Question 1 — Vectors in the Plane **(7 marks)**

Relative to a fixed origin O, the points A, B and C have position vectors $\mathbf{a} = 3\mathbf{i} + \mathbf{j}$, $\mathbf{b} = 7\mathbf{i} + 7\mathbf{j}$ and $\mathbf{c} = 11\mathbf{i} + 13\mathbf{j}$ respectively.

(a) Find the vectors AB and AC, each expressed in the form $x\mathbf{i} + y\mathbf{j}$. (2 marks)

(b) Hence show that the points A, B and C are collinear. (2 marks)

(c) State the ratio AB : BC. (1 mark)

(d) D is the point such that OABD, in that order, is a parallelogram. Find the position vector of D. (2 marks)

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Question 2 — Matrices **(8 marks)**

Let A be the matrix with rows (2, 1) and (3, 4), that is, A = [[2, 1], [3, 4]].

(a) Find the determinant of A. (1 mark)

(b) Hence write down A^{-1}, the inverse of A. (2 marks)

(c) The simultaneous equations 2x + y = 7 and 3x + 4y = 18 can be written in matrix form as A[x; y] = [7; 18]. Use A^{-1} to solve this system for x and y. (3 marks)

(d) Show that the point (1, −1) is invariant under the transformation represented by A, that is, show that A maps (1, −1) to itself. (2 marks)

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Question 3 — Geometry and Trigonometry **(7 marks)**

In triangle ABC, AB = 8 cm, AC = 5 cm and angle BAC = 60°.

(a) Use the cosine rule to find the exact length of BC. (3 marks)

(b) Show that $\sin(ABC) = \frac{5\sqrt{3}}{14}$. (2 marks)

(c) Hence, or otherwise, find the exact area of triangle ABC. (2 marks)

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