

Chemistry Year 12 Holiday Homework Questions

Working out must be shown in all cases

Reference Year 11 Text if necessary

Empirical Formula

1. Methanol is an alternative fuel to petrol that has been used in experimental cars. Determine the empirical formula of methanol, given that it is composed of 49.9% oxygen, 37.5% carbon and 12.6% hydrogen. Ans: COH₄

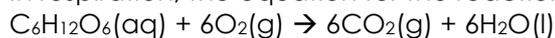
Molecular Formula

2. The taste of sour milk is due to lactic acid. The percentage composition of lactic acid by mass is 40.00% carbon, 6.71% hydrogen and 53.29% oxygen, and the molar mass is 90 g/mol. Find the empirical formula and molecular formula of lactic acid. Ans: C₃H₆O₃

3. A compound contains 12.8% carbon and 2.13% hydrogen, the rest being bromine. The relative molecular mass of the compound is 188. Calculate the empirical formula and the molecular formula of the compound. Ans: C₂H₄Br₂

Mass-mass Stoichiometry

4. In respiration, the equation for the reaction that produces energy in our bodies is:



If 8.90g of Glucose is used, determine:

- (a) The mass of oxygen needed. Ans: 9.50g
(b) The mass of carbon dioxide produced. Ans: 13.0g

5. When sodium and chlorine are reacted, table salt is produced.

(a) Write the balanced equation for this reaction

(b) If 10.0 g of sodium were used, how much table salt would be produced?

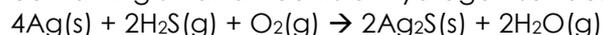
Ans: 25.0g

6. Aspirin C₉H₈O₄, is taken by many people for the relief of headaches or minor pain. It is produced from salicylic acid, C₇H₆O₃, and acetic anhydride, C₄H₆O₃. The equation is:
C₇H₆O₃ + C₄H₆O₃ → C₉H₈O₄ + C₂H₄O₂

Find the mass of salicylic acid needed to produce 155 kg aspirin.

Ans: 199 kg

7. The silver used in jewelry and tableware becomes tarnished when exposed to air containing small amounts of hydrogen sulfide. The tarnish is a layer of silver sulfide.



Calculate the mass of the tarnish when 0.025g of silver is reacted.

Ans: 0.029g

8. In a class experiment, a strip of copper was placed in an aqueous solution of silver nitrate.

Initial mass of copper strip = 4.36 g

Final mass of copper strip = 2.21 g

(a) Write an equation for the reaction.

(b) What mass of silver formed in the reaction?

Ans: 7.30g

9. Calcium carbonate can be decomposed by heating:



When 24.8 g of calcium carbonate was heated, 13.1 g of calcium oxide was obtained.

(a) Calculate the amount of calcium oxide, which theoretically should have been obtained. Ans: 13.9g

(b) Calculate the percentage yield of calcium oxide. Ans: 94.3%

Limiting Reagent Calculations

10. When sodium is placed on water it reacts violently to produce hydrogen gas and a solution of sodium hydroxide.

(a) Write a balanced chemical equation for this reaction.

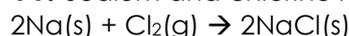
(b) If 9.2 g of sodium reacts completely, calculate the mass of gas that would be produced.

Ans: 0.4g

(c) What mass of water would react completely with 4.6 g of sodium? Ans: 3.6g

(d) If 1.0 kg of sodium was placed in 300 mL of water, which reactant would be used up first?

11. Sodium and chlorine react according to the following equation:



If 12.5 g of sodium and 25.5 g of chlorine are available for reaction, determine:

(a) the limiting reactant

(b) the mass of NaCl formed.

Ans: 31.8g

12. Sulfur dioxide gas escaping from a natural gas well may react with water to produce an acid which damages the environment when it falls to the ground as acid rain.

If 32 g of sulfur dioxide reacts with 18 g of water:

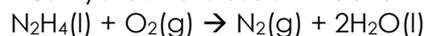
(a) How much H_2SO_3 is produced?

Ans: 41.0g

(b) Which reactant is in excess and by how much?

Ans: 9.0g

13. Hydrazine is used in rocket fuel. It reacts with oxygen as follows:



In a particular rocket engine, 2.29 g of hydrazine and 3.14 g of oxygen are available for reaction.

(a) Find the limiting reactant.

(b) Determine which reactant is in excess and by how many grams.

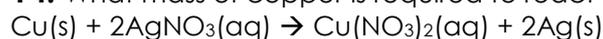
Ans: 0.853g

(c) Calculate the mass of water produced.

Ans: 2.58g

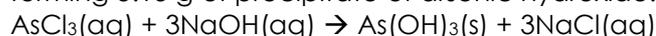
Mass-concentration Stoichiometry

14. What mass of copper is required to react completely with 250 mL of 0.100 M AgNO_3 ?



Ans: 0.794g

15. 25.0 mL of arsenic(III) chloride solution is reacted with an excess of 0.200 M NaOH solution, forming 3.15 g of precipitate of arsenic hydroxide.



(a) Find the number of moles of arsenic hydroxide.

Ans: 0.025mol

(b) Find the number of moles of sodium hydroxide that reacted.

Ans: 0.075mol

(c) Find the concentration of the original arsenic chloride solution.

Ans: 1.00M

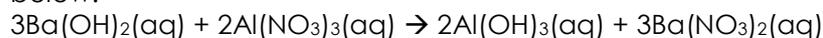
(d) Find the minimum volume of 0.200M NaOH required to react with 25.0 mL AsCl_3 .

Ans: 375mL

16. What volume of water, in mL, must be added to 400 mL of a solution containing 32.0 g of KBr to form a 0.100M solution of KBr?

Ans: 2.29L

17. The equation for the reaction between barium hydroxide and aluminium nitrate is given below:



What volume of 1.55M $\text{Ba}(\text{OH})_2$ is required to produce 287 g of $\text{Al}(\text{OH})_3$?

Ans: 3.56L

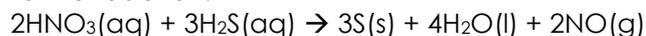
Solution Stoichiometry

18. 50 mL of 1.2 M Sulfuric acid was added to 30 mL of sodium hydroxide in order to neutralize it.

Find the molarity of the sodium hydroxide.

Ans: 4 M

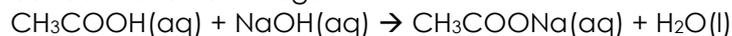
19. What volume of 0.250 M HNO₃ will react completely with 280 mL of 0.200 M H₂S according to the reaction:



Ans: 149 mL

Acid-Base Titrations

20. The concentration of vinegar was determined by titration. 20.00 mL of vinegar required 43.20 mL of 0.350M sodium hydroxide according to the following equation. Find the concentration of vinegar.



Ans: 0.756M

21. What volume of 0.460M H₂SO₄ is required to neutralize 24.00 mL of 0.620M NaOH?

Ans: 16.2 mL

22. 1.365 g of anhydrous sodium carbonate, Na₂CO₃, is dissolved in 250.0 mL of water. 20.00 mL aliquots of this solution were titrated with nitric acid. An average titre of 21.95 mL was needed. Find the concentration of the nitric acid.

Ans: 0.91 M

STP, SLC and Molar Volumes of a Gas

23. Calculate the mass of the following gas samples. All volumes are measured at STP.

(a) 150 mL of oxygen, O₂

Ans: 0.214g

(b) 4.5 L of carbon dioxide, CO₂

Ans: 8.8g

24. A gas is at STP and has a volume of 11.2 L. If its temperature is changed to 127°C, and its pressure changes to 2.5 atm, calculate its new volume.

Ans: 6.6 L

The General Gas Equation

25. A fire extinguisher contains 4.4 kg of carbon dioxide. What volume of carbon dioxide could this extinguisher deliver at STP?

Ans: 2.2 m³

26. A certain mass of unknown gas (molar mass = 30.0 g/mol) occupies 16.64 L at a pressure of 125 mmHg and a temperature of -73°C. Calculate the mass of gas present in the container.

Ans: 5.01 g

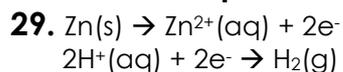
27. How many moles of gas at 127°C will be at a pressure of 101.3 kPa and a volume of 1.0 L?

Ans: 0.03 mol

28. An evacuated 200 mL flask has a mass of 84.845 g. It is filled with a gas at 17.0°C and 770 mmHg pressure and then weighs 85.084 g. Calculate the molar mass of the gas.

Ans: 28.1 g/mol

Redox Half equations and Oxidation Numbers

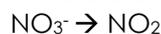


- (a) Which reactant accepts electrons?
- (b) Which reactant is reduced?
- (c) Which reactant is the reductant?
- (d) From which reactant are electrons taken?
- (e) Which reactant is oxidized?
- (f) Which reactant is the oxidant?

30. What is the oxidation number for the underlined element?

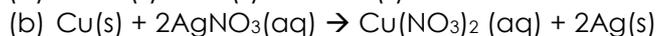
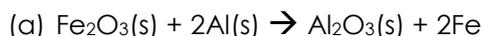
- (a) MgO
- (b) NH₄⁺
- (c) H₂SO₃
- (d) H₂O₂

31. Write a balanced half equation for the following:



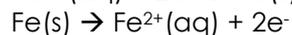
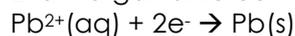
32. For each of the following

- (i) State which reaction is redox
- (ii) For redox reactions – identify the oxidant and reductant
 - write half equations for oxidation and reduction



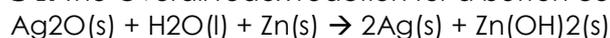
Galvanic Cell Diagram

33. Draw a galvanic cell for:



- On diagram show
- Direction of electron flow
 - The overall equation
 - The anode and cathode
 - the flow of ions from the salt bridge

34. The Overall redox reaction for a button cell is as follows:



- (a) Name the oxidizing agent
- (b) Name the reducing agent
- (c) State both half equations