

*Preparatory Chemistry*  
EXAMINATION

Reading time: 10 minutes

Writing time: 90 minutes

Your name: \_\_\_\_\_

**Instructions:**

1. The student is provided with **(a)** this examination paper; **(b)** answer sheet for Section A; and, **(c)** a data sheet.
2. Answers to Section A should be entered on the separate answer sheet.
3. All answers to Section B questions are to be written on the examination paper.
4. If you run out of room, or need to start your answer again, you may use the back of a page. Clearly indicate where this occurs.
5. Write your answers clearly.
6. You will not be permitted to leave the examination room until the scheduled completion of the exam.
7. Calculators are permitted.

**ANSWER SHEET PART A:**

**NAME** \_\_\_\_\_

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

## Section A

Questions in Section A are worth one mark each. No penalty is applied for incorrect answers so it is advisable to answer every question. Aim to spend around 30–40 mins. on this section.

If time permits, check your answers carefully after having completed the paper.

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### Question 1

Which element is in the group II of the third period of the periodic table?

- (a) Beryllium
- (b) Magnesium
- (c) Carbon
- (d) Boron

### Question 2

Two solutions were mixed and a precipitate formed. A student collected the precipitate by:

- (a) distillation.
- (b) filtration
- (c) evaporation
- (d) both distillation or filtration

### Question 3

A precipitate is best defined as :

- (a) a white solid formed by the mixing of two solutions..
- (b) a coloured solid formed by the mixing of two solutions
- (c) an insoluble solid formed by the mixing of two solutions.
- (d) a coloured solid that is found in water.

### Question 4

Calcium carbonate is mined. What is the percentage of calcium in calcium carbonate?

- (a) 100%
- (b) 40%
- (c) 60%
- (d) None of the above.

### Question 5

Sodium and potassium are found in group 1 of the periodic table but in different periods. They are expected to have

- (a) different chemical properties.
- (b) same atomic radius.
- (c) same atomic mass.
- (d) one valence electron.

★ Questions 6 – 11 use the following table of information

Element	Number of electrons	Number of protons	Number of neutrons
A	36	34	
B	18		18
C		36	47
D	26	28	

### Question 6

Which of the above elements is a  $2^+$  cation?

- (a) A
- (b) B
- (c) C
- (d) D

### Question 7

Which of the above elements is a noble gas?

- (a) A
- (b) B
- (c) C
- (d) D

### Question 8

Element B is a  $1^-$  anion. What is the name of this element?

- (a) Phosphorous
- (b) Sulfur
- (c) Chlorine
- (d) Argon

### Question 9

What is the charge on the ion represented by element A?

- (a)  $2^-$
- (b)  $1^-$
- (c)  $1^+$
- (d)  $2^+$

### Question 10

What is element C?

- (a) Fe
- (b) Ni
- (c) Kr
- (d) Si

### Question 11

What is the molar mass(formula mass) of element D?

- (a) 26 g/mol
- (b) 28 g/mol
- (c) 54 g/mol
- (d) 59 g/mol

### Question 12

Which statement below accurately describes Avogadro's number ( $N_A$ )?

- (a) The number of atoms present in a 12 g sample of pure carbon.
- (b) The number of atoms present in one litre of oxygen gas.
- (c) The estimated number of atoms present within the universe.
- (d) The estimated number of hydrogen atoms present within the sun.

### Question 13

In chemical equations, letters in brackets are often used after the name of a compound. For example,



What do the letters *s*, *l* and *g* represent?

- (a) They indicate what chemicals will react with one another.
- (b) They indicate the states of matter that each compound is present as.
- (c) They represent whether compounds are metals or non-metals.
- (d) They represent unique letters that correspond to trends in the periodic table.

### Question 14

An experiment on a compound finds that the compound has a formula mass of 18 g/mol. Further investigation reveals that this compound is composed of oxygen and one other element. What is the chemical formula of this compound?

- (a)  $\text{H}_2\text{O}$
- (b)  $\text{CuO}$
- (c)  $\text{MnO}_2$
- (d)  $\text{CO}_2$

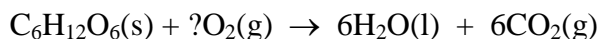
### Question 15

When cations and anions are created, which subatomic particle is either removed or added?

- (a) Proton
- (b) Neutron
- (c) Electron
- (d) Nucleus

### Question 16

Consider the following reaction. What number needs to be placed in front of the  $\text{O}_2(g)$  to balance this equation?

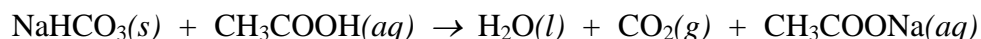


- (a) 1
- (b) 2
- (c) 4
- (d) 6

**★ Questions 17 – 20 require the following information.**

*One aspect of cooking relies on chemicals in the kitchen that react and produce carbon dioxide. In fact, it is the production of carbon dioxide in cooking bread that is responsible for the bubbles that occur inside it.*

*One reaction that produces carbon dioxide is between vinegar and sodium hydrogen carbonate (which is known as “bicarb of soda” in the kitchen). In this reaction, acetic acid (vinegar) and sodium hydrogen carbonate react to produce water, carbon dioxide and sodium acetate. This is described by the balanced chemical equation below.*



### **Question 17**

How many moles of sodium hydrogen carbonate are required to produce a 0.5 mol of carbon dioxide?

- (a) 0.25
- (b) 0.5
- (c) 1
- (d) 2

### **Question 18**

What is the formula mass of sodium acetate?

- (a) 60
- (b) 82
- (c) 84
- (d) 44

### **Question 19**

How many atoms would be present in two molecules of acetic acid?

- (a) 16
- (b) 12
- (c) 8
- (d) 6

### **Question 20**

Given the above formula for sodium acetate, what would the predicted formula for calcium acetate be?

- (a)  $\text{Ca}(\text{HCO}_3)_2$
- (b)  $\text{CH}_3\text{COOCa}$
- (c)  $(\text{CH}_3\text{COO})_2\text{Ca}$
- (d)  $(\text{CH}_3\text{COOH})_2\text{Ca}$

### **Question 21**

The mass number for an element gives:

- A the number of electrons and protons
- B the weight of the atom
- C the number of neutrons
- D the sum of neutrons and protons

### Question 22

In the Periodic Table, elements which have the same number of outer shell electrons are found in

- A Horizontal rows called Groups
- B Horizontal rows called Periods
- C Vertical columns called Groups
- D Vertical columns called Periods.

### Question 23

Choose from the following, the alternatives that contain species all of which have the same number of electrons in the outer shell:  $\text{Li}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{K}^+$ , Ne

- A  $\text{Li}^+$ ,  $\text{Al}^{3+}$
- B  $\text{K}^+$ ,  $\text{Mg}^{2+}$ , Ne
- C  $\text{Mg}^{2+}$ ,  $\text{Al}^{3+}$
- D  $\text{K}^+$ ,  $\text{Li}^+$

### Question 24

Rutherford's gold leaf experiment revealed that the

- A volume of the atom is mainly space with most of its mass located in the small nucleus
- B neutron has a neutral charge
- C neutron has a negative charge
- D presence of protons in the nucleus

### Question 25

Isotopes are:

- A elements with the same number of protons and neutrons
- B elements that are radioactive
- C elements with the same atomic number but different mass number
- D elements that have the same number of protons, electrons and neutrons

### Question 26

The element with atomic number 7 is likely to have similar chemical properties to the element with atomic number

- A 9
- B 2
- C 15
- D 17

### Question 27

The atomic number of boron is 5 and its mass number is 11. The number of protons is therefore

- A 2
- B 3
- C 5
- D 11

### Question 28

Covalent bonding results from:

- A a sharing of electrons between non-metal atoms
- B a transfer of electrons from metal atoms to non-metal atoms
- C a sharing of electrons between metal atoms
- D a transfer of electrons between non-metal atoms

### Question 29

The rate of reaction depends on:

- 1 *concentration of reactants*
- 2 *concentration of products*
- 3 *the temperature*

- A 1 only
- B 1 and 2 only
- C 2 and 3 only
- D 1 and 3 only

### Question 30

When a solution of calcium nitrate is mixed with a solution of sodium carbonate a white solid is formed. Which comment below is true?

- A The solid is nitrate carbonate with a formula  $\text{NO}_3\text{Na}$
- B The solid is calcium nitrate with a formula of  $\text{Na}_2\text{CO}_3$
- C The solid is calcium carbonate with a formula of  $\text{CaCO}_3$
- D The solid is pure calcium metal.



In Section B there are a total of 70 marks. Aim to spend around 50 mins. on this section.

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### Question 1

Draw a diagrammatic representation of an atom. Include at least two energy shells. Clearly label the following on your diagram. (5 marks)

- (a) Proton and its charge (if any).
- (b) Electron and its charge (if any).
- (c) Neutron and its charge (if any)
- (d) Electron shells
- (e) Nucleus

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### Question 2

Name the following compounds. (5 marks)

- (a)  $\text{Li}_2\text{O}$  .....
- (b)  $\text{MgCO}_3$  .....
- (c)  $\text{NH}_4\text{NO}_3$  .....
- (d)  $\text{Ca}(\text{HSO}_4)_2$  .....
- (e)  $\text{NaHCO}_3$  .....

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### Question 3

Write the chemical formulae for the following compounds. (5 marks)

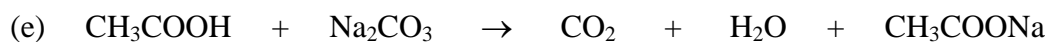
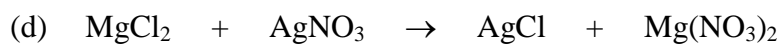
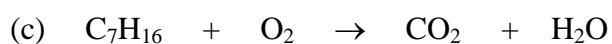
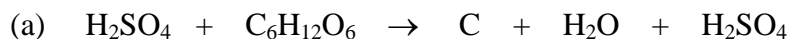
- (a) Calcium bromide .....
- (b) Lithium sulfate .....
- (c) Barium phosphate .....
- (d) Hydrogen iodide.....
- (e) Carbon monoxide .....

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### Question 4

Balance the following chemical equations.

(10 marks)



### Question 5

What are the masses of the following elements.

(6 marks)

(a) 2 mol of iron atoms.....

(b)  $6.02 \times 10^{23}$  tin atoms .....

(c)  $3.01 \times 10^{23}$  sodium atoms .....

(d) 3 mol of potassium atoms .....

(e)  $1.806 \times 10^{23}$  sodium atoms .....

(f) One argon atom .....

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**Question 7**

Using the idea of particles, explain why:

- a) a solid expands when it is heated

(2marks)

- b) a gas, but not a solid, can be compressed into a smaller volume.

(2marks)

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**Question 8**

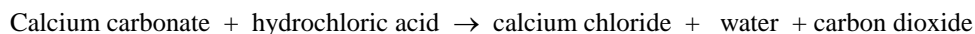
Draw a diagram to show the electron transfer when calcium and chlorine react to form calcium chloride .

(4 marks)

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### Question 9

The reaction between a fixed quantity of marble chips (calcium carbonate) and hydrochloric acid produces carbon dioxide gas.



The table below shows the results of a practical investigation involving marble chips and hydrochloric acid. (TOTAL 5 marks)

Time /minutes	Mass of gas (g)	
	Experiment 1	Experiment 2
	15°C	30°C
0	0.00	0.00
1	0.07	0.14
2	0.12	0.23
4	0.23	0.33
6	0.30	0.41
8	0.35	0.43
10	0.39	0.44
12	0.41	0.44
14	0.43	0.44
16	0.44	0.44

- a) How many grams of gas is produced during the first minute in experiment 1?  
(1 mark)
- b) How long does the reaction in experiment 2 take to stop?  
(1mark)
- c) What conclusion can you draw from this experiment about the rate of reaction?  
(1mark)
- d) What experimental condition was kept constant?  
(1 mark)
- e) Graph the results using the graph paper provided in the exam paper. Label all axis and label the graph.  
(3 marks)

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## Question 10

When hydrochloric acid reacts with zinc metal, hydrogen gas and zinc chloride are produced. The formulae for these substances are HCl, H<sub>2</sub>, Zn, and ZnCl<sub>2</sub>. (TOTAL = 10 marks)

(a) Name the reactants in this reaction? (1 mark)

.....

(b) Write a **balanced** chemical equation for the reaction between zinc and hydrochloric acid using the given chemical formulae. (2 marks)

.....

.....

(c) From the balanced chemical equation, how many moles of zinc are required to produce each mole of H<sub>2</sub> gas? (1 mark)

.....

.....

(d) What is the molar mass of zinc in g/mol? (1 mark)

.....

(e) Write down the formula used to calculate the number of moles present in a given mass? (1 mark)

.....

(f) Calculate the number of moles present in 20g of zinc? (1 mark)

.....

.....

(g) Using the number of moles calculated in part (f) along with the relationship determined in part (c), calculate the number of moles of hydrogen gas produced when all 20g of zinc have reacted. (1 mark)

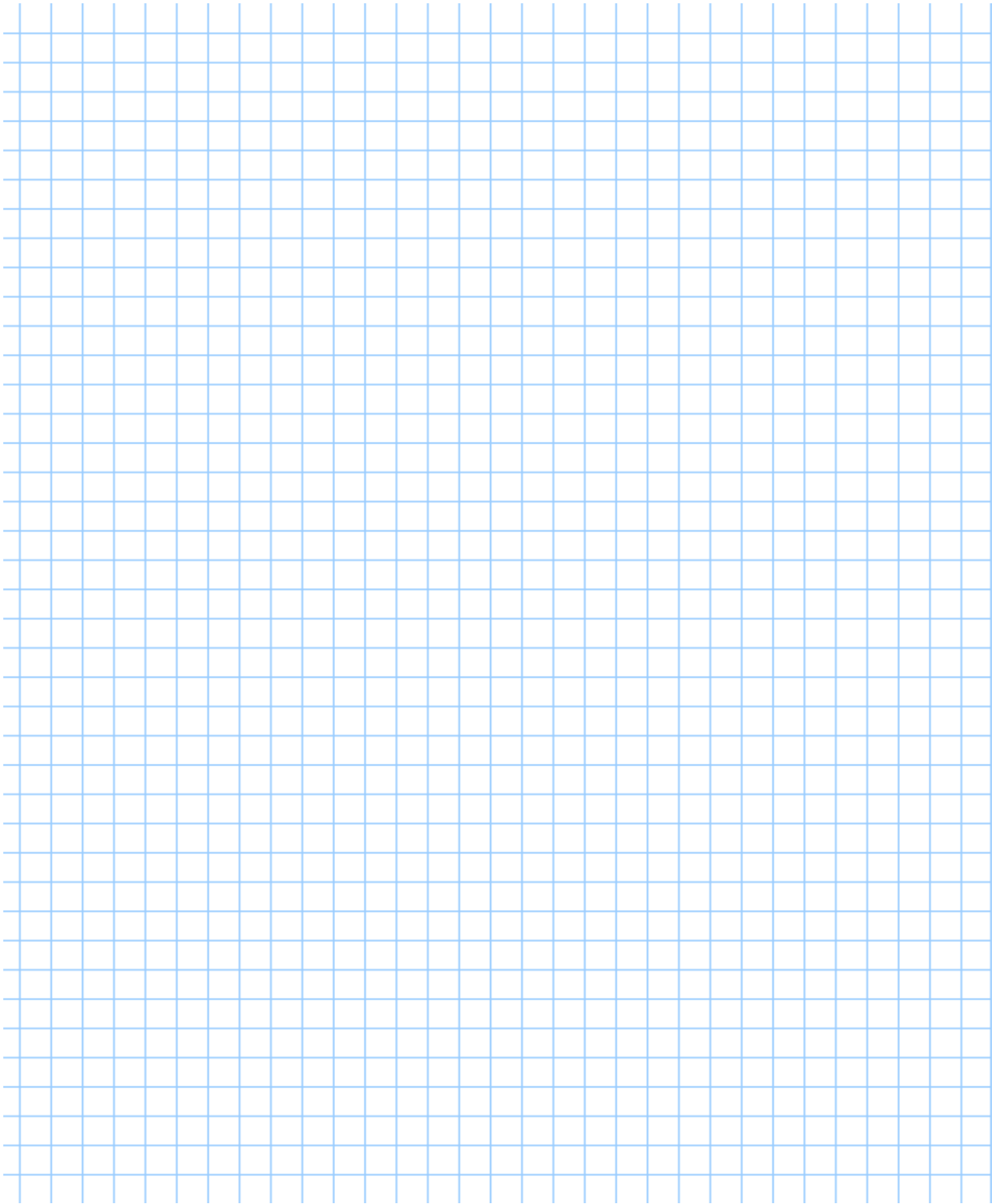
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(h) Write down the formula used to convert moles into mass. (1 mark)

.....

(i) Calculate the mass of H<sub>2</sub> gas that will have been produced when 20g of zinc have fully reacted with hydrochloric acid. (1 mark)



<b>Charge of 1+</b>	<b>Charge of 2+</b>	<b>Charge of 3+</b>
Ammonium(NH <sub>4</sub> <sup>+</sup> )	Magnesium(Mg <sup>2+</sup> )	Aluminium(Al <sup>3+</sup> )
Hydrogen(H <sup>+</sup> )	Calcium(Ca <sup>2+</sup> )	Chromium(Cr <sup>3+</sup> )
Lithium(Li <sup>+</sup> )	Barium(Ba <sup>2+</sup> )	Iron(III)(Fe <sup>3+</sup> )
Sodium(Na <sup>+</sup> )	Zinc(Zn <sup>2+</sup> )	
Potassium(K <sup>+</sup> )	Copper(II)(Cu <sup>2+</sup> )	
Silver(Ag <sup>+</sup> )	Mercury(Hg <sup>2+</sup> )	
Copper(Cu <sup>+</sup> )	Iron(II)(Fe <sup>2+</sup> )	
	Nickel(Ni <sup>2+</sup> )	
	Tin(II)(Sn <sup>2+</sup> )	
	Lead(II)(Pb <sup>2+</sup> )	
<b>Charge of 1-</b>	<b>Charge of 2-</b>	<b>Charge of 3-</b>
Hydroxide(OH <sup>-1</sup> )	Oxide(O <sup>-2</sup> )	Nitride(N <sup>-3</sup> )
Hydrogen sulfide(HS <sup>-1</sup> )	Sulfide(S <sup>-2</sup> )	Phosphate(PO <sub>4</sub> <sup>-3</sup> )
Nitrite(NO <sub>2</sub> <sup>-1</sup> )	Sulfate(SO <sub>4</sub> <sup>-2</sup> )	
Nitrate(NO <sub>3</sub> <sup>-1</sup> )	Sulfite(SO <sub>3</sub> <sup>-2</sup> )	
Acetate(CH <sub>3</sub> COO <sup>-1</sup> )	Carbonate(CO <sub>3</sub> <sup>-2</sup> )	
Fluoride(F <sup>-1</sup> )	Dichromate(Cr <sub>2</sub> O <sub>7</sub> <sup>-2</sup> )	
Chloride(Cl <sup>-1</sup> )		
Bromide(Br <sup>-1</sup> )		
Iodide(I <sup>-1</sup> )		
Permanganate(MnO <sub>4</sub> <sup>-1</sup> )		



