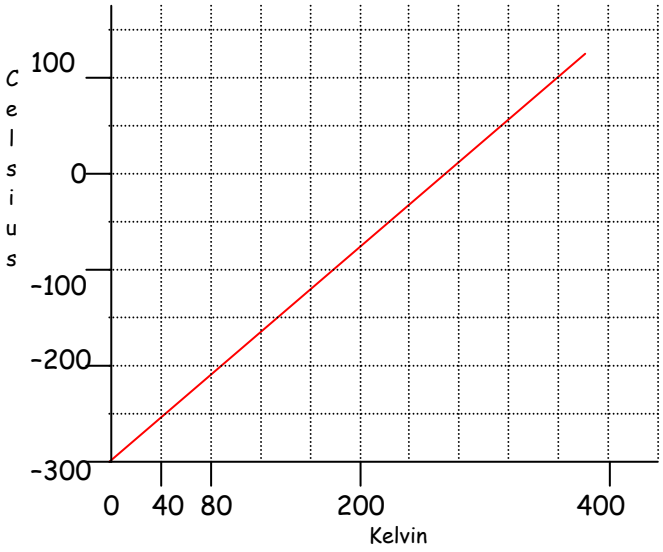
KEY

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 $10.\,℃$ to $30.\,℃$.

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 Kelvin.

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

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

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

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 ΔT and ΔT 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.) $E_H = 9.29 \times 10^3\,J$ 4.) $E_H = 5.46\,J$ 5.) $E_H = 7.39 \times 10^4\,J$