Mon April 15, 2024

Physics 11 Warm-up: <u>Energy Transformations and Work = Fd</u>

1) Write the energy transformation equation for each of the following:
   a. A battery powered drone starts on the ground, then the drone operator has it fly above a tree:
   chemical potential energy → electrical → kinetic energy → gravitational potential energy + (waste energy) sound and heat

   b. Gas fireplace: __chemical potential energy____ → ____heat_____ + ___light_____

   c. Windmill: solar generates air movement = kinetic → kinetic (spin of blades)___ → ___electrical (+ waste sound and heat)____

2) A 50.0 kg box is lifted (at a constant speed) from ground level to a 2.00 m high shelf.
   a. Draw the fbd for the box

   F_L = lift force

   $F_g = mg$
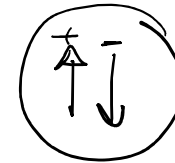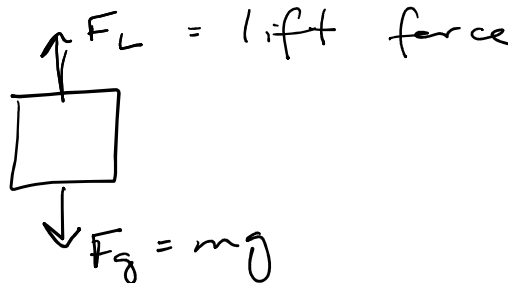
   Note

   $$1J = 1 N \cdot m$$

   b. Determine (calculate) the work done on the box by **each force**

   $$W_{F_L} = F_L \times \Delta d = (mg) \times \Delta d = (50 kg)(9.8 N/kg)(2m) = \boxed{9.80 \times 10^2 J}$$

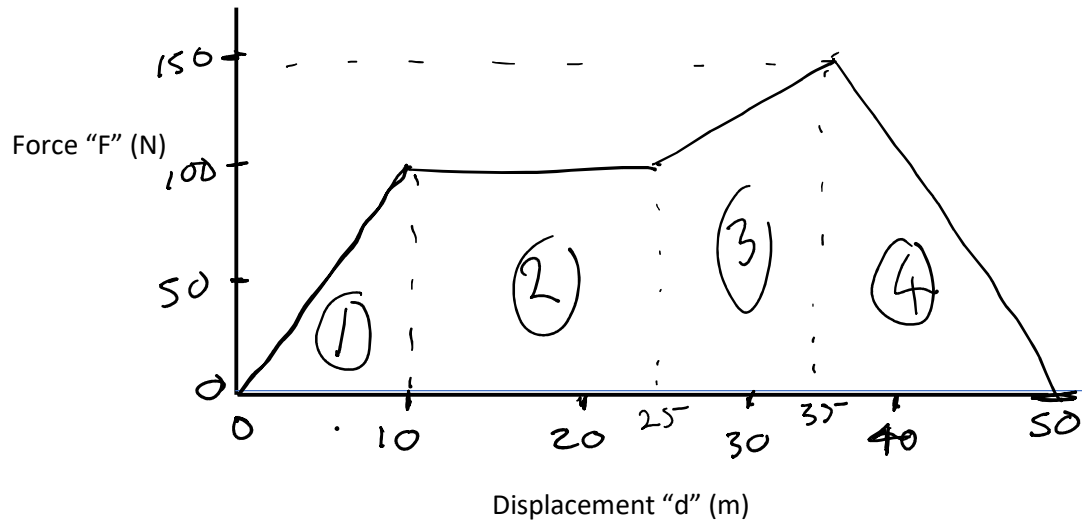 $$W_{F_g} = F_g \times \Delta d = -mg \, \Delta d = -(50 kg)(9.8 N/kg)(2m) = \boxed{-9.80 \times 10^2 J}$$

   c. Determine the **net work** done on the box

   $$W_{net} = W_{F_L} + W_{F_g} = 980 J + (-980 J) = \boxed{0 J}$$

   Reminder units $F \times \Delta d = (mg)(\Delta d) \left[kg \cdot \frac{N}{kg} \cdot m \right] = \underline{\underline{N \cdot m}} = J$

3) This graph represents the force on an object vs its displacement. Calculate the **net work** done on the object.

Forces on an object vs Displacement

Force "F" (N)

Displacement "d" (m)

$$Area = \frac{1}{2}(10m)(100N) + (15m)(100N) + \frac{1}{2}(100+150)(10m)$$

$$+ \frac{1}{2}(15m)(150N)$$

$$= 4375 \, N \cdot m$$

$$Area = Work = 4.4 \times 10^3 \, N \cdot m$$

$$\boxed{Work = 4.4 \times 10^3 J}$$

$$\left(\begin{array}{l} Note: \\ \underline{1} \, N \cdot m = 1J \end{array}\right)$$

$$J = Joule$$