## Conservation of Energy and Momentum

1. (c) $P=\sqrt{2mE}\ \therefore P\propto\sqrt{m}$ (if $E=$ const.) $\therefore \frac{P_1}{P_2}=\sqrt{\frac{m_1}{m_2}}$

2. (c) Work in raising a box
   = (weight of the box) × (height by which it is raised)

3. (a) $E=\frac{P^2}{2m}$ if $P$ = constant then $E\propto\frac{1}{m}$

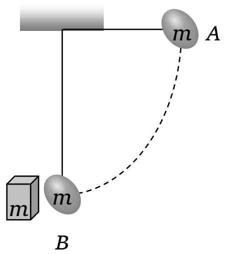
4. (a) Body at rest may possess potential energy.

5. (b) Due to theory of relativity.

6. (d) $E=\frac{P^2}{2m}\ \therefore\ E\propto P^2$
   *i.e.* if $P$ is increased $n$ times then $E$ will increase $n^2$ times

7. (c)

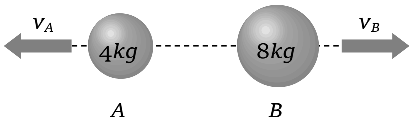
8. (c) P.E. of bob at point $A$ = $mgl$
   This amount of energy will be converted into kinetic energy
   $\therefore$ K.E. of bob at point $B$ = $mgl$
   and as the collision between bob and block (of same mass) is elastic so after collision bob will come to rest and total Kinetic energy will be transferred to block. So kinetic energy of block = $mgl$




9. (b) According to conservation of momentum
   Momentum of tank = Momentum of shell

$125000 \times v_{tank} = 25 \times 1000 \Rightarrow v_{tank} = 0.2$ *ft/sec.*

**10.** (d) As the initial momentum of bomb was zero, therefore after explosion two parts should possess numerically equal momentum



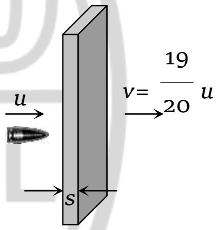

*i.e.* $m_A v_A = m_B v_B \Rightarrow 4 \times v_A = 8 \times 6 \Rightarrow v_A = 12 \rightleftarrows m \rightleftarrows / \rightleftarrows s$

$\therefore$ Kinetic energy of other mass $A$, $= \frac{1}{2} m_A v_A^2$

$= \frac{1}{2} \times 4 \times (12)^2 = 288$ *J*.

**11.** (c) Let the thickness of one plank is *s*

if bullet enters with velocity *u* then it leaves with velocity

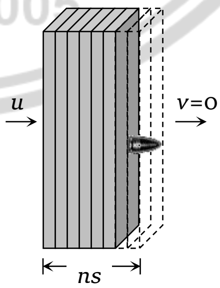



$v = \left(u - \frac{u}{20}\right) = \frac{19}{20}u$

from $v^2 = u^2 - 2as$

$\Rightarrow \left(\frac{19}{20}u\right)^2 = u^2 - 2as \Rightarrow \frac{400}{39} = \frac{u^2}{2as}$

Now if the *n* planks are arranged just to stop the bullet then again from $v^2 = u^2 - 2as$




$0 = u^2 - 2ans$

$\Rightarrow n = \frac{u^2}{2as} = \frac{400}{39}$

$\Rightarrow n = 10.25$

As the planks are more than 10 so we can consider $n = 11$

**12.** (b) Let *h* is that height at which the kinetic energy of the body becomes half its original value *i.e.* half of its kinetic energy will convert into potential energy

$\therefore mgh = \frac{490}{2} \Rightarrow 2 \times 9.8 \times h = \frac{490}{2} \Rightarrow h = 12.5m.$

**13.** (c) $P = \sqrt{2mE}$. If $E$ are same then $P \propto \sqrt{m}$

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

**14.** (a) Let initial kinetic energy, $E_1 = E$

Final kinetic energy, $E_2 = E + 300\%$ of $E = 4E$

As $P \propto \sqrt{E} \Rightarrow \frac{P_2}{P_1} = \sqrt{\frac{E_2}{E_1}} = \sqrt{\frac{4E}{E}} = 2 \Rightarrow P_2 = 2P_1$

$\Rightarrow P_2 = P_1 + 100\%$ of $P_1$

*i.e.* Momentum will increase by 100%.

**15.** (b) $P = \sqrt{2mE}$ if $E$ are equal then $P \propto \sqrt{m}$

*i.e.* heavier body will possess greater momentum.

**16.** (c) Let $P_1 = P$, $P_2 = P_1 + 50\%$ of $P_1 = P_1 + \frac{P_1}{2} = \frac{3P_1}{2}$

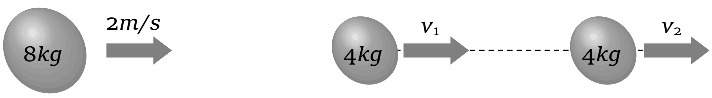
$E \propto P^2 \Rightarrow \frac{E_2}{E_1} = \left(\frac{P_2}{P_1}\right)^2 = \left(\frac{3P_1/2}{P_1}\right)^2 = \frac{9}{4}$

$\Rightarrow E_2 = 2.25E = E_1 + 1.25E_1$

$\therefore E_2 = E_1 + 125\%$ of $E_1$

*i.e.* kinetic energy will increase by 125%.

**17.** (b)




Before explosion    After explosion

As the body splits into two equal parts due to internal explosion therefore momentum of system remains conserved *i.e.* $8 \times 2 = 4v_1 + 4v_2 \Rightarrow v_1 + v_2 = 4$ ...(i)

By the law of conservation of energy

Initial kinetic energy + Energy released due to explosion

= Final kinetic energy of the system

$\Rightarrow \frac{1}{2} \times 8 \times (2)^2 + 16 = \frac{1}{2}4v_1^2 + \frac{1}{2}4v_2^2$

$\Rightarrow v_1^2 + v_2^2 = 16$ …(ii)

By solving eq. (i) and (ii) we get $v_1 = 4$ and $v_2 = 0$

*i.e.* one part comes to rest and other moves in the same direction as that of original body.

**18.** (d) $P = \sqrt{2mE} \therefore P \propto \sqrt{E}$

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

**19.** (b) Potential energy = *mgh*

Potential energy is maximum when *h* is maximum

**20.** (c) If particle is projected vertically upward with velocity of *2m/s* then it returns with the same velocity.

So its kinetic energy $= \frac{1}{2}mv^2 = \frac{1}{2} \times 2 \times (2)^2 = 4J$

**21.** (b)

**22.** (c) $E = \frac{P^2}{2m}$ if bodies possess equal linear momenta then

$E \propto \frac{1}{m}$ *i.e.* $\frac{E_1}{E_2} = \frac{m_2}{m_1}$

**23.** (d) $s \propto u^2$ *i.e.* if speed becomes double then stopping distance will become four times *i.e.* $8 \times 4 = 32m$

**24.** (c) $s \propto u^2$ *i.e.* if speed becomes three times then distance needed for stopping will be nine times.

**25.** (a) $P = \sqrt{2mE} \therefore P \propto \sqrt{E}$

Percentage increase in $P = \frac{1}{2}$ (percentage increase in $E$)

$= \frac{1}{2}(0.1\%) = 0.05\%$

**26.** (c) Kinetic energy $= \frac{1}{2}mv^2$ $\therefore$ K.E.$\propto v^2$

If velocity is doubled then kinetic energy will become four times.

**27.** (d) $P = \sqrt{2mE} \therefore \frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}}$ (if $E$ = constant)

$\therefore \frac{P_1}{P_2} = \sqrt{\frac{3}{1}}$

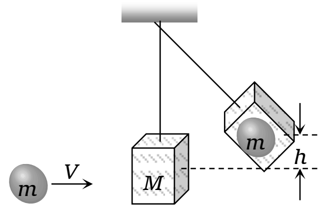
**28.** (d) In compression or extension of a spring work is done against restoring force.

In moving a body against gravity work is done against gravitational force of attraction.

It means in all three cases potential energy of the system increases.

But when the bubble rises in the direction of upthrust force then system works so the potential energy of the system decreases.

**29.** (a)




By the conservation of linear momentum

Initial momentum of sphere

= Final momentum of system

$mV = (m + M)v_{sys.}$ ...(i)

If the system rises up to height $h$ then by the conservation of energy

$\frac{1}{2}(m+M)v_{\text{sys.}}^2 = (m+M)gh$ ...(ii)

$\Rightarrow v_{\text{sys.}} = \sqrt{2gh}$

Substituting this value in equation (i)

$V = \left(\frac{m+M}{m}\right)\sqrt{2gh}$

**30.** (b) $E = \frac{P^2}{2m}$. If momentum are same then $E \propto \frac{1}{m}$

$\therefore \frac{E_1}{E_2} = \frac{m_2}{m_1} = \frac{2m}{m} = \frac{2}{1}$