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Junior Certificate Examination 2002

MARKING SCHEME

MATHEMATICS

ORDINARY LEVEL

PAPER 1

GENERAL GUIDELINES FOR EXAMINERS

1. Penalties of three types are applied to candidates' work as follows:

- Blunders - mathematical errors/omissions (-3)
- Slips - numerical errors (-1)
- Misreadings (provided task is not oversimplified) (-1).

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

2. The lists of blunders, slips and misreadings are not intended to be exhaustive.
3. 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
 - when 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.
4. Worthless work is awarded zero marks. Some examples of such work are listed in the scheme and they are labelled as W1, W2,.....etc.
5. The *same* error in the *same* section of a question is penalised *once* only.
6. Particular cases, verifications and answers derived from diagrams (unless requested) qualify for attempt marks only.
7. The phrase “and stops” means that no more work is shown by the candidate.

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# QUESTION 1

Each Part

10 marks

Att 3

Part (i)

10 marks

Att 3

(i) Mary pays for two tickets with €50. The cost of each ticket is €19.95.

How much change does she get?

(i)

10 marks

Att 3

$$19.95 \times 2 = 39.90 \quad (7m)$$

$$50.00 - 39.90 = 10.10 \quad (10m)$$

$$\text{Change} = €10.10$$

$$50.00 - 19.95 = 30.05 \quad (7m)$$

$$30.05 - 19.95 = 10.10 \quad (10m)$$

$$\text{Change} = €10.10$$

## Blunders (-3)

B1 Calculates the cost of the tickets but fails to find the change.

B2 Addition of 39.90 to 50.00 when finding the change.

B3  $50.00 - 19.95 = 30.05$  and stops.

B4 Error in decimal point (once only).

B5 Subtracts €40 from €50 and fails to add the compensating 10 cent.

B6  $\frac{50}{2} = 25 : 25 - 19.95 = 5.05$  and stops.

## Slips (-1)

S1 Numerical errors (to max -3).

## Attempts

Att Adds 19.95 to 50.00 and stops.

Att  $\frac{50}{2} = 25$  and stops.

## Notes

N1 Accept 1010, 10.10 or 10.1 regardless of subsequent labelling or work.

N2 Final subtraction step subject to maximum deduction of -3,  
e.g.  $39.90 \Rightarrow 7$  marks,  $30.05 \Rightarrow 7$  marks.

**Part (ii)****10 marks****Att 3****(ii)** A film starts at 19:40. The film ends at 22:15. How long is the film?

Give your answer in hours and minutes.

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

|             |                                                                  |                                                                                |       |                                                                  |
|-------------|------------------------------------------------------------------|--------------------------------------------------------------------------------|-------|------------------------------------------------------------------|
| <b>(ii)</b> | 22:15                                                            | 20:00                                                                          | 22:15 | $2.15 + 0.20 = 2.35$                                             |
|             | 19:40                                                            | 19:40                                                                          | 20:00 |                                                                  |
|             | <span style="border: 1px solid black; padding: 2px;">2:35</span> | 0.20                                                                           | 2.15  | <span style="border: 1px solid black; padding: 2px;">2.35</span> |
|             |                                                                  | <span style="border: 1px solid black; padding: 2px;">2 hours 35 minutes</span> |       |                                                                  |

**Blunders (-3)**

- B1 Treats as decimals (giving 2.75 which is then given as 3 hours 15 mins).  
 B2 Finds differences from 20:00 but fails to add.

**Slips (-1)**

- S1 Each numerical error (to a max -3).  
 S2 Answer not given in hours and minutes.

**Attempts**

- Att Subtracts hours only or subtracts minutes only.  
 Att Correct addition.  
 Att  $19:40 = 7\ 40\text{ p.m.}$  and / or  $22:15 = 10\ 15\text{ p.m.}$   
 Att  $22 - 19 = 3$  and  $15 - 40$  taken as  $40 - 15 = 25$  giving 3 hours 25mins.  
 Att  $19:40 - 22:15 = -3\text{ hours } 25\text{ mins.}$

**Notes**

- N1 Differences with 22: 00 can be added (as above)  
 N2 Accept correct answer without work.  
 N3 Incorrect irrelevant answer without work  $\Rightarrow$  0 marks.  
 N4  $22:15 - 20:00 = 2:15$  and stops  $\Rightarrow$  Att only.  
 N5  $20:00 - 19:40 = 0.20$  and stops  $\Rightarrow$  Att only.

**Part (iii)****10 marks****Att 3****(iii)** An item is bought for €25. It is sold at a profit of 22%. Find the selling price.**(iii)****10 marks****Att 3****(iii)**

$$100\% = 25$$

$$1\% = 0.25 \text{ (4m)}$$

$$22\% = 0.25 \times 22 \\ = 5.50 \text{ (7m)}$$

$$\text{S.P.} = 25 + 5.5 \\ = \text{€}30.5 \text{ (10m)}$$

or

$$122\% = 0.25 \times 122 \\ = \text{€}30.5 \text{ (10m)}$$

$$20\% = \frac{1}{5} \Rightarrow 5$$

$$1\% = 0.25 \text{ (4m)}$$

$$2\% = 0.5$$

$$P = 5 + .5 = 5.5 \\ \text{(7m)}$$

$$\text{S.P.} = \text{€}30.5 \text{ (10m)}$$

$$22\% = \frac{22}{100} \text{ or } 122\% = \frac{122}{100}$$

$$P = \frac{22}{100} \times 25 \text{ (4m)} = 5.5 \text{ (7m)}$$

or

$$\text{S.P.} = \frac{122}{100} \times 25 \text{ (7m)} = 30.5 \text{ (10m)}$$

**Blunders (-3)**B1 22% clearly taken as  $\frac{1}{5}$  or  $\frac{1}{4}$  with no subsequent effort to achieve 22%.B2 Inverts  $\frac{122}{100}$  or  $\frac{22}{100}$  and continues (giving S.P. = 20.49 or profit = 113.6).

B3 Errors in decimal point (once only).

B4 25 taken as 122% (same result as B2).

B5  $\frac{25}{100} \times 122$  and stops (or similar).

B6 No addition of profit (as calculated by candidate) to the cost price.

B7 Subtraction of profit (as calculated by candidate) from the cost price.

**Slips (-1)**

S1 Numerical errors (to a max-3).

**Attempts**Att  $\frac{22}{100}$  and stops.Att  $100\% = 25$  and stops.Att  $\frac{25}{100}$  and stops.Att  $100 \times \frac{22}{25}$  and stops.Att  $\frac{25}{22}$  and continues or stops.

Att Use of any other percentage.

**Part (iv)****10 marks****Att 3****(iv)** Solve for  $x$ :

$$x^2 - 9x + 14 = 0.$$

**(iv)****10 marks****Att 3****(iv)**

$$x^2 - 9x + 14 = 0$$

$$x^2 - 7x - 2x + 14 = 0$$

$$x(x - 7) - 2(x - 7) = 0$$

$$(x - 7)(x - 2) = 0 \quad (7m)$$

$$\Rightarrow x = 7 \text{ or } x = 2 \quad (10m)$$

**Factor Method****Blunders (-3)**

- B1 Incorrect two term linear factors of  $x^2 - 9x + 14$  formed from correct, but not applicable, factors of  $x^2$  and  $\pm 14$ .
- B2 Correct cross method but factors not shown and stops also incurs B4  $\Rightarrow$  4 marks (but see N1).
- B3  $x(x - 7) - 2(x - 7)$  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.
- Att Some effort at substitution, correct or incorrect.

**Notes**

- N1 Correct cross method giving  $x = 7$  and  $x = 2 \Rightarrow$  10 marks.

**Formula Method****Blunders (-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  $\frac{9 \pm 5}{2}$  or similar.

**Slips (-1)**

- S1 One root omitted in final step.
- S2 Numerical errors (to max -3).
- S3  $x = \frac{14}{2}$ .
- S4  $x = \frac{4}{2}$ .

**Attempts**

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

$$x = \frac{9 \pm \sqrt{81 - 56}}{2}$$

$$x = \frac{9 \pm 5}{2} \Rightarrow x = \frac{14}{2} \text{ or } x = \frac{4}{2}$$

$$\Rightarrow x = 7 \text{ or } x = 2.$$

(v) Calculate the mean of the following numbers:

3, 4, 4, 1, 2, 4, 3.

(v)

10 marks

Att 3

(v)

$$\frac{3+4+4+1+2+4+3}{7} = \frac{21}{7} = 3$$

*Blunders* (−3)

B1 Each value omitted in the evaluation of  $\sum x$ .

B2 Incorrect denominator or no denominator. [See N2].

B3  $\frac{7}{21}$  or  $21 \times 7$ .

B4 21 and stops. [Also S2, see N1].

B5 Incorrect  $\sum x$  without work.

B6 Incorrect method of evaluating  $\sum x$ .

*Slips* (−1)

S1 Numerical errors within the evaluation of  $\sum x$ .

S2  $\frac{21}{7}$  and stops.

*Attempts*

Att 7 and no more.

Att The mode 4 given as the mean.

Att Some use of the given data.

*Notes*

N1 21 only  $\Rightarrow$  6 marks.

N2 Sum of 6 items/6  $\Rightarrow$  B1 only.

N3 Accept correct answer without work.

N4  $\frac{21}{7} \Rightarrow$  9 marks.

N5  $\frac{3}{7} + \frac{4}{7} + \frac{4}{7} + \frac{1}{7} + \frac{2}{7} + \frac{4}{7} + \frac{3}{7}$  and stops  $\Rightarrow$  6 marks.

(vi) When  $a = 5$  and  $b = 4$ , find the value of

$$a^2 - 3\sqrt{b}.$$

(vi)

10 marks

Att 3

(vi)

$$(5)^2 - 3\sqrt{4} \text{ (3m)}$$

$$25 - 3\sqrt{4} \text{ (4m) or } (5)^2 - 3(2) \text{ (4m)}$$

$$= 25 - 3(2) \text{ (7m)}$$

$$= 25 - 6 \text{ (9m)}$$

$$= 19 \text{ (10m)}$$

### Blunders (−3)

B1 Incorrect substitution and continues.

B2 Mishandles  $(5)^2$  i.e.  $(5)^2 = 10$  or leaves  $(5)^2$  in answer.

B3 Mishandles  $\sqrt{4}$  i.e.  $\sqrt{4} = 16$  or leaves  $\sqrt{4}$  in answer.

B4 Breaks order i.e.  $[25 - 3(2) = 22(2) = 44]$  (once only).

B5  $-3\sqrt{b}$  taken as  $-3 + \sqrt{b}$ .

### Slips (−1)

S1 Numerical errors (to max −3).

### Attempts

Att Incomplete substitution.

### Notes

N1  $(5)^2 - 3\sqrt{4} \Rightarrow 3$  marks.

N2  $25 - 3(2) \Rightarrow 7$  marks i.e. evaluation of  $25 - 3(2)$  subject to maximum deduction of −3.

N3  $25 - 6 \Rightarrow 9$  marks

N4 Accept correct answer without work.

(vii) Express  $p$  in terms of  $r$  and  $t$  when  $5p - 3r = t$ .

(vii)

10 marks

Att 3

(vii)

$$5p - 3r = t$$

$$5p = t + 3r \text{ (7m)}$$

$$p = \frac{t+3r}{5} \text{ (10m) or } p = \frac{t}{5} + \frac{3r}{5} \text{ (10m)}$$

$$p - \frac{3r}{5} = \frac{t}{5} \text{ (7m)}$$

$$p = \frac{t}{5} + \frac{3r}{5} \text{ (10m)}$$

*Blunders* (-3)

B1 Each error in transposition.

B2  $5p = t + 3r$  and stops.

B3 Not dividing each term by 5 in  $p = \frac{t}{5} + \frac{3r}{5}$ .

*Misreadings* (-1)

M1  $r$  in terms of  $p$  and  $t$ .

*Attempts*

Att Some effort at transposition e.g.  $5p - 3r - t = 0$  and stops.

*Notes*

N1  $\frac{-3r-t}{-5} = p \Rightarrow 10 \text{ marks.}$

N2  $p - \frac{3r}{5} = \frac{t}{5} \Rightarrow 7 \text{ marks.}$

N3  $-3r = t - 5p \Rightarrow 6 \text{ marks [B1 and M1].}$



(viii) Find the value of  $f(-3)$  when  $f(x) = 2 - 5x$ .

(viii)

10 marks

Att 3

(viii)

$$f(x) = 2 - 5x$$

$$f(-3) = 2 - 5(-3) \text{ (7m)}$$

$$f(-3) = 2 + 15 \text{ (9m)}$$

$$f(-3) = 17 \text{ (10m)}$$

- \* Meaning of “correct function concept”:  
 $f(-3) = 2 - 5(-3)$  or  $f(-3) = 2 + 15$  i.e. multiplication of  $-5$  by  $-3$  is clearly indicated or is implied by subsequent work.
- \* Completion of  $f(-3)$  is subject to maximum deduction of  $-3$ .

*Blunders* ( $-3$ )

B1  $f(-3)$  incorrect: misunderstanding of the concept of a function.

B2 Error in sign (once only).

*Misreading* ( $-1$ )

M1  $f(3)$  instead of  $f(-3)$ .

*Slips* ( $-1$ )

S1 Numerical errors (to max  $-3$ ).

*Attempts*

Att Treats as equation and continues or stops.

*Notes*

N1 Correct function concept i.e.  $2 - 5(-3)$  and stops  $\Rightarrow 7$  marks.

N2 Ignores  $x$  giving  $2 - 5 = -3 \Rightarrow 0$  marks.

N3  $-3[f(x)] = -6 + 15x \Rightarrow 0$  marks.

N4 Accept correct answer without work for full marks.

N5  $f(x) = -13$  i.e.  $f(3)$  evaluated (written or implied)  $\Rightarrow 9$  marks.

(ix) Show on the number line all the values of  $x$  for which

$$4x - 1 \leq 2x + 5, \quad x \in \mathbb{N}.$$

(ix)

10 marks

Att 3

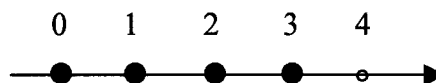
(ix)

$$4x - 1 \leq 2x + 5$$

$$4x - 2x \leq 5 + 1$$

$$2x \leq 6$$

$$x \leq 3$$



### Blunders (-3)

- B1 Each error in transposition.
- B2 Mishandling direction of inequality e.g.  $-3 \leq -x \Rightarrow 3 \leq x$ .
- B3 Adds “x’s” and “numbers” e.g.  $4x - 1 = 3x$  (once only).
- B4 No indication on number line or incorrect indication on number line [but see S2, S3].

### Slips (-1)

- S1 Numerical errors (to max -3).
- S2  $\leq$  is taken as  $<$ .
- S3  $x \in \mathbb{R}$  or  $x \in \mathbb{N}_0$ .

### Attempts

- Att Treats as an equation and continues but fully correct indication of candidate’s answer as an inequality on number line takes precedence.
- Att Attempts some substitution in an effort to test values.
- Att Creates two inequalities.
- Att Incorrect indication, without work, containing at least one natural number.

### Notes

- N1  $x \leq 3 \Rightarrow$  7 marks.
- N2 Correct answer properly indicated on number line, without work  $\Rightarrow$  10 marks.
- N3 If  $x \geq 3$  as a result of error, 3, 4 and 5, or more, as the indication on number line.

**Part (x)**

**10 (5, 5) marks**

**Att (2,2)**

**(x)** Write each of the following two numbers in scientific notation:

45000

0.0313

**(x)**

**10 (5, 5)marks**

**Att (2,2)**

**(x)**

$45000 = 4.5 \times 10^4$

$0.0313 = 3.13 \times 10^{-2}$

\* Apply the following to each number but do not penalise twice the same basic error in method.

*Blunders (-3)*

B1 Error in “*a*”.

B2 Error in “*n*”, subject to candidate’s “*a*”.

*Attempts*

Att Some effort at formulating  $a \times 10^n$ .

*Notes*

N1 4.5 and stops  $\Rightarrow$  2 marks.

N2 3.13 and stops  $\Rightarrow$  2 marks.

N3 45 and 31.3: same basic error in “*a*”.

## QUESTION 2

|                 |                               |                            |
|-----------------|-------------------------------|----------------------------|
| <b>Part (a)</b> | <b>20 (10,10) marks</b>       | <b>Att 6 (3, 3)</b>        |
| <b>Part (b)</b> | <b>30 (10, 5,10, 5) marks</b> | <b>Att 10 (3, 2, 3, 2)</b> |

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

- 2. (a)** Paul invests €3000 at 4% compound interest per annum.
- (i)** Calculate the amount of the investment at the end of one year.
- (ii)** At the beginning of the second year, he invests another €1000.  
What is the total amount of the investment at the end of the second year?

**(a)** **20 (10, 10) marks** **Att (3, 3)**

|            |            |                                                                   |                                                                                                               |
|------------|------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| <b>(a)</b> | <b>(i)</b> | $1\% = 30$ $4\% = 120$ $\Rightarrow \text{Amount} = \text{€}3120$ | $I = \frac{P.T.R}{100} = \frac{3000 \times 1 \times 4}{100} = 120$ $\Rightarrow \text{Amount} = \text{€}3120$ |
|------------|------------|-------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|

### *Blunders (-3)*

- B1 Mishandles 4%, e.g.  $3000 \times 4$  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  $\frac{3000 \times 1 \times 4}{100}$ .

### *Slips (-1)*

- S1 Numerical errors (to max -3).

### *Attempts*

- 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 Accept correct answer without work.

(a) (ii) 10 marks Att 3

|     |      |                                                                                                                              |
|-----|------|------------------------------------------------------------------------------------------------------------------------------|
| (a) | (ii) | $\frac{P \times T \times R}{100} = \frac{4120 \times 1 \times 4}{100} = 164.8$ $\Rightarrow \text{Amount} = \text{€}4284.80$ |
|     |      | $3120 + 1000 = 4120$                                                                                                         |
|     |      | $1\% = 41.2$                                                                                                                 |
|     |      | $4\% = 164.8$                                                                                                                |
|     |      | $\Rightarrow \text{Amount} = \text{€}4284.80$                                                                                |

#### Blunders (−3)

- B1 Fails to add €1000 and continues.
- B2 Subtracts €1000 instead of adding €1000 and continues.
- B3 Mishandles 4%, but no penalty if as above.
- B4 Error in decimal point (once only).
- B5 Stops at interest i.e. fails to calculate amount.
- B6 Subtracts to calculate amount.
- B7 Incorrect substitution into correct formula and continues but no penalty if as above e.g.  $T = 2$  used in both parts.
- B8 Uses €3120 as principal to find amount and then adds €1000.
- B9 €1000 added to €3000.

#### Slips (−1)

- S1 Numerical errors (to max −3)

#### Attempts

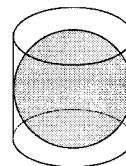
- Att Correct formula with or without substitution and stops.
- Att Some use of 100 in attempt to find percentage.
- Att Stops after adding €1000.

#### Notes

- N1 €120 recalculated  $\Rightarrow$  3 marks.
- N2  $P_1 = P_2 \Rightarrow$  Att.
- N3  $120 \times 2$  or  $120 \times 2 = 240 \Rightarrow$  Att.

(b) A sphere fits exactly inside an empty cylinder. The radius of the sphere is 3 cm.

- (i) Find the volume of the sphere.  
Take  $\pi = 3.1$ .
- (ii) Write down the height of the cylinder.
- (iii) Find the volume of the cylinder.  
Take  $\pi = 3.1$ .
- (iv) Find the volume of the empty space in the cylinder.



(b)(i) Volume of sphere

10 marks

Att 3

$$\begin{aligned}
 V &= \frac{4}{3}\pi r^3 = \frac{4}{3} \cdot (3.1)(3)^3 \\
 &= \frac{4}{3} \cdot (3.1) \cdot (27) = 111.6 \text{ cm}^3
 \end{aligned}$$

*Blunders* (−3) (To be applied when correct formula is written or implied.)

- B1  $r^3$  treated as  $3r$  or cube ignored.
- B2 Error in decimal point (once only).
- B3 Error in cancellation (once only).
- B4 Leaves  $\pi$  or takes  $\pi = 3$ .
- B5  $\frac{4}{3}$  ignored in calculation.

*Misreadings* (−1)

- M1 Volume =  $\frac{4}{8}\pi r^3$ .

*Slips* (−1)

- S1 Numerical errors (to max −3).

*Attempts*

- Att Correct formula only.
- Att Correct formula with correct substitution(s) and stops.
- Att Non-relevant formula (written or implied) with some use of 3.
- Att Some use of 3.

*Notes*

- N1 Allow  $\pi = 3.14$  or  $\pi = \frac{22}{7}$ .
- N2  $4\pi r^2$  gives 111.6 but earns only the attempt mark.

**(b)(ii) Height of cylinder**

**5 marks**

**Att 2**

**(b)(ii)**

$$\text{Height} = 3 \times 2 = 6 \text{ cm}$$

*Blunders* (−3)

B1 Height = 3.

B2 3 multiplied by a number other than 2.

*Slips* (−1)

S1 Numerical error.

(b)(iii)

$$\begin{aligned}
 V &= \pi r^2 h \\
 &= (3.1).(3)^2.(6) \\
 &= (3.1).(9).6 \\
 &= 167.4 \text{ cm}^3
 \end{aligned}$$

*Blunders* (−3) (To be applied when correct formula is written or implied.)

- B1 Interchanges  $r$  and  $h$ .
- B2  $r^2$  treated as  $2r$  or square ignored.
- B3 Error in decimal point (once only).
- B4 Error in cancellation (once only).
- B5 Leaves  $\pi$  or takes  $\pi = 3$ .

*Slips* (−1)

- S1 Numerical errors (to max −3).

*Attempts*

- Att Correct formula only.
- Att Correct formula with correct substitution(s) and stops.
- Att Non-relevant formula (written or implied) with some use of 3 and or 6.
- Att Some use of 3 or 6.

*Notes*

- N1 Allow  $\pi = 3.14$  or  $\pi = \frac{22}{7}$ .
- N2  $\frac{1}{3}\pi r^2 h$  and continues  $\Rightarrow$  7 marks.
- N3 Incorrect height from (b)(ii) may be used without penalty.
- N4  $h = 6$  embedded in this section can earn full marks for part (ii).



**(b)(iv) Volume of empty space      5 marks**

**Att 2**

|                                                                                                             |
|-------------------------------------------------------------------------------------------------------------|
| <p><b>(b)(iv)</b></p> $\begin{aligned}\text{Volume} &= 167.4 - 111.6 \\ &= 55.8 \text{ cm}^3.\end{aligned}$ |
|-------------------------------------------------------------------------------------------------------------|

*Blunders (-3)*

B1      Addition rather than subtraction.

*Slips (-1)*

S1      Numerical error.

*Attempts*

Att      Some use of the calculated volumes.

*Notes*

N1      Incorrect volumes from previous parts may be used without penalty.

## QUESTION 3

|                 |                          |                   |
|-----------------|--------------------------|-------------------|
| <b>Part (a)</b> | <b>10 marks</b>          | <b>Att 3</b>      |
| <b>Part (b)</b> | <b>20 (10, 10) marks</b> | <b>Att (3, 3)</b> |
| <b>Part (c)</b> | <b>20 (10, 10) marks</b> | <b>Att (3, 3)</b> |

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

**3(a)** Solve for  $x$ :

$$5(x - 2) = 20$$

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

|            |                                                                                                                  |                                            |
|------------|------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| <b>(a)</b> | $5(x - 2) = 20$ $5x - 10 = 20 \quad (4m)$ $5x = 30 \quad (7m)$ $x = \frac{30}{5} \quad (9m)$ $x = 6 \quad (10m)$ | $x - 2 = 4 \quad (7m)$ $x = 6 \quad (10m)$ |
|------------|------------------------------------------------------------------------------------------------------------------|--------------------------------------------|

### *Blunders (-3)*

- B1 Error in distributive law and continues, e.g.  $5x - 2 = 20$  or  $5x - 10 = 100$  (once only).  
 B2 Each error in transposition.  
 B3 Adds 'x's to 'numbers' and continues ( $5x - 10 = -5x$ ).

### *Slips (-1)*

- S1 Error in division e.g.  $x = \frac{30}{5} \Rightarrow x = 7$  (say).  
 S2 Errors in addition or multiplication (to max -3).  
 S3  $\frac{30}{5}$  and stops.

### *Attempts*

- Att  $5x - 2 = 20$  and stops.  
 Att  $5x - 10 = 100$  and stops.  
 Att  $x - 10 = 20$  and stops.  
 Att  $x - 2 = 20 \Rightarrow x = 22$ .  
 Att  $5x$  appears and stops.

### *Notes*

- N1  $x = \frac{30}{5} \Rightarrow 9$  marks.  
 N2 Accept  $x = 6$  without work for 10 marks.  
 N3  $x - 2 = 20 - 5$  and continues attracts B2.  
 N4  $5x - 10 = 20$  and stops  $\Rightarrow 4$  marks.

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

**(i)**  $ax - ay - 2bx + 2by$

**(ii)**  $5x^2 + 17x + 6.$

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

$a(x - y) - 2b(x - y)$

$x(a - 2b) - y(a - 2b)$

$(x - y)(a - 2b)$

$(a - 2b)(x - y)$

**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.**B4**  $(x - y) \pm (a - 2b).$ **Attempts****Att** Pairing off, or indication of pairing off, and stops.**Att** Correctly factorises any pair and stops.**Notes****N1**  $a(x - y) - 2x(b - y) \Rightarrow (x - y)(a - 2x) \Rightarrow 4 \text{ marks (B2 + B3)}.$

(b)(ii)

10 marks

Att 3

(b)(ii)

$$5x^2 + 15x + 2x + 6$$

$$5x(x+3) + 2(x+3)$$

$$(x+3)(5x+2)$$

$$\begin{array}{cc} 5x & +2 \\ x & +3 \end{array}$$

*Blunders (-3)*

- B1 Incorrect two term linear factors of  $5x^2 + 17x + 6$  formed from correct, but not applicable, factors of  $5x^2$  and  $\pm 6$ .
- B2 Correct cross method but factors not written.
- B3  $5x(x+3) + 2(x+3)$  or  $x(5x+2) + 3(5x+2)$  and stops.
- B4  $(x+3) \pm (5x+2)$ .
- B5 Uses quadratic equation formula to find  $x = \frac{-2}{5}$  and  $x = -3$  and stops.
- B6 Incorrect common factor and continues (applies to guide number method).

*Slips (-1)*

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

*Attempts*

- Att Correct factors of  $5x^2$  only.
- Att Correct factors of  $-6$  or  $+6$  only.
- Att  $15x + 2x$  only appears.
- Att Correct quadratic equation formula with or without substitution and stops.

*Notes*

- N1 Quadratic equation formula method is subject to slips and blunders.
- N2 Accept (with or without brackets) for 10 marks any of the following:  
 $(5x+2)$  and  $(x+3)$ . [the word **and** is written down]  
 $(5x+2)$  or  $(x+3)$ . [the word **or** is written down.]
- N3 Accept  $(5x+2), (x+3)$  for 10 marks.

**Part (c)****20 (10, 10) marks****Att (3, 3)****(c) (i)** Multiply  $x^2 - 3x + 1$  by  $3x - 2$ .**(ii)** Solve the simultaneous equations:

$$2x - 3y = 1$$

$$3x + y = 18.$$

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

$$\begin{aligned}
 &(3x - 2)(x^2 - 3x + 1) \\
 &= 3x(x^2 - 3x + 1) - 2(x^2 - 3x + 1) \\
 &= 3x^3 - 9x^2 + 3x - 2x^2 + 6x - 2 \\
 &= 3x^3 - 11x^2 + 9x - 2
 \end{aligned}$$

$$\begin{array}{r}
 x^2 - 3x + 1 \\
 \underline{3x - 2} \\
 3x^3 - 9x^2 + 3x \\
 \quad \underline{-2x^2 + 6x - 2} \\
 3x^3 - 11x^2 + 9x - 2
 \end{array}$$

**Blunders (-3)****B1** Errors in indices when multiplying (each time).**B2** Only one omission in multiplication (more than one omission  $\Rightarrow$  Att only).**B3** Adding unlike terms (each time).**B4** Errors in sign when multiplying (each time).**Slips (-1)****S1** Numerical error(s) in multiplication (to max -3).**S2** Numerical error(s) in addition or subtraction (to max -3).**Attempts****Att** Any correct multiplication.**Att**  $3x(x^2 - 3x + 1) - 2(x^2 - 3x + 1)$  and stops.**Att**  $x^2(3x - 2) - 3x(3x - 2) + 1(3x - 2)$  and stops.

|         |                                                                                                                                      |                                                                                                                                        |                                                                                                                     |
|---------|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| (c)(ii) | $\begin{array}{r} 2x - 3y = 1 \\ 3x + y = 18 \\ \hline 2x - 3y = 1 \\ 9x + 3y = 54 \\ \hline 11x = 55 \\ x = 5 \\ y = 3 \end{array}$ | $\begin{array}{r} 2x - 3y = 1 \\ 3x + y = 18 \\ \hline 6x - 9y = 3 \\ 6x + 2y = 36 \\ \hline -11y = -33 \\ y = 3 \\ x = 5 \end{array}$ | $\begin{array}{r} y = 18 - 3x \\ 2x - 3(18 - 3x) = 1 \\ 2x - 54 + 9x = 1 \\ 11x = 55 \\ x = 5 \\ y = 3 \end{array}$ |
|---------|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|

*Blunders (-3)*

- B1 Error(s) in establishing the first equation in terms of  $x$  only [ $11x = 55$ ] or the first equation in terms of  $y$  only [ $-11y = -33$ ] through elimination by cancellation.
- B2 Error(s) in establishing the first equation in terms of  $x$  only or the first equation in terms of  $y$  only through elimination by substitution.
- B3 Errors in transposition in solving the first one variable equation.
- B4 Errors in transposition when finding second variable.
- B5 Incorrect substitution when finding second variable.
- B6 Finds one variable only.

*Slips (-1)*

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

*Attempts*

- Att Attempt at transposition and stops.
- Att Multiplies either equation by some number and stops.
- Att Correct answers without algebraic work.

*Notes*

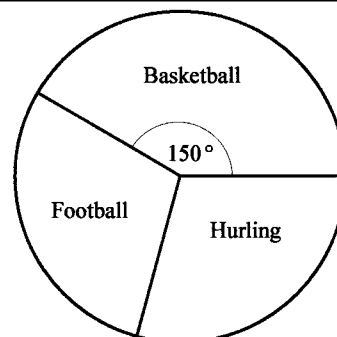
- N1 Apply only one blunder deduction (B1 or B2) to any error(s) in establishing the first equation in terms of  $x$  only or the first equation in terms of  $y$  only.
- N2 Finding the second variable is subject to a maximum deduction (-3).

## QUESTION 4

|                 |                                |                         |
|-----------------|--------------------------------|-------------------------|
| <b>Part (a)</b> | <b>10 marks</b>                | <b>Att 3</b>            |
| <b>Part (b)</b> | <b>40 (10, 10,10,10) marks</b> | <b>Att (3, 3, 3, 3)</b> |

|                 |                 |              |
|-----------------|-----------------|--------------|
| <b>Part (a)</b> | <b>10 marks</b> | <b>Att 3</b> |
|-----------------|-----------------|--------------|

- (a)** The pie chart shows the favourite sport of 24 students.  
Basketball is the favourite sport of how many students?



|                 |                 |              |
|-----------------|-----------------|--------------|
| <b>Part (a)</b> | <b>10 marks</b> | <b>Att 3</b> |
|-----------------|-----------------|--------------|

**(a)**

$$360^\circ \equiv 24 \text{ students} \Rightarrow 1^\circ \equiv \frac{24}{360} \text{ students}$$

$$150^\circ \equiv \frac{24}{360} \times 150 = 10 \text{ students}$$

### *Blunders (-3)*

- B1 Finds the number of "football/hurling " students i.e. 14.
- B2 Uses 100 or 180 instead of 360.
- B3 Takes 24 students as "basket ball" and finds the "total" i.e.  $\frac{24}{150} \times 360 = 57.6$ .
- B4 Takes 24 students as "basket ball" and finds "f/h " i.e.  $\frac{24}{150} \times 210 = 33.6$ .
- B5 Takes 24 students as "f/h " and finds the "total" i.e.  $\frac{24}{210} \times 360 = 41.14$ .
- B6 Takes 24 students as "f/h " and finds "basketball " i.e.  $\frac{24}{210} \times 150 = 17.14$ .
- B7  $\frac{360}{24} \times 150$  and continues.

### *Slips (-1)*

- S1 Numerical errors (max -3).

### *Attempts*

- Att 210 and stops.
- Att Some mention of 360.
- Att Some use of the given data e.g.  $24 \times 150$ .

### *Notes*

- N1 Accept correct answer without work for 10 marks.
- N2 Evaluation of  $\frac{150}{360} \times 24$  subject to a maximum deduction of - 3.
- N3 Incorrect answer without work  $\Rightarrow$  0 marks but accept 14 (B1) for 7 marks.

**Part (b)****40 (10, 10, 10, 10) marks****Att (3, 3, 3)****(b)** The following list gives the number of bedrooms in each of 20 homes:

|   |   |   |   |   |
|---|---|---|---|---|
| 3 | 1 | 4 | 2 | 5 |
| 4 | 5 | 2 | 3 | 4 |
| 2 | 1 | 3 | 2 | 3 |
| 5 | 2 | 4 | 3 | 2 |

**(i)** Copy and complete the following frequency table:

| Number of bedrooms per home | 1 | 2 | 3 | 4 | 5 |
|-----------------------------|---|---|---|---|---|
| Number of homes             |   |   |   |   |   |

**(ii)** Using graph paper, draw a bar chart to show this information.**(iii)** How many homes have 3 or more bedrooms?**(iv)** Calculate the mean number of bedrooms per home.**(b)(i) Table Completion****10 marks (5 × 2marks: hit or miss)****(b)(i)**

| Number of bedrooms per home | 1        | 2        | 3        | 4        | 5        |
|-----------------------------|----------|----------|----------|----------|----------|
| Number of homes             | <b>2</b> | <b>6</b> | <b>5</b> | <b>4</b> | <b>3</b> |

*Notes*

N1 If the table is absent but the bar chart is drawn, bar chart values can earn marks for this section.

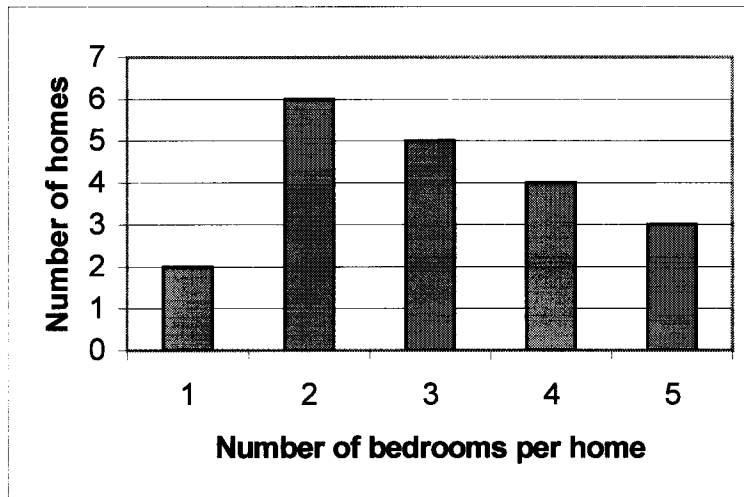


(b)(ii)

10 marks

Att 3

(b)(ii) Bar Chart



\* An incorrect table from (b)(i) can earn full marks here.

*Blunders* (−3)

B1 Vertical axis not graduated uniformly.

B2 Widths of bars inconsistent.

*Slips* (−1)

S1 Omits a bar (to a max of 3 bars).

S2 Incorrect height of bar (each time).

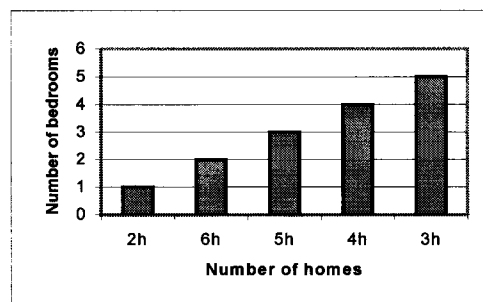
S3 A trend graph (then subject to slips and blunders, e.g. points not joined  $\Rightarrow$  −3marks).

*Attempts*

Att One bar only.

Att Number of bedrooms per home used as frequency.

Att Axes only.



*Notes*

N1 Accept implied labelling.

N2 Correct bar chart (with or without labelling)  $\Rightarrow$  10 marks.

N3 Accept bars together.

**(b)(iii)**

**10 marks**

**Att 3**

**(b)(iii)**

3 or more bedrooms =  $5 + 4 + 3 = 12$

- \* An incorrect table from **(b)(i)** can earn full marks here.
- \* The answer may be found without reference to the table.

*Blunders* (−3)

- B1 More than 3 bedrooms i.e. 7 homes.
- B2 Exactly 3 bedrooms i.e. 5 homes.
- B3 Less than 3 bedrooms i.e. 8 homes.
- B4 Not more than 3 bedrooms i.e. 13 homes.

*Slips* (−1)

- S1 Indicates 5 and 4 and 3 but no addition.

(b)(iv)

10 marks

Att 3

(b)(iv)

$$\text{Mean} = \frac{2+12+15+16+15}{20} = \frac{60}{20} = 3$$

- \* An incorrect table from (b) (i) can earn full marks here.
- \* The answer may be found without reference to the table.

*Blunders (-3)*

- B1 Inverts i.e.  $\frac{20}{60}$  and stops [also attracts S3].
- B2 Incorrect divisor or no divisor.
- B3 Incorrect  $\sum f.x$  without work.
- B4 Incorrect method of evaluating  $\sum f.x$ .

*Slips (-1)*

- S1 Numerical errors in addition within correct method of evaluating  $\sum f.x$  (max -3).
- S2 Each term evidently omitted within correct method of evaluating  $\sum f.x$  (max -3).

- S3  $\frac{60}{20}$  and stops.

*Attempts*

- Att Omits four terms in evaluation of  $\sum f.x$ .
- Att  $\frac{15}{5}$  or  $\frac{20}{5}$  or 20 are oversimplifications.
- Att The mode 2 given as the mean.

*Notes*

- N1  $\sum f.x$  only and stops  $\Rightarrow$  6 marks [B2 and S3].
- N2  $\frac{60}{20} \Rightarrow$  9 marks.
- N3 Accept  $\frac{60}{20}$  without work for 9 marks and accept 3 without work for 10 marks.
- N4  $\frac{2}{20} + \frac{12}{20} + \frac{15}{20} + \frac{16}{20} + \frac{15}{20}$  and stops  $\Rightarrow$  6 marks.

## QUESTION 5

|                   |                 |              |
|-------------------|-----------------|--------------|
| <b>Table</b>      | <b>20 marks</b> | <b>Att 7</b> |
| <b>Graph</b>      | <b>15 marks</b> | <b>Att 5</b> |
| <b>Part (i)</b>   | <b>5 marks</b>  | <b>Att 2</b> |
| <b>Part (ii)</b>  | <b>5 marks</b>  | <b>Att 2</b> |
| <b>Part (iii)</b> | <b>5 marks</b>  | <b>Att 2</b> |

### Question 5

**50 (20, 15, 5, 5, 5) marks**

**Att (7, 5, 2, 2, 2)**

**5.** Using graph paper, draw the graph of the function

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

in the domain  $-2 \leq x \leq 3, x \in \mathbf{R}$ .

- (i)** Use your graph to find the value of  $f(2.5)$ .
- (ii)** Use your graph to find the values of  $x$  for which  $f(x) = 0$ .
- (iii)** Draw the axis of symmetry of the graph of  $f(x)$ .

### Table

**20 marks**

**Att 7**

|        |          |          |           |           |          |          |
|--------|----------|----------|-----------|-----------|----------|----------|
| $x$    | -2       | -1       | 0         | 1         | 2        | 3        |
| $x^2$  | 4        | 1        | 0         | 1         | 4        | 9        |
| $-x$   | 2        | 1        | 0         | -1        | -2       | -3       |
| -1     | -1       | -1       | -1        | -1        | -1       | -1       |
| $f(x)$ | <b>5</b> | <b>1</b> | <b>-1</b> | <b>-1</b> | <b>1</b> | <b>5</b> |

| Table  | 20 marks |    |    |    |    | Att 7 |
|--------|----------|----|----|----|----|-------|
| $x$    | -2       | -1 | 0  | 1  | 2  | 3     |
| $x^2$  | 4        | 1  | 0  | 1  | 4  | 9     |
| $-x$   | 2        | 1  | 0  | -1 | -2 | -3    |
| -1     | -1       | -1 | -1 | -1 | -1 | -1    |
| $f(x)$ | 5        | 1  | -1 | -1 | 1  | 5     |

### Blunders (-3)

- B1  $x^2$  taken as  $2x$  all the way.
- B2  $-x$  taken as  $-1$  all the way.
- B3  $-1$  calculated as  $-x$  all the way.
- B4 Adds in top row when evaluating  $f(x)$ .
- B5 Omits ' $-1$ ' row or omits ' $-x$ ' row.
- B6 Omits a value in the domain each time to max of  $-12$  (5 values missing  $\Rightarrow$  Att 7).

### Slips (-1)

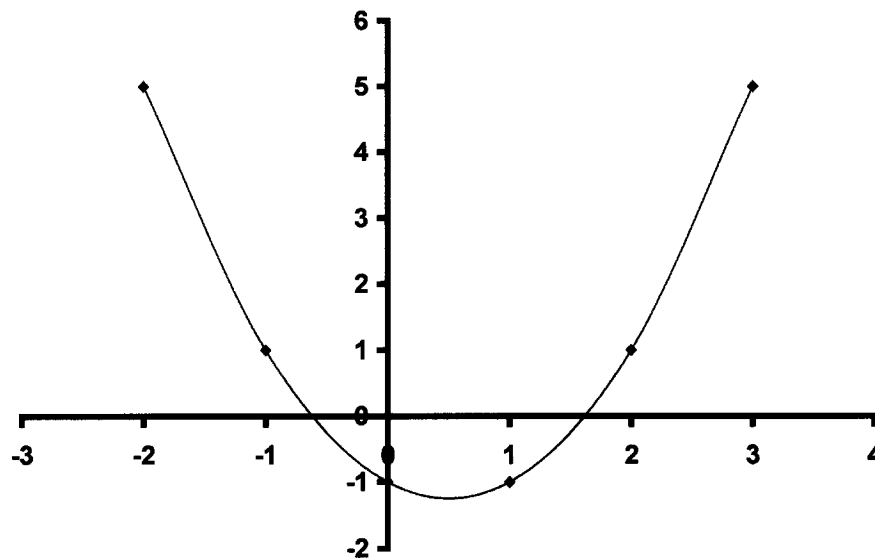
- S1 Numerical slips (to max  $-3$ ) in any row other than  $f(x)$  row.
- S2 Misreads ' $-1$ ' as ' $1$ ' and places ' $1$ ' in the table or ' $-x$ ' as ' $x$ ' and places ' $x$ ' in the table.
- S3 Each incorrect  $f(x)$  value calculated by addition within columns in candidate's table (to max  $-6$ ), but note B4.

### Attempts

- Att 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 or two points only calculated and nothing else.

### Notes

- N1 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.
- N2  $f(x)$  row attracts S3 subject to a maximum deduction of  $-6$ .

*Blunders (-3)*

- B1 Reversed co-ordinates plotted against non-reversed axes (once only) [see N3].  
 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 5  $\Rightarrow$  one or two points only calculated and graphed correctly.  
 N2 Correct graph but no table  $\Rightarrow$  full marks, i.e. 35 marks.  
 N3 Accept reversed co-ordinates (i) if axes not labelled or (ii) if axes are reversed to compensate (see B1 above).

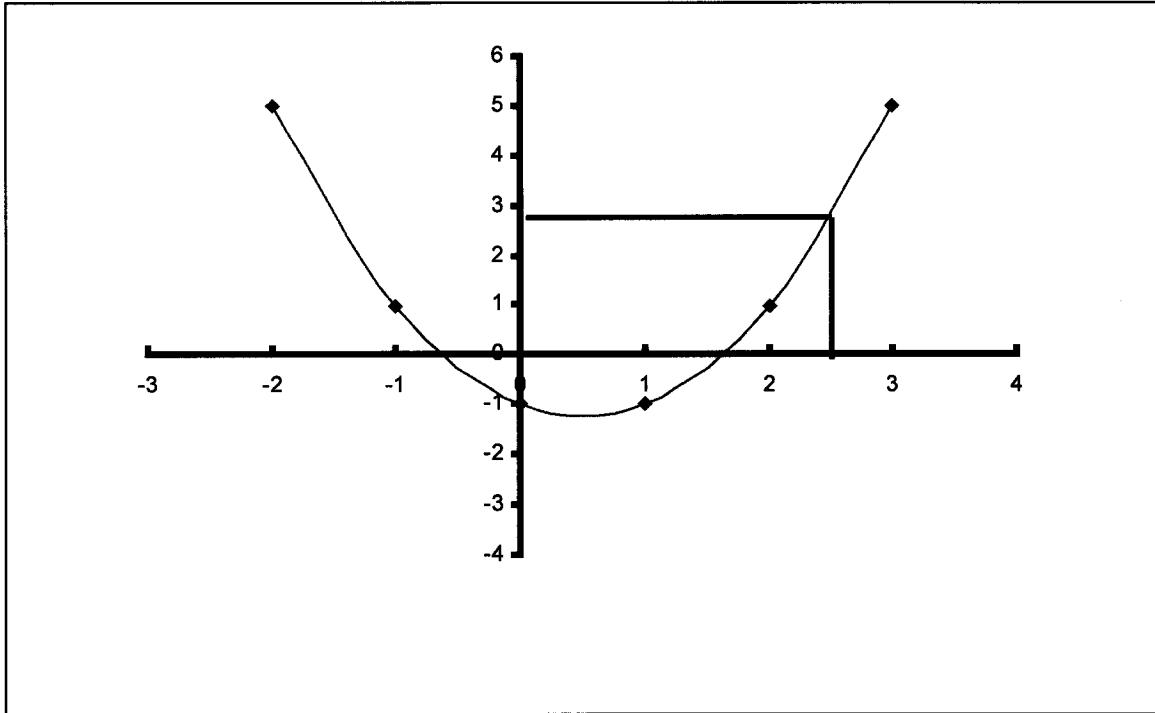
(i)

5 marks

Att 2

(i)

$$f(2.5) = 2.75$$



*Blunders (-3)*

- B1 Answer on diagram but outside of tolerance ( $2.25 \leq f(x) \leq 3.25$ ) [refers to horizontal indication].
- B2 Takes 2.5 on y-axis and indicates or reads answer on x-axis (one indication sufficient).
- B3 If  $x \neq 2.5$  be lenient: accept as correct a value of  $x$  in the interval ( $2.3 \leq x \leq 2.7$ ).

*Attempts*

- Att Marks 2.5 (in any way) on x-axis or y-axis and nothing else.

*Worthless (0)*

- W1 Answers outside of tolerance without graphical indication.

*Notes*

- N1 Correct answer inside tolerance without graphical indication  $\Rightarrow$  5 marks.
- N2 Accept reasonable indication on y - axis (it is not necessary to write down the answer, indication on graph is sufficient).
- N3 Graph takes precedence even if incorrect answer is stated.
- N4 A candidate's incorrect graph can earn up to full marks for this section [use similar tolerances].

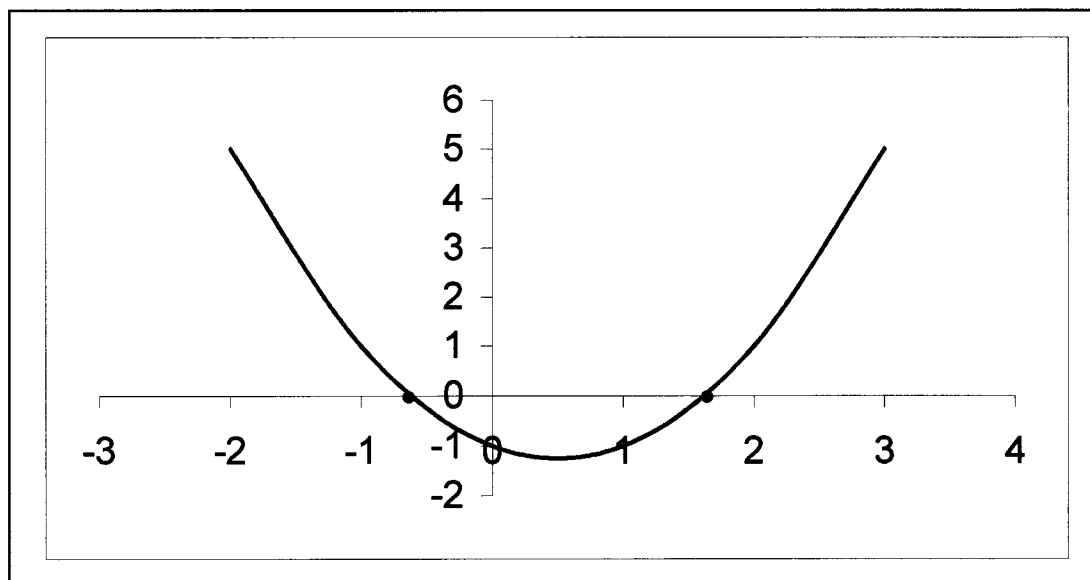
(ii)

5 marks

Att 2

(ii)

$$f(x) = 0 \Rightarrow x = -0.6 \text{ or } x = 1.6$$



*Blunders (-3)*

B1 Answer on diagram but outside of tolerance ( $\pm .25$ ).

B2 Only one value of  $x$ .

B3  $y = -1$  clearly written or indicated.

*Attempts*

Att  $x = 0$ .

*Worthless (0)*

W1 Answers outside of tolerance without graphical indication.

*Notes*

N1 Accept a written answer consistent with candidate's graph.

N2 If an answer is not written down then the two answer points must be distinguishable from other points on the curve and or axis.

N3 Accept indication on  $x$  – axis as per N2 (it is not necessary to write down the answer, indication on graph is sufficient).



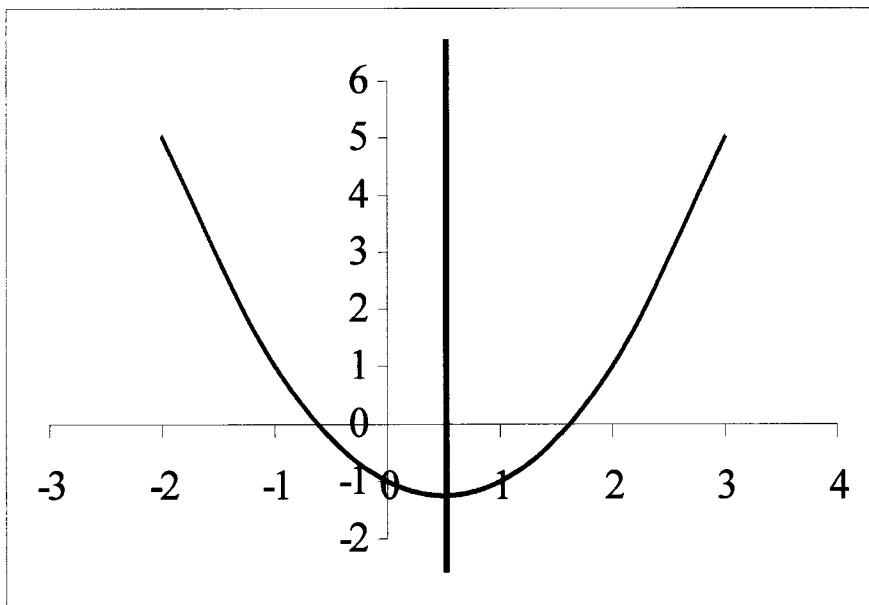
(iii)

5 marks

Att 2

(iii)

axis of symmetry at  $x = 0.5$ .



*Blunders (-3)*

- B1 Any vertical line outside of tolerance  $[0 < x < 1]$ .
- B2 Marks 0.5 on  $x$ -axis and stops.
- B3 States  $x = 0.5$  but line not indicated on graph.

*Attempts*

- Att Any non-vertical line.
- Att Any attempt at axial symmetry or central symmetry of  $f(x)$ .
- Att  $y$ -axis as the axis of symmetry.

*Notes*

- N1 Accept any vertical line in the interval  $0 < x < 1$ .
- N2 A candidate's incorrect graph can earn up to full marks for this section - mark using a similar tolerance.

## QUESTION 6

|                 |                              |                         |
|-----------------|------------------------------|-------------------------|
| <b>Part (a)</b> | <b>10 marks</b>              | <b>Att 3</b>            |
| <b>Part (b)</b> | <b>20 (5, 5, 5, 5) marks</b> | <b>Att (2, 2, 2, 2)</b> |
| <b>Part (c)</b> | <b>20 (10, 10) marks</b>     | <b>Att (3, 3)</b>       |

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

**6(a)** Write the following three numbers in order, starting with the smallest.

0.15                  0.07                  0.3

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

**(a)** 0.07 0.15 0.3

*Blunders* (−3)

B1 Any incorrect listing of the three numbers other than the misreading below (M1).

*Misreadings* (−1)

M1 Starting with the largest i.e. 0.3, 0.15, 0.07 ⇒ 9 marks.

*Attempts*

Att Only one or two numbers written down.

Att Some effort at converting to fractions but without a listing.

*Notes*

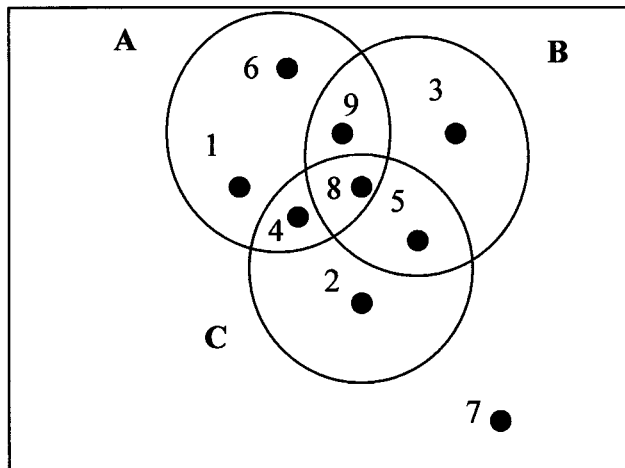
Commonly occurring incorrect answers - apply marks as follows:

|      |      |      |          |
|------|------|------|----------|
| 0.07 | 0.15 | 0.3  | 10 marks |
| 0.3  | 0.15 | 0.07 | 9 marks  |
| 0.07 | 0.3  | 0.15 | 7 marks  |
| 0.3  | 0.07 | 0.15 | 7 marks  |
| 0.15 | 0.07 | 0.3  | 7 marks  |
| 0.15 | 0.3  | 0.07 | 7 marks  |

(b)

List the elements in each of the following sets:

- (i) A
- (ii)  $A \cap B$
- (iii)  $B'$
- (iv)  $(B \cup C) \setminus A$ .



(b)(i)

5 marks

Att 2

(b)(i)

 $A = \{1, 4, 6, 8, 9\}$ *Slips (-1)*

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

*Notes*

N1 Accept a Venn Diagram (of A, and/or B, and/or C) with correct region indicated or with only the elements of A correctly placed.

N2 No correct element included  $\Rightarrow$  0 marks.

**(b)(ii)**

**5 marks**

**Att 2**

**(b)(ii)**

$$A \cap B = \{8, 9\}$$

*Blunders* (−3)

B1 Any incorrect set of the elements of  $A$  and  $B$  other than the misreading (M1) below.

*Misreadings* (−1)

M1  $A \cup B$  giving  $\{1, 3, 4, 5, 6, 8, 9\}$ .

*Attempts*

Att If one, or both, of 2 and 7 appear.

*Notes*

N1 Accept a Venn Diagram (of  $A$  and  $B$  or of  $A, B, C$ ) with correct region indicated or with only the elements of  $A \cap B$  correctly placed.

**(b)(iii)**

**5 marks**

**Att 2**

**(b)(iii)**

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

*Slips* (−1)

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

*Attempts*

Att  $B$  or any proper subset of  $B$ .

*Notes*

N1 Accept a Venn Diagram (of  $A, B, C$ ) with correct region indicated or with only the elements of  $B'$  correctly placed.

**(b)(iv)**

**5 marks**

**Att 2**

**(b)(iv)**

$$(B \cup C) \setminus A = \{2, 3, 4, 5, 8, 9\} \setminus \{1, 4, 6, 8, 9\} = \{2, 3, 5\}$$

*Blunders* (−3)

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

*Misreadings* (−1)

M1  $A \setminus (B \cup C)$  giving  $\{1, 6\}$ .

M2  $(B \cap C) \setminus A$  giving  $\{5\}$ .

*Attempt*

Att 7 appears in the answer.

*Notes*

N1 Accept a Venn Diagram (of  $A, B, C$ ) with correct region indicated or with only the elements of  $(B \cup C) \setminus A$  correctly placed.

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

Solve for x:

$$\frac{1}{x+4} - \frac{1}{x} = 1.$$

**(c) Forming Quadratic****10 marks****Att 3****(c)**

$$\frac{1}{x+4} - \frac{1}{x} = 1$$

$$\frac{x - (x+4)}{(x+4)(x)} = 1$$

$$\frac{-4}{x^2 + 4x} = 1$$

$$x^2 + 4x = -4$$

$$x^2 + 4x + 4 = 0$$

$$\frac{1}{x+4} - \frac{1}{x} = 1$$

$$\frac{x - (x+4) = x(x+4)}{x(x+4)}$$

$$\frac{-4 = x(x+4)}{x(x+4)}$$

$$-4 = x^2 + 4x$$

$$x^2 + 4x + 4 = 0$$

**Blunders (-3)****B1** Incorrect common denominator and continues.**B2**  $(x+4) - x$  as numerator.**B3**  $x - (x+4) \neq -4$ .**B4** Errors in forming quadratic equation after common denominator/ subtraction.**Slips (-1)****S1** Numerical errors (max -3).**Attempts****Att**  $x(x+4)$  only appears.**Att** "cross multiplication".

$$\text{Att} \quad \left(\frac{1}{x+4}\right)\left(\frac{1}{x}\right).$$

**Notes****N1** Subtracts numerators and then denominators i.e.  $\frac{1}{x+4} - \frac{1}{x} = \frac{0}{4} \Rightarrow 0$  marks.

(c)

$$x^2 + 4x + 4 = 0$$

$$(x + 2)(x + 2) = 0$$

$$x + 2 = 0$$

$$x = -2$$

$$x = \frac{-4 \pm \sqrt{16 - 16}}{2}$$

$$x = \frac{-4 \pm \sqrt{0}}{2} \Rightarrow x = \frac{-4}{2}$$

$$x = -2.$$

\* Solving a linear equation (resulting from errors) can only earn the attempt mark.

### Factor Method

#### Blunders (-3)

- B1 Incorrect two term linear factors of  $x^2 + 4x + 4$  formed from correct, but not applicable, factors of  $x^2$  and  $\pm 4$ .
- B2 Correct cross method but factors not shown and stops also incurs B4  $\Rightarrow$  4 marks (but see N1).
- B3  $x(x + 2) + 2(x + 2)$  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. (applies to "error Quadratic" with distinct roots: correct answer is the repeated root  $x = -2$ )

#### Slips (-1)

- S1 One root omitted or a root incorrect provided a correct root has been found [see B5].

#### Attempts

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

#### Notes

- N1 Correct cross method giving  $x = -2 \Rightarrow$  10 marks.

### Formula Method

#### Blunders (-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.

#### Slips (-1)

- S1 One root omitted in final step.
- S2 Numerical errors (to max -3).

#### Attempts

- Att Correct quadratic formula only.
- Att Correctly substituted quadratic formula and stops.