Coimisiún na Scrúduithe Stáit
State Examinations Commission

JUNIOR CERTIFICATE EXAMINATION

2009

MARKING SCHEME

MATHEMATICS HIGHER LEVEL PAPER 1

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

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

In a school library, 28% of the books are classified as fiction and the remainder as non-fiction. There are 3240 non-fiction books in the library.

✍ Find the number of books which are classified as fiction.

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

Non-fiction = $100-28=72\%$

1% of Non-fiction books = $\frac{3240}{72}=45$

$\Rightarrow$ No. of books (fiction) = $45\times 28=1260$

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Mishandles % and continues. ($3240 \neq 72\%$)
B3 Decimal error.
B4 Fails to finish.

Slips (-1)

S1 Numerical errors to a max of 3.
S2 Rounds off incorrectly.

Attempts (3 marks)

A1 Works with 28% or similar and stops. ($28\% = \frac{28}{100}$)
A2 100-28 and stops.

Worthless (0)

W1 Incorrect answer and no work shown.
W2 28×3240 and stops.

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

(i) ✍ Given that $x = 2 \times 10^{-3}$ and $y = 7 \times 10^{-4}$, evaluate $x + 8y$.
Express your answer in the form $a \times 10^n$, where $n \in \mathbf{Z}$ and $1 \leq a < 10$.

(ii) A supermarket has a special offer on three different brands of packets of soap.
The following table gives details of the offer:

Brand	No. of bars per packet	Weight of each bar	Price of packet
A	3	100g	€1·35
B	6	100g	€2·40
C	4	125g	€2·38

✍ Which brand has the cheapest price per gram?

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

(i) ✍ Given that $x = 2 \times 10^{-3}$ and $y = 7 \times 10^{-4}$, evaluate $x + 8y$.
Express your answer in the form $a \times 10^n$, where $n \in \mathbf{Z}$ and $1 \leq a < 10$.

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

✍

I

$$x+8y = 2\times10^{-3} + 8\left(7\times10^{-4}\right)$$
$$= 2\times10^{-3} + 56\times10^{-4}$$
$$= 2\times10^{-3} + 5\cdot6\times10^{-3}$$
$$= 7.6\times10^{-3}$$

II

$$2\times10^{-3} = \frac{2}{1000} \;:\; 7\times10^{-4} = \frac{7}{10000}$$
$$\Rightarrow x+8y = \frac{2}{1000} + 8\left(\frac{7}{10000}\right) = \frac{2}{1000} + \frac{56}{10000} = \frac{76}{10000}$$
$$\Rightarrow \frac{76}{10000} = 0\cdot0076 = 7\cdot6\times10^{-3}$$

III

$$2\times10^{-3} = 0\cdot002 \;:\; 7\times10^{-4} = 0\cdot0007$$
$$\Rightarrow x+8y = 0\cdot002 + 8\left(0\cdot0007\right) = 0\cdot002 + 0\cdot0056 = 0\cdot0076$$
$$\Rightarrow\; 0\cdot0076 = 7\cdot6\times10^{-3}$$

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Index error.
B3 Fails to add.
B4 Distribution error.
B5 Mathematical error.
B6 Final answer in decimal or fraction format.
B7 Incorrect operation.

Slips (-1)

S1 Numerical errors to a max of 3.

S2 Index in wrong format e.g. 76×10^{-4}

Misreadings (-1)

M1 Reads as 2×10^{3} and 7×10^{4} and continues to $5\cdot62\times10^{5}$

Attempts (3 marks)

A1 56×10^{-4} or $0\cdot0056$ and stops.

A2 Some correct work with indices and stops, (e.g. $2\times10^{-3}=0\cdot002$)

Worthless (0)

W1 Incorrect answer and no work shown.

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

1 (b) (ii) A supermarket has a special offer on three different brands of packets of soap. The following table gives details of the offer:

Brand	No. of bars per packet	Weight of each bar	Price of packet
A	3	100g	€1·35
B	6	100g	€2·40
C	4	125g	€2·38

✍ Which brand has the cheapest price per gram?

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

✍

I					
Brand		gram/pkt	Price/gram		
A	3×100	300	$\frac{135}{300}$	$0\cdot45$	
B	6×100	600	$\frac{240}{600}$	$0\cdot40$	**B Cheapest**
C	4×125	500	$\frac{238}{500}$	$0\cdot476$	
II					
Brand		Price/bar	Price/gram		
A	$\frac{135}{3}$	45	$\frac{45}{100}$	$0\cdot45$	
B	$\frac{240}{6}$	40	$\frac{40}{100}$	$0\cdot40$	**B Cheapest**
C	$\frac{238}{4}$	$59\cdot5$	$\frac{59\cdot5}{125}$	$0\cdot476$	

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Incorrect multiplier.
B3 Decimal error.
B4 Incorrect division.
B5 Price /bar or gram / packet only and continues incurs **2 blunders.**
B6 Each missing component.

Slips (-1)

S1 Numerical errors to a max of 3.
S2 No conclusion or incorrect conclusion.

Misreadings (-1)

M1 Indicates most expensive

Attempts (3 marks)

A1 Indicates total grams in packet and stops.
A2 Works cost per packet and stops.
A3 One correct or partially correct step and stops.

Worthless (0)

W1 Incorrect answer and no work shown.

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

A man travels from Arklow to Blanchardstown, a distance of 90 km. He leaves Arklow at 09:25 and arrives in Blanchardstown at 10:55.

(i) ✍ Calculate his average speed for the journey.

He continues from Blanchardstown to Cootehill, a distance of 112 km. He increases his average speed by 4 km/h for this section of his journey.

(ii) ✍ At what time does he arrive in Cootehill?

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

1(c) A man travels from Arklow to Blanchardstown, a distance of 90 km. He leaves Arklow at 09:25 and arrives in Blanchardstown at 10:55.

✍ **(i)** Calculate his average speed for the journey.

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

✍ Time of journey = 10:55 - 09:25 = 1:30 = $1\cdot5$ hrs

Average Speed = $\frac{Dis\tan ce}{Time}$ = $\frac{90}{1\cdot5}$ = 60km/h or $\frac{90}{90}$ = $1km/\min$

Average speed for the journey = 60 km/h

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Time error. (1 hr = 100min.)
B3 Decimal error.
B4 Error in S/T/D formula.
B5 Mathematical error.

Slips (-1)

S1 Numerical errors to a max of 3.

Attempts (3 marks)

A1 Writes correct S/T/D relationship in this part.
A2 Time 1hr: 30min or $1\cdot5$ hrs and stops.

Worthless (0)

W1 Incorrect answer and no work shown.

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

1(c) He continues from Blanchardstown to Cootehill, a distance of 112 km. He increases his average speed by 4 km/h for this section of his journey.

✍ **(ii)** At what time does he arrive in Cootehill?.

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

✍ New speed = 64km/h.
Distance $B \rightarrow C$ = 112km.

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{112}{64} = 1 \cdot 75\,\text{h} = 1\text{hr: } 45\text{min}$$

$\Rightarrow$ Arrival Time in C = 10:55 + 1:45 = 12:40

Blunders (-3)

B1 Correct answer but no work shown (✍)
B2 Decimal error
B3 Error in S/T/D formula
B4 Conversion error ($0 \cdot 75\,hrs \neq 45\,\text{min}$) (km/hr added to km/min)
B5 Mathematical error
B6 Mishandles calculation of new speed
B7 Fails to calculate arrival time.

Slips (-1)

S1 Numerical errors to a max of 3
S2 Rounds off incorrectly

Attempts (3 marks)

A1 New speed correct and stops
A2 Writes correct S/T/D relationship in this part

Worthless (0)

W1 Incorrect answer and no work shown.

QUESTION 2

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

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

2(a) Eight workers can build a cabin in 60 hours.

✍ How many workers are needed if the cabin is to be built in 32 hours?

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

(a)

✍

I	**II**
$\frac{\text{Work hours to build a cabin}}{\text{Hours}} = \frac{8\times 60}{32} = 15$	$60 : 32 = x : 8$ $\frac{60}{32} = \frac{x}{8}$ $1\cdot 875 = \frac{x}{8}$ $x = 15$

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Incorrect Ratio.
B3 Mathematical error.
B4 Incorrect operation.

Slips (-1)

S1 Numerical errors to a max of 3
S2 Fails to round off correctly.

Attempts (3 marks)

A1 Writes 8×60 and stops.

A2 Writes $\frac{60}{32} or \frac{32}{60} or \frac{8}{32} or \frac{32}{8}$. and stops

Worthless (0)

W1 Incorrect answer and no work shown.

W2 Writes $\frac{60}{8} or \frac{8}{60}$ and stops.

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

A group of 49 students was asked which fruit each liked.
28 said they liked apples. 25 said they liked pears while 26 said they liked oranges.
8 said they liked all three types of fruit.
17 said they liked pears and oranges. 11 said they liked apples and oranges.
5 said they did not like any of the three types of fruit.
Let *x* represent those students who liked apples and pears but not oranges.

(i) ✍ Represent the above information on a Venn diagram.

(ii) ✍ Calculate the value of *x*.

(iii) ✍ Calculate the percentage of students who liked one type of fruit only.
Give your answer correct to the nearest whole number.

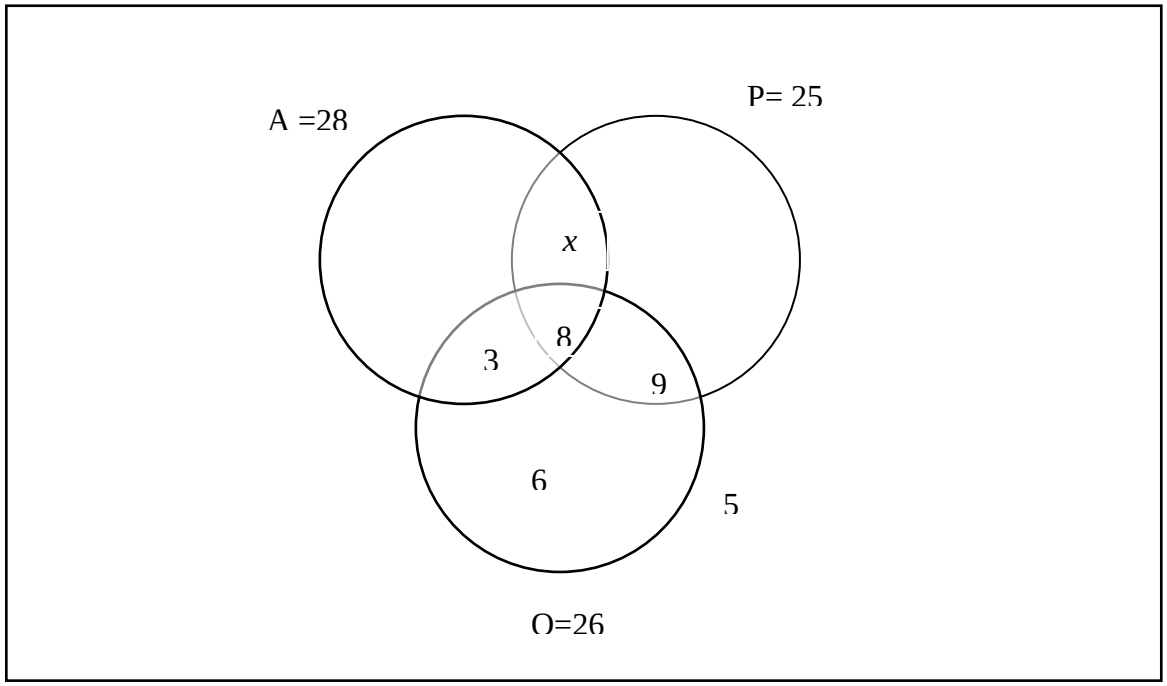
(b) (i) **10 marks** **Att 3**

2 (b) (i) ✍ Represent the above information on a Venn diagram.

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

✍

U = 49



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

Attempts (3 marks)
A1 Any single correct entry.
A2 Draws a Venn diagram of 3 intersecting circles and stops.

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

2 (b) (ii) ✍ Calculate the value of x.

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

✍
$28-(11+x)+x+8+3+25-(17+x)+9+6=49-5$
$28-11-x+x+8+3+25-17-x+9+6=44$
$17-x+x+8+3+8-x+9+6=44$
$51-x=44$
$x=51-44$
$x=7$

* Accept candidate's work from previous part.

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Missing or incorrect element from previous work in forming equation.
B3 Transposition error.
B4 Distribution error.
B5 Mathematical error.
B6 $\#U \neq 49$.

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

Attempts (2 marks)
A1 Any correct term in forming the equation and stops.
A2 Any effort to combine terms from Venn diagram.

Worthless (0)
W1 Incorrect answer and no work shown.

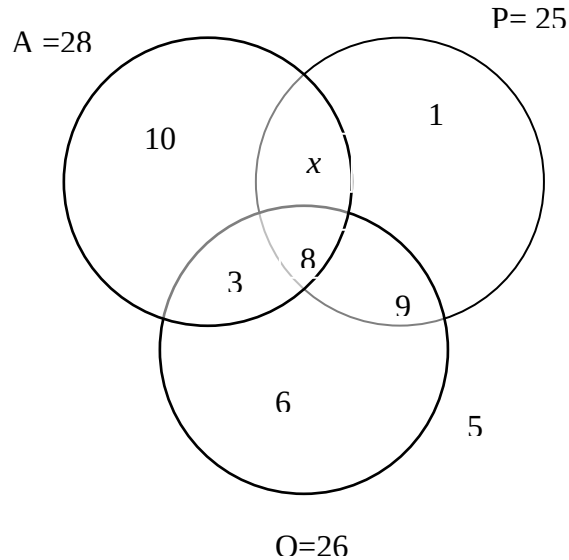
Part (b) (iii) **5 marks** **Att 2**

2 (b) (iii) ✍ Calculate the percentage of students who liked one type of fruit only. Give your answer correct to the nearest whole number.

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

✍ **I**

U = 49



Total who liked one type of fruit only = 10 + 1 + 6 = 17.

$\% \ \frac{17}{49} \times 100 = 34 \cdot 7 = 35\%$

II

Total who liked one type of fruit only = $6 + (8 - x) + (17 - x)$

$\Rightarrow \ 31 - 2x \ = \ 31 - 2(7) = 31 - 14 = 17$

$\% \ \frac{17}{49} \times 100 = 34 \cdot 7 = 35\%$

* Accept candidate's work from previous part.

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Missing or incorrect element from previous work.
B3 Decimal error
B4 Distribution error.
B5 Mathematical error.
B6 Fails to find %.
B7 $\#U \neq 49$

Slips (-1)

S1 Numerical errors to a max of 3.
S2 Fails to round off or rounds incorrectly.

Misreadings (-1)

M1 Finds % who liked two fruits.

Attempts (2 marks)

A1 Any correct value/term and stops.

Worthless (0)

W1 Incorrect answer and no work shown.

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

Three business partners, Aideen, Brian and Caroline, invest €30 000, €40 000 and €70 000 respectively. At the end of each year, 22·5 % of the profit made is placed in reserve and the remainder is divided among the partners in proportion to their investments.

(i) ✍ Given that in 2007, the profit amounted to €12 880, calculate the amount placed in reserve.

(ii) ✍ In 2008, Caroline's portion of the profit was €9331. Calculate how much Aideen and Brian each received in 2008.

(iii) ✍ Calculate the amount placed in reserve in 2008.

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

2 (c) (i) ✍ Given that in 2007, the profit amounted to €12 880, calculate the amount placed in reserve.

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

✍

I	II	III
$\frac{12880}{100} \times 22 \cdot 5 = €2898$	$12880 \times 0 \cdot 225 = €2898$	$22 \cdot 5 = \frac{9}{40}$ $12880 \times \frac{9}{40} = €2898$

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Mathematical error.
B3 Incorrect operation.
B4 Expresses $22 \cdot 5\%$ as incorrect fraction and continues.
B5 Profit taken as $77 \cdot 5\%$ and continues.

Slips (-1)

S1 Numerical errors to a max of 3.
S2 Rounds to 23% and continues. ($€2962 \cdot 40$)

Attempts (2 marks)

A1 Writes $77 \cdot 5\%$ and stops.
A2 $22 \cdot 5\%$ as $\frac{22 \cdot 5}{100}$ or similar and stops.
A3 Finds $22 \cdot 5\%$ of any of the given values.
A4 Leaves answer as $€12880 \times 22 \cdot 5\%$

Worthless (0)

W1 Incorrect answer and no work shown.
W2 2007×12880 or similar and stops.

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

2 (c)(ii) ✍ In 2008, Caroline's portion of the profit was €9331. Calculate how much Aideen and Brian each received in 2008.

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

✍

I	II	III
Ratios : $\frac{3}{14}:\frac{4}{14}:\frac{7}{14}$ C = €9331 $\Rightarrow$ Profit for distribution $=9331\times 2$ = €18662 A = $18662\times\frac{3}{14}=€3999$ B = $18662\times\frac{4}{14}=€5332$	C = €9331 $\frac{9331}{7000}=1\cdot 333$ A = $1\cdot 333\times 3000=€3999$ B = $1\cdot 333\times 4000=€5332$	C = €9331 A: B: C = 3:4:7 (or similar). $\frac{9331}{7}=1333$ A = $1333\times 3=€3999$ B = $1333\times 4=€5332$

* Candidates may work with other correct ratios or correct percentages.

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Mathematical error.
B3 Incorrect denominator. [Note M1]
B4 Incorrect numerator. [Note M1]
B5 Finds Aideen's or Brian's value only.
B6 Premature rounding that effects the answer i.e. ($1\cdot 333$ to 1) and continues correctly.

Slips (-1)

S1 Numerical errors to a max of 3.
S2 Rounds off incorrectly.

Misreadings (-1)

M1 Reads Caroline as Aideen or Brian and continues.

Attempts (3 marks)

A1 Some correct work at simplifying ratios.
A2 Writes $\frac{9331}{7000}$ or similar and stops.

Worthless (0)

W1 Incorrect answer and no work shown.

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

2 (c) (iii) ✍ Calculate the amount placed in reserve in 2008.

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

✍

Distributed Profit (2008)
= €9331 + €5332+ €3999 = €18 662 or €9331 $\times 2$ = € 18 662 (or similar)

I	**II**
€ 18 662 = $77 \cdot 5\%$ $\Rightarrow$ Reserve = $18\,662 \times \frac{22 \cdot 5}{77 \cdot 5}\left(\frac{9}{31}\right)$ = €5418	Total Profit = $\frac{18\,662}{77 \cdot 5} \times 100$ = €24 080 Reserve = €24 080 - €18 662 = €5418

* Accept candidate's answers from part (ii).

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Mathematical error.
B3 Incorrect distributed profit.
B4 Incorrect ratio
B5 Decimal error

Slips (-1)

S1 Numerical errors to a max of 3.
S2 Incorrect rounding or early rounding which affects answer.

Misreadings (-1)

M1 Reads € 18 662 as 100% i.e. Finds $22 \cdot 5\%$ of € 18 662 (€$4198 \cdot 95$) and continues.

Attempts (2 marks)

A1 Some correct work at finding total profit.
A2 States € 18 662 = $77 \cdot 5\%$ or similar and stops.
A3 Writes $100 - 22 \cdot 5 = 77 \cdot 5$ and stops.

Worthless (0)

W1 Incorrect answer and no work shown.

QUESTION 3

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

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

✍ Simplify:

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

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

✍ $(2x-3)(4-5x)$

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

$8x-10x^2-12+15x$

$-10x^2+23x-12$

Blunders (-3)

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

Slips (-1)

S1 Numerical errors to a max of 3.

Attempts (3 marks)

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

Worthless (0)

W1 Incorrect answer and no work shown.

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

(i) ✍ Given that $x = 2t - 1$ and $y = \frac{2}{3}t + 2$, express $3x - y + 2$ in terms of t, in its simplest form.

(ii) ✍ Hence, find the value of t when $3x - y + 2 = 0$.

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

3(b) (i) ✍ Given that $x = 2t - 1$ and $y = \frac{2}{3}t + 2$, express $3x - y + 2$ in terms of t, in its simplest form.

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

$$3x - y + 2$$

$$3(2t-1) - \left(\frac{2}{3}t + 2\right) + 2$$

$$6t - 3 - \frac{2}{3}t - 2 + 2$$

$$\frac{16}{3}t - 3 \text{ or } 5\frac{1}{3}t - 3 \text{ or } \frac{16t-9}{3}$$

Blunders (-3)

B1 Correct answer but no work shown (✍)
B2 Mathematical error
B3 Distribution error
B4 Fails to group or groups incorrectly
B5 Incorrect substitution for x and /or y and continues
B6 Ignores the constant in the expression and continues. [see A3]
B7 Eliminates t. Answer as ($x - 3y + 7 = 0$) (Apply B5 also.)
B8 Answer not in simplest form
B9 Mishandles fractions

Slips (-1)

S1 Numerical errors to a max of 3

Attempts (3 marks)

A1 Some correct relevant work
A2 Partial substitution and stops
A3 Ignores all the constants in each equation to give. [$3(2t) - \frac{2}{3}t$] and stops or continues

Worthless (0)

W1 Incorrect answer and no work shown

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

3(b) (ii) ✍ Hence, find the value of t when $3x - y + 2 = 0$.

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

✍

$$3x - y + 2 = 0$$

$$\frac{16}{3}t - 3 = 0$$

$$16t - 9 = 0$$

$$t = \frac{9}{16}(0 \cdot 5625)$$

* Accept candidate's answer from previous part.

* Solving $3x - y + 2 = 0$ and $x - 3y + 7 = 0$ $(\frac{1}{8}, \frac{19}{8})$ followed by substitution gives correct answer (see B7 previous part).

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Mathematical error.
B3 Transposition error.

Slips (-1)

S1 Numerical errors to a max of 3.

Attempts (3 marks)

A1 Some correct relevant work.

Worthless (0)

W1 Incorrect answer and no work shown.

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

A swimming pool can be filled by a large pipe operating alone in 4 hours.

(i) What fraction of the pool can be filled by this pipe in 1 hour?

The swimming pool can be filled by a small pipe operating alone in x hours.

(ii) ✍ Derive an expression in x for the fraction of the pool filled by the two pipes working together in 1 hour.

It takes 3 hours for the two pipes working together to fill the pool.

(iii) ✍ Find x.

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

3(c) (i) A swimming pool can be filled by a large pipe operating alone in 4 hours.
What fraction of the pool can be filled by this pipe in 1 hour?

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

Fraction of the pool = $\frac{1}{4}$

Blunders (-3)

B1 Any variable divided by 4.

B2 15 minutes or 900 seconds.

Slips (-1)

S1 Numerical errors to a max of 3.

Misreadings (-1)

M1 Not in required form (e.g. decimal or percentage).

M2 $\frac{3}{4}$.

Attempts (3 marks)

A1 Some correct relevant work.

Worthless (0)

W1 Incorrect answer and no work shown.e.g (4)

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

The swimming pool can be filled by a small pipe operating alone in x hours.

3(c) (ii) ✍ Derive an expression in x for the fraction of the pool filled by the two pipes working together in 1 hour.

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

✍

I

Large pipe delivers $\frac{1}{4}$ of Volume /hour.

Small pipe delivers $\frac{1}{x}$ of Volume/ hour.

Together they deliver $\frac{1}{4}+\frac{1}{x}$ of Volume /hour

II

L.C.M of 4 and x is $4x$.

In $4x$ hours the Large Pipe will fill the pool x times

In $4x$ hours the Small Pipe will fill the pool 4 times

In $4x$ hours Both Pipes will fill the pool $x+4$ times

In 1 hour Both Pipes will fill $\frac{x+4}{4x}$ of the pool.

* Accept candidate's answer from previous part.

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Error in forming the expression.
B3 Mathematical error.

Slips (-1)

S1 Numerical errors to a max of 3.

Attempts (2 marks)

A1 Some correct relevant work.

Worthless (0)

W1 Incorrect answer and no work shown.

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

3(c) (iii) ✍ It takes 3 hours for the two pipes working together to fill the pool. Find x.

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

✍

I	II	III
$3\left(\frac{1}{4}+\frac{1}{x}\right) = 1$ $\Rightarrow \frac{3}{4}+\frac{3}{x}=1$ $\Rightarrow \frac{3}{x} = \frac{1}{4}$ $\Rightarrow x = 12$	$\frac{1}{4}+\frac{1}{x} = \frac{1}{3}$ $\Rightarrow \frac{x+4}{4x} = \frac{1}{3}$ $\Rightarrow 3x+12 = 4x$ $\Rightarrow x = 12$	3 hours large pipe $\rightarrow \frac{3}{4}$ of pool 3 hours small pipe $\rightarrow \frac{1}{4}$ of pool $\Rightarrow \frac{1}{4}$ pool in 3 hours $\Rightarrow 1$ pool in 12 hours

* Accept candidate's answer from previous part unless oversimplifying applies.
* Accept $4\times3=12$

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Mathematical error.
B3 Transposition error.
B4 Error in setting up equation.
B5 Mishandles fractions
B6 Mishandles common denominator.

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

Attempts (2 marks)
A1 Some correct relevant work.

Worthless (0)
W1 Incorrect answer and no work shown.

QUESTION 4

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

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

✍ Given that $y = \sqrt{2x - a}$,
find the value of y when $x = 4$ and $a = -1$.

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

✍

I	**II**
$y = \sqrt{2x - a}$ $y = \sqrt{2(4) - (-1)}$ $y = \sqrt{8 + 1}$ $y = \sqrt{9}$ $y = 3$	$y^2 = 2x - a$ $y^2 = 2(4) - (-1)$ $y^2 = 9$ $y = \pm 3$

* Accept $y = \pm 3$

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Mathematical error.
B3 Mishandles square root.
B4 Incorrect operation.
B5 Substitutes into the expression and stops.
B6 Incorrect substitution ($x = -1; a = 4$ or $y = \sqrt{2a - x}$). May incur B3

Slips (-1)

S1 Numerical errors to a max of 3.

Misreadings (-1)

M1 Arbitrary substitution with value of a negative.

M2 Misreads coefficient of x .

Attempts (3 marks)

A1 Partial substitution and stops.
A2 Squares both sides and stops.

Worthless (0)

W1 Incorrect answer and no work shown.

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

(i) ✍ Graph on the number line the solution set of

$-3 < 4x + 7 \leq 23,\ x \in \mathbf{R}$.

(ii) ✍ Solve the following simultaneous equations:

$x = -\frac{1}{2}y + 36$

$y = 2x + 12$.

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

4(b) (i) ✍ Graph on the number line the solution set of

$-3 < 4x + 7 \leq 23,\ x \in \mathbf{R}$.

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

✍ I	II
$-3<4x+7\leq 23$	$-3<4x+7\leq 23$
$-3<4x+7$ *and* $4x+7\leq 23$	$-3-7<4x\leq 23-7$
$-10<4x$ *and* $4x\leq 23-7$	$-10<4x\leq 16$
$-\frac{10}{4}<x$ *and* $x\leq\frac{16}{4}$	$-\frac{10}{4}<x\leq\frac{16}{4}$
$-2\cdot 5<x$ *and* $x\leq 4$	$-2\cdot 5<x\ \leq 4$

Blunders (-3)

B1 Correct answer but no work shown (✍)
B2 Mathematical error
B3 Mishandles inequality
B4 Transposition error
B5 Fails to graph on number line or graphs incorrectly.e.g[$x \in Z$]
B6 Ignores the negative value in the original inequality and continues
B7 Solves one inequality in method I (B5 may apply)

Slips (-1)

S1 Numerical errors to a max of 3
S2 Includes the point -2.5 on the number line
S3 Excludes the point 4 on the number line

Misreadings (-1)

M1 Reverses one or both inequality signs

Attempts (3 marks)

A1 Tests any value in the inequality and stops
A2 Draws a number line and stops

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

4(b) (ii) ✍ Solve the following simultaneous equations:

$$x = -\frac{1}{2}y + 36$$

$$y = 2x + 12.$$

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

✍

I

$$x + \frac{1}{2}y = 36$$

$$\underline{2x - y = -12}$$

$$2x + y = 72$$

$$\underline{2x - y = -12}$$

$$4x = 60$$

$$x = \frac{60}{4}$$

$$x = 15$$

$$\Rightarrow y = 2x + 12$$

$$y = 2(15) + 12$$

$$y = 30 + 12 = 42$$

II

$$x + \frac{1}{2}y = 36$$

$$\underline{2x - y = -12}$$

$$-2x - y = -72$$

$$\underline{2x - y = -12}$$

$$-2y = -84$$

$$y = \frac{-84}{-2} = 42$$

$$\Rightarrow x = -\frac{1}{2}(42) + 36$$

$$x = -21 + 36$$

$$x = 15$$

III

$$x = -\frac{1}{2}y + 36 \quad y = 2x + 12$$

$$y = 2(-\frac{1}{2}y + 36) + 12$$

$$y = -y + 72 + 12$$

$$2y = 84$$

$$y = 42$$

$$\Rightarrow x = -\frac{1}{2}(42) + 36$$

$$x = -21 + 36$$

$$x = 15$$

IV

$$x = -\frac{1}{2}y + 36 \quad y = 2x + 12$$

$$x = -\frac{1}{2}(2x + 12) + 36$$

$$x = -x - 6 + 36$$

$$2x = 30$$

$$x = 15$$

$$\Rightarrow y = 2x + 12$$

$$y = 2(15) + 12$$

$$y = 30 + 12 = 42$$

* 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.

* Finding the second variable is subject to a maximum deduction of (3).

* Correct values without algebraic work **both verified** in both equations merits **10 marks**

* Correct values without algebraic work *not verified* merits attempt *3 marks*

Blunders (-3)

B1 Error(s) in establishing the first equation in terms of x only [$4x = 60$] or the first equation in terms of y only [$-2y = -84$] through elimination by cancellation**[I,II]**
B2 Error(s) in establishing the first equation in terms of x only [$2x = 30$] or the first equation in terms of y only [$2x = 30$] through elimination by substitution**[III,IV]**
B3 Transposition errors in solving the first one variable equation
B4 Transposition errors when finding the second variable
B5 Incorrect substitution when finding second variable
B6 Finds one variable only
B7 Distribution error
B8 Mathematical error

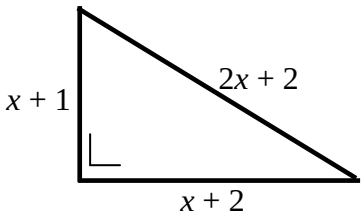
Slips (-1)
S1 Numerical errors to a max of 3

Attempts (3 marks)
A1 Any correct manipulation of either given equation and stops
A2 Some correct partial substitution and stops

Worthless (0)
W1 Incorrect answer and no work shown
W2 Trial and error

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

The lengths of the sides of a right-angled triangle are as shown in the diagram.



(i) Using the theorem of Pythagoras, write an equation in x.

(ii) ✍ Solve this equation to find x correct to 2 decimal places.

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

4 (c) (i) Using the theorem of Pythagoras, write an equation in x.

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

$$(x + 1)^2 + (x + 2)^2 = (2x + 2)^2$$

Blunders (-3)

B1 Incorrect Pythagoras e.g. $2x + 2$ not used as hypotenuse.

B2 Omits any or all of the squares from the equation.

B3 Uses an incorrect operation.

Attempts (3 marks)

A1 Writes Pythagoras theorem without reference to the triangle.

A2 Uses a value of x to write a special case.

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

4 (c) (ii) **(ii)** ✍ Solve this equation to find x correct to 2 decimal places.

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

✍

5 marks **Att 2**	**5 marks** **Att 2**
Establishing quadratic equation	**Solving quadratic equation**
$(2x+2)^2 = (x+1)^2 + (x+2)^2$ $4x^2+8x+4 = x^2+2x+1+x^2+4x+4$ $2x^2+2x-1=0$	$\frac{-(2)\pm\sqrt{(2)^2-4(2)(-1)}}{2(2)}$ $\frac{-(2)\pm\sqrt{4+8}}{4} = \frac{-(2)\pm\sqrt{12}}{4} = \frac{-2\pm3\cdot464101615}{4}$ $= \frac{-2+3\cdot464101615}{4}$ *and* $\frac{-2-3\cdot464101615}{4}$ $= \frac{1\cdot464101615}{4}$ *and* $\frac{-5.464101615}{4}$ $= 0\cdot3660254038$ *and* $-1\cdot366025404$ $= \underline{0\cdot37}$ *and* $\underline{-1\cdot37}$

* Accept candidate's work from previous part.
* No penalty for not eliminating invalid solution.

Blunders (-3)

B1 Correct answer but no work shown (✍)
B2 Error in squaring
B3 Fails to group or groups incorrectly
B4 Combines unlike terms and continues e.g. $8x+4=12$
B5 Error transposition
B6 Error in quadratic formula
B7 Error in the application of the quadratic formula
B8 Finds only one solution
B9 Decimal error
B10 Mathematical error
B11 Stops at $\frac{-2\pm\sqrt{12}}{4}$

Slips (-1)

S1 Numerical errors to a max of 3
S2 Fails to round off or rounds incorrectly

Attempts (2 marks)

A1 Any correct multiplication and stops.
A2 Simplifies to a linear equation may merit Att 2 marks at most.
A3 Solves a linear equation correctly for a single value may merit Att 2 marks at most.
A4 Writes correct quadratic formula and stops.

Worthless (0)

W1 Incorrect answer and no work shown.

QUESTION 5

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

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

5(a) ✍ Given that $f(x) = 5x - 12$ and that $f(a) = a$, find the value of a.

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

✍

$$f(x) = 5x - 12$$
$$f(a) = a$$
$$\Rightarrow \quad 5a - 12 = a$$
$$4a = 12$$
$$a = \frac{12}{4}$$
$$a = 3$$

Blunders (-3)

B1 Correct answer but no work shown. (✍)
B2 Incorrect substitution.
B3 Transposition error.
B4 Mishandles fraction.

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

Attempts (3 marks)
A1 Some correct substitution and stops.
A2 $f(a) = 5a - 12$ and stops.

Worthless (0)
W1 Incorrect answer and no work shown.

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

(i) Let f be the function $f : x \to 5x - 4$ and g be the function $g : x \to 3x + 1$.

✍ Using the same axes and scales, draw the graph of f and the graph of g, for $0 \le x \le 3$, $x \in \mathbf{R}$.

(ii) From your graphs, write down the co-ordinates of the point of intersection of the two lines.

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

5(b)(i) Let f be the function $f : x \to 5x - 4$ and g be the function $g : x \to 3x + 1$.

✍ Using the same axes and scales, draw the graph of f and the graph of g, for $0 \le x \le 3$, $x \in \mathbf{R}$.

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

✍

* **Line/s incorrect examine work and mark accordingly.**

* **Both graphs correct** ⇒ **Full Marks (15 marks)**

* **One graph correct** but no table **merits 9 marks**[B4 + B7]

* Only two points needed for each function but the graph must include the domain.

* Accept reversed co-ordinates if (i) axes are not labelled or (ii) if axes are reversed to compensate.

* Tolerance = ± 1Box on scale.

					I					
$f(x)=5x-4$ $f(0)=5(0)-4=0-4=-4\rightarrow(0,-4)$ $f(1)=5(1)-4=5-4=1\rightarrow(1,1)$ $f(2)=5(2)-4=10-4=6\rightarrow(2,6)$ $f(3)=5(3)-4=15-4=11\rightarrow(3,11)$						$g(x)=3x+1$ $g(0)=3(0)+1=0+1=1\rightarrow(0,1)$ $g(1)=3(1)+1=3+1=4\rightarrow(1,4)$ $g(2)=3(2)+1=6+1=7\rightarrow(2,7)$ $g(3)=3(3)+1=9+1=10\rightarrow(3,10)$				
					II					
x	0	1	2	3		x	0	1	2	3
$5x$	0	5	10	15		$3x$	0	3	6	9
-4	-4	-4	-4	-4		+1	+1	+1	+1	+1
$f(x)$	-4	1	6	11		$g(x)$	1	4	7	10
Points	$(0,-4)$	$(1,1)$	$(2,6)$	$(3,11)$		Points	$(0,1)$	$(1,4)$	$(2,7)$	$(3,10)$

* Error(s) in each row/column attract a maximum deduction of 3.
* Tolerance = $\pm$ 1Box on scale.

Blunders (-3)

B1 Each incorrect or missing point on the graph to maximum of two per line
B2 Adds in x row when evaluating $f(x)$ or $g(x)$ (once if consistent.)
B3 Mathematical errors in calculation (once if consistent)
B4 Points not joined or joined incorrectly once for each line
B5 (x, y) plotted as (y, x)or Axes reversed (once only)
B6 Scale error (once only)
B7 Error in plotting points from candidates table/values (once per function) [*Tolerance]
B8 Lines not extended to include full domain (once only)

Misreadings (-1)

M1 Uses separate graphs for $f(x)$ and $g(x)$

Attempts (5 marks)

A1 Correct or partially correct tables/values but no graph drawn
A2 Correctly scaled axis drawn

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

5 (b) (ii) From your graphs, write down the co-ordinates of the point of intersection of the two lines.

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

Point of intersection: $(2.5, 8.5)$

* Accept candidates work from previous part.

* Tolerance = $\pm$ 1Box on scale.

Blunders (-3)

B1 (x, y) read as (y, x)

B2 Indicates point on graph but (x, y) not stated.

B3 Finds the *x* or *y* value only.

Slips (-1)

S1 Co-ordinates of point outside tolerance.

Attempts (2 marks)

A1 Scaled axis drawn for this part.

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

5(c)

Let f be the function $f: x \to 2x^2 + x - 15$.

(i) ✍ Draw the graph of f for $-4 \le x \le 3$, $x \in \mathbf{R}$.

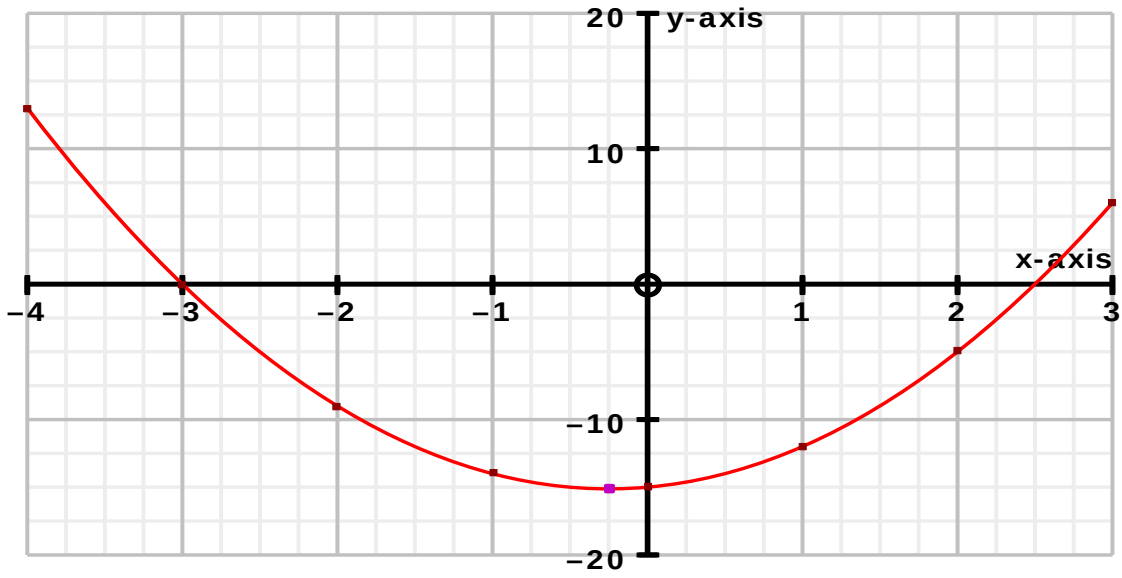
(ii) ✍ Use your graph to find the minimum value of $f(x)$.

(iii) ✍ Use your graph to find the range of values of x for which $f(x) \ge 0$.

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

5 (c) (i) ✍ Draw the graph of f for $-4 \le x \le 3$, $x \in \mathbf{R}$.

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



* **<u>Correct graph</u>** ⇒ Full Marks **<u>(10 marks)</u>**

* Accept reversed co-ordinates if
(i) axes are not labelled or (ii) if axes are reversed to compensate.

* Graph incorrect examine work and mark accordingly.

* Tolerance = ± 1Box on scale.

I
$f(x) = 2x^2 + x - 15$
$f(-4) = 2(-4)^2 + (-4) - 15 = 2(16) - 4 - 15 = 32 - 19 = 13 \rightarrow (-4,13)$
$f(-3) = 2(-3)^2 + (-3) - 15 = 2(9) - 3 - 15 = 18 - 18 = 0 \rightarrow (-3,0)$
$f(-2) = 2(-2)^2 + (-2) - 15 = 2(4) - 2 - 15 = 8 - 17 = -9 \rightarrow (-2,-9)$
$f(-1) = 2(-1)^2 + (-1) - 15 = 2(1) - 1 - 15 = 2 - 16 = -14 \rightarrow (-1,-14)$
$f(0) = 2(0)^2 + (0) - 15 = (0) - 0 - 15 = 0 - 15 = -15 \rightarrow (0,-15)$
$f(1) = 2(1)^2 + (1) - 15 = 2(1) + 1 - 15 = 2 + 1 - 15 = 3 - 15 = -12 \rightarrow (1,-12)$
$f(2) = 2(2)^2 + (2) - 15 = 2(4) + 2 - 15 = 8 + 2 - 15 = 10 - 15 = -5 \rightarrow (2,-5)$
$f(3) = 2(3)^2 + (3) - 15 = 2(9) + 3 - 15 = 18 + 3 - 15 = 21 - 15 = 6 \rightarrow (3,6)$

II

x	-4	-3	-2	-1	0	1	2	3
$2(x)^2$	32	18	8	2	0	2	8	18
$+x$	-4	-3	-2	-1	0	1	2	3
-15	-15	-15	-15	-15	-15	-15	-15	-15
$f(x)$	13	0	-9	-14	-15	-12	-5	6
Points	$(-4,13)$	$(-3,0)$	$(-2.-9)$	$(-1,-14)$	$(0,-15)$	$(1,-12)$	$(2,-5)$	$(3,6)$

* Error(s) in each row/column attract a maximum deduction of 3.

* Accept candidate's values from table when plotting graph.

Blunders (-3)

B1 Each incorrect point without work [S1 may apply]

B2 Each missing point

B3 Adds in domain row when evaluating $f(x)$ (once if consistent)

B4 Omits "x" row

B5 Omits "-15" row

B6 Mathematical errors in calculation (once if consistent)

B7 Reversed co-ordinates plotted against non reversed axes or similar (once only)

B8 Scale error (once only)

B9 Points not joined to form curve or joined in incorrect order (once only)

B10 Graph not extended to include full domain (once only).

Slips (-1)

S1 Each incorrect point plotted [Tolerance $\pm$ 1Box on scale]

S2 Numerical errors to a max of 3

Misreadings (-1)

M1 "$2(x)^2$"taken as"$(2x)^2$"all the way.[In row headed $2(x)^2$ by the candidate]

M2 "x"taken as"$-x$"all the way [In row headed x by the candidate]

M3 "-15" taken as"15"all the way [In row headed -15 by the candidate]

Attempts (3 marks)

A1 Correct or partially correct tables/values but no graph drawn

A2 Scaled axis drawn for this part.

A3 Omits "$2(x)^2$"row from table or treats "$2(x)^2$" as $\pm 2x$ or similar

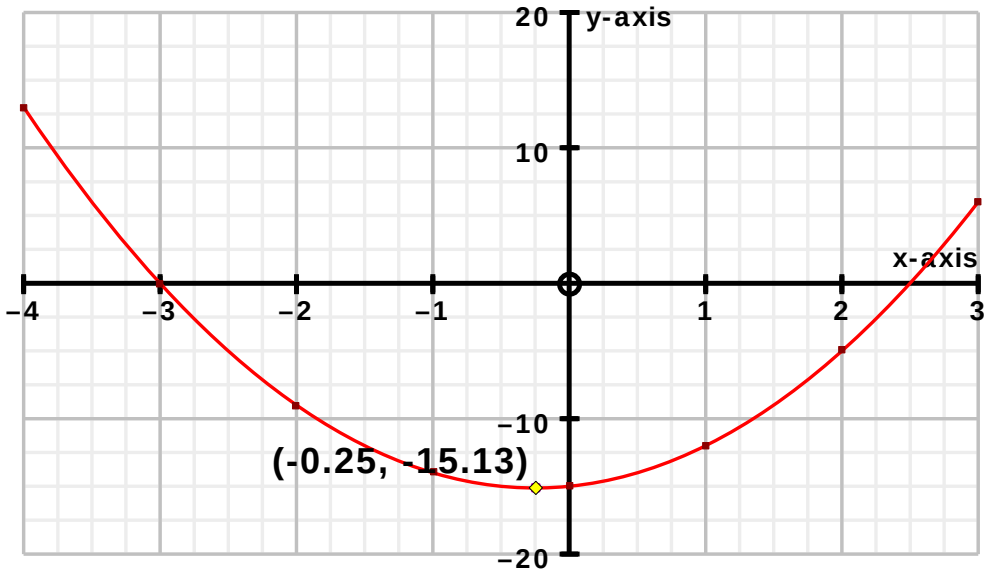
A4 Some effort to plot a point

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

5 (c) (ii) ✍ Use your graph to find the minimum value of $f(x)$.

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

(ii) Minimum value of $f(x)$: = -15·1 [indicated on graph]



* Accept answer consistent with candidate's curve [Tolerance = ± 1Box on scale]

Blunders (-3)

B1 Correct answer but no work shown (✍)
B2 Minimum indicated on graph but no value given or value outside tolerance
B3 States x co-ordinate of minimum point

Slips (-1)

S1 Identifies x *and* y co-ordinates of minimum only

Attempts (2 marks)

A1 Reads minimum from table.

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

5 (c) (iii) ✍ Use your graph to find the range of values of x for which $f(x) \geq 0$.

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

(iii) $x \leq -3$ and $x \geq 2\frac{1}{2}$ [indicated on graph]

* Accept answer consistent with candidate's curve [Tolerance = $\pm$ 1Box on scale]

* Accept range indicated correctly on graph and written in words.

* Accept $-4 \leq x \leq -3$ and $2\frac{1}{2} \leq x \leq 3$.

Blunders (-3)

B1 Correct answer but no work shown (✍)

B2 Range indicated correctly on graph but no value given or value/s outside tolerance

B3 Gives only one range value

B4 Range of values of $f(x) \leq 0$

B5 Range of values of $f(x) < 0$

B6 Values of $f(x) = 0$

Attempts (2 marks)

A1 Indicates a value that lies within the range

A2 Indicates or states either $x = -3$ or $x = 2\frac{1}{2}$

QUESTION 6

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

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

6(a) ✍ Express in its simplest form:

$$\frac{x+7}{5} + \frac{3-x}{4}.$$

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

✍

$$\frac{x+7}{5}+\frac{3-x}{4}$$

$$\frac{4(x+7)+5(3-x)}{20}$$

$$\frac{4x+28+15-5x}{20}$$

$$\frac{43-x}{20}$$

Blunders (-3)

B1 Correct answer but no work shown (✍)
B2 Incorrect denominator
B3 Mishandles denominator
B4 Mishandles numerator
B5 Distribution error
B6 Mathematical error
B7 Fails to combine like terms in final answer
B8 Combines unlike terms and continues

Slips (-1)

S1 Numerical errors to a max of 3

Attempts (3 marks)

A1 Identifies common denominator and stops
A2 Any correct relevant step and stops

Worthless (0)

W1 Incorrect answer and no work shown
W2 $\frac{x+7}{5}+\frac{3-x}{4}=\frac{10}{9}$ and stops

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

(i) Factorise $25x^2 - 36y^2$.

(ii) Factorise $11x^2 + 75x - 14$.

(iii) ✍ Simplify $(3-4x)^2 \quad - \quad (3-5x)^2$.

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

6 (b) (i) Factorise $25x^2 - 36y^2$.

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

$(5x - 6y)\,(5x + 6y)$

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

$(5x-6y)$ and $(5x+6y)$ [The word **and** is written down]

$(5x-6y)$ or $(5x+6y)$ [The word **or** is written down]

$(5x-6y)$, $(5x+6y)$ [A comma is used]

Blunders (-3)

B1 Answer as $(25x-36y)(25x+36y)$

B2 Answer as $(5x-6y)\pm(5x+6y)$

B3 Mathematical error

B4 Sign error

B5 Incorrect factorisation of one term

Attempts (2 marks)

A1 Indicates $25x^2 = (5x)^2$ or similar and stops

A2 Any correct relevant step and stops.

A3 Mentions the difference of two squares and stops

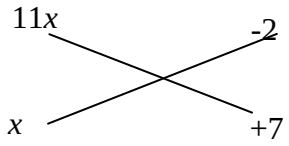
A3 *Worthless (0)*

W1 Incorrect answer and no work shown

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

6 (b) (ii) Factorise $11x^2+75x-14$.

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

$11x^2+75x-14$ $11x^2+77x-2x-14$ $11x(x+7)-2(x+7)$ $(x+7)(11x-2)$	 $\Rightarrow (x+7)(11x-2)$	$\frac{-(75)\pm\sqrt{(75)^2-4(11)(-14)}}{2(11)}$ $\frac{-75\pm\sqrt{5625+616}}{22} = \frac{-75\pm 79}{22}$ $\frac{4}{22}=\frac{2}{11}$ *and* $\frac{-154}{22}=-7$ $\Rightarrow (11x-2)(x+7)$

* Accept also (with or without brackets) for 5 marks any of the following
$(x+7)$ and $(11x-2)$ [The word **and** is written down.]
$(x+7)$ or $(11x-2)$ [The word **or** is written down.]
$(x+7)$, $(11x-2)$ [A comma is used]

Blunders (-3)

B1 Correct factors of $11x^2$ and -14 leading to incorrect middle term e.g. $(11x-14)(x+1)$.
B2 Incorrect factors of $11x^2$
B3 Incorrect factors of -14
B4 Correct cross method but factors not shown and stops
B5 $11x(x+7)-2(x+7)$ or similar and stops
B6 Incorrect common factor and continues.
B7 Incorrect quadratic formula and continues.
B8 Error in the use of quadratic formula
B9 Answer left as roots.
B10 Sign error in substituted formula
B11 Error in square root or square root ignored
B12 $(x+7)\pm(11x-2)$

Slips (-1)

S1 Numerical errors to a max of 3

Attempts (2 marks)

A1 Correct quadratic equation formula quoted and stops
A2 Correct factors of either $11x^2$ or ± 14
A3 Any correct step
A4 Guide number = ± 154 as and stops

Worthless (0 marks)

W1 $11x^2+75x=14$ or similar and stops
W2 Combines "*x*'s"to "numbers" and continues or stops

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

6 (b) (iii) ✍ Simplify $(3-4x)^2 - (3-5x)^2$.

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

✍

I	II
$(3-4x)^2 - (3-5x)^2$	$(3-4x)^2 - (3-5x)^2$
$9-24x+16x^2-(9-30x+25x^2)$	$[(3-4x)-(3-5x)][(3-4x)+(3-5x)]$
$9-24x+16x^2-9+30x-25x^2$	$(3-4x-3+5x)(3-4x+3-5x)$
$6x-9x^2$	$(x)(6-9x)$

* Accept $3(2x-3x^2)$ **or** $3x(2-3x)$ **or** $x(6-9x)$ as correct answer.

Blunders (-3)

B1 Correct answer but no work shown (✍)
B2 Mathematical error
B3 Distribution error
B4 Error in squaring
B5 Combines unlike terms and continues
B6 Fails to combine similar terms
B7 Error in the factors of the difference of two squares

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

Attempts (3 marks)
A1 Any correct attempt to square and stops
A2 Mentions the difference of two squares and stops

Worthless (0)
W1 Incorrect answer and no work shown

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

(i) ✍ Solve $\frac{6}{x} + \frac{6}{x+2} = \frac{5}{2}$, $x \in \mathbf{R}$.

(ii) ✍ Hence, or otherwise, find the two values of $t \in \mathbf{R}$, for which

$$\frac{6}{2t-1} + \frac{6}{2t+1} = \frac{5}{2}.$$

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

Q 6 (c)(i) ✍ Solve $\frac{6}{x} + \frac{6}{x+2} = \frac{5}{2}$, $x \in \mathbf{R}$

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

✍

I	II
$\frac{6}{x}+\frac{6}{x+2}=\frac{5}{2}$	$\frac{6}{x}+\frac{6}{x+2}=\frac{5}{2}$
$\frac{6(x+2)+6(x)}{x(x+2)}=\frac{5}{2}$	$\frac{6(x+2)(2)+6(x)(2)-5(x)(x+2)}{x(x+2)(2)}=0$
$\frac{6x+12+6x}{x^2+2x}=\frac{5}{2}$	
$\frac{12x+12}{x^2+2x}=\frac{5}{2}$	$\frac{12x+24+12x-5x^2-10x}{x(x+2)(2)}=0$
$5x^2+10x=24x+24$	$5x^2-14x-24=0$
$5x^2-14x-24=0$	$(5x+6)(x-4)=0$
$(5x+6)(x-4)=0$	$5x+6=0$ *and* $x-4=0$
$5x+6=0$ *and* $x-4=0$	$\Rightarrow x=-\frac{6}{5}$ *and* $x=4$
$\Rightarrow x=-\frac{6}{5}$ *and* $x=4$	

* Quadratic equation may be solved by other methods: **[as per scheme Q6 (b) (ii)]**

* Solving quadratic equation may incur maximum penalty of -3.

Blunders (-3)

B1 Correct answer, but no work shown (✍)
B2 Transposition error
B3 Distribution error
B4 Error in quadratic formula or its application (once)
B5 Mathematical error

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

Attempts (5 marks)
A1 Identifies a correct common denominator and stops
A2 Has simplified equation to linear and solves correctly for single value of x -max att 5
A3 Writes correct quadratic formula and stops
A4 Multiplies out common denominator correctly and stops
A5 Trial and error leading to one correct solution
A6 Any correct relevant work

Worthless (0)
W1 Incorrect answer and no work shown

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

Q 6 (c) (ii) ✍ Hence, or otherwise, find the two values of $t \in \mathbf{R}$, for which

$$\frac{6}{2t-1} + \frac{6}{2t+1} = \frac{5}{2}.$$

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

✍

I	II	III
$x = 2t-1$ $-\frac{6}{5} = 2t-1$ $10t-5 = -6$ $10t = -1$ *Let* $t = -\frac{1}{10}$ *and* $4 = 2t-1$ $2t = 5$ $t = \frac{5}{2}$	Let $x+2 = 2t+1$ *Let* $x+2 = 2t+1$ $\Rightarrow x = 2t-1$ $-\frac{6}{5} = 2t-1$ $10t-5 = -6$ $10t = -1$ $t = -\frac{1}{10}$ *and* $4 = 2t-1$ $2t = 5$ $t = \frac{5}{2}$	$\frac{6}{2t-1} + \frac{6}{2t+1} = \frac{5}{2}$ $\frac{6(2t+1)(2)+6(2t-1)(2)-5(2t-1)(2t+1)}{2(2t-1)(2t+1)} = 0$ $24t+12+24t-12-20t^2+5 = 0$ $20t^2-48t-5 = 0$ $(10t+1)(2t-5) = 0$ $10t = -1 \Rightarrow t = -\frac{1}{10}$ *and* $2t = 5 \Rightarrow t = \frac{5}{2}$

* Accept candidate's values from part (c) (i)
* Method III apply scheme as per 6(c)(ii)

Blunders (-3)

B1 Correct answer but no work shown (✍)
B2 $x+2 = 2t-1$ and/or $x = 2t+1$ and continues
B3 Mathematical error
B4 Distribution error
B5 Transposition error

Slips (-1)

S1 Numerical errors to a max of 3

Attempts (2 marks)

A1 $x = 2t-1$ and/or $x+2 = 2t+1$ and stops.
A2 Any correct step and stops.
A3 Trial and error [Substitutes a arbitrary value of x into either $x = 2t-1$ or $x+2 = 2t+1$]

Worthless (0)

W1 Incorrect answer and no work shown

BONUS MARKS FOR ANSWERING THROUGH IRISH

Bonus marks are applied separately to each paper as follows:

If the mark achieved is 225 or less, the bonus is 5% of the mark obtained, rounded ***down***.
(e.g. 198 marks × 5% = 9.9 ⇒ bonus = 9 marks.)

If the mark awarded is above 225, the following table applies:

Bunmharc (Marks obtained)	Marc Bónais (Bonus Mark)	Bunmharc (Marks obtained)	Marc Bónais (Bonus Mark)
226	11	261 – 266	5
227 – 233	10	267 – 273	4
234 – 240	9	274 – 280	3
241 – 246	8	281 – 286	2
247 – 253	7	287 – 293	1
254 – 260	6	294 – 300	0