CBSE Board
Class XI Chemistry

Time: 3 Hours **Marks: 70**

General Instructions

1. All questions are compulsory.
2. Question nos. 1 to 8 are very short answer type questions and carry 1 mark each.
3. Question nos. 9 to 18 are short answer type questions and carry 2 marks each.
4. Question nos. 19 to 27 are also short answer type questions and carry 3 marks each.
5. Question nos. 28 to 30 are long answer type questions and carry 5 marks each.
6. Use log tables if necessary, use of calculators is not allowed.

Q1. Give an example of a basic buffer.

Q2. Which of the two is more acidic and why? Acetic acid and chloroacetic acid

Q3. What happens to the ionic product of water if some acid is added to it?

Q4. What is the approximate molecular mass of dry air containing 78% N_2 and 22% O_2? (Atomic mass N = 14, O =16 u)

Q5. Give an example of a decomposition redox reaction.

Q6. Give the molecular formula of two gases responsible for depletion of ozone layer.

Q7. Write the name and atomic number of the second transition element.

Q8. Why does H_2 behave as an inert gas?

Q9. Why is acid rain considered to be a threat for Taj Mahal? Explain with chemical reaction.

Q10. What is the hybridization of B in BF_3 and N in NH_3? How does hybridization change when both compounds react to a coordinate bond?

Q11. Predict the shape of following molecules on the basis of VSEPR theory
a) XeF_4 b) ClF_3

Q12.
a) What is Boyle's temperature?
b) What type of intermolecular forces exist between HCl molecules in liq.HCl?

Q13. Balance the following equation by the half reaction method (acidic medium):
$C_2H_5OH + MnO_4^- \rightarrow Mn^{2+} + CH_3COOH$

Q14.

a) Calculate the mass of one atom of oxygen.
b) How many He atoms are present in 4u of He.

Q15. Calculate the mass percentage composition of copper pyrites($CuFeS_2$)

Q16.

a) Give equation for lab preparation of Hydrogen peroxide.
b) Give a use of hydrogen peroxide.

Q17. Predict the effect of addition of 2 moles of an ideal gas

a) At constant volume
b) At constant pressure on the equilibrium:

$$Na_2CO_3(s) + SO_2(g) + \tfrac{1}{2}O_2(g) \rightleftharpoons Na_2SO_4(s) + CO_2(g)$$

OR

Q17.

a) What is the condition required for precipitation to occur?
b) In which of the two solutions, solubility of sodium sulphide be more: solution with pH 3.7 or with pH 4.2?

Q18. Calculate the root mean square and average speed of oxygen molecules at 27^0C.

Q19.

a) An electron in which orbit of Li^+(Z=3) would have same energy as the electron in second orbit of H atom?
b) State Aufbau's principle

OR

Q19. Calculate the wavelength, frequency and wave number of a light wave whose period is 2.0×10^{-10} s.

Q20.

a) Second ionization enthalpy of Na is more than Mg.Why?
b) Arrange the following in the increasing order of radius. N, O, P
c) Write the general outer electronic configuration of transition elements.

Q21. Give reason:

a) Be and Mg do not impart colour to the flame.
b) Li^+ is heavily hydrated in water.

Q22. Calculate the volume of 1.0 M aq.NaOH that is neutralized by 200 mL of 2.0 M aq.HCl. Also calculate the mass of NaCl produced.

Q23.

a) Which of the two has higher ionic character and why? NaCl or NaI
b) Write the molecular orbital configuration of C_2.Predict its magnetic behaviour.
c) H_2O is a liquid at room temperature.Why?

Q24. In an equilibrium, $A + B \rightleftharpoons C + D$, A and B are mixed in a vessel at a temperature T. The initial concentration of A was twice the initial concentration of B. After equilibrium was attained, concentration of C becomes thrice the equilibrium conc. of B. Calculate K_c.

Q25.

a) Give values for all 4 quantum numbers for unpaired electron of Cl (Z=17).
b) Which quantum number defines orientation of an electron?
c) How many electrons in Cr (Z=24) have l =1?

Q26. After entering a closed coal mine area, Ravi found difficulty in breathing, also felt nausea.

a) What could be the reason for this?
b) How could Ravi estimate the level of the pollutant?
c) As a citizen of the country what should be his course of action further?

Q27.

a) Write the IUPAC name of:
   i. $HOOCCH_2CH_2COCH_2CH_3$ ii. $CH_3CH_2CONHCH_3$
b) Arrange the following free radicals in decreasing order of stability: $CH_3^{\cdot}$, $(CH_3)_3C^{\cdot}$, $(CH_3)_2CH^{\cdot}$, $CH_3CH_2^{\cdot}$

Q28.

a) Standard enthalpies of combustions of C_6H_{10}, H_2 and C_6H_{12} are -3880, -241,-3920 kJ mol^{-1} resp. Calculate the standard enthalpy of hydrogenation of C_6H_{10}.

b) Calculate the work done when 1 mole of an ideal gas expands freely in vaccuum.
c) What is the difference between H-H bond enthalpy and enthalpy of formation of H atom?

OR

Q28.

a) Calculate the enthalpy change for the reaction:
   $C_2H_4 + H_2 \rightarrow C_2H_6$
   Given enthalpies of combustions of C_2H_4, H_2 and C_2H_6 are -1401, -1550,-286 kJ mol^{-1} respectively.
b) Identify the state and path functions in the expression given: $\Delta U=q+w$
c) Predict the sign of ΔG for the following processes:
   i. Melting of ice below 0^oC
   ii. Flow of heat from high to low temperature.

Q29.

a) Give the formulae of components of borax bead.
b) Why does Si not show catenation to the extent as carbon does?
c) Al_2Br_6 is a poor conductor of electricity. Why?
d) $N(CH_3)_3$ is pyramidal while $N(SiH_3)_3$ is planar.Why?

OR

Q29.

a) Why does B resemble Si in its properties?
b) Pb (IV) chloride is a good oxidising agent. Why?
c) Which of the following is acidic and Why? SiO_2, Al_2O_3, PbO_2
d) B-F bond length in BF_3 is more than in $[BF_4]^-$ .Why?

Q30.

a) Which type of isomerism is observed in xylenes?
b) Predict the major products of the following:
   i. $C_6H_6 \xrightarrow{H_2SO_4}$
   ii. $CH_3CH_2CH(Br)CH_3 \xrightarrow{Alc.KOH}$
c) Name the reagent used to distinguish between following pairs of compounds
   i. propane and propene
   ii. but-1-yne and but-2-yne

OR

Q30.

a) Alkanes with even number of carbon atoms have higher melting point than the corresponding ones with odd number. Why?
b) Name the two conformations of ethane. Which of the two is more stable?
c) A hydrocarbon 'A' has a vapour density 36. It forms a single monochloro substitution product. Predict the structure of 'A'. Justify your answer.
d) Convert acetic acid to methane.

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Solution

1. A mixture of NH_4OH and NH_4Cl (1)

2. Chloro acetic acid is a stronger because of –I effect of chloro group. (1)

3. Ionic product remains unchanged. (1)

4. Molecular mass = 28 x 0.78 + 32 x 0.22 = 28.88g (1)

5. $2KClO_3(s) \xrightarrow{\Delta} 2KCl(s) + 3O_2(g)$ (1)

6. CCl_2F_2 and NO. (1)

7. Titanium,22 (½ + ½)

8. H-H bond is very strong. Energy required for its cleavage is very high. Hence dihydrogen is an inert gas. (1)

9. Taj Mahal is made of marble which is $CaCO_3$. Acid rain contains H_2SO_4 which reacts with marble making it pitted and mechanically weak. (1)
$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$ (1)

10. Hybridisation of B is sp^2 and N is sp^3. (1)
After formation of new complex, hybridization of B changes from sp^2 to sp^3 while that of N remains same. (1)

11.
(a) 4 bond pairs and 2 lone pairs, shape: square planar (1)

(b) 3 bond pairs and 2 lone pairs, shape: T shaped. (1)

12.
(a) Temperature at which a real gas behaves as an ideal gas over a considerable range of pressure is called Boyle's temperature. (1)

(b) Dipole - dipole interaction (1)

13. Oxidation half reaction:

$C_2H_5OH \rightarrow CH_3COOH + 4e^-$

Balance charge using H^+, H_2O

$C_2H_5OH + H_2O \rightarrow CH_3COOH + 4e^- + 4H^+$ (1/2)

Reduction half reaction

$MnO_4^- + 5\ e^- \rightarrow Mn^{2+}$

Balance charge using H^+, H_2O

$MnO_4^- + 5\ e^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O$ (1/2)

Multiply oxidation half reaction by 5 and reduction half reaction by 4 and add

$5C_2H_5OH + 4MnO_4^- + 12H^+ \rightarrow 4\ Mn^{2+} + 5CH_3COOH + 11H_2O$ (1)

14.

(a) 6.022×10^{23} atoms of oxygen weigh 16g

Therefore, Mass of one atom = $16 / (6.022 \times 10^{23})$

$= 2.657 \times 10^{-23}$ (1)

(b) 1 atom of He (1)

15. Molar mass of $CuFeS_2 = 63.5 + 55.8 + (2 \times 32) = 183.3$ gm mole^{-1} $\left(\frac{1}{2}\right)$

Mass percentage of Cu =

$$\frac{63.5}{183.3} \times 100 = 34.64\,\%$$ $\left(\frac{1}{2}\right)$

Mass percentage of Fe =

$$\frac{55.8}{183.3} x 100 = 30.44\% \qquad \left(\frac{1}{2}\right)$$

Mass percentage of S =

$$\frac{64}{183.3} x 100 = 34.92\% \qquad \left(\frac{1}{2}\right)$$

16.

(a) $BaO_2.8H_2O(s) + H_2SO_4(aq) \rightarrow BaSO_4(s) + H_2O_2\ (aq) + 8H_2O\ (l)$ (1)

(b) It is used as a bleaching agent for textiles and paper pulp etc. (1)

17.

(a) No change (1)

(b) equilibrium will shift in backward direction (1)

OR

(a) Ionic product should be more than solubility product. (1)

(b) In solution with pH 3.7, solubility will be more. (1)

18. Given data:

Molar mass of oxygen, M = 32 g mol-1 = 0.032 kg mol-1

Temperature, t = 27 ^{0}C *T* = (27 + 273) K = 300 K

Now, Root mean square speed =

$$c = \sqrt{\frac{3RT}{M}} \qquad \left(\frac{1}{2}\right)$$

$$= \sqrt{\frac{3 x 8.314 x 300}{0.032}} = 483.6\ m sec^{-1} \qquad \left(\frac{1}{2}\right)$$

Average speed =

$$\bar{c} = \sqrt{\frac{8RT}{\Pi M}} \qquad \left(\frac{1}{2}\right)$$

$$= \sqrt{\frac{8 x 8.314 x 300}{3.14 x 0.032}} = 445.6\ m sec^{-1} \qquad \left(\frac{1}{2}\right)$$

19.

(a) $E_n = -1312\ Z^2/n^2$ (1/2)

For H atom Z =1,n=2

For Li^{2+} Z = 3 , n=n

$(E_2)H = (E_n)Li^{2+}$ (1/2)

$\frac{-1312 \times 1^2}{2^2} = \frac{-1312 \times 3^2}{n^2}$ (1/2)

$¼ = 9/n^2$

n=6 (1/2)

(b) In the ground state of an atom, the electron enters the orbital of lowest energy first and the subsequent electrons are filled in orbitals of increasing energy. (1)

OR

Frequency (ν) of light

$$= \frac{1}{\text{Period}}$$

$$= \frac{1}{2.0\times10^{-10}\ \text{s}} = 5.0\times10^{9}\ \text{s}^{-1}$$

(1)

Wavelength (λ) of light $= \frac{c}{\upsilon}$

Where,

c = velocity of light in vacuum = 3×10^8 m/s

Substituting the value in the given expression of λ:

$$\lambda = \frac{3\times10^{8}}{5.0\times10^{9}} = 6.0\times10^{-2}\ \text{m}$$

(1)

Wave number $(\bar{\nu})$ of light

$= \frac{1}{\lambda}$

$= \frac{1}{6.0 \times 10^{-2}}$

$= 1.67 \times 10^{1}$ m

$= 16.67$ m (1)

20.

(a) After the loss of one electron, Na attains the configuration of a noble gas which is highly stable. Mg after loss of 1 electron becomes $3s^1$ which is not so stable.

Thus, the second ionization enthalpy of Na is higher than Mg. (1)

(b) O <N < P (1)

(c) $(n-1)d^{1-10}\ ns^{0-2}$ (1)

21.

(a) Be and Mg have comparatively small sizes. Ionisation enthalpies are high. (1)

Energy of the flame is not sufficient to excite the electrons hence they impart no colour to the flame. (1)

(b) Li^+ has a small size and very high charge density. It attracts and holds many water molecules and is so heavily hydrated. (1)

22. $NaOH + HCl \rightarrow NaCl + H_2O$

Let the volume of NaOH neutralized by given HCl=V_1mL

NaOH HCl

$M_1V_1 = M_2V_2$

$1.0\ V_1$ 2.0 X 200 (1/2)

$V_1 = 400$ mL (1/2)

Moles of NaOH used = $400 \times 1.0 \times 10^{-3}$

$$M = n \times \frac{1000}{V_1}$$

$$1 = n \times \frac{1000}{400}$$

$$n = 0.4 \text{ moles}$$ (1)

No. of moles of NaCl produced = No. of moles of NaOH

Mass of NaCl = 0.4 x 58.5 = 23.4g (1)

23.

(a) NaCl is more ionic. I^- being a bigger anion has high polarisablity and has more covalent character. (1)

(b) C_2 (12 e^-) - $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2$ ($\pi 2p_x^2 = \pi 2p_y^2$) (½)

Diamagnetic (½)

(c) Water molecules are associated by intermolecular H-bonding hence is liquid at room temperature. (1)

24. Let initial conc. of B = a mol L^{-1}

$$A + B \rightleftharpoons C + D$$

	A	B	C	D
Initial conc.	2a	a	0	0
At Equilibrium	(2a-x)	(a-x)	x	x

(1)

$$K_c = \frac{x^2}{(2a-x)(a-x)}$$ (1/2)

At equilibrium,

[C] = 3[B]

x=3(a-x)

x=3a/4 (1/2)

$$K_c = \frac{(3a/4)^2}{[(2a-3a)/4]\ [(a-3a)/4]}$$ (1/2)

=1.8 (1/2)

25.

(a) n=3, l =1, m_l =-1,m_s=-1/2 (1)

(b) Magnetic Quantum number (1)

(c) 12 electrons (1)

26.

a. In coal mines due to lack of oxygen a small percentage of carbon monoxide is formed. This carbon monoxide being poisonous gives the symptoms. (1)

b. Ravi could estimate the level of CO using I_2O_5. (1)

c. Ravi should inform the concerned authority about the excess of CO in the coal mine. (1)

27.

(a) (i) 4-ketohexanoic acid (ii) N-methylpropanamide (1+1)

(b) $(CH_3)_3C\cdot > (CH_3)_2CH\cdot > CH_3CH_2\cdot > CH_3\cdot$ (1)

28.

(a) $C_6H_{10}(g) + H_2(g) \rightarrow C_6H_{12}(g)$ = ?

$C_6H_{12}(g) + 9O_2(g) \rightarrow 6CO_2 + 6H_2O(l)$ = -3920 kJmol^{-1} (equation 1)

$C_6H_{10}(g) + 17/2O_2(g) \rightarrow 6CO_2 + 5H_2O(l)$ = -3800 kJmol^{-1} (equation 2)

$H_2(g) + 1/2O_2(g) \rightarrow H_2O(l)$ = -241 kJmol^{-1} (equation 3)

(equation 2)+ (equation 3)- (equation 1) gives the required equation

$C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$ = [(-3800+(-241)]-(-3920)] (1)

=-121 kJmol^{-1} (1)

(b) Since p_{ext} =0 work done = 0 (1)

(c) $H_2 \rightarrow 2H$ ΔH for the reaction = Bond enthalpy (1/2)

$1/2\ H_2 \rightarrow H$ ΔH = enthalpy of formation of H atom (1/2)

Hence, B.E of H-H bond = 2 x enthalpy of formation of H atom (1)

OR

(a) $C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$ = ?

$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2 + 2H_2O(l)$ = -1401 kJmol^{-1} (equation 1)

$C_2H_6(g) + 7/2O_2(g) \rightarrow 2CO_2 + 3H_2O(l)$ = -1550 kJmol^{-1} (equation 2)

$H_2(g) + 1/2O_2(g) \rightarrow H_2O(l)$ = -286 kJmol^{-1} (equation 3)

(equation 1) + (equation 3) - (equation 2) gives the required equation

$C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$ = [(-1401+(-286)]-(-1550)] (1)

=-137 kJmol^{-1} (1)

(b) q and w are path functions ΔU is a state function (1)
(c) (i) positive (1)

(ii) negative (1)

29.

(a) $NaBO_2$ and B_2O_3 (1)
(b) C-C bond is stronger than Si-Si bond due to small size of C hence C shows higher catenation. (1)

(c) Al_2Br_6 is a covalent compound due to high ionization enthalpy of Al. Therefore it is poor conductor of electricity. (1)

(d) Si has vacant d orbitals in which back transfer of electrons from lone pair on N occurs. N-Si bond develops double bond character. There are no d orbitals in C, hence $N(CH_3)_3$ is pyramidal while $N(SiH_3)_3$ is planar. (2)

OR

(a) Due to similar polarizing power of ions, B and Si show diagonal relationship so they resemble in properties. (1)
(b) Due to inert pair effect, Pb(IV) is less stable. It has a tendency to attain its lower and more stable oxidation state. Thus is an oxidizing agent. (1)
(c) SiO_2 is acidic in nature as Si is less electropositive and the oxide is a nonmetallic oxide. (1)
(d) In BF_3 B is sp^2 hybridised while in $[BF_4]^-$, it is sp^3. There is back donation of electron from F to B in BF_3 giving it partial double bond character. Thus reducing the length as compared to $[BF_4]^-$ which has single B-F bonds. (2)

30.

(a) Position isomerism. (1)

(b) (i) $C_6H_6 \xrightarrow{H_2SO_4} C_6H_5SO_3H$ (1)

(ii) $CH_3CH_2CH(Br)CH_3 \xrightarrow{Alc.KOH} CH_3CH=CHCH_3$ (1)

(c) (i) Bromine water (1)

(ii) ammoniacal silver nitrate (1)

OR

(a) Even carbon alkanes have a symmetrical structure because of which they fit into lattice more tightly thus having a high melting point. (1)

(b) Staggered and eclipsed. Staggered is more stable. (1)

(c) Molar mass= 2 x vapour density

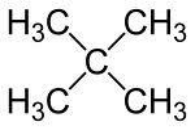
Molar mass of A = 2 x 36 = 72

Also since it forms a mono chloro substituted product, therefore, it is an alkane.

It satisfies the general formula C_nH_{2n+2}

Hence, it is an alkane with the formula C_5H_{12}. (1)

The isomer of pentane which forms monochloro product is



(1)

(d). $CH_3COOH \xrightarrow{NaOH} CH_3COONa \xrightarrow{NaOH/CaO} CH_4$ (1)