31 Years NEET CHAPTER-WISE SOLUTIONS with NCERT References

PHYSICS

Only Book with NCERT Based References

Includes NEET 2018 Exam Paper

(1988-2018)

Aim4 AIIMS NEET

ALTIS VORTEX

2 Motion in a Straight Line

1. Preeti reached the metro station and found that the escalator was not working. She walked up the stationary escalator in time t_1. On other days, if she remains stationary on the moving escalator, then the escalator takes her up in time t_2. The time taken by her to walk up on the moving escalator will be: (2017-Delhi)

a. $\frac{t_1t_2}{t_2 - t_1}$ b. $\frac{t_1t_2}{t_2 + t_1}$

c. $t_2 - t_1$ d. $\frac{t_1 + t_2}{2}$

2. The 'x' and 'y' coordinates of the particle at any time are 'x' = $5t - 2t^2$ and 'y' = 10t, respectively, where 'x' and 'y' are in metres and 't' in seconds. The acceleration of the particle at t = 2 s is: (2017-Delhi)

a. 5 m/s^2 b. –4 m/s^2

c. –8 m/s^2 d. 0

3. A ball of mass 1 kg is thrown vertically upwards and returns to the ground after 3 seconds. Another ball, thrown at 60^0 with vertical also stays in air for the same time before it touches the ground. The ratio of the two heights are: (2017-Gujarat)

a. 1 : 3 b. 1 : 2 c. 1 : 1 d. 2 : 1

4. A bullet of mass 10 g moving horizontally with a velocity of 400 ms^{-1} strikes a wooden block of mass 2 kg which is suspended by a light inextensible string of length 5 m. As a result, the center of gravity of the block is found to rise a vertical distance of 10 cm. The speed of the bullet after it emerges out horizontally from the block will be: (2016 - II)

a. 120 ms^{-1} b. 160 ms^{-1}

c. 100 ms^{-1} d. 80 ms^{-1}

5. Two cars P and Q start from a point at the same time in a straight line and their positions are represented by $X_P(t) = at + bt^2$ and $X_Q(t) = ft - t^2$. At what time do the cars have the same velocity? (2016 - II)

a. $\frac{a+f}{2(1+b)}$ b. $\frac{f-a}{2(1+b)}$

c. $\frac{a-f}{1+b}$ d. $\frac{a+f}{2(b-1)}$

6. If the velocity of a particle is $v = At + Bt^2$, where A and B are constants, then the distance travelled by it between 1 s and 2 s is: (2016 - I)

a. $\frac{3}{2}A + 4B$ b. 3A + 7B

c. $\frac{3}{2}A + \frac{7}{3}B$ d. $\frac{A}{2} + \frac{B}{3}$

7. A particle of unit mass undergoes one dimensional motion such that its velocity varies according to $v(x) = \beta x^{-2n}$ where β and n are constants and x is the position of the particle. The acceleration of the particle as a function of $\boldsymbol{x}$, is given by: (2015)

a. $-2n\beta^2 x^{-4n-1}$ b. $-2\beta^2 x^{-2n+1}$

c. $-2n\beta^2 e^{-4n+1}$ d. $-2n\beta^2 x^{-2n-1}$

8. A stone falls freely under gravity. It covers distances h_1, h_2 and h_3 in the first 5 seconds, the next 5 seconds and the next 5 seconds respectively. The relation between h_1, h_2 and h_3 is: (2013)

a. $h_1 = h_2 = h_3$ b. $h_1 = 2h_2 = 3h_3$

c. $h_1 = \frac{h_2}{3} = \frac{h_3}{5}$ d. $h_2 = 3h_1$ and $h_3 = 3h_2$

9. The motion of a particle along a straight line is described by equation : $x = 8 + 12t - t^3$ where x is in metre and t in second. The retardation of the particle when its velocity becomes zero, is: (2012 Pre)

a. 24 ms^{-2} b. Zero

c. 6 ms^{-2} d. 12 ms^{-2}

10. A particle covers half of its total distance with speed v_1 and the rest half distance with speed v_2. Its average speed during the complete journey is: (2011 Mains)

a. $\frac{v_1v_2}{v_1 + v_2}$ b. $\frac{2v_1v_2}{v_1 + v_2}$

c. $\frac{v_1^2v_2^2}{v_1^2 + v_2^2}$ d. $\frac{v_1v_2}{2}$

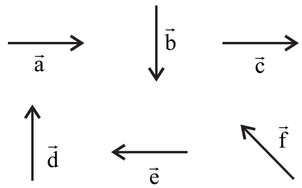
11. A boy standing at the top of a tower of 20 m height drops a stone. Assuming g = 10 m/s^2, the velocity with which it hits the ground is: (2011 Pre)

a. 10.0 m/s b. 20.0 m/s
c. 40.0 m/s d. 5.0 m/s

12. A particle has initial velocity $3\hat{i}+4\hat{j}$ and has acceleration $0.4\hat{i}+0.3\hat{j}$. Its speed after 10 s is: (2010 Pre)

a. 10 units b. 7 units
c. $7\sqrt{2}$ units d. 8.5 units

13. Six vectors, $\vec{a}$ through $\vec{f}$ have the magnitudes and directions indicated in the figure. Which of the following statements is true? (2010 Pre)



a. $\vec{b}+\vec{e}=\vec{f}$ b. $\vec{b}+\vec{c}=\vec{f}$
c. $\vec{d}+\vec{c}=\vec{f}$ d. $\vec{d}+\vec{e}=\vec{f}$

14. A particle moves a distance x in time t according to equation $x = (t + 5)^{-1}$. The acceleration of particle is proportional to: (2010 Pre)

a. $(\text{Velocity})^{2/3}$ b. $(\text{Velocity})^{3/2}$
c. $(\text{Distance})^2$ d. $(\text{Distance})^{-2}$

15. A particle starts its motion from rest under the action of a constant force. If the distance covered in first 10 seconds is S_1 and that covered in the first 20 seconds is S_2, then: (2009)

a. $S_2 = 3S_1$ b. $S_2 = 4S_1$
c. $S_2 = S_1$ d. $S_2 = 2S_1$

16. A bus is moving with a speed of 10 ms^{-1} on a straight road. A scooterist wishes to overtake the bus in 100 s. If the bus is at a distance of 1 km from the scooterist, with what speed should the scooterist chase the bus? (2009)

a. 40 ms^{-1} b. 25 ms^{-1}
c. 10 ms^{-1} d. 20 ms^{-1}

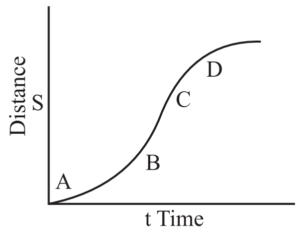
17. The distance travelled by a particle starting from rest and moving with an acceleration $\frac{4}{3}$ ms^{-2}, in the third second is (2008)

a. $\frac{10}{3}$ m b. $\frac{19}{3}$ m
c. 6 m d. 4 m

18. A particle moves in a straight line with a constant acceleration. It changes its velocity from 10 ms^{-1} to 20 ms^{-1} while passing through a distance 135 m in t second. The value of t is (2008)

a. 12 b. 9 c. 10 d. 1.8

19. A particle shows distance-time curve as given in this figure. The maximum instantaneous velocity of the particle is around the point (2008)



a. D b. A c. B d. C

20. A particle moving along x-axis has acceleration f, at time t, given by, $f = f_0\left(1-\frac{t}{T}\right)$ where f_0 and T are constants. The particle at t = 0 has zero velocity. In the time interval between t = 0 and the instant when f = 0, the particle's velocity (v_x) is: (2007)

a. $\frac{1}{2}f_0T^2$ b. f_0T^2
c. $\frac{1}{2}f_0T$ d. f_0T

21. A car moves from X to Y with a uniform speed v_u and returns to Y with a uniform speed v_d. The average speed for this round trip is: (2007)

a. $\sqrt{v_u v_d}$ b. $\frac{v_d v_u}{v_d + v_u}$
c. $\frac{v_u + v_d}{2}$ d. $\frac{2v_d v_u}{v_d + v_u}$

22. A particle starting from the origin (0, 0) moves in a straight line in the (x, y) plane. Its coordinates at a later time are $(\sqrt{3},3)$. The path of the particle makes with the x-axis an angle of: (2007)

a. 45° b. 60° c. 0° d. 30°

23. The position x of a particle with respect to time t along x-axis is given by $x = 9t^2 - t^3$ where x is in metres and t in second. What will be the position of this particle when it achieves maximum speed along the +ve x direction? (2007)

a. 54 m b. 81 m
c. 24 m d. 32 m

24. Two bodies, A (of mass 1 kg) and B (of mass 3 kg) are dropped from heights of 16 m and 25 m, respectively. The ratio of the time taken by them to reach the ground is: (2006)

a. 5/4 b. 8/5
c. 5/8 d. 4/5

25. A car runs at a constant speed on a circular track of radius 100 m, taking 62.8 s for every circular lap. The average velocity and average speed for each circular lap respectively is: (2006)

a. 0, 0 b. 0, 10 m/s
c. 10 m/s, 20 m/s d. 20 m/s, 0

26. A particle moves along a straight line OX. At a time t (in seconds) the distance x (in meters) of the particle from O is given by $x = 40 + 12t - t^3$. How long would the particle travel before coming to rest? (2006)

a. 14 m b. 28 m
c. 56 m d. 40 m

27. The vectors $\vec{A}$ and $\vec{B}$ are such that $|\vec{A}+\vec{B}| = |\vec{A}-\vec{B}|$. The angle between the two vectors is (2006)

a. 45° b. 90°
c. 60° d. 75°

28. A ball is thrown vertically upward. It has a speed of 10 m/s when it has reached one half of its maximum height. How high does the ball rise? (Taking 'g' = 10 m/s^2) (2005)

a. 6 m b. 10 m
c. 14 m d. 18 m

29. Two boys are standing at the ends A and B of a ground, where AB = a. The boy at B starts running in a direction perpendicular to AB with velocity v_1. The boy at A starts running simultaneously with velocity v and catches the other boy in a time t, where t is: (2005)

a. $\frac{a}{\sqrt{(v^2+v_1^2)}}$ b. $\frac{a}{\sqrt{(v^2-v_1^2)}}$

c. $a/(v - v_1)$ d. $a/(v + v_1)$

30. The displacement x of a particle varies with time t as $x = ae^{-\alpha t} + be^{\beta t}$, where a, b, α and β are positive constants. The velocity of the particle will (2005)

a. Be independent of β
b. Drop to zero when $\alpha = \beta$
c. Go on decreasing with time
d. Go on increasing with time

31. A stone tied to the end of a string of 1 m long is whirled in a horizontal circle with a constant speed. If the stone makes 22 revolutions in 44 seconds, what is the magnitude and direction of acceleration of the stone? (2005)

a. $\pi^2\ ms^{-2}$ and direction along the radius towards the centre
b. $\pi^2\ ms^{-2}$ and direction along the radius away from the centre
c. $\pi^2\ ms^{-2}$ and direction along the tangent to the circle
d. $\pi^2\ ms^{-2}$ and direction along the radius towards the centre

32. If a vector $2\hat{i}+3\hat{j}+8\hat{k}$ is perpendicular to the vector $4\hat{j}-4\hat{i}+\alpha\hat{k}$ then the value of α is (2005)

a. 1/2 b. –1/2 c. 1 d. –1

33. If a ball is thrown vertically upwards with speed u, the distance covered during the last 't' seconds of its ascent is: (2003)

a. ut b. $\frac{1}{2}gt^2$

c. $ut - \frac{1}{2}gt^2$ d. $(u + gt)t$

34. A man throws ball with the same speed vertically upwards one after the other at an interval of 2 seconds. What should be the speed of the throw so that more than two balls are in the sky at any time? (Given $g = 9.8\ m/s^2$) (2003)

a. More than 19.6 m/s
b. At least 9.8 m/s
c. Any speed less than 19.6 m/s
d. Only with speed 19.6 m/s

35. A particle is thrown vertically upward. Its velocity at half of the height is 10 m/s, then the maximum height attained by it: ($g = 10\ m/s^2$) (2001)

a. 8 m b. 20 m
c. 10 m d.16 m

36. The width of river is 1 km. The velocity of boat is 5 km/hr. The boat covered the width of river with shortest will possible path in 15 min. Then the velocity of river stream is: (2000)

a. 3 km/hr b. 4 km/hr
c. $\sqrt{29}$ km / hr d. $\sqrt{41}$ km / hr

37. Motion of a particle is given by equation $S = (3t^3 + 7t^2 + 14t + 8)$ m. The value of acceleration of the particle at t = 1 sec. is: (2000)

a. 10 m/s^2 b. 32 m/s^2
c. 23 m/s^2 d. 16 m/s^2

38. For a particle displacement time relation is $t = \sqrt{x} + 3$. Its displacement when its velocity is zero: (1999)

a. 2 m b. 4 m
c. 0 d. None of these

39. A particle starts from rest with constant acceleration. The ratio of—average velocity to the time average velocity is: (1999)

a. $\frac{1}{2}$ b. $\frac{3}{4}$ c. $\frac{4}{3}$ d. $\frac{3}{2}$

40. The speed of a boat is 5 km/hr is still water. It crosses a river of width 1 km along the shortest possible path in 15 minutes. The velocity of river water is: (1998)

a. 3 km/hr b. 4 km/hr
c. 5 km/hr d. 2 km/hr

41. The position x of a particle varies with time, (t) as $x = at^2 - bt^3$. The acceleration will be zero at time t is equal to: (1997)

a. $\frac{a}{3b}$ b. Zero

c. $\frac{2a}{3b}$ d. $\frac{a}{b}$

42. If a car at rest accelerates uniformly to a speed of 144 km/h in 20 sec, it covers a distance of: (1997)

a. 1440 cm b. 2980 cm
c. 20 m d. 400 m

43. A body dropped from a height) h with initial velocity zero, strikes the ground with a velocity 3 m/s. Another body of same mass dropped from the same height h with an initial velocity of 4 m/s. The final velocity of second mass, with which it strikes the ground is: (1996)

a. 5 m/s b. 12 m/s
c. 3 m/s d. 4 m/s

44. The acceleration of a particle is increasing linearly with time t as bt. The particle starts from origin with an initial velocity v_0. The distance travelled by the particle in time t will be: (1995)

a. $v_0 t + \frac{1}{3}bt^2$ b. $v_0 t + \frac{1}{2}bt^2$

c. $v_0 t + \frac{1}{6}bt^3$ d. $v_0 t + \frac{1}{3}bt^3$.

45. The water drop falls at regular intervals from a tap 5 m above the ground. The third drop is leaving the tap at instant the first drop touches the ground. How far above the ground is the second drop at that instant? (1995)

a. 3.75 m b. 4.00 m c. 1.25 m d. 2.50 m

46. 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 total time elapsed is t, then maximum velocity acquired by car will be: (1994)

a. $\frac{(\alpha^2 - \beta^2)t}{\alpha\beta}$ b. $\frac{(\alpha^2 + \beta^2)t}{\alpha\beta}$

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

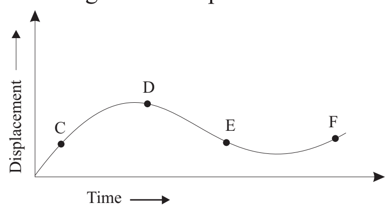
47. A particle moves along a straight line such that its displacement at any time t is given by $s = (t^3 - 6t^2 + 3t + 4)$ metres. The velocity when the acceleration is zero is: (1994)

a. 3 m/s b. 42 m/s
c. – 9 m/s d. – 15 m/s

48. The velocity of train increases uniformly from 20 km/h to 60 km/h in 4 hours. The distance travelled by the train during this period, is: (1994)

a. 160 km b. 180 km
c. 100 km d. 120 km

49. The displacement–time graph of a moving particle is shown below. The instantaneous velocity of the particle is negative at the point: (1994)

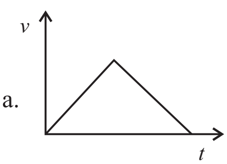


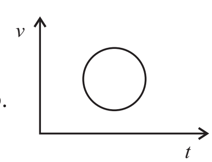
a. E b. F c. C d. D

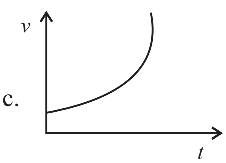
50. A body starts from rest, what is the ratio of the distance travelled by the during the 4th and 3rd second? (1993)

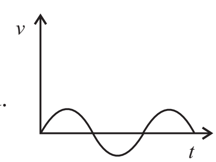
a. $\frac{7}{5}$ b. $\frac{5}{7}$ c. $\frac{7}{3}$ d. $\frac{3}{7}$

51. Which of the following curve does not represent motion in one dimension ? (1992)

a.


b.


c.


d.


52. A body dropped from top of a tower fall through 40 m during the last two seconds of its fall. The height of tower is ($g = 10\ m/s^2$): (1992)

a. 60 m b. 45 m
c. 80 m d. 50 m

53. A car moves a distance of 200 m. It covers the first half of the distance at speed 40 km/h and the second half of distance at speed v. The average speed is 48 km/h. The value of v is: (1991)

a. 56 km/h b. 60 km/h
c. 50 km/h d. 48 km/h

54. A bus travelling the first one-third distance at a speed of 10 km/h, the next one-third at 20 km/h and at last one-third at 60 km/h. The average speed of the bus is: (1997)

a. 9 km/h b. 16 km/h
c. 18 km/h d. 48 km/h

55. A car covers the first half of the distance between two places at 40 km/h and another half at 60 km/h. The average speed of the car is: (1990)

a. 40 km/h b. 48 km/h
c. 50 km/h d. 60 km/h

56. What will be the ratio of the distance moved by a freely falling body from rest in 4th and 5th seconds of journey? (1989)

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

57. A car is moving along a straight road with a uniform acceleration. If passes through two points P and Q separated by a distance with velocity 30 km/ h and 40 km/h respectively. The velocity of the car midway between P and Q is: (1988)

a. 33.3 km/h b. $20\sqrt{2}\,\text{Km}/\text{h}$
c. $25\sqrt{2}\,\text{Km}/\text{h}$ d. 35 km/h

Answer Key

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b	b	c	a	b	c	a	c	d	b	b	c	d	b	b	d	a
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
b	d	c	d	b	a	d	b	d	b	b	b	d	a	b	b	a
35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
c	a	b	c	c	a	a	d	a	c	a	d	c	a	a	a	b
52	53	54	55	56	57											
b	b	c	b	b	c											

EXPLANATIONS

1. (b) ***NCERT (XI) Ch - 3, Pg. 42***

V_1 = Preeti's velocity

V_2 = Escalator's velocity

$$t = \frac{\text{distance}}{\text{speed}} \Rightarrow t = \frac{\ell}{V_1 + V_2}$$

$$= \frac{t_1 t_2}{t_2 + t_1} \qquad = \frac{t_1 t_2}{t_2 + t_1}$$

2. (b) ***NCERT (XI) Ch - 3, Pg. 43***

$x = 5t - 2t^2 \qquad y = 10t$

$$v = \frac{dx}{dt} = 5 - 4t \qquad v = \frac{dy}{dt} = 10$$

$$a_x = \frac{dx}{dt} = -4ms^{-2} \qquad a_y = 0$$

$a = -4m/s^2$

3. (c) ***NCERT (XI) Ch - 4, Pg. 78***

$T_1 = T_2$

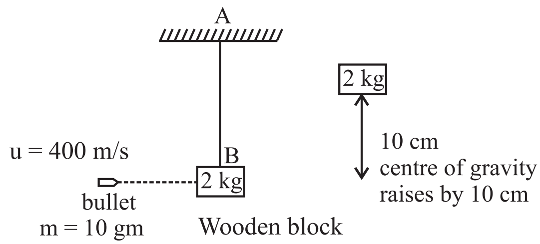
V_y = same for both cases

$$H = \frac{V_y^2}{2g}$$

$H_1 = H_2$ since all are same for both cases

4. (a) ***NCERT (XI) Ch - 4***

AB = 5 m



Apply conservation of linear momentum

mu + 0 = mv + MV

$$\frac{10}{1000} \times 400 + 0 = \frac{10}{1000} v + 2V$$

$0.01v + 2V = 4 \quad .....(1)$

$$MgH = \frac{1}{2} \times MV^2$$

$$2 \times 10 \times \frac{10}{100} = \frac{1}{2} \times 2 \times V^2$$

$\Rightarrow V^2 = 2$

$V = \sqrt{2}\ ms^{-1}$

Substituting the value of V in eq. (1), we get

$$\frac{v}{100} + 2\sqrt{2} = 4 \quad \Rightarrow \quad v = \left(4 - 2\sqrt{2}\right)100$$

$$v = \left(4 - 2\sqrt{2}\right) \simeq 120\ ms^{-1}$$

5. (b) ***NCERT (XI) Ch - 3, Pg. 42***

$X_p(t) = at + bt^2 \qquad X_Q(t) = ft - t^2$

$V_p = a + 2bt \qquad V_Q = f - 2t$

as $V_p = V_{Qs}$

$a + 2bt = f - 2t$

$$\Rightarrow t = \frac{f-a}{2(1+b)}$$

6. (c) ***NCERT (XI) Ch - 4, Pg. 47***

$v = At + Bt^2$

$$\frac{dx}{dt} = At + Bt^2$$

$$\int_0^x dx = \int_1^2 \left(At + Bt^2\right)dt$$

$$x = \frac{A}{2}\left(2^2 - 1^2\right) + \frac{B}{3}\left(2^3 - 1^3\right) = \frac{3A}{2} + \frac{7B}{3}$$

7. (a) ***NCERT (XI) Ch - 3, Pg. 45***

$$v = \beta x^{-2n}$$

$$So, \frac{dv}{dx} = -2n\beta^{-2n-1}$$

$$Now\ a = v\frac{dv}{dx} = \left(\beta x^{-2n}\right)\left(-2n\beta x^{-2n-1}\right)$$

$$\Rightarrow a = -2n\beta^2 x^{-4n-1}$$

8. (c) ***NCERT (XI) Ch - 3, Pg. 47-48***

$$AB = h_1 = \frac{1}{2}g(5)^2 \quad \Rightarrow \quad h_1 = 125\ \text{m} \qquad (\because 4 = 0)$$

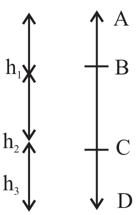
$$h_2 = BC = \frac{1}{2}g\,[10^2 - 5^2] \quad \Rightarrow \quad h_2 = 375\ \text{m}$$

$$h_3 = CD = \frac{1}{2}g\left[15^2 - 10^2\right]$$

$h_3 = 625$ m

$h_1 : h_2 : h_3$

$125 : 375 : 625 = 1 : 3 : 5$



$$\Rightarrow h_1 = \frac{h_2}{3} = \frac{h_3}{5}$$

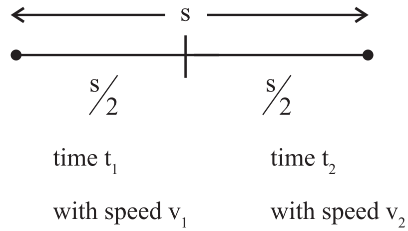
9. (d) ***NCERT (XI) Ch - 3, Pg. 45***

$$v = \frac{dx}{dt} = 0 + 12 - 3t^2 = 0 \qquad \Rightarrow t = 2s$$

At t = 2 s

$$\text{Retardation} = -\frac{dv}{dt} = -(-6t) = 12\ \text{ms}^{-2}$$

10. (b) ***NCERT (XI) Ch - 3, Pg. 42***



$$\text{Av. Speed} = \frac{\text{Total distance}}{\text{Total time taken}}$$

$$= \frac{s}{t_1 + t_2} = \frac{s}{\frac{s}{2v_1} + \frac{s}{2v_2}} = \frac{2v_1v_2}{v_1 + v_2}$$

$$\left(\because t_1 = \frac{s}{2v_1} \Rightarrow t_2 = \frac{s}{2v_2}\right)$$

11. (b) ***NCERT (XI) Ch - 3, Pg. 48***

$u = 0$

$v^2 - u^2 = 2gh \Rightarrow v^2 - 0 = 2gh$

$v = \sqrt{2gh} \quad \Rightarrow v = 20$ m/s

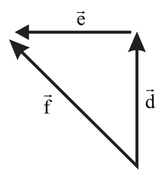
12. (c) ***NCERT (XI) Ch - 3, Pg. 76***

$$\vec{v} = \vec{u} + \vec{a}t = \left(3\hat{i} + 4\hat{j}\right) + \left(0.4\hat{i} + 0.3\hat{j}\right)(10)$$

$$= 7\hat{i} + 7\hat{j}$$

so, speed $= |\vec{v}| = 7\sqrt{2}$ units

13. (d) ***NCERT (XI) Ch - 3, Pg. 67***



$$\Rightarrow \vec{f} = \vec{d} + \vec{e}$$

14. (b) ***NCERT (XI) Ch - 3, Pg. 74***

$$x = \frac{1}{t+5} \Rightarrow v = \frac{dx}{dt} = -\frac{1}{(t+5)^2}$$

Acceleration,

$$a = \frac{dv}{dt} = \frac{2}{(t+5)^3} \Rightarrow a \propto (\text{velocity})^{3/2}$$

15. (b) ***NCERT (XI) Ch - 3, Pg. 51***

Since there is a constant force, acceleration will be constant.

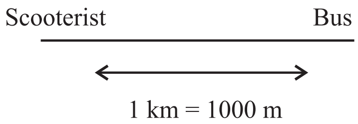
Distance covered in first 10 seconds

$(S_1) = \frac{1}{2}a(10)^2$

Distance covered in first 20 seconds

$(S_2) = \frac{1}{2}a(20)^2 \Rightarrow S_2 = 4S_1$

16. (d) ***NCERT (XI) Ch - 3, Pg. 52***



Speed of bus = 10 ms^{-1}

Scooterist has to cover 1 km more distance with respect to distance covered by bus, in 100 s

Let the speed of scooterist be x ms^{-1}

Then, distance covered by scooterist

= 1000 m + distance covered by bus

$\Rightarrow x \times 100 = 1000 + 10 \times 100$

$\Rightarrow 100x = 2000 \quad \Rightarrow x = 20\ ms^{-1}$

Hence, the speed of scooterist is 20 ms^{-1}

17. (a) ***NCERT (XI) Ch - 3, Pg. 48***

Distance travelled in the 3rd second

= Distance travelled in 3 s – distance travelled in 2 s.

As, u = 0

$$S(3^{rd}\,s) = \frac{1}{2}a.3^2 - \frac{1}{2}a.2^2 = \frac{1}{2}.a.5$$

Given $a = \frac{4}{3}\ ms^{-2} \quad \therefore\ S(3^{rd}s) = \frac{1}{2} \times \frac{4}{3} \times 5 = \frac{10}{3}$ m

18. (b) ***NCERT (XI) Ch - 3, Pg. 48***

$v^2 - u^2 = 2as$

Given $v = 20\ ms^{-1}$, $u = 10\ ms^{-1}$, $s = 135$ m

$$\therefore \quad a = \frac{400-100}{2\times135} = \frac{300}{270} = \frac{10}{9}\ ms^{-2}$$

$$v = u + at \Rightarrow t = \frac{v-u}{a} = \frac{10}{\frac{10}{9}} = 9\ s$$

19. (d) ***NCERT (XI) Ch - 3, Pg. 43***

Because the slope is highest at C, $v = \frac{ds}{dt}$ is maximum.

20. (c) ***NCERT (XI) Ch - 3, Pg. 45***

Given

Acceleration $(f) = f_0\left(1 - \frac{t}{T}\right) \quad \because f_0$ = constant

T = constant

At t = 0 V = 0

When $f = 0, f_0\left(1 - \frac{t}{T}\right) = 0 \Rightarrow t = T$

And velocity= Vx

$$f = \frac{dv}{dt}$$

$$\Rightarrow dv = fdt$$

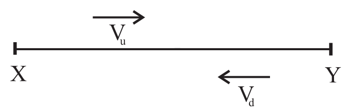
$$\Rightarrow \int_o^v dv = \int_o^v f_0\left(1 - \frac{t}{T}\right)dt$$

$$\Rightarrow V = \int_o^v f_0 dt - \int_o^v \frac{f_0 t dt}{T}$$

$$= \int_o^v f_0 dt - \frac{f_0 t^2}{2T}$$

$$= f_0 T - \frac{f_0 T^2}{2T} = \frac{1}{2} f_0 T$$

21. (d) ***NCERT (XI) Ch - 3, Pg. 42***



Total distance = d + d

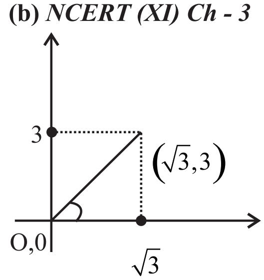
$$t_{xy} = \frac{d}{V_u}$$

$$t_{yx} = \frac{d}{V_d}$$

$$\text{Average speed} = \frac{d+d}{\frac{d}{V_u} + \frac{d}{V_d}}$$

$$= \frac{2V_u V_d}{V_d + V_u}$$

22. (b) ***NCERT (XI) Ch - 3***



Let the particle moving in a straight line makes an angle θ with x-axis.

$$\text{slope} = 2\tan\theta = \frac{y}{x} = \frac{3}{\sqrt{3}}$$

$$\text{Since}, \tan\theta = \sqrt{3},\ \theta = 60^0$$

23. (a) ***NCERT (XI) Ch - 3, Pg. 48***

Given: $x = 9t^2 - t^3$

when, it achieves maximum speed along the +x direction, the acceleration will become zero.

$\Rightarrow x = 9t^2 - t^3$

$$\Rightarrow \frac{dx}{dt} = v = \frac{d}{dt}\left(9t^2 - t^3\right)$$

$$\Rightarrow v = 18t - 3t^2$$

$$\text{Now}, a \Rightarrow \frac{dv}{dt} = \frac{d}{dt}\left(18t - 3t^2\right)$$

$$= 18 - 6t$$

Since, 'a' will be zero,

$\Rightarrow 18 - 6t = 0 \ \Rightarrow t = 3$ s

Position of particle (x) = $9 \times (3)^2 - (3)^3$

24. (d) If a body is dropped from height h, time taken to reach the ground $= \sqrt{\frac{2h}{g}}$ and it is independent of mass.

$$\Rightarrow T \propto \sqrt{h}$$

$$\Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{h_1}{h_2}}$$

$$\Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{16}{25}} = \frac{4}{5}$$

25. (b) Average velocity $= \frac{\text{Total displacement}}{\text{Time taken}}$

For each circular lap

$$\Rightarrow \frac{0}{62.8} = 0$$

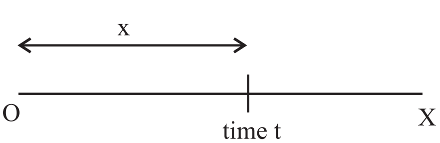
Average speed

$$= \frac{\text{Distance covered in 1 circular lap}}{\text{Take taken}}$$

$$\text{Distance} = 2\pi r = 2 \times 3.14 \times 100 = 628 \text{ m}$$

$$= \frac{628}{62.8} = 10 \text{ m/s}$$

26. (d)



X = distance from O, at time t

$X = 40 + 12t - t^3$

$$\text{Velocity} = \frac{dx}{dt}$$

$$= \frac{d\left(40 + 12t - t^3\right)}{dt} \Rightarrow \left(12 - 3t^2\right) \text{ m/s}$$

When particle will come to rest,

$v = 0$ i.e. $\Rightarrow 12 - 3t^2 = 0$
$\Rightarrow t = 2$ s

Distance travelled by particle before coming to rest,

Distance = $40 + 12 \times 2 - (2)^3$
$= 40 + 24 - 8 = 56$ m

Dist. at $t = 0 = 40 + 12 \times 0 - (0)^3$
$= 40$ m

27. (b) Let θ be angle between $\vec{A}$ and $\vec{B}$

$$\left|\vec{A} + \vec{B}\right| = \left|\vec{A} - \vec{B}\right| \text{ then} \left|\vec{A} + \vec{B}\right|^2 = \left|\vec{A} - \vec{B}\right|^2$$

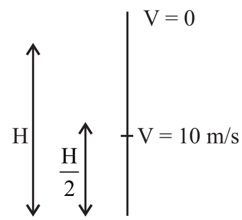
$$\text{or } \left(\vec{A} + \vec{B}\right).\left(\vec{A} + \vec{B}\right) = \left(\vec{A} - \vec{B}\right)\left(\vec{A} - \vec{B}\right)$$

$$\text{or } \vec{A}.\vec{A} + \vec{A}.\vec{B} + \vec{B}.\vec{A} + \vec{B}.\vec{B}$$

$$= \vec{A}.\vec{A} - \vec{A}.\vec{B} - \vec{B}.\vec{A} + \vec{B}.\vec{B}$$

or $4AB\cos\theta = 0$ or $\cos\theta = 0^0$ or $\theta = 90^0$

28. (b)

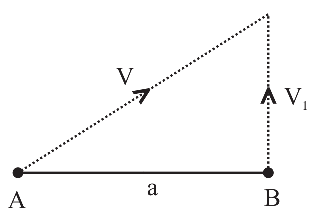


$$v^2 = u^2 + 2gh$$

$$\Rightarrow 0 = 100 + 2g \times \frac{H}{2}$$

$$\Rightarrow 100 = gH \Rightarrow H = 10\text{m} \ (\because g = 10 \text{ m/s}^2)$$

29. (b)



Since, the boy at A has to cover distance 'a' along A to B and component of velocity along AB

$$\left(v_1\right) = \sqrt{v^2 - v_1^2}$$

So, time taken $= \sqrt{\dfrac{a^2}{v^2 - v_1^2}} = \dfrac{a}{\sqrt{v^2 - v_1^2}}$

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

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

$$\frac{dx}{dt} = -a\alpha e^{-\alpha t} + b\beta e^{\beta t}$$

As t increases $e^{-\alpha t}$ decreases and increases. So v increases with time.

31. (a) Frequency = Number of revolution in 1 sec

$f = \dfrac{22}{44}$

$f = \dfrac{1}{2}^{s-1} \Rightarrow a = \omega^2 r$

$= 4\pi^2 f^2 r$

$= 4\pi^2 \times \dfrac{1}{4} \times 1 \Rightarrow = \pi^2\ ms^{-2}$

32. (b) $\vec{a} = 2\hat{i} + 3\hat{j} + 8\hat{k}, \vec{b} = -4\hat{i} + 4\hat{j} + \alpha\hat{k}$

Dot Product is zero. If $\vec{a} \perp \vec{b}$

$(2\hat{i} + 3\hat{j} + 8\hat{k})(-4\hat{i} + 4\hat{j} + \alpha\hat{k}) = 0$

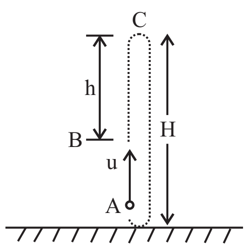
or, $-8 + 12 + 8\alpha = 0 \Rightarrow 4 + 8\alpha = 0$

$\Rightarrow \alpha = -1/2$

33. (b) Let time of flight be T, then $T = \dfrac{u}{g}$

Let h be the distance covered during last 't' second

Velocity at point B $= v_B = u - g(T - t)$



$= u - g\left(\dfrac{u}{g} - t\right) = gt \qquad \Rightarrow h = v_B t - \dfrac{1}{2}gt^2$

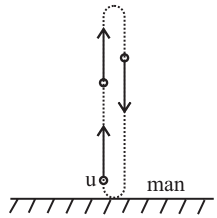
$\Rightarrow h = gt^2 - \dfrac{1}{2}gt^2 = \dfrac{1}{2}gt^2$

34. (a) In this case time of flight of a ball $\geq 2 \times 2 = 4$ sec.

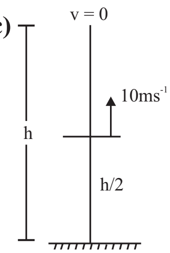
$\because$ Time of flight $= \dfrac{2u}{g} \geq 4$

$\Rightarrow u \geq 2g$

$\Rightarrow u \geq 19.6$ m/s ($\because g = 9.8\ m/s^2$)



35. (c)



$$v^2 = u^2 - 2g\frac{h}{2}$$

$0 = (10)^2 - 10h \Rightarrow h = 10$ m

36. (a) $t = \dfrac{d}{\sqrt{u^2 - v^2}} \Rightarrow \dfrac{1}{4} = \dfrac{1}{\sqrt{(5)^2 - v^2}}$

$\dfrac{1}{16} = \dfrac{1}{25 - v^2} \Rightarrow v = 3$ km/hr

37. (b) $v = \dfrac{ds}{dt} = \dfrac{d}{dt}(3t^3 + 7t^2 + 14t + 8)$

$= 9t^2 + 14t + 14$

$a = \dfrac{dv}{dt} = 18t + 14t$

At, t = 1 sec $\Rightarrow a = 32\ m/s^{-2}$

38. (c) $t = \sqrt{x} + 3 \Rightarrow x = (t-3)^2$

$v = \dfrac{dx}{dt} = 2(t-3) = 0$

at t = 3, $x = (3-3)^2 = 0$

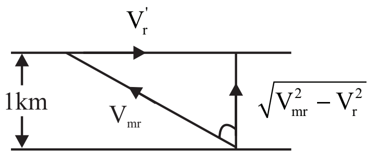
39. (c) $\langle v \rangle_{time} = \dfrac{\int v dt}{\int dt} = \dfrac{\int_0^T at dt}{\int_0^T dt} = \dfrac{aT}{2}$

$\langle v \rangle_{space} = \dfrac{\int v ds}{\int ds} = \dfrac{\int v \frac{ds}{dt} dt}{\int \frac{ds}{dt} dt}$

$$=\frac{\int_0^T v^2dt}{\int_0^T vdt}=\frac{\int_0^T a^2t^2dt}{\int_0^T atdt}=\frac{2}{3}aT$$

$$\frac{\langle v\rangle_{space}}{\langle v\rangle_{time}}=\frac{2aT/3}{aT/2}=\frac{4}{3}$$

40. (a)



V_{mr} = 5 km/hr t = 15 min

$$t=\frac{d}{\sqrt{V_{mr}^2-V_r^2}}\Rightarrow\frac{15}{60}=\frac{1}{\sqrt{25-V_r^2}}$$

$$\Rightarrow 4=\sqrt{25-V_r^2}\Rightarrow V_r^2=25-16\Rightarrow V_r^2=9$$

$\Rightarrow V_r$ = 3 km/hr

41. (a) Distance (x) = $at^2 - bt^3$

Therefore velocity $(v)=\frac{dx}{dt}=\frac{d}{dt}(at^2-bt^3)$

$= 2at - 3bt^2$

$$a=\frac{dv}{dt}=\frac{d}{dt}(2at-3bt^2)=2a-6bt=0 \text{ or}$$

$$t=\frac{2a}{6b}=\frac{a}{3b}.$$

42. (d) Initial velocity u = 0,

Final velocity = 144 km/h = 40 m/s and time = 20 sec.

Using v = u + at = a → v/t = 2 m/s^2.

Again, $s=ut+\frac{1}{2}at^2=\frac{1}{2}\times2\times(20)^2=400$ m.

43. (a) Initial velocity of first body (u_1) = 0 ;

Final velocity (v_1) = 3 m/s and initial velocity of second body (u_2) = 4 m/s.

Height $(h)=\frac{v_1^2}{2g}=\frac{(3)^2}{2\times9.8}=0.46$ m

Therefore velocity of the second body,

$$v^2=\sqrt{u_2^2+2gh}=\sqrt{(4)^2+2\times9.8\times0.46}=5\text{m/s}.$$

44. (c) Acceleration ∝ bt, i.e., $\frac{d^2x}{dt^2}=a\propto bt$

Integrating, $\frac{dx}{dt}=\frac{bt^2}{2}+C$

Initially, t = 0, dx/dt = v_0

Therefore, $\frac{dx}{dt}=\frac{bt^2}{2}+v_0$

Integrating again, $x=\frac{bt^3}{6}+v_0t+C$

When t = 0, x = 0 → C = 0.

i.e., distance travelled by the particle in time t

$$=v_0t+\frac{bt^3}{6}.$$

45. (a) Height of tap = 5 m. For the first drop,

$$5=ut+\frac{1}{2}gt^2=\frac{1}{2}\times10t^2=5t^2 \text{ or } t^2=1$$

or t = 1 sec.

It means that the third drop leaves after one second of the first drop, or each drop leaves after every 0.5 sec. Distance covered by the second drop in 0.5 sec

$$=\frac{1}{2}gt^2=\frac{1}{2}\times10\times(0.5)^2=1.25\text{m}$$

Therefore distance of the second drop above the ground 5 – 1.25 = 3.75 m.

46. (d) Initial velocity (u) = 0; Acceleration in the first phase = α; Declaration in the second phase = β and total time = t.

When car is accelerating then,

Final velocity (v) = u + αt = 0 + αt_1

Or $t_1=\frac{v}{\alpha}$ and when car is decelerating, then

final velocity 0 = v – βt or $t_2=\frac{v}{\beta}$.

Therefore total time $(t)=t_1+t_2=\frac{v}{\alpha}+\frac{v}{\beta}$

$$t=v\left(\frac{1}{\alpha}+\frac{1}{\beta}\right)=v\left(\frac{\beta+\alpha}{\alpha\beta}\right)\text{ or } v=\frac{\alpha\beta t}{\alpha+\beta}.$$

47. (c) Displacement (s) = $t^3 - 6t^2 + 3t + 4$ metres.

velocity $(v)=\frac{ds}{dt}=3t^2-12t+3$

acceleration $(a)=\frac{dv}{dt}=6t-12.$

When a = 0, we get t = 2 seconds.

Therefore velocity when the acceleration is zero (v) = 3 × $(2)^2$ – (12 ×2) + 3 = – 9 m/s.

48. **(a)** Initial velocity (u) = 20 km/h;

Final velocity (v) = 60 km/h and time (t) = 4 hours.

Velocity (v) = 60 = u + at = 20 + (a ×4)

Or, $a=\frac{60-20}{4}=10\text{ km/h}^2.$

Therefore distance travelled in 4 hours is

$$s=ut+\frac{1}{2}at^2=(20\times 4)+\frac{1}{2}\times 10\times (4)^2$$

= 160 km.

49. **(a)** The velocity $(v)=\frac{ds}{dt}.$

Therefore, instantaneous velocity at point E is negative.

50. **(a)** Distance covered in n^{th} second is given by

$$s_n=u+\frac{a}{2}(2n-1)$$

Here, u = 0

$$\therefore\quad s_4=0+\frac{a}{2}(2\times 4-1)=\frac{7a}{2}$$

$$s_3=0+\frac{a}{2}(2\times 3-1)=\frac{5a}{2}\quad\therefore\quad \frac{s_4}{s_3}=\frac{7}{5}$$

51. **(b)** In one dimensional motion, the body can have at a time one value of velocity but not two values of velocities.

52. **(b)** Let h be height of the tower and t is the time taken by the body to reach the ground.
Here, u = 0, a = g

$$s_3=0+\frac{a}{2}(2\times 3-1)=\frac{5a}{2}\quad\therefore\quad \frac{s_4}{s_3}=\frac{7}{5}$$

Or $h=\frac{1}{2}gt^2$ .....(i)

Distance covered in last two second is

$$40=\frac{1}{2}gt^2-\frac{1}{2}g(t-2)^2\qquad \text{(Here, u = 0)}$$

$$\frac{1}{2}gt^2-\frac{1}{2}g(t-2)^2=40$$

$5t^2-5(t-2)^2=40$

$t^2-(t-2)^2=8\Rightarrow (2t-2)^2=8$

$2t=6\Rightarrow t=3$ sec

From Eq. (i), we get $h=\frac{1}{2}\times 10\times (3)^2$ or h = 45 m.

53. **(b)** $V_{avg}=\frac{2xy}{x+y}$

$$48=\frac{2\times 40\times V}{40+V}\Rightarrow =60\text{ km/h}$$

54. **(c)** Aliter average speed $=\frac{3xyz}{xy+yz+xz}$

$$=\frac{3\times 10\times 20\times 60}{200+1200+600}$$

$$=\frac{36000}{2000}$$

= 18 km/h

55. **(b)** Aliter Average speed $=\frac{2xy}{x+y}$

$$=\frac{2\times 40\times 60}{40+60}=48\text{ km/h}$$

56. **(b)** Distance covered in n^{th} second is given by

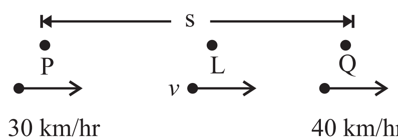
$$s_n=u+\frac{a}{2}(2n-1)$$

Given : u = 0, a = g

$$\therefore\quad s_4=\frac{g}{2}(2\times 4-1)=\frac{7g}{2}$$

$$s_5=\frac{g}{2}(2\times 5-1)=\frac{9g}{2}\quad\therefore\quad \frac{s_4}{s_5}=\frac{7}{9}$$

57. **(c)**



Let PQ = s and L is the midpoint of PQ and v be velocity of the car at point L.

Using third equation of motion, we get

$(40)^2-(30)^2=2as$

Or $a=\frac{(40)^2-(30)^2}{2s}=\frac{350}{s}$ ......(i)

Also, $v^2-(30)^2=2a\frac{s}{2}$

Or $v^2-(30)^2=2\times\frac{350}{s}\times\frac{s}{2}$

using Eq. (i)

Or $v=25\sqrt{2}$ km/hr