Access Tuition

A-Level Chemistry

Amount of Substance (Multiple Choice)

Question Paper

Time available: 34 minutes
Marks available: 30 marks

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1. A compound contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen by mass.

Which could be the molecular formula of this compound?

A $C_2H_2O_2$

B C_2H_2O

C $C_2H_4O_2$

D C_2HO_2

(Total 1 mark)

2. When driving a car, a legal limit for ethanol (M_r = 46.0) is 80 mg per 100 cm^3 of blood.

What is this concentration in mol dm^{-3}?

A 1.74×10^{-1}

B 1.74×10^{-2}

C 1.74×10^{-3}

D 1.74×10^{-4}

(Total 1 mark)

3. What is the percentage atom economy for the production of ethanol from glucose?

$$C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$$

A 25.6%

B 27.1%

C 51.1%

D 54.2%

(Total 1 mark)

4. What is the mole fraction of 1.0 g of a compound of relative molecular mass 100.0 dissolved in 30.0 g of a solvent of relative molecular mass 50.0?

A 6.0×10^{-3}

B 1.6×10^{-2}

C 1.7×10^{-2}

D 3.0×10^{-2}

(Total 1 mark)

5. Which compound needs the greatest amount of oxygen for the complete combustion of 1 mol of the compound?

A ethanal

B ethanol

C ethane-1,2-diol

D methanol

(Total 1 mark)

6. Nitration of 1.70 g of methyl benzoate (M_r = 136.0) produces methyl 3-nitrobenzoate (M_r = 181.0). The percentage yield is 65.0%

What mass, in g, of methyl 3-nitrobenzoate is produced?

A 0.830

B 1.10

C 1.47

D 2.26

(Total 1 mark)

7. What is the empirical formula of a hydrocarbon that contains 90% carbon by mass?

A C_2H_3 ⬭

B C_3H_2 ⬭

C C_3H_4 ⬭

D C_4H_3 ⬭

(Total 1 mark)

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

$$2\ KClO_3(s) \rightarrow 2\ KCl(s) + 3\ O_2(g)$$

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

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

A 9.95×10^{-4} ⬭

B 1.99×10^{-3} ⬭

C 2.99×10^{-3} ⬭

D 4.48×10^{-3} ⬭

(Total 1 mark)

9. A student rinsed the apparatus before starting an acid-base titration.
The results of the titration showed that the volume of acid added from the burette was larger than expected.

Which is a possible reason for this?

A The conical flask was rinsed with water before the titration. ⬭

B The walls of the conical flask were rinsed with water during the titration. ⬭

C The pipette was rinsed only with water. ⬭

D The burette was rinsed only with water. ⬭

(Total 1 mark)

10. Which sample, measured at room temperature and pressure, contains the greatest number of the stated particles?

A 1 g of hydrogen molecules ⬭

B 1 g of helium atoms ⬭

C 1 dm^3 of hydrogen molecules ⬭

D 1 dm^3 of helium atoms ⬭

(Total 1 mark)

11. The equation below represents the complete combustion of butane.

$$C_4H_{10}(g) + 6\frac{1}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$$

20 cm^3 of butane are completely burned in 0.20 dm^3 of oxygen.
Which statement is correct?

All volumes are measured at the same temperature and pressure.

A 40 cm^3 of carbon dioxide are formed ⬭

B 0.065 dm^3 of oxygen react ⬭

C 70 cm^3 of oxygen remain ⬭

D 0.50 dm^3 of steam are formed ⬭

(Total 1 mark)

12. A 'drink-driving' offence is committed if the blood alcohol level of a driver is over 80 mg of ethanol per 100 cm^3 of blood.
What is the concentration, in mol dm^{-3}, of ethanol if there are 80 mg of ethanol (M_r = 46.0) per 100 cm^3 of blood?

A 0.00017 ⬭

B 0.0017 ⬭

C 0.017 ⬭

D 1.7 ⬭

(Total 1 mark)

13. What is the percentage yield when 20 g of aluminium are produced from 50 g of aluminium oxide?

$$2Al_2O_3 \rightarrow 4Al + 3O_2$$

A 76% ⬭

B 40% ⬭

C 33% ⬭

D 19% ⬭

(Total 1 mark)

14. How many protons are there in 6.0 g of nitrogen gas?

Avogadro constant, $L = 6.022 \times 10^{23}\ \text{mol}^{-1}$

A 1.3×10^{23} ⬭

B 9.0×10^{23} ⬭

C 1.8×10^{24} ⬭

D 3.6×10^{24} ⬭

(Total 1 mark)

15. A solution of volume 500 cm^3 contains 150 g of ammonia.

What is the concentration, in mol dm^{-3}, of ammonia in this solution?

A 0.51 ⬭

B 8.82 ⬭

C 16.7 ⬭

D 17.6 ⬭

(Total 1 mark)

16. A student devised an experiment to find the concentration of sulfuric acid in a sample of battery acid.

- A measuring cylinder was used to transfer 10 cm^3 of battery acid to a volumetric flask.
- Distilled water was added to the volumetric flask until the volume reached 250 cm^3
- A 25.0 cm^3 sample of diluted acid was transferred from the volumetric flask to a conical flask using a pipette.
- A few drops of methyl orange indicator were added to the acid in the conical flask before titrating the acid with sodium hydroxide.
- The titration was repeated five times but concordant results were **not** obtained. (Note: Methyl orange is red in acid and yellow in alkali.)

Which suggestion about rinsing the conical flask between each titration would improve the accuracy of the titrations?

A Rinsing with acid. ○

B Rinsing with alkali. ○

C Rinsing with water. ○

D No rinsing with any liquid. ○

(Total 1 mark)

17. Which sample of liquid has the greatest volume?

A 500 mg of pentane (density = 0.63 g cm^{-3}) ○

B 650 mg of propan-1-ol (density = 0.80 g cm^{-3}) ○

C 1.20 g of dichloromethane (density = 1.33 g cm^{-3}) ○

D 1.30 g of trichloromethane (density = 1.48 g cm^{-3}) ○

(Total 1 mark)

18. Which of these contains the greatest number of atoms?

A 127 mg of iodine ○

B 1.54×10^{-4} kg of phosphorus ○

C 81.0 mg of carbon dioxide ○

D 1.70×10^{-4} kg of ammonia ○

(Total 1 mark)

19. 25.0 cm^3 samples of NaOH solution were taken by pipette from a beaker. These were then titrated with an aqueous solution of ethanoic acid. The concentration of ethanoic acid calculated from the experimental results was found to be lower than the actual value.

Which of these could explain the difference?

A Rinsing the pipette with distilled water before filling with NaOH

B Rinsing the burette with distilled water before filling with ethanoic acid

C Rinsing the walls of the conical flask with distilled water during the titration

D Rinsing the beaker with distilled water before filling with NaOH

(Total 1 mark)

20. A 20.0 cm^3 sample of a 0.400 mol dm^{-3} aqueous solution of a metal bromide (MBr_n) reacts exactly with 160 cm^3 of 0.100 mol dm^{-3} aqueous silver nitrate.

What is the formula of the metal bromide?

A MBr

B MBr_2

C MBr_3

D MBr_4

(Total 1 mark)

21. What is the empirical formula of an oxide of nitrogen that contains 26% nitrogen by mass?

A NO_2

B N_2O_3

C N_2O_5

D N_4O_5

(Total 1 mark)

22. 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 CH_2Cl_2 ⬭

B HBr ⬭

C Kr ⬭

D PF_3 ⬭

(Total 1 mark)

23. Analysis of a sample of a chemical with formula $C_{22}H_{30}N_6O_4S$, showed that it contained 0.0195 mol of carbon.

What mass of nitrogen was present in the sample?

A 0.041 g ⬭

B 0.057 g ⬭

C 0.074 g ⬭

D 0.420 g ⬭

(Total 1 mark)

24. A 385 cm^3 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 J K^{-1} 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)

25. 130 cm^3 of oxygen and 40 cm^3 of nitrogen, each at 298 K and 100 kPa, were placed into an evacuated flask of volume 0.50 dm^3.

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)

26. A measuring cylinder has an uncertainty of ±5 cm^3.

What is the minimum volume of liquid that can be measured if the percentage error in the volume is to be less than 0.20%?

A 0.025 dm^3

B 0.25 dm^3

C 2.5 dm^3

D 25 dm^3

(Total 1 mark)

27. Which reaction has the largest atom economy for the production of hydrogen?

A $C + H_2O \longrightarrow CO + H_2$ ⬭

B $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$ ⬭

C $CH_4 + H_2O \longrightarrow CO + 3H_2$ ⬭

D $CO + H_2O \longrightarrow CO_2 + H_2$ ⬭

(Total 1 mark)

28. Which of these pieces of apparatus has the lowest percentage uncertainty in the measurement shown?

A Volume of 25 cm^3 measured with a burette with an uncertainty of ±0.1 cm^3. ⬭

B Volume of 25 cm^3 measured with a measuring cylinder with an uncertainty of ±0.5 cm^3. ⬭

C Mass of 0.150 g measured with a balance with an uncertainty of ±0.001 g. ⬭

D Temperature change of 23.2 °C measured with a thermometer with an uncertainty of ±0.1 °C. ⬭

(Total 1 mark)

29. A sample of 2.18 g of oxygen gas has a volume of 1870 cm^3 at a pressure of 101 kPa.

What is the temperature of the gas?
The gas constant is R = 8.31 J K^{-1} mol^{-1}.

A 167 K ⬭

B 334 K ⬭

C 668 K ⬭

D 334 000 K ⬭

(Total 1 mark)

30. A saturated aqueous solution of magnesium hydroxide contains 1.17×10^{-3} g of $Mg(OH)_2$ in 100 cm^3 of solution. In this solution, the magnesium hydroxide is fully dissociated into ions.

What is the concentration of $Mg^{2+}(aq)$ ions in this solution?

A 2.82×10^{-2} mol dm^{-3} ○

B 2.01×10^{-3} mol dm^{-3} ○

C 2.82×10^{-3} mol dm^{-3} ○

D 2.01×10^{-4} mol dm^{-3} ○

(Total 1 mark)