

YEAR 12 CHEMISTRY

REVISION

EMPIRICAL/MOLECULAR FORMULA DETERMINATIONS

SECTION A: MULTIPLE CHOICE

1. A compound is 54.6% C, 36.2% O and 9.2% H by mass. What is the empirical formula of the compound?
- A. CH_2O
B. $\text{C}_2\text{H}_4\text{O}$
C. $\text{C}_3\text{H}_6\text{O}_2$
D. $\text{C}_4\text{H}_4\text{O}$
2. When 1.50 grams of a compound containing only carbon, hydrogen, nitrogen and oxygen is burned completely in excess O_2 , 1.72 g CO_2 , 0.585 g NO and 1.23 g H_2O are produced. What is the empirical formula for the compound?
- A. $\text{C}_2\text{H}_7\text{O}_2\text{N}$
B. $\text{C}_2\text{H}_{14}\text{O}_2\text{N}$
C. CH_7ON
D. $\text{C}_2\text{H}_7\text{ON}_2$
3. A compound of carbon, hydrogen and oxygen is found to be 52.13% carbon by mass, 13.13% hydrogen by mass, and 34.74% oxygen by mass. What is the simplest formula of the compound?
- A. $\text{C}_5\text{H}_8\text{O}$
B. $\text{C}_2\text{H}_6\text{O}$
C. CH_2O_2
D. CHO
4. Reductic acid contains 52.63% carbon, 5.30% hydrogen, and 42.07% oxygen. Its empirical formula is the same as its molecular formula. What is the number of carbon atoms in a molecule of this acid?
- A. 4
B. 5
C. 6
D. 8
5. The percent composition of the high explosive HNS is

C	H	N	O
37.35%	1.34%	18.67%	42.65%

The molar mass of HNS is 450.22. What is the molecular formula of HNS?

- A. $\text{C}_{13}\text{H}_4\text{N}_7\text{O}_{12}$
B. $\text{C}_{14}\text{H}_6\text{N}_6\text{O}_{12}$
C. $\text{C}_{15}\text{H}_{10}\text{N}_6\text{O}_{11}$
D. $\text{C}_{16}\text{H}_{12}\text{N}_5\text{O}_{11}$

6. A 10.00 g sample of a compound containing C, H, and O is burned completely to produce 14.67 g of CO_2 and 6.000 g of H_2O . What is the empirical formula of this compound?
- A. CHO
B. CH_2O
C. CH_2O_2
D. $\text{C}_2\text{H}_4\text{O}$
7. An ionic compound contains 29.08% sodium, 40.56% sulfur and 30.36% oxygen by mass. What is the formula of the sulfur-containing anion in the compound?
- A. $\text{S}_2\text{O}_3^{2-}$
B. $\text{S}_2\text{O}_4^{2-}$
C. $\text{S}_2\text{O}_5^{2-}$
D. $\text{S}_2\text{O}_6^{2-}$
8. A sample of 1.00 g of a pesticide is analysed for its arsenic content by precipitation of the arsenic as the sulfide, As_2S_3 . If 0.123 g of the sulfide is obtained, the percentage by mass of arsenic in the pesticide is
- A. 3.75
B. 7.50
C. 37.5
D. 75.0
9. A sample of a pure hydrocarbon is burnt in pure oxygen and yields 13.2 g of $\text{CO}_2(\text{g})$ and 5.40 g of $\text{H}_2\text{O}(\text{l})$. The empirical formula of the hydrocarbon is
- A. CH
B. CH_2
C. CH_3
D. CH_4
10. 5.00 g of nitrogen is completely converted into an oxide of nitrogen. The mass of the oxide formed is 19.3 g. The empirical formula of the oxide would be
- A. NO
B. N_2O_3
C. NO_2
D. N_2O_5
11. When two mole of an organic compound is burnt in oxygen, eight mole of carbon dioxide gas is formed. In a second test, when a few drops of bromine are added to the compound and shaken, the bromine rapidly decolourises. The formula of the compound could be
- A. C_4H_8
B. C_4H_{10}
C. C_8H_{16}
D. C_8H_{18}
12. A sample of hydrocarbon contains 81.8% carbon by mass. The empirical formula of the compound would be
- A. CH_2
B. CH_3
C. C_2H_5
D. C_3H_8

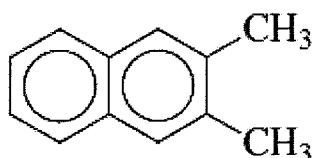
13. What is the empirical formula of a compound that is 66.64% carbon, 7.45% hydrogen and 25.91% nitrogen by mass?

- A. C_3H_4N
- B. $C_3H_4N_2$
- C. C_3H_3N
- D. $C_4H_3N_2$

14. 0.5755 g of a compound, containing sulfur and fluorine only, has a volume of 255.0 mL at 288.0 K and 50.01 kPa. What is the molecular formula of this compound?

- A. S_2F_2
- B. SF_2
- C. SF_4
- D. S_4F_{10}

15. What is the molecular formula of this chemical structure?

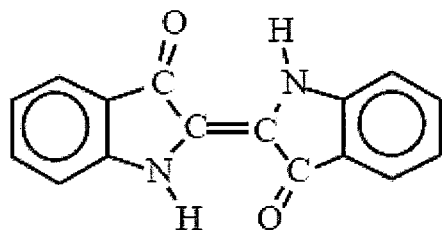


- A. $C_{10}H_{12}$
- B. $C_{10}H_{14}$
- C. $C_{12}H_{12}$
- D. $C_{12}H_{14}$

16. The percentages by mass of C, H, and Cl in a compound are C 52.2%, H 3.7%, and Cl 44.1%. How many carbon atoms are in the simplest formula of the compound?

- A. 3
- B. 4
- C. 6
- D. 7

17. What is the molecular formula of indigo shown below?



- A. C_8HNO
- B. $C_{16}H_2N_2O_2$
- C. $C_{16}H_{10}N_2O_2$
- D. $C_{16}H_{22}N_2O_2$

18. A 200 mL sample of a gaseous hydrocarbon has a density of 2.53 g L^{-1} at $55 \text{ }^\circ\text{C}$ and 95.5 kPa . What is its formula?

- A. C_2H_6
- B. C_4H_{10}
- C. C_5H_{12}
- D. C_6H_6

19. A 1.871 gram sample of an unknown metallic carbonate is decomposed by heating to form the metallic oxide and 0.656 g of carbon dioxide according to the equation



What is the metal?

- A. Ca
- B. Mn
- C. Ni
- D. Zn

20. A mineral containing only manganese and oxygen contains 69.6% Mn by mass. What is its empirical formula?

- A. MnO
- B. Mn_2O_3
- C. Mn_3O_4
- D. MnO_2

21. Analysis is carried out on a sample of unknown gas. The density of the unknown gas is 2.86 g L^{-1} at STP. (Take molar volume at STP as 22.41 L)

The molecular formula of the gas is

- A. HCl
- B. Cl_2
- C. NO_2
- D. SO_2

22. A 0.350 g sample of acid HX requires 25.4 mL of $0.140 \text{ mol L}^{-1} \text{ NaOH}_{(\text{aq})}$ for complete reaction. What is the molar mass of the acid?

- A. 98.4 g mol^{-1}
- B. 84.6 g mol^{-1}
- C. 68.4 g mol^{-1}
- D. 42.3 g mol^{-1}

23. A compound contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen.

What is its empirical formula?

- A. CHO
- B. $\text{C}_2\text{H}_2\text{O}$
- C. CH_2O
- D. CHO_2

24. A compound has an empirical formula of CH_2 . At STP, the density of the gaseous compound is 2.504 g L^{-1} . (Take molar volume at STP as 22.41 L)

Which of the following is the correct formula of the compound?

- A. C_2H_4
- B. C_3H_6
- C. C_4H_8
- C. $\text{C}_{10}\text{H}_{20}$

25. A 62 g sample of a molecular compound contains 20 g of oxygen and equal masses of carbon and nitrogen, combined together. Which of the following is nearest to the empirical formula of the compound?

- A. $\text{C}_7\text{O}_5\text{N}_6$
- B. $\text{C}_6\text{O}_8\text{N}_7$
- C. $\text{C}_2\text{O}_4\text{N}$
- D. $\text{C}_6\text{O}_4\text{N}_7$

26. A compound has the empirical formula CH_2O . If 3.50 g of the gaseous compound occupies 436 mL at STP. (Take molar volume at STP as 22.41 L)

Which of the following is the molecular formula of the compound?

- A. CH_2O
- B. $\text{C}_3\text{H}_6\text{O}_3$
- C. $\text{C}_4\text{H}_8\text{O}_4$
- D. $\text{C}_6\text{H}_{12}\text{O}_6$

27. 0.380 mol of an organic compound has a mass of 44.8 g . Its empirical formula is $\text{C}_2\text{H}_3\text{O}_2$. What is its molecular formula?

- A. $\text{C}_2\text{H}_3\text{O}_2$
- B. $\text{C}_4\text{H}_6\text{O}_4$
- C. $\text{C}_3\text{H}_4\text{O}_3$
- D. $\text{C}_4(\text{H}_2\text{O})_3$

28. Which oxide of nitrogen is 36.8% N by mass?

- A. N_2O_4
- B. NO
- C. N_2O_3
- D. NO_2

29. A compound of carbon and hydrogen is found to be 85.6% carbon, by mass, and 14.38% hydrogen. What is the simplest (empirical) formula of the compound?

- A. CH
- B. CH_2
- C. CH_4
- D. C_3H_4

30. The element M forms the compound MCl_4 . If the compound is approximately 75% Cl by mass, then what is M?
- A. C
 - B. Si
 - C. Ti
 - D. Se
31. A compound that contains only carbon, hydrogen, and oxygen is analyzed and found to be 34.6% carbon by mass and 61.5% oxygen by mass. What is the empirical formula of the compound?
- A. CH_2O_2
 - B. $C_2H_4O_3$
 - C. $C_3H_4O_4$
 - D. $C_3H_3O_4$
32. A compound that contains only carbon, hydrogen, and nitrogen is analyzed and found to be 75.9% carbon by mass and 17.7% nitrogen by mass. What is the empirical formula of the compound?
- A. C_4H_4N
 - B. C_5H_5N
 - C. $C_6H_6N_2$
 - D. $C_{10}H_7N_2$
33. Exactly 2.07 g of a pure compound is obtained when 1.50 g of solid iron reacts with excess oxygen. What is the empirical formula of this compound?
- A. FeO
 - B. Fe_2O_3
 - C. Fe_3O_4
 - D. Fe_4O_5
34. Elemental analysis of a compound gives these results by mass: Na 32.4%, H 0.71%, P 21.8% and O 45.1%. What is the simplest formula of the compound?
- A. $NaHPO_3$
 - B. $NaHP_2O_4$
 - C. NaH_2PO_4
 - D. Na_2HPO_4
35. The relative molecular mass of a gas is 56.0, and its simplest formula is CH_2 . What is the correct molecular formula for the gas?
- A. C_6H_{12}
 - B. C_4H_8
 - C. C_3H_6
 - D. C_2H_4
36. An oxide of nitrogen contains 30.4% nitrogen, by mass, and its relative molecular mass is near 90. Which oxide of nitrogen is it?
- A. N_2O_5
 - B. N_2O_4
 - C. N_3O_3
 - D. N_4O_2

37. Analysis of an oxide of carbon, C_xO_y , shows a carbon content of 52.96% by mass. What is the simplest formula for the compound?
- A. CO
 - B. CO_2
 - C. C_3O_2
 - D. C_2O_3
38. An oxide of phosphorus has the simplest formula P_2O_3 , and a relative molecular mass of about 220. The formula for one molecule of the oxide is
- A. P_4O_{10}
 - B. P_4O_6
 - C. P_2O_5
 - D. P_2O_3
39. $(NH_4)_2Fe(SO_4) \cdot 6H_2O$ (50.0 g, 0.1276 mol) is heated and 9.2 g water is lost. The product has the formula $(NH_4)_2Fe(SO_4)_2 \cdot yH_2O$. What is the value of y?
- A. 1
 - B. 2
 - C. 3
 - D. 4
40. An analysis is carried out on a sample of unknown gas. The density of the gas is 1.63 g L^{-1} at STP. (Take molar volume at STP as 22.41 L). The molecular formula of the gas is
- A. HCl
 - B. $COCl_2$
 - C. N_2O_4
 - D. SO_3
41. Xylose is a compound that has five carbon atoms in each molecule and contains 40% carbon by mass. What is the molar mass of xylose?
- A. 30
 - B. 67
 - C. 150
 - D. It cannot be determined without further information.
42. An organic compound is known to contain only carbon, hydrogen and oxygen. The compound contains, by mass, 39.1% of carbon and 8.7% of hydrogen. The number of carbon atoms in the empirical formula is
- A. 1
 - B. 2
 - C. 3
 - D. 4
43. In a particular experiment, to determine the RAM of a metal (X), 3.27 g of X was completely reacted with oxygen to produce 4.07 g of the oxide of formula XO. The RAM of X is
- A. 12.8
 - B. 32.7
 - C. 65.4
 - D. 130.8

44. A 2 L sample of a gaseous hydrocarbon is burnt in excess oxygen. The only products of the reaction are 8 L of $\text{CO}_{2(g)}$ and 10 L of $\text{H}_2\text{O}_{(g)}$, all at 100°C and 1 atm pressure. The formula of the hydrocarbon is
- A. CH
 - B. C_2H_4
 - C. C_4H_{10}
 - D. C_8H_{10}
45. If 4.0 g of a gas occupies 11.2 L at 0°C and 0.25 atmosphere, then the molecular mass of the gas is: (1 atmosphere = 101.3 kPa)
- A. 8.0 g
 - B. 16 g
 - C. 32 g
 - D. 64 g
46. Analysis of a compound known to contain only Mg, P and O gives this analysis.
- 21.8% Mg 27.7% P 50.3% O
- What is its empirical formula?
- A. $\text{Mg}_3\text{P}_2\text{O}_8$
 - B. $\text{Mg}_2\text{P}_2\text{O}_7$
 - C. MgPO_3
 - D. MgPO_2
47. The mass of 560 mL of a gas at 0°C and 101.3 kPa is 1.60 g. Which gas could it be? (Take molar volume at STP as 22.41 L)
- A. O_2
 - B. CO_2
 - C. SO_2
 - D. Cl_2
48. What is the density of carbon dioxide gas at 0.00°C and 101.3 kPa? (Take molar volume at STP as 22.41 L)
- A. 1.964 g L^{-1}
 - B. 22.41 g L^{-1}
 - C. 44.01 g L^{-1}
 - D. 0.509 g L^{-1}
49. A compound that contains only Fe and O is 69.9% Fe by mass. What is the empirical formula of this compound?
- A. FeO
 - B. FeO_2
 - C. Fe_2O_3
 - D. Fe_3O_4

50. 0.240 mol of a compound has a mass of 14.4 g. Its empirical formula is CH_2O . What is its molecular formula?

- A. CH_2O
- B. $\text{C}_2\text{H}_4\text{O}_2$
- C. $\text{C}_3\text{H}_6\text{O}_3$
- D. $(\text{CO})_3\text{H}_6$

ANSWERS to EMPIRICAL FORMULA DETERMINATIONS									
1B	2A	3B	4B	5B	6B	7A	8B	9B	10D
11A	12D	13A	14C	15C	16D	17C	18C	19D	20B
21D	22A	23C	24C	25A	26D	27B	28C	29B	30C
31C	32B	33C	34D	35B	36B	37C	38B	39B	40A
41C	42C	43C	44C	45C	46B	47C	48A	49C	50B

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