Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate 2013

Marking Scheme

Mathematics

Ordinary Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.
Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate Examination, 2013

Mathematics

Paper 1

Ordinary Level

Solutions

and

Marking Scheme

BONUS MARKS FOR ANSWERING THROUGH IRISH

Bonus marks are applied separately to each paper as follows:

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

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

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

GENERAL GUIDELINES FOR EXAMINERS

1. Penalties of three types are applied to candidates' work as follows:
    *   Blunders - mathematical errors/omissions   (-3)
    *   Slips- numerical errors   (-1)
    *   Misreadings (provided task is not oversimplified)   (-1).

    Frequently occurring errors to which these penalties must be applied are listed in the scheme. They are labelled: B1, B2, B3,…, S1, S2,…, M1, M2,…etc. These lists are not exhaustive.

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

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

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

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

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

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

8. Unless otherwise indicated in the scheme, accept the best of two or more attempts – even when attempts have been cancelled.
9. The *same* **error** in the *same* **section** of a question is penalised *once* only.

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

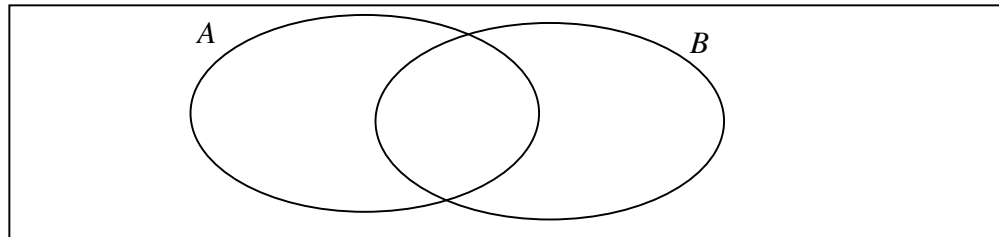11. A serious blunder, omission or misreading results in the attempt mark at most.

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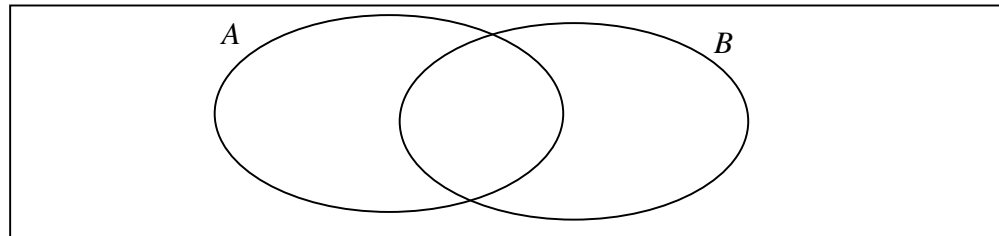
QUESTION 1

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

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

1.   **(a)**   **(i)**   Using the Venn diagram below, shade in the region that represents $A \cap B$.

         (ii)   Using the Venn diagram below, shade in the region that represents $B \setminus A$.

Part (a)(i)   **5 marks**   **Att 2**
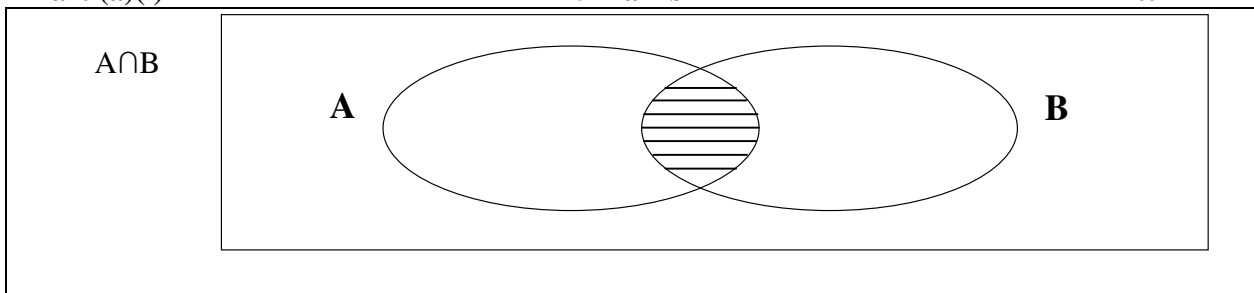
Blunders (-3)
B1   Any incorrect indication other than the misreading below

Misreadings (-1)
M1. $A \cup B$ indicated.

Worthless
W1   No filling in of the Venn Diagram

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

Blunders (-3)
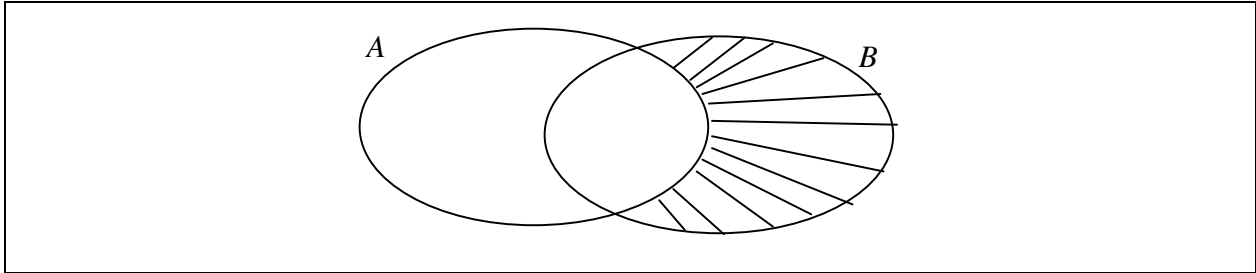B1   Any incorrect indication other than the misreading below
Misreading
M1   A \ B indicated
Worthless
W1   No filling in of the Venn Diagram

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

U is the universal set.

$P = \{2, 4, 6, 8, 10, 12\}$ is the set of multiples of 2 less than 13.

$Q = \{3, 6, 9, 12\}$ is the set of multiples of 3 less than 13.

$R = \{4, 8, 12\}$ is the set of multiples of 4 less than 13.
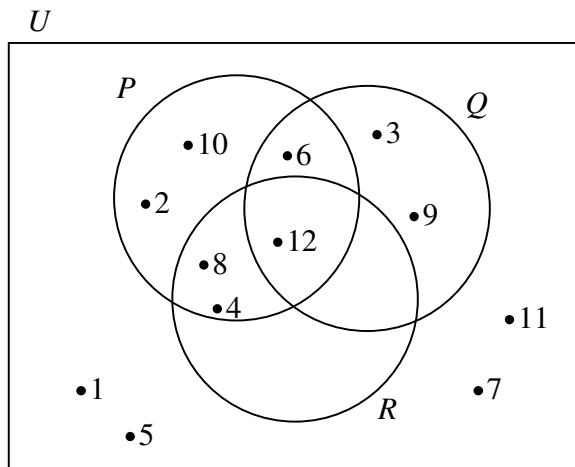
(i)   List the elements of $Q \cup R$.

(ii)   List the elements of P', the complement of the set P.

(iii) Write down #R.

(iv) What is the lowest common multiple of 2, 3 and 4?

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

$Q \cup R = \{3,4,6,8,9,12\}$

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

Misreadings (-1)
M1 $Q \cap R$ giving $\{12\}$.

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

Attempts (2 marks)
A1   Any one correct element appears in the answer
A2 $\{10,2\}$ appears or $(Q \cup R)'$

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

$P' = \{1,3,5,7,9,11\}$

Blunders (-3)
B1   Any incorrect set of the elements of P' other than the misreading below.
Misreading (-1)
M1 $P \setminus Q$ giving $\{2,4,8,10\}$, $P \setminus R$ giving $\{2,6,10\}$, $P \setminus (Q \cup R) = \{2,10\}$
M2   Set P
Slips (-1)
S1   Each correct element omitted and/or each incorrect element included. (Max -3)

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

$\#R = 3$

Blunders (-3)
B1   Incorrect $\#R \leq 12$. (See M2)

Misreadings (-1)
M1 $\#R' = 9$.

Attempts (2 marks)
A1   Uses phrase "number of elements" or "cardinal number".
A2 $\#R = 384$ or 24
A3   Lists R or R′

Worthless (0)
W1   Any number greater than 12 but see A2

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

> L.C.M of 2, 3 and 4 = 12

Blunders (-3)
B1   A common multiple that is not the lowest

Slips (-1)
S1   Answer written as 4×3

Attempts (2 marks)
A1   Any multiple of 2, 3 or 4 written in this part
A2   HCF = 1

Worthless (0)
W1   Elements listed are not multiples of 2, 3 or 4
W2   Incorrect answer without work

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

(c)   In a class survey, a group of students were asked if they liked tea (T)
              or coffee (C).
                   21 said they liked tea.
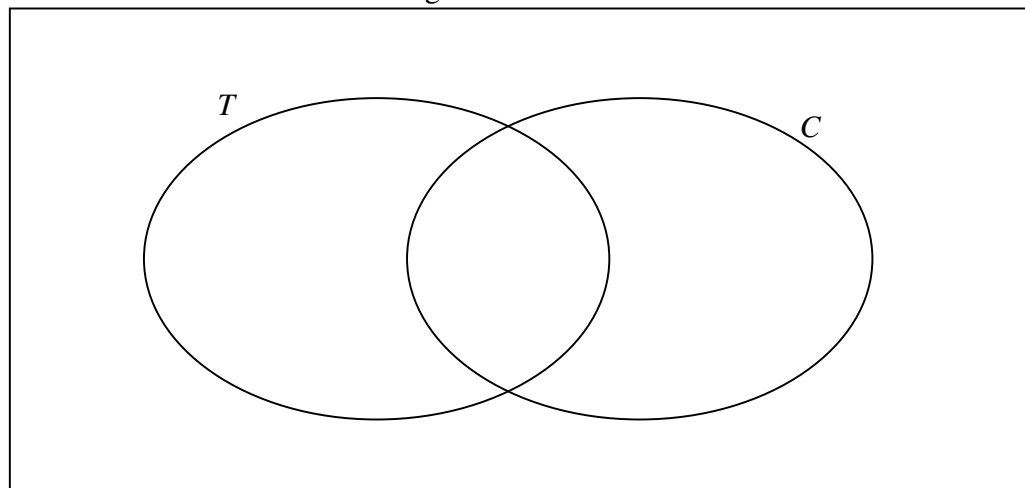   17 said they liked coffee.
                   12 said they liked tea and coffee.
                   3 said they liked neither tea nor coffee.

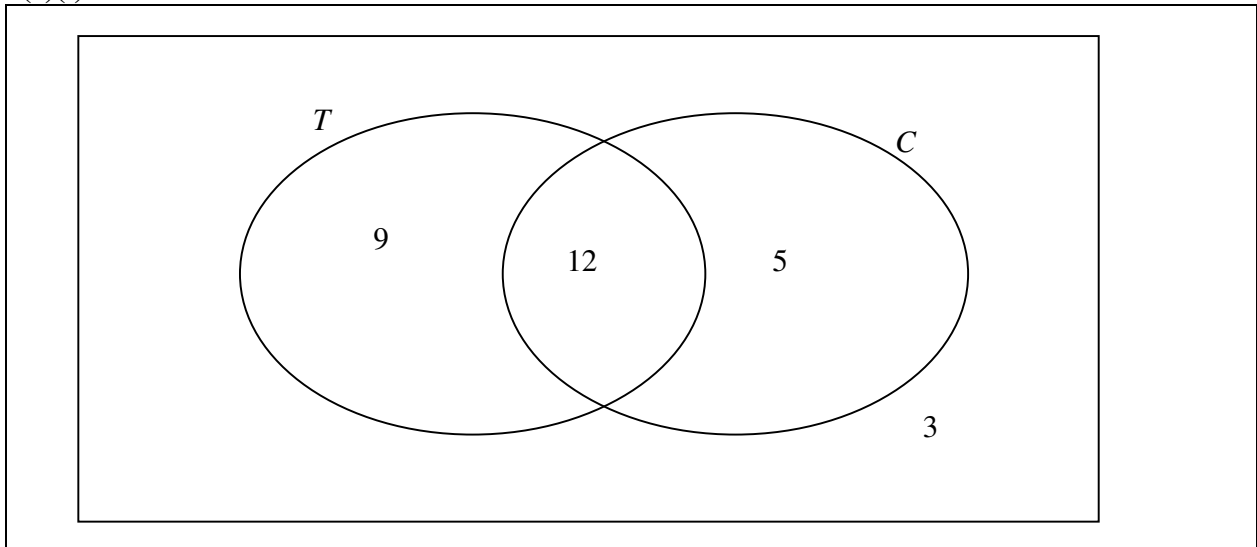**(i)**   Represent this information in the Venn diagram below.

(ii)   How many students were in the group?

(iii)   How many liked either tea or coffee only?

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

Blunders (-3)
B1   Each incorrect or omitted entry (unless consistent error) in Venn Diagram subject to S1
        below
Slips (-1)
S1   Numerical errors where work is clearly shown
Misreading (-1)
M1   Interchanges Tea and Coffee
Attempt (3 marks)
A1   Any one correct or relevant entry

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

Number of Students = 9+12+5+3=29

*   A correct answer written in the space provided takes precedence over an incorrect Venn
        diagram.
*   Accept candidates work from previous part c (i).
Blunders (-3)
B1   Any incorrect use of the given numbers or the numbers from the candidates incorrect Venn
        diagram. [Subject to S1].

Slips (-1)
S1   Numerical errors where work is clearly shown.
S2   Fails to add the correct relevant figures

Misreadings (-1)
M1   Answer not presented in designated box but presented elsewhere in c(i)

c(iii)	5 marks	Att 2

> Either tea or coffee only = 9 + 5 =14

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

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

Blunders (-3)

B1   Any incorrect use of the given relevant numbers or numbers from the previous work. [Subject to Second *above].

Slips (-1)

S1   Numerical errors where work is clearly shown.

S2   Fails to add the correct relevant figures

Misreadings (-1)

M1 $T \backslash C$ or $C \backslash T$ or $T \cup C$

M2   Answer not presented in designated box but presented elsewhere in c(i)

QUESTION 2

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

(a)	15 marks	Att 5

2. (a) A book online cost £28·00, plus a delivery charge of £5·00.

What is the total cost of the book in euro, if the exchange rate is £1 = €1·25?

(a)	15 marks	Att 5

Total cost = £28·00 + £5·00 = £33·00   or   £1 = €1·25?

33 × 1.25 = €41.25

$\begin{cases} 28×1·25 = 35 \\ 5×1·25 = 6.25 \end{cases}$

Total = €41.25

*   Candidates may offer other correct methods
*   No penalty for the omission of € or £ symbols.

*   33·00×1·25 and stops → 12 marks
*   28 ×1.25 = 35 and stops → 9 marks
*   5 × 1.25 = 6.25 and stops → 9 marks
*   28 + 5 = 33 and stops → 9 marks

Blunders (-3)

B1   Correct answer without work. ✍
B2   Incorrect multiplier or uses other operator
B3   Decimal error
B4   Fails to finish, leaves as 33× 1.25 and stops

Slips (-1)
S1   Numerical errors to a max of 3.
S2   Rounds off too early.

Attempts (5 marks)
A1   indicates (× 1.25)and stops.
A2   Any correct step

Worthless (0)
W1   Adds or subtracts 1.25 and stops
W2   Incorrect answer without work.

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

(b)   (i)   The population of a town in the year 2000 was 4850.
                  The population of the same town in 2010 was 5917.

                  What was the percentage increase in the population from 2000 to 2010?

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

                            OR $\frac{5917}{4850} \times 100 = 122\%$

Population change = 5917-4850 = 1067

                          122% – 100 %= 22%

% change = $\frac{1067}{4850} \times 100 = 22\%$

*   Stops or continues after 1067→ 4 marks, if work shown, otherwise Att 2 marks

Slips (-1)
S1   Fails to multiply by 100
S2   Uses 5917 instead of 4850 to get 18.03%
S3   Decimal error.
S4   Inverts $\frac{1067}{4850} \times 100$ and gets 454.54%
S5   Fails to finish
S6   Numerical errors
Attempts (2 marks)
A1   Some use of 100 in attempt to find percentage and stops
A2   Some attempt at subtraction
A3   1067 only (no work shown)
Worthless (0)
W1   Incorrect answer without work

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

(ii)   By rounding each of these numbers to the nearest whole number, estimate the value of
        $\dfrac{15 \cdot 765 + 5 \cdot 47}{6 \cdot 85}$.

        🖎 $\dfrac{15 \cdot 765 + 5 \cdot 47}{6 \cdot 85}$ is approximately equal to

$$\frac{\boxed{} + \boxed{}}{\boxed{}} = \frac{\boxed{}}{\boxed{}} = \boxed{}$$

.

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

$$\frac{15 \cdot 765 + 5 \cdot 47}{6 \cdot 85} \text{ is approximately equal to } \frac{16 + 5}{7} = \frac{21}{7} = 3$$

* $\frac{16+5}{7}$ and stops $\Rightarrow$ 4 marks.

* $\frac{16+5}{7} = \frac{21}{7}$ and stops $\Rightarrow$ 7 marks

*   No penalty if the intermediate step between approximations and correct final answer is not shown i.e. $\frac{21}{7}$ not shown

*   Special Case: $\frac{15 \cdot 765 + 5 \cdot 47}{6 \cdot 85} = 3.1$ in this part $\Rightarrow$ Attempt 3 marks.

Blunders (-3)
B1   Error(s) in rounding off to the nearest whole number. (**once only if consistent**)
B2   Decimal error in calculation of approximate value.
B3   An arithmetical operation other than indicated.
B4 $\frac{16}{7}$ +5 or similar and continues.
B5   Decimal error in calculation of final value
B6   Incorrect cancellation

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

Attempts (3 marks)
A1   Only one or two approximation made to the given numbers and stops
A2   Ans. 3 with no preceding rounding off

Worthless (0)
W1   Incorrect answer without work but note **Special Case *** above

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

(iii)   Using a calculator, or otherwise, find the exact value of $\frac{15 \cdot 765 + 5 \cdot 47}{6 \cdot 85}$.

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

$$\frac{15 \cdot 765 + 5 \cdot 47}{6 \cdot 85} = \frac{21 \cdot 235}{6 \cdot 85} = 3.1$$

Blunders (-3)
B1   Decimal error.
B2   Treats as: $\frac{15.765}{6.85} + 5.47 = 2.301459854 + 5.47 = 7.771459854$, [B1 may occur]
B3   Treats as: $15.765 + \frac{5.47}{6.85} = 15.765 + 0.798540146 = 16.56354015$,[B1 may occur]
B4   Treats as: $\frac{15.765 - 5.47}{6.85} = 1.502919708$, [B1 may occur]
B5   Treats as: $\frac{15.765 \times 5,47}{6.85} = 12.5889854$,[B1 may occur]

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

Attempts (2 marks)
A1   Some correct calculation done.

Worthless (0)
W1   Incorrect answer without work but see B2 to B5

(c)	15 (5,5,5) marks	Att (2,2,2)
c(i)	5 marks	Att 2

(c) (i) Using a calculator, or otherwise, find the exact value of $(8\cdot41)^{\frac{1}{2}}$.

$(8\cdot41)^{\frac{1}{2}} =$

c(i)	5 marks	Att 2

$(8\cdot41)^{\frac{1}{2}} = 2\cdot9$

Blunders (-3)

B1   Mishandling $(8\cdot41)^{\frac{1}{2}}$ e.g. 70.7281
B2   Decimal Error

Misreadings(-1)

M1 $(8\cdot41)^{\frac{1}{2}} = \dfrac{1}{(8\cdot41)^{\frac{1}{2}}}$ and continues or $\sqrt[3]{}$ etc

Attempts (2 marks)
A1 $\sqrt{}$ is mentioned
A2 $8.41 \times \frac{1}{2} = 4.205$

Worthless (0)
W1   Incorrect answer without work but see B1 .B2 or M1
W2 $8.41 \times 2 = 16.82$

c(ii)	5 marks	Att 2

(ii)   Simplify $\dfrac{a^6 \times a^3}{a^5}$. Give your answer in the form a^n, where $n \in \mathbb{N}$.

c(ii)	5 marks	Att 2

$$\frac{a^6 \times a^3}{a^5} = \frac{a^9}{a^5} = a^4$$

*	a$\times a \times$ a $\times a$ and stops	2 marks
*	a^{6+3-5} and stops	4 marks
*	4 only written down	2 marks
*	$\dfrac{a^9}{a^5}$ and stops	2 marks
*	a^9 and stops	2 marks
*	a $\times$ a^3 and stops	2 marks

Blunders (-3)

B1   Correct answers without work. ✍

B2 $a^3 = a \times a \times a$ and stops

B2   each error in calculation involving indices e.g. $a^6 \times a^3 = a^{18}$

B3   Each incorrect number of a's in the extended form

B4   Each incorrect elimination of a's in the extended form

Slips (-1)

S1   Numerical errors to a max of 3

S2 $\dfrac{a^9}{a^5}$ = 4 or (1 over a^{-4}) as answer

Attempts (2 marks)

A1 $a^6 \times a^3 = a^{6 \times 3}$ and stops

A2   Some correct manipulation of indices

A3 Writes a only

Worthless (0)

W1   Incorrect answer with no work shown

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

(iii)   Two jars of the same brand of coffee are for sale in a shop.

The smaller jar contains 150 g and is priced at €5·28.

The larger jar contains 250 g and is priced at €8·50.
Which is the better value?
Show work to explain your answer.

✍

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

Small Jar

1 g = €5·28/150 = €0·0352 <u>or</u> **50 g = €5·28/ 3 = €1·76**

Large Jar

1 g = €8·50/250 = €0·034   or   **50 g = €8·50/5 = €1·70**

Large jar is better value

OR   € relative to grams

$\frac{150}{5.28} = 28.41\ grams$

$\frac{250}{8.5} = 29.41$

Larger Jar is better

*   Correct answers without relevant work → 2 marks

Blunders (-3)

B1   Correct answers without work. ✍
B2   Operation other than division when finding the unit cost (once only)
B3   Finds only one unit cost (B5 also applies)
B4   Decimal error

Slips(-1)
S1   Numerical errors to a max of 3.
S2   Correct work but with no or wrong conclusion

Attempts (2 marks)
A1   Any attempt at division

Worthless (0)
W1   Incorrect answer without work

QUESTION 3

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

(a) Place the following numbers in order, starting with the lowest:

$$\frac{3}{4}, \quad 0\cdot7, \quad 72\%.$$

_____   _____   _____

(a)   10 marks   Att 3

$$\frac{3}{4} = 0\cdot75 \quad 0\cdot7, \quad 72\%. = 0\cdot72$$

$$\underline{0\cdot7} \quad \underline{72\% (0\cdot72)} \quad \underline{\tfrac{3}{4} (0\cdot75)}$$

*   Accept: 0.7,   0.72,   0.75   (merits **10** marks)

*   Note: $\frac{3}{4} = 0,75$ and $72\% = 0.72$ merits **4** marks

Blunders (-3)
B1   Decimal error (once only if consistent)
B2   Inverts fraction and continues.
B3   Incorrect order, but note M1 and W1

Misreadings(-1)
M1   Orders from highest to lowest

Attempts (3 marks)
A1 $0.7 = \frac{7}{10}$ and stops
A2   Any 2 of the given numbers in the correct order(if 3rd number not shown)
A3   Any step in the right direction

Worthless (0)
W1   Nothing correct or rewrites original list

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

(b)   **(i)**   Lena's gross pay is €25 000. Her tax credit is €3200.
She pays income tax at the rate of 20%.
Calculate Lena's take home pay.

Gross Pay	€25 000
Tax @ 20%	
Tax Credit	€3200
Tax Due	
Take-home Pay	

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

Gross Pay	€25 000
Tax @ 20%	**€5000**
Tax Credit	€3200
Tax Due	**€1800**
Take-home Pay	**€23 200**

Blunders (-3)

B1   Correct answer without work. ✎ (Table is work)
B2   All blunders in calculating tax (once only)
B3   Misuse of Tax Credit
B4   Tax Due and Stops
B5   Fails to finish correctly but see S1

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

Attempt (3)
A1   Some effort at calculating Tax

(b)(ii)	10 marks	Att 3

(ii)	Strong mortar can be used for exposed brickwork.

Sand and cement are mixed in a particular ratio to make strong mortar.

75 kg of strong mortar contains 60 kg of sand.

Find the ratio of sand to cement in the mixture.

Give your answer in its simplest form.

✍

Sand : Cement (S:C)   S:C

60 kg: 75-60 kg = 60:15 = 4:1

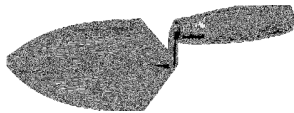*   60 : 75 = 4 : 5   7 marks   but 60 : 75 (only)6 marks
*   75:60 = 5:4 merits 6 marks   but 75:60 (only)   5 marks
*   75 – 60 = 15 (with work)   4 marks

Blunders (-3)

B1   Correct answers without work. ✍
B2   Adds instead of subtracts
B3   Incorrect ratio
B4   Incorrect division
B5   Fails to finish

Slips (-1)
S1   Numerical errors to a max of 3
S2   Finds ratio as cement to sand (i.e. 1:4)
S3   Fails to simplify or simplifies incorrectly

Attempts (3 marks)
A1   Some indication of subtraction or ratio
A2   Some correct use of 75 or 60
A3   Answer 4 (no work shown)
A4   Some mention of 15

Worthless (0)
W1   Incorrect answer without work
W2   60 + 75 = 135 and stops

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

(c)   €10 000 is invested at 1·5% per annum, compound interest.
(i)   What is the amount of the investment at the end of one year?

✎

(ii)   The money is left invested for a second year.
How much interest is earned over the two years?

✎

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

€10 000× 1·015 = €10 150 amount at end of year1

*   Candidate may offer other correct methods
*   €150 (without work) and stops $\Rightarrow$ 9 marks
*   No penalty for missing € symbol.
*   10 000 + 1.5% = 10150 $\Rightarrow$ 15 marks
*   10 000 ×1.5% = 150 and stops $\Rightarrow$ 12 marks
*   10 000 + 1.5% and stops $\Rightarrow$ 9 marks.
*   10 000 ×1.5% and stops $\Rightarrow$ 9 marks.

Blunders (-3)
B1   Correct answer without work ✎
B2   Mishandles 1.5%. e.g. (10000 must be used).
B3   Decimal error (once only)
B4   Stops at interest i.e. fails to calculate amount.
B5   Subtracts to calculate amount.

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

Attempts (5 marks)
A1   Correct formula with some correct substitution and stops
A2   Some use of 100 in attempt to find percentage and stops

Worthless (0)
W1   Incorrect answer without work
W2   10000 + 1.5 and stops

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

> Principal year 2 = €10 150
> Amount year 2 = €10 150 × 1·015 = €10 302·25
> Interest earned over two (2) years = €10 302·25 − €10 000 = € 302·25

Blunders (-3)

B1   Correct answer without work ✍
B2   Mishandles 1.5% for second year
B3   Decimal error (once only)
B4   Stops at amount i.e. fails to calculate the interest over two years
B5   Error using indices if formula used (each time)

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

Attempts (2 marks)
A1   Correct formula with some correct substitution and stops
A2   Some use of 100 in attempt to find percentage and stops
A3   Some use of answer from c(i)
A4   Oversimplification

Worthless (0)
W1   Incorrect answer without work
W2   10000 + 1.5 and stops

QUESTION 4

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

4. **(a)** If $x = 3$, find the value of:

    ✎ **(i)** $4x + 5$

    ✎ **(ii)** $20 - x^2$

Part (a)(i)	10 marks	Att 3

$$4x + 5 = 4(3) + 5 = 12 + 5 = 17$$

* $12 + 5$ ➔ 9 marks

Blunders (-3)
B1   Correct answer, without work
B2   Leaves 4(3), in the answer
B3   Breaks order $4(3 + 5) = 32$
B4   Treats 4(3) as 7 or 43
Slips (-1)
S1   Numerical errors to a max of 3
S2   Treats as $4x - 5$
Misreadings (-1)
M1 x and 5 interchanged
M2   Incorrect numerical substitution for x and continues
Attempts (3 marks)
A1   Any number substituted for x and stops
A2   Any correct step.
Worthless (0)
W1   Incorrect answer with no work.

Part (a)(ii)	5 marks	Att 2

$$20 - x^2 = 20 - (3)^2 = 20 - 9 = 11$$

* $20 - 9$ ➔ 4 marks

Blunders (-3)
B1   Correct answer, without work
B2   Leaves 3^2, in the answer
B3   Breaks order
B4   Treats 3^2 as (3×2) and continues
Slips (-1)
S1   Numerical errors to a max of 3
Misreadings (-1)
M1   Treats as $20 + x^2$
M2   Incorrect substitution and continues
Attempts (2 marks)
A1   Any number substituted for x and stops
A2   Any correct step.
Worthless (0)
W1   Incorrect answer with no work.

(b)   **15(5,5,5)**   **Att (2,2,2)**

(b)   **(i)**   Factorise $x^2 - 4$.

(ii)   Factorise $3x - 3y + cx - cy$.

(iii)   Multiply $(2x - 3)$ by $(4x - 1)$. Write your answer in its simplest form.

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

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

*   Accept also (with or without brackets) for 5 marks any of the following
        $(x - 2)$ and $(x + 2)$ [The word and is written down.]
        $(x - 2)$ or $(x + 2)$ [The word or is written down.]
        $(x - 2)$, $(x + 2)$ [A comma is used]
*   Quadratic equation formula method is subject to slips and blunders.
* $(x - \sqrt{4})(x + \sqrt{4})$ merits 5 marks.
Blunders (-3)
B1   Incorrect two term linear factors of $x^2 - 4$ formed from correct (but inapplicable) factors of
      x^2 and 4 e.g $(x - 4)(x + 1)$
B2   Incorrect factors of 4 or of x^2
B3 $(2 - x)(2 + x)$ or $(x - 4)(x + 4)$
B4   Answer left as roots. ($x = \pm 2$) from formula
B5   Correct cross method shown but factors not shown
Slips (-1)
S1 $(x - 2) \pm (x + 2)$
Attempts (2 marks)
A1   Correct factors of x^2 only
A2   Correct factors of 4 only
A3 $\pm x$ or ± 2 appears.
A4 $x^2 - 4 = x \times x - 2 \times 2$
A5   Mention of the difference of two squares e.g. $x^2 - 4^2$
A6   Correct quadratic equation formula with some correct relevant substitution
A7 $\sqrt{4}$
A8   States one correct factor
A9   Some correct attempt at factorization eg $(x \quad)(\quad)$ or the cross with at least one x in it
Worthless (0 marks)
W1   Combines xs to "numbers" and continues or stops

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

$3x - 3y + cx - cy = 3(x - y) + c(x - y)$ or $3x + cx - 3y - cy$

$= (3 + c)(x - y)$ $= x(3 + c) - y(3 + c)$

                                                       $= (x - y)(3 + c)$

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

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

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

         $(3 + c)$, $(x - y)$ [A comma is used]

Blunders (-3)

B1   Correct answer without work ✍

B2   Stops after first line of correct factorisation. e.g. $3(x - y) + c(x - y))$ or equivalent.

B3   Error(s) in factorising any pair of terms

B4   Correct first line of factorisation but ends as $(3 + c)(-xy)$ or equivalent.

Slips (-1)

S1 $(3 + c) \pm (x - y)$

Attempts (2 marks)

A1   Pairing off, or indication of common factors and stops.

A2   Correctly factorises any pair and stops.

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

$(2x - 3)(4x - 1) = 2x(4x - 1) - 3(4x - 1) = 8x^2 - 2x - 12x + 3 = 8x^2 - 14x + 3$

*   If $8x^2 - 2x - 12x + 3$ is correct   (minimum 4 MARKS)

Blunders (-3)

B1   Correct answer without work ✍

B2   Errors in distribution each time

B3   Errors in multiplication of powers

B4   Errors in grouping of terms

B5   Mathematical errors e.g. $-2. -4x = -8x$

Slips (-1)

S1   Numerical errors to a max of 3

Attempts (3 marks)

A1   One correct multiplication

A2   One correct step

Worthless (0 marks)

W1   Combines unlike terms before attempt at multiplication and stops

W2   Incorrect answer with no work

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

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

✍ **(c)   (i)**   Solve the equation $x^2 + 7x - 18 = 0$.

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

$$x^2 + 7x - 18 = 0$$
$$(x + 9)(x - 2) = 0$$
$$(x + 9) = 0 \quad \text{or} \quad (x - 2) = 0$$
$$x = -9 \quad \text{or} \quad x = 2$$

$x^2 + 7x - 18 = 0$ $x^2 + 9x - 2x - 18 = 0$ $x(x + 9) - 2(x + 9) = 0$ $(x - 2)(x + 9) = 0$ $(x - 2) = 0$ or $(x + 9) = 0$ $x = 2 \qquad or \qquad x = -9$	$x^2 + 7x - 18 = 0$ $x \diagdown \quad \diagup -2$ $\quad \diagup\diagdown$ $x \diagup \quad \diagdown +9$ $(x - 2) = 0$ or $(x + 9) = 0$ $x = 2$ or $x = -9$	$x = \dfrac{-(7) \pm \sqrt{(7)^2 - 4(1)(-18)}}{2(1)}$ $\dfrac{-7 \pm \sqrt{49 + 72}}{2} = \dfrac{-7 \pm 11}{2}$ $\dfrac{4}{2} = 2 \quad and \quad \dfrac{-18}{2} = -9$

*   **2** correct solutions by **Trial and Error**   **10** Marks
*   1 correct solution by **Trial and Error**   **3** Marks **(Attempt)**

Blunders (-3)   ___*Factor Method*___
B1   Correct answers without work ✍
B2   Incorrect two term linear factors of $x^2 + 7x - 18$ formed from correct (but inapplicable)
        factors of x^2 and/or ±18, e.g. $(x + 18)(x - 1)$
B3   No roots given, or two incorrect roots (once only)
B4   Incorrect factors of x^2 and/or ±18
B5   Correct cross method but factors not shown and stops [Note: B3 applies also].
B6 $x(x + 9) - 2(x + 9)$ or similar and stops [Note: B3 applies also].
B7   Error(s) in transposition

Slips (-1)
S1   Numerical errors to a max of 3
S2   One root only from factors

Attempts (3 marks)
A1   Some effort at factorization e.g. $(x \quad)(\quad)$ or the cross with at least one "x" written
        in, or the factors of 18
A2   States one correct root without work

Worthless (0 marks)
W1 $x^2 +7x = 18$ or similar and stops
W2 Incorrect Trial and Error
W3 Oversimplification, resulting in a linear equation

Formula Method

Blunders (-3)
B1 Error in a,b,c substitution (apply once only)
B2 Sign error in substituted formula (apply once only)
B3 Error in square root or square root ignored
B4 Stops at $\frac{-7\pm 11}{2}$
B5 Incorrect quadratic formula and continues

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

S2 Roots left in the form $\frac{p}{q}$

S3 One root only

Attempts (3 marks)
A1 Correct formula with some correct relevant substitution and stops

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

(ii) Solve for x and y:
$$3x + y = 13$$
$$2x - 5y = 20$$

✍

  $x =$ $y =$

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

$3x + y = 13 \times 5$ $y = 13 - 3x$

$2x - 5y = 20$ OR   OR

$15x + 5y = 65$ $6x + 2y = 26$ $2x - 5(13 - 3x) = 20$

$\underline{\ \ 2x - 5y = 20\ }$ $\underline{-\ 6x + 15y = -60}$

* $\underline{17x\ =\ 85\ }$ * $\underline{17y = -34\ }$ $2x - 65 + 15x = 20$

      $x = 85/17$ $y = -2$ $17x = 20 + 65$

                                             * $\underline{17x = 85\ }$ etc

       $x = 5$

$3x + y = 13$ $3x - 2 = 13$

$3(5) + y = 13$ $3x = 15$

$15 + y = 13$ $x = 5$

     $y = 13 - 15$

$y = -2$

                 $x = 5$ $y = -2$

*   Candidates may offer other solutions

*   Apply only <u>one</u> blunder deduction (B2 or B3) to any error(s) in establishing the first
      equation in terms of *x* only, or the first equation in terms of *y* only (<u>underlined</u> at * above)

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

Blunders (-3)

B1   Correct answers without work (stated or substituted)

B2   Error or errors in establishing the first equation in terms of *x* only ($17x = 85$) or the first
       equation in terms of y only ($17y = -34$) through elimination by cancellation **(but see S1)**

B3   Error or errors in establishing the first equation in terms of *x* only ($17x = 34$) or the first
       equation in terms of *y* only ($17y = -34$) through elimination by substitution **(but see S1)**

B4   Errors in transposition when finding the first variable

B5   Errors in transposition when finding the second variable

B6   Incorrect substitution when finding second variable

B7   Finds one variable only

Slips (-1)

S1   Numerical errors to a max of 3

Attempt (3 marks)

A1   Attempt at transposition and stops

A2   Multiplies either equation by some relevant number and stops

A3   Incorrect value of *x* or *y* substituted correctly to find his correct 2nd variable

A4   One correct answer without work (stated and substituted)

Worthless (0 marks)

W1   Incorrect values for *x* or *y* substituted into the equations

QUESTION 5

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

(a)	15 marks	Att 5

5. **(a)** Write in its simplest form: $2(x + 3) + 5(2x - 1)$

✍

(a)	15 marks	Att 5

$$2(x + 3) + 5(2x - 1) = 2x + 6 + 10x - 5 = 12x + 1$$

* $2x + 6 + 10x - 5$ (stops or continues) **➔ 12 marks**

Blunders (-3)
B1 Correct answer without work ✍
B2 Error in distributive law and continues (each time)
B3 Fails to finish

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

Attempts (5 marks)
A1 Any correct step.
A2 Combines "*x*'s" to numbers and continues with any correct step

Worthless (0 marks)
W1 Combines "*x*'s" to numbers and stops.
W2 Incorrect answer, with no work

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

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

> **(b)**   **(i)**   Find the values of x for which $4x - 1 < 11$, $x \in \mathbb{N}$.
>
> > ✍

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

> $4x - 1 < 11$
> $4x < 12$
> $x < 12/4$
> $x < 3$
> $x \in \mathbb{N}$ {1,2}

*   Do not penalize for **inclusion of 0** in answer
*   Stops or continues incorrectly at $x < 3$ → 4 marks

Blunders (-3)
B1   Correct answer without work. ✍
B2   Error in transposition
B3   Mishandles the direction of inequality e.g. $4x \geq 12$
B4   Treats inequality as equality and continues.

Slips (-1)
S1   Numerical errors to a max of 3
S2 $\leq$ taken instead of $<$

Misreadings (-1)
M1 $4x + 1 < 11$, and continues

Attempts (2 marks)
A1   Attempt at transposition and stops.
A2   1 or 2 substituted for x
A3   Combines "x's" to "numbers". e.g. $3x < 11$ and continues.

Worthless (0)
W1   Incorrect answer with no work e.g.{1,2,3,4,5,6,7,8,…..}.

5(b)(ii) +(iii)   **5, 10 marks**   **Att 2,3**

(ii) Write $\dfrac{4x}{7} - \dfrac{x}{2}$ as a single fraction.

✎

(iii) Verify your answer to part **(ii)** by letting $x = 7$ in $\dfrac{4x}{7} - \dfrac{x}{2}$

and in your answer to **(ii)**

✎

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

$$\frac{4x}{7} - \frac{x}{2} = \frac{2(4x) - 7(x)}{14} = \frac{8x - 7x}{14} = \frac{x}{14}$$

* $\dfrac{4x}{7} - \dfrac{x}{2} = \dfrac{4x - x}{5} = \dfrac{3x}{5}$ Zero marks.

*   Leaves answer as $\frac{8x-7x}{14}$ and stops or continues incorrectly → 4 marks

Blunders (-3)
B1   Correct answer without work ✎
B2   Error(s) in distribution
B3   Mathematical error
B4   Incorrect common denominator and continues
B5   Incorrect numerator from candidate's denominator
B6   Omitting denominator

Slips (-1)
S1   Drops denominator.
S2   Numerical error to a max of 3
S3   Correct common denominator implied
S4   If student drops x and gives answer $\frac{1}{14}$

Attempts (2 marks)
A1   14 only or a multiple of 14 only appears.
A2   Any correct step.

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

$x = 7$ $\dfrac{4x}{7} - \dfrac{x}{2} = \dfrac{4(7)}{7} - \dfrac{7}{2} = [\dfrac{28}{7} - 3\cdot5] = \mathbf{4 - 3\cdot5} = \mathbf{0\cdot5}$ (Given)

                                      or $\dfrac{56}{14} - \dfrac{49}{14} = \dfrac{7}{14} = 0.5$

$x = \mathbf{7}$ $\dfrac{x}{14} = \dfrac{7}{14}$ $= 0\cdot5$ **Answer (ii)**

Blunders (-3)
B1   Correct answer without work ✍
B2   Mathematical errors
B3   Verifies only one equation.
B4   Error in substitution to either equation
B5   Forces equality

Slips (-1)
S1   Numerical errors to a max of 3
S2   Incorrect or no conclusion from their work

Attempts (3 marks)
A1   Any correct step
A2   Writes the equations in this section.
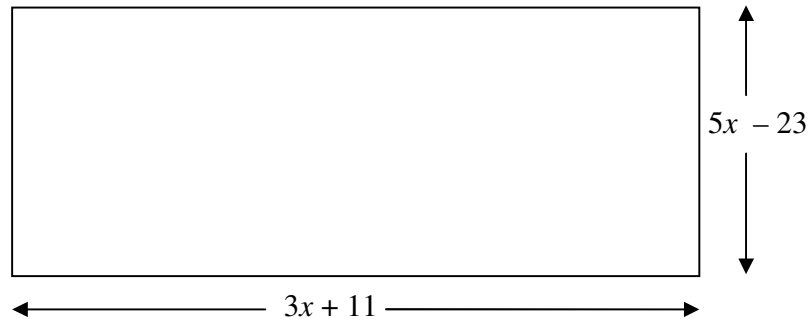A3   Substitutes into one equation and stops

Worthless (0)
W1   Invented answer verified
W2   Incorrect answer with no work

5 (c)`   **15 (10,5) marks**   **Att 3,2**

(c)   The length of a rectangle is $(3x + 11)$ units and the width is $(5x – 23)$ units, as shown in the diagram.

$5x - 23$

$3x + 11$

(i)   Find, in terms of x, the perimeter of the rectangle.

(ii)   If the perimeter is 88 units, find x.

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

Perimeter = $2(3x + 11) + 2(5x – 23)$ **OR** $(3x + 11) + (5x – 23) + (3x + 11) + (5x – 23)$ **OR**
Perimeter = $2(3x + 11 + 5x – 23)$

*   Special Case: $(3x + 11)(5x – 23)$ Award 4 marks
*   Each side omitted blunder (-3) each time

Blunders (-3)
B1   Correct answer without work ✍
B2   Fails to indicate addition of sides

Attempts (3 marks)
A1   Any correct step
A2   indication on diagram of opposite sides equal
A3   Combines "x's" to "numbers" and continues with any correct step (oversimplification)

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

Perimeter $2(3x + 11) + 2(5x – 23) = 6x + 22 + 10x – 46 = 16x – 24$
Or $2(3x + 11 + 5x – 23) = 2(8x – 12) = 16x – 24$
* $\rightarrow$ $16x – 24 = 88$
$16x = 88 + 24$
$16x = 112$
$x = 112/16$
$x = 7$

*   Accept candidates' expression from previous work
*   At most one blunder (-3) when getting $16x – 24$, to form equation
*   If some attempt at simplification in c(i) merits the Attempt mark in c(ii) if answer box left empty

Blunders (-3)
B1   Correct answer without work ($x = 7$ stated or substituted). ✍
B2   Combines "x's" to "numbers" e.g. $– 8x = 88$ and continues
B3   Errors in transposition
B4   Stops at $16x = 112$

Slip (-1)
S1   Numerical errors to a max of 3
S2   Leaves as $\frac{112}{16}$ or similar

Attempts (2 marks)
A1   Answer from part c(i) put equal to 88 and stops
A2   Any correct step
 A3   88 appears

Worthless (0 marks)
W1   Incorrect answer, with no work
W2   Combines "x's" to "numbers" and stops

QUESTION 6

Part (a)	15 (10,5) marks	Att (3,2)
Part (b)	30(15,15) marks	Att (5,5)
Part (c)	5 marks	Att 2
(a)	15(10,5) marks	Att (3,2)

6. **(a)** $f(x) = 3x - 5$.   Find:

> ✍ **(i)** $f(7)$
>
> ✍ **(ii)** $f(-1)$

Part (a) (i)	10 marks	Att3

6(a)(i) $f(7) = 3(7) - 5 = 21 - 5 = 16$

Blunders (-3)
B1   Correct answer without work
B2   Combines "$x's$" to "numbers" and continues e.g. $3x - 5 = -2x = -2(7) = -14$.
B3   Mathematical error e.g. $21 - 5 = -16$
B4   Breaks order i.e. $3(7 - 5) = 3(2) = 6$.
B5   Leaves $3(7)$ in the answer

Slips (-1)
S1   Numerical errors to a max of 3
S2   Leaves x in the answer e.g.16x.

Misreadings (-1)
M1   Correct substitution of any number other than 7 and continues.

Attempts (3marks)
A1   Substitutes for x and stops i.e. $3(7)$
A2   Treats as equation and continues or stops. i.e. $3x - 5 = 7$

Worthless (0)
W1   Combines "$x's$" to "numbers" and stops.
W2   Ignores x giving $3 - 5 = -2$.
W3 $7[f(x)] = 21x - 35$.
W4   Replaces coefficient i.e. $3x \rightarrow 7x$
W5   Incorrect answer without work.

6(a) (ii) $f(-1) = 3(-1) - 5 = -3 - 5 = -8$

Blunders (-3)

B1   Correct answer without work

B2   Combines "$x's$" to "numbers" and continues e.g. $3x - 5 = -2x = -2(-1) = 2$.

B3   Mathematical error e.g. $-3 - 5 = 8$

B4   Breaks order i.e. $3(-1-5) = 3(-6) = -18$.

B5   Leaves $2(-3)$ in the answer

Slips (-1)

S1   Numerical errors to a max of 3

S2   Leaves x in the answer e.g. $-8x$.

Misreadings (-1)

M1   Correct substitution of any negative number other than -1 and continues.

Attempts (2marks)

A1   Substitutes for x and stops i.e. $3(-1)$

A2   Treats as equation and continues or stops. i.e. $3x - 5 = -1$

Worthless (0)

W1   Combines "$x's$" to "numbers" and stops.

W2   Ignores x giving $3 - 5 = -2$

W3 $-1[f(x)] = -3x + 5$

W4   Replaces coefficient i.e. $3x \rightarrow -1x$

W5   Incorrect answer without work

(b)   **30(15,15) marks**   **Att (5,5)**

(b)   Draw the graph of the function

$$g : x \rightarrow 2x^2 - 2x - 5$$

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

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

$g(x) = 2x^2 - 2x - 5$
$g(-2) = 2(-2)^2 - 2(-2) - 5 = 2(4) + 4 - 5 = 8 + 4 - 5 = 12 - 5 = 7$ **(-2,7)**
$g(-1) = 2(-1)^2 - 2(-1) - 5 = 2(1) + 2 - 5 = 2 + 2 - 5 = 4 - 5 = -1$ **(-1,-1)**
$g(0) = 2(0)^2 - 2(0) - 5 = 0 + 0 - 5 = 0 + 0 - 5 = 0 - 5 = -5$ **(0,-5)**
$g(1) = 2(1)^2 - 2(1) - 5 = 2 - 2 - 5 = 0 - 5 = -5$ **(1,-5)**
$g(2) = 2(2)^2 - 2(2) - 5 = 2(4) - 4 - 5 = 8 - 4 - 5 = 8 - 9 = -1$ **(2,-1)**
$g(3) = 2(3)^2 - 2(3) - 5 = 2(9) - 6 - 5 = 18 - 6 - 5 = 18 - 11 = 7$ **(3,7)**

*   Candidates may offer other correct versions

A

$g(-2)$	=	$2(-2)^2$	-2(-2)	-5	=	**7**
$g(-1)$	=	$2(-1)^2$	-2(-1	-5		**-1**
$g(0)$	=	$2(0)^2$	-2(0)	-5	=	**-5**
$g(1)$	=	$2(1)^2$	-2(1)	-5	=	**-5**
$g(2)$	=	$2(2)^2$	-2(2)	-5	=	**-1**
$g(3)$	=	$2(3)^2$	-2(3)	-5	=	**7**

B

x	-2	-1	0	1	2	3
$2x^2$	8	2	0	2	8	18
$-2x$	+4	+2	- 0	- 2	-4	- 6
-5	-5	-5	-5	-5	-5	-5
$g(x)$	**7**	**-1**	**-5**	**-5**	**-1**	**7**

*   Error(s) in each row/column calculation attracts a **maximum** deduction of 3marks

Blunders (-3)
B1   Takes "$2x^2$" as "x^2" and places "x^2" in the table or function, (Applies if work shown)
B2   Errors in evaluating "$2x^2$", e.g. $2(-1)^2 = (-2)^2 = 4$, once only if consistent.
B3   "-2 x " taken as "-2" all the way [In the row headed "-2 x " by candidate]
B4   "-5" calculated as "-5 x " all the way. [In the row headed "-5" by candidate]
B5   Adds in top row when evaluating $g(x)$ in table method (**B**).
B6   Omits "-5" row
B7   Omits "-2 x " row
B8   Omits a value in the domain (each time).
B9   Each incorrect image, without work, or, calculation through the function method (**A**)

Slips (-1)
S1   Numerical errors to a max of 3 in any row / column

Misreadings (-1)
M1   Misreads "$-2x$" as "$+2x$" and places "$+2x$" in the table or function.
M2   Misreads "-5" as "+5" and places "+5" in the table or function

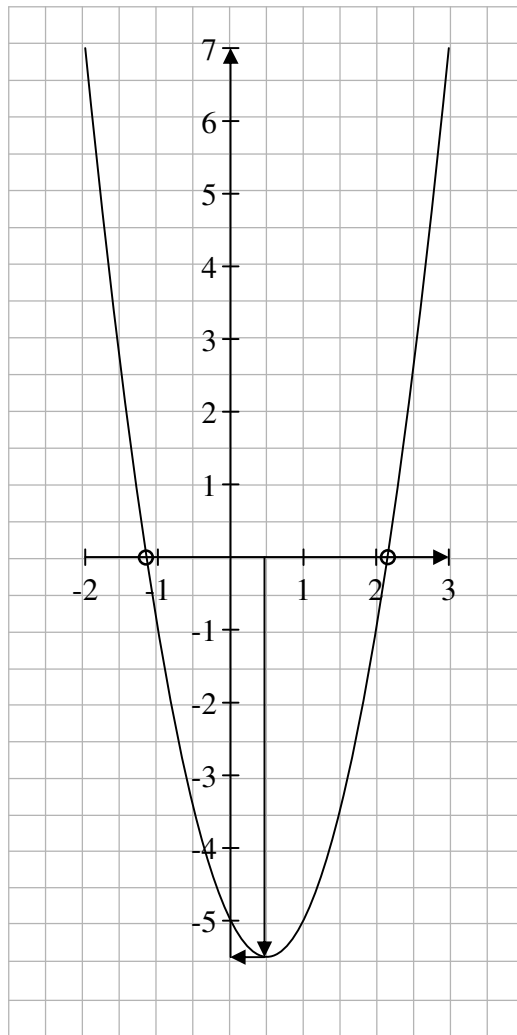*Attempts (5 marks)*
A1   Omits "$2x^2$" row or treats "$2x^2$" as $\pm 2x$ or $\pm x$, (i.e. evaluates a linear function)
A2   Any effort at calculating point(s).
A3   Only one point calculated and stops.
A4   Gives set of couples with correct domain

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

*   Accept candidates values from previous work (**6 co-ordinates needed**) but see S2
*   Only <u>**one**</u> correct point <u>**graphed correctly**</u> $\Rightarrow$ Att <u>5</u> + Att 5
*   Correct graph but no table $\Rightarrow$ full marks i.e. (15 + 15) marks.
*   Accept reversed co-ordinates if
      (i) axes not labelled   or (ii) axes are reversed to compensate (see B1 below)

Blunders (-3)
B1   Reversed co-ordinates plotted against non-reversed axes (once only) {See 4th * above}.
B2   Scale error (once only)
B3   Points not joined or joined in incorrect order (once only)

Slips (-1)
S1   Each point of candidate graphed incorrectly. {Tolerance ± 0.25 }
S2   Each point { **6 points needed** } from table not graphed [See 2nd * above]

Attempts (5 marks)
A1   Graduated axes (need not be labelled)
A2   Some effort to plot a point { See 2nd * above}
A3   Straight line att from linear table

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

(c)   **(i)**   The value of $2x^2 - 2x - 5$ when $x = 0\cdot 5$. (Show work on graph)

Answer: -5.5

(c)   **(ii)**   The values of x when $g(x) = 0$.   (Show work on graph)

Answer: $x = -1.2$ $x = 2.2$

---

*   Accept candidate's values from previous work.
*   Correct answer (clearly consistent with candidate's graph) inside the tolerance without
       graphical indication $\Rightarrow$ 2 marks.

Blunders (-3)
B1   Correct answer without work
B2   Answer on the diagram but outside of tolerance (± 0.25)
B3   Fails to write down the answer, when indicated correctly on graph.

Misreadings (-1)
M1   Answer not presented in designated box (but is written elsewhere)

Attempts (2 marks)
A1   Attempts at algebraic evaluation or calculator
A2   Marks $0\cdot 5$ in any way on either axes and stops
A3   One point of intersection indicated only or one value of x written down

Worthless (0)
W1   Answer outside of tolerance without graphical indication

Junior Certificate Examination, 2013

Mathematics
(Project Maths – Phase 1)

Paper 2

Ordinary Level

Solutions

and

Marking scheme

Question 1 (20 marks)

Niamh wants to extend her kitchen. She has two plans.
The extension is the shaded area in each plan.
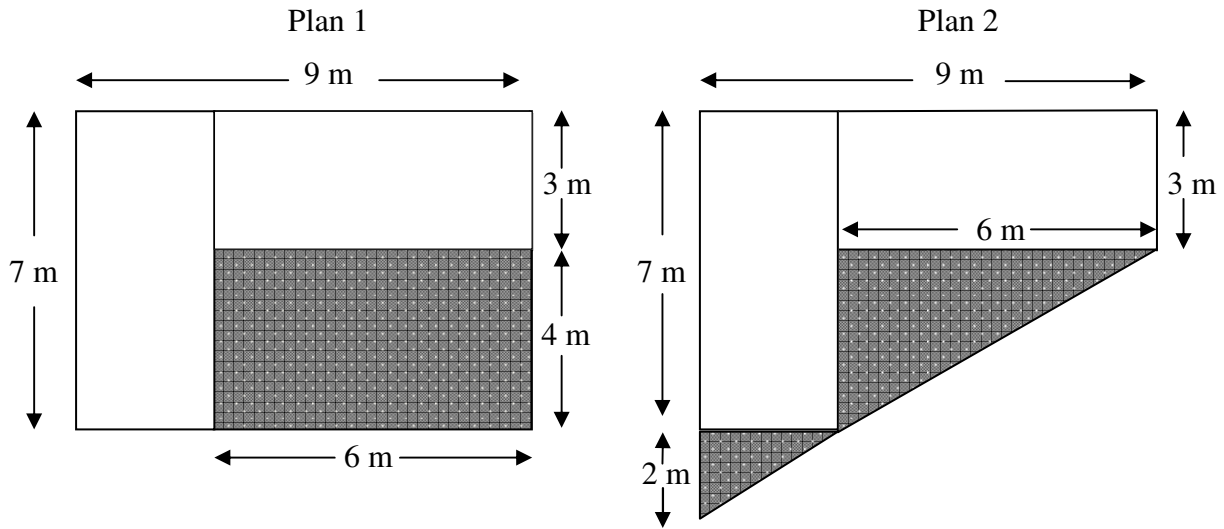
Plan 1

Plan 2

(a) Find the area of the extension for each plan.

Plan 1

$$4 \times 6 = 24 \text{ m}^2$$

Plan 2

$$\tfrac{1}{2}(2 \times 3) + \tfrac{1}{2}(6 \times 4) =$$
$$3 + 12 = 15 \text{ m}^2$$

(b) Which plan adds the biggest area to the kitchen? Tick the correct box.

Plan 1 ✔   Plan 2 ☐

(c) How many extra square metres would Niamh have if she uses this plan rather than the other plan?

$$24 - 15 = 9 \text{ m}^2$$

Question 2 (30 marks)

The data in the table below is taken from *CensusAtSchool*.
The data gives information about how students recycle soft drink cans.

Student	Gender	Age	Year	Location	Cans Bought	Cans Recycled
A	Female	12	1st Year	Dublin	6	2
B	Male	13	1st Year	Tipperary	0	0
C	Male	14	2nd Year	Cork	1	1
D	Female	15	5th Year	Cavan	0	0
E	Male	15	4th Year	Cork	2	1
F	Male	13	1st Year	Offaly	5	2
G	Female	17	5th Year	Westmeath	1	1
H	Male	17	5th Year	Westmeath	2	0
I	Male	13	1st Year	Mayo	1	1
J	Male	13	2nd Year	Galway	2	2
K	Male	17	5th Year	Kilkenny	5	5
L	Female	12	1st Year	Dublin	3	1
M	Female	17	6th Year	Kerry	2	1
N	Female	17	5th Year	Dublin	3	1

(a) How many students are in the sample?

14

(b) Complete the table below to show the **junior** students (1st to 3rd year) in the sample and to show how many cans they each bought and recycled.

Student	A	B	C	F	I	J	L
Cans Bought	6	0	1	5	1	2	3
Cans Recycled	2	0	1	2	1	2	1

(c) How many soft drink cans were bought by the junior students?

6 + 0 + 1 + 5 + 1 + 2 + 3 = 18

(d) How many soft drink cans were recycled by the junior students?

2 + 0 + 1 + 2 + 1 + 2 + 1 = 9

(e) Based on the data, would you conclude that the junior students from this sample are better at recycling than the senior students (4th to 6th year)?
Use calculations to justify your answer.

No

Student	D	E	G	H	K	M	N	Total
Cans Bought	0	2	1	2	5	2	3	15
Cans Recycled	0	1	1	0	5	1	1	9

Seniors recycled $^9/_{15}$ = 60%

Juniors recycled $^9/_{18}$ = 50%

Question 3   **(25 marks)**

A hurling match is played between Team A and Team B.
A player on Team A, Fiachra, has the ball and attempts to score.
The probability of Fiachra scoring a point is $0 \cdot 6$ and the probability of him scoring a goal is $0 \cdot 1$.

(a)   Is Fiachra more likely to score a point or a goal?

> **A point**

(b)   What is the probability that Fiachra will not score a point in this attempt?

> **1 - 0·6 = 0·4   (or $^2/_5$)**

A player on Team B, Peadar, has the ball and attempts to score. The probability of Peadar scoring a point is $0 \cdot 7$ and the probability of him scoring a goal is $0 \cdot 2$.

(c)   Peadar is more likely to score than Fiachra.
      Give a reason why this is true.

> **0·7>0·5 (point) and**
> **0·2>0·1 (goal)**

(d)   A spectator says "Peadar will always score more than Fiachra in a game between the two teams".

     Do you agree with the spectator?

         Yes [ ]   No [✔]

Give a reason for your answer.

> **While the probability of Peadar scoring is higher, it does not mean**
> **that he will score(or score more) in any particular game.**

(e)   A penalty is awarded to Team B.
      The goalkeeper for Team A has saved 12 penalties out of 20 this season.
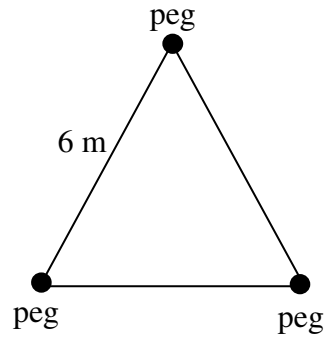
      What is the probability that the goalkeeper will save the penalty based on his previous record?

> **$^{12}/_{20}$ = $^3/_5$ or 0·6**

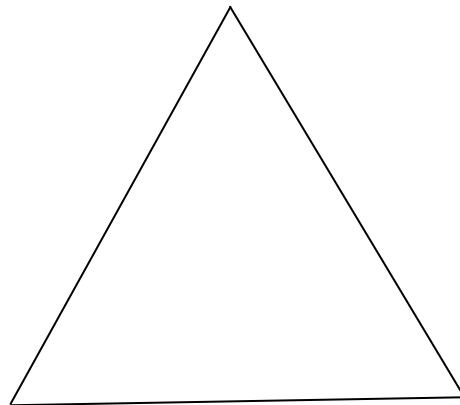**Question 4**   **(15 marks)**

Amy is a scout. The scoutmaster has made an equilateral triangle with pegs and a rope as shown in the diagram. Amy measures one side of the triangle.
It is 6 m in length.

peg

6 m

peg   peg

(a) Find the perimeter of the triangle.

6 + 6 + 6 = 18 m

(b) Construct an accurate scale diagram of the equilateral triangle in the space below.
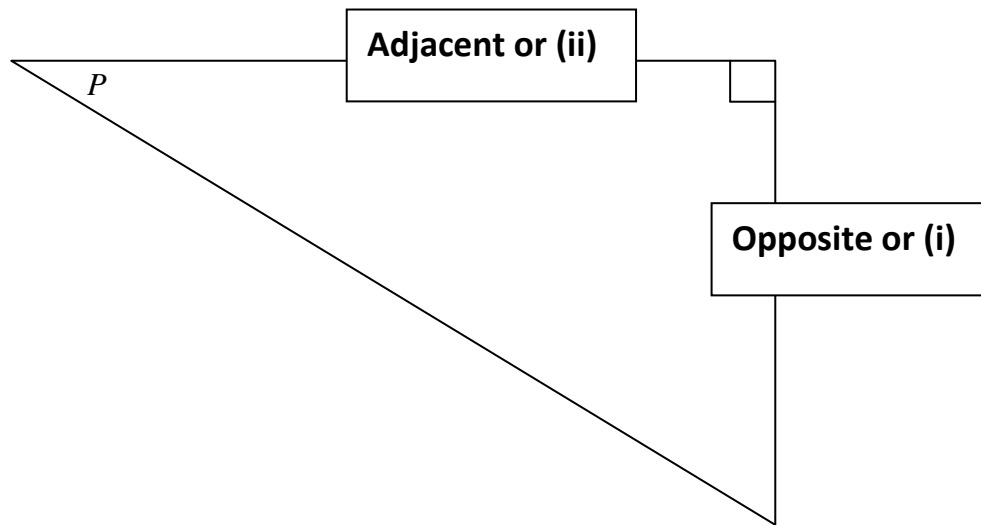Use a scale of 1 cm to represent 1 m.

Question 5 (15marks)

(a) Use your calculator to find the following trigonometric ratios.
Write each answer correct to four decimal places.

$\sin 25°$ = $\quad$ **0·4226**

$\cos 39°$ = $\quad$ **0·7771**

$\tan 40°$ = $\quad$ **0·8391**

(b) The angle P is shown in the triangle below.

P

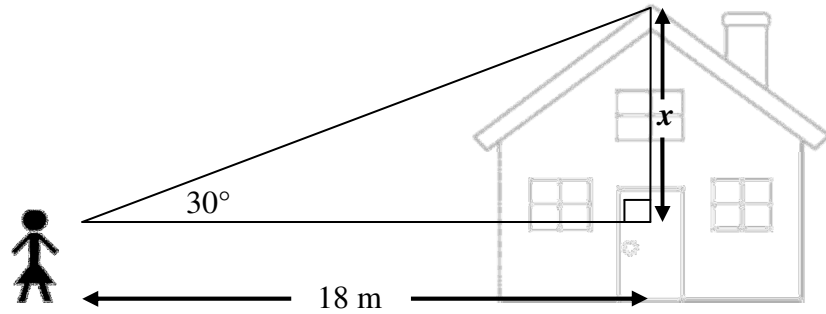| Adjacent or (ii) |
| --- |

Opposite or (i)

(i) On the diagram, clearly label the side opposite the angle P.

(ii) On the diagram, clearly label the side adjacent to the angle P.

(iii) If the length of the opposite side is 9 and the length of the adjacent side is 12, find the length of the hypotenuse.

$H^2 = 12^2 + 9^2 = 225$

$H = \sqrt{225} = 15$

Question 6   **(15marks)**

Jasmine wants to find the height of her house. She measures the angle of elevation of the top of the roof using a clinometer. The angle is 30°. She is standing 18 m from the point on the ground directly below the apex of the roof. Jasmine draws the diagram above to show this information.

(a) Use Jasmine's measurements to find x.
Write your answer in metres correct to one decimal place.

> **Tan 30° = $^x/_{18}$**
>
> **x = 18 tan 30**
>
> **= 18(0·57735....)**
>
> **= 10·3923**
>
> **= 10·4 m**

(b) What other information is needed to find the height of the house?

> **Jasmine's height**

Question 7 (20 marks)

(a) The perimeter of a rectangle is 28 cm. The length of the rectangle is 9 cm.
Find the width of the rectangle.

9 cm

2(l + w) =28

2(9+ w) =28

18 +2 w =28

2w =28 − 18 =10

w = 5 cm
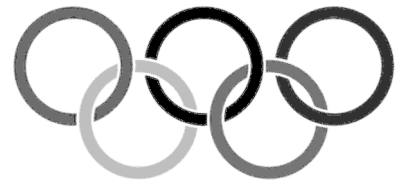
2(l + w) =28

9+ w =14

w = 14 - 9

= 5 cm

(b) The symbol for the Olympic Games is five intersecting rings.
The rings represent the five continents which compete in the
games. The radius of each ring is 4 m.
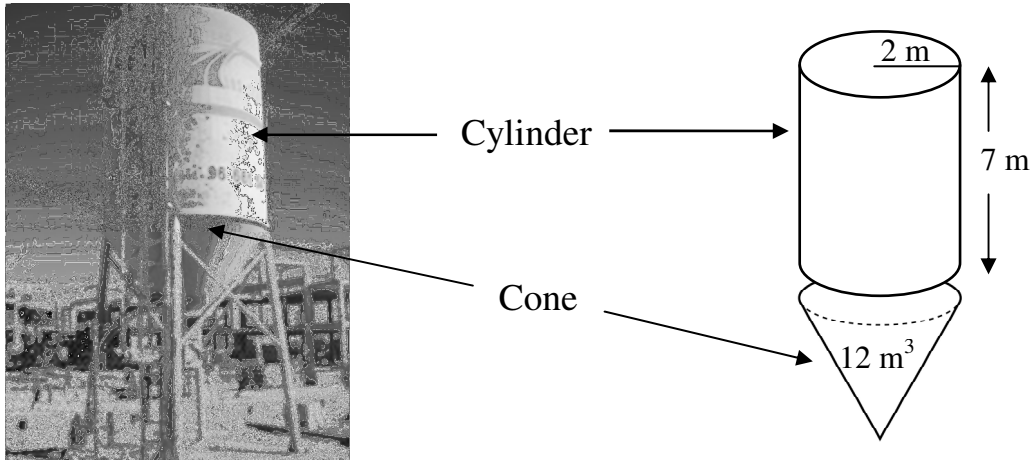Find the total circumference of the five rings. Use $\pi = 3.142$.

Circumference = 5(2πr)

= 5 × 2 × 3·142 × 4

= 125.68 m

Question 8   **(20 marks)**

Cement is stored in a silo in the shape of a cylinder on a cone as shown in the diagram.

(a) The height of the cylinder is 7 m and the radius is 2 m.
Find the volume of the cylinder. Use $\pi = 3{\cdot}142$.
Give your answer correct to the nearest m^3.

$V = \pi r^2 h$

$\quad = 3{\cdot}142 \times 2^2 \times 7$

$\quad = 87{\cdot}976 \quad = \quad 88 \ m^3$

(b) The volume of the cone is 12 m^3.
Find the total volume of cement in the silo when it is full. Give your answer correct to the nearest m^3.

$V = 88 + 12$ $V = 87{\cdot}976 + 12$

$\quad = 100 \ m^3$ $= 99{\cdot}976 \quad = 100 \ m^3$

(c) If 1 m^3 of cement weighs 2·5 tonnes, what is the total weight of the cement in the silo?

$100 \times 2{\cdot}5 \ = \ 250 \ tonnes$

Question 9 **(20 marks)**

(a) Draw two axes of symmetry of the regular pentagon shown in the diagram below.

(b) What is the total number of lines of symmetry of a regular pentagon?

5

(c) Complete the image of the pentagon under a central symmetry in the origin.

Question 10 (25marks)

(a) Convert the following times to the 24 hour clock.

    (i) 1.30 pm = ___**13:30**____

    (ii) 7.15 am = ____**07:15**___

    (iii) 9.50 pm = ___ **21:50**___

(b) An aeroplane leaves Shannon airport. It flies west for six and a half hours and lands at JFK airport in New York. The distance between the two airports is 4 596 km.
Find the average speed of the aeroplane in km/h.

> **Speed** $= {}^D/_T$
>
> $= 4596/6{\cdot}5$
>
> $= 707({\cdot}076\ldots)$ km/h

(c) During the flight, the aeroplane uses 240 litres of fuel per minute.
How many litres of fuel were used in the flight?

> **6·5 h =390 min**
>
> **240 × 390 = 93 600 litres**

(d) For emergencies the aeroplane must carry 20% more fuel than it requires.
Find the total amount of fuel carried by the aeroplane.

> **93 600 × 120% =**
>
> **112 320 litres**

> **93 600 × 20% = 18 720**
>
> **93 600 + 18 720 = 112 320 litres**

Question 11   **(30 marks)**

An archaeologist has discovered various items at a site. The site is laid out in a grid and the position of each item is shown on the grid. The items found are a brooch (B), a plate (P), a ring (R), a statue (S) and a tile (T).
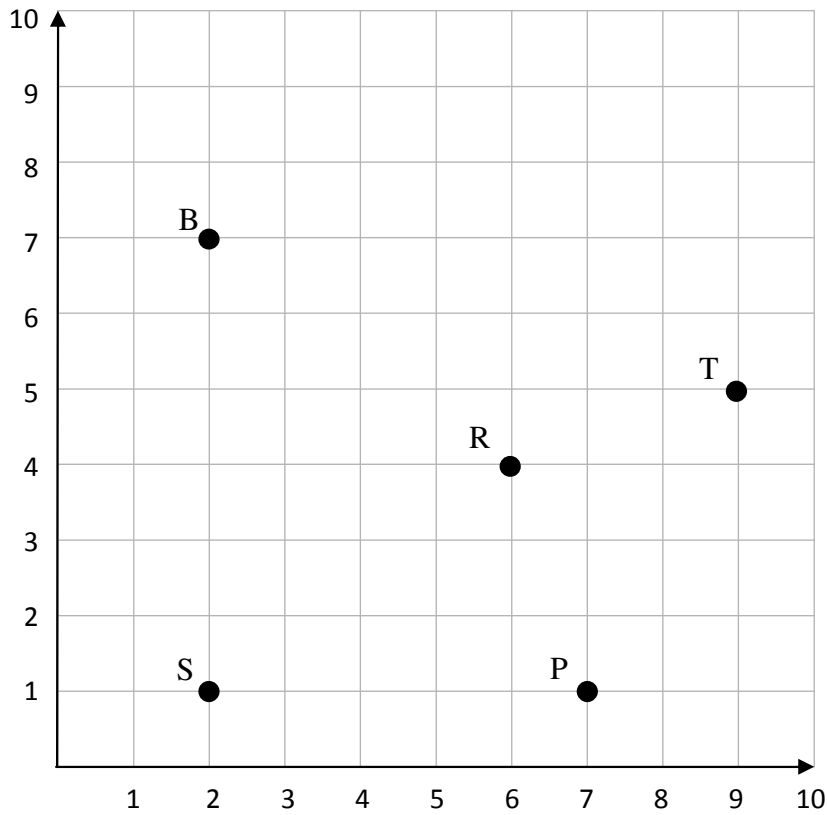
(a) Write down the co-ordinates of the position of each item.

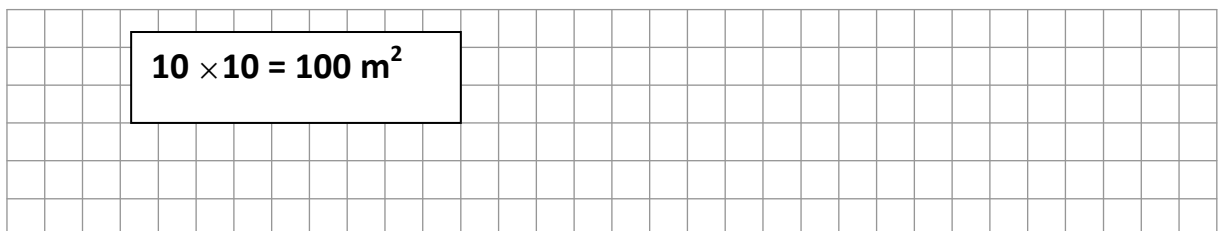B = (2 , 7)

P = (**7** , **1**)

R = (**6** , **4**)

S = (**2** , **1**)

T = (**9** , **5**)

(b) Each square of the grid represents 1 m^2.
Find the total area of the grid.

10 $\times$ 10 = 100 m^2

(c) Which of the items is nearest to the tile (T)?

				Ring (R)													
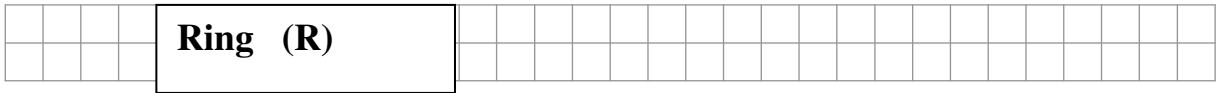
(d) Find the distance between the brooch (B) and the statue (S).

6 (by inspection)

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

$$= \sqrt{(2-2)^2 + (7-1)^2} = \sqrt{36} = 6$$
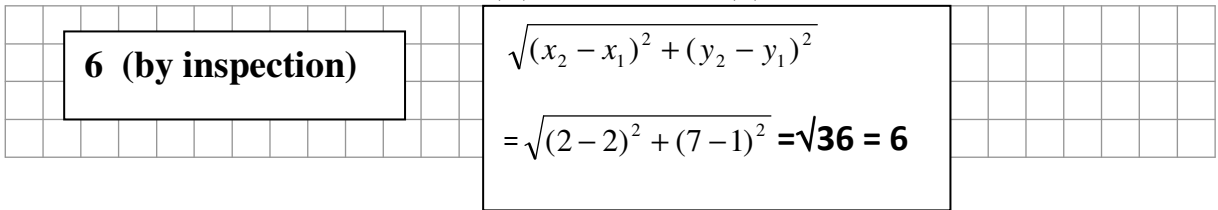
(e) What is the slope of the line from the plate (P) to the brooch (B)?

$$\frac{7-1}{2-7} = \frac{6}{-5} = -\,^6/_5$$
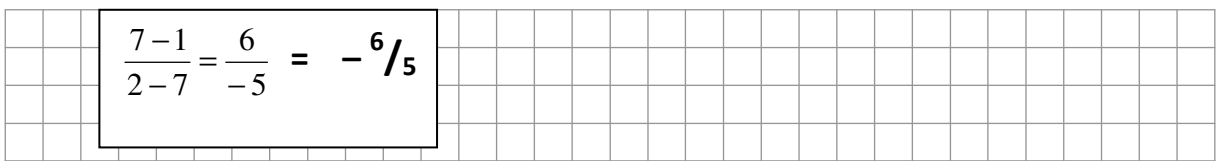
Question 12 (35 marks)

(a) Choose the correct terms for A, B and C from the following list:
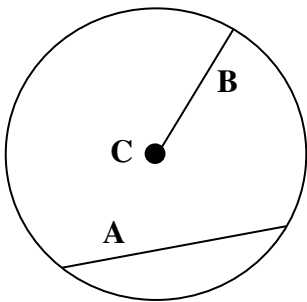
radius

diameter

circumference

centre

chord

Write the answers into the grid.

A	CHORD
B	RADIUS
C	CENTRE

(b) Find the missing angles in the diagram. Write the answers into the grid.
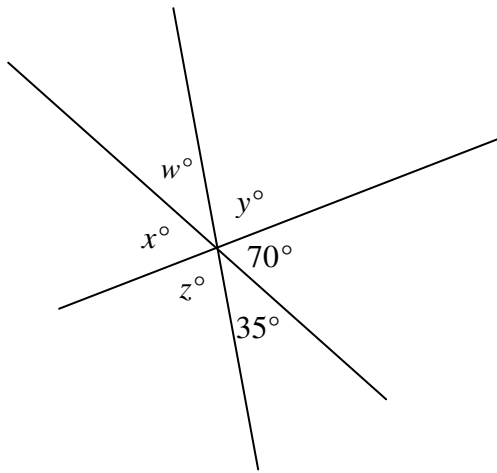
x	**70°**
w	**35°**
y	**75°**
z	**75°**

70 + 35 = 105

180 - 105 = 75

(c) The measurements of the sides of four triangles are as follows:

Triangle	Sides
A	5, 3, 4
B	5, 6, 5
C	5, 6, 7
D	5, 6, 8

Which triangle is isosceles? Give a reason for your answer.

Answer   **B**

Reason   **B has two sides of equal length.**

(d) Cian used a protractor to measure the angle α in the diagram below.
His answer was 100°.
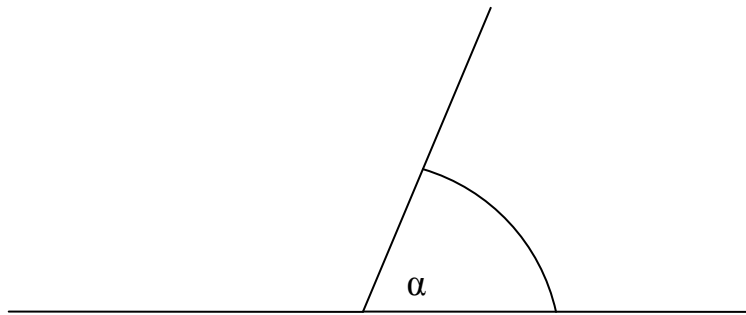
Do you agree or disagree with Cian's measurement? Give a reason for your answer.

Agree ☐   Disagree ☑

| Reason | **It is an acute angle (<90°)** |

(e) Theorems on your course can be used to find the measure of the angles in the diagram below.
Write down, in your own words, any theorem that you could use to find one of the missing angles.

73°

60° $x°$ $y°$
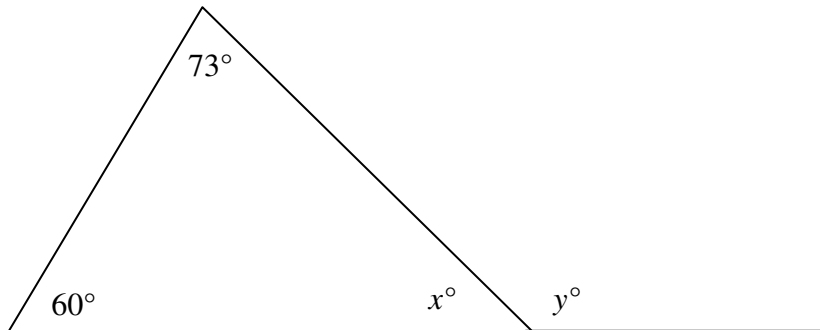
| Theorem | **Exterior angle = sum of 2 interior opposite angles** |
| | ***or***   **3 angles of a triangle add up to 180°** |

(f) Find the measure of each of the missing angles in the diagram in part **(e)** above. Show your calculations.

73 + 60 = 133

180 − 133 = 47

$x°$ = **47°** $y°$ = **133°**

Question 13 (30 marks)

A group of students was asked how many text messages each had sent the previous day.
The results were:

14	32	6	17	19	15	3	35	42	25
9	28	34	18	40	11	16	28	31	7

(a) How many students were in the group? **20**

(b) Represent the data on a stem-and-leaf diagram.

0	3	6	7	9			
1	1	4	5	6	7	8	9
2	5	8	8				
3	1	2	4	5			
4	0	2					

Key: **2|5 =25**

(c) Find the mode of the data.

28

(d) Find the mean of the data.

14 + 32+ 6 + 17 + 19 + 15 + 3 + 35 + 42 + 25 +

9 + 2 + 34 + 18 + 40 + 11 + 16 + 28 + 31+ 7

= 430

$$^{430}/_{20} = 21 \cdot 5$$

(e) What percentage of students sent more than 30 texts?

6 students sent > 30 texts

$$^{6}/_{20} \times 100 = 30\%$$

Structure of the marking scheme

Candidate responses are marked according to different scales, depending on the types of response anticipated. Scales labelled A divide candidate responses into two categories (correct and incorrect). Scales labelled B divide responses into three categories (correct, partially correct, and incorrect), and so on. The scales and the marks that they generate are summarised in this table:

Scale label	A	B	C
No of categories	2	3	4
2 mark scale	0, 2	0, 1, 2	
5 mark scale	0, 5	0, 3, 5	0, 3, 4, 5
10 mark scale	0, 10	0, 5, 10	0, 5, 8, 10
15 mark scale	0, 15	0, 10, 15	0, 10, 12, 15

A general descriptor of each point on each scale is given below. More specific directions in relation to interpreting the scales in the context of each question are given in the scheme, where necessary.

Marking scales – level descriptors

A-scales (two categories)

- incorrect response (no credit)
- correct response (full credit)

B-scales (three categories)

- response of no substantial merit (no credit)
- partially correct response (partial credit)
- correct response (full credit)

C-scales (four categories)

- response of no substantial merit (no credit)
- response with some merit (low partial credit)
- almost correct response (high partial credit)
- correct response (full credit)

In certain cases, typically involving incorrect rounding or omission of units, a mark that is one mark below the full-credit mark may also be awarded. Such cases are flagged with an asterisk.

Thus, for example, *scale 10C** indicates that 9 marks may be awarded.

Summary of mark allocations and scales to be applied Paper 2

Question 1	**Question 2**	**Question 3**	**Question 4**
(a) 10C*	(a)5A	(a) 5 A	(a)5B*
(b) 5A	(b)5B	(b) 5 A	(b)10B
(c)5B	(c)5B	(c)5B	
	(d) 5B	(d)5B	
	(e) 10C	(e)5B	

Question 5	**Question 6**	**Question7**	**Question 8**
(a)5C*	(a)10C*	(a)10C*	(a)10C*
(b)(i) and (ii) 5 B	(b)5A	(b)10C*	(b)5B*
(b)(iii) 5 C			(c)5C*

Question 9	**Question 10**	**Question 11**	**Question 12**
(a)5B	(a)5B	(a)5B	(a)10C
(b)5A	(b)5C	(b)5B	(b)5C
(c)10C	(c)10C	(c)5A	(c)5B
	(d)5C*	(d)5C	(d)5B
		(e)10C	(e)5A
			(f)5C

Question 13

(a)5A

(b)10C

(c)5A

(d)5C

(e)5C

Detailed Marking Notes Paper 2

The * for units to be applied only if answered fully correct.
The * to be applied once only per question

QUESTION 1

The * is only applied once in this question

(a)   Scale 10 C *
  High Partial Credit: Finds area of one plan correctly

  Low partial Credit: Finds area of one triangle correctly (Plan 2)
                Writes 4×6 or 9×7 or 7×3 or 6×3 (Plan 1)
                Writes 6×4 or 3×2 or 9×9 or 9×6 or 7×3 or 6×3 or 9×3 or 4×3(Plan2)
                 Correct relevant formula .

(b)   Scale 5 A

(c)   Scale 5 B

 Partial Credit: 24 – 15 .
                   Uses answer(s) from part (a) in this part
                   9 (or equivalent) .

QUESTION 2

(a) Scale 5

(b) Scale 5 B

 Partial Credit :   One correct entry in table or one correct row in table .

(c) Scale 5 B

 Partial Credit :   Attempt at adding two or more numbers from correct list
                    or adding recycled list correctly in this part.

(d) Scale 5 B

 Partial Credit :   Attempt at adding two or more numbers from correct list
                   or adding bought list correctly in this part.

(e) Scale 10 C

 High Partial Credit : Both percentages worked out correctly but no conclusion
                    or an incorrect conclusion given

Low Partial Credit :   One of the percentages worked out correctly.
                                   The number of cans that senior students bought calculated (15)
                                   or an attempt at same .
                                   The number of cans that senior students recycled calculated (9)
                                   or an attempt at same .
                                   Correct conclusion but no calculations .

QUESTION 3

(a) Scale 5 A

(b) Scale 5 A

(c) Scale 5 B

Partial Credit :   Gets the probability of Peadar scoring as 0.9.
                                 Gets the probability of Fiachra scoring as 0.7 .
                                 States $0.2 > 0.1$ or $0.7 > 0.6$.

(d) Scale 5 B

Partial Credit :   Correct answer or valid explanation
                                 Correct answer but unsound explanation
                                 Incorrect answer but gives a valid explanation

(e)   Scale 5 B

Partial Credit :   A numerator of 12 .
                                 A denominator of 20 .
                                 Any correct statement regarding the probability of an event occurring
                               (e.g. $P(E) = \dfrac{number\ of\ favourable\ outcomes}{number\ of\ possible\ outcomes}$)

Question 4

(a) Scale 5 B*

Partial Credit : $6 + 6 + 6 \neq 18$.
                               Attempt at adding two sides i.e. $6 + 6$
                               Incorrect mathematical operation .

(b) Scale 10 B

Allow tolerances of $\pm\, 0.1$ cm in lengths and $\pm\, 2°$ in degree measurements

Partial Credit :   Minimum of one side of 6 cm. and / or one angle of 60° correct within
                               tolerance .

QUESTION 5

(a) Scale 5 C*

High Partial Credit : Two correct answers .
All answers correct but calculator in incorrect mode .

Low partial credit : One correct answer .
Gets cos or tan of 25˚ or sin or tan of 39˚ or cos or sin of 40˚ correctly

(b) (i) and (ii) Scale 5 B

Accept appropriate abbreviations for the sides (e. g. Opposite $\equiv$ Opp $\equiv$ *O*)

Partial Credit : One correct label .

(b) (iii) Scale 5 C

High Partial Credit : States $H^2 = 12^2 + 9^2$.

Low Partial Credit : Gets 12^2 and / or 9^2 .
Indicates clearly the correct hypotenuse on the diagram .
States hypotenuse is side directly across from 90˚ angle .
States Pythagoras ' Theorem correctly.
Correct relevant formula .

QUESTION 6

(a) Scale 10 C*

High Partial Credit : $0.577350269 = \frac{x}{18}$.
Use of sin 30˚ or cos 30˚ and finishes correctly .

Low Partial Credit : tan 30˚ = 0.577350269 .
$\frac{x}{18}$.
States tan $= \frac{opposite}{adjacent}$. (see note in Question 5 (b) (i) and (ii))
Tan 30 ˚ .
Correct relevant formula .

(b) Scale 5 A

QUESTION 7

(a) Scale 10 C *

High Partial Credit : 28 = 2 (9) + 2 (width) or 14 = 9 + width

Low Partial Credit : 2 (9) or 9 + 9 .
States perimeter = 2 (length) + 2 (width) .
28 = 2 (length + width) or 14 = length + width .

(b) Scale 10 C *

High Partial Credit : Gets circumference of one ring correctly .
Incorrect circumference of ring after using correct formula and
then multiplies correctly .
$\pi \neq 3.142$.

Low Partial Credit : Multiplies by 5 .
4 and / or 3.142 substituted correctly into correct relevant formula
or into incorrect relevant formula , i.e. πr^2
3.142×4 or 2×4 or 3.142×2 or 3.142×8 .
Correct relevant formula.

QUESTION 8

(a) Scale 10 C*

High Partial Credit : $(3.142) (2)^2 (7)$.
$\pi \neq 3.142$.

Low Partial Credit : One or two of 3.142 , 2 or 7 substituted correctly into the correct
formula or into incorrect relevant formula i.e. $2 \pi r h$ or πr^2 .
3.142×2^2 (or 4) or 2^2 (or 4) $\times 7$ or 3.142×7.
Correct relevant formula.

(b) Scale 5 B*

Partial Credit : $88 + 12 \neq 100$
Use of 88 and / or 12
Substituting $r = 2$ into correct volume of cone formula.

(c) Scale 5 C*

High Partial Credit : $100 \times 2.5 \neq 250$.

Low Partial Credit : Use of 100 and / or 2.5 .

QUESTION 9

(a) Scale 5 B

Full Credit :   Two correct axes of symmetry.

Partial Credit :   One correct axis of symmetry.

(b) Scale 5 A

(c) Scale 10 C

Allow a tolerance of $\pm$ 0.1 cm. in lengths.

Full Credit :   All image points correct and image of pentagon drawn .

High Partial Credit :   Images of all points correct but image of pentagon not formed .
                               Two or three image points correct.

Low Partial Credit :   One correct image point.
                               Finds correct image of pentagon by symmetry in either axes.

QUESTION 10

(a) Scale 5 B

Partial Credit :   One time correct .

(b) Scale 5 C

High Partial Credit : $\dfrac{4596}{6.5}$.
                               Takes 6 hours 30 minutes as 6.3 hours and continues correctly (729 . 52)

Low Partial Credit :   Use of 4596 and / or 6.5.
                             Speed $= \dfrac{distance}{time}$ or $S = \dfrac{D}{T}$.

(c) Scale 10 C

High Partial Credit : $240 \times 390 \neq 93\,600$
                              240×390 .
                              $93\,600$.

Low Partial Credit :   Use of 240 and / or 390 .
                              Changes 6.5 hours to 390 minutes .

(d) Scale 5 C*

High Partial Credit : $93\,600 + 18\,720 \neq 112\,320$
                              $120\,\% \times 93\,600 \neq 112\,320$
                              $93\,600 + 18\,720$.
                              $120\,\% \times 93\,600$.

Low Partial Credit : $20\,\% \times 93\,600 = 18\,720$
                              $20\,\% = \frac{1}{5}$.
                              Use of $93\,600$.

                              Use of 20 % .

QUESTION 11

(a) Scale 5 B

Partial Credit :   One point correct.
                          All points correct but interchanges *x* and *y* co-ordinates.

(b) Scale 5 B*

Partial Credit : $10 \times 10 \neq 100$.
                          10×10.
                          Use of 10

(c) Scale 5 A

(d) Scale 5 C

High Partial Credit : $\sqrt{36}$.

Low Partial Credit :   Any correct substitution into correct distance formula .
                            Correct relevant formula.

(e) Scale 10 C

High Partial Credit : $\dfrac{1-7}{7-2}$.

Low Partial Credit : Any correct substitution into correct slope formula.
States slope $= \dfrac{rise}{run}$ or similar.
Correct relevant formula.

QUESTION 12

(a) Scale 10 C

High Partial Credit : Two correct answers.

Low Partial Credit : One correct answer.

(b) Scale 5 C

High Partial Credit : Two or three correct answers .

Low Partial Credit : One correct answer .

(c) Scale 5 B

Partial Credit : Correct answer but no reason or incorrect reason given .

(d) Scale 5 B

Partial Credit : Correct answer or valid explanation .
Correct answer but unsound explanation.
Incorrect answer but gives a valid explanation.

(e) Scale 5 A

(f) Scale 5 C

High Partial Credit : One correct answer .
Two correct answers without work.

Low Partial Credit : $x° + 73° + 60° = 180°$.
$y° = 60° + 73°$.
$x° + y° = 180°$.
One correct answer without work.

QUESTION 13

(a) Scale 5 A

(b) Scale 10 C

High Partial Credit : All entries in diagram correct but no key given .
Key given but one entry omitted.

Low Partial Credit : At least five correct entries with / without key.

(c) Scale 5 A

(d) Scale 5 C

High Partial Credit : $\dfrac{430}{20}$ or similar .

Low Partial Credit : Denominator of 20 or numerator of 430 .
Attempt at addition of any two numbers in list.
Correct relevant formula.

(e) Scale 5 C

High Partial Credit : $\dfrac{6}{20} \times 100 \neq 30$.

$\dfrac{6}{20} \times 100$.

Low Partial Credit : Numerator = 6 .
Denominator = 20 .
Multiplies by 100 .