Conservation of Energy and Momentum

31. (d) $P = \sqrt{2mE}$. If kinetic energy are equal then $P \propto \sqrt{m}$

i.e., heavier body posses large momentum

As $M_1 < M_2$therefore $M_1V_1 < M_2V_2$

32. (d) Condition for vertical looping $h = \frac{5}{2}r = 5cm$ $\therefore$ *r* = 2 *cm*

33. (a) Max. K.E. of the system = Max. P.E. of the system

$\frac{1}{2}kx^2 = = \frac{1}{2} \times (16) \times (5 \times 10^{-2})^2 = 2 \times 10^{-2}J$

34. (d) $E = \frac{p^2}{2m}$ $\therefore$ $m \propto \frac{1}{E}$ (If momentum are constant)

$\frac{m_1}{m_2} = \frac{E_2}{E_1} = \frac{1}{4}$

35. (a) $P = \sqrt{2mE}$ $\therefore P \propto \sqrt{E}$ *i.e.* if kinetic energy becomes four time then new momentum will become twice.

36. (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.

37. (b) Potential energy of water = kinetic energy at turbine

$mgh = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 19.6} = 19.6m/s$

38. (c) $p = \sqrt{2mE} \therefore \frac{p_1}{p_2} = \sqrt{\frac{m_1}{m_2}\frac{E_1}{E_2}} = \sqrt{\frac{2}{1} \times \frac{8}{1}} = \frac{4}{1}$

39. (a) The bomb of mass 12*kg* divides into two masses

m_1 and m_2 then $m_1 + m_2 = 12$ …(i)

and $\frac{m_1}{m_2} = \frac{1}{3}$ …(ii)

by solving we get $m_1 = 3kg$ and $m_2 = 9kg$

Kinetic energy of smaller part = $\frac{1}{2}m_1 v_1^2 = 216J$

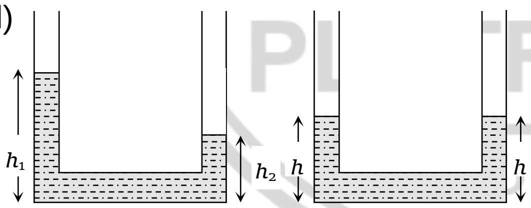
$\therefore v_1^2 = \frac{216\times 2}{3} \Rightarrow v_1 = 12m \rightleftarrows / \rightleftarrows s$

So its momentum = $m_1 v_1 = 3 \times 12 = 36\ kg \rightleftarrows - \rightleftarrows m \rightleftarrows\rightleftarrows\rightleftarrows / \rightleftarrows s$

As both parts possess same momentum therefore momentum of each part is $36\ kgm/s$

40. (c) $P = \sqrt{2mE}$. If *E* are const. then $\frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{4}{1}} = 2$

41. (d)



If *h* is the common height when they are connected, by conservation of mass

$\rho A_1 h_1 + \rho A_2 h_2 = \rho h(A_1 + A_2)$

$h = (h_1 + h_2) \rightleftarrows / \rightleftarrows 2$ [as $A_1 = A_2 = A$ given]

As (h_1/2) and (h_2/2) are heights of initial centre of gravity of liquid in two vessels., the initial potential energy of the system

$U_i = (h_1 A\rho)g\frac{h_1}{2} + (h_2 A\rho)\frac{h_2}{2} = \rightleftarrows \rho g A\frac{(h_1^2 + h_2^2)}{2}$ ...(i)

When vessels are connected the height of centre of gravity of liquid in each vessel will be *h*/2, *i.e.* $\left(\frac{(h_1+h_2)}{4}\right.$ [as $h = (h_1 + h_2) \rightleftarrows / \rightleftarrows 2]$

Final potential energy of the system

$$U_F = \left[\frac{(h_1+h_2)}{2} A\rho\right] g \left(\frac{h_1+h_2}{4}\right)$$

$$= A\rho g \left[\frac{(h_1+h_2)^2}{4}\right] \quad \ldots\text{(ii)}$$

Work done by gravity

$$W = U_i - U_f = \frac{1}{4}\rho g A[2(h_1^2 + h_2^2) - (h_1 + h_2)^2]$$

$$= \frac{1}{4}\rho g A(h_1 \sim h_2)^2$$

42. (c) $P = \sqrt{2mE}$. If m is constant then

$$\frac{P_2}{P_1} = \sqrt{\frac{E_2}{E_1}} = \sqrt{\frac{1.22E}{E}} \Rightarrow \frac{P_2}{P_1} = \sqrt{1.22} = 1.1$$

$\Rightarrow P_2 = 1.1P_1 \Rightarrow P_2 = P_1 + 0.1P_1 = P_1 + 10\% \text{ of } P_1$

So the momentum will increase by 10%

43. (b) $\Delta U = mgh = 0.2 \times 10 \times 200 =$ 400 J

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

44. (a) $E = \frac{P^2}{2m}$. If m is constant then $E \propto P^2$

$$\Rightarrow \frac{E_2}{E_1} = \left(\frac{P_2}{P_1}\right)^2 = \left(\frac{1.2P}{P}\right)^2 = 1.44$$

$\Rightarrow E_2 = 1.44E_1 = E_1 + 0.44E_1$

$E_2 = E_1 + 44\%$ of E_1

i.e. the kinetic energy will increase by 44%

45. (a) $E = \frac{P^2}{2m} = \frac{(2)^2}{2\times 2} = 1J$

46. (b) $\Delta U = mgh = 20 \times 9.8 \times 0.5 = 98J$

47. (b) $E = \frac{P^2}{2m} = \frac{(10)^2}{2\times 1} = 50J$

48. (b) Because 50% loss in kinetic energy will affect its potential energy and due to this ball will attain only half of the initial height.

49. (d) If there is no air drag then maximum height

$H = \frac{u^2}{2g} = \frac{14\times 14}{2\times 9.8} = 10m$

But due to air drag ball reaches up to height 8m only. So loss in energy

$= mg(10-8) = 0.5 \times 9.8 \times 2 = 9.8J$

50. (a) $1kcal = 10^3 Calorie = 4200J = \frac{4200}{3.6\times 10^6} K_w h$

$\therefore\ 700kcal = \frac{700\times 4200}{3.6\times 10^6} kWh = 0.81kWh$

51. (b) $v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 0.1} = \sqrt{1.96} = 1.4m/s$

52. (a)

53. (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 $V = \frac{1}{\sqrt{2}-1}$

54. (d) $P = \sqrt{2mE} \Rightarrow \frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{4}{9}} = \frac{2}{3}$

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

$\Rightarrow E_2 = 4E = E + 3E = E + 300\%$ of E

56. (a) For first condition

Initial velocity = u, Final velocity = $u/2$, s = 3 *cm*

From $v^2 = u^2 - 2as \Rightarrow \left(\frac{u}{2}\right)^2 = u^2 - 2as \Rightarrow a = \frac{3u^2}{8s}$

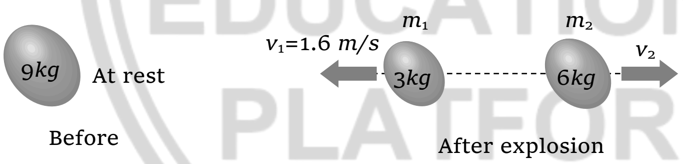
Second condition

Initial velocity = $u/2$, Final velocity = 0

From $v^2 = u^2 - 2ax \Rightarrow 0 = \frac{u^2}{4} - 2ax$

$\therefore x = \frac{u^2}{4\times2a} = \frac{u^2\times8s}{4\times2\times3u^2} = s/3 = 1cm$

57. (c)



As the bomb initially was at rest therefore

Initial momentum of bomb = 0

Final momentum of system = $m_1v_1 + m_2v_2$

As there is no external force

$\therefore m_1v_1 + m_2v_2 = 0 \Rightarrow 3 \times 1.6 + 6 \times v_2 = 0$

velocity of 6 *kg* mass $v_2 = 0.8m \rightleftarrows/\rightleftarrows s$ (numerically)

Its kinetic energy= $\frac{1}{2}m_2v_2^2 = \frac{1}{2}\times 6 \times (0.8)^2 = 1.92J$

58. (b) $P = \sqrt{2mE}$. $P \propto \sqrt{m} \therefore \frac{P_1}{P_2} = \sqrt{\frac{1}{16}} = \frac{1}{4}$

59. (c) Potential energy of a body = 75% of 12 J

$mgh = 9\ J \Rightarrow h = \frac{9}{1\times10} = 0.9m$

Now when this mass allow to fall then it acquire velocity

$v = \sqrt{2gh} = \sqrt{2\times10\times0.9} = \sqrt{18} m/s$.

60. (a)