TASMANIAN QUALIFICATIONS AUTHORITY

TASMANIAN
CERTIFICATE
OF EDUCATION

CHEMISTRY

Subject Code: CHM5C

2005 External Examination Report

Part 1

This section of the examination paper was far too easy with many candidates gaining near to full marks.

Question 1

(a) This part produced generally very good answers although sometimes +8 & +6 were given instead of +6 & +4.

(b) Again, usually pretty good.

Question 2

(a) Common mistakes included getting the reduction and oxidation around the wrong way, or balancing the thiosulfate half equation without first balancing the sulfur. Sometimes answers involved entirely different half equations such as the oxidation of water.

(b) Some candidates were unsure on the definition of oxidation state, stating that as precipitates had zero charge it has to be a redox system!

Question 3

(a) Many candidates gave an equation rather than the electrode

(b) Quite often the candidates got this one the wrong way around with the copper being oxidised and the iron being reduced. Other common errors were iron(II) going to iron(III) or copper(II) going to copper(I).

(c) If (a) was correct then this was usually right too.

(d) Again, if (a) was correct then this was generally right. A lot of candidates think the colour is due to the sulfate ions or the electrons.

Question 4

(a) Copper solid being oxidised made a regular appearance here. Quite often there was a reduction equation at the anode and an oxidation at the cathode here as well. Copper(I) appeared far too frequently as well. Occasionally the platinum was not treated as an inert electrode.

(b) Quite often the reaction and gas were from the anode, not cathode, and some even stated this fact.

(c) Far too often this was treated as a sodium chloride solution replacing the copper chloride solution rather than just contaminating it. Other mistakes were that sodium was easier to reduce than copper!

Question 5

This question was generally completed well. Following the formulae in a straightforward manner gained an easy six marks.

However it should be noted that 1.50 hours does not equal 110 minutes. Some candidates used a metal 2+ as an average for their calculations.

Question 6

(a) The artwork was most interesting and entertaining. A simple diagram showing the movement of ions and electron on the surface was all that was required. Equations were quite often left out.

(b) Well answered

(c) Usually pretty good although alloying was not a practical alternative.

Question 7

(a) There was apparently little understanding of the process that is occurring to produce the potential. The zinc electrolyte is not that important as it is the zinc electrode being oxidised that is the important part of that half of the cell. Silver ion was the other important part of the reaction.

(b) Electrons do not flow in a salt bridge!

(c) Question was badly worded as hydrogen is not the electrode (it will not conduct at standard conditions) but many candidates were confused as to what would actually be the reactions that occurred.

(d) (i) The cell will not reverse. There will be a displacement reaction in the zinc electrode/silver nitrate half cell and nothing happening in the other half cell.

(e) (i) Good answers were rare here.

(ii) The observations should be formation of silver on zinc electrode or the potential being zero.

Part 2

Question 8

This question was very poorly attempted, many candidates tried to utilise the gas laws to help obtain an answer or justify why the temperature and pressure both stay constant, rather than explaining the breaking of inter molecular bonds during a phase change would require energy.

Question 9

(a) Endothermic, well answered by most candidates

(b) Candidates needed to identify that heat is absorbed when bonds are broken and heat released when new bonds formed. A number of candidates believed that heat energy was released when bonds were broken.

(c) Very few candidates obtained full marks by showing the correct reactants and products in the enthalpy diagram.

Question 10

Well answered by many, although a poor use of significant figures or inappropriate units were often given.

Question 11

Candidates demonstrated that they could do this very well or had very little idea. Many had an illogical approach to answering the question and a significant number of candidates tried to determine the enthalpy using only 2 or 3 of the provided equations.

Question 12

(a) Candidates were given credit for any sensible explanation, however many suggested an equilibrium situation rather than a decrease in the concentration of the reactants.

(b) This question was well answered. To get full marks candidates were required to mention that the kinetic energy of particles in the warmed beaker enabled a greater number of effective collisions and had sufficient energy to overcome the activation energy.

(c) Copper acting as a catalyst was the response being sought. A surprising number of candidates thought that Cu more reactive than Zn or $Cu_{(s)} + 2H^+ \_ Cu^{2+}_{(aq)} + H_{2(g)}$ occurred.

Question 13

This question was flawed in that silver metal will not react with a copper(II) chloride solution however any sensible answer assuming that it would was still awarded full marks.

a) This question was well attempted. Most candidates identified the difference in surface area but ignored the activation energy.

(b) Question generally well answered.

Question 14

(a) This question was poorly answered as many candidates failed to recognise this question as an equilibrium reaction.

(b) Most candidates demonstrated an increase in the pressure, however few showed a levelling out of the pressure and an equilibrium point reached, as a significant feature.

(c) Candidates were given credit for sensible responses. The sought after responses were:

- Immediate change - decrease in pressure or concentration of the CO_2, many candidates did not recognise that the concentration of the solids in the reaction do not change when volume is altered.
- Change over a period of time - More CO2 is produced or CaCO3 decomposed until a new equilibrium established.

(d) The enthalpy of reaction was the sought after response and answered well by many candidates

(e) This question was poorly answered by many candidates, the pressure of the system increases, but has no effect on equilibrium.

Question 15

Answers which were logical but not correct were given credit. Very few candidates understood the idea of % yield or refluxing. Many candidates mentioned a change in concentration, pressure, temperature and adding a catalyst for the 4 ways to increase yield.

Only 1 reactant can be in excess. This makes it more likely for the limiting reagent to react.
Removing the product periodically slows the reverse reaction, allowing more of the product to form.

Adding extra H_2SO_4 absorbs H_2O, preventing the reverse reaction from occurring.

The only way to change the refluxing temperature is to adjust the external pressure. This would have required answers that were outside the course e.g.

(i) If the forward reaction is exothermic, then decreasing the refluxing temperature (by lowering the pressure) will favour the forward reaction, thus giving a greater yield.

(ii) If the forward reaction is endothermic, then increasing the refluxing temperature (by raising the pressure) will favour the forward reaction, thus giving a greater yield.

Part 3

Question 16

(a) Most candidates gave the correct order for the elements' reactivity but only a few backed up their answer with reasons. A number of very imaginative but incorrect answers were presented too.

(b) Many varied answers were offered and where candidates did refer to electron donation, seldom was there a relation discussed between e^- donors and atomic radius or nuclear charge.

(c) Many candidates kept thinking in terms of electronegativity and nuclear charge and then described melting as a process involving ionization!

Question 17

(a) This was well answered.

(b) Very few managed to answer this correctly but half a mark was awarded to any reasonable attempt. 'Position in the Periodic Table' was not an acceptable answer.

Question 18

(a) This was well done though most did not write the Xe configuration in increasing order of quantum number.

(b) Good answers but a significant number of candidates continue to use words like "needs to", "likes to", "desperately wants to".. in relation to atoms.

(c) Well answered.

Question 19

This is nominally a year 11 question and was very well answered although a common misconception was that the soot was carbon monoxide. Any chemical equation with $C_{(s)}$ as one of the products was a welcome addition.

Question 20

This was very well answered. Where location numbers were given although not required such as in methylpropanal (named as 2-methylpropanal) no marks were deducted. Propaldehyde was a common error.

Some candidates were obviously unaware of the numbering system for carbon atoms in pentanoic acid and numbered the **C**OOH carbon as number 5 instead of number 1.

Question 21

(a) Many varied products were offered as answers with butane and oxygen being the most popular choice. The formation of the product (butan-2-ol) was best described as ‘addition’ although ‘hydration, hydrolysis and hydrogenation’ were not uncommon offerings.

(b) Most got this correct although a common error was to have C6H4Cl2 and H2 as the products.

Question 22

(a) About 95% of candidates wrote hexanol instead of hexan-1-ol and lost half a mark.

(b) Excellent.

(c) Well done although some forgot that water was a product too.

(d) All said ‘oxidise’, some with H^+/MnO_4^- and some with $H^+/Cr_2O_7^{2-}$ but very few gave half-equations or a net equation.

Question 23

Very well answered and an easy 4 marks were gained by most candidates.

Question 24

(a) Very well done.

(b) Most candidates managed to get butan-1-ol and butan-2-ol but missed out on the other primary alcohol which was 2-methylpropan-1-ol.

(c) (i) The question asking for “four” alcohols floored a number of candidates but they were not penalised by the confusion that may have resulted. Candidates gained their marks if the alcohols mentioned in part (b) were the alcohols reacted with H^+/MnO_4^- in part (c).

(ii) Common answers and their marks were:
- Both discolour H^+/MnO_4^- and so one can’t distinguish between them (2 marks)
- Both discolour but a lower pH implies it was the primary alcohol (1.5 marks)
- Titrate both alcohols against H^+/MnO_4^- and the primary will require more than the secondary. (2.5 marks, i.e. this scored a bonus of 0.5 mark)

General errors in this section that were very common included:
(i) spelling of “flourine, nobel gas and keytone”.
(ii) electromagnetic force confused with electrostatic force
(iii metals possessing ‘intermolecular’ forces.

Part 4

This section of the paper was done very badly with many candidates failing to score more than half marks.

Question 25

This question was very poorly done with a significant number of candidates not attempting to answer it. The question would have been much easier had the expected density units of g L^{-1} been specified. A surprising number of candidates converted 400°C to kelvin by subtracting 273.

Question 26

(a) This question was made more difficult by the mass unit being ***tonnes***. Rather than using scientific notation, many candidates wrote answers with (many) zeros which caused confusion and often resulted in errors. Answers incorporating up to 11 significant figures were not uncommon. Failure to recognise that there are two moles of Al per mole of Al_2O_3 meant that many candidates obtained an answer of 81.0 tonnes instead of the correct 162 tonnes. The spectrum of candidates' answers ranged from 10^{-8} g through to 10^{+25} tonnes!

(c) Because this question followed on from part (a), a significant number worked their answer based on 900 kg of Al_2O_3 rather than 900 kg of Al. The number of electrons was frequently given as a mole amount (1.00 x 10^{5}) rather than 6.02 x 10^{28}. This scored 2.5 out of 3.

Question 27

The most common error was to omit the negative sign for _H. Frequently J and kJ units were confused. The 50°C was a 'distractor' and resulted in a number of candidates attempting to use the calorimetry equation (E = mass x _T x 4.18 J) to determine _H. The markers accepted both _H = –128 kJ and _H = –64.2 kJ mol^{-1}.

Question 28

This was done poorly. The 10.0 kg was often misrepresented as 10.0 g and the element magnesium was confused with the element manganese. Despite the correct answer being 13 years (to 2 S.F.) the answers given ranged from 0.024 seconds through to 8.13 x 10^{14} years.

Question 29

Of the small number of candidates who did complete this question successfully, very few also realised that the correct answer was unrealistically small (1.18 mg).

The most common errors involved calculating that the [OH^-] was $10^{-9.26}$ mol L^{-1} or forgetting that the n(Na) = [$OH^-_{(aq)}$] x 4.50 mol.

A significant number of candidates found the n(H_2O) in 4500 g and then said this is the same as the n(Na). The mass of sodium in this 'small piece' gave answers that ranged from 5.68 x 10^{-22} g to 56.8 tonnes!

Question 30

(a) A disappointing number of candidates had NaCl as the precipitate rather than $BaSO_{4(s)}$. Failure to include the precipitate's subscript meant the loss of _ a mark.

(b) If no explanation was given as to which reagent that was in excess (or limiting) even correct answers were awarded only 2 marks.

(d) Not well done.

(d) This part was often omitted and those who did the question frequently gave the answer as 0.125 mol L^{-1} forgetting the sodium compound was Na_2SO_4.

Question 31

(a) Very badly done and even when the products were known, the equation was seldom given as an ***ionic*** equation as required.

(b) The number of numerical terms in the data caused confusion and thus errors were frequent. The 1:5 mole ratio between permanganate ions and Fe^{2+} was often overlooked. Many failed to realise that the titration was based on a 25.0 mL aliquot and not the 500 mL which thus resulted in a 4.2% iron composition rather than the correct 84.2%. Answers of more that 100% Fe were sometimes presented.

Question 32

This part was generally well done with many candidates scoring 5 or more marks and a significant number gaining the maximum of 8.

(a) A colour change from purple to colourless or vice-versa was acceptable but a significant number assumed it was an acid-base titration and had phenolphthalein as the indicator.

(b) The reason for the slow reaction due to bond breaking was occasionally mentioned but most discussed the tedious process of having to titrate over a long period of time and the possibility of a subsequent reaction of $KMnO_{4(aq)}$ with the air. To speed up the reaction catalysts were frequently recommended but a more common option is to use a higher temperature.

(c) (c) This was a rather vague question and consequently the markers accepted all reasonable answers that showed knowledge of titration procedures. Conical flasks rather than volumetric (or standard) were frequently suggested for preparing a standard solution of oxalic acid. Again, phenolphthalein was commonly used in the redox titration. $KMnO_4{}^{-}{}_{(aq)}$ was a commonly encountered error.

(d) This was very well done although the 20.65 mL reading was often mis-read as 22.65 mL. Some candidates suggested that the first reading of 22.43 mL should be neglected too as this reading is most prone to initial contaminants on the glassware.

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