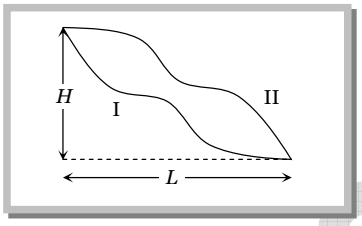
Work, Power, Energy

1. A body is lifted over route I and route II such that force is always tangent to the path. Coefficient of friction is same for both the paths. Work done



(a) On both routes is same
(b) On route I is more
(c) On route II is more
(d) On both routes is zero

2. A force acts on a 3.0 *g* particle in such a way that the position of the particle as a function of time is given by $x = 3t - 4t^2 + t^3$, where *x* is in *metres* and *t* is in seconds. The work done during the first $4\,s$ is

(a) 576 *mJ* (b) 450 *mJ* (c) 490 *mJ* (d) 530 *mJ*

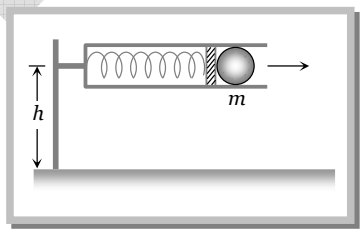
3. A force $\vec{F} = -K(y\hat{i} + x\hat{j})$ (where *K* is a positive constant) acts on a particle moving in the *xy*-plane. Starting from the origin, the particle is taken along the positive *x*-axis to the point (*a,* 0) and then parallel to the *y*-axis to the point (*a, a*). The total work done by the force $\vec{F}$ on the particles is

(a) $-2Ka^2$ (b) $2Ka^2$ (c) $-Ka^2$ (d) Ka^2

4. An engine pumps a liquid of density *d* continuously through a pipe of area of cross-section *A*. If the speed with which the liquid passes the pipe is *V*, then the rate at which kinetic energy is being imparted to the liquid, is

(a) $\frac{1}{2}AdV^3$ (b) $\frac{1}{2}AdV^2$ (c) $\frac{1}{2}AdV$ (d) AdV^2

5. A compressed spring of spring constant *k* releases a ball of mass *m*. If the height of spring is *h* and the spring is compressed through a distance *x*, the horizontal distance covered by ball to reach ground is



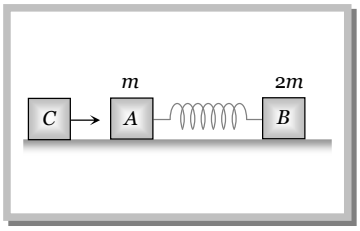
(a) $x\sqrt{\frac{kh}{mg}}$

(b) $\frac{xkh}{mg}$

(c) $x\sqrt{\frac{2kh}{mg}}$

(d) $\frac{mg}{x\sqrt{kh}}$

6. Two bodies *A* and *B* of masses *m* and 2*m* respectively are placed on a smooth floor. They are connected by a spring. A third body *C* of mass *m* moves with velocity V_0 along the line joining *A* and *B* and collides elastically with *A* as shown in fig. At a certain instant of time t_0 after collision, it is found that instantaneous velocities of *A* and *B* are the same. Further at this instant the compression of the spring is found to be x_0. Determine the spring constant



(a) $\frac{2mV_0^2}{3x_0^2}$

(b) $\frac{1}{3}\frac{mV_0^2}{x_0^2}$

(c) $\frac{1}{4}\frac{mV_0^2}{x^2}$

(d) $\frac{4}{5}\frac{mV_0^2}{x_0^2}$

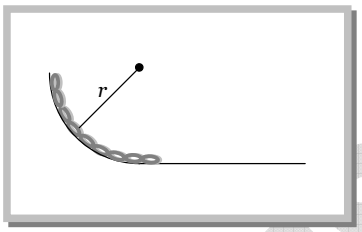
7. The attractive force between the two particles is $F = -G\frac{m_1m_2}{x^2}$. The work done in changing the distance between them from *x* to $x + d$ would be

(a) $\frac{Gm_1m_2}{x^2}d$ (b) $\frac{Gm_1m_2}{d}$ (c) $\frac{Gm_1m_2d}{x(x+d)}$ (d) $\frac{Gm_1m_2d}{(x+d)^2}$

8. In above question, the work done by the man is

(a) *mgl* (b) *mgh* (c) $\frac{1}{2}mgl$ (d) *mg*(1 – *h*)

9. A smooth chain *PQ* of mass *M* rests against a $\frac{1}{4}$ *th* circular and smooth surface of radius *r*. If released, its velocity to come over the horizontal part of the surface is



(a) $\sqrt{2gr}\times\frac{1}{4}$

(b) $\sqrt{2gr\left(1-\frac{1}{\pi}\right)}$

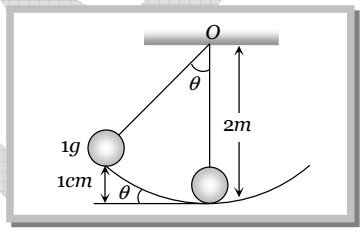
(c) $\sqrt{2gr\left(1-\frac{2}{\pi}\right)}$

(d) $\sqrt{gr\left(1-\frac{2}{\pi}\right)}$

10. A hammer of mass *M* falls from a height *h* repeatedly to drive a pile of mass *m* into the ground. The hammer makes the pile penetrate in the ground to a distance *d* in single blow. Opposition to penetration is given by

(a) $\frac{m^2gh}{M+md}$ (b) $\frac{M^2gh}{(M+m)d}+(M+m)g$ (c) $\frac{M^2gh}{M+md}$ (d) $\frac{m^2gh}{(m+M)d}-(M+m)g$

11. A particle of mass 1 *gm* executes an oscillatory motion on a concave surface of radius of curvature 2*m*. If the particle starts its motion from a point at a height of 1 *cm* from the horizontal and the coefficient of friction is 0.01, then the total distance covered by the particle before it comes to rest, will be



(a) 5.001 *m*

(b) 0.015 *m*

(c) 1.005 *m*

(d) None of these

12. A person decides to use his bath tub water to generate electric power to run a 40 *W* bulb. The bath tub is located at a height of *h m* from ground and it holds *V litres* of water. He installs a water driven wheel generator on ground. The rate at which water should drain from bath tub to light the bulb if efficiency of machine be 90% is

(a) $\frac{11.11}{\rho gh}$ (b) 44.44 $\rho\, gh$ (c) $\frac{44.44}{\rho gh}$ (d) $\frac{22.22}{\rho gh}$

13. An engine of mass one metric ton is ascending on a inclined plane, at an angle $\tan^{-1}\left(\frac{1}{2}\right)$ with horizontal, with a speed of 36 *km*/*hour*. If the coefficient of friction of the surface is $1/\sqrt{3}$ then the power (in watts of engine is)

(a) 94400 (b) 9440 (c) 944 (d) 94.4

14. Two particles having position vectors $\vec{r_1}=(3\hat{i}+5\hat{j})$ *metres* $\vec{r_2}=(-5\hat{i}-3\hat{j})$ *metres* are moving with velocities $\vec{v_1}=(4\hat{i}+3\hat{j})m/s$ and $\vec{v_2}=(\alpha\hat{i}+7\hat{j})m/s$. If they collide after 2 *seconds*, the value of 'α' is

(a) 2 (b) 4 (c) 8 (d) 1