

**Q1.**

Which one of the following samples of gas, when sealed into a vessel of volume 0.10 m^3 , is at the highest pressure?

- A 1.6 g of helium (He) at 100 K
- B 1.6 g of methane (CH_4) at 100 K
- C 1.6 g of oxygen (O_2) at 600 K
- D 1.6 g of sulphur dioxide (SO_2) at 1200 K

(Total 1 mark)

Q2.

What is the volume occupied by 10.8 g of the freon CCl_2F_2 at 100 kPa and 273 K?

- A 2.02 dm^3
- B 2.05 dm^3
- C 2.02 cm^3
- D 2.05 cm^3

(Total 1 mark)

Q3.

Which one of the following samples of gas occupies the largest volume?

- A 1.0 g of ozone (O_3) at 100 kPa and 300 K
- B 1.0 g of oxygen at 100 kPa and 300 K
- C 1.0 g of water vapour at 250 kPa and 450 K
- D 1.0 g of methane at 333 kPa and 500 K

(Total 1 mark)

**Q4.**

When heated, a sample of potassium chlorate(V) (KClO_3) produced 67.2 cm^3 of oxygen, measured at 298 K and 110 kPa



What is the amount, in moles, of potassium chlorate(V) that has decomposed?

The gas constant, $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$

- A 9.95×10^{-4}
- B 1.99×10^{-3}
- C 2.99×10^{-3}
- D 4.48×10^{-3}

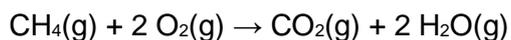
(Total 1 mark)

Q5.

Some bond enthalpies are given.

Bond	C—H	O—H	O=O	C=O
Bond enthalpy/ kJ mol^{-1}	412	463	496	743

Which is the enthalpy change of this reaction in kJ mol^{-1} ?



- A +698
- B +228
- C -228
- D -698

(Total 1 mark)

**Q6.**

Two sealed flasks with the same volume are left side by side.

Flask **A** contains 4.0×10^{-3} mol of methane.

Flask **B** contains 340 mg of a different gas.

Both gases are at the same temperature and pressure.

Which gas could be in Flask **B**?

- A** CH₂Cl₂
- B** HBr
- C** Kr
- D** PF₃

(Total 1 mark)

Q7.

A 385 cm³ sample of carbon dioxide at 100 kPa and 25 °C was mixed with 2.89×10^{-2} mol of argon. The gas constant, $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$

What is the mole fraction of carbon dioxide in the mixture?

- A** 0.35
- B** 0.46
- C** 0.54
- D** 0.65

(Total 1 mark)

Q8.

A student is provided with 5.00 cm³ of 1.00 mol dm⁻³ ammonia solution. The student was asked to prepare an ammonia solution with a concentration of 0.050 mol dm⁻³

What volume of water should the student add?

- A** 45.0 cm³
- B** 95.0 cm³
- C** 100 cm³
- D** 995 cm³



(Total 1 mark)

Q9.

130 cm³ of oxygen and 40 cm³ of nitrogen, each at 298 K and 100 kPa, were placed into an evacuated flask of volume 0.50 dm³.

What is the pressure of the gas mixture in the flask at 298 K?

- A 294 kPa
- B 68.0 kPa
- C 34.0 kPa
- D 13.7 kPa

(Total 1 mark)

Q10.

Which of these samples of gas contains the largest number of molecules?

The gas constant $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$.

- A $5.0 \times 10^{-4} \text{ m}^3$ at $1.0 \times 10^6 \text{ Pa}$ and 300 K
- B $4.0 \times 10^{-3} \text{ m}^3$ at $2.0 \times 10^5 \text{ Pa}$ and 400 K
- C $3.0 \times 10^1 \text{ dm}^3$ at $3.0 \times 10^4 \text{ Pa}$ and 500 K
- D $2.0 \times 10^2 \text{ dm}^3$ at $4.0 \times 10^3 \text{ Pa}$ and 600 K

(Total 1 mark)

Q11.

A sample of 2.18 g of oxygen gas has a volume of 1870 cm³ at a pressure of 101 kPa.

What is the temperature of the gas?

The gas constant is $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$.

- A 167 K
- B 334 K
- C 668 K
- D 334 000 K

(Total 1 mark)

**Q12.**

In an experiment to identify a Group 2 metal (X), 0.102 g of X reacts with an excess of aqueous hydrochloric acid according to the following equation.



The volume of hydrogen gas given off is 65 cm³ at 99 kPa pressure and 303 K.
The gas constant is $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$.

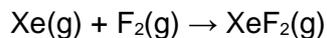
Which is X?

- A** Barium
- B** Calcium
- C** Magnesium
- D** Strontium

(Total 1 mark)

Q13.

30 cm³ of xenon are mixed with 20 cm³ of fluorine. The gases react according to the following equation. Assume that the temperature and pressure remain constant.



What is the final volume of gas after the reaction is complete?

- A** 50 cm³
- B** 40 cm³
- C** 30 cm³
- D** 20 cm³

(Total 1 mark)

**Q14.**

2 mol of ideal gas **X** are stored in a flask of fixed volume.

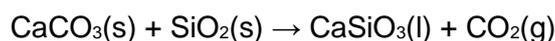
Which of the following changes would lead to the greatest increase in pressure inside the flask?

- A** Increasing the temperature from 20 °C to 200 °C
- B** Adding another 1 mol of gas **X** into the flask at fixed temperature
- C** Adding 0.5 mol of argon gas and increasing the temperature from 20 °C to 150 °C
- D** Removing 0.5 mol of gas **X** and increasing the temperature from 20 °C to 300 °C

(Total 1 mark)

Q15.

The removal of silicon dioxide with limestone in the Blast Furnace can be represented by the following equation.



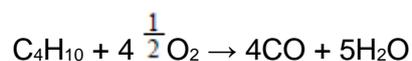
The volume of carbon dioxide, measured at 298 K and 1.01×10^5 Pa, formed in this reaction during the removal of 1.00 tonne (1000 kg) of silicon dioxide is

- A** 24.5 dm³
- B** 408 dm³
- C** 24.5 m³
- D** 408 m³

(Total 1 mark)

Q16.

An equation for the incomplete combustion of butane in oxygen is



The volume in dm³ of oxygen at 295 K and 100 kPa required to burn 0.1 mol of butane to form steam and carbon monoxide only is

- A** 8.6
- B** 11
- C** 12
- D** 16

(Total 1 mark)

**Q17.**

Sodium hydrogencarbonate decomposes on heating as shown by the equation below.



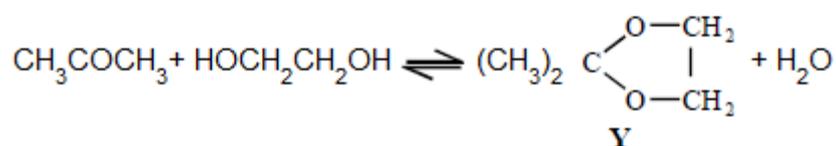
The volume of carbon dioxide, measured at 298 K and 101 kPa, obtained by heating 0.0500 mol of sodium hydrogencarbonate is

- A 613 cm³
- B 1226 cm³
- C 613 dm³
- D 1226 dm³

(Total 1 mark)

Q18.

This question is about the reaction between propanone and an excess of ethane-1,2-diol, the equation for which is given below.



In a typical procedure, a mixture of 1.00 g of propanone, 5.00 g of ethane-1,2-diol and 0.100 g of benzenesulphonic acid, C₆H₅SO₃H, is heated under reflux in an inert solvent. Benzenesulphonic acid is a strong acid.

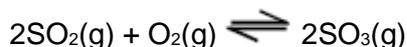
If 1.00 g of propanone was vapourised at 100 °C and 100 kPa pressure, the volume in m³ of gas formed would be

- A 31.0
- B 8.31
- C 0.534
- D 5.34 × 10⁻⁴

(Total 1 mark)

**Q19.**

This question relates to the equilibrium gas-phase synthesis of sulphur trioxide:



Thermodynamic data for the components of this equilibrium are:

Substance	$\Delta H_f^\ominus / \text{kJ mol}^{-1}$	$S^\ominus / \text{J K}^{-1} \text{mol}^{-1}$
$\text{SO}_3(\text{g})$	-396	+257
$\text{SO}_2(\text{g})$	-297	+248
$\text{O}_2(\text{g})$	0	+204

This equilibrium, at a temperature of 585 K and a total pressure of 540 kPa, occurs in a vessel of volume 1.80 dm³. At equilibrium, the vessel contains 0.0500 mol of $\text{SO}_2(\text{g})$, 0.0800 mol of $\text{O}_2(\text{g})$ and 0.0700 mol of $\text{SO}_3(\text{g})$.

At equilibrium in the same vessel of volume 1.80 dm³ under altered conditions, the reaction mixture contains 0.0700 mol of $\text{SO}_3(\text{g})$, 0.0500 mol of $\text{SO}_2(\text{g})$ and 0.0900 mol of $\text{O}_2(\text{g})$ at a total pressure of 623 kPa. The temperature in the equilibrium vessel is

- A 307 °C
- B 596 K
- C 337 °C
- D 642 K

(Total 1 mark)

Q20.

Which one of the following contains the smallest number of moles of carbon dioxide gas?

- A 2.65 g
- B 0.0150 m³ at 1000 K and 33.0 kPa
- C 1.50 dm³ at 327 °C and 200 kPa
- D 1500 cm³ at 300 K and 100 kPa

(Total 1 mark)

**Q21.**

On complete combustion, 0.0150 mol of an organic acid produced 735 cm³ of carbon dioxide (measured at 101 kPa and 298 K). The same amount of acid required 15.0 cm³ of 2.00 M sodium hydroxide solution for neutralisation. Which one of the following could be the formula of the acid?

- A** HCOOH
- B** CH₃COOH
- C** HOCCOH
- D** HOOCCH₂CH₂COOH

(Total 1 mark)

**Mark schemes****Q1.**

A

[1]

Q2.

A

[1]

Q3.

C

[1]

Q4.

B

[1]

Q5.

D

[1]

Q6.

A

[1]

Q7.

A

[1]

Q8.

B

[1]

Q9.

C

[1]

Q10.

B

[1]



Q11.
B

[1]

Q12.
B

[1]

Q13.
C

[1]

Q14.
C

[1]

Q15.
D

[1]

Q16.
B

[1]

Q17.
A

[1]

Q18.
D

[1]

Q19.
D

[1]

Q20.
B

[1]

Q21.
C