Applecross Senior High School
Year 11 Physics Heating and Cooling Problems Sets Validation

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Name:_____

Useful Data : Specific heat capacity of glass = 670 J $kg^{-1}K^{-1}$

1. (a) Explain the difference between thermal energy(internal energy) and heat. (2 marks)

Thermal energy is the sum of all E_p and E_K of particles in a body
Heat is a transfer of energy from one body to another due to a difference in temp.

(b) Explain the difference between thermal energy(internal energy) and temperature. (2 marks)

Thermal energy - sum of E_p and E_K of particles in body
Temp is the average E_K of the particles in a body

(c) 60 °C is **not** twice as hot as 30 °C, it is 9.9% hotter. Explain (2 marks)

$60^\circ C = 333K$, $30^\circ C = 303K$, $\frac{333-303}{303} \times 100 = 9.9\%$ hotter

2. You want to heat a glass mug of water at 22.5 °C to 98.5 °C. The mass of the glass is 215 g and it contains 185 g of water. How much energy would the glass and water need to absorb? (5 marks)

$Q = mc\Delta T_{glass} + mc\Delta T_{water}$

$= 0.215 \times 670 \times (98.5-22.5) + 0.185 \times 4180 \times (98.5-22.5)$

$= 10947.8 + 58770.8$

$= 69718.6$

$= 6.97 \times 10^4$ J

3. A gas burner supplies 3.24×10^5 J of heat to 2.55 kg of soup at 20 °C. (5 marks)
The heat capacity of the soup is 4.13×10^3 J $kg^{-1}K^{-1}$. Determine the final temperature of the soup.

$Q = mc\Delta T$

$3.24 \times 10^5 = 2.55 \times 4.13 \times 10^3 \Delta T$

$3.24 \times 10^5 = 10531.5 \Delta T$

$\Delta T = \frac{3.24 \times 10^5}{10531.5}$

$\Delta T = 30.76^\circ C$

Final Temp $= 20 + 30.8 = 50.8^\circ C$

4. In different parts of a car air conditioner, a liquid changes to a gas, and a gas changes to a liquid.
   (a) Which of these changes causes cooling? (1 mark)

Change from liquid to gas requires heat so heat is absorbed → causes cooling

   (b) Describe how the air conditioner removes heat from the car's cabin. (3 marks)

Coolant is inside a system of pipes going inside and outside the car's cabin. Low pressure in pipes inside cabin causes evaporation of coolant (liquid → gas) so heat is absorbed making car cabin cooler. Gas is pumped in pipes to outside cabin where high pressure causes it to condense (gas → liquid) and release heat outside car cabin.

5. You want to make tap water colder for you to drink by adding ice.
   Calculate the mass of ice needed at -11.3 °C needed to cool 245 g of tap water at 22.7 °C in a 205 g glass to a temperature of 3.60 °C. (5 marks)

Heat lost by water + glass = Heat gained by ice

$mc\Delta T_{water} + mc\Delta T_{glass} = mc\Delta T_{ice} + mL_{f\,ice} + mc\Delta T_{ice\,water}$

$0.245 \times 4180 \times (22.7 - 3.6) + 0.205 \times 670 \times (22.7 - 3.6) = m \times 2100 \times (11.3 - 0) + m \times 3.34 \times 10^5 + m \times 4180 \times (3.6 - 0)$

$19560.31 + 2623.385 = 23730m + 3.34 \times 10^5 m + 15048m$

$22183.695 = 372778m$

$m = 0.0595\ kg = 59.5\ g$ of ice