WEEKLY TEST TYJ -1 TEST - 20 R & B
SOLUTION Date 08-09-2019

[PHYSICS]

1.

Velocity of total mass $(u) = 0$ (because it is stationary). According to law of conservation of momentum

$$(m_1 + m_2)u = m_1 v_1 + m_2(-v_2)$$

or $$(m_1 + m_2) \times 0 = m_1 v_1 - m_2 v_2$$

or $$m_1 v_1 = m_2 v_2$$

or $$\frac{v_1}{v_2} = \frac{m_2}{m_1}$$

We also know that;

Kinetic energy, $(E) = \frac{1}{2} mv^2 \propto mv^2$

$$\therefore \quad \frac{E_1}{E_2} = \left(\frac{m_1}{m_2}\right) \times \left(\frac{v_1}{v_2}\right)^2$$

$$= \frac{m_1}{m_2} \times \left(\frac{m_2}{m_1}\right)^2 = \frac{m_2}{m_1}.$$

2.

When the mass attached to a spring fixed at the other end is allowed to fall suddenly, it extends the spring by x. Potential energy lost by the mass is gained by the spring,

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

or $$x = \frac{2\,Mg}{k}.$$

3.

Work done = area under $F - x$ curve

= area of trapezium

$$= \frac{1}{2} \times (6 + 3) \times 3 = 13.5 \text{ J}.$$

4.
5.
6.

Given that $\frac{dW}{dt} = P = K$

or, $$W = Pt = \frac{1}{2} mv^2$$

or, $$\sqrt{\frac{2Pt}{m}} = v$$

Hence, $$a = \frac{dv}{dt} = \sqrt{\frac{2P}{m}} \frac{1}{2\sqrt{t}}$$

Hence, $$\text{force} = ma = \sqrt{\frac{2Pm^2}{m}} \frac{1}{2\sqrt{t}}$$

$$= \left[\sqrt{\frac{mK}{2}}\right] t^{-1/2} \qquad (\because P = K)$$

7.

Because the collision is perfectly inelastic, hence the two blocks stick together. By conservation of linear momentum, $2mV = mv$ or $V = v/2$

By conservation of energy,

$$mgh = \frac{1}{2} mV^2 = \frac{1}{2} m \cdot \frac{v^2}{4} \quad \text{or} \quad h = \frac{v^2}{8g}.$$

8.

$$u_1 = \sqrt{2gh_1}, \quad v_1 = \sqrt{2gh_2}$$

$$e = \frac{v_1 - v_2}{u_2 - u_1}$$

Since, $u_2 = v_2 = 0$,

$$\therefore \quad e = -\frac{v_1}{u_1} = \sqrt{\frac{h_2}{h_1}}.$$

9.

Loss in potential energy $= mgh$

$= 2 \times 10 \times 10 = 200$ J

Gain in kinetic energy = Work done = 300 J

$\therefore$ Work done against friction = 300 − 200 = 100 J.

10.

Applying the law of conservation of momentum we get; $$mv_0 + 0 = 2m \times v \quad \text{or} \quad v = \frac{v_0}{2}$$

$$\text{KE} = \frac{1}{2}(2m)v^2 = \frac{1}{2} \times 2m \times \left(\frac{v_0}{2}\right)^2 = \frac{mv_0^2}{4}$$

Let the system reach a height h.

Potential energy of the system = $2mgh$

Hence, $$\frac{mv_0^2}{4} = 2mgh \quad \text{or} \quad h = \frac{v_0^2}{8g}.$$

11.

12.

As $F_{ext.} = 0$

hence according to law of conservation of momentum,

$\vec{p}_s = \vec{p}_1 + \vec{p}_2 = \text{constant}$

However, initially both the blocks were at rest so,

$$\vec{p}_1 + \vec{p}_2 = 0, \quad i.e., \quad \vec{p}_2 = -\vec{p}_1$$

i.e., at any instant, the two blocks will have momentum equal in magnitude but opposite in direction (though they have different values of momentum in different positions).

13.

According to law of conservation of momentum

$$0 = m_1v_1 + m_2v_2 \qquad \ldots(i)$$

$$K_2 = \frac{1}{2}m_2v_2^2 = \frac{1}{2}\frac{m_2^2v_2^2}{m_2} = \frac{m_1^2v_1^2}{2m_2}$$

$$= \frac{(3)^2 \times (16)^2}{2 \times 6} = 192 \text{ J.}$$

14.

$$dU = -dW$$

dU = Change in potential energy

dW = Work done by conservative forces

Hence, work done by conservative forces on a system is equal to the negative of the change in potential energy.

15.

$\frac{3}{4}$th energy is lost, *i.e.*, $\frac{1}{4}$th kinetic energy is left.

Hence, its velocity becomes $\frac{v_0}{2}$ under a retardation of μg in time t_0.

$\therefore \quad \frac{v_0}{2} = v_0 - \mu g t_0$

$\therefore \quad \mu g t_0 = \frac{v_0}{2} \quad \text{or} \quad \mu = \frac{v_0}{2gt_0}.$

[CHEMISTRY]

22 For n moles of a real gas, the van der Waals equation becomes

$$\left(p + \frac{a}{V_m^2}\right)(V_m - b) = RT$$

At high temperature and low pressure, V_m is large in comparison to b and $\frac{a}{V_m^2}$ is negligibly small in comparison to p. Hence the above equation is reduced to $pV_m = RT$.

23. $K \to L$: heating at constant pressure increases volume

$L \to M$: cooling at constant volume decreases pressure

$M \to N$: cooling at constant pressure decreases volume

$N \to K$: heating at constant volume increases pressure

34. $PV = nRT$

For 1L volume, $n = \frac{P}{RT}$

25. Higher the critical temperature, easier is the liquefaction of the gas.

26. Highest product of charges of ions.