



# MAGDALEN COLLEGE SCHOOL

## 16+ Entrance Exam: **Chemistry**

Time allowed: 45 minutes

Name: .....

Current school: .....

### Instructions

- Use **black** ink or ball-point pen.
- Attempt **all** questions.
- Use the **answer grid** to answer the questions.
- Write your name and school on both this booklet **and** the answer grid.
- Remember to transfer your answers to the answer grid before the end of the test.
- You may use the space between questions for rough working, but nothing written in this booklet will be marked.

### Information

- There is one mark per question. The total mark for this paper is 30. You will not lose marks for incorrect answers.
- Calculators are permitted.

### Advice

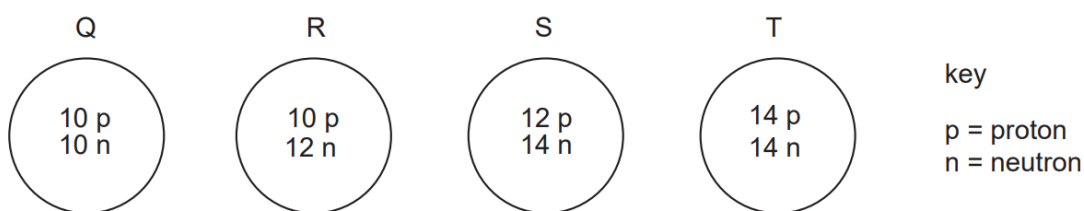
- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Write your answers neatly.
- Try to answer every question.
- Check your answers if you have time at the end.

**Total**      \_\_\_\_\_ /30      \_\_\_\_\_ %



1.

The diagrams show the nuclei of four different atoms.



Which two atoms are isotopes of each other?

- A** Q and R                      **B** Q and T                      **C** R and S                      **D** S and T

2.

Which change takes place when an atom becomes a positive ion?

- A** An electron is added.  
**B** An electron is removed.  
**C** A proton is added.  
**D** A proton is removed.

3.

One method of producing carbon dioxide is to react calcium carbonate with dilute hydrochloric acid.

What is the balanced chemical equation for the reaction?

- A**  $\text{CaCO}_3 + \text{HCl} \rightarrow \text{CaO} + \text{CO}_2 + \text{HCl}$   
**B**  $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$   
**C**  $\text{CaCO}_3 + 4\text{HCl} \rightarrow \text{CaCl}_4 + \text{CO}_2 + \text{H}_2 + \text{H}_2\text{O}$   
**D**  $\text{Ca}(\text{HCO}_3)_2 + \text{HCl} \rightarrow \text{CaCl} + 2\text{CO}_2 + \text{H}_2\text{O}$

4.

What changes when an ion is made from an atom?

- A** the number of electrons only
- B** the number of neutrons only
- C** the number of protons only
- D** the number both of protons and of neutrons

5.

Strontium, Sr, is a metal that forms an ionic chloride  $\text{SrCl}_2$ .

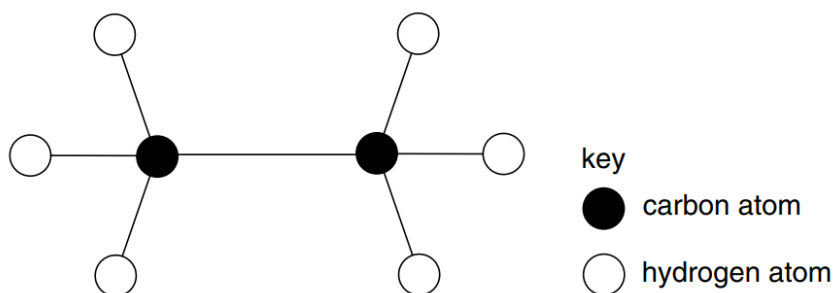
Sulphur, S, is a non-metal that forms a covalent chloride  $\text{SCl}_2$ .

Which compound is likely to have the higher melting point (m.p.) and which is more soluble in water?

	higher m.p.	more soluble in water
<b>A</b>	$\text{SrCl}_2$	$\text{SrCl}_2$
<b>B</b>	$\text{SrCl}_2$	$\text{SCl}_2$
<b>C</b>	$\text{SCl}_2$	$\text{SrCl}_2$
<b>D</b>	$\text{SCl}_2$	$\text{SCl}_2$

6.

The diagram shows a model of an organic compound.



What is the name of this compound?

- A ethane
- B ethanoic acid
- C ethanol
- D ethene

7.

An organic compound contains 38.4 % carbon, 4.80 % hydrogen and 56.8 % chlorine by mass. What is the empirical formula of the compound?

- A  $C_2H_3Cl$
- B  $CH_3Cl$
- C  $C_2H_5Cl$
- D  $C_3H_5Cl_3$

8.

Which of the following contains the greatest number of hydrogen atoms?

- A 2 moles of water,  $H_2O$
- B 1.5 moles of ammonia,  $NH_3$
- C 1 mole of hydrogen gas,  $H_2$
- D 0.5 moles of methane,  $CH_4$

9.

Which of the following formulae for compounds of germanium, Ge, is unlikely to be correct, given the position of germanium in the Periodic Table?

- A  $\text{GeF}_3$
- B  $\text{GeS}_2$
- C  $\text{GeO}_2$
- D  $\text{GeH}_4$

10.

Which of the following does **not** have exactly 10 electrons?

- A An ion of fluorine,  $\text{F}^-$
- B A molecule of methane,  $\text{CH}_4$
- C A molecule of nitrogen,  $\text{N}_2$
- D An ion of sodium,  $\text{Na}^+$

11.

Which pair of atoms contains the same number of neutrons?

- A  ${}_{27}^{59}\text{Co}$  and  ${}_{28}^{59}\text{Ni}$
- B  ${}_{29}^{64}\text{Cu}$  and  ${}_{29}^{65}\text{Cu}$
- C  ${}_{29}^{64}\text{Cu}$  and  ${}_{30}^{65}\text{Zn}$
- D  ${}_{29}^{65}\text{Cu}$  and  ${}_{30}^{65}\text{Zn}$

12.

Which statement describes the bonding in sodium chloride?

- A A shared pair of electrons between two atoms leading to a noble gas configuration.
- B A strong force of attraction between oppositely charged ions.
- C A strong force of attraction between two molecules.
- D A weak force of attraction between oppositely charged ions.

13.

A compound with the formula  $XO_2$  has a relative formula mass of 64.

What is X?

- A** cadmium
- B** copper
- C** gadolinium
- D** sulfur

14.

Metals W, X, Y and Z are reacted with dilute hydrochloric acid.

The oxides of metals W, X, Y and Z are heated with carbon.

The results are shown.

reaction	W	X	Y	Z
metal + dilute hydrochloric acid	fizzing	fizzing	violent fizzing	no reaction
metal oxide + carbon and heat	no reaction	metal produced	no reaction	metal produced

What is the order of reactivity of the metals?

	most reactive	—————→			least reactive
<b>A</b>	Y	W	X	Z	
<b>B</b>	Y	X	W	Z	
<b>C</b>	Z	W	X	Y	
<b>D</b>	Z	X	W	Y	

15.

Aqueous iron(III) sulfate and aqueous sodium hydroxide react to give a precipitate of iron(III) hydroxide and a solution of sodium sulfate.

What is the balanced symbol equation for this reaction?

- A**  $Fe_2(SO_4)_3(aq) + 2NaOH(aq) \rightarrow Fe(OH)_3(s) + Na_2SO_4(aq)$
- B**  $Fe_2(SO_4)_3(aq) + 3NaOH(aq) \rightarrow Fe(OH)_3(s) + 3Na_2SO_4(aq)$
- C**  $Fe_2(SO_4)_3(aq) + 6NaOH(aq) \rightarrow 2Fe(OH)_3(s) + 3Na_2SO_4(aq)$
- D**  $2Fe_2(SO_4)_3(aq) + 6NaOH(aq) \rightarrow 4Fe(OH)_3(s) + 6Na_2SO_4(aq)$

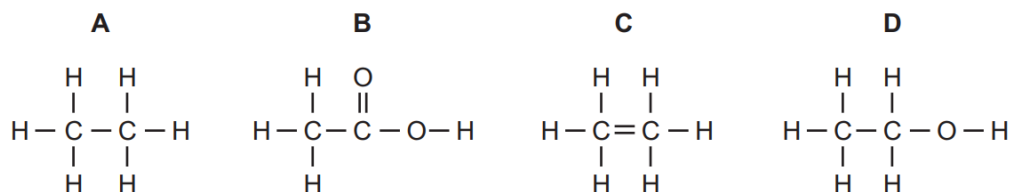
16.

What is the relative molecular mass,  $M_r$ , of  $\text{HNO}_3$ ?

- A 5                      B 31                      C 32                      D 63

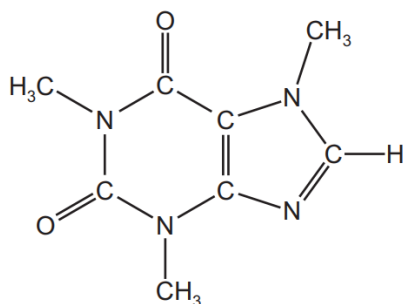
17.

Which structure is **incorrect**?



18.

Caffeine is a stimulant found in coffee.



caffeine

Which formula represents caffeine?

- A  $\text{C}_7\text{H}_{10}\text{N}_4\text{O}_2$     B  $\text{C}_8\text{H}_{10}\text{N}_3\text{O}_2$     C  $\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$     D  $\text{C}_8\text{H}_{11}\text{N}_4\text{O}_2$

19.

Which compound is made from elements which are **all** in the same period?

- A  $\text{Al}_2(\text{SO}_4)_3$     B  $\text{C}_2\text{H}_5\text{OH}$     C  $\text{LiNO}_3$     D  $\text{Na}_3\text{AlF}_6$

20.

Period 3 of the Periodic Table is shown.

Na	Mg	Al	Si	P	S	Cl	Ar
----	----	----	----	---	---	----	----

What increases from left to right across Period 3?

- A density
- B melting point
- C non-metallic character
- D the number of electron shells

21.

The table shows the electronic structure of four atoms.

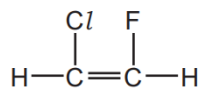
atom	electronic structure
W	2,8,1
X	2,8,4
Y	2,8,7
Z	2,8,8

Which two atoms combine to form a covalent compound?

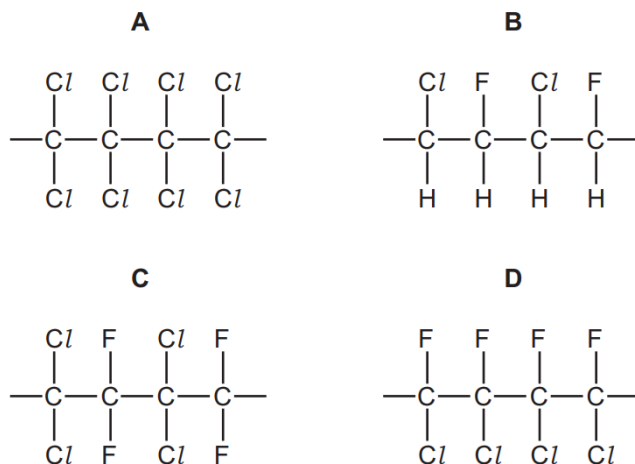
- A W and X
- B W and Y
- C X and Y
- D X and Z

22.

The structure of a monomer is shown.



Which polymer can be made from this monomer?



23.

Two atoms of magnesium, Mg, react with one molecule of oxygen, O<sub>2</sub>.

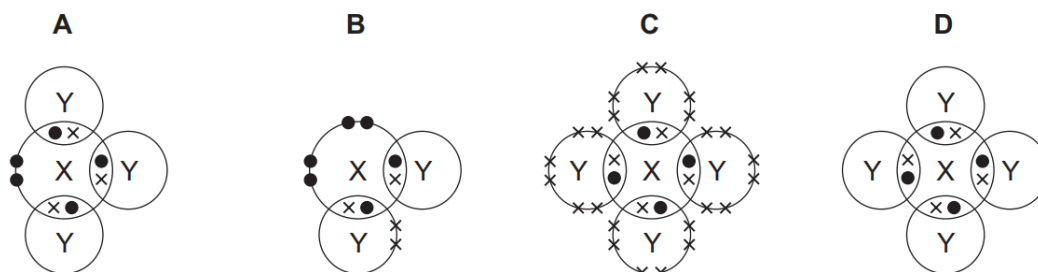
What is the formula of the product?

- A** MgO      **B** MgO<sub>2</sub>      **C** Mg<sub>2</sub>O      **D** Mg<sub>2</sub>O<sub>2</sub>

24.

In the following diagrams, X and Y are atoms of different elements.

Which diagram correctly shows the arrangement of outer electrons in a molecule of methane?



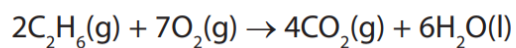
25.

Which statements comparing the properties of electrons, neutrons and protons are correct?

	neutrons and protons are both heavier than electrons	only electrons and neutrons are charged
<b>A</b>	✓	✓
<b>B</b>	✓	x
<b>C</b>	x	✓
<b>D</b>	x	x

26.

The equation for the complete combustion of ethane is



What volume of oxygen, measured at room temperature and pressure, is needed to completely burn 0.1 mol of ethane?

[The volume of 1 mol of any gas measured at room temperature and pressure is 24 dm<sup>3</sup>]

- A** 2.4 dm<sup>3</sup>
- B** 4.8 dm<sup>3</sup>
- C** 8.4 dm<sup>3</sup>
- D** 16.8 dm<sup>3</sup>

27.

The hydroxide ion,  $\text{OH}^-$ , has a total of 9 protons.

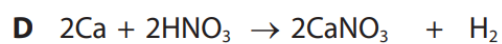
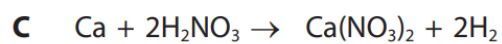
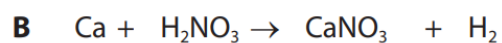
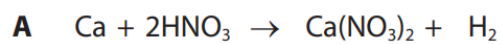
How many neutrons and electrons are there in this ion?

	Number of neutrons	Number of electrons
<b>A</b>	8	8
<b>B</b>	8	10
<b>C</b>	9	8
<b>D</b>	9	9

28.

Calcium reacts with dilute nitric acid to form calcium nitrate and hydrogen.

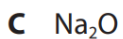
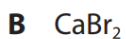
Which is the balanced equation for this reaction?



29.

Ions with the same electronic configuration are said to be **isoelectronic**.

Which of the following compounds is made up of isoelectronic ions?



30.

If **X** represents the element of atomic number 9 and **Y** the element of atomic number 20, the compound formed between these two elements is

- A covalent, **YX<sub>2</sub>**.
- B ionic, **YX<sub>2</sub>**.
- C covalent, **YX**.
- D ionic, **YX**.

**END OF QUESTION PAPER**

# 16+ Chemistry: ANSWER GRID

Name: \_\_\_\_\_

Current School: \_\_\_\_\_

<i>For marker's use only:</i>	
<i>Mark</i>	<i>Check</i>

You will have **45 minutes** for the test, which consists of 30 multiple choice questions. Each correct answer scores 1 mark. You will not lose marks for incorrect answers.

For each question, select the correct answer and write the corresponding letter in the answer grid below. For example, if you think the correct answer to question 1 is B, you would fill in the grid as shown in **Example 1**. If you make a mistake, clearly cross out your wrong answer and write the correct one next to it, as shown in **Example 2**.

**Example 1:**

Question	Answer
1	B

**Example 2:**

Question	Answer
1	<del>B</del> D

There is space for working by each question. Remember to transfer your answers to the answer grid (below) before the end of the test.

## Answer grid - write your answers here before the end of the test.

Question	Answer
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

*For marker's use only:*

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Question	Answer
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

*For marker's use only:*

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Question	Answer
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	

*For marker's use only:*

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