# Coimisiún na Scrúduithe Stáit
State Examinations Commission

## Leaving Certificate 2013

## Marking Scheme

## Mathematics
## (Project Maths – Phase 2)

## Foundation 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.

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## Paper 1



## Paper 2

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Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2013

# Mathematics
# (Project Maths – Phase 2)

## Paper 1

## Foundation Level

Friday 7 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 **three** sections in this examination paper.

| | | | |
|---|---|---|---|
| Section A | Concepts and Skills | 175 marks | 7 questions |
| Section B | Contexts and Applications | 75 marks | 2 questions |
| Section C | Functions and Graphs | 50 marks | 1 question |

Answer all ten questions.

Write your answers in the spaces provided in this booklet. You may lose marks if you do not do so. 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 *Formulae and Tables* booklet. 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: 

## Section A — Concepts and Skills — 175 marks

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

**Question 1** **(25 marks)**

Use your calculator to answer the following.

**(a)** Find $\sqrt[3]{264 \cdot 3}$, correct to two decimal places.

$$\sqrt[3]{264 \cdot 3} = 6 \cdot 417 = 6 \cdot 42$$

**(b)** Find the exact value of $\frac{1}{(0 \cdot 5)^2} - (1 \cdot 2)^3$.

$$\frac{1}{(0 \cdot 5)^2} - (1 \cdot 2)^3 = \frac{1}{0 \cdot 25} - 1 \cdot 728 = 4 - 1 \cdot 728 = 2 \cdot 272$$

**(c)** Write down the whole number closest to the value of $\sqrt{70} \times \tan 56°$.

$$\sqrt{70} \times \tan 56° = 8 \cdot 3666 \times 1 \cdot 4826 = 12 \cdot 40399 \approx 12$$

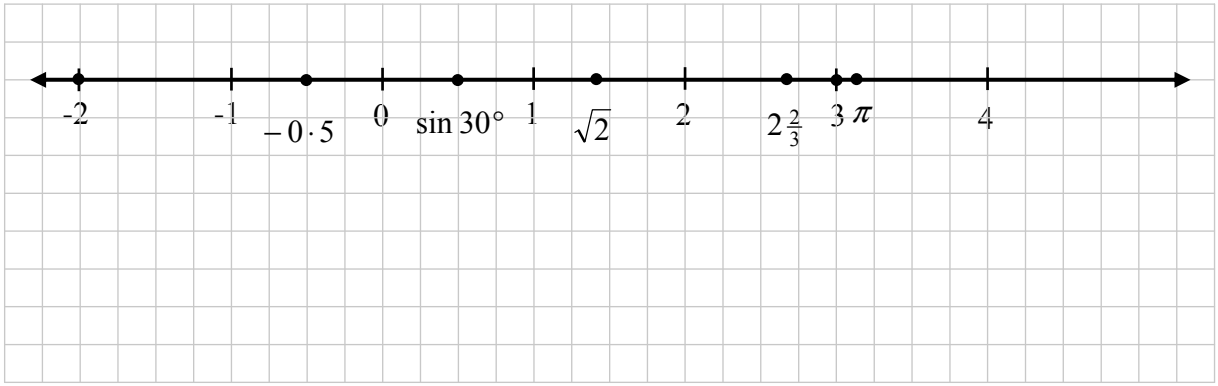
**Question 2** **(25 marks)**

**(a)** The table below shows a list of numbers and a list of sets that a number could be an element of.

**(i)** Tick **each** box opposite the number if the number belongs to that set.

| Number | Natural numbers $\mathbb{N}$ | Integers $\mathbb{Z}$ | Rational numbers $\mathbb{Q}$ | Real numbers $\mathbb{R}$ |
|---|---|---|---|---|
| $3$ | ✓ | ✓ | ✓ | ✓ |
| $-2$ | | ✓ | ✓ | ✓ |
| $-0\cdot5$ | | | ✓ | ✓ |
| $\sqrt{2}$ | | | | ✓ |
| $2\frac{2}{3}$ | | | ✓ | ✓ |
| $\sin 30°$ | | | ✓ | ✓ |
| $\pi$ | | | | ✓ |

**(ii)** Plot each of the numbers in the table above on the number line below and label each number clearly.




**(b)** The average distance from the earth to the moon is $3\cdot84\times10^5$ km.

**(i)** Write this distance as a whole number.

$3\cdot84\times10^5 = 384\,000$ km

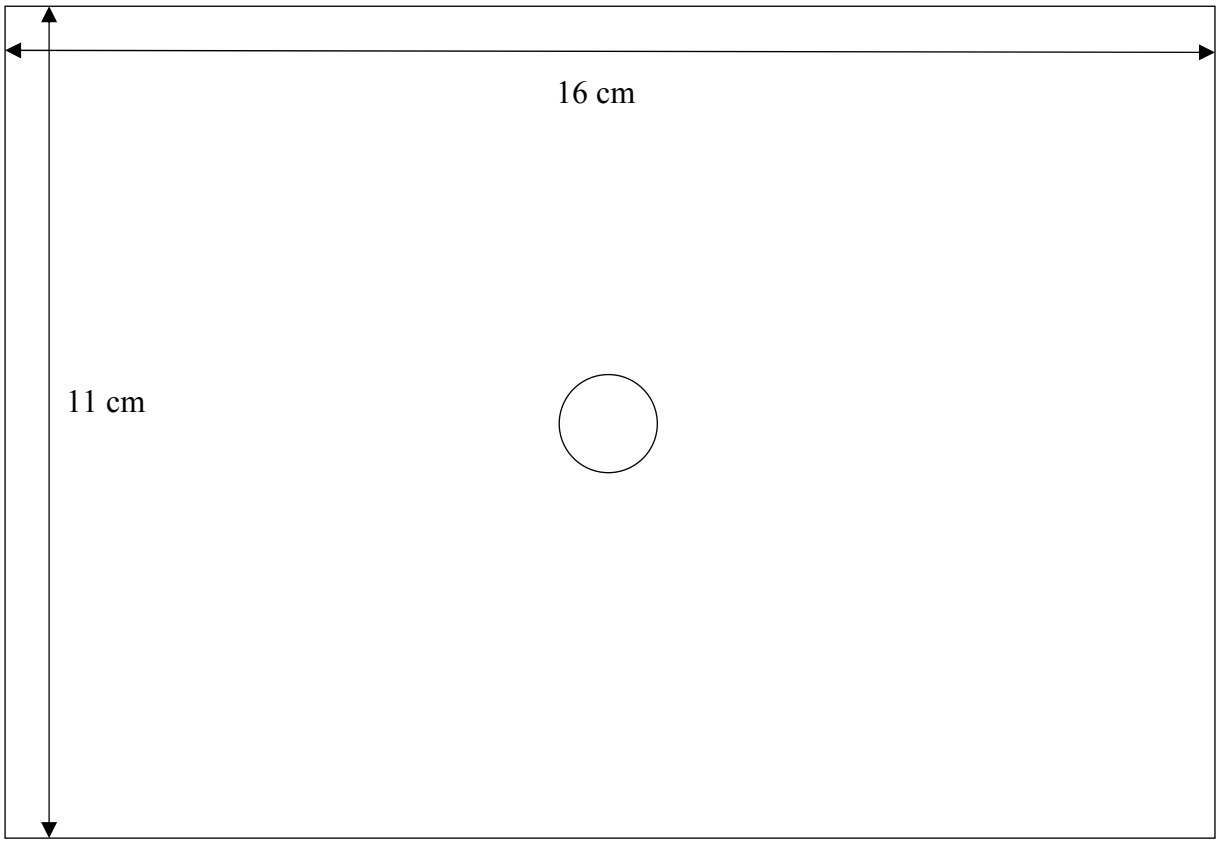
**(ii)** It took Apollo astronauts 3 days and 4 hours to travel to the moon from earth. Find their average speed in km per hour.

$$\text{Average speed} = \frac{384000}{76} = 5053 \text{ km/h}$$

[6]

**Question 3** **(25 marks)**

Liam wants to draw a scaled diagram of a soccer pitch using a scale of 1 cm = 6·25 m. He begins by drawing a rectangle measuring 16 cm long and 11 cm wide and adds in the centre circle.




**(a)** **(i)** Find the length of the soccer pitch.

$16 \times 6 \cdot 25 = 100$ m

**(ii)** Find the length of the perimeter of the soccer pitch.

$2(L + W) = 2(100 + 68 \cdot 75) = 337 \cdot 5$ m

**(b)** The centre circle of the soccer pitch has a radius of 9·15 m.

**(i)** Calculate the area of the centre circle on the soccer pitch.

$\pi r^2 = \pi(9 \cdot 15)^2 = 263 \cdot 02 = 263\,\text{m}^2$

**(ii)** Find the correct radius of the centre circle for Liam's scaled diagram.

$\frac{9 \cdot 15}{6 \cdot 25} = 1 \cdot 464$ cm

[7]

**Question 4** **(25 marks)**

**(a)** Mary buys a new car which costs €26 000. The garage gives her €8400 for her old car. She also has savings of €5600. She borrows the remainder of the cost. How much does she borrow?

€26 000 − (€8400 + €5600)

= €26 000 − €14 000 = €12 000.

**(b)** Mary borrows the money for three years at an annual equivalent rate (AER) of 11%. She repays all the money and interest in one repayment at the end of three years. How much interest will she pay?

$$F = P(1+i)^t$$

$$\Rightarrow F = 12000(1+0\cdot 11)^3$$

$$= 12000(1\cdot 11)^3 = €16\,411\cdot 57$$

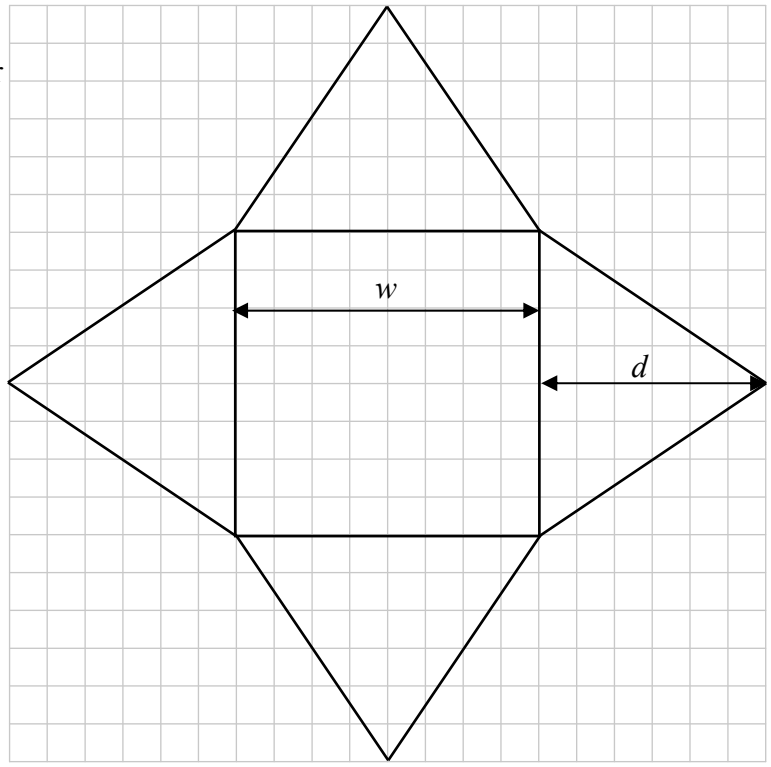
Interest = €16411·57 − €12000 = €4411·57

[8]

**Question 5** **(25 marks)**

The net for a figure with a square base is shown. Each grid unit is 5 mm.

**(a)** Find $w$, the length of the base, and $d$, the height of each triangular side.




$w = 40$ mm

$d = 30$ mm

**(b)** Find the area of the base of the solid figure.

$A = 40^2 = 1600 \text{ mm}^2$

**(c)** Find the total surface area of the solid figure.

Area of side $= \frac{1}{2}(40)(30) = 600 \text{ mm}^2$

Total surface area $= 1600 + 4(600) = 4000 \text{ mm}^2$

[9]

**Question 6** **(25 marks)**

**(a)** Find the value of $a^2 + b^2$ when $a = 20$ and $b = 21$.

$$\begin{aligned} a^2 + b^2 &= 20^2 + 21^2 \\ &= 400 + 441 \\ &= 841 \end{aligned}$$

**(b)** Given that $a^2 + b^2 = c^2$, find the value of $c$.

$$a^2 + b^2 = c^2 = 841$$

$$\Rightarrow c = \sqrt{841} = 29$$

**(c)** Solve the equation $x^2 - 3x - 10 = 0$.

$$x^2 - 3x - 10 = 0$$

$$\Rightarrow (x + 2)(x - 5) = 0$$

$$\Rightarrow (x + 2) = 0 \quad \text{or} \quad (x - 5) = 0$$

$$\Rightarrow x = -2 \quad \text{or} \quad x = 5$$

**Question 7** **(25 marks)**

**(a)** Simplify $2(3x-6)-(4x-8)$.

$$\begin{aligned} 2(3x-6)-(4x-8) &= 6x-12-4x+8 \\ &= 2x-4 \end{aligned}$$

**(b)** Solve the equation $7x-4=5x+16$.

$$7x-4=5x+16$$

$$\Rightarrow 7x-5x=16+4$$

$$\Rightarrow 2x=20$$

$$\Rightarrow x=10$$

**(c)** Write down the natural numbers which satisfy the inequality $3x-2\leq 13$.

$$3x-2\leq 13$$

$$\Rightarrow 3x\leq 15$$

$$\Rightarrow x\leq 5$$

$$\Rightarrow x\in\{1, 2, 3, 4, 5\}$$

## Section B — Contexts and Applications — 75 marks

Answer **both** Question 8 **and** Question 9.

**Question 8** **(40 marks)**

Mr. and Mrs. Murphy and their three children want to fly from Dublin to Arrecife for a weeks holiday. They look up the airline timetable below.

| Outbound: Dublin to Arrecife | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Flight | Mon | Tues | Wed | Thur | Fri | Sat | Sun | Departs | Arrives |
| E107 |  | | |  |  |  | | 06:45 | 10:40 |
| E117 | | | | | |  | | 13:15 | 17:25 |
| Return: Arrecife to Dublin | | | | | | | | | |
| E108 |  | | |  |  |  | | 11:55 | 15:55 |
| E118 | | | | | |  | | 18:40 | 22:35 |

**(a)** The Murphy's book the early flight outbound on Saturday and the latest return flight on the following Saturday afternoon.

**(i)** The flight number for the outbound flight is E107

The flight number for the return flight is E118

**(ii)** The latest check-in time at Dublin is 1 hour 50 minutes before the flight departure time. What is the latest check-in time for their outbound flight?

06:45 − 1:50 = 04:55

**(iii)** How long does the flight from Dublin to Arrecife take?

10:40 −06:45 = 3:55

**(iv)** Their return flight from Arrecife to Dublin was delayed by 1 hour 40 minutes. At what time did their flight arrive back in Dublin?

18:40 + 1:40 + 3:55 = 24:15 = 00:15 on Sunday morning.

**(b)** The following information was used to calculate the cost of their holiday.

- The return airfare is €360 for an adult and €270 for a child.
- The cost of hotel accommodation for a week is €420 for an adult and €210 for each of the first two children. The third child is free.
- Holiday insurance costs €18·75 per person.

**(i)** Find the total cost of the airfares for the Murphy family.

$€360 \times 2 + €270 \times 3$

$= 720 + 810 = €1530$

**(ii)** Find the total cost of the holiday for the Murphy family.

Airfares $= €1530$

Accommodation $= €420 \times 2 + €210 \times 2 = €840 + €420 = €1260$

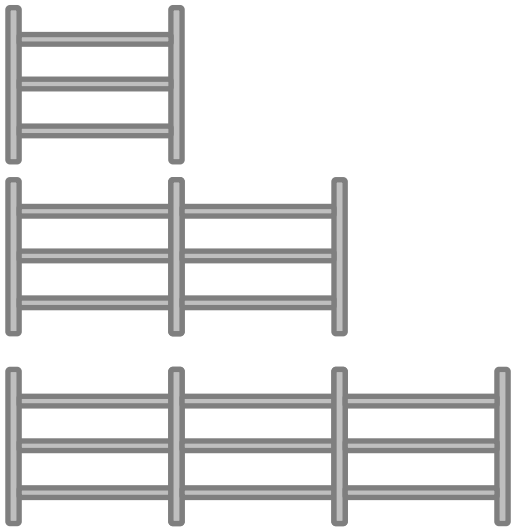
Insurance $= €18{\cdot}75 \times 5 = €93{\cdot}75$

Total cost $= €1530 + €1260 + €93{\cdot}75 = €2883{\cdot}75$

**Question 9** **(35 marks)**

Jim constructs a fence by using three horizontal rails between each two vertical posts. Jim draws the diagrams below and begins a table to show the number of rails he will need depending on how many posts he uses.

| Number of posts ($x$) | Number of rails ($y$) |
|---|---|
| 2 | 3 |
| 3 | 6 |
| 4 | 9 |
| 5 | 12 |
| 6 | 15 |



**(a)** Complete the table above.

Jim thinks that to find the number of rails needed he should subtract 1 from the number of posts used and multiply the answer by 3.

**(b)** Write an algebraic expression to represent Jim's rule, using $x$ to represent the number of posts and $y$ to represent the number of rails.

$y = 3(x-1))$

**(c)** Test your expression in **(b)** above using the numbers in one row of the table.

$x = 2 \Rightarrow y = 3(2-1) = 3$ $\quad$ $x = 3 \Rightarrow y = 3(3-1) = 6$

$x = 4 \Rightarrow y = 3(4-1) = 9$ $\quad$ $x = 5 \Rightarrow y = 3(5-1) = 12$

$x = 6 \Rightarrow y = 3(6-1) = 15$

**(d)** Jim needs 60 posts for his fence. Find the number of rails he needs.

$x = 60 \Rightarrow y = 3(60-1) = 177$

**(e)** Ann thinks that an alternative rule to find the number of rails is to multiply the number of posts by 3 and then subtract 3 from the answer. Write an algebraic expression to represent Ann's rule, using $x$ to represent the number of posts and $y$ to represent the number of rails.

$y = 3x - 3$

**(f)** **(i)** Use Ann's rule to find how many rails are needed if 10 posts are used.

$x = 10 \Rightarrow y = 3(10) - 3 = 27$

**(ii)** Use Ann's rule to find how many posts were used if 228 rails were needed.

$y = 228 \quad \Rightarrow \quad 228 = 3x - 3 \quad \Rightarrow \quad 3x = 231 \quad \Rightarrow \quad x = 77$

## Section C — Functions and Graphs (old syllabus) — 50 marks

Answer Question 10 from this section.

**Question 10** **(50 marks)**

**(a)** Draw the graph of the function $f : x \mapsto 2x^2 - 3x - 6,$ for $-2 \le x \le 3,\ x \in \mathbb{R}$.

$f(x) = 2x^2 - 3x - 6$

$f(-2) = 2(-2)^2 - 3(-2) - 6 = 8 + 6 - 6 = 8$

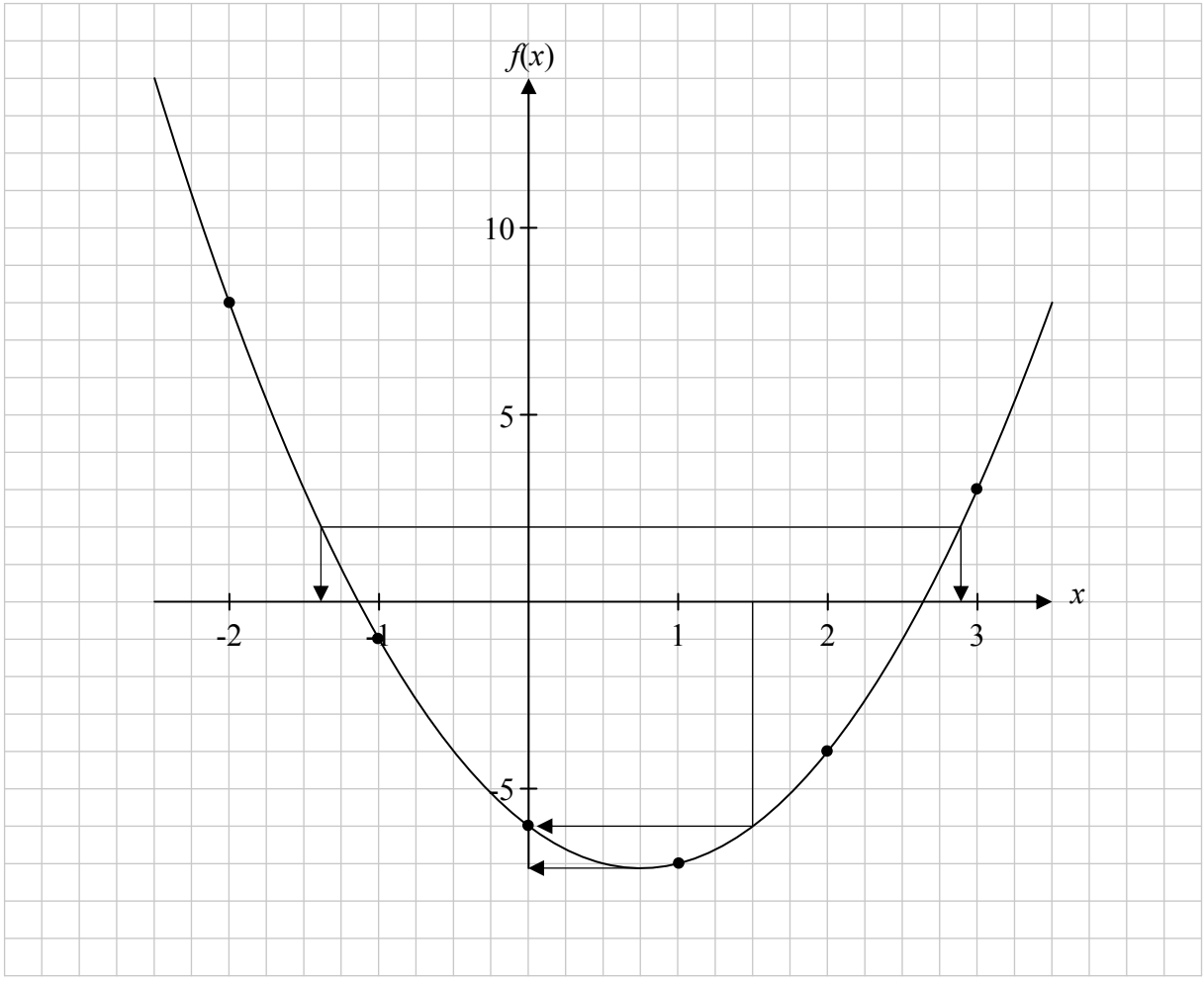
$f(-1) = 2(-1)^2 - 3(-1) - 6 = 2 + 3 - 6 = -1$

$f(0) = 2(0)^2 - 3(0) - 6 = 0 - 0 - 6 = -6$

$f(1) = 2(1)^2 - 3(1) - 6 = 2 - 3 - 6 = -7$

$f(2) = 2(2)^2 - 3(2) - 6 = 8 - 6 - 6 = -4$

$f(3) = 2(3)^2 - 3(3) - 6 = 18 - 9 - 6 = 3$



**(b)** Use your graph to estimate the following:

**(i)** the value of $f(1{\cdot}5)$,

$f(1\cdot 5) = -6$

**(ii)** the minimum value of $f(x)$,

Answer: $-7\cdot 1$

**(iii)** the values of $x$ for which $f(x) = 2$,

$f(x) = 2$ for $x = -1\cdot 4$ and $x = 2\cdot 9$

**(iv)** the range of values of $x$ for which $f(x)$ is decreasing.

$f(x)$ is decreasing for $-2 \le x < 0\cdot 75$

# Marking Scheme – Paper 1, Section A , Section B and Section C

## 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 | B | C | D |
|---|---|---|---|
| No of categories | 3 | 4 | 5 |
| 5 mark scales | 0, 2, 5 | 0, 2, 4, 5 | |
| 10 mark scales | 0, 5, 10 | 0, 3, 7, 10 | |
| 15 mark scales | | 0, 6, 10, 15 | |
| 20 mark scales | | 0, 7, 13, 20 | |
| 25 mark scales | | | 0, 6, 12, 19, 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
- partially correct response
- correct response

**C-scales (four categories)**

- response of no substantial merit
- response with some merit
- almost correct response
- correct response

**D-scales (five categories)**

- response of no substantial merit
- response with some merit
- response about half-right
- almost correct response
- correct response

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) 15D
(b) 10C

Question 3
(a) 15C*
(b) 10C*

Question 4
(a) 20C
(b) 5C

Question 5
(a) 15C*
(b) 5B*
(c) 5B*

Question 6
(a) 15C
(b) 5B
(c) 5C

Question 7
(a) 5C
(b) 15C
(c) 5C

### *Section B*

Question 8
(a) (i) 10B
(ii) 5B
(iii) 5B
(iv) 5B
(b) (i) 10C
(ii) 5C

Question 9
(a) 15C
(b)+ (c) 5B
(d) 5B
(e) 5B
(f) 5C

### *Section C*

Question 10
(a) Points 25D
(a) Graph 10C*
(b) 15C

## Detailed marking notes

## Section A

### Question 1

Scale 25D*(0, 6, 12, 19, 25)
*Low Partial Credit*
- Any work of merit

*Middle Partial Credit*
- One correct answer and no further work
- Work of merit in only two parts

*High Partial Credit*
- Two correct answers
- Work of merit in all three parts

### Question 2

**(a)** Scale 15D (0, 4, 7, 11, 15)
*Low Partial Credit*
- Any work of merit

*Middle Partial Credit*
- Work of merit in both parts
- Part (i) or part (ii) correct only

*High Partial Credit*
- Part (i) correct and work of merit in part (ii)
- Part (ii) correct and work of merit in part (i)

**(b)** Scale 10C (0, 3, 7, 10)
*Low Partial Credit*
- Any work of merit

*High Partial Credit*
- One correct answer
- Some work of merit in both parts

**Note:** Accept the use of candidates answer from part (i)

**Question 3**

**(a)** Scale 15C* (0, 6, 10, 15)

*Low Partial Credit*

- Any work of merit

*High Partial Credit*

- One correct answer
- Some work of merit in both parts

**Note**: Accept the use of candidates answer from part (i) in answering part (ii)

**(b)** Scale 10C* (0, 3, 7, 10)

*Low Partial Credit*

- Any work of merit

*High Partial Credit*

- One correct answer
- Some work of merit in both parts

**Question 4**

**(a)** Scale 20C (0, 7, 13, 20)

*Low Partial Credit*

- Any work of merit

*High Partial Credit*

- Gets the answer €14 000 and fails to finish or finishes incorrectly

**(b)** Scale 5C (0, 2, 4, 5)

*Low Partial Credit*

- Any work of merit

*High Partial Credit*

- Correct substitution into formula and fails to finish or finishes incorrectly
- Works out the amount due after two years and fails to finish or finishes incorrectly

**Note:** Accept the use of candidates answer from part (a)

**Question 5**

(a) Scale 15C* (0, 6, 10, 15)

*Low Partial Credit*

- Any work of merit

*High Partial Credit*

- One correct answer
- Work of merit in both parts

(b) Scale 5B* (0, 2, 5)

*Partial Credit*

- Any work of merit

**Note**: Accept the use of candidates answer from part (a)

(c) Scale 5B* (0, 2, 5)

*artial Credit*

- Any work of merit

**Note:** Accept the use of candidates answer from part (b)

**Question 6**

**(a)** Scale 15C (0, 6, 10, 15)

*Low Partial Credit*

- Any work of merit

*High Partial Credit*

- Correctly finds $a^2$ and $b^2$ and fails to add

**(b)** Scale 5B (0, 2, 5)

*Partial Credit*

- Any work of merit

**(c)** Scale 5C (0, 2, 4, 5)

*Low Partial Credit*

- Any work of merit
- Incorrect factors and fails to finish
- Effort at solution by trial and improvement

*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

*Full Credit*

- For correct solutions from trial and improvement, if both are verified

**Question 7**

**(a)** Scale 5C (0, 2, 4, 5)

*Low Partial Credit*

- Any work of merit

*High Partial Credit*

- Multiplies out correctly and fails to finish or finishes incorrectly
- One mistake in multiplication and finishes correctly

**(b)** Scale 15C (0, 6, 10, 15)

*Low Partial Credit*

- Any work of merit
- Attempt to solve equation by trial and improvement

*High Partial Credit*

- Correct method but with one error

*Full Credit*

- Correct solution verified by trial and improvement

**(c)** Scale 5C (0, 2, 4, 5)

*Low Partial Credit*

- Any work of merit
- Attempt to solve equation by trial and improvement

*High Partial Credit*

- Correct solution to equation but ignores inequality
- Correct method, but with one error
- Correct, verified solution by trial and improvement but without a solution set

## Section B

### Question 8

**(a)(i)** Scale 10B (0, 5, 10)
*Partial Credit*
- One correct answer
- Relevant work for both answers

**Note**: Accept the use of candidates answer from (a)(i) when marking (a)(ii), (a)(iii) & (a)(iv)

**(a)(ii)** Scale 5B (0, 2, 5)
*Partial Credit*
- Any work of merit

**(a)(iii)** Scale 5B (0, 2, 5)
*Partial Credit*
- Any work of merit

**(a)(iv)** Scale 5B (0, 2, 5)
*Partial Credit*
- Any work of merit

**(b)(i)** Scale 10C (0, 3, 7, 10)
*Low Partial Credit*
- Any work of merit

*High Partial Credit*
- One calculation completed correctly

**(b)(ii)** Scale 5C (0, 2, 4, 5)
*Low Partial Credit*
- Any work of merit

*High Partial Credit*
- Cost of accommodation or insurance worked out correctly

**Note:** Accept the use of candidates answer from (b)(i)

**Question 9**

**(a)** Scale 15C (0, 6, 10, 15)
*Low Partial Credit*
- One correct answer

*High Partial Credit*
- Two correct answers

**(b) + (c)** Scale 5B (0, 2, 5)
*Partial Credit*
- Any work of merit

**Note**: Accept the use of candidates answer from (b) in (c) and (d)

**(d)** Scale 5B (0, 2, 5)
*Partial Credit*
- Any work of merit

**(e)** Scale 5B (0, 2, 5)
*Partial Credit*
- Any work of merit

**(f)(i)+(ii)** Scale 5C (0, 2, 4, 5)
*Low Partial Credit*
- Any work of merit

*High Partial Credit*
- One correct answer

## Section C

### Question 10

**(a)** Points, Scale 25D (0, 6, 12, 19, 25)

*Low Partial Credit*

- One point correct
- Any work of merit

*Middle Partial Credit*

- Two or three points correct

*High Partial Credit*

- Four or five points correct

**(a)** Graph, Scale 10C* (0, 3, 7, 10)

*Low Partial Credit*

- One, two or three points plotted correctly
- Any work of merit

*High Partial Credit*

- Four, five or six points plotted correctly

*Full Credit*

- All points plotted and curve completed correctly

**(b)** Scale 15C (0, 6, 10, 15)

*Low Partial Credit*

- One or two correct answers
- Any work of merit

*High Partial Credit*

- Three correct answers

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2013

# Mathematics
# (Project Maths – Phase 2)

## Paper 2

## Foundation Level

Monday 10 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 **two** sections in this examination paper.

| | | | |
|---|---|---|---|
| Section A | Concepts and Skills | 200 marks | 8 questions |
| Section B | Contexts and Applications | 100 marks | 2 questions |

Answer all ten questions, as follows:

In Section A, answer:

Questions 1 to 7 and

**either** Question 8A **or** Question 8B.

In Section B, answer Question 9 and Question 10.

Write your answers in the spaces provided in this booklet. You may 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 *Formulae and Tables* booklet. You must return it at the end of the examination. You are not allowed to bring your own copy into the examination.

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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:

## Section A — Concepts and Skills — 200 marks

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

**Question 1** **(25 marks)**

**(a)** **(i)** Answer each of the following:

What is the probability of an event that is certain to happen? | 1 |

What is the probability of an event that will never happen? | 0 |

What is the probability of an event that has a 50:50 chance of happening? | 0·5 |

**(ii)** In an experiment a standard fair die is tossed. In the context of that experiment give one example of each of the following:

an event that has a 50:50 chance of happening.

Throwing an even number or throwing an odd number

an event that will never happen;

Throwing a number greater than 6

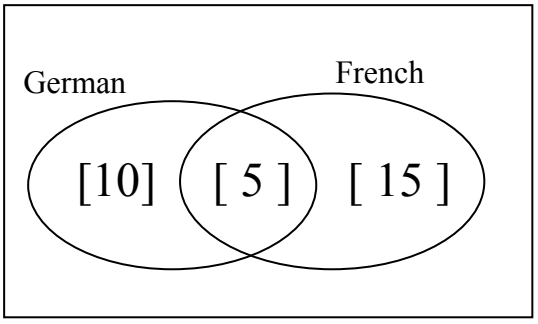
an event that is certain to happen;

Throwing a whole number between 1 and 6 inclusive

**(b)** The sets in the Venn diagram below represent the students in a class of 30 students who study German and French.

**(i)** How many students study both German and French?

Answer: 5




A student is picked at random from the class.

**(ii)** Find the probability that the student studies both German and French. | 1/6 |

**(iii)** Find the probability that the student studies French but not German. | 1/2 |

**Question 2** **(25 marks)**

There are four main blood groups: Group O, Group A, Group B and Group AB.
The blood in each group is further classed as either rhesus positive (+) or rhesus negative (-).

In Ireland the percentage of the population in each blood group is given in the following table:

| Blood group | O | | A | | B | | AB | |
|---|---|---|---|---|---|---|---|---|
| Rhesus positive (+) or rhesus negative (-) | $O^+$ | $O^-$ | $A^+$ | $A^-$ | $B^+$ | $B^-$ | $AB^+$ | $AB^-$ |
| Percentage | 8 | 47 | 5 | 26 | 2 | 9 | 1 | 2 |

**(a)** **(i)** Find the percentage of the population in blood group O.

$8 + 47 = 55\%$

**(ii)** Find the percentage of the population with rhesus positive blood.

$8 + 5 + 2 + 1 = 16\%$

**(b)** The table below has statements about a person's blood group. A person is picked at random from the population. In each case, find the probability that the statement is true for that person.

| **Statement** | **Probability** |
|---|---|
| Is in blood group $A^+$ | 0·05 |
| Is in blood group AB | 0·03 |
| Is in blood group A or B | 0·42 |
| Has blood which is rhesus negative | 0·84 |
| Not in blood group O | 0·45 |

**(c)** Over a period, 8000 people donate blood at a clinic.
How many of these 8000 people would you expect to donate each of the following blood types.

**(i)** Type AB blood

$8000 \times 0 \cdot 03 = 240$

**(ii)** Rhesus negative blood

$8000 \times 0 \cdot 84 = 6720$

**(iii)** Rhesus positive blood

$8000 \times 0 \cdot 16 = 1280$

or

$8000 - 6720 = 1280$

**Question 3** **(25 marks)**

Sarah has a three-course lunch at a restaurant. She selects a starter, a main course and a dessert from the menu below.

| Starters | Main course | Dessert |
|---|---|---|
| Melon | Roast beef | Fruit salad |
| Soup | Fish of the day | Chocolate brownie |
| Goats cheese salad | Vegetation curry | Apple crumble |
| Smoked salmon | | Pear flan |
| | | Ice cream |

**(a)** Write one three-course lunch that Sarah could select.

Melon, Roast beef, Fruit salad etc.

**(b)** How many possible different selections can Sarah make?

$4 \times 3 \times 5 = 60$

**(c)** Assuming that each selection is equally likely, what is the probability that she selects:

- smoked salmon for her starter

$\frac{1}{4}$

- smoked salmon for her starter followed by roast beef for her main course

$\frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$

- smoked salmon for her starter followed by roast beef followed by fruit salad or ice cream for her dessert?

$\frac{1}{4} \times \frac{1}{3} \times \frac{2}{5} = \frac{1}{30}$

**Question 4** **(25 marks)**

The stem and leaf plot shows the age, in years, of each patient who visited the accident department in a hospital over a two hour period.

| | |
|---|---|
| 0 | 6, 8, 8, 9 |
| 1 | 0, 4, 5, 6, 8 |
| 2 | 4, 4, 7 |
| 3 | 1, 2, 6, 6, 6, 9 |
| 4 | 3, 6 |
| 5 | 0, 0, 5, 8 |
| 6 | 2, 2, 7, 9 |
| 7 | 1, 4, 5, 5, 6, 8 |
| 8 | 2, 3, 7 |

Key: 4 | 3 = 43

**(a)** How many patients visited the accident department during the two hour period?

37

**(b)** What was the age of the oldest patient who visited the accident department?

87

**(c)** What was the modal age of the patients who visited the accident department?

36

**(d)** Find the median age of the patients who visited the accident department.

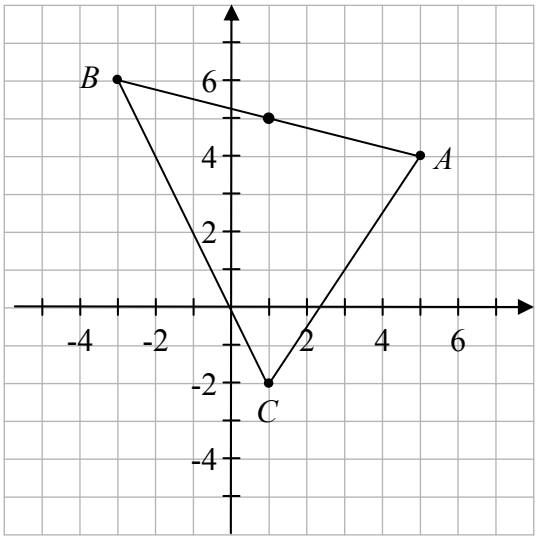
43

**(e)** List the ages of the patients, aged between 30 and 60, who visited the accident department

31, 32, 36, 36, 36, 39, 43, 46, 50, 50, 55, 58

**Question 5** **(25 marks)**

The diagram shows the triangle $ABC$.
The co-ordinates of the point $A$ are (5, 4).




**(a)** Write down the co-ordinates of the points:

$B \quad (-3, 6)$

$C \quad (1, -2)$

**(b)** **(i)** On the diagram, mark the point $M$, the midpoint of $[AB]$.

**(ii)** Use a formula to find the co-ordinates of $M$.

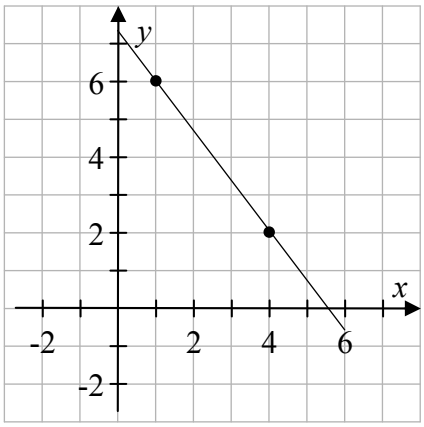
$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right) = (1, 5)$$

**(c)** Use a formula to find the length of $[BC]$, the longest side of the triangle.

$$|BC| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= \sqrt{(1+3)^2 + (-2-6)^2} = \sqrt{(4)^2 + (8)^2} = \sqrt{16+64} = \sqrt{80} = 4\sqrt{5}$$

**Question 6** **(25 marks)**

The line $l_1$ passes through the points $P(1, 6)$ and $Q(4, 2)$.
The line $l_2$ has equation $3x - 4y - 4 = 0$.




**(a)** Plot $P$ and $Q$ on the diagram and show the line $l_1$.

**(b)** Find the slope of the line $l_1$.

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

**(c)** State whether or not the two lines $l_1$ and $l_2$ are perpendicular to each other.
Give a reason for your answer.

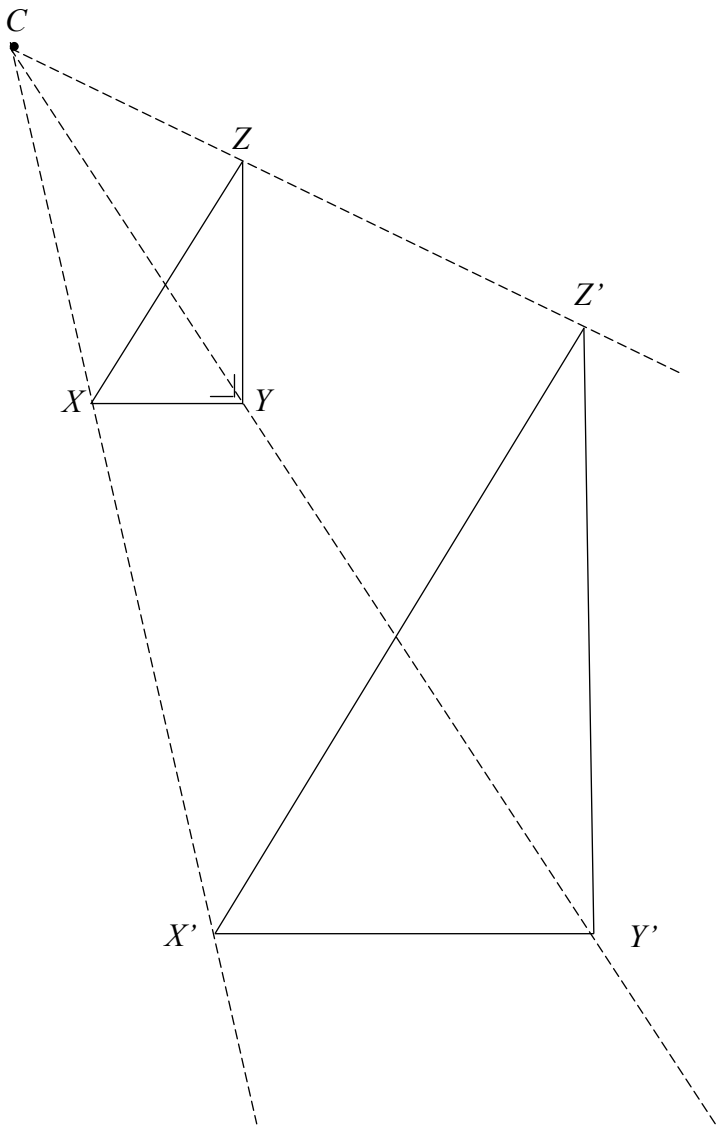
$3x - 4y - 4 = 0 \quad \Rightarrow \quad y = \frac{3}{4}x - 1 \quad \Rightarrow \quad \text{Slope } l_2 = \frac{3}{4}$

$m_1 \times m_2 = -\frac{4}{3} \times \frac{3}{4} = -1 \quad \Rightarrow \quad l_1 \perp l_2$.

**Question 7** **(25 marks)**

The diagram shows the point $C$ and the right angled triangle $XYZ$.

**(a)** Construct $X'Y'Z'$, the image of the triangle $XYZ$, under an enlargement of centre $C$ and scale factor 2·5.



**(b)** **(i)** The length $|XY| = 2\,\text{cm}$. Find the length $|X'Y'|$.

$$|X'Y'| = 2\cdot 5 \times |XY| = 2\cdot 5 \times 2 = 5\,\text{cm}$$

**(ii)** The length $|Z'Y'| = 8\,\text{cm}$. Find the length $|ZY|$. Show your calculations below.

$$|Z'Y'| = 2\cdot 5 \times |ZY| = 8 \quad \Rightarrow \quad |ZY| = \frac{8}{2\cdot 5} = 3\cdot 2 \text{ cm}$$

**(iii)** Find the area of the triangle *XYZ*.

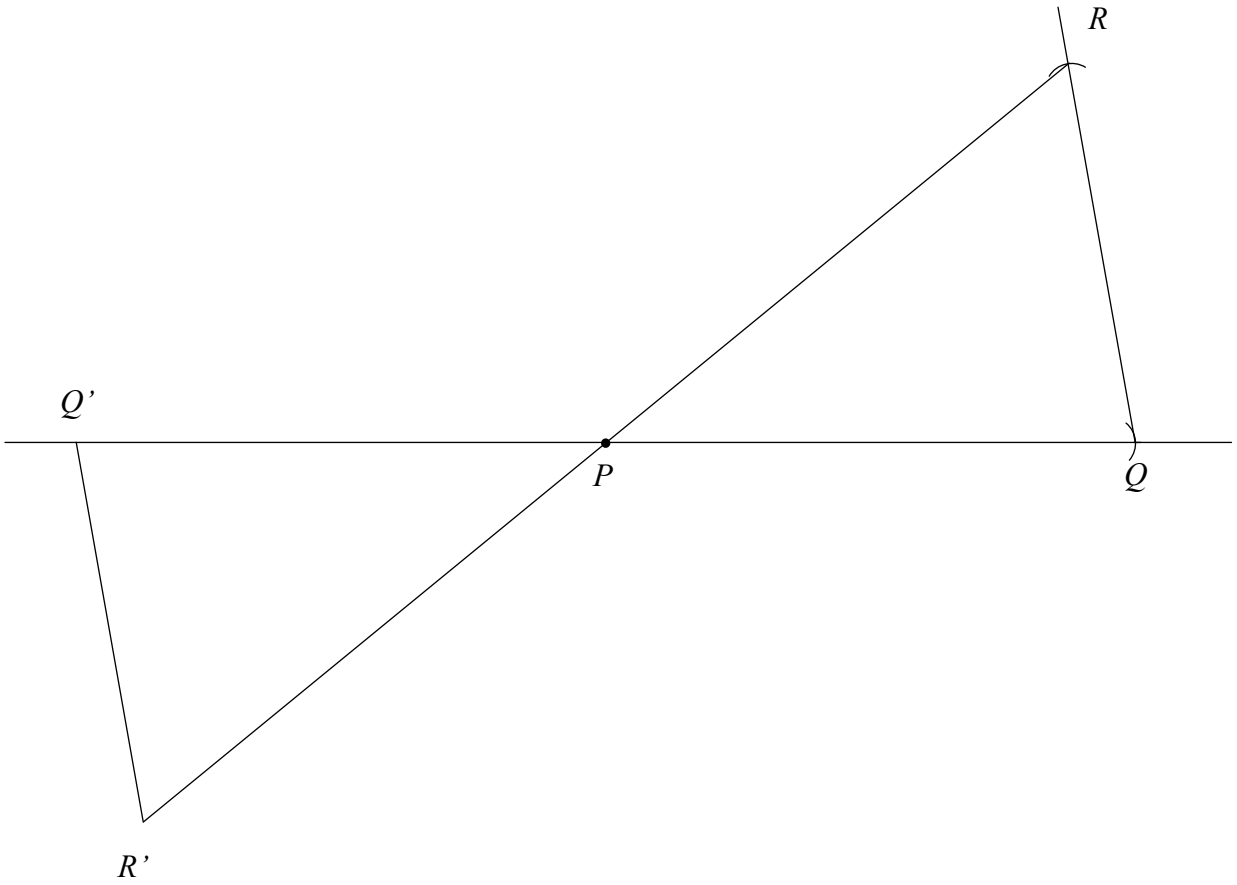
$$\text{Area of } XYZ = \tfrac{1}{2}|XY| \times |ZY| = \tfrac{1}{2}(2)(3\cdot 2) = 3\cdot 2 \text{ cm}^2$$

**Question 8** **(25 marks)**

Answer **either** 8A **or** 8B.

**Question 8A**

**(a)** Construct a triangle $PQR$ in which $|PQ| = 7$ cm, $|QR| = 5$ cm and $|\angle PQR| = 80°$.
The point $P$ is marked for you.




**(b)** On the diagram in part **(a)**, construct the image of the triangle $PQR$ under the central symmetry in the point $P$.

**(c)** Use your protractor to measure the angle $RPQ$**.**

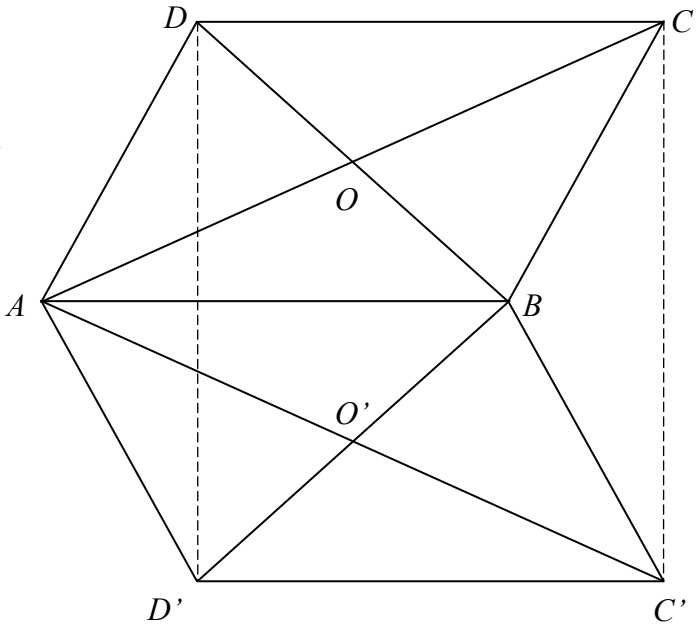
| |
|---|
| $\|\angle RPQ\| = 39°$ |

**OR**

**Question 8B**

*ABCD* is a parallelogram.
The diagonals of *ABCD* intersect at *O*.

$|AB| = 9$ cm, $|BC| = 6$ cm and $|\angle DAB| = 60°$.




**(a)** Find $|DC|$.

$|DC| = |AB| = 9$ cm

**(b)** Find $|\angle ABC|$.

$|\angle ABC| = 180° - |\angle DAB|$
$= 180° - 60° = 120°$

**(c)** Name one pair of parallel lines in the diagram.

$AB \parallel DC$ or $DA \parallel CB$

**(d)** Is the statement
$|DO| = |OB|$ and $|AO| = |OC|$
true or false?
Give a reason for your answer.

True.
The diagonals of a parallelogram bisect each other.

**(e)** Construct the image of the parallelogram *ABCD* under the axial symmetry in the line *AB* on the diagram above.

## Section B — Contexts and Applications — 100 marks

Answer **Question 9** and **Question 10**.

**Question 9** **(50 marks)**

Michelle and Jerry visit their local shop each day. The amount each of them spent in the shop during one week is given in the table below.

| | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
|---|---|---|---|---|---|---|---|
| Michelle | €16 | €12 | €20 | €5 | €24 | €8 | €27 |
| Jerry | €10 | €18 | €25 | €19 | €26 | | |

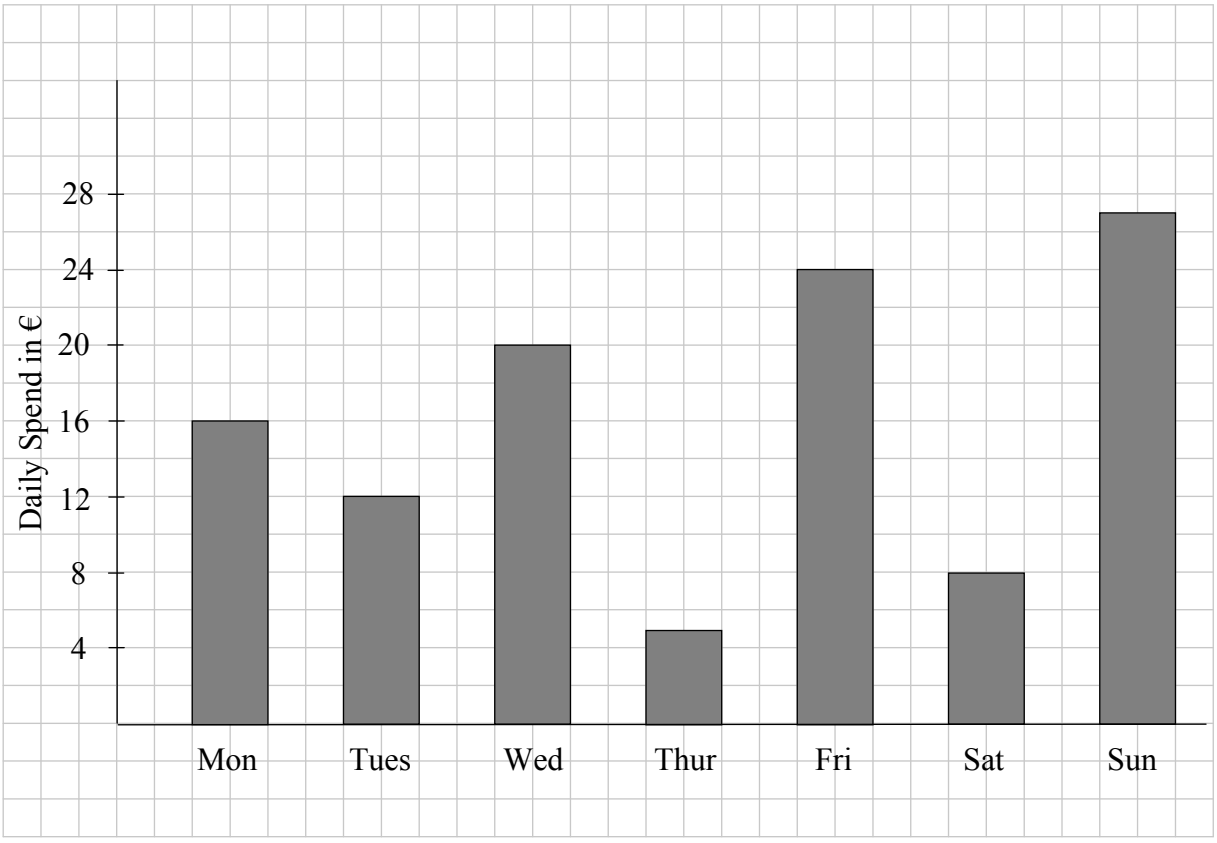
**(a)** On which day of the week did Michelle spend the most?

Sunday

**(b)** Find the difference between the most and the least amount that Michelle spent in a day.

$27 - 5 = €22$

**(c)** Draw a bar chart to illustrate the amount Michelle spent each day.




[40]

**(d)** Calculate the mean amount per day spent by Michelle during that week.

$$\text{Mean amount} = \frac{16+12+20+5+24+8+27}{7} = \frac{112}{7} = €16$$

**(e)** Jerry spent a total of €140 during the week. He spent equal amounts on Saturday and Sunday. How much did he spend on Saturday?

$$10+18+25+19+26+2x = 140 \Rightarrow 98+2x = 140 \Rightarrow 2x = 42 \Rightarrow x = 21$$

**(f)** On average Jerry spent €4 per day more than Michelle.
Justify this statement.

Jerry: Mean amount $= \frac{140}{7} = 20$; $20-16 = €4$

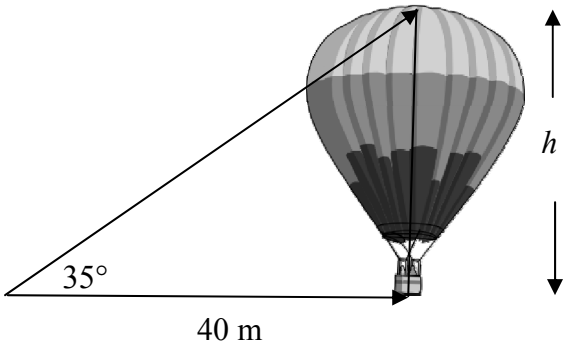
or

$140-112 = 28$; $\frac{28}{7} = €4$

The difference of €4 means that on average Jerry spent €4 more each day.

**Question 10** **(50 marks)**

Tom stands 40 m from the base of the basket of a hot air balloon. The angle of elevation to the top of the balloon is $35°$.



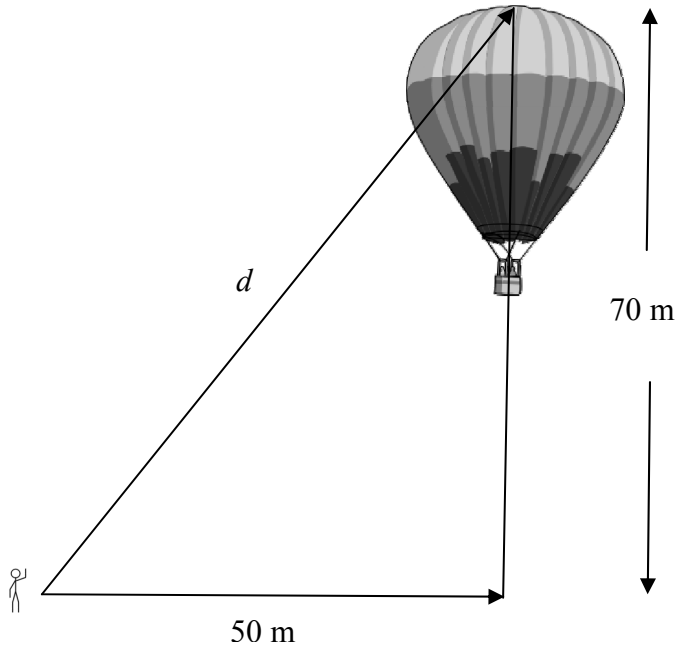

**(a)** **(i)** Find $\tan 35°$.

$$\tan 35° = 0 \cdot 7002$$

**(ii)** Find the height, $h$, of the balloon.

$$\tan 35° = \frac{h}{40} \quad \Rightarrow \quad h = 40(\tan 35°) = 40 \times 0 \cdot 7002 = 28 \cdot 008 = 28 \text{ m}$$

**(b)** The balloon rises vertically until the highest point on the balloon is 70 m above the ground. Tom moves to a new position 50 m from the point vertically under the basket of the balloon, as shown.




**(i)** Find the new angle of elevation to the top of the balloon.

$$\tan A = \frac{70}{50} = 1 \cdot 4 \quad \Rightarrow \quad A = 54 \cdot 46°$$

**(ii)** Use the Theorem of Pythagoras to find the distance, *d*, from Tom's position to the top of the balloon.

$$d^2 = 50^2 + 70^2 = 2500 + 4900 = 7400 \quad \Rightarrow \quad d = 86 \cdot 023 \approx 86\,\text{m}$$

**(c)** Tom estimates that the volume of air in the balloon is the same as the volume of a sphere of radius 11 m. Find Tom's estimate of the volume of air in the balloon.

$$V = \tfrac{4}{3}\pi r^3 = \tfrac{4}{3}\pi(11)^3 = 5575 \cdot 27\,\text{m}^3$$

# Marking Scheme – Paper 2, Section A and Section B

## 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 | B | C | D |
|---|---|---|---|
| No of categories | 3 | 4 | 5 |
| 5 mark scales | 0, 2, 5 | 0, 3, 4, 5 | 0, 2, 3, 4, 5 |
| 10 mark scales | 0, 5, 10 | 0, 4, 8, 10 | 0, 4, 8, 9, 10 |
| 15 mark scales | 0, 7, 15 | 0, 5, 13, 15 | 0, 4, 8, 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

***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) (i) | 5C |
| (a) (ii) | 5C |
| (b) (i) | 5B |
| (b) (ii) | 5C |
| (b) (iii) | 5C |

Question 2

| | |
|---|---|
| (a) (i) | 10C |
| (a) (ii) | 5C |
| (b) | 5D |
| (c) | 5C |

Question 3

| | |
|---|---|
| (a) | 15C |
| (b) | 5C |
| (c) | 5D |

Question 4

| | |
|---|---|
| (a) | 5B |
| (b) | 5B |
| (c) | 5B |
| (d) | 5B |
| (e) | 5C |

Question 5

| | |
|---|---|
| (a) | 10C |
| (b) (i) | 5C |
| (b) (ii) | 5C |
| (c) | 5C |

Question 6

| | |
|---|---|
| (a) | 15D |
| (b) | 5C |
| (c) | 5C |

Question 7

| | |
|---|---|
| (a) | 10D |
| (b) (i) | 5C* |
| (b) (ii) | 5C* |
| (b) (iii) | 5C* |

Question 8A

| | |
|---|---|
| (a) | 10D |
| (b) | 10D |
| (c) | 5B |

Question 8B

| | |
|---|---|
| (a) | 5B* |
| (b) | 5C |
| (c) | 5B |
| (d) | 5C |
| (e) | 5C |

### *Section B*

Question 9

| | |
|---|---|
| (a) | 5B |
| (b) | 5C |
| (c) | 15C |
| (d) | 10D |
| (e) | 10D |
| (f) | 5C |

Question 10

| | |
|---|---|
| (a) (i) | 15B |
| (a) (ii) | 10C* |
| (b) (i) | 10C |
| (b) (ii) | 10C* |
| (c) | 5D* |

## Detailed marking notes

## Section A

### *Question 1*

**(a)(i)** Scale 5C

*Low partial credit*

- One correct answer or relevant work

*High partial credit*

- Two correct answers

**(a)(ii)** Scale 5C

*Low partial credit*

- One correct answer or relevant work

*High partial credit*

- Two correct answers

**(b)(i)** Scale 5B

P*artial credit*

- Any work of merit

**(b)(ii)** Scale 5C

*Low partial credit*

- Any work of merit

*High partial credit*

- Correct numerator or correct denominator
- Inverted fraction

**(b)(iii)** Scale 5C

*Low partial credit*

- Any work of merit

*High partial credit*

- Correct numerator or correct denominator
- Inverted fraction

**Question 2**

**(a)(i)** Scale 10C

*Low partial credit*

- One correct value

*High partial credit*

- Correct values chosen

**(a)(ii)** Scale 5C

*Low partial credit*

- One correct value

*High partial credit*

- Correct values chosen

**(b)** Scale 5D

*Low partial credit*

- One correct entry or relevant work

*Middle partial credit*

- Two or three correct entries

*High partial credit*

- Four correct entries

**(c)(i)(ii)(iii)** Scale 5C

*Low partial credit*

- One correct part or relevant work

*High partial credit*

- Two correct parts

**Question 3**

**(a)** Scale 15C

*Low partial credit*

- One course correct
- Any work of merit

*High partial credit*

- Two courses correct

**(b)** Scale 5C

*Low partial credit*

- Any work of merit

*High partial credit*

- $4 \times 3 \times 5$ without evaluating
- Answer of 12 given

**(c)** Scale 5D

*Low partial credit*

- Any work of merit

*Middle partial credit*

- One correct answer

*High partial credit*

- Two correct answers

**Question 4**

**(a)** Scale 5B

*Partial credit*

- Any work of merit

**(b)** Scale 5B

*Partial credit*

- Any work of merit

**(c)** Scale 5B

*Partial credit*

- Any work of merit

**(d)** Scale 5B

*Partial credit*

- Any work of merit

**(e)** Scale 5C

*Low partial credit*

- Less than three correct entries

*High partial credit*

- Three or more correct entries

**Question 5**

(a) Scale 10C

*Low partial credit*

- Any work of merit

*High partial credit*

- One point correct
- $x$ and $y$ co-ordinates obviously interchanged

**(b)(i)** Scale 5C

*Low partial credit*

- Incorrect midpoint identified

*High Partial credit*

- Correct midpoint of $[AC]$ or $[BC]$

**b(ii)** Scale 5C

*Low partial credit*

- Identifies the correct formula

*High Partial credit*

- Substitutes incorrectly into formula and finishes

**(c)** Scale 5C

*Low partial credit*

- Identifies the correct formula

*High Partial credit*

- Substitutes incorrectly into formula and finishes

**Question 6**

**(a)** Scale 15D

*Low partial credit*

- Any work of merit

*Middle partial credit*

- One plot correct

*High partial credit*

- Any two plots correct
- $x$ and $y$ co-ordinates interchanged with line drawn

**(b)** Scale 5C

*Low partial credit*

- Identifies the correct formula

*High Partial credit*

- Substitutes incorrectly into formula and finishes

**(c)** Scale 5C

*Low partial credit*

- Any meaningful attempt at a correct reason

*High partial credit*

- Correct assumption with no reason given

**Question 7**

**(a)** Scale 10D

*Low partial credit*

- Any work of merit

*Middle partial credit*

- Image of one side constructed

*High partial credit*

- Image of two sides constructed or incorrect scale factor

**(b)(i)** Scale 5C*

*Low partial credit*

- Any work of merit

*High partial credit*

- Correct use of scale factor

**(b)(ii)** Scale 5C*

*Low partial credit*

- Any work of merit

*High partial credit*:

- Correct use of scale factor

**(b)(iii)** Scale 5C*

*Low partial credit*

- Any work of merit e.g. formula written

*High partial credit*

- Substitutes incorrectly into formula and finishes

**Question 8A**

**(a)** Scale 10D

*Low partial credit*

- One side constructed or relevant work

*Middle partial credit*

- Two sides constructed

*High partial credit*

- Two sides and angle constructed

**(b)** Scale 10D

*Low partial credit*

- Any work of merit

*Middle partial credit*

- Image of one side constructed

*High partial credit*

- Image of two sides constructed

**(c)** Scale 5B

*Partial credit*

- Measures incorrect angle

**Question 8B**

**(a)** Scale 5B*

*Partial credit*

- Any work of merit

**(b)** Scale 5C

*Low partial credit*

- Relevant geometrical statement

*High partial credit*

- Some relevant with work $\angle DAB$

**(c)** Scale 5B

*Partial credit*

- Identifies a line correctly

**(d)** Scale 5C

*Low partial credit*

- Relevant geometrical statement

*High partial credit*

- Correct assumption but no reason given

**(e)** Scale 5C

*Low partial credit*

- Image of one side or one point constructed

*High partial credit*

- Image of two or three sides constructed

## Section B

**Question 9**

**(a)** Scale 5B

P*artial credit*

- Incorrect day chosen

**(b)** Scale 5C

*Low partial credit*

- One amount identified

*High Partial credit*

- Highest and lowest amounts identified

**(c)** Scale 15C

*Low partial credit*

- Any work of merit

*High partial credit*

- Diagram mainly correct but with some error(s)

**(d)** Scale 10D

*Low partial credit*

- Any work of merit

*Middle partial credit*

- Numerator or denominator correct

*High partial credit*

- Numerator and denominator correct

**(e)** Scale 10D

*Low partial credit*

- Any work of merit

*Middle partial credit*

- Calculates amount spent Monday to Friday

*High partial credit*

- Calculates amount spent on Saturday and Sunday

**(f)** Scale 5C

*Low partial credit*

- Any work of merit

*High Partial credit*

- Calculates relevant mean amount

**Question 10**

**(a)(i)** Scale 15B

*Partial credit*

- Any work of merit

**(a)(ii)** Scale 10C*

*Low partial credit*

- Any work of merit

*High partial credit*

- Equation formulated correctly

**(b)(i)** Scale 10C

*Low partial credit*

- Any work of merit

*High partial credit*

- $\alpha = \tan^{-1}\left(\frac{70}{50}\right)$ or similar

**(b)(ii)** Scale 10C*

*Low partial credit*

- Any work of merit

*High partial credit*

- Pythagoras substituted correctly

**(c)** Scale 5D*

*Low partial credit*

- Any work of merit e.g. formula written

*Middle partial credit*

- Some correct substitution

*High partial credit*

- Fully correct substitution but error(s) made in calculation

**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 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 – 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 |