

Student Number:

2006

HIGHER SCHOOL CERTIFICATE
Sample Examination Paper

CHEMISTRY

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- A data sheet and Periodic Table are provided with this paper
- Write your student number at the top of this page

Total Marks – 100

Section I

75 marks

Part A – 15 marks

- Attempt Questions 1–15
- Allow about 30 minutes for this part

Part B – 60 marks

- Attempt Questions 16–22
- Allow about 1 hour and 45 minutes for this part

Section II

25 marks

- Attempt ONE question from Questions 23–27
- Allow about 45 minutes for this section

Directions to school or college

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Section I

75 marks

Allow about 2 hours and 15 minutes for this section

This section has TWO parts

Part A – 15 marks Questions 1–15

Part B – 60 marks Questions 16–22

Part A

15 marks

Select the alternative A, B, C, or D that best answers the question. Fill in the response sheet clearly.

1	X			
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If you think you have made a mistake, blank out the incorrect answer and fill in the new answer.

1	X			X
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If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word *correct* and drawing an arrow.

1	X			X
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Correct →

Section I – 75 marks**Part A – 15 marks****Attempt Questions 1–15****Allow about 30 minutes for this part**

Use the multiple choice answer sheet provided.

-
- 1 Which of the following is present in an alkene hydrocarbon?
- A branched carbon chain
 - B C to C double bond
 - C monomer group
 - D hydroxyl group on the terminal C atom
- 2 Which of the following is a condensation polymer?
- A cellulose
 - B polypropylene
 - C teflon
 - D PVC
- 3 Which of the following statements correctly describes a redox reaction?
- A The oxidation half-reaction and the reduction half-reaction occur simultaneously.
 - B The oxidation half-reaction occurs before the reduction half reaction.
 - C The oxidation half-reaction occurs after the reduction half-reaction.
 - D The oxidation half-reaction occurs spontaneously but the reduction half-reaction does not.
- 4 Which of the substances listed below functions as the electrolyte in a lead-acid automobile battery?
- A PbO_2
 - B PbSO_4
 - C H_2SO_4
 - D H_2O
- 5 Of the following statements, which would predict that a particular isotope of an element is radioactive?
- A The atomic number of the element is 15 and its neutron to proton ratio is equal to about 1.
 - B The atomic number of the element is 50 and its neutron to proton ratio is equal to about 1.3.
 - C The atomic number of the element is 80 and its neutron to proton ratio is less than 1.
 - D The atomic number of the element is greater than 83.

- 6 The radioactive isotope cobalt-60 is used in the treatment of cancer. Which property of the isotope makes it useful for this purpose?
- A Disintegrates by β -emission
 - B Produces γ -rays that can penetrate deeply into body tissues
 - C Is a radioactive isotope that has a half life of only a few hours
 - D Emits radiation that will kill cancer cells and not harm normal cells

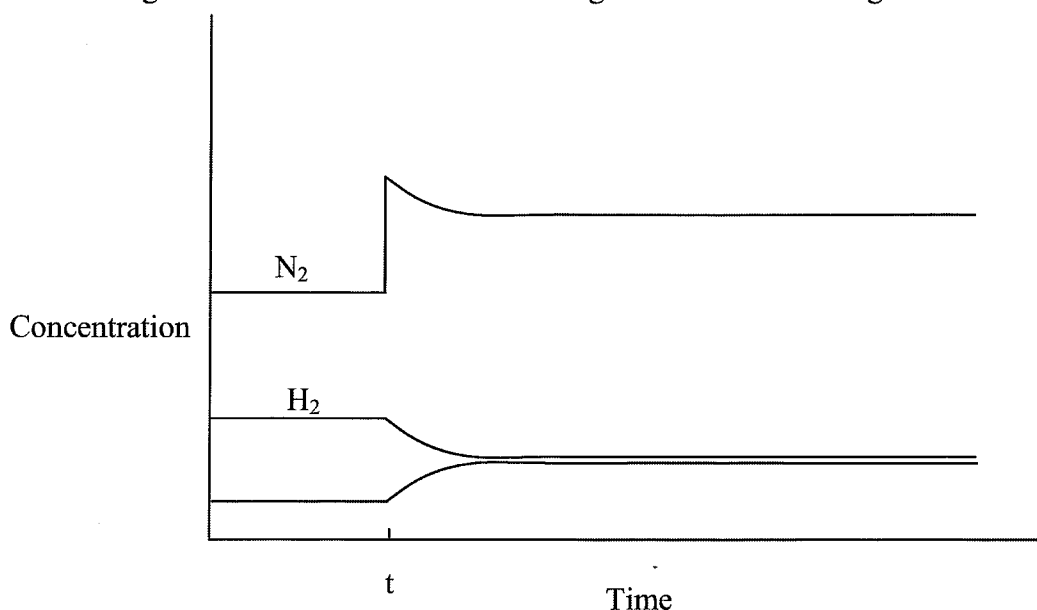
- 7 The hydronium ion concentration (in mol L^{-1}) of some common substances is given in the Table below

$[\text{H}_3\text{O}^+]$	Substance
10^{-9}	baking soda
10^{-5}	black coffee
10^{-8}	sea water
10^{-11}	laundry detergent
10^{-6}	milk
10^{-13}	chlorine bleach
10^{-4}	soda water

Of the substances listed which of the following are acidic?

- A soda water and chlorine bleach
 - B milk and laundry detergent
 - C sea water and baking soda
 - D black coffee and milk
- 8 In the equilibrium
- $$\text{N}_2\text{H}_5^+(\text{aq}) + \text{SCN}^-(\text{aq}) \rightleftharpoons \text{HSCN}(\text{aq}) + \text{N}_2\text{H}_4(\text{aq})$$
- A N_2H_5^+ acts as an acid
 - B SCN^- acts as an acid
 - C HSCN acts as a base
 - D N_2H_4 acts as an acid
- 9 Which statement best describes a weak acid solution?
- A There are no neutral acid molecules present.
 - B Only a fraction of the acid molecules is ionised.
 - C All acid present is ionised to hydrogen ions.
 - D The total concentration of acid molecules present is high.
- 10 In the process of esterification the reactant alcohol and acid mixture is refluxed. What is the purpose of refluxing the mixture?
- A Speed up the reaction
 - B Prevent the loss of alcohol as the reactant mixture is heated
 - C Remove the water produced as a product of the reaction
 - D Force the reaction to come to equilibrium

- 11 An equilibrium mixture between nitrogen, hydrogen and ammonia was subjected to a change at time t . The result of this change is shown in the diagram below.



- What was the change made to the equilibrium mixture at time t ?
- The pressure in the equilibrium mixture of nitrogen and hydrogen was decreased.
 - The temperature of the reaction mixture was raised.
 - The concentration of nitrogen gas in the equilibrium mixture was increased.
 - The volume of the reaction vessel was increased.
- 12 The technique of atomic absorption spectroscopy (AAS) is widely used. For which of the following measurements would AAS be used?
- concentration of ozone in the upper atmosphere
 - amount of dissolved oxygen in a water sample
 - phosphate concentration in water quality analysis
 - concentration of metal ions in solution
- 13 Which is a simple test that can be used to test for the presence of carbonate ions in water?
- volatilising the solution in a flame
 - addition of silver nitrate to the solution
 - addition of a weak acid to the solution
 - addition of ammonia to the solution
- 14 Oxygen and ozone differ in their molecular structure and bonding. The difference in bonding structure is reflected in different properties. How can the two molecules be distinguished?
- a difference in reactivity
 - the colour of the gases at room temperature
 - the presence of covalent bonds in one but not the other

D oxygen having a higher boiling point than ozone

15 Which of the following halogen-containing compounds is NOT a source of ozone-destroying atoms in the stratosphere?

- A CCl_4
- B CH_2FCF_3
- C CCl_2F_2
- D CBrClF_2

Section I (continued)**Part B – 60 marks****Attempt Questions 16–22****Allow about 1 hour and 45 minutes for this part**

Answer the questions in the spaces provided.

Show all relevant working in questions involving calculations.

Marks**Question 16 (14 marks)**

- (a) (i) The reaction of ethylene with water is an important industrial process. Write a balanced equation for this reaction.

1

- (ii) Give the experimental conditions required for the reaction in (i).

1

- (b) (i) Three commercially significant monomers used in the manufacture of polymers are given in the Table below. Write the structure of each of these monomers and give the names of the polymers formed from each of these monomers.

3

Monomer	Structure of Monomer	Name of Polymer
ethylene		
chloroethylene		
phenylethylene		

- (ii) Each of the polymers in (i) are called addition polymers. What does the term imply in regard to the polymerisation process?

2

- (iii) What types of intermolecular forces would you expect between the polymers formed from ethylene?

1

Question 16 cont.

- (c) (i) Define the term 'biopolymer'.

1

- (ii) What is the major chemical component of biomass?

1

- (d) Ethanol has been proposed as an alternative fuel. Give TWO advantages and TWO disadvantages of its use as a fuel.

4

Question 17 (11 marks)

- (a) (i) From the Table of Standard Potentials, select TWO metals that will reduce hydrogen ions to hydrogen gas.

1

- (ii) Using one of the metals in part (i) write oxidation and reduction half reactions for the reaction which occurs.

2

- (iii) Write a balanced overall cell equation for the redox reaction.

1

Marks

Question 17 cont.

- (b) (i) Sketch and label a diagram showing the structure of a silver oxide 'button' cell. Mark in your diagram the positive and negative terminals of the cell. 5

- (ii) Write the balanced overall cell reaction for the silver oxide 'button' cell. 2

Question 18 (8 marks)

A student wished to determine the percentage of calcium carbonate present in a shell found at the beach. The clean dry shell, which weighed 1.306 g, was placed in a small beaker and 10 mL of 5 mol L^{-1} of hydrochloric acid was added. When the shell had completely dissolved, the resulting solution was transferred to a volumetric flask and the volume made up to 25 mL with distilled water. A 10 mL sample from this solution required 11.2 mL of 1 mol L^{-1} sodium hydroxide for complete neutralisation.

All working, for parts (b) to (e) of this question, should be shown.

- (a) Write a balanced equation for the reaction of calcium carbonate with hydrochloric acid. 1

- (b) Calculate the number of moles of NaOH present in the 11.2 mL of 1 mol L^{-1} NaOH solution. 1

- (c) How many moles of acid remained in the beaker after the reaction with the shell (before the dilution was made)? 2

Question 18 cont.

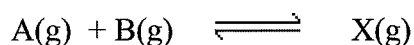
(d) How many moles of acid reacted with the shell?

1

(e) What mass of calcium carbonate was present in the shell?

2

(f) What was the percentage of calcium carbonate in the shell?

1**Question 19 (8 marks)**

When two gases, A and B, are reacted, partial conversion to product X occurs according to the equation above. The following data provide information about the percentage composition of the gaseous mixture at equilibrium under various conditions.

At constant pressure:

Temperature (°C)	100	200	300	400	500
Percentage of X in the mixture	50	35	23	14	8

At constant temperature:

Pressure (MPa)	5	10	15	20	25
Percentage of X in the mixture	12	18	25	34	44

(a) From the above data, is the formation of X from A and B endothermic or exothermic? Briefly explain your answer.

2

Marks**Question 19 cont.**

- (b) From the data above, does the volume increase, decrease or remain the same when A and B react to form X? Explain your answer. **2**

- (c) State qualitatively what combination of temperature and pressure conditions (i.e. high or low) would give the highest percentage of X at equilibrium. **2**

Temperature: _____

Pressure: _____

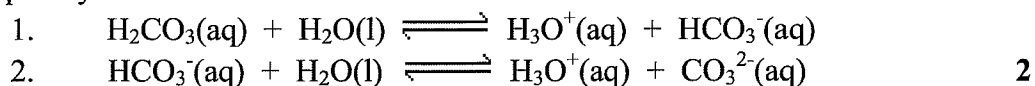
- (d) Suggest a means of increasing the amount of product in this reaction other than by altering the temperature or pressure. Explain your answer. **2**

Marks

Question 20 (10 marks)

- (a) (i) Define acids and bases according to the Bronsted-Lowry theory. 2

- (ii) In the following two reactions, state whether HCO_3^- behaves as an acid or a base. Explain your answer in each case.



- (b) The pH of a 0.001 mol L^{-1} solution of hydrochloric acid and the pH of a 0.056 mol L^{-1} of ethanoic acid is 3.
 (i) Compare the concentration of each acid. Explain your answer. 2

- (ii) Compare the strength of each acid. Explain your answer. 2

- (iii) Compare the hydrogen ion concentration in the solutions of each acid. Explain your answer. 2

Marks**Question 21 (4 marks)**

- (a) Write the formula for ozone and note the type of bond(s) found in the molecule. **2**

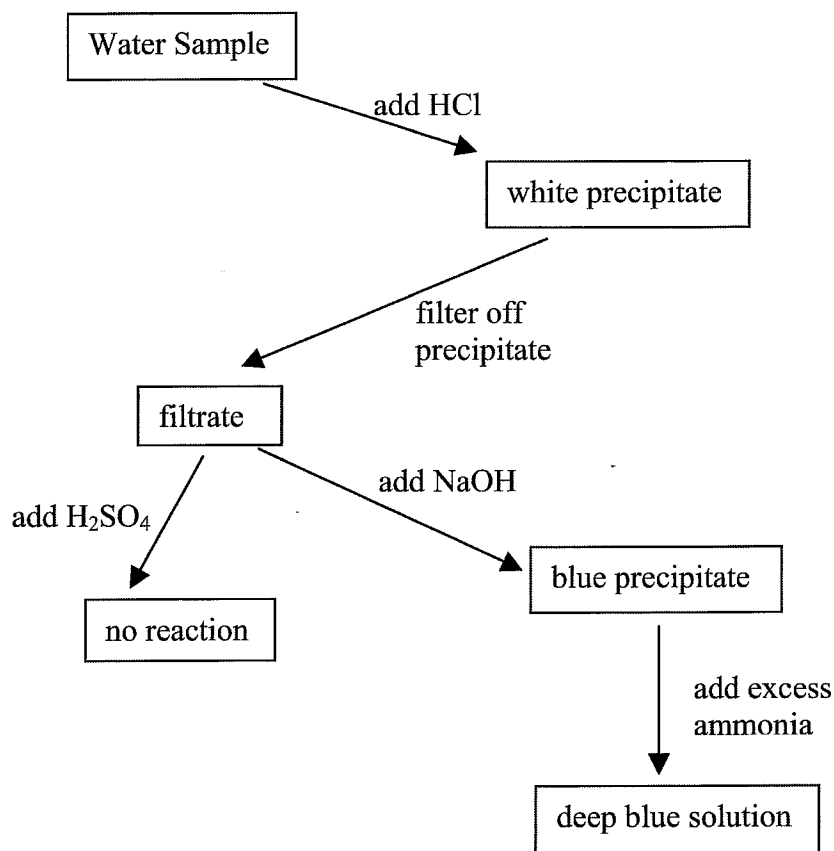
- (b) Explain why ozone in the stratosphere is beneficial to humans. **2**

Question 22 (5 marks)

- (a) It was suspected that the water in a river was being contaminated by sewage. What test(s) would you use to check for sewage pollution downstream from the point of suspected discharge? Explain what answer you would expect from the test(s) if the water was indeed polluted by sewage. **2**

Question 22 cont.

- (b) A chemist performed the tests shown in the flow chart below to determine the cation(s) present in a water sample.



- (i) What cation(s) is/are present in the solution?

1

- (ii) Write balanced chemical equations for the FIRST TWO reactions in the flow chart sequence.

2

End of Section I

Section II – 25 marks**Attempt ONE question from Questions 23–27****Allow about 45 minutes for this section**

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

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Question 23 – INDUSTRIAL CHEMISTRY (25 marks)

- (a) N_2O_4 , a colourless gas, and NO_2 , a brown gas, exist in equilibrium as follows
- $$2\text{NO}_2(\text{g}) \rightleftharpoons \text{N}_2\text{O}_4(\text{g})$$
- A closed container at 25°C is charged with NO_2 and N_2O_4 at partial pressures of 0.56 atm and 0.51 atm respectively. At equilibrium the partial pressure of N_2O_4 is found to be 0.54 atm.
- (i) Write the equilibrium expression for the reaction. 1
- (ii) What is the value of K_p for the equilibrium? 3
- (b) Sulfuric acid is one of the world's most widely used chemicals. It is produced industrially by the so called Contact Process. Sulfur dioxide, air and water are the main feedstocks in its production.
- (i) Why is the production process called the Contact Process? 1
- (ii) The sulfur dioxide for the Contact Process is usually obtained from the combustion of sulfur. Write a balanced equation for the combustion of sulfur. 1
- (iii) What reaction conditions will maximise the yield of sulfur trioxide in the Contact Process? 3
- (iv) Sulfuric acid is an oxidising agent. Describe, with a balanced equation, sulfuric acid being used in the oxidation of copper(II) metal. 2
- (v) What are the safety precautions necessary for the transport and storage of concentrated (98%) sulfuric acid? Explain the reasons for the precautions you specify. 3
- (c) The process for the manufacture of sodium carbonate is called the Solvay Process.
- (i) The first stage of the Solvay Process involves the saturation of concentrated NaCl with NH_3 and the bubbling of CO_2 through this solution to produce NaHCO_3 . What volume of carbon dioxide (measured at RTP) is required per tonne of sodium hydrogen carbonate produced by the Solvay Process? 3
- (ii) What is the only waste product in the Solvay Process and how can this waste be disposed of from plants remote from oceans or waterways? 2
- (d) (i) Describe how a saponification reaction can be carried out in the school laboratory. 3
- (ii) Soaps are often called surfactants or 'surface active agents'. Explain. 2
- (iii) What is the major environmental concern with the use of washing powders and liquids? 1

Marks**Question 24 – SHIPWRECKS, CORROSION and CONSERVATION (25 marks)**

- | | | | |
|-----|-------|---|---|
| (a) | (i) | The electrodes in an electrolytic cell are given the names anode and cathode. What processes occur at the surface of these electrodes in electrolysis? | 2 |
| | (ii) | List three factors that can affect the products that are formed in an electrolysis reaction. | 3 |
| | (iii) | Describe the major achievement of Michael Faraday in the field of electrochemistry. | 1 |
| (b) | (i) | How does the solubility of a gas in water change with change in temperature, a change in pressure and a change in salinity? | 3 |
| | (ii) | Outline an experiment you have performed to compare the effect of varying salinity on the rate of corrosion of a material. | 3 |
| (c) | (i) | Describe the mechanism of corrosion of iron. | 4 |
| | (ii) | How is the galvanic corrosion of iron affected by pH? | 1 |
| | (iii) | Explain how coating the surface of iron with zinc can offer protection from corrosion. Include in your explanation the equation that describes this protection. | 4 |
| | (iv) | From the oxygen and temperature conditions in the deep ocean it would be predicted that the rate of corrosion of a sunken iron ship would be fairly slow. However, from observation of wrecks it is found that corrosion is more extensive than expected. Explain this observation. | 1 |
| (d) | | The first stage of restoration of ancient wooden ships raised from the ocean floor is spraying with fresh water. This stage of restoration can often last for many years. Explain the purpose of this prolonged exposure to water and describe what would have happened if this procedure had not been carried out as a first stage of restoration. | 3 |

Question 25 – THE BIOCHEMISTRY OF MOVEMENT (25 marks)

- (a) (i) Even though the general formula for glucose, galactose and fructose is $C_6H_{12}O_6$ the molecules are structurally different. What are the differences in structure? 3
- (ii) Cellulose and starch are both polymers of glucose. They are found, however, to have different properties. Explain. 2

(b) The Table below shows some characteristics of saturated fatty acids.

Name of Acid	Formula	Melting Point ($^{\circ}C$)
lauric acid	$CH_3(CH_2)_{10}COOH$	44
palmitic acid	$CH_3(CH_2)_{14}COOH$	63
stearic acid	$CH_3(CH_2)_{16}COOH$	70

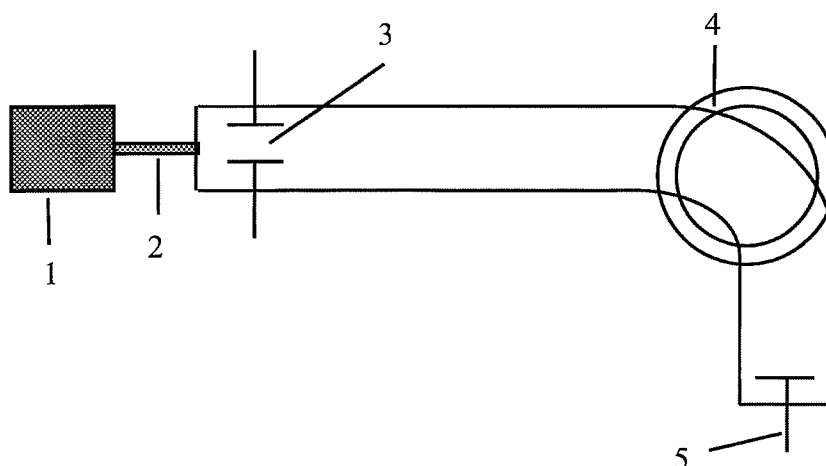
- Explain the trend in melting point of these fatty acids. 2
- (c) (i) Amino acids are the building blocks of protein molecules. Write the general formula for an amino acid and identify and name the functional groups present. 2
- (ii) Proteins can be denatured, particularly by heating. What does the term 'denaturation' mean? 2
- (d) (i) Adenosine triphosphate (ATP) is sometimes known as the 'energy currency' of the cell. Explain. 2
- (ii) In what organelle of the cell are the enzymes and electron carriers associated with cellular respiration found? 1
- (e) (i) What are the four major proteins found in muscle and to what structures within muscle do these proteins contribute? 3
- (ii) State an important structural difference between Type 1 and Type 2 muscle cells. 1
- (iii) Compare the primary fuel usage for metabolism by athletes in sprint events with that of athletes in endurance events. 3
- (iv) Explain the relationship between production of lactic acid and impairment of muscle function. 3
- (v) What is the IUPAC name for lactic acid? 1

Marks**Question 26 – THE CHEMISTRY OF ART (25 marks)**

- | | | |
|-----|---|---|
| (a) | How is a canvas prepared for painting before the application of pigments? | 2 |
| (b) | (i) The flame test is regularly used to identify metals in solution. Discuss the theory behind the test. | 3 |
| | (ii) What is meant by the term 'line absorption spectra' and why is it important in the conservation of art? | 3 |
| (c) | What are the fundamental ideas in the Bohr theory of the atom? What are the limitations of the Bohr theory? | 3 |
| (d) | How are X-rays used in art conservation? | 3 |
| (e) | (i) What is the electronegativity of an atom and what are the trends in electronegativity across a Period and down a Group in the Periodic Table? | 3 |
| | (ii) Discuss the principal factors that influence the ionisation energy of an atom. | 3 |
| (f) | (i) Compare the electron configuration of the transition elements with that of the main Group elements. | 2 |
| | (ii) Name two properties of transition metal ions that can be largely explained by the presence of partially filled d shells. | 3 |

Question 27 – FORENSIC CHEMISTRY (25 marks)

- (a) (i) The first step in determining the structure of a protein is to hydrolyse the bonds between the amino acids. Describe how electrophoresis can be used to separate and identify the amino acids. 4
- (ii) How can DNA be used to identify relationships between individuals? 2
- (iii) Briefly discuss any ethical issues associated with the maintenance of data banks of DNA. 2
- (b) Describe the structure of a nucleic acid, using the genetic material deoxyribonucleic acid (DNA) as an example. 5
- (c) One of the monosaccharides from which sucrose is formed is α -glucose.
- (i) What is meant by the term 'monosaccharide'? 3
- (ii) Name the other monosaccharide (apart from α -glucose) from which sucrose is formed. 1
- (d) Below is a schematic diagram of a mass spectrometer. What are the functions of the numbered parts of the spectrometer? 5



- (e) In what way have the various methods of spectroscopy contributed to forensic science? Give one example. 3

End of Section II

DATA SHEET

Avogadro constant, N_A	$6.022 \times 10^{23} \text{ mol}^{-1}$
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	$4.18 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$

Some useful formulae

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

Some standard potentials

$\text{K}^+ + \text{e}^-$	\rightleftharpoons	K(s)	-2.94 V
$\text{Ba}^{2+} + 2\text{e}^-$	\rightleftharpoons	Ba(s)	-2.91 V
$\text{Ca}^{2+} + 2\text{e}^-$	\rightleftharpoons	Ca(s)	-2.87 V
$\text{Na}^+ + \text{e}^-$	\rightleftharpoons	Na(s)	-2.71 V
$\text{Mg}^{2+} + 2\text{e}^-$	\rightleftharpoons	Mg(s)	-2.36 V
$\text{Al}^{3+} + 3\text{e}^-$	\rightleftharpoons	Al(s)	-1.68 V
$\text{Mn}^{2+} + 2\text{e}^-$	\rightleftharpoons	Mn(s)	-1.18 V
$\text{H}_2\text{O} + \text{e}^-$	\rightleftharpoons	$\frac{1}{2}\text{H}_2(\text{g}) + \text{OH}^-$	-0.83 V
$\text{Zn}^{2+} + 2\text{e}^-$	\rightleftharpoons	Zn(s)	-0.76 V
$\text{Fe}^{2+} + 2\text{e}^-$	\rightleftharpoons	Fe(s)	-0.44 V
$\text{Ni}^{2+} + 2\text{e}^-$	\rightleftharpoons	Ni(s)	-0.24 V
$\text{Sn}^{2+} + 2\text{e}^-$	\rightleftharpoons	Sn(s)	-0.14 V
$\text{Pb}^{2+} + 2\text{e}^-$	\rightleftharpoons	Pb(s)	-0.13 V
$\text{H}^+ + \text{e}^-$	\rightleftharpoons	$\frac{1}{2}\text{H}_2(\text{g})$	0.00 V
$\text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	$\text{SO}_2(\text{aq}) + 2\text{H}_2\text{O}$	0.16 V
$\text{Cu}^{2+} + 2\text{e}^-$	\rightleftharpoons	Cu(s)	0.34 V
$\frac{1}{2}\text{O}_2(\text{g}) + \text{H}_2\text{O} + 2\text{e}^-$	\rightleftharpoons	2OH^-	0.40 V
$\text{Cu}^+ + \text{e}^-$	\rightleftharpoons	Cu(s)	0.52 V
$\frac{1}{2}\text{I}_2(\text{s}) + \text{e}^-$	\rightleftharpoons	I^-	0.54 V
$\frac{1}{2}\text{I}_2(\text{aq}) + \text{e}^-$	\rightleftharpoons	I^-	0.62 V
$\text{Fe}^{3+} + \text{e}^-$	\rightleftharpoons	Fe^{2+}	0.77 V
$\text{Ag}^+ + \text{e}^-$	\rightleftharpoons	Ag(s)	0.80 V
$\frac{1}{2}\text{Br}_2(\text{l}) + \text{e}^-$	\rightleftharpoons	Br^-	1.08 V
$\frac{1}{2}\text{Br}_2(\text{aq}) + \text{e}^-$	\rightleftharpoons	Br^-	1.10 V
$\frac{1}{2}\text{O}_2(\text{g}) + 2\text{H}^+ + 2\text{e}^-$	\rightleftharpoons	H_2O	1.23 V
$\frac{1}{2}\text{Cl}_2(\text{g}) + \text{e}^-$	\rightleftharpoons	Cl^-	1.36 V
$\frac{1}{2}\text{Cr}_2\text{O}_7^{2-} + 7\text{H}^+ + 3\text{e}^-$	\rightleftharpoons	$\text{Cr}^{3+} + \frac{7}{2}\text{H}_2\text{O}$	1.36 V
$\frac{1}{2}\text{Cl}_2(\text{aq}) + \text{e}^-$	\rightleftharpoons	Cl^-	1.40 V
$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^-$	\rightleftharpoons	$\text{Mn}^{2+} + 4\text{H}_2\text{O}$	1.51 V
$\frac{1}{2}\text{F}_2(\text{g}) + \text{e}^-$	\rightleftharpoons	F^-	2.89 V

PERIODIC TABLE OF THE ELEMENTS

KEY		Atomic Number		Symbol of element		Name of element	
79	Au	197.0	Gold				
1	H	1.008	Hydrogen				
3	Li	6.941	Lithium				
4	Be	9.012	Beryllium				
11	Na	22.99	Sodium				
12	Mg	24.31	Magnesium				
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	65.39	Zinc				
31	Ga	69.72	Gallium				
32	Ge	72.61	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	[98.91]	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	Cesium				
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	[210.0]	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	Ds	[262.1]	Dubnium				
106	Sg	[263.1]	Seaborgium				
107	Bh	[264.1]	Bohrium				
108	Hs	[265.1]	Hassium				
109	Mt	[268]	Meitnerium				
110	Uun	—	Ununithium				
111	Uuu	—	Unununium				
112	Uub	—	Ununbium				
113	Uuq	—	Ununquadium				
114	Uuh	—	Ununhexium				
115	—	—	—				
116	—	—	—				
117	—	—	—				
118	Uuo	—	Ununoctium				

Lanthanides

57	La	138.9	Lanthanum
58	Ce	140.1	Cerium
59	Pr	140.9	Praseodymium
60	Nd	144.2	Neodymium
61	Pm	[146.9]	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	[239.1]	Plutonium
95	Am	[241.1]	Americium
96	Cm	[244.1]	Curium
97	Bk	[249.1]	Berkelium
98	Cf	[252.1]	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 .