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Mathematics: applications and interpretation

Standard level

Paper 1

14 May 2026

Zone A afternoon | Zone B afternoon | Zone C afternoon

Session number

1 hour 30 minutes

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Instructions to students

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A clean copy of the **mathematics: applications and interpretation SL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[80 marks]**.

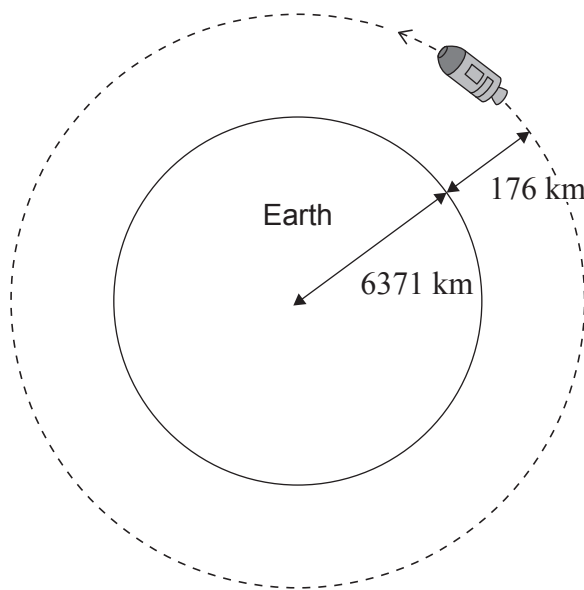


Answers must be written within the answer boxes provided. Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Solutions found from a graphic display calculator should be supported by suitable working. For example, if graphs are used to find a solution, you should sketch these as part of your answer. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

1. [Maximum mark: 5]

In 1962, astronaut Walter Schirra orbited the Earth six times in his spacecraft at a height of 176 km above the Earth's surface. The radius of the Earth is 6371 km. This is shown in the following diagram.

diagram not to scale



Jorge wants to find the total distance travelled by the spacecraft for its six orbits.

He assumes the spacecraft follows a circular path above the Earth's surface.

- (a) Using Jorge's assumption, show that the total distance travelled is 2.47×10^5 km, correct to three significant figures. [3]

The actual total distance travelled by the spacecraft was 231 718 km.

- (b) Find the percentage error in Jorge's calculation. [2]

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(Question 1 continued)

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24EP03

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2. [Maximum mark: 5]

The fifth term of a geometric sequence is 48 and the sixth term is 96.

(a) For this sequence, find

(i) the common ratio.

(ii) the first term.

[3]

(b) Find the sum of the first 15 terms of the sequence.

[2]

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3. [Maximum mark: 8]

A school librarian conducts a survey to determine the favourite genre of book within different age groups. A group of 230 students was asked to state their age and their favourite from three genres of books: mystery, science fiction and romance. The data is summarized in the following table.

	Mystery	Science fiction	Romance
< 13 years old	26	52	22
13 to 16 years old	22	31	19
> 16 years old	28	17	13

A χ^2 test at the 5% significance level is carried out to determine if a student's favourite genre of book is independent of their age.

(a) State the

(i) null hypothesis.

(ii) alternative hypothesis.

[2]

(b) Find the p -value for this test.

[2]

(c) State, in context, the conclusion for this test. Justify your answer.

[2]

The students who participated in the survey were the first 230 students who visited the library that week.

(d) (i) Write down the sampling method that the librarian used.

(ii) State one reason why the sampling method used may lead to an invalid conclusion. [2]

(This question continues on the following page)



(Question 3 continued)

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24EP07

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4. [Maximum mark: 6]

In an experimental trial, 12 identical biased coins are made by coating the tails side with a heavy, metallic paint. When a biased coin is tossed, the probability that it lands heads side up is 0.73.

All 12 coins are tossed at the same time.

(a) Find the probability that exactly 8 coins will land heads side up. [2]

(b) Find the probability that more coins will land heads side up than tails side up. [2]

The experiment is repeated for a total of 49 trials.

(c) Find the expected number of trials in which more coins will land heads side up than tails side up. [2]

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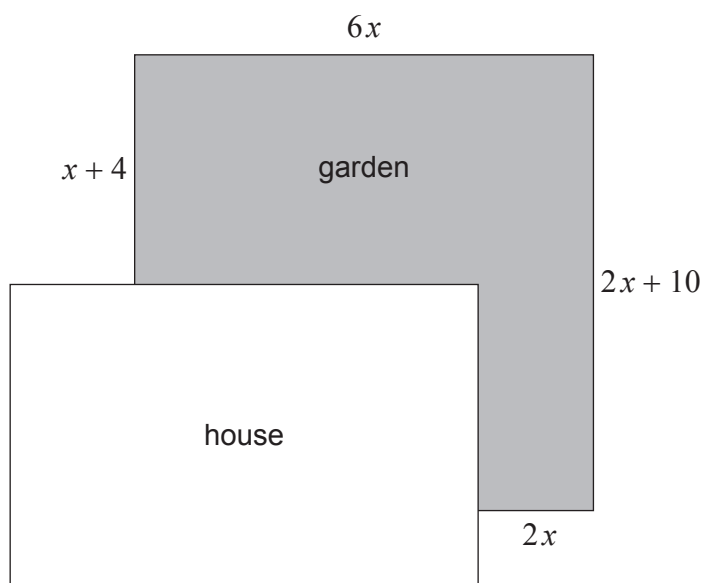
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5. [Maximum mark: 7]

Jeff is designing a garden around a corner of his house. The lengths, in metres, of each side of the garden are given in terms of x , as shown in the following diagram.

diagram not to scale



- (a) Show that the garden's area, $A \text{ m}^2$, is given by $A = 8x^2 + 36x$. [3]

The garden's area is 72 m^2 .

- (b) Find the value of x . [2]

Jeff decides to construct a fence around the garden. The fence is not required around the parts of the garden that touch the side of the house.

- (c) Find the length of fence that Jeff needs. [2]

(This question continues on the following page)



(Question 5 continued)

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24EP11

Turn over

6. [Maximum mark: 7]

An airline conducted a survey to see how many items of luggage are lost during transit. A sample of 80 items of luggage were selected at random and tracked, and 5 of those were lost.

Items of luggage that weigh over 18 kg are considered “heavy”. In the sample, 24 items of luggage were heavy, and 2 of those were lost.

(a) Using this information, complete the following table.

[2]

	Lost	Not lost	Totals
Heavy			
Not heavy			
Totals	5		80

(b) An item of luggage is selected at random from the sample. Find the probability that this item is

(i) not heavy.

(ii) lost, given that it is heavy.

[2]

It can be assumed that the proportions of lost luggage in the survey are representative of the proportions on any given flight with this airline.

The airline’s research also shows that the weight of an item of luggage can be modelled by a normal distribution with a mean of 16 kg and a standard deviation of 3 kg.

An item of luggage is selected at random from all those in transit with this airline.

(c) Find the probability that it will be heavy and lost.

[3]

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(Question 6 continued)

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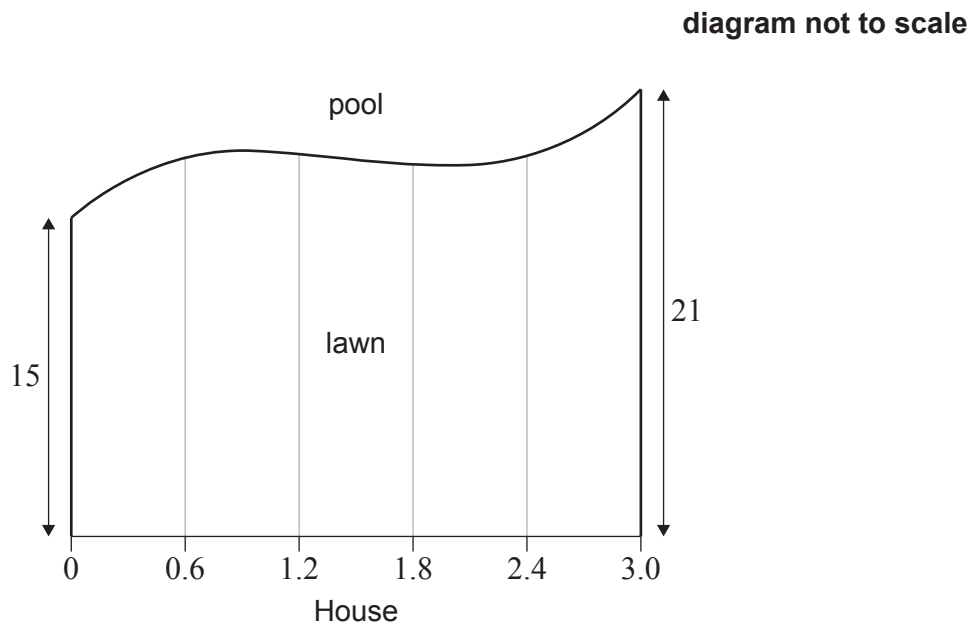


24EP13

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7. [Maximum mark: 9]

Bogdan is planning to replace the grass on his lawn, between his house and the edge of his pool. This is shown in the following diagram.



The following table gives the distances, to the nearest metre, between the house and the pool. These are taken at intervals of 0.6 metres from the left corner of Bogdan's house.

Distance from left corner of house (x metres)	0	0.6	1.2	1.8	2.4	3.0
Distance between house and pool (y metres)	15	18	18	17	18	21

- (a) Calculate an estimate for the area of the lawn using the trapezoidal rule. [2]

The curve of the edge of the pool for the interval $0 \leq x \leq 3.0$ is given by the equation

$$y = 1.37x^3 - 6.07x^2 + 7.87x + 15.$$

- (b) Show that the exact area of the lawn is greater than the estimated area calculated in part (a). [3]

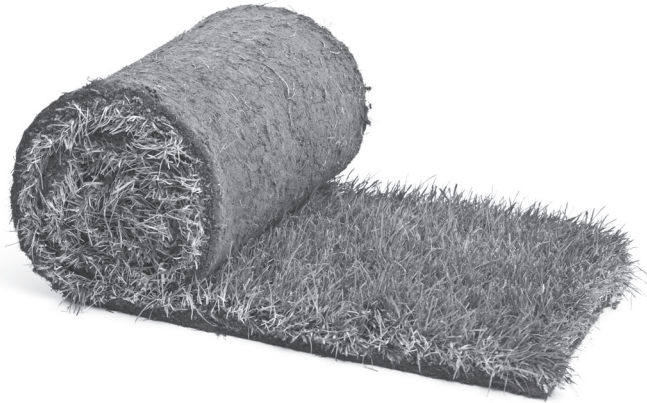
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(Question 7 continued)

Bogdan will use rolls of natural grass that have a width of 0.6 metres and a length of 1.4 metres when unrolled. Each roll costs \$12.50 and there is an additional charge of \$28.00 for delivery to Bogdan's home.

diagram not to scale



(c) Find the minimum cost for Bogdan to replace the grass on his lawn.

[4]

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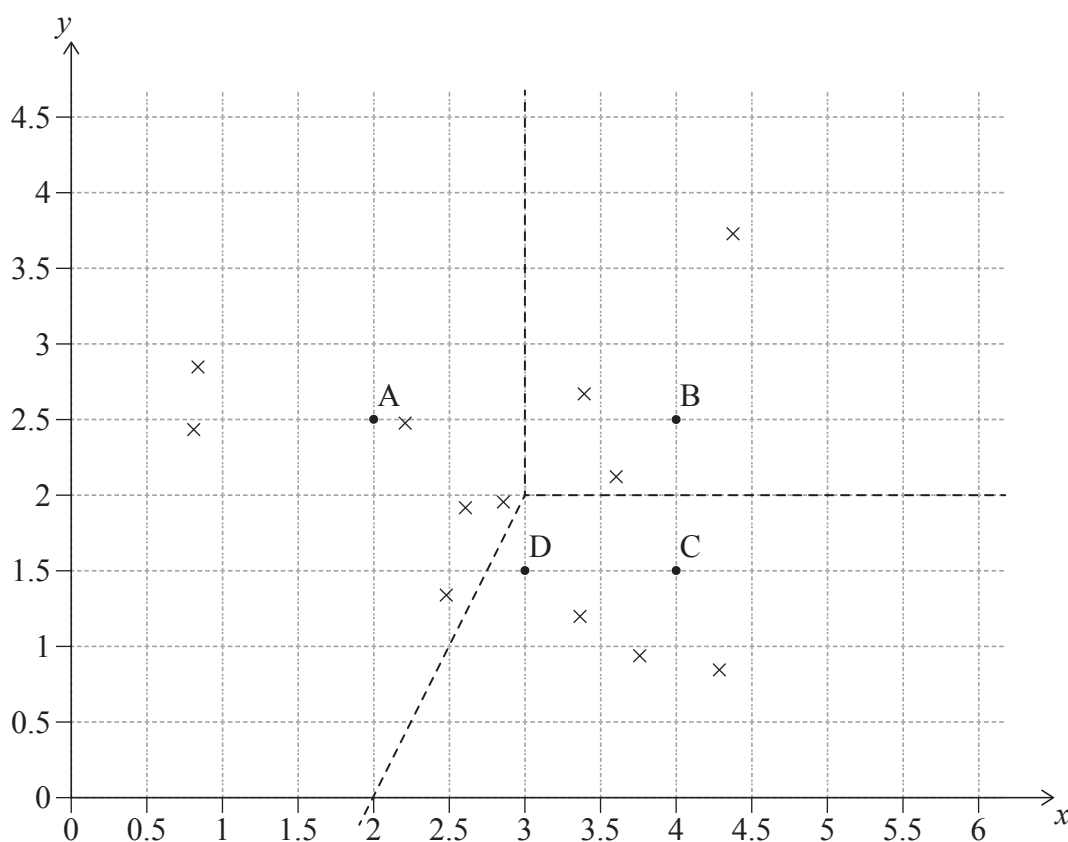


8. [Maximum mark: 6]

George is planning to visit Rome. He finds a list of the top 12 tourist attractions and their positions on a map of the city.

George also finds four possible hotels to stay at. He decides he will book the hotel that is closest to most attractions.

Each tourist attraction is marked with an $\times$ on the following coordinate axes. The hotels are at the following points: $A(2, 2.5)$, $B(4, 2.5)$, $C(4, 1.5)$ and $D(3, 1.5)$. George draws a Voronoi diagram with A , B and C as the sites. The edges are shown as dashed lines on the diagram.



(This question continues on the following page)



(Question 8 continued)

- (a) Draw the perpendicular bisectors of $[AD]$, $[BD]$ and $[CD]$ on the diagram using three new dashed lines. [3]
- (b) Hence complete the Voronoi diagram with the four hotels as the sites. Represent the edges of the Voronoi diagram as solid lines. [2]
- (c) State which of the hotels is closest to most attractions. [1]

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9. [Maximum mark: 8]

The grasshopper population in a cornfield is modelled by the function P .

Scientists are developing a new pesticide to reduce the population of grasshoppers. They have found that the rate of change of the grasshopper population can be modelled by

$$P'(t) = 70 + t - 3t^2,$$

where t is the time, in weeks, after the pesticide was sprayed.

(a) (i) Find the value of $P'(5)$.

(ii) Interpret, in context, the value of $P'(5)$.

[2]

Five weeks after the pesticide was sprayed, the grasshopper population in the cornfield was 254.

(b) Find an expression for $P(t)$.

[4]

(c) Find the amount of time required to eliminate the grasshopper population in the cornfield.

[2]

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10. [Maximum mark: 6]

Earthquakes are given a magnitude, M , based on the amount of energy released, S , in Joules. The formula for an earthquake's magnitude is

$$M = -10.7 + \frac{2}{3} \log_{10} S, \text{ for } S > 0.$$

In 1960, the Great Chilean earthquake released 2.1×10^{30} Joules of energy.

- (a) Calculate the magnitude of the Great Chilean earthquake. [2]

In 2024, the Noto earthquake in Japan had a magnitude of 7.5.

- (b) Calculate the amount of energy released by the Noto earthquake. [2]

The amount of energy released by the Great Chilean earthquake is k times the amount of energy released by the Noto earthquake.

- (c) Find the value of k . [2]

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11. [Maximum mark: 5]

Hailey is playing a game in which a die is rolled. Each time Hailey rolls the die she receives the number she rolls as points, but if she rolls a 2 she instead loses all her points.

The following table shows the distribution of Y , where Y is the amount of points Hailey could receive when she already has x points.

Number on the die	1	2	3	4	5	6
Points received (y)	a	b	3	4	5	6
$P(Y = y)$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$

(a) Write down

(i) the value of a .

(ii) an expression for b in terms of x .

[2]

(b) Find an expression for $E(Y)$.

[2]

Before each roll of the die, Hailey has the choice to stop playing the game and keep all her points, or to continue playing and risk losing all her points.

Hailey decides to stop when $E(Y) < 0$.

(c) Find the least number of points Hailey could have when she decides to stop.

[1]

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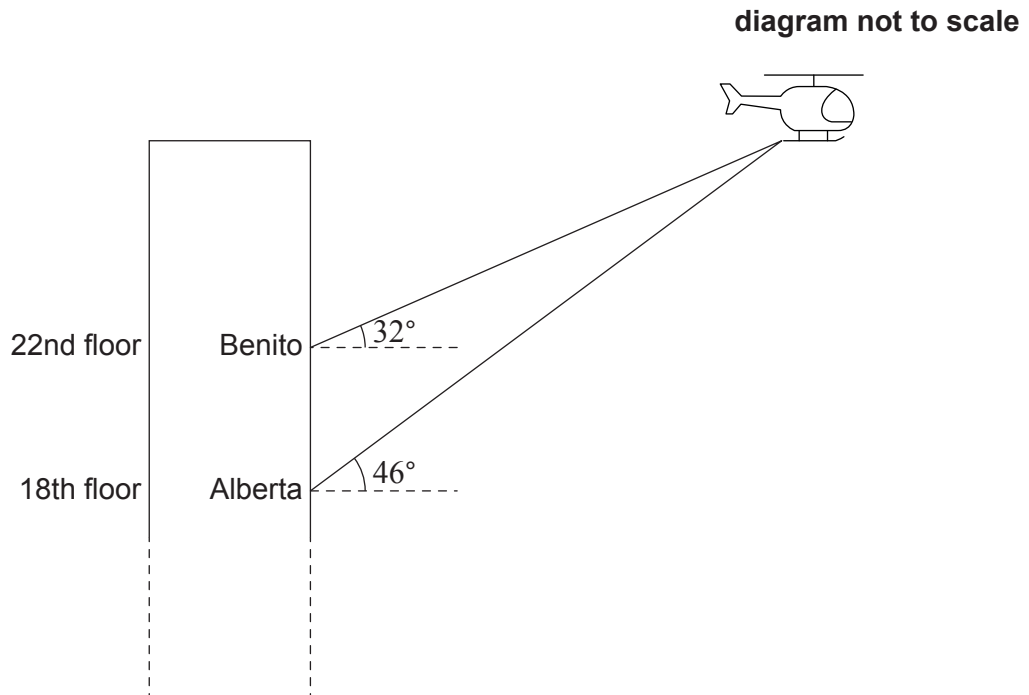
12. [Maximum mark: 8]

Alberta and Benito live in the same apartment building. Alberta lives on the 18th floor and Benito lives on the 22nd floor. The distance between each floor of the building is 3.75 metres.

- (a) Find the vertical distance between the 18th and 22nd floors.

[1]

Alberta looks up at an angle of elevation of 46° and sees a helicopter hovering in the sky. At the exact same time, Benito looks up at an angle of elevation of 32° and sees the same helicopter. This is shown in the following diagram.



Carlos lives on the top floor of the building and sees the helicopter hovering at his eye level. You may assume that Alberta, Benito and Carlos are the same height.

- (b) Find the number of floors in the building.

[7]

(This question continues on the following page)



(Question 12 continued)

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References:

- 7.(c) MentalArt, 2012. *Green carpet*. [image online] Available at: <https://www.gettyimages.co.uk/detail/photo/green-carpet-royalty-free-image/166610615> [Accessed 21 March 2025]. Source adapted.



24EP24