Diploma Programme
Programme du diplôme
Programa del Diploma

Mathematics: applications and interpretation
Standard level
Paper 2

15 May 2026

Zone A morning | **Zone B** morning | **Zone C** morning

1 hour 30 minutes

Instructions to students

- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper.
- Answer all the questions in the answer booklet 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]**.

2226 – 5224

11 pages

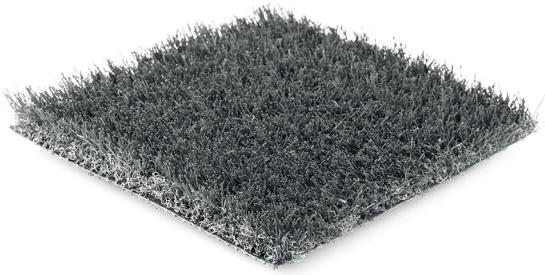
Answer **all** questions in the answer booklet provided. Please start each question on a new page. Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Solutions found from a graphic display calculator should be supported 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: 14]

Fariah wants to cover her garden with grass. She chooses Swiftlawn, which can be purchased in either rolls, which cover 1.4 metres (m) by $0.6\,\text{m}$ when unrolled, or flats, which cover $0.6\,\text{m}$ by $0.4\,\text{m}$.

diagram not to scale

Roll

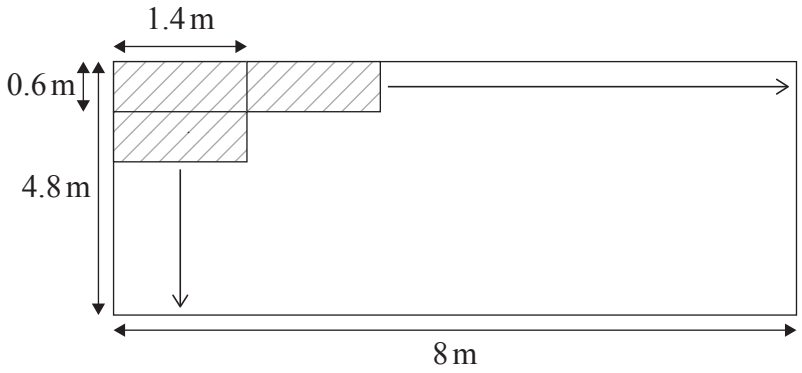


Flat

Fariah's garden is rectangular and measures $8\,\text{m}$ by $4.8\,\text{m}$, as shown in the following diagram. She wants to cover the garden with rolls and flats without extending beyond the garden's dimensions. She plans two phases for the work: phase 1 and phase 2.

In phase 1, she will lay rolls from left to right with no space between them. She will place as many **complete** rolls as she can, then begin a new row. She will keep adding rows until she cannot add another row.

diagram not to scale



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(Question 1 continued)

(a) (i) Find the number of rolls Fariah will be able to lay in phase 1.

(ii) Hence, calculate the remaining area of the garden that will not be covered by the rolls. [4]

In phase 2, Fariah will cover the remaining area of the garden using only flats.

(b) Find the number of flats Fariah will need. [2]

Each roll costs $\$5$ and each flat costs $\$2$.

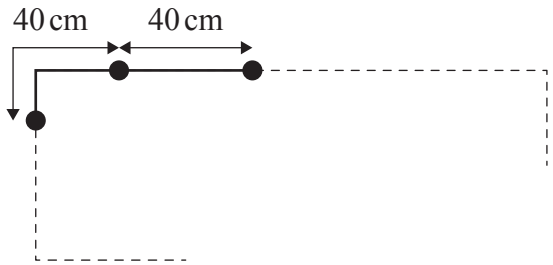
(c) Find the total cost of the Swiftlawn for Fariah's plan. [2]

Fariah's friend Ayden claims that a different layout for phase 2 that uses a combination of complete flats and complete rolls, where neither can be cut, could be cheaper than Fariah's plan.

(d) Show that Ayden's claim is correct. Justify your answer. [3]

Fariah wants to place small lights 40 centimetres (cm) apart around the entire perimeter of the garden, as shown in the following diagram.

diagram not to scale



(e) Find the number of lights Fariah will need. [3]

2. [Maximum mark: 17]

Mathilda works at a local service station that sells lottery scratchcards. Each scratchcard costs $\$1$. The prizes, and the probability of winning each prize according to the lottery company, are shown in the following table.

Prize ($)	0	2	5	10	100	500
Probability	b	0.085	a	0.004	0.002	0.001

(a) Given that the probability of winning $\$5$ is six times the probability of winning $\$100$ for each scratchcard, find the value of

(i) a.

(ii) b. [4]

(b) Determine whether a scratchcard represents a fair game. Justify your answer. [4]

Mathilda wants to determine whether the probability of winning each prize matches the lottery company's claims. She records the prizes from 750 scratchcards. Her data are shown in the following table.

Prize ($)	0	2	5	10	100	500
Number of scratchcards	692	48	7	1	2	0

(c) Write down the probability of winning a $\$2$ prize, according to Mathilda's data. [1]

(This question continues on the following page)

(Question 2 continued)

Mathilda claims that the lottery company has incorrectly stated the probability of winning a $\$2$ prize.

(d) With reference to your answer to part (c), state a reason to

(i) support Mathilda's claim.

(ii) counter Mathilda's claim. [2]

Mathilda decides to perform a χ^2 goodness of fit test using her data at the 10% significance level to test her claim. To prepare for the test and to ensure that her expected frequencies are all greater than 5, Mathilda merges the data for the $\$10$, $\$100$, and $\$500$ prizes into one column, as shown in the following table.

Prize ($)	0	2	5	10, 100, 500
Number of scratchcards	692	48	7	3

(e) (i) Write down the null and the alternative hypothesis for Mathilda's test.

(ii) Find the p-value for the test.

(iii) State the conclusion of Mathilda's test in context. Justify your answer. [6]

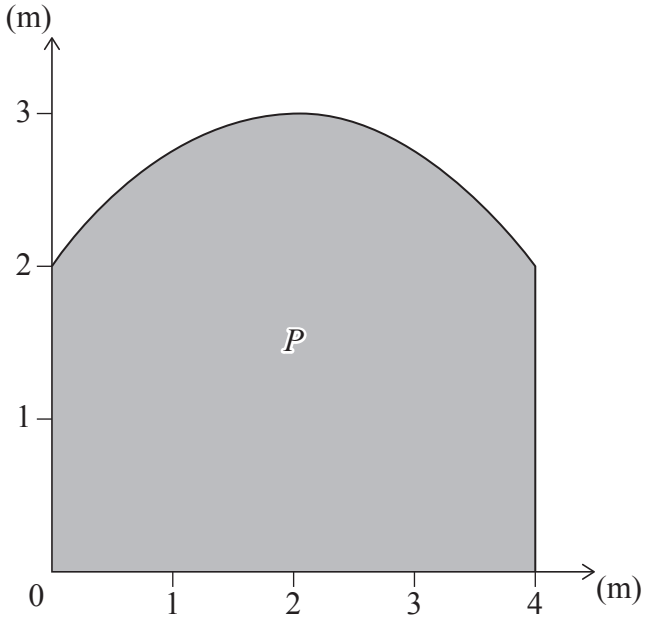
3. [Maximum mark: 18]

Demarius is designing a greenhouse. His design for a side wall of the greenhouse is modelled by the shaded region P, which is bounded by:

- the parabola $f(x) = -\frac{1}{4}x^2 + x + 2$, where $0 \le x \le 4$
- the lines $x = 0$ and $x = 4$, where $0 \le y \le 2$
- the line $y = 0$, where $0 \le x \le 4$.

This information is shown in the following diagram, where both axes represent length in metres.

diagram not to scale



The angle of inclination, θ, at any point along the curved top can be calculated using

$$\theta = \tan^{-1}(f'(x)).$$

(a) (i) Write down an expression for $f'(x)$.

(ii) Write down the value of $f'(0)$.

(iii) Hence, find the angle of inclination at $x = 0$. [3]

Demarius plans to have the side wall made out of plexiglass with a thickness of $3\,\text{mm}$.

(b) (i) Write down the integral that can be used to find the area of the side wall.

(ii) Show that the volume of one plexiglass side wall is $0.032\,\text{m}^3$. [4]

(This question continues on the following page)

(Question 3 continued)

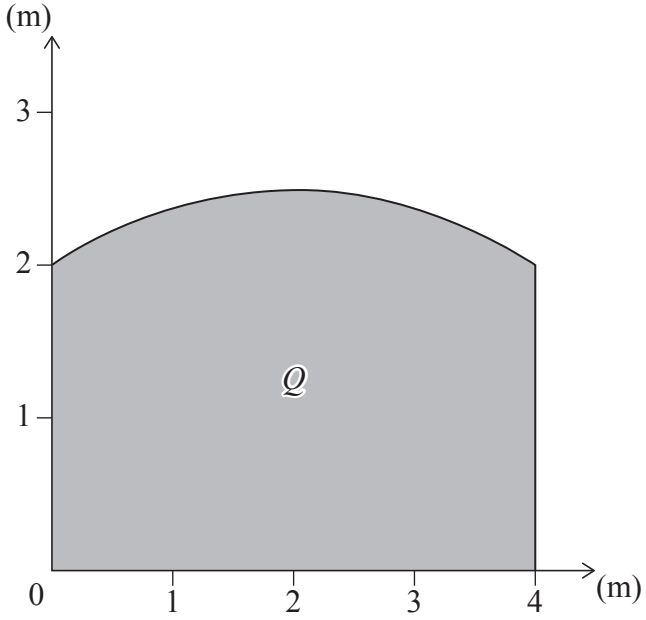
The mass per unit volume of plexiglass is $0.00119\,\text{kg/cm}^3$.

(c) Find the mass, in kilograms, of one plexiglass side wall. [2]

Demarius decides to reduce the maximum height of the side wall from $3\,\text{m}$ to $2.5\,\text{m}$. The shaded region, Q, in the following diagram shows his new design. The two vertical sides and the base in his design stay the same, but the curved top is now modelled by

$$g(x) = -\frac{1}{8}x^2 + \frac{1}{2}x + 2, \text{ where } 0 \le x \le 4.$$

diagram not to scale



Demarius claims that his new design will reduce the area of the side wall by 15%.

(d) (i) Find the area of the new design for the side wall in m^2.

(ii) Determine if Demarius's claim is correct. Justify your answer. [5]

Demarius plans to install a steel frame around the perimeter of the new side wall.

The length, l, of the curved top of the side wall can be found using the formula

$$l = \int_0^4 \sqrt{1 + \left(g'(x)\right)^2}\,\text{d}x.$$

(e) (i) Find l.

(ii) Hence, write down the perimeter of the side wall. [4]

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4. [Maximum mark: 16]

For this question, give all monetary answers to the nearest dollar ($).

When Kelley begins working at Waldron Industries, she opens an investment account. Waldron Industries will match any deposit Kelley makes into her investment account, up to a maximum of 4% of her monthly earnings. For example, if Kelley deposits $\$20$ into her investment account one month, then Waldron Industries will also deposit $\$20$ into her account.

Kelley earns an initial annual salary of $\$60\,000$, which she receives in equal monthly payments.

(a) Find the smallest deposit Kelley needs to make into her investment account each month to maximize the amount that Waldron Industries will match. [2]

Kelley decides to deposit exactly the amount from part (a) at the end of each month and makes the following assumptions:

- the investment account will have a nominal 9.5% annual rate of return, compounded monthly
- her salary will remain constant
- Waldron Industries will continue to match her deposits up to a maximum of 4% of her annual salary
- she will retire after working at Waldron Industries continuously for 40 complete years.

(b) Determine the total amount in Kelley's investment account when she retires, if her assumptions are true. [3]

(c) By considering the validity of two **different** assumptions made by Kelley, state, in context, why the amount in her investment account when she retires may be

(i) significantly **less** than your answer from part (b).

(ii) significantly **more** than your answer from part (b). [2]

After working at Waldron Industries for 10 complete years, Kelley decides to buy a house. She needs to withdraw $\$50\,000$ from her investment account to use as the initial payment on the house.

(d) Calculate how much **less** Kelley will have in her investment account when she retires after withdrawing the $\$50\,000$, given that she continues to deposit the amount from part (a) each month and her assumptions remain true. [6]

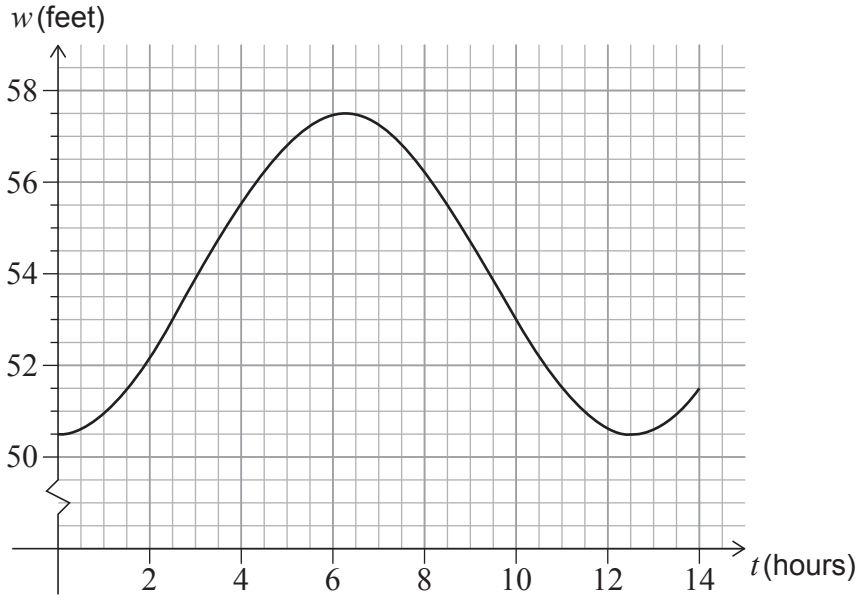
After Kelley withdraws the $\$50\,000$, she wants to increase her monthly deposits into the investment account so that she will still have at least $\$2\,000\,000$ when she retires.

(e) Calculate the minimum necessary increase in Kelley's monthly deposit, given her assumptions remain true. [3]

5. [Maximum mark: 15]

Cargo ships can only enter the Port of Savannah when the water is deep enough. The following graph shows a sinusoidal model of the depth of the water, w feet, on a given day at a time t hours after $00{:}00$ (midnight). The model begins at a minimum of $(0, 50.5)$ and its first maximum is at $(6.25, 57.5)$.

diagram not to scale



(a) Write down the period of the model. [1]

The equation of the model can be expressed in the form

$$w(t) = a\cos(bt) + d \text{ where } b > 0.$$

(b) Determine the equation of the model in this form. [5]

The depth of the water must be at least 53 feet for cargo ships to enter the port.

(c) Find how many hours after midnight $(t = 0)$ the first cargo ship can enter the port on the given day. [2]

(d) Hence, determine the total number of hours between midnight and $12{:}00$ (midday) $(t = 12)$ during which cargo ships can enter the port. [2]

(This question continues on the following page)

(Question 5 continued)

The *Aimmika* is a cargo ship heading for the Port of Savannah. At $t = 0$, the *Aimmika* needs to travel 550 miles to reach the entrance to the Port of Savannah. It travels at an average speed of 21 miles per hour. You can assume that the model from part (b) continues to correctly predict the water depth.

(e) Determine the minimum amount of time the *Aimmika* will need to wait at the entrance before entering the Port of Savannah. [5]

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References:

1. Verges, G., 2020. *Photograssed roll in studio*. [image online] Available at: https://www.gettyimages.co.uk/detail/photo/photograssed-roll-in-studio-royalty-free-image/1214217167 [Accessed 8 August 2025]. Source adapted.

Feverpitched, 2020. *Section of artificial turf grass isolated on white background*. [image online] Available at: https://www.gettyimages.co.uk/detail/photo/section-of-artificial-turf-grass-isolated-on-white-royalty-free-image/1205592797 [Accessed 8 August 2025]. Source adapted.