IB Mathematics AI SL - Prediction Exams
May 2025 - Paper 1

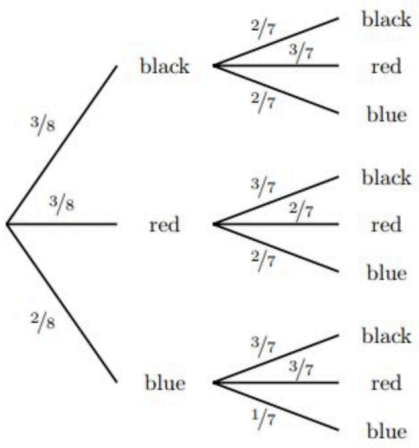
Paper 1 | 12 questions | 90 mins | 80 marks

Question 1

CALCULATOR | Easy

[Maximum mark: 4]

Oliver has 8 pens in his desk drawer, three black, three red and two blue. He randomly selects two pens, one after the other, from the drawer. The following tree diagram shows all the possible outcomes of taking the two pens.



(a) Find the probability that the second pen is red. [2]

(b) Given that the second pen is red, find the probability that the first pen is **not** red. [2]

Question 2

CALCULATOR

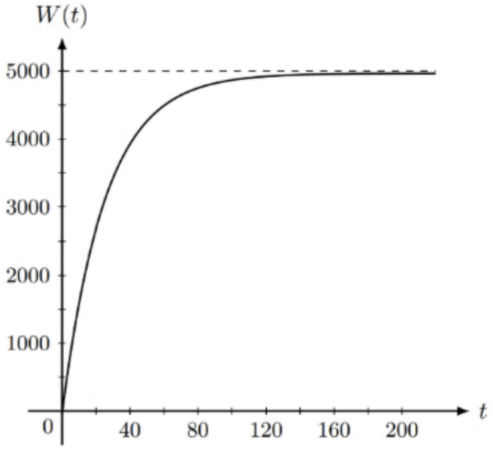
Easy

[Maximum mark: 6]

A water tank has a float valve that allows water to enter while the tank is not full. Over time, the float valve reduces the water flow until the tank is almost at its maximum capacity.

The amount of water in the tank, in litres, is given by the function $W(t) = 5\,000 - C\,(1.04^{-t})$

where t is minutes after the tank starts to fill.



(a) Given that the tank was initially empty, find the value of C. [2]

(b) State what the horizontal asymptote represents in the context of the question. [1]

(c) Find the total amount of water in the tank after one and half hours. Give your answer in cubic metres. [3]

Question 3

CALCULATOR

Easy

[Maximum mark: 7]

An e-commerce company has eight distribution centres and wants to know if there is a relationship between the number of employees at each centre and the average delivery time of sales. The data involved are summarized in the following table.

Distribution Centre	Number of employees x	Average delivery time, y (hours)
1	689	38.9
2	531	43.2
3	451	67.3
4	395	71.8
5	735	32.5
6	490	65.2
7	502	51.7
8	623	40.1

(a) From the data for these eight centres

(i) Calculate the Pearson's product-moment correlation coefficient, r.

(ii) Describe the correlation between the number of employees and the average delivery time. [3]

(b) Find the equation of the regression line, y on x, in the form $y = mx + c$. Give the values of m and c to 3 significant figures. [2]

The company opened a new distribution centre recently with 425 employees.

(c) Use your regression line, the solution to part (b), to estimate the average delivery time for this new distribution centre. [2]

Question 4

CALCULATOR

Medium

[Maximum mark: 7]

A'ja is a keen basketball player. Each time A'ja attempts a free throw, she has a 75% chance of scoring. Suppose she practises 120 free throws and counts the total number of free throws she makes. It can be assumed that the probability of scoring on any given free throw is independent of her other previous free throw attempts.

(a) (i) Write down the mean number of free throws she makes.

(ii) Calculate the variance of the number of free throws she makes. [4]

(b) Find the probability that the number of free throws she makes is less than one standard deviation away from the mean. [3]

Question 5

CALCULATOR

Easy

[Maximum mark: 6]

Bruno rides his bike to school each morning. During the first minute, he travels 160 metres. In each subsequent minute, he travels 80 % of the distance travelled during the previous minute.

The distance from his home to school is 750 metres. Bruno leaves his house at 8:30 am and must be at school by 8:40 am.

(a) Verify that Bruno will not arrive at school on time. [3]

Bruno realises that if he can increase the distance he travels each minute, from 80 % of the distance travelled during the previous minute to k %, he will make it to school on time.

(b) Determine the minimum value of k, given that Bruno still travels 160 m in the first minute. [3]

Question 6

CALCULATOR

Medium

[Maximum mark: 7]

Jack, a volleyball player, serves the ball with a trajectory modelled by the function

$$h_1(x) = -0.12x^2 + x + 0.725$$

where h is the height of the ball above the ground, in metres, and x is the horizontal distance from the serving point, in metres.

(a) Find the height of the ball when Jack makes his serve (i.e. the height above the ground at the point where he connects with the ball). [2]

Unfortunately, the serve is short and misses. For his next attempt, Jack will serve the ball c metres higher at the serving point, so that the ball has the same trajectory (only the vertical height changes, increasing by c metres).

(b) Write down a second function, $h_2(x)$, modelling the new path of the ball in terms of x and c. [1]

(c) (i) Calculate the value of c, if the horizontal distance is 10 metres from the serving point to the point where the ball would hit the ground.

(ii) Determine the vertical height of the ball from which Jack makes his successful serve. [4]

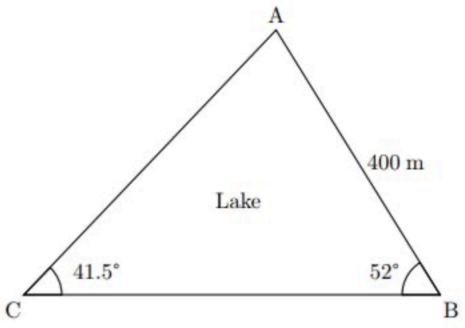
Question 7

CALCULATOR

Medium

[Maximum mark: 8]

A walking trail surrounding a man-made lake in a park is in the shape of a triangle, ABC, as shown in the following diagram. The side length AB is 400 m. Angle $A\hat{B}C$ is 52° and angle $A\hat{C}B$ is 41.5°.



(a) Calculate the side length BC. [5]

(b) Hence, calculate the area of the man-made lake surrounded by the walking trail, rounding your answer **to the nearest square metre**. [3]

Question 8

CALCULATOR Medium

[Maximum mark: 7]

Give all answers for this question to 2 decimal places, unless otherwise stated.

On 1 January 2024, Emily invests \$600 000 in a savings account which pays a nominal annual interest rate of 4.5%, compounded annually.

(a) Determine the amount of money that will be in the account after 12 years. [3]

After these 12 years, Emily is planning to retire and place the money she has saved into an annuity fund which pays a nominal annual interest rate of 3.5%, compounded monthly.

Emily wants to withdraw money from this account at the end of each month.

(b) (i) Calculate the amount Emily can withdraw at the end of each month if she wants the money to last for 18 years after her retirement.

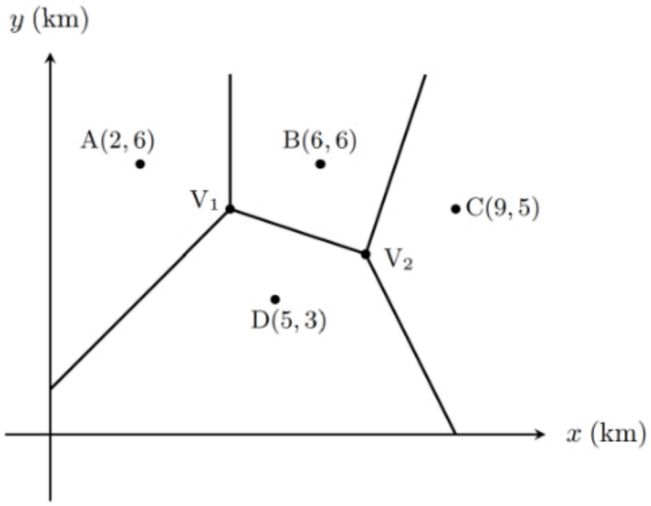
(ii) Find how many **complete months**, counted from 1 January 2036, it will take for the balance of the fund to fall below \$500 000. [4]

Question 9

CALCULATOR Medium

[Maximum mark: 9]

Consider the Voronoi diagram below for a town centre that contains four coffee shops A, B, C, and D.



The equation of the perpendicular bisector between sites B and C is $y = 3x - 17$. The coordinates of the midpoint between C and D is (7,4).

(a) Determine the equation of the perpendicular bisector between C and D. [3]

(b) Hence, determine the coordinates of the intersection point V_2. [3]

The perpendicular bisectors of AB and AD intersect at the point $V_1(4,5)$, which is 2.236 km from location D, correct to 4 significant figures. A new coffee shop will be built at either V_1 or V_2.

(c) Given that the new shop is to be as far away as possible from an existing coffee shop, determine which of the locations the new coffee shop should be built at. [3]

Question 10

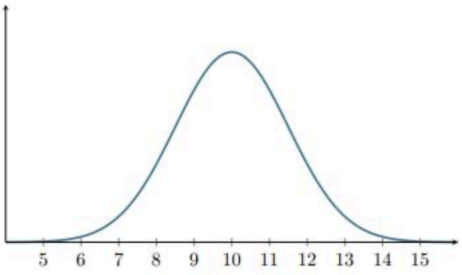
CALCULATOR

Medium

[Maximum mark: 6]

The number of hours that a fully charged laptop battery lasts is normally distributed with a mean of 10 hours and a standard deviation of 1.5 hours.

(a) On the following diagram, shade the region representing the probability that after a full charge, the battery lasts less than 8 hours. [1]



The value a hours is exactly two standard deviations below the mean.

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

(ii) Find the probability that a full charge lasts between a hours and 8 hours. [3]

The manufacturer states that 25% of batteries will last at least x hours when fully charged.

(c) Find the value of x. [2]

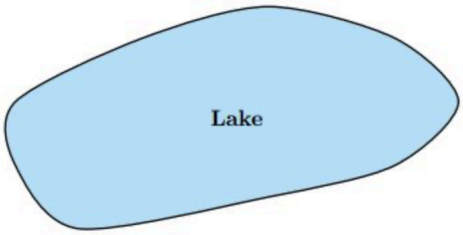
Question 11

CALCULATOR

Medium

[Maximum mark: 5]

A town's water distribution system supplies water from a lake. The operating cost is \$3.25 per cubic metre of water. The following table shows an estimate of the areas of horizontal cross-sections at 50-metre intervals, of the water in the lake, where the depth is measured in metres below the ground level.



Depth (m)	0	50	100	150	200	250	300
Area (m^2)	623	592	560	568	537	519	494

(a) Use the trapezoidal rule to find an estimate of the volume of water in the lake. [3]

(b) Hence or otherwise, estimate the operating cost of extracting all the water. [2]

Question 12

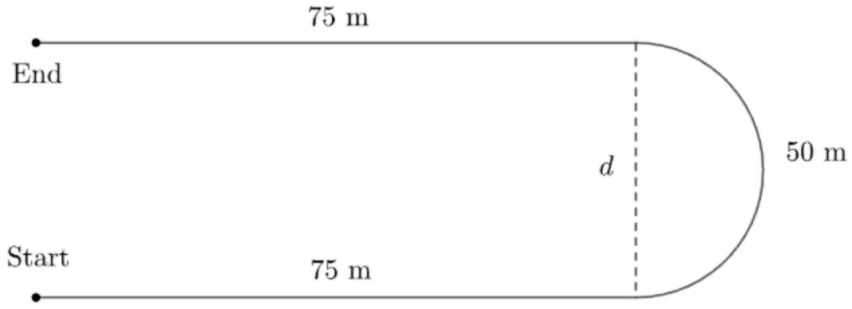
CALCULATOR Hard

[Maximum mark: 8]

Samira is designing a running track for the 200 metre race of her school sports day.

The 200 metre track is formed by two straight lines of 75 m each and a semi-circular part of 50 m.

Here is her initial design.



d is the diameter of the semi-circular part of the track.

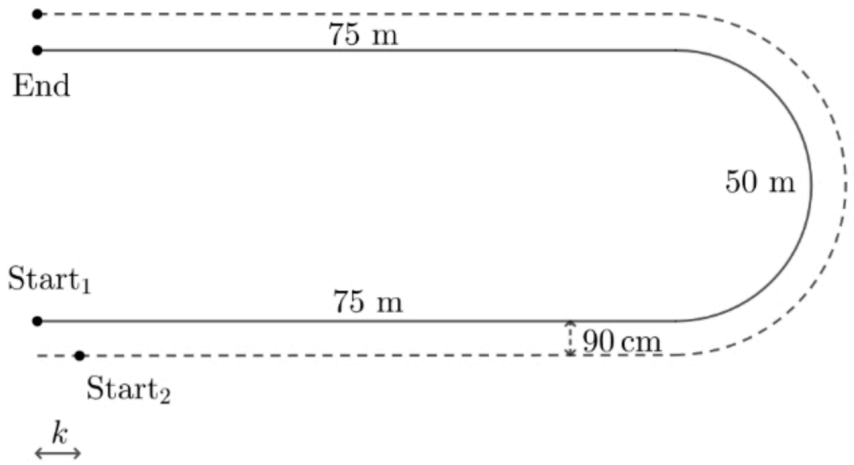
(a) Find the value of d. [2]

Samira wants to add a second lane to the track.

The width of each lane is 90 centimetres.

The runner in lane 1 starts at Start_1 and follows the solid line around the track, while the runner in lane 2 starts at Start_2 and follows the dashed line around the track.

This is shown below.



In order to make sure both lanes are exactly 200 metres in length, Samira must move Start_2 forward k metres.

(b) Find the value of k. [6]