Additional Problems For Self Practice (APSP)

PART-I : PRACTICE TEST PAPER

Max. Marks : 120 **Max. Time : 1 Hr.**

Important Instructions :

1. The test is of **1 hour** duration and max. marks 120.
2. The test consists **30** questions, **4 marks** each.
3. Only one choice is correct **1 mark** will be deducted for incorrect response. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
4. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 3 above.

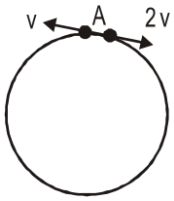
1. A ball collides with an inclined plane of inclination θ after falling through a distance h. If it moves horizontally just after the impact, the coefficient of restitution is :
(1) $\tan^2\theta$ (2) $\cot^2\theta$ (3) $\tan\theta$ (4) $\cot\theta$

2. A particle of mass 1 kg is thrown vertically upwards with speed 100 m/s. After 5s it explodes into two parts. One part of mass 400g comes back with speed 25 m/s, what is the speed of other part just after explosion?
(1) 100 m/s upwards (2) 600 m/s upwards (3) 100 m/s downward (4) 300 m/s upward

3. Two spherical bodies of mass M and 5M and radii R and 2R respectively are released in free space with initial separation between their centres equal to 12R. If they attract each other due to gravitational force only, then the distance covered by the smaller body just before collision is :
(1) 2.5R (2) 4.5 R (3) 7.5R (4) 1.5 R

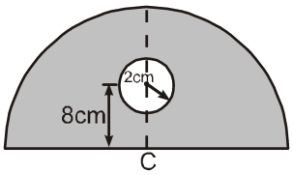
4. A solid iron ball A of radius r collides head on with another stationary solid iron ball B of radius 2r. The ratio of their speeds just after the collision (e = 0.5) is :
(1) 3 (2) 4 (3) 2 (4) 1

5. Two small particles of equal masses start moving in opposite directions from a point A in a horizontal circular orbit. Their tangential velocities are v and 2v, respectively, as shown in the figure. Between collisions, the particles move with constant speeds. After making how many elastic collisions, other than that at A, these two particles will again reach the point A?
(1) 4 (2) 3 (3) 2 (4) 1

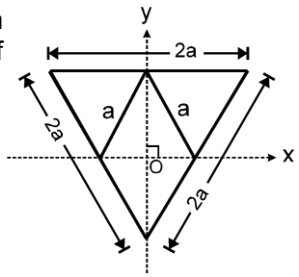


6. A plate in the form of a semicircle of radius a has a mass per unit area of *kr* where *k* is a constant and *r* is the distance from the centre of the straight edge. By dividing the plate into semicircular rings, find the distance of the centre of mass of the plate from the centre of its straight edge.
(1) $3a/2\pi$ (2) $a/2\pi$ (3) $3a/\pi$ (4) a/π

7. In the figure shown a hole of radius 2 cm is made in a semicircular disc of radius 6π cm at a distance 8 cm from the centre C of the disc. The distance of the centre of mass of this system from point C is:
(1) 4 cm
(2) 8 cm
(3) 6 cm
(4) 12 cm



8. The ' y ' co-ordinate of the centre of mass of the system of three rods of length '2a' and two rods of length 'a' as shown in figure is : (Assume all rods to be of uniform density)



(1) $\frac{9a}{8\sqrt{3}}$ (2) $\frac{9a}{16\sqrt{3}}$

(3) zero (4) $\frac{8a}{\sqrt{3}}$

9. A uniform sphere is placed on a smooth horizontal surface and a horizontal force F is applied on it at a distance h above the surface. The acceleration of the centre
(1) is maximum when h = 0 (2) is maximum when h = R
(3) is maximum when h = 2R (4) is independent of h

10. A ball hits a floor and rebounds after an inelastic collision. In this case
(1) the momentum of the ball just after the collision is same as that just before the collision
(2) the mechanical energy of the ball remains the same during the collision
(3) the total momentum of the ball and the earth is conserved
(4) the total energy of the ball and the earth remains the same

11. A particle of mass m moving with a speed v hits elastically another stationary particle of mass 2m in a fixed smooth horizontal circular tube of radius r. Find the time when the next collision will take place?

(1) t = $\frac{2\pi r}{v}$ (2) t = $\frac{\pi r}{v}$ (3) t = $\frac{\pi r}{2v}$ (4) t = $\frac{3\pi r}{2v}$

12. A can of height h is filled with liquid of uniform density ρ. If the liquid is coming out from the bottom then centre of mass of the **" can + water in the can "**
(1) first ascends and then descends
(2) first descends and then ascends
(3) always decreases
(4) none of these

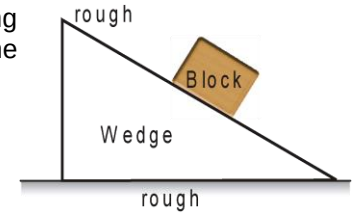
13. Two semicircular rings of linear mass densities λ and 2λ and of radius 'R' each are joined to form a complete ring. The distance of the center of the mass of complete ring from its geometrical centre is :

(1) $\frac{3R}{8\pi}$ (2) $\frac{2R}{3\pi}$ (3) $\frac{3R}{4\pi}$ (4) none of these

14. A man of mass M stands at one end of a plank of length L which lies at rest on a frictionless horizontal surface . The man walks to the other end of the plank. If the mass of the plank is M/3, the distance that the man moves relative to the ground is
(1) 3 L/4 (2) 4 L/5 (3) L/4 (4) none of these

15. Which of the following is incorrect ?
(1) If centre of mass of three particles is at rest, and it is known that two of them are moving along different non parallel lines then the third particle must also be moving.
(2) If centre of mass remains at rest, then net work done by the forces acting on the system must be zero.
(3) If centre of mass remains at rest then net external force must be zero
(4) None of these statement is incorrect

16. When a block is placed on a wedge as shown in figure, the block starts sliding down and the wedge also start sliding on ground. All surfaces are rough. The centre of mass of (wedge + block) system will move



(1) leftward and downward. (2) right ward and downward.
(3) leftward and upwards. (4) only downward.

17. A bomb at rest explodes in three segments of unequal masses. The most general description of the final state is that:
(1) the fragments fly off in any arbitrary direction.
(2) the fragments fly off in such a way that there directions lie in the same plane.
(3) two of the three must go opposite to each other.
(4) two of the three must fly off at right angles to each other.

18. Two particles A and B start moving due to their mutual interaction only. If at any time 't', $\vec{a}_A$ & $\vec{a}_B$ are their respective accelerations, $\vec{V}_A$ and $\vec{V}_B$ are their respective velocities, and upto that time w_A and w_B are the work done on A & B respectively by the mutual force, m_A and m_B are their masses respectively, then which of the following is always correct.

(1) $\vec{V}_A + \vec{V}_B = 0$ (2) $m_A\vec{V}_A + m_B\vec{V}_B = 0$ (3) $w_A + w_B = 0$ (4) $\vec{a}_A + \vec{a}_B = 0$

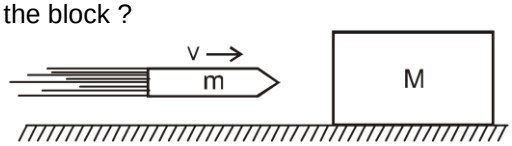
19. Two balls having mass 2 kg and 3 kg are approaching each other with velocities 3 m/s and 2 m/s respectively on the horizontal frictionless surface. They undergo a head on elastic collision. Find out the maximum potential energy of deformation.
(1) zero (2) 12.5 J (3) 15 J (4) none of these

20. A particle 'A' of mass m collides head on with another stationary particle 'B' of the same mass 'm'.The kinetic energy lost by the colliding particle 'A' will be maximum if the coefficient of the restituition is
(1) 1 (2) 0 (3) 0.5 (4) none

21. Two particles A and B of masses 10 kg and 38 kg respectively are moving along the same straight line with velocities 15 m/s & 3 m/s respectively in the same direction. After elastic collision the velocities of A and B are v_A and v_B in the direction of initial motion. Then :

(1) $v_A = 20, v_B = 8$ (2) $v_A = -4, v_B = 8$
(3) $v_A = 16, v_B = 28$ (4) $v_A = -5, v_B = 10$

22. In the diagram shown, a block of mass M initially at rest on a frictionless horizontal surface is struck by a bullet of mass m moving with horizontal velocity v. What is the velocity of the bullet-block system after the bullet embeds itself in the block ?



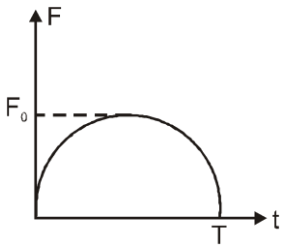
(1) $\left(\frac{M+m}{M}\right)v$ (2) $\left(\frac{m}{M}\right)v$ (3) $\left(\frac{m+M}{m}\right)v$ (4) $\left(\frac{m}{m+M}\right)v$

23. Two small spheres of equal mass, and heading towards each other with equal speeds, undergo a head-on collision (no external force acts on system of two spheres). Then which of the following statement is correct?
(1) Their final velocities must be zero.
(2) Their final velocities may be zero.
(3) Each must have a final velocity equal to the other's initial velocity.
(4) Their velocities must be reduced in magnitude

24. Two balls of the same mass are dropped from the same height onto the floor. The first ball bounces upwards from the floor elastically. The second ball sticks to the floor. The first applies an impulse to the floor of I_1 the second applies an impulse I_2 (for the duration of collision). Then the relation between both the impulses is,

(1) $I_2 = 2I_1$ (2) $I_2 = \frac{I_1}{2}$ (3) $I_2 = 4I_1$ (4) $I_2 = \frac{I_1}{4}$

25. A particle of mass m initially at rest, is acted upon by a variable force F for a brief interval of time T. It attains a velocity u after the force stops acting. F is shown in the graph as a function of time. The curve is a semicircle, find u.



(1) $\frac{\pi F_0^2}{2m}$ (2) $\frac{\pi T^2}{8m}$

(3) $\frac{\pi F_0 T}{4m}$ (4) $\frac{F_0 T}{2m}$

26. A continuous stream of particles of mass *m* and velocity *v*, is emitted from a source at a rate of *n* per second. The particles travel along a straight line, collide with a body of mass M and are buried in this body. If the mass M was originally at rest, its velocity when it has received N particles will be:

(1) $\frac{mvn}{Nm+n}$ (2) $\frac{mvN}{Nm+M}$ (3) $\frac{mv}{Nm+M}$ (4) $\frac{Nm+M}{mv}$

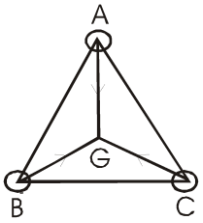
27. A balloon having mass ' m ' is filled with gas and is held in hands of a boy. Then suddenly it get released and gas starts coming out of it with a constant rate. The velocities of the ejected gases is also constant 2 m/s with respect to the balloon. Find out the velocity of the balloon when the mass of gas is reduced to half.

(1) ℓ n 2 (2) 2 ℓn 4 (3) 2 ℓn 2 (4) none of these

28. Two particles with equal kinetic energies are having masses in the ratio of 1 : 2. Then linear momenta will be in the ratio-

(1) 1 (2) 4 (3) 0.707 (4) 2

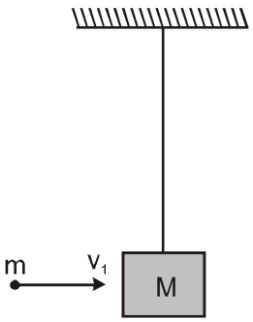
29. Three particles A, B and C of equal mass move with equal speeds v along the medians of an equilateral triangle as shown in the figure. They collide at the centroid G of the triangle. After collision A comes to rest, B retraces its path with speed v. The velocity of C is-



(1) $\vec{v}$, direction $\vec{GA}$ (2) $\vec{v}$, & direction GA

(3) 2v, direction $\vec{GB}$ (4) $\vec{v}$, & direction $\vec{BG}$

30. A bullet of mass m moving with a velocity v_1 strikes a suspended wooden block of mass M as shown in the figure and sticks to it. If the block rises to a height h the initial velocity of the bullet is-



(1) $\frac{m+M}{m}\sqrt{2gh}$ (2) $\sqrt{2gh}$

(3) $\frac{M+m}{M}\sqrt{2gh}$ (4) $\frac{m}{M+m}\sqrt{2gh}$

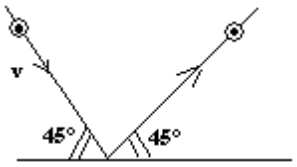
Practice Test (JEE-Main Pattern)

OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25	26	27	28	29	30
Ans.										

PART - II : PRACTICE QUESTIONS

1. A body of mass M moving with a speed V collides on a surface at an angle 45 degree without changing its speed the change in momentum of the body will be-



(1) $MV(\hat{j}-\hat{i})$ (2) $MV(\hat{i}+\hat{j})$

(3) $2MV\hat{j}$ (4) $\sqrt{2}MV\hat{j}$

2. After falling from a height h and striking the ground twice, a ball rise up to the height [e = coefficient of restitution]

(1) he (2) he^2 (3) he^3 (4) he^4

3. A steel ball of radius 2cm is initially at rest on a horizontal frictionless surface. It is struck head on by another steel ball of 4 cm radius travelling with a velocity of 81 cm/s. The velocities of two balls after collision are-

(1) 72 cm/s and 56 cm/s (2) 144 cm/s and 56 cm/s

(3) 144 cm/s and 63 cm/s (4) 63 cm/s and 72 cm/s

4. Two putty balls of equal mass moving with equal velocity in mutually perpendicular directions, stick together after collision. If the balls were initially moving with a velocity of $45\sqrt{2}$ ms^{-1} each, the velocity of their combined mass after collision is :

(1) $45\sqrt{2}$ ms^{-1} (2) 45 ms^{-1} (3) 90 ms^{-1} (4) $22.5\sqrt{2}$ ms^{-1}

5. A 6000 kg rocket is set for vertical firing. If the exhaust speed is 1000 m/sec. How much gas must be ejected each second to supply the thrust needed to give the rocket an initial upward acceleration of 20 m/sec^2- (consider g = 9.8 $msec^{-2}$ acceleration due to gravity)

(1) 92.4 kg/sec (2) 178.8 kg/sec (3) 143.2 kg/sec (4) 47.2 kg/sec

6. A thin uniform wire is bent to form the two equal sides AB and AC of triangle ABC, where AB = AC = 5 cm. The third side BC, of length 6cm, is made from uniform wire of twice the linear mass density of the first. The distance of centre of mass from A is :

(1) $\frac{34}{11}$ cm (2) $\frac{11}{34}$ cm (3) $\frac{34}{9}$ cm (4) $\frac{11}{45}$ cm

7. There are two particles of same mass. If one of the particles is at rest always and the other has an acceleration $\vec{a}$. Acceleration of centre of mass is

(1) zero (2) $\frac{1}{2}\vec{a}$ (3) $\vec{a}$

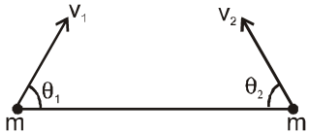
(4) centre of mass for such a system can not be defined.

8. A body of mass 1 kg moving in the x-direction, suddenly explodes into two fragments of mass $\frac{1}{8}$ kg and $\frac{7}{8}$ kg. An instant later, the smaller fragment is 0.14 m above the x-axis. The position of the heavier fragment is -

(1) $\frac{1}{50}$ m above x-axis (2) $\frac{1}{50}$ m below x-axis

(3) $\frac{7}{50}$ m below x-axis (4) $\frac{7}{50}$ m above x-axis

9. Two particles of equal mass m are projected form the ground with speed v_1 and v_2 at angle θ_1 and θ_2 (θ_1 , $\theta_2 \neq 0, 180^o$) as shown in figure. The centre of mass of the two particles



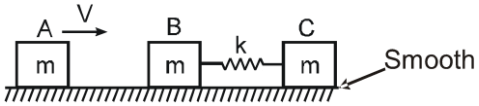
(1) will move in a parabolic path for any values of v_1, v_2, θ_1 and θ_2

(2) can move in a vertical line

(3) can move in a horizontal line

(4) will move in a straight line for any value of v_1, v_2, θ_1 and θ_2

10. Mass A hits B inelastically (e = 0) while moving horizontally with some velocity along the common line of centres of the three equal masses each of same mass. Initially mass B and C are stationary and the spring is unstretched. Then which is incorrect.



(1) compression will be maximum when blocks have same velocity

(2) velocity of C is maximum when (A + B) is at rest

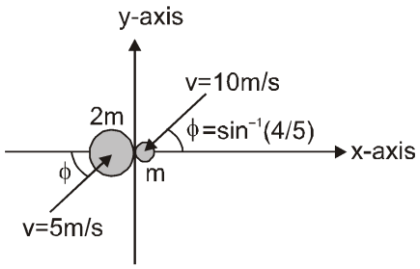
(3) velocity of C is maximum when spring is undeformed.

(4) velocity of C is minimum when spring is undeformed.

11. Ball 1 collides head on with an another identical ball 2 at rest. Velocity of ball 2 after collision becomes two times to that of ball 1 after collision. The coefficient of restitution between the two balls is :

(1) e = 1/3 (2) e = 1/2 (3) e = 1/4 (4) e = 2/3

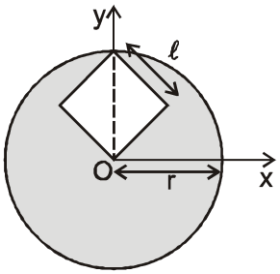
12. Two smooth spheres made of identical material having masses 'm' and 2m undergoes an oblique impact as shown in figure. The initial velocities of the masses are also shown. The impact force is along the line joining their centres along the x-axis. The coefficient of restitution is $\frac{5}{9}$. The velocities of the masses after the impact and the approximate percentage loss in kinetic energy.



(1) $\frac{10}{3}\hat{i}+8\hat{j}$; $\frac{5}{3}\hat{i}+4\hat{j}$, 15% (2) $\frac{5}{3}\hat{i}-8\hat{j}$; $\frac{-5}{3}\hat{i}+4\hat{j}$, 20%

(3) $\frac{10}{3}\hat{i}-8\hat{j}$; $\frac{-5}{3}\hat{i}+4\hat{j}$, 25% (4) $\frac{10}{3}\hat{i}-8\hat{j}$; $\frac{-5}{3}\hat{i}+4\hat{j}$, 20%

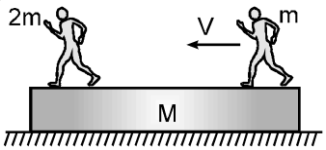
13. A disc (of radius r cm) of uniform thickness and uniform density ρ has a square hole with sides of length $\ell = \frac{r}{\sqrt{2}}$ cm. One corner of the hole is located at the center of the disc and centre of the hole lies on y-axis as shown. Then the y-coordinate of position of center of mass of disc with hole (in cm) is



(1) $-\frac{r}{2(\pi-¼)}$ (2) $-\frac{r}{4(\pi-¼)}$

(3) $-\frac{r}{4(\pi-½)}$ (4) $-\frac{3r}{4(\pi-¼)}$

14. A plank of mass M rests on a frictionless surface as shown in the figure. A man of mass m walks with a velocity V towards left. Knowing that m & 2 m are initially at rest and plank remains at rest during the motion of m and 2 m, the velocity of man of mass 2 m will be :



(1) V m/s towards left (2) V m/s towards right

(3) $\frac{V}{2}$ m/s towards right (4) $\frac{V}{2}$ m/s towards left

15. Two particles are moving towards each other along a line joining them, so that their centre of mass does not move. After elastic collision between them,

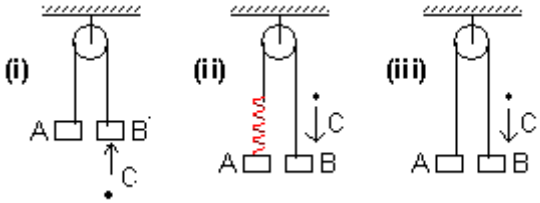
(1) their centre of mass will move

(2) their velocities will not change

(3) their speeds will not change

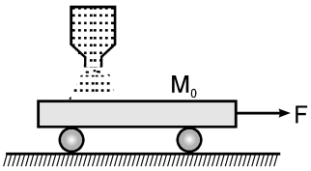
(4) their velocities will not change only if they have equal mass

16. In the figures (i), (ii) & (iii) shown the objects A, B & C are of same mass . String, spring and pulley are massless. C strikes B with velocity 'u' in each case and sticks to it . The ratio of velocity of B in case (i) to (ii) to (iii) is :



(1) 1 : 1 : 1 (2) 3 : 3 : 2 (3) 3 : 2 : 2 (4) none of these

17. In the fig. shown a cart moves on a smooth horizontal surface due to an external constant force of magnitude F. The initial mass of the cart is M_0 and velocity is zero. Sand falls on to the cart with negligible velocity at constant rate μ kg/s and sticks to the cart. The velocity of the cart at time t is :



(1) $\frac{Ft}{M_0+\mu t}$ (2) $\frac{F}{\mu}\ell n\frac{m_0+\mu t}{m_0}$

(3) $\frac{Ft}{M_0}$ (4) $\frac{Ft}{M_0+\mu t}e^{\mu t}$

Comprehension # 1

A 3kg block 'A ' moving with 4 m/sec on a smooth table collides inelastically and head on with an 8kg block 'B' moving with speed 1.5 m/sec towards 'A '. Given e = 1/2

18. Final velocities of both the blocks

(1) V_A = 2m/s, $V_B = \frac{3}{4}$m/s (2) V_A = 1m/s, $V_B = \frac{3}{4}$m/s

(3) V_A = 2m/s, $V_B = \frac{1}{4}$m/s (3) $V_A = \frac{3}{4}$m/s , V_B = 2m/s

19. The impulse of reformation and deformation

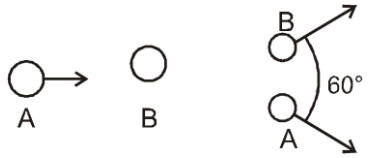
(1) 12Ns, 6 Ns (2) 4Ns, 12 Ns (3) 6Ns, 12 Ns (4) 12Ns, 4Ns

20. The maximum potential energy of deformation
(1) 34J (2) 35J (3) 30J (4) 33J

21. Find out loss in kinetic energy of system.
(1) $\frac{89}{4}$J (2) $\frac{99}{4}$J (3) $\frac{79}{4}$J (4) zero

Comprehension # 2

A smooth ball 'A' moving with velocity 'V' collides with another smooth identical ball at rest. After collision both the balls move with same speed with angle between their velocities 60°. No external force acts on the system of balls.



22. The speed of each ball after the collision is
(1) $\frac{V}{2}$ (2) $\frac{V}{3}$ (3) $\frac{V}{\sqrt{3}}$ (4) $\frac{2V}{\sqrt{3}}$

23. If the kinetic energy lost is fully converted to heat then heat produced is
(1) $\frac{1}{3}mV^2$ (2) $\frac{2}{3}mV^2$ (3) 0 (4) $\frac{1}{6}mV^2$

24. The value of coefficient of restitution is
(1) 1 (2) $\frac{1}{3}$ (3) $\frac{1}{\sqrt{3}}$ (4) 0

APSP Answers

PART - I

1.	(1)	**2.**	(1)	**3.**	(3)	**4.**	(3)	**5.**	(3)	**6.**	(1)	**7.**	(2)
8.	(2)	**9.**	(4)	**10.**	(3)	**11.**	(1)	**12.**	(2)	**13.**	(2)	**14.**	(3)
15.	(2)	**16.**	(2)	**17.**	(2)	**18.**	(2)	**19.**	(3)	**20.**	(1)	**21.**	(2)
22.	(4)	**23.**	(2)	**24.**	(2)	**25.**	(3)	**26.**	(2)	**27.**	(3)	**28.**	(3)
29.	(4)	**30.**	(1)										

PART – II

1.	(4)	**2.**	(4)	**3.**	(3)	**4.**	(2)	**5.**	(2)	**6.**	(1)	**7.**	(2)
8.	(2)	**9.**	(2)	**10.**	(2)	**11.**	(1)	**12.**	(3)	**13.**	(3)	**14.**	(3)
15.	(3)	**16.**	(2)	**17.**	(1)	**18.**	(1)	**19.**	(3)	**20.**	(4)	**21.**	(2)
22.	(3)	**23.**	(4)	**24.**	(2)								