Mark schemes

1

(a) $\Delta T = \left(\frac{\Delta Q}{mc} =\right) \frac{8.5 \times 10^3}{4200 \times 0.12}$ ✓

17 K ✓

2

(b) $\left(\frac{\frac{\Delta Q}{\Delta t}}{mc} = \frac{\Delta T}{\Delta t}\right) = \frac{100 - 26}{\Delta t} = \frac{8.5 \times 10^3}{0.41 \times 4200}$ ✓

t = 15 s ✓

2

[4]

2

(a) (use of $\Delta Q = mc\Delta T$ gives) $\Delta Q = 0.45 \times 4200 \times (35 - 15)$ **(1)**

$= 3.8 \times 10^4$ J (3.78×10^4 J) **(1)**

2

(b) (i) 3.8×10^4 J **(1)**
(allow C.E. for incorrect value of ΔQ from (a))

(ii) ($mc\Delta T = \Delta Q$ gives) $0.12 \times 390 \times \Delta T = 3.8 \times 10^4$ **(1)**
$\Delta T = 812$ K **(1)**
(use of $\Delta Q = 3.78$ gives $\Delta T = 808$ K
(allow C.E. for incorrect value of ΔQ from (i))

(iii) (812 + 35) = 847 ºC **(1)**
(use of 808 gives 843 ºC)
(allow C.E. from (ii))

4

[6]

3 (i) (heat supplied by glass = heat gained by cola)
(use of $m_g\, c_g\, \Delta T_g = m_c\, c_c\, \Delta T_c$)

1st mark for RHS or LHS of substituted equation

$0.250 \times 840 \times (30.0 - T_f) = 0.200 \times 4190 \times (T_f - 3.0)$ ✓

2nd mark for 8.4°C

$(210 \times 30 - 210\, t_f = 838\, T_f - 838 \times 3)$

$T_f = 8.4(1)$ (°C) ✓

Alternatives:

8°C is substituted into equation (on either side shown will get mark) ✓

resulting in 4620J~4190J ✓

or

8°C substituted into LHS ✓ *(produces ΔT = 5.5°C and hence)*

= 8.5°C ~ 8°C ✓

8°C substituted into RHS ✓

(produces ΔT = 20°C and hence)

= 10°C ~ 8°C ✓

2

(ii) (heat gained by ice = heat lost by glass + heat lost by cola)

NB correct answer does not necessarily get full marks

(heat gained by ice = $mc\Delta T + ml$)

heat gained by ice = $m \times 4190 \times 3.0 + m \times 3.34 \times 10^5$ ✓

(heat gained by ice = $m \times 346600$)

3rd mark is only given if the previous 2 marks are awarded

heat lost by glass + heat lost by cola

$= 0.250 \times 840 \times (8.41 - 3.0) + 0.200 \times 4190 \times (8.41 - 3.0)$ ✓

(= 5670 J)

(especially look for $m \times 4190 \times 3.0$)

the first two marks are given for the formation of the substituted equation not the calculated values

m (=5670 / 346600) = 0.016 (kg) ✓

if 8°C is used the final answer is 0.015 kg

or (using cola returning to its original temperature)

(heat supplied by glass = heat gained by ice)

(heat gained by glass = $0.250 \times 840 \times (30.0 - 3.0)$)

heat gained by glass = 5670 (J) ✓

(heat used by ice = $mc\Delta T + ml$)

heat used by ice = $m(4190 \times 3.0 + 3.34 \times 10^5)$ ✓ (= $m(346600)$)

m (=5670 / 346600) = 0.016 (kg) ✓

3

[5]

4 (a) the energy required to change the state of a unit mass of water to steam / gas ✓

when at its boiling point temperature / 100°C / without a change in temperature) ✓

allow 1 kg in place of unit

allow liquid to vapour / gas without reference to water

don't allow 'evaporation' in first mark

2

(b) (i) thermal energy given by copper block (= $mc\Delta T$)

$= 0.047 \times 390 \times (990 - 100)$

$= 1.6 \times 10^4$ (J) ✓

2 sig figs ✓

can gain full marks without showing working

a negative answer is not given credit

sig fig mark stands alone

2

(ii) thermal energy gained by water and copper container
(= $mc\Delta T_{water} + mc\Delta T_{copper}$)
= 0.050 × 4200 × (100 – 84) + 0.020 × 390 × (100 – 84)
or
= 3500 (J) ✓ (3485 J)
available heat energy (= $1.6 \times 10^4 - 3500$) = 1.3×10^4 (J) ✓

allow both 12000 J and 13000 J

allow CE from (i)
working must be shown for a CE
take care in awarding full marks for the final answer – missing out the copper container may result in the correct answer but not be worth any marks because of a physics error
(3485 is a mark in itself)
ignore sign of final answer in CE
(many CE's should result in a negative answer)

2

(iii) (using Q = *ml*)
$m = 1.3 \times 10^4 / 2.3 \times 10^6$
= 0.0057 (kg) ✓
Allow 0.006 but not 0.0060 (kg)

allow CE from (ii)
answers between 0.0052 → 0.0057 kg resulting from use of 12000 and 13000 J

1

[7]