Student Number .....

Barker College

2010

TRIAL
HIGHER SCHOOL
CERTIFICATE

Chemistry

Staff Involved:

- **RJP**
- **RZS ***
- **KHW**
- **NJD**

AM WEDNESDAY 4TH AUGUST

94 copies

SECTION I
ANSWER SHEET

Section I
Multiple Choice

Choose the best response and fill in the response oval completely

1.	(A)	(B)	(C)	(D)
2.	(A)	(B)	(C)	(D)
3.	(A)	(B)	(C)	(D)
4.	(A)	(B)	(C)	(D)
5.	(A)	(B)	(C)	(D)
6.	(A)	(B)	(C)	(D)
7.	(A)	(B)	(C)	(D)
8.	(A)	(B)	(C)	(D)
9.	(A)	(B)	(C)	(D)
10.	(A)	(B)	(C)	(D)
11.	(A)	(B)	(C)	(D)
12.	(A)	(B)	(C)	(D)
13.	(A)	(B)	(C)	(D)
14.	(A)	(B)	(C)	(D)
15.	(A)	(B)	(C)	(D)
16.	(A)	(B)	(C)	(D)
17.	(A)	(B)	(C)	(D)
18.	(A)	(B)	(C)	(D)
19.	(A)	(B)	(C)	(D)
20.	(A)	(B)	(C)	(D)

Student Number: .....

Barker College

2010
TRIAL
HIGHER SCHOOL CERTIFICATE

Chemistry

Staff Involved:

- **RJP**
- **RZS ***
- **KHW**
- **NJD**

AM WEDNESDAY 4TH AUGUST

94 copies

Total marks – 100

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen
- Board-approved calculators may be used
- Draw diagrams using pencil
- A Data Sheet and Periodic Table are provided at the back of this paper
- Write your Barker Student Number at the top of the Section I Answer Sheet, at the top of this page and at the top of **ALL** answer pages in Section II
- Show ALL working for calculations

Section I Pages 2 - 7

20 marks

- Multiple Choice
- Indicate all answers on the Answer Sheet provided
- Allow about 30 minutes for this section.

Section II Pages 8 - 28

80 marks

- Short Response
- Indicate all answers in the spaces provided on the paper
- Allow about 150 minutes for this section

Section I
20 marks

Attempt Questions 1-20
Allow about 30 minutes for this part

Use the multiple-choice answer sheet provided for Questions 1-20.

---

1. Which of the following is classified as a biopolymer?

(A) PVC

(B) Polystyrene

(C) Glucose

(D) Cellulose

2. Which of the following species has the greatest ability to gain electrons from a reducing agent in solution?

(A) Zinc ions

(B) Silver ions

(C) Zinc

(D) Silver

3. Which of the following elements is classified as transuranic?

(A) Cerium

(B) Curium

(C) Caesium

(D) Cadmium

4. When glucose is fermented to form ethanol and carbon dioxide, the carbon dioxide produced can be bubbled into limewater, $Ca(OH)_2$ to form a white precipitate of calcium carbonate. What is the maximum mass of calcium carbonate which could be formed from 90 g of glucose?

(A) 100 g

(B) 50 g

(C) 200 g

(D) 90 g

Section I continued

5. Some salts, when dissolved in water, produce acidic or alkaline solutions, while others produce neutral solutions. Which is the CORRECT statement?

(A) When sodium chloride is dissolved in water, the pH increases slightly.

(B) When potassium ethanoate is dissolved in water, the concentration of hydroxide ions decreases.

(C) When sodium carbonate is dissolved in water, the pH decreases.

(D) When ammonium nitrate is dissolved in water, the concentration of hydronium ions increases.

6. An indication that an oxide is classified as basic is when it:

(A) reacts with water to form a base or with a salt to form an acid.

(B) reacts with water to form an acid or with a base to form a salt.

(C) reacts with an acid to form a salt or with water to form hydroxide ions.

(D) turns litmus paper red.

7. Which of the following mixtures would form a buffer solution?

(A) 100 mL of 0.1 mol L^{-1} HCOOH and 1000 mL of 0.1 mol L^{-1} CH_3COO Na

(B) 100mL of 0.1 mol L^{-1} HNO_3 and 25 mL of 1 mol L^{-1} NO_3^-

(C) 100 mL of 0.1 mol L^{-1} HCOOH and 100 mL of 0.1 mol L^{-1} CH_3COOH

(D) 100 mL of 0.1 mol L^{-1} HCOOH and 100 mL of 0.1 mol L^{-1} HCOO Na

8. The chemical added to bulk water supplies to make the solution alkaline is:

(A) chlorine

(B) sodium fluoride

(C) lime

(D) iron (III) chloride

Section I continued

9. Some measurements were made on various water samples and the results tabulated.

Sample	A	B	C	D
DO (ppm)	2.2	7.0	8.7	5.6
TDS (ppm)	550	600	45	200
Turbidity (NTU)	100	250	5	10
pH	7.5	3.5	6.5	7.5
Coliforms (CFU / 100 mL)	200	0	0	0

The sample most likely to have been drawn from a water supply polluted by run-off from a mining site is:

(A) *A*

(B) *B*

(C) *C*

(D) *D*

10. Which of the following is the conjugate acid of $H_2PO_4^-$?

(A) H_2PO_4

(B) H_3PO_4

(C) HPO_4^{2-}

(D) PO_4^{3-}

11. Consider the four chloroalkanes

1. 2, 4-dichloropentane
2. 2, 4-dichlorohexane
3. 2, 3-dichlorohexane
4. 2, 2, 3, 4-tetrachloropentane

Which of the four chloroalkanes are isomers?

(A) 1 and 2

(B) 1 and 4

(C) 2 and 3

(D) 3 and 4

12. Atomic absorption spectroscopy (AAS) would be a suitable method for determining the concentration of:

(A) Phosphorus in detergents

(B) Ethanol in wine

(C) Mercury in fish

(D) Nitrogen in fertilisers

13. 0.1 mol/L citric acid is neutralised by a solution of 0.1 mol/L sodium hydroxide. Choose the best indicator for this titration.

(A) Methyl orange

(B) Phenolphthalein

(C) Bromothymol blue

(D) Universal

14. Butanoic acid and ethyl butanoate have the same molecular formula, $C_4 H_8 O_2$ **.**
Which of the following is the best chemical test to distinguish between these two compounds?

(A) Dilute sodium carbonate

(B) Bromine water

(C) Solubility in water

(D) Smell

15. The following equation represents the nuclear decay of radium - 88.

$$^{228}_{88}Ra \rightarrow {}^{228}_{89}Ac + X$$

Identify the species marked X.

(A) An alpha particle

(B) A beta particle

(C) A neutron

(D) A proton

Section I continued

16. The quantity of flocculent added to a water supply was less than the amount required to effectively treat that supply. What would be the effect on the water quality?

(A) A high value of TDS (total dissolved solids)

(B) A pH between 5 and 6

(C) Turbid water

(D) A high bacterial count

17. One possible source of hydrogen for use of a fuel is through the "reforming" of natural gas. The key reaction is :

$$CH_{4(g)} + H_2O_{(g)} \rightarrow CO_{(g)} + 3H_{2(g)} \quad \Delta H = +172\,KJ$$

A catalyst is used for this reaction.

Which of the following is the most suitable set of conditions for this reaction?

(A) Low pressure and low temperature

(B) Low pressure and high temperature

(C) High pressure and high temperature

(D) High pressure and low temperature

18. In an aqueous solution of the weak acid nitrous acid, HNO_2, which of the following species is present?

(A) HNO_2

(B) H_3O^+

(C) OH^-

(D) NO_2^-

19. Which of the following reactions will occur as written?

(A) $Cu_{(s)} + Zn(NO_3)_{2(aq)} \rightarrow Cu(NO_3)_{2(aq)} + Zn_{(s)}$

(B) $Cu_{(s)} + Sn(NO_3)_{2(aq)} \rightarrow Cu(NO_3)_{2(aq)} + Sn_{(s)}$

(C) $2Ag_{(s)} + Cu(NO_3)_{2(aq)} \rightarrow 2Ag\,NO_{3(aq)} + Cu_{(s)}$

(D) $Sn_{(s)} + Cu(NO_3)_{2(aq)} \rightarrow Sn(NO_3)_{2(aq)} + Cu_{(s)}$

20. Why is the maximum yield of ethanol produced by the yeast - catalysed fermentation of 1 litre of glucose solution approximately 150ml?

(A) The reaction is limited by the amount of water.

(B) There is too much heat generated if more ethanol is produced.

(C) Too much oxygen is generated if more ethanol is produced.

(D) The yeast can only tolerate an environment with a maximum 15% alcohol.

End of Section I

Student Number: .....

Section II
Total marks 80
Attempt Question 21 - 36
Allow about 150 minutes for this section.

Question 21 (3 marks) **Marks**

A student prepared a sample of an indicator, using red cabbage. She tested the indicator with solutions of known pH and tabulated her observations.

Colour	Red		violet		purple			blue		green		yellow		
pH	1	2	3	4	5	6	7	8	9	10	11	12	13	14

(a) State the colour of the indicator in a 0.0005 mol L^{-1} solution of sulfuric acid. Show your working. **2**

.....

.....

.....

.....

(b) 1.00 mL of the 0.0005 mol L^{-1} solution of sulfuric acid was diluted to 1 L, using deionised water. What could be the colour of the diluted solution after addition of a few drops of red cabbage indicator? Show working. **1**

.....

Page Total

Student Number: .....

Question 22 (5 marks) **Marks**

Cobalt-60 (Co - 60) is a gamma emitter. It is produced by the neutron bombardment of Co-59.

(a) Name an instrument that can be used to detect gamma radiation. **1**

.....

(b) Write a nuclear equation to show the formation of Co-60 from Co - 59. **1**

.....

(c) Evaluate the medical use of Co-60 or another identified medical radioisotope you have studied. **3**

.....

.....

.....

.....

.....

.....

.....

.....

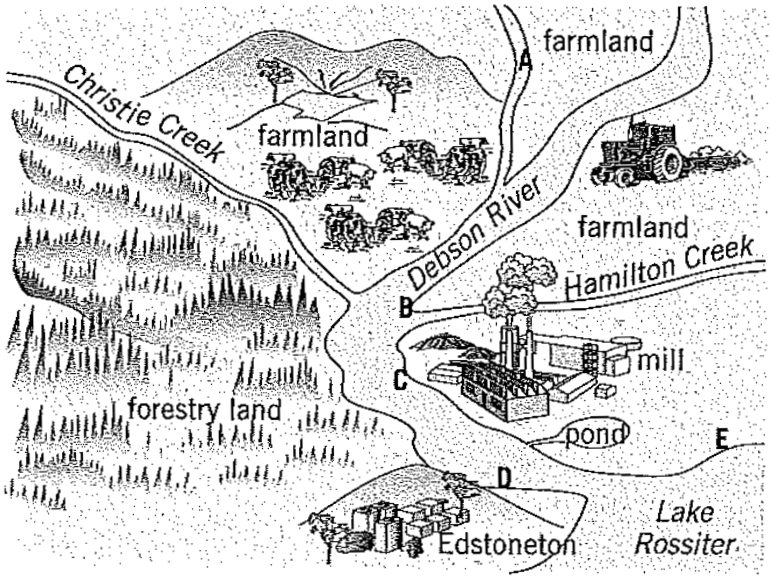
.....

Page Total

Student Number: .....

Question 23 (7 marks) **Marks**

The map below shows the location of several sites which affect the water quality of the town, Edstoneton. Various water testing stations are labelled A - E.



(i) The water temperature at testing station D is quite high. Account for this high temperature. **1**

.....

(ii) The water in the Debson River experiences algal blooms especially after heavy rain. Name the possible nutrient responsible for the algal bloom and state its likely source. **2**

.....

.....

(iii) What effect could increased water temperature have on the level of dissolved oxygen in the river? Explain your answer. **2**

.....

.....

.....

Question 23 continues on page 11

Page Total

Question 23 (continued) **Marks**

(iv) Recently some of the forestry land along Christie Creek has been cleared for urban development. This has affected the water quality at Testing Station B particularly after heavy rain. What would an observer notice about a water sample at Testing Station B? **1**

.....

.....

(v) Describe **ONE** water treatment method that could be used to sterilise the water at site A so that it would be suitable for drinking. **1**

.....

.....

Page Total

Student Number: .....

Marks

Question 24 (5 marks)

Sodium hydrogen phosphate (Na_2HPO_4) forms an amphiprotic species in water that is involved in the buffering of living cells.

(a) Write an equation showing how Na_2HPO_4 can act as an acid in water. **1**

.....

(b) Write an equation showing how Na_2HPO_4 can act as a base in water. **1**

.....

(c) From one of your equations above clearly identify a conjugate acid-base pair. **1**

.....

(d) The behaviour of the above amphiprotic species (HPO_4^{2-}) fits the definition of an acid / base theory you have studied. Identify the theory and explain how it fits that definition. **2**

.....

.....

.....

.....

Page Total

Student Number: .....

Marks

Question 25 (4 marks)

In class you analysed, by means of titration, a sample of fertiliser to determine the percentage of sulfate it contained. Below is a typical table of results.

Titre	$BaCl_2$ Volume (mL)
1	29.50
2	29.45
3	29.42

9.32 g of the original fertiliser were dissolved in 250 mL of deionised water. 10 mL of this solution were pipetted into a conical flask. The burette contained 0.051 mol L^{-1} barium chloride.

Calculate the percentage of sulfate in the fertiliser. Show all your working as a means of explaining the chemistry involved. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Page Total

Question 26 (7 marks) **Marks**

The Haber process was developed in 1908 as a method of synthesising ammonia and was converted into a successful industrial process during the following decade.

(a) Evaluate the significance of the Haber process at that time in world history. **2**

.....

.....

.....

.....

.....

.....

.....

.....

(b) Write an equation that describes the Haber process. **1**

.....

(c) By analysing the factors affecting ammonia synthesis, explain why the Haber process requires a compromise between these factors. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

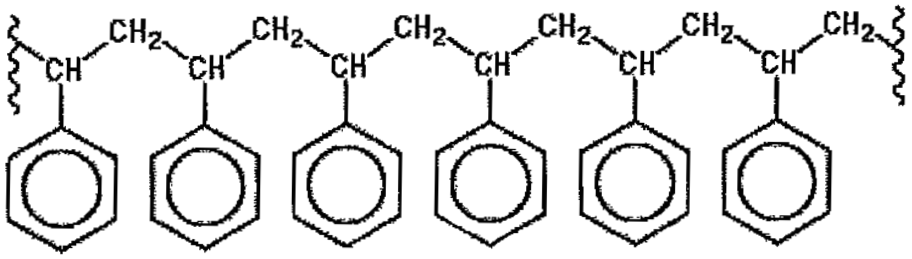
.....

Page Total

Student Number: .....

Question 27 (4 marks) **Marks**

The diagram shows a section of a polymer chain.



(a) Draw a structure of the monomer from which this polymer is made. **1**

(b) State the IUPAC preferred name for this polymer. **1**

.....

(c) Identify **ONE** common use of this polymer and explain how this use is related to a property of the polymer. **2**

.....

.....

.....

.....

Page Total

Question 28 (4 marks) **Marks**

An electrochemical cell is constructed from the following two half cells under standard conditions.

Half cell 1 : a nickel electrode in a solution of 1.0 M nickel nitrate

Half cell 2 : a cadmium electrode in a solution of 1.0 M cadmium nitrate

(a) Draw a labelled diagram of this electrochemical cell. **3**

(b) Given that the standard reduction potential of the cadmium half cell is -0.4V, show on your diagram the direction in which electrons will flow in the external circuit of this cell. **1**

Page Total

Question 29 (3 marks) **Marks**

An electrochemical cell is constructed from the following two half cells under standard conditions.

Half cell 1 : a copper electrode in a solution of 1.0 M copper nitrate
Half cell 2 : a lead electrode in a solution of 1.0 M lead nitrate

(a) Give the equation for the half reaction that takes place at the anode of this cell. **1**

.....

(b) Calculate the overall cell voltage of this cell. **2**

.....

.....

.....

.....

.....

.....

.....

Page Total

Student Number: .....

Question 30 (7 marks) **Marks**

The following table lists the pH of 0.10 M solutions of four different acids at 25°C.

Acid	pH
P	1.0
Q	3.0
X	0.7
Y	2.1

(a) Which acid **must** have more than one acidic hydrogen per molecule? Give a reason for your answer. **2**

.....

.....

.....

.....

(b) Using the concentration and the pH of acid Y, calculate the percentage ionisation of acid Y in the 0.10 M solution. **1**

.....

.....

(c) Samples of the solutions of acids P and Y are diluted by a factor of 10.
The resulting **change in pH units** would be: **1**
(*Tick **one** of the following boxes).*

greater for acid P than for acid Y	
greater for acid Y than for acid P	
the same for both acids	

Question 30 continues on page 19

Page Total

Question 30 (continued) **Marks**

(d) The dissociation of ethanoic acid in water is exothermic. If a solution of the acid is heated, will the pH of the solution **increase, decrease or remain constant?**
Given an explanation for your answer. Include an equation in your answer **3**

.....

.....

.....

.....

.....

.....

.....

Page Total

Student Number: .....

Question 31 (7 marks) **Marks**

(a) Explain why the presence of ozone in the upper atmosphere is beneficial to life on earth. **1**

.....

.....

.....

.....

(b) CFCs can lower the concentration of ozone in the upper atmosphere.

(i) Which element in the molecules of CFCs causes the destruction of the ozone molecule? **1**

.....

(ii) Write an equation which shows how ozone is destroyed by this element. **1**

.....

(c) (i) Using electron dot diagrams (Lewis diagrams), draw and label the oxygen molecule and the ozone molecule. Put a circle around the coordinate covalent bond. **2**

(ii) Referring to their structure and bonding, compare oxygen and ozone over one property. **2**

.....

.....

.....

.....

Page Total

Question 32 (5 marks) **Marks**

"Some bulk water supplies are collected from valleys in wilderness areas, while others are collected from valleys surrounded by mixed farming lands. These different supplies require different levels of clarification and purification before they can be used for human consumption."

Assess this statement referring to the methods used for treatment of water supplies collected from these different environments. **5**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Page Total

Question 33 (6 marks) **Marks**

The accuracy of acid-base titrations depends on several factors. These include the primary standard used, how the glassware is prepared and how the equivalence point is determined.

(a) Explain why sodium hydroxide is not used as a primary standard. **1**

.....

.....

(b) During a titration, a conical flask is prepared by rinsing it with distilled water. While this flask is still wet, a clean, dry pipette is used to transfer 20 mL of a standard solution into it. Will the accuracy of the titration be affected? Explain your answer. **1**

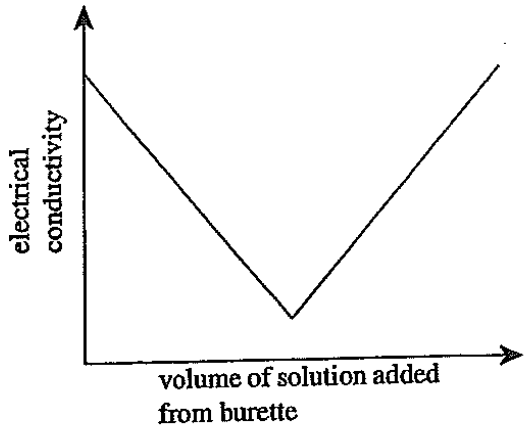
.....

.....

.....

.....

(c) Although an indicator can be used to determine the equivalence point of an acid-base titration, an alternative method is to monitor the electrical conductivity of the reaction mixture during the titration. The following graph shows the variation in electrical conductivity during such titration.



Explain why the electrical conductivity:

(i) starts at a maximum but then decreases to a minimum value. **2**

.....

.....

Question 33 continues on page 23

Page Total

Question 33 (continued) **Marks**

(ii) does not reach a zero value. **1**

.....

.....

(iii) starts to increase again after the minimum value. **1**

.....

.....

Page Total

Question 34 (8 marks) **Marks**

Ethylene is an important resource for chemical industries. It is formed by industrial processes from the components of crude oil (a mixture of alkanes).

(a) Outline the industrial processes used to convert crude oil into ethylene. Include an equation for the conversion of an alkane into ethylene by one of these industrial processes. **3**

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Ethanol can be formed from ethylene. Describe how this conversion is achieved and write an equation for the chemical reaction you describe. **2**

.....

.....

.....

.....

.....

.....

Question 34 continues on page 25

Page Total

Question 34 (continued) **Marks**

(c) Ethylene can be distinguished from ethane by a simple laboratory test. Describe how this test is carried out and its results and include balanced equations for chemical reactions which occur in both the dark and in the light.. Name the product formed. **3**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

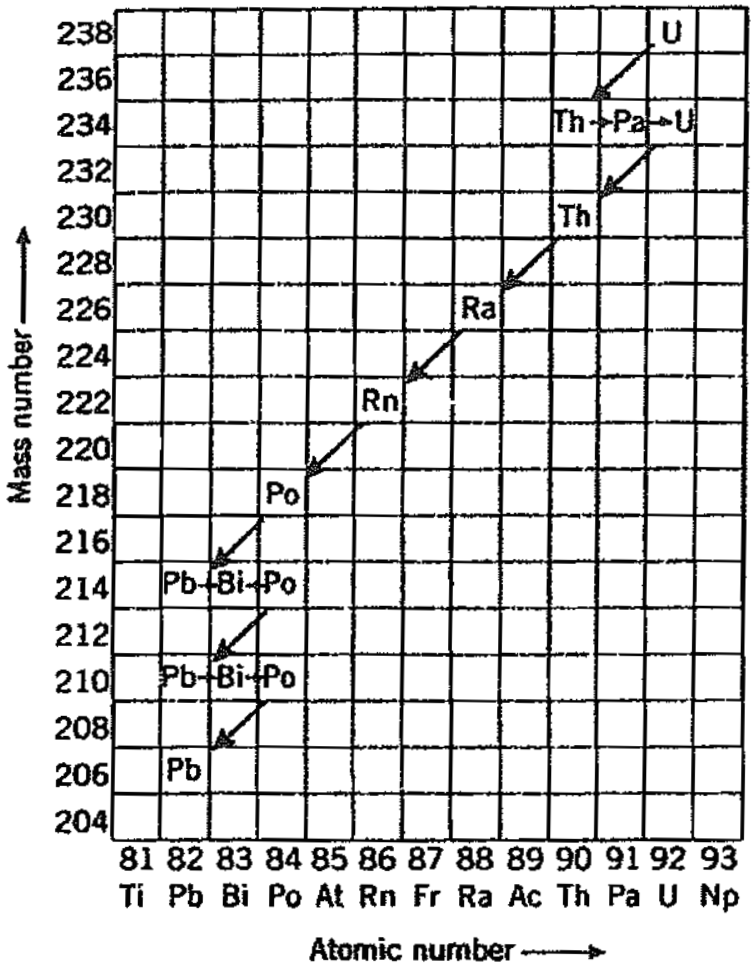
.....

Page Total

Student Number: .....

Question 35 (2 marks) **Marks**

Uranium is a radioactive element that slowly undergoes decay.



Using the flow diagram shown above, trace the sequence of fission products during the decay of uranium for the steps Pa (Protactinium) to Th (Thorium) Th-230.
(Include the two equations.) **2**

.....

.....

Page Total

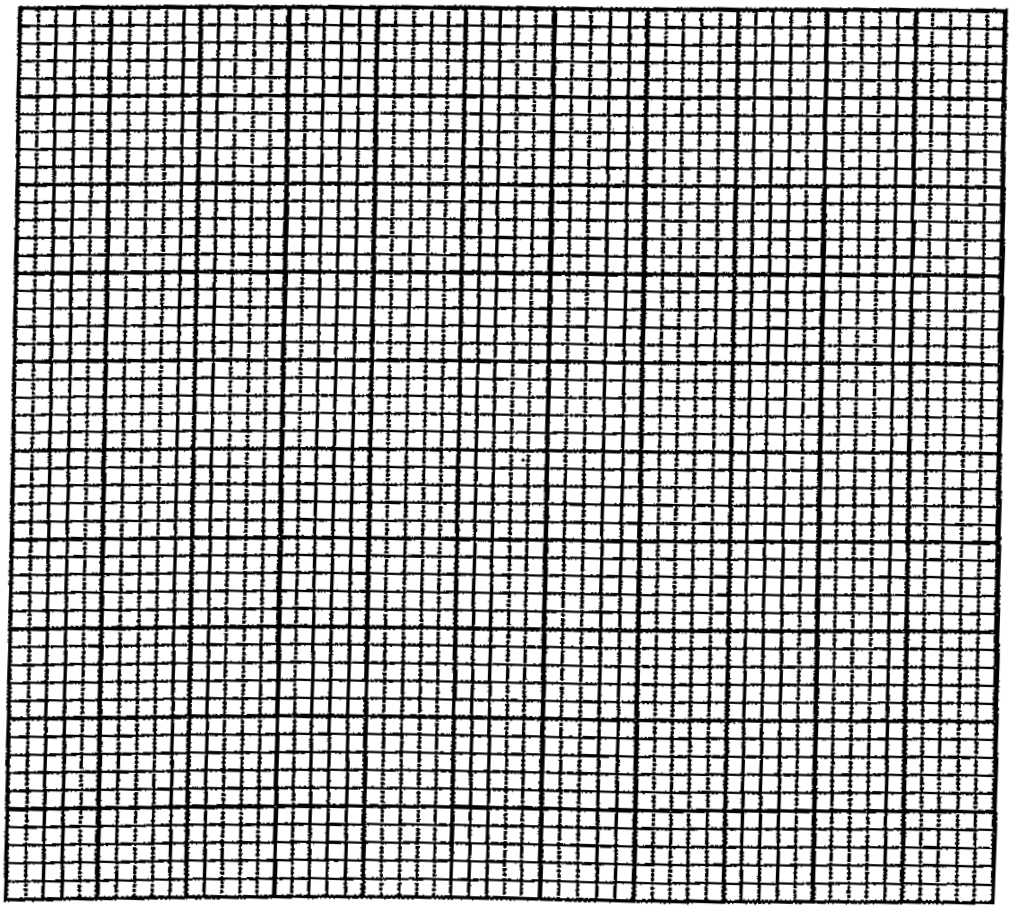
Question 36 (3 marks) **Marks**

Railways often test the cooling water of their diesel engines for dissolved metals. The presence of particular metal ions in the water gives an indication as to the "health" of the engine. The most commonly used method for this analysis is atomic absorption spectroscopy.

In one particular analysis a chemist was testing for the presence of iron. She used a series of standard solutions to obtain the following results.

Concentration of Fe (ppm)	Absorbance (%)
0	0.00
2	0.13
4	0.28
6	0.41
8	0.53
10	0.67

(a) Draw a calibration graph of these results. **2**



Question 36 continues on page 28

Page Total

Question 36 (continued) **Marks**

The chemist then tested the water from three engines.

For each engine she placed 50 mL of sample in a 1000 mL standard flask. The flask was then filled to the mark with distilled, deionised water and shaken to ensure mixing. She then tested each of the diluted samples and obtained the following results.

Engine Number	Absorbance (%)
X12	0.04
X45	0.01
X67	0.30

(b) Calculate the concentration of iron in the original sample from engine X67. **1**

.....

End of Paper

Page Total

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

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 Lanthanoids	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] Francium	88 Ra [226] Radium	89–103 Actinoids	104 Rf [261] Rutherfordium	105 Db [262] Dubnium	106 Sg [266] Seaborgium	107 Bh [264] Bohrium	108 Hs [277] Hassium	109 Mt [268] Meitnerium	110 Ds [271] Darmstadtium	111 Rg [272] Roentgenium							

KEY

Atomic Number — 79 — Symbol of element

Atomic Weight — 197.0 — Name of element

Gold

Lanthanoids

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm [145] 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

Actinoids

89 Ac [227] Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np [237] Neptunium	94 Pu [244] Plutonium	95 Am [243] Americium	96 Cm [247] Curium	97 Bk [247] Berkelium	98 Cf [251] Californium	99 Es [252] Einsteinium	100 Fm [257] Fermium	101 Md [258] Mendelevium	102 No [259] Nobelium	103 Lr [262] Lawrencium

For elements that have no stable or long-lived nuclides, the mass number of the nuclide with the longest confirmed half-life is listed between square brackets.

The International Union of Pure and Applied Chemistry Periodic Table of the Elements (October 2005 version) is the principal source of data. Some data may have been modified.

FINAL PRINTED VERSION
23 / 7 / 10
Rob Paynter

RJP

Student Number SUGGESTED ANSWERS.

Barker College

2010

TRIAL HIGHER SCHOOL CERTIFICATE

Chemistry

Staff Involved:

- *RJP*
- *RZS **
- *KHW*
- *NJD*

AM WEDNESDAY 4TH AUGUST

94 copies

Section I
Multiple Choice

SECTION I ANSWER SHEET

Choose the best response and fill in the response oval completely

1.	A	B	C	**D**
2.	A	**B**	C	D
3.	A	**B**	C	D
4.	**A**	B	C	D
5.	A	B	C	**D**
6.	A	B	**C**	D
7.	A	B	C	**D**
8.	A	B	**C**	D
9.	A	**B**	C	D
10.	A	**B**	C	D
11.	A	B	**C**	D
12.	A	B	**C**	D
13.	A	**B**	C	D
14.	**A**	B	C	D
15.	A	**B**	C	D
16.	A	B	**C**	D
17.	A	**B**	C	D
18.	**A**	B	C	D
19.	A	B	C	**D**
20.	A	B	C	**D**

Student Number: .....

Barker College

2010
TRIAL HIGHER SCHOOL CERTIFICATE

Chemistry

Staff Involved:

- RJP
- RZS *
- KHW
- NJD

AM WEDNESDAY 4TH AUGUST

94 copies

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen
- Board-approved calculators may be used
- Draw diagrams using pencil
- A Data Sheet and Periodic Table are provided at the back of this paper
- Write your Barker Student Number at the top of the Section I Answer Sheet, at the top of this page and at the top of **ALL** answer pages in Section II
- Show ALL working for calculations

Total marks – 100

Section I Pages 2 - 7

20 marks

- Multiple Choice
- Indicate all answers on the Answer Sheet provided
- Allow about 30 minutes for this section.

Section II Pages 8 - 28

80 marks

- Short Response
- Indicate all answers in the spaces provided on the paper
- Allow about 150 minutes for this section

Section I
20 marks

Attempt Questions 1-20
Allow about 30 minutes for this part

Use the multiple-choice answer sheet provided for Questions 1-20.

---

1. Which of the following is classified as a biopolymer?

   (A) PVC
   (B) Polystyrene
   (C) Glucose
   (D) Cellulose

2. Which of the following species has the greatest ability to gain electrons from a reducing agent in solution?

   (A) Zinc ions
   (B) Silver ions
   (C) Zinc
   (D) Silver

3. Which of the following elements is classified as transuranic?

   (A) Cerium
   (B) Curium
   (C) Caesium
   (D) Cadmium

4. When glucose is fermented to form ethanol and carbon dioxide, the carbon dioxide produced can be bubbled into limewater, $Ca(OH)_2$ to form a white precipitate of calcium carbonate. What is the maximum mass of calcium carbonate which could be formed from 90 g of glucose?

   (A) 100 g
   (B) 50 g
   (C) 200 g
   (D) 90 g

5. Some salts, when dissolved in water, produce acidic or alkaline solutions, while others produce neutral solutions. Which is the CORRECT statement?

   (A) When sodium chloride is dissolved in water, the pH increases slightly.

   (B) When potassium ethanoate is dissolved in water, the concentration of hydroxide ions decreases.

   (C) When sodium carbonate is dissolved in water, the pH decreases.

   (D) When ammonium nitrate is dissolved in water, the concentration of hydronium ions increases.

6. An indication that an oxide is classified as basic is when it:

   (A) reacts with water to form a base or with a salt to form an acid.

   (B) reacts with water to form an acid or with a base to form a salt.

   (C) reacts with an acid to form a salt or with water to form hydroxide ions.

   (D) turns litmus paper red.

7. Which of the following mixtures would form a buffer solution?

   (A) 100 mL of 0.1 mol L^{-1} HCOOH and 1000 mL of 0.1 mol L^{-1} CH_3COO Na

   (B) 100mL of 0.1 mol L^{-1} HNO_3 and 25 mL of 1 mol L^{-1} NO_3^-

   (C) 100 mL of 0.1 mol L^{-1} HCOOH and 100 mL of 0.1 mol L^{-1} CH_3COOH

   (D) 100 mL of 0.1 mol L^{-1} HCOOH and 100 mL of 0.1 mol L^{-1} HCOO Na

8. The chemical added to bulk water supplies to make the solution alkaline is:

   (A) chlorine

   (B) sodium fluoride

   (C) lime

   (D) iron (III) chloride

9. Some measurements were made on various water samples and the results tabulated.

Sample	A	B	C	D
DO (ppm)	2.2	7.0	8.7	5.6
TDS (ppm)	550	600	45	200
Turbidity (NTU)	100	250	5	10
pH	7.5	3.5	6.5	7.5
Coliforms (CFU / 100 mL)	200	0	0	0

The sample most likely to have been drawn from a water supply polluted by run-off from a mining site is:

(A) *A*

(B) *B*

(C) *C*

(D) *D*

10. Which of the following is the conjugate acid of $H_2PO_4^-$?

(A) H_2PO_4

(B) H_3PO_4

(C) HPO_4^{2-}

(D) PO_4^{3-}

11. Consider the four chloroalkanes

1. 2, 4-dichloropentane
2. 2, 4-dichlorohexane
3. 2, 3-dichlorohexane
4. 2, 2, 3, 4-tetrachloropentane

Which of the four chloroalkanes are isomers?

(A) 1 and 2

(B) 1 and 4

(C) 2 and 3

(D) 3 and 4

12. Atomic absorption spectroscopy (AAS) would be a suitable method for determining the concentration of:

    (A) Phosphorus in detergents

    (B) Ethanol in wine

    (C) Mercury in fish

    (D) Nitrogen in fertilisers

13. 0.1 mol/L citric acid is neutralised by a solution of 0.1 mol/L sodium hydroxide. Choose the best indicator for this titration.

    (A) Methyl orange

    (B) Phenolphthalein

    (C) Bromothymol blue

    (D) Universal

14. Butanoic acid and ethyl butanoate have the same molecular formula, $C_4H_8O_2$.
    Which of the following is the best chemical test to distinguish between these two compounds?

    (A) Dilute sodium carbonate

    (B) Bromine water

    (C) Solubility in water

    (D) Smell

15. The following equation represents the nuclear decay of radium - 88.

    $^{228}_{88}Ra \rightarrow {}^{228}_{89}Ac + X$

    Identify the species marked X.

    (A) An alpha particle

    (B) A beta particle

    (C) A neutron

    (D) A proton

Section I continued

16. The quantity of flocculent added to a water supply was less than the amount required to effectively treat that supply. What would be the effect on the water quality?

(A) A high value of TDS (total dissolved solids)

(B) A pH between 5 and 6

(C) Turbid water

(D) A high bacterial count

17. One possible source of hydrogen for use of a fuel is through the "reforming" of natural gas. The key reaction is :

$$CH_{4(g)} + H_2O_{(g)} \rightarrow CO_{(g)} + 3H_{2(g)} \quad \Delta H = +172\,KJ$$

A catalyst is used for this reaction.

Which of the following is the most suitable set of conditions for this reaction?

(A) Low pressure and low temperature

(B) Low pressure and high temperature

(C) High pressure and high temperature

(D) High pressure and low temperature

18. In an aqueous solution of the weak acid nitrous acid, HNO_2, which of the following species is present? IN THE HIGHEST CONCENTRATION.

(A) HNO_2

(B) H_3O^+

(C) OH^-

(D) NO_2^-

19. Which of the following reactions will occur as written?

(A) $Cu_{(s)} + Zn(NO_3)_{2(aq)} \rightarrow Cu(NO_3)_{2(aq)} + Zn_{(s)}$

(B) $Cu_{(s)} + Sn(NO_3)_{2(aq)} \rightarrow Cu(NO_3)_{2(aq)} + Sn_{(s)}$

(C) $2Ag_{(s)} + Cu(NO_3)_{2(aq)} \rightarrow 2AgNO_{3(aq)} + Cu_{(s)}$

(D) $Sn_{(s)} + Cu(NO_3)_{2(aq)} \rightarrow Sn(NO_3)_{2(aq)} + Cu_{(s)}$

20. Why is the maximum yield of ethanol produced by the yeast - catalysed fermentation of 1 litre of glucose solution approximately 150ml?

(A) The reaction is limited by the amount of water.

(B) There is too much heat generated if more ethanol is produced.

(C) Too much oxygen is generated if more ethanol is produced.

(D) The yeast can only tolerate an environment with a maximum 15% alcohol.

End of Section I

p 8-12 RJP 20
p 13-17 KHW. 22
p 18-21 HSD 19
p 22-28 RZS. 19.

Student Number: .....

Section II
Total marks 80
Attempt Question 21 - 36
Allow about 150 minutes for this section.

Question 21 (3 marks) **Marks**

A student prepared a sample of an indicator, using red cabbage. She tested the indicator with solutions of known pH and tabulated her observations.

Colour	Red		violet		purple			blue		green		yellow		
pH	1	2	3	4	5	6	7	8	9	10	11	12	13	14

(a) State the colour of the indicator in a 0.0005 mol L^{-1} solution of sulfuric acid. Show your working. **2**

$[H_2SO_4] = 0.0005\ mol.L^{-1}$ $\therefore [H^+] = 0.001\ mol.L^{-1}$

$pH = -\log_{10}[H^+]$

$pH = -\log 1\times10^{-3}$

$pH = 3$ $\therefore$ COLOUR IS VIOLET

(b) 1.00 mL of the 0.0005 mol L^{-1} solution of sulfuric acid was diluted to 1 L, using deionised water. What could be the colour of the diluted solution after addition of a few drops of red cabbage indicator? Show working. **1**

$C_1V_1 = C_2V_2$

$0.0005 \times 1 = C_2 \times 1000$

$C_2 = 5\times10^{-7}\ mol.L^{-1}$ for H_2SO_4

$\therefore [H_3O^+] = 1\times10^{-6}\ M$

$pH = 6$

COLOUR IS PURPLE.

Page Total

Student Number: .....

Question 22 (5 marks) **Marks**

Cobalt-60 (Co - 60) is a gamma emitter. It is produced by the neutron bombardment of Co-59.

(a) Name an instrument that can be used to detect gamma radiation. 1

GEIGER COUNTER, SCINTILLATION COUNTER, CLOUD CHAMBER.

(b) Write a nuclear equation to show the formation of Co-60 from Co - 59. 1

$^{59}_{27}Co + {}^{1}_{0}n \longrightarrow {}^{60}_{27}Co$

(c) Evaluate the medical use of Co-60 or another identified medical radioisotope you have studied. 3

Co-60 emits GAMMA RAY which carry a suitable amount of energy to DESTROY CANCER CELLS

Co-60 has a suitable HALF-LIFE (4 to 6 YEARS) so radiation source has a reasonable lifetime in the equipment.

Despite the possibility of some good cells being destroyed during treatment Co-60 remains a valuable medical radioisotope for treating cancer.

STERILISE MEDICAL EQUIPMENT

TECHNETIUM 99m – NON-INVASIVE and HIGHLY SENSITIVE means of DIAGNOSIS of conditions such as OSTEOMYLITIS. HALF-LIFE of 6 HOURS and is a GAMMA EMITTER. Short half-life means the EXPOSURE of patient and doctor to radiation is MINIMISED.

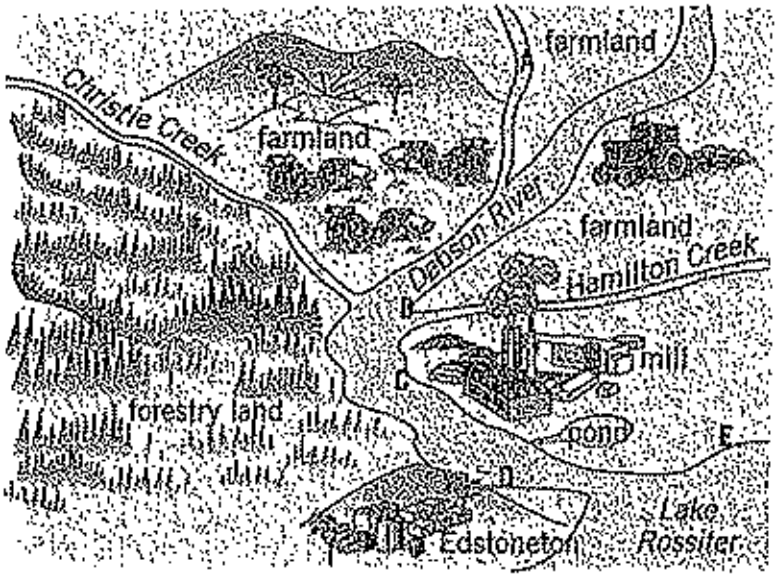
Despite these intrinsic risks of production in a nuclear reactor, TRANSPORTATION and STORAGE, the benefits of NON-INVASIVE and ACCURATE DIAGNOSIS OUTWEIGH the possible risks when appropriate SAFETY PRECAUTIONS are taken.

Page Total

Student Number: .....

Question 23 (7 marks) **Marks**

The map below shows the location of several sites which affect the water quality of the town, Edstoneton. Various water testing stations are labelled A - E.



(i) The water temperature at testing station D is quite high. Account for this high temperature. 1

Mill could be using water to cool plant and return warmed water to the river. WARM WATER FROM TOWN (½) HIGH TURBIDITY leads to ↑ T (½)

(ii) The water in the Debson River experiences algal blooms especially after heavy rain. Name the possible nutrient responsible for the algal bloom and state its likely source. 2

NITRATE OR PHOSPHATE ✓ from FARMLANDS ✓

PHOSPHORUS (½)

(iii) What effect could increased water temperature have on the level of dissolved oxygen in the river? Explain your answer. 2

Level of DISSOLVED OXYGEN would DECREASE. ✓

The SOLUBILITY OF GASES DECREASES with ✓ INCREASING TEMPERATURE.

½ if increased BACTERIA etc

Question 23 continues on page 11

Page Total

Student Number: .....

Question 23 (continued) **Marks**

(iv) Recently some of the forestry land along Christie Creek has been cleared for urban development. This has affected the water quality at Testing Station B particularly after heavy rain. What would an observer notice about a water sample at Testing Station B? 1

HIGH TURBIDITY.

(v) Describe **ONE** water treatment method that could be used to sterilise the water at site A so that it would be suitable for drinking. 1

GASEOUS CHLORINE could be dissolved in it. This destroys bacteria and some viruses.

MEMBRANE FILTERS

OZONE.

DISTILLATION. ½ if just listed

HIGH UV all methods.

BOILING ½ if just said CHLORINATION but did not DESCRIBE.

Page Total

Student Number: .....

Marks

Question 24 (5 marks)

Sodium hydrogen phosphate (Na_2HPO_4) forms an amphiprotic species in water that is involved in the buffering of living cells.

(a) Write an equation showing how Na_2HPO_4 can act as an acid in water. 1

$HPO_4^{2-} + H_2O \rightleftharpoons H_3O^+ + PO_4^{3-}$

$Na_2HPO_4 + H_2O \rightleftharpoons H_3O^+ + Na_2PO_4^-$

(b) Write an equation showing how Na_2HPO_4 can act as a base in water. 1

$HPO_4^{2-} + H_2O \rightleftharpoons H_2PO_4^- + OH^-$

$Na_2HPO_4 + H_2O \rightleftharpoons OH^- + Na_2H_2PO_4^+$

(c) From one of your equations above clearly identify a conjugate acid-base pair. 1

Eqn (a) HPO_4^{2-} / PO_4^{3-} or H_2O/H_3O^+

Eqn (b) HPO_4^{2-}/$H_2PO_4^-$ or H_2O/OH^-

(d) The behaviour of the above amphiprotic species (HPO_4^{2-}) fits the definition of an acid / base theory you have studied. Identify the theory and explain how it fits that definition. 2

LOWRY-BRONSTED

In equation (a) HPO_4^{2-} is acting as a PROTON DONOR. In equation (b) HPO_4^{2-} is acting as a PROTON ACCEPTOR.

Page Total

Student Number: .....

Marks

Question 25 (4 marks)

In class you analysed, by means of titration, a sample of fertiliser to determine the percentage of sulfate it contained. Below is a typical table of results.

Titre	$BaCl_2$ Volume (mL)
1	29.50
2	29.45
3	29.42

9.32 g of the original fertiliser were dissolved in 250 mL of deionised water. 10 mL of this solution were pipetted into a conical flask. The burette contained 0.051 mol L^{-1} barium chloride.

Calculate the percentage of sulfate in the fertiliser. Show all your working as a means of explaining the chemistry involved. 4

Average titre = $\frac{29.50 + 29.45 + 29.42}{3}$ = 29.46 mL

moles of $BaCl_2$ $n = cV$

$n = (0.051)(29.46 \times 10^{-3})$

$n = 1.50246 \times 10^{-3}$ mol.

∴ same number of moles of Ba^{2+}

$Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4(s)$

moles of SO_4^{2-} is also 1.50246×10^{-3} mol in 10 mL

moles of SO_4^{2-} in 250 mL $= (1.5024 \times 10^{-3})(25)$

$= 0.03756$ mol.

mass of SO_4^{2-} in 250 mL $= (0.03756)(96.07)$

$= 3.609$ g

% SO_4 $= \frac{3.609}{9.32} \times \frac{100}{1}$

$= 38.72\%$

Page Total

Student Number: .....

Question 26 (7 marks) **Marks**

The Haber process was developed in 1908 as a method of synthesising ammonia and was converted into a successful industrial process during the following decade.

(a) Evaluate the significance of the Haber process at that time in world history. 2

World War I was occuring at that time. The British had a NAVAL BLOCKADE of German supply ships bringing SALTPETRE nitrate from CHILE. The HABER process enabled Germany to have a supply of NH_3, despite the blockade. The NH_3 could then be used to make EXPLOSIVES and FERTILISERS. The HABER PROCESS was highly significant as it PROLONGED the war effort by GERMANY.

(b) Write an equation that describes the Haber process. 1

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

(c) By analysing the factors affecting ammonia synthesis, explain why the Haber process requires a compromise between these factors. 4

PRESSURE: According to Le Chatelier Principle the higher the pressure the more NH_3 produced. However high pressures require VERY EXPENSIVE equipment and their are SAFETY ISSUES. A compromise pressure of 250 Atm is used.

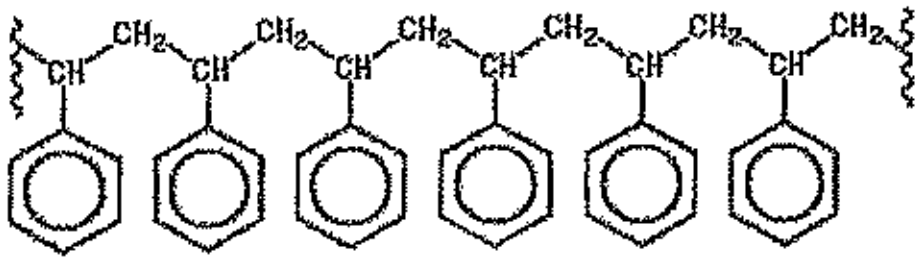
TEMPERATURE: The HABER PROCESS is EXOTHERMIC releasing 92 kJ. mol^{-1} of N_2 reacted. According to Le Chatelier Principle if we LOWER THE TEMPERATURE at equilibrium then the reaction which releases energy will be favoured and this is the forward reaction producing NH_3. However at low temperatures REACTION RATE is too slow so a compromise temperature of about 400°C is used.

Page Total

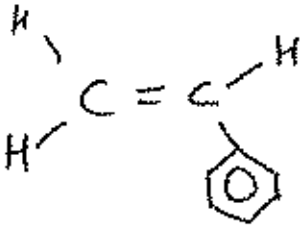
Student Number: .....

Question 27 (4 marks) **Marks**

The diagram shows a section of a polymer chain.



(a) Draw a structure of the monomer from which this polymer is made. **1**



(b) State the IUPAC preferred name for this polymer. **1**

POLYSTYRENE

(c) Identify **ONE** common use of this polymer and explain how this use is related to a property of the polymer. **2**

TOOL HANDLES :

CD CASES

CAR BATTERY CASES

Polystyrene is HARD, STRONG PLASTIC

Page Total

Student Number: .....

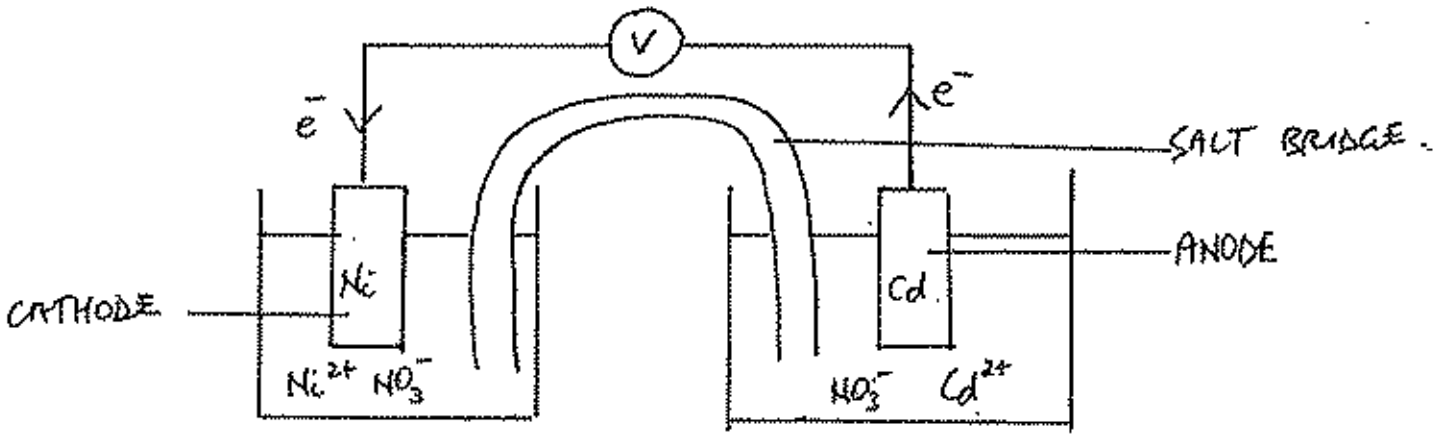
Question 28 (4 marks) **Marks**

An electrochemical cell is constructed from the following two half cells under standard conditions.

Half cell 1 : a nickel electrode in a solution of 1.0 M nickel nitrate

Half cell 2 : a cadmium electrode in a solution of 1.0 M cadmium nitrate

(a) Draw a labelled diagram of this electrochemical cell. **3**



(b) Given that the standard reduction potential of the cadmium half cell is -0.4V, show on your diagram the direction in which electrons will flow in the external circuit of this cell. **1**

Page Total

Student Number: .....

Question 29 (3 marks) **Marks**

An electrochemical cell is constructed from the following two half cells under standard conditions.

Half cell 1 : a copper electrode in a solution of 1.0 M copper nitrate
Half cell 2 : a lead electrode in a solution of 1.0 M lead nitrate

(a) Give the equation for the half reaction that takes place at the anode of this cell. **1**

$Pb_{(s)} \rightarrow Pb^{2+}_{(aq)} + 2e^-$

(b) Calculate the overall cell voltage of this cell. **2**

$Pb_{(s)} \rightarrow Pb^{2+}_{(aq)} + 2e^- \quad E^0 = 0.13V$

$Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)} \quad E = 0.34V$

$EMF = E_{OX} + E_{RED}$

$EMF = 0.13V + 0.34V$

$EMF = 0.47\ V$

Page Total

Student Number: .....

Question 30 (7 marks) **Marks**

The following table lists the pH of 0.10 M solutions of four different acids at 25°C.

Acid	pH
P	1.0
Q	3.0
X	0.7
Y	2.1

(a) Which acid **must** have more than one acidic hydrogen per molecule? Give a reason for your answer. 2

ACID X. If acid X was monoprotic it would have a pH of 1. Since the pH is less than 1.0, the $[H^+]$ must be greater than 0.1 M and the acid must be diprotic at least.

(b) Using the concentration and the pH of acid Y, calculate the percentage ionisation of acid Y in the 0.10 M solution. 1

$pH = 2.1$, $[H^+] = 10^{-2.1}$, $[H^+] = 7.94 \times 10^{-3}$

Fully ionised $[H^+] = 0.1$ $\therefore$ % IONISATION $= \frac{7.94 \times 10^{-3}}{0.1} \times \frac{100}{1}$

$= 7.94\%$

(c) Samples of the solutions of acids P and Y are diluted by a factor of 10.
The resulting **change in pH units** would be: 1
(Tick one of the following boxes).

greater for acid P than for acid Y	
greater for acid Y than for acid P	
the same for both acids	✓

Question 30 continues on page 19

Page Total

Question 30 (continued) **Marks**

(d) The dissociation of ethanoic acid in water is exothermic. If a solution of the acid is heated, will the pH of the solution **increase, decrease or remain constant?**
Give an explanation for your answer. Include an equation in your answer **3**

$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+ + ENERGY$

According to Le Chatelier heating the system will favour the REVERSE ENDOTHERMIC reaction as it ABSORBS ENERGY.

Re $[H_3O^+]$ would DECREASE ∴ the pH INCREASES.

Page Total

Student Number: .....

Question 31 (7 marks) **Marks**

(a) Explain why the presence of ozone in the upper atmosphere is beneficial to life on earth. **1**

OZONE ABSORBS HARMFUL U-V RADIATION.
This radiation if not absorbed would cause increased incidence of SKIN CANCER, EYE CATARACTS

(b) CFCs can lower the concentration of ozone in the upper atmosphere.

(i) Which element in the molecules of CFCs causes the destruction of the ozone molecule? **1**

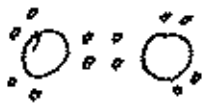
CHLORINE

(ii) Write an equation which shows how ozone is destroyed by this element. **1**

$O_3 + Cl\cdot \rightarrow ClO\cdot + O_2$

(c) (i) Using electron dot diagrams (Lewis diagrams), draw and label the oxygen molecule and the ozone molecule. Put a circle around the coordinate covalent bond. **2**

OXYGEN



OZONE

(ii) Referring to their structure and bonding, compare oxygen and ozone over one property. **2**

Melting or boiling point.
O_2 IS NON-POLAR ∴ ONLY DISPERSION FORCES between molecules. O_3 IS POLAR ∴ HAS DIPOLE/DIPOLE FORCES AS WELL AS DISPERSION FORCES hence O_3 has HIGHER m.p. and b.p. compared to O_2

Page Total

Student Number: .....

Question 32 (5 marks) **Marks**

"Some bulk water supplies are collected from valleys in wilderness areas, while others are collected from valleys surrounded by mixed farming lands. These different supplies require different levels of clarification and purification before they can be used for human consumption."

Assess this statement referring to the methods used for treatment of water supplies collected from these different environments. 5

Clarification involves removing any turbidity or colour so that the water is sparklingly clear and colourless. Water that is collected in wilderness areas needs far less clarification than that collected from valley surrounded by farming lands. Farming land water will need lime added to raise the pH then Fe^{3+} ions are added to form a precipitate and enable coagulation to occur. This takes most of the suspended matter out of the water which is then FILTERED through sand.

Water from both sources will need to be sanitised. This can be done by bubbling chlorine through the water to kill bacteria, or membrane filters could be used, but they are very expensive.

The statement is accurate as far more clarifying is needed in the case of the farmland water.

Page Total

Student Number: .....

Question 33 (6 marks) **Marks**

The accuracy of acid-base titrations depends on several factors. These include the primary standard used, how the glassware is prepared and how the equivalence point is determined.

(a) Explain why sodium hydroxide is not used as a primary standard. 1

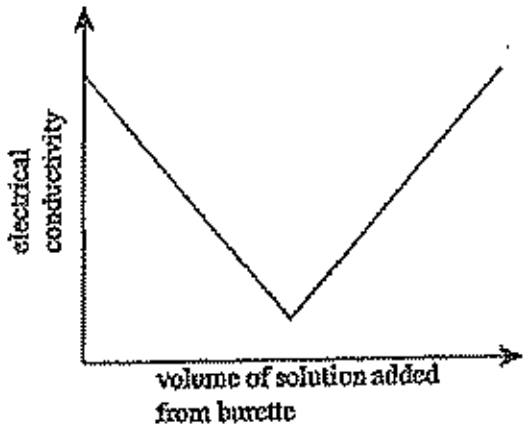
Its concentration does not remain constant as NaOH absorbs water from the atmosphere

(b) During a titration, a conical flask is prepared by rinsing it with distilled water. While this flask is still wet, a clean, dry pipette is used to transfer 20 mL of a standard solution into it. Will the accuracy of the titration be affected? Explain your answer. 1

NO:

The NUMBER OF MOLES of standard solution has not been changed by having some water in the conical flask.

(c) Although an indicator can be used to determine the equivalence point of an acid-base titration, an alternative method is to monitor the electrical conductivity of the reaction mixture during the titration. The following graph shows the variation in electrical conductivity during such titration.



Explain why the electrical conductivity:

(i) starts at a maximum but then decreases to a minimum value. 2

Initially there is a maximum number of IONS, ∴ high conductivity. As salt and water form IONS are REMOVED SO CONDUCTIVITY DECREASES.

Question 33 continues on page 23

Page Total

Question 33 (continued) **Marks**

(ii) does not reach a zero value. **1**

THERE ARE STILL IONS IN SOLUTION (DISSOLVED NaCl).

$HCl + NaOH \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

(iii) starts to increase again after the minimum value. **1**

The extra acid (OR BASE) that is added will provide more IONS so conductivity will INCREASE.

Page Total

Student Number: .....

Question 34 (8 marks) **Marks**

Ethylene is an important resource for chemical industries. It is formed by industrial processes from the components of crude oil (a mixture of alkanes).

(a) Outline the industrial processes used to convert crude oil into ethylene. Include an equation for the conversion of an alkane into ethylene by one of these industrial processes. **3**

FRACTIONAL DISTILLATION: CRUDE OIL IS HEATED IN A FRACTIONATING COLUMN AND VARIOUS HYDROCARBONS CONDENSE AT SPECIFIC TEMPERATURES AND CAN BE COLLECTED.

CATALYTIC CRACKING: LONGER CHAIN HYDROCARBONS ARE BROKEN INTO SMALLER MOLECULES

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

(b) Ethanol can be formed from ethylene. Describe how this conversion is achieved and write an equation for the chemical reaction you describe. **2**

ETHYLENE IS HYDRATED IN THE PRESENCE OF DILUTE SULFURIC ACID

$C_2H_4 + H_2O \xrightarrow[H_2SO_4]{\text{DILUTE}} C_2H_5OH$

Question 34 continues on page 25

Page Total

Question 34 (continued) **Marks**

(c) Ethylene can be distinguished from ethane by a simple laboratory test. Describe how this test is carried out and its results and include balanced equations for chemical reactions which occur in both the dark and in the light.. Name the product formed. 3

ETHYLENE C_2H_4 is bubbled through some BROMINE water and the ORANGE/BROWN colour of BROMINE becomes COLOURLESS. $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$

1,2 - DIBROMOETHANE.

The above reaction occurs in both the dark + light.

ETHANE C_2H_6 is BUBBLED THROUGH some BROMINE water in the dark and no colour change is OBSERVED. However the ethane bubbled through bromine water in the PRESENCE OF LIGHT causes the BROMINE water to DECOLOURISE after a while.

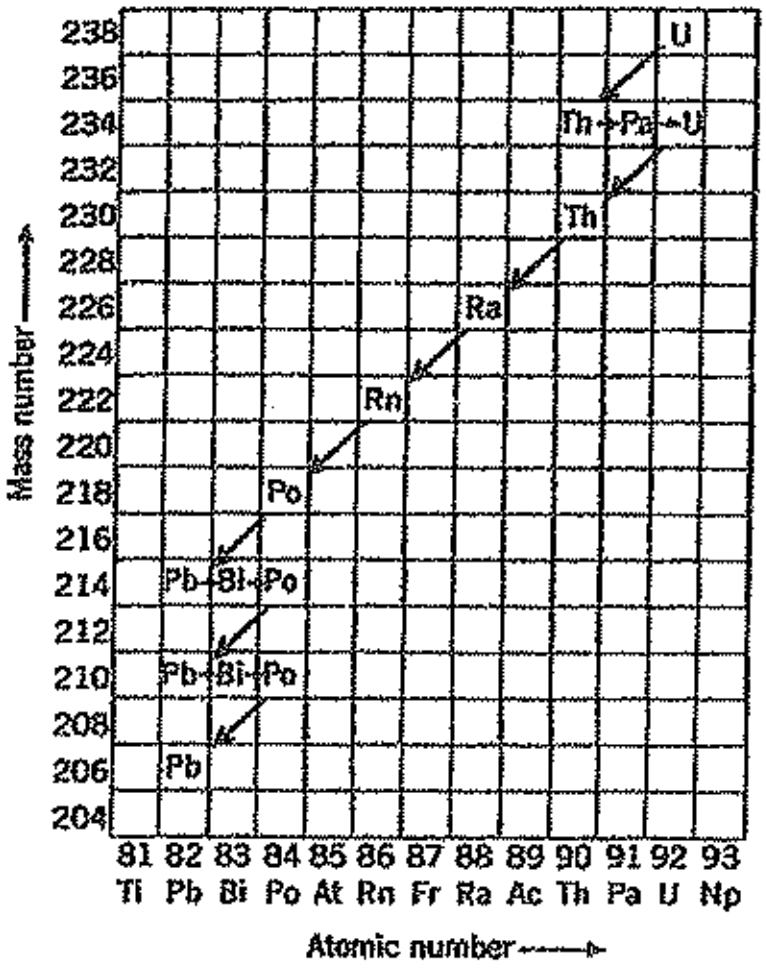
$C_2H_6 + Br_2 \xrightarrow[\text{LIGHT}]{UV} C_2H_5Br + HBr$

Page Total

Student Number: .....

Question 35 (2 marks) **Marks**

Uranium is a radioactive element that slowly undergoes decay.



Using the flow diagram shown above, trace the sequence of fission products during the decay of uranium for the steps Pa (Protactinium) to Th (Thorium) Th-230.
(Include the two equations.) 2

$^{234}_{91}Pa \longrightarrow {}^{234}_{92}U + {}^{0}_{-1}e$

$^{234}_{92}U \longrightarrow {}^{230}_{90}Th + {}^{4}_{2}He$

Page Total

Student Number: .....

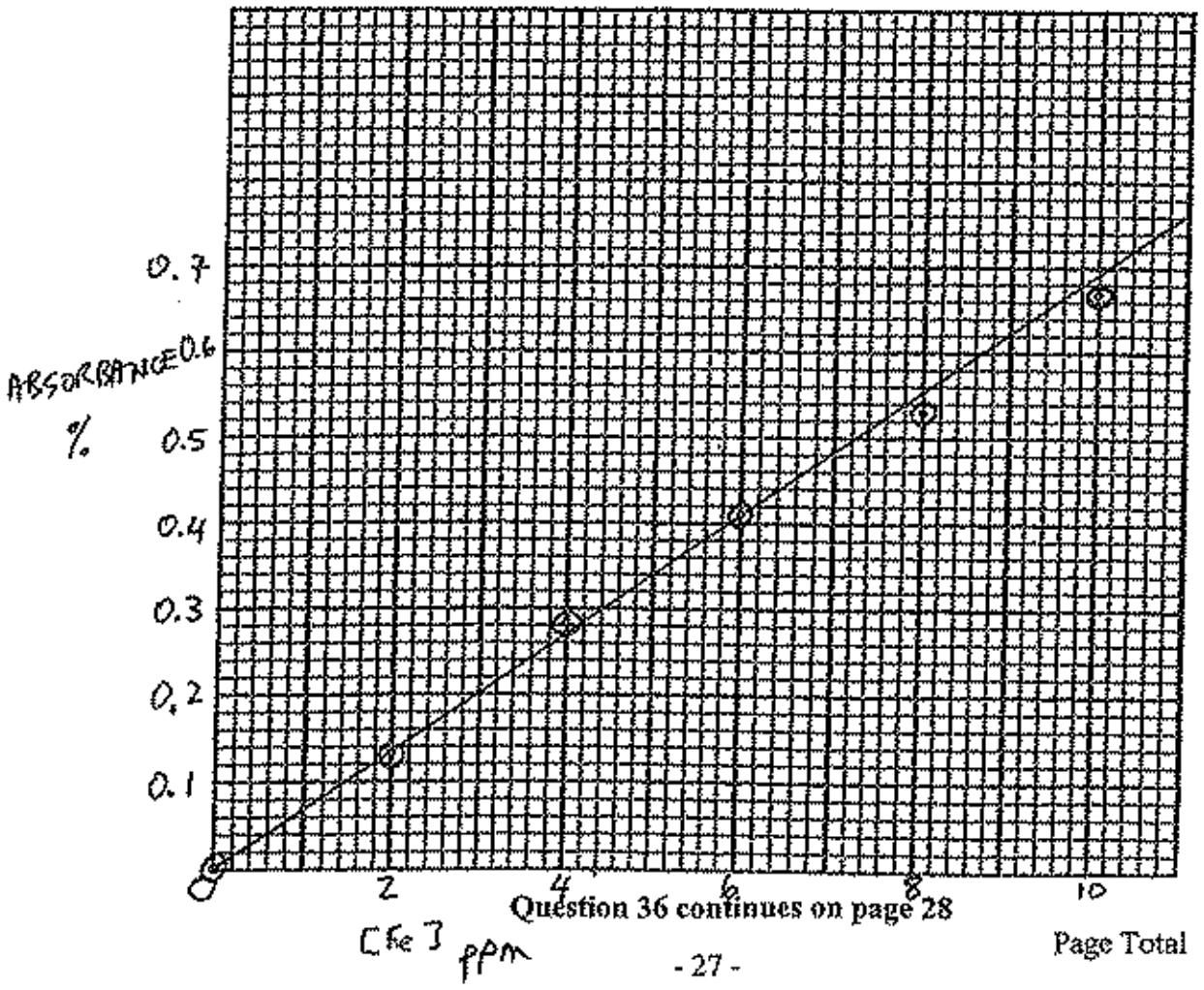
Question 36 (3 marks) **Marks**

Railways often test the cooling water of their diesel engines for dissolved metals. The presence of particular metal ions in the water gives an indication as to the "health" of the engine. The most commonly used method for this analysis is atomic absorption spectroscopy.

In one particular analysis a chemist was testing for the presence of iron. She used a series of standard solutions to obtain the following results.

Concentration of Fe (ppm)	Absorbance (%)
0	0.00
2	0.13
4	0.28
6	0.41
8	0.53
10	0.67

(a) Draw a calibration graph of these results. 2



Question 36 continues on page 28

Page Total

Question 36 (continued) **Marks**

The chemist then tested the water from three engines.

For each engine she placed 50 mL of sample in a 1000 mL standard flask. The flask was then filled to the mark with distilled, deionised water and shaken to ensure mixing. She then tested each of the diluted samples and obtained the following results.

Engine Number	Absorbance (%)
X12	0.04
X45	0.01
X67	0.30

(b) Calculate the concentration of iron in the original sample from engine X67. **1**

DILUTED SAMPLE 4.4 ppm is the concentration of Fe.

DILUTED 20X so [Fe] IN ORIGINAL SAMPLE 20×4.4

$= 88 ppm.$

OR $C_1V_1 = C_2V_2$

$C_1 \times 50 = 4.4 \times 1000$

$C_1 = \frac{4.4 \times 1000}{50}$

$C_1 = 88 ppm.$

End of Paper

Page Total