NEET ANSWER KEY & SOLUTIONS

SUBJECT :- PHYSICS
CLASS :- 11th **PAPER CODE :- CWT-7**
CHAPTER :- CENTRE OF MASS

ANSWER KEY

1.	(D)	**2.**	(B)	**3.**	(B)	**4.**	(C)	**5.**	(A)	**6.**	(D)	**7.**	(D)
8.	(C)	**9.**	(D)	**10.**	(C)	**11.**	(A)	**12.**	(B)	**13.**	(B)	**14.**	(D)
15.	(C)	**16.**	(B)	**17.**	(D)	**18.**	(C)	**19.**	(B)	**20.**	(D)	**21.**	(A)
22.	(C)	**23.**	(A)	**24.**	(C)	**25.**	(C)	**26.**	(B)	**27.**	(A)	**28.**	(D)
29.	(A)	**30.**	(B)	**31.**	(C)	**32.**	(D)	**33.**	(D)	**34.**	(A)	**35.**	(D)
36.	(B)	**37.**	(D)	**38.**	(B)	**39.**	(B)	**40.**	(A)	**41.**	(D)	**42.**	(C)
43.	(C)	**44.**	(A)	**45.**	(A)	**46.**	(A)	**47.**	(D)	**48.**	(A)	**49.**	(A)
50.	(C)												

SOLUTIONS

SECTION-A

1. (D)
Sol. Centre of mass is a point which can lie within or outside the body.

2. (B)
Sol. Centre of mass is nearer to heavier mass

3. (B)
Sol. we have $m_1 r_1 = m_2 r_2$

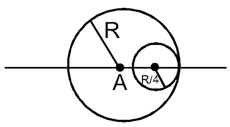
$\Rightarrow$ mr = 2m (3a – r) $\Rightarrow$ r = 2a

4. (C)

5. (A)

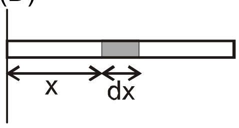
Sol. $A_1 = \pi R^2$ $\qquad A_2 = \dfrac{\pi R^2}{16}$

$x_1 = 0$ $\qquad x_2 = \dfrac{3R}{4}$



$$x_{cen} = \frac{0 - \frac{\pi R^2}{16} \times \frac{3R}{4}}{\pi R^2 - \frac{\pi R^2}{16}} = -\frac{R}{20}$$

6. (D)



Sol. mass of small element is dm = λdx = $K(x/L)^n$ dx

$$x_{CM} = \frac{\int dm.x}{\int dm} = \frac{\int_0^L K.\left(\frac{x}{L}\right)^n dx.x}{\int_0^L K.\left(\frac{x}{L}\right)^n dx} = \frac{(n+1)L}{n+2}$$

So, graph shown in option (D) is correct.

7. (D)
Sol. In abscence of external force both move away from each other to keep the centre of mass at rest.

8. (C)
Sol. $V_{cm} = \dfrac{M_1V_1 + M_2V_2}{M_1 + M_2}$

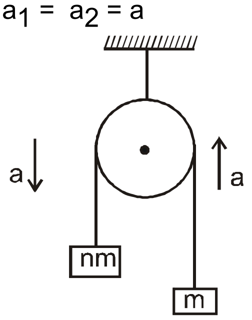
$= \dfrac{200\times 10\hat{i} + 500(3\hat{i} + 5\hat{j})}{700} = 5\hat{i} + \dfrac{25}{7}\hat{j}$

9. (D)
Sol. V_{CM} = 0, because internal force cannot change the velocity of centre of mass

10. (C)
Sol. $a = \dfrac{(nm-m)}{nm+m}g$

$= \dfrac{(n-1)}{(n+1)}g$

$a_1 = a_2 = a$



$a_{cm} = \dfrac{nma_1 - ma_2}{(nm+m)} = \dfrac{(n-1)}{(n+1)} \times a$

$a_{cm} = \dfrac{(n-1)^2}{(n+1)^2} g$.

11. (A)
Sol. Equation of motion

$M\vec{g} + \vec{R} = M\vec{a}_{cm}$

so $\vec{a}_{cm} = \dfrac{M\vec{g} + \vec{R}}{M}$

12. (B)

Sol. $\vec{a}_{CM} = \dfrac{\vec{F}_{ext}}{m}$

$= \dfrac{3\hat{i} - 2\hat{j} + 2\hat{k} + (-\hat{i}) + 2\hat{j} - \hat{k} + \hat{i} + \hat{j} + \hat{k}}{6}$

$\vec{a}_{CM} = \dfrac{1}{2}\hat{i} + \dfrac{1}{6}\hat{j} + \dfrac{1}{3}\hat{k}$

$= \sqrt{\dfrac{1}{4} + \dfrac{1}{9} + \dfrac{1}{36}} = \sqrt{\dfrac{9+4}{36} + \dfrac{1}{36}} =$

$\dfrac{1}{6}\sqrt{13+1}$

$\dfrac{\sqrt{14}}{6} ms^{-2}$

13. (B)

Sol. Friction force between wedge and block is internal i.e. will not change motion of COM. Friction force on the wedge by ground is external and causes COM to move towards right. Gravitational force (mg) on block brings it downward hence COM comes down.

14. (D)

Sol. Here : Mass of the body m_1 = m

Velocity of the first body u_1 = 312 m/sec

Mass of second body at rest m_2 = 2m

Velocity of second body u_2 = 0

After combination total mass of the body

$M = m + 2m = 3m$

Now from the law of conservation of momentum

$Mv = m_1u_1 + m_2u_2$

(where M = m + 2m = 3m)

$3mv = m \times 3 + 2m \times 0$

$v = 1$ km/hr

15. (C)

Sol. use $m_1v_1 = m_2v_2 = P$

F.E. = $\dfrac{1}{2} m v_1^2 + \dfrac{1}{2} m_2 v_2^2$

$= \dfrac{1}{2} m_1 \left(\dfrac{P}{m_1}\right)^2 + \dfrac{1}{2} m_2 \left(\dfrac{P}{m_2}\right)^2 = \dfrac{1}{2}$

$\dfrac{P^2(m_2 + m_1)}{m_1m_2}$.

16. (B)

Sol. $\dfrac{k_1}{k_2} = \dfrac{1}{2} \dfrac{P^2/(m)}{P^2/2(4m)} = 4/1$

17. (D)

Sol. Velocity of man w.r.t. train is zero so kinetic energy of man w.r.t. train = 0

18. (C)

Sol. $\vec{p}_1 + \vec{p}_2 = 0 \quad \Rightarrow \quad \vec{p}_1 = -\vec{p}_2$

$\Rightarrow \quad |\vec{p}_1| = |\vec{p}_2|$

19. (B)

Sol. When the centre of mass remains at rest, it is possible that different individual forces do individual works though the net resultant force is zero. As work is a scalar quantity, they gets added up.

Also, $\Sigma F_{ext} = 0 \quad \Rightarrow \quad a_{CM} = 0$.

20. (D)

Sol. $\Delta P = P_f - P_i = (-Mv) - (Mv) = -2Mv$

21. (A)

22. (C)

Sol. by energy conservation $\dfrac{1}{2} mv^2 = \dfrac{1}{2}(2m)\left(\dfrac{v}{2}\right)^2 + \dfrac{1}{2} kx^2$

$\Rightarrow \quad x = \sqrt{2mK}$

23. (A)

Sol. Area of F-t curve = A = Impulse.

Impulse = dP = A = mv – 0

$\therefore v = \dfrac{A}{M}$.

24. (C)

Sol. Impulse = $\int F dt$

= Area under curve

$= \dfrac{1}{2}(2)(2) = 2$ kg-m/sec.

25. (C)

Sol. $|(m_1\vec{v}'_1 + m_2\vec{v}'_2) - (m_1\vec{v}_1 + m_2\vec{v}_2)| =$ | Change in momentum of the two particles |

= | External force on the system | × time interval

$= (m_1 + m_2)\, g(2t_0)$

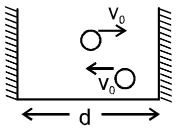
$= 2(m_1 + m_2)\, gt_0$

26. (B)

Sol. $t = \frac{2d}{v_0}$ (time for succeesive collision)

$N \times t = dP = mv_0 - (-mv_0)$

$N \times \frac{2d}{v_0} = 2mv_0$



$\therefore N = \frac{mv_0^2}{d}$

27. (A)

28. (D)

29. (A)

Sol. $v_1 = \frac{(m_1 - em_2)u_1}{m_1 + m_2} + \frac{m_2(1+e)u_2}{m_1 + m_2}$

$= \frac{(m - e2m)u_1}{m + 2m} + \frac{2m(1+e) \times 0}{m + 2m} = 0$

$\Rightarrow \quad 0 = m - e2m \quad \Rightarrow \quad e = 1/2$

30. (B)

31. (C)

32. (D)

Sol. $0.5 \times v_p + m \times 0 = 5.05\ v$

$\therefore \frac{v_f}{v_i} = \frac{0.05}{5} = 10^{-2}$

$\Rightarrow \frac{\frac{1}{2}m(v_f)^2}{\frac{1}{2}m(v_i)^2} = (10^{-2})^2 = 10^{-4}$.

33. (D)

Sol. Kinetic energy remains conserved in elastic collision

34. (A)

Sol. $e = \frac{\text{velocity of seperation}}{\text{velocity of approch}} = 1$ for elastic collision.

35. (D)

Sol. In an inelastic collision, the particles do not regain their shape and size completely after collision. Some fraction of mechanical energy is retained by the colliding particles in the form of deformation potential energy. Thus, the kinetic energy of particles no longer remains conserved. However, in the absence of external forces, law of conservation of linear momentum still holds good.

SECTION-B

36. (B)

Sol. According to Newton's Law

$$e = \frac{\vec{v}_2 - \vec{v}_1}{\vec{u}_1 - \vec{u}_2}$$

For elastic collision cofficient of restitution

$\vec{v}_2 - \vec{v}_1 = \vec{u}_1 - \vec{u}_2$

Statement - 1 is correct Linear momentum is conserved in both elastic & non elastic collision but it's not the explanation of statement -1 so it is not the correct explanation of the statement A.

37. (D)

Sol. $F = \mu \frac{dm}{dt} \quad \Rightarrow \quad 210 = 300 \times \frac{dm}{dt}$

$\Rightarrow \frac{dm}{dt} = 0.7$ kg/s.

38. (B)

Sol. Let Initial thrust of the blast be F then $F - mg = ma$

$F = m\,(g + a) = 3.5 \times 10^4 \times (10 + 10)$

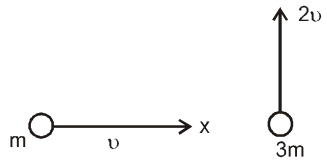
$= 7 \times 10^5$ N

39. (B)

Sol. As no external force is acting on the system, the centre of mass must be at rest i.e. $v_{CM} = 0$.

40. (A)

Sol.



From momentum conservation

$m\upsilon\hat{i} + 3m(2\upsilon)\hat{j} = (4m)\,\vec{\upsilon}$

$\vec{\upsilon} = \frac{\upsilon}{4}\hat{i} + \frac{6}{4}\upsilon\hat{j}$

$= \frac{\upsilon}{4}\hat{i} + \frac{3}{2}\upsilon\hat{j}$

41. (D)

Sol. From momentum conservation

$mu + 0 = 0 + (4m)\,V_2 \quad \Rightarrow \quad V_2 = \frac{u}{4}$

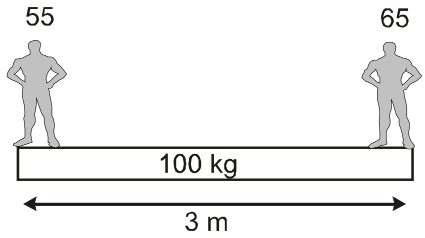
$e = \frac{V_2}{u} = \frac{u_4}{u} = \frac{1}{4} = 0.25$

42. (C)

Sol. Statement-2 contradicts Newton's third law and hence is false.

43. (C)

Sol.



There is no external force so com will not shift

44. (A)

Sol. $v_{cm} = \dfrac{1\times 2+\dfrac{1}{2}\times 6}{1+1/2} = \dfrac{10}{3}\text{m / sec}.$

45. (A)

Sol. vector sum of internal forces on system is zero.

46. (A)

47. (D)

Sol. by conservation of linear momentum $P_i = P_f$

$\Rightarrow \quad mu = \dfrac{m}{4} \times 0 + \dfrac{3m}{4} \times V$

$\Rightarrow \quad v = \dfrac{4u}{3}$

48. (A)

Sol. Impulse = change in momentum = 2 mv

= 2 × 0.06 × 4 = 0.48 kg m/s. Ans.

49. (A)

Sol. Momentum conservation

5 × 10 + 20 × 0 = 5 × 0 + 20 × v Þ v = 2.5 m/s

50. (C)

Sol. $m_G = \dfrac{m_B v_B}{v_G} = \dfrac{50\times 10^{-3}\times 30}{1}$ = 1.5kg