Diploma Programme
Programme du diplôme
Programa del Diploma

# Mathematics: applications and interpretation
# Standard level
# Paper 1

10 November 2025

**Zone A** afternoon | **Zone B** afternoon | **Zone C** afternoon

Candidate session number

| | | | | | | | | | |
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| | | | | | | | | | |

1 hour 30 minutes

## Instructions to candidates

- 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]**.

25 pages

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Please **do not** write on this page.

Answers written on this page
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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]

The first three terms of a geometric sequence are $2$, $6$ and $18$.

(a) Write down the common ratio, $r$. [1]

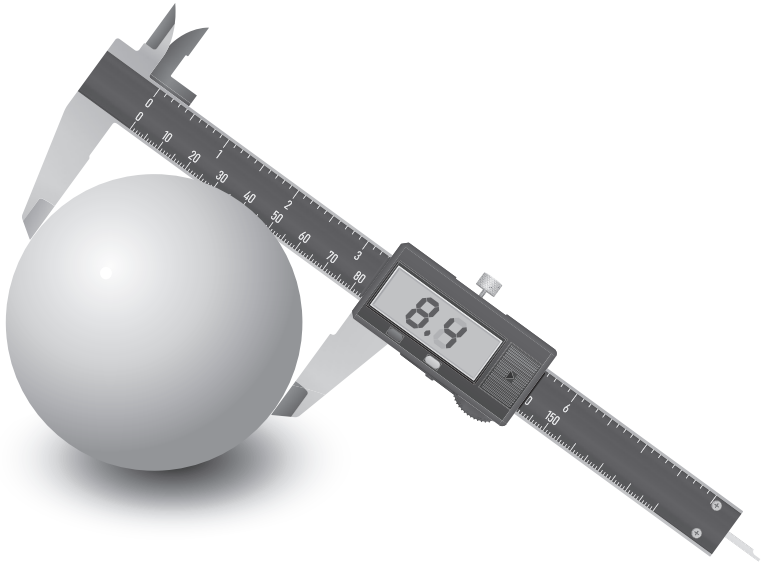
(b) Find the $8\text{th}$ term of the sequence. [2]

(c) Find the sum of the first $10$ terms of the sequence. [2]

**2.** [Maximum mark: 6]

A digital caliper is used to measure the diameter of a spherical ball.

**diagram not to scale**




The digital caliper displays the diameter of the ball as $8.4\,\text{cm}$, and is accurate to one decimal place.

(a) (i) Write down the smallest possible diameter of the ball.

(ii) Hence, calculate the smallest possible volume of the ball. [4]

The exact diameter of the ball is $8.38\,\text{cm}$.

(b) Calculate the percentage error in the measurement of $8.4\,\text{cm}$, as shown on the digital caliper. [2]

**(This question continues on the following page)**

**(Question 2 continued)**

**3.** [Maximum mark: 6]

TurboEats is a food delivery company that charges customers $\$0.80$ per kilometre plus a fixed amount of $\$1.50$. Their delivery charge, $T$ in $\$$, is represented by the function

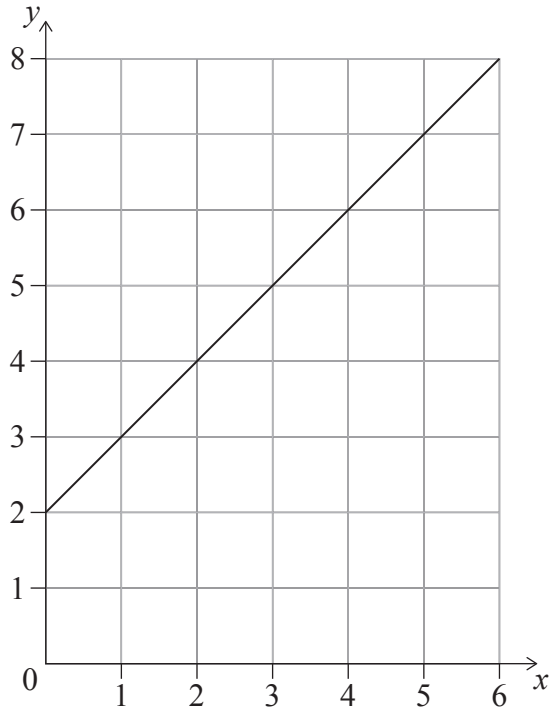
$$T(x) = 0.80x + 1.50, \text{ for } x \geq 0,$$

where $x$ is the distance in kilometres from where the food is picked up to where it is delivered.

Lorena's home is $5.1\,\text{km}$ from a pizza café.

(a) Find the charge for TurboEats to deliver a pizza from the café to her home. [2]

A second food delivery company, GogoDart, charges customers according to the function $G(x) = ax + b$, for $x \geq 0$. Their charges for the first $6\,\text{km}$ are shown in the following graph of $y = G(x)$. The line passes through integer grid points.




(b) (i) Write down the value of $a$.

(ii) Write down the value of $b$. [2]

(c) Explain why TurboEats is **always** cheaper than GogoDart. [2]

**(This question continues on the following page)**

**(Question 3 continued)**

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**4.** [Maximum mark: 7]

Under controlled driving conditions, Jacob investigated the fuel efficiency of his car when using premium fuel compared to standard fuel.

Jacob recorded the distance travelled per litre $(\mathrm{km\,L^{-1}})$ using standard fuel for six days and then using premium fuel for seven days. This information is shown in the following tables.

| | **Standard fuel** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Distance travelled per litre ($\mathrm{km\,L^{-1}}$)** | 8.1 | 8.2 | 7.9 | 8.2 | 7.9 | 8.0 | |

| | **Premium fuel** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Distance travelled per litre ($\mathrm{km\,L^{-1}}$)** | 8.3 | 8.4 | 8.1 | 8.3 | 8.2 | 8.0 | 8.2 |

At the $5\%$ significance level, Jacob performs a $t$-test to determine whether there is sufficient evidence that his car travels further using premium fuel compared to standard fuel.

(a) State one mathematical assumption made for this test to be valid. [1]

(b) Write down the

(i) null hypothesis;

(ii) alternative hypothesis. [2]

(c) (i) Find the $p$-value.

(ii) State your conclusion to the test in context. Justify your answer. [4]

**(This question continues on the following page)**

**(Question 4 continued)**

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**5.** [Maximum mark: 6]

Mikko deposits $\$10\,000$ into a savings account with a fixed nominal annual interest rate of $r\%$ compounded monthly. At the end of each month, he deposits $\$800$ into the account.

After $10$ years, the value in the savings account is $\$160\,000$.

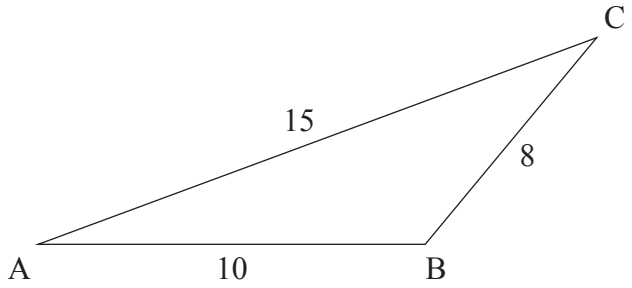
(a) Find the value of $r$. [3]

(b) Find the amount of interest earned over the $10$ years. [3]

**6.** [Maximum mark: 8]

Triangle $ABC$ has sides of length $AB = 10\,\text{cm}$, $BC = 8\,\text{cm}$ and $AC = 15\,\text{cm}$, as shown in the diagram.

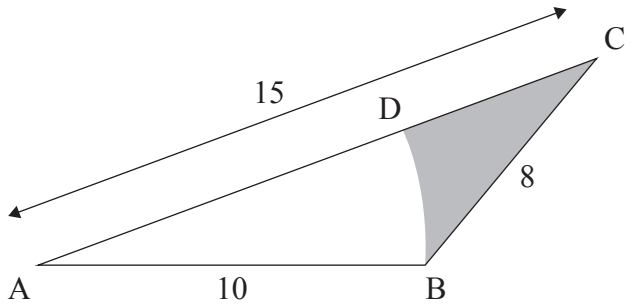
**diagram not to scale**




(a) Find the size of $B\hat{A}C$. [3]

The circular arc $BD$, with centre $A$, is drawn inside the triangle, such that $D$ lies on $AC$.

**diagram not to scale**




(b) Find the area of the shaded region. [5]

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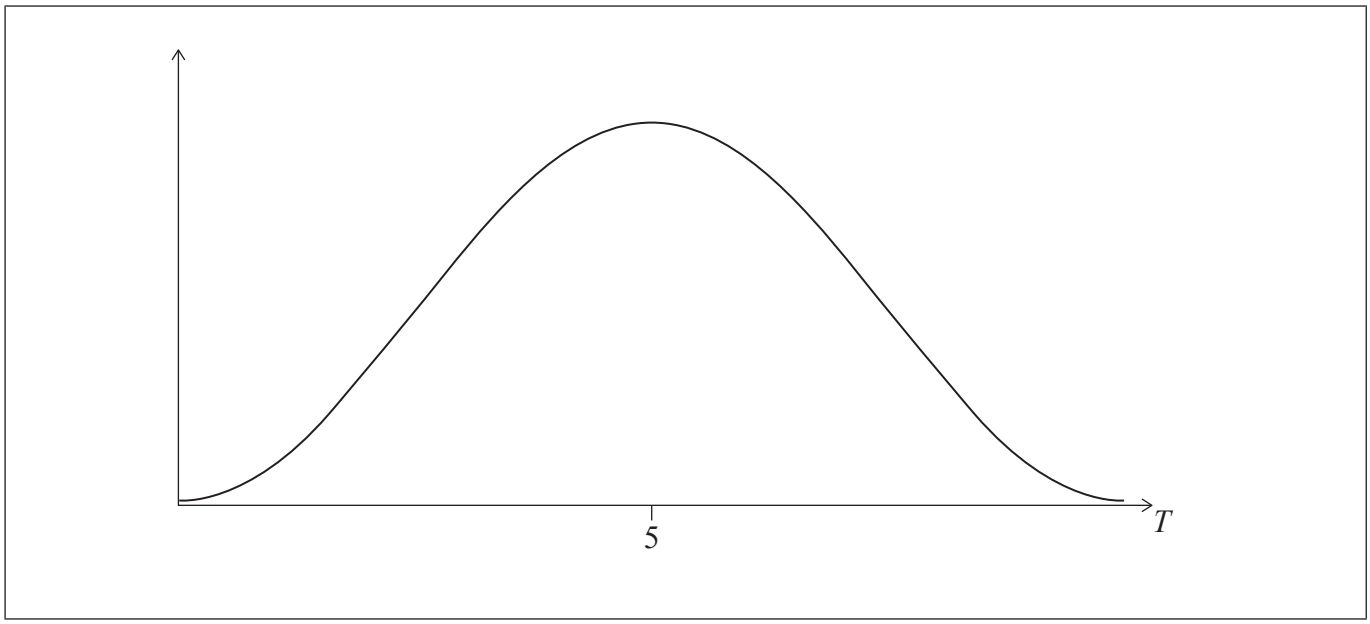
**(Question 6 continued)**

**7.** [Maximum mark: 5]

In a reaction test, the time, $T$ seconds, taken to complete the test can be modelled by a normal distribution with a mean of $5$ seconds and a standard deviation of $1$ second.

(a) Find the probability that a randomly selected person completes the reaction test in less than $4$ seconds. [2]

The graph of the distribution of $T$ is shown in the following diagram.




The slowest $15\%$ of participants will be given training to reduce their time to complete the test.

(b) (i) Shade the region on the given diagram that corresponds to these participants.

(ii) Find the least time taken to complete the test by a person who will be given training. [3]

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**(Question 7 continued)**

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**8.** [Maximum mark: 8]

Sheena purchased a new mobile phone. The value of Sheena's mobile phone, $V$ in Philippine Pesos $(\text{PHP})$, can be modelled by the function

$$V(t) = 2000 + 30\,000\,(\mathrm{e}^{-kt}), \text{ for } t \geq 0,$$

where $t$ is the time, in months, after the mobile phone was purchased.

(a) Calculate the value of the mobile phone when it was purchased. [2]

Ten months after it was purchased, the value of the mobile phone has decreased by $40\%$.

(b) Find the value of $k$. [4]

Sheena believes the value of the mobile phone will always be more than $\text{PHP } 2000$.

(c) (i) State a mathematical property of the graph of $y = V(t)$ that supports Sheena's belief.

(ii) State one contextual reason why Sheena's belief might be incorrect. [2]

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**9.** [Maximum mark: 7]

On a television quiz show, a contestant is asked **ten questions**. Each question is multiple choice with four possible options, only one of which is correct.

Xiaoyi is a contestant and randomly guesses each answer. Her answers to the questions are independent of each other.

(a) Find the probability that Xiaoyi

(i) answers exactly five questions correctly;

(ii) answers at least three questions correctly. [4]

Xiaoyi answers all ten questions correctly and is offered the choice of two prizes:

- **Option A:** $\$50\,000$ in cash

- **Option B:** Toss a biased two-sided coin where the probability of showing heads is $0.3$ and the probability of showing tails is $0.7$. If the outcome is heads, Xiaoyi will win $\$500\,000$. If the outcome is tails, Xiaoyi will receive no money.

(b) Show that the expected value of Xiaoyi's winnings if she chooses **Option B** is $\$150\,000$. [2]

(c) State, giving a reason, whether Xiaoyi should choose **Option A** or **Option B**. [1]

**(This question continues on the following page)**

**(Question 9 continued)**

**10.** [Maximum mark: 7]

At 12:05 pm, Navam starts draining water from a small reservoir into an empty pond.

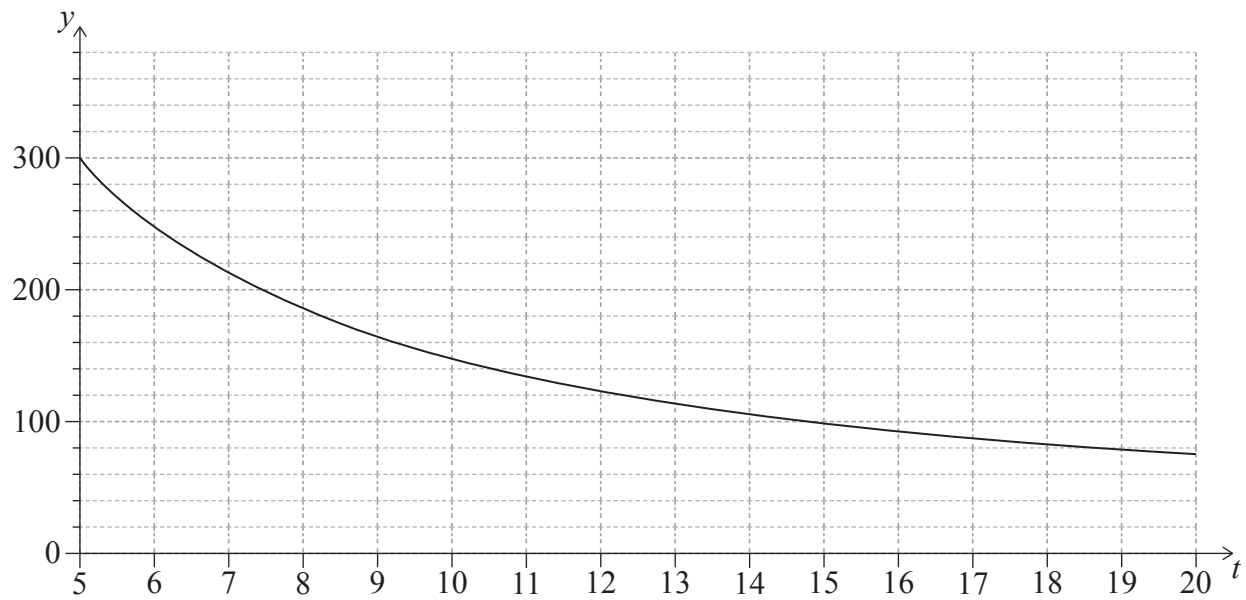
He controls the rate the water is drained so that the volume of water **remaining** in the reservoir, $V\,\mathrm{m}^3$, varies inversely with the time, $t$, where $t$ is the number of minutes after 12:00 pm.

At 12:05 pm, the volume of water in the reservoir is $300\,\mathrm{m}^3$.

(a) Show that $V = \dfrac{1500}{t}$. [2]

(b) Find the value of $t$ when the volume of water remaining in the reservoir equals the volume of water in the pond. [2]

The following diagram shows part of the graph of $y = V(t)$.




(c) On the same diagram, sketch the graph of $y = P(t)$, where $P$ is the volume of water in the pond. [2]

(d) Write down an expression for $P(t)$. [1]

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**(Question 10 continued)**

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**11.** [Maximum mark: 8]

Consider the function $B(x) = 20 + \frac{32}{x} + 2x$, where $x \geq 1$, $x \in \mathbb{R}$.

(a) (i) Find $B'(x)$.

(ii) Use your answer to part (a)(i) to find the minimum value of $B(x)$. You may assume that $B(x)$ has no local maximum point over the given domain. [6]

Kim goes to a restaurant that offers a large family banquet. The time, $T$, in minutes, to prepare the family banquet depends on the number of chefs, $n$.

To predict the value of $T$, Kim uses the model $T(n) = 20 + \frac{32}{n} + 2n$, where $n \in \mathbb{Z}^+$.

The restaurant informs Kim that the time taken to prepare the family banquet is less than $40$ minutes. There are $k$ chefs preparing the family banquet.

(b) Find the possible values of $k$. [2]

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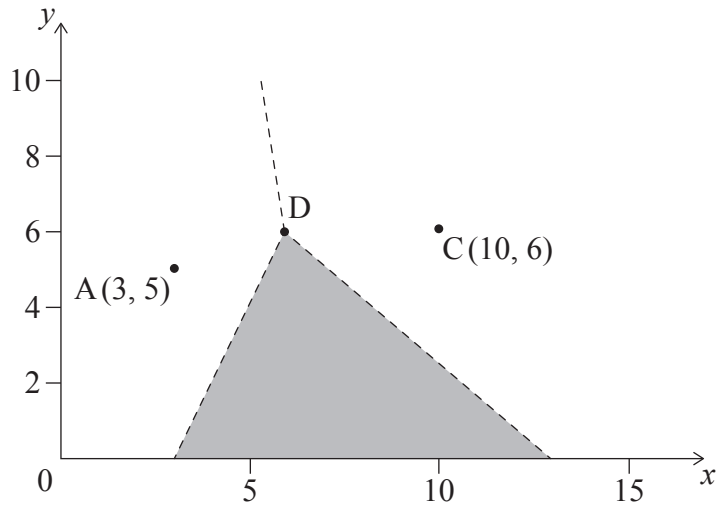
**12.** [Maximum mark: 7]

The city of Benoulli has three police stations, located at $A(3, 5)$, $C(10, 6)$ and $B$. In the following Voronoi diagram, $A$ and $C$ represent sites. The dashed lines represent the edges and the cell for site $B$ is shaded.




(a) State the geometrical significance of

(i) the shaded region;

(ii) point $D$. [2]

The equation of the edge between $A$ and $B$ is $y = 2x - 6$. The equation of the edge between $C$ and $B$ is $y = -x + 13$.

(b) Calculate the coordinates of $B$. [5]

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**(Question 12 continued)**

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**References:**

**2.** Pepifoto, 2021. *Digital caliper measuring screw*. [image online] Available at: https://www.gettyimages.co.uk/detail/photo/digital-caliper-measuring-screw-royalty-free-image/1302481493?phrase=digital+caliper+hand&adppopup=true Images [Accessed 20 November 2024]. Source adapted.

Lesikvit, 2024. *White round sphere or 3d ball*. [image online] Available at: https://www.gettyimages.co.uk/detail/illustration/white-round-sphere-or-3d-ball-royalty-free-illustration/2157157426?phrase=grey+sphere&adppopup=true Images [Accessed 20 November 2024]. Source adapted.

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