CHAPTER 2: KINEMATICS OF LINEAR MOTION

Linear Motion (Explanation Question & Graph Question)

1. (i) If the object has zero acceleration, what happen to its velocity? Explain your answer.
   (ii) If the velocity of an object is constant, can it's speed varies? Explain your answer.
   (iii) Does the speedometer of a car measure speed or velocity? Justify your answer.
   (iv) What is meant by distance and displacement?
   (v) Define the average speed and average velocity.
   (vi) A honeybee travels 2 km looking for nectar and return to its hive. Is the displacement the same as the distance travelled? Explain your answer.
   (vii) State ONE similarity between free fall and projectile motion.
   (ix) Is it possible for an object moving at a non-zero velocity has a zero acceleration? Explain.
   (x) State two differences between distance and displacement.

2. A car is initially at rest at t = 0 s. It then accelerates through three gear changes with the following velocities:
   11.1 m s^{-1} at t = 5 s, 16.7 m s^{-1} at t = 10 s and 25.0 m s^{-1} at t = 15 s.
   Sketch the acceleration-time graph of the car.

3. A train moves from rest and stops at a station in 20 minutes. For the first 5 minutes, the train moves with constant acceleration of 0.08 m s^{-2}. Its speed remains constant until a braking force is exerted to stop it. The time of braking is 2 minutes.
   (i) Calculate the maximum speed of the train.
   (ii) Sketch a graph of velocity against time for the whole journey.

4. An object starts from rest, accelerates at 1.2 m s^{-2} for 3.0 s and then moves at a constant velocity for 6.0 s. Determine the final velocity and sketch the velocity-time graph.

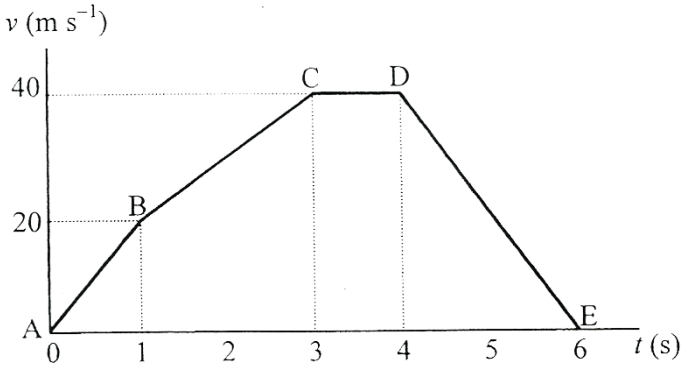
5. 

FIGURE 1

The graph is **FIGURE 1** shows the motion of a body.
(i) Which part of the graph shows the body is moving with a maximum speed?
(ii) Calculate the maximum acceleration of the body.
(iii) Calculate the average velocity of the body for the first 3 seconds.

6.

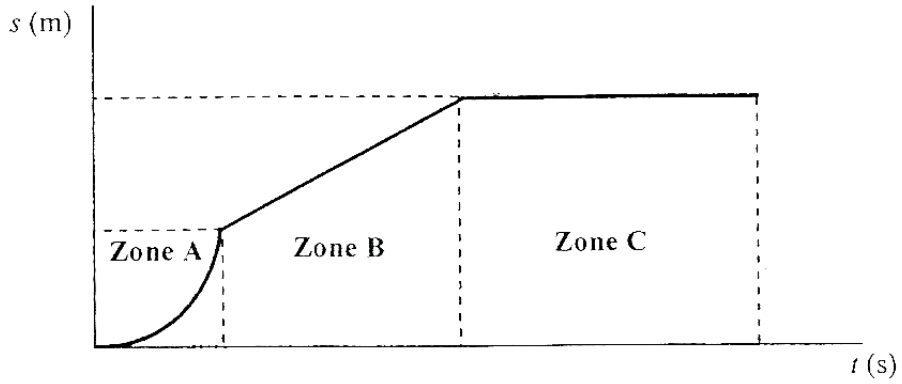


FIGURE 2

FIGURE 2 shows a displacement-time graph for a car moving along a straight road.

(i) Copy and complete **TABLE 1** by stating any change (increase/ decrease/ constant/ zero/ no change) in the distance, speed and acceleration of the car for each zone.

TABLE 1

Zone	Distance	Speed	Acceleration
A			
B			
C			

(ii) Which zone will the car instantaneous acceleration equal to its average acceleration?

7.

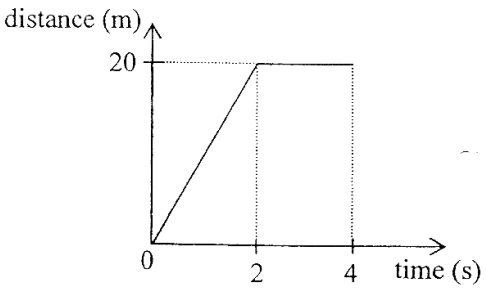


FIGURE 3

The distance-time graph in **FIGURE 3** represents the motion of a car in 4 seconds,

(i) describe its motion.

(ii) sketch its velocity-time graph.

(iii) determine its total distance travelled.

Uniform Accelerated Motion [Horizontal Linear Motion]

1. A firework is shot straight up and burst at a maximum height of 100 m. Calculate the
   (i) initial velocity of the firework.
   (ii) time to reach the maximum height.

2. The speed of a car when passing a point P is 30 m s^{-1} and changes uniformly over a distance of 323 m to 60 m s^{-1}. Calculate the speed of the car 3 s after passing point P.

3. A world-class runner can reach a top-speed of 11 m s^{-1} in the first 15 m of a race. Calculate the average acceleration of the runner.

4. A car is capable of accelerating at 0.60 m s^{-2}. Calculate the time needed for this car to go from speed of 5.5 m s^{-1} to a speed of 8.0 m s^{-1}.

5. An airplane taxiing at constant acceleration for a distance of 280 m. If it starts from rest and becomes airborne after 8.00 s, calculate its speed during take-off.

6. A bus moving with an initial speed 20 m s^{-1} decelerates at a constant rate of 3 m s^{-2}. Calculate the distance travelled by the bus before it stops.

Projectile Motion (θ = 90°) [Vertical linear motion]

1. A ping pong ball is thrown vertically upward and returns to its starting point after 4 s. Calculate the
   (i) initial speed of the ball.
   (ii) maximum height of the ball.

2. A ball is thrown upward from the ground with an initial speed of 25 m s^{-1}. At the same instant, another ball is dropped from a 15 m building. When will the two balls be at the same height from the ground?

Projectile Motion (0° ≤ θ <90°)

1.

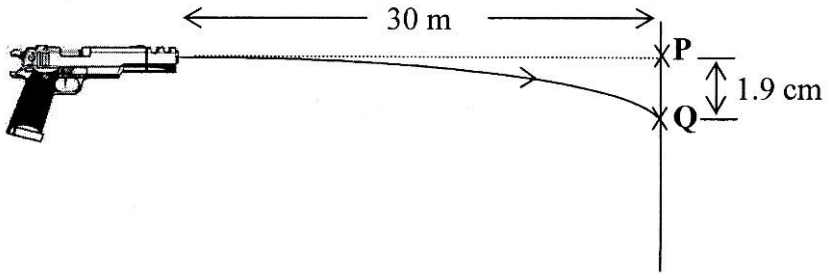


FIGURE 4

A gun is aimed and fired horizontally at a target **P** which is 30 m away. The bullet accidently hits point **Q** which is 1.9 cm below the target as shown in **FIGURE 4**. Calculate the
(i) time for the bullet to hit point **Q**.
(ii) speed of the bullet as it emerges from the gun.

2. An apple is thrown horizontally from the edge of a table with an initial velocity of 2.5 m s^{-1}. If the height of the table is 1.5 m, calculate
   (i) the time taken for the apple to reach the floor.
   (ii) the horizontal displacement of the apple.

3.

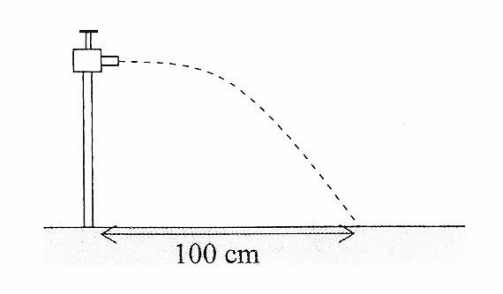


FIGURE 5

Water flows out horizontally at the end of a pipe at a height of 52 cm from the floor. If the horizontal distance before it hits the floor is 100 cm as shown in **FIGURE 5**, calculate the velocity of the water at the instant it leaves the pipe.

4.

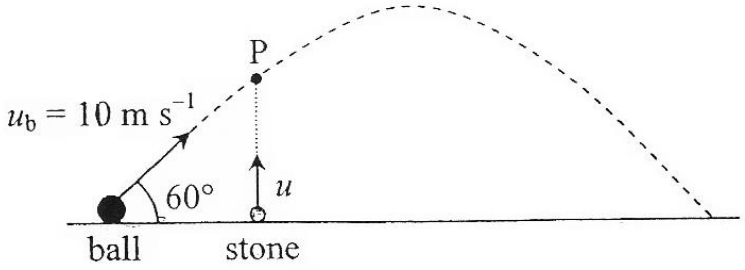


FIGURE 6

A ball is thrown upward with an initial velocity 10 m s^{-1}, 60° with respect to the horizontal. At the same instant, a stone at certain distance from the ball is thrown vertically upward with an initial velocity u as shown in **FIGURE 6**. Calculate u so that both objects will collide at P.

5. A stone is thrown upward from the roof of a building with velocity 15.0 m s^{-1} at an angle of 30.0° to the horizontal. The height of the building is 40.0 m. Calculate
   (i) the maximum height of the stone from the ground.
   (ii) the magnitude of the velocity of the stone just before it strikes the ground.