



Part 1 –Criteria 4 and 7

Question 1

Candidates generally did well on this question.

Some consistent errors that were noticed included:

- saying that sulfur was oxidised rather than H₂S being oxidised.
- failing to be *specific* with the explanation of an oxidation – reduction reaction. Markers were on the lookout for an answer that explained that electrons were transferred from H₂S (as this was being oxidised) to MnO₄⁻ (as this was being reduced)

Question 2

Candidates seemed to cope easily with this question as well.

Errors that occurred:

- Writing a half equation for permanganate rather than manganate in part (b).
- Incorrectly calculating the number of electrons required to balance the respective equations.

Markers were able to give credit for incorrect overall equations in (c) as long as they matched up correctly to earlier responses in (a) and (b).

Question 3

Most candidates were able to score the full 2 marks for this question by correctly predicting that the iron nail was oxidised by the Sn²⁺ ions in solution. A handful of candidates responded that the iron nail underwent corrosion; credit for this alternative answer was considered as long as the correct corrosion half-equations were given and some mention was made about cathodic and anodic sites on the nail.

Question 4

This question was generally done pretty successfully thanks to the combined formula:

$$\text{mass Al} = \frac{A_r(\text{Al}) \times I \times t}{Z \times 96500} \text{ grams.}$$

Most candidates obviously have this formula on their formula sheet although it was evident to the markers that at times candidates may have not been fully aware of how to apply it to a particular half-equation.

Most candidates used the half equation $Al^{3+} + 3e^{-} \rightarrow Al$ but incorrectly used (aq) state symbols. This was ignored for this question, but marks were deducted in the next question for incorrect use of state symbols.

Some consistent (and frustrating) errors noticed:

- Unable to convert 24 hours to the correct number of seconds
- Using the 'red-herring' 5 volts in the formula instead of the 150,000 amperes.
- Failing to use the correct charge (Z) in the formula if the alternative half-equation was used (i.e. $Al_2O_3 + 6H^{+} + 6e^{-} \rightarrow 2Al + 3H_2O$)
- Incorrectly converting a calculator answer from grams into kilograms or tonnes.
- OR even more frustrating, simply incorrectly pressing buttons on the calculator!

Question 5

This question was the one question deemed by markers to attract penalties for incorrect use of state symbols, as it required equation writing.

Candidates were *not* given any credit for swapping the anode or cathode half equations for either of part (a) or (b).

In part (b), candidates were given credit for choosing either chlorine gas or oxygen gas as a predicted product as both are possible especially as the concentration of the solution was not mentioned in the question.

Some errors that occurred frequently:

- Using (aq) instead of (l) for half equations involving molten calcium chloride.
- Confusing the anode and cathode half equations.
- Using the incorrect H_2O half equation in part (b), including in some cases, the one that yields H_2O_2 as a product!!

Question 6

This question was generally done quite well and most candidates were able to score highly.

Interestingly, a handful of candidates indicated a flow of '*positive current*' in the external circuit as going in the opposite direction to the flow of electrons. This was only picked up by markers

since these candidates dutifully showed both the electron flow and the ‘current’ flow according to physics principles!

The moral of this is to not offer unnecessary information as it could easily have been marked incorrect.

The explanations for the requirements of a suitable salt bridge required key terms/words such as:

- A soluble electrolyte
- Preventing polarisation in respective half cells
- Avoiding compounds that would form precipitates

Despite choosing a suitable ionic compound for the salt bridge some candidates lost marks for giving incorrect formulae (e.g. Na_2NO_3 instead of NaNO_3)

Question 7

This question really separated out the candidates, as it was very easy to go off on a tangent.

Part (a) required some explanation about the corrosion process occurring on the iron nails due to the differing concentrations of available oxygen with reduction occurring at higher concentrations of oxygen and oxidation occurring at lower concentrations of oxygen. This was the reason for the ‘pitting’ of the nails inside the wood. Equations were necessary for full marks!

Unfortunately many candidates started an explanation about two metals in contact with regard to one of those metals being the zinc coating (galvanised wire). This did not answer the question so little credit was given for this.

In part (b) many candidates were tricked into coming up with an explanation for how copper nails underwent oxidation. The ECS does indeed point to the potential redox reaction between copper nails and the half equation $2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightarrow 4\text{OH}^-$, however this question was always about the corrosion of the steel signs that were attached to the copper nails.

Those candidates who were able to talk about the electrochemical process that occurs when two metals are in contact scored very well.

Errors that cropped up:

- Thinking that steel was less reactive than copper.
- Correctly saying that reduction occurred on the copper nails but then giving the reduction half equation as $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$
- Not realising that steel is made up of iron.

In part (c) credit was given to candidates who were able to mention that the galvanised coating on the wires was in some way damaged or removed by the fire and consequently the exposed iron strands were able to undergo the usual corrosion process after the fire.

Question 8 – Criterion 4

Very few candidates got full marks for this question.

In part (a), candidates were asked to be *very specific* about the location of the germanium and titanium half equation on the ECS. Markers were on the lookout for information that placed the desired equation in between *two valid possibilities*. For example, some candidates were able to say that from the available information, the germanium half equation must have an E° value between 0.34 V and 0.00 V. Alternatively candidates mentioned that it was between the $Cu^{2+} + 2e^- \rightarrow Cu$ and $2H^+ + 2e^- \rightarrow H_2$ half equations.

Marks were deducted for only mentioning one half equation or saying ‘below $Cu^{2+} + 2e^- \rightarrow Cu$ ’ without giving any other information.

Similarly, in the question requiring a prediction as to whether a reaction would occur between hydrochloric acid and titanium, candidates were penalised for not offering explanations or equations.

Some candidates incorrectly predicted a reaction between the chloride ions and the titanium metal!

Part (b) was very hard to mark, as the variety of ‘potential’ answers was quite frightening. Markers gave credit for sensible and logical attempts at testing the hypothesis of the question. In particular the following things were used as a checklist for markers:

- A *sensible* procedure which was clearly and succinctly described
- Discussion of variables:
 - Constant variables such as size of nail, volume of water and temperature of water
 - Independent variable – the varying concentrations of the sodium chloride solutions
 - Dependent variable - the times at which measuring the rusting process would occur.
 - A control against which comparisons could be made.
- Expected results:
 - Some discussion about what the expected trends might be given a high or low concentration of sodium chloride and how this would relate to the initial hypothesis.

Part 2 – Criteria 8 and 4**Question 9**

- (a) (i) An understanding of **change** in **enthalpy** not well expressed. Examiners looked for energy/enthalpy differences between reactants and products.
- (ii) This was straightforward. Responses ranged from one word (exothermic) to detailed explanations.
- (b) Common errors encountered included:
- Incorrect $M(\text{CaCl}_2)$, often calculated as CaCl
 - Unable to correctly calculate fraction of molar enthalpy
 - Signs and units often forgotten

Question 10

Common errors:

- *Calculating DH correctly from the bond energies of products and reactants not done overly well – often candidates would simply subtract the two numbers.*
- Fluorine molecule bond calculated as $2 \times (\text{F} - \text{F})$, and C_2H_6 as $2 \times (\text{C} - \text{C})$
- Forgetting a reactant or product (carelessness)
- Units sometimes forgotten

Question 11

Done fairly well, common mistakes seemed to be a result of confusing the states (particularly with HCl equation).

Question 12

- (a) Surprisingly, a significant number of candidates incorrectly explained heat released as endothermic.

Explanations for exothermic included ‘beaker getting warm’ or ‘reaction getting faster’.

- (b) Varied responses as candidates interpreted the term ‘relative size’ differently. Some candidates compared E_a with DH . A common misunderstanding was that E_a changed during the reaction. Often candidates reasoned that since it was an exothermic reaction it *must* have a small E_a .

Good responses recognised there was enough energy available at room temp to exceed E_a and get the reaction started.

- (c) Well done. Some profiles were not carefully drawn and/or labelled.
- (d) Well done.

Question 13

- (a) Very well done.
- (b) Many candidates answered this question very well with a lot of detail. Occasionally candidates gave very 'wordy' answers where conciseness would have been better. There were some candidates who only focussed on *one* factor.

Question 14

- (a) – (d) Well done overall. Sometimes candidates confused the term 'yield' with 'equilibrium constant'.

Question 15

- (a) Well done.
- (b) Candidates mostly correctly identified exothermic; however, occasionally candidates were unable to correctly explain their reasoning.
- (c) Very well done. Surprisingly there were a few candidates who had the ratio inverted.
- (d) Most difficult question in Part 2. Calculation errors were common.

Many errors stemmed from confusing the amount and concentration in *both* their calculations and from information given in the question.

There seemed to be a general confusion on how to approach this question; the most common approach was to use a table (with **I**nitial concentration, **C**hange in concentration and concentration at **E**quilibrium). This table was not always used correctly.

Some of the best responses did not use the table method.

Question 16 – Criterion 4

- (a) (i) & (ii) Generally well done. Some candidates identified correct shift to products etc however failed to give an observation.
- (b) (i) Easy marks. Surprisingly, however, a number of graphs were incorrectly drawn; axes not given, units omitted (in some cases incorrect units), data-points inaccurate, line of best fit often drawn as a dot-to-dot, scale caught a few people out.
- (ii) Quite a number of candidates had trouble with *accuracy* in reading their own graph.
- (iii) Well done.
- (iv) Good responses included a *short* explanation.

Part 3 – Criteria 9 and 4**Question 17**

- a) (i) & (ii) Candidates who gave the electronic configuration of $[\text{Ar}] 4s^2 3d^{10}$ invariably answered part ii) incorrectly as they suggested that the electrons were lost from the 3d sub level rather than the 4s.
- b) (i) This question was well answered except for the a few candidates who answered in terms of aluminium bromide rather than the symbols A and B. A common error was for candidates to confuse the ratio of A to B and thus gave the formula as A_3B rather than AB_3
- (ii) Very poorly answered for the full 2 marks. Most candidates correctly mentioned the intramolecular covalent bonding, however failed to discuss intermolecular forces. It was good to see that some candidates used an electron dot diagram to assist with their answer.
- c) (i) This question was very poorly answered.
- (ii) A frequently incorrect response was provided where the ion was ignored and candidates merely discussed the size of the atomic radii decreasing across a period and increasing down a group.

Question 18

- (a) (i) Full marks were not given unless candidates specifically discussed valence electrons rather than outer shell electrons.

-
- (ii) There was a lack of reference to the relative size of each alkali metal. Candidates also failed to mention the fact that an electron is lost.
- (iii) As above. The mention of the words stripping, pulling, wanting, needing and grabbing etc... should be avoided. Anthropomorphic responses should not be used.
- b) (i) This question was generally poorly answered by the majority of candidates. Candidates attempted to answer the question by using the formula or oxidation state of the oxide provided which was irrelevant. No marks were awarded where candidates simply listed the general trends associated with the periodic table rather than referring specifically to reactivity. Another typical response was to say a general increase or decrease only across the period rather than specifically mentioning each of the elements in the period.
- (ii) This question was generally well answered. However some failed to distinguish between the acid and base properties and stated that 'the acid/base properties of the oxides decrease (or increase) across the period.'

Question 19

Candidates found it difficult to correctly identify the functional group. Answers such as carbonyl, carboxyl, alkyl and hydroxyl and benzenes were not given credit. Confusion between the pent and prop prefix was common as well as confusion between aldehydes and ketones. A significant number of candidates had a lack of familiarity with aromatics.

Question 20

Commonly candidates were unable to show the substitution of chlorine to form the alcohol and NaCl. A common answer candidates gave was to substitute hydrogen with sodium and having water as a product.

Question 21

(a) & (b) The lack of the recognition of the polar nature of the OH group was disappointing. Intermolecular hydrogen bonding or dipole/dipole interaction between molecules was rarely mentioned.

A common incorrect answer in part b) was to say that as propanal had the lowest boiling point and subsequently had the weakest intermolecular bonds, it would therefore be the most soluble. Some candidates also tried to reason by way of intramolecular bonding.

Question 22

- (a) & (b) This question was very well answered.
- (c) The only common error found was the incorrect balancing of the equation. In a few situations candidates used the alcohol or attempted to give an aldehyde reaction with sodium.

Question 23

- (a) This question was well answered.
- (b) A surprising number of candidates failed to include water as a product of the esterification process.

Question 24

- (a) It was quite noticeable that a significant proportion of candidates were not familiar with addition polymerisation.
- (b) Most candidates were unable to either draw the monomer structure showing the double bond or name the monomer correctly. Some showed only the repeat unit in the polymer which was not acceptable for the monomer asked.

Question 25 – Criterion 4

- (a) (i) This question was quite well answered although 1^+ or even 1^- ions were commonly encountered.
- (ii) The marks here were based on each candidate's response to part i) even if incorrect. However most candidates were unable to write simple balanced equations and correct chemical formula of the product. Many candidates failed to recognize that the element was calcium and consequently used a symbol instead. Another common error was the use of the metal ion as the reactant in the equations. The product of calcium reacting with water was commonly answered as calcium oxide rather than calcium hydroxide and hydrogen gas. This was surprising considering that the correct equation was given in question 13.
- (b) This question was well answered. Most candidates identified the compound as an ester. Full marks were not awarded when candidates failed to include/eliminate aldehydes and ketones. In addition candidates needed to include some discussion of the reaction with NaOH solution to gain full marks.

Part 4 – Criteria 10 and 4**Question 26**

Done well by most candidates. Main errors included, significant figures – too many in the final answer or too few in the working – using the isotope number instead of the isotopic mass, or adding all three masses and dividing by three. A large number of candidates gave units for the relative atomic mass.

Question 27

- (a) It was assumed that the question was asking for the percentage by mass not atoms. A number of candidates used atomic numbers not mass numbers in their calculations. The most common error was, after correctly determining the formula masses, not to use the total mass of oxygen.
- (b) Some candidates did not determine the mass of hydrogen or determined an incorrect mass. Oxygen was used instead of hydrogen as the remainder. The mole of hydrogen atoms was determined by dividing the mass by 2.0 in a number of cases, or all the masses were divided by 2.48. A significant number of answers were left as $C_2H_4Cl_2$.

Question 28

- (a) Main errors included, significant figures – too many in the final answer or too few in the working and using $^{\circ}C$ temperatures in the combined gas law equation. Some ignored the temperatures and used Boyle's Law instead. Many had the correct method but had algebraic rearrangement difficulties.
- (b)
 - (i) Many incorrect answers were due to selecting the wrong value of the gas constant, R . Other errors included using CH_3 for methane or determining the moles of methane not the partial pressure.
 - (ii) The main errors included not using the partial pressure of methane from (i) or that the partial pressure was given as the answer.

Question 29

Many candidates were not able to convert quantities between kg and g. The molar mass of propane or carbon dioxide was incorrectly calculated (atomic numbers were used), but the main difficulty was determining the stoichiometric ratio.

Question 30

Calculating the moles of HCl by dividing the concentration by the volume was a regular error. Not attempting to identify a limiting reagent was quite common. The ratio of chlorine from the HCl was inverted and the mass of chlorine was calculated using Cl not Cl₂ was common. A number of candidates calculated the moles of chlorine by adding the moles of MnO₂ to the moles of HCl.

Question 31

- (a) Not doubling the concentration of the barium hydroxide to obtain the concentration of the hydroxide was very common as was determining the pOH not the pH.
- (b) An incorrect equation for K_a was the major error, e.g. confusing K_a with K_w, followed by not taking the square root of [H⁺]² to get the concentration of hydrogen/hydronium ions.

Question 32 – Criterion 4

- (a)
 - (i) Many candidates did not convert the 151°C to kelvin, and/or used the gas constant, R, for pressure measured in atm.
 - (ii) Many candidates calculated the molar mass correctly, or carried forward an error from (i). Those who attempted to give an explanation often ran into difficulties. Many thought the same mass would mean the same pressure.
- (b) Interpretation of the question was a problem. Candidates were often confused as to whether the question was referring to determining the percentage of water in sea water, the ‘water of crystallisation’ in salt crystals or that the salt obtained from the sea water was damp.

The number of different experimental methods was nearly infinite. The most common involved drying the crystals in an oven (commonly obtaining the electricity from solar panels). Other methods included precipitating the chloride ions, using electrolysis, titration with acidified permanganate and for those who thought salt was NaOH, titrating against HCl. Mixing with cobalt chloride crystals also featured. Only a small number of candidates mentioned good ‘experimental’ practice such as repeating to obtain an average value, repeating the drying until constant mass etc.

All correspondence should be addressed to:

Tasmanian Qualifications Authority
PO Box 147, Sandy Bay 7006
Ph: (03) 6233 6364 Fax: (03) 6224 0175
Email: reception@tqa.tas.gov.au
Internet: <http://www.tqa.tas.gov.au>