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International Examinations Papers

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Mechanics

TOPIC- Kinematics

Straight line motion

Kinematics-St. line motion

1 A car of mass 1200 kg travels on a horizontal straight road with constant acceleration $a\,\text{m s}^{-2}$.

(i) Given that the car's speed increases from $10\,\text{m s}^{-1}$ to $25\,\text{m s}^{-1}$ while travelling a distance of 525 m, find the value of a. [2]

The car's engine exerts a constant driving force of 900 N. The resistance to motion of the car is constant and equal to RN.

(ii) Find R. [2]

02 A particle P moves in a straight line that passes through the origin O. The velocity of P at time t seconds is $v\,\text{m s}^{-1}$, where $v = 20t - t^3$. At time $t = 0$ the particle is at rest at a point whose displacement from O is -36 m.

(i) Find an expression for the displacement of P from O in terms of t. [3]

(ii) Find the displacement of P from O when $t = 4$. [1]

(iii) Find the values of t for which the particle is at O. [3]

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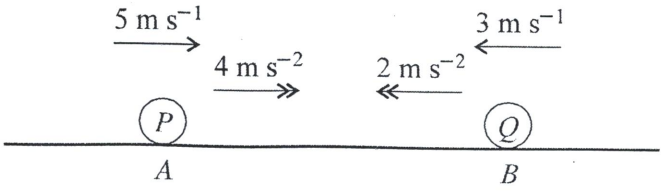

Particles P and Q start from points A and B respectively, at the same instant, and move towards each other in a horizontal straight line. The initial speeds of P and Q are 5 m s^{-1} and 3 m s^{-1} respectively. The accelerations of P and Q are constant and equal to 4 m s^{-2} and 2 m s^{-2} respectively (see diagram).

(i) Find the speed of P at the instant when the speed of P is 1.8 times the speed of Q. [4]

(ii) Given that $AB = 51$ m, find the time taken from the start until P and Q meet. [4]

4 The velocity of a particle t s after it starts from rest is v m s^{-1}, where $v = 1.25t - 0.05t^2$. Find

(i) the initial acceleration of the particle, [2]

(ii) the displacement of the particle from its starting point at the instant when its acceleration is 0.05 m s^{-2}. [5]

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5 Particles P and Q are projected vertically upwards, from different points on horizontal ground, with velocities of $20\,\text{m s}^{-1}$ and $25\,\text{m s}^{-1}$ respectively. Q is projected 0.4 s later than P. Find

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(i) the time for which P's height above the ground is greater than 15 m, [3]

(ii) the velocities of P and Q at the instant when the particles are at the same height. [5]

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6 **(i)** A man walks in a straight line from A to B with constant acceleration $0.004\,\text{m s}^{-2}$. His speed at A is $1.8\,\text{m s}^{-1}$ and his speed at B is $2.2\,\text{m s}^{-1}$. Find the time taken for the man to walk from A to B, and find the distance AB. [3]

(ii) A woman cyclist leaves A at the same instant as the man. She starts from rest and travels in a straight line to B, reaching B at the same instant as the man. At time t s after leaving A the cyclist's speed is $k(200t - t^2)\,\text{m s}^{-1}$, where k is a constant. Find

(a) the value of k, [4]

(b) the cyclist's speed at B. [1]

(iii) Sketch, using the same axes, the velocity-time graphs for the man's motion and the woman's motion from A to B. [3]

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7 A motorcyclist starts from rest at A and travels in a straight line. For the first part of the motion, the motorcyclist's displacement x metres from A after t seconds is given by $x = 0.6t^2 - 0.004t^3$.

(i) Show that the motorcyclist's acceleration is zero when $t = 50$ and find the speed V m s^{-1} at this time. [5]

For $t \geqslant 50$, the motorcyclist travels at constant speed V m s^{-1}.

(ii) Find the value of t for which the motorcyclist's average speed is 27.5 m s^{-1}. [5]

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Kinematics-St. line motion

1 A car travels in a straight line with constant acceleration $a\,\text{m s}^{-2}$. It passes the points A, B and C, in this order, with speeds $5\,\text{m s}^{-1}$, $7\,\text{m s}^{-1}$ and $8\,\text{m s}^{-1}$ respectively. The distances AB and BC are d_1 m and d_2 m respectively.

(i) Write down an equation connecting

(a) d_1 and a,

(b) d_2 and a.

[2]

(ii) Hence find d_1 in terms of d_2. [2]

2 A motorcyclist starts from rest at A and travels in a straight line until he comes to rest again at B. The velocity of the motorcyclist t seconds after leaving A is $v\,\text{m s}^{-1}$, where $v = t - 0.01t^2$. Find

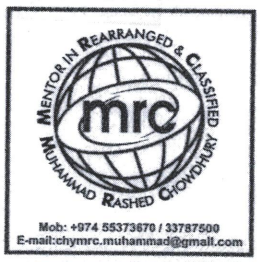
(i) the time taken for the motorcyclist to travel from A to B, [2]

(ii) the distance AB. [3]

3 A particle slides down a smooth plane inclined at an angle of $\alpha°$ to the horizontal. The particle passes through the point A with speed $1.5\,\text{m s}^{-1}$, and $1.2\,\text{s}$ later it passes through the point B with speed $4.5\,\text{m s}^{-1}$. Find

(i) the acceleration of the particle, [2]

(ii) the value of α. [2]



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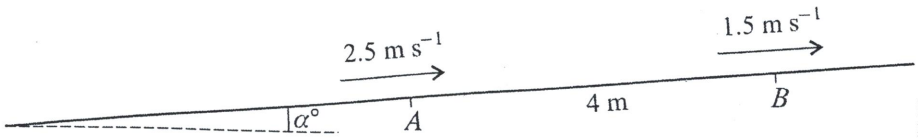

A particle slides up a line of greatest slope of a smooth plane inclined at an angle $\alpha°$ to the horizontal. The particle passes through the points A and B with speeds 2.5 m s^{-1} and 1.5 m s^{-1} respectively. The distance AB is 4 m (see diagram). Find

(i) the deceleration of the particle, [2]

(ii) the value of α. [2]