DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 1

Topic :- WORK ENERGY AND POWER

1 **(b)**

Kinetic energy of a body

$K = \frac{P^2}{2M}$

Or $K \propto P^2$

Or $\frac{p_2}{p_1} = \sqrt{\frac{K_2}{K_1}} = \sqrt{4}$

$or \ P_2 = 2P_1$

2 **(b)**

Work = Force $\times$ Displacement

If force and displacement both are doubled then work would be four times

3 **(d)**

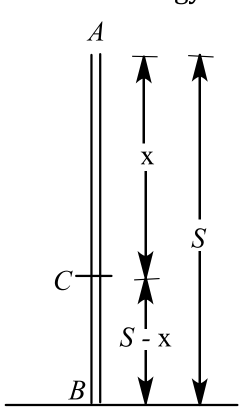
We can realize the situation as shown .Let at point C distance x from highest point A, the particle's kinetic energy is three times its potential energy.

$Velocity\ at\ C,$

$v^2 = 0 + 2gx$

$Or \quad v^2 = 2gx$ .....(i)

Potential energy at C, $= mg\ (S - x)$ .....(ii)



At Point C,

Kinetic energy=3 $\times$ $potential\ energy$

ie, $\frac{1}{2}m \times 2gx = 3 \times mg(S - x)$

or $x = 3S - 3x$

or $4x = 3S$

or $S = \frac{4}{3}x$

or $x = \frac{3}{4}S$

Therefore, from Eq.(i)

$$v^2 = 2g \times \frac{3}{4}S$$

Or $v^2 = \frac{3}{2}gS \quad or \quad v = \sqrt{\frac{3}{2}gS}$

Height of the particle from the ground

$$= S - x = S - \frac{3}{4}S = \frac{s}{4}$$

4 **(d)**

$$W = \int_0^5 F dx = \int_0^5 (7 - 2x + 3x^2)dx = [7x - x^2 + x^3]_0^5$$

$$= 35 - 25 + 125 = 135\,J$$

5 **(b)**

According to the graph the acceleration a varies linearly with the coordinate x. We may write $a = \alpha x$, where α is the slope of the graph.

From the graph

$$\alpha = \frac{20}{8} mg_0 = 2.5 \text{ s}^{-2}$$

The force on the brick is in the positive x-direction and according to Newton's second law, its magnitude is given by

$$F = \frac{a}{m} = \frac{\alpha}{m}x$$

If x_f is the final coordinate, the work done by the force is

$$W = \int_0^{x_f} F\,dx = \frac{a}{m}\int_0^{x_f} x\,dx$$

$$= \frac{\alpha}{2m}x_f^2 = \frac{2.5}{2 \times 10} \times (8)^2$$

$$= 8 \text{ J}$$

6 **(d)**

The potential energy of a stretched spring is

$$U = \frac{1}{2}kx^2$$

Here, k=spring constant, x=elongation in spring.

But given that, the elongation is 2 cm.

So $U = \frac{1}{2}K(2)^2$

Or $U = \frac{1}{2}k \times 4$ ...(i)

If elongation is 10 cm then potential energy

$U' = \frac{1}{2}k(10)^2$

Or $U' = \frac{1}{2}k \times 100$ ...(ii)

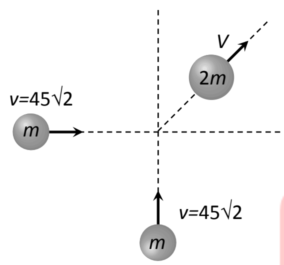
On dividing Eq. (ii) by Eq. (i), We have

$$\frac{U'}{U} = \frac{\frac{1}{2}k \times 100}{\frac{1}{2}k \times 4}$$

Or $\frac{U'}{U} = 25 \Rightarrow U' = 25U$

7 **(b)**

Initial momentum



$\vec{P} = m45\sqrt{2}\,\hat{i} + m45\sqrt{2}\,\hat{j}$

$\Rightarrow |\vec{P}| = m \times 90$

Final momentum $2m \times V$

By conservation of momentum

$2m \times V = m \times 90$

$\therefore V = 45\ m/s$

8 **(d)**

Potential energy of the particle $U = k(1 - e^{-x^2})$

Force on particle $F = \frac{-dU}{dx} = -k[-e^{-x^2} \times (-2x)]$

$F = -2kxe^{-x^2} = -2kx\left[1 - x^2 + \frac{x^4}{2!} - \ldots\right]$

For small displacement $F = -2kx$

$\Rightarrow F \propto -x$ *i.e.* motion is simple harmonic motion

9 **(a)**

Given $F = -5x - 16x^3 = -(5 + 16x^2)x = -kx$

where $k(= 5 + 16x^2)$is force constant of spring ,Therefore , work done in stretching the spring from position x_1 to position x_2 *is*

$w = \frac{1}{2}k_2x_2^2 - \frac{1}{2}k_1x_1^2$

We have,$x_1 = 0.1$ m and$x_2 = 0.2$m.

$\therefore W = \frac{1}{2}[5 + 16(0.2)^2](0.2)^2 - \frac{1}{2}[5 + 16(0.1)^2](0.1)^2$

$= 2.82 \times 4 \times 10^{-2} - 2.58 \times 10^{-2} = 8.7 \times 10^{-2}$J

10 **(a)**

In a perfectly elastic collision the relative velocity remains unchanged in magnitude but reserved in direction. Therefore , velocity of heavy body after collision is v.

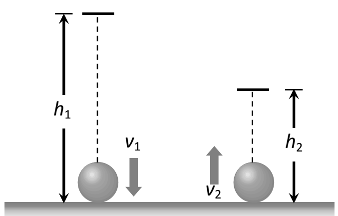
11 **(a)**

$E = \frac{p^2}{2m}$. If $P =$ constant then $E \propto \frac{1}{m}$

i.e., kinetic energy of heavier body will be less. As the mass of gun is more than bullet therefore it possess less kinetic energy

12 **(b)**

If ball falls from height h_1 and bounces back up to height h_2 then $e = \sqrt{\frac{h_2}{h_1}}$



Similarly if the velocity of ball before and after collision are v_1 and v_2 respectively then $e = \frac{v_2}{v_1}$

So $\frac{v_2}{v_1} = \sqrt{\frac{h_2}{h_1}} = \sqrt{\frac{1.8}{5}} = \sqrt{\frac{9}{25}} = \frac{3}{5}$

i.e. fractional loss in velocity $= 1 - \frac{v_2}{v_1} = 1 - \frac{3}{5} = \frac{2}{5}$

13 **(c)**

Let $m =$ mass of boy, $M =$ Mass of man

$v =$ velocity of boy, $V =$ velocity of man

$\frac{1}{2}MV^2 = \frac{1}{2}\left[\frac{1}{2}mv^2\right]$ ...(i)

$\frac{1}{2}M(V+1)^2 = 1\left[\frac{1}{2}mv^2\right]$ ...(ii)

Putting $m = \frac{M}{2}$ and solving $V = \frac{1}{\sqrt{2}-1}$

14 **(a)**

Since body moves with constant velocity, so. Net force on the body is zero.

Here, $N = mg, F = f$

$\therefore W = \vec{\mathbf{F}}.\vec{\mathbf{s}} = fs\cos 180''$

$= fs = -10 \times 2 = -20$ J

15 **(a)**

Given,

$m = 100$kg, h = 10m, t = 5s,

g = $10ms^{-2}$ and η = 60%

Power=$\frac{\text{work/time}}{\eta} = \frac{100}{60} \times \frac{\text{mgh}}{\text{t}}$

$= \frac{100}{60} \times \frac{100 \times 10 \times 10}{5}$

$= 3.3 \times 10^3$W

$= 3.3\text{kW}$

16 **(c)**

Height of CG of mass $m_1 = \frac{a}{2}$

Height of CG of mass $m_2 = a + \frac{b}{2}$

$\therefore$ Gravitational potential energy of system

$$= m_1 g\frac{a}{2} + m_2 g\left(a + \frac{b}{2}\right) = \left[\frac{m_1}{2} + m_2\right]ga + m_2 g\frac{b}{2}$$

$$= \left[\left(\frac{m_1}{2} + m_2\right)a + m_2\frac{b}{2}\right]g$$

17 **(a)**

The ball rebounds with the same speed. So change in it's Kinetic energy will be zero *i.e.* work done by the ball on the wall is zero

18 **(b)**

To leave the block, it oscillates in vertical plane. If maximum extension in spring in extreme position of block is x_1 , then

Work done by weight of the block

=Potential energy stored in spring

$$mg\,x = \frac{1}{2}kx^2$$

$$\therefore x = 2\frac{mg}{k}\ 2d \qquad \left(\because d = \frac{mg}{k}\right)$$

19 **(a)**

The weight of bucket when it has been pulled up a distance x *is* (5-0.2x).

Hence, the required work is

$$W = \int_{x=20}^{x=0} - (5 - 0.2x) \times 10 \times dx$$

$$= [50x]_{x=0}^{x=20} - \left[2\frac{x^2}{2}\right]_{x=0}^{x=20}$$

$$W = 50 \times 20 - (20)^2 = 600\text{J}$$

20 **(b)**

$\Delta U = mg\text{h} = 0.2 \times 10 \times 200 = 400J$

$\therefore$ Gain in K.E. = decrease in P.E. $= 400\ J$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	B	B	D	D	B	D	B	D	A	A
Q.	11	12	13	14	15	16	17	18	19	20

A.	A	B	C	A	A	C	A	B	A	B