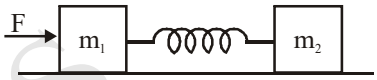
CLASS : CC (ADVANCED) MOMENTUM SYSTEM OF PARTICLE M.M. 56 TEST-23

[SINGLE CORRECT CHOICE TYPE]

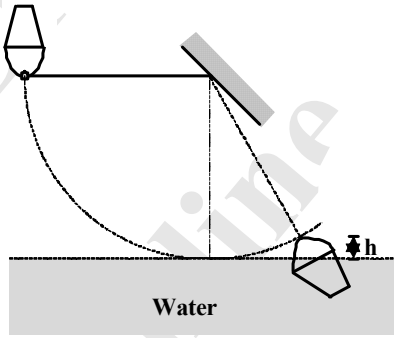
Q.1 Two identical blocks each of mass m being interconnected by a light spring of stiffness k is pulled by a force F as shown in the figure. The maximum potential energy stored in the spring is equal to: **[3]**



(A) $\frac{F^2}{2k}$ (B) $\frac{F^2}{4k}$

(C) $\frac{F^2}{8k}$ (D) None of these

Q.2 A small bucket of mass M attached to a long inextensible rope of length L as shown in the figure. The bucket is released from rest at the horizontal position and it scoops up m kg of water and swings up to a height h. The height h is given by: **[3]**



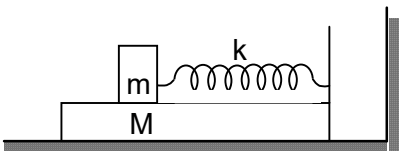
(A) $\left[\frac{M}{M+m}\right]^2 L$ (B) $\left[\frac{M+m}{M}\right]^2 L$

(C) $\left[\frac{M+m}{m}\right] L$ (D) $\left[\frac{M}{M+m}\right] L$

Q.3 A chain of mass M, length ℓ hangs from a pulley. If it is wound such that half of the chain remains overhung, the work done by the external agent is equal to **[3]**

(A) $\frac{Mg\ell}{2}$ (B) $\frac{3}{4}Mg\ell$ (C) $\frac{3}{8}Mg\ell$ (D) None of these

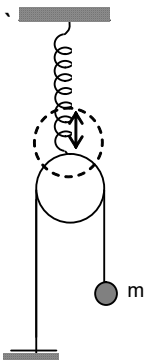
Q.4 A system of two bodies of masses m and M being interconnected by a spring of stiffness k moves towards a rigid wall with a K.E. E . If the body M sticks to the wall after the collision, the maximum compression of the spring will be **[3]**



(A) $\sqrt{\frac{m.E}{k}}$ (B) $\sqrt{\frac{2m.E}{(M+m)k}}$

(C) $\sqrt{\frac{2m.E}{Mk}}$ (D) $\sqrt{\frac{2M.E}{(M+m)k}}$

Q.5 A body of mass m hangs by an inextensible string that passes over a smooth mass less pulley that is fitted with a light spring of stiffness k as shown in the figure. If the body is released from rest, the maximum elongation of the spring is: **[3]**



(A) $\frac{4mg}{k}$ (B) $\frac{2mg}{k}$

(C) $\frac{mg}{k}$ (D) None of these

Q.6 A man of mass M stands at one end of a plank of length L which lies at rest on a frictionless 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 **[3]**

(A) $\frac{3L}{4}$ (B) $\frac{4L}{5}$ (C) $\frac{L}{4}$ (D) $\frac{L}{3}$

Q.7 Two balls of equal mass have a head on collision with equal speed 6m/s. If the coefficient of restitution is 1/4, the speed of each ball after impact will be **[3]**

(A) 0 (B) 24 m/s (C) 6 m/s (D) 1.5 m/s

Q.8 A uniform metal rod of length 1m is bent at 90º so as to form two arms of equal length. The centre of mass of this bent rod is **[3]**

(A) on the bisector of the angle, $(1/\sqrt{2})$ m from vertex

(B) on the bisector of the angle, (1/2 $\sqrt{2}$ 2) m from vertex

(C) on the bisector of the angle, (1/2) m from vertex

(D) on the bisector of the angle, (1/4 $\sqrt{2}$) m from vertex

Q.9 A machinegun fires n bullets per second and the mass of each bullet is m. If v is the speed of each bullet, then the force exerted on the machine gun is **[3]**

(A) mng (B) mnv (C) mnvg (D) (mnv)/g

Q.10 A particle of mass 15 kg has an initial velocity $\vec{v}_i = \hat{i} - 2\hat{j}$ m/s. It collides with another body and the impact time is 0.1s, resulting in a velocity $\vec{v}_f = 6\hat{i} + 4\hat{j} + 5\hat{k}$ m/s after impact. The average force of impact on the particle is **[3]**

(A) 150 ($5\hat{i} + 6\hat{j} + 5\hat{k}$) (B) 15 ($5\hat{i} + 6\hat{j} + 5\hat{k}$) (C) 150 ($5\hat{i} - 6\hat{j} + 5\hat{k}$) (D) 15 ($5\hat{i} + 6\hat{j} + 5\hat{k}$)

Q.11 A shot of mass m penetrates a thickness t of a fixed plate of mass M. If M were free to move and the resistance supposed to be uniform, find the thickness penetrated **[3]**

(A) $\frac{Mt}{M+m}$ (B) $\frac{mt}{M+m}$ (C) $\frac{t}{M+m}$ (D) $\frac{t}{M+2m}$

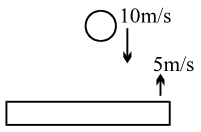
Q.12 A shell is fired from a canon with velocity v m/s at an angle θ with the horizontal direction. At the highest point in it path it explodes into two pieces of equal mass. One of the piece retraces its path to the canon and the speed in m/s of the other piece immediately after the explosion is **[3]**

(A) 3v cos θ (B) 2v cos θ (C) 3/2 v cos θ (D) $\frac{\sqrt{3}}{2}$ v cos θ

Q.13 A ball is projected from a flat horizontal floor vertically with speed v. If the coefficient of restitution for every collision between ball and floor be 'e', the ball would finally come to rest after a time **[3]**

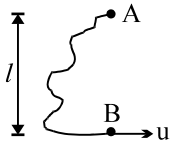
(A) $\frac{2v}{g(1-e)}$ (B) $\frac{2v}{g(1+e)}$ (C) $\frac{v}{g(1-e)}$ (D) $\frac{2v}{g(1-e^2)}$

Q.14 A ball of mass 1kg strikes a heavy platform, elastically, moving upwards with a velocity of 5m/s. The speed of the ball just before the collision is 10m/s downwards. Then the impulse imparted by the platform on the ball is **[3]**



(A) 15 N – s (B) 10 N – s (C) 20 N – s (D) 30 N – s

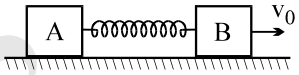
Q.15 Two particles A and B each of mass m are attached by a light inextensible string of length 2*l*. The whole system lies on a smooth horizontal table with B initially at a distance *l* from A. The particle at end B is projected across the table with speed u perpendicular to AB. Velocity of ball A just after the jurk, is **[3]**



(A) $\frac{u\sqrt{3}}{4}$ (B) $u\sqrt{3}$ (C) $\frac{u\sqrt{3}}{2}$ (D) $\frac{u}{2}$

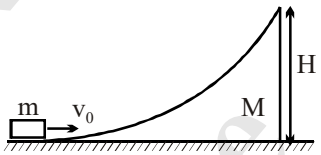
[MULTIPLE CORRECT CHOICE TYPE]

Q.16 Two blocks A and B of the same mass are connected to a light spring and placed on a smooth horizontal surface. B is given velocity v_0 (as shown in the figure) when the spring is in natural length. In the subsequent motion. **[4]**



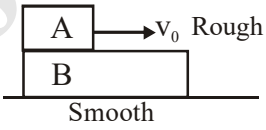
(A) the maximum velocity of B will be v_0
(B) as seen from ground, A can move towards right only
(C) the spring will have maximum extension when A and B both stop
(D) the spring will be at natural length again when B is at rest

Q.17 Figure shows a block of mass m projected with velocity v_0 towards a wedge. Consider all the surfaces to be smooth. Block does not have sufficient energy to negotiate (over come) wedge. Mark the correct option(s) **[4]**



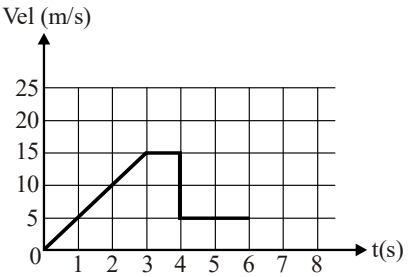
(A) when block is at the maximum height on wedge, block and wedge have velocity equal to velocity of centre of mass of block wedge system.
(B) wedge acquires maximum speed with respect to ground when block returns to lowest point on wedge.
(C) momentum of wedge and block is conserved at all times.
(D) centre of mass of wedge and block remains stationary.

Q.18 In a two block system an initial velocity v_0 (w.r.t. ground) is given to block A, which is placed on a stationary block B as shown in the figure. Which of the following is true : **[4]**



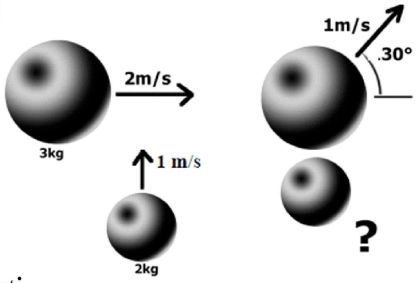
(A) the momentum of block A is not conserved
(B) the increase in kinetic energy of B is equal to decrease in KE of A.
(C) the increase in momentum of B is equal to the decrease in momentum of block A
(D) the increase in kinetic energy of B is less than decrease in KE of A.

Q.19 The figure shows the velocity as a function of time for an object with mass 10 kg being pushed along a frictionless surface by external force. At t = 3s, the force stops pushing and the object moves freely. It then collides head-on and sticks to another object of mass 25 kg. **[4]**



(A) Initial external force acting on the system is 50 N
(B) Speed of the second particle just before the collision is 1 ms^{-1}.
(C) Before collision both bodies are moving in the same direction.
(D) Before collision, bodies are moving in opposite direction.

Q.20 A 3 kg ball is moving 2 m/s in the positive x direction when it is struck dead center by a 2 kg ball moving in the positive y-direction at 1 m/s. After collision the 3 kg ball moves at 1 m/s 30° from the positive x-axis. **[4]**



(A) The collision is inelastic

(B) The velocity of 2 kg block after the collision in x-direction is $\left(3-\frac{3\sqrt{3}}{2}\right)$ m/s

(C) The velocity of 2 kg block after the collision in y-direction is $\frac{1}{4}$ m/s

(D) The given velocity is not possible after the collision

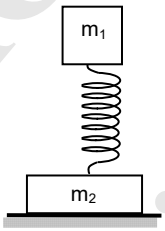
[MATRIX TYPE]

Q.21 Consider isolated system of two balls colliding head on. **[6]**

	Column-I		Column-II
(A)	Elastic collision between balls of mass m and m.	(P)	Total linear momentum is conserved.
(B)	Inelastic collision between balls of mass m and m.	(Q)	Momentum will interchange
(C)	Elastic collision between balls of mass m and 2m	(R)	Kinetic energy will interchange
		(S)	Total kinetic energy after the collision is same as before the collision.

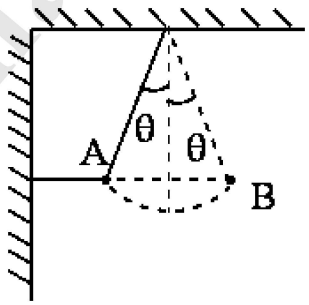
[SUBJECTIVE TYPE]

Q.22 Two blocks of masses m_1 and m_2 connected by a light spring of stiffness k, are kept on a smooth horizontal surface as shown in the figure. What should be the initial compression of the spring so that the system will be about to break off the surface, after releasing the block m_1 ? **[5]**



Q.23 Water of density ρ flows with a linear speed v through a horizontal rubber tube having the form of a ring of radius R. If the diameter of the tube is d (<< R), find the tension in the rubber tube . **[5]**

Q.24 A ball is held at rest in position A by two light cords. The horizontal cord is cut and the ball starts swinging as pendulum. What is the ratio of the tension in the supporting cord in position B to that in position A? **[5]**



CLASS : CC (ADVANCED) MOMENTUM SYSTEM OF PARTICLE M.M. 56 TEST-23

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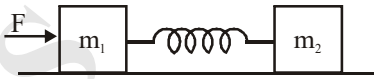

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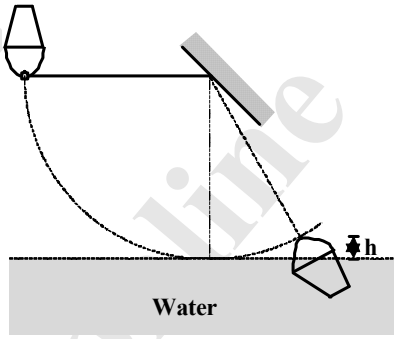

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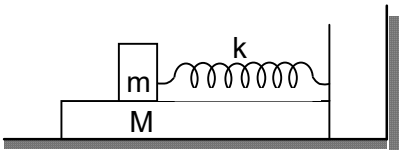

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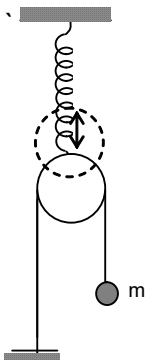

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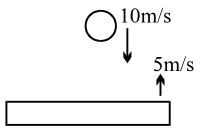

(A) 15 N – s (B) 10 N – s (C) 20 N – s (D*) 30 N – s

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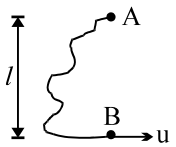

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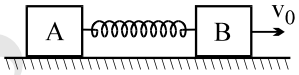
[MULTIPLE CORRECT CHOICE TYPE]

Q.16 Two blocks A and B of the same mass are connected to a light spring and placed on a smooth horizontal surface. B is given velocity v_0 (as shown in the figure) when the spring is in natural length. In the subsequent motion. **[4]**



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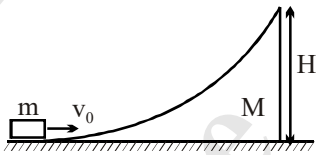

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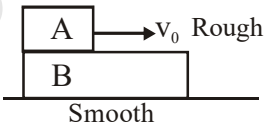

(A*) the momentum of block A is not conserved
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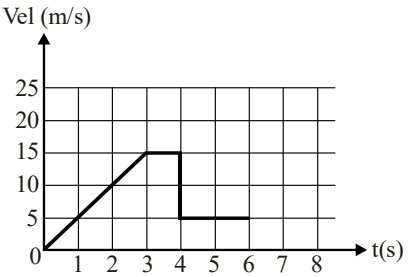

(A*) Initial external force acting on the system is 50 N
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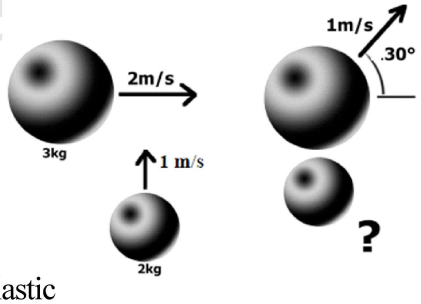
(D) Before collision, bodies are moving in opposite direction.

Q.20 A 3 kg ball is moving 2 m/s in the positive x direction when it is struck dead center by a 2 kg ball moving in the positive y-direction at 1 m/s. After collision the 3 kg ball moves at 1 m/s 30° from the positive x-axis. **[4]**



(A*) The collision is inelastic

(B) The velocity of 2 kg block after the collision in x-direction is $\left(3-\frac{3\sqrt{3}}{2}\right)$ m/s

(C*) The velocity of 2 kg block after the collision in y-direction is $\frac{1}{4}$ m/s

(D) The given velocity is not possible after the collision

[MATRIX TYPE]

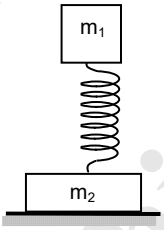
Q.21 Consider isolated system of two balls colliding head on. **[6]**

	Column-I		Column-II
(A)	Elastic collision between balls of mass m and m.	(P)	Total linear momentum is conserved.
(B)	Inelastic collision between balls of mass m and m.	(Q)	Momentum will interchange
(C)	Elastic collision between balls of mass m and 2m	(R)	Kinetic energy will interchange
		(S)	Total kinetic energy after the collision is same as before the collision.

[Ans. (A) P,Q,R,S (B) P (C) P,S]

[SUBJECTIVE TYPE]

Q.22 Two blocks of masses m_1 and m_2 connected by a light spring of stiffness k, are kept on a smooth horizontal surface as shown in the figure. What should be the initial compression of the spring so that the system will be about to break off the surface, after releasing the block m_1 ? **[5]**



Ans. $\frac{(2m_1+m_2)g}{k}$

Q.23 Water of density ρ flows with a linear speed v through a horizontal rubber tube having the form of a ring of radius R. If the diameter of the tube is d (<< R), find the tension in the rubber tube . **[5]**

Ans. $\pi\rho v^2 d^2/4$