

Mathematics

Higher level

Paper 2

Wednesday 13 May 2015 (afternoon)

Candidate session number

2 hours

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Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper.
- Section A: answer all questions in the boxes provided.
- Section B: answer all questions in the answer booklet provided. Fill in your session number on the front of the answer booklet, and attach it to this examination paper and your cover sheet using the tag 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 HL and further mathematics HL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[120 marks]**.



3. [Maximum mark: 5]

(a) Sketch the graph of $y = (x - 5)^2 - 2|x - 5| - 9$, for $0 \leq x \leq 10$. [3]

(b) Hence, or otherwise, solve the equation $(x - 5)^2 - 2|x - 5| - 9 = 0$. [2]



Do **not** write solutions on this page.

Section B

Answer **all** questions in the answer booklet provided. Please start each question on a new page.

10. [Maximum mark: 12]

Farmer Suzie grows turnips and the weights of her turnips are normally distributed with a mean of 122 g and standard deviation of 14.7 g.

- (a) (i) Calculate the percentage of Suzie's turnips that weigh between 110 g and 130 g.
- (ii) Suzie has 100 turnips to take to market. Find the expected number weighing more than 130 g.
- (iii) Find the probability that at least 30 of the 100 turnips weigh more than 130 g. [6]

Farmer Ray also grows turnips and the weights of his turnips are normally distributed with a mean of 144 g. Ray only takes to market turnips that weigh more than 130 g. Over a period of time, Ray finds he has to reject 1 in 15 turnips due to their being underweight.

- (b) (i) Find the standard deviation of the weights of Ray's turnips.
- (ii) Ray has 200 turnips to take to market. Find the expected number weighing more than 150 g. [6]

11. [Maximum mark: 15]

A curve is defined by $x^2 - 5xy + y^2 = 7$.

- (a) Show that $\frac{dy}{dx} = \frac{5y - 2x}{2y - 5x}$. [3]
- (b) Find the equation of the normal to the curve at the point (6, 1). [4]
- (c) Find the distance between the two points on the curve where each tangent is parallel to the line $y = x$. [8]



Do **not** write solutions on this page.

12. [Maximum mark: 15]

A particle moves in a straight line, its velocity $v \text{ ms}^{-1}$ at time t seconds is given by $v = 9t - 3t^2$, $0 \leq t \leq 5$.

At time $t = 0$, the displacement s of the particle from an origin O is 3 m.

- (a) Find the displacement of the particle when $t = 4$. [3]
- (b) Sketch a displacement/time graph for the particle, $0 \leq t \leq 5$, showing clearly where the curve meets the axes and the coordinates of the points where the displacement takes greatest and least values. [5]

For $t > 5$, the displacement of the particle is given by $s = a + b \cos \frac{2\pi t}{5}$ such that s is continuous for all $t \geq 0$.

- (c) Given further that $s = 16.5$ when $t = 7.5$, find the values of a and b . [3]
- (d) Find the times t_1 and t_2 ($0 < t_1 < t_2 < 8$) when the particle returns to its starting point. [4]

13. [Maximum mark: 18]

The equations of the lines L_1 and L_2 are

$$L_1 : \mathbf{r}_1 = \begin{pmatrix} 1 \\ 2 \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} -1 \\ 1 \\ 2 \end{pmatrix}$$

$$L_2 : \mathbf{r}_2 = \begin{pmatrix} 1 \\ 2 \\ 4 \end{pmatrix} + \mu \begin{pmatrix} 2 \\ 1 \\ 6 \end{pmatrix}.$$

- (a) Show that the lines L_1 and L_2 are skew. [4]
- (b) Find the acute angle between the lines L_1 and L_2 . [4]
- (c) (i) Find a vector perpendicular to both lines.
- (ii) Hence determine an equation of the line L_3 that is perpendicular to both L_1 and L_2 and intersects both lines. [10]



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Answers written on this page
will not be marked.



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