QB365

Important Questions - Motion in a Straight Line

11th Standard CBSE

Physics

Reg.No. : | | | | | | |

Time : 01:00:00 Hrs

Total Marks : 50

Section-A

1) What is the condition for an object to be considered as a point object? **1**

2) Can a tumbling beaker that has slipped off the edge of a table considered as a point object? **1**

3) Position-time graph could have negative slope Is it true or false? **1**

4) The displacement-time graph of a particle is parallel to time-axis, what is the velocity of the particle? **1**

5) The displacement-time graph for two particles X and Y are straight lines making angles of 30^o and 60^o with the time axis. What is the ratio of the velocities of Y and X ? **1**

6) Is it possible that a body have a constant velocity but varying speed? **1**

7) Given an example of uniformly accelerated linear motion. **1**

8) Consider that the acceleration of a moving body varies with timewe.What does the area under acceleration - time graph for any time interval represnt? **1**

9) Find the acceleration and velocity of a ball at the instant it reaches its highest point it was thrown up with velocity v. **1**

10) Two particles A and B are moving along the same straight line. B is ahead of A. Velocities remaining unchanged, what would be effect on the magnitude of relative velocity if A ahead of B? **1**

Section-B

11) A bus starting from rest moves with a uniform acceleration of 0.1 m / s^2 for 2 min. Find the **2**
(i) the speed acquired
(ii) the distance travelled.

12) Points P, Q and R are in a vertical line such that PQ = QR. A ball at P is allowed to fall freely. What is the ratio of the times of descent through PQ and QR ? **2**

13) Explain how an object could have zero avaerage velocity but non-zero average speed? **2**

14) Thye position x of a body is given by x = A sin(wt). Find the time at which the displacements is maximum. **2**

15) the velocity of a particle is gievn by equation **2**
$v = 4 + 2(C_1 + C_2t)$
where , C_1 and C_2 are constant .Find the intial velocity and acceleration of the particle.

16) The data regarding the motion of two different objects P and Q are given in the following table.Examine them carefully ad state whether the motion of the objects is unifrom or non-unifrom. **2**

17) A body travels with a velocity v_1 for time t_1 and with a velocity v_2 for time t_2 find the average velocity of the body for the total time. **2**

18) Two bodies of different masses m_1 and m_2 are dropped from two different heights a and b.What is the ratio of tyime taken by the two bodies to drop through these distances? **2**

19) A car accelerates from rest at a constant rate $\alpha$for some time, after which it decelerates at a constant rate β to come to rest. If t is total time elapsed, then calculate **2**

(i)the maximum velocity attained by the car

(ii)the total distance travelled by the car

20) A woman starts from her home at 9:00 am walks with a speed of 5 km/h on straight road up to her office 2.5 km away, stays at the office up to 5.00 pm and returns home by an auto with a speed of 25 km/h. Choose suitable scales and plot the x-t graph of her motion. **2**

Section-C

21) Two parallel rail tracks run North-South.Train A moves North with a speed of 54 kmh-1. and train B moves South with a speed of 90 kmh-1 . What is the relative velocity of ground with respect to B? **5**

22) It is a common observation that rain clouds can be at about a kilometre altitude above the ground. Rate of change of momentum is force.Estimate how much force such a drop would exert on you? **5**

23) It is a common observation that rain clouds can be at about a kilometre altitude above the ground. Estimate the order of magnitude force on umbrella. Typical lateral separation between two rain drops is 5cm. **5**

24) A train takes 4 min to go between stations 2.25 km apart starting and finishing at rest. The acceleration is uniform for the first 40 s and the deceleration is uniform for the last 20 s. Assuming the velocity to be constant for the remaining time, calculate the maximum speed, acceleration and retardation, use only the graphical method. **5**

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Section-A

1) An object can be considered as a point object if the distance travelled by it is very large than its size. **1**

2) No, because the size of the beaker is not negligible as compared to the height of the table. **1**

3) It is true because if the velocity of the object is negative, then slope of v-t graph is negative. **1**

4) The velocity of the paritcle is zero bacuse the slope of x-t graph is zero. **1**

5) $\frac{v_y}{v_x} = \frac{tan60^o}{tan30^o} = \frac{\sqrt{3}}{1/\sqrt{3}} = 3:1$ **1**

6) **1**

No, because velocity is a speed with direction. Therefore, abody having constant velocity cannot have a varying speed.

7) Motion of a body under gravity. **1**

8) **1**

The area under acceleration - y time graph for many time interval represents the change of velocity of the body during that time interval.

9) Acceleration is 9.8 m/s^2 (downwards) and velocity is zero at the highest point. **1**

10) There will be no effect on the magnitude of relative velocity. **1**

Section-B

11) (i) u = 0, a = 0.1 m / s^2 and t = 2 min 120 m / s **2**

v = u + at

= 0 + 0.1 × 120

= 12 m / s

(ii) u = 0, a = 0.1 m / s^2 and t = 2 min 120 m / s

$v = ut + \frac{1}{2}at^2$

$= 0 + \frac{1}{2} \times 0.1 \times (120)^2$

$= \frac{1}{2} \times 0.1 \times 120 \times 120$

= 720 m

12) Let t_1 and t_2 be the times of descent through PQ and QR respectively. **2**

Let PQ = QR = h

Then, $h = \frac{1}{2} g \times t_1^2$ and $2h = \frac{1}{2} g (t1 + t2)^2$

By dividing , we get

$\frac{1}{2} = \frac{t_1^2}{(t_1+t_2)^2}$ or $\frac{1}{\sqrt{2}} = \frac{t_1}{t_1+t_2}$

Hence, $t_1 : t_2 = 1 : (\sqrt{2} - 1)$

13) Average velocity, **2**

$$v = \frac{Net \quad displacement}{Total \quad time \quad taken}$$

and aveae speed,

$$S_{av} = \frac{Total \quad distance \quad travelled}{Total \quad time \quad taken}$$

If an object moves along a straight line starting from origin and then returns back to origin.

Average velocity = 0

and

Average speed = $\frac{2s}{t}$

14) The value of position x will be maximum, when the value of sin (wt) is maximum for this **2**

$$sin(\omega t) = 1 = sin \quad \pi/2$$

or

$$\omega t = \frac{\pi}{2} \Rightarrow t = \left(\frac{\pi}{2\omega}\right)$$

15) The given equation is $v = 4 + 2(C_1 + C_2 t)$ **2**

$v = (4 + 2C_1) + 2C_2 t$

Comparing the above equations with equation of motion

v = u +at

Intial velocity, $u = 4 + 2C_1$

Acceleration of the particle = $2C_2$

16) **2**

Time	Distance travelled by object P (in m)	Distance travelled by object E (in m)
9:30 am	10	12
9:45 am	20	19
10:00 am	30	23
10:15 am	40	35
10:30 am	50	37
10:45 am	60	41
11:00 am	70	44

17) Displacement travelled in time **2**

$(t_1 + t_2) = s_1 + s_2$

$= v_1t_1 + v_2t_2$

Average velocity $= \frac{Net\ \ displacement}{Total\ \ time\ \ taken} = \frac{v_1t_1 + v_2t_2}{(t_1 + t_2)}$

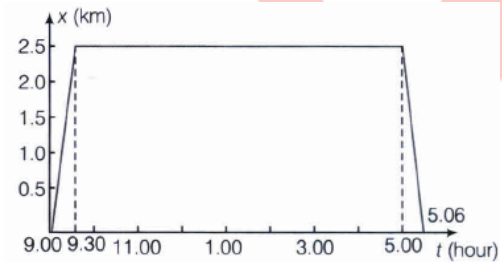
18) $\sqrt{a} : \sqrt{b}$ **2**

19) (i) $\frac{\alpha\beta t}{\alpha + \beta}$, **2**

(ii) $\frac{1}{2}\frac{(\alpha\beta t)^2}{2(\alpha + \beta)}$

20) Time taken in reaching the office=$\frac{distance}{speed} = \frac{2.5}{5} = 0.5h$ **2**

Time taken in returning from office $= \frac{2.5}{25} = 0.1h = 6min$



It means that woman reaches the office at 9:30 am and returns home at 5:06 pm.

Section-C

21) **5**

Taking South to North direction as the positive direction

i.e., x-axis, we have

$v_A = +54km/h = \frac{54 \times 1000}{3600} ms^{-1} = 15ms^{-1} v_B = -90km/h = \frac{90 \times 1000}{3600} ms^{-1} = -25ms^{-1}$

Relative velocity of monkey with respect to train B

$=0-v_B=0+25=25ms^{-1}$

So, to an observer in train B, the Earth appears to move with a speed of 25 m/s from South to North.

22) Force exerted by a rain drop **5**

$F = \frac{Change\ \ in\ \ momentum}{Time} = \frac{\rho - 0}{t} = \frac{4.7 \times 10^{-3}}{2.8 \times 10^{-5}} \approx 168N$

23) Radius of the umbrella(R)=$\frac{1}{2}m$ **5**

$\therefore \quad Area \quad of \quad the \quad umbrella(A) = \pi R^2 = \frac{22}{7} \times (\frac{1}{2})^2 = \frac{22}{28} = \frac{11}{14} \approx 0.8m^2$

Number of drops striking the umbrella simultaneously with average of 5cm or 5 x 10^{-2}m

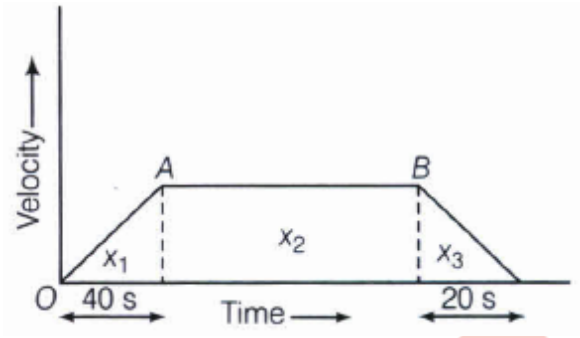
$= \frac{0.8}{(5 \times 10^{-2})^2} = 320$

Net force exerted on umbrella

=320x168=53760N

24) **5**

The velocity-time graph of the train's motion is shown in the following figure.



Let v represents the maximum speed of the train if XI be the distance covered during the first 40 s, then

$\frac{v}{2} \times 40 = x_1 or x_1 = 20v$

Since total time is 4 min, i.e. 240 s therefore, the time corresponding to velocity-time graph AB is (240 - 40 - 20) s

Le. 180 s. If x_2 be the distance covered during this time, then x_2 =180 v.

If x_3 be the distance covered during the last 20 s, then

$x_3 = \frac{v}{2} \times 20 = 10v x_1 + x_2 + x_3 = 20v + 180v + 10v \qquad 2250 = 210v \qquad v = \frac{225}{21} ms^{-1} = 10.7 ms^{-1}$

Acceleration=$\frac{v}{40} = \frac{10.7}{40} ms^{-2} = 0.2675 ms^{-2}$

Retardation=$\frac{v}{20} = \frac{10.7}{20} ms^{-2} = 0.535 ms^{-2}$