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Scrúdú an Teastais Shóisearaigh 2001

Junior Certificate Examination 2001

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. When awarding attempt marks, e.g. Att(4), it is essential to note that
    *   any correct relevant step in a part of a question merits, *at least,* the attempt mark for that part
    *   if deductions result in a mark which is lower than the attempt mark, then the attempt mark must be awarded
    *   a mark between zero and the attempt mark is never awarded.

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

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

5. Special notes relating to the marking of a particular part of a question are indicated by N1, N2, N3,.. etc.

6. Particular cases, verifications and answers derived from diagrams (unless requested) qualify for the attempt mark 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

1(i)   Find the total cost of

3 cans of orange @ 55p per can

4 chocolate bars @ 28p per bar

2 bags of crisps @ 23p per bag

(i)	10 marks	Att 3

1(i)

$3 \times 0.55 = 1\ 65$

$4 \times 0\ 28 = 1\ 12$ $1\ 65 + 1.12 + 0\ 46 = 3\ 23$

$2 \times 0\ 23 = 0\ 46$

Total cost = 323p = IR£3 23

Blunders (-3)
B1   Each missing product
B2   No addition.
B3   Errors in decimal point (once only)

Slips (-1)
S1   Numerical errors in multiplication or addition (to max −3)

Attempts
Att   One correct multiplication and stops.
Att   Some use of the given data e.g. 3+4+2 = 9 or 55+28+23 =106

Notes
N1   Accept 323 or 3 23 regardless of subsequent labelling or work
N2   32 3 ⇒ B3.

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

1(ii)	A bus travels a distance of 75 km in one hour thirty minutes
	Find the average speed of the bus in km per hour

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

1(ii)

$$\frac{75}{1.5} = 50 \text{ km/hr.} \quad \text{or} \quad \frac{75}{1\frac{1}{2}} = \frac{75 \times 2}{3} = \frac{150}{3} = 50 \text{ km/hr} \quad \text{or} \quad$$

$$3(\frac{1}{2}) = 75$$
$$1(\frac{1}{2}) = 25$$
$$2(\frac{1}{2}) = 50 \text{ km/hr.}$$

Blunders (−3)

B1 $\frac{75}{1\frac{1}{2}} = \frac{75 \times 3}{2}$ or error in decimal point in division or no division.

B2 $\frac{1\frac{1}{2}}{75}$ or $\frac{1.5}{75}$ and continues

B3 $1\frac{1}{2} \times 75$ and continues (incorrect formula – i e $s = d\,t$)

B4   Treating 1hr 30min as 1 3 hrs or as 130 hrs.

B5 $\frac{75}{1\frac{1}{2}}$ treated as $\frac{75}{1} + \frac{75}{\frac{1}{2}} = 225$

Slips (−1)

S1   Each numerical error in multiplication and division (to a max −3)

Misreadings (−1)

M1   Speed $= \frac{75}{90} = \frac{5}{6}$ km/min or $= \frac{75000}{1\,5} = 50,000$ m/hr etc

Attempts

Att   1 hour and 30 minutes as $1\frac{1}{2}$ hours or 90 minutes and stops

Att   Correct or incorrect formula relating s, d and t only

Notes

N1   Correct answer without work $\Rightarrow$ 10 marks

N2 $\frac{75}{1\frac{1}{2}}$ or $\frac{75}{1.5}$ and stops $\Rightarrow$ 7 marks

N3 $\frac{75}{1\,\text{hr}\,30\,\text{min.}}$ and stops $\Rightarrow$ 4 marks

Part (iii)	10 marks	Att 3

1(iii) Simplify.

$$\frac{2}{5} \div \frac{4}{5} + \frac{3}{4}$$

(iii)	10 marks	Att 3

1(iii)

$$\frac{2}{5} \times \frac{5}{4} = \frac{2}{4} \qquad \frac{2}{4} + \frac{3}{4} = \frac{5}{4}$$

$$\frac{2}{5} \times \frac{5}{4} = \frac{10}{20} . \quad \frac{10}{20} + \frac{3}{4} = \frac{10+15}{20} = \frac{25}{20} = \frac{5}{4}$$

$.4 \div 8 + 75$

$= .5 + 75$

$= 1\ 25.$

Blunders (-3)

B1 Error in operation order, i.e $\frac{2}{5} \div \frac{4}{5} + \frac{3}{4} = \frac{2}{5} \div \frac{16+15}{20} = \frac{2}{5} \times \frac{20}{31} = \frac{8}{31}$ (each time)

B2 Treats $-$ as $\times$ and continues, i e $\frac{2}{5} \times \frac{4}{5} + \frac{3}{4} = \frac{8}{25} + \frac{3}{4} = \frac{32+75}{100} = \frac{107}{100}$

B3 $\frac{2}{5} - \frac{4}{5} = \frac{5 \cdot 5}{2 \times 4} = \frac{25}{8}$ and continues

B4 Errors in cancellation when simplifying within multiplication (once only).

B5 Incorrect common denominator in addition step and continues

B6 Errors in addition step while using correct common denominator (once only).

B7 $\frac{8 \times 25+15}{20}$ and continues but $\frac{8 \times 16+15}{20}$ attracts B2 as well as B7

B8 Error in decimal point

Slips (−1)

S1 Numerical errors (to a max−3).

S2 Not reducing fraction to its simplest form

Attempts

Att Uses + or − instead of ×

Att Correctly adds $\frac{3}{4}$ to $\frac{4}{5}$ or $\frac{2}{5}$ and stops

Att Correctly converts one or more fractions to decimals and stops

Notes

N1 $\frac{25}{20} \Rightarrow 9$ marks

N2 Adds "without common denominator", e g $\frac{2}{4} + \frac{3}{4} = \frac{5}{8}$ or $\frac{10}{20} + \frac{3}{4} = \frac{13}{24} \Rightarrow 4$ marks

N3 No addition $\Rightarrow 4$ marks

N4 $\frac{8 \times 25+15}{20}$ and stops $\Rightarrow 3$ marks

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

1(iv)	Find the mean of the six numbers:
	1 2, 2 8, 3.6, 4 3, 5.7, 6 4.

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

1(iv)	$\dfrac{1\,2 + 2.8 + 3\,6 + 4\,3 + 5\,7 + 6\,4}{6} = \dfrac{24}{6} = 4$

Blunders (-3)

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

B2   Incorrect denominator.

B3 $\dfrac{6}{24}$ or 24×6 and continues.

B4   24 and stops. [Also S2, see N1]

Slips (-1)

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

S2 $\dfrac{24}{6}$ and stops

Attempts

Att   6 and no more.

Att   Some use of the given data

Notes

N1   24 only $\Rightarrow$ 6 marks.

N2   Sum of 5 items/5 $\Rightarrow$ B1 only.

N3   1.2 = 2 or 2 8 = 16 etc − treat as misreading

N4   Accept correct answer without work.

N5 $\dfrac{24}{6} \Rightarrow$ 9 marks

1(v)   A function f is $x \to 2x - 1$.

         Find the value of $f(2) + f(-1)$

1(v)

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

Blunders (-3)

B1 $f(2)$ incorrect misunderstanding of the concept of a function.

B2 $f(-1)$ incorrect misunderstanding of the concept of a function.

B3   Fails to evaluate $f(2)$ or $f(-1)$. [Also attracts S1]

Note   If function concept is correct, then completion of $f(2) + f(-1)$ is subject to maximum deduction of −3

B4   Error in sign (once only)

Slips (-1)

S1   Fails to add, having evaluated $f(2)$ and $f(-1)$

S2   Numerical errors (to max −3).

Attempts

Att   One correct substitution and stops

Att   Treats as equation(s) and continues or stops

Att $f(2) + f(-1) = f(1)$ and continues with understanding of function concept

Notes

N1   Correct function concept, i.e $2(2) - 1 + 2(-1) - 1$ and stops $\Rightarrow$ 7 marks

N2 $4 - 1 - 2 - 1$ and stops $\Rightarrow$ 7 marks

N3   Ignores x giving $2 - 1 = 1 \Rightarrow$ 0 marks

N4 $f(2) + f(-1) = f(1)$ and stops $\Rightarrow$ 0 marks

N5 $2[f(x)] = 4x - 2$ and or $-1[f(x)] = -2x + 1 \Rightarrow$ 0 marks

Part (vi)	10 marks	Att 3

1(vi)	Solve the simultaneous equations

$$2x + 3y = 12$$
$$2x - y = 4$$

(vi)	10 marks	Att 3

1(vi)	$2x + 3y = 12$	$2x + 3y = 12$	$y = 2x - 4$
	$2x - y = 4$	$2x - y = 4$	$2x + 3(2x - 4) = 12$
	$4y = 8$	$2x + 3y = 12$	$2x + 6x - 12 = 12$
	$y = 2$	$6x - 3y = 12$	$8x = 24$
	$2x + 6 = 12$	$8x = 24$	$x = 3$
	$2x = 6$	$x = 3$	$y = 2$
	$x = 3$	$y = 2$	

Blunders (-3)

B1 Error(s) in establishing the first equation in terms of x only [$8x = 24$] or the first equation in terms of y only [$4y = 8$] 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

1(vii)   Express c in terms of a and b when $2c\text{-}b = a$.

(vii)   **10 marks**   **Att 3**

1(vii)

$$2c - b = a$$
$$2c = a + b$$
$$c = \frac{a+b}{2} \quad \text{or} \quad c = \frac{a}{2} + \frac{b}{2}$$

$$c - \frac{b}{2} = \frac{a}{2}$$
$$c = \frac{a}{2} + \frac{b}{2}$$

Blunders (-3)

B1   Each error in transposition.

B2 $2c = a + b$ and stops

B3   Not dividing each term by 2 to get $c = \frac{a}{2} + \frac{b}{2}$

Misreadings (-1)

M1 b in terms of a and c, e g $2c - a = b$

Attempts

Att   Some effort at transposition, e.g $2c - b - a = 0$ and stops.

Notes

N1 $\dfrac{-b-a}{-2} = c \Rightarrow 10$ marks

N2 $c - \dfrac{b}{2} = \dfrac{a}{2} \Rightarrow 7$ marks.

N3 $-b = -a - 2c \Rightarrow 6$ marks.

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

1(viii) Write out all the values of x for which

$$2x - 3 < 2 + x, \quad x \in N$$

(viii)   **10 marks**   **Att 3**

1(viii)

$$2x - 3 < 2 + x$$
$$2x - x < 2 + 3$$
$$x < 5$$

The values of x are 0, 1, 2, 3 and 4.

Blunders (-3)

B1   Each error in transposition

B2   Mishandling direction of inequality, e g. $-5 < -x \Rightarrow 5 < x$.

B3   Adds "x"s and "numbers", e.g. $2x - 3 = -x$ (once only)

B4   No listing or no indication on number line.

Slips (-1)

S1   Numerical errors (to max -3)

S2   Incorrect listing of x-values (from candidate's work) but accept an indication on number line

S3 $<$ is taken as $\leq$

S4 $x \in R$ in number line indication

Attempts

Att   Treats as an equation and continues <u>but</u> fully correct listing or 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 listing (with at least one natural number) without work, or indication (with at least one natural number indicated) without work.

Notes

N1 $x < 5 \Rightarrow 7$ marks.

N2   Correct answer listed, or properly indicated on number line, without work $\Rightarrow 10$ marks.

N3   If $x > 5$ as a result of error, accept 6,7,8 and or more as a listing or such an indication on number line

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

1(ix)	Write down the factors of $$x^2 - 4x - 21$$	

(ix)	**10 marks**	**Att 3**

1(ix)	$x^2 - 4x - 21$ $x^2 - 7x + 3x - 21$ $x(x - 7) + 3(x - 7)$ $(x - 7)(x + 3)$	$x \quad\quad -7$ (cross method) $x \quad\quad +3$ $(x - 7)(x + 3)$

Blunders (-3)

B1   Incorrect two term linear factors of $x^2 - 4x - 21$ formed from correct, but not applicable, factors of x^2 and ± 21.

B2   Correct cross method but factors not written

B3 $x(x - 7) + 3(x - 7)$ or $x(x + 3) - 7(x + 3)$ or $x(x + 3) + 7(-x - 3)$ and stops.

B4 $(x - 7) \pm (x + 3)$.

B5   Uses quadratic equation formula to find $x = 7$ 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)

S2   Each error in sign.

Attempts

Att   Correct factors of x^2 only

Att   Correct factors of -21 or $+21$ only

Att $-7x + 3x$ 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

$(x - 7)$ and $(x + 3)$ [The word **and** is written down]

$(x - 7)$ or $(x + 3)$ [The word **or** is written down.]

N3   Accept $(x - 7), (x + 3)$ for 10 marks

Part (x)	10 marks	Att 3

1(x) Multiply 324 4 by 2 5

Express your answer in the form $a \times 10^n$, where $1 \le a < 10$ and $n \in \mathbf{Z}$.

(x)	10 marks	Att 3
1(x)	$324\ 4 \times 2.5 = 811 = 8\ 11 \times 10^2$	

Blunders (-3)
B1   Error in decimal point on multiplication
B2   Error in "a"
B3   Error in "n", subject to candidate's "a".

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

Attempts
Att   Use of any other operator
Att   Incorrect multiplication and stops

Notes
N1   811 and stops $\Rightarrow$ 4 marks.
N2   8 11 (after getting 811) and stops $\Rightarrow$ 7 marks.

QUESTION 2

Part (a)	10 marks	Att 3
Part (b)	20(10, 10) marks	Att 6(3, 3)
Part (c)	20(10, 5, 5) marks	Att 7(3,2,2)

Part (a)	10 marks	Att 3

2(a)	John is 15 years old Mary is 10 years old IR£50 is shared between them in the ratio of their ages. How much does each of them receive?

(a)	10 marks	Att 3

2(a)	15 parts 10 parts $\Rightarrow$ 1 part $\equiv \dfrac{50}{25}$ $\Rightarrow$ 1 part $\equiv 2$ $\Rightarrow$ 15 parts $\equiv 30$ and 10 parts $\equiv 20$	*x method* $15x \cdot 10x$ $\Rightarrow 25x = 50$ $\Rightarrow x = 2$ $\Rightarrow 15x = 30$ and $10x = 20$	$15 \cdot 10 \Rightarrow 30 \cdot 20$ John receives IR£30 and Mary receives IR£20

Blunders (-3)
B1   One share incorrect or one share omitted
B2   Incorrect divisor and continues.
B3   Incorrect multipliers
B4   Error in transposition.

Slips (-1)
S1   Numerical errors in division or multiplication (max –3).

Attempts
Att   Incorrect divisor and stops
Att   Indicates 25 shares and stops.
Att   750·500
Att $\dfrac{50}{15}$ and / or $\dfrac{50}{10}$ and stops.
Att $\dfrac{15}{10} \times 50 = 75$ and stops

Notes
N1   Accept correct answer without work giving 10 marks.
N2   2 and stops $\Rightarrow$ 4 marks

Part (b)   **20(10, 10) marks**   **Att 6(3, 3)**

2(b)	IR£2000 is invested for two years at 4% per annum compound interest. How much interest is earned?

2(b)

	IR£	
Pr 1	2000	(1%=20)
Int. 1	80	(4%=80)
Pr 2	2080	(1%=20 8)
Int. 2	83 2	(4%=83 2)
Amt	2163 2	
Pr 1	2000	
C I	163.2	

$$\frac{PTR}{100} = \frac{2000 \times 1 \times 4}{100} \Rightarrow \text{Int.}1 = \text{IR£}80$$

$$\frac{PTR}{100} = \frac{2080 \times 1 \times 4}{100} \Rightarrow \text{Int } 2 = \text{IR£}83.2$$

$$\Rightarrow \text{Total Interest} = \text{IR£}163\ 2$$

Interest 1 and Principal 2   **10 marks**   **Att 3**

Blunders (-3)

B1   Mishandles 4% e g 2000 × 4 or 2000 − 4 (£2000 must be used)
B2   Error in decimal point (once only)
B3   Subtracts Interest 1 from Principal 1
B4   Stops at Interest 1
B5   Incorrect substitution(s) into correct formula and continues (2000 must be used)

Slips (-1)

S1   Numerical errors (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

Att $\left[\frac{2000 \times 2 \times 4}{100} \right]$ or $\left[\frac{2000 \times 2 \times 4}{100} = 160 \right]$ or 160 and no further work

Notes

N1   80 and stops ⇒ 7 marks
N2   2000 × 4 = 8000 and stops ⇒ 4 marks (B1+ B4).
N3   2000 × 4 = 8000 and 8000 + 2000 = 10000 ⇒ 7 marks (B1).

Blunders (-3)
B1   Mishandles 4%, but no penalty if as above
B2   Error in decimal point (once only).
B3   Incorrect substitution(s) into correct formula and continues but no penalty if as above,
     e.g T=2 used in both parts but $P_2 \neq P_1$.
B4   Subtracts interest 2 from principal 2

Slips (-1)
S1   Numerical errors (to max –3).
S2   Gives amount as answer.
S3   Fails to add Interest 1 and Interest 2.

Attempts
Att   Correct formula with or without substitution and stops
Att   Again some use of 100 in attempt to find percentage, e.g 4% = $\frac{4}{100}$ and stops.

Att   Again $\left[\dfrac{2000 \times 2 \times 4}{100}\right]$ or $\left[\dfrac{2000 \times 2 \times 4}{100} = 160\right]$ or 160

Notes
N1   80 is recalculated $\Rightarrow$ 3 marks.
N2 $P_2 = P_1 \Rightarrow$ Att
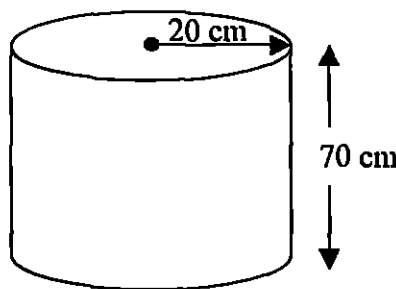N3 $[80 \times 2]$ or $[80 \times 2 = 160] \Rightarrow$ Att

(c)(i)   Volume of Cylinder   10 marks   Att 3

2(c)(i)   A cylindrical drum full
of milk has a radius 20 cm
and height 70 cm

Find its volume in cm³

Take $\pi = \dfrac{22}{7}$.

20 cm

70 cm

2(c)(i)

$$V = \pi r^2 h$$

$$= \frac{22}{7}(20)^2(70)$$

$$= \frac{22}{7}(400)(70) = 88,000 cm^3$$

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 π 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 20 and or 70
Att   Some use of 20 or 70

Notes

N1   Allow $\pi = 3.14$ or $\pi = 3.1$ (from an evaluation of $\dfrac{22}{7}$).

N2   88,000 without work $\Rightarrow$ 10 marks

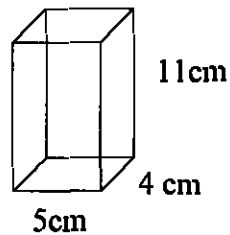N3 $\dfrac{1}{3}\pi r^2 h$ and continues $\Rightarrow$ 7 marks.

(c)(ii) Volume of carton　　　　　**5 marks**　　　　　**Att 2**

2(c)(ii)

Find the volume of a

rectangular carton measuring

5 cm by 4cm by 11cm

11cm

4 cm

5cm

(c)(ii)　　　　　**5 marks**　　　　　**Att 2**

2(c)(ii)

$$v = l \times b \times h$$
$$= 5 \times 4 \times 11$$
$$= 220 cm^3$$

Blunders (-3)
B1　　Each incorrect dimension

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 given data

Notes
N1　　220 as answer without work $\Rightarrow$ 5 marks

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

2(c)(iii)	How many of these cartons can be filled using all the milk from the drum?

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

2(iii)	Number of cartons $= \dfrac{88000}{220} = 400$.

Blunders (-3)
B1   Error in decimal point

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

Attempts
Att 88000×220
Att   Some incorrect use of candidate's answers from parts **(i)** and **(ii)**.

QUESTION 3

Part (a)	10 marks	Att 3
Part (b)	20(10, 10) marks	Att 6(3, 3)
Part (c)	20(10, 5, 5) marks	Att 7(3, 2, 2)

Part (a)	10 marks	Att 3

3(a)　　When $a = 3$ and $b = 2$ find the value of

$$\frac{2a^2 - 5b}{4b - 2a}.$$

(a)	10 marks	Att 3

3(a)

$$\frac{2a^2 - 5b}{4b - 2a} = \frac{2(3)^2 - 5(2)}{4(2) - 2(3)}$$

$$= \frac{2(9) - 5(2)}{4(2) - 2(3)} = \frac{18 - 10}{8 - 6}$$

$$= \frac{8}{2} = 4$$

Blunders (-3)
B1　　Error in substitution (once only)
B2　　A substitution omitted (once only).
B3　　Mishandles $(3)^2$, e g 6
B4　　Breaks order in evaluating $2(3)^2$, e g. 36
B5　　Illegal cancellation (once only).

Misreading (-1)
M1　　$a = 2 : b = 3$

Slips (-1)
S1　　Numerical errors (to max –3)
S2　　Each error in sign

Attempts
Att　　Some effort at substitution and stops.

Notes
N1　　$\frac{8}{2} \Rightarrow 9$ marks.

N2　　Correct substitution and stops $\Rightarrow 4$ marks

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

3(b) Factorise	
	(i)　　$2ax + ay + 2bx + by$
	(ii)　　$x^2 - 16$

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

3(b)(i)	$a(2x + y) + b(2x + y)$
	$(2x + y)(a + b)$

Blunders (-3)
B1　Stops after first line of correct factorisation
B2　Error in factorising any pair of terms (once only).
B3　Incorrect common factor and continues
B4　$(2x + y) \pm (a + b)$

Slips (-1)
S1　Each error in sign

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

Notes
N1　$a(2x + y) + x(2b + y) \Rightarrow (2x + y)(a + x) \Rightarrow 4$ marks (B2 + B3).
N2　$a(2x + y) + b(x + y) \Rightarrow (x + y)(a + b) \Rightarrow 4$ marks (B2 + B3).

(b)(ii)	10 marks	Att 3

3(b)(ii)	
	$x^2 - 16$ $= (x)^2 - (4)^2$ $= (x + 4)(x - 4)$

Blunders (-3)

B1   Incorrect two term linear factors of $x^2 - 16$ formed from correct, but not applicable, factors of x^2 and ± 16.

B2 $(x + 16)(x - 16)$ or $(x + 8)(x - 8)$

B3 $(x + 4) \pm (x - 4)$

Attempts

Att   Factors of x^2 or 16 only.

Att $(x + 4)$ or $(x - 4)$, i e one factor only

Att $(4x)(4x)$.

Notes

N1 $(x)^2 - (4)^2 \Rightarrow 4$ marks.

N2   Accept (with or without brackets) for 10 marks any of the following:

      $(x + 4)$ and $(x - 4)$ [The word **and** is written down.]

      $(x + 4)$ or $(x - 4)$ [The word **or** is written down]

      $(x + 4).(x - 4)$

3(c)   **(i)**   Multiply $2x^2 - x + 1$ by $x - 2$

       (ii)   Anne has IR£x Jim has IR£4 more than Anne

              They have IR£16 in total.

              Write an equation in x to show this information

              Solve the equation to find how much money Anne has

3(c)(i)

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

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

$= 2x^3 - x^2 + x - 4x^2 + 2x - 2$

$= 2x^3 - 5x^2 + 3x - 2$

$2x^2 - x + 1$

$\underline{x - 2}$

$2x^3 - x^2 + x$

$\underline{-4x^2 + 2x - 2}$

$2x^3 - 5x^2 + 3x - 2$

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 $x(2x^2 - x + 1) - 2(2x^2 - x + 1)$ and stops

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

(c)(ii) Write an equation   **5 marks**   **Att 2**

3(c)(ii)		
	Anne. x	$(x) + (x + 4) = 16$
	Jim $x + 4$	
	Total. 16	

Blunders (-3)
B1 $x + 4$ taken as $4x$
B2   Incorrectly formed equation with x, $x + 4$ and 16.

Attempts
Att   Jim. $x + 4$ only and stops

Notes
N1 $2x + 4 = 16 \Rightarrow 5$ marks   [Can also earn attempt marks for solving equation].

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

3(c)(ii)	
	$x + x + 4 = 16$
	$2x + 4 = 16$
	$2x = 12$
	$x = 6$

Blunders (-3)
B1   Errors in transposition
B2   Adds "x"s to numbers and continues ($2x + 4 = 6x$)

Slips (-1)
S1   Error in division e.g $2x = 12$ giving $x = 5$ (say)
S2   Errors in addition (to max –3)
S2   Jim·IR£10 as only answer

Attempts
Att $2x + 4 = 16$ and stops.

Notes
N1   Correct answer without work $\Rightarrow$ 5 marks.

N2   Accept correct arithmetic methods e g $16 - 4 = 12$, $\dfrac{12}{2} = 6$, or similar

QUESTION 4

Part (i)	20 marks	Att 7
Part (ii)	5 marks	Att 2
Part (iii)	10 marks	Att 3
Part (iv)	5 marks	Att 2
Part (v)	10 marks	Att 3

4.

All the families living in a certain street are surveyed to find how many children

are in each family The results of the survey are shown in the frequency

table below For example, 3 families have one child each

Number of Children per Family	1	2	3	4	5	6
Number of Families	3	5	7	9	4	2

(i)   Using graph paper, draw a bar chart to show this information

Put the number of children per family on the horizontal axis

(ii)   How many families live in the street?

(iii) Calculate the mean number of children per family

(iv)   Write down the modal number of children per family

(v)   What percentage of families in the street have more than 4 children?

4(i)   Bar Chart
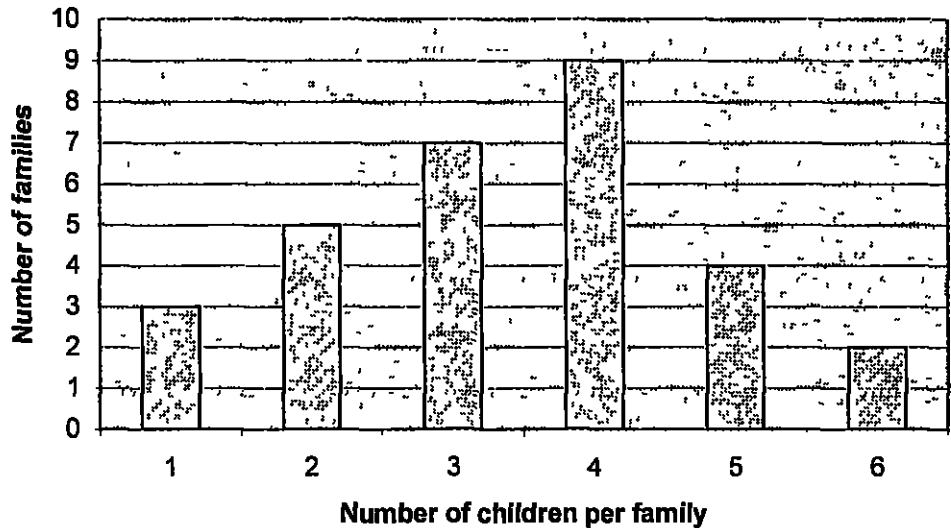
Blunders (-3)

B1   Vertical axis not graduated uniformly.

B2   Widths of bars is inconsistent

Slips (−1)

S1   Omits a bar (to a max of 3 bars)
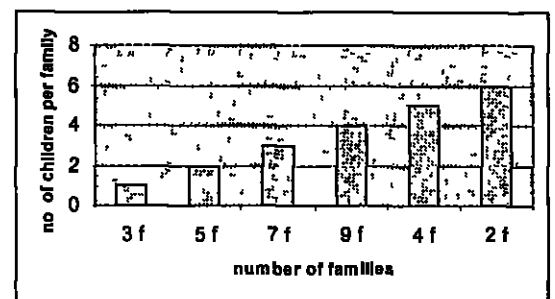
S2   Incorrect height of bar (each time)

S3   Number of children per family not put on horizontal axis but not used as frequency,

S4   A trend graph (then subject to slips and blunders, e g points not joined ⇒ −3marks)

Attempts

Att   One bar or two bars only

Att   Number of children per family used as frequency

Notes

N1   Accept implied labelling

N2   Correct bar chart (with or without labelling) ⇒ 20 marks

N3   Accept bars together

4(ii)
$3 + 5 + 7 + 9 + 4 + 2 = 30$

Blunders (-3)

B1   Omits more than one value (clearly evident from student's work).

Slips (−1)

S1   Omits one value only (clearly evident from student's work).

S2   Numerical error(s) in addition (clearly evident from student's work).

Attempts

Att   1+2+3+4 +5 + 6 = 21

Notes

N1   Accept correct answer without work

N2   Wrong answer without work $\Rightarrow$ 0 marks

4(iii)	$$\text{Mean} = \frac{3+10+21+36+20+12}{30} = \frac{102}{30} = 3\,4.$$

Blunders (-3)

B1   Inverts i e $\dfrac{30}{102}$ and stops   [Also attracts S4.]

B2   Incorrect divisor

B3   Incorrect $\sum f x$ without work

B4   Incorrect method of evaluating $\sum f x$

Slips (−1)

S1   Numerical errors 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 $\dfrac{102}{30}$ and stops

Attempts

Att   Omits four or more terms in evaluation of $\sum f x$

Att $\dfrac{21}{6}$ or $\dfrac{30}{6}$ are over simplifications

Notes

N1 $\sum f x$ only and stops $\Rightarrow$ 6 marks. [B2 and S3.]

N2 $\dfrac{102}{30} \Rightarrow$ 9 marks

N3   An incorrect $\sum f x$ can be divided by 30 or candidate's relevant number without further penalty

N4   Accept $\dfrac{102}{30}$ without work for 9 marks and accept 3 4 without work for 10 marks

N5 $\dfrac{3}{30} + \dfrac{10}{30} + \dfrac{21}{30} + \dfrac{36}{30} + \dfrac{20}{30} + \dfrac{12}{30}$ and stops $\Rightarrow$ 6 marks

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

4(iv)	modal number of children per family = 4

Blunders (-3)

B1   9 (number of families)

B2 $\dfrac{21}{6}$ or 3.5 i e mean of 1, 2, 3, 4, 5, 6

Attempts

Att $1 + 2 + 3 + 4 + 5 + 6 = 21$.

Att   Student's mean from part (iii) clearly restated.

(v)	**10 marks**	**Att 3**

(v)	Number of families with more than 4 children = 4 + 2 = 6. Percentage of families with more than 4 children = $\dfrac{6}{30} \times 100 = 20\%$

Blunders (-3)

B1   incorrect number of families with more than 4 children. (but note M1.)

B2 $\dfrac{6}{30} \times 100$ and stops.

B3 $\dfrac{30}{6} \times 100$ and continues

B4   Errors in cancellation (once only)

B5   Error in decimal point (once only)

B6   Not multiplying by 100

Misreadings (-1)

M1   15 as the number of families with more than 4 children (taking more than 4 as 4 or more) giving 50%

Slips (-1)

S1   Obvious error in addition e.g. $4 + 2 \neq 6$ when 4 + 2 indicated.

Attempts

Att $4 + 2 = 6$ or 6 only

Att   Some use of 100 in an effort to find percentage

Att   50% without work or $33\frac{1}{3}\%$ without work

Notes

N1 $\dfrac{6}{30} \Rightarrow 4$ marks

QUESTION 5

Table	25 marks	Att 8
Graph	10 marks	Att 3
Part (i)	5 marks	Att 2
Part (ii)	5 marks	Att 2
Part (iii)	5 marks	Att 2

---

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

$$f \cdot x \to x^2 - 4x + 3$$

in the domain $-1 \leq x \leq 5$, $x \in \mathbf{R}$

Use your graph to find

(i)   the value of $f(3\ 5)$.

(ii)   the values of x for which $f(x) = 0$

(iii)   the minimum value of $f(x)$.

Table   **25 marks**   **Att 8**

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

Blunders (-3)

B1 x^2 taken as $2x$ all the way.

B2 $-4x$ taken as -4 all the way

B3   3 calculated as $3x$ all the way

B4   Adds in top row when evaluating $f(x)$.

B5   Omits '3' row or omits '$-4\ x$' row

B6   Omits a value in the domain each time to max of -12 (5 values m ssing $\Rightarrow$ Att 8).
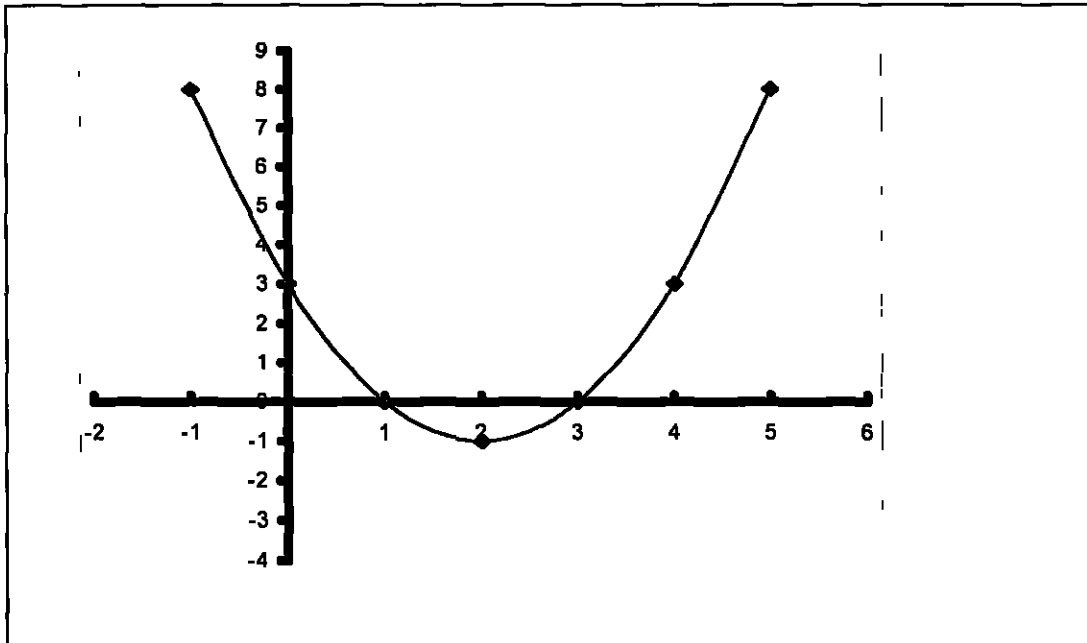
Slips (-1)

S1   Numerical slips (to max -3) in any row other than $f(x)$ row

S2   Misreads '3' as '-3' and places '-3' in the table or '$-4x$' as '$4x$' and places '$4x$' in the table

S3   Each incorrect $f(x)$ value calculated by addition within columns in student's table (to max -7) 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 -1 to max -3 apart from blunders above
but $f(x)$ row has a max -7

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 8 + Att 3 $\Rightarrow$ 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).

(ii)	5 marks	Att 2
5(ii)	$f(x) = 0 \Rightarrow x = 1$ and $x = 3$	
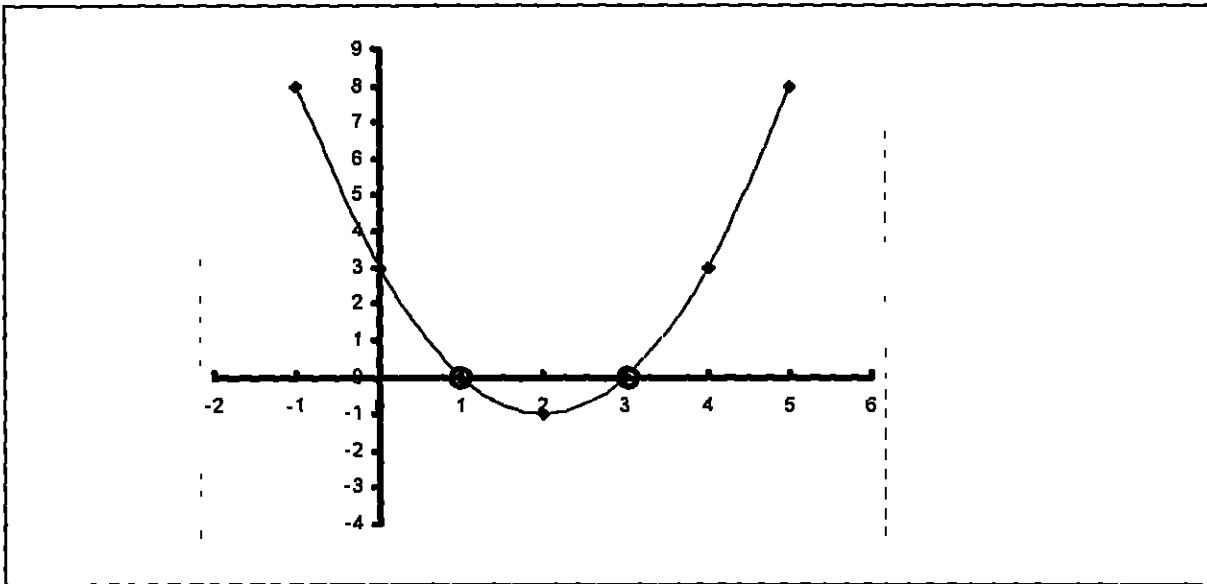
Blunders (-3)

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

B2   Only one value of x

B3 $y = 3$ 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).

5(i)

$$f(3\ 5) = 1\ 25$$
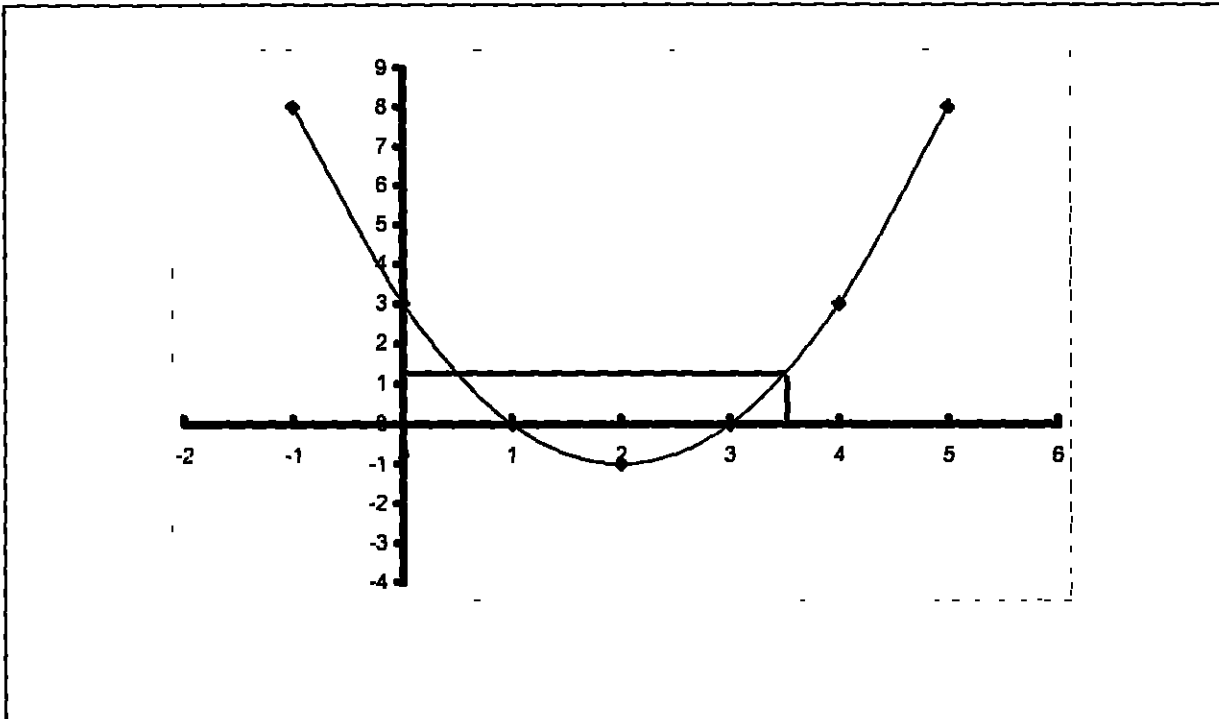
Blunders (-3)

B1   Answer on diagram but outside of tolerance ($.75 \le f(x) \le 1\ 75$) [refers to horizontal indication]

B2   Takes 3.5 on y-axis and indicates or reads answer on x-axis (one indication sufficient)

B3   If $x \ne 3\ 5$ (be lenient. accept as correct a value of x in the interval $3\ 3 \le x \le 3\ 7$).

Attempts

Att   Marks 3 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 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.]

QUESTION 6

Part (a)	10 marks	Att 3
Part (b)	20(10, 5, 5) marks	Att 7(3, 2, 2)
Part (c)	20(10, 10) marks	Att 6(3, 3)

Part (a)	10 marks	Att 3

6(a)	Solve for x	$2(x - 3) = 10$

6(a)	
	$2(x - 3) = 10$
	$2x - 6 = 10$
	$2x = 16$
	$x = 8$

Blunders (-3)
B1 Error in distributive law and continues, e g $2x - 3 = 10$ or $2x - 6 = 20$ (once only).
B2 Each error in transposition.
B3 Adds 'x's to 'numbers' and continues $(2x - 6 = -4x)$.

Slips (-1)
S1 Error in division e g $2x = 16 \Rightarrow 7$ (say)
S2 Errors in addition or multiplication (to max −3)
S3 $\dfrac{16}{2}$ and stops

Attempts
Att $2x - 3 = 10$ and stops
Att $2x - 6 = 20$ and stops
Att $x - 6 = 10$ and stops.
Att $x - 3 = 10 \Rightarrow x = 13$
Att $2x$ appears and stops

Notes
N1 $x = \frac{16}{2} \Rightarrow 9$ marks.
N2 Accept $x = 8$ without work for 10 marks
N3 $x - 3 = 10 - 2$ and continues attracts B2
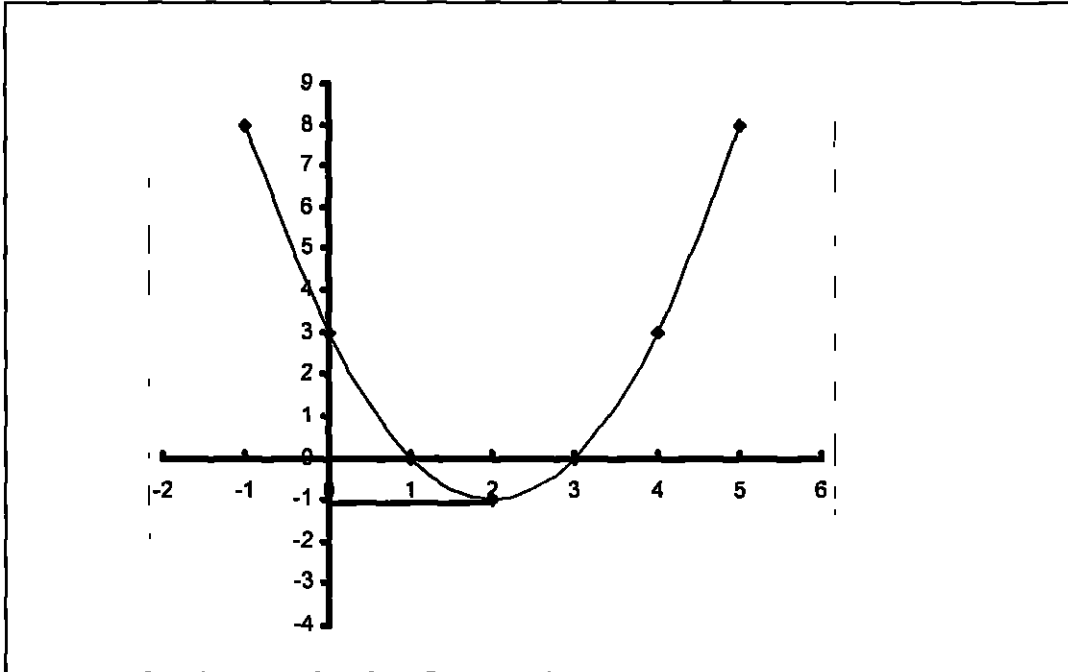N4 $2x - 6 = 10$ and stops $\Rightarrow 4$ marks.

5(iii)

The minimum value of $f(x) = -1$

Blunders (-3)

B1   Answer on diagram but outside of tolerance (± 25)

B2   Only gives the x value at which minimum occurs

Slips (-1)

S1   Gives coordinates of minimum rather than the y value.

S2   Minimum indicated on the curve but not stated.

Attempts

Att   Axis of symmetry drawn

Notes

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

N2   Accept indication on y-axis consistent with student's graph.

N3   Accept indication on y - axis (it is not necessary to write down the answer, indication on graph is sufficient)

Part (b)   **20(10, 5, 5) marks**   **Att 7(3, 2, 2)**
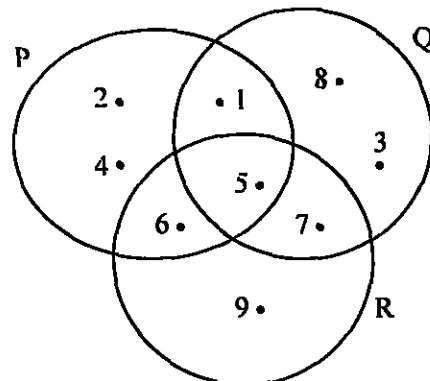

6(b)   The elements of the sets P, Q and R are shown on the Venn diagram.

   (i)   List the elements of

   P/Q

   (ii)   List the elements of

   $(P \cup R) \cap Q$.

   (iii)   Name the set whose elements are 5 and 6

6(b)(i)	{2, 4, 6}

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

Misreadings (-1)
M1   Q/P giving {3, 7, 8}.

Attempts
Att   A set with 9 as an element
Att   P = {1, 2, 4, 5, 6} and or Q = {1, 3, 5, 7, 8} and these sets are labelled.

Notes
N1   Accept a Venn Diagram (of P and Q or of P, Q and R) with correct region indicated or with only the elements of P/Q correctly placed.

(b)(ii)	5 marks	Att 2

6(b)(ii)	
	$P \cup R = \{1,2,4,5,6,7,9\}$
	$(P \cup R) \cap Q = \{1,2,4,5,6,7,9\} \cap \{1,3,5,7,8\}$
	$= \{1,5,7\}$

Blunders (-3)

B1   Any incorrect set of the elements of P, Q and R other than the misreadings as below

Misreadings (-1)

M1 $P \cap R$ for $P \cup R$ giving $\{5\}$ as answer

M2 $(P \cup R) \cup Q$ giving $\{1, 2, 3. 4, 5, 6, 7, 8, 9\}$

M3 $(P \cap R) \cup Q$ giving $\{1, 3, 5, 6. 7, 8\}$ as answer

Notes

N1   Accept a Venn Diagram of P, Q and R with correct region indicated
        or with only the elements of $(P \cup R) \cap Q$ correctly placed

N2   One correct diagram will suffice for both parts

(b)(iii)	5 marks	Att 2

6(b)(iii)	
	$\{5, 6\} = P \cap R$

Blunders (-3)

B1   P or Q or R

B2   Any incorrect relationships between the given sets other than [$P \cap R$] or [P **and** R]

Attempts

Att   A separate answer for 5 and a separate answer for 6

Notes

N1   It is necessary to check the candidate's answer as correct answers (other than
        $P \cap R$) are possible.

| Part (c) | 20(10, 10) marks | Att 6(3, 3) |

6(c)

Solve for x

$$\frac{1}{x-4} - \frac{1}{x} = \frac{1}{8}$$

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

6(c)

$$\frac{1}{x-4} - \frac{1}{x} = \frac{1}{8}$$

$$\frac{x-(x-4)}{(x-4)(x)} = \frac{1}{8}$$

$$\frac{4}{x^2-4x} = \frac{1}{8}$$

$$x^2 - 4x = 32$$

$$x^2 - 4x - 32 = 0$$

$$\frac{1}{x-4} - \frac{1}{x} = \frac{1}{8}$$

$$\frac{8x - 8(x-4) = x(x-4)}{8x(x-4)}$$

$$\frac{32 = x(x-4)}{8x(x-4)}$$

$$32 = x^2 - 4x$$

$$x^2 - 4x - 32 = 0$$

Blunders (-3)

B1   Incorrect common denominator and continues

B2 $(x-4)-x$ as numerator

B3 $x-(x-4) \neq 4$ or $8x - 8(x-4) \neq 32$

B4   Errors in forming $x^2 - 4x - 32 = 0$ after common denominator/ subtraction

Slips (-1)

S1   Numerical errors (max -3)

Attempts

Att $x(x-4)$ only appears

Att   "cross multiplication"

Att $\left(\frac{1}{x-4}\right)\left(\frac{1}{x}\right)$

Notes

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

6(c)

$$x^2 - 4x - 32 = 0$$

$$(x - 8)(x + 4) = 0$$

$$x - 8 = 0 \ \ or \ \ x + 4 = 0$$

$$x = 8 \ or \ x = -4$$

$$x = \frac{4 \pm \sqrt{16 + 128}}{2}$$

$$x = \frac{4 \pm \sqrt{144}}{2} \Rightarrow x = \frac{4 \pm 12}{2}$$

$$x = \frac{16}{2} = 8 \ \ or \ x = \frac{-8}{2} = -4.$$

Note: Solving a linear equation (resulting from errors) can only earn attempt mark at most.

Factor Method
Blunders (-3)

B1   Incorrect two term linear factors of $x^2 - 4x - 32$ formed from correct, but not applicable, factors of x^2 and ± 32

B2   Correct cross method but factors not shown and stops also incurs B4 $\Rightarrow$ 4 marks (but see N1).

B3 $x(x + 4) - 8(x + 4)$ 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 $x = 8$ and $x = -4 \Rightarrow 10$ 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 $\dfrac{4 \pm 12}{2}$ or similar

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

An Roinn Oideachais agus Eolaíochta

Scrúdú an Teastais Shóisearaigh 2001

Junior Certificate Examination 2001

Marking Scheme

MATHEMATICS

Ordinary Level

Paper 2

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)
    - Misleadings (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   When awarding attempt marks, e g Att(4), it is essential to note that
    - any correct relevant step in a part of a question merits, *at least*, the attempt mark for that part
    - if deductions result in a mark which is lower than the attempt mark, then the attempt mark must be awarded
    - a mark between zero and the attempt mark is never awarded

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

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

5. 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.

6   Particular cases, verifications and answers derived from diagrams (unless requested) qualify for the attempt mark only

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

QUESTION 1

Each part	10 marks	Att 3

Part (i)	10 marks	Att 3

1(i)   Two angles of a triangle measure 65° and 45° 23'.
What is the measure of the third angle?

Part (i)	10 marks	Att 3

1(i)   65° + 45°23' = 110°23'
Third angle = 180° - 110°23' = 69°37'

*   Accept correct answer and no work
*   Ignore degrees and minutes notation

Blunders (-3)

B1   Error in handling minutes → degrees (e g 180° - 110° 23' = 69° 77' –– i e. 1° = 100').
Note some candidates may write 65° as 64° 59' and 180° as 179° 59' and come up with
a correct answer with incorrect work.

B2   Sum of angles in a triangle not 180° and finishes

B3   Subtracts 45° 23' from 180°and stops, i e 180°- 45° 23' = 134° 37'

B4   Ignores minutes. i e 180° - 110° = 70°.

B5×2   Subtracts 65° or 45° from 180° and stops, i e 180° - 65° = 115° or 180° - 45° = 135°

Slips (-1)

S1   Numerical errors to a maximum of –3 (but note Blunders above).

Misreadings (-1)

M1   Misreads 45° 23' as 45° 32' or similar

Attempts

A1   Any mention of 180°

A2   Any attempt at adding the given angles

A3   Subtracts 2 angles (19° 37') but must handle minutes correctly to gain the attempt

Worthless (0)

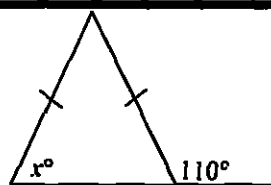W1   Incorrect answer with no work but note blunders above. Note· 69° 77' may be written
as 70° 17'

Part (ii)	10 marks	Att 3

1(ii) Calculate the value of x in the diagram

Part (ii)	10 marks	Att 3

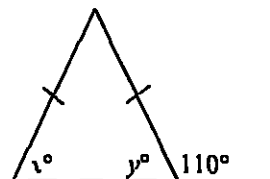**1(i)** Show angle y on diagram

$y^\circ + 110^\circ = 180^\circ$ ... .   Straight angle

$\therefore y^\circ = 70^\circ$

$x^\circ = y^\circ$ ...   . .Isosceles triangle

$x^\circ = 70^\circ$

*   Accept correct answer and no work

Blunders (-3)

B1   Incorrect equal (base) angles, i e $2x^\circ = 110^\circ \Rightarrow x^\circ = 55^\circ$ or $y^\circ = 70^\circ \Rightarrow x^\circ = 180^\circ - (70^\circ + 70^\circ) = 40^\circ$

B2   Straight line angle <u>not</u> 180° and finishes

B3   Angle sum of triangle <u>not</u> 180° and finishes.

B4   May divide 70° by 2 to give an answer of 35°.

B5   States $y^\circ = 70^\circ$ and stops (may be indicated on diagram)

Slips (-1)

S1   Numerical error to a maximum of –3

Attempts

A1   Angle sum of triangle = 180° and stops

A2   Straight line angle = 180° and stops

A3   States that the base angles of isosceles triangle are equal and stops (may be marked on diagram)

A4   States that exterior angle of triangle equals sum of interior remote angles and stops

Worthless (0)

W1   Incorrect answer and no work (but note B1 and B4 above)

W2   Angle measured with a protractor (65°)
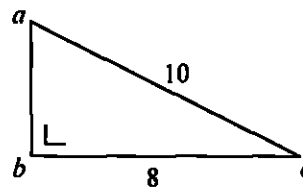
1(iii)   In the triangle abc, $|ac| = 10$, $|bc| = 8$

and $|\angle abc| = 90°$

Calculate $|ab|$

1(iii)

$$|ab|^2 + 8^2 = 10^2$$

$$|ab|^2 + 64 = 100$$

$$|ab|^2 = 36$$

$$|ab| = 6$$

*   Accept correct answer and no work.

*   Accept recognition of Pythagorean triple 6, 8, 10

Blunders (-3)

B1 $|ab|^2 = 8^2 + 10^2 = 164 \Rightarrow |ab| = \sqrt{164} = 12\,81$

B2   Incorrect transposition, e.g $|ab|^2 = 100 + 64$ and finishes

B3   Gets $|ab|^2 = 36$ and stops

B4   Calculates $|ab| = \sqrt{36}$ and stops.

B5 $8^2 = 16$ or similar and finishes, but penalise once only.

B6   Incorrect use of square root or squares tables, e g gets $\sqrt{3\,6} = 1\,897$ or $8^2 = 6400$ — penalise once only.

B7   Recognises Pythagorean triple 3, 4, 5, but does not double, i e gives answer as 3.

Slips (-1)

S1   Each numerical error to a maximum of −3

Attempts

A1 $|ab| = 10 - 8 = 2$

A2   Some correct statement of Pythagoras, e g $|ac|^2 = |ab|^2 + |bc|^2$

A3 $\text{Sin } a = \dfrac{8}{10}$ or $\text{Cos } c = \dfrac{8}{10}$ and stops

A4   Any correct trigonometric ratio written down

A5 $8^2 = 64$ and/or $10^2 = 100$ and stops.

A6   Attempt at a scaled diagram.

Worthless (0)

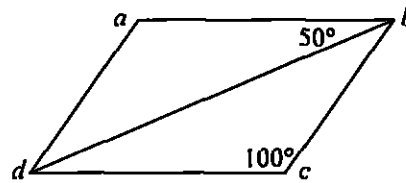W1   Incorrect answer and no work (but note Blunders above)

W2 $10 + 8 = 18$.

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

| 1(iv) | $abcd$ is a parallelogram $\|\angle bcd\| = 100°$ and $\|\angle abd\| = 50°$. Calculate $\|\angle adb\|$ |

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

1(iv) $\|\angle dab\| = \|\angle bcd\| = 100°$......Opposite angles of parallelogram

$\|\angle dab\| + \|\angle abd\| + \|\angle adb\| = 180°$.... .3 angles of a triangle

∴ $100° + 50° + \|\angle adb\| = 180°$

.. $\|\angle adb\| = 30°$

or

$\|\angle dbc\| = 180° - (100° + 50°) = 30° \Rightarrow \|\angle adb\| = 30°$

*   Accept correct answer and no work

*   Accept correct indication on a diagram.

*   Accept any other correct method

Blunders (-3)

B1   Sum of angles in a triangle <u>not</u> 180°.

B2   Doesn't subtract from 180°, i.e. leaves answer as 150°.

B3 $\|\angle dbc\| = 30°$ and stops

B4   Failure to add 100° and 50°, e.g. $\|\angle adb\| = 180° - 100° = 80°$

B5   Failure to recognise that $\|\angle dab\| = 100°$ in method (i).

B6×2 $\|\angle adb\| = 180° - 50° = 130°$.

B7×2 $\|\angle dab\| = 100°$ and stops.

B8×2 $\|\angle bdc\| = 50°$ and stops.

Slips (-1)

S1   Each numerical error to a maximum of –3

Attempts

A1   Angle sum of triangle = 180° and no other relevant work

A2   Some correct statement ie alternate angles or angles in a parallelogram

Worthless (0)

W1   Incorrect answer and no work (but note Blunders above)
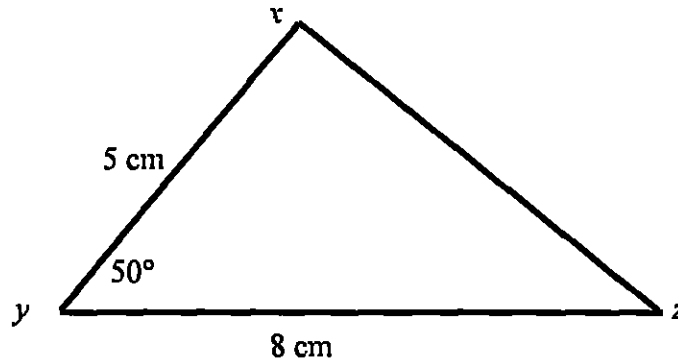
W2   Angle measured with protractor (32°).

1(v) Construct the triangle *xyz* in which $|xy|$ =5 cm, $|\angle xyz|$ = 50° and $|yz|$ =8 cm

1(v)

* Tolerance of ± 2 mm on sides
* Tolerance of ± 2° on the angle
* Examiners must measure candidates' work

Blunders (-3)
B1 Incorrect length, i.e. outside tolerance
B2 Incorrect angle, i e outside tolerance
B3 Failure to complete triangle, i e does not join *x* to *z*.

Attempts
A1 Pilot diagram drawn
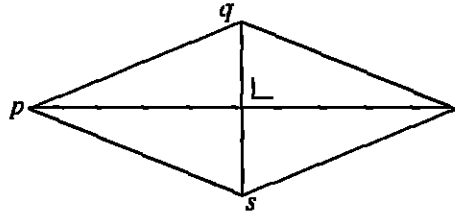A2 One side drawn correctly and stops.

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

1(vi)

pqrs is a parallelogram with diagonals intersecting at an angle of 90°

Write down the image of triangle *pqr* under the axial symmetry in [*pr*]

| 1(vi) | Image of triangle *pqr* under the axial symmetry in [*pr*] is triangle *psr* |

*   Accept correct indication on a diagram
*   Accept any order of letters.
*   Accept $p \rightarrow p$, $q \rightarrow s$, $r \rightarrow r$ in any order.

Blunders (-3)

B1   Each point whose image is not found, to a maximum of 2 blunders

B2   Correct image of Δpqr under some other axial symmetry

B3   Correct image of Δpqr under some central symmetry or translation

B4   Correct image of some other triangle under $S_{[pr]}$

Attempts

A1   Shows some knowledge of axial symmetry and stops.

A2   An axial symmetry not related to the diagram or question.

A3   Correct central symmetry or translation on some other triangle

A4   States image is a triangle

Worthless (0)
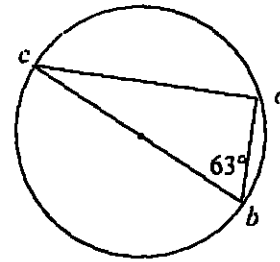
W1   Diagram reproduced without modifications

1(vii)
[cb] is a diameter of the circle and
a is a point on the circle
$|\angle abc| = 63°$.

Calculate $|\angle acb|$

1(viii)
$|\angle cab| = 90°$ ...   .   The angle in a semicircle

$|\angle cab| + |\angle abc| + |\angle acb| = 180°$.   3 angles of a triangle

$$90° + 63° + |\angle acb| = 180°$$

$$|\angle acb| = 180° - 153°$$

$$|\angle acb| = 27°$$

*   Accept correct answer and no work
*   Accept correct indication on diagram
*   Accept any other correct method

Blunders (-3)
B1   Angle sum of triangle <u>not</u> 180°
B2   Failure to subtract from 180° (i e leaves as 153°)
B3 $|\angle cab| \neq 90°$ — may write $|\angle acb| = 180° - (63° + 63°) = 54°$ (common incorrect answer)
B4×2 $|\angle acb| = 180° - 63° = 117°$.
B5×2 $|\angle cab| = 90°$ and stops (note· may be indicated on diagram).

Slips (-1)
S1   Each numerical error to a maximum of –3

Misreadings (-1)
M1   Misreads 63° as 60° or similar.

Attempts
A1   Any mention of 180°
A2   States "angle at centre is twice the angle at circle standing on same arc" and stops
A3   Joins a to the centre and stops

Worthless (0)
W1   Diagram reproduced without modification
W2   Incorrect answer and no work (but note Blunders above)

1(viii) Find the midpoint of the line segment joining the points (3, 5) and (−1, 1)

Midpoint formula $\left(\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2}\right)$

1(viii)

Midpoint formula $\left(\dfrac{3 + (-1)}{2}, \dfrac{5+1}{2}\right) = \left(\dfrac{2}{2}, \dfrac{6}{2}\right) = (1,3)$

*   Accept correct answer and no work
*   Note no penalty on brackets — 1, 3 is acceptable.
*   Accept translation method

Blunders (-3)
B1   Incorrect sign in mid-point formula—penalise once only
B2   Formula correctly filled but not completed, i e $\left(\dfrac{3-1}{2}, \dfrac{5+1}{2}\right)$ (Note. also incurs S3)
B3   Incorrect multiplication of signs, i e $3 + (-1) = 3+1$.
B4   Each incorrect substitution to a maximum of two Blunders
B5   Omits divisor 2, but penalise once only
B6   Reversal of coordinates, i e (3,1)
B7   One ordinate only worked out
B8   Uses one of the points given and some other arbitrary point, e.g. (3,5) and (0,0)
B9×2 $x \rightarrow x - 4, y \rightarrow y - 4$ or similar

Slips (-1)
S1   Numerical errors to a maximum of −3
S2   Takes (-1,1) as midpoint and finds extremity, e g (3,5) → (-1,1) → (-5,-3)) or takes
       (3,5) as midpoint and finds extremity, i e (-1,1) → (3,5) → (7,9).
S3   Leaves as $\left(\dfrac{2}{2}, \dfrac{6}{2}\right)$

Attempts
A1   Correct graphical merits attempt only, i e between the two given points, but <u>not</u>
       named
A2   One correct substitution and no further work

Worthless (0)
W1   Uses incorrect formula, e.g. slope formula
W2   Incorrect point marked on graph

Part (ix)	10 marks	Att 3

1(ix) (2, k) is a point on the line $3x + 2y = 4$. Find the value of k

Part (ix)	10 marks	Att 3

$$3(2) + 2(k) = 4$$
$$6 + 2k = 4$$
$$2k = -2$$
$$k = -1$$

Blunders (-3)

B1   Substitutes k in for the x value and 2 for the y value (gives an answer $k = 0$)

B2   Incorrect transposition, e g $2k = 10 \Rightarrow k = 5$

B3   Fails to divide by 2, i e leaves as $2k = -2$.

B4×2 Leaves as $6 + 2k = 4$, i e no transposition and failure to divide by 2

Slips (-1)

S1   Numerical errors to a maximum of –3

Attempts

A1   Correct substitution and no further work, i e. $3(2) + 2k = 4$ (failure to evaluate 3(2)).

A2   Some statement similar to "substituting in will satisfy the equation"

A3   Draws a line $x = 2$ or states $x = 2$ and/or $y = k$ and stops.

A4   States $x = k$ and $y = 2$ and stops

A5   Use of arbitrary point, e g $x = 0$ giving $y = k = 2$ or $y = 0$ giving $x = \dfrac{4}{3}$.

A6   Any correct transposition of equation and stops

Worthless (0)

W1   Incorrect answer and no work.

Part (x)	10 marks	Att 3
1(x)	$A = 36°\ 18'$ Use the book of Tables to find $\cos A + \sin A$	

Part (x)	10 marks	Att 3
1(x)	$\cos(36°\ 18') = 0.8059$ $\sin(36°\ 18') = 0.5920$ $\cos A + \sin A = 1.3979$	

Blunders (-3)

B1   No decimal point or misplaced decimal point, but penalise once only   (This Blunder covers answers written as 80° 59' or similar.)

B2   Failure to add 0 8059 and 0 5920

B3   Looks up incorrect tables, i e. tan 36° 18' and finishes correctly

B4   Looks up cos 18° 36' correctly and continues, i e reversal of degrees and minutes

B5×2 Looks up sin or cos 36° 18' correctly and stops

B6   Ignores minutes and continues correctly, e.g. cos 36° = 8090 and continues.

Slips (-1)

S1   Numerical errors to a maximum of –3

S2   Reads from incorrect line or column related to the question

Attempts (3 marks)

A1   Any correct trigonometric ratio written down

QUESTION 2

Part (a)	10 marks	Att 3
Part (b)	20(10,10) marks	Att 6(3,3)
Part (c)	20(10,10) marks	Att 6(3,3)

Part (a)	10 marks	Att 3

2(a)   Helen has savings of IR£390 in the credit union.
       Find the value of her savings in euro (Use 1 euro = IR£0 78).

Part (a)	10 marks	Att 3

2(a)   390 – 0.78 = 500   ⇒ 500 euro saved.

*   Euro symbol not required

Blunders (-3)

B1   Misplaced decimal point
B2   Multiplies 390 × 0 78 (or 390 – 390 × 0.22, giving an answer of 304 20 euro)
B3   Does not do the division, i e. leaves as $\dfrac{390}{0\,78}$ euro
B4   States 50 = IR£ 39 or 5 = IR£ 3 90 and stops
B5×2   390 × 0.22 = 85 80 euro, but adds this to 390, instead of subtracting (giving an answer of 475.80 euro)
B6×2   States 100 = IR£ 78 and stops

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

Attempts
A1   0.78 × 2, 0 78 × 3 etc., but note B4 above (i e trial and error)
A2   390 × 0 22 = 85.80 euro and stops

Worthless (0)
W1   390 ± 0 78 (whether calculated or not)

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

2(b)   A car dealer buys a car for IR£6500.

        (i)   At what price should the car be sold to make a profit of 30% ?

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

2(b)(i)

Profit of 30% $\Rightarrow$ Selling price of 130%   or $30\% \text{ of } 6500 = \dfrac{30}{100} \times 6500 = 1950$

$100\% = 6500$

$1\% = \dfrac{6500}{100}$

                                             Price $= 6500 + 1950 = $ IR£ 8450

$130\% = \dfrac{6500 \times 130}{100} = $ IR£8450

Blunders (-3)

B1 $30\% = \dfrac{100}{30}$ and completes, i e price $= \dfrac{100}{30} \times 6500 + 6500 = $ IR£ 28166.67

B2   Subtracts profit, i.e $6500 - 1950 = $ IR£4550.

B3   Decimal error

B4 $6500 + 1950$ and stops

B5 65×130 and stops.

B6×2 $1\% = 65$ and stops

B7×2 Finds 30% of 6500 correctly and stops, i e 30% of 6500 = 1950

Slips (-1)

S1   Numerical errors to a maximum of –3.

Attempts

A1 $30\% = 6500 \Rightarrow 1\% = 216.67 \Rightarrow 100\% = $ IR£ 21666 67.

A2 $30\% = \dfrac{30}{100}$ and stops

A3 $100\% = 6500$ and stops

Worthless (0)

W1 6500 ± 30 (whether calculated or not)

2(b)   (ii)   The car is actually sold for IR£7800   Find the percentage profit.

2(b)(ii)

Profit = IR£7800 - IR£6500 = IR£1300 | or   6500 = 100%

$$\% \text{ profit } = \frac{1300}{6500} \times \frac{100}{1} = 20\%$$

$$1 = \frac{100}{6500}$$

$$7800 = \frac{100}{6500} \times 7800 = 120\%$$

% Profit = 120 –100 = 20%

or $8450 = 130\% \Rightarrow 1\% = \dfrac{8450}{130} = 65 \Rightarrow \dfrac{7800}{65} = 120\% \Rightarrow \% \text{ Profit} = 120 - 100 = 20\%$

or $8450 - 7800 = 30\% - x\% = 650$

$$\frac{650}{6500} \times 100 = 10\%$$

30% - 10% = 20%

*   If method three or four is used, accept candidate's answer to part (i) as correct for 130%

Blunders (-3)

B1 $\dfrac{1300}{6500} \times 100$ and stops

B2   Decimal error

B3 $\dfrac{1300}{7800} \times 100 = 16\ 67\%$

B4   Fails to subtract from 30%, i.e $8450 - 7800 = 650 \Rightarrow \% \text{ profit} = \dfrac{650}{6500} \times 100 = 10\%$

B5×2   Works from base figure of IR£8450, i.e $8450 - 7800 = 650 \Rightarrow \% \text{ Profit} =$
$$\frac{650}{8450} \times 100 = 7.69\%.$$

B6   7800 = 120% and stops.

Slips (-1)

S1   Numerical errors to a maximum of –3

Attempts

A1   Finds profit = 1300 and stops.

A2   6500 = 100% and stops.

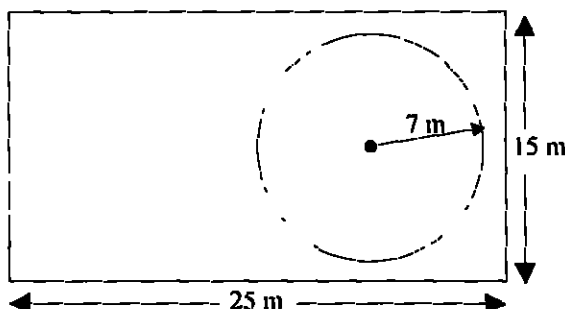A3   8450 (or candidate's answer to part (i)) = 130% and stops.

Worthless (0)

W1   6500 + 7800 or 6500 × 7800, whether calculated or not

2(c)   A rectangular garden measures 25 m by 15 m   Part of the garden is a circular lawn, of radius 7 m   The rest of the garden is covered with gravel.

(i)   Find the area of the circular lawn.

     Take $\pi = \dfrac{22}{7}$.

2(c)(i) Area of circular lawn $= \pi r^2 = \dfrac{22}{7} \times 49 = 154$	Area $= 154 \, m^2$

*   Accept $\pi = 3\,14$ and continues correctly.

*   No penalty on units

Blunders (-3)

B1 $7^2 = 14$ and finishes correctly   (Answer $= 44$.)

B2   Uses area $= 2\pi r$ and finishes correctly   (Answer $= 44$.)

B3 $\dfrac{22}{7} \times 49$ and stops

B4×2 $\dfrac{22}{7} \times 7^2$ and stops

Slips (-1)

S1   Numerical errors to a maximum of -3.

Attempts

A1   Substitutes a value for π or r into πr^2 or $2\pi r$ and stops

Worthless (0)

W1   Area $= \pi r^2$ and no substitution

W2   Area $= \dfrac{4}{3} \pi r^3$ or   Area $= 4\pi r^2$ and no substitution, but note A1

2(c)(ii)	10 marks	Att 3
2(c)(ii)	Calculate the area covered with gravel.	

(c)(ii)	10 marks	Att 3
2(c)(ii)	Area covered in gravel $=$ Area of garden - area of circular lawn Area of garden $= 25\text{ m} \times 15\text{ m} = 375\text{ m}^2$ Area covered in gravel $= 375\text{ m}^2 - 154\text{ m}^2$ $= 221\text{ m}^2$	

*   Accept candidate's answer for area of lawn from part **(i)**.

Blunders (-3)
B1 $375 - 154$ and stops. i e does not carry out subtraction.
B2 $375 + 154 = 529$, i e adds instead of subtracts
B3   Finds perimeter of garden and proceeds correctly, i e $2(25+15) = 80 \Rightarrow$ Area $= 80 - 154 = -74$ or area $= 154 - 80 = 74$
B4   Area of garden $= 15 \times 15 \times 25 \times 25 = 140625$ and continues.
B5×2 Finds area of garden and stops

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

Attempts
A1   States area of garden $=$ length $\times$ breadth and stops.
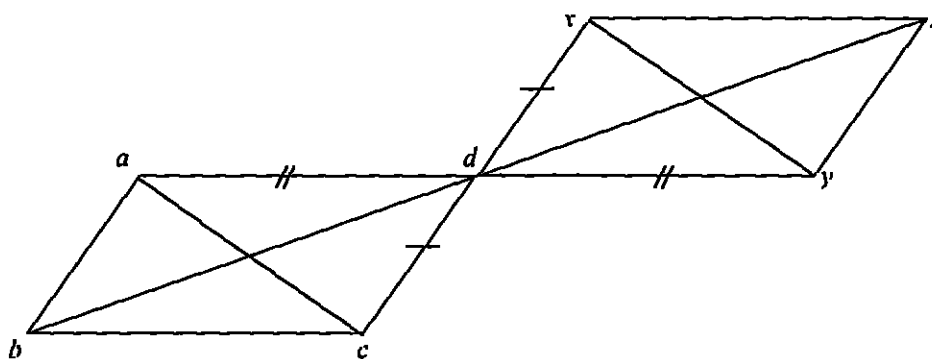A2   Finds perimeter of garden and stops

Worthless (0)
W1 $25 \pm 15 = 40$ or 10 and stops.

QUESTION 3

Part (i)	5 marks	Att 2
Part (ii)	10 marks	Att 3
Part (iii)	10 marks	Att 3
Part (iv)	10 marks	Att 3
Part (v)	10 marks	Att 3
Part (vi)	5 marks	Att 2

3(i)

abcd and *xdyz* are two parallelograms   *d* is the mid-point of [*ay*] and of [*cx*].

3(i)	5 marks	Att 2

3(i)	Name two line segments equal in length to [*bc*].

3(i)	5 marks	Att 2

3(i)	Any two of. [*ad*], [*dy*], [*xz*]

* Note. one Blunder results in Attempt 2
* Indicating line segments on a diagram is not sufficient
* Line segment notation ([ ]) not required.
* Accept $|ad| = |dy|$ or similar.

Misreadings (-1)
M1   Misreads [*bc*] as [*dc*], i e gives the answer as any two of. [*ab*], [*xd*], [*zy*]

Attempts
A1   Names only one line segment equal in length to [*bc*]
A2   Names two line segments which are equal in length to one another, but are not equal in length to [*bc*], e.g $|bd| = |dz|$ or $|ac| = |xy|$
A3   States " opposite sides of a parallelogram are equal in length ", but does not name the line segments.

Worthless (0)
W1   One point answers.

3(ii)	10 marks	Att 3

3(ii)	Find the image of the line segment [ab] under the translation $\vec{xz}$.

3(ii)	10 marks	Att 3

3(ii)	The image of the line segment [ab] under the translation $\vec{xz}$ is [dc]

* Accept correct line segment clearly indicated on a diagram.
* Accept $a \rightarrow d;\ b \rightarrow c$
* Accept [a' b'] plotted near [dc] on diagram
* Accept any order of letters.

Blunders (-3)
B1   Only one end point correct
B2   Correct image of [ab] under some other translation.
B3   Correct image of [ab] under some central symmetry or axial symmetry
B4   Correct image of some other line segment under translation $\vec{xz}$
B5   Correct image of [xz] under translation $\xrightarrow[ab]{}$, i e. [dy]

Attempts
A1   A translation not related to the diagram or question.
A2   Shows some knowledge of translation and stops
A3   Correct central symmetry or axial symmetry on some other line segment, but note Blunders above
A4   States image is a line segment

Worthless (0)
W1   Diagram reproduced without modification.

3(iii)	10 marks	Att 3

3(iii)	Name two angles equal in measure to $\angle xdz$

3(iii)	10 marks	Att 3

3(iii)	Any two of: $\angle bdc$, $\angle dzy$, $\angle abd$

*   Accept correct angles clearly indicated on diagram

Blunders (-3)

B1   Names only one angle equal in measure to $\angle xdz$

B2×2   Names any two angles, which are equal in measure to one another, but not equal in measure to $\angle xdz$, e g names $\angle adb$ as one of the angles (may mistake this as the vertically opposite angle), but then goes on to name an angle equal in measure to $\angle adb$, e g $\angle dbc$ (alternate angles)

Attempts

A1   Any mention of alternate angles , corresponding angles, vertically opposite angles or opposite angles in a parallelogram

Worthless (0)

W1   Angles named using one point only, e.g. $\angle x$

Part (iv)	10 marks	Att 3

3(iv)	Find the image of the triangle *abd* under the central symmetry in the point *d*.

3(iv)	10 marks	Att 3

3(iv)	The image is triangle *yzd*

* Accept triangle *yzd* with points in any order.
* Accept $a \rightarrow y, b \rightarrow z, d \rightarrow d$
* Accept diagram with correct indication/shading.

Blunders (-3)
B1   Each point whose image is not found (or incorrectly found) to a maximum of 2 blunders (but note B2, B3, B4)
B2   Correct image of triangle *abd* under some other central symmetry (even on extended diagram)
B3   Correct image of triangle *abd* under some axial symmetry or translation
B4   Correct image of some other triangle under S_d.

Attempts
A1   Shows some knowledge of central symmetry and stops.
A2   A central symmetry not related to the diagram or question.
A3   Correct axial symmetry or translation on some other triangle
A4   States that the image is a triangle

Worthless (0)
W1   Diagram reproduced without modification.

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

3(v)	The area of the triangle xdy is 12 cm^2 Find the area of the parallelogram $abcd$

3(v)   **10 marks**   **Att 3**

3(v)	Area of the parallelogram $xdyz$ = 2(area of triangle xdy)
	= 2(12)
	= 24
	Area of the parallelogram $abcd$ = 24 cm^2

*   Accept correct answer and no work

Blunders (-3)

B1   Area of the parallelogram $abcd$ = 4 (12) = 48, i.e. gets area of both parallelograms.

B2   Area of the parallelogram $abcd$ = ½ (12) = 6

Slips (-1)

S1   Numerical errors to a maximum of –3

Attempts (3 marks)

A1   States area of parallelogram = base × perpendicular height (but not ah, since given in Tables).

A2   States area of triangle = ½ × base × perpendicular height (but not ½ah, since given in Tables)

A3   Any multiple of 12, other than ones mentioned in Blunders.

Worthless (0)

W1   Incorrect answer and no work, but note Blunders and A3 above

3(vi)	5 marks	Att 2
3(vi)	Name a triangle congruent to triangle *acd* Give a reason for your answer.	

3(vi)	
	$\triangle abc \equiv \triangle acd$ S.S S ($\|ab\| = \|dc\|$, $\|bc\| = \|ad\|$, $\|ac\| = \|ac\|$)
	or
	$\triangle xdy \equiv \triangle acd$ S A S ($\|xd\| = \|dc\|$, $\|\angle xdy\| = \|\angle adc\|$, $\|dy\| = \|ad\|$).
	etc.

*   Accept S.S.S or S A S or A A S without naming equal sides or angles.
*   Accept 'equal in all respects' or 'maps onto' or 'same as ' for reason
*   Note· One blunder results in Attempt 2
*   Accept correct triangle marked/indicated on diagram

Attempts

A1   Names a correct triangle, but does not supply a reason
A2   Gives a correct reason S S.S or S A S or A A.S. but does not name congruent triangles
     (Note R H S is not acceptable as a reason)
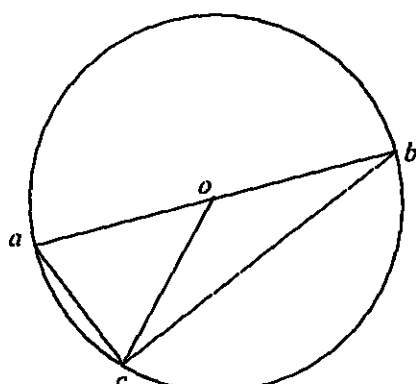
Worthless (0)

W1   No triangle named and incorrect reason for congruence given
W2   Diagram reproduced without modification.

QUESTION 4

Part (i)	10 marks	Att 3
Part (ii)	10 marks	Att 3
Part (iii)	10 marks	Att 3
Part (iv)	10 marks	Att 3
Part (v)	10 marks	Att 3

4
[ab] is a diameter of a circle
with centre o and
c is a point on the circle

Part (i)	10 marks	Att 3

4(i)	Write down $|\angle acb|$	

4(i)	10 marks	Att 3

4(i)	$|\angle acb| = 90°$	

* Accept right angle indicated/marked on diagram
* Accept correct answer and no work. (Reason not needed)
* Note· Work in parts (iii) or (iv) may suffice to answer part (i).

Blunders (-3)
B1 States angle standing on a diameter at circumference and stops, i.e. no conclusion
B2 States $|\angle acb| = ½ |\angle aob| = ½(180°)$ and stops
B3×2 States $|\angle acb| = ½ |\angle aob|$ and stops
B4 Takes an arbitrary angle, e.g. 60° and fills out remaining angles on that basis. (Note may also incur S1. if angles not added)

Misreadings (-1)
M1 Reads $|\angle acb|$ as $|\angle abc|$, leading to an answer 40°

Slips (-1)
S1 Does not add 40° and 50°

Attempts
A1 States "angle at centre = twice angle at circle standing on same arc" and stops.
A2 States "straight line angle = 180°" and stops

60

A3   States "angle sum of triangle = 180°" and stops

Wor thless (0)
W1   Diagram reproduced without modifications
W2   Incorrect answer and no work, but note M1 above.

4(ii)	10 marks	Att 3
4(ii)	Name two line segments equal in length to [*ao*]	

4(ii)	10 marks	Att 3
4(ii)	[*bo*] and [*co*]	

*   Accept correct line segments clearly indicated/marked on diagram

Blunders (-3)
B1   Names only one line segment equal in length to [*ao*] (Note· W1 below)
B2×2 States [*ao*] is a radius, but does not name other radii
B3×2 States. $|ab| = 2 \times |ao|$ and stops
B4×2 States Δ *oac* or Δ *ocb* is isosceles.

Attempts
A1   States "all radii are equal" but does not name any line segment

Worthless (0)
W1   Names [*oa*] and stops.
W2   [*ac*] named and stops

4(iii)   Given that $|\angle oac| = 50°$, find $|\angle cob|$

4(iii)

$|\angle oac| = 50° \Rightarrow |\angle oca| = 50°$ ...   ... Isosceles triangle

$|\angle aoc| = 80°$.   . .. Third angle in the triangle

$|\angle aoc| + |\angle cob| = 180°$ ...   . Straight angle

.. $80° + |\angle cob| = 180°$. $|\angle cob| = 100°$

or $|\angle cob| = 2 \times |\angle cab| = 2(50°) = 100°$

* Accept any other correct method.
* Accept correct answer indicated on diagram
* Accept correct answer and no work.
* Note. All the angles may be filled in correctly on one diagram in part (i)—this is acceptable here.

Blunders (-3)

B1   Shows $|\angle aoc| = 80°$ and stops

B2   States $|\angle cob| = 2 \times |\angle cab| = 2(50°)$ and stops

B3   Error in transposition. i e $80° + |\angle cob| = 180°$. $|\angle cob| = 260°$

B4   Chooses an arbitrary angle, e g $60°$ and finishes (giving $|\angle cob| = 120°$)

B5×2   Indicates $|\angle oac| = |\angle oca| = 50°$ or $|\angle obc| = |\angle ocb| = 40°$ and stops

B6×2   States $|\angle cob| = 2 \times |\angle cab|$ and stops.

Slips (-1)

S1   Numerical errors to a maximum of −3

Attempts

A1   States "angle at centre = 2× angle at the circle standing on same arc".
A2   States "straight line angle = $180°$".
A3   States "angle sum of triangle = $180°$"
A4   Any mention of an isosceles triangle
A5 $|\angle cob| = 180° - 50° = 130°$

Worthless (0)

W1   Incorrect answer and no work.
W2   Angle measured with protractor

| 4(iv) | The area of the triangle acb is 5 cm^2. If $|cb|$ = 5 cm, calculate $|ac|$ |

4(iv)

Area of triangle acb = $5\,cm^2$ $\Rightarrow \frac{1}{2}\left(|cb| \times |ac|\right) = 5$

$\Rightarrow |cb| \times |ac| = 10$

$\Rightarrow 5 \times |ac| = 10$

$\Rightarrow |ac| = 2$ $|ac| = 2\,cm$

Alternative solution to part (iv):

$Tan\,40° = \dfrac{|ac|}{5} \Rightarrow |ac| = 5 \times Tan40° = 5 \times 0.8391 = 4.1955$ $|ac| = 4.1955$

*   Accept any other correct method
*   Note If alternative solution is used, apply scheme similar to Q6(b)
*   Accept use of ½ $absinC$

Blunders (-3)
B1   Incorrect area of triangle formula, e g ½ missing in the formula.
B2   Each incorrect or missing substitution
B3   Transposition error
B4   Uses sin or cos 40° in alternative solution
B5   Writes 5 = ½ × 5 × $|ac|$ $\Rightarrow$ $|ac|$ = 2.5
B6   Uses an arbitrary angle instead of 40° and continues
B7×2   Writes 5 = ½ × 5 × $|ac|$ and stops.

Slips (-1)
S1   Rounds 0.8391 to 0.84 or similar before multiplying in alternative solution
S2   Numerical errors to a maximum of –3

Attempts
A1   States "area of triangle = ½ × base × perpendicular height" (but not ½ah).
A2   Identifies perpendicular height as 5 and stops.
A3   Any correct trigonometric ratio written down.
A4   Writes 2.5 with no work.

Worthless (0)
W1   Length measured with a ruler

4(v)
Copy the diagram and draw the image of the triangle *aoc* under the central symmetry in *o*

4(v)
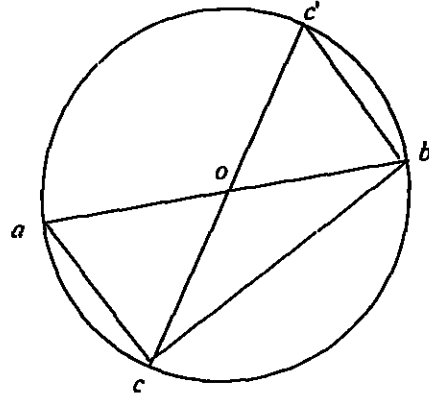Image of triangle *aoc* under the central
symmetry in *o* is triangle *boc'*

Blunders (-3)

B1   Each missing or incorrect image to a maximum of 2 blunders
B2   Correct image of Δ *aoc* under some other central symmetry, e.g. S_c
B3   Correct image of some other triangle under central symmetry in *o*
B4   Correct image of Δ *aoc* under some axial symmetry or translation, e g. S_{ab}
B5   Each side of the image triangle not drawn

Attempts

A1   Shows some knowledge of central symmetry and stops
A2   Central symmetry not related to diagram or question.
A3   Correct axial symmetry or translation on some other triangle.
A4   States image is a triangle.

Worthless (0)
W1   Diagram reproduced without modification

QUESTION 5

Part (i)	10 marks	Att 3
Part (ii)	10 marks	Att 3
Part (iii)	10 marks	Att 3
Part (iv)	10 marks	Att 3
Part (v)	10 marks	Att 3

5(i)	10 marks	Att 3

5(i)	The point $p(2,1)$ is shown on the diagram Copy the diagram and plot the point $q(4,5)$.

5(i)	10 marks	Att 3

5(i)	Show $q(4,5)$ on the diagram.

Blunders (-3)

B1   Incorrect scales on axes—penalise once only
B2   Plots $(4,y)$ or $(x,5)$ (but note M1)
B3   Draws a line joining $(4,0)$ to $(0,5)$
B4   Draws $x = 4$ or $y = 5$ (if both drawn, no penalty, provided intersection is on the graph).
B5   Plots $(5,4)$.

Misreadings (-1)

M1   Plots $(-4,5)$, $(-4,-5)$ or $(4,-5)$ but note B5

Attempts

A1   Plots an arbitrary point

5(ii)	10 marks	Att 3

5(ii)	Find the slope of *pq*

5(ii)	Slope $= \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{5-1}{4-2} = \dfrac{4}{2} = [2]$ or $\dfrac{1-5}{2-4} = \dfrac{-4}{-2} = [2]$
	Slope $= 2$

*   Accept $\dfrac{4}{2}$ oi $\dfrac{-4}{-2}$ without further simplification, but if evaluated incorrectly then

penalise in part (iv), e.g $\dfrac{-4}{-2} = -2$

*   Accept correct trigonometric method, i.e $\operatorname{Tan} \theta = \dfrac{4}{2}$

Blunders (-3)

B1   Answer left as $\dfrac{5-1}{4-2}$ or similar

B2   Serious numerical enoi, e g $\dfrac{5-1}{4-2} = \dfrac{5}{4} \pm \dfrac{1}{2}$

B3   Incoiiect sign in slope foimula, e g $\dfrac{y_2 + y_1}{x_2 + x_1}$

B4   Uses $\dfrac{x_2 - x_1}{y_2 - y_1}$ or $\dfrac{y_2 - y_1}{x_1 - x_2}$ and continues

B5×2   Uses $\dfrac{x_1 - y_1}{x_2 - y_2}$ and continues

B6   Each incorrect substitution if not already penalised to a maximum of 2 blundeis, e.g gets slope of *op* or *oq*

B7 $\operatorname{Tan} \theta = \dfrac{adjacent}{opposite}$ oi $m = \dfrac{horizontal}{veitical}$ and continues

B8×2   Calculates *vertical* $= 4$ and *horizontal* $= 2$, but does not state $m = \dfrac{4}{2}$. (Note may be calculated on diagram by inseiting right-angled triangle)

Slips (-1)

S1   Numeiical eiiors to a maximum of −3

Attempts

A1 $\operatorname{Tan} \theta = \dfrac{opposite}{adjacent}$ oi $m = \dfrac{veitical}{hoiizontal}$ and stops or makes one substitution

Woithless (0)

W1   Uses wrong formula, e g midpoint or distance formula

5(iii)   Show that $|pq| = \sqrt{20}$.

5(iii)

$$|pq| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$|pq| = \sqrt{(4 - 2)^2 + (5 - 1)^2}$$

$$|pq| = \sqrt{(2)^2 + (4)^2}$$

$$|pq| = \sqrt{4 + 16}$$

$$|pq| = \sqrt{20} \ . \ . \ . \ . \ . \ q\,e.d$$

*   Accept correct use of Pythagoras

Blunders (-3)

B1   Incorrect sign in distance formula, but penalise once only
B2   Omits square root sign
B3   Omits squares, but penalise once only
B4   Each incorrect substitution to a maximum of 2 blunders.
B5 $(4)^2 = 8$ or $(-4)^2 = -16$, but penalise once only

B6   Unfinished work. e g. leaves as $\sqrt{(2)^2 + (4)^2}$

B7×2   Leaves as $\sqrt{(4 - 2)^2 + (5 - 1)^2}$

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

Attempts

A1   Any one number filled correctly into formula
A2 $\sqrt{20} = 4\,472$

Worthless (0)
W1   Using incorrect formula, e g slope formula
W2   Writes down distance formula and stops.
W3   Identifies (x_1, y_1) and (x_2, y_2) and no further work
W4 $|pq| = \sqrt{20}$ with no work shown

5(iv)	10 marks	Att 3

5(iv)	Find the equation of the line *pq*

5(iv)	
	$y - y_1 = m(x - x_1)$
	$y - 1 = 2(x - 2)$
	$y - 1 = 2x - 4$
	$2x - y - 3 = 0$

* Accept candidate's slope from part **(ii)**.
* Accept $y - 1 = 2(x - 2)$ or $y - 5 = 2(x - 4)$ for full marks
* Accept substitution of $m = 2$ and $c = -3$ into $y = mx + c$ to give $y = 2x - 3$

Blunders (-3)
B1   Incorrect sign in formula, but penalise once only

B2   Sign error in slope (from part **(ii)** may have written $m = \dfrac{-4}{-2} = -2$)

B3 $y = 2x + c$ and stops, i.e c not worked or c not answer to part **(v)**

B4   Each incorrect substitution, if not already penalised, to a maximum of 2 blunders (e g $5 - 1 = 2(4 - 2)$ is two blunders).

B5   Uses $x - x_1 = m(y - y_1)$ and continues

B6×2   Uses $y - x_1 = m(x - y_1)$ and continues

B7   Omits brackets, e g. $y - 1 = 2x - 2$ or similar

B8 $y = mx - 3$ and stops

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

S2   Equation of *op* or *oq* if origin is used as (x_1, y_1) , but correct if *p* or *q* used as (x_1, y_1) since incorrect slope has already been penalised in part **(ii)**

Attempts

A1   States $m = 2$ or candidate's value and stops.

Worthless (0)
W1   Writes down a given formula for the equation of a line

W2 $y = mx + c$ and incorrect *m* and *c*

Part (v)	10 marks	Att 3

5(v) The line pq intersects the y-axis at the point k
Calculate the coordinates of k

5 (v)	10 marks	Att 3

5(iv)

$pq \quad 2x - y - 3 = 0$
Cuts the y-axis when $x = 0$
$2(0) - y - 3 = 0$
$y = -3 \quad$ coordinates of k are $(0,-3)$

*   Accept candidate's equation from part (iv).
*   Accept $x = 0$ and $y = -3$, even if incorrect k written down.

Blunders (-3)

B1   Uses incorrect equation from part (iv) above, if not already penalised.

B2   Cuts x-axis at $\left(\dfrac{3}{2},0\right)$ (Note may also incur B1, if incorrect equation is used)

B3 $k = -3$ and stops, i.e no x ordinate, if work is shown. (If incorrect equation is used , then also incurs B1.)

B4   Verification of graphical solution.

Slips (-1)

S1   Numerical errors to a maximum of –3.

Attempts

A1   Graphical solution

A2   Some incorrect substitution into equation of line

A3   States $x = 0$ or $y = 0$ and stops

Worthless (0)

W1   Indicates k on diagram

W2   Incorrect graphical, but note A3

QUESTION 6

Part (a)	10 marks	Att 3
Part (b)	20 marks	Att 7
Part (c)	20 marks	Att 7

Part (a)	10 marks	Att 3

6(a)	Sin$A$ = 0 5045. Use the book of Tables to find A

Part (a)	10 marks	Att 3

6(a)	Sin A = 0 5045 $\Rightarrow$ $\angle$A = 30°18′

Blunders (-3)

B1   Answer given as a decimal, i e $\angle$ A = 30 18.

B2   Looks up Cos tables correctly, $\angle$ A = 59° 42'.

B3   Looks up Tan tables correctly, $\angle$ A = 26° 46'

B4   Incorrect use of mean difference column, if it occurs, i e if candidate looks up Tan table.

Slips (-1)

S1   Reads from incorrect line or column related to the question

Misreadings (-1)

M1   Reads as 0 5445 or similar

Attempts

A1   Any correct trigonometric ratio written down.

A2   Sin 50° 45' = 0.7744

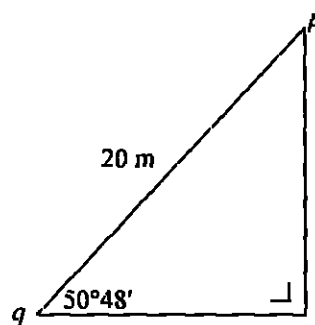**6(b)**

In the triangle pqr, $|\angle pr\,q| = 90°$,

$|\angle pqr| = 50°48'$ and $|pq| = 20\ m$

Calculate $|qr|$, correct to one decimal place

20 m

p

q 50°48' r

6(b)

$$\text{Cos } 50°48' = \frac{|qr|}{|pq|} = \frac{|qr|}{20}$$

$$\Rightarrow 20(0\ 6320) = |qr|$$

$$|qr| = 12\ 64 \quad = \quad 12\ 6 \text{ correct to one place of decimals.}$$

Blunders (-3)

B1   No decimal point or misplaced decimal point

B2   Incorrect trigonometric ratio and continues

B3   Writes $\text{Cos } 50°\ 48' = \dfrac{20}{|qr|}$ and finishes correctly ($|qr| = 31\ 6$)

B4×2   Leaves as Cos 50° 48' × 20 (note. also incurs S3).

B5×2 $\dfrac{|qr|}{20} = 0\ 6320$ and stops (note: also incurs S3)

B6   Picks an arbitrary angle and proceeds correctly

B7   Incorrect use of the mean difference column, if it occurs

Misreadings (-1)

M1   Finds $|pr|$ correctly ($|pr| = 15\ 5$)

Slips (-1)

S1   Numerical errors to a maximum of –3.

S2   Reads from incorrect line or column related to question

S3   Fails to round correctly to one decimal place

Attempts

A1   Any correct trigonometric ratio written down

A2 $|qr| = $ Cos 50° 48' and stops

A3   Writes $|\angle qpr| = 39°\ 12'$ and stops

A4   Looks up Sin, Cos or Tan of 50° 48' or 39° 12' correctly and stops.

Worthless (0)

W1   20 "combined with" 50° 48'

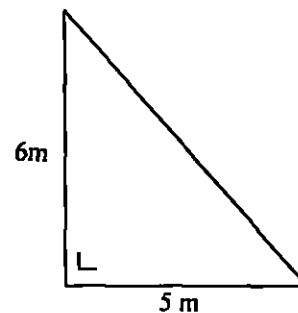**Part (c)**   **20 marks**   **Att 7**

6(c)
A vertical pole is 6 m high

It casts a shadow 5 m long
on level ground
Calculate the angle of elevation of the sun,
correct to the nearest degree

6m

5 m

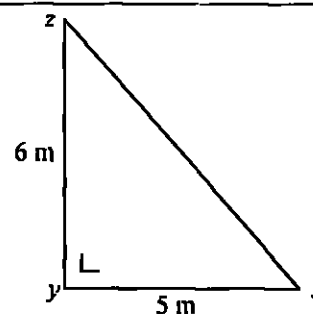**Part (c)**   **20 marks**   **Att 7**

6(c)

$$\tan \angle zxy = \frac{6}{5}$$

$$\tan \angle zxy = 1\,2$$

. $\left| \angle zxy \right| = 50°12'$.
. $\left| \angle zxy \right| = 50°$ to the nearest degree

z

6 m

y   5 m   x

---

*   Accept other correct method, e g use of Pythagoras, then sin or cos

Blunders (-3)

B1   Incorrect trigonometric ratios, but note W3 below (Note Finding $\left| \angle yzx \right|$ correctly is one blunder)

B2   No decimal point or misplaced decimal point

B3   Writes Tan $\angle zxy = 1\,2$ and stops (Note- also incurs S2)

B4×2   Writes Tan $\angle zxy = \dfrac{6}{5}$ and stops (Note also incurs S2)

Slips (-1)

S1   Reads from incorrect line or column related to the question

S2   Fails to round to nearest degree

S3   Numerical errors to maximum of −3.

Attempts

A1   Any correct trigonometric ratio written down

A2   States theorem of Pythagoras or uses it to find $\left| zx \right|$ and stops ($\left| zx \right| = \sqrt{61} = 7.81$)

A3   Copies diagram and indicates angle of elevation of sun

Worthless (0)

W1   Diagram reproduced without modification.

W2   Angle measured with protractor (49°).

W3   Value of Sin or Cos > 1