

CHEMISTRY

ALLEN

MOLE CONCEPT

Solved Example

1. Law of conservation of mass: When $4.2g$ of sodium hydrogen carbonate ($NaHCO_3$) is added to a solution of acetic acid (CH_3COOH) weighing $10.0g$ then $2.2g$ of carbon dioxide (CO_2) is released into the atmosphere and the residue left weighs $12.0g$. Show that these observations are in agreement with the law of conservation of mass.

Strategy: Find the sum total of mass of reactants before the reaction and sum total of mass of products after the reaction.



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2. 1.80g of a certain metal burnt in oxygen gave 3.0g of its oxide 1.50g of the same metal heated in steam gave 2.50g of its oxide. Show that these illustrate the law of constant proportion .

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3. The % composition of NH_3 , H_2O and N_2O_3 is as given below:

$NH_3 \rightarrow 82.35\% N$ and $17.65\% H$

$H_2O \rightarrow 88.90\%$ and $11.10\% H$

$N_2O_3 \rightarrow 63.15\% O$ and $36.85\% N$

On the basis of above data prove law of reciprocal proportions.

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4. For the gaseous reaction $H_2 + Cl_2 \rightarrow 2HCl$

If 40ml of hydrogen completely reacts with chlorine then find out the required volume of chlorine and volume of produced HCl ? .

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5. Calculate the atomic mass (average) of chlorine using the following data:

	% natural abundance	Molar mass
^{35}Cl	75.77	34.9689
^{37}Cl	24.23	36.9659

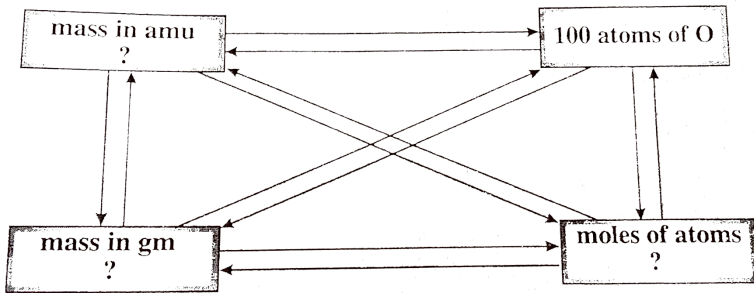
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6. Use data given in the following table to calculate the molar mass of naturally occurring argon isotopes:

Isotope	Isotopic molar mass	Abundance
^{36}Ar	$35.96755\text{g mol}^{-1}$	0.337 %
^{38}Ar	$37.96272\text{g mol}^{-1}$	0.063 %
^{40}Ar	39.9624g mol^{-1}	99.600 %

(Round of the answer to the nearest whole number).

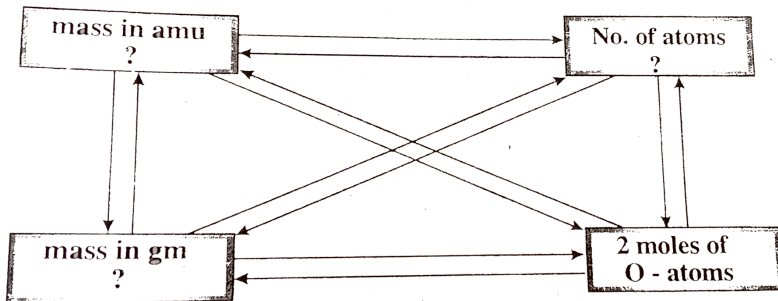
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9. Find : (i) No. of moles in 10^{20} atoms of Cu

(ii) Mass of $200_8^{16}O$ atoms in amu

(iii) Mass of 100 atoms of N in gm

(iv) No. of molecules & atoms in $54\text{gmH}_2\text{O}$

(v) No. of atoms in 88gmCO_2 .

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10. In one mole of ethane (C_2H_6), calculate the following:

- Number of moles of carbon atoms
- Number of moles of hydrogen atoms
- Number of molecules of ethane.

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11. Calculate the number of atoms in each of the following

- 52mol of He
- $52u$ of He
- 52g of He

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12. What will be the mass of one ^{12}C atom in g ?

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13. Calculate mass of O atoms is $6gm\text{CH}_3\text{COOH}$?

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14. How many sucrose molecules ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) are present in $3.42g$ sucrose ? .

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15. Calculate mass of water present in $499gm\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$?

(Atomic mass – $\text{Cu} = 63.5$, $\text{S} = 32$, $\text{O} = 16$, $\text{H} = 1$) .

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16. Find mass of 12.046×10^{23} atoms $^{12}C_6$ sample ? .

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17. What is no of O_2 molecules in $3.2 \times 10^{-15}g$ sample of oxygen ? .

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18. Find no protons in $180molH_2O$ Density of water = $1gm/ml$.

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19. What mass of $Na_2SO_4 \cdot 7H_2O$ contains exactly 6.023×10^{22} atoms of oxygen ? .

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20. What is number of atoms of molecules in $112L$ of $O_3(g)$ at STP ? .



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21. Oxygen exists as three isotopes ${}^{16}_8\text{O}$, ${}^{17}_8\text{O}$, ${}^{18}_{18}\text{O}$ with relative abundance 90 %, 7 % and 3 % respectively. What is the average atomic mass of oxygen?



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22. If an element M has $M_{avg} = 51.7$, find the relative abundances of ${}^{50}M$ and ${}^{52}M$ isotopes in nature? [Assume M exists in only two allotropic forms in nature].



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23. How many grams of KClO_4 contain 40 gm 'O'?



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24. Calculate mass of Cu in $3.67 \times 10^3 g CuFeS_2$? (Atomic mass $Cu = 63.5, Fe = 56, S = 32$).

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25. What mass of H_2SO_4 contains 32g oxygen ? .

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26. A sample of $MgSO_4$ has $6.023 \times 10^{20} O$ atoms What is mass of Mg in sample ? .

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27. If mass % of oxygen in monovalent metal 'M' carbonate (M_2CO_3) is 48 % , find atomic mass of metal ? .

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28. Find value of X if $36.6\text{ gm BaCl}_2 \cdot X\text{H}_2\text{O}$ on strong heating loses 5.4 g moisture ?

[At mass $Ba = 137$ $Cl = 35.5$].

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29. 0.492 g sample of haemoglobin has 0.34% by mass of Fe. If each molecule of haemoglobin has 4 Fe atoms find its molecular mass ? .

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30. Cadverine molecule has 58.77% C , 13.81% H and 27% N by mass
Find Empirical formula of cadverine .

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31. The empirical formula of an organic compound carbon & hydrogen is CH_2 . The mass of 1 litre of organic gas is exactly equal to mass of 1 litre N_2 therefore molecular formula of organic gas is .

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32. What mass of CaO is formed by heating $50gCaCO_3$ in air ?
[molar mass : $CaCO_3 = 100$, $CaO = 56$].

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33. What volume of $H_2(g)$ is produced by decomposition of $2.4LNH_3(g)$? .

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34. What is mass of O_2 required to produce 960gm of O_3 if % yield of reaction $3O_2 \rightarrow 2O_3$ is 50 % ? .

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35. What is mass of C obtained on reacting 20 moles of A with excess B by reaction



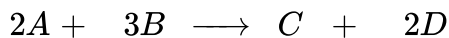
If % yield of reaction is 80 % ? .

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36. A 120gm $CaCO_3$ sample having inert impurities on heating produced 56gm of residue. Find % purity of sample .

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37. Which of the following reactions occur to completion ? .



(a) Initial moles	20	30	0	0
(b) Initial moles	40	60	10	0
(c) Initial moles	40	90	0	0
(d) Initial moles	50	75	0	10

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38. For the reaction $A(s) + 2B(g) \rightarrow 3C(g) + D(g)$

Molar mass [$gmol^{-1}$] $A = 100, B = 50, C = 60, D = 20$

(a) How many grams of C are produced by reaction of $250gA$? [Hint :

Mass relation]

(b) What mass of B reacts to give $500gD$

(c) How many grams of A will produce $11.2L$ of C at STP ? .

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39. $18.625gKCl$ is formed due to decomposition of $KClO_4$ in reaction



Find volume of O_2 obtained at STP [Atomic mass $K = 39$ $Cl = 35.5$]

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40. What volume of CO_2 at STP is obtained by thermal decomposition of $20gKHC O_3$ to CO_2 & H_2O [Atomic mass $K = 39$].

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41. What mass of CH_3OH (methanol) will be produced by reacting $1120L$ of $H_2(g)$ at STP with excess $CO(g)$? .

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42.
$$2A(s) + 3B(g) \longrightarrow 4C(g)$$

 $t = 0 \quad 10mol \quad \quad 10mol$

Find final moles of A , B and C .

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43. If 2.4gm Mg is treated with 0.64gm O_2 Find composition of final product mixture ?

[Atomic Mass $\text{Mg} = 24$].

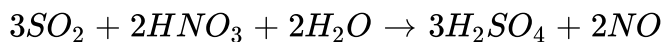
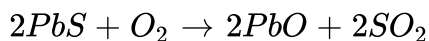
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44. 20g of impure NaCl sample is added aqueous solution having excess AgNO_3 AgCl precipitate is filtered

[Atomic mass $\text{Ag} = 108$, $\text{Cl} = 35.5$].

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45. How many grams H_2SO_4 can be obtained from 1320gm PbS as per reaction sequence ?.



[At mass $\text{Pb} = 208$. $\text{S} = 32$].

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46. Carbon reacts with oxygen forming carbon monoxide and/or carbon dioxide depending on the availability of oxygen. Find moles of each product obtained when 160 gm oxygen reacts with (a) 12 g carbon (b) 120 g carbon (c) 72 g carbon.

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47. 27.6g K_2CO_3 was treated by a series of reagents so as to convert all of its carbon to $K_2Zn_3[Fe(CN)_6]_2$. Calculate the weight of the product [mol.wt. of $K_2CO_3 = 138$ and mol. Wt. of $K_2Zn_3[Fe(CN)_6]_2 = 698$].

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48. 0.15g of substance displaced 58.9cm^3 of air at 300K and 746mm pressure. Calculate the molecular mass (Aq Tension at 300K = 26.7mm)



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49. $0.41g$ of the silver salt of a dibasic organic acid left a residue of $0.216g$ of silver on ignition. Calculate the molecular mass of the acid .



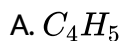
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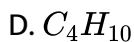
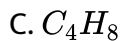
50. $0.98g$ of the chloroplatinate salt of some diaacid base when ignited left $0.39g$ of platinum as residue. What is the molecular mass of the base ? (At mass of $Pt = 195$) .



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51. $10mL$ of gaseous hydrocarbon on combustion gives $40ml$ of $CO_2(g)$ and $50mL$ of H_2O (vapour) The hydrocarbon is .





Answer: D

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52. Calculate the mole fractions of the components of the solution composed by 92g glycerol and 90g water ? ($M(\text{water}) = 18$, $M(\text{glycerol}) = 92$) .

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53. What will be the Molarity of solution when water is added to 10g $CaCO_3$ to make 100mL of solution ? .

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54. Calculate the molality of a solution containing 20g of sodium hydroxide ($NaOH$) in 250g of water ? .

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55. Calculate the grams of copper sulphate ($CuSO_4$) needed to prepare 250.0mL of 1.00M $CuSO_4$?.

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56. How many grams of H_2SO_4 are present in 500ml of 0.2M H_2SO_4 solution ? .

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57. Calculate the ppm of mercury in water in given sample contain 30mg of Hg in 500ml of solution .

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58. $50\text{ml } 0.2\text{M H}_2\text{SO}_4$ is mixed with $50\text{ml } 0.3\text{M H}_2\text{SO}_4$. Find molarity of final solution .

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59. Find final molarity in each case : (i) $500\text{ml } 0.1\text{M HCl} + 500\text{ml } 0.2\text{M HCl}$
(ii) $50\text{ml } 0.1\text{M HCl} + 150\text{ml } 0.3\text{M HCl} + 300\text{ml H}_2\text{O}$ (iii) $4.9\text{g H}_2\text{SO}_4 + 250\text{ml H}_2\text{O} + 250\text{ml } 0.1\text{M H}_2\text{SO}_4$

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60. How much water should be added to 2M HCl solution to form 1litre of 0.5M HCl ? .

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61. Find number of Na^+ & PO_4^{-3} ions in $250ml$ of $0.2MNa_3PO_4$ solution .

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62. $1.11gCaCl_2$ is added to water forming $500ml$ of solution $20ml$ of this solution is taken and diluted 10 folds Find moles of Cl ions in $2ml$ of diluted solution .

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63. What volume of $1M$ & $2MH_2SO_4$ solution are required to produce $2L$ of $1.75MH_2SO_4$ solution ? .

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64. $80gNaOH$ was added to $2L$ water. Find molality of solution density of water = $1g/mL$.

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65. A $100gNaOH$ solution has $20gNaOH$. Find molality .

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66. Find molality of aqueous solution of CH_3COOH whose molarity is $2M$ and density $d = 1.2g/mL$

$$\text{Hint : } m = \frac{M}{d - MM_s} \times 1000$$

Where d = density in g/L^{-1} , M = Molarity, m = molality, M_s = molar mass of solute .

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67. A solution is made by mixing $300ml1.5MAl_2(SO_4)_3 + 300ml2MCaSO_4 + 400ml3.5MCaCl_2$

Find final molarity of (1) SO_4^{2-} , (2) Ca^{2+} (3) Cl^- [Assume complete dissociation of these compound] .



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68. A solution has 80 % $\frac{w}{w}$ $NaOH$ with density $2gL^{-1}$ Find (a) Molarity
(b) Molality of solution .



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69. 4.450g 100 per sulphuric acid was added to 82.20g water and the density of the solution was found to be $1.029g/$ at $25^{\circ}C$ and 1 atm pressure. Calculate (a) the weight percent, (b) the mole fraction, (c) the mole percent, (d) the molality, (e) the molarity of sulphuric acid in the solution under these conditions .



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70. A solution of KCl has a density of $1.69gmL^{-1}$ and is 67% by weight. Find the density of the solution if it is diluted so that the percentage by weight of KCl in the diluted solution is 30%



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71. 10L of hard water requires 0.28g of lime (CaO) for removing hardness. Calculate the temporary hardness in ppm of $CaCO_3$.



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72. Calculate the % of free SO_3 in oleum (a solution of SO_3 in H_2SO_4) that is labelled 109 % H_2SO_4 by weight.



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73. If the percent free SO_3 in an oleum is 20% then label the sample of oleum in terms of percent H_2SO_4 ,



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74. An oleum sample contains $10gSO_3$ and $15gH_2SO_4$

Answer the following questions on the basis of above information :

% labelling of oleum sample is .

A. 27.25 %

B. 106 %

C. 109 %

D. 118 %

Answer: (C)



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75. An oleum sample contains $10gSO_3$ and $15gH_2SO_4$

Answer the following questions on the basis of above information :

Find new % labeling of $0.45g$ of H_2O is added to the above oleum sample

- A. 100 %
- B. 102.83 %
- C. 107.07 %
- D. 109 %

Answer: (C)

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76. Find the % w/v of '10V' H_2O_2 solution

- A. 10.2 %
- B. 3.03 %
- C. 22.4 %
- D. 5.04 %

Answer: (B)

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Exercise 01

1. All samples of carbon dioxide contain carbon and oxygen in the mass ratio of 3: 8 This is in agreement with the law of .

- A. conservation of mass
- B. constant proportion
- C. multiple proportions
- D. gaseous volumes

Answer: B



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2. That the atom is indivisible was proposed by .

- A. Rutherford

B. Dalton

C. Bohr

D. Einstein

Answer: B



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3. Atomic mass of an element is :

A. actual mass of one atom of the element

B. relative mass of an atom of the element

C. average relative mass of different atoms of the element

D. always a whole number

Answer: C



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4. Which of the following expressions is correct ($n = \text{no. of moles of the gas}$, $N_A = \text{Avogadro constant}$ $m = \text{mass of 1 molecule of the gas}$, $N = \text{no of molecules of the gas}$) ? .

A. $n = mN_A$

B. $m = N_A$

C. $N = nN_A$

D. $m = n / N_A$

Answer: C

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5. The volume of 1 mol of a gas at standard temperature and pressure is .

A. 11.2 litre

B. 22.4 litres

C. 100 litre

D. none of these

Answer: B



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6. The charge on 1 gram ions of Al^{3+} is .

A. $\frac{1}{27} N_A e$ coulomb

B. $\frac{1}{3} N_A e$ coulomb

C. $\frac{1}{9} N_A e$ coulomb

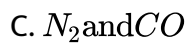
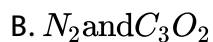
D. $3 \times N_A e$ coulomb

Answer: D



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7. In which of the following pairs do 1 g of each have an equal number of molecules .



Answer: C



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8. A quantity of aluminium has a mass of 54.0g. What is the mass of the same number of magnesium atoms ?.

A. 12.1g

B. 23.3g

C. 48g

D. 97.2g

Answer: C

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9. Which of the following samples contains the largest number of atoms ?

A. 1g of (Ni) s

B. 1g of Ca(s)

C. 1g of $N_2(g)$

D. 1g of B(s)

Answer: D

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10. Which of the following contains greatest number of oxygen atoms ? .

A. 1g of O

B. 1g of O_2

C. g of O_3

D. all have the same number of atoms

Answer: D



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11. A sample of ammonium phosphate $(NH_4)_3PO_4$ contains 3.18 moles of hydrogen atoms . The number of moles of oxygen atoms in the sample is

A. 0.265

B. 0.795

C. 1.06

D. 3.18

Answer: C



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12. How many moles of electrons weigh one kilogram?

A. 6.023×10^{23}

B. $\frac{1}{9.108} \times 10^{31}$

C. $\frac{6.023}{9.108} \times 10^{54}$

D. $\frac{1}{9.108 \times 6.023} \times 10^8$

Answer: D



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13. A compound was found to contain 5.37% nitrogen. What is the minimum molecular wt. of compound :

A. 26.07g

B. 2.607

C. 260.7

D. none

Answer: C

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14. Under the same conditions, two gases have the same number of molecules. They must

A. be noble gases

B. have equal volumes

C. have a volume of $22.4dm^3$ each

D. have an equal number of atoms

Answer: B

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15. Four one litre flasks are separately filled with the gases H_2 , He , O_2 and O_3 at the same temperature and pressure. The ratio of total number of atoms of these gases present in different flask would be:

A. 1 : 1 : 1 : 1

B. 1 : 2 : 2 : 3

C. 2 : 1 : 2 : 3

D. 3 : 2 : 2 : 1

Answer: C

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16. The atomic weight of Cu is 63.546. There are only two naturally occurring isotopes of copper ^{63}Cu and ^{65}Cu . The natural abundance of the ^{63}Cu isotope must be approximately.

A. 10 %

B. 30 %

C. 50 %

D. 72.7 %

Answer: D



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17. If the percentage of water of crystallization in $MgSO_4 \cdot xH_2O$ is 13 % .

What is the value of x :

A. 1

B. 4

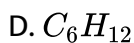
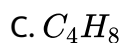
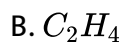
C. 5

D. 7

Answer: A

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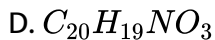
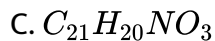
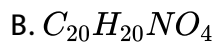
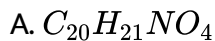
18. A pure gas that is 14.3 % hydrogen and 85.7 % carbon by mass has a density of 2.5gL^{-1} at 0°C and 1 atm pressure. What is the molecular formula of the gas :



Answer: C

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19. A certain alkaloid has 70.8 % carbon, 6.2 % hydrogen, 4.1 % nitrogen and the rest oxygen. What is its empirical formula :



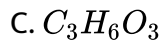
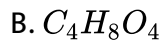
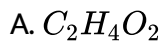
Answer: A



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20. The empirical formula of a compound of molecular mass 120 is CH_2O .

The molecular formula of the compound is :



D. all of these

Answer: B

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21. 0.250g of an element M , reacts with excess fluorine to produce 0.547g of the hexafluoride MF_6 . What is the element :
[$Cr = 52, Mo = 96, S = 32, Te = 127.6$].

A. Cr

B. MO

C. S

D. Te

Answer: B

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22. A 1000 gram sample of $NaOH$ contains 3 mole of O atoms, what is the % purity of $NaOH$:

A. 14 %

B. 100 %

C. 12 %

D. 24 %

Answer: C



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23. A 15mL sample of 0.20M MgCl_2 is added to 45ML of 0.40M AlCl_3 What is the molarity of Cl ions in the final solution

A. 1.0M

B. 0.60M

C. 0.35M

D. 0.30M

Answer: A

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24. Mole fraction of ethanol in ethanol water mixture is 0.25. Hence, the percentage concentration of ethanol by weight of mixture is

A. 25 %

B. 75 %

C. 46 %

D. 54 %

Answer: C

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25. How many moles of Na^+ ions are in 20 mL of 0.40 M Na_3PO_4 .

A. 0.0080

B. 0.024

C. 0.050

D. 0.20

Answer: B



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26. Out of molarity (M), molality (m), formality (F) and mole fraction (x) those independent of temperature are:

A. M, m

B. F, x

C. m, x

D. M, x

Answer: C



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27. The molality of 1L solution with $x\%$ H_2SO_4 is equal to 9. The weight of the solvent present in the solution is 910g. The value of x in g per 100 mL is

- A. 90
- B. 80.3
- C. 30.38
- D. 46.87

Answer: D



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28. Density of azone relative to oxygen is under the same temperature & pressure :

- A. 1
- B. 2

C. 1.5

D. 2.5

Answer: C



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29. Mole fraction of a solute in an aqueous solution is 0.2. The molality of the solution will be

A. 13.8

B. 15.5

C. 14.5

D. 16.8

Answer: A



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30. The molarity of the solution containing 2.8% (mass/volume) solution of KOH is: (Given atomic mass of K=39) is:

A. $0.1M$

B. $0.5M$

C. $0.2M$

D. $1M$

Answer: B



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31. The molality of a sulphuric acid solution is $0.2\text{mol}/\text{kg}$ Calculate the total weight of the solution :

A. $1000mL$

B. $1098.6g$

C. $980.4g$

D. 1019.6g

Answer: D



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32. What volume of a $0.8M$ solution contains 100 millimoles of the solute

.

A. $100mL$

B. $125mL$

C. $500mL$

D. $62.5mL$

Answer: B



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33. 500mL of a glucose solution contains 6.02×10^{22} molecules. The concentration of the solution is :

A. 0.1M

B. 1.0M

C. 0.2M

D. 2.0M

Answer: C



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34. 50mL of CO is mixed with 20mL of oxygen and sparked. After the reaction, the mixture is treated with an aqueous KOH solution. Choose the correct option :

A. the volume of CO that reacts = 30mL

B. volume of CO_2 formed = 50mL

C. volume of CO that remains after treatment with $KOH = 10mL$

D. the volume of the CO that remains after treatment with

$KOH = 20mL$

Answer: C

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35. $14gm$ of element X combine with $16gm$ of oxygen. On the basis of this information, which of the following is the correct statement .

A. The element 'X' could have atomic weight of 7 and its's oxide the formula XO

B. The element 'X' could have atomic weight of 14 and its's oxide the formula X_2O

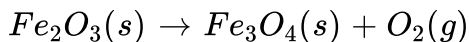
C. The element 'X' could have atomic weight of 7 and its's oxide the formula X_2O

D. The element 'X' could have atomic weight of 14 and its oxide the formula X_2O

Answer: C

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36. 1.5gm mixture of SiO_2 and Fe_2O_3 on very strong heating leave a residue weighting 1.46gm. The reaction responsible for loss of weight is .



What is the percentage by mass of Fe_2O_3 is original sample .

A. 80 %

B. 20 %

C. 40 %

D. 60 %

Answer: A

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37. Aspartame an artificial sweetener contains 9.52wt. % nitrogen. There are two nitrogen atoms per molecule. What is the molecular weight of aspartame ? .

A. 147

B. 294

C. 588

D. 266

Answer: B

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38. The total number of neutrons present in 10g D_2O (D "is" 2 H are .

A. 2.5

B. 5.0

C. 10.0

D. none of these

Answer: D

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39. The % of Fe^{+2} in $Fe_{0.93}O_{1.00}$ is .

A. 15 %

B. 85 %

C. 93 %

D. 7 %

Answer: B

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40. The mass percent of oxygen in 109 % oleum is .

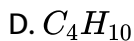
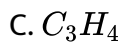
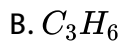
- A. 40 %
- B. 63.18 %
- C. 60 %
- D. 24 %

Answer: B

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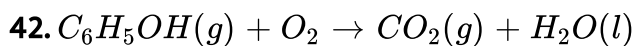
41. A definite amount of gaseous hydrocarbon having (carbon atoms less than 5) was burnt with sufficient amount of O_2 . The volume of all reactants was 600mL . After the explosion the volume of the product [$CO_2(g)$ and $H_2O(g)$] was found to be 700mL under the similar conditions. The molecular formula of the compound is ?

- A. C_3H_8



Answer: A

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Magnitude of volume change if $30ml$ of $C_6H_5OH(g)$ is burnt with excess amount of oxygen, is

A. $30ml$

B. $60ml$

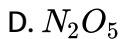
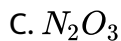
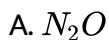
C. $20ml$

D. $10ml$

Answer: B

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43. 10ml of compound containing 'N' and 'O' is mixed with 30ml of H_2 to produce $\text{H}_2\text{O}(l)$ and 10ml of $\text{N}_2(g)$. Molecular formula of compound if both reactants completely, is



Answer: C

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44. 200ml of a gaseous mixture containing CO , CO_2 and N_2 on complete combustion in just sufficient amount of O_2 showed contraction of 40ml . When the resulting gases were passed through KOH solution

it reduces by 50 % then calculate the volume ratio of $V_{CO_2} : V_{CO} : V_{N_2}$ in original mixture .

A. 4 : 1 : 5

B. 2 : 3 : 5

C. 1 : 4 : 5

D. 1 : 3 : 5

Answer: C



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45. When 20ml of mixture of O_2 and O_3 is heated the volume becomes 29ml and disappears in alkaline pyragallol solution. What is the volume percent of O_2 in the original mixture ? .

A. 90 %

B. 10 %

C. 18 %

D. 2 %

Answer: B

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46. A mixture of C_2H_2 and C_3H_8 occupied a certain volume at 80mm Hg . The mixture was completely burnt to CO_2 and H_2O (l). When the pressure of CO_2 was found to be 230mm Hg at the same temperature and volume, the fraction of C_2H_2 in mixture is .

A. 0.125

B. 0.5

C. 0.85

D. 0.25

Answer: A

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47. 20 ml of a mixture of CO and H_2 were mixed with excess of O_2 and exploded and cooled. There was a volume contraction of 18ml. All volume measurements corresponds to room temperature ($27^\circ C$) and one atmospheric pressure. Determine the volume ratio V_1, V_2 of CO and H_2 in the original mixture.

A. 6.5: 13.5

B. 5: 15

C. 9: 11

D. 7: 13

Answer: D



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48. The % by volume of C_4H_{10} in a gaseous mixture of C_4H_{10} and CO is 40. When 200ml of the mixture is burnt in excess of O_2 . Find volume (in ml) of CO_2 produced.

A. 220

B. 340

C. 440

D. 560

Answer: C



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49. An ideal gaseous mixture of ethane (C_2H_6) and ethane (C_2H_4) occupies 28 litre at $1\text{atm } 0^\circ C$. The mixture reacts completely with $128\text{gm}O_2$ to produce CO_2 and H_2O . Mole of fraction at C_2H_6 in the mixtture is-

A. 0.6

B. 0.4

C. 0.5

D. 0.8

Answer: A

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Exercise 02

1. An alloy of gold and silver contains 38.5% silver by mass and has a density of 14.6 g mL^{-1} . What is the molar concentration of silver in this alloy :

A. 52.1 mol. L^{-1}

B. 45.6 mol. L^{-1}

C. 3.57 mol. L^{-1}

D. 2.64 mol. L^{-1}

Answer: A

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2. "Suvarnabhasm", an ayurvedic drug, is found to contain 400ppm of colloidal gold. Mass % of gold (atomic mass of Au = 197) will be :

A. 0.040 %

B. 7.88 %

C. 0.0788 %

D. 4×10^{-4} %

Answer: A



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3. A solution containing 12.0 % sodium hydroxide by mass has a density of $1.131\text{g}/\text{mL}$. What volume of this solution contains 5.00mol of NaOH :

A. 0.0240L

B. 1.67L

C. 1.47L

D. $1.00L$

Answer: C



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4. An aqueous solution of concentrated hydrobromic acid contains 48 % HBr by mass. If the density of the solution is $1.50g/L$, what is its concentration :

A. $11.4mol/L$

B. $8.9mol/L$

C. $5.9mol/L$

D. $18.5mol/L$

Answer: B



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5. An antifreeze mixture consists of 40 % ethylene glycol ($C_2H_6O_2$) by weight in aqueous solution. If the density of this solution is $1.05g/mol$, what is the molar concentration :

- A. $6.77M$
- B. $6.45M$
- C. $0.017M$
- D. $16.9M$

Answer: A



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6. What is the molality m , of methanol in a solution prepared by dissolving $160g$ of methanol, CH_3OH , in $200.0g$ of water :

- A. $1.0m$
- B. $5.0m$

C. $10.0m$

D. $25.0m$

Answer: D

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7. XeF_6 fluorinates I_2 to IF_7 and liberates Xenon (g). $210mmol$ of XeF_6 can yield a maximum of $_ mmol$ of IF_7 :

A. 420

B. 180

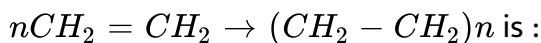
C. 210

D. 245

Answer: B

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8. When 100g of ethylene polymerises entirely to polythene, the weight of polyethene formed as per the equation



A. $(n/2)g$

B. $100g$

C. $(100/n)g$

D. $100ng$

Answer: B



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9. A 10gram sample of natural gas containing CH_4 and C_2H_4 was burnt in excess of oxygen to give 29.0grams of CO_2 and some water. How many games of water are formed :

A. $9.42g$

B. 18.81g

C. 11.42g

D. 15.31g

Answer: B



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10. 50g of ZnS are strongly heated in air to effect partial oxidation and the resultant mass weighed 44g. What is the ratio of ZnO to ZnS in the resultant mixture :

A. 13.5: 30.5

B. 27: 12.58

C. 27: 15.31

D. 30.52: 13.48

Answer: D



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11. The % loss in weight heating a pure sample of potassium chlorate ($M. wt. 122.5$) will be :

A. 12.25

B. 24.50

C. 39.17

D. 49.0

Answer: C



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12. In a gaseous reaction of the type

$aA + bB \rightarrow cC + dD$, which is wrong:

A. a litre of A combines with b litre of B to give $C\&D$

B. a mole of A combines with b mole of B to give C & D

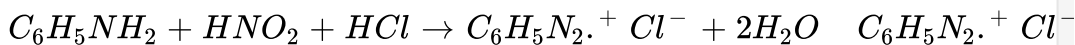
C. a g of A combines with b g litre of B to give C & D

D. a molecules of A combines with b molecule of B to give C & D

Answer: C

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13. Iodobenzene (C_6H_5I) is prepared from aniline ($C_6H_5NH_2$) in a two step process as shown below



In an actual preparation 9.30g of aniline was converted to 16.32g of iodobenzene. The percentage yield of iodobenzene is :

A. 8 %

B. 50 %

C. 75 %

D. 80 %

Answer: D

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14. In an organic compound of molar mass greater than 100 containing only C, H and N, the percentage of C is 6 times the percentage of H while the sum of the percentage of C and H is 1.5 times the percentage of N. What is the least molar mass of the compound?

- A. 175
- B. 140
- C. 105
- D. 210

Answer: B

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15. The simplest formula of a compound containing 50% of an element X (atomic weight 10) and 50% of element Y (atomic weight 20) is:

- A. XY
- B. X_2Y
- C. XY_2
- D. X_2Y_3

Answer: B



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16. The sodium salt of methyi orange has 7% sodium. What is the minimum molecular weight of the compound? :

- A. 420
- B. 375
- C. 329

D. 295

Answer: C

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17. In the preceding problem, if the compound contains 12.8 % nitrogen and 9.8 % sulphur how many nitrogen and sulphur atoms are present per atom of sodium?

A. 2 and 1

B. 1 and 3

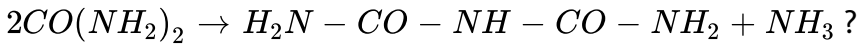
C. 1 and 2

D. 3 and 1

Answer: D

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18. How many grams of urea on heating yield 10^{22} molecules of biuret by the reaction :



A. 1.495

B. 0.995

C. 1.99

D. 1.753

Answer: C



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19. A compound has the molecular formula X_4O_6 . If 10g of X_4O_6 has 5.72g of X , then atomic mass of X is :

A. 32amu

B. 37amu

C. 42amu

D. 98amu

Answer: A

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20. DNA has density of 1.1 gm/ml and its molecular mass is 6×10^3 g/mol.

Average volume occupied by its single molecule will be:

A. 9.1×10^{-20}

B. 9.1×10^{-21}

C. 9.8×10^{-21}

D. 9.6×10^{-20}

Answer: B

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21. For an infinitely dilute aqueous solution molality will be equal to :

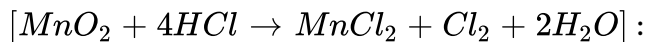
- A. formality
- B. molarity
- C. mole fraction
- D. ppm

Answer: B



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22. If 1g of HCl and 1g of MnO_2 heated together the maximum weight of Cl_2 gas evolved will be :



- A. 2g
- B. 0.975g
- C. 0.486g

D. 0.972g

Answer: C



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23. Molarity of H_2SO_4 is 18M. Its density is $1.8g/cm^3$, hence molaity is :

A. 18

B. 100

C. 36

D. 500

Answer: D



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24. If $1\frac{1}{2}$ moles of oxygen combine with Al to form Al_2O_3 the weight of Al used in the reaction is (Al=27)

A. 27g

B. 54g

C. 40.5g

D. 81g

Answer: B



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25. $Na_2SO_4 \cdot xH_2O$ has 50 % H_2O . Hence, x is :

A. 4

B. 5

C. 6

D. 8

Answer: D



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26. Cortisone is a molecular substance containing 21 atoms of carbon per molecule. The mass percentage of carbon in cortisone is 69.98%. Its molar mass is :

A. 176.5

B. 252.2

C. 287.6

D. 360.1

Answer: D



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27. A spherical ball of radius 7cm contains 56% iron. If density is $1.4\text{g}/\text{cm}^3$, number of mol of Fe present approximately is :

- A. 10
- B. 15
- C. 20
- D. 25

Answer: C



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28. In the following final result is

$0.1\text{molCH}_4 + 3.01 \times 10^{23}\text{moleculesCH}_4 - 9.6\text{gCH}_4 = x\text{molH atoms}$:

- A. 0molHatom
- B. 0.2molHatom
- C. 0.3molH

D. 0.4 mol H atom

Answer: A



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29. The density of 2.45 M aqueous methanol (CH_3OH) is $0.976 \frac{\text{g}}{\text{mL}}$.

What is the molality of the solution ($\text{CH}_3\text{OH} = 32$) ?

A. 27.3 m

B. 0.273 m

C. 7.23 m

D. 2.73 m

Answer: D



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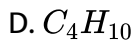
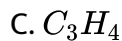
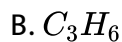
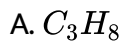
30. Equal volume of 10 % (v/v) of HCl is mixed with 10 % (v/v) $NaOH$ solution. If density of pure $NaOH$ is 1.5 times that of pure HCl then the resultant solution be ?

- A. basic
- B. neutral
- C. acidic
- D. can't be predicted.

Answer: A

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31. A definite amount of gaseous hydrocarbon having (carbon atoms less than 5) was burnt with sufficient amount of O_2 . The volume of all reactants was $600mL$. After the explosion the volume of the product [$CO_2(g)$ and $H_2O(g)$] was found to be $700mL$ under the similar conditions. The molecular formula of the compound is ?



Answer: A



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32. What is the molar mass of diacidic organic Lewis base, if $12g$ of chloroplatinate salt on ignition produced $5g$ residue ?

A. 52

B. 58

C. 88

D. none of these

Answer: B

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33. Solutions containing 23 g HCOOH is/are :

A. 46g of 70 % $\left(\frac{w}{v}\right)$ HCOOH ($d_{\text{solution}} = 1.40\text{g/mL}$)

B. 50g of 10M HCOOH ($d_{\text{solution}} = 1\text{g/mL}$)

C. 50g of 25 % $\left(\frac{w}{w}\right) = \text{HCOOH}$

D. 46g of 5 M HCOOH ($d_{\text{solution}} = 1\text{g/mL}$)

Answer: A::B

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34. A sample of H_2O_2 solution labelled as "28 volume" has density of 265 g/L. Mark the correct option(s) representing concentration of same solution in other units :

A. $M_{\text{H}_2\text{O}_2} = 2.5$

B. $\% \frac{w}{v} = 17$

C. mole fraction of $H_2O_2 = 0.2$

D. $m_{H_2O_2} = 13.88$

Answer: A::C::D

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35. How many grams of H_2SO_4 are present in 500ml of 0.2M H_2SO_4 solution ? .

A. 56

B. 5.6

C. 11.2

D. none of these

Answer: C

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36. Calculate the mass of sucrose $C_{12}H_{22}O_{11}(s)$ produced by mixing 78g of $C(s)$, 11g of $H_2(g)$ & 67.2 litre of $O_2(g)$ at *STP* according to given reaction (unbalanced) ?

A. 171g

B. 155.4g

C. 185.25g

D. None of these

Answer: A



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37. A hydrate of magnesium iodide has a formula $Mgl_2 \cdot xH_2O$. A 1.055g sample is heated to a constant weight of 0.695g. What is the value of x ?

A. 2

B. 4

C. 6

D. 8

Answer: D



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38. Number of neutrons in 5.5gm T_2O (T is ${}_{.1}H^3$) are.

A. $0.25N_A$

B. $2.5N_A$

C. $3N_A$

D. None of these

Answer: C



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39. H_2SO_4 solution (80 % by weight and specific gravity $1.75g/ml$) is used to prepare 2litre of $0.25MH_2SO_4$ (aq). The volume of H_2SO_4 solution (original) which must be used is :

A. $107.18ml$

B. $43.75ml$

C. $35ml$

D. None of these

Answer: C

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40. A mixture of hydrocarbon C_2H_2 , C_2H_4 & CH_4 in mole ration of 2:1:2 is burnt completely in the pressence of air containing 80 % N_2 % 20 % O_2 by volume. The mass of air required for the complete combustion of the one gm of mixture is

A. $\frac{1728}{112}$

B. $\frac{1528}{73}$

C. $\frac{1920}{120}$

D. $\frac{112}{1728}$

Answer: A



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41. 100ml of 2.45% (w/v) H_2SO_4 solution is mixed with 200ml of 7% (w/w) H_2SO_4 solution (density = 1.4gm/ml) and the mixture is diluted to 500ml . What is the molarity of the diluted solution ?

A. $0.25M$

B. $1.0M$

C. $0.75M$

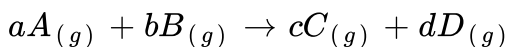
D. $0.45M$

Answer: D



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42. Two gases A and B which react according to the equation



to give two gases C and D are taken (amount not known) in an Eudiometer tube (operating at a constant Pressure and temperature) to cause the above.

If one causing the reaction there is no volume change observed then which of the following statement is/are correct.

A. $(a + b) = (c + d)$

B. average molecular mass may increase or decrease if either of A or B is present in limited amount.

C. Vapour Density of the mixture will remain same throughout the course of reaction.

D. Total moles of all the component of mixture will change.

Answer: A::C

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43. A mixture of $C_3H_8(g)$ & O_2 having total volume $100ml$ in an Eudiometry tube is sparked & it is observed that a contraction of $45ml$ is observed what can be the composition of reacting mixture.

A. $15\ ml\ C_3H_8$ & $85\ ml\ O_2$

B. $25\ ml\ C_3H_8$ & $75\ ml\ O_2$

C. $45\ ml\ C_3H_8$ & $55\ ml\ O_2$

D. $55\ ml\ C_3H_8$ & $45\ ml\ O_2$

Answer: A::B

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44. A mixture of 100ml of CO , CO_2 and O_2 was sparked. When the resulting gaseous mixture was passed through KOH solution, contraction in volume was found to be 80ml, the composition of initial mixture may be (in the same order)

A. 30ml, 60ml, 10ml

B. 30ml, 50ml, 20ml

C. 30ml, 60ml, 20ml

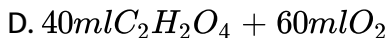
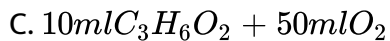
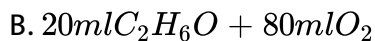
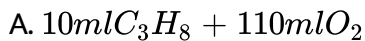
D. 30ml, 40ml, 30ml

Answer: A:B



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45. An organic compound is burnt with excess of O_2 to produce $CO_2(g)$ and $H_2O(l)$. Which results in 25% volume contraction. Which of the following option(s) satisfy the given conditions.



Answer: A:C

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46. 100 gm mixture of Co and CO_2 is mixed with 30 mL of O_2 and sparked in eudiometer tube. The residual gas after treatment with aq. KOH has a volume of 10 mL which remains unchanged when treated with alkline pyrogallol . If all the volume are under the same conditions, point out the correct option(s)

A. The volume of CO that reacts, is 60mL

B. The volume of CO that remains unreacted, is 10mL

C. The volume of O_2 that remains unreacted, is 10mL

D. The volume of CO_2 that gets absorbed by aq. KOH is $90mL$.

Answer: A::B::D

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Exercise 03

	Column-I	Column-II (mass of product)
	(A) $2H_2 + O_2 \rightarrow 2H_2O$ (p) $lg \quad lg$	1.028g
1.	(B) $3H_2 + N_2 \rightarrow 2NH_3$ (q) $lg \quad lg$	1.333g
	(C) $H_2 + Cl_2 \rightarrow 2HCl$ (r) $lg \quad lg$	1.125g
	(D) $2H_2 + C \rightarrow CH_4$ (s) $lg \quad lg$	1.214g

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2. Statement-I : $16g$ each O_2 and O_3 contains $\frac{N_A}{2}$ and $\frac{N_A}{3}$ atoms respectively

Because

Statement-II : $16g$ of O_2 , and O_3 contains same no. of atoms.

A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I

B. Statement-I is true, Statement-II is true , Statement-II is *NOT* a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: D



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3. Statement-I : $44g$ of CO_2 , $28g$ of CO have same volume at STP

Because

Statement-II : Both CO_2 and CO are formed by C and oxygen.

- A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I
- B. Statement-I is true, Statement-II is true , Statement-II is *NOT* a correct explanation for statement-I
- C. Statement-I is true, Statement-II is false
- D. Statement-I is false, Statement-II is true

Answer: B



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4. Statement-I : Law of conservation of mass hold good for nuclear reaction.

Because

Statement-II : Law states that mass can be neither created nor destroyed in a chemical reaction.

- A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I
- B. Statement-I is true, Statement-II is true , Statement-II is *NOT* a correct explanation for statement-I
- C. Statement-I is true, Statement-II is false
- D. Statement-I is false, Statement-II is true

Answer: D



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5. Statement-I : A reactant that is entirely consumed when a reaction goes to completion is known as limiting reactant.

Because

Statement-II : The amount of reactant limits the amount of product formed.

- A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I
- B. Statement-I is true, Statement-II is true , Statement-II is *NOT* a correct explanation for statement-I
- C. Statement-I is true, Statement-II is false
- D. Statement-I is false, Statement-II is true

Answer: A



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6. Statement-I : The balancing of chemical equations is based on law of consevation of mass.

Because

Statement-II : Total mass of reactants is equal to total mass of products.

- A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I
- B. Statement-I is true, Statement-II is true , Statement-II is *NOT* a correct explanation for statement-I
- C. Statement-I is true, Statement-II is false
- D. Statement-I is false, Statement-II is true

Answer: A

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7. Statement-I : Pure water obtained from different sources such as, river, well, spring, sea etc. always contains hydrogen and oxygen combined in the ratio 1 : 8 by mass.

Because

Statement-II : A chemical compound always contains elements combined together in same proportion by mass. it wa discovered by French chemist, Joseph Proust (1799).

- A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I
- B. Statement-I is true, Statement-II is true , Statement-II is *NOT* a correct explanation for statement-I
- C. Statement-I is true, Statement-II is false
- D. Statement-I is false, Statement-II is true

Answer: A

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8. Assertion: The weight percentage of a compound A in a solution is given by

$$\% \text{ of } A = \frac{\text{Mass } A}{\text{Total mass of solution}} \times 100$$

Reason: The mole fraction of a component A is given by, Mole fraction of A

$$= \frac{\text{No. of moles of } A}{\text{Total no. of moles of all components}}$$

- A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I
- B. Statement-I is true, Statement-II is true , Statement-II is *NOT* a correct explanation for statement-I
- C. Statement-I is true, Statement-II is false
- D. Statement-I is false, Statement-II is true

Answer: B

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9. Assertion: A one mole solution prepared at 20°C will retain the same molality at 100°C , provided there is no loss of solute or solvent on heating.

Reason: Molality is independent of temperature.

- A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I

- B. Statement-I is true, Statement-II is true , Statement-II is *NOT* a correct explanation for statement-I
- C. Statement-I is true, Statement-II is false
- D. Statement-I is false, Statement-II is true

Answer: A

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10. Assertion: The molality and molarity of very dilute aqueous solutions differ very little.

Reason: The density of water is about 1.0gcm^{-3} at room temperature.

- A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I
- B. Statement-I is true, Statement-II is true , Statement-II is *NOT* a correct explanation for statement-I
- C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: A

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11. Assertion: The average mass of one Mg atom is $24.305a\mu$, which is not actual mass of one Mg atom.

Reason: Three isotopes, ^{24}Mg , ^{25}Mg and ^{26}Mg , of Mg are found in nature.

A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I

B. Statement-I is true, Statement-II is true , Statement-II is *NOT* a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: A

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12. Assertion: A molecule of butane, C_4H_{10} has a mass of $58.12a\mu$.

Reason: One mole of butane contains 6.022×10^{23} molecules and has a mass of $58.12g$.

- A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I
- B. Statement-I is true, Statement-II is true , Statement-II is *NOT* a correct explanation for statement-I
- C. Statement-I is true, Statement-II is false
- D. Statement-I is false, Statement-II is true

Answer: A

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13. Assertion: Both 12g. of carbon and 27g. of aluminium will have 6.02×10^{23} atoms.

Reason: Gram atomic mass of an element contains Avogadro's number of atoms.

A. Statement-I is true, Statement-II is true , Statement-II is correct explanation for Statement-I

B. Statement-I is true, Statement-II is true , Statement-II is *NOT* a correct explanation for statement-I

C. Statement-I is true, Statement-II is false

D. Statement-I is false, Statement-II is true

Answer: A



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Comprehension 1

1. Comprehension # 1

Potash is any potassium mineral that is used for its potassium content.

Most of the potash produced in the United States goes into fertilizer. The

major sources of potash are potassium chloride (KCl) and potassium

sulphate (K_2SO_4). Potash production is often reported as the potassium

oxide (K_2O) equivalent or the amount of K_2O that could be made from

a given mineral. KCl cost Rs50perkg

What is the cost of K per mole of the KCl sample?

A. Rs. 13.42mol^{-1}

B. Rs. 3.73mol^{-1}

C. Rs. 1.00mol^{-1}

D. Rs. 2.00mol^{-1}

Answer: B



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2. Comprehension # 1

Potash is any potassium mineral that is used for its potassium content.

Most of the potash produced in the United States goes into fertilizer. The

major sources of potash are potassium chloride (KCl) and potassium

sulphate (K_2SO_4). Potash production is often reported as the potassium

oxide (K_2O) equivalent or the amount of K_2O that could be made from

a given mineral. KCl cost Rs50perkg

For what price must K_2SO_4 be sold in order to supply the same amount of potassium as in KCl ?

A. Rs. $58.40kg^{-1}$

B. Rs. $50.00kg^{-1}$

C. Rs. $42.82kg^{-1}$

D. Rs. $25.00kg^{-1}$

Answer: C



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3. Comprehension # 1

Potash is any potassium mineral that is used for its potassium content.

Most of the potash produced in the United States goes into fertilizer. The

major sources of potash are potassium chloride (KCl) and potassium

sulphate (K_2SO_4). Potash production is often reported as the potassium

oxide (K_2O) equivalent or the amount of K_2O that could be made from

a given mineral. KCl cost $Rs50$ per kg

What mass (in kg) of K_2O contains the same number of moles of K

atoms as $1.00kgKCl$?

A. $0.158kg$

B. $0.315kg$

C. $1.262kg$

D. $0.631kg$

Answer: D

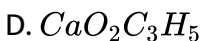
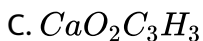
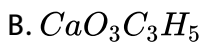
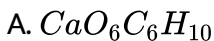


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1. Comprehension # 2

Calcium lactate is used in the food and beverage industries. It has also been used medicinally for treatment of various allergies, for treatment of muscular leg cramps, and as an antidote for variety of poisons, including lead, arsenicals and carbon tetrachloride. A 0.8274 g of anhydrous calcium lactate sample is found by analysis contains 0.2732 g of C, 0.0382 g H, 0.1520 g Ca and 0.3640 g O. Each mole of calcium lactate is found to contain one mole of calcium ions. Calcium lactate can be crystallised from water as pentahydrate salt.

Simplest formula of the calcium lactate is :



Answer: A



2. Comprehension # 2

Calcium lactate is used in the food and beverage industries. It has also been used medicinally for treatment of various allergies, for treatment of muscular leg cramps, and as an antidote for variety of poisons, including lead, arsenicals and carbon tetrachloride. A 0.8274g sample of anhydrous calcium lactate is found by analysis to contain 0.2732g of C , 0.0382gH , 0.1520gCa and 0.3640gO . Each mole of calcium lactate is found to contain one mole of calcium ions. Calcium lactate can be crystallised from water as pentahydrate salt.

Formula weight of calcium lactate is :

A. 129g mol^{-1}

B. 111g mol^{-1}

C. 218g mol^{-1}

D. 113g mol^{-1}

Answer: C



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3. Comprehension # 2

Calcium lactate is used in the food and beverage industries. It has also been used medicinally for treatment of various allergies, for treatment of muscular leg cramps, and as an antidote for variety of poisons, including lead, arsenicals and carbon tetrachloride. A 0.8274g sample of anhydrous calcium lactate is found by analysis to contain 0.2732g of C , 0.0382gH , 0.1520gCa and 0.3640gO . Each mole of calcium lactate is found to contain one mole of calcium ions. Calcium lactate can be crystallised from water as pentahydrate salt.

How many grams of calcium lactate pentahydrate would be recovered from 1g of anhydrous salt :

A. 1.41g

B. 1.00g

C. 1.27g

D. 1.51g

Answer: A



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Comprehension 3

1. Comprehension # 3

$NaBr$, used to produce $AgBr$ for use in photography can be self prepared as follows :



How much Fe in kg is consumed to produce

$2.06 \times 10^3 kg NaBr$ (iv)

Mass of iron required to produce $2.06 \times 10^3 kg NaBr$

A. 420g

B. $420kg$

C. $4.2 \times 10^5 kg$

D. $4.2 \times 10^8 g$

Answer: B

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2. Comprehension # 3

$NaBr$, used to produce $AgBr$ for use in photography can be self prepared as follows :



If the yield of (ii) is 60 % & (iii) reaction is 70 % then mass of iron required to produce $2.06 \times 10^3 kg NaBr$.

A. $10^5 kg$

B. $10^5 g$

C. 10^3 kg

D. none

Answer: C

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3. Comprehension # 3

NaBr , used to produce AgBr for use in photography can be self prepared as follows :



How much Fe in kg is consumed to produce

$2.06 \times 10^3 \text{ kg NaBr}$ (iv)

If yield of (iii) reaction is 90% then mole of CO_2 formed when

$2.06 \times 10^3 \text{ kg NaBr}$ is formed.

A. 20

B. 10

C. 40

D. none

Answer: B



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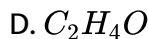
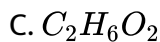
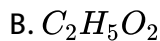
Comprehension 4

1. Comprehension # 4

A monobasic acid of weight $15.5g$ is heated with excess of oxygen & evolved gases when passed through KOH solution increased its weight by $22g$ and when passed through anhydrous $CaCl_2$, increased its weight by $13.5g$. When the same mass of this organic acid is reacted with excess of silver nitrate solution form $41.75g$ silver salt of the acid which on ignition gave the residue of weight $27g$.

The molecular formula of the organic acid is.

A. C_2H_6



Answer: C



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Comprehension 5

1. 342 g of 20% by mass of $ba(OH)_2$ solution (sq.gr.0.57) is reacted with 1200mL of 2M HNO_3 . If the final density of solution is same as pure water then molarity of the iron in resulting solution which decides the nature of the above solution is :

A. acidic

B. neutral

C. basic

D. can't say

Answer: C

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2.342 g of 20% by mass of $\text{Ba}(\text{OH})_2$ solution (sp.gr.0.57) is reacted with 1200 mL of 2M HNO_3 . If the final density of solution is same as pure water then molarity of the iron in resulting solution which decides the nature of the above solution is :

A. 0.5M

B. 0.8M

C. 0.4M

D. 1M

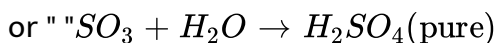
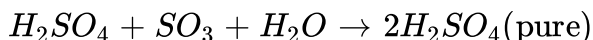
Answer: A

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1. Comprehension # 6

The percentage labelling of oleum is a unique process by means of which, the percentage composition of H_2SO_4 , SO_3 (free) and SO_3 (combined) is calculated.

Oleum is nothing but it is a mixture of H_2SO_4 and SO_3 i.e., $H_2S_2O_7$, which is obtained by passing SO_3 in solution of H_2SO_4 . In order of dissolve free SO_3 in oleum, dilution of oleum is done, in which oleum converts into pure H_2SO_4 . It is shown by the reaction as under :



When 100g sample of oleum is diluted with desired weight of H_2O (ing), then the total mass of pure H_2SO_4 obtained after dilution is known as percentage labelling in oleum.

For example, if the oleum sample is labelled as 109 % H_2SO_4 it means that 100g of oleum on dilution with 9m of H_2O provides 109g pure H_2SO_4 , in which all free SO_2 in 100g of oleum is dissolved.

For 109% labelled oleum if the number of moles of H_2SO_4 and free SO_3 be x and y respectively, then what will be the value of $\frac{x+y}{x-y}$?

A. 18

B. 18

C. $\frac{1}{3}$

D. 9.9

Answer: D



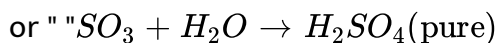
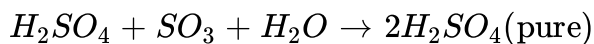
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2. Comprehension # 6

The percentage labelling of oleum is a unique process by means of which, the percentage composition of H_2SO_4 , SO_3 (free) and SO_3 (combined) is calculated.

Oleum is nothing but it is a mixture of H_2SO_4 and SO_3 i.e., $H_2S_2O_7$, which is obtained by passing. SO_3 in solution of H_2SO_4 . In order of dissolve free SO_3 in oleum, dilution of oleum is done, in which oleum

converts into pure H_2SO_4 . It is shown by the reaction as under :



When 100g sample of oleum is diluted with desired weight of H_2O (ing), then the total mass of pure H_2SO_4 obtained after dilution is known as percentage labelling in oleum.

For example, if the oleum sample is labelled as 109 % H_2SO_4 it means that 100g of oleum on dilution with 9m of H_2O provides 109g pure H_2SO_4 , in which all free SO_2 in 100g of oleum is dissolved.

In the above question number 1, what is the percentage of free SO_3 and H_2SO_4 in the oleum sample respectively ?

A. 60 % , 40 %

B. 30 % , 70 %

C. 85 % , 15 %

D. 40 % , 60 %

Answer: D

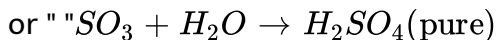
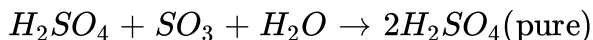


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3. Comprehension # 6

The percentage labelling of oleum is a unique process by means of which, the percentage composition of H_2SO_4 , SO_3 (free) and SO_3 (combined) is calculated.

Oleum is nothing but it is a mixture of H_2SO_4 and SO_3 i.e., $H_2S_2O_7$, which is obtained by passing SO_3 in solution of H_2SO_4 . In order of dissolve free SO_3 in oleum, dilution of oleum is done, in which oleum converts into pure H_2SO_4 . It is shown by the reaction as under :



When 100g sample of oleum is diluted with desired weight of H_2O (ing), then the total mass of pure H_2SO_4 obtained after dilution is known as percentage labelling in oleum.

For example, if the oleum sample is labelled as 109 % H_2SO_4 it means that 100g of oleum on dilution with 9m of H_2O provides 109g pure H_2SO_4 , in which all free SO_2 in 100g of oleum is dissolved.

In the above question number 1, what will be the percentage of combined SO_3 in the given oleum sample?

A. 20 %

B. 30 %

C. 48, 98 %

D. 51 %

Answer: C

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Comprehension 7

1. Oleum is considered as a solution of SO_3 in H_2SO_4 , which is obtained by passing SO_3 in solution of H_2SO_4 . When 100 g sample of oleum is diluted with desired mass of H_2O then the total mass of H_2SO_4 obtained after dilution is known as % labelling in oleum.

For example, a oleum bottle labelled as 109% H_2SO_4 means the 109 g total mass of pure H_2SO_4 will be formed when 100 g of oleum is diluted by 9 g of H_2O which combines with all the free SO_3 present in oleum to

form H_2SO_4 as $SO_3 + H_2O \rightarrow H_2SO_4$

What is the % of free SO_3 in an oleum that is labelled as 104.5% H_2SO_4 ?

- A. 10
- B. 20
- C. 40
- D. none of these

Answer: B

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2. Oleum is considered as a solution of SO_3 in H_2SO_4 , which is obtained by passing SO_3 in solution of H_2SO_4 . When 100 g sample of oleum is diluted with desired mass of H_2O then the total mass of H_2SO_4 obtained after dilution is known as % labelling in oleum.

For example, a oleum bottle labelled as '109 % H_2SO_4 ' means the 109 g total mass of pure H_2SO_4 will be formed when 100 g of oleum is diluted by 9 g of H_2O which combines with all the free SO_3 present in oleum to

form H_2SO_4 as $SO_3 + H_2O \rightarrow H_2SO_4$

9.0 g water is added into oleum sample labelled as "112%" H_2SO_4 then the amount of free SO_3 remaining in the solution is : (STP=1 atm and 273 K)

A. 14.93L at STP

B. 7.46L at STP

C. 3.78L at STP

D. 11.2L at STP

Answer: C



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3. Oleum is considered as a solution of SO_3 in H_2SO_4 , which is obtained by passing SO_3 in solution of H_2SO_4 . When 100 g sample of oleum is diluted with desired mass of H_2O then the total mass of H_2SO_4 obtained after dilution is known as % labelling in oleum.

For example, a oleum bottle labelled as '109 % H_2SO_4 ' means the 109 g total mass of pure H_2SO_4 will be formed when 100 g of oleum is diluted

by 9 g of H_2O which combines with all the free SO_3 present in oleum to form H_2SO_4 as $SO_3 + H_2O \rightarrow H_2SO_4$

If excess water is added into a bottle sample labelled as "112% H_2SO_4 " and is reacted with 5.3 g $NaCO_3$ then find the volume of CO_2 evolved at 1 atm pressure and 300 K temperature after the completion of the reaction :

A. 2.46L

B. 24.6L

C. 1.23L

D. 12.3L

Answer: C



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4. Oleum is considered as a solution of SO_3 in H_2SO_4 , which is obtained by passing SO_3 in solution of H_2SO_4 When 100 g sample of oleum is diluted with desired mass of H_2O then the total mass of H_2SO_4

obtained after dilution is known as % labelling in oleum.

For example, a oleum bottle labelled as '109 % H_2SO_4 ' means the 109 g total mass of pure H_2SO_4 will be formed when 100 g of oleum is diluted by 9 g of H_2O which combines with all the free SO_3 present in oleum to form H_2SO_4 as $SO_3 + H_2O \rightarrow H_2SO_4$

1 g of oleum sample is diluted with water. The solution required 54 mL of 0.4 N NaOH for complete neutralization. The % free SO_3 in the sample is :

- (a) 74
- (b) 26
- (c) 20
- (d) None of these

A. 74

B. 26

C. 20

D. none of these

Answer: B

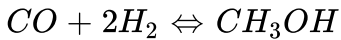


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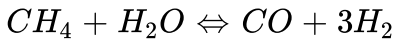
Comprehension 8

1. Comprehension # 8

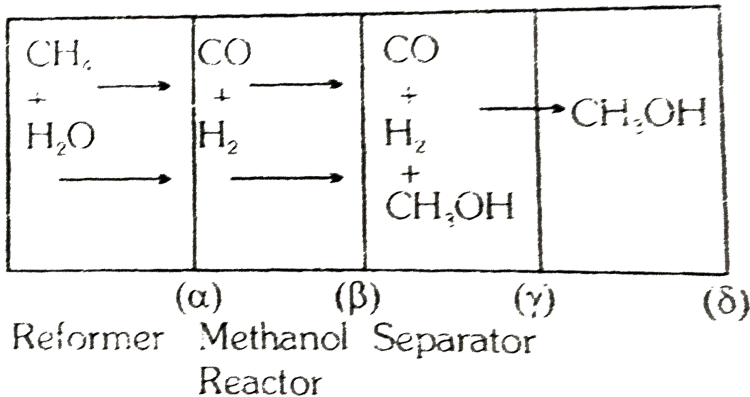
A factory, producing methanol, is based on the reaction:



Hydrogen & carbon monoxide are obtained by the reaction



Three units of factory namely, the "reformer" for the H_2 and CO production, the "methanol reactor" for production of methanol and a "separator" to separate CH_3OH from CO and H_2 are schematically shown in figure.



four positions are indicated as α , β , γ and δ . The flow of methanol at

position γ is 10^3 mol/sec . The factory is so designed that $\frac{2}{3}$ of the CO is converted to CH_3OH . Excess of CO and H_2 at position δ are used to heat the first reaction. Assume that the reformer reaction goes to completion. At the position (β) mole ratio of CO to H_2 is $\frac{1}{3}$



What is the flow of CO and H_2 at position (β) ?

A. $CO: 1500 \text{ mol/sec.}, H_2: 2000 \text{ mol/sec.}$

B. $CO: 1500 \text{ mol/sec.}, H_2: 3000 \text{ mol/sec.}$

C. $CO: 1000 \text{ mol/sec.}, H_2: 2000 \text{ mol/sec.}$

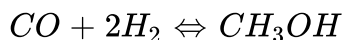
D. $CO: 1500 \text{ mol/sec.}, H_2: 4500 \text{ mol/sec.}$

Answer: D

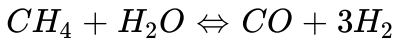
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2. Comprehension # 8

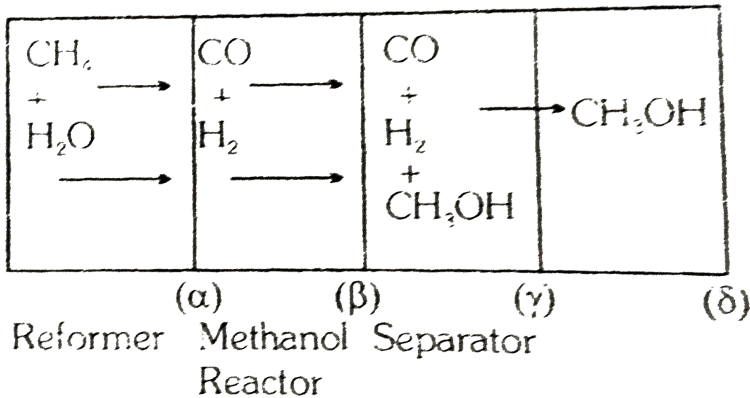
A factory, producing methanol, is based on the reaction:



Hydrogen & carbon monoxide are obtained by the reaction



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What is the flow of CO and H_2 at position (γ) ?

A. $CO: 500\text{mol/sec.}$, $H_2: 1000\text{mol/sec.}$

B. $CO: 500\text{mol/sec.}$, $H_2: 2500\text{mol/sec.}$

C. $CO: 500\text{mol/sec.}$, $H_2: 2000\text{mol/sec.}$

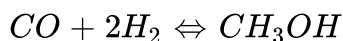
D. $CO: 500\text{mol/sec.}$, $H_2: 1500\text{mol/sec.}$

Answer: B

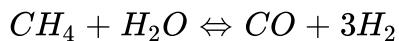
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3. Comprehension # 8

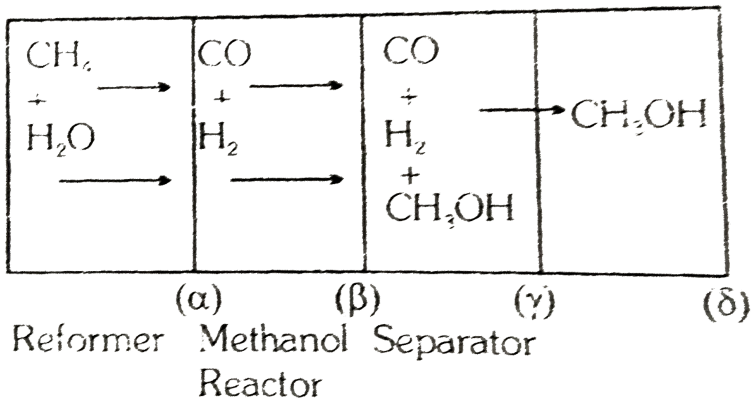
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Amount of energy released in methanol reactor in 1 minute ?

- A. 1200 kcal
- B. 12000 kcal
- C. 6000 kcal
- D. None of these

Answer: B

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Comprehension 9

1. Comprehension # 9

A 10ml mixture of N_2 , an alkane & O_2 undergo combustion in Eudiometry tube. There was contraction of 2ml , when residual gases are passed are passed through KOH . To the remaining mixture comprising of only one gas excess H_2 was added & after combustion the gas product is absorbed by water. causing a reduction in volume of 8ml .

Gas produced after introduction of H_2 in the mixture?

A. H_2O

B. CH_4

C. CO_2

D. NH_3

Answer: D

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2. Comprehension # 9

A 10ml mixture of N_2 , an alkane & O_2 undergo combustion in Eudiometry tube. There was contraction of 2ml , when residual gases are passed are passed through KOH . To the remaining mixture comprising of only one gas excess H_2 was added & after combustion the gas product is absorbed by water. causing a reduction in volume of 8ml .

Gas produced after introduction of H_2 in the mixture?

Volume of N_2 present in the mixture?

A. 2ml

B. 4ml

C. 6ml

D. 8ml

Answer: B

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3. Comprehension # 9

A 10ml mixture of N_2 , a alkane & O_2 undergo combustion in Eudiometry tube. There was contraction of 2ml , when residual gases are passed are passed through KOH . To the remaining mixture comprising of only one gas excess H_2 was added & after combustion the gas product is absorbed by water. causing a reduction in volume of 8ml .

Gas produced after introduction of H_2 in the mixture?

A. 4ml

B. 2ml

C. 0

D. 8ml

Answer: C



4. Comprehension # 9

A 10ml mixture of N_2 , an alkane & O_2 undergo combustion in Eudiometry tube. There was contraction of 2ml , when residual gases are passed are passed through KOH . To the remaining mixture comprising of only one gas excess H_2 was added & after combustion the gas product is absorbed by water. causing a reduction in volume of 8ml .

Gas produced after introduction of H_2 in the mixture?

- A. CH_4
- B. C_2H_6
- C. C_3H_8
- D. C_4H_{10}

Answer: A



Exercise 04 A

1. 1.375g of cupric oxide was reduced by heating in a current of hydrogen and the weight of copper that remained was 1.098g . In another experiment, 1.179g of copper was dissolved in nitric acid and the resulting copper nitrate converted into cupric oxide by ignition. The weight of cupric oxide formed was 1.476g . Show that these results illustrate the law of constant composition.

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2. Element X and Y form two different compounds. In the first compound, $0.324\text{g}X$ is combined with $0.471\text{g}Y$. In the second compound, $0.117\text{g}X$ is combined with $0.509\text{g}Y$. Show that these data illustrate the law of multiple proportions.

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3. How many g of element are present in $35, 125g$ atom of Si . (Given at. wt of $Si = 28.$)

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4. Calculate the no. of molecules in a drop of water weighing $0.07g$.

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5. Calculate no. of each atom present in $106.5g$ of $NaClO_3$.

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6. Find the no. of mole of phosphorus in $92.9g$ of phosphorus assuming that molecular formula of phosphorus in P_4 . Also determine the no. of atoms and molecules of phosphorus in the sample.

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7. Calculate the number of moles in $5.75g$ of sodium.

(Atomic mass of sodium = 23)

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8. How many grams of each of the following elements must be taken to get 1 mol of the element ?

(a) Sodium

(b) Chlorine

(c) Copper

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9. The density of liquid mercury is $13.6g/cm^3$. How many moles of mercury are there in 1 litre of the metal? (Atomic mass of $Hg = 200$).

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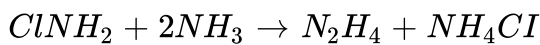
10. 50g of $CaCO_3$ is allowed to react with 70g of H_3PO_4 . Calculate :

(i) amount of $Ca_3(PO_4)_2$ formed

(ii) amount of unreacted reagent

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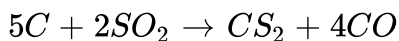
11. N_2H_4 , Hydrazine a rocket fuel can be produced according to the following reaction :



When 1000g $ClNH_2$ is reacted with excess of NH_3 , 473g N_2H_4 is produced. What is the % yield of the reaction.

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12. Carbon disulphide CS_2 can be made from SO_2 . The overall reaction is



How much CS_2 can be produced from 450kg of waste SO_2 with excess of coke the SO_2 conversion is 82 % .



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13. Calculate the percentage of BaO in $29.0g$ mixture of BaO and CaO which just reacts with $100.8mL$ of $6.0MHCl$.



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14. Calculate the amount of 95% pure Na_2CO_3 required to prepare 5 litre of $0.5M$ solution.



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15. Calculate the molality of a sulphuric acid solution of specific gravity 1.2 containing 27% H_2SO_4 by weight.



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16. A gaseous alkane was exploded with oxygen. The volume of O_2 for complete combustion to CO_2 formed was in the ratio of 7:4. The molecular formula of alkane is:

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17. When 2.86g of a mixture of 1 – butene, C_4H_8 and butane C_4H_{10} was burned in excess of oxygen 8.80g of CO_2 and 4.14g of H_2O were obtained. What is percentage by mass of butane in the mixture

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18. If vmL of a gaseous hydrocarbon, after explosion with excess of oxygen, showed a contraction of $2.5vmL$ and a further contraction of $2vmL$ with caustic potash, Find the formula of hydrocarbon.

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19. The average mass of one gold atom in a sample of naturally occurring gold is $3.2707 \times 10^{-22} g$. Use this to calculate the molar mass of gold.

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20. A plant virus is found to consist of uniform cylindrical particle of 150 \AA in diameter 5000 \AA long. The specific volume of the virus is 0.75 mLg^{-1} . If the virus is considered to be a single particle, find its molar mass.

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21. Density of a gas relative to air is 1.17. Find the mol. Mass of the gas
[$M_{air} = 29 \text{ g/mol}$]

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22. One type of artificial diamond (commonly called YAG for yttrium aluminium garnet) can be represented by the formula $Y_3Al_5O_{12}$

(a) Calculate the weight percentage composition of this compound.

(b) What is the weight of yttrium present in a 200 – carat *YAG* if 1 carat – 200mg? ($Y = 89$), $Al = 27$)

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23. A chemical commonly called "dioxin" has been very much in the news in the past few years. (It is the by product of herbicide manufacture and is thought to be quite toxic.) Its formula is $C_{12}H_4Cl_4O_2$. If you have a sample of dirt (28.3g) that contains $1.0 \times 10^{-4} \%$ dioxin, how many moles of dioxin are in the dirt sample?

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24. During the electrolysis of conc H_2SO_4 , it was found that $H_2S_2O_8$ and O_2 liberated in a molar ratio of 3: 1. How many moles of H_2 were found of moles of $H_2S_2O_8$?

(Express your answer as : $3 \times \text{moles of } H_2$, integer answer is between 0 and 50



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25. One gram of an alloy of aluminium and magnesium when heated with excess of dil. HCl forms magnesium chloride, aluminium chloride and hydrogen. The evolved hydrogen collected over mercury at $0^{\circ}C$ has a volume of 1.2 litre at 0.92atm pressure. Calculate the composition of the alloy.



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26. 10g of a sample of a mixture of $CaCl_2$ and $NaCl$ is treated to precipitate all the calcium as $CaCO_3$. This $CaCO_3$ is heated to convert all the Ca to CaO and the final mass of CaO is 1.62 g. The percent by mass of $CaCl_2$ in the original mixture is



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27. By the reaction of carbon and oxygen, a mixture of CO and CO_2 is obtained. What is the composition of the mixture by mass obtained when 20 grams of O_2 reacts with 12 grams of carbon ?

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28. Cadverine molecule has 58.77 % C , 13.81 % H and 27 % N by mass
Find Empirical formula of cadverine .

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29. Given the following empirical formula and molecular weight, compute the true molecular formulae :

	Empirical formula	Molecular weight
(a)	CH_2	84
(b)	CH_2O	150
(c)	HO	34
(d)	$HgCl$	472
(e)	HF	80

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30. What is the percentage of nitrogen in an organic compound 0.14g of which gave by Dumas method 82.1c. c. Of nitrogen collected over water at $27^{\circ}C$ and at a barometric pressure of 774.5mm ? (aqueous tension of water at $27^{\circ}C$ is 14.5mm)

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31. Calculate the molarity of the following solution:

(a) 4g of caustic soda is dissolved in 200mL of the solution.

(b) 5.3 g of anhydrous sodium carbonate is dissolved in 100 mL of solution.

(c) 0.365 g of pure HCl gas is dissolved in 50 mL of solution.

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32. A mixture of ethanol and water contains 54% water by mass. Calculate the mole fraction of alcohol in this solution.



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33. Ten millilitre of a mixture of CO , CH_4 , and N_2 exploded with an excess of O_2 and gave a contraction of 6.5ml . When the residual gas was treated with $NaOH$, there was further contraction of 7 ml . What is the composition of the original mixture?



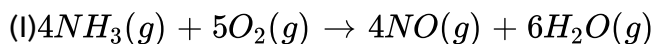
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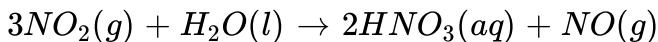
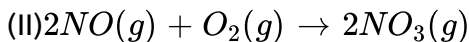
34. When 100 ml of $O_2 - O_3$ mixture was passed through turpentine oil, there was reduction of volume by 20 ml . If 100 ml of such a mixture is heated, what will be the increase in the volume?



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35. Nitric acid can be produced from NH_3 in three steps process given below





percent yield of 1st, 2nd and 3rd steps are respectively 50%, 60% and 80% respectively then what volume of $NH_3(g)$ at 1 atm and 0° required to produced 1575 g of HNO_3 .

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36. A mineral consists of an equimolar mixture of the carbonates of two bivalent metals. One metal is present to the extent of 13.2 % by weight. 2.58g of the mineral on heating lost 1.232g of CO_2 . Calculate the % by weight of the other metal.

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37. 6.2 g of a sample containing $NaHCO_3$, $NaHCO_3$ and non-volatile inert impurity on gentle heating loses 5% of its mass due to reaction $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$. Residue is dissolved in water and formed 100 mL solution and its 10 mL portion requires 7.5 mL of 0.2

M aqueous solution of $BaCl_2$ for complete precipitation of carbonates.

Determine mass (in gram) of Na_2CO_3 in the original sample .

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38. Chlorine gas can be produced by the reaction of $HCl(aq)$ with $MnO_2(s)$. Only $MnCl_2$ and $H_2O(l)$ are the by products. What volume of $Cl_2(g)$ (in litre) of density $2.84g/L$ will be produced from the reaction of $400mL$ of $0.1MHCl(aq)$ with an excess of MnO_2 ?

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Exercise 04 B

1. A crystalline hydrated salt on being rendered anhydrous, loses 45.6 % of its weight. The percentage composition of anhydrous salt is : $Al = 10.5\%$, $K = 15.1\%$, $S = 24.8\%$ and $O = 49.6\%$. Find the empirical formula of the anhydrous and crystalline salt :

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2. How much quantity of zinc will have to be reacted with excess of dilute HCl solution to produce sufficient hydrogen gas for completely reacting with the oxygen obtained by decomposing $5.104g$ of potassium chlorate?

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3. A $1.85g$ sample of mixture of $CuCl_2$ and $CuBr_2$ was dissolved in water and mixed thoroughly with $1.8g$ portion of $AgCl$. After reaction, the solid which now dissolved contain $AgCl$ and $AgBr$ was filtered, dried and weighed to be $2.052g$. What was the % by weight of $CuBr_2$ in the mixture?

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4. $1.0g$ of a sample containing $NaCl$, KCl and some inert impurity is dissolved in excess of water and treated with excess of $AgNO_3$ solution.

2.0g precipitate to $AgCl$ separate out. Also sample is 23 % by mass in sodium. Determine mass percentage of KCl in the sample :

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5. A mixture of $CuSO_4 \cdot 5H_2O$ and $MgSO_4 \cdot 7H_2O$ was heated until all the water was driven off. If 5.0g of mixture gave 3g of anhydrous salts, what was the percentage by mass of $CuSO_4 \cdot 5H_2O$ in the original mixture :

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6. A compound containing Ca , C , N and S was subjected to quantitative analysis and formula mass determination. 0.25g of this compound was mixed with Na_2CO_3 to convert all Ca into 0.16 g $CaCO_3$. 0.115g sample of compound was carried through a series of reaction until all its S was changed into SO_4^{2-} and precipitated as 0.344g of $BaSO_4$. 0.712g sample was processed to liberate all of its N as NH_3

and $0.155gNH_3$ was obtained. The formula mass was found to be 156.

Determine the empirical and molecular formula of the compound :

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7. A $0.2g$ sample , which is mixture of $NaCl$, $NaBr$ and NaI was dissolved in water and excess of $AgNO_3$ was added. The precipitate containing $AgCl$, $AgBr$ and AgI was filtered, dried and weighed to be $0.412g$. The solid was placed in water and treated with excess of $NaBr$, which converted all $AgCl$ into $AgBr$. The precipitate was then weighed to be $0.4881g$. It was then placed into water and treated with excess of NaI , which converted all $AgBr$ into AgI . The precipitate was then weighed to be $0.5868g$. What was the percentage of $NaCl$, $NaBr$ and NaI in the original mixture :

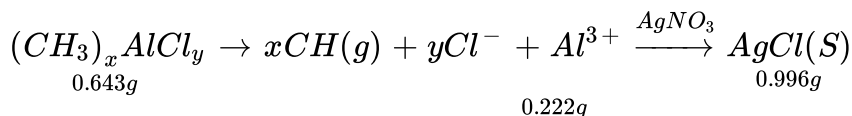
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8. $6.2g$ of a sample containing Na_2CO_3 , $NaHCO_3$ and non-volatile inert impurity on gentle heating loses 5% of its mass due to reaction

$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$. Residue is dissolved in water and formed $100mL$ solution and its $10mL$ portion requires $7.5mL$ of $0.2M$ aqueous solution of $BaCl_2$ for complete precipitation of carbonates. Determine mass (in gram) of Na_2CO_3 in the original sample.

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9. Based on the following information, determine value x and y :



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10. A $5.0g$ sample of felspar containing Na_2O , K_2O and some inert impurity is dissolved in dilute HCl solution and $NaCl$ and KCl formed are separated by fractional crystallization. During crystallization some less soluble impurities also come out. Mass of $NaCl$, KCl and impurity accompanying these salts was found to be $6.47g$. Solid crystal was then re-dissolved and required $300mL$ of $0.3M AgNO_3$ for complete

precipitation of chlorides. The precipitate thus, obtained was found to contain 4.23 % insoluble impurity. Determine mass percentage of Na_2O and K_2O in the original sample:

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11. $Pb(NO_3)_2$ and KI reacts in aqueous solution to form an yellow precipitate of PbI_2 . In one series of experiments, the masses of two reactants varied, but the total mass of the two was held constant at 5.0g. What maximum mass of PbI_2 can be produced in the above experiment :

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12. Uranium is isolated from its ore by dissolving it as $UO_2(NO_3)_2$ and separating it as solid $UO_2(C_2O_4) \cdot xH_2O$. A 1.0g sample of ore on treatment with nitric acid yielded 1.48g $UO_2(NO_3)_2$ which on further treatment with 0.4g $Na_2C_2O_4$ yielded 1.23g $UO_2(C_2O_4) \cdot xH_2O$. Determine weight percentage of uranium in the original sample and x :

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13. A mother cell disintegrate into sixty identical cells and each daughter cell further disintegrate into 24 smaller cells. The smallest cells are uniform cylindrical in shape with diameter of 120\AA and each cell is 6000\AA long. Determine molar mass of the mother cell if density of the smallest cell is 1.12g/cm^3 :

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14. A sample is a mixture of Mohr's salts and $(\text{NH}_4)_2\text{SO}_4$. A 0.5g sample on treatment with excess of BaCl_2 solution gave 0.75gBaSO_4 . Determine percentage composition of the salt mixture. What weight of Fe_2O_3 would be obtained if 0.2g of the sample were ignited in air?

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15. A chloride mixture is prepared by grinding together pure $BaCl_2 \cdot 2H_2O$, KCl and $NaCl$. What is the smallest and largest volume of $0.15M AgNO_3$ solution that may be used for complete precipitation of chloride from a $0.3g$ sample of the mixture which may contain any one or all of the constituents ?

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16. One mole of a mixture of N_2 , NO_2 and N_2O_4 , has a mean molar mass of 55.4 . On heating to a temperature at which N_2O_4 may be dissociated : $N_2O_4 \rightarrow 2NO_2$, the mean molar mass tends to the lower value of 39.6 . What is the mole ratio of $N_2 : NO_2 : N_2O_4$ in the original mixture?

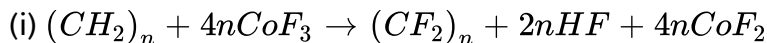
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17. 10 ml of a gaseous organic compound containing C, H and O only was mixed with 100 ml of O_2 and exploded under conditions which allowed the water formed to condense. The volume of the gas after explosion was

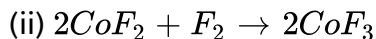
90ml. On treatment with NaOH solution, a further contraction in volume of 20 ml was observed. Given the vapour density of the compound as 23, deduce the molecular formula of the compound. All volume measurements were carried out under the same conditions.

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18. Fluoro carbon polymers can be made by fluorinating polythene.

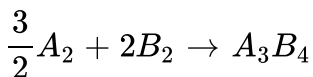
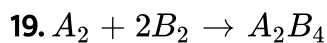


Where n is large integer. The COF_3 can be regenerated by the above reaction.



If the HF formed in reaction (i) cannot be reused, calculate the weight of F_2 consumed by 1.0g of $(CF_2)_n$ produced.

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Two substance A_2 & B_2 react in the above manner when A_2 is limited it gives A_2B_4 in excess gives A_3B_4 . A_2B_4 can be converted to A_3B_4 when reacted with A_2 . Using this information calculate the composition of the final mixture when the mentioned amount of A % B are taken : c

(a) 4 mole A_2 & 4 mole B_2

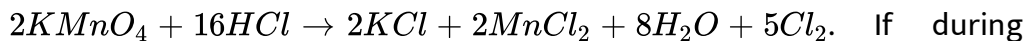
(b) $\frac{1}{2}$ moles A_2 & 2 moles B_2

(c) 1.25 moles A_2 & 2 moles B_2



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20. In a water treatment plant, Cl_2 used for the treatment of water is produced from the following reaction



If during each feed 1L $KMnO_4$ having 79% (w/v) $KMnO_4$ & 9L HCl with

$d = 1.825g/mL$ & 10% (w/w) HCl are entered & if that percent yield is

80% then calculate :

(a) amount of Cl_2 produced.

(b) amount of water that can be treated by Cl_2 if 1 litre consumes

28.4gCl₂ for treatment,

(c) calculate efficiency η of the process is $\eta = \frac{\text{vol. of water treated}}{\text{vol. of total feed}}$

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21. A sea water sample has density of $1.03\text{g}/\text{cm}^3$ and 2.8% NaCl by mass. A saturated solution of NaCl in water is 5.45MNaCl . How much water would have to be evaporated from 10^6 litres of sea water before NaCl would precipitate?

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22. A sample of oleum is such that ratio of free SO_3 by combined SO_3 is equal to unity. Calculate its labelling in terms of percentage oleum.

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23. One litre of milk weighs 1.035kg . The butter fat is 4% (v/v) of milk has density of $875\text{kg}/\text{m}^3$. Find the density of fat free skimmed milk.

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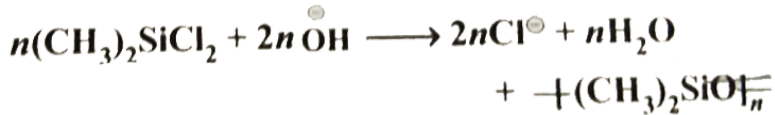
24. A sample of fuming sulphuric acid containing H_2SO_4 , SO_3 and SO_2 weighing 1.00g is found to require 23.47mL of 1.00M alkali (NaOH) for neutralisation. A separate sample shows the presence of 1.50% SO_2 . Find the percentage of "free" SO_3 , H_2SO_4 and "combined" SO_3 in the sample.

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25. In one process of waterproofing, a fabric is exposed to $(\text{CH}_3)_2\text{SiCl}$ vapour. The vapour reacts with (OH) groups on the surface of the fabric or with traces of H_2O to form waterproofing film of by the reaction

Where n is large integer. The waterproofing film is deposited on the fabric layer upon layer. Each layer is 10\AA thick [the thickness of the

$(CH_3)_2SiO$ group]. How much $(CH_3)_2SiCl_2$ is required to waterproof one side of a piece of a fabric, $1.0m$ by $3.0m$, with a film 1000 layers thick? The density of the film is $1.0gcm^{-3}$. (Atomic weight of $Si = 28$ and $Cl = 35.5$)



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26. 9 mL of a mixture of methane and ethylene was exploded with 30 mL (excess) of oxygen. After cooling, the volume was 21.0 mL. Further treatment with caustic potash solution reduced the volume to 7.0 mL. Determine the composition of the mixture.

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27. In a solution the concentration of $CaCl_2$ is $5M$ & that of $MgCl_2$ is $5m$. The specific gravity of solution is 1.05, calculate the concentration of

Cl^- in the solution in terms of Molarity.

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Exercise 05 A

1. The weight of 2.01×10^{23} molecules of CO is-

A. $9.3g$

B. $7.2g$

C. $1.2g$

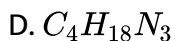
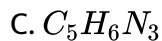
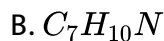
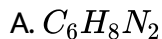
D. $3g$

Answer: A

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2. In a compound C, H, N atoms are present in 9:1:3.5 by weight.

Molecular weight of compound is 108. Its molecular formula is:

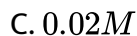
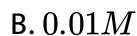


Answer: A



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3. 6.02×10^{23} molecules of urea are present in 100ml of its solution. The concentration of urea solution is -



D. $10M$

Answer: D



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4. If $1/6$, in place of $1/12$, mass of carbon atom is taken to be the relative atomic mass unit, the mass of one one of a substance will:

- A. be a function of the molecular mass of the substance
- B. remain unchanged
- C. increase two fold
- D. decrease twice

Answer: A



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5. How many moles of magnesium phosphate $Mg_3(PO_4)_2$ will contain 0.25 mole of oxygen atoms ?

A. 3.125×10^{-2}

B. 1.25×10^{-2}

C. 2.5×10^{-2}

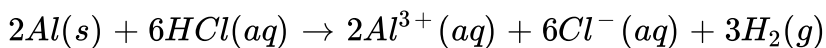
D. 0.02

Answer: A



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6. In the reaction :



A. $6LHCl_{aq}$ is consumed for every $3LH_2(g)$ produced

B. $33.6LH_2(g)$ is produced regardless of temperature and pressure for every mole Al that reacts

C. $67.2H_2(g)$ at *STP* is produced for every mole Al that reacts

D. $11.2LH_2(g)$ at *STP* is produced for every mole HCl_{aq} consumed

Answer: D

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7. If $10^{-4}dm^3$ of water is introduced into a $1.0dm^3$ flask at 300 K, how many moles of water are in the vapour phase when equilibrium is established?

(Given : Vapour pressure of H_2O at 300K is 3170 Pa,

$R = 8.314JK^{-1}mol^{-1}$)

A. 1.27×10^{-3} mol

B. 5.56×10^{-3} mol

C. 1.53×10^{-2} mol

D. 4.46×10^{-2} mol

Answer: A



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8. A 5.2 molal aqueous solution of methyl alcohol, CH_3OH is supplied.

What is the mole fraction of methyl alcohol in the solution ?

A. 0.086

B. 0.050

C. 0.100

D. 0.190

Answer: A



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9. The mass of potassium dichromate crystals required to oxidize 750cm^3 of 0.6 M Mohr's salt solution is (molar mass : 392) :

A. 0.49g

B. $0.45g$

C. $22.05g$

D. $2.2g$

Answer: C



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10. A transition metal M forms a volatile chloride which has a vapour density of 94.8. If it contains 74.75 % of chlorine the formula of the metal chloride will be

A. MCl_2

B. MCl_4

C. MCl_5

D. MCl_3

Answer: B

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11. The ratio of number of oxygen atoms (O) in 16.0g ozone (O_3), 28.0g carbon monoxide (CO) and 16.0g oxygen (O_2) is :-

(Atomic mass: $C = 12$, $O = 16$ and Avogadro's constant $N_A = 6.0 \times 10^{23} \text{ mol}^{-1}$)

A. 3 : 1 : 1

B. 1 : 1 : 2

C. 3 : 1 : 2

D. 1 : 1 : 1

Answer: D

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12. The density of a solution prepared by dissolving 120 g of urea (mol. Mass = 60 u) in 1000 g of water is 1.15 g/mL. The molarity of this solution is

A. $2.05M$

B. $0.50M$

C. $1.78M$

D. $1.02M$

Answer: A



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13. The molarity of a solution obtained by mixing 750 mL of 0.5 (M) HCl with 250 mL of 2(M)HCl will be:

A. $0.875M$

B. $1.00M$

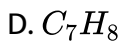
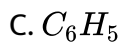
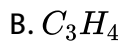
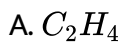
C. $1.75M$

D. $0.975M$

Answer: A

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14. A gaseous hydrocarbon gives upon combustion 0.72 g of water and 3.08 g of CO_2 . The empirical formula of the hydrocarbon is:



Answer: D

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15. For the estimation of nitrogen 1.4g of organic compound was diagest by Kjeldahl method an the evolved ammonia was absorbed in 60mL of $\frac{M}{10}$ sulphuric acid. The unreacted acid required 20 ml of $\frac{M}{10}$ sodium

hydroxide for complete neutralization. The percentage of nitrogen in the compound is :

- A. 3 %
- B. 5 %
- C. 6 %
- D. 10 %

Answer: D



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16. The ratio of masses of oxygen and nitrogen in a particular gaseous mixture is 1 : 4 The ratio of number of their molecule is :

- A. 1 : 8
- B. 3 : 16
- C. 1 : 4

Answer: D

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17. The molecular formula of a commercial resin used for exchanging ions in water softening is $C_8H_7SO_3Na$ (*mol. wt.* 206) . What would be the maximum uptake of Ca^{2+} ions by the resin when expressed in mole per gram resin?

A. $\frac{2}{309}$

B. $\frac{1}{412}$

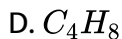
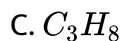
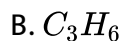
C. $\frac{1}{103}$

D. $\frac{1}{206}$

Answer: B

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18. At 300 K and 1 atm, 15 mL of a gaseous hydrocarbon requires 375 mL air containing 20% O_2 by volume for complete combustion. After combustion the gases occupy 330 mL. Assuming that the water formed is in liquid form and the volumes were measured at the same temperature and pressure, the formula of the hydrocarbon is:



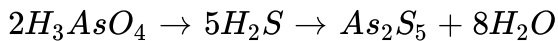
Answer: B::C



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19. The amount of arsenic pentasulphide that can be obtained when 35.5 g arsenic acid is treated with excess H_2S in the presence of conc. HCl

(assuming 100% conversion) is : (Atomic mass of As = 75u)



A. 0.25 mol

B. 0.50 mol

C. 0.125 mol

D. 0.333 mol

Answer: C



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20. An organic compound contains C, H and S. The minimum molecular weight of the compound containing 8% sulphur is : (Atomic weight of

A. 300g mol^{-1}

B. 400g mol^{-1}

C. 200g mol^{-1}

D. 600g mol^{-1}

Answer: B

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21. $5L$ of an alkane requires $25L$ of oxygen for its complete combustion. If all volumes are measured at constant temperature and pressure, the alkane is :

A. Butane

B. Isobutane

C. Propane

D. Ethane

Answer: C

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Exercise 05 B

1. At $100^{\circ}C$ and 1 atm, if the density of the liquid water is 1.0gcm^{-3} and that of water vapour is 0.00006gcm^{-3} , then the volume occupied by water molecule in 1 L steam at this temperature is:

- A. 6cm^3
- B. 60cm^3
- C. 0.6cm^3
- D. 0.06cm^3

Answer: C

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2. How many moles of electron weigh one kilogram .

- A. 6.023×10^{23}

B. $\frac{1}{9.108} \times 10^{31}$

C. $\frac{6.023}{9.108} \times 10^{54}$

D. $\frac{1}{9.108 \times 6.023} \times 10^8$

Answer: D

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3. Calculate the molarity of water if its density is 1000kgm^{-3}

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4. One gram of charcoal adsorbs 100ml of 0.5M acetic acid to form a monolayer, and the molarity of acetic acid reduces to 0.49 . Calculate the surface area of charcoal adsorbed by each molecule of acetic acid. The surface area of charcoal is $3.01 \times 10^2 \text{m}^2 \text{g}^{-1}$.

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5. Calculate the amount of calcium oxide required when it reacts with 852g of P_4O_{10} .

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6. 20 % surface sites have adsorbed N_2 . On heating, N_2 gas was made to evolve from sites and was collected at 0.001 atm and 298 K in a container of volume is 2.46cm^3 . Total number of surface sites are $6.023 \times 10^{14}\text{cm}^2$ and surface area is 1000cm^2 . Find the number of surface sites occupied per molecule of N_2 .

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7. Given that the abundance of isotopes ^{54}Fe , ^{56}Fe , and ^{57}Fe is 5%, 90% and 5% respectively. The atomic mass of Fe is

A. 55.85

B. 55.95

C. 55.75

D. 56.05

Answer: B

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8. Dissolving 120 g of urea (M W = 60) in 1000 g of water gave a solution of density 1.15gmL^{-1} . The molarity of solution is:

A. $1.78M$

B. $2.00M$

C. $2.05M$

D. $2.22M$

Answer: C

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