DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

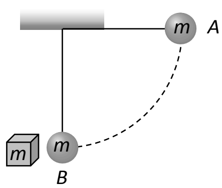
SUBJECT : PHYSICS
DPP NO. : 3

Topic :- WORK ENERGY AND POWER

1 **(c)**

P.E. of bob at point $A = mgl$

This amount of energy will be converted into kinetic energy



$\therefore$ K.E. of bob at point $B = mgl$

And as the collision between bob and block (of same mass) is elastic so after collision bob will come to rest and total Kinetic energy will be transferred to block. So kinetic energy of block $= mgl$

2 **(a)**

Work done = Area under curve and displacement axis

= Area of trapezium

$= \frac{1}{2} \times$ (sum of two parallel lines) $\times$ distance between them

$= \frac{1}{2}\ (10 + 4) \times (2.5 - 0.5) = \frac{1}{2} 14 \times 2 = 14\,J$

As the area actually is not trapezium so work done will be more than 14 J *i.e.* approximately 16 J

3 **(d)**

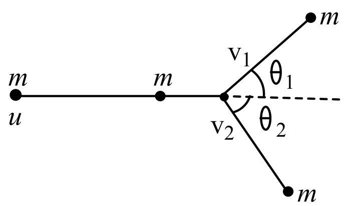
$U(x) = \frac{a}{x^{12}}$ - $\frac{b}{x^6}$ at the stable equilibrium $\frac{du}{dx} = 0$

$\therefore \quad -\frac{12}{x^{13}} + \frac{6b}{x^7} = 0 \Rightarrow x = \left(\frac{2a}{b}\right)^{1/6}$

4 **(b)**

Let particle with mass m, move with velocity u,and $v_1$and $v_2$be velocity after collision.

Since , elastic collision is one in which the momentum is conserved , we have



$\therefore mu = mv_1 \cos\theta_1 + mv_2 \cos\theta_2$ .....(i)

In perpendicular direction

$0 = mv_1 \sin\theta_2 - mv_2 \sin\theta_2$ .....(ii)

Also elastic collision occurs only if there is no conversion of kinetic energy into other from, Hence

$$\frac{1}{2}mu^2 = \frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2$$

$u_2 = v_1^2 + v_2^2$ ....(iii)

Squaring Esq.(i)and (ii)and adding we get

$$m^2u^2 = m^2\left(v_1\cos\theta_1 + v_2\cos\theta_2\right)^2 + m^2\left(v_1\sin\theta_1 - v_2\sin\theta_2\right)^2$$

$u^2 = v_1^2 + v_2^2 + 2v_1v_2\cos\theta_1\cos\theta_2 - 2v_1v_2\sin\theta_1\sin\theta_2$

$u^2 = v_1^2 + v_2^2 + 2v_1v_2\cos(\theta_1 + \theta_2)$

Using Eq.(iii),we get

$2v_1v_2\cos(\theta_1 + \theta_2) = 0$

since $v_1v_2 \neq 0$

Hence $\cos(\theta_1 + \theta_2) = 0$

Or $\theta_1 + \theta_2 = 90°$

When two identical particles collide elastically and obliquely,

One being at rest, then they fly off in mutually perpendicular directions.

5 **(d)**

$P = \sqrt{2mE} \therefore P \propto \sqrt{E}$

i.e., if kinetic energy of a particle is doubled then its momentum will becomes $\sqrt{2}$ times

6 **(a)**

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

$\therefore E \propto k$

$$\therefore \frac{E_1}{E_2} = \frac{k_1}{k_2}$$

7 **(b)**

$$dW = -\mu\left[\frac{M}{L}\right]gl\,dl$$

$$W = \int_0^{\frac{2L}{3}} -\frac{\mu Mg}{L} l\,dl$$

or $W = -\frac{\mu M g}{L}\left|\frac{l^2}{2}\right|_0^{\frac{2L}{3}}$

or $W = -\frac{\mu M g}{L}\left|\frac{4L^2}{9} - 0\right|$

or $W = -\frac{2}{9}\mu MgL$

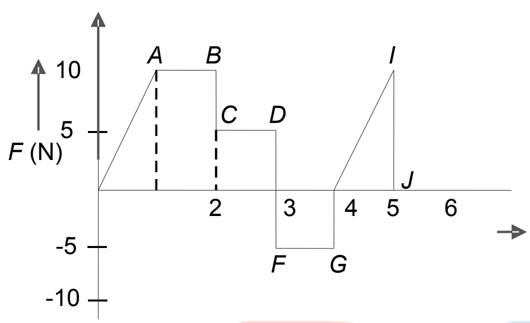
8 **(a)**

When a shell fired from cannon explodes in mid air then is kinetic energy increases.

9 **(b)**

Work done=area enclosed by F - $x$graph

=area of $ABNM$ + area of CDEN - area of $EFGH$ + area of HIJ



$=1 \times 10 + 1 \times 5 - 1 \times 5 + \frac{1}{2} \times 1 \times 10$

$= 10 + 5 - 5 + 5 = 15\text{ J}$

10 **(c)**

The energy gained by the particle

$U = \frac{1}{2}k(x_2^2 - x_1^2)$

$= \frac{1}{2}k(3^2 - 0^2) = \frac{9}{2}k4.5k$

11 **(a)**

$$W = F \times s = F \times v \times t = 5 \times 2 \times 60 = 600\,J$$

12 **(b)**

Work done on the body = K.E. gained by the body

$Fs\cos\theta = 1 \Rightarrow F\cos\theta = \frac{1}{s} = \frac{1}{0.4} = 2.5N$

13 **(a)**

When block strikes the spring, the kinetic energy of block converts into potential energy of spring ie,

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

Or $\quad x = \sqrt{\frac{mv^2}{k}}$

$$= \sqrt{\frac{25 \times 3^2}{100}} \sqrt{\frac{9}{4}} = \frac{3}{2} = 1.5\ m$$

When block returns to the original position, again potential energy converts into kinetic energy of the blocks, so velocity of the block is same as before but its sign changes as it goes to mean position.

$Hence\ v = -3ms^{-1}$

14 **(a)**

Because in perfectly inelastic collision the colliding bodies stick together and move with common velocity

15 **(c)**

Power of a pump $= \frac{1}{2}\rho A v^3$

To get twice amount of water from same pipe v has to be made twice. So power is to be made 8 times

16 **(a)**

Initial energy of body $= \frac{1}{2}mv^2 = \frac{1}{2} \times 1 \times (20)^2 = 200\ J$

A part of this energy consumes in doing work against gravitational force and remaining part consumes in doing work against air friction

i.e., $W_T = W_{grav.} + W_{air\ friction}$

$\Rightarrow 200 = 1 \times 10 \times 18 + W_{air} \Rightarrow W_{air} = 20\ J$

17 **(d)**

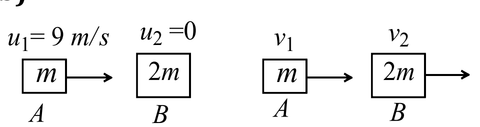
$$s = \frac{u^2}{2\mu g} = \frac{10 \times 10}{2 \times 0.5 \times 10} = 10m$$

18 **(c)**

$U = \frac{F^2}{2k} \Rightarrow \frac{U_1}{U_2} = \frac{k_2}{k_1}$ [If force are same]

$$\therefore \frac{U_1}{U_2} = \frac{3000}{1500} = \frac{2}{1}$$

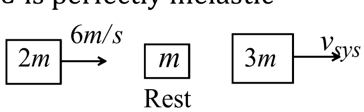
19 **(b)**



Before elastic collision After elastic collision

$$v_2 = \frac{2m_1 v_1}{m_1 + m_2} = \frac{2 \times m \times 9}{m + 2m} = 6\ m/s$$

i.e. After elastic collision B strikes to C with velocity of 6 m/s. Now collision between B and C is perfectly inelastic



By the law of conservation of momentum

$2m \times 6 + 0 = 3m \times v_{sys}$
$\Rightarrow v_{sys} = 4\ m/s$

20 **(a)**

If after the collision of two bodies, the total kinetic energy of the bodies remains the same as it was before the collision, and also momentum remains same, then it is a case of perfectly elastic collision.

Momentum before collision= Momentum after collision

Kinetic energy before collision
=Kinetic energy after collision

Also, $u_1 - u_2 = -(v_1 - v_2)$

Where ($u_1 - u_2$) is the relative velocity before the collision and $(v_1 - v_2)$is the relative velocity after the collision. Thus, in a perfectly elastic collision the relative velocity remains unchanged in magnitude, but is reserved in direction. Hence, velocity of the last ball is -0.4 ms^{-1}.

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