CHEMISTRY

1. What is the pH of 1×10^{-8} M HCl?
   (a) < 7
   (b) 8
   (c) = 7
   (d) it is not possible to make such a solution

1. (a) We know that pH = $-\log_{10}[H^+]$

   here $[H^+]$ = Total H^+ ions from HCl and H_2O
   Contribution of H_2O, $[H^+] = 1 \times 10^{-7}$ M
   Contribution of HCl, $[H^+] = 1 \times 10^{-8}$ M
   So total $[H^+] = 10^{-7} + 10^{-8} = 10^{-8}\,[1 + 10] = 10^{-8} \times 11$
   So pH of 1×10^{-8} M HCl is,

   $$pH = -\log_{10}[1\times10^{-8}\times11] = -[\log_{10}10^{-8} + \log 11] = -(-8) - (1.01.....) < 7$$

   $\Rightarrow$ pH < 7.

2. On passing SO_2 gas in acidified $K_2Cr_2O_7$ solution, green colour is produced due to formation of
   (a) $CrSO_4$ (b) K_2CrO_4 (c) $Cr_2(SO_4)_3$ (d) Cr_2O_3

2. (c) When SO_2 gas made to pass through in acidified $K_2Cr_2O_7$ solution. Following reactions were taking place.

   $$SO_2 + H_2O \longrightarrow H_2SO_3 \rightleftharpoons 2H^+ + SO_3^{2-}$$

   $$SO_3^{2-} + [O] \longrightarrow SO_4^{2-}$$

   SO_3^{2-} quickly oxidises by reducing $K_2Cr_2O_7$

   $$Cr_2O_7^{2-} + SO_2 + H^+ \longrightarrow \underset{\text{green colour}}{2Cr^{3+}} + 3SO_4^{2-} + H_2O\ (\ell)$$

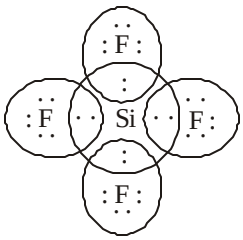
3. In the equation, $NaOH + HNO_3 \longrightarrow NaNO_3 + H_2O$

   Nitric acid is acting as
   (a) an oxidising agent (b) an acid
   (c) a nitrating agent (d) a dehydrating agent

3. (b) It is neutralisation reaction in which an acid reacts with a base to produce salt and water. Here HNO_3 is acid, NaOH is a base and $NaNO_3$ formed is called salt.

4. In which of the following compounds does every atom have eight electrons in its valence shell?
   (a) IF_5 (b) C_2H_4 (c) SiF_4 (d) KH

4. (c) In SiF_4 every atoms i.e. Si and four F have eight electrons in their outer orbit.



   While in other cases,
   In IF_5 iodine has 10 electrons in its outer orbit.
   In C_2H_4, Hydrogen atom do not complete its octet.
   Same case in KH, 'H' atom do not complete its octet because hydrogen atom has two electrons in its outer shell.

5. Which of the following reactions will produce hydrogen gas at the fastest rate?
   (a) 6 gm granular zinc with 10 mL of 1 M HCl
   (b) 6 gm granular zinc with 10 mL of 2 M HCl
   (c) 3 gm granular zinc with 5 mL of 1 M HCl
   (d) 3 gm granular zinc with 5 mL of 2 M HCl

5. (b) $Zn\ (s) + 2HCl\ (aq) \longrightarrow ZnCl_2\ (aq) + H_2\ (g)$

   so rate of formation of H_2 (g) = $\frac{-1}{2}\frac{d}{dt}[HCl\ (aq)]$

   it means larger the HCl concentration, faster will be H_2 gas formed.
   So 10 ml of 2M HCl is better to produce hydrogen gas at a faster rate.

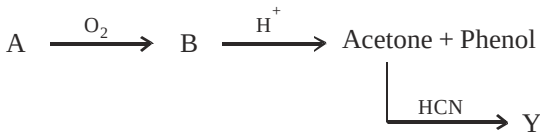
   Secondly rate of formation of H_2 (g) = $-\frac{d[Zn]}{dt}$

   Higher will be the concentration of Zn, higher will be the formation of H_2 gas. So, 6 g grannular Zn is better option. So, ans (b) is correct choice.

6. Raju has a sample of an ore which he crushed and concentrated it by hydraullic washing and then by magnetic separation. After that he converts it into oxide and found that the gas evolved during this process turns the lime water milky but do not reduces $K_2Cr_2O_7$ solution. What may be the ore from the following options?
   (a) siderite (b) bauxite (c) Haematite (d) Gyolite

6. (a) Siderite is $FeCO_3$, Haematite is Fe_2O_3, Bauxite is $Al_2O_3.x.H_2O$ and Cryolite is Na_3AlF_6.
   So only two ores are concentrated using magnetic separation which are $FeCO_3$ and Fe_2O_3.
   In Fe_2O_3 we do not need to convert into oxide as it is already oxide of iron and secondly the gas evolved during conversion converts lime water milky but does not reduce $K_2Cr_2O_7$ solution so the gas must be CO_2.
   CO_2 is released during the conversion of ore into its oxide. So the ore must contains carbonate. So the ore must be siderite ($FeCO_3$).

7. A series of reactions given below :



Find out A and Y from the following options.

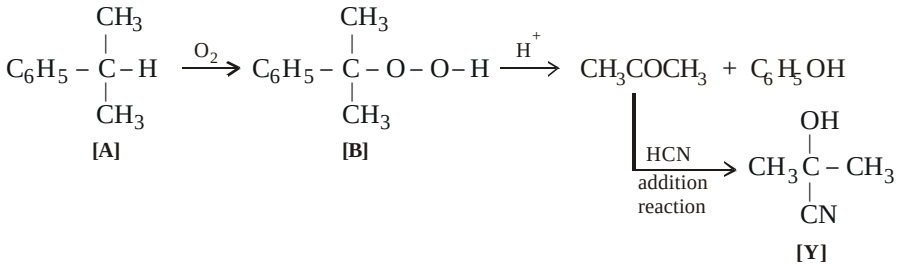
(a) $C_6H_5-\underset{\displaystyle CH_3}{\underset{|}{C}H}-CH_2OH$ and $CH_3-\overset{\displaystyle OH}{\overset{|}{\underset{\displaystyle CN}{\underset{|}{C}}}}-CH_3$

(b) $C_6H_5-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-C-O-OH$ and $CH_3-\overset{\displaystyle OCN}{\overset{|}{\underset{\displaystyle H}{\underset{|}{C}}}}-CH_3$

(c) $C_6H_5-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}H$ and $CH_3-\overset{\displaystyle OH}{\overset{|}{\underset{\displaystyle CN}{\underset{|}{C}}}}-CH_3$

(d) $C_6H_5-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-O-H$ and $CH_3-\overset{\displaystyle OCN}{\overset{|}{\underset{\displaystyle H}{\underset{|}{C}}}}-CH_3$

7. (c) The reaction will be as follows



8. Consider the following equations :

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$$

Find the amount of calcium chloride formed when 2.5 g of calcium carbonate are dissolved in excess of hydrochloric acid?

(a) 1.39 g (b) 2.78 g (c) 5.18 g (d) 17.8 g

8. (b) The given equation is

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$$

Molecular masses $100\ g + 73\ g \longrightarrow 111\ g + 18g + 44g$

We can see that, amount of $CaCl_2$ formed when 100 g of $CaCO_3$ is dissolved in excess of HCl = 111 g
So, amount of $CaCl_2$ formed when 2.5 g of $CaCO_3$ is dissolved in excess of HCl

$$= \frac{111}{100} \times 2.5 = 2.775\ g \cong 2.78\ g$$

9. Raveena makes 30 ml brine solution and pass some ammonia gas in solution and then he made to pass a gas X in this solution at high pressure and a salt is formed. This salt is also used in making cakes. She heats the salt upto 45°C and gas 'X' comes out with water. 'X' is

(a) CO_2 (b) SO_2 (c) H_2 (d) CH_4

9. (a) Brine solution is solution of NaCl in cold water.

So, $\text{Brine solution} + NH_3 \xrightarrow[\text{high pressure}]{CO_2\,(g)\ \text{at}} NaHCO_3$

When $NaHCO_3$ is heated it loses CO_2 and H_2O.
$NaHCO_3$ is also used in making cakes

$$2NaHCO_3 \xrightarrow[45°C]{\Delta} Na_2CO_3 + CO_2 + H_2O$$

So, X is CO_2.

10. The first IE and Na, Mg, Al and Si are in the order

(a) Na < Mg < Al < Si (b) Na < Mg > Al > Si
(c) Na < Mg > Al < Si (d) Na > Mg > Al > Si

10. (c) As we go across a period the atomic radii decreases due to addition of an extra electrons we define first I.E. as the amount of energy required to remove an electron from the outermost shall of an atom.
So, we need highest energy to remove an electron from the outermost shell of S; as compare to Na, Al and Mg.
But in case of Mg and Al, we have to remove an odd electron in case of Al and one of an even electron in Mg. The energy required to break a pair is more than to remove an odd electron. So, first I.E. of Mg is more than Al inspite of the fact that Al has less atomic radii than Mg. Na has lowest first I.E.
So, the correct order is, Na < Mg > Al < Si.

	Atomic No.	**Valence Electrons**	
Na	11	1	I.E. increases ↓ Atomic radius decreases
Mg	12	2	
Al	13	3	
Si	14	4	

11. In the reaction $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$
The rate of disappearance of hydrogen is 5.0×10^{-3} mol $L^{-1}s^{-1}$. The rate of formation of ammonia will be
(a) 3.3×10^{-3} mol $L^{-1}s^{-1}$ (b) 2.5×10^{-3} mol $L^{-1}s^{-1}$
(c) 1.67×10^{-3} mol $L^{-1}s^{-1}$ (d) 5.0×10^{-3} mol $L^{-1}s^{-1}$

11. (a) We can write instantaneous rate of reaction as

$$-\frac{d}{dt}[N_2(g)] = \frac{-1}{3}\frac{d}{dt}[H_2(g)] = \frac{1}{2}\frac{d[NH_3(g)]}{dt}$$

Given $-\frac{d}{dt}[H_2(g)] = 5\times10^{-3}$ mol $L^{-1}S^{-1}$

$$\Rightarrow \frac{1}{3}\times5\times10^{-3} = \frac{1}{2}\frac{d}{dt}[NH_3(g)] \Rightarrow \frac{d}{dt}[NH_3(g)] = \frac{10}{3}\times10^{-3} = 3.33\times10^{-3} \text{ mol } L^{-1}S^{-1}$$

12. Select the correct reason from the options given below.
Gypsum is added to cooled clinker during cement manufacture
(a) because gypsum permits formation of fine powder
(b) to delay the initial setting time of cement
(c) to increase the hardening of cement
(d) to increase the strength of concrete

12. (b) Gypsum delays the initial setting time of cement.

30. Ambika starts a reaction between A (ℓ) and B (ℓ) in an open vessel. The product formed C is a liquid. She performed this reaction in winter season. Which one of the following statements is not true about this reaction?
(a) This reaction can never reach upto an equilibrium point at room temperature
(b) Equilibrium constant for this reaction may be $K_C = \frac{[C(\ell)]^{\gamma}}{[A(\ell)]^{\alpha}[B(\ell)]^{\beta}}$, where α, β, γ are the stichiometric numbers
(c) The equilibrium point cannot be reach at higher temperature
(d) At equilibrium rate of disappearance of B is equal rate of disappearance of A

30. (a) This reaction can reach upto an equilibrium point at room temperature because here equilibrium can be affected by evaporation process but evaporation rate is very low at room temperature especially in winter season. So, practically it will not affect the equilibrium

14. Which statement is correct from the following?
(a) Potable water contains coliform bacteria
(b) Pneumoconiosis occurs due to inhalation of cotton fibres
(c) Wet scrubbers are used to trap SO_2, NH_3 and metal fumes in chemical industries
(d) Planting trees and sowing grasses results in soil erosion

14. (c) Wet scrubbers are used in chemical, mining and metallurgical industries to trap SO_2, NH_3, metal fumes etc.

15. Tin can be refined by which one of the following processes?
(a) Liquation (b) distillation (c) Electrolytic refining
(d) None of these

15. (a) Tin is a metal with low melting point.

16. Lime, alumina, ferric oxide and SiO_2 when react in rotary klin at 1773 K it results in formation of which of the following compounds?
(a) Ca_2SiO_4 and Ca_3SiO_5 (b) $Ca_3Al_2O_6$
(c) Gypsum (d) Both (a) and (b)

16. (d) It is the process of making cement in a klin. On heating Lime, alumina, Fe_2O_3 and SiO_2 in rotary klin at 1773 a mixture Ca_2SiO_4, Ca_3SiO_3 and $Ca_3Al_2O_6$ is formed which on cooling converted into cement.

17. Bleaching powder is prepared in which of the following plants or machines?
(a) Hasenclever or Bachmann's plant (b) Rotary klin
(c) Blast furnace (d) Not given

17. (a) It is prepared in Hasenclever or Bachmann's plant.

18. What do you mean by 18 carat gold?
(a) 18 parts pure gold + 6 part either copper or silver
(b) 18 part pure gold
(c) 13 part gold + 5 parts either Cu or Ag
(d) None of these

18. (a) 18 carat gold means 18 part pure gold +6 parts either copper or silver.

19. Which of the following reaction will not take place in Bessemer converter used for manufacturing steel?
(a) $MnO + SiO_2 \longrightarrow MnSiO_3$ (b) $3CaO + P_2O_5 \longrightarrow Ca_3(PO_4)_2$
(c) $Na_2CO_3 + SiO_2 \longrightarrow Na_2SiO_3$ (d) $C + O_2 \longrightarrow CO_2$

19. (c) This reaction takes place in tank furnace used in manufacture of glass.

20. Find the no. of moles in 1 Kg of Sugar?
(a) ~ 2 moles (b) ~ 3 moles (c) 2.5 moles (d) None of these

20. (b) $\text{No. of moles} = \frac{\text{Weight (g)}}{\text{Molecular mass}} = \frac{1000}{342} = \sim 3$

21. Which of the following does not show Tyndall effect?
(a) smoke in dark room where sunlight enters from a hole
(b) when light is make to pass through copper sulphate solution
(c) when light is made to pass through mixture of milk and water
(d) when light is made to pass through a solid milk icecream

21. (b) Light does not scattered when made to pass through this solution.

22. Which of the following statement is correct?
(a) 58g He is more in amount than 15.055×10^{24} He atoms
(b) 58g He is less in amount than 15.055×10^{24} He atoms
(c) 58g He is equals to 15.055×10^{24} He atoms
(d) none of above

22. (b) (1) 58 g He = $\frac{58}{4}$ moles of He = 14.5 moles of He

(2) 15.055×10^{24} atom of He = $\frac{15.055 \times 10^{24}}{6.022 \times 10^{23}} = 2.5 \times 10 = 25$ moles of He

Therefore (2) > (1).

23. $^{40}_{20}Ca$ and $^{40}_{18}Ar$ are
(a) isotopes (b) isotones (c) isobars (d) isochors

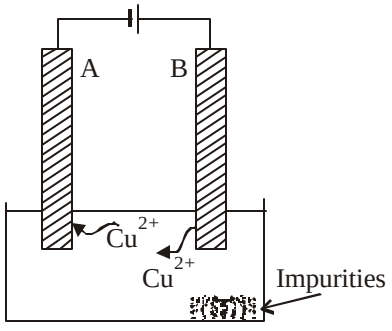
23. (c)

Mass No.	***Atomic No.***	
Same	Not Same	*Isobars*
Not Same	Same	*Isotopes*

24. Find the average atomic mass of Br atoms? Given that Br is available in three isotopic forms.
$^{79}_{35}Br$ (49.7%) $^{81}_{35}Br$ (42.8%) and $^{80}_{35}Br$ (7.5%)
(a) 79.921 (b) 79.931 (c) 79.941 (d) 79.911

24. (b) Average Atomic Mass = $\left(79 \times \frac{49.7}{100}\right) + \left(81 \times \frac{42.8}{100}\right) + \left(80 \times \frac{7.5}{100}\right) = 34.668 + 39.263 + 6.00 = 79.931.$

25. The given figure shows the electrolytic refining of copper.



Which one of the following is true about the above figure?
(a) Electrode A is anode
(b) Electrode B is cathode
(c) Direction of flow of electron is from A to B
(d) Direction of flow of current is from A to B

25. (c) In this electrolytic cell A is cathode having –ve sign, B is anode having +ve sign. So electron flows from –ve electrode to +ve electrode so direction of flow of electron is from A to B. Current flows in opposite direction of flow of electrons. If electrons flows from A to B so current flows from B to A.

26. Which one of the following reaction represents the redox reaction?

(a) $^{14}_{7}N + ^{1}_{0}n \longrightarrow ^{15}_{8}O + ^{0}_{-1}e$ (b) $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

(c) $AgBr \rightleftharpoons Ag^+ + Br^-$ (d) $NaOH + HCl \longrightarrow NaCl + H_2O$

26. (b) In this reaction CO oxidises to give CO_2 and Fe_2O_3 reduces to form Fe.

27. A compound 'A' gives red colour with Benedicts reagent. When A is oxidised in the presence of a Fe/Mo catalyst at high temperature the resulting substance (B) gives red colour precipitates with Fehling solution. A is simplest alkyl alcohol and used for denaturing spirit. Find which of the following is B

(a) Formaldehyde (b) Acetaldehyde (c) Propanal (d) Butanal

27. (a) $\underset{\substack{\text{Simplest alkyl alcohol used in denaturing spirit}\\(A)}}{CH_3OH} \xrightarrow[Fe/Mo]{O_2} \underset{(B)}{HCHO} \xrightarrow[(Fehlingsol.)]{Cu(OH)_2}$ Red colour precipitate

So (B) is Formaldehyde.

28. Which one of the following can liberate H_2 gas from the 10 M HCl solution?

(a) Na (b) S (c) I (d) CO_2

28. (a) Only that substance can liberate H_2 from an acid solution which has tendency to replace H^+ ions from solution by reducing them.
Na can easily loose its outer electron which can be used in reduction of H^+ ions.

$2H^+ + 2e^- \longrightarrow H_2$

29. Raju is performing an interesting experiment. He take 5 ml of 0.2 M $CuSO_4$ solution acidifies it with glacial CH_3COOH in a test tube and start adding liquor ammonia solution dropwise in acidified $CuSO_4$ solution. After the addition of few drops he observe some precipitates settling down in the test tube. He filter these precipitates. What should he do to obtain purest Cu from the precipitates? Select your answer from following options.

(a) Heat the precipitates and subject them to electrical refining.
(b) Make solution of the precipitate and subject them to electrical refining.
(c) Heat the precipitate and then reduce it electrically and to obtain pure copper subject it to electrical refining.
(d) Heat the precipitate and then reduce them by using coke in a triple walled chamber.

29. (c) Best possible answer of this question is (c), because on adding liquor ammonia solution in 0.2 M $CuSO_4$ solution, we first get the precipitates of $Cu(OH)_2$. Filter it and refine it electrically. Method to obtain pure Cu from these precipitates is represented as follows:

$$\underset{\text{precipitates}}{Cu(OH)_2} \xrightarrow[-H_2O]{\text{heat}} CuO \xrightarrow[\text{reduction}]{\text{electrical}} \underset{\substack{\text{impurities are}\\\text{also present}}}{Cu} \xrightarrow{\text{electrical refining}} \underset{\text{Pure}}{Cu}$$

While in other methods -

(a) $CuO \xrightarrow{\text{electrical refining}}$ You can do so but the amount of Cu you get is as same as you lost in solution (think over it).

(b) $CuO(\ell) \xrightarrow{\text{electrical refining}}$ You can do so but the amount of Cu you get is as same as you lost in solution (think over it).

(d) $CuO + C \xrightarrow[\text{high temperature}]{\text{heat}}$ Very exothermic reaction but after all we can't get purest Cu. We have to refine it since impurities are left in solution obtained after reduction.