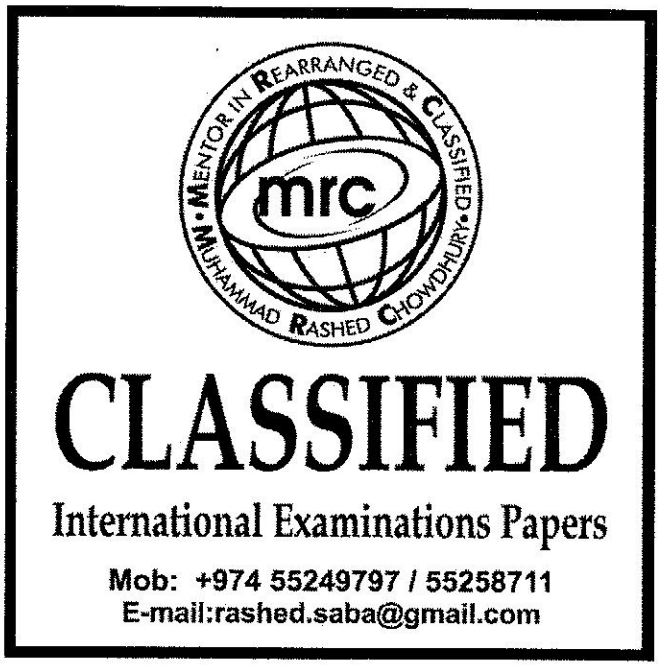
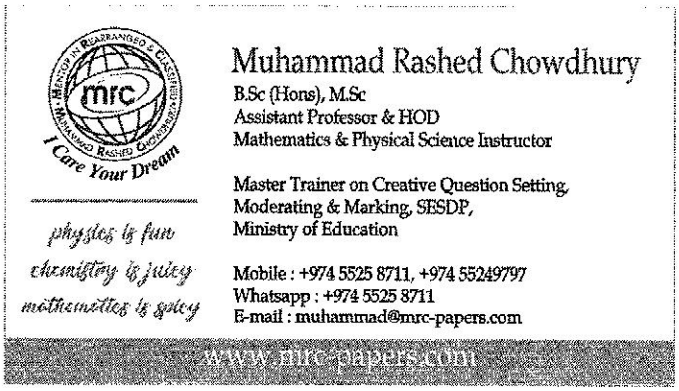


Edexcel AS Mechanics M1

TOPIC-Kinematics of a particle moving in a straight line



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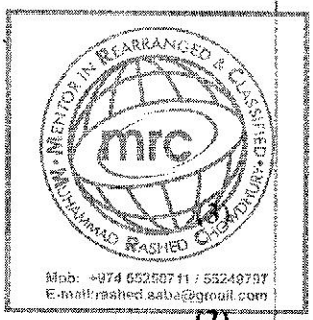
5. A stone is projected vertically upwards from a point A with speed $u\,\text{m s}^{-1}$. After projection the stone moves freely under gravity until it returns to A. The time between the instant that the stone is projected and the instant that it returns to A is $3\frac{4}{7}$ seconds.



Modelling the stone as a particle,

(a) show that $u = 17\frac{1}{2}$,

(b) find the greatest height above A reached by the stone,

(2)

(c) find the length of time for which the stone is at least $6\frac{3}{5}$ m above A.

(6)

1-12 Ky

Leave blank

2. A small stone is projected vertically upwards from a point O with a speed of $19.6\,\text{m s}^{-1}$.

Modelling the stone as a particle moving freely under gravity,

(a) find the greatest height above O reached by the stone,

(2)

(b) find the length of time for which the stone is more than 14.7 m above O.

(5)

6-15 Daly Khe

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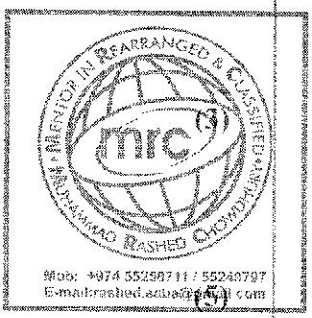
5. A particle P is projected vertically upwards from a point A with speed u m s^{-1}. The point A is 17.5 m above horizontal ground. The particle P moves freely under gravity until it reaches the ground with speed 28 m s^{-1}.



(a) Show that $u = 21$

At time t seconds after projection, P is 19 m above A.

(b) Find the possible values of t.

(5)

The ground is soft and, after P reaches the ground, P sinks vertically downwards into the ground before coming to rest. The mass of P is 4 kg and the ground is assumed to exert a constant resistive force of magnitude 5000 N on P.

(c) Find the vertical distance that P sinks into the ground before coming to rest.

(4)

6-12 Kinetics

Leave blank

1. At time $t = 0$ a ball is projected vertically upwards from a point O and rises to a maximum height of 40 m above O. The ball is modelled as a particle moving freely under gravity.

(a) Show that the speed of projection is 28 m s^{-1}.

(b) Find the times, in seconds, when the ball is 33.6 m above O.

6-11

Leave blank

7.

Figure 3

Two particles P and Q, of mass 0.3 kg and 0.5 kg respectively, are joined by a light horizontal rod. The system of the particles and the rod is at rest on a horizontal plane. At time $t = 0$, a constant force **F** of magnitude 4 N is applied to Q in the direction PQ, as shown in Figure 3. The system moves under the action of this force until $t = 6$ s. During the motion, the resistance to the motion of P has constant magnitude 1 N and the resistance to the motion of Q has constant magnitude 2 N.

Find

(a) the acceleration of the particles as the system moves under the action of **F**,

(3)

(b) the speed of the particles at $t = 6$ s,

(2)

(c) the tension in the rod as the system moves under the action of **F**.

(3)

At $t = 6$ s, **F** is removed and the system decelerates to rest. The resistances to motion are unchanged. Find

(d) the distance moved by P as the system decelerates,

(4)

(e) the thrust in the rod as the system decelerates.

(3)

Leave blank

6. A ball is projected vertically upwards with a speed of $14.7\ \text{m s}^{-1}$ from a point which is 49 m above horizontal ground. Modelling the ball as a particle moving freely under gravity, find

(a) the greatest height, above the ground, reached by the ball, **(4)**

(b) the speed with which the ball first strikes the ground, **(3)**

(c) the total time from when the ball is projected to when it first strikes the ground. **(3)**

6–10 Kinet

Leave blank

4. A lorry is moving along a straight horizontal road with constant acceleration. The lorry passes a point A with speed u m s^{-1}, ($u < 34$), and 10 seconds later passes a point B with speed 34 m s^{-1}. Given that $AB = 240$ m, find

(a) the value of u,

(b) the time taken for the lorry to move from A to the mid-point of AB.

6-13 Kine

Leave blank

5. A racing car is moving along a straight horizontal track with constant acceleration. There are three checkpoints, P, Q and R, on the track, where $PQ = 48$ m and $QR = 200$ m. The car takes 3 s to travel from P to Q and 5 s to travel from Q to R. Find

(i) the acceleration of the car,

(ii) the speed of the car as it passes P.

W-1-4

Leave blank

4. The points P and Q are at the same height h metres above horizontal ground. A small stone is dropped from rest from P. Half a second later a second small stone is thrown vertically downwards from Q with speed $7.35\ \text{m s}^{-1}$. Given that the stones hit the ground at the same time, find the value of h.

W-1-15 Kinetics

Leave blank

6. A cyclist is moving along a straight horizontal road and passes a point A. Five seconds later, at the instant when she is moving with speed $10\ \text{m s}^{-1}$, she passes the point B. She moves with constant acceleration from A to B.

Given that $AB = 40\,\text{m}$, find

(a) the acceleration of the cyclist as she moves from A to B.

(4)

(b) the time it takes her to travel from A to the midpoint of AB.

(5)

6-17 Ki

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1. A train moves along a straight horizontal track between two stations R and S. Initially the train is at rest at R. The train accelerates uniformly at $\frac{1}{2}$ m s^{-2} from rest at R until it is moving with speed 15 m s^{-1}. For the next 200 seconds the train maintains a constant speed of 15 m s^{-1}. The train then decelerates uniformly at $\frac{1}{4}$ m s^{-2} until it comes to rest at S.

Find

(a) the time taken by the train to travel from R to S,

(3)

(b) the distance from R to S,

(4)

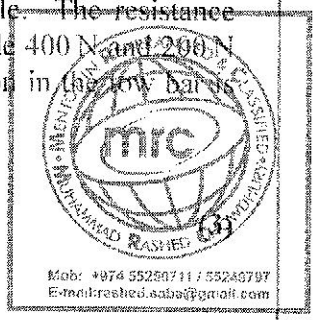
(c) the average speed of the train during the journey from R to S.

(2)

W-1-17 Ki

Leave blank

1. A truck of mass 2400 kg is pulling a trailer of mass M kg along a straight horizontal road. The tow bar, connecting the truck to the trailer, is horizontal and parallel to the direction of motion. The tow bar is modelled as being light and inextensible. The resistance forces acting on the truck and the trailer are constant and of magnitude 400 N and 200 N respectively. The acceleration of the truck is 0.5 m s^{-2} and the tension in the tow bar is 600 N.



(a) Find the magnitude of the driving force of the truck.

(3)

(b) Find the value of M.

(3)

(c) Explain how you have used the fact that the tow bar is inextensible in your calculations.

(1)

W-1-16 Dy—