CHEMISTRY

BOOKS - VGS PUBLICATION-BRILLIANT

STOICHIOMETRY

Very Short Answer Questions

1. How many number of moles of glucose are present in 540 gms of glucose ?

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2. Calculate the weight of 0.1 mole of sodium carbonate.

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3. How many molecules of glucose are present in 5.23g of glucose (Molecular weight of glucose 180 u).

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4. Calculate the number of molecules persent in 1.12×10^{-7} c.c. of a gas at STP (c.c.- cubic centimeters = cm^3).

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5. The empirical formula of a compound is CH_2O. Its molecular weight is 90. Calculate the molecular formula of the compound.

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6. Balance the following equation by the oxidation number method.

$Cr_{(s)} + Pb(NO_3)_{2(aq)} \rightarrow Cr(NO_3)_{3(aq)} + Pb_{(s)}$

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7. What volume of H_2 at STP is required to reduce 0.795 g of CuO to give Cu and H_2O.

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8. Calculate the volume of O_2 at STP required to completely burn 100 ml. of acetylene.

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9. Now a days it is thought that oxidation is simply decrease in electron density and reduction is increase in electron density.

How would you justify this?

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10. What is a redox concept? Give an example.

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11. Calculate the mass percent of the different elements present in sodium sulphate (Na_2SO_4).

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12. What do you mean by significant figures?

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13. If the speed of light is $3.0 \times 10^8 ms^{-1}$. Calculate the distance covered by light in $2.00ns$.

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Short Answer Questions

1. The approximate production of sodium carbonate per month is 424×10^6g. While that of methyl alcohol is 320×10^6 gm. Which is produced more in terms of moles ?

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2. How much minimum volume of CO at STP is needed to react completely with 0.112 L of O_2 at 1.5 atm. Pressure and $127^\circ C$ to give CO_2.

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3. Chemical analysis a carbon compound gave following percentage composition by weight of the element present, carbon = 10.06%, hydrogen = 0.84%, chlorine = 89.10%. Calculate the empirical formula of the compound.

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4. A carbon compound on analysis gave the following percentage composition, carbon 14.5%, hydrogen 1.8%, chlorine 64.46%, oxygen 19.24%. Calculate the empirical formula of the compound.

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5. Calculate the empirical formula of a compound having percentage composition:

Potassium (K) = 26.57, Chromium (Cr) = 35.36, Oxygen (O) = 38.07.

(Given the Atomic weights of K, Cr and O are 39, 52 and 16 respectively)

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6. A carbon compound contains 12.8% Carbon, 2.1% Hydrogen, 85.1% Bromine. The molecular weight of the compound is 187.9. Calculate the molecular formula.

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7. 0.188 g of an organic compound having an empirical formula CH_2Br displaced 24.2 cc of air at $14^{\circ} C$ and 752 mm pressure. Calculate the molecular formula of the compound. (Aqueous tension at $14^{\circ} C$ is 12 mm)

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8. Calculate the amount of 90% H_2SO_4 required for the preparation of 420 kg HCl.

$2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$

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9. An astronaut receives the energy required in his body by the combustion of 34g of sucrose per hour. How much oxygen he has to carry along with him for his energy requirement in a day?

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10. What volume of CO_2 is obtained at STP by heating 4 g of $CaCO_3$?

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11. When 50 gm of a sample of sulphur was burnt in air 4% of the sample was left over. Calculate the volume of air required at STP containing 21% oxygen by volume.

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12. Calculate the volume of oxygen gas required at STP conditions for the complete combustion of 10 cc of methane gas at $20^{\circ}C$ and 770mm pressure.

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13. Calculate the volume of H_2 liberated at $27^\circ C$ and 760 mm of Hg pressure by action by 0.6 g magnesium with excess of dil HCl.

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14. Explain the role of redox reactions in titrimetre processes and galvanic cells.

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15. Define and explain molar mass.

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16. What are disproportionate reactions? Give example.

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17. What is comproportionation reactions? Give example.

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18. Determine the empirical formula of an oxide of iron which has 69.9% iron and 30.1% dioxygen by mass.

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19. Calculate the mass of sodium acetate (CH_3COONa) required to make 500 ml. of 0.375 molar aqueous solution. Molar mass of sodium acetate is 82.0245g mol^{-1}.

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20. What is the concentration of sugar $(C_{12}H_{22}O_{11})$ in mol L^{-1} if 20 g are dissolved in enough water to make a final volume upto 2L?

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21. How many significant figures are present in the following ?

i) 0.0025, ii) 208, iii) 5005, iv) 126,000 v) 500.0, vi) 2.0034

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22. Round up the following upto three significant figures :

i) 34.216, ii) 10.4107, iii) 0.04597, iv) 2808

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23. Calculate the molarity of a solution of ethanol in water in which the mole fraction of ethanol is 0.040 (assume the density of water to be one). Use the data given in the following table to calculate the molar mass of naturally occuring argon isotopes :

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

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24. A welding fuel gas contains carbon and hydrogen only. Burning a small sample of it in oxygen gives 3.38 g carbon dioxide, 0.690 g of water and no other products. A volume of 10.0 L (measured at STP) of this welding gas is found to weigh 11.6 g. Calculate (i) empirical formula, (ii) molar mass of the gas, and (iii) molecular formula.

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25. Calcium Carbonate reacts with aqueous HCl to give $CaCl_2$ and CO_2 according to the reaction,

$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$

What mass of $CaCO_3$ is required to react completely with 25 ml of 0.75 M HCl?

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26. Chlorine is prepared in the laboratory by treating manganese dioxide (MnO_2) with aqueous hydrochloric acid according to the reaction

$4HCl(aq) + MnO_2(s) \rightarrow 2H_2O(l) + MnCl_2(aq) + Cl_2(g)$

How many grams of HCl react with $5.0g$ of manganese dioxide ?

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27. To 50 ml. of 0.1 N Na_2CO_3 solution 150 ml. of H_2O is added. Then calculate the normality of resultant solution.

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28. Calculate the volume of 0.1 N H_2SO_4 required to neutralise 200 ml. of 0.2 N NaOH solution.

It is an acid base neutralisation reaction.

Hence, at the neutralisation point.

Number of equivalents of acid = Number of equivalents of base.

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29. Calculate normality of H_2SO_4 solutions if 50 ml of it completely neutralise 250 ml. of 0.1 N $Ba(OH)_2$ solutions.

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30. Calculate the volume of 0.1$MKMnO_4$ required to react with 100 ml. of 0.1 M $H_2C_2O_4$.

$2H_2O$ solution in the presence of H_2SO_4.

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31. Assign oxidation number to the underlined elements in each of the following species.

a) $NaH_2\underline{P}O_4$ $b)NaH\underline{S}O_4$ $c)H_4\underline{P_2}O_7$

d) $K_2\underline{Mn}O_4$ $e)Ca\underline{O_2}$ $f)Naun\partial \in e(B)H_4$

g)$H_2\underline{S_2}O_7$ $h\Big)KAl\underline{SO_4}_2.12H_2O$

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32. What are the oxidation number to the underlined elements in each of the following and how do you rationalise your results?

a) $K\underline{I_3}$ b) $H_2\underline{S_4}O_6$ c) $\underline{Fe_3}O_4$

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33. Justify that the following reactions are redox reactions.

a) $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(g)$

b) $Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$

c) $4BCl_3(g) + 3LiAlH_4(s) \rightarrow 2B_2H_6(g) + 3LiCl(s) + 3AlCl_3(s)$

d) $2K(s) + F_2(g) \rightarrow 2K^+F^-(s)$

e) $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$

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34. Fluorine reacts with ice and results in the change.

$H_2O(s) + F_2(g) \rightarrow HF(g) + HOF(g)$

Justify that this reaction is a redox reaction.

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35. Calculate the oxidation number of sulphur, chromium and nitrogen ion H_2SO_5, $Cr_2O_7^{2-}$ and NO_3^-. Suggest structure of those compounds.

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36. Write the formulae for the following compounds.

a) Mercury (II) chloride

b) Nickel (II) sulphate

c) Tin (IV) oxide

d) Thallium (I) sulphate

e) Iron (III) sulphate

f) Chromium (III) oxide.

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37. Suggest a list of the substances where carbon exhibit oxidation states from -4 to +4 and nitrogen from -3 to +5.

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38. While sulphue dioxide and hydrogen peroxide and act as oxidising as well as reducing agents in their reactions, ozone and nitric acid act only as oxidants. Why?

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39. Consider the reactions

a) $6CO_2(g) + 6H_2O(I) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g)$

b) $O_3(g) + H_2O_2(I) \rightarrow H_2O(I) + 2O_2(g)$

Why it is more appropriate to write these reaction as

a) $6CO_2(g) + 12H_2O(I) \rightarrow C_6H_{12}O_6 + 6H_2O(I) + 6O_2(g)$

b) $O_3(g) + H_2O_2(I) \rightarrow H_2O(I) + O_2(g) + O_2(g)$

Also suggest a technique to investigate the path of the above (a) and (b) redox reactions.

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40. The compound AgF_2 is unstable compound. However, if formed, the compound acts as a very strong oxidising agent. Why ?

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41. Whenever a reaction between an oxidising agent and a reducing agent is carried out, a compound of lower oxidation state is formed if the reducing agent is in excess and a compound of higher oxidation state is formed if the oxidising agent is in excess. Justify this statement giving three illustrations.

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42. How do you count the following observations?

a) Though alkaline potassium permanganate and acidic potassium permanganate both are used as oxidants, yet in the manufacture of benzoic acid from toluene we use alcoholic potassium permanganate as an oxidant. Why ? Write balanced redox equation for the reaction.

b) When concentrated sulphuric acid is added to inorganic mixture containing chloride, we get colourless pungent smelling gas HCl, but if the mixture contains bromide then we get red vapour of bromine. Why ?

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43. Identify the substance oxidised, reduced, oxidising agent and reducing agent for each of the following reactions :

a) $2AgBr(s) + C_6H_6O_2(aq) \rightarrow 2Ag(s) + 2HBr(aq) + C_6H_4O_2(aq)$

b)

$HCHO(l) + 2\left[Ag(NH_3)_2\right]^+(aq) + 3OH^-(aq) \rightarrow 2Ag(s) + HCOO^-(aq$

c)

$HCHO(l) + 2Cu^{2+}(aq) + 5OH^-(aq) \rightarrow Cu_2O(s) + HCOO^-(aq) + 3H$

d) $N_2H_4(l) + 2H_2O_2(l) \rightarrow N_2(g) + 4H_2O(l)$

e) $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$

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44. Consider the reactions

$2S_2O_3^{2-}(aq) + I_2(s) \rightarrow S_4O_6^{2-}(aq) + 2I^-(aq)$

$S_2O_3^{2-}(aq) + 2Br_2(l) + 5H_2O(l) \rightarrow 2SO_4^{2-}(aq) + 4Br^-(aq) + 10H^+(aq$

Why does the same reductant, thiosulphate react differently with iodine and bromine ?

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45. Justify giving reactions that among halogens, fluorine is the best oxidant and among hydrohalic compounds, hydroiodic acid is the best reductant.

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46. Why does the following reaction occur ?

$XeO_6^{4-}(aq) + 2F^-(aq) + 6H^+(aq) \rightarrow XeO_3(g) + F_2(g) + 3H_2O(l)$

What conclusion about the compound Na_4XeO_6 (of which XeO_6^{4-} is a part) can be drawn from the reaction.

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47. Consider the reactions :

a)

$H_3PO_2(aq) + 4AgNO_3(aq) + 2H_2O(l) \rightarrow H_3PO_4(aq) + 4Ag(s) + 4HNO$

b)

$H_3PO_2(aq) + 2CuSO_4(aq) + 2H_2O(l) \rightarrow H_3PO_4(aq) + 2Cu(s) + H_2SO$

c)

$C_6H_5CHO(l) + 2\left[Ag(NH_3)_2\right]^+(aq) + 3OH^-(aq) \rightarrow C_6H_5COO^-(aq) +$

d) $C_6H_5CHO(l) + 2Cu^{2+}(aq) + 5OH^-(aq) \rightarrow$ no change is observed.

What inference do you draw about the behaviour of Ag^+ and Cu^{2+} from these reactions?

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48. Balance the following redox reaction in basic medium by ion-electron method :

$MnO^-_{4(aq)} + 1^-_{(aq)} \rightarrow MnO_{2(s)} + 1_{2(s)}$

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49. Balance the following equations in basic medium by ion-electron method and oxidation number methods and identify the oxidising agent and the reducing agent.

(a) $P_4(s) + OH^-(aq) \rightarrow PH_3(g) + HPO_2^-(aq)$

(b) $N_2H_4(I) + ClO_3^-(aq) \rightarrow NO(g) + Cl^-(g)$

(c) $Cl_2O_7(g) + H_2O_2(aq) \rightarrow ClO_2^-(aq) + O_2(g) + H^+$

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50. What sorts of information can you draw from the following reaction ?

$(CN)_2(g) + 2OH^-(aq) \rightarrow CN^-(aq) + CNO^-(aq) + H_2O(l)$

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51. The Mn^{3+} ion is unstable solution and undergoes disproportionation to give Mn^{2+}, MnO_2 and H^+ ion. Write balanced ionic equation for the reaction.

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52. Consider the elements Cs, Ne, I and F.

a) Identify the element that exhibits only negative oxidation state.

b) Identify the element that exhibits only positive oxidation state.

c) Identify the element that exhibit both positive and negative oxidation states

d) Identify the element which neither exhibit the negative nor does the positive oxidation state.

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53. Chlorine is used to purify drinking water. Excess of Chlorine is harmful. The excess of Chlorine is removed by treating with sulphur dioxide. Present a balanced equation for this redox change taking place in water.

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54. Refer to the periodic table given in your book and now answer the following questions.

a) Select the possible non metals that can show disproportionation reaction

b) Select the metals that can show disproportionation

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55. In Ostwal's process for the manufacture of nitric acid the first step involves the oxidation of ammonia gas by oxygen gas to give nitric oxide gas and steam. What is the maximum weight of nitric oxide that can be obtained starting only with 10.00 g of ammonia and 20.00 g of oxygen.

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56. i) Arrange the following metals in the order in which they displace each other from the solution of their salts.

Al, Cu, Fe, Mg and Zn

ii) Calculate the molarity of sodium carbonate in a solution prepared by dissolving 5.3 g in enough water to form 250 ml of the solution.

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Long Answer Question

1. Write the balanced ionic equation which represents the oxidation of iodine (I^{-}) ion by per-manganate ion in basic medium to give iodine (I) and manganese dioxide (MnO_2).

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2. Write the balanced ionic equation for the oxidation of sulphite ions to sulphate ions in acid medium by permanganate ion.

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3. Oxalic acid is oxidised by permanganate ion in acid medium of Mn^{2+} balance the reaction by ion-electron method.

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4. Phosphorus when heated with NaOH solution gives Phosphine (PH_3) and $H_2PO_2^-$. Give balanced equation.

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5. Balance the following equation.

$$Cr(OH)_3 + IO_3^- \xrightarrow{OH^-} I^- + CrO_4^{2-}$$

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6. Balance the following equation by the oxidation number method.

$$MnO_4^{2-} + Cl_2 \rightarrow MnO_4^{2-} + Cl^-$$

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7. Explain the different types of redox reactions.

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8. State the law of definite proportions. Suggest one problem to understand the law by working out that problem.

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9. How are the end points of titrations detected in the following reactions ?

a) MnO_4^{-2} oxidises Fe^{2+}

b) $Cr_2O_7^{2-}$ oxidises Fe^{2+}

c) Cu^{+2} oxidises I^-

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10. Calculate the amount of Carbondioxide that could be produced when

i) 1 mole of carbon is burnt in air

ii) 1 mole of carbon is burnt in 16 g of dioxygen

iii) 2 moles of carbon are burnt in 16 g of dioxygen.

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11. Dinitrogen and dihydrogen react with each other to produce ammonia according to the following chemical equation.

$N_2(g) + H_2(g) \rightarrow 2NH_3(g)$

i) Calculate the mass of ammonia produced if $2.00 \times 10^3 g$ dinitrogen reacts with $1.00 \times 10^3 g$ of dihydrogen.

ii) Will any of the two reactants remain unreacted ?

iii) If yes, which one and what would be its mass?

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12. Assign oxidation number to the underlined elements in each of the following species.

a) $NaH_2\underline{P}O_4$ $\quad$ $b)NaH\underline{S}O_4$ $\quad$ $c)H_4\underline{P_2}O_7$

d) $K_2\underline{Mn}O_4$ $\quad$ $e)Ca\underline{O_2}$ $\quad$ $f)Naun\partial \in e(B)H_4$

g)$H_2\underline{S_2}O_7$ $\quad$ $h\Big)KAl\underline{SO_4}_2.12H_2O$

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13. What are the oxidation numbers of the underlined elements in each of the following and how do you rationalise your results?

a) $H_2\underline{S}_4O_6$ b) $\underline{F}e_3O_4$

c) $\underline{C}H_3\underline{C}H_2OH$ d) $\underline{C}H_3\underline{C}OOH$

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Additional Questions Answers

1. Calculate molecular mass of glucose $(C_6H_{12}O_6)$ molecule.

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

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3. Calculate the amount of water (g) produced by the combustion of 16 g of methane.

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4. How many moles of methane are required to produce 22 g $CO_2(g)$ after combustion?

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5. 50.0 kg of $N_2(g)$ and 10.0 kg of $H_2(g)$ are mixed to produce $NH_2(g)$. Calculate the $NH_2(g)$ formed. Identify the limiting reagent in the production of NH_3 in this situation.

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6. A solution is prepared by adding 2 g of a substance A to 18 g of water. Calculate the mass per cent of the solute.

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7. Calculate the molarity of NaOH in the solution prepared by dissolving its 4 g in enough water to form 250 mL of the solution.

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8. The density of 3M solution of NaCL is 1.25 gmL^{-1}. Calculate molality of the solution.

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9. Calculate the normality of oxalic acid solutions containing 6.3g of $H_2C_2O_4.2H_2O$ in 500 ml of solutions.

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10. Calculate the mass of Na_2CO_3 required to prepare 250 ml of 0.5 N solution.

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