YEAR 12 PHYSICS TERM 1 TEST 1

W-85

1. 2.52×10^3 J of heat energy is supplied to 12.0 g of water at 21.0°C. Find the resulting temperature ($c_{water} = 4.18 \times 10^3$ J kg^{-1} K^{-1}) (3)

2. How much heat is needed to melt 4.19 kg of ice? (latent heat of fusion of water is 3.35×10^5 J kg^{-1}) (2)

3. A lump of iron (specific heat = 5.04×10^2 J kg^{-1} K^{-1}) falls from a height of 2.00×10^2 m. If all the energy it acquires in falling is used to heat it, find its rise in temperature. (3)

4. 30.0 g of tacks at 100.0°C are dropped into a 15.0 g copper calorimeter (specific heat = 3.90×10^2 J kg^{-1} K^{-1}) containing 40.0 g of water at 13.2°C. If the final temperature is 19.6°C, calculate the specific heat of the tacks. (4)

5. A copper calorimeter has a mass of 50.0 g and contains 85.0 g of water at 16.0°C. 6.00 g of dried ice is then added and all the ice melted. What is the final temperature of the mixture? (3)

6. A 3.2×10^3 W heater takes 53.0 s to heat 250.0 g of water from 5.00°C to boiling. What is the efficiency of the heater? (3)

TOTAL: 18.

1. $Q = 2.52\times10^{3}$ J
$m = 1.20\times10^{-2}$ kg
$T_1 = 21.0^\circ C$.
$c_w = 4.18\times10^{3}\ J\,kg^{-1}\,K^{-1}$
$T_2 = ?$

$Q = mc\Delta T$
ie $2.52\times10^{3} = (1.20\times10^{-2})(4.18\times10^{3})(T-21.0)$
$\Rightarrow 2.52\times10^{3} = 50.16\,T - 1053.36$
$\therefore T = 71.239^\circ C$
$\therefore$ final temp. $= 71.2^\circ C$. $= 344.2^\circ K$.

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2. $m_i = 4.19$ kg
$Q = ?$
$L_f = 3.35\times10^{5}\ J\,kg^{-1}$

$Q = mL_f$
$= (4.19)(3.35\times10^{5})$
$= 1.4036\times10^{6}$ J
$\therefore$ heat needed $= 1.40\times10^{6}$ J.

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3. $c_{Fe} = 5.04\times10^{2}\ J\,kg^{-1}\,K^{-1}$
$h = 2.00\times10^{2}$ m
$Q = ?$
$\Delta T = ?$

$Q = E_p = mgh$ (since all energy $\rightarrow$ heat)
$= m(9.80)(2.00\times10^{2})$
$= 1.96\times10^{3}m$ J.

$Q = mc\Delta T$
ie $1.96\times10^{3}\cancel{m} = \cancel{m}(5.04\times10^{2})\Delta T$
$\Rightarrow \Delta T = 3.888^\circ K$.
ie change in temp $= 3.89^\circ K$.

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4. $m_t = 3.00\times10^{-2}$ kg
$T_i = 100.0^\circ C$.
$m_{cu} = 1.50\times10^{-2}$ kg
$c_{cu} = 3.90\times10^{2}\ J\,kg^{-1}\,K^{-1}$
$m_w = 4.00\times10^{-2}$ kg
$T_i = 13.2^\circ C$.
$T_f = 19.6^\circ C$.

$Q_{lost} = Q_{gained}$.
$m_t c_t \Delta T = m_{cu} c_{cu} \Delta T + m_w c_w \Delta T$
ie $(3.00\times10^{-2})c_t(100.0-19.6) = (1.50\times10^{-2})(3.90\times10^{2})(19.6-13.2) + (4.00\times10^{-2})(4.18\times10^{3})(19.6-13.2)$
$2.412\,c_t = 37.44 + 1070.08$
$\therefore c_t = 459.1708\ J\,kg^{-1}\,K^{-1}$.
$\therefore$ specific heat of the tacks $= 4.59\times10^{2}\ J\,kg^{-1}\,K^{-1}$.

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5. $m_{cu} = 0.0500 kg$

$m_w = 0.0850 kg$

$T_i = 16.0^\circ C$

$m_i = 6.00 \times 10^{-3} kg$

$T_f = ?$

$Q_{lost} = Q_{gained}$

$m_{cu} c_{cu} \Delta T + m_w c_w \Delta T = m_i L_f + m_i c_w \Delta T$

$\Rightarrow (0.0500)(3.90 \times 10^2)(16 - T) + (0.0850)(4.18 \times 10^3)(16.0 - T)$

$= (6.00 \times 10^{-3})(3.35 \times 10^5) + (6.00 \times 10^{-3})(4.18 \times 10^3)(T - 0)$

$\Rightarrow 312 - 19.5T + 5684.8 - 355.3T = 2010 + 25.08T$

$3986.8 = 399.88T$

$\therefore T = 9.9699^\circ C$ (4)

$\therefore$ final temp. $= 9.97^\circ C$.

6. $P = 3.2 \times 10^3 W$

$t = 53.0 s$

$m_w = 250.0 g = 0.250 kg$

$\Delta T = 95.0^\circ K$.

Heated needed to cause ΔT:

$Q = mc\Delta T$

$= (0.250)(4.18 \times 10^3)(95.0)$

$= 9.9275 \times 10^4 J$

Energy input of heater is: $Q_{in} = Pt$

$= (3.2 \times 10^3)(53.0)$

$= 1.696 \times 10^5 J$

$\therefore$ eff. $= \frac{Q_{out}}{Q_{in}}$

$= \frac{9.9275 \times 10^4}{1.696 \times 10^5} \times \frac{100}{1}$

$= 58.5\%$

$\therefore$ efficiency is 58 % (3)

TOTAL: $\overline{19}$.