Strathfield Girls High School

2007

Trial Higher School Certificate Examination

Chemistry

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Board-approved calculators may be used
- Write using blue or black pen
- Draw diagrams using pencil
- A Data Sheet and Periodic Table are provided at the back of this paper.

Section I Pages 2 – 16

Total marks (**80**)

This section has two parts, Part A and Part B

Part A
Total marks (**15**)
- Attempt questions 1 – 15
- Allow about 30 minutes for this part

Part B
Total marks (**65**)
- Attempt questions 16 – 31
- Allow about 1 hour and 55 minutes for this part.

Section II Pages 17 – 18

Total marks (**20**)

- Attempt all parts of this question
- Allow about 35 minutes for this section.

Section I
Total marks (75)

Part A
Total marks (15)
Attempt questions 1 – 15

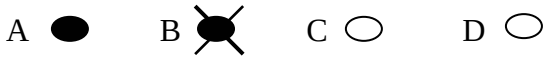
Allow about 30 minutes for this part

Use the multiple-choice answer sheet.
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

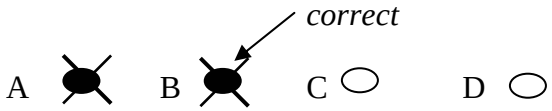
Sample 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.



If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows:



1 The common name for the commercially significant monomer shown below is –

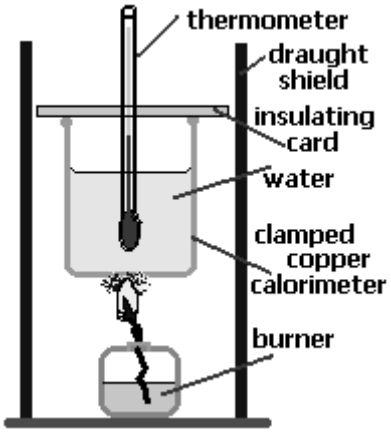
$$H_2C=CHCl$$

(A) chloroethene
(B) ethylene
(C) styrene
(D) vinyl chloride

2 Which of the following is a major component of biomass?

(A) cellulose
(B) ethanol
(C) ethylene
(D) petroleum

3 The following equipment was used to measure the Heat of Combustion of ethanol.



In this experiment it was found that the combustion of a known mass of ethanol produced a temperature change of 17.2 ºC in 200 mL of water. The Molar Heat of Combustion of ethanol is 1364 kJ mol $^{-1}$. Allowing for experimental errors the mass of ethanol burnt would be –

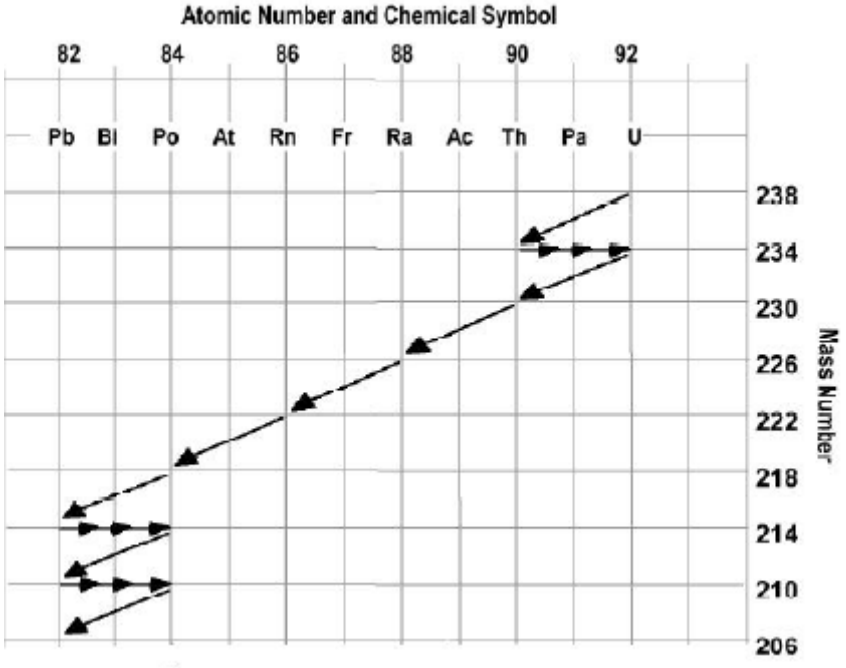
(A) 0.41 g
(B) 0.61 g
(B) 17.2 g
(D) 480.0 g

4 A student measures the potential difference between pairs of metal electrodes when placed in sodium sulfate solution.

Which metal gives the highest positive voltage in combination with copper?

(A) Magnesium
(B) Silver
(C) Tin
(D) Zinc

5 The following diagram shows the decay of uranium – 238.



The nuclear equation for the step producing polonium-218 from another radioisotope would be –

(A) $^{222}_{86}Rn \rightarrow {}^{218}_{84}Po + {}^{4}_{2}He$

(B) $^{218}_{83}Bi \rightarrow {}^{218}_{84}Po + {}^{4}_{2}He$

(C) $^{218}_{84}Po \rightarrow {}^{218}_{84}Po + \gamma$

(D) $^{218}_{84}Po + {}^{0}_{-1}\beta \rightarrow {}^{218}_{84}Po$

6 The most widely used radioisotope in nuclear medicine is technetium-99m. This isotope accounts for 80% of all medical tracer usage. Technetium-99m is widely used as it –

(A) has a short half life of 6 hours and is readily excreted by the body.
(B) has a long half life and is not readily excreted by the body.
(C) is a radioisotope that gives off intense gamma radiation and it has a long half life.
(D) causes patients to take special precautions to avoid genetic damage and leukaemia that may result from any contamination.

7 The table below shows the pH and colour ranges of some common acid-base indicators.

Indicator	**Colour in Low pH**	**pH range**	**Colour in high pH**
phenolphthalein	colourless	8.3 – 10.0	pink
bromothymol Blue	yellow	6.0 – 7.6	blue

A student carries out the following procedure:

i. To a test tube containing 50 mL of 0.1 mol L^{-1} ammonia solution, add 4 drops of phenolphthalein
ii. Then add 50 mL of 0.1 mol L^{-1} nitric acid
iii. Finally add 4 drops of bromothymol blue to the mixture in the test tube.

Which of the following is the most likely colour of the mixture at the end of each step?

	Step i	Step ii	Step iii
A	colourless	pink	yellow
B	colourless	colourless	green
C	pink	colourless	yellow
D	pink	colourless	blue

8. Which compound results in a lower pH when dissolved in water?

(A) potassium carbonate
(B) sodium nitrate
(C) sodium hydroxide
(D) chlorine dioxide

9. 25.0 mL of 2.0 mol L^{-1} nitric acid is diluted using a volumetric flask to a total volume of 500 mL using distilled water. The pH of the final solution is -

(A) – 0.30
(B) 1.00
(C) 1.30
(D) 2.00

10. Which of the following observations can be explained by the Brönsted-Lowry theory of acids but not the Arrhenius theory?

(A) A solution of hydrochloric acid is a good conductor of electricity.
(B) Hydrogen chloride and ammonia gas react to produce solid ammonium chloride.
(C) Magnesium will displace hydrogen from a solution of sulfuric acid.
(D) When passed through water, carbon dioxide decreases the pH of the water.

11. A resident discovered and reported on a number of dead fish floating in their local creek. A team of chemists, including an analytical chemist, an organic chemist and a biochemist, was established to investigate the fish death. What does this example best illustrate?

(A) Collaboration helps chemists solve complex problems.
(B) Experimental results are more accurate when procedures are undertaken by a team.
(C) Reliability is increased when an experiment is done by a group rather than an individual.
(D) Validity is improved by increasing the number of people solving a problem.

12. The effect of increasing the temperature of the reaction, upon the rate of ammonia production in the Haber process is –

(A) a brief increase, then gradual decrease as the equilibrium shifts.
(B) a decrease because the reaction is exothermic.
(C) an increase because the kinetic energy of the molecules increases.
(D) no change as according to Le Chatelier's Principle the equilibrium will adjust to the change of temperature.

13. Which of the following substances is best analysed by atomic absorption spectroscopy (AAS)?

(A) The iodine concentration in blood of a patient with thyroid cancer.
(B) The concentration of calcium ions in Warragamba Dam.
(C) Nitrogen dioxide levels in the air over Sydney.
(D) The amount of phosphate in water running from a car wash into a local creek.

14. Which of the following statements best describes a coordinate covalent bond?

(A) A group of atoms with one or more unpaired electrons.
(B) Atoms sharing electrons to from a bond.
(C) Attraction between oppositely charged ions.
(D) One atom donates both the electrons to form a bond.

15. Identify which of the following would most likely indicate eutrophication of a waterway.

(A) High nutrients, low dissolved oxygen levels, low turbidity.
(B) High nutrients, high dissolved oxygen levels, high turbidity.
(C) Low nutrients, low dissolved oxygen levels, low pH.
(D) High nutrients, high dissolved oxygen levels, low pH.

2007 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Chemistry

Section I

Part B – 65 marks

Attempt Questions 16–28 Allow about 1 hour and 55 minutes for this part

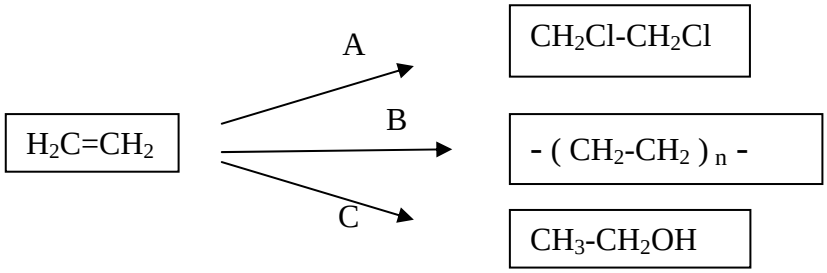
Answer the questions in the spaces provided.

Show all relevant working in questions involving calculations.

Marks

Question 16 (5 marks)

Catalytic Cracking is an important process used by the Petrochemical Industry. One of the most important products is ethene which is used as a starting material for many industrial chemical products as shown below.



a) Explain how the process of cracking is used to produce ethene. **2**

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b) Outline why ethene is much more reactive than ethane. **1**

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c) Identify process C and describe the reaction conditions.

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Marks

Question 17 (4 marks)

a) Describe one use for a named radioisotope used in industry and give a reason why it is appropriate for this use. **2**

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b) Describe how commercial radioisotopes are produced. **2**

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Question 18 (5 marks)

"NRMA seeks a cap of 10 percent on the ethanol content in petrol, and a clear labelling on bowsers dispensing ethanol blends." (http://www.openroad.com.au/motoring_carcare_ethanolinpetrol.asp)

"When blended with petrol at levels of 10% (E10) it provides a number of benefits to your car and to the environment." (http://www.friendsofethanol.com/facts.html)

Using the above information, assess the use of ethanol as a car fuel. **5**

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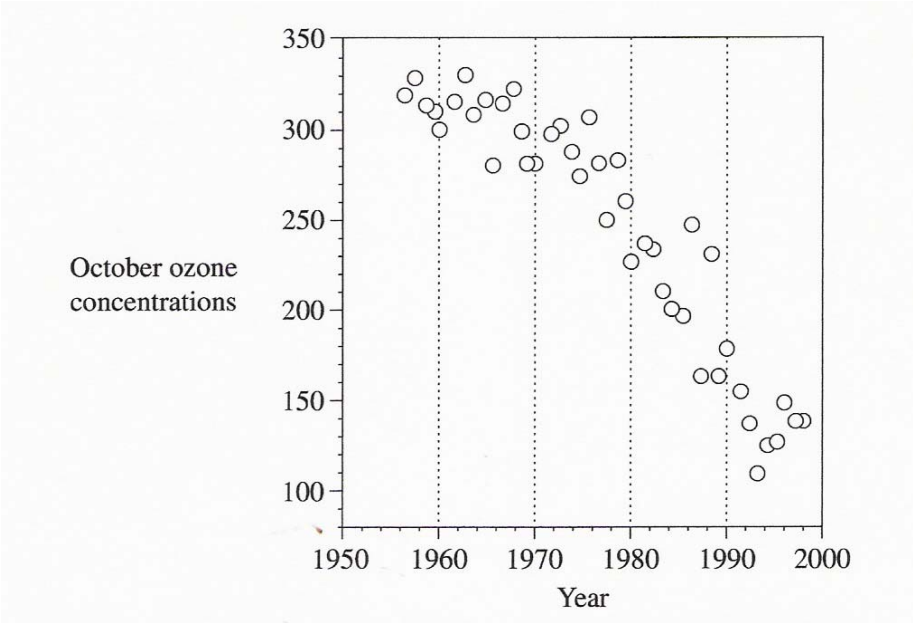
Marks

Question 19 (4 marks)

The graph below shows average ozone concentrations for October above Halley Bay in Antarctica.

Analyse the graph to describe the variations in the ozone concentration over Antarctica and explain the trend shown. **4**



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Question 20 (3 marks)

Explain the difference between a condensation polymer and an addition polymer and identify an example of each type of polymer.

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Marks

Question 21 (8 marks)

A student planned and performed an experiment to decarbonate a can of soda water and calculate the volume of gas released. She found the mass of the unopened can to be 387.56 g. She then opened the can and left it in a warm place for 2 days reweighing it regularly. Her results are shown in the table below.

Time (hours)	Mass
6	385.42
12	384.87
24	383.15
30	382.29
36	382.23
48	382.21

a) Calculate the volume of gas released at 25º C and 100 kPa. **2**

b) Suggest two ways to improve this experiment and justify your recommendations. **3**

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c) The sealed can of soda water represented a system at equilibrium. Use Le Chatelier's Principle to explain why the pH of the soda water was higher at the end of the experiment after being left open for 2 days. Include an equation in your answer. **3**

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Marks

Question 22 (5 marks)

"Every day of the year, industry and motor vehicles spew out gases, which when hit by the sunlight, change into acids. The acids collect on clouds and when it rains, come straight down onto us.

As Australia is sparsely populated, its cities are far apart and it has no neighbours, the readings are not very high. In areas where there are smelters and power stations however, the problem of acid rain is far greater.

CSIRO is working with Australian industry to help accurately and inexpensively track the spread and levels of acidic particles, before they become a health or environmental hazard."
http://www.csiro.au/promos/ozadvances/Series14Acidrain.htm

Discuss reasons for concern about the release of gases from vehicles and industry that can result in acid rain. **5**

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Question 23 (2 marks) **2**

A piece of copper metal is placed in a beaker containing 0.10 mol L^{-1} silver(I) nitrate solution. After several hours, many small shiny silver coloured crystals appear on the piece of copper and the solution appears to have a light blue colour.
Explain these observations in terms of the transfer of electrons.

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Marks

Question 24 (4 marks)

A student was provided with two colourless solutions, each in a separate beaker, labelled X and Y. They were informed that one solution was 0.1 mol L^{-1} hydrochloric acid and the other 0.1 mol L^{-1} acetic acid.

The student performed two tests on the solutions:
Test 1: The pH was determined using a pH meter.
Test 2: The volume of 0.100 mol L-1 sodium hydroxide solution needed to neutralise each acid was determined using phenolphthalein indicator.

Compare the effectiveness of these two tests in determining the identity of each acid. Justify your answer. **4**

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Question 25 (4 marks)

Lyndsay refluxed 1-propanol with butanoic acid and 2mL of concentrated sulfuric acid.

a) Draw the structural formula of the ester formed. **1**

b) Describe the purpose of adding sulfuric acid to the reaction vessel. **2**

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c) Identify one use of an ester. **1**

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Marks

Question 26 (4 marks)

25.0 mL of 0.125 mol L^{-1} standard sodium carbonate solution was titrated with sulfuric acid. The results are recorded in the table.

Titration	Volume of acid (mL)
1	22.70
2	21.85
3	21.90
4	21.80

a) Write a balanced chemical equation for the reaction of sodium carbonate with sulfuric acid. **1**

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b) Calculate the concentration of the sulfuric acid. **3**

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Question 27 (2 marks)

Chemists are employed in a variety of chemical occupations. During your study you would have gathered detailed information on the specific role played by the chemist in a named industry.

Outline the role played by the chemist in a named industry identifying the chemical principle(s) that the chemist uses as they do their work. **2**

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Marks

Question 28 (4 marks)

Evaluate the significance of the development of the industrial synthesis of ammonia by Haber at that time in world history. **4**

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Question 29 (3 marks)

Outline tests that can be used to identify each of the following ions – CO_3^{2-}, Ca^{2+}, Fe^{2+} **3**

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Marks

Question 30 (4 marks)

The water in Sydney is relatively soft whereas the water in Adelaide is very hard.

(a) Identify the cause of water hardness. **1**

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(b) Outline why water hardness can vary between locations. **1**

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(c) Describe the design and composition of microscopic membrane filters used to purify water supplies for residents in some homes in cities such as Sydney and Adelaide. **2**

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Marks

Question 31 (4 marks)

Human activity impacts on natural waterways. During your course you studied your local water supply and performed tests to analyse and compare water samples.

(a) Outline one qualitative and one quantitative test you performed in comparing the quality of water samples. **2**

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(b) A research scientist carried out various tests on samples of river water from 5 different locations, A to E. Her results are summarised in the table below.

	A	B	C	D	E
turbidity (NTU)	0.9	15.5	2.1	10.4	50.2
pH	7.4	8.6	7.0	7.2	6.9
dissolved oxygen (ppm)	9.2	6.0	6.8	6.5	6.8
phosphate (ppm)	0.03	0.30	0.03	0.01	0.05

Identify which site (A to E) which is most likely to have been located adjacent to farmland. Justify your choice. **2**

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Chemistry

Section II

20 marks
Attempt ONE question from Questions 32–33
Allow about 35 minutes for this section

Answer the question in a writing booklet. Extra writing booklets are available. Show all relevant working in questions involving calculations.

Pages

Question 32 – Industrial Chemistry (20 marks)

Marks

(a) The world population in 2007 is 6.6 billion. By 2020 is it predicted to rise by another billion people. Discuss the issues associated the need to find alternative resources with regard to one identified natural product (not a fossil fuel). **3**

(b) During your chemical studies you performed a first hand investigation to analyse an equilibrium reaction,

i. Outline the reaction you investigated. **2**
ii. Write the equilibrium constant expression for the reaction in part (i) **1**
iii. Propose a method of altering the equilibrium position and justify your reasons for choosing this method. **2**
iv. Describe ways in which accuracy and reliability could be improved in the method described in part (iii). **2**

(c) Sulfur is the starting material for the production of sulfuric acid. **2**
i. Describe the processes used to extract sulphur from mineral deposits.
ii. Analyse environmental issues associated with these extraction processes. **2**

(d) Construct a table which summarises the effect of changing 3 factors on an identified equilibrium reaction. **4**

(e) Describe and explain the exothermic nature of sulfuric acid ionisation and relate this to the safety precautions necessary for storing and transporting it. **2**

Question 33 – Shipwrecks, Corrosion and Conservation (20 marks)

Marks

(a) Analyse the impact of the work of Galvani, Volta, Davy and Faraday in increasing our understanding of electron transfer reactions. **4**

(b) A student set up an electrochemical cell as shown **2**

$Ni_{(s)} / Ni^{2+}_{(aq)} // Ag^{+}_{(aq)} / Ag_{(s)}$

Predict which metal will corrode by using the list of standard potentials and write an equation for the reaction that occurs.

(c) A chemistry student noticed that some metals such as aluminium which appear high on the table of standard reduction potentials are used for purposes which indicate that they do not corrode easily. **3**

Account for this observation, identifying at least one metal other than aluminium which displays passivating behaviour.

(d) During your chemical studies you performed a first hand investigation to compare the rate of corrosion of mild steel nails at different temperatures.

i. Outline the procedure. **2**

ii. Explain the results of this experiment. **2**

iii. Write the oxidation and reduction reactions involved in the corrosion of mild steel. **1**

iv. Describe ways in which accuracy and reliability could be improved in the procedure described in part (i). **2**

(e) Construct a table which compares the composition, properties and uses of at least 2 different steels. **4**

DATA SHEET

Avogadro constant, N_A ..... 6.022×10^{23} mol^{-1}

Volume of 1 mole ideal gas: at 100 kPa and

at 0°C (273.15 K) ..... 22.71 L

at 25°C (298.15 K) ..... 24.79 L

Ionisation constant for water at 25°C (298.15 K), K_w ..... 1.0×10^{-14}

Specific heat capacity of water ..... 4.18×10^3 J kg^{-1} K^{-1}

Some useful formulae

$$\mathrm{pH} = -\log_{10}[\mathrm{H}^+] \qquad \Delta H = -m\,C\,\Delta T$$

Some standard potentials

$K^+ + e^-$	$\rightleftharpoons$	$K(s)$	–2.94 V
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	$Ba(s)$	–2.91 V
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	$Ca(s)$	–2.87 V
$Na^+ + e^-$	$\rightleftharpoons$	$Na(s)$	–2.71 V
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	$Mg(s)$	–2.36 V
$Al^{3+} + 3e^-$	$\rightleftharpoons$	$Al(s)$	–1.68 V
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	$Mn(s)$	–1.18 V
$H_2O + e^-$	$\rightleftharpoons$	$\frac{1}{2}H_2(g) + OH^-$	–0.83 V
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	$Zn(s)$	–0.76 V
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	$Fe(s)$	–0.44 V
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	$Ni(s)$	–0.24 V
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	$Sn(s)$	–0.14 V
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	$Pb(s)$	–0.13 V
$H^+ + e^-$	$\rightleftharpoons$	$\frac{1}{2}H_2(g)$	0.00 V
$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons$	$SO_2(aq) + 2H_2O$	0.16 V
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	$Cu(s)$	0.34 V
$\frac{1}{2}O_2(g) + H_2O + 2e^-$	$\rightleftharpoons$	$2OH^-$	0.40 V
$Cu^+ + e^-$	$\rightleftharpoons$	$Cu(s)$	0.52 V
$\frac{1}{2}I_2(s) + e^-$	$\rightleftharpoons$	I^-	0.54 V
$\frac{1}{2}I_2(aq) + e^-$	$\rightleftharpoons$	I^-	0.62 V
$Fe^{3+} + e^-$	$\rightleftharpoons$	Fe^{2+}	0.77 V
$Ag^+ + e^-$	$\rightleftharpoons$	$Ag(s)$	0.80 V
$\frac{1}{2}Br_2(l) + e^-$	$\rightleftharpoons$	Br^-	1.08 V
$\frac{1}{2}Br_2(aq) + e^-$	$\rightleftharpoons$	Br^-	1.10 V
$\frac{1}{2}O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons$	H_2O	1.23 V
$\frac{1}{2}Cl_2(g) + e^-$	$\rightleftharpoons$	Cl^-	1.36 V
$\frac{1}{2}Cr_2O_7^{2-} + 7H^+ + 3e^-$	$\rightleftharpoons$	$Cr^{3+} + \frac{7}{2}H_2O$	1.36 V
$\frac{1}{2}Cl_2(aq) + e^-$	$\rightleftharpoons$	Cl^-	1.40 V
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	1.51 V
$\frac{1}{2}F_2(g) + e^-$	$\rightleftharpoons$	F^-	2.89 V

Aylward and Findlay, *SI Chemical Data* (5th Edition) is the principal source of data for this examination paper. Some data may have been modified for examination purposes.

PERIODIC TABLE OF THE ELEMENTS

KEY

Atomic Number	Symbol of element	Name of element
79	Au	Gold
Atomic Weight	197.0	

1 H 1.008 Hydrogen																	2 He 4.003 Helium
3 Li 6.941 Lithium	4 Be 9.012 Beryllium											5 B 10.81 Boron	6 C 12.01 Carbon	7 N 14.01 Nitrogen	8 O 16.00 Oxygen	9 F 19.00 Fluorine	10 Ne 20.18 Neon
11 Na 22.99 Sodium	12 Mg 24.31 Magnesium											13 Al 26.98 Aluminium	14 Si 28.09 Silicon	15 P 30.97 Phosphorus	16 S 32.07 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.87 Titanium	23 V 50.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.55 Copper	30 Zn 65.41 Zinc	31 Ga 69.72 Gallium	32 Ge 72.64 Germanium	33 As 74.92 Arsenic	34 Se 78.96 Selenium	35 Br 79.90 Bromine	36 Kr 83.80 Krypton
37 Rb 85.47 Rubidium	38 Sr 87.62 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.94 Molybdenum	43 Tc [97.91] Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon
55 Cs 132.9 Caesium	56 Ba 137.3 Barium	57–71 Lanthanides	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.8 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth	84 Po [209.0] Polonium	85 At [210.0] Astatine	86 Rn [222.0] Radon
87 Fr [223.0] Francium	88 Ra [226.0] Radium	89–103 Actinides	104 Rf [261.1] Rutherfordium	105 Db [262.1] Dubnium	106 Sg [266.1] Seaborgium	107 Bh [264.1] Bohrium	108 Hs [277] Hassium	109 Mt [268] Meitnerium	110 Ds [271] Darmstadtium	111 Rg [272] Roentgenium							

Lanthanides

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm [144.9] Promethium	62 Sm 150.4 Samarium	63 Eu 152.0 Europium	64 Gd 157.3 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.0 Ytterbium	71 Lu 175.0 Lutetium

Actinides

89 Ac [227.0] Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np [237.0] Neptunium	94 Pu [244.1] Plutonium	95 Am [243.1] Americium	96 Cm [247.1] Curium	97 Bk [247.1] Berkelium	98 Cf [251.1] Californium	99 Es [252.1] Einsteinium	100 Fm [257.1] Fermium	101 Md [258.1] Mendelevium	102 No [259.1] Nobelium	103 Lr [262.1] Lawrencium

Where the atomic weight is not known, the relative atomic mass of the most common radioactive isotope is shown in brackets.
The atomic weights of Np and Tc are given for the isotopes ^{237}Np and ^{99}Tc.

HSC CHEMISTRY 2007
Trial HSC Examination

Marking scheme and sample answers

Multiple Choice

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

Question 16 (a) (2 marks)

Criteria	Marks
Correctly explains the process of cracking (either thermal or catalytic) large alkane molecules into ethene and another smaller alkane with balanced equation or detailed explanation of either process.	2
Correct balanced equation representing cracking Or Correct description of cracking process (either thermal or catalytic)	1

Sample answer

Cracking is the process of breaking down a large alkane molecule into ethene and a smaller alkane molecule. Steam or thermal cracking uses temperatures of 750 – 900ºC to break the molecules and catalytic cracking uses specifically designed zeolite catalysts (aluminium silicate) at about 500ºC.

Eg $C_{10}H_{22} \rightarrow C_2H_4 + C_8H_{18}$

Question 16 (b) (1 mark)

Criteria	Marks
Correctly identifies the presence of the reactive double bond in ethene but not ethane	1

Sample answer

Ethene has a reactive double bond between the 2 carbon atoms, whereas ethane has only a less reactive single bond.

Question 16 (c) (2 marks)

Criteria	Marks
Correctly identifies the reaction as hydration of ethene and describes the appropriate conditions (catalyst or temperature) required. OR identifies addition of water and both conditions	2
Correctly identifies the reaction as hydration of ethene OR describes the appropriate conditions required.	1

Sample answer

C represents the hydration of ethene to produce ethanol and requires dilute sulfuric acid at about 300º C.

Question17 (a) (2 marks)

Criteria	Marks
Describes one industrial use for the named radioisotope and a reason as to why it is appropriate for this use.	2
Describes one industrial use for the named radioisotope. OR Identifies one radioisotope and a property	1

Sample answer

Americium -241 is used to automatically control the thickness of thin plastic films, such as food wraps. It is suited to this use because it is an alpha emitter which is readily absorbed by the thin wrap.

Question 17 (b)

Criteria	Marks
Describes the two major methods of production of commercial radioisotopes (nuclear reactors and particle accelerators).	2
Describes one method of production of commercial radioisotopes or identifies two methods of production of commercial radioisotopes.	1

Sample answer

A nuclear reactor is used to produce some commercial radioisotopes. Uranium-235 produces neutrons which bombard stable nuclei to produce other elements eg the production of technetium from molybdenum. Other radioisotopes are produced in particle accelerators such as a cyclotron where charged particles such as proton are accelerated and then bombard target nuclei eg xenon-124 is bombarded with protons to produce caesium-123 which eventually decays to produce iodine-123.

Question 18 (5 marks)

Criteria	Marks
Outlines benefits and problems of using ethanol as a car fuel in pure form or as a petrol/ethanol blend and uses this information to assess this use.	5
Outlines benefits and problems of using ethanol as a car fuel in pure form or as a petrol/ethanol blend and provides opinion	3 - 4
Identifies benefits and/or problems of using ethanol as a car fuel	1 - 2

Sample answer

Ethanol can be produced as a carbon dioxide neutral fuel by fermentation of plant waste. Ethanol burns efficiently producing less pollutants ie CO than petrol and is biodegradable. However some car engines may need to be modified to burn ethanol especially in high concentration and due to its lower density fuel tanks would need to be larger to travel the same distance. If it is produced in an energy efficient manner it will eventually become a very useful car fuel, particularly as petroleum prices rise.

Question 19 (4 marks)

Criteria	Marks
Correctly identifies and explains both the trends shown in the graph ie minor fluctuations between individual years due to climatic variations, with an overall trend of decreasing ozone concentrations from late 1950s to 2000 caused by use of CFCs as propellants and refrigerants.	4
Correctly identifies both the trends shown in the graph and explains one OR identifies and explains one trend in detail	2 -3
Correctly identifies one trend shown in the graph OR Explains one trend without identifying it	1

Sample Answer

Overall the ozone concentration over Antarctica decreases from the late 1950s to 2000. This decline can be attributed to the use of ozone depleting chlorofluorocarbons as propellants and refrigerants. There are slight fluctuations of CFC levels between individual years eg1987 to 1988 where the level goes up which relate to climatic changes.

Question 20 (3 marks)

Criteria	Marks
Correctly explains the difference between condensation and addition polymers and identifies one example of each type.	3
Correctly explains the difference between condensation and addition polymers OR identifies one example of each type of polymer	1 - 2

Sample answer
Condensation and addition polymers are both very long chain molecules. They are produced by different types of reactions. Addition polymers are produced when many small molecules called monomers each containing a C=C double bond link up by opening the double bond eg ethene monomer forms polyethylene. Condensation polymers are formed when small molecules containing functional groups join up and eliminate a small molecule such as water. An example of a condensation polymer is cellulose.

Question 21 (a) (2 marks)

Criteria	Marks
Calculates the correct volume of gas released including correct units	2
Calculates moles of gas released or correctly completes part of calculation	1

Sample answer

Maximum mass change = 387.56 – 382.21 = 5.35 g

Moles gas = 5.35/44.01 x 24.79 = 3.01 L

Question 21 (b) (3 marks)

Criteria	Marks
Identifies and justifies 2 correct methods of improving experiment (reliability and/or accuracy)	3
Identifies 2 correct methods of improving experiment (reliability and/or accuracy) OR Identifies and justifies one correct method of improving experiment	2
Identifies one correct method of improving experiment	1

Sample answer
The can of soda water has not been allowed to achieve constant mass so reweighing until constant mass was achieved would improve accuracy. Repeating the experiment several times to get similar results and then averaging them would improve reliability.

Question21 (c) (1 mark)

Criteria	Marks
Uses at least one equation to represent CO_2 equilibrium and uses Le Chatelier's principle to explain change in equilibrium position linking this to pH.	3
Uses at least one equation to represent CO_2 equilibrium and uses Le Chatelier's principle to explain change in equilibrium position OR Uses Le Chatelier's principle to explain change in equilibrium position linking this to pH.	2
Correct equation for CO_2 equilibrium OR uses Le Chatelier's principle to explain change in equilibrium position OR links soluble CO_2 to pH	1

Sample answer

The can of soda water contains dissolved carbon dioxide and an equilibrium is established producing hydrogen ions.

$CO_2(g) \leftrightarrows CO_2(aq)) \leftrightarrows HCO_3^-(aq) + H^+(aq) \leftrightarrows CO_3^{2-}(aq) + 2H^+(aq)$

As the can is opened and the pressure is reduced, carbon dioxide gas escapes disturbing the equilibrium. According to Le Chatelier's Principle the equilibrium shifts to the left to replace it. This reduces the concentration of hydrogen ions thus raising the pH.

Question 22 (5 marks)

Criteria	Marks
Discusses at least 3 reasons for concerns about the release of gases which can result in acid rain, identifying specific gases and their sources. At least one equation must be correctly used.	5
Describes reasons for concerns about the release of gases which can result in acid rain, identifying specific gases and some sources. At least one equation must be correctly used.	3 - 4
Identifies reasons for concerns about the release of gases which can result in acid rain, identifying specific gases. OR Explains the formation of acid rain	1 - 2

Sample answer

Sulfur dioxide gas is released by the burning of fossil fuels containing elemental sulfur such as coal in power stations and petrol and diesel in car, truck and trains.

$S(s) + O_2(g) \rightarrow SO_2(g)$

Sulfur dioxide can be oxidised to sulphur trioxide.

Nitrogen oxides are produced as a by product of high temperature combustion in car engines and other vehicles.

These gases are soluble in water and can produce acid rain.

$SO_3(g) + H_2O)(l) \rightarrow H_2SO_4(aq)$

Low levels of these gases cause natural rain water to have a pH slightly less than 7. Higher levels caused by industrial activity can cause considerable problems. The gases themselves can cause respiratory problems for livestock and humans.

Acid rain produced from these gases can cause damage to the environment. For example it can alter the pH of natural waterways and disturb the reproductive cycles of fish. It can destroy the protective coating on the leaves on plants and therefore destroy forests. Acid rain can also damage human structures such as statues made from limestone or marble and the metals used in buildings or vehicles.

Question 23 (2 marks)

Criteria	Marks
Correctly explains the chemistry of both observations	2
Correctly explains the chemistry of one observation or writes a correct equation representing the transfer of electrons	1

Sample answer

The copper is a more active metal than silver and therefore replaces the Ag+ ions from solution. The tiny silver coloured crystals are formed from the silver metal coming out of solution ie $Ag^+ + e^- \rightarrow Ag(s)$ and the pale blue colour appears as Cu^{2+} ions enter solution ie $Cu(s) \rightarrow Cu^{2+} + 2e^-$. Thus electrons are transferred from the copper metal to the silver ions.

Question 24 (4 marks)

Criteria	Marks
Correctly identifies test 1 as the more effective test, outlines the relative effectiveness of both tests and justifies their decision.	4
Correctly identifies test 1 as the more effective test, outlines the relative effectiveness of one test and justifies their decision OR correctly identifies test 1 as the more effective test, outlines the relative effectiveness of both tests with no justification.	2-3
Justifies their choice using correct chemistry.	1

Sample answer

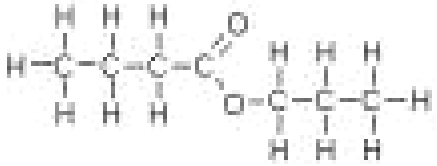
Test 2 would not effectively identify each acid as they have the same concentration, and being monoprotic acids, would require the same volume of sodium hydroxide for neutralisation. Test 1

would identify each acid as even though both are monoprotic acids, HCl is a strong acid and acetic acid is a weak acid. This means that HCl will completely dissociate and have a pH = 1. However, acetic acid will not completely dissociate and will therefore have a pH >1 as the concentration of H^+ will be less.

Question 25 (a) (1 mark)

Criteria	Marks
Correctly draw the structure of propyl butanoate	1

Sample answer



Question 25 (b) (2 marks)

Criteria	Marks
Describe two purposes for adding sulfuric acid to the reaction vessel	2
Identifies two purposes for adding sulfuric acid to the reaction vessel OR Describe one purpose two for adding sulfuric acid to the reaction vessel	1

Sample answer

Sulfuric acid is added to the reaction vessel during esterification as a dehydrating agent to shift the equilibrium towards the formation of products. This has the effect of increasing the yield. It also acts as a catalyst to increase the rate of the reaction.

Question 25 (c) (1 mark)

Criteria	Marks
Identify a use if an ester	1

Sample Answer

Esters are used as a perfume in cosmetics.

Question 26 (a) (1 mark)

Criteria	Marks
Correctly write the balanced chemical equation for the reaction, including states.	1

Sample Answer

$Na_2CO_{3(aq)} + H_2SO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + CO_{2(g)} + H_2O_{(l)}$

Question 26 (b) (3 marks)

Criteria	Marks
Calculates the correct concentration of sulfuric acid. Answer given to 3 significant figures.	3
Calculates the concentration of sulfuric acid correctly without disregarding 22.70 OR Calculates the correct number of moles or correctly completes part of the calculation.	1 - 2

Sample answer

(21.85 + 21.90 + 21.80)/3 = 21.85mL H_2SO_4 (outlier 22.70 omitted)

moles Na_2SO_4 = 0.025L x 0.125molL^{-1}

= 3.125 x 10^{-3}

moles Na_2SO_4 = moles H_2SO_4 = 3.125 x 10^{-3}

Molarity = 3.125 x 10^{-3}/ 0.02185 = 0.143M

Question 27 (2 marks)

Criteria	Marks
Outline the role of a chemist in a named industry and identify at least one chemical principle they use.	2
Outline the role of a chemist without naming an industry and identify at least one chemical principle they use OR without identifying a chemical principle.	1

Sample answer
A polymer chemist for ORICA working on developing optimal reaction conditions for the formation of different plastics. Needs to be aware of the effects of changing temperature and pressure on the rate of a reaction according to Le Chatelier's principle.

Question 28 (4 marks)

Criteria	Marks
Comprehensively describe several factors in world history influenced by the industrial synthesis of ammonia and evaluate the significance.	4
Comprehensively describe several factors in world history influenced by the industrial synthesis of ammonia without an evaluation of their significance OR A description of a couple factors and an evaluation of their significance.	3
A couple of factors identified and their significance evaluated, OR A couple factors described without an evaluation	2
A couple of factors identified only	1

Sample answer
The process for the industrial synthesis of ammonia was developed in the early 1900s by German scientist Fritz Haber. At the time a method for the production of ammonia was considered to be a priority as it could be used as a precursor for fertilisers, ammunition such as TNT, and nitric acid. That the Germans were able to develop this process had a significant impact on the world events of the early twentieth century.
The use of lands in Europe for agriculture had occurred for many hundreds of years and therefore the soils were lacking nutrients leading to poorer crops. This problem was intensified by the recent population boom. Nitrates in the form of guano imported from South America were an efficient fertiliser but costly and a rapidly diminishing solution. Synthesised ammonia was cheaper, just as effective and more importantly reduced Germany's reliance on imports. This was particularly relevant due to the naval blockade established during WW1 by the allies.
The commencement of WW1 also meant that Germany needed more ammonia to produce more explosives. Possessing this ammonia meant that Germany may have been able to prolong the length of the war and the accompanying hardships. However, it also resulted in the increased production of food and the prevention of mass starvation.

Question 29 (3 marks)

Criteria	Marks
Correctly outline a test that would identify each of the ions.	3
Correctly outline a test that would identify two of the ions	2
Correctly outline a test that would identify one ion OR identify tests that would identify each of the ions.	1

NB- the test must identify the ion, not narrow it down, for example, both Ba^{2+} and Ca^{2+} will forma white precipitate with sulfates and so the test doesn't identify them *by itself*.

Sample Answer
CO_3^{2-} - add HCl to the sample. If there is a gas produced it is a carbonate.
Ca^{2+} - hold a sample in a flame it should produce a brick red flame.
Fe^{2+} - when added to potassium ferrocyanide it forms a deep blue precipitate.

Question 30 (a) (1 mark)

Criteria	Marks
Correctly identify the cause of water hardness	1

Sample Answer
Water hardness is caused by a increased concentration of Ca^{2+} and Mg^{2+} ions.

Question 30 (b) (1 mark)

Criteria	Marks
Correctly outline a reason why water hardness may vary between locations	1

Sample answer
The concentration of different ions may be a result of the rock or soil types that the body of water flows over. If it contains calcium (for example limestone) or magnesium then they will be present at higher concentrations than of they don't.

Question 30 (c) (2 marks)

Criteria	Marks
Correctly describe both the design and composition of a microscopic membrane filter	2
Correctly describe either the design or composition of a microscopic membrane filter OR identify both the design and composition of a microscopic membrane filter	1

Sample answer
Microscopic membrane filters are composed of thin sheets of porous synthetic polymers, such as polyester. This sheet can be formed into thin capillary tubes over which water flows. Clean water can pass through the tiny holes into the tubes, leaving larger particles behind.

Question 31 (a) (2 marks)

Criteria	Marks
One quantitative and one qualitative test correctly outlined and identified.	2
Either one quantitative or one qualitative test correctly outlined and identified OR one quantitative and one qualitative test correctly outlined but not identified	1

Sample answer
A quantitative test we performed was using a pH meter to establish the acidity of the water sample. A qualitative test we performed was to test for water hardness. A small amount of soap flakes were added to the water sample in a test tube. This was then vigorously shaken. If a large amount of froth was produced the water was soft, if there were no, or little froth formed then it was hard.

Question 31 (b) (2 marks)

Criteria	Marks
Correctly identify site B as the most likely location and justified their response	2
Correctly identify site B without a justification.	1

Sample Answer
Site B is the most likely site to have been located adjacent to farmland as the turbidity and phosphate level are high, possibly caused by run off from soils and fertilisers.

Question 32 – OPTION 9.5 Industrial Chemistry (20 marks)

(a)

Criteria	Marks
Identifies an appropriate natural product and it's source, and discusses logically at least TWO issues associated with the need to find alternatives for it.	3
Identifies an appropriate natural product and outlines an issue associated with the need to find alternatives for it.	2
Identifies an appropriate natural product OR Discusses the need to find alternatives for some unidentified natural products or an inappropriate natural product (ie a fossil fuel)	1

Sample answer

Natural vanilla (from tropical orchids) is used extensively in flavouring foods eg vanilla ice cream, perfumes and many other scented products such as candles, hand and body lotions. The supply of natural vanilla cannot keep up with the demand from a growing world population and increased consumerism. More people want more vanilla. This would result in land clearing of rainforests, habitat destruction and erosion. A synthetic form of vanilla, vanillin was developed from petrochemicals. This is cheaper and easier to produce.

(b) i.

Criteria	Marks
Outlines a detailed knowledge of an appropriate equilibrium reaction including equations (including states)	2
Includes equation for an equilibrium reaction OR Identifies an equilibrium reaction	1

Sample answer

An equilibrium studied was that between potassium dichromate (orange) and potassium chromate (yellow) as shown by the equation below.

$$Cr_2O_7^{2-}(aq) + H_2O(l) \leftrightarrow 2CrO_4^{2-}(aq) + 2H^+(aq)$$

The position of the equilibrium is altered by adding H^+ and OH^- to the mixture and changing the colour between orange and yellow.

(b) ii.

Criteria	Marks
Correct equilibrium expression for reaction in (b) i.	1

Sample answer

$$K = \frac{[CrO_4^{2-}]\,[H^+]}{[Cr_2O_7^{2-}]}$$

(b) iii.

Criteria	Marks
Proposes an appropriate method of altering the position for the equilibrium reaction identified in (b) i. and justifies choice in terms of chemistry of reaction	2
Proposes an appropriate method of altering the position for the equilibrium reaction	1

Sample answer

Adding dilute sodium hydroxide to the equilibrium causes the colour to become more yellow. This is because the NaOH reacts with the H^+ ions and removes them to form water. The equilibrium reacts according to Le Chatelier's Principle to minimise the disturbance and replace the H^+ ions so it moves to the right and produces more yellow chromate ions.

(b) iv.

Criteria	Marks
Clearly distinguishes between accuracy (precision of instruments/ observations) and reliability (similarity of results through repetition) and describes a way to improve each	2
States one way to improve accuracy OR States one way to improve reliability	1

Sample answer
Repeat the experiment 4 to 6 times achieving consistent results will improve reliability. Accuracy could be improved by using a measuring cylinder or pipette to measure the quantities of reactants and using a colourimeter to record the colour of the equilibrium.

(c) i.

Criteria	Marks
Provides a full description of the Frasch process used to extract sulphur from mineral deposits.	2
Provides a partial description of the Frasch process.	1

Sample answer
To extract sulphur from underground mineral deposits the Frasch Process is used. This involves injecting superheated steam and compressed air into the underground deposit. This melts the sulphur and forces a foam containing melted sulphur up through a pipe to the surface where the almost pure sulphur solidifies.

(c) ii.

Criteria	Marks
Identifies and analyses environmental issues associated with the Frasch process	2
Identifies environmental issues associated with the Frasch process OR analyses one environmental issue associated with the Frasch process	1

Sample answer
There are several possible environmental concerns. Firstly the injection of superheated steam into underground deposits could result in thermal pollution of the surrounding area, this heated water could find its way into local waterways and kill organisms or reduce dissolved oxygen levels. Also sulphur is readily oxidised to produce sulphur dioxide and can be r4duced to produce hydrogen sulphide. Both of these gases are caustic and can cause respiratory problems.

(d)

Criteria	Marks
Constructs an appropriate table (at least 8 boxes) succinctly identifying 3 factors that effect an identified equilibrium reaction and the effects of each.	4
Constructs an appropriate table (at least 4 boxes) clearly identifying 3 factors that effect an identified equilibrium reaction and the effects of each OR Constructs a table identifying 3 factors that effect an identified equilibrium reaction and the effects of each OR Constructs a table identifying less than 3 factors that effect an identified equilibrium reaction and the effects of each	2-3

Outlines the effect of changing one factor on an identified equilibrium reaction OR Constructs an appropriate table (at least 6 boxes) clearly identifying 3 factors that effect an equilibrium reaction	1

Sample answer

Equilibrium reaction: $N_2(g) + 3H_2(g) \leftrightarrows 2NH_3(g)$ $\Delta = -92$ kJ/mol

Factor/change	Effect
Increase temperature	Equilibrium position moves to the reactants, less ammonia produced
Increase pressure	Equilibrium position moves to the products, more ammonia produced
Use of iron/aluminium oxide catalyst	Equilibrium position not affected but rate of forward and reverse reaction increases

(e)

Criteria	**Marks**
Explains the exothermic nature of sulfuric acid ionisation using an appropriate equation and relates this to at least one safety precaution for storing and/or transporting it.	2
Describes the exothermic nature of sulfuric acid ionisation OR Identifies a safety precaution for storing or transporting sulfuric acid	1

Sample answer

Concentrated sulfuric acid exists in it's covalent molecular form. When water is added to the acid the acid ionises in a very exothermic reaction, releasing a great deal of heat energy which can cause the mixture to boil and spit into the air. In a sealed container this could cause an explosion.

ie $H_2SO_4(l) + H_2O(l) \rightarrow 2H^+(aq) + SO_4^{2-}(aq)$

Concentrated sulfuric acid must be stored to minimise the chance of leaks or breaks which could allow the acid to come into contact with water. Stainless steel tankers are used to transport large quantities as the acid in it's molecular form will not react with this and the steel is unlikely to crack or leak. In laboratories it should be stored in glass and kept on low shelves, preferable used in small quantities.

Question 33 – OPTION 9.6 Shipwrecks, Corrosion and Conservation (20 marks)

(a)

Criteria	Marks
Describes the work of each of Galvani, Volta, Davy and Faraday and the implications of their work in increasing our understanding of electron transfer reactions.	3-4
Describes the work of at least two of Galvani, Volta, Davy and Faraday.	1-2

Sample Answer

Galvani discovered that continual muscle contractions occurred when a frog's spinal cord was connected by copper hooks to an iron railing. He concluded that animal tissue contained a 'vital force' called 'animal electricity'.

Volta challenged Galvani's conclusion stating that the electricity was produced by the contact between the two different metals not the animal tissue. He set up the first battery called the voltaic pile in which he sandwiched a piece of brine-soaked cardboard between two different metallic plates, tin and copper.

Davy used a version of Volta's pile to pass strong electric currents through molten salts that were suspected of containing undiscovered elements. He isolated the new elements potassium, sodium, barium, calcium, strontium and magnesium and thus showed that electricity could be used to cause a chemical reaction.

Faraday investigated quantitative relationships in electrolytic processes. He continued Davy's experiments and accurately measured the amounts of substances deposited on electrodes. From his measurements he deduced that the amount of substance deposited was directly proportional to the amount of electricity passing through the cell. He also introduced terminology still used today, such as anode, cathode, anion, cation, electrode and electrolysis.

At the time of these electrolytic experiments of Volta, Davy and Faraday there was no idea that many compounds were made of ions. These experiments provided valuable information about the existence of ions.

(b)

Criteria	Marks
Correctly predicts that nickel will corrode and writes the net redox equation for the cell reaction.	2
Correctly predicts that nickel will corrode	1

Sample Answer

Nickel will corrode. The overall reaction for the cell is :

$Ni_{(s)} + 2Ag^{+}_{(aq)} \rightarrow Ni^{2+}_{(aq)} + 2Ag_{(s)}$

(c)

Criteria	Marks
Accounts for the passivating behaviour of a reactive metal such as aluminium in terms of the formation of a strongly bonded, impervious metal oxide layer and identifies another passivating metal	3
Describes a passivating metal and identifies another passivating metal (not aluminium)	1 - 2

Sample Answer
Aluminium is widely used in windows, door frames and guttering as, apart from going dull, it remains unchanged over time even though it is a highly reactive metal. This is because aluminium forms an oxide layer on top of the metal which is tightly bonded to the metal and is non-permeable to both oxygen and water. Hence this unreactive oxide coating protects the metal from further oxidation. Another passivating metal is chromium.

(d) (i)

Criteria	**Marks**
Clearly identifies how the independent variable is changed and how the dependent variable is to be measured. Controls all other variables that could affect results.	2
Clearly identifies how the independent variable is changed and how the dependent variable is to be measured.	1

Sample Answer
1. Select 6 identical mild steel nails.
2. Place each nail in a separate medium sized test tube and cover each nail with 10 mL of distilled water.
3. Place two test tubes in the fridge (low temp), leave two test tubes on the laboratory bench (med temp) and place two test tubes in the incubator set at 40 ^{o}C (high temp).
4. Observe the test tubes after 5 days and, for each test tube, record the amount of brown deposit that has formed on the bottom of the test tube and on the nail using a scale of 0 (no brown deposit) to 10 (largest amount).

(d) (ii)

Criteria	**Marks**
Describes the results of the investigation and explains these results in terms of reaction rate.	2
Describes the results.	1

Sample Answer
The results showed that the test tubes in the fridge produced the least amount of rust after 5 days (rated 2), the test tubes left at room temperature produced more rust (rated 5) and the test tubes at 40 ^{o}C produced the greatest amount of rust (rated 10). This is because increasing the temperature increases the kinetic energy of the reactant species and so there are more successful collisions at higher temperatures. Hence the rate of the reaction increases and so more rust forms over the same time period at higher temperatures.

(d) (iii)

Criteria	**Marks**
Correctly writes both the oxidation and reduction half equations for rusting	1

Sample Answer
Oxidation $Fe_{(s)} \rightarrow Fe^{2+}_{(aq)} + 2e^-$
Reduction $\frac{1}{2} O_{2\,(aq)} + H_2O_{(l)} + 2e^- \rightarrow 2OH^-_{(aq)}$

(d) (iv)

Criteria	Marks
Clearly distinguishes between accuracy (precision of measuring instruments / observations) and reliability (similarity of results through repetition) and describes a way to improve each.	2
States one way to improve accuracy OR States one way to improve reliability	1

Sample Answer

Accuracy refers to the precision of the measuring instruments used or observations made in obtaining results. The accuracy of this investigation can be improved by using a more quantitative method to assess the amount of rust produced such as using an electronic balance to weigh the rinsed and dried nails both initially and at the end of the investigation.
Reliability refers to the similarity of results obtained by repeating the experiment. Reliability could be improved by testing a greater variety of different temperatures such as 5^{o}C, 10 ^{o}C, 20 ^{o}C, 30 ^{o}C, 40 ^{o}C and 50 ^{o}C to provide a better understanding of the relationship between temperature and the rate of corrosion.

(e)

Criteria	Marks
Constructs an appropriate table which shows the percentage composition of at least two identified steels (including iron and small amounts of carbon) and describes the specific properties and uses of each type of steel.	4
Constructs an appropriate table which shows the composition of at least two identified steels in terms of the alloying metals present or the carbon content and describes the properties and uses of each type of steel.	2 – 3
Identifies one type of steel by the alloying metals present or the carbon content and states one use OR one property of that steel.	1

Sample Answer

Steel	Composition	Properties	Uses
Mild Steel	Iron with < 0.2% carbon added	Soft and malleable and corrodes fairly rapidly due to presence of small amount of carbon; easily welded	Ship hulls, car bodies, roofing
Stainless steel	Iron (74%) with a small amount of carbon and 10 to 20 % Cr, 5 to 20% Ni	Is corrosion resistant and chemically unreactive due to the presence of Cr (a passivating metal) Is hard and strong due presence of Ni	Cutlery, kitchen sinks, surgical and dental instruments.