1. A glass ball is dropped from height 10 m. If there is 20% loss of energy due to impact, then after one impact, the ball will be upto

a) 2 m b) 4 m c) 6 m d) 8 m

2. Under the action of a force, a 2 kg body moves such that its position x as a function of time t is given by $x = t^3/3$, where x is in metre and t in second. The work done by the force in the first two seconds is

a) 1.6 J b) 16 J c) 160 J d) 1600 J

3. A body of mass $2kg$ makes an elastic collision with another body at rest and continues to move in the original direction with one fourth of its original speed. The mass of the second body which collides with the first body is

a) $2\ kg$ b) $1.2\ kg$ c) $3\ kg$ d) $1.5\ kg$

4. Two masses of 1 g and 4g are moving with equal kinetic energies. The ratio of the magnitudes of their linear momenta is

a) 4 : 1 b) $\sqrt{2} : 1$ c) 1 : 2 d) 1 : 16

5. The potential energy of a system increases if work is done

a) Upon the system by a conservative force b) Upon the system by a non-conservative force c) By the system against a conservative force d) By the system against a non-conservative force

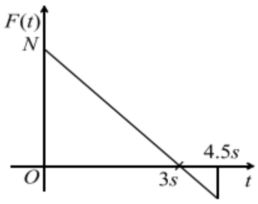
6. A force of $2\hat{\imath} + 3\hat{\jmath} + 4\hat{k}\ N$ acts on a body for 4 second, produces s displacement of $(3\hat{\imath} + 4\hat{\jmath} + 5\hat{k})m$. The power used is

a) $9.5\ W$ b) $7.5\ W$ c) $6.5\ W$ d) $4.5\ W$

7. The decrease in the potential energy of a ball of mass $20\ kg$ which falls from a height of $50\ cm$ is

a) $968\ J$ b) $98\ J$ c) $1980\ J$ d) None of these

8. A block of mass $2\ kg$ is free to move along the x- axis. It is at rest and from $t = 0$ onwards it is subjected to a time-dependent force $F(t)$ in the x- direction. The force $F(t)$ varies with t as shown in the figure. The kinetic energy of the block after 4.5 seconds is



a) $4.50\ J$ b) $7.50\ J$ c) $5.06\ J$ d) $14.06\ J$

9. A particle of mass m at rest is acted upon by a force F for a time t. Its kinetic energy after an interval t is

a) $\frac{F^2t^2}{m}$ b) $\frac{F^2t^2}{2m}$ c) $\frac{F^2t^2}{3m}$ d) $\frac{Ft}{2m}$

10. If the linear momentum is increased by 50%, then kinetic energy will be increased by

a) 50% b) 20% c) 125% d) None of these

11. The power of a water pump is 200 kW. If $g = 10ms^{-2}$, then the amount of water it can raise in 1 min to a height of 10 m is

a) 2000 L b) 1000 L c) 100 L d) 1200 L

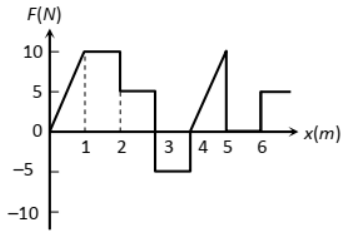
12. Two springs have their force constants as $k_1$and $k_2 (k_1 > k_2)$, when they are stretched by the same force

a) No work is done in case of both the springs
b) Equal work is done in case of both the springs
c) More work is done in case of second spring
d) More work done in case of first spring

13. A light inextensible string that goes over a smooth fixed pulley as shown in the figure connects two blocks of masses 0.36kg and 0.72kg.Taking g=10ms^{-2} ,find the work done (in joule)by string on the block of mass 0.36kg during the first second after the system is released from rest .

a) 8 J b) 9 J c) 7 J d) 0.48 J

14. The relationship between the force F and position x of a body is as shown in figure. The work done in displacing the body from $x = 1m$ to $x = 5m$ will be

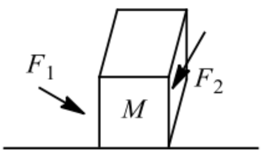


a) 30 J b) 15 J c) 25 J d) 20 J

15. A particle is released from a height s. At certain height its kinetic energy is three times its potential energy. The height and speed of the particle at that instant are respectively

a) $\frac{s}{4}, \frac{3gs}{2}$ b) $\frac{s}{4}, \frac{\sqrt{3gs}}{2}$ c) $\frac{s}{2}, \frac{\sqrt{3gs}}{2}$ d) $\frac{s}{4}, \frac{\sqrt{3gs}}{2}$

16. A body of mass M is moving with a uniform speed of 10 m/s on frictionless surface under the influence of two forces F_1 and F_2. The net power of the system is

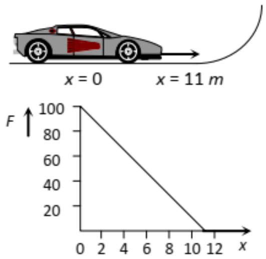


a) 10 $F_1 F_2 M$ b) $10(F_1 + F_2)M$ c) $(F_1 + F_2)/M$ d) Zero

17. A spring of spring constant $5 \times 10^3 Nm^{-1}$ is stretched initially by 5 cm from the unstretched position. Then the work required to stretch it further by another 5 cm is

a) 12.50 N-m b) 18.75 N-m c) 25.00 N-m d) 6.25 N-m

18. A toy car of mass 5 kg moves up a ramp under the influence of force F plotted against displacement x. The maximum height attained is given by



a) $y_{\max} = 20m$ b) $y_{\max} = 15m$ c) $y_{\max} = 11m$ d) $y_{\max} = 5m$

19. In a children's park, there is a slide which has a total length of 10 m and a height of 8.0 m. A vertical ladder is provided to reach the top. A boy weighing 200 N climbs up the ladder to the top of the slide and slides down to the ground. The average friction offered by the slide is three-tenth of his weight. The work done by the slide on the boy as he comes down is

a) Zero b) +600 J c) −600 J d) +1600 J

20. A particle is moving under the influence of a force given by $F = kx$ where k is a constant and x is the distance moved. The energy (in joules) gained by the particle in moving from $x = 0$ to $x = 3$ is
a) 2.5 k b) 3.5 k c) 4.5 k d) 9 k

21. The kinetic energy acquired by a mass m in travelling a certain distance d starting from rest under the action of a constant force is directly proportional to
a) $\sqrt{m}$ b) Independent of m c) $1/\sqrt{m}$ d) m

22. A 60 kg man runs up a staircase in 12 seconds while a 50 kg man runs up the same staircase in 11 seconds. The ratio of the rate of doing their work is
a) 6 : 5 b) 12 : 11 c) 11 : 10 d) 10 : 11

23. In the stable equilibrium position, a body has
a) Maximum potential energy b) Minimum potential energy
c) Minimum kinetic energy d) Maximum kinetic energy

24. Power supplied to a particle of mass 2 kg varies with time as $P = \frac{3t^2}{2}$ watt. Here t is in second. If the velocity of particle at $t = 0$ is $v = 0$, the velocity of particle at time $t = 2$ s will be
a) 1 ms^{-1} b) 4 ms^{-1} c) 2 ms^{-1} d) $2\sqrt{2}$ ms^{-1}

25. A light and a heavy body have equal kinetic energy. Which one has a greater momentum

a) The light body
b) The heavy body
c) Both have equal momentum
d) It is not possible to say anything without additional information

26. If the momentum of a body is increased by 100%, then the percentage increase in the kinetic energy is

a) 150%
b) 200%
c) 225%
d) 300%

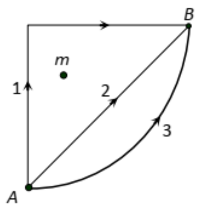
27. From a waterfall, water is falling down at the rate of 100 kg/s on the blades of turbine. If the height of the ball is 100 m, then the power delivered to the turbine is approximately equal to

a) 100 kW
b) 10 kW
c) 1 kW
d) 1000 kW

28. A variable force, given by the 2-dimensional vector $\vec{F} = (3x^2\hat{\imath} + 4\,\hat{\jmath})$, acts on a particle. The force is in newton and x is in metre. What is the change in the kinetic energy of the particle as it moves from the point with coordinates (2,3) to (3,0) (The coordinates are in metres)

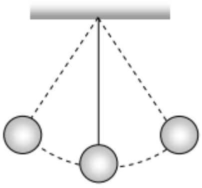
a) $-7\,J$
b) Zero
c) $+7\,J$
d) $+19\,J$

29. If W_1, W_2 and W_3 represent the work done in moving a particle from A to B along three different paths 1, 2 and 3 respectively (as shown) in the gravitational field of a point mass m, find the correct relation between W_1, W_2 and W_3



a) $W_1 > W_2 > W_3$
b) $W_1 = W_2 = W_3$
c) $W_1 < W_2 < W_3$
d) $W_2 > W_1 > W_3$

30. What is the velocity of the bob of a simple pendulum at its mean position, if it is able to rise to vertical height of 10 cm (Take $g = 9.8\,m/s^2$)



a) 0.6 m/s
b) 1.4 m/s
c) 1.8 m/s
d) 2.2 m/s

ANSWER KEY

1.	D	2.	B	3.	B	4.	C	5.	C	6.	A	7.	B
8.	C	9.	B	10.	C	11.	D	12.	C	13.	A	14.	B
15.	D	16.	D	17.	B	18.	C	19.	C	20.	C	21.	B
22.	C	23.	B	24.	C	25.	B	26.	D	27.	A	28.	C
29.	B	30.	B										

SOLUTIONS

1. **(d)**

Clearly, 80% energy is retained after impact

$\therefore\ h' = \frac{80}{100} \times 10 = 8\text{ m}$

2. **(b)**

$v = \frac{dx}{dt} = \frac{d}{dt}\left(\frac{t^3}{3}\right) = t^2$

When $t = 0$, then $v = 0$, when $t = 2$, then

$v = 4\text{ m/s}$

Work done in first two second = change in KE

$W = \frac{1}{2}m[(4)^2 - (0)^2] = \frac{1}{2} \times 2 \times 16 = 16\text{ J}$

3. **(b)**

$m_1 = 2\ kg$ and $v_1 = \left(\frac{m_1 - m_2}{m_1 + m_2}\right)u_1 = \frac{u_1}{4}$ [Given]

By solving we get $m_2 = 1.2\ kg$

4. **(c)**

$p = \sqrt{2mE_k}$

or $p \propto \sqrt{m}$ [$\because E_k$ is given to be constant]

$\therefore\ \frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$

5. **(c)**

By definition

6. **(a)**

$$P = \frac{\vec{F}.\vec{s}}{t} = \frac{(2\hat{\imath} + 3\hat{\jmath} + 4\hat{k}).(3\hat{\imath} + 4\hat{\jmath} + 5\hat{k})}{4} = \frac{38}{4}$$
$$= 9.5\,W$$

7. **(b)**

$$\Delta U = mgh = 20 \times 9.8 \times 0.5 = 98\,J$$

8. (C)

$$\int F dt = \Delta\rho$$
$$\Rightarrow \frac{1}{2} \times 4 \times 3 - \frac{1}{2} \times 1.5 \times 2 = p_f - 0 \Rightarrow p_f$$
$$= 6 - 1.5 = \frac{9}{2}$$
$$K.E. = \frac{p^2}{2m} = \frac{81}{4 \times 2 \times 2}; K.E. = 5.06\,J$$

9. **(b)**

Kinetic energy $E = \frac{P^2}{2m} = \frac{(Ft)^2}{2m} = \frac{F^2t^2}{2m}$ [As $P = Ft$]

10. **(c)**

The relation between linear momentum and kinetic energy is

$p^2 = 2mk$ ....(i)

But linear momentum is increased by 50%, then

$$p' = \frac{150}{100}p$$
$$p' = \frac{3}{2}p$$

Hence, $p'^2 = 2mk'$

Or $\left(\frac{3}{2}p\right)^2 = 2mk'$

Or $\frac{9}{4}p^2 = 2mk'$ ....(ii)

On putting the value of p^2 from Eq. (i) in Eq. (ii)

$$\frac{9}{4} \times 2mk = 2mk'$$

Or $K' = \frac{9}{4}k$

So, the increase in kinetic energy is

$$\Delta K = \frac{9}{4}k - k = \frac{5}{4}k$$

Hence, percent increase in kinetic energy

$$= \frac{(5/4)K}{K} \times 100\%$$

$$= \frac{5}{4} \times 100\% = 125\%$$

11. **(d)**

$$P = \frac{mgh}{t}$$

$$m = \frac{Pt}{gh} = \frac{200 \times 60}{10 \times 10} = 1200 \text{ L}$$

12. **(c)**

$$w = \frac{F^2}{2k}$$

If both springs are stretched by same force then

$w \propto \frac{1}{k}$.

As $k_1 > k_2$ therefore, $w_1 < w_2$

I.e., more work is done in case of second spring.

13. **(a)**

$$a = \frac{\text{Net pulling force}}{\text{Total mass}}$$

$$= \frac{0.72g - 0.36g}{0.72 + 0.36} = \frac{g}{3}$$

$$s = \frac{1}{2}at^2 = \frac{1}{2}\left(\frac{g}{3}\right)(1)^2 = \frac{g}{6}$$

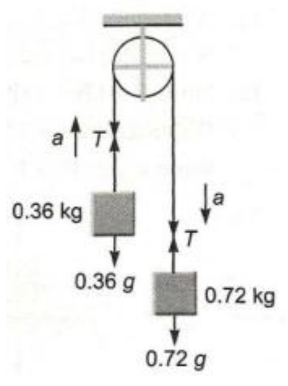
$$\text{T} - 0.36g = 0.36a = 0.36\frac{g}{3}$$

$$\therefore T = 0.48g$$

Now, $w_T = TS \cos 0° (on\ 0.36\ kg\ mass)$

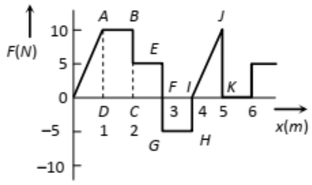
$$= (0.48\ g)\left(\frac{g}{6}\right)(1) = 0.08(g^2)$$

$$= 0.08(10)^2 = 8\text{J}$$



14. **(b)**

Work done = area under F-x graph
= area of rectangle $ABCD$ + area of rectangle
$LCEF$ + area of rectangle $GFIH$ + area of triangle
IJK



$= (2-1)\times(10-0)+(3-2)(5-0)$
$+(4-3)(-5-0)+\frac{1}{2}(5-4)(10-0)=15\,J$

15. **(d)**

Velocity at B when dropped from A
where $AC = s$
$v^2 = u^2 + 2g(s-x)$ ....(i)
$v^2 = 2g(s-x)$ ....(ii)
Potential energy at $B = mgx$
∴ Kinetic energy = $3\times$ potential energy

16. **(d)**

As the speed of mass is uniform hence, net power will be zero.

17. **(b)**

$W_1 = \frac{1}{2}k\times x_1^2$
$= \frac{1}{2}\times 5\times 10^3\times(5\times 10^{-2})^2 = 6.25\text{J}$
$W_2 = \frac{1}{2}k(x_1+x_2)^2$
$= \frac{1}{2}\times 5\times 10^3(5\times 10^{-2}+5\times 10^{-2})^2 = 25\text{ J}$
Net work done $= W_2 - W_1 = 25 - 6.25$
$= 18.75\text{J} = 18.75\text{N}-\text{m}$

18. **(c)**

Work done = Gain in potential energy
Area under curve = mgh
$\Rightarrow \frac{1}{2}\times 11\times 100 = 5\times 10\times h \Rightarrow h = 11m$

19. **(c)**

$F = \frac{3}{10} mg$

$W = -F\, s$ or $W = -\frac{3}{10} mgs$

or $W = -\frac{3}{10} \times 200 \times 10 \text{ J} = -600 \text{ J}$

20. **(c)**

$U = \frac{1}{2} K(x_2^2 - x_1^2) \Rightarrow U = \frac{1}{2} K(3^2 - 0) \Rightarrow U$

$= 4.5\, K$

21. **(b)**

Kinetic energy acquired by the body
= Force applied on it × distance covered by the body

K.E. $= F \times d$

If F and d both are same then K. E. acquired by the body will be same

22. **(c)**

$P = \frac{mgh}{t} \Rightarrow \frac{P_1}{P_2} = \frac{m_1}{m_2} \times \frac{t_2}{t_1}$ [As h = constant]

$\therefore \frac{P_1}{P_2} = \frac{60}{50} \times \frac{11}{12} = \frac{11}{10}$

23.

24. **(c)**

From work-energy theorem

$\Delta \text{ KE } = W_{\text{net}}$

or $K_f - K_i = \int P d$

or $\frac{1}{2} mv^2 = \int_0^2 \left(\frac{3}{2} t^2\right) dt$

$v^2 = \left[\frac{t^3}{2}\right]_0^2$

$v = 2 \text{ ms}^{-1}$

25. **(b)**

$P = \sqrt{2mE}$ if E are equal then $P \propto \sqrt{m}$

$i.e.$, heavier body will possess greater momentum

26. **(d)**

$$E = \frac{P^2}{2m} \Rightarrow E_2 = E_1\left(\frac{P_2}{P_1}\right)^2 = E_1\left(\frac{2P}{P}\right)^2$$

$$\Rightarrow E_2 = 4E_1 = E_1 + 3E_1 = E + 300\% \text{ of } E$$

27. **(a)**

$$P = \left(\frac{m}{t}\right)gh = 100 \times 10 \times 100 = 10^5 W$$

$$= 100\ kW$$

28. **(c)**

$\vec{F} = 3x^2\hat{\imath} + 4\hat{\jmath}, \vec{r} = x\hat{\imath} + y\hat{\jmath}$

$\therefore d\vec{r} = dx\hat{\imath} + dy\hat{\jmath}$

Work done, $W = \int \vec{F}.d\vec{r} = \int_{(2,3)}^{(3,0)}(3x^2\hat{\imath} + 4\hat{\jmath}).(dx\hat{\imath} + dy\hat{\jmath})$

$$= \int_{(2,3)}^{(3,0)}(3x^2dx + 4dy) = [x^3 + 4y]_{(2,3)}^{(3,0)}$$

$$= 3^3 + 4 \times 0 - (2^3 + 4 \times 3)$$

$$= 27 + 0 - (8 + 12) = 27 - 20 = +7J$$

According to work energy theorem

Change in the kinetic energy = Work done,

$$W = +7J$$

29. **(b)**

Gravitational force is a conservative force and work done against it is a point function $i.e.$ does not depend on the path

30. **(b)**

$$v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 0.1} = \sqrt{1.96} = 1.4\ m/s$$