DPP - Daily Practice Problems

Name : 　　　　　　　　Date :

Start Time : 　　　　　　End Time :

PHYSICS 03

SYLLABUS : MOTION IN A STRAIGHT LINE 1 (Distance, Displacement, Uniform & Non-uniform motion)

Max. Marks : 116 　　　　　　**Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 29 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.20) : There are 20 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** choice is correct.

Q.1 A particle moving in a straight line covers half the distance with speed of 3 m/s. The other half of the distance is covered in two equal time intervals with speed of 4.5 m/s and 7.5 m/s respectively. The average speed of the particle during this motion is

(a) 4.0 m/s (b) 5.0 m/s
(c) 5.5 m/s (d) 4.8 m/s

Q.2 The acceleration of a particle is increasing linearly with time t as bt. The particle starts from the origin with an initial velocity v_0. The distance travelled by the particle in time t will be

(a) $v_0 t + \frac{1}{3}bt^2$ (b) $v_0 t + \frac{1}{3}bt^3$
(c) $v_0 t + \frac{1}{6}bt^3$ (d) $v_0 t + \frac{1}{2}bt^2$

Q.3 The motion of a body is given by the equation $\frac{dv(t)}{dt} = 6.0 - 3v(t)$, where v(t) is speed in m/s and t in sec.

If body was at rest at t = 0

(a) The terminal speed is 4 m/s
(b) The speed varies with the time as $v(t) = 2(1 - e^{-5t})$m/s
(c) The speed is 0.1m/s when the acceleration is half the initial value
(d) The magnitude of the initial acceleration is 6.0 m/s^2

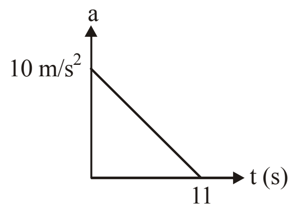
RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ

Space for Rough Work

Q.4 A particle of mass m moves on the x-axis as follows: it starts from rest at t = 0 from the point x = 0 and comes to rest at t = 1 at the point x = 1. No other information is available about its motion at intermediate time ($0 < t < 1$). If α denotes the instantaneous acceleration of the particle, then

(a) α cannot remain positive for all t in the interval $0 \le t \le 1$
(b) $|\alpha|$ cannot exceed 2 at any point in its path
(c) $|\alpha|$ must be > 4 at some point or points in its path
(d) $|\alpha| = 2$ at any point in its path.

Q.5 A particle starts from rest. Its acceleration (a) versus time (t) graph is as shown in the figure. The maximum speed of the particle will be



(a) 110 m/s (b) 55 m/s
(c) 550 m/s (d) 660 m/s

Q.6 A car accelerates from rest at a constant rate α for some time, after which it decelerates at a constant rate β and comes to rest. If the total time elapsed is t, then the maximum velocity acquired by the car is

(a) $\left(\dfrac{\alpha^2+\beta^2}{\alpha\beta}\right)t$ (b) $\left(\dfrac{\alpha^2-\beta^2}{\alpha\beta}\right)t$

(c) $\dfrac{(\alpha+\beta)t}{\alpha\beta}$ (d) $\dfrac{\alpha\beta t}{\alpha+\beta}$

Q.7 A small block slides without friction down an inclined plane starting from rest. Let S_n be the distance travelled from time t = n – 1 to t = n. Then $\dfrac{S_n}{S_{n+1}}$ is

(a) $\dfrac{2n-1}{2n}$ (b) $\dfrac{2n+1}{2n-1}$ (c) $\dfrac{2n-1}{2n+1}$ (d) $\dfrac{2n}{2n+1}$

Q.8 A particle starts moving from the position of rest under a constant acc. If it covers a distance x in t second, what distance will it travel in next t second?

(a) x (b) 2 x (c) 3 x (d) 4 x

Q.9 What will be the ratio of the distances moved by a freely falling body from rest in 4th and 5th seconds of journey?

(a) 4 : 5 (b) 7 : 9 (c) 16 : 25 (d) 1 : 1

Q.10 If a ball is thrown vertically upwards with speed u, the distance covered during the last t seconds of its ascent is

(a) (u+gt)t (b) ut (c) $\dfrac{1}{2}gt^2$ (d) $ut - \dfrac{1}{2}gt^2$

Q.11 If the displacement of a particle is $(2t^2 + t + 5)$ meter then, what will be acc. at t = 5 second?

(a) 21 m/s^2 (b) 20 m/s^2
(c) 4 m/s^2 (d) 10 m/s^2

Q.12 A particle moves along x-axis with acceleration $a = a_0(1 - t/T)$ where a_0 and T are constants if velocity at t = 0 is zero then find the average velocity from t = 0 to the time when a = 0.

(a) $\dfrac{a_0T}{3}$ (b) $\dfrac{a_0T}{2}$ (c) $\dfrac{a_0T}{4}$ (d) $\dfrac{a_0T}{5}$

Q.13 A point moves with uniform acceleration and v_1, v_2 and v_3 denote the average velocities in the three successive intervals of time t_1, t_2 and t_3. Which of the following relations is correct ?

(a) $(v_1 - v_2) : (v_2 - v_3) = (t_1 - t_2) : (t_2 + t_3)$
(b) $(v_1 - v_2) : (v_2 - v_3) = (t_1 + t_2) : (t_2 + t_3)$
(c) $(v_1 - v_2) : (v_2 - v_3) = (t_1 - t_2) : (t_2 - t_3)$
(d) $(v_1 - v_2) : (v_2 - v_3) = (t_1 - t_2) : (t_2 - t_3)$

Q.14 The position of a particle moving in the xy-plane at any time t is given by $x = (3t^2 - 6t)$ metres, $y = (t^2 - 2t)$ metres. Select the correct statement about the moving particle from the following

(a) The acceleration of the particle is zero at t = 0 second
(b) The velocity of the particle is zero at t = 0 second
(c) The velocity of the particle is zero at t = 1 second
(d) The velocity and acceleration of the particle are never zero

RESPONSE GRID					
	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ
	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ
	14. ⓐⓑⓒⓓ				

Space for Rough Work

Q.15 Two cars A and B are travelling in the same direction with velocities v_1 and v_2 ($v_1 > v_2$). When the car A is at a distance d ahead of the car B, the driver of the car A applied the brake producing a uniform retardation a. There will be no collision when

(a) $d < \frac{(v_1 - v_2)^2}{2a}$ (b) $d < \frac{v_1^2 - v_2^2}{2a}$

(c) $d > \frac{(v_1 - v_2)^2}{2a}$ (d) $d > \frac{v_1^2 - v_2^2}{2a}$

Q.16 A body travels for 15 second starting from rest with constant acceleration. If it travels distances S_1, S_2 and S_3 in the first five seconds, second five seconds and next five seconds respectively the relation between S_1, S_2 and S_3 is

(a) $S_1 = S_2 = S_3$ (b) $5S_1 = 3S_2 = S_3$

(c) $S_1 = \frac{1}{3}S_2 = \frac{1}{5}S_3$ (d) $S_1 = \frac{1}{5}S_2 = \frac{1}{3}S_3$

Q.17 The position of a particle moving along the x-axis at certain times is given below

$t(s)$	0	1	2	3
$x(m)$	–2	0	6	16

Which of the following describes the motion correctly?
(a) Uniform, accelerated
(b) Uniform, decelerated
(c) Non-uniform, accelerated
(d) There is not enough data for generalization

Q.18 A body A moves with a uniform acceleration a and zero initial velocity. Another body B, starts from the same point moves in the same direction with a constant velocity v. The two bodies meet after a time t. The value of t is

(a) $\frac{2v}{a}$ (b) $\frac{v}{a}$

(c) $\frac{v}{2a}$ (d) $\sqrt{\frac{v}{2a}}$

Q.19 A particle moves along x-axis as $x = 4(t - 2) + a(t - 2)^2$
Which of the following is true?
(a) The initial velocity of particle is 4
(b) The acceleration of particle is 2a
(c) The particle is at origin at t = 0
(d) None of these

Q.20 The displacement x of a particle varies with time t, $x = ae^{-\alpha t} + be^{\beta t}$, where a, b, α and β are positive constants. The velocity of the particle will
(a) Go on decreasing with time
(b) Be independent of α and β
(c) Drop to zero when α = β
(d) Go on increasing with time

DIRECTIONS (Q.21-Q.23) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :
(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct
(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.21 A particle moves as such acceleration is given by a = 3 sin 4t, then :
(1) the acceleration of the particle becomes zero after each interval of $\frac{\pi}{4}$ second
(2) the initial velocity of the particle must be zero
(3) the particle comes at its initial position after sometime
(4) the particle must move on a circular path

Q.22 A reference frame attached to the earth :
(1) is an inertial frame by definition
(2) cannot be an inertial frame because the earth is revolving round the sun
(3) is an inertial frame because Newton's laws are applicable in this frame
(4) cannot be an inertial frame because the earth is rotating about its own axis

RESPONSE GRID					
	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ
	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ		

Space for Rough Work

Q.23 If a particle travels a linear distance at speed v_1 and comes back along the same track at speed v_2.
(1) Its average speed is arithmetic mean $(v_1 + v_2)/2$
(2) Its average speed is harmonic mean $2\, v_1 v_2/(v_1 + v_2)/2$
(3) Its average speed is geometric mean $\sqrt{v_1 v_2}$
(4) Its average velocity is zero

DIRECTION (Q.24-Q.26) : Read the passage given below and answer the questions that follows :

A particle moves along x-axis and its acceleration at any time t is $a = 2\sin(\pi t)$, where t is in seconds and a is in m/s^2. The initial velocity of particle (at time t = 0) is u = 0.

Q.24. The distance travelled (in meters) by the particle from time to t = 0 to t = 1s will be –
(a) $\frac{2}{\pi}$ (b) $\frac{1}{\pi}$
(c) $\frac{4}{\pi}$ (d) None of these

Q.25 The distance travelled (in meters) by the particle from time t = 0 to t = t will be –
(a) $\frac{2}{\pi^2}\sin\pi t - \frac{2t}{\pi}$ (b) $-\frac{2}{\pi^2}\sin\pi t + \frac{2t}{\pi}$
(c) $\frac{2t}{\pi}$ (d) None of these

Q.26 The magnitude of displacement (in meters) by the particle from time t = 0 to t = t will be –
(a) $\frac{2}{\pi^2}\sin\pi t - \frac{2t}{\pi}$ (b) $-\frac{2}{\pi^2}\sin\pi t + \frac{2t}{\pi}$
(c) $\frac{2t}{\pi}$ (d) None of these

DIRECTIONS (Qs. 27-Q.29) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(c) Statement -1 is False, Statement-2 is True.
(d) Statement -1 is True, Statement-2 is False.

Q.27 Statement-1 : The position-time graph of a uniform motion in one dimension of a body can have negative slope.
Statement-2 : When the speed of body decreases with time, the position-time graph of the moving body has negative slope.

Q.28 Statement-1 : A body having non-zero acceleration can have a constant velocity.
Statement-2 : Acceleration is the rate of change of velocity.

Q.29 Statement-1 : Displacement of a body may be zero when distance travelled by it is not zero.
Statement-2 : The displacement is the longest distance between initial and final position.

RESPONSE GRID					
	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ
	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ			

DAILY PRACTICE PROBLEM SHEET 3 - PHYSICS			
Total Questions	29	Total Marks	116
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	28	Qualifying Score	48
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

PHYSICS SOLUTIONS 03

1. (a) If t_1 and 2 t_2 are the time taken by particle to cover first and second half distance respectively.

$$t = \frac{x/2}{3} = \frac{x}{6} \quad ...(i)$$

$x_1 = 4.5t_2$ and $x_2 = 7.5\, t_2$

So, $x_1 + x_2 = \frac{x}{2} \Rightarrow 4.5t_2 + 7.5t_2 = \frac{x}{2}$

$$t_2 = \frac{x}{24} \quad ...(ii)$$

Total time t = $t_1 + 2t_2 = \frac{x}{6} + \frac{x}{12} = \frac{x}{4}$

So,average speed = 4 m/sec.

2. (c) $\frac{dv}{dt} = bt \Rightarrow dv = bt\,dt \Rightarrow v = \frac{bt^2}{2} + K_1$

At $t = 0, v = v_0 \Rightarrow K_1 = v_0$

We get $v = \frac{1}{2}bt^2 + v_0$

Again $\frac{dx}{dt} = \frac{1}{2}bt^2 + v_0 \Rightarrow x = \frac{1}{2}\frac{bt^2}{3} + v_0t + K_2$

At $t = 0,\ x = 0 \Rightarrow K_2 = 0$

$\therefore\ x = \frac{1}{6}bt^3 + v_0t$

3. (d) $\frac{dv}{dt} = 6 - 3v \Rightarrow \frac{dv}{6-3v} = dt$

Integrating both sides, $\int \frac{dv}{(6-3v)} = \int dt$

$\Rightarrow \frac{\log_e(6-3v)}{-3} = t + K_1$

$\Rightarrow \log_e(6-3v) = -3t + K_2 \quad ....(i)$

At t = 0, v = 0 $\Rightarrow \log_e 6 = K_2$

Substituting the value of K_2 in equation (i)

$\log_e(6-3v) = -3t + \log_e 6$

$\Rightarrow \log_e\left(\frac{6-3v}{6}\right) = -3t \Rightarrow e^{-3t} = \frac{6-3v}{6}$

$\Rightarrow 6 - 3v = 6e^{-3t} \Rightarrow 3v = 6(1-e^{-3t})$

$\Rightarrow v = 2(1-e^{-3t})$

$\therefore\ v_{terminal} = 2$ m/s (when t = ∞)

Acceleration a = $\frac{dv}{dt} = \frac{d}{dt}\left[2(1-e^{-3t})\right] = 6e^{-3t}$

Initial acceleration = 6 m/s^2.

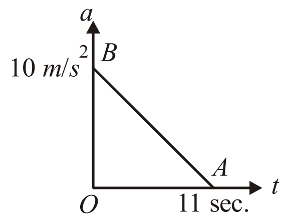
4. (a) The body starts from rest at x = 0 and then again comes to rest at x = 1. It means initially acceleration is positive and then negative.

So we can conclude that α can not remain positive for all t in the interval $0 \le t \le 1$ i.e. α must change sign during the motion.

5. (b) The area under acceleration time graph gives change in velocity. As acceleration is zero at the end of 11 sec.

i.e. v_{max} = Area of ΔOAB

$$= \frac{1}{2} \times 11 \times 10 = 55 \text{ m/s}$$



6. (d) Let the car accelerate at rate a for time t_1 then maximum velocity attained, $v = 0 + \alpha t_1 = \alpha t_1$

Now, the car decelerates at a rate β for time $(t - t_1)$ and finally comes to rest. Then,

$0 = v - \beta(t - t_1)$

$\Rightarrow 0 = \alpha t_1 - \beta t + \beta t_1$

$\Rightarrow t_1 = \frac{\beta}{\alpha+\beta}t$

$\Rightarrow v = \frac{\alpha\beta}{\alpha+\beta}t$

7. (c) $S_n = u + \frac{a}{2}(2n-1)$

$= \frac{a}{2}(2n-1)\ (\because u = 0)$

$S_{n+1} = \frac{a}{2}[2(n+1)-1] = \frac{a}{2}(2n+1)$

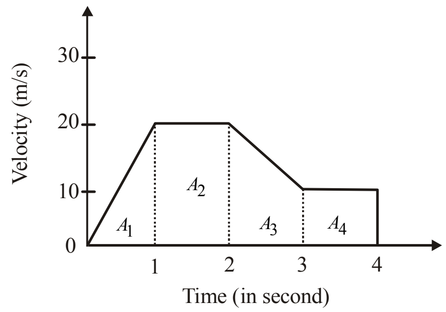
$\therefore\ \frac{S_n}{S_{n+1}} = \frac{2n-1}{2n+1}$

8. (b) Distance = Area under v – t graph

$= A_1 + A_2 + A_3 + A_4$

$= \frac{1}{2} \times 1 \times 20 + (20 \times 1) + \frac{1}{2}(20+10) \times 1 + (10 \times 1)$

$= 10 + 20 + 15 + 10 = 55$ m



9. **(c)** As acc. is constant so from $s = ut + \frac{1}{2}at^2$ we have

$$x = \frac{1}{2}at^2 \quad [u = 0] \qquad ....(i)$$

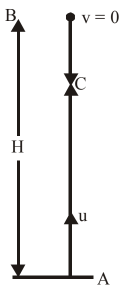
Now if it travels a distance y in next t sec.
in 2t sec total distance travelled

$$x + y = \frac{1}{2}a(2t)^2 \qquad ....(ii) \qquad (t + t = 2t)$$

Dividing eq^n. (ii) by eq^n (i), $\frac{x+y}{x} = 4$ or $y = 3x$

10. **(b)** $\frac{x(4)}{x(5)} = \frac{\frac{g}{2}(2\times4-1)}{\frac{g}{2}(2\times5-1)} = \frac{7}{9}$ $\quad \left[\because S_{n^{th}} = u + \frac{a}{2}(2n-1)\right]$

11. **(c)** Let body takes T sec to reach maximum height.
Then $v = u - gT$
$v = 0$, at highest point.



$$T = \frac{u}{g} \qquad ....[1]$$

Velocity attained by body in (T – t) sec
$v = u - g(T - t)$

$$= u - gT + gt = u - g\frac{u}{g} + gt$$

or $v = gt$ ....(2)

$\therefore$ Distance travelled in last t sec of its ascent

$$S = (gt)t - \frac{1}{2}gt^2 = \frac{1}{2}gt^2$$

12. **(c)** $v = \frac{dx}{dt} = \frac{d}{dt}(2t^2 + t + 5) = 4t + 1$ m/s

and $a = \frac{dv}{dt} = \frac{d}{dt}(4t+1)$; $a = 4$ m/s^2

13. **(a)** $\frac{dv}{dt} = a_0\left(1 - \frac{t}{T}\right)$

$$\Rightarrow \int_0^v dv = \int_0^t a_0\left(1 - \frac{t}{T}\right)dt \Rightarrow v = a_0\left(t - \frac{t^2}{2T}\right)$$

$$\because \frac{dx}{dt} = v \text{ so, } \int dx = \int v\,dt \Rightarrow x = \int_0^t a_0\left(t - \frac{t^2}{2T}\right)dt$$

$$\Rightarrow x = a_0\left(\frac{t^2}{2} - \frac{t^3}{6T}\right) \qquad \because a = 0 \Rightarrow t = T$$

$$\text{Average velocity} = \frac{\text{displacement}}{\text{time}}$$

$$= \frac{a_0\left(\frac{T^2}{2} - \frac{T^3}{6T}\right)}{T} = \frac{a_0T}{3}$$

14. **(b)** Let u_1, u_2, u_3 and u_4 be velocities at time $t = 0$, t_1, $(t_1 + t_2)$ and $(t_1 + t_2 + t_3)$ respectively and acceleration is a then

$$v_1 = \frac{u_1 + u_2}{2}, v_2 = \frac{u_2 + u_3}{2} \text{ and } v_3 = \frac{u_3 + u_4}{2}$$

Also $u_2 = u_1 + at_1$, $u_3 = u_1 + a(t_1 + t_2)$
and $u_4 = u_1 + a(t_1 + t_2 + t_3)$
By solving, we get

$$\frac{v_1 - v_2}{v_2 - v_3} = \frac{(t_1 + t_2)}{(t_2 + t_3)}$$

15. **(c)** $v_x = \frac{dx}{dt} = \frac{d}{dt}(3t^2 - 6t) = 6t - 6$. At $t = 1$, $v_x = 0$

$v_y = \frac{dy}{dt} = \frac{d}{dt}(t^2 - 2t) = 2t - 2$. At $t = 1$, $v_y = 0$

Hence $v = \sqrt{v_x^2 + v_y^2} = 0$

16. **(c)** Initial relative velocity $= v_1 - v_2$.
Final relative velocity $= 0$
From $v^2 = u^2 - 2as$

$\Rightarrow$ $0 = (v_1 - v_2)^2 - 2 \times a \times s$

$$\Rightarrow s = \frac{(v_1 - v_2)^2}{2a}$$

If the distance between two cars is 's' then collision will take place. To avoid collision $d > s$

$$\therefore d > \frac{(v_1 - v_2)^2}{2a}$$

where d = actual initial distance between two cars.

17. **(c)** If the body starts from rest and moves with constant acceleration then the ratio of distances in consecutive equal time interval $S_1 : S_2 : S_3 = 1 : 3 : 5$

18. **(c)** Instantaneous velocity $v = \frac{\Delta x}{\Delta t}$

By using the data from the table

$$v_1 = \frac{0-(-2)}{1} = 2\text{m/s}, \quad v_2 = \frac{6-0}{1} = 6\text{m/s},$$

$$v_3 = \frac{16-6}{1} = 10\text{m/s}$$

So, motion is non-uniform but accelerated.

19. **(a)** $\frac{1}{2}at^2 = vt \Rightarrow t = \frac{2v}{a}$

20. **(b)** $x = 4(t-2) + a(t-2)^2$

At $t = 0$, $x = -8 + 4a = 4a - 8$

$$v = \frac{dx}{dt} = 4 + 2a(t-2)$$

At $t = 0$, $v = 4 - 4a = 4(1 - a)$

But acceleration, $a = \frac{d^2x}{dt^2} = 2a$

21. **(d)** $x = ae^{-\alpha t} + be^{\beta t}$

Velocity $v = \frac{dx}{dt} = \frac{d}{dt}(ae^{-\alpha t} + be^{\beta t})$

$= a.e^{-\alpha t}(-\alpha) + be^{\beta t}(\beta) = -a\alpha e^{-\alpha t} + b\beta e^{\beta t}$

Acceleration $= -a\alpha e^{-\alpha t}(-\alpha) + b\beta e^{\beta t}.\beta$

$= a\alpha^2 e^{-\alpha t} + b\beta^2 e^{\beta t}$

Acceleration is positive so velocity goes on increasing with time.

22. **(d)** (1) $a = 3 \sin 4t$

$\Rightarrow \frac{dv}{dt} = 3\sin 4t$

$\Rightarrow \int dv = \int 3\sin 4t\ dt + c$

$\Rightarrow v = \frac{-3}{4}\cos 4t + c$

For initial velocity, $t = 0$

$v_0 = -\frac{3}{4} + C$

At particular value of $C = \frac{3}{4}$, $v_0 = 0$

Therefore, initial velocity may or may not be zero.

(2) Acceleration = 0

$\Rightarrow a = 3\sin 4t = 0 \Rightarrow \sin 4t = 0$

$\Rightarrow 4t = n\pi \quad \Rightarrow t = \frac{n\pi}{4}$

where $n = 0, 1, 2, \ldots$

Therefore, the acceleration of the particle becomes zero after each interval of $\frac{\pi}{4}$ second.

(3) As acceleration is sinusoidal function of time, so particle repeats its path periodically. Thus, the particle comes to its initial position after sometime (period of function).

(4) The particle moves in a straight line path as it performs S.H.M.

Since (1) & (3) are correct, hence correct answer is (d).

23. **(c)** For an inertial frame of reference, its acceleration should be zero. As reference frame attached to the earth i.e. a rotating or revolving frame is accelerating, therefore, it will be non-inertial.

Thus (2) & (4) are correct, so correct answer is (c).

24. **(c)** Average speed

$$= \frac{\text{Total distance}}{\text{Total time}} = \frac{2x}{\frac{x}{v_1} + \frac{x}{v_2}} = \frac{2v_1v_2}{v_1 + v_2}$$

Average velocity $= \frac{\text{Total displacement}}{\text{Total time}}$

$\because$ It comes back to its initial position

$\therefore$ Total displacement is zero.

Hence, average velocity is zero.

Sol. For Qs. 25-27. $a = \sin \pi t$

$\therefore \int dv = \int 2\sin \pi t\ dt$ or $v = -\frac{2}{\pi}\cos \pi t + C$

At $t = 0$, $v = 0$ $\therefore C = \frac{2}{\pi}$ or $v = \frac{2}{\pi}(1 - \cos \pi t)$

Velocity is always non-negative, hence particle always moves along positive x-direction.

$\therefore$ Distance from time $t = 0$ to $t = t$ is

$$S = \int_0^t \frac{2}{\pi}(1 - \cos \pi t)\ dt = \frac{2}{\pi}\left(t - \frac{1}{\pi}\sin \pi t\right)\Bigg|_0^t = \frac{2}{\pi}t - \frac{2}{\pi^2}\sin \pi t$$

Also displacement from time $t = 0$ to $t = \frac{2t}{\pi} - \frac{2}{\pi^2}\sin \pi t$

Distance from time $t = t$ to $t = 1s = \frac{2}{\pi}$ meters.

25. **(a)** **26.** (b) **27.** (b)

28. **(d)** Negative slope of position time graph represents that the body is moving towards the negative direction and if the slope of the graph decrease with time then it represents the decrease in speed i.e. retardation in motion.

29. **(c)** As per definition, acceleration is the rate of change of velocity,

i.e. $\vec{a} = \frac{d\vec{v}}{dt}$.

If velocity is constant

$\frac{d\vec{v}}{dt} = 0, \therefore \vec{a} = 0$

Therefore, if a body has constant velocity it cannot have non zero acceleration.

30. **(d)** The displacement is the shortest distance between initial and final position. When final position of a body coincides with its initial position, displacement is zero, but the distance travelled is not zero.