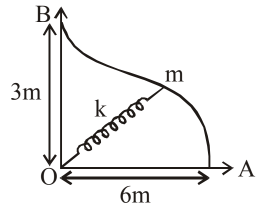
CLASS TEST

SECTION-I

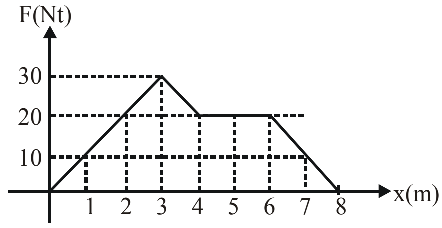
Single Correct Answer Type **5 Q. [3 M (–1)]**

1. A small object with mass m = 2 kg is attached to the free end of an ideal spring with k = 10 Nm^{-1}. The other end of the spring is connected to a fixed frictionless pivot located at the origin O as shown in the Figure. The relaxed length of the spring is 1 m. An unspecified force F carries the object at rest from point A to point B. At point B, the object has the speed 5 ms^{-1}. The work done by the force F is (Neglect gravity) :-



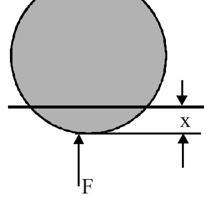
(A) 130 J (B) 80 J (C) –105 J (D) –80 J

2. A body of 4 kg mass placed on a smooth horizontal surface experiences a force varying with displacement of block as shown in figure. Find the speed of the body when force ceases to act on it :-



(A) $\sqrt{65}$ m/s (B) $\sqrt{85}$ m/s (C) $\sqrt{45}$ m/s (D) None of these

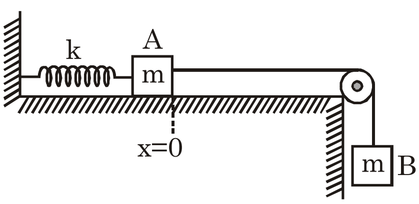
3. Experimentally it has been found that the force F needed to compress elastically a ball through a distance x (as shown in the figure) follows the formula $F(x) = ax + bx^2 + cx^3$ where a, b and c are constants. The small ball of mass m at rest is dropped from a great height h. It bounces elastically off the floor and is compressed a maximum distance 'd' during the bounce. The height h is :- (where 'g' is the acceleration due to gravity)



(A) $\frac{1}{mg}\left(\frac{1}{2}ad^2 + \frac{1}{3}bd^3 + \frac{1}{4}cd^4\right)$ (B) $\frac{1}{mg}\left(ad + bd^2 + cd^3\right)$

(C) $\frac{1}{mg}\left(ad^2 + bd^3 + cd^4\right)$ (D) $\frac{1}{mg}\left(ad^2 + 2bd^3 + 3cd^4\right)$

4. The system is released from rest when spring is at its natural length. Spring constant is 100 N/m and mass of each block is 10 kg. The velocity 'v' of block A as a function of position x is given as $v^2 = ax - bx^2$. The value of a/b is equal to.



(A) 1 (B) 2
(C) 3 (D) 4

5. A bungee jumper is jumping with help of elastic ideal rope (Force constant k). Jumper steps off the bridge and falls from the rest towards the river below. He does not hit the water. The mass of jumper is m, natural length of rope is *l*. Gravity is g, assume every thing ideal. then, choose the incorrect option :

(A) Jumper comes to rest first time after falling a distance $S = \frac{(k\ell + mg) + \sqrt{2mgk\ell + m^2g^2}}{k}$

(B) Maximum speed attained is $\upsilon = \sqrt{2gl + \frac{mg^2}{k}}$

(C) time of free fall from rest $= \sqrt{2l/g}$

(D) None of the above options is correct

Multiple Correct Answer Type 4 Q. [4 M (–1)]

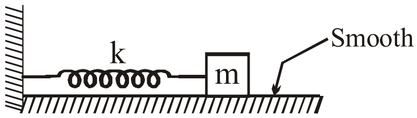
6. A block of mass 1kg kept on a rough horizontal surface ($\mu = 0.4$) is attached to a light spring (force constant = 200 N/m) whose other end is attached to a vertical wall. The block is pushed to compress the spring by a distance d and released. Find the value(s) of 'd' for which (spring + block) system loses its entire mechanical energy in form of heat.

(A) 4cm (B) 6cm (C) 8cm (D) 10 cm

7. Figure shows an ideal spring block system, force constant of spring is k which has been compressed by an amount x_0. If x is instantaneous deflection of spring from its natural length, mark the correct option(s).

(A) Instantaneous power developed by spring is $P = kx\sqrt{\frac{k}{2m}(x_0^2 - x^2)}$

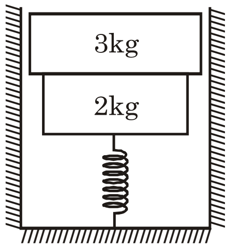
(B) Maximum power of spring is $\frac{k}{2}\sqrt{\frac{k}{m}}x_0^2$



(C) Maximum power occurs at $x = \frac{x_0}{\sqrt{2}}$

(D) Maximum power occurs at $x = \frac{x_0}{2}$

8. A 3 kg block rests on a 2 kg block on a spring of spring constant 50 N/m. The upper block is suddenly removed.

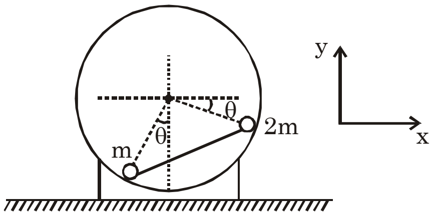


(A) If 2 kg block is not attached to spring, maximum velocity of the block is 3 m/s.
(B) If 2 kg block is not attached to the spring, maximum height of the block above the natural length of the spring is 0.25 m.
(C) If 2 kg block is attached to the spring, maximum velocity of the block is 3 m/s.
(D) If 2 kg block is attached to the spring, maximum height of the block above the natural length of the spring is 0.5 m

9. The two particles of mass m and 2m, respectively are connected by a light rod of negligible mass and slide with negligible friction on a circular path of radius r inside a fixed vertical circular ring. If the system is released from rest at $\theta = 0°$ and θ is taken from positive x-axis in clockwise direction.

(A) The speed of the particles when the rod passes the horizontal position is $\sqrt{\frac{2gr}{3}\left(\frac{3}{\sqrt{2}} - 1\right)}$

(B) The maximum speed of the particles is $\sqrt{\frac{2}{3}gr\left(\sqrt{5} - 1\right)}$



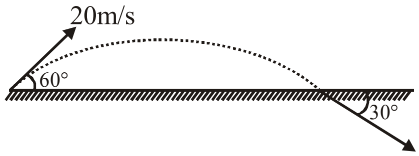
(C) The maximum speed of the particles is at $\theta = \tan^{-1}\left(\frac{1}{2}\right)$

(D) The maximum value of θ is $2\tan^{-1}(2)$.

Linked Comprehension Type (3 Para × 2Q.) [3 M (-1)]
(Single Correct Answer Type)

Paragraph for Question No. 10 and 11

A particle of mass 10 kg is projected from a horizontal surface with a velocity of 20 m/s at an angle of 60° with the horizontal. When it hits the horizontal surface, its velocity makes an angle of 30° with the horizontal. Apart from gravity, a horizontal force acts on the particle during the motion ($g = 10\ m/s^2$)



10. The speed of the particle when it hits the ground is :-

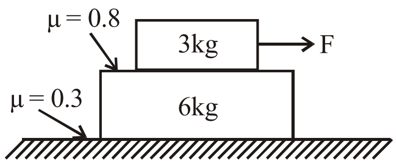
(A) 20 m/s (B) $20\sqrt{3}$ m/s (C) 10 m/s (D) $10\sqrt{3}$ m/s

11. The work done by the horizontal force during the complete motion is :-

(A) 2000 J (B) 6000 J (C) 5000 J (D) 4000 J

Paragraph for Question no. 12 and 13

Two Blocks 3kg and 6kg are placed on a rough surface ($\mu = 0.3$) as shown in the figure. The friction coefficient between two blocks is $\mu = 0.8$. If a force F is applied on the upper block then



12. Choose the **CORRECT** statement.

(A) work done by friction on 6kg block may be negative from ground frame

(B) For any value of F, 6kg block will not move

(C) 3kg block will not move for any value of F < 27 N

(D) Friction force on 6kg block can have greater value between block and ground than friction between blocks.

13. If F is applied on 6kg block instead of 3kg block then choose the **INCORRECT** statement

(A) Work done by friction on 3kg block will be non negative from ground frame.

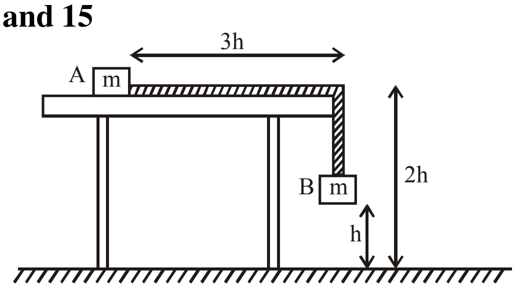
(B) If acceleration of 6kg block is $10 m/s^2$ then acceleration of 3kg block is $8 m/s^2$

(C) If acceleration of 6kg block is $1 m/s^2$ then acceleration of 3kg block is $1 m/s^2$

(D) Work done by friction on 6kg block may be positive from ground frame.

Paragraph for Question no. 14 and 15

Two small blocks, each of mass m are connected by a string of constant length 4h and negligible mass. Block A is placed on a smooth table top as shown, and block B hangs over the edge of the table. The table top is at a distance 2h above the floor. Block B is then released from rest at a distance h above the floor at time t = 0. At time t_0 block B strikes the floor and does not bounce



14. Determine the velocity of block A, when it leaves the table

(A) $\sqrt{\frac{gh}{2}}$ (B) $\sqrt{gh}$ (C) $\sqrt{2gh}$ (D) $2\sqrt{gh}$

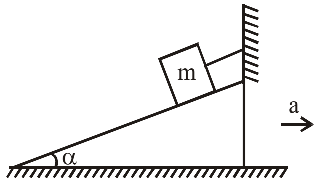
15. Determine the distance between the landing points of the two blocks

(A) 4h (B) 2h (C) $\frac{9h}{8}$ (D) $\frac{7h}{6}$

Linked Comprehension Type (1 Para × 2 Q.) [4 M (–1)]
(Multiple Correct Answer Type)

Paragraph for Question no. 16 and 17

A smooth wedge moves to the right on the horizontal plane with an acceleration a. A mass m is attached to the wedge through a thread as shown in the figure. The thread is parallel to the incline.



16. Which among the following equations is/are **correct :-**

(A) The tension in the thread is $T = m(g \sin \alpha + a \cos \alpha)$

(B) The tension in the thread is $T = m(g \sin \alpha - a \cos \alpha)$

(C) The Normal acting on mass 'm' is $N = m (g \cos \alpha + a \sin \alpha)$

(D) The Normal acting on mass 'm' is $N = m (g \cos \alpha - a \sin \alpha)$

17. Which among the following equations is/are **correct :-**

(A) Tension does non zero work in ground frame during any time 't'.

(B) Tension does non zero work in wedge frame during any time 't'.

(C) Pseudo force does non zero work in ground frame during any time 't'.

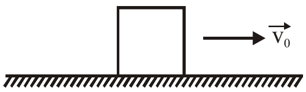
(D) Pseudo force does non zero work in wedge frame during any time 't'.

SECTION-IV

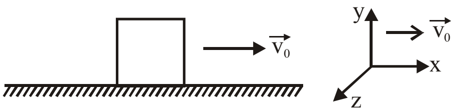
Matrix Match Type (4 × 5) 1 Q. [8 M (for each entry +2(0)]

1. Column-I shows some situations with specified observers. Surface-1 refers to block and surface-2 refers to lower contacting surface. In all the cases velocity of block is in ground frame.

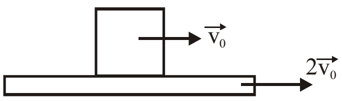
Column-I

(A) 

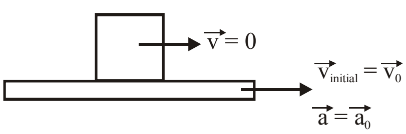
Block projected on rough surface, observer on ground.

(B) 

Block projected on rough surface observer moving with constant velocity $\vec{v}_0$.

(C) 

Block projected with velocity $\vec{v}_0$ on rough belt moving with constant velocity $2\vec{v}_0$ observer on belt

(D) 

Block projected on rough belt moving with initial velocity $\vec{v}_0$ and constant acceleration $\vec{a}_0$ initially block is at rest observer is on ground.

Column-II

(P) work done by friction on surface-2 is negative

(Q) Till block stops ingiven reference frame friction on surface-1 is in +ve x direction

(R) Till block stops in given reference frame friction on surface-1 is in –ve x direction

(S) Net work done by kinetic friction is $-\frac{1}{2}mv_0^2$

(T) When block stops in given reference frame friction is static in nature.

CLASS TEST

CLASS TEST # 32 **ANSWER KEY**

SECTION-I

Single Correct Answer Type **5 Q. [3 M (–1)]**

1. Ans. (D) **2. Ans. (A)** **3. Ans. (A)** **4. Ans. (B)**
5. Ans. (D)

Multiple Correct Answer Type **4 Q. [4 M (–1)]**

6. Ans. (A,C) **7. Ans. (B,C)** **8. Ans. (A,B,C)** **9. Ans. (A,B,D)**

Linked Comprehension Type **(3 Para × 2Q.) [3 M (-1)]**
(Single Correct Answer Type)

10. Ans. (B) **11. Ans. (D)** **12. Ans. (B)** **13. Ans. (D)**
14. Ans. (B) **15. Ans. (B)**

Linked Comprehension Type **(1 Para × 2 Q.) [4 M (–1)]**
(Multiple Correct Answer Type)

16. Ans. (A,D) **17. Ans. (A)**

SECTION-IV

Matrix Match Type (4 × 5) **1 Q. [8 M (for each entry +2(0)]**

1. Ans. (A) R,S; (B)P,S; (C) P,Q,S; (D) P,Q,T