\dfrac{4 \cdot 368 + 10 \cdot 92}{3 \cdot 12}$ is approximately equal to:

$$\frac{\boxed{4} \;+\; \boxed{11}}{\boxed{3}} \;=\; \frac{\boxed{15}}{\boxed{3}} \;=\; \boxed{5}$$

* $\dfrac{4+11}{3}$ and stops $\Rightarrow$ 4 marks.

*   No penalty if the intermediate step between approximations and final answer not shown. i.e. $\dfrac{15}{3}$ not shown.

*   Special Case: $\dfrac{4.368 + 10.92}{3.12} = 4.9 \Rightarrow$ 3 marks.

Blunders (-3)

B1   Correct answer without work. ✍
B2   Error(s) in rounding off to the nearest whole number.
B3   Decimal error in calculation of approximate value.
B4   An arithmetical operation other than indicated.
B5 $\dfrac{4}{3} + 11$ or similar and continues.

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

Attempts (3 marks)
A1   Only one or two approximations made to the given numbers & stops.

Part (b) (iii)   **5marks**   **Att2**

Part(b)

(iii)   Using a calculator, or otherwise, find the exact value of $\dfrac{4\cdot368+10\cdot92}{3\cdot12}$.

Part (b) (iii)   **5marks**   **Att2**

$$\frac{4\cdot368+10\cdot92}{3\cdot12} = \frac{15.288}{3.12} = 4.9$$

Blunders (-3)
B1   Decimal error.

B2   Treats as: $\dfrac{4.368}{3.12}+10.92=1.4+10.92=12.32$.[B1 may occur].

B3   Treats as: $4.368+\dfrac{10.92}{3.12} = 4.368+3.5= 7.868$.[B1 may occur].

B4   Treats as: $\dfrac{4.368-10.92}{3.12} = -2.1$ [B1 may occur].

B5   Treats as: $\dfrac{4.368\times10.92}{3.12}=15.288$.[B1 may occur].

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

Attempts (2 marks)
A1   Some correct calculation done.

Part (c) (i)	5 marks	Att 2

2(c) (i) Using a calculator, or otherwise, find the exact value of $\left(4^2\right)^3$.

Part(c) (i)	5marks	Att2

$$\left(4^2\right)^3 = 4096$$

* 4^6 and stops. = 4 marks.

Blunders (-3)

B1 Mishandles $\left(4^2\right)^3$ .e.g. $4^5 = 1024$, $\left(\sqrt{4}\right)^3 = 8$, $\left(\sqrt[3]{4}\right)^2 = 2.5198421$.

Attempts (2 marks)

A1 $\left(4\right)^3 = 64$.

A2 $\left(4\right)^2 = 16$.

A3 $4 \times 3 \times 2 = 24$.

Part (c) (ii)	5 marks	Att 2

Using a calculator, or otherwise, multiply $65\cdot5$ by 40 and express your answer in the form $a \times 10^n$, where $1 \le a < 10$ and $n \in Z$.

Part (c) (ii)	5 marks	Att 2

$$65.5 \times 40 = 2620 = 2.62 \times 10^3$$

Blunders (-3)

B1 Correct answer without work.

B2 Decimal error.

B3 Incorrect format, where $a \le 1$ *or* $a \ge 10$ and $n \notin Z$.

Slips (-1)

S1 Numerical errors to a max of 3.

S2 Rounds off to 3×10^3, 2.6×10^3.

S3 Incorrectly rounds off. e.g. 2.7×10^3 also attracts S2.

Attempts (2 marks)

A1 2620 and stops.

A2 Any relevant step.e.g. Partial multiplication.

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

(iii)   Using a calculator, or otherwise, evaluate

$$\frac{1}{0\cdot 0125} + \frac{\sqrt{86\cdot 49}}{15\cdot 5} \times 7\cdot 48.$$

Give your answer correct to two decimal places.

Part (c) (iii)   **10 marks**   **Att3**

✍

$$= 80 + \frac{9.3}{15.5} \times 7.48$$

$$= 80 + 0.6 \times 7.48$$

$$= 80 + 4.488$$

$$= 84.488$$

$$= 84.49$$

*   Correct answer (without work) incorrectly rounded off $\Rightarrow$ **6** marks

Blunders (-3)

B1   Correct answer without work. ✍

B2   Mishandles $\dfrac{1}{0\cdot 0125}$.

B3   Mishandles $\sqrt{86.49}$

B4   Error in $\dfrac{9.3}{15.5}$ or candidate's equivalent from previous work.

B5   Error in multiplication of 0.6×7.48 or candidate's equivalent from previous work.

B6   Decimal error.

B7   Adds before Multiplication: $\dfrac{1}{0\cdot 0125} + \dfrac{\sqrt{86\cdot 49}}{15\cdot 5} \times 7\cdot 48.= 602.888.$

B8   Incorrect denominator.

B9   Incorrect numerator.

B10 Works as $80 \times 7.48 + 0.6 = 599$.

B11 Multiplies instead of adds.

Slips (-1)

S1   Numerical errors to a max of 3.

S2   Each premature rounding off to a max of 3.

S3   Fails to round off or rounds off incorrectly when giving final answer.

Attempts (3 marks.)

A1   Any relevant step e.g. $\dfrac{1}{0\cdot 0125} = 80$, $\sqrt{86.49} = 9.3$

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

Part (a)	10 marks	Att 3

3. **(a)** Find the total cost of the following bill:

✍

6 litres of milk at €1.05 a litre
3 loaves of bread at €1 .20 a loaf
5 apples at 65c each

Part (a)	10 marks	Att 3

$$1.05 \times 6 = 6.3$$
$$1.20 \times 3 = 3.6$$
$$0.65 \times 5 = 3.25$$
$$Total\ Cost = €13.15$$

OR

$$1.05 + 1.05...6\,Times = 6.30$$
$$+1.20 + 1.20....3\,Times = 3.60$$
$$+0.65 + 0.65....5\,Times = 3.25$$
$$Total\ Cost = €13.15$$

* Accept 1315, 13.15.
* No penalty for missing € symbol.
* Adds $1.05 + 1.20 + 0.65 = 2.90$ and stops $\Rightarrow$ 3 marks. (Oversimplification).

Blunders (-3)

B1 Correct answer without work. ✍
B2 Each missing product when finding items cost e.g. 1.05 not multiplied by 6.
B3 Each missing item when finding total cost e.g. cost of bread omitted.
B4 Fails to find total cost i.e. no addition.
B5 Operation other than addition of items to find total cost.
B6 Decimal error e.g. 131.5 (Note: First *).

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

Attempts (3 marks)
A1 Any attempt at addition /multiplication.

Worthless (0)
W1 Incorrect answer without work.

3(b) (i) V.A.T .at 21% is added to a bill of €750.
Calculate the total bill.

Method 1

$100\% = 750$

$1\% = \dfrac{750}{100}$

✍ $121\% = \dfrac{750}{100} \times 121$

$= 7.5 \times 121$

$Total\ bill = €907.5$

Method 2

$100\% = 750$

$1\% = \dfrac{750}{100}$

$21\% = \dfrac{750}{100} \times 21 = 157.50$

$Total\ Bill = 157.5 + 750 = €907.50$

Method 3

$21\% = \dfrac{21}{100}$

$V.A.T. = \dfrac{21}{100} \times 750.$

$Total\ bill = 157.5 + 750 = €907.5$

Method 4

$750 \times 1.21 = 907.5$

$Total\ bill = €907.50$

* €157.50 (without work) and stops ⇒ 4 marks.
* No penalty for missing € symbol.

Blunders (-3)

B1 Correct answer without work. ✍

B2 Inverts $\dfrac{121}{100}$ or $\dfrac{21}{100}$ and continues (giving answers 619.83 or 3571.43).

B3 Mishandles 21%. e.g. 750×21 or $750 \div 21$ (750 must be used).

B4 750 taken as 121%

B5 No addition of V.A.T. (as per candidates work) to the bill.

B6 Subtraction of V.A.T. (as per candidates work) from the bill.

Slips (-1)

S1 Numerical errors to a max of 3.

Attempts (3 marks)

A1 $\dfrac{21}{100}$ and stops.

A2 $100\% = 750$ and stops.

A3 $\dfrac{750}{100}$ and stops.

A4 $100 \times \dfrac{21}{750}$ and stops.

A5 $\dfrac{750}{21}$ and stops.

A6 Use of any other %

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

(ii)   €7450 is invested at $2 \cdot 6\%$ per annum.

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

✍ **(ii)**

$$1\% = \frac{7450}{100}$$
$$2.6\% = 74.50 \times 2.6$$
$$Interest = €193.70$$
$$Amount = €7643.70$$

$$I = \frac{P \times R}{100} = \frac{7450 \times 2.6}{100} = 193.7$$
$$\text{Amount} = €7643.70$$

$$7450 \times 1 \cdot 026$$
$$= 7643.7$$
$$\text{Amount} = €7643.7$$

*   €193.70 (without work) and stops $\Rightarrow$ 4 marks.
*   No penalty for missing € symbol.

Blunders (-3)

B1   Correct answer without work. ✍
B2   Mishandles 2.6%. e.g. 7450×2.6 or $7450 \div 2.6$ (7450 must be used).
B3   Decimal error (once only).
B4   Stops at interest i.e. fails to calculate amount.
B5   Subtracts to calculate amount.
B6   Illegal cancellation(s) in $\dfrac{7450 \times 2.6}{100}$.

B7 $1 \cdot 026 = 1 \cdot 26$.

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

Attempts (3 marks)
A1   Correct formula with or without substitution and stops.
A2   Some use of 100 in attempt to find percentage e.g. $2.6\% = \dfrac{2.6}{100}$ and stops.

Worthless (0)
W1   Incorrect answer without work.

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

3(c)   John's weekly wage is €730.
He pays income tax at the rate of 20% on the first €440 of his wage
and income tax at the rate of 42% on the remainder of his wage.
John has a weekly tax credit of €65.

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

(i)   Find the tax on the first €440 of his wage, calculated at the rate of 20%.

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

✍ (i)

1% = 4.4
20% = 88 $\text{Tax} = \dfrac{440}{100} \times 20 = €88$ $440 \times 0 \cdot 2 = €88$
Tax = €88

.

*   No penalty for missing € symbol.

Blunders (-3)

B1   Correct answer without work. ✍
B2   Mishandles 20%, e.g. $440 \times 20 = 8800$ or $440 \div 20 = 22$.
B3   Uses €730 instead of €440.
B4   Decimal error.

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

Attempts (2 marks)
A1   Some use of 100 in attempt to find percentage e.g. $20\% = \frac{20}{100}$ and stops

Worthless (0)
W1   Incorrect answer without work

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

(ii)   Find the tax on the remainder of his wage, calculated at the rate of 42%.

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

✎ **(ii)**   Remainder of wage = €730 – €440 = €290

$$1\% = 2\cdot9$$
$$42\% = 121.8$$ or $\text{Tax} = \dfrac{290}{100} \times 42 = €121.8$ or $290 \times 0\cdot42 = €121.8$
$$\text{Tax} = €121.8.$$

*   No penalty for missing € symbol.

Blunders (-3)

B1   Correct answer without work. ✎
B2   Mishandles 42%, e.g. 290×42 or $290 \div 42$. [No penalty if already penalised in (c) (i)].
B3   Uses €730 or €440 instead of €290.
B4   Decimal error.
B5   730 - 440 = 290 and stops.

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

Attempts (2 marks)
A1   Some use of 100 in attempt to find percentage e.g. $42\% = \frac{42}{100}$ and stops.

Worthless (0)
W1   Incorrect answer without work.

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

(iii)   Hence calculate John's gross tax.

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

✎ **(iii)**   John's gross tax = €88 + €121.80= €209.80

*   Allow candidates incorrect answers from parts (i) and (ii).
*   No penalty for missing € symbol.

Blunders (-3)

B1   Correct answer without work. ✎
B2   €88 – €121.80 = - €33.80
B3   Misuse of tax credit.

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

Attempts (2)
A1   Answer from c (i) and /or c (ii) written in this part.

Worthless (0)
W1   Incorrect answer without work

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

(iv)   Calculate John's take home pay.

✎   Tax payable = €209.80 - €65
                      Take home pay = €730 - €144.80
                      Take home pay = €585.20

*   Allow candidate's incorrect gross tax figure from (c) (iii).
*   No penalty for missing € symbol.

Blunders (-3)
B1   Correct answer without work. ✎
B2   Misuse of tax credit e.g. $209.80 + 65 = 274.80$.
B3   Decimal error.

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

Attempts (2)
A1   Answer from c (iii) written in this part.

Worthless (0)
W1   Incorrect answer without work.

QUESTION 4

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

Part (a)	10(5, 5) marks	Att 2,2
(i)	If $a = 2$ and $b = 5$, find the value of $3a + b$	

Part (a) (i)	5 marks	Att 2
✎	**(i)** $3a + b = 3(2) + 5 = 6 + 5 = 11$	

* $6 + 5 \Rightarrow$ 4 marks.
* <u>One substitution</u> coupled with an <u>implied substitution</u> leading to correct answer
  $\Rightarrow$ 5 marks. e.g. $= 3a + 5 = 11$

Blunders (-3)

B1 Correct answer without work. ✎
B2 Leaves 3(2) in the answer.
B3 Breaks order i.e. $[3(2 + 5) = 21]$.
B4 Treats 3(2) as 5 or 32.

Slips (-1)

S1 Numerical errors to a max of 3.
S2 Values of a and b interchanged.

Misreadings (-1)

M1 Incorrect numerical substitution for either a or b, but not both, and continues. (See W1)

Attempts (2 marks)

A1 Incomplete substitution and stops e.g. $3a + 5$,

Worthless (0)

W1 Incorrect substitution for both *a* and b.

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

(ii)   If $a = 2$ and $b = 5$, find the value of $ab - 3$

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

✎   **(ii)** $ab - 3 = 2(5) - 3 = 10 - 3 = 7$

* $10 - 3 \Rightarrow$ 4 marks.

Blunders (-3)

B1   Correct answer without work. ✎   [Do not penalise if already penalised in part (a) (i) or work is shown in part (a) (i).]

B2   Leaves 2(5) in the answer.

B3   Breaks order i.e. [$2(5 - 3) = 4$].

B4   Treats 2(5) as 25, 7, or 52.

Slips (-1)

S1   Numerical errors to a max of 3.

Misreadings (-1)

M1   Incorrect numerical substitution for either a or b but not both, and continues. (See W1)

Attempts (2 marks)

A1   Incomplete substitution and continues or stops e.g. $2b - 3$, $5a - 3$

Worthless (0)

W1   Incorrect substitution for both *a* and b.

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

4(b) (i)   Solve the equation $2(x-3) = x+1$.

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

✍

$$2(x-3)=x+1$$
$$2x-6 = x+1$$
$$2x - x = 1+6$$
$$x = 7$$

Blunders (-3)

B1   Correct answer without work. ✍
B2   Error in distributive law and continues,e.g. $2x-3=x+1$, $2x-6 = 2x+2$ (once only).
B3   Error(s) in transposition.
B4   Combines "x"to "numbers" and continues. e.g. $2x-6=-4x$.
B5   Fails to finish.

Slips (-1)

S1   Numerical errors to a max of 3.

Attempts (3 marks)

A1   Any correct step.

Worthless (0)

W1   Combines "x"to "numbers" and stops.

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

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

$$(x-5)(2x+3)=x(2x+3)-5(2x+3)$$
$$=2x^2+3x-10x-15$$
$$=2x^2-7x-15$$

*   First line = $x(2x+3)-5(2x+3)$ or $2x(x-5)+3(x-5)$ = 4 marks.

Blunders (-3)

B1   Correct answer without work. ✍
B2   Error(s) in distribution.
B3   Combining unlike terms.
B4   Fails to group or groups incorrectly.

Slips (-1)

S1   Numerical errors to a max of 3.

Attempts (3 marks)

A1   Any correct multiplication.
A2   Oversimplification of question.
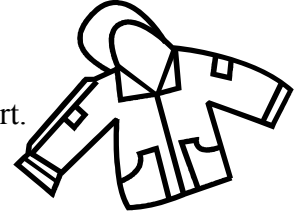A3   A correct step.

Worthless (0)

W1 $(x-5)\pm(2x+3)$ stops or continues.

W2   Combining unlike terms before attempting multiplication and stops.

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

> The cost of 2 jumpers and 3 shirts is €84.
> The cost of 4 jumpers and 1 shirt is €78.
> Let €x be the cost of a jumper and let €y be the cost of a shirt.
>
> **(i)** Write down two equations, each in x and y
> to represent the above information.

Write down two equations   **10(5, 5) marks**   **Att(2,2)**

✍   First equation: $2x + 3y = 84$

                 Second equation: $4x + y = 78$

*   Special Case: $2 + 3 = 84$, $4 + 1 = 78$. Award 7 marks.
Blunders (-3)

B1   Correct answer without work. ✍

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 (2 marks)
A1   Any effort at a linear equation in x only or a linear equation in y only.
A2 $2x$ only or $4x$ only or $3y$ only appear.

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

ii) Solve these equations to find the cost of a jumper and the cost of a shirt.

$$2x+3y=84$$
$$4x+\ y=78$$
$$\overline{}$$
$$2x+3y=84$$
$$-12x-3y=-234 \quad \text{or}$$
$$\overline{}$$
$$-10x\ \ =-150$$
$$x\ \ =\ €15$$
$$y\ \ =\ €18$$

$$2x+3y=84$$
$$\underline{4x+\ y=78}$$
$$-4x-6y=-168$$
$$\underline{4x+y\ =\ 78}$$
$$-5y=-90$$
$$5y\ =\ 90$$
$$y\ =\ €18 \quad \text{or}$$
$$x\ =€15$$

$$y=78-4x$$
$$2x+3(78-4x)=84$$
$$2x+234-12x=84$$
$$-10x=-150$$
$$x\ =\ €15$$
$$y\ =€18$$

* Apply only <u>one</u> blunder deduction (B2 or B3) to any error(s) in establishing the first equation in terms of x only or the first equation in terms of y only.
* Finding the second variable is subject to a maximum deduction of (-3).
* If the candidates equations in (c)(i) are such that they lead to an over simplification of the work in (c)(ii) then Attempt marks apply at most.
* No penalty for missing € symbol.

Blunders (-3)

B1 Correct answers without work. ✍

B2 Error(s) in establishing the first equation in terms of x only $[-10x=-150]$ or the first equation in terms of y only $[-5y=-90]$ through elimination by cancellation.

B3 Error(s) in establishing the first equation in terms of x only $[4x=60]$ or the first equation in terms of y only $[3y=54]$ through elimination by substitution.

B4 Errors in transposition in solving the first one variable equation.

B5 Errors in transposition when finding the second variable.

B6 Incorrect substitution when finding second variable.

B7 Finds one variable only.

Slips (-1)

S1 Numerical errors to a max of 3

Attempts (2 marks)

A1 Attempt at transposition and stops.

A2 Multiplies either equation by some number and stops.

Part(c) (iii)	**5marks**	**Att2**

(iii)   Verify your result.

✍

$$2(15) + 3(18) = 84$$

$$4(15) + 18 = 78$$

*   Accept candidates answers from previous work in this part.

Blunders (-3)

B1   Correct answers without work. ✍
B2   Verifies only one equation.
B3   Error in substitution to either equation.
B4   Forces equality

Slips (-1)

S1   Numerical errors to a max of 3.
S2   Conclusion missing.

Attempts (2 marks)

A1   Substitutes into one equation and stops.
A2   Writes the equations in this section.
A3   Answers from (c) (ii) written in this part.

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

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

Write in its simplest form
$$4(x+3)+2(5x+4).$$

Part (a)	**10 marks**	**Att3**

✎	$4x+12+10x+8$
	$14x+20$

* Stops after correct removal of brackets $\Rightarrow$ 7 marks.
* Ignore excess work $2(7x+10)$

Blunders (-3)

B1 Correct answer without work. ✎
B2 Error(s) in distribution.
B3 Combining unlike terms.
B4 Fails to group like terms.

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

Misreadings (-1)
M1 $4(x+3) \times 2(5x+4)$ and continues.

Attempts (3 marks)
A1 Any correct multiplication.

Worthless (0)
W1 Combining unlike terms before attempting multiplication and stops.

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

(i) Factorise:	$xy + wy$

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

(i)	$y(x + w)$

Blunders (-3)

B1   An incorrect factor.
B2   Removes factor incorrectly.

Attempts (2 marks)

A1   Indication of common factor. e.g. underline y's and stops.

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

(ii) Factorise:	$ax - ay + bx - by$

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

✍ (ii)	$ax - ay + bx - by$		$ax + bx - ay - by$
	$a(x-y) + b(x-y)$	or	$x(a+b) - y(a+b)$
	$(x-y)(a+b)$		$(a+b)(x-y)$

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

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

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

    $(x-y)$, $(a+b)$.   [A comma is used]

Blunders (-3)

B1   Correct answer without work. ✍

B2   Stops after first line of correct factorisation. e.g. $a(x-y) + b(x-y)$ or equivalent.

B3   Error(s) in factorising any pair of terms.

B4   Incorrect common factor and continues. e.g. $a(x-y) + b(x+y) = (a+b)(x-y)$

Slips (-1)

S1 $(a+b) \pm (x-y)$

S2   Correct first line of factorisation but ends as $ab(x-y)$.

Attempts (2 marks)

A1   Pairing off, or indication of pairing off, and stops.
A2   Correctly factorises any pair and stops.

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

> Factorise: $p^2 - 36$

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

(iii)	$p^2 - 36$
	$P^2 - 6^2$
	$(p-6)(p+6)$

*   Accept (with or without brackets) for 5 marks any of the following
$(p+6)$ and $(p-6)$.   [The word **and** is written down.]
$(p+6)$ or $(p-6)$.   [The word **or** is written down.]
$(p+6), (p-6)$ [A comma is used]

*   Quadratic equation formula is subject to slips and blunders.[See 5(c)(i)]

Blunders (-3)
B1   Incorrect two term linear factors of $p^2 - 36$ formed from correct (but not applicable) factors of p^2 and ± 36 e.g. $(p-9)(p+4)$.
B2 $(6+p)(6-p)$.
B3 $(p-36)(p+36)$.
B4   Incorrect factors of p^2 and/or 36.

Slips (-1)
S1   Solves $p^2 = 36$ to give $p = 6$ and $p = -6$ and stops.
S2 $(p+6) \pm (p-6)$

Attempts (2 marks)
A1   Correct factors of p^2 only.
A2   Correct factors of 36 or -36 only.
A3 p or ± 6 appears.
A4 $p^2 - 36 = p.p - 6.6$ and stops.
A5   Mention of the difference of two squares.

Part (b) (iv)	**5 marks**	**Att2**
(iv)	Factorise: $4a^2 + 8a$	

Part (b) (iv)	**5 marks**	**Att2**
(iv)	$4a^2 + 8a$ $4a(a+2)$	

*   Accept $4a^2 + 8a$ or $4a^2 + 8a$ or $4a^2 + 8a$ or $2a(2a+4)$

                      $4(a^2 + 2a)$ $2(2a^2 + 4a)$ $a(4a+8)$

Blunders (-3)
B1   An incorrect factor.
B2   Stops after some correct effort at factorisation. e.g. $4.a.a + 4.2a$
B3   Mathematical blunder $4a^2 = 16a^2$ & continues.

Attempts (2 marks)
A1 $4a(a)$ *and / or* $8(a)$ or effort at brackets.
A2   Common factor identified or indicated and stops. e.g. $\underline{4}a\,a + \underline{4}2\,a$ or similar.

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

(i)   Solve the equation: $x^2 - 5x - 14 = 0$
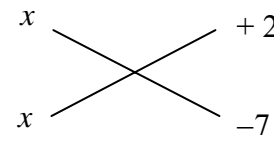

Part (c) (i)   **10 marks**   **Att 3**

✍ (iii)

$$x^2 - 5x - 14 =$$
$$= x^2 - 7x + 2x - 14 = 0$$
$$= x(x-7) + 2(x-7) = 0$$
$$= (x-7)(x+2) = 0$$
$$\Rightarrow x = 7 \text{ and } x = -2$$

$$\Rightarrow (x-7)(x+2) = 0$$
$$\Rightarrow x = 7 \text{ and } x = -2$$

or

$$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(1)(-14)}}{2(1)}$$

$$\Rightarrow \frac{5 \pm \sqrt{25 + 56}}{2} = \frac{5 \pm 9}{2} = \frac{14}{2} \text{ and } \frac{-4}{2}$$

$$\Rightarrow x = 7 \text{ and } x = -2$$

or

Factor Method:
B1   Correct answers without work. ✍
B2   Incorrect two term linear factors of. $x^2 - 5x - 14$ formed from correct (but inapplicable factors of x^2 or ± 14.
B3   No roots given.
B4   Incorrect factors of x^2 and/or ± 14.
B5   Correct cross method but factors not shown and stops [Note: B3 applies also].
B6 $x(x-7) + 2(x-7)$ or similar and stops. [Note: B3 applies also].
B7   Error(s) in transposition.
B8   One root only.

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

Attempts (3 marks)
A1   Some effort at factorisation.
A2   Oversimplification resulting in a linear equation & continues.

Worthless (0 marks)
W1 $x^2 - 5x = 14$ or similar and stops.
W2   Trial and error.

Formula Method

Blunders (-3)

B1   Correct answers without work. ✍

B2   Error in a,b,c, substitution (apply once only).

B3   Sign error in substituted formula (apply once only).

B4   Error in square root or square root ignored.

B5   Stops at $\dfrac{5 \pm 9}{2}$.

B6   Incorrect quadratic formula and continues.

B7   One root only.

B8   Roots left in the form $\dfrac{p}{q}$

Slips (-1)

S1   Numerical errors to a max of 3.

Attempts (3 marks)

A1   Correct formula and stops.

A2   One correct substitution and stops.

A3   Oversimplification of formula.

Part (c) (ii)   **5 marks**   **Att2**

(ii)   Express $\dfrac{3x+2}{4} - \dfrac{x+4}{5}$ as a single fraction.

Give your answer in its simplest form.

Part (c) (ii)   **5 marks**   **Att2**

✍

$$\dfrac{3x+2}{4} - \dfrac{x+4}{5}$$

$$= \dfrac{5(3x+2)-4(x+4)}{20}$$

$$= \dfrac{15x+10-4x-16}{20}$$

$$= \dfrac{11x-6}{20} \qquad (5\,marks)$$

* $\dfrac{3x+2}{4} - \dfrac{x+4}{5} = \dfrac{2x+6}{9}$ *Zero marks.*

Blunders (-3)

B1   Correct answer without work. ✍

B2   Error(s) in distribution. e.g $5(3x+2) = 15x+2$.

B3   Mathematical error e.g. 10 -16 =6, -4(4) = 16.

B4   Incorrect common denominator and continues.

B5   Incorrect numerator from candidate's denominator e.g. $\dfrac{4(3x+2)-5(x+4)}{20}$.

B6   No simplification of numerator.

Slips (-1)

S1   Correct common denominator implied.

S2   Numerical error to a max of 3.

Attempts (2 marks)

A1   20 only or a multiple of 20 only appears.

Worthless (0)

W1 $\dfrac{5x}{4} - \dfrac{4x}{5}, or \left(\dfrac{3x+2}{4}\right)\left(\dfrac{x+4}{5}\right)$ and stops.

Part (c) (iii)   **5 marks**   **Att2**

(iii)   Verify your answer to part **(ii)** by letting $x = 6$.

Part (c) (iii)   **5 marks**   **Att2**

$$\frac{11x-6}{20}$$

$$=\frac{11(6)-6}{20}$$

$$=\frac{66-6}{20}$$

$$=\frac{60}{20}$$

$$=3$$

and

$$\frac{3(6)+2}{4} - \frac{(6)+4}{5}$$

$$= \frac{18+2}{4} - \frac{10}{5}$$

$$= \frac{20}{4} - \frac{10}{5}$$

$$= 5 \quad - \quad 2$$

$$= \quad\quad 3$$

*   Accept candidates answer from previous section. [May result in inequality].
*   Accept usage of a value other than 6 for verification.

Blunders (-3)

B1   Correct answer without work. ✍
B2   Substitutes into **one** expression only.
B3   Manipulation to force equality.

Slips (-1)
S1   Numerical errors to a max of 3.
S2   Conclusion missing if unequal.

Attempts (2marks)
A1   Writes answer from previous part in this section.
A2   Substitutes a value into one expression and stops.

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) (i)	**5 marks**	**Att 2**
(i) $f(x) = 2x - 1.$ Find: $f(4)$		

Part (a) (i)	**5 marks**	**Att2**
✍ **(i)**	$f(4) = 2(4) - 1$ $= 8 - 1$ $= 7$	

Blunders (-3)

B1   Correct answer without work. ✍

B2   Mathematical error. e.g. $(2)(4) = 24,$

Slips (-1)

S1   Numerical errors to a max of 3.

Misreadings (-1)

M1   Correctly substitutes in any number other than 4 and continues.

Attempts (2marks)

A1   Treats as equation and continues or stops.

Worthless (0)

W1   Ignores x giving $2 - 1 = 1.$

W2 $4[f(x)] = 8x - 4$

Part (a) (ii)	**5 marks**	**Att2**
(ii)	Find: $f(-5)$	

✍	**(ii)**	$f(-5) = 2(-5) - 1$
		$= -10 - 1$
		$= -11$

Blunders (-3)

B1 Correct answer without work. ✍[Do not penalise if already penalised in part (a) (i) or work is shown in part (a) (i).]

B2 Mathematical error.

Slips (-1)

S1 Numerical errors to a max of 3.

Misreadings (-1)

M1 Substitutes in any negative number other than -5 and continues.

Attempts (2marks)

A1 Treats as equation and continues or stops.

A2 Substitutes in any positive number other than 4.

Worthless (0)

W1 Ignores x giving $2 - 1 = 1$.

W2 $-5[f(x)] = -10x + 5$

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

Draw the graph of the function

$$f : x \rightarrow 1 + 4x - x^2$$

in the domain $-1 \le x \le 5$ where $x \in \mathbf{R}$.

Part (b) Table   **20 marks**   **Att7**

$f(-1)$	=	1	+	$4(-1)$	–	$(-1)^2$	=	**-4**
$f(0)$	=	1	+	$4(0)$	–	$(0)^2$	=	**1**
$f(1)$	=	1	+	$4(1)$	–	$(1)^2$	=	**4**
$f(2)$	=	1	+	$4(2)$	–	$(2)^2$	=	**5**
$f(3)$	=	1	+	$4(3)$	–	$(3)^2$	=	**4**
$f(4)$	=	1	+	$4(4)$	–	$(4)^2$	=	**1**
$f(5)$	=	1	+	$4(5)$	–	$(5)^2$	=	**-4**

or

x	-1	0	1	2	3	4	5
1	1	1	1	1	1	1	1
$4x$	-4	0	4	8	12	16	20
$-x^2$	-1	0	-1	-4	-9	-16	-25
$f(x)$	**-4**	**1**	**4**	**5**	**4**	**1**	**-4**

*   Error in each row or column attracts a maximum deduction of 3 marks.

Blunders (-3)

B1 $-x^2$ taken as x^2.
B2 $-x^2$ taken as $-2x$ all the way. [In row headed $-x^2$ by candidate]
B3 $+4x$ taken as $+4$ all the way. [In row headed $+4x$ by candidate]
B4   1 calculated as x all the way.[In row headed 1 by candidate]
B5   Adds in top row when evaluating $f(x)$.
B6   Omits '1' row or omits '$4x$' row.
B7   Omits a value in the domain.
B8   Each incorrect image without work.

Slips (-1)

S1   Numerical errors to a max of 3

Misreadings (-1)

M1   Misreads '$4x$' as '$-4x$' and places '$-4x$' in the table

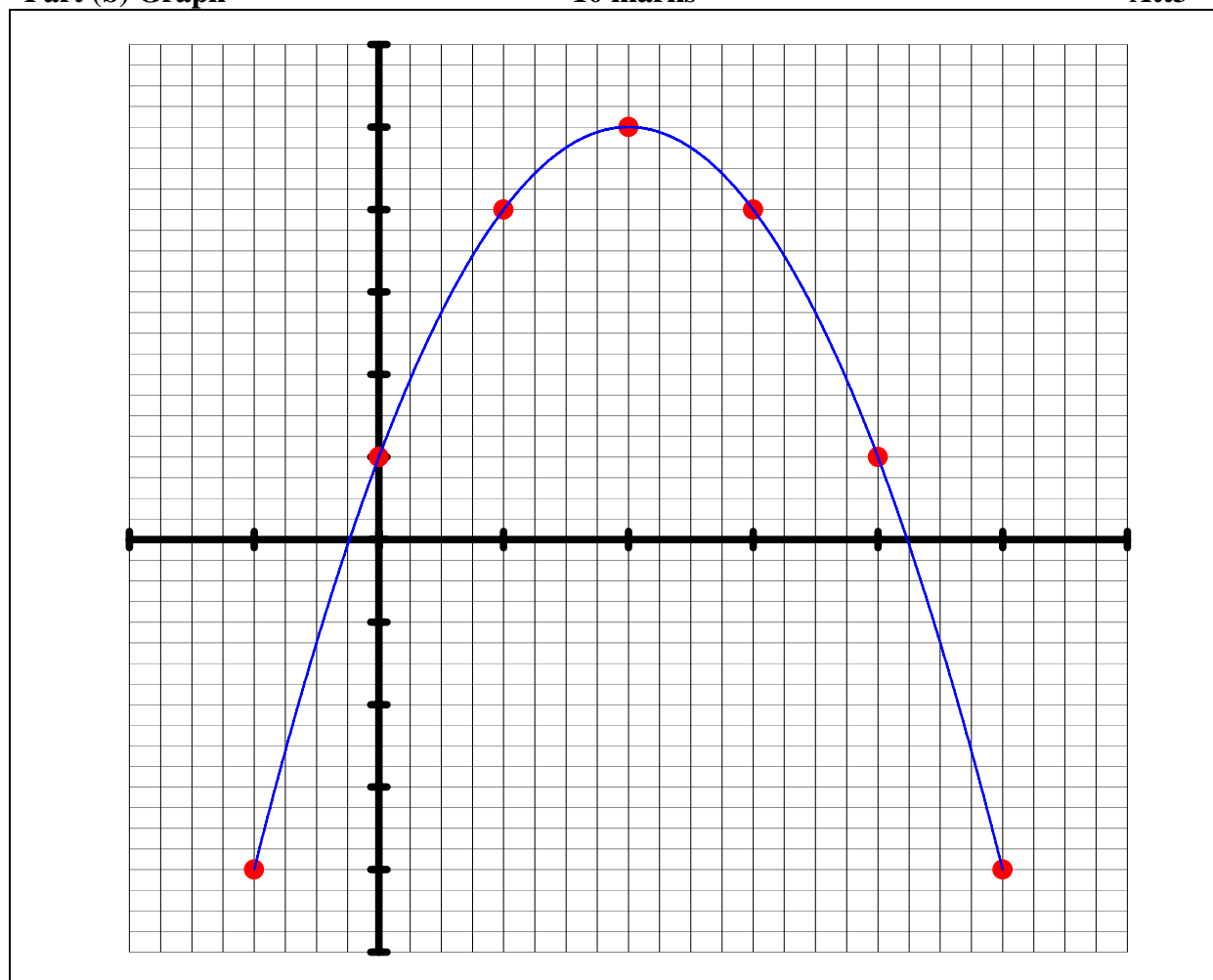M2   Misreads '$+1$' as '-1' and places '-1' in the table.

Attempts (7marks)

A1   Omits $-x^2$ row from table or treats $-x^2$ as $\pm x$.

A2   Table with only $f(x) = \pm\, x^2$

A3   Any effort at calculating point(s).

A4   Only one point calculated and stops.

*   Accept candidate's values from previous work.
*   Only **one** point **graphed correctly** $\Rightarrow$ Att **7** + Att **3**
*   **Correct graph but no table** $\Rightarrow$ full marks i.e. **30** marks.
*   Accept reversed co-ordinates if
    (i)   if axes not labelled or (ii) if axes are reversed to compensate (see B1 below)

Blunders (-3)
B1   Reversed co-ordinates plotted against non-reversed axes (once only) [See 4th * above].
B2   Scale error (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 [See 2nd * above].

Attempts (3 marks)
A1   Graduated axes (need not be labelled).

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

(i)   Draw the axis of symmetry of the graph drawn in **6 (b)** above.
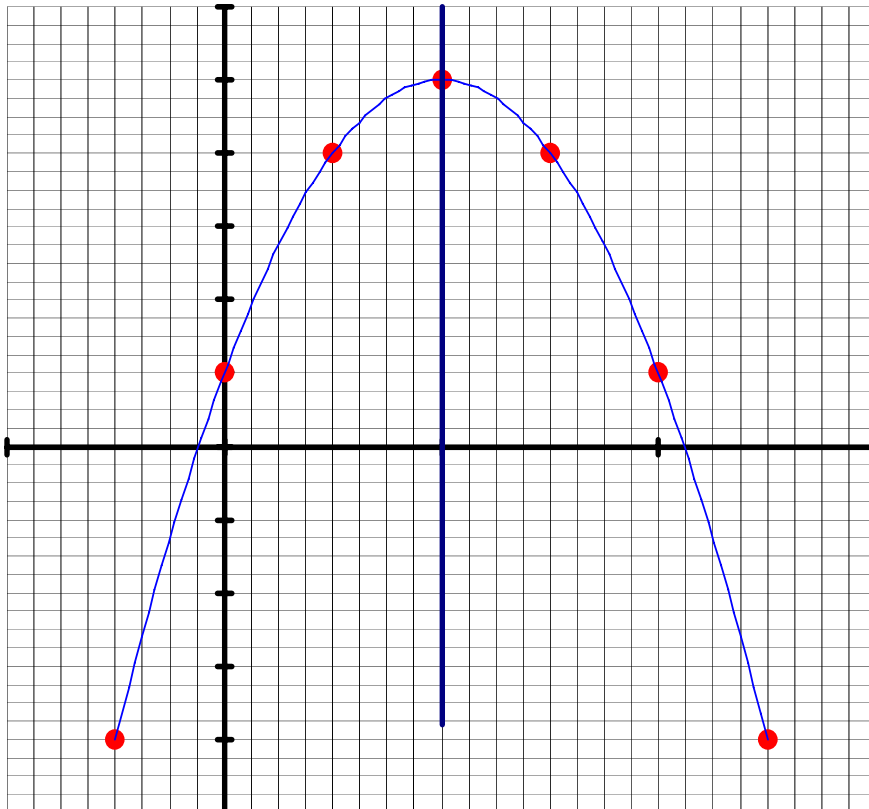
✍   Work to be shown on the graph.

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

*   Accept any vertical line (parallel to candidate's y-axis) within a tolerance of (± 0.25).
*   A candidate's incorrect graph may merit full marks for this section subject to the same tolerance)

Blunders (-3)
B1   Any vertical line (parallel to the candidate's y-axis) outside of tolerance.
B2   Marks $x=2$ on the x -axis and stops.
B3   States $x=2$ but no line is indicated on the graph.

Attempts (2marks)
A1   Any attempt at axial symmetry of $f(x)$.
A2   y -axis as the axis of symmetry (See B1)

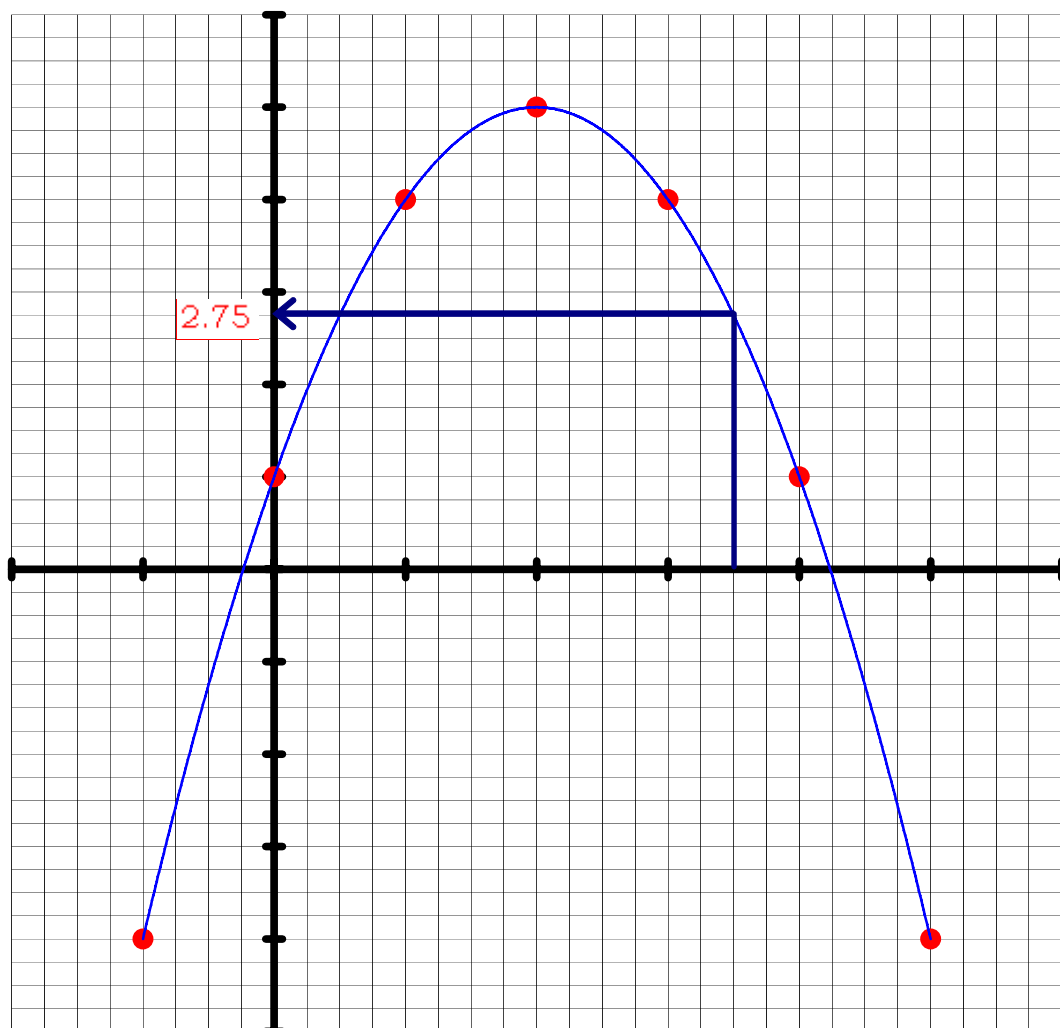**(ii)**   <u>Use the graph drawn in **6 (b)**</u> to estimate the value of $f(x)$ when $x = 3 \cdot 5$.

✍ Work to be shown on the graph and answer to be written here.

2.75

*   Correct answer (clearly consistent with graph) inside tolerance without graphical
       indication $\Rightarrow$ 2 marks.
*   A candidates incorrect graph can earn up to full marks for this section (see tolerance)

Blunders (-3)

B1   Correct answer without work. ✍

B2   Answer on diagram but outside of tolerance ($\pm 0 \cdot 25$).

B3   Fails to write down the answer.

Attempts (2 marks)

A1   Algebraic evaluation or calculator.

A2   Marks $3 \cdot 5$ in any way on either axis and stops.

Worthless (0)

W1   Answer outside of tolerance without graphical indication.

W2 $f(0)=1$ as answer.