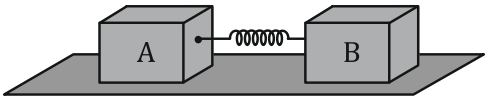
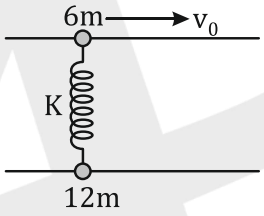
DPP – 04

Spring system & Impulse

Q.1 Two blocks A and B having masses 6m and 3m respectively lying on a smooth horizontal surface are connected by light spring of spring constant k. If the spring is stretched through x and then released. The relative velocity of the blocks when the spring comes to its natural length is $x\sqrt{\frac{k}{\beta m}}$. Then β is____

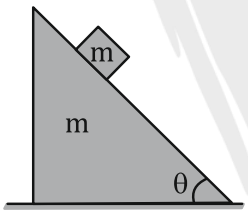


Q.2 Two beads having masses 6 m and 12 m are connected with a light spring. The beads can slide over two frictionless parallel horizontal rails as shown in Figure.



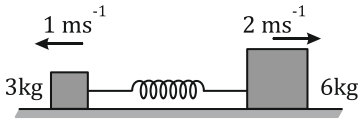
The lighter bead is given an initial velocity v_0 in horizontal direction. The maximum extension produced in the spring is $\beta v_0\sqrt{\frac{m}{k}}$. Then β is___

Q.3 A block of mass m slides down an inclined wedge of same mass m shown in figure. Friction is absent everywhere. Acceleration of centre of mass of the block and wedge is



(A) ZERO (B) $\frac{g\cos^2\theta}{(1+\sin^2\theta)}$ (C) $\frac{g\sin^2\theta}{(1+\sin^2\theta)}$ (D) $\frac{g\sin\theta}{(1+\cos\theta)}$

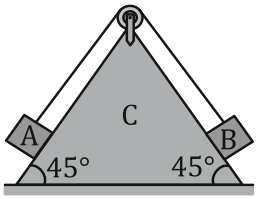
Q.4 Two blocks of mass 3 kg and 6 kg respectively are placed on a smooth horizontal surface. They are connected by a light spring of force constant $k = 200 Nm^{-1}$. Initially the spring is unstretched and velocities of 1 ms^{-1} and 2 ms^{-2} are imparted in opposite directions to the respective blocks as shown in figure.



The maximum extension of the spring will be

(A) 15 cm (B) 20 cm (C) 25 cm (D) 30 cm

Q.5 A system of two blocks A and B and a wedge C is released from the rest as shown in the figure. Masses of the blocks and the wedge are m, 2m and 2m respectively.



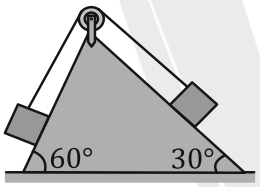
The displacement of wedge C when block B slides down the plane, a distance 10 cm is (neglect friction)

(A) $5\sqrt{2}$ cm (B) $3\sqrt{2}$ cm (C) 4 cm (D) $\frac{5}{\sqrt{2}}$ cm

Q.6 Two particles A and B initially at rest move towards each other under a mutual force of attraction. At the instant when speed of A is v and the speed of B is 2v, the speed of center of mass of the system is

(A) zero (B) v (C) $\frac{3v}{2}$ (D) 3v

Q.7 Two blocks of equal mass are tied with a light string which passes over a massless pulley as shown in the figure.



The magnitude of acceleration of centre of mass of both the blocks is (neglect friction everywhere)

(A) $\left(\frac{\sqrt{3}-1}{4\sqrt{2}}\right)g$ (B) $\left(\frac{\sqrt{3}+1}{4\sqrt{2}}\right)g$ (C) $\left(\frac{\sqrt{3}-1}{2\sqrt{2}}\right)g$ (D) $\left(\frac{\sqrt{3}+1}{2\sqrt{2}}\right)g$

Q.8 Two particles, each of mass m, are connected by a light inextensible string of length 2l. Initially they lie on a smooth horizontal table at points A and B distant I apart. The particle at A is projected across the table with velocity u. Find the speed with which the second particle begins to move, if the direction of u is

(a) along the line BA,

(b) perpendicular to AB.

Q.9 A shell of mass m is fired from a gun of mass km which can recoil freely on a horizontal plane, the elevation of the gun is 45°. Find the ratio of the energy of the shell to that of the gun.

Q.10 A railroad car of mass M is at rest on a frictionless track with a man of mass m standing at its edge. If the man jumps off from the car towards right with an initial velocity u, with respect to the car, find the velocity of the car after its jump.

Q.11 A railroad car of mass M with a man of mass m is moving with a velocity v_1. The man jumps in the direction motion of car with a velocity u with respect to the car. Find the final velocities of the man after jump.

ANSWER KEY

1. 2 **2.** 2 **3.** (C) **4.** (D) **5.** (B) **6.** (A) **7.** (A)

8. (a) $v' = \frac{u}{2}$ (b) $v' = \frac{u\sqrt{3}}{4}$

9. $\frac{2k^2+2k+1}{k}$

10. $\frac{mu}{m+M}$ **11.** $\frac{(M+m)v_1 - Mu}{M+m}$

Home Work

Ex. 1	Q. 10, 13
Ex. 2	Q. 4,10
Ex.3	Q.7,9
Ex.4	Q. 11,1214
Ex.5	Q.5,6,7,12,13,16