

A Level Maths Mechanics Practice Exam

Pearson Edexcel A Level Mathematics (9MA0) · 18 questions · 60 marks

Name _____

Date _____

Score / 60

- Answer every question. Show your working: most marks are for method.
- Calculator allowed.
- Topics: Modelling assumptions; Moments and the turning effect; SI units and quantities in mechanics; Displacement-time and velocity-time graphs; Constant acceleration formulae; Vertical motion under gravity; Variable acceleration; Kinematics in 2D with vectors; Force diagrams and resultant forces; Connected particles; Motion on inclined planes; Resolving forces in 2D; Equilibrium of rigid bodies; Non-uniform rods; Newton's laws of motion; Friction and the coefficient of friction.
- The mark scheme is a separate free PDF: alevelmathrevision.com/alevel-frontend/downloads/practice-exams/9ma0/a-level-maths-mechanics-practice-exam-mark-scheme.pdf

1. In mechanics models, the acceleration due to gravity is taken as a constant 9.8 m s^{-2} . Explain why this is reasonable for a stone falling from a cliff, and describe one situation where it would not be appropriate. [2]
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2. A mechanic pulls on the end of a spanner with a force of 40 N. The end of the spanner is 0.25 m from the centre of the nut, and the force acts at 70° to the line of the spanner. Work out the turning moment about the centre of the nut. [2]
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3. The speed of a car increases uniformly from 36 km h^{-1} to 90 km h^{-1} in 6 seconds. Find the acceleration of the car in m s^{-2} . [3]
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4. The speed of a train decreases uniformly from 30 m s^{-1} to 10 m s^{-1} in 40 s. Use its velocity-time graph to find the deceleration of the train and the distance it travels in the 40 s. [3]
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5. A particle starts with speed 2 m s^{-1} and moves in a straight line with constant acceleration 3 m s^{-2} . Find the time it takes to travel 40 m, to 3 significant figures. [3]
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6. A ball is thrown vertically upwards from ground level. On the way up, it passes a window 15 m above the ground 1.2 s after it is thrown. Find the speed with which the ball was thrown. Take $g = 9.8 \text{ m s}^{-2}$. [3]
7. A particle starts at O and moves in a straight line with velocity $v = 9 - t^2 \text{ m s}^{-1}$ at time t seconds. Find its displacement from O at the instant it comes to rest. [3]
8. A particle moves with constant velocity from the point A with position vector $(-3\mathbf{i} + 7\mathbf{j}) \text{ m}$ to the point B with position vector $(9\mathbf{i} - 2\mathbf{j}) \text{ m}$, taking 3 seconds. Find its velocity and its speed. [3]
9. A particle is in equilibrium under the action of three forces $(2\mathbf{i} - 3\mathbf{j}) \text{ N}$, $(-5\mathbf{i} + \mathbf{j}) \text{ N}$ and $\mathbf{F} \text{ N}$. Find $\mathbf{F}$ and its magnitude. [3]
10. Particles A of mass 3 kg and B of mass 2 kg are joined by a light inextensible string and lie on a smooth horizontal surface. A horizontal force of 15 N is applied to A , in the direction from B to A , so the string becomes taut. Find the acceleration of the particles and the tension in the string. [3]
11. A block rests on a rough plane inclined at an angle α to the horizontal, where $\tan \alpha = \frac{3}{4}$. The block is on the point of slipping down the plane. Show that the coefficient of friction is 0.75. [3]
12. A small boat is held at rest on a still lake by three horizontal forces: a rope pulling with 9 N due west, a second rope pulling with 12 N due south, and the force $\mathbf{F}$ from its anchor chain. Work out the magnitude of $\mathbf{F}$ and the bearing on which it acts. [3]



13. A uniform rod AB of length 1.6 m and weight 50 N is freely hinged at A . It is held horizontal by a force P N applied at B , acting at 40° above the horizontal, in the vertical plane containing the rod. Find P . [3]
14. A non-uniform rod AB of length 2 m and mass 8 kg hangs horizontally from two vertical light strings attached at A and B . Its centre of mass is 0.75 m from A . Find the tension in each string. Take $g = 9.8 \text{ m s}^{-2}$. [3]
15. A particle of mass 2 kg is at rest at the origin O on a smooth horizontal surface. A constant horizontal force $(6\mathbf{i} - 8\mathbf{j})$ N then acts on the particle, and no other horizontal force acts. Find the position vector of the particle 3 seconds later, and its distance from O at this time. [4]
16. A parcel leaves the end of a conveyor belt at 6 m s^{-1} and slides in a straight line over a level rough floor, stopping after 4.5 m. Work out the coefficient of friction between the parcel and the floor. Take $g = 9.8 \text{ m s}^{-2}$. [4]
17. Points A and B are 100 m apart on a straight track. At time $t = 0$ particle P starts from rest at A and moves towards B with constant acceleration 2 m s^{-2} . At the same instant particle Q passes B moving towards A with speed 5 m s^{-1} and constant acceleration 1 m s^{-2} in the direction of its motion.
 (a) Find the time at which P and Q meet. [4]
 (b) Find the distance from A of the meeting point. [2]



18. A car of mass 1200 kg is towing a trailer of mass 600 kg along a straight horizontal road at 20 m s^{-1} , [6]
using a light rigid tow bar. The driver brakes, producing a constant braking force of 5400 N on the car
only. Other resistances are ignored.
- (a) Find the deceleration of the car and trailer. [2]
(b) Find the magnitude of the force in the tow bar, and state whether it is a tension or a thrust. [3]
(c) Find the distance travelled while the car and trailer come to rest. [1]

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