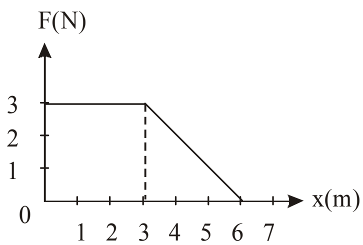
5

Work, Energy And Power

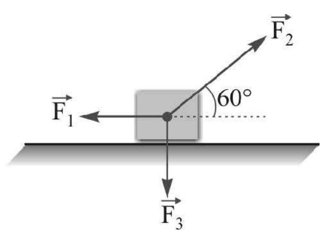
Diagram Based Questions :

1. A force F acting on an object varies with distance x as shown here. The force is in N and x in m. The work done by the force in moving the object from x = 0 to x = 6 m is



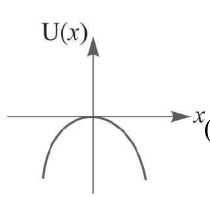
(a) 18.0 J (b) 13.5 J
(c) 9.0 J (d) 4.5 J

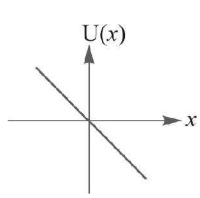
2. Figure shows three forces applied to a trunk that moves leftward by 3 m over a smooth floor. The force magnitudes are $F_1 = 5N$, $F_2 = 9N$, and $F_3 = 3N$. The net work done on the trunk by the three forces

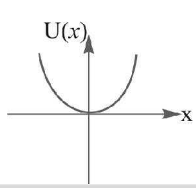


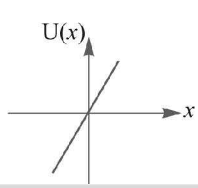
(a) 1.50 J (b) 2.40 J
(c) 3.00 J (d) 6.00 J

3. A particle is placed at the origin and a force $F = kx$ is acting on it (where k is positive constant). If $U(0) = 0$, the graph of $U(x)$ versus x will be (where U is the potential energy function) :

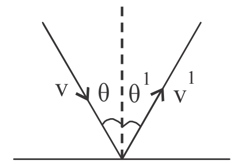
(a)


(b)


(c)


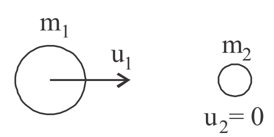
(d)


4. A ball of mass m hits the floor making an angle θ as shown in the figure. If e is the coefficient of restitution, then which relation is true, for the velocity component before and after collision?

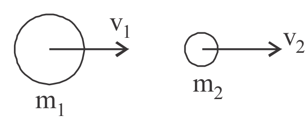


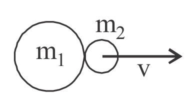
(a) $V^1 \sin\theta = V \sin\theta$
(b) $V^1 \sin\theta' = -\sin\theta$
(c) $V^1 \cos\theta' = V \cos\theta$
(d) $V^1 \cos\theta' = -V \cos\theta$

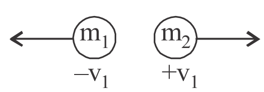
5. For the given case which figure is correctly showing the after inelastic collision situation?

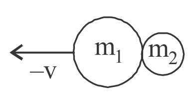


Before collision

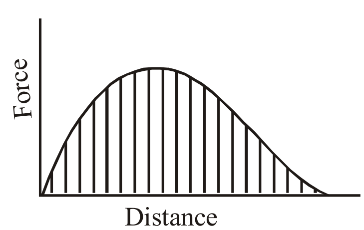
(a)


(b)


(c)


(d)


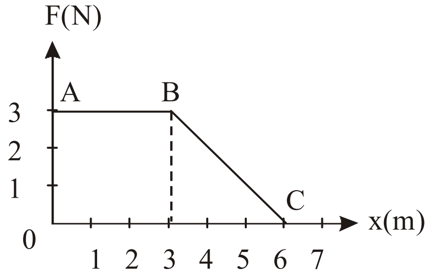
6. Which one of the following physical quantities is represented by the shaded area in the given graph?



(a) Torque (b) Impulse
(c) Power (d) Work done

Solution

1. **(b)**



Work done = area under F-x graph

= area of trapezium OABC = $\frac{1}{2}(3+6)(3)$

= 13.5 J

2. **(a)** $\vec{F} = -5\hat{i} + 9\cos 60°\hat{i} + 9\sin 60°\hat{j} - 3\hat{j}$

$= -5\hat{i} + \frac{9}{2}\hat{i} + \frac{9\sqrt{3}}{2}\hat{j} - 3\hat{j}$

$= -\frac{\hat{i}}{2} + \left(\frac{9\sqrt{3}}{2} - 3\right)\hat{j}$

$\vec{s} = -3\hat{i}$.

$W = \vec{F}.\vec{s} = \left[-\frac{\hat{i}}{2} + \left(\frac{9\sqrt{3}}{2} - 3\right)\hat{j}\right].(-3\hat{i})$

= 1.5 J.

3. **(a)** $U = -\int_0^x F dx = -\int_0^x kx dx = -\frac{1}{2}kx^2$.

It is correctly drawn in **(a)**

4. **(a)** As the floor exerts a force on the ball along the normal, & no force parallel to the surface, therefore the velocity component along the parallel to the floor remains constant. Hence V sin θ = V[1] sin θ[1].

5. **(b)** When $m_1 > m_2$ & m_2 at rest then the bodies collide in elastically and move together as one body without changing the direction.

6. **(d)** Work done $= \int \text{Fdx}$