EXAM: WORK & ENERGY	
Name:	Course:

① The body stops at C ; therefore, its energy will be

$$E_C = \underset{0}{\underset{\parallel}{KE_C}} + PE_C = m \times (10\ m/s^2) \times (1.5\ m) = m \times (15\ m^2/s^2)$$

a) The energy of this body at A will be the same: $E_A = E_C$

$$E_A = KE_A + PE_A = \frac{1}{2} \times m \times v^2 + m \times (10\ m/s^2) \times (0.8\ m)$$

$$E_A = \frac{1}{2} \times m \times v^2 + m \times (8\ m^2/s^2)$$

$$E_A = E_C \longrightarrow \frac{1}{2} \times m \times v^2 + m \times (8\ m^2/s^2) = m \times (15\ m^2/s^2)$$

We can eliminate the mass (m):

$$\frac{1}{2} v^2 + 8 \frac{m^2}{s^2} = 15 \frac{m^2}{s^2} \longrightarrow v = \sqrt{14 \frac{m^2}{s^2}} \longrightarrow \boxed{v_A = 3.74 \frac{m}{s}}$$

b) The altitude at point B. The mechanical energy at point B is:

$$E_B = KE_B + PE_B = \frac{1}{2} \times m \times \left(5 \frac{m}{s}\right)^2 + m \times (10\ m/s^2) \times h$$

We can equalize the energies at points B and C:

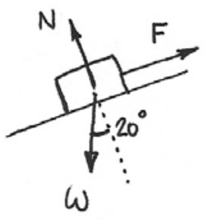
$$E_B = E_C \rightarrow \frac{1}{2} \times m \times \left(25 \frac{m^2}{s^2}\right) + m \times (10\ m/s^2) \times h = m \times (15\ m^2/s^2)$$

Eliminating the mass:

$$12.5 \frac{m^2}{s^2} + \left(10 \frac{m}{s^2}\right) \times h = 15 \frac{m^2}{s^2} \longrightarrow$$

$$\longrightarrow \boxed{h_B = 0.25\ m}$$

② a) The work of each force:



$\omega_N = N \times \Delta x \times \cos 90^\circ = 0 \rightarrow \boxed{\omega_N = 0}$

The distance travelled is:

$\sin 20^\circ = \dfrac{h}{\Delta x} \rightarrow \Delta x = \dfrac{h}{\sin 20^\circ} = \dfrac{0.6\ m}{0.34} = 1.76\ m$

$\omega_F = F \times \Delta x \times \cos \alpha \rightarrow \omega_F = (23\ N) \times (1.76\ m) \times (\cos 0^\circ)$

$\boxed{\omega_F = 40.48\ J}$

$\omega_\omega = (40\ N) \times (1.76\ m) \times (\cos 110^\circ) \rightarrow \boxed{\omega_\omega = -24.08\ J}$

b) Applying the work-energy theorem:

$\omega_{TOT} = \Delta KE = KE_f - KE_i$ and knowing that the initial speed is 0, we have

$\omega_{TOT} = KE_f \longrightarrow 40.48\ J - 24.08\ J = \frac{1}{2} \times (4\ Kg) \times v^2 \longrightarrow$

$\rightarrow \boxed{v_B = 2.86\ m/s}$

c) The change in mechanical energy depends on the work done by non-conservative forces.

In our case, $\Delta E = \omega_{NC} = 40.48\ J$

During this process, the body gains mechanical energy (40.48 J).

③ a) We can determine the mechanical energies at A and C. In this case, the energies at C and B are equal, because the path BC is frictionless.

$$E_A = KE_A = \frac{1}{2} \times (5\,Kg) \times (8\,m/s)^2 \longrightarrow E_A = 160\,J$$

$$E_C = PE_C = (5\,Kg) \times (10\,m/s^2) \times (2\,m) \longrightarrow E_C = E_B = 100\,J$$

The friction coefficient can be calculated in this way:

$$\Delta E_{A \to B} \longrightarrow W_{NC} \longrightarrow W_{Ff} \longrightarrow Ff \longrightarrow \mu$$

According to the conservation of energy:

$$\Delta E_{A \to B} = E_B - E_A = (100\,J) - (160\,J) = -60\,J$$

$$W_{Ff} = -60\,J = Ff \times (12\,m) \times \underbrace{\cos 180^\circ}_{-1} \longrightarrow Ff = \frac{60\,J}{12\,m} = 5\,N$$

$$Ff = \mu \times N \longrightarrow \mu = \frac{Ff}{N} = \frac{5\,N}{50\,N} \longrightarrow \mu = 0.1$$

b) Yes, it will reach the point A, because it will keep some energy: 40 J

(4) a) The heat absorbed by the water is

$$Q = (1.5\ Kg) \times (4180\ J/Kg.°C) \times (76°C - 19°C)$$

$$Q = 357\ 390\ J$$

That heat is also the heat released by the electric heating system in 4 minutes.

$$P = \frac{\text{Energy released}}{\text{time}} = \frac{357\ 390\ J}{240\ s} \rightarrow P = 1489\ Watt$$

b) The current can be calculated from this expression:

$$P = V \times I \rightarrow 1489\ W = (220V) \times I \rightarrow I = \frac{1489\ W}{220\ V}$$

$$\rightarrow I = 6.77\ A$$

Applying Ohm's law:

$$I = \frac{V}{R} \rightarrow R = \frac{V}{I} = \frac{220\ V}{6.77 A} \rightarrow R = 32.5\ \Omega$$