1.2 Reacting Masses & Volumes

Question Paper

Course	DP IB Chemistry
Section	1. Stoichiometric Relationships
Topic	1.2 Reacting Masses & Volumes
Difficulty	Hard

Time allowed: 20

Score: /12

Percentage: /100

Question 1

A periodic table is needed for this question

When a 1.00 g sample of carbon is burned in a limited supply of oxygen, 0.72 g of the carbon combusts to form CO_2 and 0.28 g of the carbon combusts to form CO

These gases were passed through excess NaOH(aq) which absorbs the CO_2, but not the CO. The remaining gas was then dried and collected.

Assuming that all gas volumes were taken at 25˚C and 100 kPa pressure, what was the volume of gas at the end of the reaction? (Molar Volume of a gas at rtp = 24 dm^3)

A 0.01 dm^3

B 100 cm^3

C 2.40 dm^3

D 240 cm^3

[1 mark]

Question 2

A periodic table is needed for this question

Chicken eggs are made up of 5% by mass of egg shell. The average egg has a mass of 50 g.

Assume that chicken eggshell is pure calcium carbonate.

How many complete chicken's egg shells would need to neutralise 50 cm^3 of 2.0 mol dm^{-3} ethanoic acid?

A 4

B 3

C 2

D 1

[1 mark]

Question 3

A periodic table is needed for this question

When a sample of potassium oxide, K_2O, is dissolved in 250 cm^3 of distilled water, 25 cm^3 of this solution is titrated against sulfuric acid with a concentration of 2.00 mol dm^{-3}. Complete neutralisation takes place with 15 cm^3 of sulfuric acid.

What is the mass of the original sample of potassium oxide dissolved in 250 cm^3 of distilled water?

A $\frac{0.015 \times 250 \times 94.20}{25}$

B $\frac{2.00 \times 0.015 \times 94.20}{25}$

C $\frac{2.00 \times 0.015 \times 250 \times 94.20}{25}$

D $\frac{2.00 \times 0.015 \times 25 \times 94.20}{250}$

[1 mark]

Question 4

A periodic table is needed for this question

Iron and chromium can be made into an alloy called ferrochrome. Ferrochrome can be dissolved in dilute sulfuric acid to produce $FeSO_4$ and $Cr_2(SO_4)_3$. The $FeSO_4$ reacts with acidified $K_2Cr_2O_7$ as shown in this equation:

$$14H^+ + 6Fe^{2+} + Cr_2O_7^{2-} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$$

When 1.00 g of ferrochrome is dissolved in dilute sulfuric acid and then titrated, 13.1 cm^3 of 0.100 mol dm^{-3} $K_2Cr_2O_7$ is needed for the complete reaction.

In the sample of ferrochrome, what is the percentage by mass of Fe?

A $\dfrac{13.1 \times 0.1 \times 6 \times 55.85 \times 100}{1000 \times 1}$

B $\dfrac{13.1 \times 0.1 \times 6 \times 55.85}{1000}$

C $\dfrac{13.1 \times 0.1 \times 55.85 \times 100}{1000 \times 1}$

D $\dfrac{13.1 \times 0.1 \times 6 \times 55.85 \times 1000}{100 \times 1}$

[1 mark]

Question 5

10 cm^3 of methane and 10 cm^3 of ethane were sparked with an excess of oxygen. Once cooled, the remaining gas was passed through aqueous potassium hydroxide, which absorbs carbon dioxide.

Assume all measurements were taken at 25°C and 1 atm pressure.

What volume of gas is absorbed by the alkali?

A 45 cm^3

B 30 cm^3

C 20 cm^3

D 10 cm^3

[1 mark]

Question 6

A solution of Sn^{2+} ions will reduce MnO_4^- ions to Mn^{2+} ions when acidified. The Sn^{2+} ions are oxidised to Sn^{4+} ions in this reaction.

How many moles of Mn^{2+} ions are formed when a solution containing 18.96 g of $SnCl_2$ (M_r: 189.60) is added to an excess of acidified $KMnO_4$ solution?

A 0.010

B 0.015

C 0.040

D 0.050

[1 mark]

Question 7

Some fireworks can use the reaction between aluminium powder and anhydrous barium nitrate as a propellant. Metal oxides and nitrogen are the only products when this happens.

$$10Al + 3Ba(NO_3)_2 \rightarrow 5Al_2O_3 + 3BaO + 3N_2$$

When 0.783 g of anhydrous barium nitrate (M_r 261.35) reacts with an excess of aluminium what is the volume of nitrogen produced in cm^3?
(Molar volume of a gas = 24 dm^3)

A $\frac{0.783 \times 24 \times 3}{261.35}$

B $\frac{261.35 \times 24000}{0.783 \times 1000}$

C $\frac{261.35}{0.783 \times 24000}$

D $\frac{0.783 \times 24000}{261.35}$

[1 mark]

Question 8

A periodic table is needed for this question

Excess acidified potassium dichromate(VI) was mixed with 2.76 g of ethanol. The reaction mixture was then boiled under reflux for one hour. Once the reaction had completed, the organic product was collected by distillation.

The yield of the product was 75.0%

What is the mass of the product collected?

A $\frac{2.76 \times 60.06}{46.08}$

B $\frac{75 \times 2.76 \times 60.06}{100 \times 46.08}$

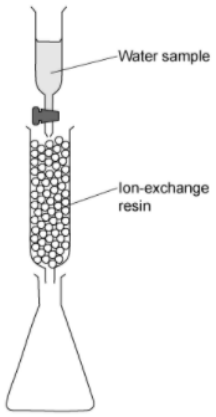
C $\frac{100 \times 2.76 \times 60.06}{75 \times 46.08}$

D $\frac{75 \times 2.76 \times 46.08}{100 \times 60.06}$

[1 mark]

Question 9

The concentration of calcium ions in a sample of water can be determined by using an ion-exchange column, shown in the diagram below:



A 50 cm^3 sample of water containing dissolved calcium sulfate was passed through the ion-exchange resin.

Each calcium ion in the sample was exchanged for two hydrogen ions. The resulting acidic solution collected in the flask required 25 cm^3 of 1.0 x 10^{-2} mol dm^{-3} potassium hydroxide for complete neutralisation.

What was the concentration of the calcium sulfate in the original sample?

A $\frac{0.050 \times 1.0 \times 10^{-2}}{2 \times 0.025}$

B $\frac{0.025 \times 1.0 \times 10^{-2}}{0.050}$

C $\frac{25 \times 1.0 \times 10^{-2}}{2 \times 0.050}$

D $\frac{0.025 \times 1.0 \times 10^{-2}}{2 \times 0.050}$

[1 mark]

Question 10

A tube of volume 0.3 dm^3 is filled with a gas at 27 °C and 100kPa, the mass of the tube increases by 1.01×10^{-3} kg.

Assume the gas is obeying the ideal gas laws.

If M_r is the Molar mass of the gas, what is the mass of this sample of gas?

A $\frac{100000 \times 0.0003}{8.314 \times 27 \times M_r}$

B $\frac{100 \times 0.0003 \times M_r}{8.314 \times 300}$

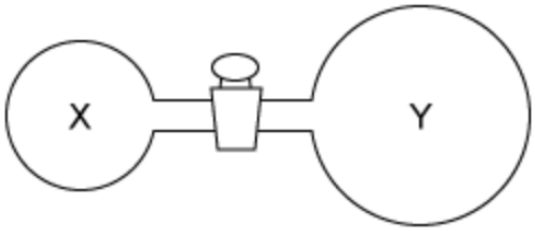
C $\frac{100000 \times 0.3 \times M_r}{8.314 \times 300}$

D $\frac{100000 \times 0.0003 \times M_r}{8.314 \times 300}$

[1 mark]

Question 11

The glass containers X and Y are connected by a closed valve.



X contains pure CO_2 gas at 25 °C and a pressure of 1×10^5 Pa. Container Y has been evacuated prior to the experiment and has a volume three times bigger than container X.

During the experiment, the valve is opened, and the temperature of the whole apparatus is raised to 160 °C.

What is the final pressure in the system?

A $\frac{1 \times 10^5 \times 160}{4 \times 25}$

B $\frac{4 \times 10^5 \times 433}{3 \times 298}$

C $\frac{1 \times 10^5 \times 433}{3 \times 298}$

D $\frac{1 \times 10^5 \times 433}{4 \times 298}$

[1 mark]

Question 12

Iodine is a shiny, black solid. Solid iodine sublimes easily when heated to produce a purple vapour.

A block of solid iodine is put into a closed container and completely sublimed to produce 1.3 dm^3 of iodine vapour. It is then kept at a constant temperature and pressure of 100kPa.

The empty container had a mass of 3.22 g and when iodine was added the mass increased to 9.57 g. (M_r I_2= 253.8)

If iodine vapour acts as an ideal gas, what is the approximate temperature of the iodine vapour?

A $\dfrac{(9.57 - 3.22) \times 100000 \times 0.0013}{253.8 \times 8.314}$

B $\dfrac{253.8 \times 100000 \times 0.0013}{(9.57 - 3.22) \times 8.314}$

C $\dfrac{253.8 \times 100000 \times 1.3}{(9.57 - 3.22) \times 8.314}$

D $\dfrac{253.8 \times 100 \times 0.0013}{(9.57 - 3.22) \times 8.314}$

[1 mark]