Diploma Programme
Programme du diplôme
Programa del Diploma

Mathematics: applications and interpretation
Higher level
Paper 2

15 May 2026

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

2 hours

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 HL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[110 marks]**.

2226 – 5226

14 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]

Give your answers to parts (a), (b) and (d) correct to two decimal places.

Suriyana invests GBP $14\,500$ into an account that pays a nominal annual interest rate of $2.3\,\%$, compounded monthly.

(a) Calculate the amount Suriyana will have in her account after three years. [3]

After the initial three years of investment, Suriyana starts making additional monthly payments of GBP 250 into the same account at the end of each month.

(b) Calculate the amount Suriyana will have in her account after two years of making additional monthly payments. [3]

(This question continues on the following page)

(Question 1 continued)

After these two years of making additional monthly payments, Suriyana decides to buy a used car. She notices that the costs of the used cars at a particular dealership form an arithmetic sequence. The following table shows the age of a car n and its cost u_n.

Age of car n (years)	**Cost of used car u_n (GBP)**
1	28 492
2	26 616
3	24 740
…	…

(c) (i) Find the formula for the n^{th} term of the sequence in the form $u_n = a + bn$, where $a, b \in \mathbb{Z}$.

(ii) Hence find the cost of a car that is 7 years old.

(iii) Comment on the limitations of the formula found in part (c)(i). [5]

Suriyana buys a used car of the least age possible using only the money from her account.

(d) Find the amount of money Suriyana has remaining in her account after purchasing the car. [3]

2. [Maximum mark: 12]

The human body temperature changes during the day, and these changes can be approximately modelled by a sine function.

Tom takes his temperature three times during a day and records the results in the table below.

Time	08:00	13:00	18:00
Body temperature (°C)	36.2	36.6	36.9

Tom decides to model his body temperature, T °C, using an equation of the form $T = a\sin(bt) + c$, where t is the time in hours after $00{:}00$ (midnight).

(a) Given that body temperature, T, has a period of 24 hours, find the value of b. [2]

(b) (i) Use the value of T at $18{:}00$ to show that $36.9 = -a + c$.

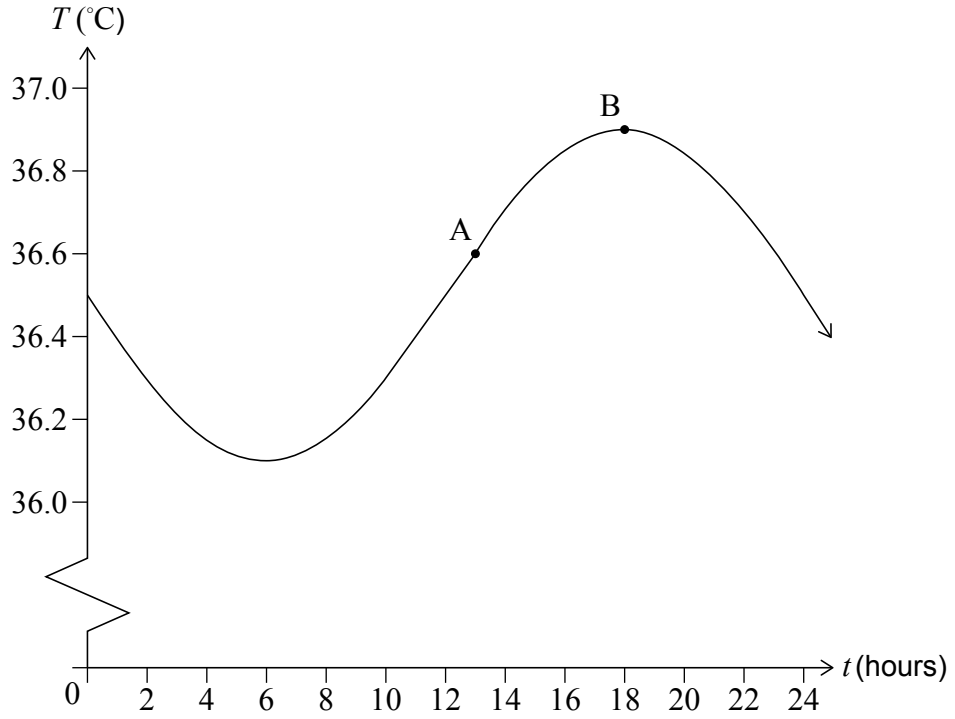
(ii) Use the value of T at $13{:}00$ to find a second equation for a and c.

(iii) Hence find the value for a and the value for c. [6]

(This question continues on the following page)

(Question 2 continued)

A graph of Tom's model with the points $\mathrm{A}(13, 36.6)$ and $\mathrm{B}(18, 36.9)$ is shown in the following diagram.



(c) Determine whether the point $(8, 36.2)$ will be above or below the curve. Justify your answer. [2]

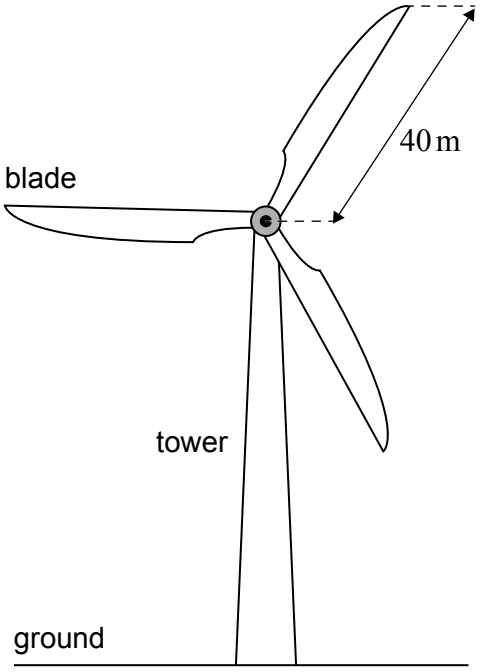
Research indicates that sleep is more likely to occur when the body temperature is decreasing.

(d) Using Tom's model, state the interval(s) during a 24-hour cycle when sleep is more likely to occur, according to this research. [2]

Blank page

3. [Maximum mark: 17]

A wind turbine is designed so that the rotation of the blades generates power. The turbine consists of a vertical tower and three blades, each of length $40\,\text{m}$. This is shown in the following diagram.



The relative power, P, generated by the wind turbine is modelled by

$$P = 0.245\pi r^2 v^3,$$

where r is the length of the wind turbine blades in metres, and v is the wind speed in metres per second.

(a) Find the relative power, P, generated by the wind turbine with a wind speed of $10\,\text{m s}^{-1}$. Give your answer in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [3]

(This question continues on the following page)

(Question 3 continued)

The Beaufort scale categorizes wind speeds from calm to hurricane. The following table shows the Beaufort scale categories with their relative descriptions and wind speeds.

Beaufort scale category	**Description**	**Wind speed ($\mathbf{m\,s^{-1}}$)**
0	Calm	0.2 or less
1	Light air	0.3 to 1.5
2	Light breeze	1.6 to 3.3
3	Gentle breeze	3.4 to 5.4
4	Moderate breeze	5.5 to 7.9
5	Fresh breeze	8.0 to 10.7
6	Strong breeze	10.8 to 13.8
7	Near gale	13.9 to 17.1
8	Gale	17.2 to 20.7
9	Strong gale	20.8 to 24.4
10	Storm	24.5 to 28.4
11	Violent storm	28.5 to 32.6
12	Hurricane	32.7 or more

In the table the wind speeds are given **correct to one decimal place**.

(b) (i) Show that the minimum possible relative power produced by this wind turbine in a category 6 wind is 1.53×10^6, correct to three significant figures.

(ii) Find the greatest possible difference in relative power produced in category 6 winds. [5]

(This question continues on the following page)

(Question 3 continued)

A second wind turbine can only operate in wind speeds of $3.35 \leq v < 17.15$.

The relative power, P, generated by the second wind turbine can be modelled by

$$P = 4.48v^4 - 236v^3 + 3570v^2 - 8740v - 735,$$

where v is the wind speed in metres per second.

(c) For this second wind turbine,

(i) find $\frac{\mathrm{d}P}{\mathrm{d}v}$.

(ii) find the value of v for which $\frac{\mathrm{d}P}{\mathrm{d}v} = 0$.

(iii) state, in context, what this value of v represents. [6]

(d) Find the range of wind speeds that will allow this wind turbine to generate a relative power of at least $90\,000$. Give your answer in the form $a \leq v < b$, where a and b are given correct to two decimal places. [3]

4. [Maximum mark: 13]

Anne and Sofia both take part in a series of three kilometre cross-country races. The times, in minutes, taken by Anne to complete her races follow a normal distribution with a mean of 14.2 and a standard deviation of 2.1.

(a) Find the probability that

(i) Anne completes a race in less than 14 minutes.

(ii) Anne completes each of her next three races in less than 14 minutes. [4]

(b) State one assumption you are making in the calculation in part (a)(ii). [1]

Sofia completes one race in 13.2 minutes.

(c) Find the probability that she beats Anne in that race. [2]

Let the random variable A denote Anne's time to complete a race and the random variable S denote Sofia's time to complete a race. Both times are measured in minutes.

It is given that $S \sim \mathrm{N}(13.4, 1.7^2)$.

Let $D = A - S$.

(d) State, in context, what is meant by the event $D > 0$. [1]

(e) Find

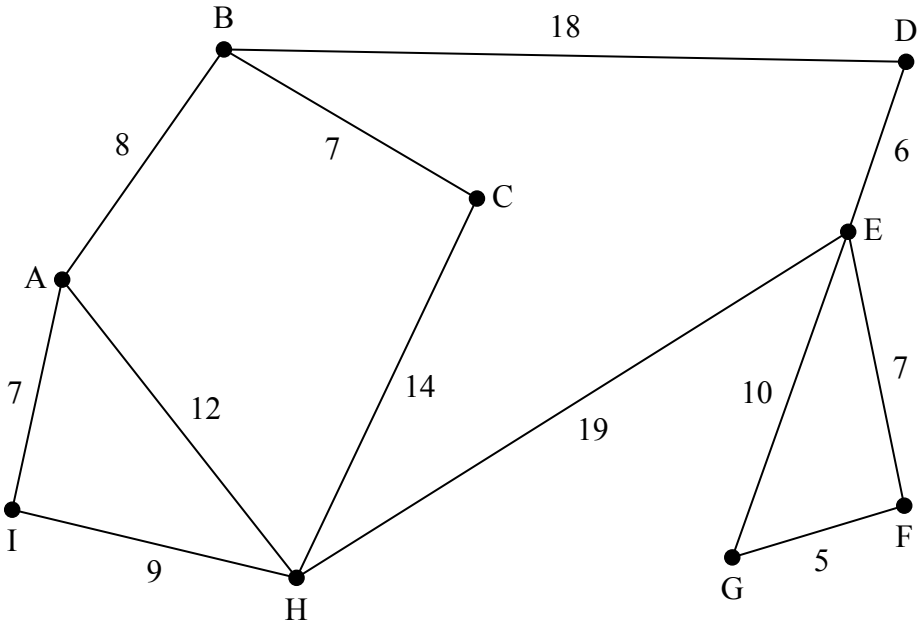
(i) $\mathrm{E}(D)$.

(ii) $\mathrm{Var}(D)$. [3]

(f) Find the probability that Anne will beat Sofia in a randomly selected race. [2]

5. [Maximum mark: 12]

An inspector, Eduardo, needs to check the condition of the network of roads shown in the following weighted graph. To do so he walks down each road at least once. The weights on the graph represent the time, in minutes, it takes to check a road. If Eduardo has to walk any road twice, his second walk only takes half the time it took when checking.



The sum of the times on all the edges is 122 minutes.

Eduardo begins and ends his inspection at vertex A.

(a) (i) Find the minimum possible time required for Eduardo to complete his inspection.

(ii) Write down one route he could take. [3]

A new road is built connecting vertices C and D. The time taken to check this road is 14 minutes.

(b) (i) Find which roads now need to be repeated for Eduardo to complete his inspection in the minimum possible time. Justify your answer.

(ii) Write down the minimum possible time the inspection could take. [6]

Eduardo can now begin and end his inspection at any two of the vertices shown on the graph.

(c) (i) State which vertices he should choose to complete his inspection in the minimum possible time.

(ii) Find the amount of time he saves with his new route, compared to when he had to begin and end his route at vertex A. [3]

6. [Maximum mark: 13]

A coordinate system is constructed with the positive x direction due east and the positive y direction due north. The units of the coordinate system are kilometres.

A boat, B, is travelling with a velocity $\begin{pmatrix} a \\ -10 \end{pmatrix}$ kilometres per hour and a speed of $26\,\mathrm{km\,h^{-1}}$.

(a) Find

(i) the value of a, given that $a > 0$.

(ii) the bearing on which the boat is travelling. [5]

A harbour, H, is situated at a point with coordinates $(5, 20)$. B left H at $08{:}00$.

(b) Find the coordinates of B's position at $11{:}00$. [2]

At $11{:}00$, B changes direction and travels due east at $26\,\mathrm{km\,h^{-1}}$ for two hours until it reaches a port, P.

(c) Find the distance of P from H. [3]

A second boat leaves H and travels directly to P, with a speed of $40\,\mathrm{km\,h^{-1}}$. It arrives at P at the same time as B.

(d) Find the time at which the second boat left H. Give your answer to the nearest minute. [3]

7. [Maximum mark: 12]

A matrix, $\boldsymbol{A}$, has the form $\begin{pmatrix} a & 2 \\ 0 & 1 \end{pmatrix}$, where $a > 0$.

(a) Find an expression for

(i) $\boldsymbol{A}^2$.

(ii) $\boldsymbol{A}^3$. [3]

A triangle, T, is transformed to triangle T_n by the matrix $\boldsymbol{A}^n$.

Triangle T has an area of 16 units^2. Triangle T_3 has an area of 2 units^2.

(b) Show that $a = 0.5$. [3]

The matrix $\boldsymbol{A}^n$ can be written in the form $\begin{pmatrix} p_n & q_n \\ 0 & 1 \end{pmatrix}$, where $n \in \mathbb{Z}^+$.

(c) Assuming the patterns seen in part (a) continue,

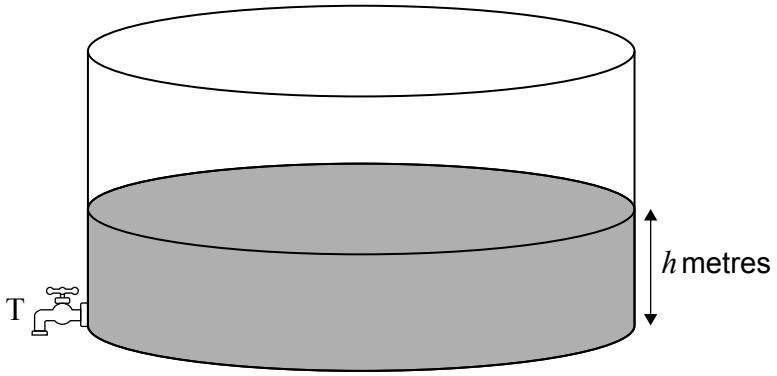
(i) write down an expression for p_n.

(ii) show that $q_n = 4(1 - 0.5^n)$. [3]

The point $(128, 96)$ lies in T. Its image in T_n is at $(383.75, 96)$.

(d) Find the value of n. [3]

8. [Maximum mark: 17]



A farmer turns on a tap, T, placed at the base of a cylindrical water tank.

At time t, measured in minutes since the tap was turned on, the volume of water in the tank is $V\,\mathrm{m}^3$ and the height of the water is $h\,\mathrm{m}$.

Water flows out of the tank at a rate $\frac{\mathrm{d}V}{\mathrm{d}t}$ where $\frac{\mathrm{d}V}{\mathrm{d}t}$ is proportional to h.

When $h = 0.5$, water flows out at a rate of $0.4\,\mathrm{m}^3$ per minute.

(a) Find an equation for $\frac{\mathrm{d}V}{\mathrm{d}t}$ in terms of h. [3]

With tap T still on, at $t = 5$ the farmer begins to fill the tank with water from a hose pipe at a constant rate of $2.0\,\mathrm{m}^3$ per minute.

(b) Given that the base of the water tank has an area of $16\,\mathrm{m}^2$,
show that for $t \geq 5$, $\frac{\mathrm{d}h}{\mathrm{d}t} = 0.125 - 0.05h$. [4]

At $t = 5$, $h = 0.5$.

(c) Use separation of variables to find an equation for h in terms of t, for $t \geq 5$. [8]

(d) Describe how the height of the water in the tank changes for $t > 5$. [2]