ESSENTIAL

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QUESTIONS & PAPERS

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Practice Questions

Area	Key area	Multiple choice (1 mark)	Structured questions				Check
			Knowledge and understanding	Problem solving	Open-ended*	Based on experimental work	
Chemical changes and structure	Periodicity (properties)	6, 7	1, 2, 3, 4	8, 5	1, 2, 3, 4, 5		☐ 15
	Periodicity (patterns and trends in the periodic table)	1, 2, 3, 4, 5	6, 7, 8, 9				☐ 24
	Periodicity (bonding)	1, 2, 3, 4, 5, 6	7, 8, 9	10			☐ 14
	Oxidising and reducing agents	1, 2, 3, 4, 5, 6	7, 8, 9, 10, 11				☐ 13
Nature's chemistry	Systematic carbon chemistry	1, 2, 3, 4	5, 6, 7, 8				☐ 13
	Alcohols and carboxylic acids	1	2, 3, 5, 6, 7	4			☐ 23
	Esters, fats and oils	1, 2, 3, 4, 5	6a, 6b, 7	6c			☐ 16
	Soaps, detergents and emulsions	1, 2	3, 4				☐ 14
	Proteins	1, 2, 3, 4, 5	6a, 7, 8			6b	☐ 16
	Oxidation of food	1, 2, 3, 4, 5, 6, 7	8, 9, 10, 11a			11b, 11c	☐ 20
	Fragrances and skin care	1, 2	3, 4, 5, 6				☐ 19
Chemistry in society	Getting the most from reactants			1, 2, 3, 4, 5, 6, 7, 8, 9			☐ 46
	Percentage yield			1, 2, 3, 4, 5			☐ 13
	Molar volume	1, 2, 3, 4		5, 6, 7, 8			☐ 16
	Excess calculations			1, 2, 3, 4			☐ 14
	Atom economy			1, 2, 3, 4, 5			☐ 16
	Controlling the rate	1, 2, 3, 4, 5, 6, 7	8b, 9, 10			8a, 8c	☐ 18
	Chemical energy	1, 2, 3, 4		5, 6, 7, 8, 9, 10, 11			☐ 34
	Equilibrium	1, 2, 3, 4	5, 6, 7				☐ 11
	Volumetric analysis	1, 2, 3		4, 5c, 5d, 6b, 7b		5a, 5b, 6a, 7a	☐ 25

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

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	**Check**
Chemical changes and structure						
Periodicity (properties)	3	2a	12c	3, 11	5di, 6aii	☐ 6
Periodicity (patterns and trends in the periodic table)	2	1a, 1b, 1c	1d			☐ 8
Periodicity (bonding)	1, 5, 6		15b			☐ 4
Oxidising and reducing agents	22, 23	8c	6ai			☐ 4
Nature's chemistry						
Systematic carbon chemistry		7b	7ai, 7aii			☐ 3
Alcohols and carboxylic acids	8, 15					☐ 2
Esters, fats, and oils	9, 11, 17, 18	9ai, 9aii, 9d	9bii		9c	☐ 9
Soaps, detergents and emulsions	12	14ai, 14aii				☐ 4
Proteins	14	12ai, 12aii, 12b	12d			☐ 6
Oxidation of food	13, 16	14bii	2bi		13a	☐ 6
Fragrances and skincare		5a, 5ci, 5cii, 14bi, 14c	6bi, 6bii			☐ 7
Chemistry in society						
Getting the most from reactants		6ci	2bii, 6aiii, 8d,15d		15a, 15c	☐ 13
Percentage yield			9bi			☐ 3
Molar volume			5dii			☐ 3
Excess calculations		5b				☐ 3
Atom economy	21					☐ 1
Controlling the rate	7, 10, 25					☐ 3
Chemical energy	4	4a, 6cii	4b, 12e, 13b		4c	☐ 12
Equilibrium	19, 20	10b	10a, 10c, 10d, 10e			☐ 7
Volumetric analysis	24	8ai, 8aii	7ci, 7cii, 7ciii, 8b			☐ 10

*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	**Check**
Chemical changes and structure						
Periodicity (properties)		2b	3a, 13a	6, 9	5dii, 10a, 13b, 14dii	☐ 8
Periodicity (patterns and trends in the periodic table)	1, 6	1a, 1b, 1d, 1ei, 1eii	1c			☐ 11
Periodicity (bonding)	2, 4	2a				☐ 5
Oxidising and reducing agents	15, 22, 24	7ci	7cii, 8ci, 8cii, 10ci			☐ 8
Nature's chemistry						
Systematic carbon chemistry	7	7ai	7bi, 7bii			☐ 4
Alcohols and carboxylic acids	8	5a				☐ 2
Esters, fats and oils		5bii, 14a, 14b, 14c	5bi		5di	☐ 7
Soaps, detergents and emulsions	9, 13	4b, 4c, 5c	4a			☐ 7
Proteins	10	11a, 11bi, 11biii, 11c	11bii		11di	☐ 8
Oxidation of food	11, 12	12a, 12b, 12c				☐ 5
Fragrances and skincare						
Chemical in society						
Getting the most from reactants	18		8aii		13d	☐ 4
Percentage yield			5diii			☐ 3
Molar volume	17, 20		10b			☐ 5
Excess calculations			3bi			☐ 3
Atom economy			10cii			☐ 2
Controlling the rate	3, 5	10ciii			11dii	☐ 4
Chemical energy	16, 21, 23		7aii, 7biii, 8b		7aiii	☐ 13
Equilibrium	14	3c				☐ 3
Volumetric analysis	19, 25	3biii	8ai, 13cii, 13ciii		3bii, 13ci, 14di	☐ 12

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

Area 1 Chemical changes and structure

Periodicity (properties)

Hint!

If you are asked to explain in a question, then you must **explain your answer fully**. For example, if you are asked to explain fully the change in covalent radius going down a group in the periodic table then you cannot simply say: 'It increases going down a group.'

This answer tells the examiner the trend but to gain the marks you must explain the trend fully: 'Covalent radius increases going down a group because atoms have more energy levels going down a group. This means that the outer electrons are further from the nucleus and the shielding by the inner energy levels means that the nucleus has less influence on the outer electrons.'

Including diagrams or equations in your answers to 'explain fully' and open questions can improve your explanations.

MARKS

1 All known elements are listed in the periodic table.

a) Copy and complete the following statement. **1**

The elements are arranged in the periodic table in order of increasing …

b) Explain why elements listed in the same group of the periodic table have similar chemical properties. **1**

c) The newly discovered element oganesson has the electron arrangement 2, 8, 18, 32, 32, 18, 8 and the symbol Og. **1**

Suggest what chemical properties this element will have and to which group in the periodic table it will belong.

2 The first twenty elements of the periodic table can be categorised according to their bonding and structure. **2**

Complete the table below by placing the elements from the list provided into the correct column of the table.

carbon (graphite)	oxygen	sodium	calcium	argon	nitrogen	neon

Covalent molecule	Covalent network	Metallic lattice	Monatomic

3 Phosphorus and sulfur are examples of covalent molecular compounds which are solids at room temperature.

a) Write the molecular formula of each compound. **2**

b) A student suggests that the covalent bonds which hold the atoms together are broken when a molecule of sulfur or phosphorous is melted. **1**

Explain **fully** why this statement is incorrect.

MARKS

Volumetric analysis

1 The results of a titration experiment are recorded in the table below. What is the average titre, in cm^3, that should be used? **1**

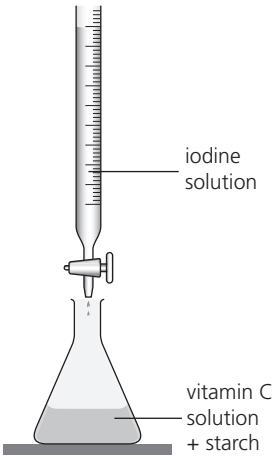
Titre	Start volume (cm^3)	Final volume (cm^3)	Total volume (cm^3)
1	0.0	10.7	10.7
2	11.0	21.1	10.1
3	22.0	32.4	10.4
4	33.0	43.0	10.0

A 10.05 **B** 10.17 **C** 10.20 **D** 10.30

2 A solution of accurately known concentration is more commonly known as a **1**

A correct solution
B precise solution
C prepared solution
D standard solution.

3 A student performed the following titration. **1**



Which of the following would help the student achieve a precise end-point?

A Repeating titrations
B Performing a rough titration
C Using a white tile under the conical flask
D Reading the scale on the burette at eye level

4 Calculate the volume of potassium hydroxide required to neutralise the following acids.

a) $1.0\,mol\,l^{-1}$ KOH and $50\,cm^3$ of $1\,mol\,l^{-1}$ hydrochloric acid. **2**

$KOH(aq) + HCl(aq) \rightarrow KCl(aq) + H_2O(\ell)$

b) $2.0\,mol\,l^{-1}$ KOH and $10\,cm^3$ of $1\,mol\,l^{-1}$ sulfuric acid. **2**

$2KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(\ell)$

c) $0.5\,mol\,l^{-1}$ KOH and $10\,cm^3$ of $2\,mol\,l^{-1}$ phosphoric acid. **2**

$3KOH(aq) + H_3PO_4(aq) \rightarrow K_3PO_4(aq) + 3H_2O(\ell)$

d) $1.5\,mol\,l^{-1}$ KOH and $15\,cm^3$ of $2\,mol\,l^{-1}$ nitric acid. **2**

$KOH(aq) + HNO_3(aq) \rightarrow KNO_3(aq) + H_2O(\ell)$

Hint!

$N = C \times v$ must be used along with the molar ratio and $v = \frac{n}{C}$.

Section 1

Total marks: 25
Attempt **ALL** questions.

MARKS

1 Which of the following is an example of a van der Waals force? **1**

A Metallic bond
B Covalent bond
C Hydrogen bond
D Polar covalent bond

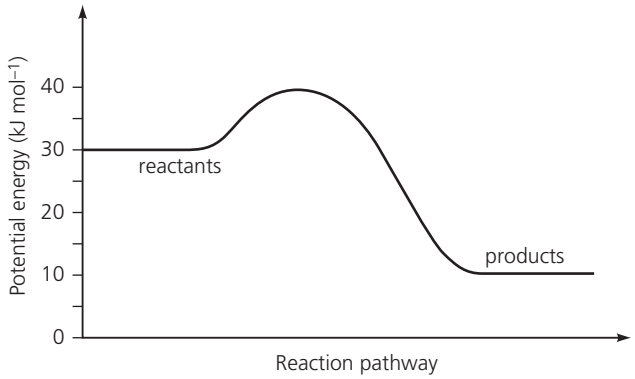
2 Which of the following compounds has the greatest ionic character? **1**

A Sodium fluoride
B Sodium chloride
C Sodium bromide
D Sodium iodide

3 Particles with the same electron arrangement are said to be isoelectronic. **1**
Which of the following compounds contains ions that are isoelectronic?

A LiF
B Na_2O
C $CaBr_2$
D $AlCl_3$

4 The diagram below shows the energy profile for a reaction. **1**



What is the enthalpy change, in kJ mol^{-1}, for the **reverse** reaction?

A −20
B +20
C −30
D +30

5 Which types of bond are at opposite ends of the bonding continuum? **1**

A van der Waals and pure covalent
B Pure covalent and ionic
C Polar covalent and ionic
D Polar covalent and pure covalent

Section 2

Total marks: 95

Attempt **ALL** questions.

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

MARKS

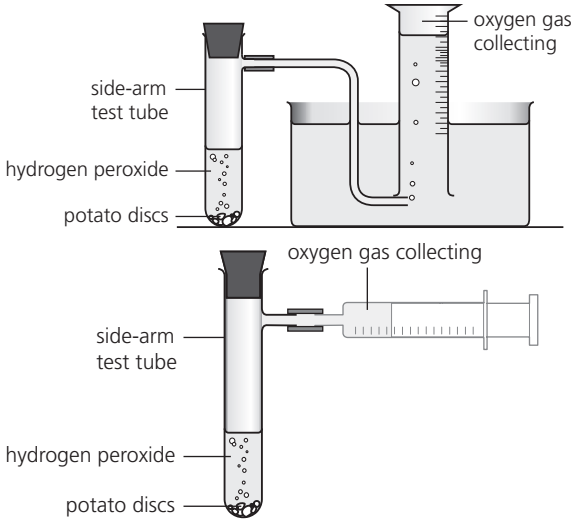
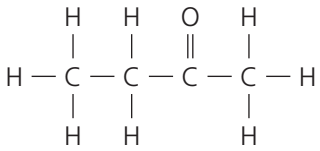
1 The table below gives the covalent radius and ionisation values of some group 1 elements.

Element	Covalent radius (pm)	First ionisation energy (kJ mol^{-1})	Second ionisation energy (kJ mol^{-1})
Lithium	134	520	7298
Sodium	154	496	4562
Potassium	196	419	3052
Rubidium	216	403	2633
Caesium	235	376	2234

a) Explain **fully** why the covalent radius increases as you move down a group of the periodic table. **2**

b) State the link between covalent radius and the first ionisation energy. **1**

c) Write the ion–electron equation corresponding to the second ionisation energy of caesium. **1**

Question		Answer	Marks	Hint
	d i		1	Either of these diagrams. Markers assess these questions by asking 'would this work as drawn?' All labels should be included and the measurements on the measuring cylinder/syringe must be shown. Ensure that the delivery tube does not have a line drawn across it at any point as this is classed as a blockage.
	d ii	33.3 s	1	T = 1/rate. The rate at 30 °C is 0.03 s^{-1}. Time = 1 ÷ 0.03 = 33.3 seconds.
12	a		1	The carbonyl group of a ketone is not on an end carbon. Ensure that all bonds and hydrogen atoms are correctly drawn.
	b	Any of the following: Acidified dichromate solution Tollens' reagent Fehling's reagent	1	Aldehydes can be oxidised to form carboxylic acids but ketones cannot. Using one of the oxidising agents listed would produce a positive result with aldehydes but no reaction with a ketone.
	c	Primary alcohol	1	Primary alcohols can be oxidised to form aldehydes, secondary alcohols are oxidised to form ketones and tertiary alcohols cannot be readily oxidised.
13	a	Covalent molecular	1	Both covalent and molecular must be stated as the question asks for the bonding and structure. The state symbol given in the equation for stannic chloride ($SnCl_4$) is liquid and this suggests that it has a low melting point and therefore is more likely to be a covalent molecular substance.
	b	Any correct description of the following: Decant (pour off the top layer to leave the bottom layer behind). Use a separating funnel. Use a dropper to remove the top layer.	1	Mercury has a density of 13.5 g cm^{-3} (page 5 of the data booklet) and so the stannic chloride would form as a layer on top of the mercury.
	c i	Self-indicating reaction	1	The potassium permanganate changes colour as the permanganate ion is converted to a manganese ion. The colour change is purple to colourless.
	c ii	26.9 cm^3	1	The results of titrations 2 and 4 should be used, as they are concordant results.