



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Junior Certificate Examination, 2013

Mathematics
(Project Maths – Phase 3)

Paper 1

Higher Level

Friday, 7 June – Afternoon, 2.00 to 4.30
300 marks

Examination number

Centre stamp

Running total	
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For examiner			
Question	Mark	Question	Mark
1		11	
2		12	
3		13	
4		14	
5		15	
6			
7			
8			
9			
10		Total	

Grade

Instructions

There are 15 questions on this examination paper. Answer **all** questions.

Questions do not necessarily carry equal marks. To help you manage your time during this examination, a maximum time for each question is suggested. If you remain within these times you should have about 10 minutes left to review your work.

Write your answers in the spaces provided in this 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.

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:

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Question 1 (Suggested maximum time: 10 minutes)

Question 1 (Suggested maximum time: 10 minutes)

- (a) (i)** The columns in the table below represent the following sets of numbers:
Natural numbers ($\mathbb{N}$), Integers ($\mathbb{Z}$), Rational numbers ($\mathbb{Q}$),
Irrational numbers ($\mathbb{R} \setminus \mathbb{Q}$) and Real numbers ($\mathbb{R}$).

Complete the table by writing either ‘**Yes**’ or ‘**No**’ into each box indicating whether each of the numbers $\sqrt{5}$, 8 , -4 , $3\frac{1}{2}$, $\frac{3\pi}{4}$ is or is not an element of each.

(One box has already been filled in. The ‘**Yes**’ indicates that the number 8 is an element of the set of Real numbers, $\mathbb{R}$).

Number/Set	$\mathbb{N}$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{R} \setminus \mathbb{Q}$	$\mathbb{R}$
$\sqrt{5}$					
8					Yes
-4					
$3\frac{1}{2}$					
$\frac{3\pi}{4}$					

- (ii)** In the case of $\sqrt{5}$ explain your choice in relation to the set of Irrational numbers ($\mathbb{R} \setminus \mathbb{Q}$) (i.e. give a reason for writing either 'Yes' or 'No').

A blank sheet of graph paper with a grid of squares. The grid consists of 20 columns and 15 rows of small squares. The lines are thin and gray, set against a white background. There are no margins or additional markings on the page.

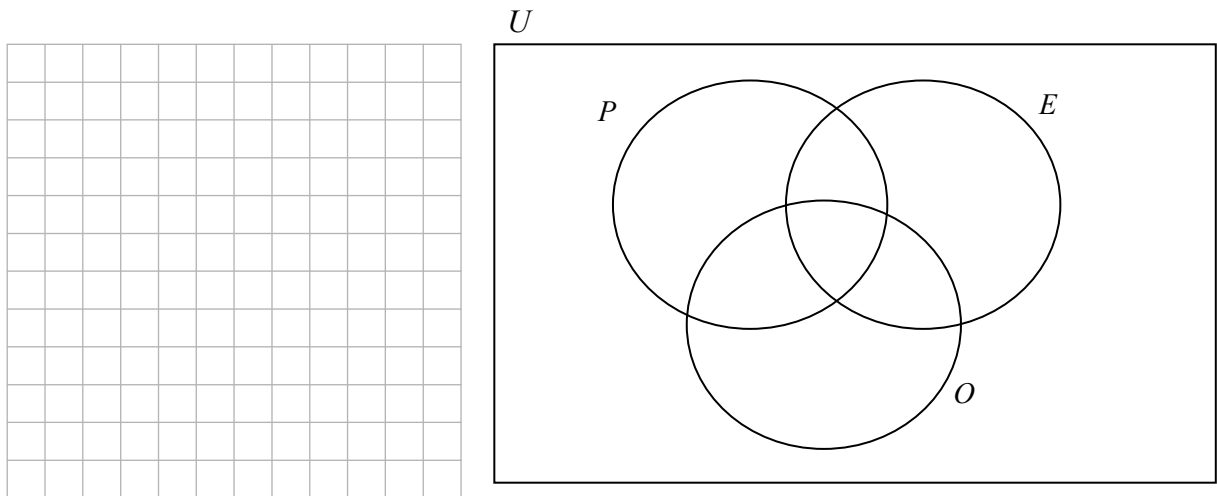
- (b)** Use the properties of surds to show that $\sqrt{98} - \sqrt{18} + \sqrt{2}$ simplifies to $5\sqrt{2}$.

[illegible]

Question 2 (Suggested maximum time: 5 minutes)

$U = \{1, 2, 3, \dots, 12\}$. P is the set of prime numbers less than 12. E is the set of even numbers less than 12. O is the set of odd numbers less than 12.

- (a)** Represent these sets on the Venn diagram.



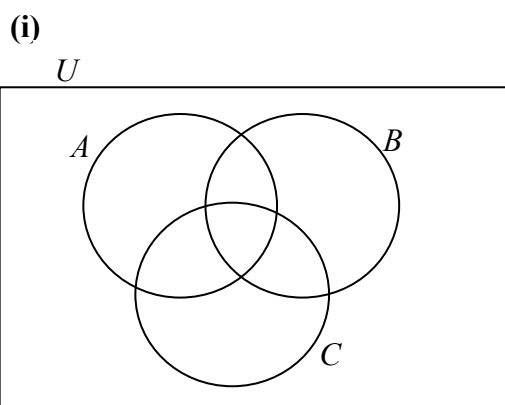
- (b)** Name any set on this diagram (after part **(a)** has been completed) that is a null set.

- (c) If a number is drawn at random from **set P**, what is the probability that it is even?

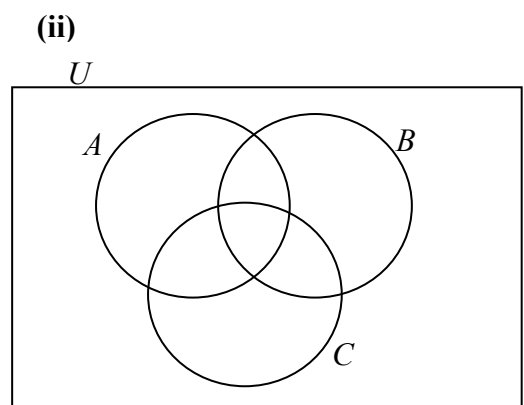
Question 3 (Suggested maximum time: 15 minutes)

(Suggested maximum time: 15 minutes)

- (a)** For diagrams (i) and (ii) below, shade in the named region.



$$A \cap B \cap C$$



$$(A \cap B) \setminus C$$

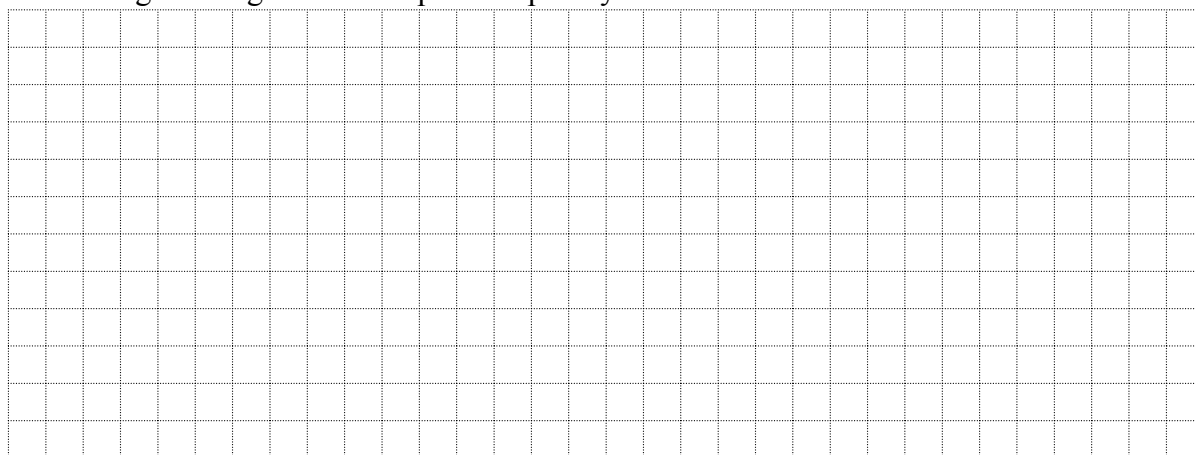
- (b) The box on the right contains six statements,
(note: P' , is the complement of a set P).

A number of the statements are incorrect.

Write down one incorrect statement.

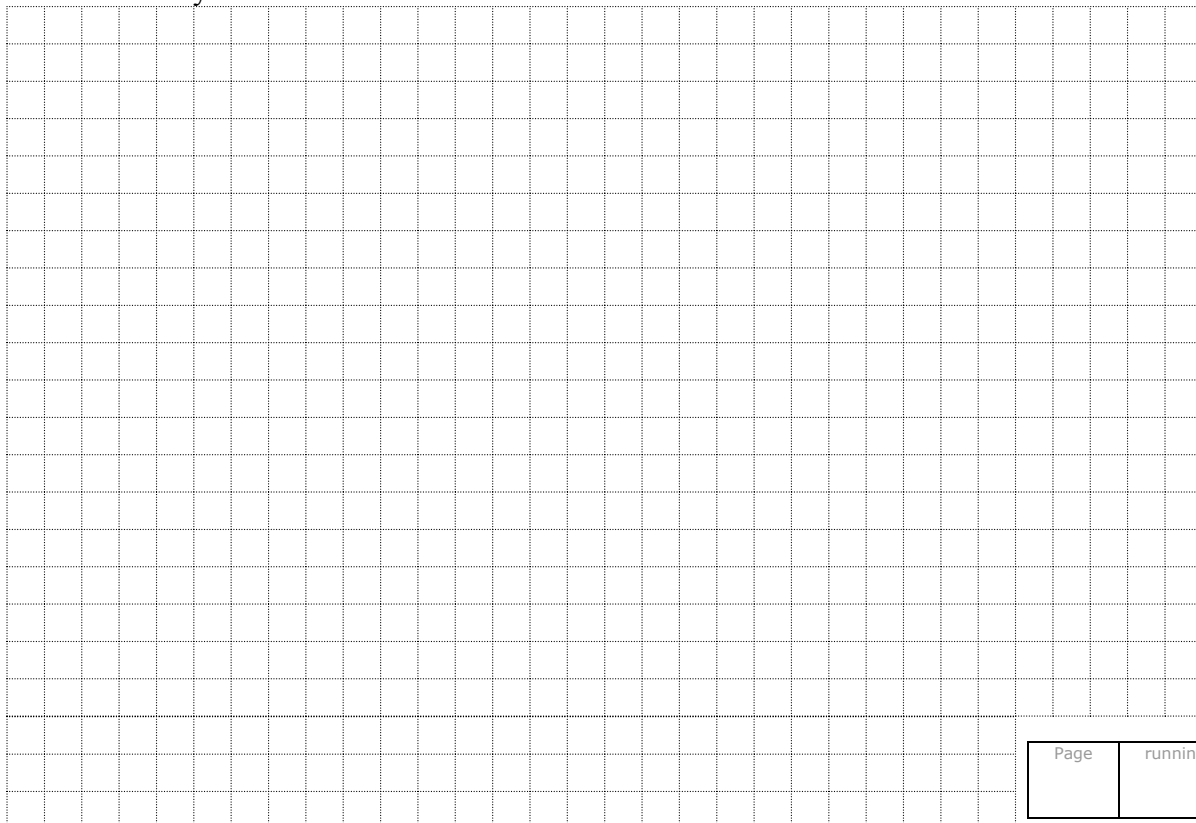
Statements	
(i)	$A \cup B = B \cup A$
(ii)	$(A \cup B) \cup C = A \cup (B \cup C)$
(iii)	$(A \setminus B) \setminus C = A \setminus (B \setminus C)$
(iv)	$(A \cap B)' = U \setminus (A \cap B)$
(v)	$A \setminus B = B \setminus A$
(vi)	$B \setminus (A \cup C) = (B \cup C) \setminus A \setminus C$

Draw a diagram **or** give an example to explain your choice.



- (c) A group of 38 students were asked if they had ever been to France or Spain.
The number who had been to Spain only was 3 more than the number who had been to both countries.
Twice as many had been to France as Spain.
4 students had not been to either country.

Find how many had been to both countries.



Page	running
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Question 4 (Suggested maximum time: 10 minutes)

Question 4 (Suggested maximum time: 10 minutes)

The minimum wage per hour for different categories of workers is shown in the table.

By law the Under 18 minimum wage is set at 70% of the minimum wage for an experienced adult worker.

- (a)** Verify that this is true for the rates shown in the table on the right.

Category	Min. Wage per hour
Experienced adult worker	€8.65
Aged under 18	€6.06
Over 18 in first year from date of first employment	€6.92
Over 18 in second year of first employment	€7.79
Source: www.citizensinformation.ie	

[illegible]

- (b)** The government has decided that it is going to reduce all minimum wage rates by 6%. Calculate the new minimum wage for an experienced adult worker, correct to two decimal places, after this reduction.

[illegible]

- (c) John is an experienced adult worker. After the reduction he says “If the minimum wage were to be increased by 6% then I would be back earning €8.65 per hour.” Is John’s statement correct? Explain your answer.

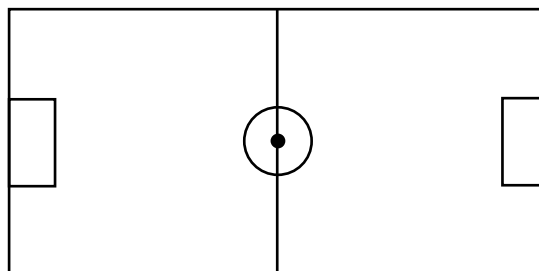
[illegible]

Question 5

(Suggested maximum time: 5 minutes)

Two members of a soccer club want to find out if their football pitch has been lined out properly.

- (a) They have a 10 metre tape measure, a calculator, pen and paper.
By using only these, explain how they could test if the angle at each corner is a right angle.



- (b) By using only a trundle wheel, calculator, pen and paper, explain how the two members could test if the 'centre-circle' on the pitch is really a circle. (You may assume that the centre spot on the pitch is the centre of the circle).

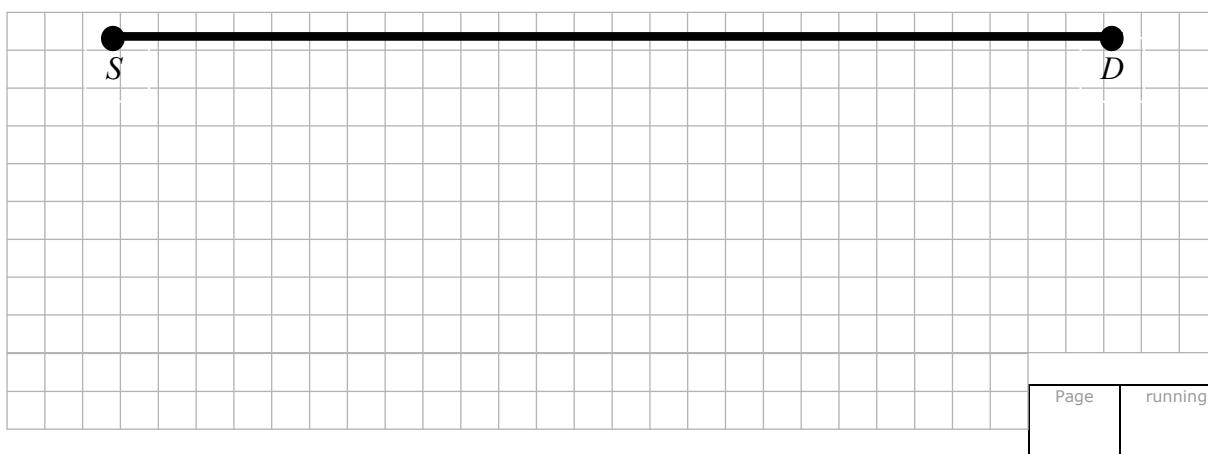


Question 6

(Suggested maximum time: 5 minutes)

Car A and Car B set off from a starting point S at the same time. They travel the same route to destination D , which is 70 km away. Car A travels at an average speed of 50 km/h and car B travels at an average speed of 45 km/h.

How far will car B have travelled by the time car A arrives at destination D ?



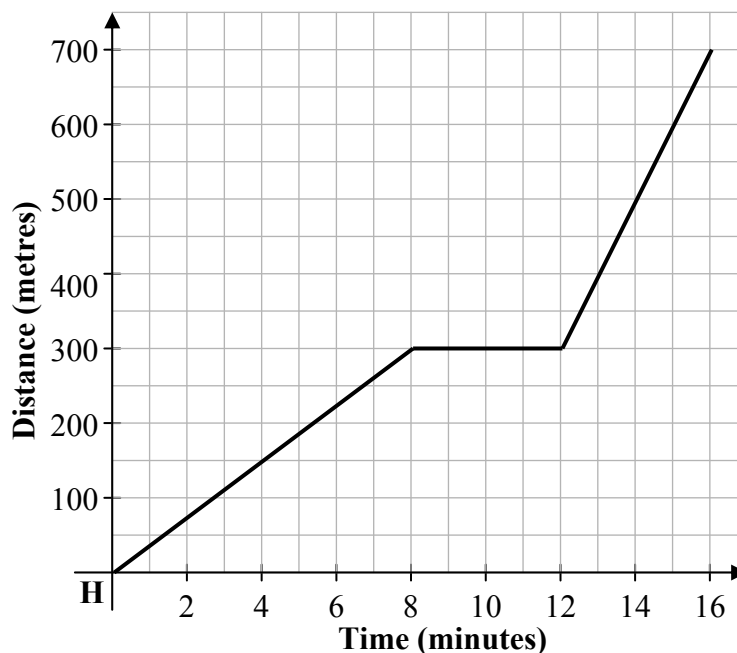
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Question 7

(Suggested maximum time: 10 minutes)

Angela leaves home (H) at 5 pm to go to football practice, which is 700 m away. The graph shows her journey, on foot, to football practice.

- (a) One of the stories below matches Angela's journey. Place a tick in the box beside the correct matching story.
(Note: Only **one** story matches Angela's journey).



Story	Tick one story (✓)
Angela walks at a constant pace and stops at 5.08 for four minutes. She then walks at a slower pace and arrives at practice at 5.16.	
Angela walks at a constant pace and stops at 5.12 for four minutes. She then walks at a faster pace and arrives at practice at 5.16.	
Angela walks at a constant pace and stops at 5.08 for five minutes. She then walks at a faster pace and arrives at practice at 5.16.	
Angela walks at a constant pace and stops at 5.08 for four minutes. She then walks at a faster pace and arrives at practice at 5.16.	
Angela walks at a constant pace and stops at 5.08 for four minutes. She then walks at the same pace and arrives at practice at 5.16.	

- (b) Mary also lives 700 m from football practice, but cycles to practice. She leaves home five minutes after Angela. She cycles at a constant pace and arrives at practice two minutes before Angela.
Represent Mary's journey on the graph above.

Question 8

(Suggested maximum time: 20 minutes)

- (a) Express in its simplest form: $\frac{5-x}{5} + \frac{x-4}{4}$.

- (b)** Solve for x : $3x^2 + 11x = 4$.

[illegible]

- (c) Divide $2x^3 + x^2 - 13x + 6$ by $x + 3$.

- (d) A company employs two drivers, John and David. Each has use of a company car and small van. The company buys €30 worth of Toll Tags for each driver. Each time that a vehicle goes through the M50 Toll, a charge will be deducted from the Toll Tags.

John goes through the M50 toll five times in his car and four times in his small van. He then has €7.90 remaining on his Toll Tags. David goes through the M50 Toll twice in his car and six times in his small van. He then has €8.40 left on his Toll Tags.

Calculate how much it costs for a car and for a small van to go through the M50 Toll.

Question 9

(Suggested maximum time: 5 minutes)

The 'Multiplier' is a variable used by economists to measure the affect of an increase in spending in an economy.

One version of the Multiplier is $M = \frac{1}{S+P}$ where M is the Multiplier, S relates to savings and P relates to imports.

- (a)** Calculate the value of the M , the Multiplier, if $S = 0.2$ and $P = 0.1$.

- (b)** Explain the effect on the size of M if the value of P increases.

[illegible]

- (c)** Sometimes the above formula is used to calculate P . Rearrange the formula to make P its subject.

[illegible]

Question 10

(Suggested maximum time: 10 minutes)

- (a)** If $n = 7$ find the value of $2n$ and also the value of $2n + 1$.

[illegible]

- (b) (i)** x represents an even number. Explain why $x + 2$ is the next even number.

[illegible]

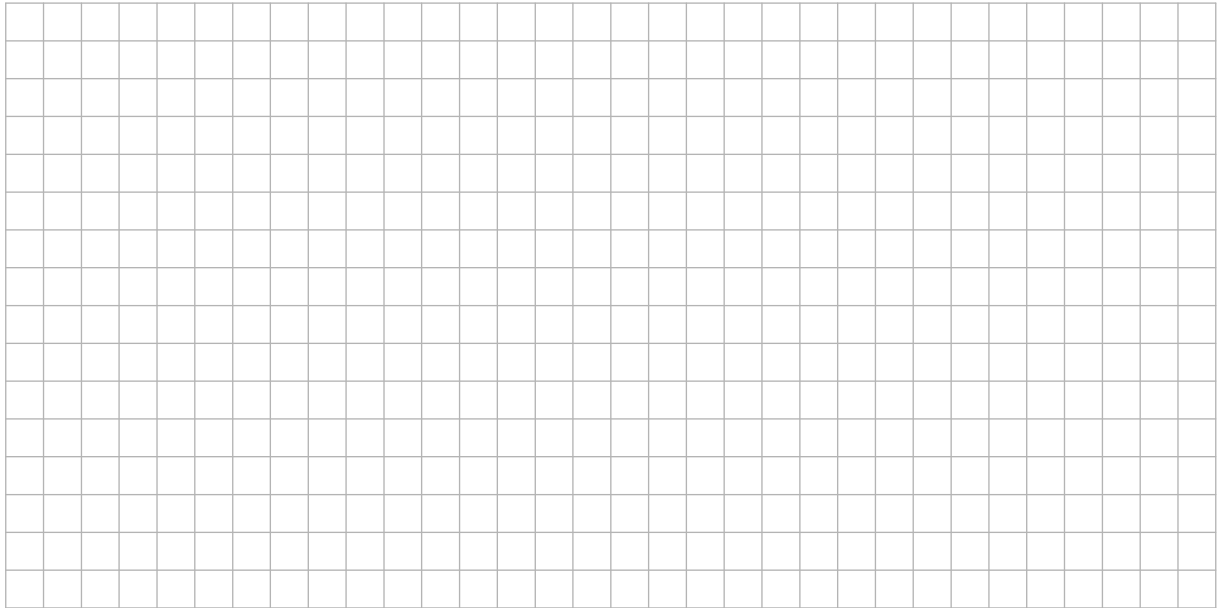
- (ii) If one third of the smaller even number is subtracted from half of the larger even number the result is 8. Find the value of x .

Page	running
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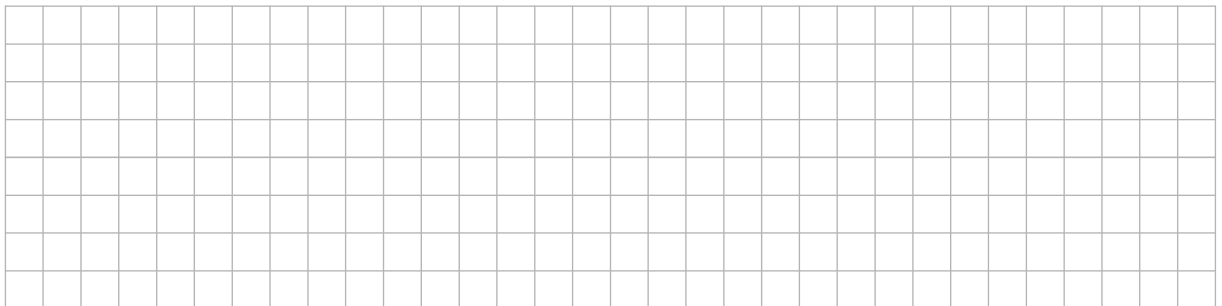
Question 11**(Suggested maximum time: 10 minutes)**

- (a) Solve the following inequality and show the solution on the number line.

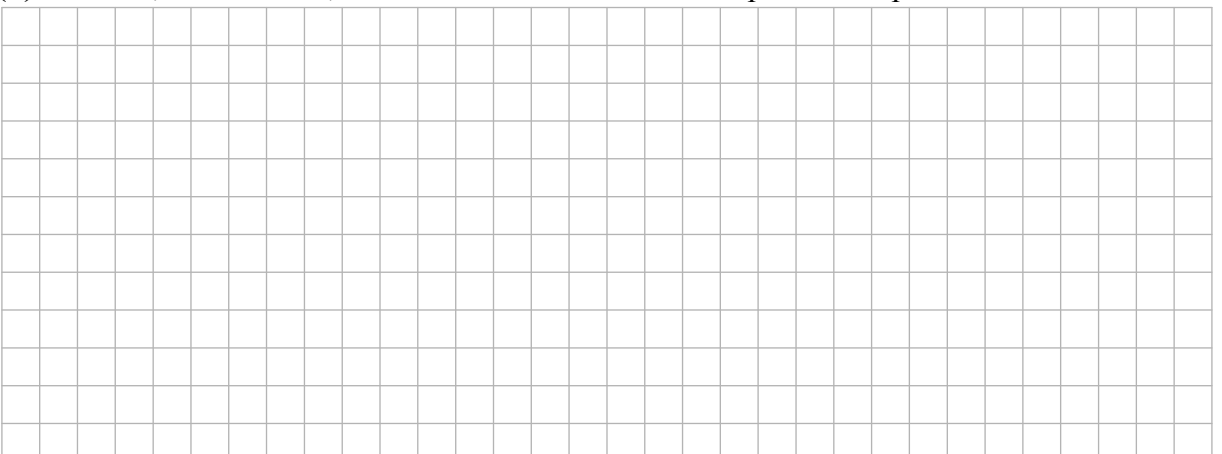
$$-2 \leq \frac{1}{2}x - 3 < 1, x \in \mathbb{N}.$$



- (b) Josephine hopes to go to college. She has saved €3000. She will attend college for 32 weeks in her first year. She plans to have at least €800 left at the end of the year.
- (i) If she spends € x each week, write an inequality to represent her spending during the year.



- (ii) Hence, or otherwise, find the maximum amount Josephine can spend each week.



Question 12

(Suggested maximum time: 5 minutes)

Irish Sport Promotions has designed a company logo. The actual size of the logo is shown here.

- (a) Write the dimensions of the logo, to the nearest mm, below.

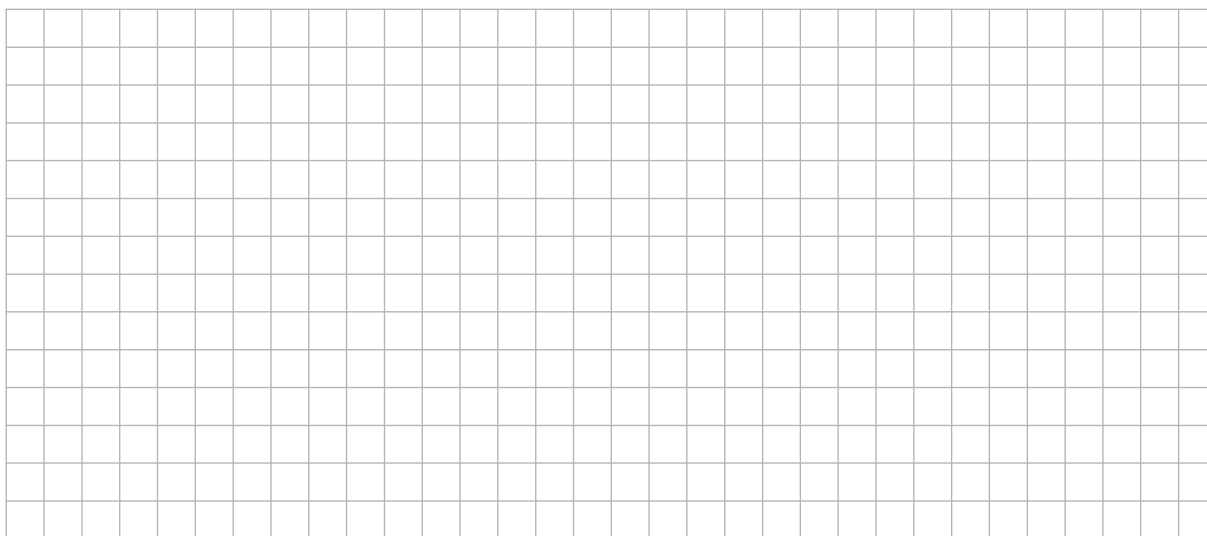
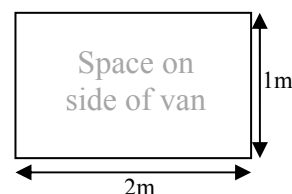
Width _____ mm Height _____ mm



- (b) The company wants to enlarge this logo in order to put it on the side of its vans.

The space available for the logo on the side of each van is:
width 2 m and height 1 m.

If the company wants to keep the same width to height ratio as in the original logo, calculate the dimensions of the largest logo that will fit onto the side of the van.

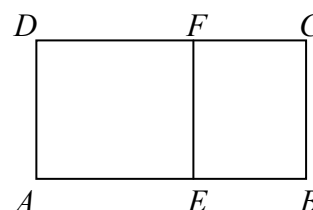
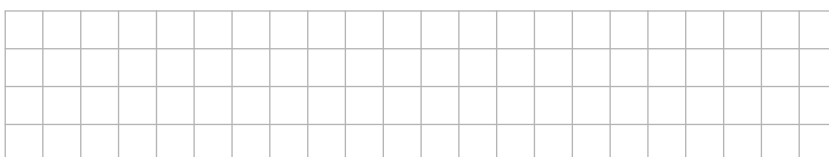


Question 13

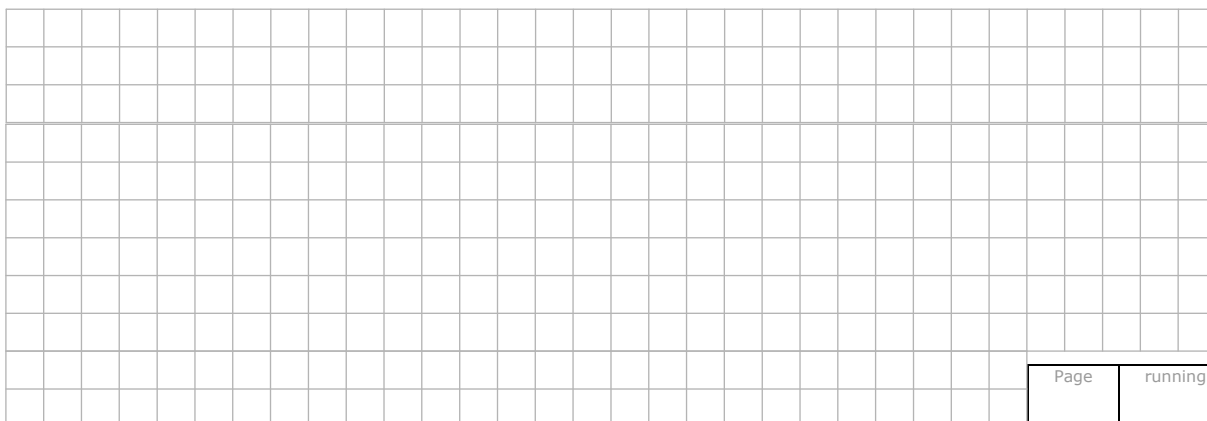
(Suggested maximum time: 10 minutes)

$ABCD$ is a rectangle. $AEFD$ is a square. $|AD| = 1$ cm. $|DC| = x$ cm.

- (i) Write $|EB|$ in terms of x .



- (ii) If $\frac{|AB|}{|AD|} = \frac{|EF|}{|EB|}$, find the distance x . Give your answer correct to two decimal places.



Page	running
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Question 14 (Suggested maximum time: 5 minutes)

Question 14 (Suggested maximum time: 5 minutes)

Investigate whether the pattern in the table below is linear, quadratic or exponential.

Explain your conclusion.

Term 1	Term 2	Term 3	Term 4	Term 5
$2a - b + 2c$	$8a - 2b + 2c$	$18a - 3b + 2c$	$32a - 4b + 2c$	$50a - 5b + 2c$

This image shows a full page of blank graph paper. The grid consists of small, uniform squares formed by thin, light gray lines. There are no margins, text, or other markings on the page.

Question 15 (Suggested maximum time: 15 minutes)

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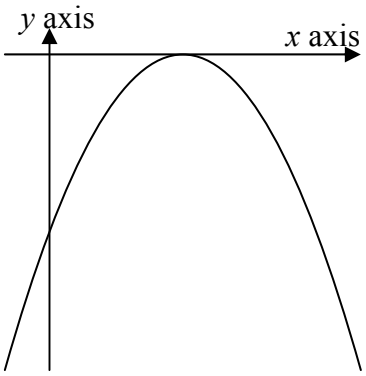
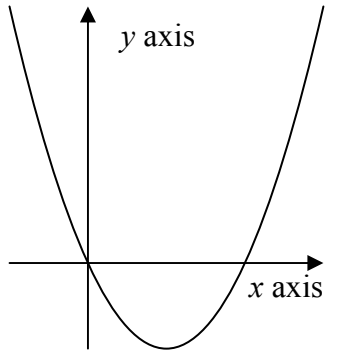
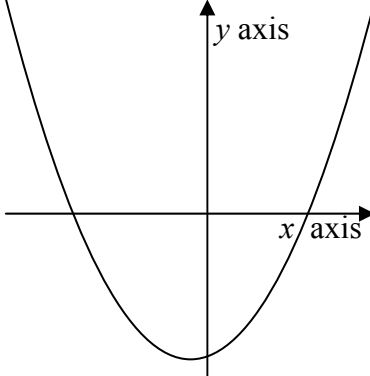
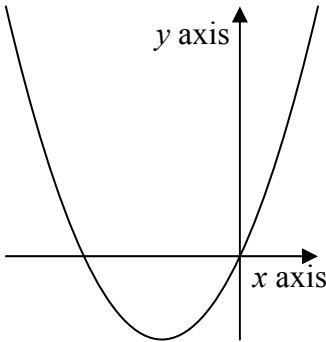
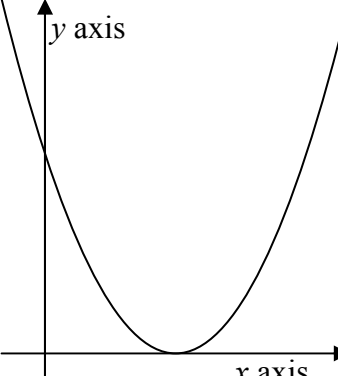
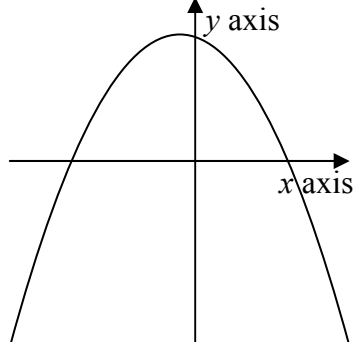
(a) Three functions: $f(x)$, $g(x)$ and $h(x)$ are defined as follows:

$$f(x) = 2x^2 + x - 6, \quad g(x) = x^2 - 6x + 9 \quad \text{and} \quad h(x) = x^2 - 2x.$$

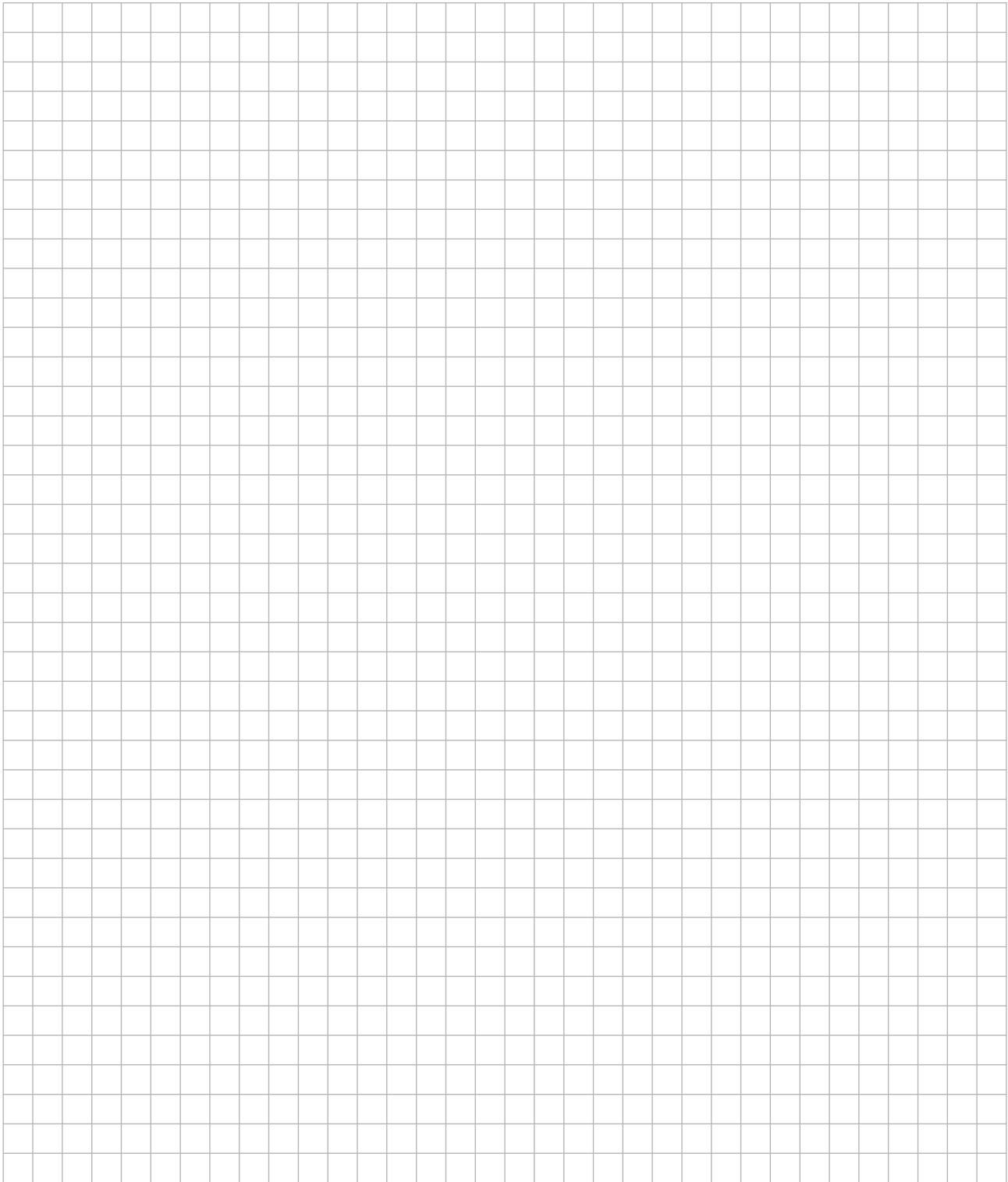
[illegible]

- (b) The table below shows the sketches of six different functions. Three of the sketches belong to the three functions from part (a).

Write $f(x)$, $g(x)$ or $h(x)$ into the box underneath the correct sketch for each of the three functions.

Diagram 1 	Diagram 2 	Diagram 3 
Diagram 4 	Diagram 5 	Diagram 6 





Junior Certificate 2013 – Higher Level

Mathematics (Project Maths – Phase 3) – Paper 1

Friday 7 June

Afternoon 2.00 to 4.30