ESSENTIAL

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NATIONAL 5

CHEMISTRY

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Barry McBride

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Practice Questions

Area	Key area	Multiple choice (1 mark)	Structured questions					Check
			Knowledge and understanding (1–12 marks)		Problem solving (1–3 marks)	Based on experimental work (1–4 marks)	Scientific literacy (1 mark)	
Rates of reaction	Rates of reaction	1, 2, 3	4a–d, 5a–d, 6a–d, 7a–b, 8d, 9c, 9e, 10a–b, 11a–c, 12a–b			8a–c, 8e, 9a–b, 9d, 12c		74
Atomic structure and bonding related to properties of materials	Atomic structure	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	12a–d, 13a–e, 14a–d, 15a–b, 16a–b, 17a–b					62
Covalent bonding	Covalent bonds		1a–c, 2a–c, 3a–b, 4a–b			3c		67
	Ionic bonding		1a–d, 2a–d, 3, 4a–d, 5a–d					
	Properties of substances	2	1a–b, 4a–b, 5c, 6a–c, 8a–b		3, 5a, 7	5b		
Formulae and reaction quantities	Chemical formulae	8	1a–f, 2a–f, 3a–f, 4a–f, 5a–f, 6a–f, 7a–f					43
Calculations involving the mole and balanced equations	Balancing equations	1	2a–l				3a–f	93
	The mole		1a–h, 2a–f, 3a–f, 4a–f, 5a–f, 6, 7, 8, 9					
Percentage composition	Percentage composition		1, 2, 3, 4, 5, 6, 7					21
Acids and bases	Acids and bases		1, 2a–c, 3, 4, 5, 6b		6a			25
Neutralisation reactions	Neutralisation reactions		1a, 2a–f, 3a–c, 4a–c, 5a–c			1b–c		56
	Titrations					1a–c, 2a–d, 3a–c, 4a–c, 5a–b, 6a–d		
Homologous series	Alkanes		1a–d, 2, 4a–b	3a–d				93
	Alkenes	3	1a–c, 2, 5a–b	4a–d				
	Cycloalkanes		1a–c, 2, 5a–f	3a–d, 4a–c				
	Addition reactions	4	1, 2a, 3a–c, 5a–d, 6a–c	7b	2b, 7a			
	Naming branched hydrocarbons		1, 2a–g, 3a–g					
	Isomers	1	3a	2, 4	3b			

Area	Key area	Multiple choice (1 mark)	Structured questions					Check
			Knowledge and understanding (1–12 marks)		Problem solving (1–3 marks)	Based on experimental work (1–4 marks)	Scientific literacy (1 mark)	
Everyday consumer products	Alcohols		1a–c, 2, 4a–b, 5a–b	3a–d, 5c				☐ 96
	Carboxylic acids		1a–c, 2, 4a–b, 5a–b, 6a–c	3a–d	5c–d			
	Energy from fuels	1, 2	3c, 4, 5, 6, 7a–d	3b	3a			
Metals	Metallic bonding and reactions of metals	2, 3	1a–c, 4a–c, 5c, 6a	5a	6b		5b	☐ 23
Redox	Redox		1a–f, 2a–d, 3a–e, 4b	4a	4c			☐ 35
	Extraction of metals	1	2a–c, 4a–c	3d, 4d	3a–c			
Electrochemical cells		1, 3, 4	2	5b	5a			☐ 7
Plastics		1	2a, 3a–c, 4a–c, 5a–b, 6b	2b, 6a				☐ 14
Fertilisers		1	2a–b, 2d, 3a, 3c, 4a–b, 4e, 5a–c	2cii, 3b, 6a–c	2ci, 4c–d, 5d			☐ 36
Radioactivity and half-life		1	2a–b, 4a–j, 6a, 7a	2c, 3a–b, 5a–d, 6b, 7b–c				☐ 32

Practice Paper 1

Paper 1							
Course areas	Section 1	Section 2					
Area	Multiple choice	Knowledge and understanding	Problem solving	Open-ended*	Based on experimental work	Scientific literacy	Check
Rates of reaction	2	1ci, 12di	1cii		1a, 1b		☐ 11
Atomic structure and bonding	3, 4, 6, 8, 9, 10, 12	10a, 10b	7b, 10ci, 10cii, 10ciii, 13a				☐ 14
Covalent bonding	1, 5	12aii					☐ 3
Formulae and reaction quantities	7	1dii, 3cii	12ci				☐ 4
Calculations involving the mole and balanced equations	11	6bii					☐ 4
Percentage composition			3ci, 3d				☐ 4
Acids and bases	13						☐ 1
Neutralisation reactions	22, 23	8ci, 12cii	8a, 8b		8cii		☐ 10
Homologous series	14, 15, 17	4cii	4ci, 11b, 11c				☐ 7
Everyday consumer products	16	1di, 4b, 7a, 7ci, 12ciii	4ai, 4aii, 7cii		7d		☐ 13
Metals		6a					☐ 1
Redox	18, 19, 21		6bi, 13bii				☐ 5
Electrochemical cells	20	13c	13bi, 13d				☐ 4
Plastics	24	11ai	11aii				☐ 3
Fertilisers	25	12ai, 12dii	12bi		12bii	3a, 3b	☐ 7
Radioactivity and half-life		9a, 9b, 9c					☐ 3
				2,5		Total marks in Paper 1	☐ 100

*The marks for open-ended questions are not included in the check column.

Practice Paper 2

Paper 2							
Course areas	Section 1	Section 2					
Area	Multiple choice	Knowledge and understanding	Problem solving	Open-ended*	Based on experimental work	Scientific literacy	Check
Rates of reaction	1, 25	5a, 5b		4, 7	5c		☐ 6
Atomic structure and bonding	2	1bii, 9cii	1bi, 2bi, 14a, 14e				☐ 7
Covalent bonding	3, 4	13bii					☐ 3
Formulae and reaction quantities	5	9ci	14b				☐ 3
Calculations involving the mole and balanced equations	8, 9	1c, 13bi	13biii				☐ 9
Percentage composition		11c					☐ 3
Acids and bases	6	13a					☐ 2
Neutralisation reactions	7	2biii	1ai, 2bii, 11bii				☐ 4
Homologous series	10, 11, 12	2aii, 2aiii, 3ci, 15aii	2ai, 3cii, 12ai, 12aii		15c	3a, 3b	☐ 15
Everyday consumer products	13, 14, 15	6ai, 6aii, 6d	6c, 12b, 15ai, 15b		6b		☐ 13
Metals	18, 19, 23, 24	14c			1d		☐ 7
Redox	22	9a, 9b	1aii, 14d				☐ 6
Electrochemical cells							
Plastics	21	8ai, 8aii	8bi, 8bii				☐ 5
Fertilisers	20	11a, 11bi					☐ 3
Radioactivity and half-life	16, 17	10b	10a, 10ci, 10cii				☐ 8
						Total marks in Paper 2	☐ 100

*The marks for open-ended questions are not included in the check column.

Unit 1 Chemical changes and structure

Rates of reaction

Hint!

There are four factors which affect the rate of a chemical reaction. These are shown in the table below.

Variable	Effect on reaction rate
Temperature	Low temperature = Slow reaction High temperature = Fast reaction
Concentration	Low concentration = Slow reaction High concentration = Fast reaction
Surface area	Large surface area = Fast reaction Small surface area = Slow reaction
Catalyst	Catalysts speed up the rate of a reaction but are not used in a reaction

MARKS

1 Which of the following would not have an effect on the rate of a chemical reaction? **1**

A Size of the beaker
B Concentration of reactants
C Particle size of the reactants
D Temperature of the reaction mixture

2 Which of these factors would slow down the rate of a chemical reaction? **1**

A Increase in particle size
B Increase in temperature
C Increase in concentration
D Increase in the volume of reactants

Hint!

To calculate rate, the following equation is used.

$$\text{rate} = \frac{\Delta\text{quantity}}{\Delta\text{time}}$$

The change in quantity, such as volume or mass, is entered here.

$$\text{rate} = \frac{50}{60}$$

The time taken for that change is entered here.

3 In a chemical reaction, 30 cm^3 of gas was collected in the first 25 seconds. What was the average rate of reaction, in $cm^3 s^{-1}$, for the first 25 seconds? **1**

A $\frac{25}{30}$
B $\frac{30}{25}$
C $\frac{5}{25}$
D $\frac{25}{5}$

MARKS

4 Calculate the average rate of reaction, in $cm^3 s^{-1}$, for the following reactions.

a) $10\,cm^3$ of gas was collected in 20 seconds — **2**

b) $25\,cm^3$ of gas was collected in 50 seconds — **2**

c) $20\,cm^3$ of gas was collected in 20 seconds — **2**

d) $5\,cm^3$ of gas was collected in 20 seconds — **2**

5 Calculate the average rate of reaction for the following reactions. Your answer should include the correct unit.

a) 0.5 litres of gas was collected in 6 minutes — **3**

b) $20\,cm^3$ of gas was collected in 5 minutes — **3**

c) 5 grams were lost in 6 minutes — **3**

d) 0.3 litres of gas was collected in 150 seconds — **3**

Top Tip!

Some questions require you to include the appropriate unit. Some examples of units used for rate are given below.

Quantity unit	Time unit	Rate unit
cm^3	s	$cm^3 s^{-1}$
g	s	$g\,s^{-1}$
l	min	$l\,min^{-1}$

6 Calculate the average rate of reaction for the following. Your answer should include the correct unit.

a) $30\,cm^3$ of gas was collected between 20 and 50 seconds. — **3**

b) The volume of gas collected increased from $20\,cm^3$ to $60\,cm^3$ between 25 and 50 seconds. — **3**

c) The mass decreased from 15 g to 14.1 g between 0 and 25 seconds. — **3**

d) The volume of carbon dioxide collected increased from 0.2 l to 0.3 l between 2 and 3 minutes. — **3**

7 A solution of hydrogen peroxide can be used to disinfect contact lenses before use. The hydrogen peroxide used must be broken down into oxygen and water before the lenses are used, to avoid damage to the eye.

The equation for this reaction is

$2H_2O_2 \rightarrow 2H_2O + O_2$

A student investigated the most effective way to break down the hydrogen peroxide.

a) Catalysts increase the rate at which hydrogen peroxide breaks down.

(i) Suggest **two** other factors that may affect the rate of this reaction. — **1**

(ii) One catalyst that can be used in the lab is manganese dioxide. Suggest why the manganese dioxide is more effective when used as a fine powder. — **1**

b) Using a catalyst, the student collected $15\,cm^3$ of oxygen gas in 45 seconds.

(i) Calculate the average rate of this reaction. Your answer must include the appropriate unit. — **3**

(ii) Suggest why the rate of this reaction would decrease as the reaction proceeded. — **1**

Section 1

Total marks: 25

Attempt **ALL** questions.

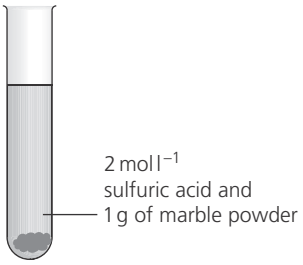
MARKS

1 Which of the following elements exists as a covalent molecule? **1**

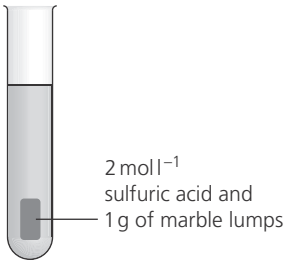
A Neon
B Silicon
C Oxygen
D Magnesium

2 Which of the following reactions would have the highest rate of reaction? **1**

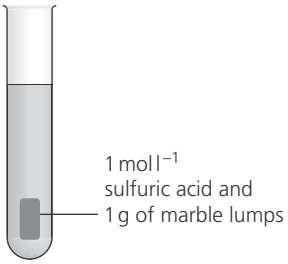
A



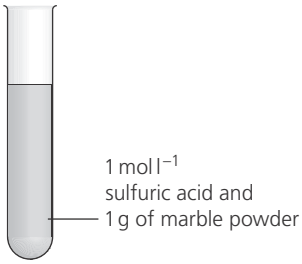
C



B



D



3 An atom has an atomic number of 11 and a mass number of 23. **1**

The atom has

A 11 protons and 12 neutrons
B 11 protons and 23 neutrons
C 12 protons and 11 neutrons
D 23 protons and 11 neutrons.

4 Which of the following particles is an ion? **1**

Particle	Protons	Electrons	Neutrons
A	19	19	20
B	7	7	14
C	17	17	18
D	8	10	16

Section 2

Total marks: 75

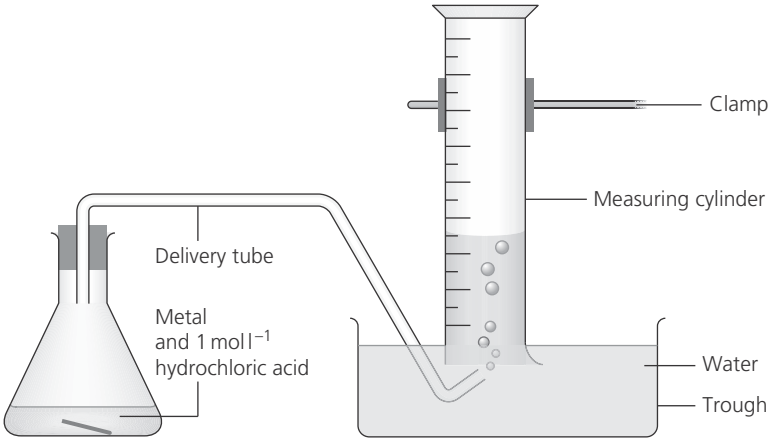
Attempt **ALL** questions.

Write your answers clearly in the spaces provided in this paper. You should score through your rough work when you have written your final copy.

MARKS

1 Many, but not all, metals react with acid. Hydrogen gas is formed as the metal reacts with the acid to form a salt.

Performing the experiment shown allows the rate of the reaction to be monitored.



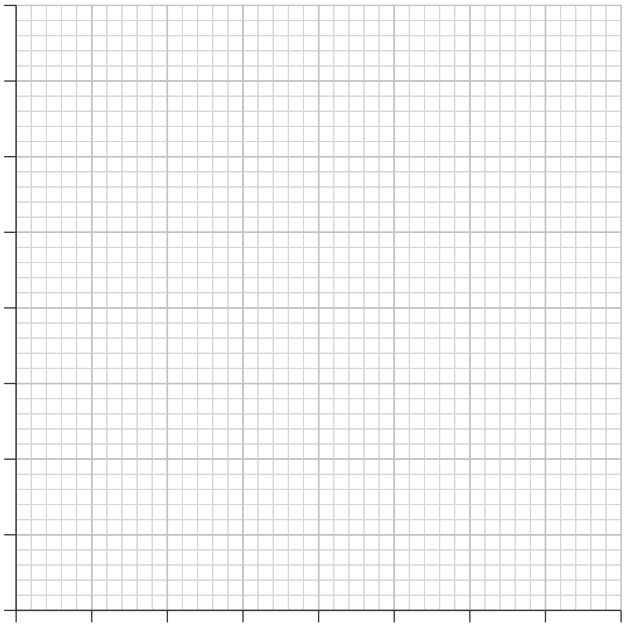
The results below were produced when magnesium metal was used.

Time (s)	0	20	40	60	80	100	120	140
Volume of hydrogen (cm^3)	0	30	51	65	74	78	80	80

a) Draw a diagram to show an alternative method of collecting the hydrogen gas produced in this reaction. **1**

MARKS

b) Draw a graph of the results. **4**



c) **(i)** Calculate the average rate of reaction between 40 and 80 seconds. Your answer must include the appropriate unit. **3**

Show your working clearly.

(ii) The rate of the reaction decreases as the reaction progresses. **1**

Suggest a reason for this.

d) **(i)** The temperature of the reaction mixture increased as the reaction proceeded.

What name is given to a reaction that releases heat? **1**

(ii) Write the formula equation for the reaction between magnesium and hydrochloric acid. **1**

(There is no need to balance the equation.)

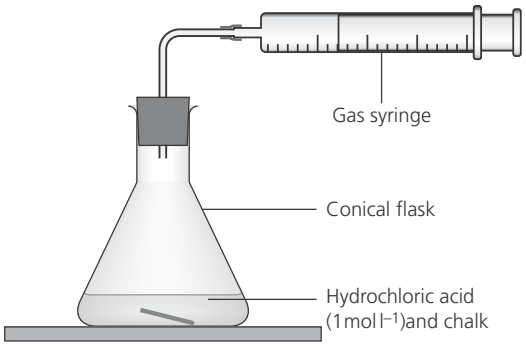
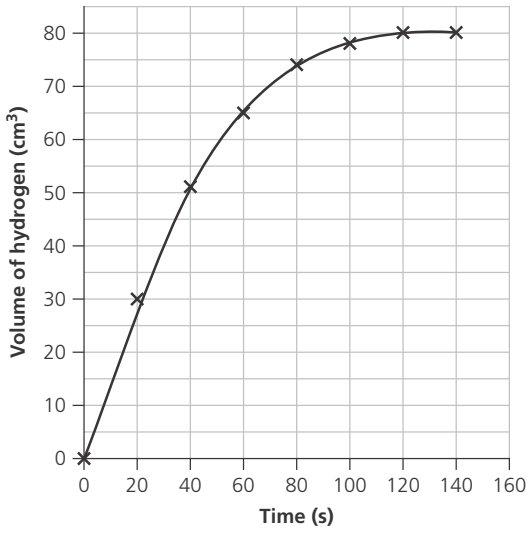
Practice Paper 1

Section 1

Question	Answer	Marks	Hints
1	C	1	Oxygen exists as a diatomic molecule in which the atoms are held together by covalent bonds. Neon does not form bonds, silicon forms a covalent network and magnesium atoms are held together by metallic bonds.
2	A	1	Option A has the higher concentration of acid (2 mol l^{-1}) and the smaller particle size (powder), which will result in the fastest reaction.
3	A	1	The atomic number of an atom is equal to the number of protons, in this case 11; the mass number is equal to the atomic number plus the number of neutrons. In this atom the number of neutrons is equal to 23 – 11 = 12 (mass number – atomic number).
4	D	1	An ion is a charged particle, which means there is a difference between the number of protons and electrons in the atom. In options A, B and C, the numbers of protons and electrons are equal, which means they are not ions but atoms.
5	D	1	It is important to learn the shapes of molecules and you should be able to draw and name the shapes. Water is angular, ammonia is (trigonal) pyramidal, carbon dioxide is linear and carbon tetrafluoride is tetrahedral.
6	B	1	Isotopes have the same atomic number but different mass numbers. Be careful not to get isomers and isotopes confused.
7 A-Type	C	1	Titanium ions will carry a positive charge as all metals form positively charged ions. In this case the charge will be 3+ because it is combined with three bromine ions which each carry a –1 charge.
8	A	1	For a substance to be in the liquid state at 20 °C, the melting point must be below this value and the boiling point must be greater than 20 °C.
9	D	1	Ionic compounds have high melting points and will conduct electricity only when molten or in solution but not in the solid state because the ions are not free to move.
10	D	1	If potassium sulfate is colourless then the potassium ion must also be colourless, and as a result the yellow colour of potassium chromate must be the result of the chromate ion.
11 A-Type	B	1	At first glance, this one seems to be quite tricky. If 0.1 moles is equal to 4.4 g, then 1 mole is equal to 44 g (10 × 4.4). The mass of 1 mole of carbon dioxide is 44 g.
12	B	1	**Ionic** substances will conduct electricity when in solution, or when molten, because the **ions** are free to move.
13	C	1	Soluble metal oxides (bases) dissolve in water to form alkaline solutions, i.e. solutions with a pH greater than 7. Potassium oxide is a soluble oxide but magnesium oxide is insoluble. The table of 'Solubilities of Selected Compounds in Water' is on page 8 of your data booklet.
14	C	1	Alkanes, alkenes and cycloalkanes are all insoluble in water but small alcohol molecules such as propanol are miscible with water.
15	B	1	To name branched hydrocarbons, identify the longest chain of carbons (butane), then identify the branches (methyl) and number each branch to give the lowest set of numbers (2,2). The 'di' prefix is required to show there are two methyl branches.
16	A	1	It is important to learn all the homologous series and their functional groups. Alcohols contain the hydroxyl functional group (–OH).
17 A-Type	C	1	To make this question simpler, write down the molecular formula of each diene, e.g. C_3H_4, C_4H_6, C_4H_8. Looking at molecular formulae can make it easier to work out general formulae.
18	A	1	Reduction is the gain of electrons and the zinc(II) ions (Zn^{2+}) are gaining two electrons to form zinc metal.
19	D	1	The method used to extract a metal from its ore is dependent on the reactivity of the metal. More reactive metals such as aluminium are extracted from their ores by electrolysis.

Question	Answer	Marks	Hints
20	D	1	The greater the difference in reactivity between the two metals in a cell, the greater the voltage that will be produced by the cell. Aluminium is more reactive than tin, copper and iron and would therefore create the greatest voltage when connected to silver.
21 A-Type	D	1	A tricky question. Spectator ions are ions that are unchanged by a chemical reaction; this includes changes in state. The silver and iodide ions change state from aqueous to solid and so they are not spectator ions.
22	B	1	A precipitation reaction is one in which an insoluble solid is produced by two liquids reacting. The precipitate is silver iodide.
23	C	1	Filtration is used to remove an insoluble solid from a liquid.
24	A	1	The monomers for addition polymerisation are unsaturated, which means they contain a carbon-to-carbon double bond. Monomer D would form a different polymer than the one shown.
25	A	1	The Ostwald process uses a platinum catalyst to produce nitric acid from ammonia, water and oxygen.

Section 2

Question		Answer	Marks	Hints
1	a		1	This method can also be used to collect water soluble gases. Hydrogen is a low-density gas so it can also be collected in an upturned measuring cylinder but because it is colourless this method would not allow you to measure the quantity of hydrogen gas collected.
	b	 Selecting line graph as the correct format **(1 mark)** Both axes labelled with units **(1 mark)** Both scales correct **(1 mark)** Graph drawn accurately **(1 mark)** (points must be plotted correctly and line drawn, either by joining the dots or by a smooth curve or curve of best fit)	4	When drawing any graph ensure that: ■ the graph is bigger than half the size of the graph paper given ■ all the labels and units are correct ■ all points are correctly plotted including 0,0 (the origin) if it is included in the table.