2006 HSC Trial Chemistry Exam

1D 2A 3B 4C 5D 6B 7C 8D 9A 10D 11D 12A 13B 14D 15B

Question 16 (4 marks)
Explain why the chemical properties of alkanes and alkenes are very different. Outline an experiment you performed to demonstrate this difference.

- Alkenes – unsaturated or double bond and alkanes – sat or single bond
- Double bond more reactive
- Use of bromine water
- One decolourises it; one does not

Question 17 (3 marks)
Using specific examples, compare addition and condensation polymerisation reactions.

- 2 x examples (1 x addition, 1 x condensation)
- compare using one criteria

Question 18 (5 marks)
Discuss one recent development in polymer science that alleviates the uncertainty about future sources of raw materials for current polymers. Refer to one specific polymer and include details of how it can be made.

- Mention that currently source is petroleum which will runout
- Name biopolymer
- Organism that makes it
- Feedstock
- Other point about the polymer eg biodegradable

Question 19 (8 marks)
A galvanic cell operating under standard conditions and using nickel a the cathode, produced an emf of 1.44 volts.

(a) Identify the element reacting as the anode and justify your choice

- Calculation
- Appropriate element from table

(b) Draw a labelled diagram of this galvanic cell

- Salt bridge, anode, cathode, voltmeter
- Solutions (Al^{3t}, Ni^{2r}) and electrodes (Al, Ni)

- Diagram drawn correctly including e^- direction

(c) Explain what is meant by standard conditions

- 1.0 M solutions)
- Room temp 25°C)any 2 (none incorrect)
- Pressure 100k Pa)

(d) Identify the oxidising agent in this cell

- Ni^{2t} or nickel ions

Question 20 (7 marks)
An environmental officer measured the pH of a lake near a zinc mine and smelter. The zinc sulphide mined was roasted in air to produce crude zinc. The pH of the lake was 5.5.

(a) Write an equation for the release of sulphur dioxide into the environment

- $ZnS(s) + O_2(g) \rightarrow ZnO(s) + SO_2(g)$
- Correct products and reactants (Zn also accepted)

(b) What volume of gas (at SLC) would be released per tonne (1000kg) of zinc sulphide refined?

- $\frac{10^6 g}{97.46} \times 24.79\ L$

(c) Evaluate reasons for concern about the release of this gas into the environment

4 detailed description of formation of acid rain and its effects (at least 3) (or respiratory effects of SO_2)
3 some details missing or only two effects
2 one effect
1 something relevant, eg formation of acid rain

Question 21 (8 marks)
A data logger with a pH probe attached was used in the titration of 30mL of dilute propanoic acid with 0.010 mol L^{-1} sodium hydroxide to determine its concentration.

(a) Draw a graph of pH versus volume of NaOH added on the grid supplied.

- Plotting

- Axis title and units
- pH as NaOH

(b) Use the graph to determine the volume of NaOH used to reach the equivalence point

- if looking at right part of curve

(c) Propanoic acid is monoprotic. Determine the concentration of the acid from the titration results.

- Method eg $C_1 V_1 - C_2 V_2$
- Substitution

(d) Is propanoic acid a strong or weak acid? Justify your response using two different pieces of evidence from the data and responses above.

- (all marks for justification only)
- Buffering region)
- pH higher than expected for acid of that concentration)
- equivalence pt is >7) any 2

Question 22 (5 marks)

(a) Write an equation for the esterification reaction used to prepare propyl butanoate.

- Propanol + butanoic acid →Ester + water

(b) Describe the effect of using concentrated sulphuric acid on the yield and rate in this process.

- Rate increases due to catalyst
- Yield – stays same (if dehydration not mentioned)
- Yield – increases (if dehydration was mentioned

(c) Identify one use of esters in processed food.

- Flavouring agent
- Energy (as fats)
- Emulsifier

Question 23 (5 marks)

Explain why monitoring of the reaction vessel used in the Haber process is crucial, and describe the monitoring required.

- Temperature)

- Pressure) at least 3
- Catalyst)
- Reactant mixture)

- Relate conditions to rate and yield or safety

Question 24 (4 marks)
Some students measured the sulphate content of lawn fertiliser. The value they obtained was 68.4% and the value quoted on the packets was 72.7%. Explain the chemistry involved in this analysis and one possible cause for the inaccurate result.

- SO_4^{2-} precipitated from a solution of a weighed amount of fertiliser using Ba^{2+} ➔ $BaSO_4^{2-}$

- Precipitate weighed

- mass SO_4^{2-} calculated from mass of precipitate using stoichiometry

- Cause eg precipitate very fine and passes through the filter paper *or* not all sulfate precipitated because not enough barium ions were added.

Question 25 (6 marks)
As the demand for drinking water increases, it has become necessary to monitor levels of contaminants and to develop new technologies for treating impure water sources.

(a) To measure the concentration of chloride ions in a sample of water, 20.0mL of this water was titrated with 0.0050 mol L^{-1} silver nitrate using a suitable indicator such as potassium chromate. The volume of the titre was 8.0 mL.

(i) Write an ionic equation for the precipitation reaction

$Ag^+_{m)} + Cl^-_{(m)}$ ➔ $Ag\,Cl_{(s)}$

(ii) Calculate the concentration of the chloride ions in ppm (mg L^{-1}).

$C_1 V_1 = C_2 V_2$

$0.0050 \times 0.0080 = C_2 \times 0.0200$

$C_2 = 0.0020$ mol L^{-1}

$= .0020 \times 35.45 \times 10^3$ ppm

(b) Describe the design and composition of microscopic membrane filters and explain how they purify contaminated water.

- Thin film of eg polymer with uniform holes
- Semi – permeable
- Contaminated water at high pressure passes over surface of filter and reverse osmosis ➔ clean water
- Diagram with explaining labels may be used

Question 26 (5 marks)

(a) Describe, using equations, how the compound 1,1-dichloro-1,1-difluoro methane contributes to ozone depletion.

- $C_2F_2Cl_2 + \rightarrow CF_2Cl + Cl^{\cdot}$ The CFC photo dissociates in the stratosphere releasing a chlorine radical
- $Cl^{\circ} + O_3 \rightarrow ClO^{\circ} + O_2$. The chlorine radical reacts with ozone
- $ClO^{\circ} + O^{\circ} \rightarrow Cl^{\circ} + O_2$. The ClO° radical reacts further so that the chlorine radical is again formed and is free to react with more ozone molecules.

(b) During your study of ozone depletion you gathered secondary information to evaluate the effectiveness of alternative chemicals to replace CFC's.

Describe how you processed and analysed the gathered information.

State how you assessed the reliability of the data obtained.

- Process and analysis of HCF's and HCFCl's properties using data collected from textbooks and web sites (edu. or gov. sources)
- Books & web site cross referenced for consistency ➔ reliability assessment.

27(a)

(i)

Clearly explains role of control in measuring changes in independent variable while other variables are controlled Outlines experimental set up Clearly explains results of experiment.	3
Any two of the above	2
Has some idea of controlled experiment or experimental set up Or results of experiment	1

(ii)

Clearly relates experimental results to conditions around the Titanic Predicts corrosion of Titanic Describes actual conditions (eg activity of SRB and consequent corrosion) Makes a judgement based on criteria	4
Any three of the above	3
Makes a correlation between results of experiment and Titanic and predict corrosion	2
Correctly describes some conditions at Titanic	1

27 (b)

$K^+ + e^- \rightarrow K$	1
$- 0.4 - 2.94 = - 3.34$ V	1
Nature of electrolyte affects product of electrolysis Role of electrolyte in galvanic cell Or any other one good relevant contribution	2

27(c)

(i)

Presence of 0_2 / H_2O/ Provide ideal condition for a galvanic cell $Fe \rightarrow Fe^{2+} + 2e^-$ oxidation stress site $½O_2 + H_2O + 2e^- \rightarrow . 2OH^-$ at anode eg site of impurities in solution $Fe^{2+} + OH^- \rightarrow Fe(OH)_2$ further oxidation $\rightarrow Fe_2O_3 xH_2O$	3
Provides correctly at 2 of these and correctly identify anode /cathode	2
State O_2/H_2O/ water necessary for Fe $\rightarrow$ Fe_2O_3xH2O in a galvanic cell reaction	1

(i) At a site of impurities in steel eg C atoms
Cathode $½ O_2 + H_2O + 2e \rightarrow 2 OH^-$
At a site where there is a weakness in the metal lattice
Anode $Fe \rightarrow Fe^2 + 2e^-$
Ions travel through the ocean electrolyte
electrons through the hull

$Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$
Further oxidation $\rightarrow Fe(OH)_3$ or ($Fe_2O_3 .xH_2 0$)

(ii) Cathodic Protection

Sacrificial anode (galvanic all)	An active metal eg Zn plate attached

	$Zn \rightarrow Zn^{2+} + 2e^-$ anode sacrificed while iron hull is protected as it is cathode. Water is reduced.
Impressed current (electrolytic cell)	Inert electrodes made of eg titanium attached by an insulator to hull Inert electrode made the anode by an impressed voltage so electrolysis of water Iron hull made cathode so Fe cannot oxidise any Fe^{2+} will be reduced

4 marks for both type of protection and description.

27
(d)

- Must clearly distinguish between conservation and restoration
- Must identify 2 Australian artefacts and correctly state whether they were conserved or restored
- Must discuss chemistry of their conservation/restoration providing a reasonable outline of the processes in both artefacts.