CHEMISTRY

BOOKS - EVERGREEN CHEMISTRY (ENGLISH)

MOLE CONCEPT AND STOICHIOMETRY

Solved Numerical Problems

1. What volume of propane is burnt for every 100 cm^3 of oxygen used in the reaction

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$? Gas volumes are measured under the same conditions.

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2. 500 cc of nitric oxide is reacted with 300 cc of oxygen to form nitrogen dioxide. What would be the composition of resulting mixture?

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3. If 6 litres of hydrogen and 5.6 litres of chlorine are mixed and exploded, what will · be the

composition by volume of resulting mixture?

4. Acetylene burns in air according to the reaction

$$2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O \qquad \text{at} \qquad 100^oC.$$

Calculate the volume of air required to completely

burn 50 cc of acetylene. (Air contains 20% oxygen

by volume).

5. 40 cm^3 of methane are mixed with 100 cm^3 of pure oxygen at room temperature and pressure. The mixture is then ignited when it burns as illustrated by the equation. Calculate the composition of the resulting mixture if it cooled to initial room temperature and pressure.

$[CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)]$
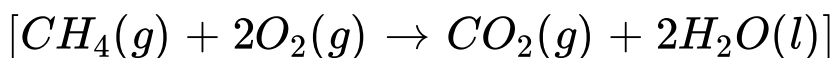
6. 50 cc gas A contains x molecules. How many molecules will be present in 25 cc of another gas B

under the same conditions of temperature and pressure ?

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7. If 200 cm^3 of nitrogen contains 'n' molecules how many molecules of oxygen will be present in $100cm^3$ of oxygen, under similar conditions of temperature and pressure.

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8. Calculate the relative molecular masses (or molecular weights), of the following compounds :

Ammonium sulphate, $(NH_4)_2SO_4$

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9. Calculate the relative molecular masses (or molecular weights), of the following compounds :

Ammonium chloroplatinate, $(NH_4)_2[PtCl_6]$

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10. Calculate the relative molecular masses (or molecular weights), of the following compounds :

Fructose($C_6H_{12}O_6$).

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11. Calculate the relative molecular masses (or molecular weights), of the following compounds :

Copper sulphate crystals, $CuSO_4.5H_2O$

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12. Calculate the relative molecular masses (or molecular weights), of the following compounds :

Urea, NH_2CONH_2 (Given : Atomic mass in amu of N = 14, H = 1, S = 32, O = 16, C = 12, Pt= 195, Cl= 35.5, Cu= 63.5)

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13. Calculate the actual mass of:

one atom of oxygen.

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14. Calculate the actual mass of:

one molecule of oxygen.

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15. Calculate number of moles in 392 g of H_2SO_4?

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16. Calculate the mass of 2.8 litres of CO_2 at S.T.P.

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17. What is the volume occupied at S. T.P. by 10^{24} molecules of :

nitrogen

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18. What is the volume occupied at S. T.P. by 10^{24} molecules of :

oxygen

▶ Watch Video Solution

19. What is the volume occupied at S. T.P. by 10^{24} molecules of :

chlorine

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20. Compare the number of atoms in 10 g of chlorine with that of 10 g of nitrogen.

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21. Calculate the weight of :

10.0 g atoms of sodium.

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22. Calculate the weight of :

10 atoms of sodium.

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23. A student puts his signature with graphite pencil. If the mass of carbon in the signature is

10^{-12} g. Calculate the number of carbon atoms in the signature.

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24. Calculate the number of atoms in 60 g of neon (Ne = 20).

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25. Calculate the volume occupied by 11 grams of carbon dioxide at S. T.P.

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26. Calculate the mass of 70 litres of carbon dioxide at S. T.P.

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27. A gas jar contains 7.2×10^{20} molecules of NH_3 gas. Find :

number of moles

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28. A gas jar contains 7.2×10^{20} molecules of NH_3

gas. Find :

weight in grams

29. A gas jar contains 7.2×10^{20} molecules of NH_3

gas. Find :

volume in cm_3 of ammonia gas at S. T.P.

[N = 14, H = 1]

30. A gas jar contains 1.6 g of sulphur dioxide gas at S. T.P. calculate no. of moles [S = 32, O = 16]

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31. A gas jar contains 1.6 g of sulphur dioxide gas at S. T.P. calculate no. of molecules [S = 32, O = 16]

▶ Watch Video Solution

32. A gas jar contains 1.6 g of sulphur dioxide gas at S. T.P. calculate volume of gas at S. T.P. [S = 32, O = 16]

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33. Calculate the number of molecules in 2 kg of sodium hydroxide

[At. wt. Na= 23, O = 16, H = 1]

34. Which of the following weighs most

(a) 2 gram-atom of oxygen

(b) 25 g of Fe

(c) 4×10^{23} atoms of carbon

(d) 22.4 litres of CO_2

35. Calculate

number of atoms in 1.2 g of carbon.

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36. Calculate

number of molecules in 3.6 g of water.

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37. Calculate

number of atoms in 1.8 g of water.

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38. What volume in litres will be occupied by 4.4 g

of CO_2 at STP ?

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39. Calculate the volume occupied by 1.4 g of N_2 at

S.T.P.

40. Calculate the vapour density and atomicity of

chlorine if 35.5 g of it occupies a volume of 11.2 L at

S. T.P.

41. Calculate the vapour density of sulphur dioxide.

[S = 32, O = 16)

42. 11.2 dm^3 of a gas at S.T.P. weighs equal to 22 g. Find out its molecular mass .

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43. 11.2 dm^3 of a gas at S.T.P. weighs equal to 22 g. Find out its vapour density.

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44. 500 cm3 of hydrogen at S. T.P. contain N molecules. How many molecules are present in 25

cm^3 of oxygen at S. T.P. ?

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45. 6×10^{20} molecules are present in a sample of hydrogen gas, having volume V at S. T.P. Find the volume of oxygen at S. T.P. which contains 3×10^{24} molecules.

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46. State the volume occupied by 40 gm of methane at STP, if its vapour density (V.D.) is 8

47. Calculate the relative molecular mass and vapour density of methyl alcohol (CH_3OH) if 160 g of the alcohol on vapourisation has a volume of 112 litres at S. T.P.

48. Calculate the percentage of iron in potassium ferrocyanide. $K_4\big(Fe(CN)_6\big]$ (K = 39, Fe = 56, C = 12, N = 14)

49. Which out of the following compounds has the hi&hest percentage of nitrogen -

$Ca(NO_3)_2$ or (NH4)2SO4?

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50. Which out of the following compounds has the hi&hest percentage of nitrogen -

$CaCN_2$ or NH4NO3?

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51. Which out of the following compounds has the hi&hest percentage of nitrogen - $Ca(NO_3)_2$ or (NH4)2SO4?

52. Find the percentage mass of water in washing soda crystals `Na_2CO_3 , 10H_2O.

53. Calculate the percentage composition of hydrated calcium chloride, $CaCl_2.6H_2O$.

54. Calculate the mass of nitrogen supplied to soil by 5 kg of urea $\left[CO(NH_2)_2\right]$ (O = 16, N = 14, C = 12, H = 1)

55. Calculate the volume occupied by 8 g of sulphur dioxide at S. T.P. [S = 32, O = 16)

56. What do you understand by the statement that 'Vapour density of carbon dioxide is 22' ?

57. Atomic weight of chlorine is 35.5. What is its vapour density ?

58. Calculate the percentage of boron (B) in borax, $Na_2B_4O_7 . 10H_2O$.

(H = 1, B = 11, O = 16, Na = 23)

59. Calculate the relative molecular mass of ammonium chloroplatinate, $(NH_4)_2[PtCl_6]$

60. Calculate the mass of iron in 10 kg of iron ore which contains 80% of pure ferric oxide.

61. Calculate the percentage of water of crystalization in $CuSO_{4.5}H_2O$

(H = 1, O = 16, S = 32, Cu = 64)

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62. A 3.0 g sample of $Na_2CO_3 . H_2O$ is heated to a constant mass. How much anhydrous salt remains ?

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63. A 5.0 g sample of $Cu(NO_3)_2.\,n(H_2O)$ is heated, and 3.9 g of anhydrous salt remains. What is the value of 'n' ?

$$Cu(NO_3)_2, n(H_2O) \xrightarrow{\Delta} Cu(NO_3)_2 + nH_2O$$
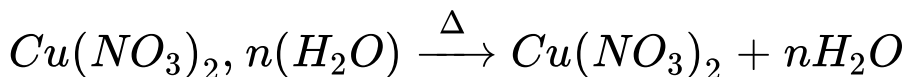
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64. What percentage of water is found in $Na_2S, 9H_2O$?

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65. A 2.5 g sample of hydrate of $Ca(NO_3)_2$ was heated and only 1. 7 g of anhydrous salt remained. What percentage of water was in the hydrate ?

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66. A chemical compound is found to have the following composition :

C = 19.5%, Fe = 15.2%, N = 22.8%, K = 42.5%

Calculate the empirical formula of the compound. What will be the molecular formula if the molecular mass of the compound is 368 ?

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67. A compound contains 40% carbon, 6.6% hydroaen and 53.33% oxy1en._Its vapour density is 30. Calculate its empirical and molecular formulae.

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68. A crystalline salt on being rendered anhydrous loses 45.6% of its mass. The percentage composition of anhydrous salt is Al = 10.5%, K = 15.1 %, S = 24.8% and I = 49.6%.

Calculate the simplest formula of anhydrous salt and the crystalline salt. (Al= 27, K = 39, S = 32, I= 127)

69. A compound on analysis gave the following percentage composition :

Na= 14.31%, S = 9.97%, H = 6.22%, O = 69.50%.

Calculate the molecular formula of the compound on the assumption that all the hydrogen in the compound is present in combination with oxygen as water of crystallisation. Molecular mass of the compound is 322.

(At. wt. of Na = 23, S = 32, H = 1, O = 16)

70. A compound (molecular mass 246) has following

data :

Element	Percentage	Relative no. of atoms
A	9.76	0.406
B	13.01	0.406
C	26.01	1.625
D	51.22	2.846

From the data, find out :

Atomic weight of elements A, B, C and D.

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Element	Percentage	Relative no. of atoms
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D	51.22	2.846

From the data, find out :

Simple ratio

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72. A compound (molecular mass 246) has following data :

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C	26.01	1.625
D	51.22	2.846

From the data, find out :

Simple ratio

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73. The compound A has the following percentage composition by mass : carbon 26. 7%, oxygen 71.1 %, hydrogen 2.2%. Determine the empirical formula of A. (Work to one decimal place) (H = 1, C = 12, O = 16).

If the relative molecular mass of A is 90, what is the molecular formula of A ?

74. Determine the empirical formula of the compound whose composition by mass is : 42% nitrogen, 48% oxygen and 9% hydrogen. (H = 1, N = 14, O = 16)

75. A compound has the following percentage composition : C = 40%, H = 6. 7%, O = 53.3%, the vapour density of the compound is 30. Calculate its molecular formula (C = 12, H = 1, O = 16).

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76. A hydrocarbon contains 17.2% H. If the vapour density is 29, calculate its molecular formula.

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77. Determine the formula of organic compound if its molecule contains 12 atoms of carbon. The percentage composition of hydrogen and oxygen are 6.48 and 51.42 respectively.

78. Calculate the mass of magnesium oxide which would be obtained by burning 120 g of magnesium in air.

79. Calculate the mass of iron which will be converted into its oxide (Fe_3O_4) by the action of 36 g steam on it.

80. Calculate

mass of sulphuric acid requiredwhen 2.56 g of copper reacts completely as illustrated by the equation below :

[Cu = 64 , S = 32 , O = 16, H = 1]

81. Calculate

mass of copper sulphate formed when 2.56 g of

copper oxide reacts completely as illustrated by the

equation below :

[Cu = 64 , S = 32 , O = 16, H = 1]

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82. Calculate the mass of limestone required to

produce 112 kg of quicklime by burning it.

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83. 200 g of impure Na_2CO_3 of 90% purity is treated with dil. H_2SO_4 according to the reaction

$$Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + CO_2$$
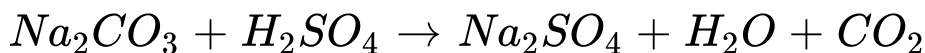
Calculate the mass of pure sodium sulphate formed

[Na = 23, C = 12, O = 16, H = 1, S = 32]

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84. 3.00 g of H_2 react with 28.00 g of O_2 to yield H_2O.

Which is the limiting reactant ?

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85. 3.00 g of H_2 react with 28.00 g of O_2 to yield H_2O.

Calculate the maximum amount of H_2O that can be formed.

86. 3.00 g of H_2 react with 28.00 g of O_2 to yield H_2O.

Calculate the mass of one of the reactants which remains unreacted.

87. What mass of slaked lime would be required to decompose completely 4.28 g of ammonium chloride ?

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88. Washing soda has the formula $Na_2CO_2.10H_2O$. What is mass of anhydrous sodium carbonate left when all the water of crystallisation is expelled by heating 57.2 g of washing soda?

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89. When excess lead nitrate solution was added to a solution of sodium sulphate, 15.15 g of lead sulphate was precipitated. What mass of sodium sulphate was present in the original solution?

$$Na_2SO_4 + Pb(NO_3)_2 \rightarrow PbSO_4 + 2NaNO_3$$
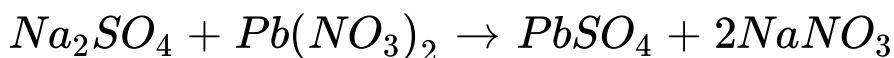
(O=16,Na=23,S=32,Pb=207)

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90. A 5.0 g sample of $Cu(NO_3)_2 . n(H_2O)$ is heated, and 3.9 g of the anhydrous salt remains. What is the value of 'n' ?

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91. Calculate the volume of NO_2 formed at S.T.P. and weight of copper oxide formed in grams when 1.88 g of copper nitrate crystals decompose as:

$$2Cu(NO_3)_2 \xrightarrow{\Delta} 2CuO + 4NO_2 + O_2$$
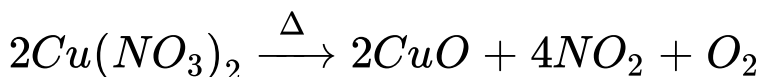
[Cu = 64, N = 14, O = 16]

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92. What volume of hydrogen sulphide at STP will burn in oxygen to yield 12.8 g of sulphur dioxide according to the equation

$$2H_2S + 3O_2 \rightarrow 2H_2O + 2SO_2.$$

93. What volume of hydrogen sulphide at STP will burn in oxygen to yield 12.8 g of sulphur dioxide according to the equation

$$2H_2S + 3O_2 \rightarrow 2H_2O + 2SO_2.$$

94. Consider the reaction and based on the reaction answer the questions that follow :

$$(NH_4)_2Cr_2O_7 \xrightarrow{\text{Heat}} N_{2(g)} + 4H_2O(g) + Cr_2O_3$$
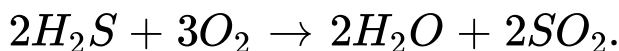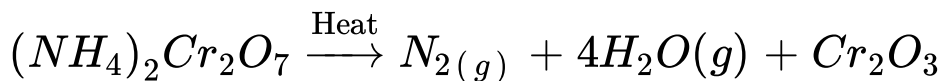
Calculate:

The volume in litres or dm of N_2 evolved at S.T.P

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95. Chlorine combines with excess of ammonia to form ammonium chloride and nitrogen. Calculate the volume of ammonia required to completely react with 42 litres of chlorine. Under similar conditions of temperature and pressure.

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96. What volume of oxygen, at S. T.P. is required to form complete combustion of 200 cm^3 of acetylene, and what would be the volume of carbon dioxide formed ?

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Worksheet 1

1. Find the volume of oxygen at S. T.P. required. for the complete combustion of 2 litres of carbon monoxide at S.T.P.

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2. A sample of coal gas contained $45\%\ H_2$, $30\%\ CH_4$, $20\%\ CO$ and $5\%\ C(2)H2$ by volume. $100cm_3$ of this gaseous mixture was mixed with $190cm^3$ of oxygen and exploded. Calculate the volume and composition of the mixture, when cooled to room temperature and pressure.

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3. What volume of nitrogen dioxide would be formed when $100cm^3$ of NO read with $50cm^3$ of O_2

under same conditions of temp. and pressure.

$$2NO + O_2 \rightarrow 2NO_2$$
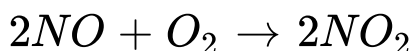
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4. $100cm^3$ of water gas is exploded with $100cm^3$ of oxygen' and the residual gases are cooled to room temperature. Find the volume composition of the resulting mixture.

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5. 1500 cm^3 of oxygen was burnt with $300cm^3$ of ethane (C_2H_6). calculate the volume of unused oxygen.

6. 120 cm^3 of hydrogen gas is mixed with $120cm^3$ of oxygen gas and then exploded. Calculate the composition of resulting mixture on cooling.

7. 100 cm^3 of acetylene is mixed with 300 cm^3 of pure oxygen and ignited when the reaction takes place as illustrated above. Calculate the composition of resulting mixture.

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8. $2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(l)$
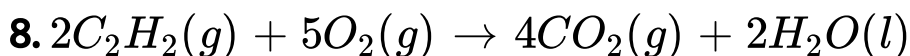
$100cm^3$ of acetylene is mixed with $300cm^3$ of pure oxygen and ignited when the reaction takes place as illustrated above. Calculate the composition of resulting mixture.

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9. One volume of nitrogen reacts with 3 volumes of hydrogen to produce two volumes of ammonia gas. How much nitroget? and hydrogen gas is required to produce $400cm^3$ of ammonia gas ?

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10. 200 cc of CO_2 is collected at S. T .P. when a mixture of acetylene and oxygen is ignited. Calculate the volume of acetylene and oxygen at

S.T.P. in the original mixture.

$$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(g)$$
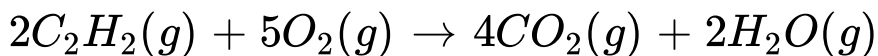
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Worksheet 2

1. Calculate

number of atoms in 1.2 g of carbon.

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2. Calculate

number of molecules in 3.6 g of water.

3. Calculate

number of atoms in 1.8 g of water.

4. Calculate

volume occupied by 2.2 g of CO_2 at S.T.P.

5. What mass of Ca will have the same number of

atoms as in 3.2 g of S ?

6. Calculate the number of oxygen atoms in 0.20

mole of $Na_2CO_3.10H_2O$.

7. Calculate the volume occupied by 8 g of sulphur dioxide at S. T.P. [S = 32, O = 16)

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8. The following question refer to one gram molecular mass of chlorine gas :

What is the volume occupied by this gas at S.T.P.?

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9. The following question refer to one gram molecular mass of chlorine gas :

What will happen to volume if the pressure of the gas is doubled?

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10. The following question refer to one gram molecular mass of chlorine gas :

What volume will the gas occupy at 273°C?

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11. The following question refer to one gram molecular mass of chlorine gas :

If the relative atomic mass of chlorine is 35.5, what will be the mass of one mole of Cl_2 gas ?

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12. Calculate the volume occupied by 0.46 g of nitrogen dioxide at S.T.P. [N = 14 amu, O = 16 amu]

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13. Calculate the actual mass of :

an atom of hydrogen

14. Calculate the actual mass of :

a molecule of NH_3

15. Calculate the actual mass of :

the atom of silver. Given mass (Ag = 108, N = 14, H =

1)

16. Calculate :

the number of moles of O_2 which contain 8.00 g of O_2.

17. Calculate :

the number of moles of methane in 0.80 g of methane.

18. Calculate :

the weight of 0.25 g atom of calcium.

19. Which of the following contains maximum number of molecules ?

A. 4g of O_2

B. 4g of NH_3

C. 4g of SO_2

D. None of these

Answer:

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20. Calculate the number of:

molecules in one kg of calcium chloride.

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21. Calculate the number of:

hydrogen atoms in 0.1 mole of H_2SO_4

22. Calculate the number of:

particles in 0.1 mole of any substance.

23. The mass of 5.6 litres of a certain.gas at S.T.P. is 12 g. What is the ielative molecular mass or molar mass of the gas ?

24. Calculate the volume occupied at S.T.P. by 2 moles of CO_2

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25. How many gram of Al are present in 0.2 mole of it ?

▶ Watch Video Solution

26. What is the mass of 0.1 mole of HCl?

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27. How many gram of H_2O are present in 0.2 mole of it

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28. What is the mass of 0.1 mole of CO_2 in gram?

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29. What is the mass of 50 cm^3 of carbon monoxide at S.T.P. ? [C = 12 amu, O = 16 amu]

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30. What is the volume at S.T.P. of 7.1 g of.chlorine?

[Cl= 35.5 amu]

31. Find the :

number of molecules in 73 g of HCl.

32. Find the :

weight of 0.5 mole of O_2

33. Find the :

number of molecules in 1.8 g of H_2O.

34. Find the :

number of moles in 10 g of $CaCO_3$.

35. Find the :

weight of 0.2 mole of H_2 gas

36. Which of the following would weight most ?

    A. 1 mole of H_2O

    B. 1 mole of CO_2

    C. 1 mole of NH_3

    D. None of these

Answer:

37. Match the group A with result in group B

GROUP A		GROUP B
1.	Number of molecules present in 88 g of CO_2.	(a) 4.25 grams
2.	Number of moles in 128 gm of SO_2	(b) 28.4 g
3.	Weight of 5.6 litres of NH_3	(c) 12.044 × 10^{23}
4.	Volume occupied by 46 g of NO_2	(d) 22.4 litres
5.	Mass of 0.4 moles of Cl_2	(e) 2 moles
6.	Atoms in 18 g of H_2O	(f) 18.066 × 10^{23}

Worksheet 3

1. 5000 molecules are present in a sample of dry hydrogen having a volume V at S.T.P. Calculate the

volume of nitrogen gas which has 2.5×10^8 molecules at S.T.P.

2. 6×10^{22} molecules are present in 2.24 dm^3 of chlorine at S.T.P. Calculate the volume of sulphur dioxide gas at S.T.P. which has 3×10^{19} molecules

3. 2.24 dm^3 of dry ammonia gas contain $6x10^{22}$ molecules at S.T .P. Calculate the number of

molecules in $56 cm^3$ of dry nitrogen at S.T.P.

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4. $112 cm^3$ of dry carbon monoxide contains P molecule. Calculate the number of molecules in $336 dm^3$ of dry chlorine gas. Assume all measutements are made at same temperature and pressure.

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5. Find the relative molecular mass of a gas, 0.546 g of which occupies 360 cm^3 at 87°C and 380 mm Hg ptessure. [1 litre of hydrogen at S.T.P. weighs 0.09 g]

6. A cylinder can hold 1 kg of hydrogen at room temperature and pressure. What mass of carbon dioxide it can hold under similar conditions of temperature and pressure ? If the number of molecules of hydrogen in the cylinder is x, calculate the number of carbon dioxide molecules in the cylinder. Give reasons for your answer.

7. Calculate the volume occupied by 8 g of sulphur dioxide at S. T.P. [S = 32, O = 16)

8. Calculate the mass of a substance 'A' which in gaseous form occupies 10 litres at 27°C and 700 mm pressure. The molecular mass of 'A' is 60.

9. What is the volume (measured in dm^3 or litres) occupied by one mole of at at S.T.P.?

10. 112 cm^3 at S.T.P. of a gaseous fluoride of phosphorus has a mass of 0.63 g calculate the relative molecular mass of fluoride. If the molecule of the fluoride contains only one atom of phosphorus, determine the formula of the phosphorus fluoride. [F = 19, P = 31]

11. A gas occupies 700 cm^3 at a pressure of 700 mm of Hg and a temperature of -57°C . If, at S.T.P., the mass of the gas is 1.5 g, find the vapour density and the molecular mass of the gas. Given I litre of hydrogen weighs 0.09 g at S.T.P.

12. A cylinder can hold 5.6 g of hydrogen at S.T.P. Calculate :

the amount of carbon dioxide gas, it can hold at S.T.P.

13. A cylinder can hold 5.6 g of hydrogen at S.T.P.

Calculate :

the amount of carbon dioxide gas, it can hold at

S.T.P.

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Worksheet 4

1. What is the percentage composition of

$Na_2S_2O_3.5H_2O$?

2. Which of the following compounds has highest percentage of nitrogen :

A. Ferriferro cyanide, $Fe_4[Fe(CN)_6]_3$?

B. Aluminium nitrate, $Al(NO_3)_3$?

C. Ammonium dichromate, $(NH_4)_2Cr_2O_7$?

D. None of these

Answer:

3. Calculate the mass of nitrogen in 1000 kg of urea, $CO(NH_2)_2$ (Answer corrected to the nearest kg).

4. Calculate the total percentage of oxygen in magnesium nitrate crystals $Mg(NO_3)_2.6H_2O$ (Atomic masses H = 1, N = 14, O = 16, Mg = 24)

5. Calculate the mass of nitrogen supplied to soil by 5 kg of urea $[CO(NH_2)_2]$ (O = 16, N = 14, C = 12, H =

1)

6. Calculate the percentage of nitrogen in ammonium nitrate (NH_4NO_3) [R.A.M: H = 1, N = 14,0 = 16]

7. Calculate the percentage of boron (B) in borax, $Na_2B_4O_7 \cdot 10H_2O$.

(H = 1, B = 11, O = 16, Na = 23)

8. Manganese forms nonstoichiometric oxides having the general formula MnOn. Find the value of n for the compound that analysed 63.7% Mn.

9. A compound is composed of 2.2% hydrogen, 26.6% carbon and 71.2% oxygen. Calculate the empirical formula of the compound. If its molecular mass is 90, find its molecular formula.

10. A compound is composed of 29.11% sodium, 40.51% sulphur and 30.38% oxygen. Find its empirical formula. (R.A.M. : Na = 23, S = 32, O = 16.)

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11. A compound is composed of 2.2% hydrogen, 26.6% carbon and 71.2% oxygen. Calculate the empirical formula of the compound. If its molecular mass is 90, find its molecular formula.

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12. The empirical formula of the compound is C_2H_5. It has a vapour density of 29. Determine the relative mass of the compound and hence, its molecular formula.

13. Calculate the empirical formula of the compound having 37.6% sodium 23.1 % silicon and 39.3% oxygen (workout to two decimal places). (O = 16, Na= 23, Si= 28)

14. A compound contains 87.5% nitrogen and 12.5% hydrogen by mass. Determine the empirical formula and molecular of this compound if its molecular mass is 32

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15. Determine the empirical formula of the compound whose composition by mass is : 42% nitrogen, 48% oxygen and 9% hydrogen. (H = 1, N = 14, O = 16)

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16. A metal M forms a volatile chloride containing 65.5% chlorine. If the vapour density of the metal chloride is 162.5, find the molecular formula of the chloride. (M = 56, Cl = 35.5)

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17. Silicon (Si = 28) forms a compound with chlorine (Cl = 35.5) in which 5.6 g of silicon is combined with 21.3 g of chlorine. Calculate the empirical formula of the compound.

[Hint. Total mass of silicon and chlorine in the

compound = 5.6 + 21.3 = 26.9

$$\% \text{ age of Si } = \frac{5.6}{26.9} \times 100 \text{ and}$$

$$\% \text{age of Cl } = \frac{21.3}{26.9} \times 100$$

18. A crystalline salt on being rendered anhydrous loses 45.6% of its mass. The percentage composition of anhydrous salt is Al = 10.5%, K = 15.1 %, S = 24.8% and I = 49.6%.

Calculate the simplest formula of anhydrous salt and the crystalline salt. (Al= 27, K = 39, S = 32, I= 127)

19. A compound contains 4.07% hydrogen, 24.27% carbon and 71.65% chlorine. Its molar mass is 98.96 g. What are its empirical and molecular formulas?

20. 0.290 g of an organic compound containing C, H and O gave on combustion 0.270 g of water and 0.66 g of CO_2. What is empirical formula of the compound.

21. Calculate the percentage of platinum in ammonium chloroplatinate $(NH_4)_2PtCI_6$ (Give your answer correct to the nearest whole number).

(Atomic masses: H = 1, N = 14, CI = 35.5, Pt = 195)

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22. Calculate the percentage of Nitrogen in aluminium nitride . (Al = 27,N = 14) .

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23. Calculate the percentage of phosphorus in the fertiliser superphosphate $Ca(H_2PO_2)_2$

(H = 1, O = 16, P = 31, Ca = 40).

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Worksheet 5

1. Calculate the mass of pure CO_2 formed when 500 g of magnesium carbonate of 64 % purity dissolves in an excess of HCl as given below :

$$MgCO_3 + 2HCl \rightarrow MgCl_2 + H_2O + CO_2$$

(Mg = 24, C = 12, O = 16, H = 1, Cl = 35.5)

2. Calculate the amount of pure aluminium obtained when 100 g of impure Al_2O_3 of 85% pure is reduced electrolytically as under

$$2Al_2O_3 \rightarrow 4Al + 3O_2(Al = 27, O = 16)$$
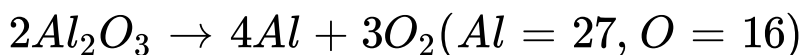
3. Calculate the mass of potassium chlorate which will produce 24 g of oxygen on complete decomposition. Also calculate the mass of potassium chloride formed. (K = 39, O = 16)

4. Calculate the mass of copper nitrate obtained by treating 6.4 g of copper with excess of concentrated nitric acid. (Cu = 64,. N = 14, O = 16)

5. What mass of silver chloride will be obtained by adding an excess of hydrochloric acid to a solution of 0.68 g of silver nitrate?

(Cl = 35.5, Ag = 108, N = 14,O = 16).

6. Calculate the mass of aluminium oxide formed when 27 g of aluminium foil is burnt completely in oxygen. (Al= 27, O = 16)

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7. Calculate the mass of lead chloride formed by treating an aqueous solution 13.24 g of lead nitrate with excess of hydrochloric acid.

(Pb = 207, Cl = 35.5, H = 1, O = 16)

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1. Calculate the weight of copper sulphate formed when 128 g of copper are added to conc. H_2SO_4. What is the volume of SO_2 liberated at S.T.P.?

(Cu= 64, H = 1, S = 32, O = 16)

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2. Concentrated nitric acid oxidises phosphorus to phosphoric acid according to the following equation:

$$P + 5HNO_3 \rightarrow H_3PO_4 + H_2O + 5NO_2$$
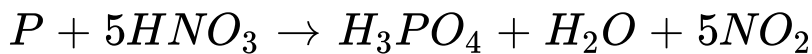
What mass of phosphoric acid can be prepared from 6.2 g of phosphorus?

(H = 1, N = 14, O = 16, P = 31)

3. Concentrated nitric acid oxidises phosphorus to phosphoric acid according to the following equation:

$$P + 5HNO_3 \rightarrow H_3PO_4 + H_2O + 5NO_2$$
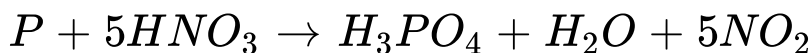
What mass of nitric acid will be consumed at the same time?

(H = 1, N = 14, O = 16, P = 31)

4. Concentrated nitric acid oxidises phosphorus to phosphoric acid according to the following equation:

$$P + 5HNO_3 \rightarrow H_3PO_4 + H_2O + 5NO_2$$
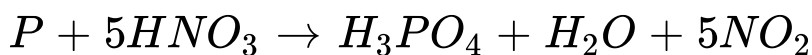
What would be the volume of steam produced at the same time if measured at 760 mm pressure of Hg and 273 K ?

(H = 1, N = 14, O = 16, P = 31)

5. If a crop of wheat removes 20 kg of nitrogen per hectare of soil, what mass of fertiliser calcium nitrate, $Ca(NO_3)_2$, would be required to replace the nitrogen in 910 hectare field?

(N = 14, O = 16, Ca= 40). Answer to the nearest kg.

6. The equations given below relate to the manufacture of sodium carbonate (molecular mass of

$$NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$$

Na $CO_3 = 106$).

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$
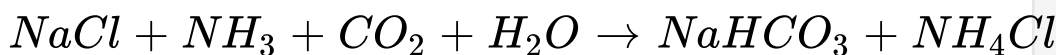
Question a and b are based on the production of 21.2 g of sodium carbonate

a. What is the mass of sodium hydrogen carbonate must be heated to give 21.2 g of sodium carbonate (molecular weight of NaHCO_(3) = 84)

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7. The equations given below relate to the manufacture of sodium carbonate (molecular mass of Na $CO_3 = 106$).

$$NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$$

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$
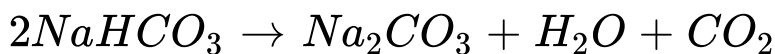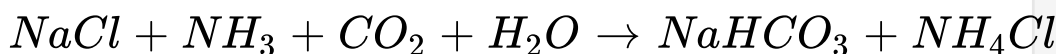
Question a and b are based on the production of 21.2 g of sodium carbonate

b. To produce the mass of sodium hydrogen carbonate calculated in (a) what volume of carbon dioxide measured at STP, would be required?

8. When heated, potassium permangnate decomposes according to the following equation :

$$2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$$
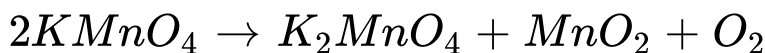
Some potassium permangnate was heated in a test tube. After collecting one litre of oxygen at room temperature, it was found that the test tube had

undergone a loss in mass of 1.32 g. If one litre of hydrogen under the same conditions of temperature and pressure has a mass of 0.0825 g, calculate the relative molecular mass of oxygen.

9. When heated, potassium permangnate decomposes according to the following equation :

$$2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$$
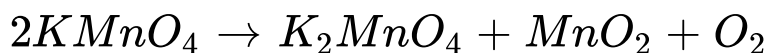
Given that the molecular mass of potassium permangnate is 158, what volume of oxygen measured at room temperature, would be obtained by the complete decomposition of 15.8 g of

potassium permangnate? (Molar volume of room temperature is 22.4 litres)

10. Solid ammonium dichromate (relative molecular mass = 252) on heating decomposes as follows :

$$(NH_4)_2 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$$
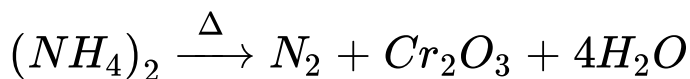
Calculate the volume of nitrogen at S.T.P., that will be evolved when 31.5 g ammonium dichromate is heated.

11. Consider the reaction and based on the reaction answer the questions that follow :

$$(NH_4)_2Cr_2O_7 \xrightarrow{\text{Heat}} N_{2(g)} + 4H_2O(g) + Cr_2O_3$$
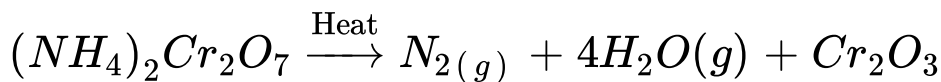
Calculate:

The mass in gram of Cr_2O_3 formed at the same time.

[Atomic masses : H = 1, Cr = 52, N = 14]

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Worksheet 7

1. Ammonia is oxidised according to equation :

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$
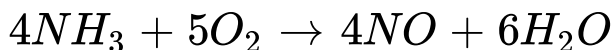
How many litres of NO are formed when 90 litres of oxygen react with ammonia at S.T.P.?

2. Ammonia may be oxidised to nitrogen monoxide in the presence of a catalyst according to the following equation :

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$
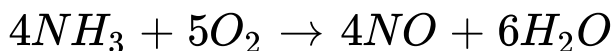
If 27 litres of reactants are consumed, what volume

of nitrogen monoxide is produced at the same temperature and pressure?

3. $200 cm^3$ of methane at 27°C and 760 mm pressure of Hg were exploded with excess of oxygen. Determine the volume of CO_2 at N.T.P.

4. What volume of nitrogen dioxide would be formed when 100 cm^3 of NO reacts with 50 cm^3 of

O_2 under the same conditions of temperature and pressure?

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5. What volume of oxygen at $0°C$ and 760 mm pressure of Hg is required to effect the complete combustion of 6L of methane at 15ºC and 760 mm pressure of Hg.

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Additional Questions For Practice

1. A compound of empirical formula CH_2O has a V.D. of 30. Write down its molecular formula.

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2. What do you understand by :

Atomic weight

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3. What do you understand by :

Molecular weight

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4. State Gay-Lussac.s Law of combining volumes.

5. $60cm^3$ of oxygen was added to $24cm^3$ of carbon monoxide and the mixture ignited. Calculate :

the volume of oxygen used up.

6. $60 cm^3$ of oxygen was added to $24 cm^3$ of carbon monoxide and the mixture ignited. Calculate :

the volume of carbon dioxide formed.

7. A gas cylinder filled with hydrogen holds 5 g of the gas. The same cylinder holds 85 g of a gas X, under the same temperature and pressure. Calculate the vapour density and mol. wt. of the gas X.

8. If $100 cm^3$ of oxygen contains y molecules, how many molecules of nitrogen will be present in $50 cm^3$ of nitrogen under the same conditions of temperature and pressure?

9. If 12.5 g of solid zinc carbonate is heated to constant mass, what is the mass of the substance formed ?

(Zn = 65, C = 12, O = 16).

10. A compound is formed by 24 g of X and 64 g of oxygen. If X = 12 and O = 16, calculate the simplest formula of the compound.

11. Find the empirical form~a of a compound of carbon and hydrogen which contains 80% carbon. If the molecular weight of the above compound is 30, what is its molecular formula ?

12. Calculate the volume occupied at S.T.P. by 2 moles of carbon dioxide. (C = 12, O = 16)

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13. Urea is a very important nitrogenous fertiliser. Its formula is CON_2H_4. Calculate the percentage of nitrogen in urea. (C = 12, O = 16, N = 14 and H = 1)

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14. The mass of 5.6 litres of a certain gas at S.T .P. is 12 g. What is the relative molecular mass or molar

mass of the gas ?

15. When carbon dioxide is passed over red hot carbon, carbon monoxide is produced according to the equation:

$$CO_2 + C \rightarrow 2CO$$

What volume of carbon monoxide at S.T.P. can be obtained from 3 g of carbon ? (The molar volume of a gas is 22.4 litres)

16. State :

Avogadro's law

17. State :

Charle's law.

18. Calculate :

the mass measured at S.T .P. of carbon dioxide released when 8.40 g of sodium hydrogen

carbonate is decomposed according to the equation :

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$
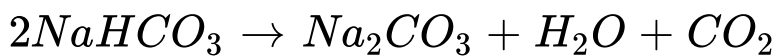
(Na = 23, H = 1, C = 12, O = 16)

19. Calculate :

the volume measured at S.T .P. of carbon dioxide released when 8.40 g of sodium hydrogen carbonate is decomposed according to the equation :

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$
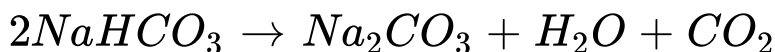
(Na = 23, H = 1, C = 12, O = 16)

20. If the molecular formula of an organic compound is C_2H_2 it is :

21. State Gay-Lussac.s Law of combining volumes.

22. Calculate the vapour density of sulphur dioxide.

[S = 32, O = 16)

23. In the preparation of ammonia in industry, the raw materials are nitrogen and hydrogen. These are mixed together in the correct proportions needed to form ammonia.

Write the balanced equation for the manufacture of ammonia.

24. In the preparation of ammonia in industry, the raw materials are nitrogen and hydrogen. These are mixed together in the correct proportions needed to form ammonia.

How much hydrogen would there be in 400 litres of the gaseous mixture required for the manufacture of ammonia ?

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25. In the preparation of ammonia in industry, the raw materials are nitrogen and hydrogen. These are mixed together in the correct proportions needed

to form ammonia.

Write the balanced equation for the manufacture of ammonia.

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26. In the preparation of ammonia in industry, the raw materials are nitrogen and hydrogen. These are mixed together in the correct proportions needed to form ammonia.

How would the volume of ammonia formed compare with the volume of the original mixture?

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27. A compound X has a molecular formula of C_5H_{10}. Write down the empirical formula of X.

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28. Calculate the volume occupied by 8 g of sulphur dioxide at S. T.P. [S = 32, O = 16)

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29. Define or state :

Vapour density of a gas

30. State Boyle.s Law.

31. State the Avogadro law of ideal gas

32. Calcium nitrate decomposes on heating according to the equation :

$$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$$

The relative molecular mass of calcium nitrate is 164. Calculate :

the volume of nitrogen dioxide (NO_2) obtained at S.T.P. when 16.4 g of $Ca(NO_3)_2$ is heated to constant weight

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33. Calcium nitrate decomposes on heating according to the equation :

$$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$$

The relative molecular mass of calcium nitrate is 164. Calculate :

the weight of calcium oxide obtained when 16.4 g of

calcium nitrate is heated to constant weight. $(Ca = 40, O = 16, N = 14)$

34. Quick lime, CaO, is obtained by the burning of limestone, $CaCO_3$, in a lime kiln and the reaction is represented as :

$$CaCO_3 \rightarrow CaO + CO_2$$

What weight of limestone must be heated to obtain 112 kilograms of quick lime ? (Ca = 40, O = 16, C = 12)

35. State Gay-Lussac.s Law of combining volumes.

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36. Define the following :

Molar volume of a gas.

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37. 'The number of atoms in 1 mole of hydrogen is twice the number of atoms in 1 mole of helium, at the same temperature and pressure." Why ?

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38. From the equation :

$$3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO$$
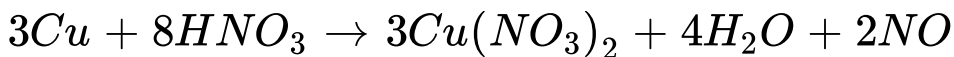
Calculate :

mass of copper needed to react with 63 g of HNO_3

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39. From the equation :

$$3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO$$
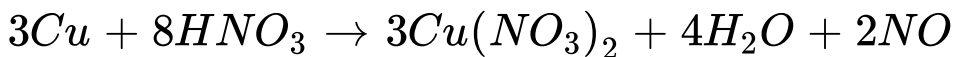
Calculate :

volume of nitric oxide at S.T.P. that can be collected.

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40. Find the percentage mass of water in washing soda crystals `Na_2CO_3 , 10H_2O.

41. Some of the fertilisers are sodium nitrate $NaNO_3$, ammonium sulphate $(NH_4)_2SO_4$ and urea $CO(NH_2)_2$. Which of these contains the highest percentage of nitrogen ?

42. The compound A has 26.7% C, 71.1% O and 2.2%H.

determine the empirical formula of A

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43. The compound A has 26.7% C, 71.1% O and 2.2%H.

if the relative molecular mass of A is 90, what is the molecular formula of A

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44. Use equation $2H_2O(l) \rightarrow 2H_2(g)$ to answer the following

What volume of O_2 will be produced if the volume of H_2 produced is $2500cm^3$ under similar conditions?

45. Water decomposes to O_2 and H_2 under suitable conditions as represented by the equation below :

$$H_2O \rightarrow 2H_2 + O_2$$
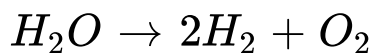
the $2500cm^3$ is subjected to $2\dfrac{1}{2}$ times increase in pressure (temp. remaining constant). What volume of H_2 will now occupy ?

46. Water decomposes to O_2 and H_2 under suitable conditions as represented by the equation below :

$$H_2O \rightarrow 2H_2 + O_2$$
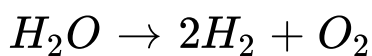
taking the value of H_2 what changes must be made in kelvin (absolute) temperature to return the volume to $2500cm^3$ pressure remaining constant.

(Use:5000/7cc=V2)

47. Urea $(CO(NH_2)_2)$ is an important nitrogenous fertilizer. Urea is sold in 50 kg sack. What mass of nitrogen is in one sack of urea ?

48. The following experiment was performed in order to qetermine the formula of a hydrocarbon. The hydrocarbon X is purified by fractional distillation. 0.145 g of X were heated with dry copper (II) oxide and $224cm^3$ of carbon dioxide was collected at S.T.P

Which elements does X contain ?

49. The following experiment was performed in order to qetermine the formula of a hydrocarbon. The hydrocarbon X is purified by fractional distillation. 0.145 g of X were heated with dry copper (II) oxide and $224cm^3$ of carbon dioxide was collected at S.T.P

Which elements does X contain ?

50. The following experiment was performed in order to qetermine the formula of a hydrocarbon. The hydrocarbon X is purified by fractional distillation. 0.145 g of X were heated with dry copper (II) oxide and $224cm^3$ of carbon dioxide was collected at S.T.P

Calculate the empirical formula of X by the following steps :

Calculate the number of moles of carbon dioxide gas.

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51. The following experiment was performed in order to qetermine the formula of a hydrocarbon. The hydrocarbon X is purified by fractional distillation. 0.145 g of X were heated with dry copper (II) oxide and $224cm^3$ of carbon dioxide was collected at S.T.P

Calculate the empirical formula of X by the following steps :

Calculate the number of moles of carbon dioxide gas.

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52. The following experiment was performed in order to qetermine the formula of a hydrocarbon. The hydrocarbon X is purified by fractional distillation. 0.145 g of X were heated with dry copper (II) oxide and $224cm^3$ of carbon dioxide was collected at S.T.P

Calculate the empirical formula of X by the following steps :

Calculate the mass of hydrogen in sample X.

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53. The following experiment was performed in order to determine the formula of a hydrocarbon. The hydrocarbon X is purified by fractional distillation. 0.145 g of X were heated with dry copper (II) oxide and $224cm^3$ of carbon dioxide was collected at S.T.P

Calculate the empirical formula of X by the following steps :

Deduce the ratio of atoms of each element in X (empirical formula).

54. From the equation for burning of hydrogen and oxygen

$2H_2 + O_2 \rightarrow 2H_2O$ (Steam)
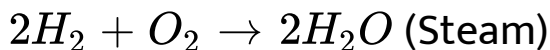
Write down the number of mole (or moles) of steam obtained from 0.5 moles of oxygen.

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55. Calculate the number of moles in 7g of nitrogen.

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56. Calculate the percentage of nitrogen in ammonium nitrate (NH_4NO_3) [R.A.M: H = 1, N = 14,0 = 16]

57. A fixed mass of gas has volume $750\ cm^3$ at - 23°C and 800 mm pressure. Calculate the pressure for which its volume will be 720 cm3 the temp. being $-3°C$

58. A hydrocarbon contains 82.8% of carbon and has a relative molecular mass of 58. Write its empirical formula.

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59. A hydrocarbon contains 82.8% of carbon and has a relative molecular mass of 58. Write its empirical formula.

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Questions From Previous Icse Board Papers

1. 1 mole of sulphur dioxide occupies $24dm^3$ at room temperature and pressure. Calculate at room temperature and pressure :

mass of $6dm^3$ of sulphur dioxide gas.

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2. 1 mole of sulphur dioxide occupies $24dm^3$ at room temperature and pressure. Calculate at room temperature and pressure :

volume occupied by 80 g of sulphur dioxide.

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3. 1 mole of sulphur dioxide occupies $24dm^3$ at room temperature and pressure. Calculate at room temperature and pressure :

molecules in 0.64 g of sulphur dioxide, if 1 mole of sulphur dioxide contains N molecules.

4. 1 mole of sulphur dioxide occupies $24dm^3$ at room temperature and pressure. Calculate at room temperature and pressure :

weight of 0.5 g-molecules of sulphur dioxide. [S = 32 , O = 16]

5. Calculate the empirical formula of a compound having following - percentage composition. Carbon = 25.41%, hydrogen 3.17%, oxygen = 33.86% and chlorine 37.56%.[C = 12 , H = 1 , O = 16 , Cl = 35.5)

6. Calculate the volume of oxygen required for the complete combustion of 20 ml of propane (C_3H_8)

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$
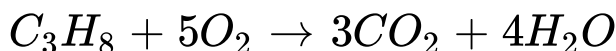
7. The volumes of gases A, B, C and D are in the ratio, 1:2:2:4 under the same conditions of temperature and pressure.

Which sample of gas contains the maximum number of molecules?

8. The volumes of gases A, B, C and D are in the ratio, 1:2:2:4 under the same conditions of temperature and pressure.

If the temperature and the pressure of gas A are kept constant, then what will happen to its volume when the number of molecules is doubled?

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9. The volumes of gases A, B, C and D are in the ratio, 1:2:2:4 under the same conditions of temperature and pressure.

If this ratio of gas volumes refers to the reactants and products of a reaction, which gas law is being observed?

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10. The volumes of gases A, B, C and D are in the ratio, 1:2:2:4 under the same conditions of temperature and pressure.

If the volume of A is actually 5.6 dm at STP, calculate the number of molecules in the actual volume of D at STP (Avogadro's number is 6×10^{23})

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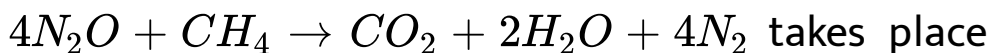
11. The reaction $4N_2O + CH_4 \rightarrow CO_2 + 2H_2O + 4N_2$ takes place in the gaseous state. If all volumes are measured at the same temperature and pressure, calculate the

volume of dinitrogen oxide (N_2O) required to give 150 ml of steam. (N = 14, O = 16, C = 12, H = 1)

12. Calculate the percentage of Nitrogen in aluminium nitride . (Al = 27,N = 14) .

13. The equations given below relate to the manufacture of sodium carbonate (molecular mass of

$$NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$$

Na CO_3 = 106).

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$
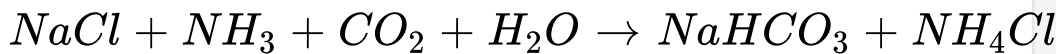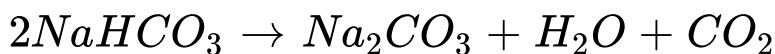
Question a and b are based on the production of

21.2 g of sodium carbonate

a. What is the mass of sodium hydrogen carbonate

must be heated to give 21.2 g of sodium carbonate

(molecular weight of NaHCO_(3) = 84)

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14. The equations given below relate to the

manufacture of sodium carbonate (molecular mass

of Na CO_3 = 106).

$$NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$$

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$
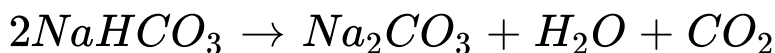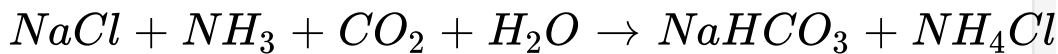
Question a and b are based on the production of 21.2 g of sodium carbonate

b. To produce the mass of sodium hydrogen carbonate calculated in (a) what volume of carbon dioxide measured at STP, would be required?

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15. The equations given below are related to the manufacture of sodium carbonate. [molecular weight of $Na_2CO_3 = 106$]

(i)

$$NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$$

(ii) $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$
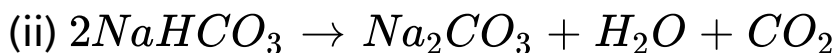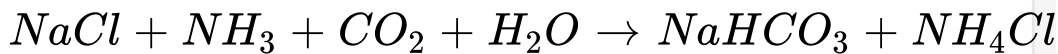
Question are based on the production of 21.2 g of sodium carbonate.

Define the following terms :

(i) Atomic weight (ii) Catenation

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16. Calculate the percentage of :

Sodium

in sodium aluminium fluoride $[Na_3AlF_6]$, to the nearest whole number. (Atomic Mass : Na = 23, Al = 27, F = 19]

17. 560 mL of carbon monoxide is mixed with 500 mL of oxygen and ignited. The chemical equation for the reaction is $2CO + O_2 \rightarrow 2CO_2$.

Calculate the volume of oxygen used and carbon dioxide formed in the above reaction.

18. Determine the empirical formula of a compound containing 47.9% potassium, 5.5% beryllium and

46.6% fluorine by mass.

(Atomic weight of Be=9, F = 19, K = 39).

19. Given that the relative molecular mass of copper oxide is 80, what volume of ammonia (measured at STP) is required to completely reduce 120 g of copper oxide? The equation for the reaction is:

$$3CuO + 2NH_3 \rightarrow 3Cu + 3H_2O + N_2$$
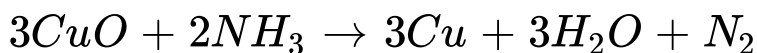
20. A sample of ammonium nitrate when heated yields 8.96 L of steam (measured at STP).

$$NH_4NO_3 \rightarrow N_2O + 2H_2O$$
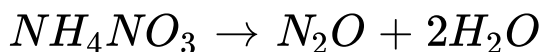
What volume of dinitrogen oxide is produced at the same time as 8.96 L of steam?

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21. A sample of ammonium nitrate when heated yields 8.96 L of steam (measured at STP).

$$NH_4NO_3 \rightarrow N_2O + 2H_2O$$
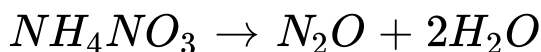
What mass of ammonium nitrate should be heated to produce 8.96 L of steam?

(Relative molecular mass of ammonium nitrate is 80.)

22. A sample of ammonium nitrate when heated yields 8.96 litres of steam (measured at S.T.P.)

$$NH_4NO_3 \rightarrow N_2O + 2H_2O$$
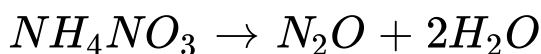
Determine the percentage of oxygen in ammonium nitrate (O = 16).

23. A compound X consists of 4.8% carbon and 95.2% bromine by mass.

Determine the empirical formula of this compound working correct to one decimal place (C = 12, Br = 80)

24. A compound X consists of 4.8% carbon and 95.2% bromine by mass.

If the vapour density of the compound is 252, what is the molecular formula of the compound?

25. Name the type of reaction by which X [compound of C & Br] can be prepared from ethane.

26. The equation for the burning of octane is

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$
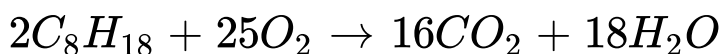
How many moles of carbon dioxide are produced when one mole of octane burns ?

27. The equation for the burning of octane is

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$
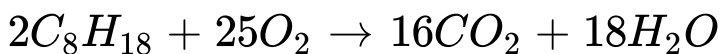
What volume at S.T .P. is occupied by the number of moles of carbon dioxide produced when one mole of octane burns ?

28. The equation for the burning of octane is

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$
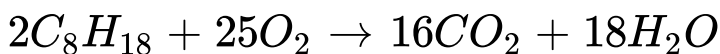
If the relative molecular mass of carbon dioxide is 44, what is the mass of carbon dioxide produced by burning two moles of octane ?

29. The equation for the burning of octane is

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$
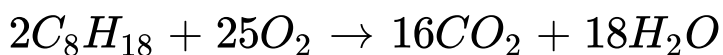
What is the empirical formula of octane ?

30. A compound has the following percentage composition by mass: carbon 14.4%, hydrogen 1.2% and chlorine 84.5%. Determine the empirical formula of this compound. Work correct to 1 decimal place. (H = 1, C = 12, Cl = 35.5)

31. Empirical formula of a compound is $CHCl_2$ and

molecular mass is 168. Find molecular formula.

32. By what type of reaction could a compound

containing C, H and Cl – be obtained from ethyne?

33. From the equation :

$$C + 2H_2SO_4 \rightarrow CO_2 + 2H_2O + 2SO_2$$

Calculate :

The mass of carbon oxidised by 49 g of sulphuric acid (C = 12, relative molecular mass of sulphuric acid = 98)

34. From the equation

$$C + 2H_2SO_4 \rightarrow CO_2 + 2SO_2 + 2H_2O$$

Calculate :

The volume of sulphur dioxide measured at S. T. P.

liberated at the same time. (Volume occupied by 1 mole of a gas at S.T.P. 22.4 dm^3)

35. A gas cylinder of capacity of $20dm^3$ is filled with gas X, the mass of which is 10g. When the same cylinder is filled with hydrogen gas at the same temperature and pressure, the mass of the hydrogen is 2g. Hence the relative molecular mass of the gas is

A. 5

B. 10

C. 15

D. 20

Answer: D

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36. Calcium carbide is used for the artificial ripening

of fruits. Actually the fruit ripens because of the

heat evolved while calcium carbide reacts with

moisture. During this reaction calcium hydroxide

and acetylene gas is formed. If $200cm^3$ of acetylene

is formed from a certain mass of calcium carbide,

find the volume of oxygen required and carbon dioxide formed during the complete combustion. The combustion reaction can be represented as below :

$$C_2H_2(g) + SO_2 \rightarrow 4CO_2(g) + 2H_2O(g)$$
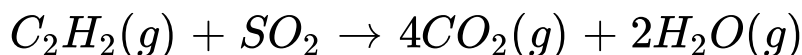
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37. A gaseous compound of nitrogen and hydrogen contains 12.5% hydrogen by mass. Find the molecular formula of the compound if its relative molecular mass is 37.

[N = 14, H = 1]

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38. Correct the following statements.For Example : "Chlorine is a bleaching agent'. Should read : "Moist chlorine is a bleaching agent'. Haematite is the chief ore of aluminium.

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39. A gas cylinder contains 24×10^{24} molecules of nitrogen gas. If Avogadro's number is 6×10^{23} and the relative atomic mass of nitrogen is 14, calculate:

Mass of nitrogen gas in the cylinder.

40. A gas cylinder contains 24×10^{24} molecules of nitrogen gas. If Avogadro's number is 6×10^{23} and the relative atomic mass of nitrogen is 14, calculate :

Volume of nitrogen at S.T.P. in dm^3.

41. Commerical sodium hydroxide weighing 30 g has some sodium chloride in it. The mixture on dissolving in water and subsequent treatment with

excess silver nitrate solution formed a precipitate weighing 14.3 g. What is the percentage of sodium chloride in the commercial sample of sodium hydroxide? The equation for the reaction is

$$NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$$
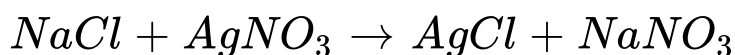
(Relative molecular mass of $NaCl = 58, AgCl = 143$)

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42. A certain gas 'X' occupies a volume of 100 cm^3 at S.T.P. and weighs 0.5 g. Find its relative molecular mass.

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43. LPG stands for liquefied petroleum gas. Varieties of LPG are marketed including a mixture of propane (60%) and butane (40%). If 10 L of this mixture is burnt, find the total volume of carbon dioxide gas added to the atmosphere. Combustion reactions can be represented as:

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$$

$$2C_4H_{10} + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g)$$
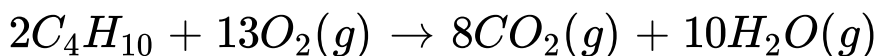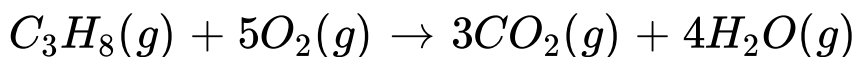
44. Calculate the percentage of nitrogen and oxygen in ammonium nitrate. [Relative molecular mass of ammonium nitrate is 80, H = 1, N = 14, O = 16).

45. In an experiment,4.5 mol of calcium carbonate are reacted with dilute hydrochloric acid.

Write the equation for the reaction.

46. In an experiment,4.5 mol of calcium carbonate are reacted with dilute hydrochloric acid.

What is the mass of4.5 mol of calcium carbonate? (Relative molecular mass of calcium carbonate is 100.)

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47. In an experiment,4.5 mol of calcium carbonate are reacted with dilute hydrochloric acid.

What is the volume of carbon dioxide liberated at STP?

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48. In an experiment,4.5 mol of calcium carbonate are reacted with dilute hydrochloric acid.

What mass of calcium chloride is formed? (Relative molecular mass of calcium chloride is 111.)

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49. In an experiment,4.5 mol of calcium carbonate are reacted with dilute hydrochloric acid.

How many moles of HCl are used in this reaction?

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50. Calculate the volume of 320 g of SO_2 at S.T.P. (Atomic mass : S = 32 and O = 16).

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51. State Gay-Lussac.s Law of combining volumes.

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52. Calculate the volume of oxygen required for the complete combustion of 8.8 g of propane (C_3H_8).

(Atomic mass : C = 14, O = 16, H = 1, Molar Volume = 22.4 dm^3 at S.T.P).

53. An organic compound with vapour density = 94 contains

C=12.67%, H = 2.13%, and Br = 85-11%. Find the molecular formula.

[Atomic mass: C = 12, H = 1, Br = 80]

54. Calcuate the mass of

10^{22} atoms of sulphur.

[Atocmi mass S=32,C and O=16 and Avogadro's

number $= 6 \times 10^{23}$]

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55. Calculate the mass of

0.1 mole of carbon dioxide.

[Atomic mass : S = 32, C = 12 and O = 16 and

Avogadro.s Number $= 6 \times 10^{23}$]

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56. The vapour density of carbon dioxide [C=12,O=16]

A. 32

B. 16

C. 44

D. 22

Answer: D

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57. Concentrated nitric acid oxidises phosphorus to phosphoric acid according to the following

equation:

$$P + 5HNO_3(\text{conc.}) \quad \rightarrow H_3PO_4 + H_2O + 5NO_2$$
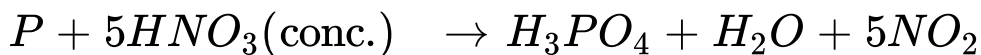
If 9.3 g of phosphorus was used in the reaction, calculate :

Number of moles of phosphorus taken.

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58. Concentrated nitric acid oxidises phosphorus to phosphoric acid according to the following equation:

$$P + 5HNO_3(\text{conc.}) \quad \rightarrow H_3PO_4 + H_2O + 5NO_2$$
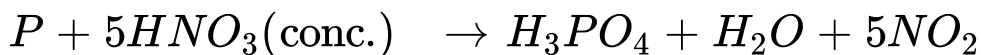
If 9.3 g of phosphorus was used in the reaction,

calculate :

The mass of phosphoric acid formed.

59. Concentrated nitric acid oxidises phosphorus to phosphoric acid according to the following equation:

$$P + 5HNO_3(\text{conc.}) \quad \rightarrow H_3PO_4 + H_2O + 5NO_2$$
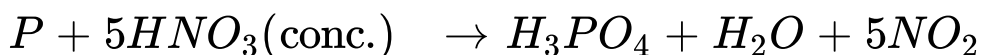
If 9.3 g of phosphorus was used in the reaction, calculate :

The volume of nitrogen dioxide produced at S.T.P.

[H = 1, N = 14, P = 31, O = 16]

60. 67.2 litre of hydrogen combines with 44.8 litres of nitrogen to form ammonia under specific conditions as :

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$
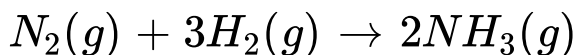
Calculate the volume of ammonia produced. What is the other substance, if any, that remains in the resultant mixture ?

61. The mass of 5.6 dm^3 of a certain gas at S.T.P.is 12.0 g. Calculate the relative molecular mass of the gas.

62. Find the total percentage of magnesium in magnesium nitrate crystals $[Mg(NO_3)_2.6H_2O]$

[Mg=24, N=14, O=16,H-1]

63. Solve

What volume of oxygen is required to burn completely $90dm^3$ of butane under similar conditions of temperature and pressure ?

$$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$$
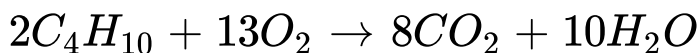
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64. Solve

The vapour density of a gas is 8. What would be the volume occupied by 24.0 g of the gas at STP ?

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65. Solve

A vessel contains X number of molecules of hydrogen gas at a certain temperature and pressure. How many molecules of nitrogen gas would be present in the same vessel under the same conditions of temperature and pressure ?

66. O_2 is evolved by heating $KClO_3$ using MnO_2 as a catalyst

$$2KClO_3 \xrightarrow{MnO_2} 2KCl + 3O_2$$
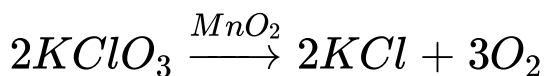
Calculate the mass of $KClO_3$ required to produce

6.72 litre of O_2 at S.T.P. [atomic masses of K = 39, Cl = 35.5, O = 16).

67. O_2 is evolved by heating $KClO_3$ using MnO_2 as a catalyst

$$2KClO_3 \xrightarrow{MnO_2} 2KCl + 3O_2$$
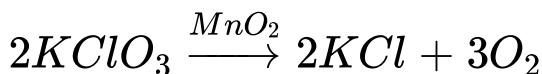
Calculate the number of moles of oxygen produced in the above reaction if 56g of $KClO_3$ is used.

68. O_2 is evolved by heating $KClO_3$ using MnO_2 as a catalyst

$$2KClO_3 \xrightarrow{MnO_2} 2KCl + 3O_2$$
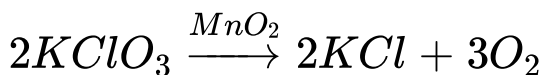
Calculate the volume occupied by 0.01 mole of O_2 at S.T.P.

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69. The ratio of the mass of a certain volume of gas to the mass of an equal volume of hydrogen under the same conditions of temperature and pressure is known as_____

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70. Oxygen oxidizes ethyne to carbon dioxide and water as shown by the equation :

$$2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$$
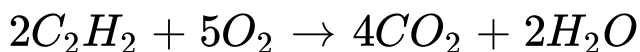
What volume of ethyne gas at S.T.P. is required to produce 8.4 dm^3 of carbon dioxide at S.T.P. ? [H= 1, C = 12, O = 16]

71. A compound made up of two elements X and Y has an empirical formula X2Y. If the atomic weight

of X is 10 and that of Y is 5 and the compound has a vapour density 25, find the molecular formula,

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72. State the Avogadro law of ideal gas

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73. A cylinder contains 68 g of ammonia at STP. What is the volume occupied by this gas?

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74. A cylinder contains 68 g of ammonia gas at S.T.P. How many moles of ammonia are present in the cylinder?

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75. A cylinder contains 68 g of ammonia gas at S.T.P. How many moles of ammonia are present in the cylinder?

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76. Which of the following would weigh the least?

[Atomic masses : Ag = 108, N = 14, O = 16, C = 12]

    A. 2 gram atoms of Nitrogen

    B. 1 mole of Silver

    C. 22.4 litres of oxygen gas at 1 atmospheric

       pressure and 273 K

    D. 6.02×10^{23} atoms of carbon

Answer:

77. Complete the calculation. Show working for complete credit :

Calculate the mass of calcium that will contain the same number of atoms as are present in 3.2 gm of sulphur. [Atomic masses : S = 32, Ca = 40]

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78. Complete the calculation. Show working for complete credit :

If 6 litre of hydrogen and 4 litre of chlorine are mixed and exploded and if water is added to the gases formed, find the volume of the residual gas

79. Complete the calculation. Show working for complete credit :

If the empirical formula of a compound is CH and it has a vapour density of 13, find the molecular formula of the compound.

80. Consider the reaction and based on the reaction answer the questions that follow :

$$(NH_4)_2Cr_2O_7 \xrightarrow{\text{Heat}} N_{2(g)} + 4H_2O(g) + Cr_2O_3$$
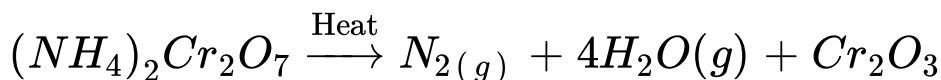
Calculate:

The quantity in moles of $(NH_4)_2Cr_2O_7$ if 63 gm of $(NH_4)_2Cr_2O_7$ is heated.

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81. In the formula $F = Gm_1m_2/r^2$, the quantity G:

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82. Consider the reaction and based on the reaction answer the questions that follow :
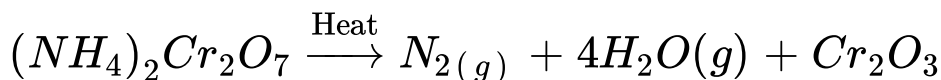
$$(NH_4)_2Cr_2O_7 \xrightarrow{\text{Heat}} N_{2(g)} + 4H_2O(g) + Cr_2O_3$$

Calculate:

The volume in litres or dm of N_2 evolved at S.T.P

83. Consider the reaction and based on the reaction answer the questions that follow :
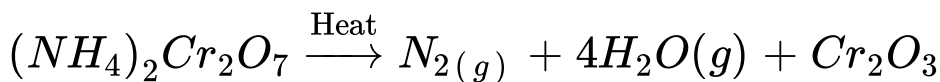
$$(NH_4)_2Cr_2O_7 \xrightarrow{\text{Heat}} N_{2(g)} + 4H_2O(g) + Cr_2O_3$$

Calculate:

The mass in gram of Cr_2O_3 formed at the same time.

[Atomic masses : H = 1, Cr = 52, N = 14]

84. The ratio between the number of molecules in 2 g of hydrogen and 32 g of oxygen is:

[Given that H = 1, O = 16]

A. $1:2$

B. $1:001$

C. $1:1$

D. $0.01:1$

Answer:

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85. A gas of mass 32 gm has a volume of 20 litre at S.T.P. Calculate the gram molecular weight of the gas.

86. How much calcium oxide is formed when 82 g of calcium nitrate is heated ? Also find the volume of nitrogen dioxide evolved :

$$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$$

(Ca = 40, N = 14, O = 16)

87. A gas cylinder contains 12×10^{24} molecules of oxygen gas.

If Avogadro's number is 6×10^{23}. Calculate :

The mass of oxygen present in the cylinder.

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88. A gas cylinder contains 12×10^{24} molecules of oxygen gas.

If Avogadro's number is 6×10^{23}. Calculate :

The volume of oxygen at S.T.P. present in the cylinder. [O = 16]

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89. A gaseous hydrocarbon contains 82.76% of carbon. Given that its vapour density is 29, find its molecular formula. [C = 12, H = 1]

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90. The equation $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$, represents the catalytic oxidation of ammonia. If $100 \ cm^3$ of ammonia is used, calculate the volume of oxygen required to oxidise the ammonia completely.

91. Calculate the number of gram atoms in 4.6 grams of sodium (Na = 23).

92. Calculate the percentage of water of crystalization in $CuSO_4.5H_2O$

(H = 1, O = 16, S = 32, Cu = 64)

93. A compound of X and Y has the empirical formula XY2 Its vapour density is equal to its empirical formula weight. Determine its molecular formula.

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94. Propane burns in air according to the following equation :

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O.$$
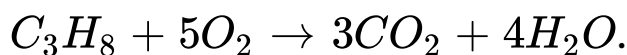
What volume of propane is consumed on using 1000 cm^3 of air, considering only 20% of air contains oxygen ?

95. The mass of 11.2 litre of a certain gas at S.T.P. is 24 g. Find the gram molecular mass of the gas.

96. A gas cylinder can hold 1 kg of hydrogen at room temperature and pressure :

Find the number of moles of hydrogen present.

97. A gas cylinder can hold 1 kg of hydrogen at room temperature and pressure :

What weight of CO_2 can the cylinder hold under similar conditions of temperature and pressure ?

(H=1, C = 12, O=16)

98. A gas cylinder can hold 1 kg of hydrogen at room temperature and pressure :

If the number of molecules of hydrogen in the cylinder is X, calculate the number of CO_2

molecules in the cylinder under the same conditions of temperature and pressure.

99. A gas cylinder can hold 1 kg of hydrogen at room temperature and pressure :

State the law that helped you to arrive at the above result.

100. The percentage composition of a gas is : Nitrogen 82.35%, Hydrogen 17.64%. Find the empirical formula of the gas.

[N = 14, H = 1]

101. Aluminium carbide reacts with water according to the following equation :

$$Al_4C_3 + 12H_2O \rightarrow 4Al(OH)_3 + 3CH_4$$
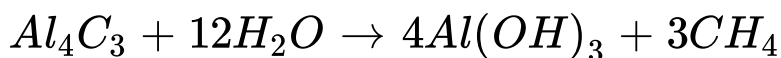
What mass of aluminium hydroxide is formed from 12 g of aluminium carbide ?

102. Aluminium carbide reacts with water according to the following equation :

$$Al_4C_3 + 12H_2O \rightarrow 4Al(OH)_3 + 3CH_4$$
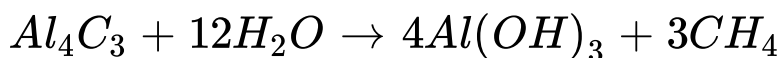
What volume of methane at S.T.P. is obtained from 12 g of aluminium carbide ?

[Relative molecular weight of $Al_4C_3 = 144$, $Al(OH)_3 = 78$]

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103. If 150 cc of gas A contains X molecules, how many molecules of gas B will be present in 75 cc of B? The gases A and B are under the same condition of temperature and pressure.

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104. Define Oxidation in terms of Oxygen and Hydrogen

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105. Ethane burns in oxygen to form CO_2 and H_2O according to the equation :
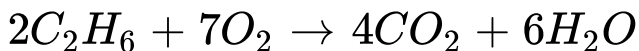
$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

If 1250 cc of oxygen is burnt with 300 cc of ethane.

Calculate :

the volume of unused O_2.

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106. Ethane burns in oxygen to form CO_2 and H_2O according to the equation :
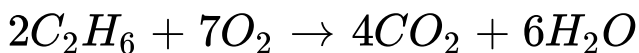
$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

If 1250 cc of oxygen is burnt with 300 cc of ethane.

Calculate :

the volume of unused O_2.

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Fill In The Blanks

1. A/An .... is the smallest unit of matter, which may or may not have an independent existence, but always takes part in a chemical reaction.

    A. atom

    B. molecule

C. particle

D. compound

Answer: A

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2. The temperature at which all molecular motion ceases is ....

A. Absolute zero

B. Standard temperature

C. Both (a) and (b)

D. None of these

Answer: A

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3. The ratio of certain mass of a gas or vapour to the mass of same volume of hydrogen is it's ....

A. Vapour density

B. Empirical formula

C. Molecular formula

D. Percentage composition

Answer: A

Multiple Choise Questions

1. If two compounds have the same empirical formula but different molecular formula, they must have

A. Different percentage composition.

B. Different molecular weights.

C. Same viscosity.

D. Same vapour density.

Answer: B

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2. When two compounds R and S have same percentage composition. Then the compounds R and S are:

   A. identical

   B. isomer

   C. either identical or isomer

D. All are correct

Answer: D

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3. What indicates the actual number of constituent atoms in a molecule?

A. Empirical formula

B. Molecular formula

C. Empirical mass

D. Molecular mass

Answer: B

4. If two compounds have the same empirical formula but different molecular formulae, they must have

    A. different percentage composition.

    B. different molecular mass.

    C. same viscosity.

    D. same vapour density.

Answer: B

5. The starting material which takes part in chemical reaction is called:

A. product

B. reactant

C. catalyst

D. starter

Answer: B

6. The formula which gives the simple ratio of each kind of atoms present in the molecule of a compound is called

    A. Molecular Formula

    B. Empirical Formula

    C. Structural Formula

    D. None of these

Answer: B

7. The formula which expresses the actual number of each kind of atom present in the molecule of a compound is called

A. Empirical Formula

B. Molecular Formula

C. Structural Formula

D. None of these

Answer: B

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8. Relation between vapour density and molecular weight

    A. Molecular weight = 2/ vapour density

    B. Molecular weight = $2 \times$ vapour density

    C. Molecular weight $\times$ 2 = Vapour density

    D. None of these

Answer: B

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Numerical Based Questions

1. The empirical formula and molecular mass of a compound are CH_2O and 180 g respectively. What will be the molecular formula of the compound?

A. $C_9H_{18}O_9$

B. CH_2O

C. $C_6H_{12}O_6$

D. $C_2H_4O_2$
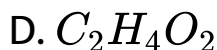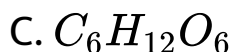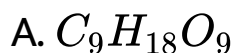
Answer: C

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2. Naphthalene contains 93.75% C and the rest hydrogen. Molecular mass of naphthalene is 128. Find its empirical formula.

A. $C_5 H_4$

B. $C_6 H_4$

C. $C_5 H_{10}$

D. $C_5 H_2$
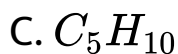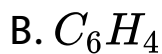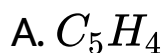
Answer: A

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3. An organic compound contains carbon, hydrogen and oxygen. Its elemental analysis gave Carbon 38.7% and Hydrogen 9.67%. The empirical formula of the compound would be

A. CH_3O

B. CH_2O

C. CHO

D. CH_4O

Answer: A

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4. What is the percentage of water in $CuSO_4 . 5H_2O$
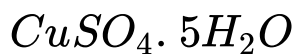
A. 0.12

B. 0.14

C. 0.36

D. 0.18

Answer: C

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5. The vapour density of carbon dioxide [C = 12, O = 16] is:

    A. 22

    B. 16

    C. 44

    D. 22

Answer: D

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6. The empirical formula of hexane is:

A. C_2H_2

B. C_5H_8

C. C_3H_7

D. C_4H_7
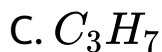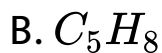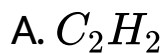
Answer: C

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7. If empirical formula of an organic compound is CH_2O then its molecular formula can be:

A. $C_2H_2O_2$

B. C_2H_4O

C. C_3H_6O

D. $C_6H_{12}O_6$
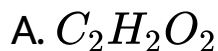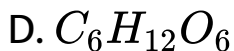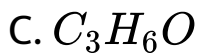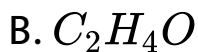
Answer: D

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8. Empirical formula of a substance is CH_2O.

Molecular mass is 180. Find its molecular formula.

A. $C_2H_2O_4$

B. $C_2H_4O_6$

C. $C_6H_{12}O_6$

D. $C_2H_4O_8$
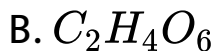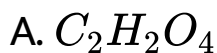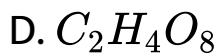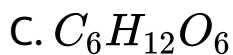
Answer: C

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9. The molecular formula of a gas with vapour density 15 and empirical formula CH_3 is:

A. C_2H_6

B. C_3H_8

C. C_4H_{10}
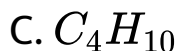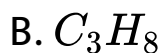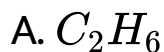
D. CH_3

Answer: A

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10. A compound with Empirical formula AB_2 has the vapour density equal to its Empirical formula weight. Its molecular formula is:
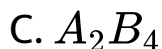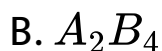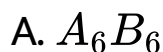
A. A_2B_2

B. A_2B_4

C. A_2B_3

D. A_4B_8
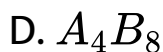
Answer: B

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11. A compound with empirical formula AB has vapour density three times its empirical formula. Its molecular formula will be:

A. A_6B_6

B. A_2B_4

C. A_2B_4

D. AB

Answer: A

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12. What is the percentage mass of copper in Blue Vitriol crystal?
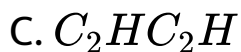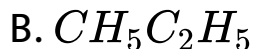
A. 0.2545

B. 0.3607

C. 0.4956

D. None of these

Answer: B

13. What is the empirical formula of Butane?

A. CH_5

B. $CH_5C_2H_5$

C. C_2HC_2H

D. None of these

Answer: D

14. Find the percentage of chlorine in calcium chloride. (Molecular mass of calcium is 40, chlorine is 35.50)

A. 0.6396

B. 0.3604

C. 0.3198

D. 0.5

Answer: A

15. Calculate the percentage of Nitrogen in aluminium nitride. (Al = 27, N = 14)

A. 0.3415

B. 0.2327

C. 12.8%

D. 0.256

Answer: A

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16. Calculate the atomicity of a gas whose vapor density is equal to its relative molecular mass.

A. 3

B. 2

C. 4

D. 1

Answer: B

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17. Determine the percentage of oxygen in Ammonium Nitrate. (Nitrogen = 14, Hydrogen = 1, Oxygen = 16).

    A. 0.2

    B. 0.3

    C. 0.6

    D. 0.8

Answer: C

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18. If the empirical formula of a compound is CH and its vapor density is 13. Its molecular formula will be (C=12, H=1)

    A. CH

    B. C_2H_2

    C. C_4H_4

    D. C_3H_3

Answer: B

19. The weight of lime obtained by heating 200 kg of 95% pure lime stone is:

A. 98.4 kg

B. 106.4 kg

C. 112.8 kg

D. 122.6 kg

Answer: B

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20. An organic compound contains carbon, hydrogen and oxygen. Its elemental analysis gave C, 38.71% and H, 9.67%. The empirical formula of the compound would be:
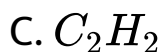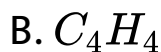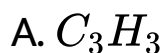
A. CHO

B. CH_4O

C. CH_3O

D. CH_2O

Answer: C

21. If vapour density of the gas is 39 and has molecular formula $(CH)_n$. Then what should be the formula of the compound?

A. C_3H_3

B. C_4H_4

C. C_2H_2

D. C_6H_6

Answer: D

22. Impure sample of ZnS contains 42.34% Zn. What is the percentage of pure ZnS in the sample?

A. 0.67

B. 0.63

C. 0.58

D. 0.37

Answer: B

23. Calculate the value of x, when the hydrated salt

$Na_2CO_3 . xH_2O$ undergoes 63% loss in mass on

heating and becomes anhydrous.

A. 3

B. 5

C. 7

D. 10

Answer: D

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24. Percentage of nitrogen in urea is about:

A. 0.46

B. 0.85

C. 0.18

D. 0.28

Answer: A

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25. In Na_2CO_3, percentage mass of oxygen is:

A. 62.93

B. 45.3

C. 59.6

D. 40.3

Answer: B

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26. Percentage of oxygen [O] in sulphur dioxide [SO_2]:

A. 2.5

B. 50

C. 60

D. 40

Answer: B

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27. Vapour density of a gas is 22. What is its molecular mass?

A. 23

B. 22

C. 44

D. 11

Answer: C

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Assertion And Reason Based Questions

1. In the following question, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

Assertion: The reactant which is present in lesser

amount parameters the amount of product formed is called limiting reagent.

Reason: Amount of product formed does not depend upon the number of reactants taken.

A. Assertion and Reason both are correct statements and reason is the correct explanation of the assertion.

B. Assertion and Reason both are correct statements, but reason is not the correct explanation of the assertion.

C. Assertion is true, but reason is false.

D. Assertion is false, but reason is true.

Answer: C

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