

Edexcel IAL M1 Vectors in Mechanics Practice Exam

Pearson Edexcel International A Level Mathematics · 11 questions · 57 marks

Name _____

Date _____

Score / 57

- Answer every question. Show your working: most marks are for method.
- Calculator allowed.
- Topics: Vectors in mechanics.
- The mark scheme is a separate free PDF: [alevelmathrevision.com/alevel-frontend/downloads/practice-exams/ial/edexcel-ial-m1-vectors-in-mechanics-practice-exam-mark-scheme.pdf](https://www.alevelmathrevision.com/alevel-frontend/downloads/practice-exams/ial/edexcel-ial-m1-vectors-in-mechanics-practice-exam-mark-scheme.pdf)

1. Three forces $(2\mathbf{i} + 3\mathbf{j})$ N, $(-5\mathbf{i} + \mathbf{j})$ N and $(p\mathbf{i} + q\mathbf{j})$ N act on a particle, which is in equilibrium. [3]
Find the value of p and the value of q .

2. A force $\mathbf{F} = (5\mathbf{i} - 12\mathbf{j})$ N acts on a particle. [4]
(a) Find the magnitude of $\mathbf{F}$. [2]
(b) Find the angle between the line of action of $\mathbf{F}$ and the vector $\mathbf{i}$. [2]

3. [In this question $\mathbf{i}$ and $\mathbf{j}$ are horizontal unit vectors due east and due north respectively.] [4]
A ship moves with constant velocity $(-6\mathbf{i} + 8\mathbf{j})$ km h⁻¹.
(a) Find the speed of the ship. [2]
(b) Find the bearing on which the ship is moving. [2]

4. A particle of mass 2.5 kg moves under the action of two forces, $\mathbf{F}_1 = (3\mathbf{i} - 2\mathbf{j})$ N and $\mathbf{F}_2 = (4.5\mathbf{i} + 7\mathbf{j})$ N. [4]
(a) Find the acceleration of the particle in the form $(a\mathbf{i} + b\mathbf{j})$ m s⁻². [3]
(b) Find the magnitude of the acceleration. [1]



5. A particle P moves with constant velocity. At time $t = 0$, P is at the point with position vector $(-3\mathbf{i} + 4\mathbf{j})$ m. At time $t = 5$ s, P is at the point with position vector $(7\mathbf{i} - 11\mathbf{j})$ m. [5]
- (a) Find the velocity of P . [2]
- (b) Find the speed of P . [1]
- (c) Find the position vector of P when $t = 8$. [2]
6. Two forces $(2\mathbf{i} - \mathbf{j})$ N and $(a\mathbf{i} + 3\mathbf{j})$ N, where a is a constant, act on a particle. The resultant $\mathbf{R}$ of the two forces is parallel to the vector $(3\mathbf{i} + \mathbf{j})$. [5]
- (a) Find the value of a . [3]
- (b) Find the magnitude of $\mathbf{R}$. [2]
7. [In this question $\mathbf{i}$ and $\mathbf{j}$ are horizontal unit vectors due east and due north respectively, and position vectors are given relative to a fixed origin O .] [5]
- At time t hours after noon, a boat has position vector $\mathbf{r} = ((4 + 3t)\mathbf{i} + (-2 + 4t)\mathbf{j})$ km. A harbour H has position vector $(16\mathbf{i} + 14\mathbf{j})$ km.
- (a) Show that the boat passes through H , and find the time at which it does so. [2]
- (b) Find the speed of the boat. [1]
- (c) Find the bearing on which the boat is moving. [2]



8. Two ships A and B move with constant velocities. At noon, A is at the point with position vector $(2\mathbf{i} + 9\mathbf{j})$ km and B is at the point with position vector $(-4\mathbf{i} + 3\mathbf{j})$ km. The velocity of A is $(3\mathbf{i} - \mathbf{j})$ km h⁻¹ and the velocity of B is $(5\mathbf{i} + \mathbf{j})$ km h⁻¹. [6]

(a) Write down the position vectors of A and B at time t hours after noon. [2]

(b) Show that, if the ships do not change course, they will collide, and find the time and the position vector of the point where they collide. [4]

9. [In this question $\mathbf{i}$ is a horizontal unit vector and $\mathbf{j}$ is a unit vector vertically upwards. Take $g = 9.8 \text{ m s}^{-2}$.] [6]

A particle of mass m kg is in equilibrium under the action of its weight and three forces $(4\mathbf{i} + 7\mathbf{j})$ N, $(-9\mathbf{i} + 5\mathbf{j})$ N and $p\mathbf{i}$ N.

(a) Find the value of p and the value of m . [4]

(b) The force $(-9\mathbf{i} + 5\mathbf{j})$ N is removed. The other forces are unchanged. Find the magnitude of the acceleration of the particle. [2]

10. At time t hours after 09:00, a boat P has position vector $((1 + 2t)\mathbf{i} + (5 - t)\mathbf{j})$ km relative to a fixed origin. A lighthouse L is at the point with position vector $(8\mathbf{i} + 7\mathbf{j})$ km. [7]

(a) Find $\overrightarrow{PL}$ in terms of t . [2]

(b) Show that $PL^2 = 5t^2 - 24t + 53$. [2]

(c) Find the shortest distance between the boat and the lighthouse, and the time at which it occurs. [3]



- 11.** A particle P of mass 0.5 kg is moving with velocity $(6\mathbf{i} - 2\mathbf{j}) \text{ m s}^{-1}$ when $t = 0$. From $t = 0$, P is acted on by a single constant force $(-1.5\mathbf{i} + 2\mathbf{j}) \text{ N}$. [8]
- (a) Find the acceleration of P . [2]
- (b) Find the velocity of P at time t seconds. [1]
- (c) Find the time at which P is moving parallel to $\mathbf{j}$, and its speed at that time. [3]
- (d) Find the value of t when P is moving in the direction of the vector $(\mathbf{i} + \mathbf{j})$. [2]

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