Q1

$$K.E. = \frac{1}{2} m v^2$$
$$= \frac{1}{2} \times 0.2 \times (18)^2 = 32.4\,J$$

Q2

a) $$K.E_a = \frac{1}{2} m v^2 = \frac{1}{2} \times 700 \times (20)^2 = 140000\,J = 140\,kJ$$

b) $$KE_b = \frac{1}{2} m v^2 = \frac{1}{2} \times 700 \times (40)^2 = 560\,000\,J = 560\,kJ$$

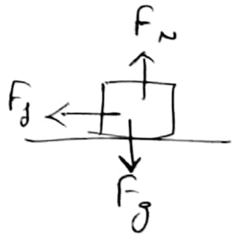
c) $$\text{Differance} = KE_b - KE_a = 560\,000 - 140\,000$$
$$= 420\,000\,J = 420\,kJ$$

d) $$\text{Work done} = \Delta K.E. = KE_b - KE_a$$
$$= 420\,kJ$$

Q3. From Work - Kinetic energy theoram :

$$W_T = \Delta KE = K.E_f - K.E_i$$
$$\Rightarrow 2 \times 3 = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$
$$= 6 = \frac{1}{2} \times 4\, v_f^2 - \frac{1}{2} \times 4 \times 0^2$$
$$\Rightarrow v_f^2 = 3 \Rightarrow v_f = \sqrt{3} = 1.73\,m/s$$

Q4. $$F_f = \mu F_N = \mu m g$$



a) From Work - kinetic energy theorem:

$$W_T = \Delta KE = K.E_f - KE_i$$
$$\Rightarrow F_f \cdot \Delta x = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$
$$\Rightarrow -\mu m g \Delta x = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$
$$\Rightarrow -\mu m g \Delta x = -\frac{1}{2} m v_i^2 \quad — (1)$$

[-ve sign of F_f because direction of friction is opposite to movement.]

$v_f = 0$

Putting values

$$\cancel{-}0.7 \times 8\cancel{00} \times 10 \times x = \cancel{-}\frac{1}{2} \times \cancel{8}00 \times (20)^2$$

$$\Rightarrow 7x = \frac{400}{2} \quad \Rightarrow x = 28.57\text{ m}$$

Which is less than 40 m. Car won't hit the tree.

b) $v_i = 40$

Putting in 1

$$\cancel{-}0.7 \times 8\cancel{00} \times 10 \times x = \cancel{-}\frac{1}{2} \times \cancel{8}00 \times (40)^2$$

$$7x = \frac{1600}{2} \quad \Rightarrow x = 114.28\text{ m}$$

Which is greater than 40 m. Hence Car will hit the tree.

c.) When Speed was increased by the factor of 2.

Stopping distance changed from 28.57 to 114.28 m

$$\text{Factor} = \frac{114.28}{28.57} = 4.$$

d) From eq 1.

$$\cancel{-}\mu \cancel{m} g \,\Delta x = \cancel{-}\frac{1}{2} \cancel{m} v_i^2$$

$$\boxed{\Delta x = \frac{v_i^2}{2\mu g}} \quad — 2$$

e) Scenario 1, When $\Delta x = 7$; $v_i = 10$

Putting in 2

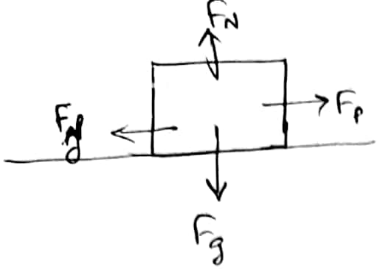
$$7 = \frac{(10)^2}{2\mu \times 10} \quad \Rightarrow \mu = \frac{5}{7} = 0.71$$

Scenario 2 When $v_i = 30$; $\Delta x = ?$

Putting in 2

$$\Delta x = \frac{(30)^2}{2 \times \frac{5}{7} \times 10} = 63\text{ m.}$$

Q5



$F_g = mg$

$F_N = F_g = mg$

$F_f = \mu F_N = \mu mg$

$F_p - F_f = 0 \Rightarrow F_p = \mu mg$

a) To get the entertainment Center moving

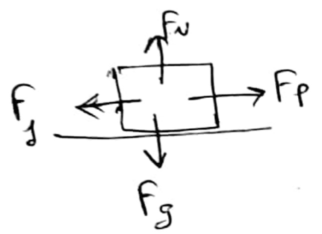
$$F_p = F_f = \mu mg = 0.36 \times 80 \times 10 = 288\,N$$

b) Work done on the entertainment Center

$$W = F.\Delta x = 288 \times 1.6 = 460.8\,J$$

c) Total Work done is zero because Net force is zero on the entertainment Center.

d)



$F_f = \mu_k mg = 0.33 \times 80 \times 10$
$= 264\,N$

$F_p = 288\,N$

Net force is $F_p - F_f = 288 - 264 = 24\,N$

By Work - Kinetic energy theorem,

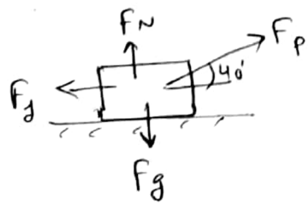
$$F.\Delta x = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$

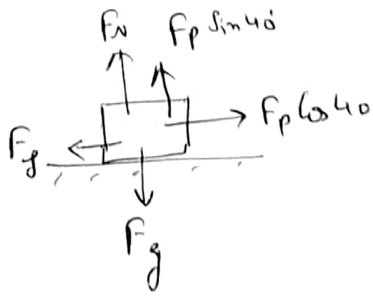
$$24 \times 1.6 = \frac{1}{2} \times 80\, v_f^2 - \frac{1}{2} \times 80 \times (0)^2$$

$$\Rightarrow v_f^2 = \frac{24 \times 1.6 \times 2}{80}$$

$$v_f = 0.98\,m/s$$

Q6.





$\Sigma F_y = 0 \Rightarrow F_g = F_N + F_p \sin 40'$

$= (50 \times 10) = F_N + 300 \sin 40'$

$\Rightarrow F_N = 307.16\,N$

$\Sigma F_x = 0 \qquad F_{Net} = F_p \cos 40 - F_f = F_p \cos 40^\circ - \mu F_N$

$= 300 \cos 40^\circ - 0.7 \times 307.16$

$= 14.8\,N$

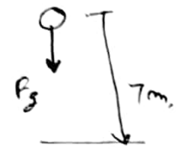
By Work Kinetic energy theorem.

$F \cdot \Delta x = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$

$(14.8)(4) = \frac{1}{2} \times 50\, v_f^2 - 0$

$v_f^2 = \frac{14.8 \times 4 \times 2}{50} \Rightarrow v_f = 1.54\, m/s.$

Q7.



$F_g = mg$

By work-Kinetic energy theorem.

$F_g \cdot \Delta x = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$

$\cancel{m} g \Delta x = \frac{1}{2} \cancel{m} v_f^2 - 0$

$\Rightarrow 2 g \Delta x = v_f^2 \Rightarrow v_f = \sqrt{2 g \Delta x}$

$= \sqrt{2 \times 10 \times 7} = 11.83\, m/s$ down

Q8.

$F_g = mg$

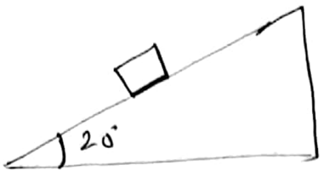
By work-Kinetic energy theorem

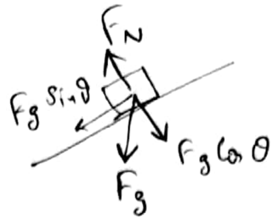
$F_g \cdot \Delta x = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$

$\cancel{m} g \Delta x = \frac{1}{2} \cancel{m} v_f^2 - 0$

$\Rightarrow v_f = \sqrt{2 g \Delta x} = \sqrt{2 \times 10 \times 50} = 31.62\, m/s$ down

Q9.





$F_g = mg$

Work done by block in sliding $= F_g \sin\theta$

$= mg \sin 20°$

$= 4 \times 10 \sin 20° = 13.68\ N$

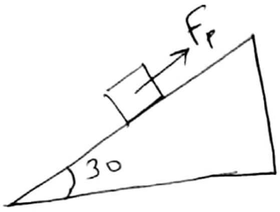
By Work - Kinetic energy theorem:

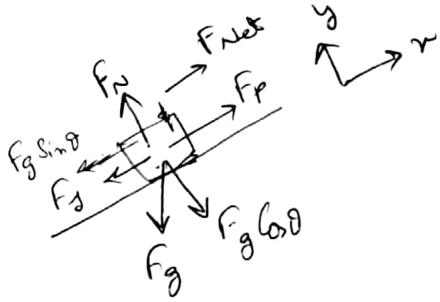
$$13.68 \times 5 = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$

$$68.4 = \frac{1}{2} \times 4\, v_f^2 - 0$$

$$v_f^2 = \frac{68.4 \times 2}{4} \Rightarrow v_f = 5.85\ m/s$$

Q10





$\Sigma F_y = F_N = F_g \cos\theta$

$F_N = mg \cos\theta = 4 \times 10 \times \cos 30° = 34.64\ N$

$\Sigma F_x = 0$

$F_{Net} = F_p - (F_f + F_g \sin\theta)$

$\cancel{F_{Net} = F_f + F_g \sin\theta - F_p}$

$\cancel{= \mu F_N + F_g \sin\theta - F_p}$

$= 35 - [\mu F_N + F_g \sin\theta]$

$= 35 - [0.1 \times 34.64 + 40 \sin 30°)$

$F_{Net} = 11.54\ N$

By Work - Kinetic energy ~~theorem~~ theorem,

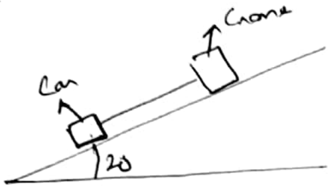
$$F_{Net}\,\Delta x = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$

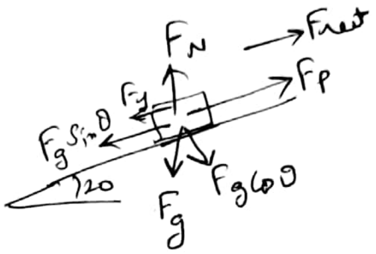
$$(11.54)(4.7) = \frac{1}{2} \times 4 \times (5.3)^2 - \frac{1}{2} \times 4 \times v_i^2$$

$$\frac{1}{2} \times 4 \times v_i^2 = \frac{1}{2} \times 4 \times (5.3)^2 - (11.54)(4.7)$$

$$v_i^2 = 19.97 \Rightarrow v_i = 4.47 \text{ m/s}$$

Q11





By Work - Kinetic energy theorem:

$$F_{Net}\,\Delta x = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$

$$\cancel{F_{Net}\, 5 = \frac{1}{2} \times 1000 (\;)^2}$$

$$F_{Net} \times 5 = \frac{1}{2} \times 1000 \times (1.3)^2 - 0$$

$$F_{Net} = 169 N$$

From FBD

$\Sigma F_y = 0$

$$F_N = F_g \cos\theta = mg\cos\theta$$

$\Sigma F_x = 0$

$$F_{Net} = F_p - F_g \sin\theta - F_f$$

$$= F_p - mg\sin\theta - \mu F_N$$

$$F_{Net} = F_p - mg\sin\theta - \mu mg\cos\theta$$

Putting values

$$169 = F_p - [1000 \times 10 \sin 20^\circ] - [0.9 \times 1000 \times 10 \cos 20^\circ]$$

$$169 = F_p - 3420.20 - 8457.23$$

$$F_p = 11708.43 N$$

Scanned with CamScanner

Q12.

$F_g = mg$

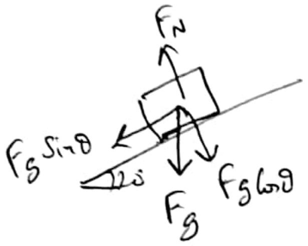
By work-kinetic energy theorem

$F_g \Delta x = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$

$\cancel{m} g \Delta x = \frac{1}{2} \cancel{m} v_f^2 - 0$

$v_f = \sqrt{2 g \Delta x} = \sqrt{2 \times 10 \times 50} = 31.62$ m/s down.

Q13.



By work-kinetic energy theorem.

$F_g \sin\theta \, \Delta x = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$

$\cancel{m} g \sin\theta \Delta x = \frac{1}{2} \cancel{m} v_f^2 - 0$

$v_f = \sqrt{2 g \sin\theta \, \Delta x}$

$= \sqrt{2 \times 10 \times \sin 20 \times 7} = 6.92$ m/s