SPH3U 5.5 Power

1. Power

Power:	the rate at which energy is transferred.
equation	$P = \frac{W_{net}}{\Delta t} = \frac{\Delta E}{\Delta t}$ Units: $\frac{J}{s} = W$ (Watt).

How much power does a swimmer produce if she transforms 2.4 kJ of chemical energy (in food) into kinetic energy and thermal energy in 12.5 s?

$\Delta E = 2.4 kJ$. $P = \frac{\Delta E}{\Delta t}$

$\Delta t = 12.5 s$.

$P = \frac{2.4 kJ}{12.5 s} = \frac{2400 J}{12.5 s} = 190 W$

A 64 kg student climbs from the ground floor to the second floor of his school in 5.5 s. The second floor is 3.7 m above the ground floor. What is the student's power?

$P = \frac{\Delta E}{\Delta t}$ $\Delta E = E_{gf} - E_{gi}$ $P = \frac{\Delta E}{\Delta t} = \frac{2320}{5.5}$

$\Delta t = 5.5 s$. $= mgh = (64)(9.8)(3.7)$ $= 420 W$.

$= 2320 J$.

The student runs back down the stairs in 2.25 s. What is the student's power?

$P = \frac{\Delta E}{\Delta t}$. $P = \frac{-2320}{2.25}$

$\Delta E = -2320 J$. $= -1031 W$

$\Delta t = 2.25 s$. $= -1.0 \times 10^3 W = -1.0 kW$.

2. Electrical power

Power rating:	Maximum power of an electric device.
energy transformed	$\Delta E = P \Delta t$

What is the power of an electric elevator motor if it uses 2.9 x 10^5 J of electrical energy to lift an elevator car 12 m in 16 s?

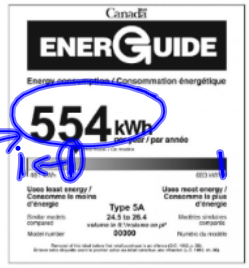
$P = \frac{\Delta E}{\Delta t}$ $\Delta E = 2.9 \times 10^5 J$. $\Delta t = 16 s$.

$P = \frac{2.9 \times 10^5}{16} = 18125 W$

$= 18 kW$.

Appliance	Power Rating (W)	Appliance	Power Rating (W)	Appliance	Power Rating (W)
laptop	20-75	microwave	600-1500	fridge	100-500
vacuum	200-700	dishwasher	1200-1500	stove	6000-10000.

Electricity metres:	Measures your house's energy usage in kWh. (energy... J).
EnerGuide:	labels on appliances in Canada that tell you their efficiency.



What is the cost of operating a 25 W light bulb 4.0 h a day for 6.0 days if the price of electrical energy is 5¢/kWh?

$\Delta E = P\Delta t$ $\Delta t = (4h)(6\ days) = 24h.$

$= (25)(24)$

$= 600\ wh$

$= 0.6\ kWh.$

$Cost = Price \times Energy.$

$= (\$0.05)(0.6)$

$= \$0.03$

Twenty incandescent light bulbs are turned on for 12 h a day for an entire year to light up a store. Each bulb has a power rating of 100.0 W. The average cost of electricity is 6.0¢/kWh.

Calculate the cost of lighting the store for a year.

$\Delta E = P\Delta t$

$P = (100\ W)(20) = 2\ kW.$

$\Delta t = (12)(365)$

$= 4380\ h.$

$\Delta E = (2\ kW)(4380h)$

$= 8760\ kWh.$

$Cost = \Delta E \times price.$

$= (8760)(\$0.06)$

$= \$525.60.$

How much money could be saved by using CFLs, if they have a power rating of 23 W?

$\frac{\$525.60}{100\ W} \times 23\ W = \$120.89.$ Savings: $\$525.60 - 120.89$

$= \$404.71.$

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