TESTS

RECALL TEST

1 What is meant by 'temperature'? (2)

2 What is meant by 'heat energy'? (2)

3 What is 'specific heat capacity'? (2)

4 What is meant by 'specific latent heat of vaporization'? (2)

5 What is Boyle's law? (2)

6 What is Charles's law? (2)

7 What is the pressure law? (2)

8 When is a gas no longer regarded as ideal? (2)

9 What evidence is there for the kinetic theory of gases? (2)

10 What is a mole? (2)

(Total 20 marks)

CONCEPT TEST

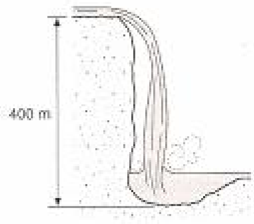
Take $R = 8.3\,\text{J/(K mol)}$

1 4.0kg of copper at 25 °C are heated and increase in temperature to 80 °C; how much heat energy is required to do this? (Specific capacity of copper = 380 J/(kg K).) Assume no heat is lost to the surroundings. (2)

2 A 12 V electric heater draws 2.0 A for 12 min to raise the temperature of a 3.0 kg block of metal. If the initial temperature is 20 °C, what would the final temperature be? Assume no heat is lost to the surroundings. (Specific heat capacity of the metal = 500 J/(kg K).) (4)

3 A car of mass 1400 kg is travelling at 30 m/s. When it applies its brakes, each of mass 26 kg, what will be the increase in the temperature of the brakes? What assumption have you made? (Specific heat capacity of brake material = 600 J/(kg K).) (4)

4 What is the temperature difference between the top and the bottom of the waterfall shown right? Would it be possible to detect this difference? (Take the specific heat capacity of water as 4200 J/(kg K).)



(4)

5 200 g of ice at 0 °C are dropped into a copper container of mass 100 g containing 300 g of water at 21 °C. What is the final temperature of the mixture? (Specific heat capacity of copper = 400 J/(kg K), specific heat capacity of water = 4200 J/(kg K), latent heat of fusion of ice = 3.3×10^5 J/kg.)

(6)

6 4.0 m^3 of helium is at a temperature of 25 °C and a pressure of 4.5 kPa. It is compressed to 1.0 m^3 and heated simultaneously to 56 °C. What is its new pressure?

(4)

7 10 m^3 of a gas is at a pressure of 2.4×10^4 Pa and temperature of 27 °C. How many moles of gas are present, how many atoms are present, and what mass of gas is present? (Molar mass of gas = 0.029 kg/mol.)

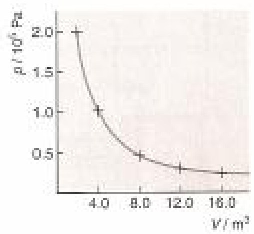
(6)

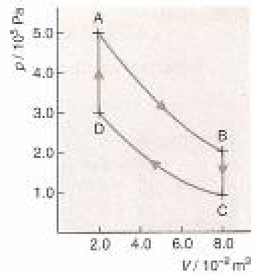
8 200 g of gas occupies 3.0 m^3 at a pressure of 2.0×10^3 Pa. What is the root mean square speed of the gas's molecules?

(4)

9 A runner has just stopped after a race. Perspiration is used by her body (mass 60 kg) to cool her down. If her temperature is dropping by 0.75 K per second, what is the rate of evaporation of water? (Take the specific heat capacity of the human body to be the same as water, 4200 J/(kg K), and the latent heat of vaporization to be 2.4×10^6 J/kg.)

(8)





10 The graph above right shows a gas changing. Use the information in the graph to see if this change is taking place at a constant temperature (isothermal). The graph below right shows a cyclic process for 4.0 mol of gas. Determine the maximum temperature of the gas during the process.

(8)

(Total 50 marks)

1.

$m_{cu} = 4 kg$

$t_1 = 25°C$

$t_2 = 80°C$

$c_{cu} = 380 \frac{J}{kg K}$

$Q = ? J$

$Q = m_{cu} c_{cu} \Delta t = m_{cu} c_{cu} (t_2 - t_1) =$

$= 4 \times 380 \times (80 - 25) =$

$\doteq 84 kJ$

2.

$U = 12V$

$I = 2A$

$t = 12 min = 720 s$

$m_m = 3 kg$

$t_1 = 20°C$

$c_m = 500 \frac{J}{kg K}$

$t_2 = ?$

$P = U.I = 12 \times 2 = 24 W$

$P = \frac{W}{t} = \frac{Q}{t} \Rightarrow Q = P.t$

$m_m c_m (t_2 - t_1) = P.t$

$(t_2 - t_1) = \frac{P.t}{m_m c_m}$

$t_2 - 20 = \frac{24 \times 720}{3 \times 500}$

$t_2 \doteq 32°C$

3.

$m_c = 1400 kg$

$v = 30 \frac{m}{s}$

$m_b = 26 \times 4 = 104 kg$

$c_b = 600 \frac{J}{kg K}$

$\Delta t = ? °C$

$E_k = Q$

$\frac{1}{2} m_c . v^2 = m_b . c_b . \Delta t$

$\frac{1}{2} \times \frac{m_c . v^2}{m_b . c_b} = \Delta t$

$\frac{1}{2} \times \frac{1400 \times 30^2}{104 \times 600} = \Delta t$

$10°C = \Delta t$

(4.) $h = 400 m$

$c_w = 4200 \frac{J}{kg K}$

$\Delta t = ?$

$g = 9.8\ m.s^{-2}$

$$E_p = Q$$

$$m.g.h = m c_w \Delta t$$

$$\frac{g.h}{c_w} = \Delta t$$

$$\frac{9.8 \times 400}{4200} = \Delta t$$

$$\underline{\underline{0.93°C = \Delta t}}$$

It is impossible to detect this difference!

(5.) $m_i = 200 g = 0.2\ kg$

$m_{cu} = 100 g = 0.1\ kg$

$m_w = 300 g = 0.3\ kg$

$t_w = 21°C$

$t_i = 0°C$

$t = ?\ °C$

$c_{cu} = 400 \frac{J}{kg K}$

$c_w = 4200 \frac{J}{kg K}$

$l_i = 3300 \frac{J}{kg}$

$$m_i l_i + m_i c_w (t - t_i) =$$

$$= m_w c_w (t_w - t) + m_{cu} c_{cu} (t_w - t)$$

$$0.2 \times 3300 + 0.2 \times 4200 \times (t - 0) =$$

$$= 0.3 \times 4200 \times (21 - t) + 0.1 \times 400 \times (21 - t)$$

$$660 + 840t = 26460 - 1260t + 840 - 40t$$

$$2140t = 26640$$

$$\underline{\underline{t = 12°C}}$$