EXERCISE

ⓐ From $A \rightarrow B$

Frictionless implies $\rightarrow F_f = 0 \rightarrow W_{F,F_f} = 0$

$\Delta E = W_{F,F_f} \rightarrow \Delta E = 0 \rightarrow E_i = E_f \rightarrow$

$\rightarrow PE_i + KE_i = PE_f + KE_f \rightarrow$ initial $= A$; final $= B$

$$\boxed{PE_A + KE_A = PE_B + KE_B}$$

$$\hookrightarrow PE_A = mgh_A = 500\,kg \times 10\,\frac{m}{s^2} \times 40\,m = 200\,000\,J$$

$$KE_A = \frac{1}{2}mv_A^2 = 0 \quad \text{(at rest)}$$

$$PE_B = mgh_B = 0$$

$$KE_B = \frac{1}{2}mv_B^2 = 250\,kg \times v_B^2$$

$$200\,000\,J = 250\,kg \times v_B^2 \rightarrow v_B^2 = \frac{200\,000\,J}{250\,kg} = 800\,\frac{m^2}{s^2} \rightarrow$$

$$\rightarrow \boxed{v_B = 28.3\,\frac{m}{s}}$$

ⓑ From A to C

$$\boxed{PE_A + KE_A = PE_C + KE_C}$$

$$\hookrightarrow PE_C = mgh_C = 500\,kg \times 10\,\frac{m}{s^2} \times 30\,m = 150\,000\,J$$

$$KE_C = \frac{1}{2}mv_C^2 = 250\,kg \times v_C^2$$

$$200\,000\,J = 150\,000\,J + 250\,kg \times v_C^2$$

$$v_C^2 = \frac{50\,000\,J}{250\,kg} = 200\,\frac{m^2}{s^2} \rightarrow \boxed{v_C = 14.1\,\frac{m}{s}}$$

© From A to D

$$\boxed{PE_A + KE_A = PE_D + KE_D}$$

$$\downarrow$$

$$\rightarrow PE_D = mgh_D = 500\,Kg \times 10\,\frac{m}{s^2} \times h_D = 5000\,N \times h_D$$

$$KE_D = \frac{1}{2}mv_D^2 = \frac{1}{2} \times 500\,Kg \times \left(10\,\frac{m}{s}\right)^2 = 25000\,J$$

$$\downarrow$$

$$200\,000\,J = 5000\,N \times h_D + 25000\,J$$

$$h_D = \frac{175000\,J}{5000\,N} \rightarrow \boxed{h_D = 35\,m}$$