

A Level Mathematics A
H240/02 Pure Mathematics and Statistics

Question Set 1

- 1
- (a) Express $2x^2 - 12x + 23$ in the form $a(x + b)^2 + c$. [4]
- (b) Use your result to show that the equation $2x^2 - 12x + 23 = 0$ has no real roots. [1]
- (c) Given that the equation $2x^2 - 12x + k = 0$ has repeated roots, find the value of the constant k . [2]

2

The points A and B have position vectors $\begin{pmatrix} 1 \\ -2 \\ 5 \end{pmatrix}$ and $\begin{pmatrix} -3 \\ -1 \\ 2 \end{pmatrix}$ respectively.

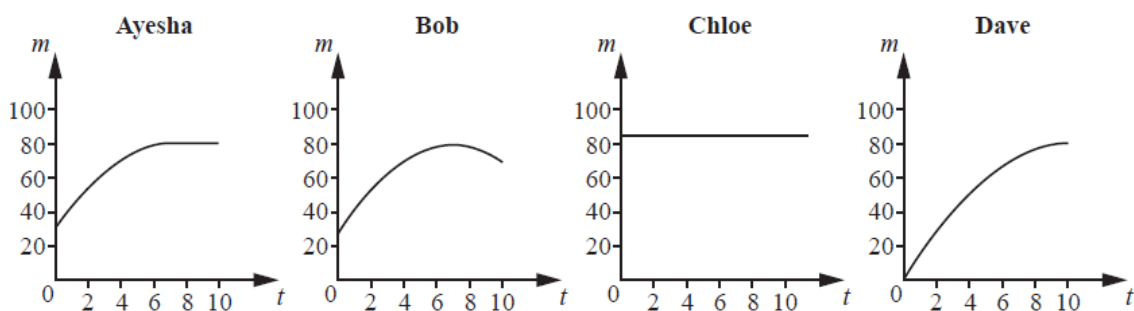
- (a) Find the exact length of AB . [2]
- (b) Find the position vector of the midpoint of AB . [1]

The points P and Q have position vectors $\begin{pmatrix} 1 \\ 2 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 5 \\ 1 \\ 3 \end{pmatrix}$ respectively.

- (c) Show that $ABPQ$ is a parallelogram. [3]

3

Ayesha, Bob, Chloe and Dave are discussing the relationship between the time, t hours, they might spend revising for an examination, and the mark, m , they would expect to gain. Each of them draws a graph to model this relationship for himself or herself.



- (a) Assuming Ayesha's model is correct, how long would you recommend that she spends revising? [1]
- (b) State one feature of Dave's model that is likely to be unrealistic. [1]
- (c) Suggest a reason for the shape of Bob's graph as compared with Ayesha's graph. [1]
- (d) What does Chloe's model suggest about her attitude to revision? [1]

4

Prove that $\sin^2(\theta + 45)^\circ - \cos^2(\theta + 45)^\circ \equiv \sin 2\theta^\circ$. [4]

5 Charlie claims to have proved the following statement.

“The sum of a square number and a prime number cannot be a square number.”

(a) Give an example to show that Charlie’s statement is not true. [1]

Charlie’s attempt at a proof is below.

Assume that the statement is not true.

⇒ There exist integers n and m and a prime p such that $n^2 + p = m^2$.

⇒ $p = m^2 - n^2$

⇒ $p = (m - n)(m + n)$

⇒ p is the product of two integers.

⇒ p is not prime, which is a contradiction.

⇒ Charlie’s statement is true.

(b) Explain the error that Charlie has made. [1]

(c) Given that 853 is a prime number, find the square number S such that $S + 853$ is also a square number. [4]

6 In this question you must show detailed reasoning.

A curve has equation $y = \frac{\ln x}{x}$.

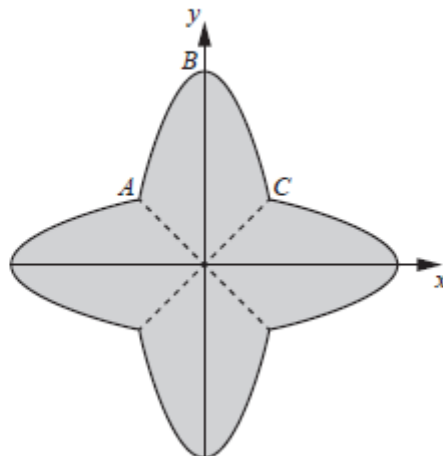
(a) Find the x -coordinate of the point where the curve crosses the x axis. [2]

(b) The points A and B lie on the curve and have x coordinates 2 and 4. Show that the line AB is parallel to the x -axis. [2]

(c) Find the coordinates of the turning point on the curve. [4]

(d) Determine whether this turning point is a maximum or a minimum. [5]

7 The diagram shows a part ABC of the curve $y = 3 - 2x^2$, together with its reflections in the lines $y = x$, $y = -x$ and $y = 0$.



Find the area of the shaded region. [7]

Total Marks for Question Set 1: 47 Marks

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