RIVER VALLEY HIGH SCHOOL
SEC 3 END-OF-YEAR EXAMINATION

CHEMISTRY
PAPER 1
9 OCTOBER 2023
45 MINUTES

NAME				
CLASS	3		**INDEX NO.**	

READ THESE INSTRUCTIONS FIRST

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number in the spaces provided.

There are **thirty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet provided.

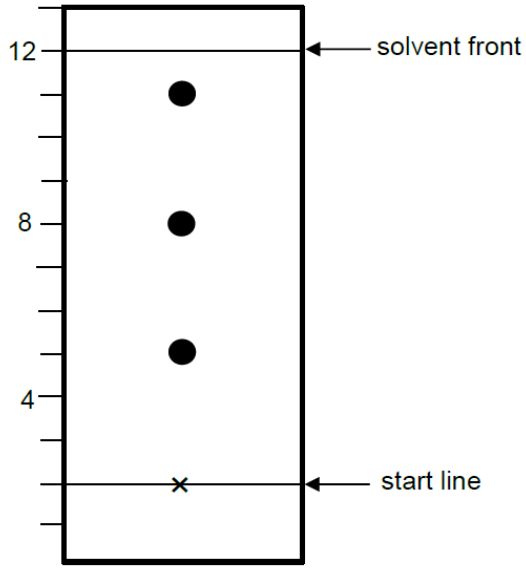
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page **12**.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **11** printed pages and **1** blank page.

1 Which piece of apparatus would be most suitable for measuring 25.5 cm^3 of a liquid?

A conical flask
B volumetric flask
C measuring cylinder
D pipette

2 The Health Sciences Authority (HSA) tested a weight loss product which is suspected to contain harmful ingredients. The chromatogram of the weight loss product is obtained as shown below, along with a reference table of R_f values of some harmful ingredients.



ingredient	R_f value
sibutramine	0.8
dexamethasone	0.6
chlorpheniramine	0.3
frusemide	0.1

What are the harmful ingredients present in the weight loss product?

A dexamethasone only
B chlorpheniramine and dexamethasone only
C frusemide and sibutramine only
D chlorpheniramine, dexamethasone and sibutramine only

3 In an experiment, the melting point of an unknown solid was found to be 60 °C, the same as cyclohexene. To check its identity, the experiment was repeated by using equal parts of the solid and pure cyclohexene. The melting point of the mixture was found to be 50 – 53 °C.

What can be deduced from the experimental results?

A The unknown solid is a mixture.
B The unknown solid is pure cyclohexene.
C The unknown solid may contain cyclohexene.
D The unknown solid is not cyclohexene.

4 Three separations are listed.

1 obtaining water from sodium chloride solution

2 obtaining iodine from a mixture of iodine and sodium chloride

3 obtaining solid sodium chloride from aqueous sodium chloride

Which techniques would be involved in these separations?

	1	2	3
A	distillation	sublimation	evaporation
B	distillation	sublimation	filtration
C	filtration	crystallisation	evaporation
D	sublimation	crystallisation	filtration

5 Two gases, H_2S (M_r = 34.1) and SO_2 (M_r = 64.1) were separately released from one end of a laboratory on a cold day. The experiment was repeated on a hot day. The time taken for the gases to reach the opposite end of the laboratory was recorded for each experiment.

Which gas on which day would take the longest to reach the end of the laboratory?

	gas	day
A	H_2S	cold
B	H_2S	hot
C	SO_2	cold
D	SO_2	hot

6 Which statement correctly describes the particles of a liquid as it boils?

A The particles lose heat energy.

B The spaces between the particles increase.

C The particles vibrate faster about their fixed positions.

D A chemical change occurs as particles combine to form products.

7 The boiling points of three gases are given in the table below.

gas	argon	nitrogen	oxygen
boiling point /^{o}C	−186	−196	−183

If a mixture of these gases at −180 ^{o}C is allowed to cool gradually to −190 ^{o}C, which of the following will happen?

A Argon, nitrogen and oxygen will exist in the liquid state.

B Argon and oxygen will remain in gaseous state.

C Argon and nitrogen will remain in the gaseous state.

D Nitrogen will remain in the gaseous state.

8 Which statement about the particles of 'fluorine' and 'fluoride' is correct?

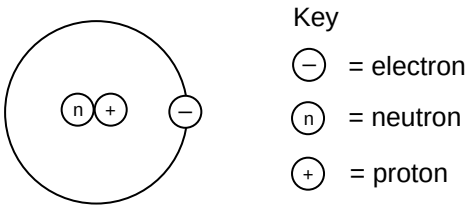
A They are chemically identical.

B They are isotopes.

C They have the same number of electrons.

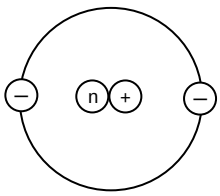
D They have the same number of protons.

9 The diagram shows the structure of an atom.



Which diagram shows the structure of an isotope of this atom?

A



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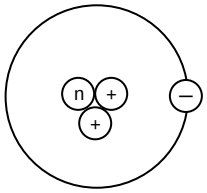

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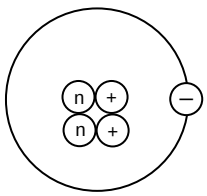

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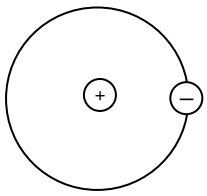


10 In the lattice structure of ionic compounds, the coordination number of each ion is the number of neighbouring ions of opposite charge.

The table below shows the ions present and the coordination number of ions in some ionic compounds. Taking sodium chloride for instance, each sodium ion is surrounded by 6 chloride ions, while each chloride ion is surrounded by 6 sodium ions. Hence, the coordination number for both the sodium ions and chloride ions is 6.

ionic compound	ions present		coordination number of		formula
	cation	anion	cation	anion	
sodium chloride	Na^+	Cl^-	6	6	NaCl
titanium(IV) oxide	Ti^{4+}	O^{2-}	6	3	TiO_2
compound **P**	Q	R	4	8	?

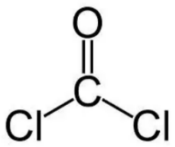
Using information from the table, determine the formula of compound **P**.

A QR_2 **B** Q_2R

C QR_4 **D** Q_4R

11 Phosgene is a poisonous gas that was used as a chemical weapon during World War I.

Its structure is shown below.



Which statements about phosgene are correct?

I. Phosgene has a boiling point below 100 °C.

II. The total number of valence electrons that are involved in bonding in the phosgene molecule is 8.

III. Each chlorine atom has 6 valence electrons which are not involved in bonding.

A I and II

B I and III

C II and III

D I, II and III

12 A covalent oxide compound has the chemical formula $\mathbf{P}_2O$.

What could be the electronic configuration of atom **P**?

A 2.4 **B** 2.8.1

C 2.8.6 **D** 2.8.7

13 The table below shows the physical properties of 3 substances.

	X	**Y**	**Z**
melting point / °C	98	714	3652
electrical conductivity at room temperature	conducts electricity	does not conduct electricity	conducts electricity

What could be substances **X**, **Y** and **Z**?

	X	**Y**	**Z**
A	water	silicon dioxide	diamond
B	sodium chloride	silicon dioxide	graphite
C	ethanoic acid	magnesium chloride	diamond
D	sodium	magnesium chloride	graphite

14 Which substance contains the greatest number of atoms in 1 g?

A Ne

B F_2

C NO_2

D SO_2

15 Ammonium nitrate, NH_4NO_3, can be manufactured from ammonia, NH_3, in a two-step process.

Step 1: $NH_3 + 2O_2 \rightarrow HNO_3 + H_2O$

Step 2: $HNO_3 + NH_3 \rightarrow NH_4NO_3$

What is the maximum mass of NH_4NO_3 that can be made from 17 tonnes of ammonia? [1 tonne = 1000 kg]

A 34 tonnes **B** 40 tonnes

C 80 tonnes **D** 97 tonnes

16 On heating, the carbonate of element **Y** decomposes.

$$\mathbf{Y}_2CO_3(s) \rightarrow \mathbf{Y}_2O(s) + CO_2(g)$$

When 13.8 g of $\mathbf{Y}_2CO_3$ was heated, 1.2 dm^3 of carbon dioxide gas, measured at room temperature and pressure, was released.

What is the relative atomic mass, A_r of **Y**?

A 216.0 **B** 108.0

C 276.0 **D** 123.0

17 12.2 g of impure magnesium was added to excess hydrochloric acid. 6.00 dm^3 of H_2 was evolved at room temperature and pressure.

What is the percentage purity of the magnesium?

A 24.9 % **B** 49.8 %

C 74.7 % **D** 99.6 %

18 The formula of a nitride of element **X** is $\mathbf{X}_3N_2$.

80.0 g of $\mathbf{X}_3N_2$ contains 57.8 g of **X**.

How many moles of **X** does 57.8 g of the element contain?

A $\frac{22.2}{14.0} \times \frac{3}{2}$ **B** $\frac{22.2}{14.0} \times \frac{2}{3}$

C $\frac{80.0}{14.0} \times \frac{2}{3}$ **D** $\frac{80.0}{14.0} \times \frac{3}{2}$

19 Which of the following equations clearly indicates that lead(II) oxide, PbO, has amphoteric properties?

A $Pb(s) + H_2O(l) \rightarrow PbO(s) + H_2(g)$

B $PbO(s) + H_2SO_4(aq) \rightarrow PbSO_4(aq) + H_2O(l)$

C $PbO(s) + 2KOH(aq) + H_2O(l) \rightarrow K_2Pb(OH)_4(aq)$

D $PbO(s) + 2NH_4Cl(aq) \rightarrow PbCl_2(s) + 2NH_3(g) + H_2O(l)$

20 Ant bites can be painful to some and may even cause swelling and itching. This could be due to the release of formic acid into the skin. Calamine lotion is commonly used to relieve the symptoms.

What is the chemical in calamine lotion that is likely to be helpful for this instance?

A citric acid **B** magnesium chloride

C sodium nitrate **D** zinc carbonate

21 What is the best method to prepare a high yield of lead(II) sulfate?

A Adding excess dilute sulfuric acid to lead(II) hydroxide.

B Adding excess lead(II) carbonate to dilute sulfuric acid.

C Adding excess lead metal to dilute sulfuric acid, filter and collect the residue.

D Adding excess lead metal to dilute nitric acid, filter, and followed by adding dilute sulfuric acid to filtrate.

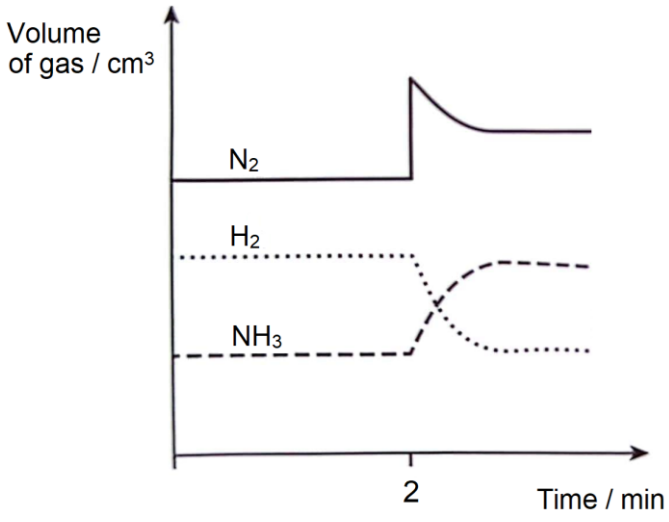
22 The solubilities of some salts of metal **E** in cold water are given in the table shown below.

salt	solubility in water
carbonate of **E**	insoluble
chloride of **E**	soluble
sulfate of **E**	soluble

What is the identity of metal **E**?

A barium **B** copper **C** lead **D** sodium

23 The elements hydrogen, H_2, and nitrogen, N_2, react to produce ammonia, NH_3. The volumes of all three gases were recorded against time.



Which of the following change was carried out at the second minute?

A Ammonia was removed from the mixture.

B Hydrogen was removed from the mixture.

C Additional hydrogen was added to the mixture.

D Additional nitrogen gas was added to the mixture.

24 In the Haber process, the elements hydrogen and nitrogen react to produce ammonia.

How can ammonia be collected from the mixture of gases?

A Cooling the mixture of gases.

B Heating the mixture of gases.

C Passing the mixture of gases through solid calcium oxide.

D Passing the mixture of gases through concentrated sulfuric acid.

25 Solid **X** has the following properties.

1 It is soluble in water.
2 It gives off a gas when added to dilute nitric acid.
3 When warmed with sodium hydroxide solution, a gas is evolved.

Which of the following is **X**?

A ammonium carbonate **B** magnesium

C potassium nitrate **D** zinc sulfate

26 In an experiment, 30.0 cm^3 of 1.00 mol dm^{-3} iron(III) nitrate solution was mixed with 30.0 cm^3 of 1.00 mol dm^{-3} potassium carbonate solution in a flask.

$$2Fe(NO_3)_3 + 3K_2CO_3 \rightarrow 6KNO_3 + Fe_2(CO_3)_3$$

What was observed in the flask at the end of the reaction?

A a colourless solution only

B a red-brown precipitate and a yellow solution

C a red-brown precipitate and a colourless solution

D a white precipitate and a colourless solution

27 Which equation does **not** represent a redox reaction?

A $3Cl_2 + 2Fe \rightarrow 2FeCl_3$

B $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$

C $Fe^{2+} + Mg \rightarrow Fe + Mg^{2+}$

D $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

28 The reaction in which the same element is both oxidised and reduced is called a *disproportionation* reaction.

Which equation is an example of a *disproportionation* reaction?

A $PbCO_3 \rightarrow PbO + CO_2$

B $Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + H_2O$

C $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

D $Fe_2(SO_4)_3 + 3Ba(NO_3)_2 \rightarrow 3BaSO_4 + 2Fe(NO_3)_3$

29 Dichromate(VI) ions, $Cr_2O_7^{2-}$, react with iron(II) ions as shown by the equation below.

$$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 7H_2O + 6Fe^{3+}$$

Which of the following statement is true?

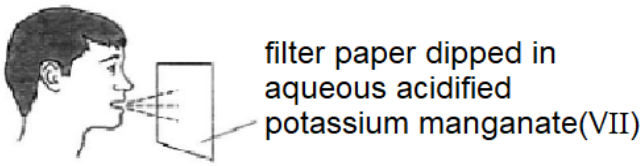
A Fe^{2+} is oxidised as it lost an electron.

B H^+ is oxidised as it gained oxygen atoms.

C H^+ is reduced as the oxidation state of hydrogen decreased.

D $Cr_2O_7^{2-}$ is reduced as the oxidation state of oxygen decreased.

30 Acidified potassium manganate (VII) can be used to detect the presence of ethanol vapour in the breath of a person who has consumed alcohol.



It was observed that the acidified potassium manganate(VII) turned from purple to colourless in the presence of ethanol vapour.

Which observation is true?

A Ethanol has been oxidised.

B Ethanol is an oxidising agent.

C Acidified potassium manganate(VII) has been oxidised.

D Acidified potassium manganate(VII) is a reducing agent.

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CHEMISTRY

Paper 1

1	2	3	4	5	6	7	8	9	10
C	B	D	A	C	B	D	D	D	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	D	D	C	B	B	B	A	C	D
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
D	B	D	A	A	B	B	B	A	A