Physics 11
Energy
6.4 Measuring Thermal Energy

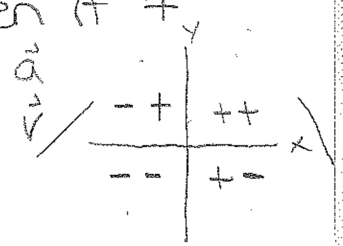
<u>Review</u>

$-273°C = 0°K$
$0°C = 273°K$
$+30 \qquad +30$
$30°C = 303°K$

Acceleration ÷ Velocity $\quad \vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{V_f - V_i}{t_f - t_i}$

R both vector quantities
∴ have direction. If $\vec{v}$ and $\vec{a}$ R both i/t [in the] same direction then ŧ object is speeding up → even if ŧ $\vec{v}$ and $\vec{a}$ R both i/t ⊖ direction

$\rightarrow \vec{a} \quad \leftarrow \vec{a}$
$\rightarrow \vec{v} \quad \leftarrow \vec{v}$



... but if they R in opposite directions then ŧ object is slowing down

$\rightarrow \vec{a} \quad \leftarrow \vec{a}$
$\leftarrow \vec{v} \quad \rightarrow \vec{v}$

<u>New</u> Thermal nrg of an object depends on ŧ mass/temp/material of ŧ objects.

Different (diff.) materials hold thermal nrg differently.
<u>Specific Heat Capacity</u>: ŧ amount [amt.] of heat required [req'd] to ↑ temp. of 1kg of a substance 1°C

→ J/kg/°C

Specific Heat Capacity (c)

$c = \frac{\Delta E}{m \Delta T}$ ΔE = nrg transferred

$\Delta E = mc\Delta T$

Power of a Heat Source

Power is ‡ rate @ which nrg is produced or consumed (rate @ which work is done)

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

Efficiency

$$\text{efficiency} = \frac{\text{useful nrg out}}{\text{useful nrg in}} \times 100\%$$

$$\text{efficiency} = \frac{W_{out}}{W_{in}} = \frac{P_{out}}{P_{in}}$$

can be measured from Work or Power

Examples

1) 25 kJ of heat is transferred to 50 kg of water initially at 20.0°C, what will ‡ final temp. be? [c = 4200 J/kg/°C]

$\Delta E = 25\,kJ$

$T_i = 20.0°C$

$c = 4200\ J/kg/C°$

$m = 50\ kg$

$\Delta E = mc\Delta T$

$25\,000 = (50)(4200)(\Delta T)$

$25\,000 = 210\,000(\Delta T)$

$0.119 = \Delta T$

$0.119 = T_f - 20.0°C$

$20.119 = T_f$

$20.1 = T_f$

#2 To lift a 1200 N motorcycle a vertical height of 1.3 m, a rider pushes ‡ bike up a 2.4 m ramp, requiring an effort force of 820 N. What is ‡ efficiency of ‡ ramp?

$W = F \cdot d$ $W_{out} = (1200\,N)(1.3\,m) = 1560\,J$

$W_{in} = (820\,N)(2.4\,m) = 1968\,J$

$$\text{efficiency} = \frac{1560\,J_{out}}{1968\,J_{in}} \times 100\% = 79\%$$

The ramp is 79% efficient