$\boxed{\frac{66.5}{74}}$ (1)

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TEST 2

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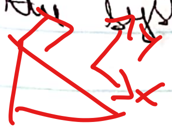
Not conserved

Q1. Ans:- According to the laws of physics, energy is conserved only when the system is under conservative forces (like gravity).



$V'_y = 0$

$W_x = F_{g_x} \ell$

In both cases (a) & (b), non-conservative force of friction is absent and the system is only under the influence of the gravitational force.

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$\therefore$ Energy is conserved in both cases.

Q2. Ans: (a) Let K be the minimum value of spring constant.

$\therefore$ Work done by the frictional force on the box = Energy stored in the spring.

$\therefore$ Frictional force = $\mu_k mg$

$\therefore$ Displacement of box = $l + x_i$

$\therefore$ Work done by frictional force = $-\mu_k mg(l + x_i)$

Energy stored in the spring = $\frac{1}{2} K x_i^2$

$$\therefore \frac{1}{2} K x_i^2 = \mu_k mg (l + x_i)$$

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$$\therefore K = \frac{2 \mu_k mg (l + x_i)}{x_i^2}$$

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(b) Energy stored in spring, $E = \frac{1}{2} K x_1^2$

$\therefore E = \frac{1}{2} \times 2500 \times (0.15)^2 = 28.125 J$

Work done by box against friction $= \mu_k mg (l + x_1)$

$\therefore W_f = 0.35 \times 1.8 \times 9.8 \times (0.75 + 0.15)$
$= 0.35 \times 1.8 \times 9.8 \times 0.90$
$= 5.5566 J$

Let v be the speed of the box when it leaves the table, then $\frac{1}{2} mv^2 = 28.125 - 5.5566$
$= 22.5684$

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$\therefore v = \sqrt{\frac{2 \times 22.5684}{1.8}}$

$v = 5.006 m/s$

$\therefore$ Speed of the box after it leaves the table $= 5.006 m/s$

Q3. Ans:- (a) Work $= \frac{1}{2} m v_i^2$

$m = 145 g$
$= 0.145 kg$

$v_i = 46 m/s$

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$\therefore W = \frac{1}{2} \times 0.145 \times (46)^2$

$W = 153.41 J$

(1-) Displacement, $s = r\theta$

$\theta = 115^\circ = 115 \times \frac{\pi}{180}$ rad

$r = 55\,cm = 0.55\,m$

$\therefore S = 0.55 \times \frac{115 \times \pi}{180}$

$\therefore S = 1.104\,m$

$\therefore$ Work = Force × Displacement

$\therefore F = \frac{W}{S}$

$= \frac{153.41}{1.104}$

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$F = 138.96$

$F \approx 139\,N$

(2) $(K.E.)_{final} = \frac{1}{2} m v_b^2$

$(W - W_a) = \frac{1}{2} m v_b^2$

$\sqrt{\frac{2(W - W_a)}{m}} = v_b$

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$\therefore v_b = \sqrt{\frac{2(153.41 - 37)}{0.145}}$

$v_b = 40.07\,m/s$

P.T.O

Q4.Ans. $F_{ave} = 1926\ N$

$t = 0.004\ s$

$$\text{Impulse} = F_{ave} \times t$$
$$= 1926 \times 0.004$$
$$= 7.704$$

$$\text{Impulse} = \text{change in momentum}$$
$$= m_b(v_f - v_i)$$

$$7.704 = 0.145(v_f + 25)$$

$$\frac{7.704}{0.145} - 25 = v_f$$

$$\therefore v_f = 53.13 - 25$$
$$v_f = 28.13\ m/s$$

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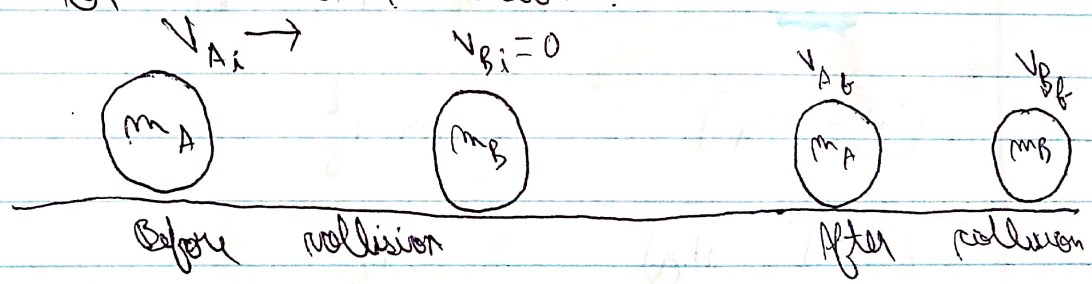
$\therefore$ Velocity of the ball just after it leaves the bat = 28.13 m/s

Q5.Ans. For elastic collision :-



Given:- $m_A = 1.5\ m_B$

$V_{Ai} = 4.5\ m/s$

$V_{Bi} = 0\ m/s$

$V_{Bf} = 2\ m/s$

(a) V_{Af} = find velocity of cart A.

$\therefore V_{Af} = \frac{(1.5 m_B - m_B)}{(1.5 m_B + (m_B))} \times 4.5$ } ← How did you get this?

$V_{Af} = \frac{0.5 m_B}{2.5 m_B} \times 4.5$

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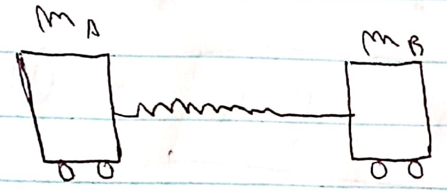
$= \underline{\underline{0.9 m/s}}$

(b) $m_A = 1.5 m_B$

$\therefore m_B = \frac{m_A}{1.5} = \underline{\underline{\frac{2}{3} m_A}}$

Q6-Ans:



$K = 250 \ J/m^2$

$m_B = 0.55 \ kg$

$m_A = \frac{4}{3} \times 0.55$

(a) Total energy = Initial stored energy in spring

$= \frac{1}{2} k x_i^2$

$= \frac{1}{2} \times 250 \times (0.25)^2 \quad [\because x_i = 0.25 m]$

$= \underline{\underline{7.8125 \ J}}$ 5/5

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(b) After release, when the spring returns to natural length all its stored potential energy is converted into kinetic energy of blocks.

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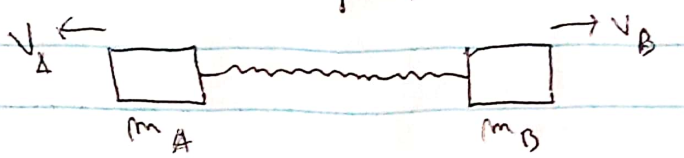
$\Delta K > 0$ super elastic

$\therefore$ The collision is an elastic collision.

(one-to-many)

(c) At natural length, $x = 0$



Applying conservation of linear momentum:-

$$m_A v_A = m_B v_B$$

$$\frac{4}{3} \cancel{m_B} v_A = \cancel{m_B} v_B$$

$$\boxed{v_B = \frac{4}{3} v_A} \quad \text{— (1)}$$

From conservation of energy:-

$$E_i = E_f$$

$$\frac{1}{2} k x_i^2 = \frac{1}{2} m_A v_A^2 + \frac{1}{2} m_B v_B^2$$

$$k x_i^2 = \frac{4}{3} \times 0.55 \times v_A^2 + 0.55 \times \frac{16}{9} \times v_A^2$$

Substituting 250 J/m² in k & 0.25 m in x_i, we get:-

$$v_A = -3.021836 \text{ m/s}$$

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P.T.O

Substituting v_A in ①, we get:-

$$v_B = 4,0291148 \text{ m/s}$$