

Edexcel IAL M2 Mechanics 2 Practice Exam

Pearson Edexcel International A Level Mathematics · 11 questions · 59 marks

Name _____

Date _____

Score / 59

- Answer every question. Show your working: most marks are for method.
- Calculator allowed.
- Topics: Variable acceleration; Projectiles; Centres of mass; Work, energy and power; Collisions and the coefficient of restitution; Further moments and rigid bodies.
- The mark scheme is a separate free PDF: alevelmathrevision.com/alevel-frontend/downloads/practice-exams/ial/edexcel-ial-m2-mechanics-2-practice-exam-mark-scheme.pdf

1. A bead slides along a straight horizontal wire. At time t seconds its displacement from a fixed point O on the wire is s metres, where $s = 2t^3 - 15t^2 + 24t$, $t \geq 0$. [4]

1. Find the velocity of the bead when $t = 2$. [2]
2. Find the acceleration of the bead when $t = 2$. [2]

2. A particle of mass 0.5 kg moves in a horizontal plane under the action of a single force $\mathbf{F}$ newtons. At time t seconds, the velocity of the particle is $((3t^2 - 4t)\mathbf{i} + (2t + 1)\mathbf{j}) \text{ m s}^{-1}$. Find the magnitude of $\mathbf{F}$ when $t = 2$. [4]

3. Take $g = 9.8 \text{ m s}^{-2}$. A ball is thrown with speed 25 m s^{-1} from a point A . It moves freely under gravity. Use the principle of conservation of mechanical energy to find the speed of the ball when it is 15 m above the level of A , explaining why the answer does not depend on the angle of projection. [4]

4. A uniform lamina is in the shape of a square $ABCD$ of side 4 cm joined along DC to an isosceles triangle DCE , where E is 3 cm from DC and on the far side of DC from AB . Find the distance of the centre of mass of the lamina from AB . [4]



5. A car of mass 1000 kg moves along a straight horizontal road with its engine working at a constant rate of 18 kW. When the speed of the car is $v \text{ m s}^{-1}$, the resistance to motion has magnitude $30v$ newtons. [5]
1. Find the acceleration of the car when its speed is 15 m s^{-1} . [3]
 2. Find the maximum speed of the car. [2]
6. A smooth sphere A of mass 4 kg moving with speed 5 m s^{-1} collides directly with a smooth sphere B of mass 6 kg moving with speed 1 m s^{-1} in the same direction. Immediately after the collision A moves with speed 1.4 m s^{-1} in its original direction. Find the speed of B immediately after the collision and the coefficient of restitution between A and B . [5]
7. A uniform ladder rests with its foot on rough horizontal ground and its top against a smooth vertical wall. The coefficient of friction between the ladder and the ground is 0.4. Find the least angle that the ladder can make with the ground if it is not to slip. [5]
8. Take $g = 9.8 \text{ m s}^{-2}$. A firework is launched from a point on level ground with speed 35 m s^{-1} at an angle α above the horizontal, where $\tan \alpha = \frac{4}{3}$. Before it explodes it is modelled as a particle moving freely under gravity. [7]
1. Find the length of time for which the firework is at least 20 m above the ground. [5]
 2. Find the horizontal distance travelled during this time. [2]



9. A uniform rectangular lamina has vertices $(0, 0)$, $(12, 0)$, $(12, 8)$ and $(0, 8)$. The triangle with vertices $(8, 0)$, $(12, 0)$ and $(12, 8)$ is removed. Find the exact coordinates of the centre of mass of the remaining lamina. [7]
10. Take $g = 9.8 \text{ m s}^{-2}$. A small ball is released from rest at a height of 4.9 m above a horizontal floor. The coefficient of restitution between the ball and the floor is 0.5. [7]
1. Find the height to which the ball rises after its first bounce. [4]
 2. Find the time from the release of the ball until it hits the floor for the second time. [3]
11. Take $g = 9.8 \text{ m s}^{-2}$. A decorator of mass 75 kg climbs a uniform ladder of length 8 m and mass 25 kg. The foot of the ladder is on rough horizontal ground, where the coefficient of friction is 0.3, and the top rests against a smooth vertical wall; the ladder is inclined at 65° to the ground. How far along the ladder can the decorator climb before the ladder starts to slip? [7]



