

## States of matter – 2023 AS Chemistry 9701

1. Nov/2023/Paper\_9701/11/No.7

When an evacuated tube of volume  $400\text{ cm}^3$  is filled with gas at  $300\text{ K}$  and  $101\text{ kPa}$ , the mass of the tube increases by  $0.65\text{ g}$ .

Assume the gas behaves as an ideal gas.

What is the identity of the gas?

- A argon
- B helium
- C krypton
- D neon

2. Nov/2023/Paper\_9701/11/No.8

Nitrogen,  $\text{N}_2$ , and carbon monoxide,  $\text{CO}$ , both have  $M_r = 28$ .

The boiling point of  $\text{N}_2$  is  $77\text{ K}$ .

The boiling point of  $\text{CO}$  is  $82\text{ K}$ .

What could be responsible for this difference in boiling points?

- A  $\text{CO}$  molecules have a permanent dipole; the  $\text{N}_2$  molecules are **not** polar.
- B  $\text{N}_2$  has  $\sigma$  and  $\pi$  bonding;  $\text{CO}$  has  $\sigma$  bonding only.
- C  $\text{N}_2$  has a strong  $\text{N}\equiv\text{N}$  bond;  $\text{CO}$  has a  $\text{C}=\text{O}$  bond.
- D The  $\text{CO}$  molecule has more electrons than the  $\text{N}_2$  molecule.

3. Nov/2023/Paper\_9701/12/No.9

At a temperature of  $2500\text{ K}$  and a pressure of  $1.00 \times 10^{-4}\text{ Pa}$ , a sample of  $0.321\text{ g}$  of sulfur vapour has a volume of  $2.08 \times 10^6\text{ m}^3$ .

What is the molecular formula of sulfur under these conditions?

- A S
- B  $\text{S}_2$
- C  $\text{S}_4$
- D  $\text{S}_8$

4. Nov/2023/Paper\_9701/12/No.10

In the structure of solid  $\text{SiO}_2$

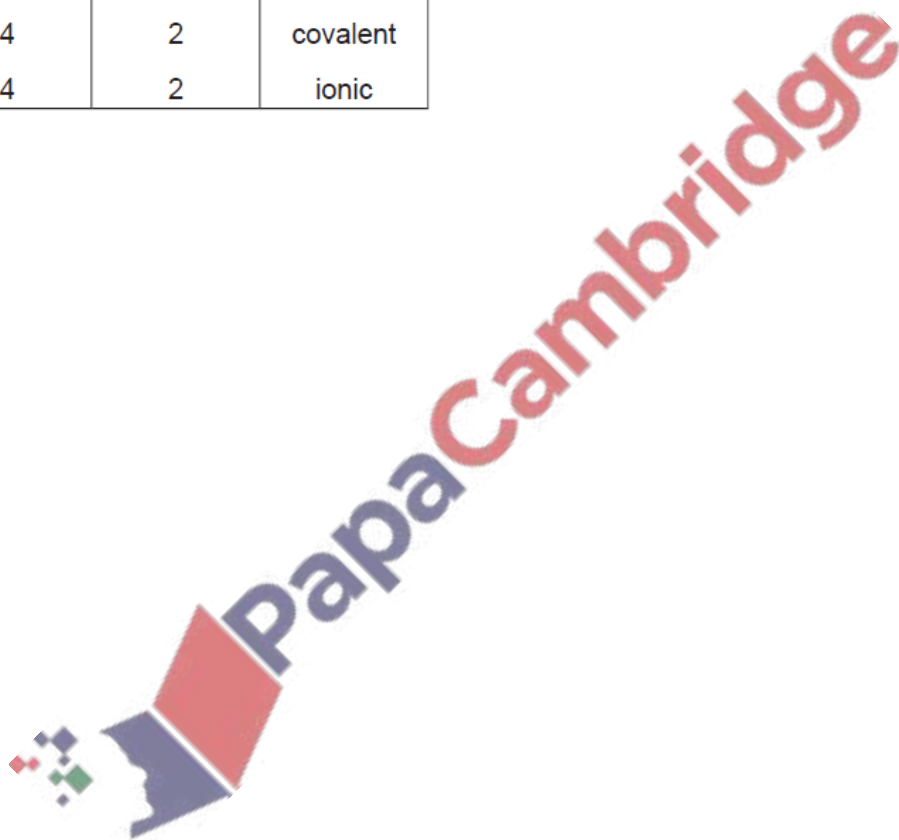
each silicon atom is bonded to  $x$  oxygen atoms

each oxygen atom is bonded to  $y$  silicon atoms

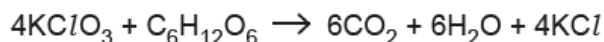
each bond is a  $z$  type bond.

What is the correct combination of  $x$ ,  $y$  and  $z$  in these statements?

	$x$	$y$	$z$
<b>A</b>	2	1	covalent
<b>B</b>	2	1	ionic
<b>C</b>	4	2	covalent
<b>D</b>	4	2	ionic



(d) Molten  $KClO_3$  reacts with glucose,  $C_6H_{12}O_6$ .



$KClO_3$  melts at 630K. At this temperature, both  $CO_2$  and  $H_2O$  are gases.

(i) Use the ideal gas equation to calculate the volume, in  $m^3$ , of one mole of gas at 630K and  $1.00 \times 10^5 Pa$ .

Show your working. Give your answer to 3 significant figures.

volume of 1 mol of gas = .....  $m^3$   
[1]

(ii) 5.00g of  $C_6H_{12}O_6$  reacts completely with molten  $KClO_3$ .

Use your answer to (d)(i) to calculate the total volume of gas released at 630K and  $1.00 \times 10^5 Pa$  in this reaction.

(If you were unable to answer (d)(i), use  $0.0463m^3$  in this question. This is **not** the correct answer to (d)(i).)

total volume of gas released = .....  $m^3$   
[2]

6. June/2023/Paper\_9701/11/No.6

In the sodium chloride lattice the number of chloride ions that surround each sodium ion is called the coordination number of the sodium ions.

What are the coordination numbers of the sodium ions and the chloride ions in the sodium chloride lattice?

	coordination number of sodium ions	coordination number of chloride ions
<b>A</b>	4	6
<b>B</b>	6	4
<b>C</b>	6	6
<b>D</b>	8	6

7. June/2023/Paper\_9701/11/No.13

In this question you should assume that the gas formed behaves as an ideal gas.

A 1.7 g sample of Mg reacts with 50.0 cm<sup>3</sup> of 2.2 mol dm<sup>-3</sup> HCl at 303 K and 110 400 Pa.

Which volume of gas is produced, measured under these conditions?

- A** 1.3 dm<sup>3</sup>      **B** 1.6 dm<sup>3</sup>      **C** 2.5 dm<sup>3</sup>      **D** 5.0 dm<sup>3</sup>

8. June/2023/Paper\_9701/11/No.16

For which compound is there the greatest percentage loss of mass on strong heating?

- A** anhydrous calcium carbonate  
**B** anhydrous calcium nitrate  
**C** anhydrous magnesium carbonate  
**D** anhydrous magnesium nitrate

9. June/2023/Paper\_9701/12/No.8

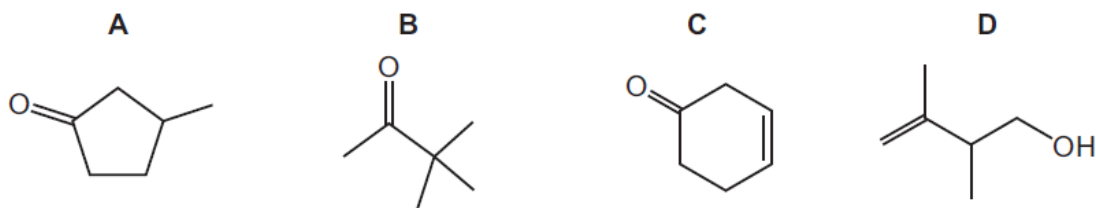
The volume of a vessel is 1.20 × 10<sup>-3</sup> m<sup>3</sup>. It contains pure argon at a pressure of 1.00 × 10<sup>5</sup> Pa, and at a temperature of 25.0 °C. Under these conditions it can be assumed that argon behaves as an ideal gas.

Which mass of argon does it contain?

- A** 0.0485 g      **B** 1.93 g      **C** 10.4 g      **D** 23.0 g

10. June/2023/Paper\_9701/12/No.25

Which compound has the molecular formula  $C_6H_{10}O$ ?



11. June/2023/Paper\_9701/13/No.7

Which assumptions are made about ideal gases?

- 1 Ideal gases contain molecules with no mass.
- 2 Ideal gases contain molecules with no volume.
- 3 Ideal gases have no intermolecular forces.

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

12. June/2023/Paper\_9701/13/No.8

A  $200\text{ cm}^3$  sample of water has an amount of oxygen gas dissolved in it.

This amount of oxygen gas has a volume of  $6.00\text{ cm}^3$  when measured at  $1.00 \times 10^5\text{ Pa}$  and  $35\text{ }^\circ\text{C}$ .

What is the concentration of oxygen gas in the water? (You should assume that oxygen behaves as an ideal gas.)

- A  $2.34 \times 10^{-4}\text{ mol dm}^{-3}$   
B  $1.17 \times 10^{-3}\text{ mol dm}^{-3}$   
C  $1.25 \times 10^{-3}\text{ mol dm}^{-3}$   
D  $1.03 \times 10^{-2}\text{ mol dm}^{-2}$

13. June/2023/Paper\_9701/13/No.9

Which statement explains why buckminsterfullerene has a lower melting point than graphite?

- A Buckminsterfullerene exists as discrete molecules with weak intermolecular bonding.  
B Graphite is partly ionic as its structure contains mobile electrons and it conducts electricity.  
C The carbon-carbon bonds in buckminsterfullerene are shorter and more strained.  
D The mobile electrons in graphite mean it has a metallic structure.

14. March/2023/Paper\_9701/12/No.9

Under which conditions will nitrogen behave most like an ideal gas?

	temperature	pressure
A	low	high
B	high	low
C	low	low
D	high	high

15. March/2023/Paper\_9701/12/No.11

Molten aluminium chloride has a simple molecular structure. Each molecule consists of two aluminium atoms and six chlorine atoms.

Which statement is correct?

- A All the chlorine atoms in 1 g of molten aluminium chloride have the same mass.
- B One mole of molten aluminium chloride contains  $6.02 \times 10^{23}$  aluminium atoms.
- C One mole of molten aluminium chloride contains  $3.61 \times 10^{24}$  chlorine atoms.
- D The empirical formula of molten aluminium chloride is  $Al_2Cl_6$ .

