# Section 1 Physical chemistry 1
# Answers to practice questions

| Question number | Answer | Marks | Guidance |
|---|---|---|---|
| 1 (a) (i) | 2.16 / 241.8 = 0.008 93 or $8.93 \times 10^{-3}$ mol | 1 | Penalise if not 3 significant figures. |
| 1 (a) (ii) | n(O2) = 0.00893 × 0.75 (= 0.006 70 mol) | 1 | Allow (a)(i) × 0.75 |
| 1 (a) (iii) | M1 = T = 566 K and P = 100 000 Pa<br><br>M2 = Moles NO2 = 0.0268 mol<br><br>M3 = $V = nRT / p$<br>**OR** = 0.0268 × 8.31 × 566 / 100 000<br><br>M4 = 0.001 26 $m^3$ or $1.26 \times 10^{-3}$ $m^3$ | 1<br><br>1<br><br>1<br><br>1 | If M1 incorrect can only score M2 and M3<br><br>If M2 incorrect can only score M1 and M3<br>Allow moles of $NO_2$ = student's answer to (a)(i) × 3<br>**OR** (a)(ii) × 4 and consequential M4<br>Minimum of 2 significant figures.<br><br>If M3 incorrect can only score M1 and M2<br><br>Allow minimum of 2 significant figures.<br>Allow no units but incorrect units loses M4<br><br>**If 0.00642 moles used:**<br>M2 = Moles $NO_2$ = 0.0193 mol<br>M3 = $V = nRT / p$ = 0.0193 × 8.31 × 566 / 100 000<br>M4 = $9.06 \times 10^{-4}$ $m^3$ allow 9.06 to $9.08 \times 10^{-4}$ |
| 1 (b) | (Thermal) decomposition | 1 | Do not allow catalytic decomposition. |
| 1 (c) | Other products are gases / other products escape easily | 1 | Allow no other solid (or liquid) product. |
| 2 (a) (i) | **3**Fe + $Sb_2S_3$ → **3**FeS + **2**Sb | 1 | Or multiples.<br>Ignore state symbols. |
| 2 (a) (ii) | Fe → $Fe^{2+}$ + $2e^-$ | 1 | Ignore charge on the electron unless incorrect.<br>Or multiples.<br>Credit the electrons being subtracted on the LHS.<br>Ignore state symbols. |
| 2 (b) (i) | $Sb_2S_3$ + **4.5**$O_2$ → $Sb_2O_3$ + **3**$SO_2$ | 1 | Or multiples. |

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| | | | Ignore state symbols. |
| 2 (b) (ii) | $SO_3$ or sulfur trioxide / sulfur (VI) oxide | 1 | Credit also the following ONLY<br>$H_2SO_4$ or sulfuric acid<br>***OR***<br>gypsum / $CaSO_4$ or plaster of Paris |
| 2 (c) (i) | **M1 (could be scored by a correct mathematical expression)**<br>**M1** $\Delta H_r$ = ∑$\Delta H_f$ (**products**) - ∑$\Delta H_f$ (**reactants**)<br><br>**OR** a correct cycle of balanced equations / correct numbers of moles<br><br>**M2** = 2(+20) + 3(– 394) – (– 705) – 3(–111)<br>= 40 –1182 + 705 + 333<br>= –1142 – (–1038)<br>(This also scores M1)<br><br>**M3** = **–104** kJ mol$^{-1}$<br><br>**(Award 1 mark ONLY for + 104)** | 3 | Correct answer gains full marks.<br>Credit 1 mark for +104 kJ mol$^{-1}$.<br>For other incorrect or incomplete answers, proceed as follows:<br>• Check for an arithmetic error (AE), which is either a transposition error or an incorrect multiplication; this would score 2 marks.<br>• If no AE, check for a correct method; this requires either a correct cycle with 3CO, 2Sb and $3CO_2$ OR a clear statement of **M1** which could be in words and scores **only M1**. |
| 2 (c) (ii) | It / Sb is not in its standard state<br>**OR**<br>Standard state (for Sb) is solid / (s)<br>**OR**<br>(Sb) liquid is not its standard state | 1 | Credit a correct definition of standard state as an alternative to the words 'standard state'.<br><br>**QoL** |
| 2 (c) (iii) | Reduction **OR** reduced **OR** redox | 1 | |
| 2 (d) | Low-grade ore extraction / it<br>• uses (cheap) scrap / waste iron / steel<br>• is a single-step process<br>• uses / requires less / low(er) energy | 1 | Ignore references to temperature / heat or labour or technology. |
| 3 (a) | <table><tr><th></th><th>Relative Mass</th><th>Relative Charge</th></tr><tr><td>Proton</td><td>1</td><td>+1</td></tr><tr><td>Electron</td><td>1/1800</td><td>-1</td></tr></table> | 1<br>1 | This is just easy learning stuff. Make sure you put the – and + signs for the electron and proton though, i.e. not just 1. |
| 3 (b) | $^{38}Ar$ | 2 | |
| 3 (c) (i) | $1s^2 2s^2 2p^6$ | 1 | Remember the order of filling up the levels.<br>Remember that ions have the noble gas arrangement. |
| 3 (c) (ii) | *any two from*: | 2 | This type of question is common |

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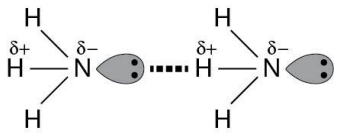
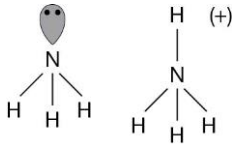
| | more protons / atomic number / proton number / bigger nuclear charge<br>$Al^{3+}$ smaller (size) than $Na^{+}$ / $e^{-}$ closer to nucleus / more attraction for $e^{-}$ from / $e^{-}$ pulled more strongly by $Al3^{+}$ | | so learn the points well. Remember that the 3+ ions have more pulling power and why. |
| 4 (a) (i) | difference in electronegativity / F more electronegative than H<br><br>bonding electrons drawn towards F | 1<br><br>1 | Remember it's the difference in electronegativity that is needed not just the electronegativity values.<br><br>State which way the electrons flow. |
| 4 (a) (ii) | $NH_3$ | 1 | Electronegativity increases across the period. |
| 4 (a) (iii) | N has smallest electronegativity of N, O, and F<br>$NH_3$ has smallest electronegativity difference | 1 | |
| 4 (a) (iv) | Four electron pairs around oxygen, so shape is based on tetrahedron<br>Greater repulsion between the two lone pairs of electrons on oxygen and the two bonding pairs.<br>H—O—H bond angle reduced. | 1<br><br>1 | |
| 4 (b) (i) | hydrogen bonding | 1 | Don't just put hydrogen. |
| 4 (b) (ii) |  <br><br>1 pair of charges shown on both molecules<br><br>lone pair on both molecules<br><br>hydrogen bond between lone pair and H atom | 1<br><br>1<br><br>1 | A diagram is asked for so you must do that and make sure all the charges, lone pairs, etc. are shown. (If this is asked for as just writing then you need to know the 3 points well.) |
| 4 (c) (i) | dative / co-ordinate | 1 | Learn this. |
| 4 (c) (ii) |  | 4 | |
| 4 (c) (iii) | pyramidal / (distorted) tetrahedral / (trigonal) pyramid | 1 | |

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| 4 (c) (iv) | 109(.5) ° | 1 | Although these are both based on a tetrahedron you should learn the shapes of just the atoms in each case. Learn the bond angles and in this case realise that it's a regular tetrahedron in $NH^{4+}$ since it has 4 bonds. |