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# IB Demystified

## Mathematics: Applications and Interpretation HL

Paper 1 | Mock Examination

### Mock Exam 2

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**Calculator:** A graphic display calculator (GDC) is required

**Time allowed:** 2 hours

**Maximum mark:** 110 marks

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**Candidate name:** .....

**Session number:** .....

**Date:** .....

## Information for Candidates

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- A graphic display calculator is required throughout this paper.
- You may use one clean copy of the *Mathematics: Applications and Interpretation HL* formula booklet.
- Attempt every question. Write each response in the working space provided for that question.
- Unless a question states otherwise, give numerical answers either exactly or rounded to three significant figures.
- Where a question concerns an amount of money, give your answer to two decimal places unless told otherwise.
- Any answer obtained from a calculator must be accompanied by appropriate supporting working.
- If you use a graph to reach an answer, include a sketch or a clear description of the graphing method you used.
- Answers stated without supporting working may not receive full marks.
- The maximum mark for this paper is **110 marks**. The time allowed is **2 hours**.

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*Full marks are not necessarily awarded for a correct answer with no working. Where an answer is incorrect, some marks may be awarded for a correct method, provided this is shown by written working. You are therefore advised to show all working.*

**Question 1**

**[Maximum mark: 6]**

The number of members,  $N$ , of a new sports club is modelled by  $N(t) = 1200(1.18)^t$ , where  $t$  is the time in years since the club opened.

- (a) Write down the number of members when the club opened. [1]
- (b) Find the number of members after 6 years. [2]
- (c) Find the number of years it takes for the membership to first exceed 5000. [3]

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**Question 2**

**[Maximum mark: 7]**

chemist records the mass,  $m$  grams, of a sample of a compound at time  $t$  hours.

$t$ (hours)	1	2	3	4	5	6
$m$ (grams)	84	71	59	50	42	35

The chemist models the data with an exponential function of the form  $m = ab^t$ .

- (a) Use your calculator to find the value of  $a$  and the value of  $b$ . [2]
- (b) Write down the value of the coefficient of determination  $R^2$ . [1]
- (c) Use your model to predict the mass of the sample after 8 hours. [2]
- (d) Explain why this model should not be used to predict the mass after 30 hours. [2]

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■ Question 4

[Maximum mark: 7]

triangular sail has corners at the points  $A(2, 1, 5)$ ,  $B(6, 4, 2)$  and  $C(3, 7, 4)$ , where distances are measured in metres.

- (a) Find the vector  $\overrightarrow{AB}$  and its magnitude. [2]
- (b) Find the size of the angle  $B\hat{A}C$ . [3]
- (c) Find the area of the sail. [2]

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**Question 5**

**[Maximum mark: 8]**

machine is set to fill bottles with 500 ml of juice. A quality inspector takes a random sample of 12 bottles and finds a sample mean of 497.5 ml and a sample standard deviation  $s_{n-1} = 4.8$  ml. The inspector tests, at the 5% significance level, whether the machine is underfilling the bottles.

- (a) State the null and alternative hypotheses. [1]
- (b) Find the  $p$ -value for this test. [3]
- (c) State, with reason, the conclusion of the test. [2]
- (d) State one assumption required for this test to be valid, and describe what a Type I error would mean in this context. [2]

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**Question 6**

**[Maximum mark: 6]**

our mobile-coffee vans operate from fixed points  $P(2, 2)$ ,  $Q(8, 3)$ ,  $R(5, 9)$  and  $S(1, 7)$ , where coordinates are in kilometres. Each customer is served by the nearest van.

- (a) Find the equation of the boundary between the regions served by van  $P$  and van  $Q$ . [3]
- (b) A customer is at the point  $T(4, 8)$ . Determine, by calculation, whether van  $P$  or van  $S$  should serve this customer. [2]
- (c) Interpret your answer to part (b) in context. [1]

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**Question 7**

**[Maximum mark: 7]**

The height of water in a harbour,  $h$  metres, is modelled by

$$h(t) = 5 + 2.8 \sin\left(\frac{\pi}{6}t\right), \quad t \geq 0,$$

where  $t$  is the time in hours after midnight.

- (a) Write down the maximum and minimum heights of the water. [2]
- (b) Find the two times during the first 12 hours at which the height is 6.5 metres. [2]
- (c) Find the average height of the water during the first 5 hours. [3]

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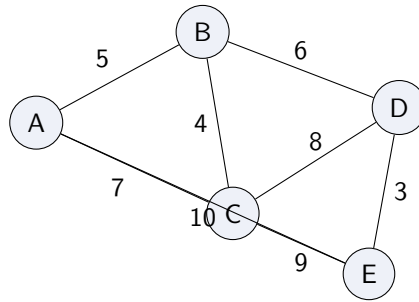




**Question 10**

**[Maximum mark: 9]**

A street-cleaning vehicle must travel along every road in a small network. The graph shows the roads connecting five junctions and their lengths in metres.



- (a) Write down the degree of each junction and hence explain why the vehicle cannot travel along every road exactly once and return to its starting point. [3]
- (b) The vehicle starts and finishes at the same junction. Find the length of the shortest possible route that travels along every road at least once. [4]
- (c) State which roads must be travelled twice in such a route. [2]

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**Question 13**

**[Maximum mark: 7]**

teacher records the number of hours,  $x$ , that seven students spent revising and their score,  $y$ , on a test.

$x$	2	3	5	6	8	9	11
$y$	35	41	52	58	70	68	82

- (a) Find Pearson's product–moment correlation coefficient,  $r$ . [2]
- (b) Find the equation of the regression line of  $y$  on  $x$ . [2]
- (c) Use your line to estimate the score of a student who revised for 7 hours. [2]
- (d) Comment on the reliability of your estimate in part (c). [1]

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**Question 14**

**[Maximum mark: 14]**

hot-water tank cools so that its temperature,  $T$  degrees Celsius,  $t$  minutes after the heater is switched off, is modelled by

$$T(t) = 20 + 65 e^{-0.08t}, \quad t \geq 0.$$

- (a) (i) Write down the temperature at the moment the heater is switched off. [1]
- (a) (ii) Find the temperature after 15 minutes. [2]
- (b) Find the time taken for the temperature to fall to  $30^\circ\text{C}$ . [3]
- (c) Find the rate at which the temperature is changing when  $t = 10$ , and state what the sign of your answer means. [3]
- (d) Find the average temperature of the water during the first 20 minutes. [3]
- (e) State, with a reason, the temperature that this model predicts the water will approach after a long time, and explain why this is a limitation of the model. [2]

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End of Mock Exam 2