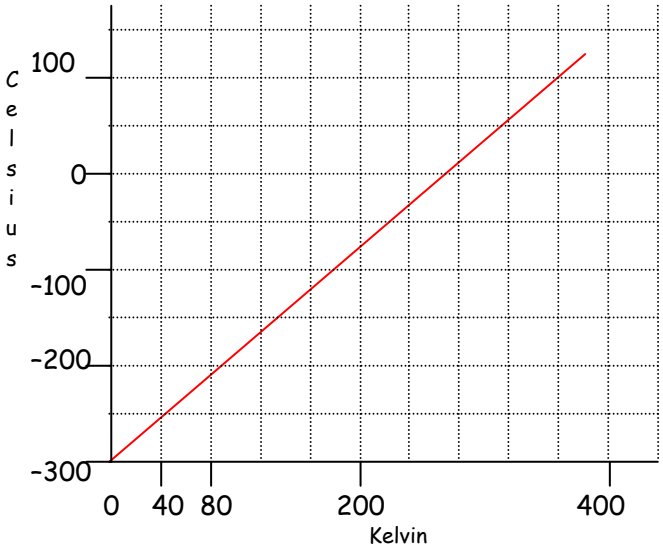
KEY

# Heat Energy

1.) Develop a graph below for conversion from Celsius to Kelvin.




2.) Calculate the energy required to raise a $1.0\ kg$ mass of iron from $10°C$ to $30°C$.

Answers - $E_H = mc\Delta T$ $E_H = (1.0)(450)(20)$ $E_H = 9.00 \times 10^3\ J$

3.) Explain why the same amount of energy is required even if the calculation is performed in Kelvins.

Answers – Since both scales have the same value between increments $1°C$ is equal to $1\ K$.

4.) What happens to water at $273\ K$?

Answers – water freezes as this is equivalent to $0°C$.

5.) What happens at $0\ K$?

Answers – all movement at an atomic level ceases.

Answers - 1)  2) $9.00 \times 10^3\ J$ 3) Because $E_H$ is based on $\Delta T$ and $\Delta T$ is the same in °C as in K
4) Freezing point 5) no molecular motion

KEY

# Energy as $E_H$

1.) A car of mass $1000\ kg$ requires $1.25 \times 10^{6}\ J$ of energy to reach a speed of $90\frac{km}{h}$. How much energy is "lost" as heat?

**Answers** - $E_k = \frac{1}{2}mv^2$ $E_k = 0.5(1000)(25)^2$ $E_k = 3.125 \times 10^5\ J$

$1.25 \times 10^6 - 3.125 \times 10^5$ $= 9.375 \times 10^5\ J$ $= 9.4 \times 10^5\ J$

2.) What is the efficiency of the car above?

**Answers** - $Eff = \frac{out}{in} \times 100$ $Eff = \frac{3.125 \times 10^5}{1.25 \times 10^6} \times 100$ $Eff = 25\%$

3.) A skier of mass $70\ kg$ descends a $30°$ slope. If he travels a distance of $50\ m$ along the slope and has a speed of $15\frac{m}{s}$ at the bottom how much energy is "lost" due to friction and air resistance?

**Answers** - $E_{total} = E_{total}{}'$ $E_k + E_p = E_k{}' + E_p{}'$ $E_p = E_k{}'$

$mgh = \frac{1}{2}mv^2$ $(70)(9.81)(25) = 0.5(70)(15)^2$ $17167.5 \neq 7875$

$17167.5 - 7875 = 9292.5$ $= 9.29 \times 10^3\ J$

4.) A $0.25\ kg$ ball falls from height $5.0\ m$ and bounces up. If it is still rising at $5.0\frac{m}{s}$ when it has rebounded to height 1.5 m how much energy is "lost" as heat?

**Answers** - $E_{total} = E_{total}{}'$ $E_k + E_p = E_k{}' + E_p{}'$ $E_p = E_k{}' + E_p{}'$

$mgh = \frac{1}{2}mv^2 + mgh$ $(0.25)(9.81)(5.0) = 0.5(0.25)(5.0)^2 + (0.25)(9.81)(1.5)$

$12.2625 \neq 6.80375$ $12.2625 - 6.80375 = 5.45875$ $E_H = 5.46\ J$

5.) Two copper spheres of mass $500\ g$ are clashed together causing paper between them to ignite. If the ignition point of paper is $212℃$ and the spheres started at $20℃$ what will be the energy required to ignite the paper? (Assume the spheres are the same temp as the paper, and all energy stays in the spheres from the collision.)

**Answers** - $E_H = mc\Delta T$ $E_H = (1.0)(385)(192)$ $E_H = 7.39 \times 10^4\ J$

**Answers** - 1.) $E_H = 9.38 \times 10^5\ J$ 2.) $25\%$ 3.) $E_H = 9.28 \times 10^3\ J$ 4.) $E_H = 5.46\ J$ 5.) $E_H = 7.39 \times 10^4\ J$