Practice Question Set For A-Level
Subject : Physics
Paper-2 Topic: Thermal Physics

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Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Mark Schemes

Q1.

(a) the number of atoms in 12g of carbon-12
or the number of particles / atoms / molecules in one mole of substance ✓

not – N_A quoted as a number

1

(b) (i) mean kinetic energy (= 3 / 2 *kT*) = 3 / 2 × 1.38 × 10^{-23} × (273 + 22)
= 6.1 × 10^{-21} (J) ✓

6 × 10^{-21} J is not given mark

1

(ii) mass of krypton atom
= 0.084 / 6.02 × 10^{+23} ✓
(= 1.4 × 10^{-25} kg)
$\overline{c^2}$ (= 2 × mean kinetic energy / mass

= 2 × 6.1 × 10^{-21} / 1.4 × 10^{-25})
= 8.7 - 8.8 × 10^{4} ✓
$m^2\ s^{-2}$ or J kg^{-1} ✓

1st mark is for the substitution which will normally be seen within a larger calculation.
allow CE from (i)
working must be shown for a CE otherwise full marks can be given for correct answer only
no calculation marks if mass has a physics error i.e. no division by N_A
note for CE
answer = (i) × 1.43 × 10^{25}

3

(c) (at the same temperature) the mean kinetic energy is the same
or
gases have equal $\frac{1}{2}mc_{rms}^2$
or
mass is inversely proportional to mean square speed / m ∝ 1 $/\overline{c^2}$ ✓
$\overline{c^2}$ or mean square speed of krypton is less ✓

1st mark requires the word <u>mean / average</u> or equivalent in an algebraic term
2nd mark 'It' will be taken to mean krypton. So, 'It is less' can gain a mark
allow 'heavier' to mean more massive'
allow vague statements like speed is less for 2nd mark but not in the first mark

2

[7]

Q2.

(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 × 390 × (990 – 100)
= 1.6×10^4 (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 (= 1.6×10^4 – 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 = 1.3×10^4 / 2.3×10^6
= 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]

Q3.

(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 × 30 – 210 t_f = 838 T_f – 838 × 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 × 840 × (8.41 – 3.0) + 0.200 × 4190 × (8.41 – 3.0) ✓
(= 5670 J)

(especially look for m × 4190 × 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 × 840 × (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

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