



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2012

Marking Scheme

Mathematics
(Project Maths – Phase 3)

Foundation Level

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Marcanna Breise as ucht Freagairt trí Ghaeilge	57

Introduction

The Foundation Level Mathematics examination for candidates in the 24 initial schools for *Project Maths* shared some content with the examination for all other candidates. The marking scheme used for the shared content was identical for the two groups.

This document contains the complete marking scheme for both papers for the candidates in the 24 schools.

Readers should note that, as with all marking schemes used in the state examinations, the detail required in any answer is determined by the context and the manner in which the question is asked, and by the number of marks assigned to the question or part. Requirements and mark allocations may vary from year to year.



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2012

Mathematics
(Project Maths – Phase 3)

Paper 1

Foundation Level

Friday 8 June Afternoon 2:00 – 4:30

300 marks

Model Solutions – Paper 1

Note: the model solutions for each question are not intended to be exhaustive – there may be other correct solutions. Any examiner unsure of the validity of the approach adopted by a particular candidate to a particular question should contact his / her advising examiner.

Instructions

There are **two** sections in this examination paper:

Section A	Concepts and Skills	150 marks	6 questions
Section B	Contexts and Applications	150 marks	2 questions

Answer all eight questions.

Write your answers in the spaces provided in this booklet. You will lose marks if you do not do so. There is space for extra work at the back of the booklet. You may also ask the superintendent for more paper. Label any extra work clearly with the question number and part.

The superintendent will give you a copy of the booklet of *Formulae and Tables*. You must return it at the end of the examination. You are not allowed to bring your own copy into the examination.

Marks will be lost if all necessary work is not clearly shown.

Answers should include the appropriate units of measurement, where relevant.

Answers should be given in simplest form, where relevant.

Write the make and model of your calculator(s) here:

Answer **all six** questions from this section.

Question 1**(25 marks)**

For each of the following sequences of numbers, use the pattern to continue the sequence. In each case, explain your answer by describing the pattern.

- (a) 12, 17.5, 23, 28.5, **34**, **39.5**.

Add 5.5 to a term to get the next term

- (b) 64, 96, 144, 216, **324**, **486**.

Multiply a term by 1.5 to get the next term.

- (c) 1, 1, 2, 3, 5, 8, 13, 21, **34**, **55**.

Add two consecutive terms to give the next term.

Question 2

(25 marks)

- (a) (i)** Let $a = 8640$. Express a as a product of prime factors.

2	8640	
2	4320	
2	2160	
2	1080	
2	540	
2	270	
3	135	
3	45	
3	15	
5	5	
	1	

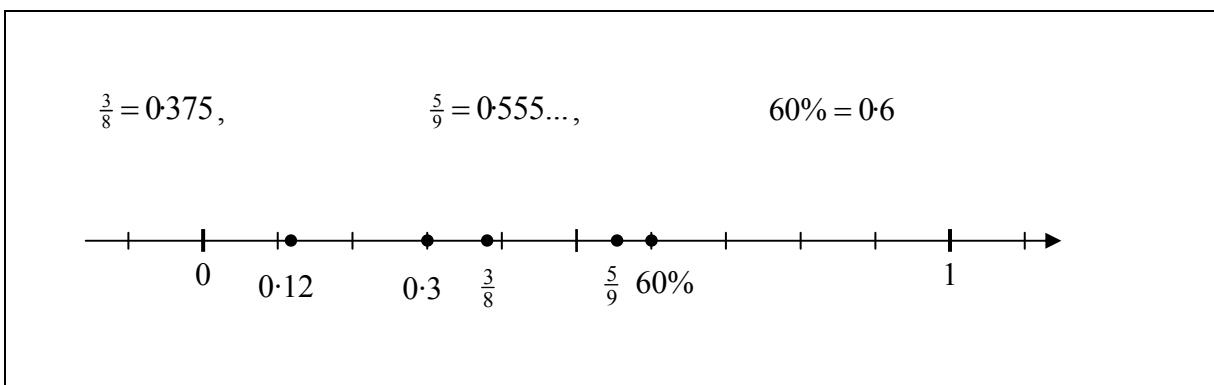
$8640 = 2^6 \times 3^3 \times 5$

- (ii)** Let $b = 2^{10} \times 3^5 \times 13^6$. Express ab as a product of prime factors, using powers appropriately.

$$ab = 2^6 \times 3^3 \times 5 \times 2^{10} \times 3^5 \times 13^6 = 2^{16} \times 3^8 \times 5 \times 13^6$$

- (b)** Place each of the following numbers in the correct position on the number line below.

0.3, $\frac{3}{8}$, $\frac{5}{9}$, 60%, 0.12



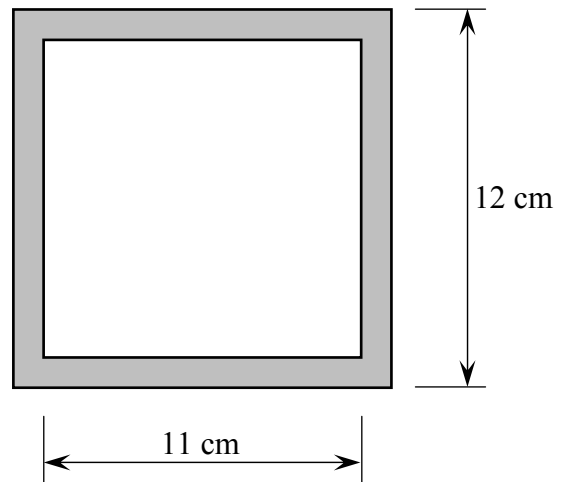
Question 3

(25 marks)

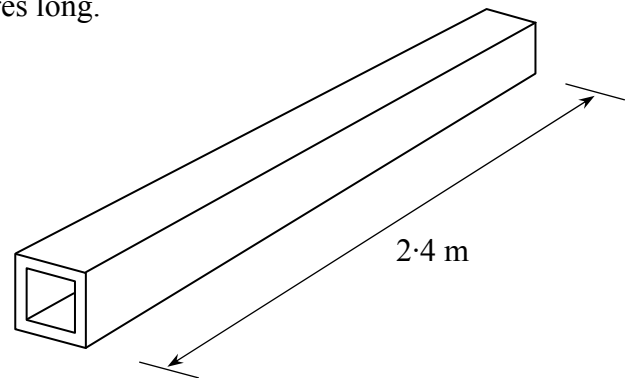
- (a) In the diagram, the inner square has side 11 cm and the outer square has side 12 cm.

Find the area of the shaded region, which is the region between the two squares, in cm^2 .

$$\begin{aligned} A &= 12 \times 12 - 11 \times 11 \\ &= 144 - 121 \\ &= 23 \text{ cm}^2 \end{aligned}$$



- (b) The diagram shows a steel beam that is 2.4 metres long. Its cross-section has the dimensions in part (a). Find the volume of steel in the beam, in cm^3 .



$$V = 23 \times 240 = 5520 \text{ cm}^3$$

- (c) Each cm^3 of steel weighs 7.9 grams. How much does the steel beam weigh, in kilograms?

$$W = \frac{5520 \times 7.9}{1000} = 43.608 \text{ kg}$$

Question 4**(25 marks)**

- (a) Solve the inequality $3x - 11 \leq 4$, for $x \in \mathbb{N}$.
List the elements of the solution set.

$$3x - 11 \leq 4 \Rightarrow 3x \leq 15 \Rightarrow x \leq 5$$
$$x \in \{1, 2, 3, 4, 5\}$$

- (b) Solve the simultaneous equations

$$a - 6b = 11$$
$$4a + 3b = 17$$

$$\begin{array}{l} a - 6b = 11 \\ 4a + 3b = 17 \end{array} \Rightarrow \begin{array}{l} a - 6b = 11 \\ \underline{8a + 6b = 34} \\ 9a = 45 \Rightarrow a = 5 \end{array}$$
$$a - 6b = 11 \Rightarrow 5 - 6b = 11 \Rightarrow -6b = 6 \Rightarrow b = -1$$

Question 5**(25 marks)**

- (a) Solve the equation $x^2 + 9x + 8 = 0$.

$$\begin{aligned}x^2 + 9x + 8 &= 0 \\ \Rightarrow (x + 8)(x + 1) &= 0 \\ \Rightarrow x + 8 = 0 \text{ or } x + 1 &= 0 \\ \Rightarrow x = -8 \text{ or } x &= -1\end{aligned}$$

- (b) Solve the equation $p^2 + 5p - 11 = 0$, giving your answers correct to two decimal places.

$$\begin{aligned}p^2 + 5p - 11 &= 0 \\ \Rightarrow p &= \frac{-5 \pm \sqrt{5^2 - 4(1)(-11)}}{2(1)} \\ &= \frac{-5 \pm \sqrt{69}}{2} = \frac{-5 \pm 8.3066}{2} \\ &= \frac{3.3066}{2} \text{ or } \frac{-13.3066}{2} \\ &= 1.6533 \text{ or } -6.6533 \\ &= 1.65 \text{ or } -6.65\end{aligned}$$

Question 6**(25 marks)**

The graphs of two functions f and g are shown on the next page. The functions are:

$$f(x) = 8 + 3x - x^2$$

$$g(x) = 2x^2 - 5x - 2$$

Use the diagram to answer the questions below.
Show your work on the diagram.

- (a) Find the value of $f(2.6)$.

Answer: 9

- (b) Find the maximum value of f .

Answer: 10.25

- (c) Find the values of x for which $g(x) = 11$.

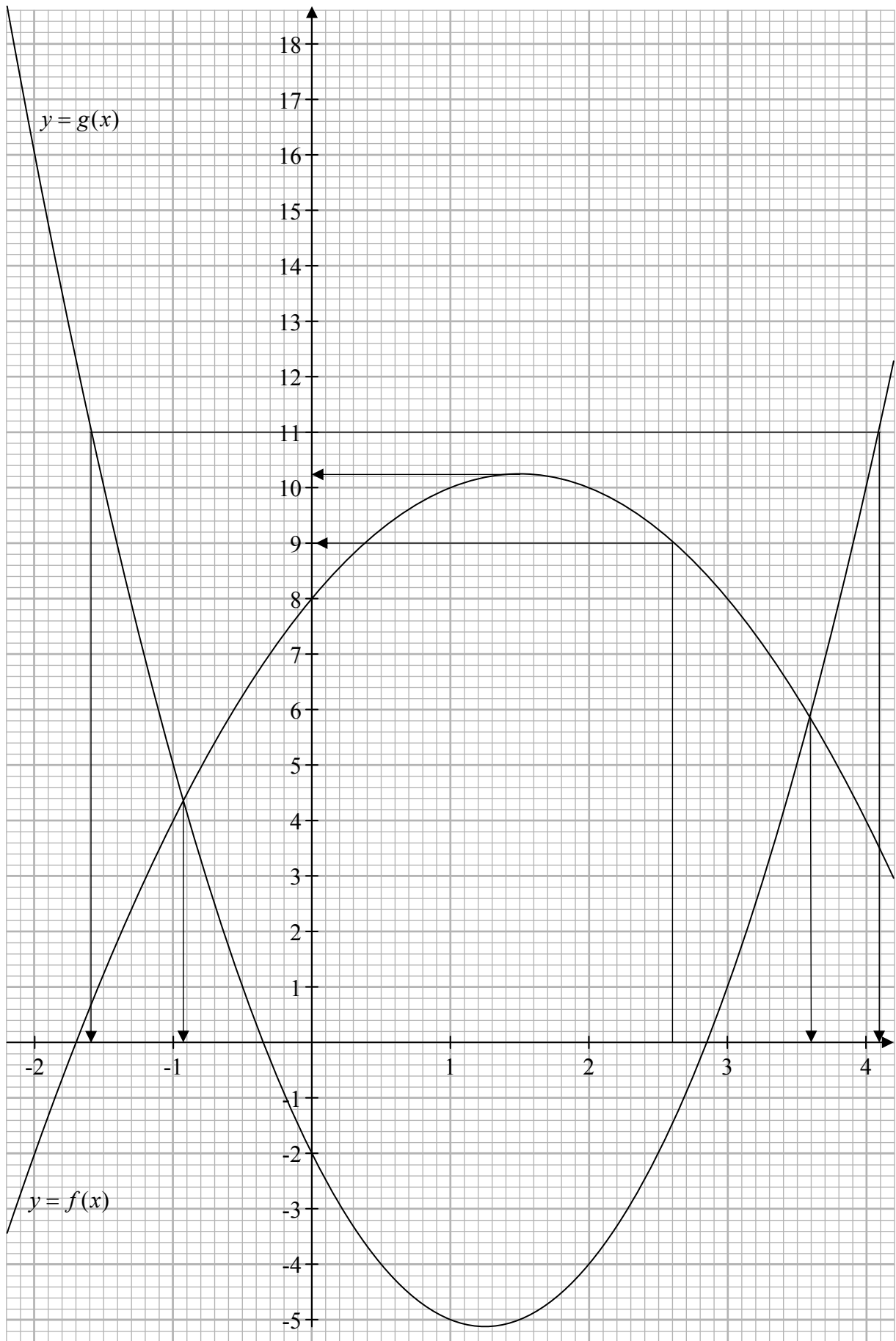
Answer: $x = -1.6$ or $x = 4.1$

- (d) Find the range of values of x for which $g(x) \leq 0$.

Answer: $-0.35 \leq x \leq 2.85$

- (e) Solve the equation $8 + 3x - x^2 = 2x^2 - 5x - 2$.

Answer: $x = -0.92$ or $x = 3.6$



Answer **both** Question 7 and Question 8.

Question 7

(75 marks)

- (a) Mary works in a shop. She has a time card for recording the hours she works every day, so that her pay for the week can be calculated. Her time card for one week is shown below. Some of the information is missing.

Time Card							
Name: Mary McGowen		Department: Floor		Work Number: N523		Week No: 19	
	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Start	10:30	11:30	14:00	08:50	08:45	09:00	09:35
Finish	17:30	14:00	19:00	18:10	18:45	18:55	18:20
Lunch break	1hr	-	-	1hr	1hr	1hr	1hr
Daily Hrs	6.00	2.50	5.0	8.33	9.0	8.92	7.75
SUMMARY		Total Sat/Sun hours	8.50	<i>Total weekday hours (Monday to Friday)</i>			39
		<i>Weekday standard</i>	37	<i>hrs</i>	<i>Weekday overtime</i>	2	<i>hrs</i>

- (i) Calculate the number of hours Mary worked on Monday, Wednesday, and Friday, and insert these on the time card above.

19:00	18:45	18:20 = 17:80
<u>14:00</u>	<u>8:45</u>	<u>9:35</u>
5:00	10:00	8:45
	<u>1:00</u>	<u>1:00</u>
	9:00	7:45

- (ii) Mary's standard working week is 37 hours. Complete the SUMMARY section of the time card to show the Saturday/Sunday hours, the total weekday hours, and the weekday overtime hours that Mary worked.

Sat/Sun hours = 6.00 + 2.50 = 8.50
Weekday hours = 5.00 + 8.33 + 9.00 + 8.92 + 7.75 = 39.00
Weekday overtime = 39.00 - 37.00 = 2.00.

- (iii) Mary is paid €9·80 per hour for standard weekday hours.
She is paid “time and a half” for weekday overtime.
She is paid “double time” for work on Saturdays and Sundays.
Calculate her gross pay for the week.

$$\begin{aligned}\text{Weekday: } & 37 \times \text{€}9\cdot80 = \text{€}362\cdot60 \\ \text{Overtime: } & 2 \times \text{€}9\cdot80 \times 1\cdot50 = \text{€}29\cdot40 \\ \text{Sat/Sun: } & 8\cdot5 \times \text{€}9\cdot80 \times 2 = \text{€}166\cdot60 \\ \text{Total: } & \text{€}362\cdot60 + \text{€}29\cdot40 + \text{€}166\cdot60 = \text{€}558\cdot60\end{aligned}$$

- (iv) The following week, Mary had a gross pay of €680. The standard rate of income tax is 21% and the higher rate is 41%. Mary has weekly tax credits of €63 and a weekly standard-rate cut-off point of €630. Calculate the amount of tax Mary paid that week.

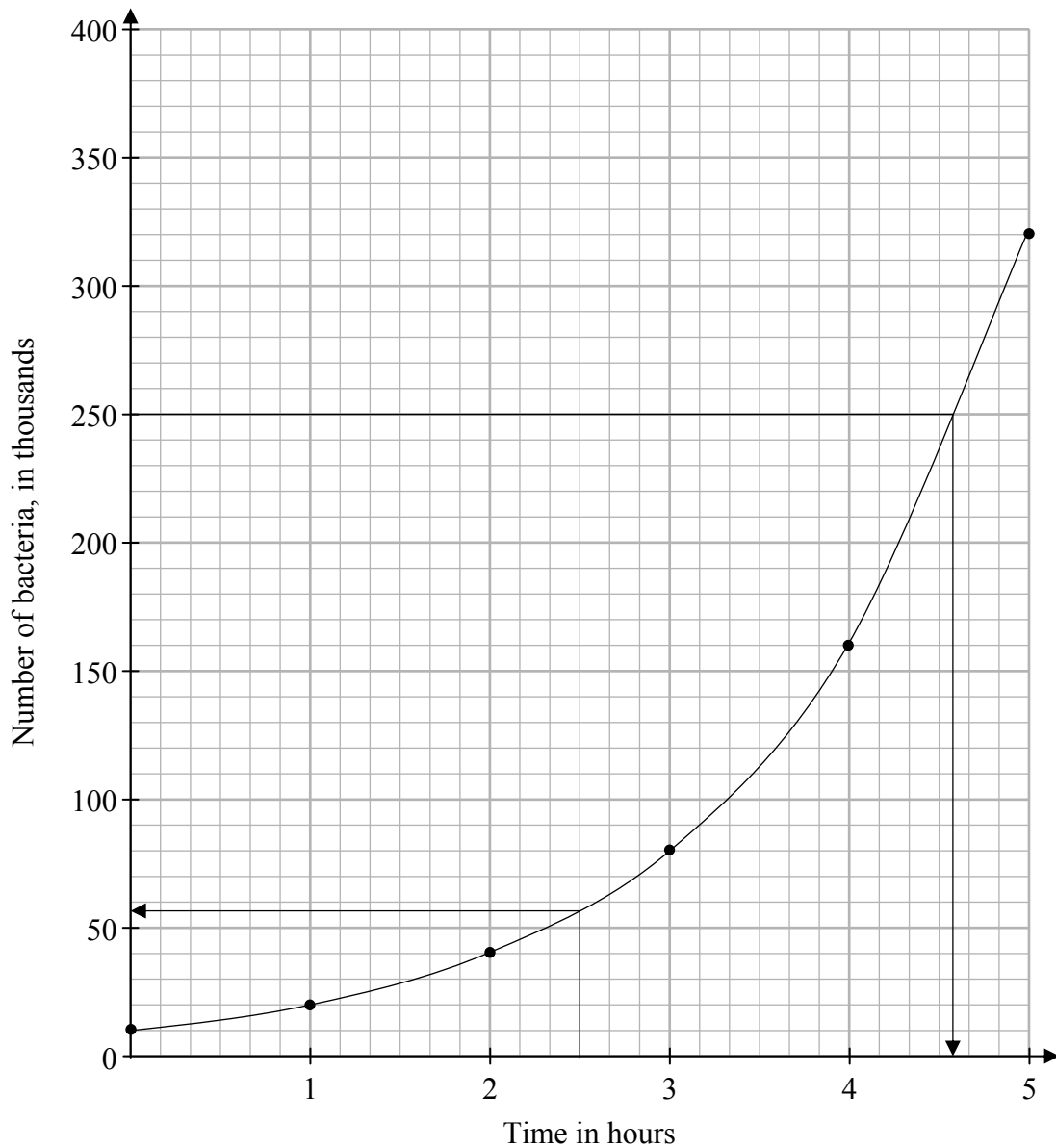
$$\begin{aligned}\text{Gross pay: } & \text{€}680 \\ \text{Tax at 21\%: } & \underline{\text{€}630} \times 0\cdot21 = \text{€}132\cdot30 \\ \text{Tax at 41\%: } & \text{€}50 \times 0\cdot41 = \underline{\text{€}20\cdot50} \\ \text{Total tax: } & \underline{\underline{\text{€}152\cdot80}} \\ \text{Tax credits: } & \underline{\underline{\text{€}63\cdot00}} \\ \text{Tax paid: } & \text{€}89\cdot80\end{aligned}$$

(b) A scientist is growing bacteria in a dish. The number of bacteria starts at 10 000 and doubles every hour.

(i) Complete the table below to show the number of bacteria over the next five hours.

Time in hours	0	1	2	3	4	5
Number of bacteria (in thousands)	10	20	40	80	160	320

(ii) Draw a graph below to show the number of bacteria over the five hours.



(iii) Use your graph to estimate the number of bacteria in the dish after $2\frac{1}{2}$ hours.

56 000 bacteria

(iv) The scientist is growing the bacteria in order to do an experiment. She needs at least 250 000 bacteria in the dish to do the experiment. She started growing the bacteria at 10:00 in the morning. At what time is the dish of bacteria ready for the experiment?

250 000 bacteria after 4 hours 34 minutes.

Time: 14:34 or 2:34 pm

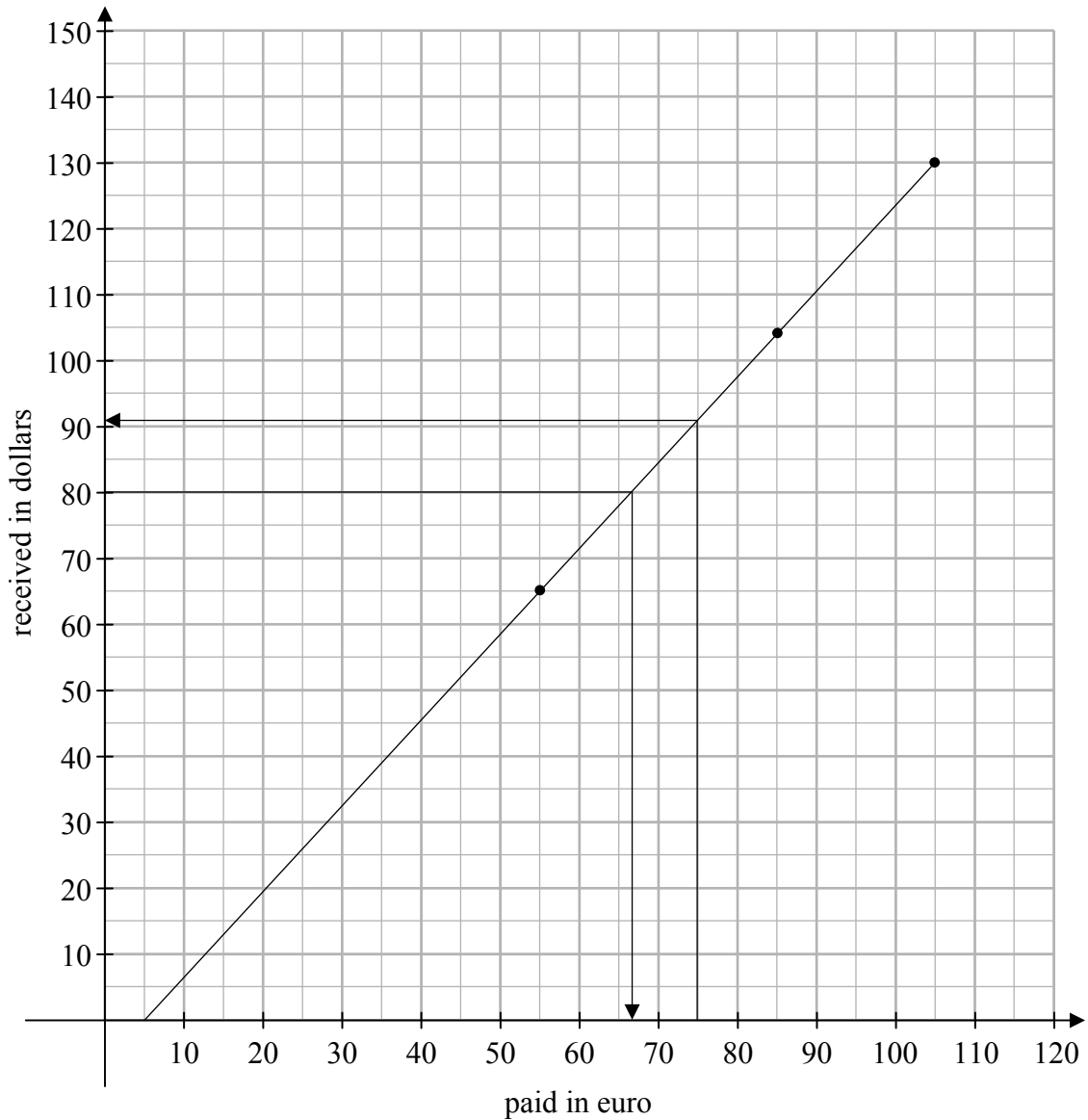
Question 8

(75 marks)

Three friends were travelling to the USA together. They each went into the same bank on the same day to change some cash in euro into dollars. As well as applying an exchange rate, the bank charged a fee of a fixed amount. The total amounts that the friends paid and received were as follows:

- Deirdre paid 55 euro to get 65 US dollars
- Olga paid 85 euro to get 104 US dollars
- Frank paid 105 euro to get 130 US dollars.

(a) Use the information above to plot three points on the diagram below.



(b) On the diagram, draw a straight-line graph to show the amount you can get in dollars for any particular amount in euro (in that bank on that day).

- (c) Use your graph to estimate how much you could get in dollars for €75.

Answer: \$91

- (d) Use your graph to estimate how much it would cost in euro to get 80 US dollars.

Answer: €67

- (e) Find the slope of the graph and the point where it crosses the horizontal axis (the euro axis).

$$\text{Slope} = \frac{130 - 0}{105 - 5} = \frac{130}{100} = 1.3$$

Crosses axis at: $(5, 0)$

- (f) Use the pattern in the amounts the friends got, **or** the graph, to complete this sentence:

“For every extra €10 you spend, the amount you get in dollars goes up by \$13.”

- (g) Complete the following:

The exchange rate that the bank used that day was: 1 euro = 1.3 US dollars.

The fixed fee charged by the bank was €5.

- (h) Which of the three friends got the best value from the bank, in your opinion?
Give a reason for your answer.

Frank.

For the fixed fee, you get best value the more euro you convert.

- (i) On the same day, another bank had the following exchange rate: 1 euro = 1.23 US dollars. This second bank did not charge any extra fixed fee.

Using tables **or** graphs **or** algebra **or** any other method, work out which of the friends, if any, would have been better off going to this second bank.

1 euro = 1.23 US dollars

Deirdre: 55 euro converts to $55 \times 1.23 = \$67.65$

Olga: 85 euro converts to $85 \times 1.23 = \$104.55$

Frank: 105 euro converts to $105 \times 1.23 = \$129.15$

Deirdre and Olga would have been better off.

Marking Scheme – Paper 1

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	D
No of categories	2	3	4	5
5 mark scale		0, 3, 5	0, 3, 4, 5	
10 mark scale		0, 6, 10	0, 5, 8, 10	0, 5, 8, 9, 10
15 mark scale			0, 8, 13, 15	0, 7, 10, 13, 15
20 mark scale			0, 12, 18, 20	
25 mark scale				0, 15, 19, 22, 25

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)

D-scales (five categories)

- response of no substantial merit (no credit)
- response with some merit (low partial credit)
- response about half-right (middle 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

Section A

Question 1

25D

Question 2

- (a) 5C
- (b) 20C

Question 3

- (a) 15C
- (b) 5B
- (c) 5C

Question 4

- (a) 10C
- (b) 15D

Question 5

- (a) 10C
- (b) 15D

Question 6

25D

Section B

Question 7

- (a) (i)+(ii) 25D
- (a) (iii) 10D
- (a) (iv) 5C
- (b) (i) 10B
- (b) (ii) 15C
- (b) (iii) 5C
- (b) (iv) 5C

Question 8

- (a) 15C
- (b) 10B
- (c) 10C
- (d) 10C
- (e) 10B
- (f) 5B
- (g) 5B
- (h) 5B
- (i) 5B

Detailed marking notes

Section A

Question 1

Scale 25D (0, 15, 19, 22, 25)

Low partial credit:

- Any work of merit.

Middle Partial credit:

- One correct sequence AND some further work of merit
- Work of merit in ALL three.

High partial credit:

- Two correct sequences, with or without correct reasons.

Question 2

(a) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Any work of merit.

High partial credit:

- One part correct.

(b) Scale 20C (0, 12, 18, 20)

Low partial credit:

- 1 or 2 of the given numbers correctly placed on the line.

High partial credit:

- 3 or 4 of the given numbers correctly placed on the line.

Question 3

(a) Scale 15C (0, 8, 13, 15)

Low partial credit:

- Attempt at multiplication of dimensions in the diagram but does not finish.
- Area defined.

High partial credit:

- Correct area of one or both squares found.

(b) Scale 5B (0, 3, 5)

Partial credit:

- Correct formula with / without substitution.

Note: Accept use of candidates answer from 3(a).

(c) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Any relevant multiplication.

High partial credit:

- Correct answer (from candidates work) in grams.

Note: Accept use of candidates answer from 3(b).

Question 4

(a) Scale 10C (0, 5, 8, 10)

Low partial credit:

- Attempt to solve equation by Trial and Improvement.
- Any one correct step.

High partial credit:

- Correct solution to equation and ignores inequality.
- Correct method but with an error.
- Correct verified solution to equation by Trial and Improvement but no solution set.

(b) Scale 15D (0, 7, 10, 13, 15)

Low partial credit:

- Effort at equalising the coefficients of a or b .
- Effort at cancelling one variable.
- Effort at writing a in terms of b or vice versa.
- Correct answer without work.
- Random a picked and used to calculate b or vice versa.

Middle Partial credit:

- One variable correctly cancelled.

High partial credit:

- One solution correctly found.

Note: Award full marks for substitution of correct values in both equations if verification is shown.

Question 5

(a) Scale 10C (0, 5, 8, 10)

Low partial credit:

- Incorrect factors and did not finish.
- Effort at solution by Trial and Improvement.
- Any correct step.

High partial credit:

- Correct factors but roots not found.
- Incorrect factors but finished correctly.
- One correct solution from Trial and Improvement, but must be verified.

Note: Award full marks for correct solutions from Trial and Improvement, if both are verified.

(b) Scale 15D (0, 7, 10, 13, 15)

Low partial credit:

- Any correct work, e.g. effort at factors or a correct transposition.
- Correct formula written.
- Value of a , b or c (for quadratic formula) identified.

Middle Partial credit:

- Correct method but errors made in calculating.

High partial credit:

- One solution correctly found.

Note: Award full marks for substitution of both correct values into equation if verification is shown.

Question 6

Scale 25D (0, 15, 19, 22, 25)

Low partial credit:

- Work of merit in at least 1 part.

Middle Partial credit:

- 1 or 2 parts correct or work of merit in at least 3 parts.

High partial credit:

- 3 or 4 parts correct, or
- 2 parts correct + work of merit in two other parts.

Note: Accept use of candidates' values from their work on the graph.
Allow tolerance of ± 0.2 .

Section B

Question 7

(a)(i)&(ii) Scale 25D (0, 15, 19, 22, 25)

Low partial credit:

- 1 correct.
- Any work of merit.

Middle Partial credit:

- 2 or 3 parts correct.

High partial credit:

- 4 or 5 parts correct.

Note: Any insertion in the “Summary” section which is consistent with earlier section counts as “correct”.

(a)(iii) Scale 10D (0, 5, 8, 9, 10)

Low partial credit:

- One correct step.

Middle partial credit:

- One calculation completed correctly.

High partial credit:

- One calculation omitted or incorrect.

Note: Accept the use of candidates answers from 7(a)(ii) above.

(a)(iv) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Any correct step.

High partial credit:

- Method correct but with errors.

(b)(i) Scale 10B (0, 6, 10)

Partial credit:

- Candidate completes the table, pattern obvious but incorrect.
- At least one correct or consistent step.

(b)(ii) Scale 15C (0, 8, 13, 15)

Low partial credit:

- 1, 2 or 3 points plotted correctly.
- Correct indication of any of the heights.

High partial credit:

- 4 points plotted correctly.

Note: if all the points are plotted correctly but not joined, award *full credit*.

(b)(iii) Scale 5C (0, 3, 4, 5)

Low partial credit:

- A reasonable answer outside of the tolerance allowed.

High partial credit:

- Answer read correctly from graph but not given in thousands.

Note: Accept an answer from the candidate's graph – *full credit* if correct, etc.
Allow tolerance of $\pm 10\,000$.

(b)(iv) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Some relevant work shown.

High partial credit:

- Answer is correct but forgot to add the time to 10:00.

Question 8

(a) Scale 15C (0, 8, 13, 15)

Low partial credit:

- 1 of the three given points plotted correctly.

High partial credit:

- 2 of the three given points plotted correctly.

(b) Scale 10B (0, 6, 10)

Partial credit:

- The line is drawn through at least one correct point.

(c) Scale 10C (0, 5, 8, 10)

Low partial credit:

- Some relevant work shown.
- Answer read from incorrect axis but outside tolerance of ± 7 .

High partial credit:

- Answer outside of tolerance of ± 1 but inside tolerance of ± 7 .
- Answer read from incorrect axis but inside tolerance of ± 1 .

Note: Accept an answer consistent with the candidates graph – *full credit* if correct etc.
Allow tolerance of ± 1 .

(d) Scale 10C (0, 5, 8, 10)

Low partial credit:

- Some relevant work shown.
- Answer read from incorrect axis but outside tolerance of ± 7 .

High partial credit:

- Answer outside of tolerance of ± 1 but inside tolerance of ± 7 .
- Answer read from incorrect axis but inside tolerance of ± 1 .

Note: Accept an answer consistent with the candidates graph – *full credit* if correct etc.
Allow tolerance of ± 1 .

(e) Scale 10B (0, 6, 10)

Partial credit:

- Any correct / relevant step, e.g. correct formula identified, or Slope = Rise over Run, with or without substitution.

- (f)** Scale 5B (0, 3, 5)
Partial credit:
- Answer indicates an upward trend or a positive slope of the line on the graph.

- (g)** Scale 5B (0, 3, 5)
Partial credit:
- Either of the two required answers correct.
 - Any relevant step or correct indication of the exchange rate.

Note: Accept the use of candidates values from their work on the graph.

- (h)** Scale 5B (0, 3, 5)
Partial credit:
- Reason omitted or incorrect.

- (i)** Scale 5B (0, 3, 5)
Partial credit:
- A correct or relevant step.



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination

Mathematics (Project Maths – Phase 3)

Paper 2

Foundation Level

Monday 11 June Morning 9:30 – 12:00

300 marks

Model Solutions – Paper 2

Note: the model solutions for each question are not intended to be exhaustive – there may be other correct solutions. Any examiner unsure of the validity of the approach adopted by a particular candidate to a particular question should contact his / her advising examiner.

Instructions

There are **three** sections in this examination paper:

Section A	Concepts and Skills	150 marks	6 questions
Section B	Contexts and Applications	150 marks	2 questions

Answer **all eight** questions, as follows:

In Section A, answer

Questions 1 to 5 and

either Question 6A **or** Question 6B.

In Section B, answer Questions 7 and 8.

Write your answers in the spaces provided in this booklet. You will lose marks if you do not do so. There is space for extra work at the back of the booklet. You may also ask the superintendent for more paper. Label any extra work clearly with the question number and part.

The superintendent will give you a copy of the booklet of *Formulae and Tables*. You must return it at the end of the examination. You are not allowed to bring your own copy into the examination.

A sheet of formulae will also be given to you by the superintendent.

Marks will be lost if all necessary work is not clearly shown.

Answers should include the appropriate units of measurement, where relevant.

Answers should be given in simplest form, where relevant.

Write the make and model of your calculator(s) here:

Answer **all six** questions from this section.

Question 1**(25 marks)**

- (a) Which of the following best describes how likely it is that each of the following events occur? Write the letter corresponding to the correct answer in the box in the table.

- A. Impossible or almost impossible
- B. Not very likely
- C. About 50% likely
- D. Very likely
- E. Certain or almost certain.

<i>Event</i>	<i>How likely</i>
A baby will be born in Ireland tomorrow.	E
If you pick one card from an ordinary pack of cards you will pick the queen of hearts.	B
There will be 400 days in the year 2013.	A
If a coin is tossed you will get a head.	C
It will not rain in Ireland during the month of November.	B
If two ordinary dice are thrown, the sum of the numbers will be 1.	A

- (b) A small business employs 1 manager, 4 technicians, 2 technical assistants and 2 secretaries. The manager is paid €1020 a week, the technicians are each paid €800 a week, the technical assistants are each paid €500 a week and the secretaries are each paid €450 a week. Find the difference between the mean weekly wage and the median weekly wage.

$$\text{Mean} = \frac{1020 \times 1 + 800 \times 4 + 500 \times 2 + 450 \times 2}{1 + 4 + 2 + 2} = \frac{6120}{9} = \text{€}680$$

$$\text{Median} = \text{€}800$$

$$\text{Difference } \text{€}800 - \text{€}680 = \text{€}120$$

Question 2**(25 marks)**

John has two bags. In one bag there are two balls numbered 1 and 2. In the other bag there are three balls numbered 5, 6 and 7.

John picks one ball at random from each bag and records the two numbers drawn.

- (a) How many different possible outcomes are there?

$$2 \times 3 = 6$$

- (b) What is the probability that the outcome will be the balls numbered 1 and 5?

$$\frac{1}{6}$$

- (c) What is the probability that both numbers drawn will be odd?

$$\frac{2}{6} = \frac{1}{3}$$

- (d) What is the probability that at least one of the numbers will be odd?

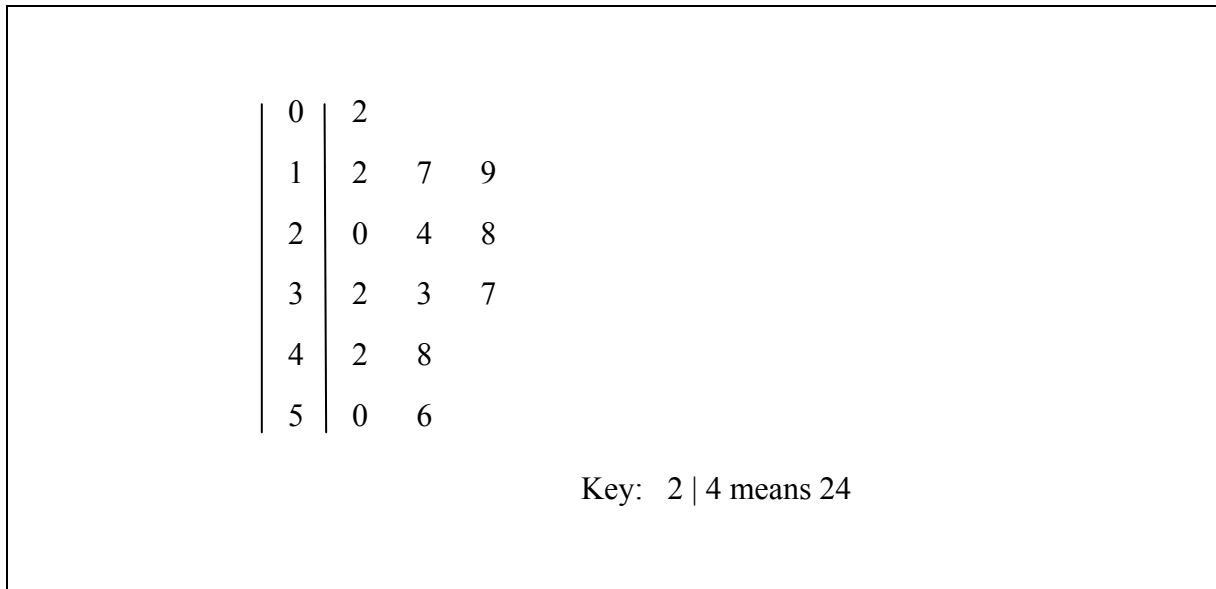
$$\frac{5}{6}$$

Question 3**(25 marks)**

The number of text messages that a student sent each day over a certain two-week period was as follows. The numbers are in date order, starting on a Monday.

17,	20,	28,	24,	33,	56,	48
12,	19,	32,	2,	37,	50,	42

- (a) Construct a stem-and-leaf plot of the data.



- (b) Find the median and the range.

Median = 30	Range = 54
-------------	------------

- (c) There was one day in this two-week period when the student lost her phone in the morning and only found it the following morning. Based on the data, what day of the week do you think that was?

Give a reason for your answer.

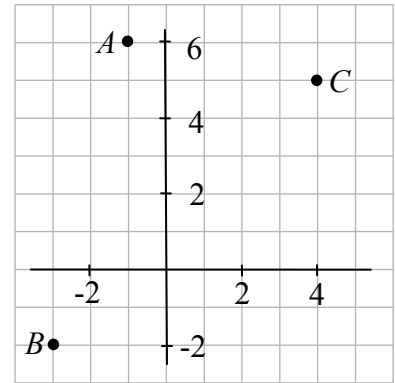
Day: Thursday (of second week)
Reason: Only 2 text messages were sent that day, very much less than any other day.

Question 4**(25 marks)**

The diagram shows the points A , B and C .

- (a) Write down the co-ordinates of

$$\begin{aligned} A &(-1, 6) \\ B &(-3, -2) \\ C &(4, 5) \end{aligned}$$



- (b) Find the co-ordinates of the midpoint of $[BC]$.

$$\text{Midpoint } [BC] = \left(\frac{-3+4}{2}, \frac{-2+5}{2} \right) = \left(\frac{1}{2}, \frac{3}{2} \right)$$

- (c) Find the slope of AB .

$$\text{Slope } AB = \frac{-2-6}{-3+1} = \frac{-8}{-2} = 4$$

- (d) The point X has co-ordinates $(7, 17)$.
Is the line AB parallel to the line CX ? Give a reason for your answer.

$$\begin{aligned} \text{Slope } CX &= \frac{17-5}{7-4} = \frac{12}{3} = 4 \\ \text{Slope of } AB &= \text{slope of } CX \Rightarrow \text{line } AB \text{ is parallel to line } CX. \end{aligned}$$

Question 5**(25 marks)**

The line l passes through the point $A\left(3, \frac{1}{2}\right)$ and has slope $\frac{5}{2}$.

(a) Show that the equation of l can be written as $2y = 5x - 14$.

$$\begin{aligned}y - \frac{1}{2} &= \frac{5}{2}(x - 3) \\ \Rightarrow y - \frac{1}{2} &= \frac{5}{2}x - \frac{15}{2} \\ \Rightarrow 2y - 1 &= 5x - 15 \\ \Rightarrow 2y &= 5x - 14\end{aligned}$$

(b) Investigate whether or not the point $B(6, 8)$ is on l .

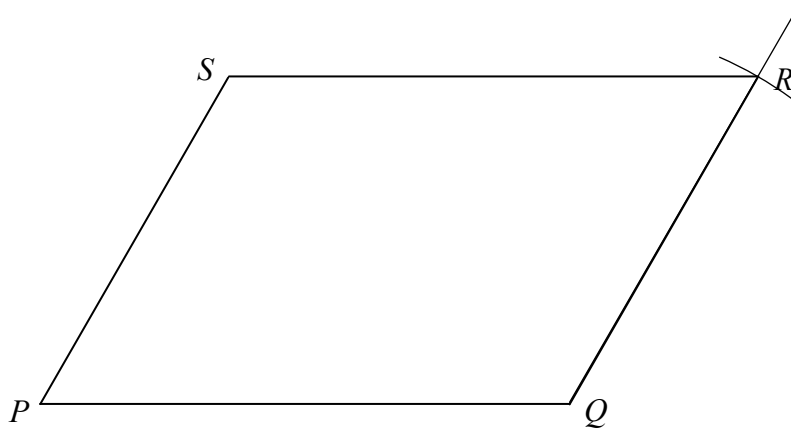
$$\begin{aligned}2y &= 5x - 14 \\ 2(8) &= 5(6) - 14 \\ \Rightarrow 16 &\neq 30 - 14 = 16 \\ \Rightarrow (6, 8) &\notin l\end{aligned}$$

(c) Find the distance from A to B .

$$|AB| = \sqrt{(6-3)^2 + \left(8 - \frac{1}{2}\right)^2} = \sqrt{3^2 + \left(\frac{15}{2}\right)^2} = \sqrt{9 + \frac{225}{4}} = \sqrt{\frac{36}{4} + \frac{225}{4}} = \frac{1}{2}\sqrt{261}$$

Question 6**(25 marks)**Answer **either** 6A **or** 6B.**Question 6A**

- (a) Construct a parallelogram $PQRS$ in which $|PQ| = 7$ cm, $|QR| = 5$ cm and $|\angle PQR| = 120^\circ$. Show all the construction lines clearly.



- (b) Use your protractor to measure the angle RSP .

$$|\angle RSP| = 120^\circ$$

- (c) Explain how you would use the measurement in part (b) to check the accuracy of your construction.

Opposite angles in a parallelogram are equal in measure.

If $|\angle RSP| = 120^\circ = |\angle PQR|$, then the construction is accurate.

OR

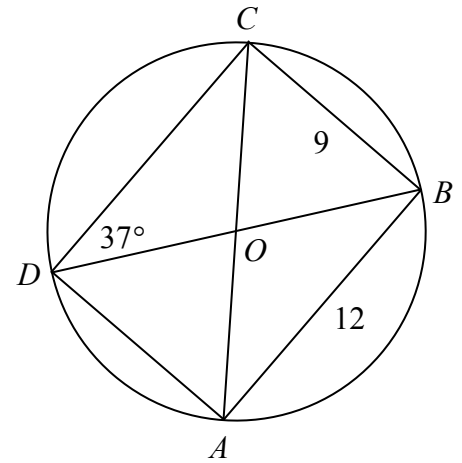
Question 6B

$ABCD$ is a parallelogram.

A circle of centre O passes through the four vertices of the parallelogram.

The diagonals of the parallelogram intersect at O .

$|AB| = 12$, $|BC| = 9$ and $|\angle CDB| = 37^\circ$.



(a) Write down $|\angle BCD|$.

$$|\angle BCD| = 90^\circ$$

(b) Calculate $|DB|$.

$$\begin{aligned} |DB|^2 &= |BC|^2 + |CD|^2 = 9^2 + 12^2 = 225 \\ \Rightarrow |DB| &= \sqrt{225} = 15 \end{aligned}$$

(c) Name two isosceles triangles in the diagram.

$$\triangle OAB, \triangle OBC, \triangle OCD, \triangle ODA$$

(d) Find $|\angle BOC|$.

$$\begin{aligned} |\angle BOC| &= |\angle OCD| + |\angle CDO| = 37^\circ + 37^\circ = 74^\circ \\ \text{or} \\ |\angle DOC| &= 180^\circ - (37^\circ + 37^\circ) = 106^\circ \\ |\angle BOC| &= 180^\circ - |\angle DOC| = 180^\circ - 106^\circ = 74^\circ \end{aligned}$$

(e) Find the area of the triangle ABD .

$$\text{Area } \triangle ABD = \frac{1}{2} |AD| \times |AB| = \frac{1}{2} (9)(12) = 54 \text{ square units.}$$

Answer Question 7 and Question 8 from this section.

Question 7**(75 marks)**

- (a) A researcher is investigating the number of hours that Leaving Certificate students in Ireland spend studying each week. The researcher asks the Principal in her old school to pick some students to be surveyed. Each student was asked how many hours they spent studying, on average, each week. The results are as follows:

9	14	13	17	8
6	8	19	12	9
7	18	13	14	21
6	22	11	6	16
9	7	13	11	22

- (i) Complete the following table:

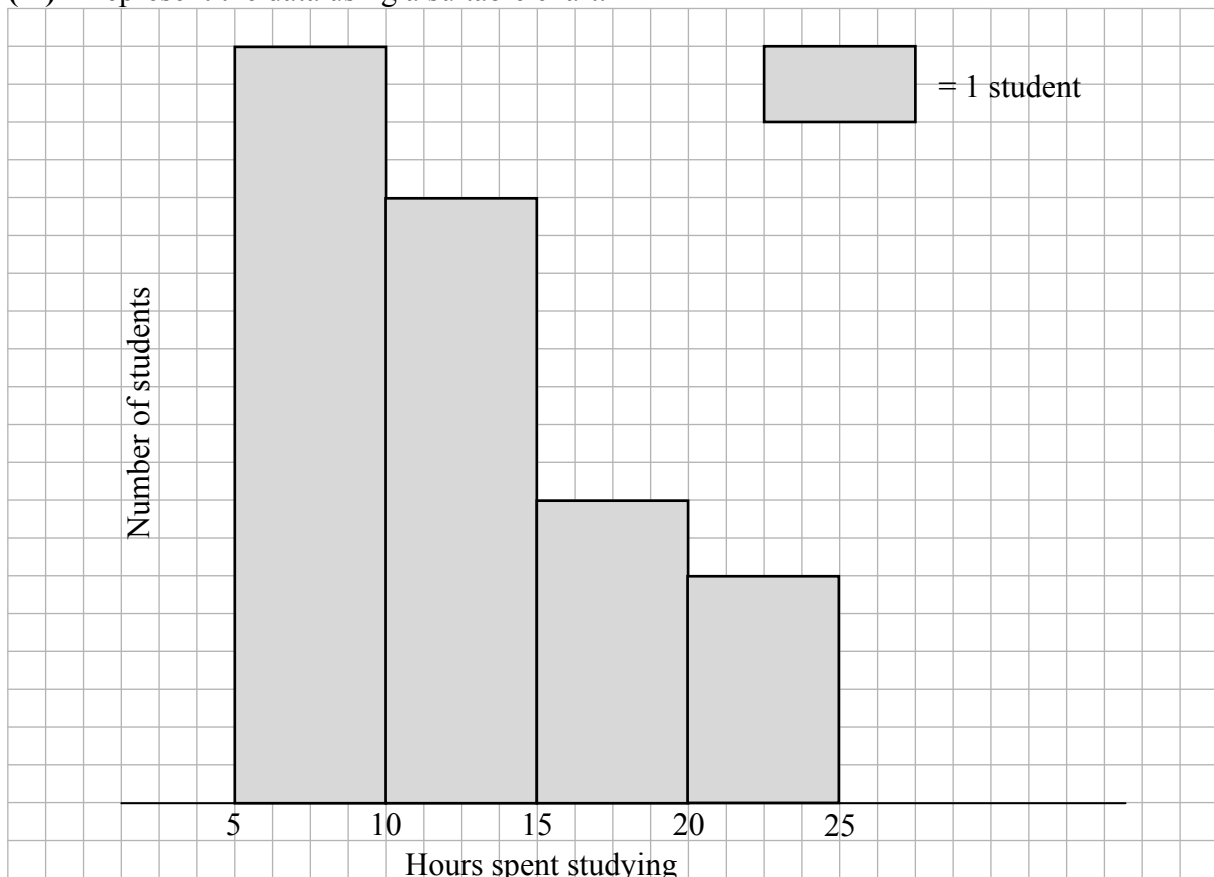
Hours spent studying	5 – 10	10 – 15	15 – 20	20 – 25
Number of students	10	8	4	3

Note: “5 – 10” means at least 5 but less than 10, etc.

- (ii) How many students took part in the research?

Answer: 25 students

- (iii) Represent the data using a suitable chart.



- (iv) A student is picked at random from the group. What is the probability that this student spends less than 10 hours a week studying.

$$\frac{10}{25} = \frac{2}{5}$$

- (v) A sample should always be chosen in a way that represents the population fairly. Otherwise, the sample may be *biased*. Give one reason why the sample in this case might be biased.

Students *picked* by an individual, rather than random selection.

Students picked from one school only.

- (vi) State one thing the researcher could have done to avoid bias in the sample.

Select students at random.

Select students from a variety of schools which are geographically spread.

(b) A shop sells T-shirts. The different choices available are:

Sleeve	Neck shape	Colour
long sleeve	round-neck	White
short sleeve	V-neck	Black
no sleeve		Blue
		Grey

All of the different possible combinations are available.

(i) How many different possible T-shirts are there?

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

(ii) A customer picks a T-shirt at random from all those available.
What is the probability that the customer picks

- a long-sleeved, round-neck, white T-shirt

$$\text{Answer: } \frac{1}{24}$$

- a short-sleeved grey T-shirt

$$\text{Answer: } \frac{2}{24} = \frac{1}{12}$$

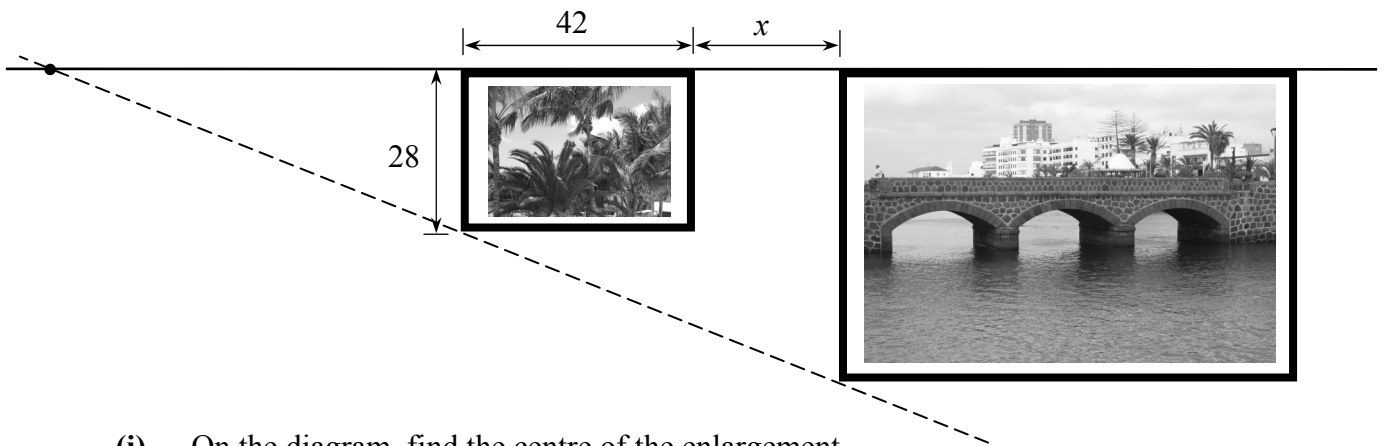
- a long-sleeved T-shirt.

$$\text{Answer: } \frac{8}{24} = \frac{1}{3}$$

Question 8**(75 marks)**

(a) John hangs two pictures from a horizontal rail.

The smaller picture frame is a rectangle measuring 42 cm by 28 cm. The larger picture frame is an enlargement of the smaller picture frame. The scale factor of the enlargement is 2.



(i) On the diagram, find the centre of the enlargement.

(ii) Find the measurements of the larger picture.

$$42 \times 2 = 84 \text{ cm}$$

$$28 \times 2 = 56 \text{ cm}$$

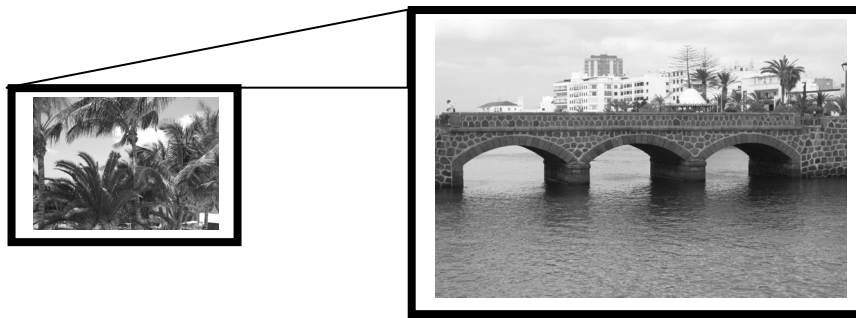
(iii) The centre of enlargement is 70 cm from the nearest corner of the smaller picture. Find x , the distance between the two pictures.

$$70 + 42 + x = 140 \Rightarrow x = 140 - (70 + 42) = 28 \text{ cm}$$

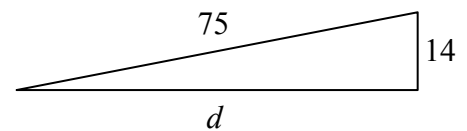
- (iv) Verify that the ratio of the area of the larger picture to the area of the smaller picture is equal to the square of the scale factor.

$$\frac{\text{Area larger picture}}{\text{Area smaller picture}} = \frac{84 \times 56}{42 \times 28} = \frac{4}{1}$$

- (b) John decides that the pictures might look better if he moves the larger one across and up. To arrange them, he drew the triangle shown and noted the measurements.

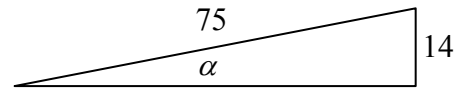


- (i) Use Pythagoras' theorem to find the length d , correct to the nearest cm.



$$\begin{aligned} 75^2 &= 14^2 + d^2 \\ \Rightarrow d^2 &= 75^2 - 14^2 = 5625 - 196 = 5429 \\ \Rightarrow d &= 73.68 = 74 \text{ cm} \end{aligned}$$

- (ii) Find α , correct to the nearest degree.

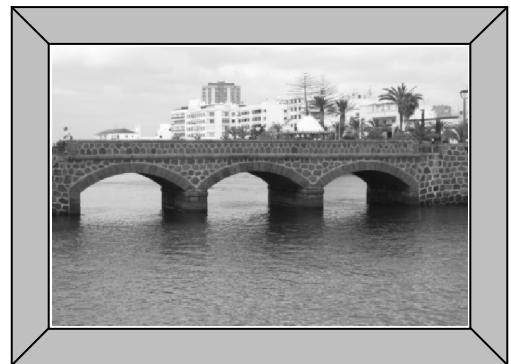


$$\sin \alpha = \frac{14}{75} = 0.1866\dots$$
$$\Rightarrow \alpha = 10.75 \approx 11^\circ$$

- (c) John decides to make a different frame for the larger picture. The framing material is sold by the metre.

John estimates the length of framing material he needs by calculating the perimeter of the existing picture frame and adding 5%.

How many metres of framing material does he need to buy?



$$\text{Existing perimeter: } 2(84 + 56) = 280 \text{ cm}$$

$$280 \times 1.05 = 294 \text{ cm}$$

Buys: 3 m

Marking Scheme – Paper 2

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	D
No of categories	2	3	4	5
5 mark scales		0, 3, 5	0, 3, 4, 5	
10 mark scales		0, 5, 10	0, 5, 7, 10	
15 mark scales				0, 6, 9, 12, 15
20 mark scales			0, 15, 17, 20	0, 8, 12, 16, 20
25 mark scales				0, 15, 18, 22, 25

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

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)

D-scales (five categories)

- response of no substantial merit (no credit)
- response with some merit (low partial credit)
- response about half-right (middle 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

Section A

Question 1
(a) 20D
(b) 5C

Question 2
(a) 10C
(b) 5C
(c) 5C
(d) 5C

Question 3
(a) 10C
(b) 10C
(c) 5B

Question 4
(a) 10C
(b) 5C
(c) 5C
(d) 5C

Question 5
25D

Question 6A
(a) 15D
(b) 5B
(c) 5B

Question 6B
(a) 5B
(b) 5C
(c) 5C
(d) 5C
(e) 5C

Section B

Question 7
(a) (i) 15D
(a) (ii) 10B
(a) (iii) 10C
(a) (iv) 5C
(a) (v) 5B
(a) (vi) 5B
(b) (i) 10C
(b) (ii) 5C
5C
5C

Question 8
(a) (i) 5B
(a) (ii) 20C*
(a) (iii) 10C*
(a) (iv) 10C
(b) (i) 10C*
(b) (ii) 5C*
(c) 15D*

Detailed marking notes

Section A

Question 1

(a) Scale 20D (0, 8, 12, 16, 20)

Low partial credit:

- One correct
- Any work of merit

Middle partial credit:

- Two or three correct answers

High partial credit:

- Four or five correct answers

(b) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Any work of merit

High partial credit:

- Mean or median correct

Question 2

(a) Scale 10C (0, 5, 7, 10)

Low partial credit:

- Any work of merit

High partial credit:

- 2×3 without evaluating
- Answer of 5 given

(b) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Any work of merit

High partial credit:

- Correct numerator or correct denominator
- Inverted fraction

(c) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Any work of merit

High partial credit:

- Correct numerator or correct denominator
- Inverted fraction

(d) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Any work of merit

High partial credit:

- Correct numerator or correct denominator
- Inverted fraction

Question 3

(a) Scale 10C (0, 5, 7, 10)

Low partial credit:

- Correct stem

High partial credit:

- Incomplete plot with 3 or fewer entries missing or incorrect

Full credit:

- Accept plot without key, leaves not ordered, stem ordered in either direction

(b) Scale 10C (0, 5, 7, 10)

Low partial credit:

- Median only or range only

High partial credit:

- Median or range correct

(c) Scale 5B (0, 3, 5)

Partial credit:

- Any meaningful attempt at a correct reason

Question 4

(a) Scale 10C (0, 5, 7, 10)

Low partial credit:

- One correct co-ordinate of a point

High partial credit:

- Any two points correct
- x and y co-ordinates obviously interchanged

(b) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Shows midpoint on diagram
- Identifies the correct formula

High partial credit:

- Substitutes incorrectly into formula and finishes

(c) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Identifies the correct formula

High partial credit:

- Substitutes incorrectly into formula and finishes

(d) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Any meaningful attempt at a correct reason

High partial credit:

- Plots (7, 17) correctly

Question 5

Scale 25D (0, 15, 18, 22, 25)

Low partial credit:

- Relevant work in one part

Middle partial credit:

- One part correct or relevant work in more than one part

High partial credit:

- One part correct with relevant work in another part

Full credit:

- Fully correct answer

Question 6A

(a) Scale 15D (0, 6, 9, 12, 15)

Low partial credit:

- One side constructed
- Sketch diagram

Middle partial credit:

- Two sides constructed

High partial credit:

- Two sides and angle constructed

(b) Scale 5B (0, 3, 5)

Partial credit:

- Measures angle incorrectly

(c) Scale 5B (0, 3, 5)

Partial credit:

- Relevant geometrical statement

Question 6B

(a) Scale 5B (0, 3, 5)

Partial credit:

- Measures angle incorrectly

(b) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Any use of 9 or 12

High partial credit:

- Pythagoras substituted correctly

(c) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Identifies a triangle

High partial credit:

- One correct triangle

(d) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Any work of merit

High partial credit:

- Finds $\angle DCO$ and $\angle DOC$

(e) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Correct formula

High partial credit:

- Correctly substituted formula

Section B

Question 7

(a)(i) Scale 15D (0, 6, 9, 12, 15)

Low partial credit:

- 1 correct entry

Middle partial credit:

- 2 correct entries

High partial credit:

- 3 correct entries

(a)(ii) Scale 10B (0, 5, 10)

Partial credit:

- Any work of merit

(a)(iii) Scale 10C (0, 5, 7, 10)

Low partial credit:

- Any work of merit

High partial credit:

- Diagram mainly correct but with some error(s)

(a)(iv) Scale 5C (0, 3, 4, 5)

Low partial credit:

- Any work of merit

High partial credit:

- Correct numerator or correct denominator or inverted fraction

(a)(v) Scale 5B (0, 3, 5)

Partial credit:

- Any meaningful attempt at a correct reason

(a)(vi) Scale 5B (0, 3, 5)

Partial credit:

- Any meaningful attempt at a correct reason

(b)(i) Scale 10C (0, 5, 7, 10)

Low partial credit:

- Any work of merit

High partial credit:

- $3 \times 2 \times 4$ without evaluating
- Answer of 9 given

(b)(ii) Scale 5C (0, 3, 4, 5) Apply the scale to each of the three bullet points

Low partial credit:

- Any work of merit

High partial credit:

- Correct numerator or correct denominator or inverted fraction

Question 8

(a)(i) Scale 5B (0, 3, 5)

Partial credit:

- Any work towards finding the centre of enlargement.

(a)(ii) Scale 20C* (0, 15, 17, 20)

Low partial credit:

- Any use of scale factor

High partial credit:

- One correct dimension

(a)(iii) Scale 10C* (0, 5, 7, 10)

Low partial credit:

- Use of 70 and 42 or 84

High partial credit:

- Equation formulated correctly

(a)(iv) Scale 10C* (0, 5, 7, 10)

Low partial credit:

- Any work of merit

High partial credit:

- One area calculated correctly

(b)(i) Scale 10C* (0, 5, 7, 10)

Low partial credit:

- Any work of merit

High partial credit:

- Pythagoras substituted correctly

(b)(ii) Scale 5C* (0, 3, 4, 5)

Low partial credit:

- Any work of merit

High partial credit:

- $\alpha = \sin^{-1}\left(\frac{14}{75}\right)$ or similar

(c) Scale 15D* (0, 6, 9, 12, 15)

Low partial credit:

- Any work of merit

Middle partial credit:

- Perimeter of frame calculated

High partial credit:

- Length of framing material calculated

Marcanna Breise as ucht Freagairt trí Ghaeilge

(Bonus marks for answering through Irish)

Ba chóir marcanna de réir an ghnáthráta a bhronnadh ar iarrthóirí nach ngnóthaíonn níos mó ná 75% d'iomlán na marcanna don pháipéar. Ba chóir freisin an marc bónais sin a shlánú **síos**.

Déantar an cinneadh agus an ríomhaireacht faoin marc bónais i gcás gach páipéir ar leithligh.

Is é 5% an gnáthráta agus is é 300 iomlán na marcanna don pháipéar. Mar sin, bain úsáid as an ngnáthráta 5% i gcás iarrthóirí a ghnóthaíonn 225 marc nó níos lú, e.g. $198 \text{ marc} \times 5\% = 9.9 \Rightarrow$ bónas = 9 marc.

Má ghnóthaíonn an t-iarrthóir níos mó ná 225 marc, ríomhtar an bónas de réir na foirmle $[300 - \text{bunmharc}] \times 15\%$, agus an marc bónais sin a shlánú **síos**. In ionad an ríomhaireacht sin a dhéanamh, is féidir úsáid a bhaint as an tábla thíos.

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

