Blue Print (As per PU Board)

Topic	1 mark questions	2 marks questions	3 marks questions	5 marks questions	Total Marks
Motion in a Straight Line	–	1	–	1	7

One mark questions

1. **What is displacement?**
   Answer: The change of position in a particular direction or the distance between the initial and final position of the object is called displacement.
2. **The average velocity of a body is equal to its instantaneous velocity. What do you conclude by this?**
   Answer: The body is moving with constant velocity.
3. **What does area under velocity - time graph represent?**
   Answer: Displacement for a given time interval.

Two marks questions

4. **Distinguish between distance and displacement.**
   Answer: (i) The distance is the length of path traversed. The displacement is the change of position in a particular direction.
   (ii) Distance is a scalar. But displacement is a vector.
   (iii) When a body returns to initial position, then distance is not zero but displacement is zero.
5. **The displacement (in metre) of a particle moving along $x-$ axis given by $x = 20t + 10t^2$. Calculate the instantaneous velocity at $t = 2s$.**

   Answer: We have $x = 20t + 10t^2$.

   Velocity $v = \frac{dx}{dt} = 20 + 20t$

   Instantaneous velocity at $t = 2$ s is $V = 20 + 20 \times 2 = 60$ ms^{-1}
6. **A car travels with a uniform velocity of 20 ms^{-1}. The drive applies the brakes and the car comes to rest in 10 second. Calculate the retardation.**

   Answer: $v_0 = 20$ ms^{-1}, $v = 0$, $t = 10$ s

   $a = \frac{v - v_0}{t} = \frac{0 - 20}{10} = -2$ ms^{-2}

   $\therefore$ Retardation $= 2$ ms^{-2}
7. **A ball is thrown vertically upward and it reaches a height of 90 m. Find the velocity with which it was thrown.**

   Answer: $V = 0$, $X = 90$ m, g $= 9.8$ ms^{-2}, $v_0 = ?$

   Using the equation $V^2 = V_0^2 + 2g \times$ we get

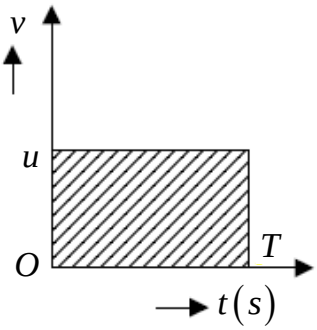
   $0 = v_0^2 - 2 \times 9.8 \times 90$

   $\therefore v_0^2 = 2 \times 9.8 \times 90$

   $v_0 = \sqrt{2 \times 9.8 \times 90} = 42$ ms^{-1}

Four marks questions

8. **(a) What is the velocity - time graph?**
   (b) Show that area under velocity - time graph is equal to displacement.
   Answer: When instantaneous velocities of a particle in motion are plotted against time, the esultant graph is called velocity - time graph.



Area under the v - t graph is the area of the rectangle of height u and base T.
Therefore Area $= u \times T$ …….. (1)
By definition, displacement during this time interval $= u \times T$ …… (2)
Equation equations (1) and (2),
Area under velocity - time graph is equal to displacement

9. **What is the significance of velocity - time graph?**
Answer: Significance of velocity - time graph
(i) It represents the nature of motion of the particle.
(ii) Instantaneous velocity and instantaneous acceleration can be obtained from the curve.
(iii) Equations of motion along a straight line can be derived.
(iv) Area under velocity - time graph in a given time interval represents the distance traveled by the particle in that time interval.

Five marks questions

10. **A car moving along a straight highway with speed of 126 km h^{-1} to brought to stop within a distance of 200 m. What is the retardation of the car and how long does it take for the car to stop?**

Answer: $v_0 = 126\,\text{kmh}^{-1}, = \frac{126 \times 1000}{3600} = 35\ \text{ms}^{-1}, v = 0,\ x = 200\ \text{m}$

Applying $v^2 = v_0^2 + 2ax$

$0 = 35^2 + 2a \times 200$

$\therefore 0 = -\frac{35^2}{200 \times 2} = -3.06\ \text{ms}^{-2}$

Applying $v = v_0 + at$

$0 = 35 - 3.06 \times t$

$t = \frac{35}{3.06} = 11.44$ second

11. **The displacement (in metre) of a particle moving along x-axis is given by $x = At^2 + B$, where $A = 2m$ and $B = 3m$. Calculate (i) average velocity between $t = 3s$ and $t = 5\text{s}$. (ii) instantaneous velocity at $t = 5\text{s}$ and (iii) instantaneous acceleration.**

Answer: (i) Average velocity
At $t_1 3s$, the displacement of the particle is

$x_1 = 2.3^2 + 3 = 21\ \text{m}$

At $t_2 = 5\text{s}$, the displacement of the particle is

$x_2 = 2.5^2 + 3 = 53\ \text{m}$

Average velocity $\bar{v} = \frac{x_2 - x_1}{t_2 - 1_1} = \frac{53 - 21}{5 - 3} = \frac{32}{2} = 16\ \text{ms}^{-1}$

(ii) Instantaneous velocity

$v = \frac{dx}{dt} = \frac{d}{dt}\left(At^2 + B\right) = 2At$

At $t = 5s, v = 2 \times 2 \times 5 = 20 \text{ ms}^{-1}$

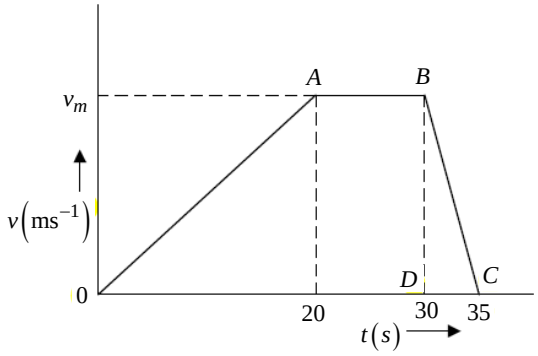
(iii) Instantaneous acceleration

$a = \frac{dv}{dt} = \frac{d}{dt}(2At) = 2A$

$= 2 \times 2 = 4 \text{ ms}^{-2}$

12. **A car starts from rest and accelerates uniformly at a rate of 2 ms^{-2} for 20 second. It then maintains a constant velocity for 10 second. The brakes are then applied and the car is uniformly retarded and comes to rest in 5 second. Draw the velocity – time graph for the motion and find: (i) the maximum velocity (ii) the retardation in the last 5 second (iii) total distance traveled and (iv) average velocity.**

Answer: The velocity – time graph for the motion of the car is shown below



(i) Maximum velocity

$a = 2 \text{ ms}^{-2}, v_0 0, t = 20\text{s}$

$v_m = v_0 + \text{at}$

$= 0 + 2 \times 20$

$= 40 \text{ ms}^{-1}$

(ii) Retardation

Retardation is equal to the slope of the line BC

$= -\frac{BC}{DC} = -\frac{40}{5} = 8 \text{ ms}^{-2}$

(iii) Total distance traveled S = Area of trapezium OABC

$= \frac{1}{2}(AB + OC)BD$

$= \frac{1}{2}(10 + 35)40 = 900 \text{ m}$

(iv) Average velocity

$= \frac{S}{t} = \frac{900}{35} = 25.71 \text{ ms}^{-1}$