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CHEMISTRY

BOOKS - CENGAGE CHEMISTRY

EMPIRICAL AND MOLECULAR FORMULA

Worked Examples

1. Calculate the percentage composition of magnesium sulphate . [Give : Atomic massess

Mg = 24, S = 32, O = 16].

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2. Find the precentage of water of hydration in blue vitriol $(CuSO_4.5H_2O)$. [Given : Atomic masses Cu = 63.6,S = 32 , H = I and O = 16].

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3. Find the percentage of carbon dioxide in calcium carbonate . [Give : Atomic masses Ca =

40 ,C=12 , and O = 16]

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4. Molecular formula of acetic acid is CH_3COOH. Calculate its percentage composition . [Given : Atomic masses C=12, H = 1 and O = 16].

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5. An organic compound with molecular mass 180 contains 40% carbon, 6.7% hydrogen and 53.3% oxygen. Find its empirical formula .

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6. An oxide of nitrogen contains 25.94% nitrogen . What is the empirical formula ?

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Mandatory Exercise

1. The molecular mass of a compound with empirical formula CH_2O is 60. What is its molecular formula?

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2. An inorganic salt on analysis gave the following percentage composition: Ca = 40, C = 12, O = 48.Find the empirical formula of the compound.

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3. A salt sample has the following percentage composition: Fe = 37, S = 21, O = 42. Calculate the empirical formula of the compound.

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4. An organic substance containing carbon, hydrogen and oxygen has the following percentage composition: C = 40.7, H = 5, and O = 54.3. 0.59 g of vapour of the compound

occupies $112cm^3$ at STP. Find the molecular formula of the compound.

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5. Find the empirical formula of the compound containing Na = 29.1%, O = 30.38%, and S = 40.51%.

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6. An organic compound has been found to possess the empirical formula CH_2O and molecular mass 90. Give its molecular formula.

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7. A gaseous compound of carbon and nitrogen containing 53.8% by mass of nitrogen was found to have molecular mass 51.6. What is the molecular formula of the compound? (Atomic masses of N = 14, C = 12).

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8. The empirical formula of a compound containing 50% of an element A (atomic mass = 10) and 50% of another element B (atomic mass = 20) is

A. AB

B. AB_2

C. A_2B

D. A_2B_3

Answer: C

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9. Which of the following is the empirical formula of acetic acid (CH_3COOH)?

A. $C_6H_{12}O_2$

B. $C_3H_6O_3$

C. CH_2O

D. CHO

Answer: C

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10. An organic compound contains 75% by mass of carbon and the rest is hydrogen. Its empirical formula is

A. CH_4

B. C_2H_6

C. CH_3

D. C_2H_2

Answer: A

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11. Molecular mass of an organic compound containing carbon and hydrogen is 100. Its molecular formula is

A. C_6H_6

B. C_7H_{16}

C. C_8H_{16}

D. C_6H_{12}

Answer: B

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12. The percentage of water of crystallisation in washing soda $Na_2CO_310H_2O$ [Na = 23, C = 12, O = 16, H = 1] is

A. 0.6292

B. 0.5

C. 0.75

D. 0.9

Answer: A

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13. A formula with the lowest whole number ratio of elements in a compound is called

A. covalent compound

B. chemical formula

C. molecular formula

D. empirical formula

Answer: D

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14. A chemical formula that shows the actual number of atoms present in one molecule of a compound is called

A. molecular formula

B. empirical formula

C. ionic formula

D. covalent formula

Answer: A

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15. The empirical formula of a substance is CH_2O. Its molar mass is 180. What is the molecular formula.

A. $C_8H_{16}O_8$

B. $C_4H_8O_4$

C. $C_6H_{12}O_6$

D. $C_2H_4O_2$

Answer: C

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16. A compound contains 59.0%C, 7.15%H, 26.2%O and 7.65%N and has a molar mass of 183 g/mole. What is its molecular formula.

A. $C_5H_{11}N_3O_2$

B. $C_7H_9N_2O$

C. $C_9H_{13}NO_3$

D. $C_8H_{12}NO_2$

Answer: C

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17. A compound contains 6 g of carbon and 1 g of hydrogen. The percent composition of the compound is.

A. 14% H, 86% C

B. 86% H, 14% C

C. 17% H, 83% C

D. 83% H, 17% C

Answer: A

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18. Which of the following could be empirical formulas?

A. N_2O_4

B. N_2O_6

C. N_2O_5

D. all

Answer: C

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19. If the empirical formula of a compound is CH, What is a possible molecular formula for the compound?

A. CH_2

B. C_2H_6

C. C_4H_8

D. C_5H_{12}

Answer: C

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20. If the empirical formula of a compound is P_2O_3, what could be a possible molar mass of the compound .

A. 55 g

B. 165 g

C. 275g

D. none

Answer: D

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21. A compound is 40% C, 53.3% oxygen and 6.66% hydrogen. What is its empirical formula.

A. CH_3o_2

B. $C_4O_5H_7$

C. CH_2O

D. $C_6H_{12}O_6$

Answer: C

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22. If empirical formula is CH_2O and molar mass is 60 g/mol. What is the molecular formula.

A. C_3H_6O

B. $C_2H_4O_2$

C. CH_2O

D. $C_2H_{12}O_6$

Answer: B

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23. Which of the following sets of empirical formula, molar mass and molecular formula is correct.

A. $HO, 34g, H_2O$

B. $CaO, 56g, Ca_2O$

C. $CH_4N, 90g, C_3H_{12}N_3$

D. $C_3H_8O, 120g, C_3H_8O_2$

Answer: C

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24. The combustion of one mole of a compound yields 3.0 moles of CO_2, and 4.0 moles of H_2O. The empirical formula of this compound is.

A. C_3H_3

B. CH_4

C. C_3H_4

D. C_3H_8

Answer: D

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25. A sample of an oxide of an unknown metal M_1 contains 46 g of M and 16 g of O. If the formula of the metal oxide is M_2O, what is the atomic weight of the metal M?

A. 23

B. 39

C. 46

D. 63.5

Answer: A

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26. The compound formed when 1.95 moles of oxygen combine with 1.46 moles of iron is

A. FeO

B. Fe_2O_4

C. Fe_4O_3

D. Fe_4O_3

Answer: B

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27. x is an element that consists of diatomic molecules (x_2) Calculate the weight of an atom of x if 1.23×10^{23} molecules of x_2 weight 32.7 g.

A. 2.66×10^{-22} g

B. 1.36×10^{-22} g

C. 1.23×10^{-23} g

D. 7.52×10^{-21} g

Answer: B

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Consolidated Exercise

1. Match the following:

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Challenging Exercise

1. Find the empirical and molecular formula of an organic acid containing C = 40%, H = 6.67%, and having molecular mass = 60.

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2. Calculate the empirical formula of a compound whose molecular formula is $C_8H_6O_4$ and empirical formula mass is 83. (C = 12, H = 1, 0 = 16)

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3. 15.3 g of element X (atomic mass = 27) combines with 13.6 g of oxygen to form an oxide.

(a) Express this in moles.

(b) What is the simplest formula for the oxide?

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4. An inorganic salt contains 15.89% calcium, 2.4% hydrogen, 24.6% phosphorus and 57.11% oxygen. Its molecular mass is 252.2. Deduce its molecular formula.

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5. Emerald contains 5.06% Be, 10.05% Al, 31.48% Si and 53.4% oxygen. Find its empirical formula.

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6. A metal sulphide (MS) which is responsible for the discolouration of paints contains 13.3% sulphur by mass. Identify the metal likely to be present in the sulphide?

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7. 0.8 g sample of gaseous hydrocarbon occupying 1.12 L at STP, when completely burnt in air produced 2.2 g of carbon dioxide and 1.8 g of water. Calculate.

(a) the mass of the compound

(b) the molecular formula of the compound, and

(c) the volume of oxygen at STP required for combustion.

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8. An organic compound contains C, H, and O. 0.30 g of this compound on combustion gives 0.44 g of carbon dioxide and 0.18 g of water. If the mass of one mole of the compound is 60, show that the molecular formula is $C_2H_4O_2$

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9. 0.5 g of an oxide of carbon was produced by oxidation of 0.135 g of carbon. If the molecular mass of the oxide is 44, find its molecular formula.

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Olympiad And Ntse Level Exercises

1. A compound has an empirical formula C_2H_4O. An independent analysis gave a value of 132.16 for its molecular mass. What is the correct molecular formula .

A. $C_4H_4O_5$

B. $C_{10}H_{12}$

C. C_7O_3

D. $C_6H_{12}O_3$

Answer: D

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2. An organic compound has an empirical formula CH_2O, its vapour density is 45. The molecular formula of the compounds is

A. CH_2O

B. C_2H_5O

C. C_2H_2O

D. C_3H_6O

Answer: D

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3. When 32.25 gm ethyl chloride dehydro halogenated, if gives 50%. Alkene, what is the mass of product. (atomic mass of chlorine = 35.5)

A. 14 gm

B. 28 gm

C. 64.5 gm

D. 7 gm

Answer: D

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4. An organic compound made of C, H and N contains 20% nitrogen. Its molecular weight is.

A. 70

B. 140

C. 100

D. 65

Answer: A

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5. An organic compound contains C = 38.8%, H = 16% and N = 45.2%. Empirical formula of the compound is

A. CH_3NH_2

B. CH_3CN

C. C_2H_5CN

D. $CH_2(NH)_2$

Answer: A

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6. 0.30 g of an organic compound containing C, H and Oxygen on combustion yields 0.44 g CO_2, and 0.18 g of H:0. If one mole of

compound weighs 60, then molecular formula of the compound is

A. C_4H_6O

B. CH_2O

C. $C_2H_4O_2$

D. C_3H_8O

Answer: C

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7. An organic compound containing C, H and N gave following analysis : C = 40%, H = 13.33% and N = 46.67%. Its emprical formula would be

.

A. $C_2H_7N_2$

B. CH_5N

C. CH_4N

D. C_2H_7N

Answer: C

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8. 0.24 g of an organic compound gave 0.22 g CO_2, on complete combustion. If it contains 1.66 % hydrogen, then the percentage of C and O will be .

A. 12.5 and 36.6

B. 25 and 75

C. 25 and 36.6

D. 25 and 80

Answer: B

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9. 0.246 g of an organic compound containing 58.53% carbon and 4.06% hydrogen gave 22.4 mL of nitrogen at STP. What is the empirical formula of the compound?

A. $C_2H_7N_2$

B. $C_6H_5NO_2$

C. $C_2H_7NO_2$

D. $C_2H_2NO_2$

Answer: B

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10. 0.246 g of an organic compound gave 0.198 g of carbon dioxide and 0.1014 g of water on complete combustion. 0.37 g of the compound gave 0.638 g of silver bromide. What is the molecular formula of the compound if its vapour density is 54.4?

A. C_2H_5Br

B. CH_3Br

C. C_2H_7Br

D. C_3H_8Br

Answer: B

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