Quiz - Work + Energy (Thurs)

Work → $W = F_{\parallel} \Delta d$

$W = F \Delta d \cos\theta$

W = area under F·d graph

$W = \Delta E$

Energy → $E_K = \frac{1}{2}mv^2$ (kinetic energy)

$E_g = mgh$ (gravitational energy)

$E_e = \frac{1}{2}kx^2$ (elastic potential energy)

$F_a = kx$ (Hooke's Law)

§6-4 Power + Efficiency

Power - the rate at which work is done

$$P = \frac{W}{\Delta t} \quad \text{or} \quad P = \frac{\Delta E}{\Delta t}$$

Where P is the power (J/s or Watt)
W is the work done (J)
Δt is the time interval to do the work (s)

MP1263

$W = 1.50 \times 10^5 J$
$\Delta t = 10.0 s$
$P = ?$

$$P = \frac{W}{\Delta t} \quad \text{(work)}$$

$$P = \frac{1.50 \times 10^5 J}{10.0 s}$$

$$P = 1.50 \times 10^4 W \quad \text{(watts)}$$

MP1264

$m = 60.0 kg$
$h = 4.00 \times 10^2 m$
$\Delta t = 1.00 min$
a) $W = ?$
b) $P = ?$

a) $W = \Delta E_g$ or $W = F_{||} d$

$W = E_{g_2} - E_{g_1}$ ($E_{g_1} = 0$)

$W = mgh$

$W = (60.0 kg)(9.81 m/s^2)(4.00 \times 10^2 m)$

$W = 2.35 \times 10^5 J$

b) $P = \frac{W}{\Delta t}$

$P = \frac{2.35 \times 10^5 J}{60.0 s}$

$P = 3.92 \times 10^3 W$ or $3.92 kW$

Consider your "Power" Bill:
you are charged for $kW \cdot h$ (kilowatt hour)

↑ energy unit not a power unit.

$P = \frac{W}{\Delta t}$

$W = P\Delta t$

$W \Rightarrow kW \cdot h$

$1 kW \cdot h = (1000 J)(3600 s)$

$1 kW \cdot h = 3.6 \times 10^6 J$

Efficiency

$$\text{Efficiency} = \frac{E_O}{E_I} \times 100\%$$

MP|269

$E_I = 3.50 \times 10^3 \text{ J}$

$m = 0.500 \text{ kg}$

$h = 1.00 \times 10^2 \text{ m}$

Efficiency = ?

chemical energy → grav. pot. energy + others

$E_I \rightarrow E_O$

$E_g = mgh$

$E_g = (0.500\text{kg})(9.81 \text{ m/s}^2)(1.00 \times 10^2 \text{m})$

$E_g = 490.5 \text{ J}$

$$\text{Efficiency} = \frac{E_O}{E_I} \times 100\%$$

$$\text{Efficiency} = \frac{490.5 \text{ J}}{3.50 \times 10^3 \text{ J}} \times 100\%$$

$$\text{Efficiency} = 14.0\%$$

TO DO

① PP|266 (Power)

② PP|270-271 (Efficiency)