



CHEMISTRY ONLINE
— TUITION —

Phone: 00442081445350

www.chemistryonlinetuition.com

Emil:asherrana@chemistryonlinetuition.com

CHEMISTRY

Physical Chemistry

Level & Board	AQA (A-LEVEL)
TOPIC:	AMOUNT OF SUBSTANCE
PAPER TYPE:	QUESTION PAPER 1
TOTAL QUESTIONS	10
TOTAL MARKS	47

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Amount of Substance

1. 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

(1)

2. Sodium chlorate(V), $NaClO_3$, contains 21.6% by mass of sodium, 33.3% by mass of chlorine and 45.1% by mass of oxygen.

(a) Use the above data to show that the empirical formula of sodium chlorate(V) is $NaClO_3$

(1)

(b) Sodium chlorate(V) may be prepared by passing chlorine into hot aqueous sodium hydroxide. Balance the equation for this reaction below.



(3)

3. A sample of hydrated nickel sulfate ($NiSO_4 \cdot xH_2O$) with a mass of 2.287 g was heated to remove all water of crystallisation. The solid remaining had a mass of 1.344 g.

(a) Calculate the value of the integer x. Show your working.

(4)

(b) Suggest how a student doing this experiment could check that all the water had been removed.

(2)

4. 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)

5. Steel rods are cleaned before they are painted. The rods are cleaned by passing them through a bath of dilute sulfuric acid.
This process produces large quantities of iron(II) sulfate.

(a) Write an equation for the reaction between iron and dilute sulfuric acid.

(1)

(b) State one chemical hazard in this process and suggest an appropriate safety precaution for this hazard.

(2)

6. 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)

7. Zinc forms many different salts including zinc sulfate, zinc chloride and zinc fluoride.

(a) People who have a zinc deficiency can take hydrated zinc sulfate ($\text{ZnSO}_4 \cdot x\text{H}_2\text{O}$) as a dietary supplement.

A student heated 4.38 g of hydrated zinc sulfate and obtained 2.46 g of anhydrous zinc sulfate.

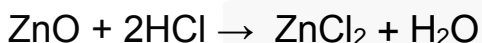
Use these data to calculate the value of the integer x in $\text{ZnSO}_4 \cdot x\text{H}_2\text{O}$
Show your working.

I am Sorry !!!!!

(3)

(b) Zinc chloride can be prepared in the laboratory by the reaction between zinc oxide and hydrochloric acid.

The equation for the reaction is

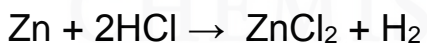


A 0.0830 mol sample of pure zinc oxide was added to 100 cm³ of 1.20 mol dm⁻³ hydrochloric acid.

Calculate the maximum mass of anhydrous zinc chloride that could be obtained from the products of this reaction.

(4)

(c) Zinc chloride can also be prepared in the laboratory by the reaction between zinc and hydrogen chloride gas.



An impure sample of zinc powder with a mass of 5.68 g was reacted with hydrogen chloride gas until the reaction was complete. The zinc chloride produced had a mass of 10.7 g.

Calculate the percentage purity of the zinc metal. Give your answer to 3 significant figures.

(4)

(d) Predict the type of crystal structure in solid zinc fluoride and explain why its melting point is high.

(3)

8. A student carried out an experiment to find the mass of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ in an impure sample, X. The student recorded the mass of X. This sample was dissolved in water and made up to 250 cm^3 of solution. The student found that, after an excess of acid had been added, 25.0 cm^3 of this solution reacted with 21.3 cm^3 of a $0.0150 \text{ mol dm}^{-3}$ solution of $\text{K}_2\text{Cr}_2\text{O}_7$

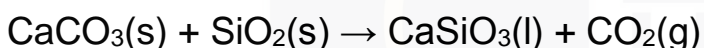
(a) Use this information to calculate a value for the mass of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ in the sample of X.

(5)

(b) The student found that the calculated mass of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ was greater than the actual mass of the sample that had been weighed out. The student realised that this could be due to the nature of the impurity. Suggest one property of an impurity that would cause the calculated mass of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ in X to be greater than the actual mass of X. Explain your answer.

(2)

9. 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)

10. A student added 550 mg of hydrated potassium chloride ($\text{KCl} \cdot y\text{H}_2\text{O}$) to 150 cm³ of 0.300 mol dm⁻³ sulfuric acid in a beaker and stirred the mixture.

After the reaction was complete, the resulting solution was transferred to a volumetric flask, made up to 200 cm³ with distilled water and mixed thoroughly.

Several 20.0 cm³ portions of the resulting solution were titrated with 0.200 mol dm⁻³ aqueous potassium hydroxide.

The mean titre was 18.75 cm³ of aqueous potassium hydroxide. Calculate the value of y in $\text{KCl} \cdot y\text{H}_2\text{O}$.

Show your working.



DR. ASHAR RANA
M.B.B.S / MS. CHEMISTRY



- Founder & CEO of Chemistry Online Tuition Ltd.
- Completed Medicine (M.B.B.S) in 2007
- Tutoring students in UK and worldwide since 2008
- CIE & EDEXCEL Examiner since 2015
- Chemistry, Physics, Math's and Biology Tutor

CONTACT INFORMATION FOR CHEMISTRY ONLINE TUITION

- UK Contact: 02081445350
 - International Phone/WhatsApp: 00442081445350
 - Website: www.chemistryonlinetuition.com
 - Email: asherrana@chemistryonlinetuition.com
- Address: 210-Old Brompton Road, London SW5 OBS, UK