CHEMISTRY

Chemistry
Class XI

Broad Guidelines for Practicals

1. Each student has to do at least 15 experiments for which the list is provided.
2. Additional experiments may be done if the time permits.
3. Laboratory records should be maintained regularly. The experiments performed in a week should be recorded and submitted to the teacher for evaluation in the coming week.
4. Emphasis should be more on developing skills for different laboratory techniques and proper handling of apparatus.
5. Safety measures should be taken care of when the students are working in the laboratory [use of lab coats, safety glasses, proper handling / disposal of hazardous chemicals].
6. First aid box and charts related to safety measures should be available in the laboratory.
7. Each laboratory should have fire extinguishers and sand buckets.

1. Total practicals to be performed	:	15
2. Maximum marks	:	30
3. Duration	:	3 hours

Marking scheme		**Marks**
1. Practical notebook	-	**5**
a) Class record	-	3
b) Project record	-	2
2. Viva voce	-	**5**
a) Experiments related	-	3
b) Project related	-	2
3. Experiments	-	**20**

Total Marks (5 + 5 + 20) = 30

Three experiments to be given in the examination as follows:

1. Volumetric analysis **(8 Marks)**

i. Standard solution to be provided

ii. One exercise out of the following:

a) Determination of strength of a given solution of sodium hydroxide by titrating it against standard solution of oxalic acid.

OR

b) Determination of strength of a given solution of hydrochloric acid by titrating it against standard solution of sodium carbonate.

Distribution of 8 marks:

• Procedure and manipulative skills	-	3	= 8
• Observations (Including recording of data)	-	2	
• Calculations	-	1	
• Result	-	2	

2. Qualitative analysis **(8 Marks)**

Salt analysis consisting of one anion and one cation (only water soluble salts and no interfering radical)

Distribution 8 marks:

• Systematic reporting		- 4	= 8
• Correct result	Anion	- 2	
	Cation	- 2	

3. One of the following experiments **(4 Marks)**

(i) Determination of melting or boiling point of an organic compound.

(ii) Comparing pH of solutions of strong and weak acid of same concentration.

(iii) Study of pH change by common ion effect in the case of a weak acid or a weak base.

(iv) Study of shift in equilibrium by increasing/decreasing the concentration of either of the ions in case of:

(a) Equilibrium between ferric ions and thiocynate ions.

(b) $[Co(H_2O)_6]^{2+}$ and Cl^- ions.

(v) Detection of nitrogen/chlorine/sulphur in organic compounds.

List of Experiments in Chemistry

A. Laboratory Techniques

Experiment 1: (a) Cutting and bending of glass tubes
(b) Drawing out a glass jet
(c) Boring a cork

B. Characterization and Purification of Chemical Substances

Experiment 2: Determination of melting point of organic compounds.

Experiment 3: Determination of boiling point of organic liquid.

Experiment 4: Preparation of crystals of any one of the following:
alum, copper sulphate, benzoic acid.

C. Experiments Related to pH Change

Experiment 5: Comparison of pH of solutions of strong and weak acid of same concentration.

Experiment 6: Study of pH change by common-ion effect in the case of weak acids and weak bases.

D. Chemical Equilibrium

Experiment 7: Study of shift in equilibrium by increasing/decreasing the concentration of either of the ions in case of:
(a) Equilibrium between ferric ions and thiocynate ions.

OR

(b) Equilibrium between $[Co(H_2O)_6]^{2+}$ and Cl^- ions.

E. Quantitative Estimation

Experiment 8: Preparation of standard solution of oxalic acid/sodium carbonate.

Experiment 9: Determination of strength of a given solution of sodium hydroxide by titrating it against standard solution of oxalic acid.

Experiment 10: Determination of strength of a given solution of hydrochloric acid by titrating it against standard sodium carbonate solution.

F. Qualitative Analysis

Experiment 11: Identification of the following anions:
$CO_3^{2-}, S^{2-}, SO_3^{2-}, SO_4^{2-}, NO_2^-, NO_3^-$

Experiment 12: Identification of following anions:
$Cl^-, Br^-, I^-, PO_4^{3-}, C_2O_4^{2-}, CH_3COO^-$

Experiment 13: Identification of cations by systematic analysis
(Cations of group I to IV)
$Pb^{2+}, Cu^{2+}, As^{3+}, Al^{3+}, Fe^{3+}, Mn^{2+}, Ni^{2+}, Zn^{2+}$

Experiment 14: Identification of cations by a systematic analysis:
(Group V, VI, Zero)
$CO^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, NH_4^+$

Experiment 15: Detection of nitrogen, sulphhur and chlorine in organic compounds.

Project : One project to be done by each student in the school laboratory. If necessary, the part of the investigation may be done outside the school laboratory.

Subject: Chemistry Class: XI
Total Marks: 70 Time: 3 Hours
Assessment Objectives & Distribution of Forms of Questions

UNIT	KNOWLEDGE				UNDERSTANDING				APPLICATION				SKILLS				Marks
	LA	SA	VSA	Objective	LA	SA	VSA	Objective	LA	SA	VSA	Objective	LA	SA	VSA	Objective	
I							1			1							5
II		1													1		5
III				1		1											4
IV				1						1					1		6
V							1							1			5
VI						1		1			1	1					7
VII	1							1			1						8
VIII										1							3
IX			1	1													3
X		1					1										5
XI				1	1												6
XII	1																5
XIII		1		1			1										6
XIV			1														2
	2(10)	3(9)	2(4)	5(5)	1(5)	2(6)	4(8)	2(2)	-	3(9)	2(4)	1(1)		1(3)	2(4)	--	70

Type	Number of Questions(Marks)
Objective	8 (8)
VSA	10(20)
SA	9(27)
LA	3(15)

QUESTION PAPER DESIGN
CHEMISTRY XI

Subject:- Chemistry **Class:- XI**
Marks:- 70 **Duration:- 3 Hours**

1. Weightage by objectives

Objective	Marks	Percentage of total marks
Knowledge	28	40.0
Understanding	21	30.0
Application	14	20.0
Skill	07	10.0

2. Weightage by types of questions

Type	Number of Questions	Max. Marks	Total	Estimated time a candidate is expected to take
Long answer questions	3	5	15	9 × 3 = 27 min
Short answer questions	9	3	27	9 × 6 = 54 min
Very short answer questions	10	2	20	10 × 5 = 50 min
Objective type questions (4 MCQs + 4 fixed answer type)	8	1	08	8 × 3 = 24 min
	30		**70**	**155 min**

25 min for reading of question paper and revision
[Total time: 155 min + 25 min = 180 min]

3. Weightage by content

Unit/Sub-units	Marks
1. Some Basic Concepts of Chemistry	5
2. Structure of Atom	5
3. Classification of Elements and Periodicity in Properties	4
4. Chemical Bonding	6
5. States of Matter : Gases and Liquids	5
6. Thermodynamics	7
7. Equilibrium	8
8. Redox Reactions	3
9. Hydrogen	3
10. *s*-Block Elements (Alkali and alkaline Earth Metals)	5
11. Some *p*-Block Elements	6

12. Organic Chemistry- Some Basic Principles and Techniques		5
13. Hydrocarbons		6
14. Environmental Chemistry		2
	Total	**70**

4. Difficulty level of the question paper

Level	Marks	Percentage of marks
Difficult	14	20.0
Average	35	50.0
Easy	21	30.0

SAMPLE QUESTION PAPER

Subject : Chemistry

Time: 3 Hours **Class XI** **Maximum Marks: 70**

General Instructions:

(a) All questions are compulsory.
However question numbers 15, 16, 21, 25 and 30 have internal choices.

(b) Questions 1 to 8 carry 1 mark each.
Questions 9 to 18 carry 2 marks each.
Questions 19 to 27 carry 3 marks each.
Questions 28 to 30 carry 5 marks each.

1. In the modern periodic table, elements are arranged in the order of (1)
   (a) increasing mass
   (b) increasing volume
   (c) increasing atomic number
   (d) alphabetically

2. Lateral overlap of *p*-orbitals leads to the formation of (1)
   (a) π - bond
   (b) metallic bond
   (c) σ - bond
   (d) ionic bond

3. The number of neutrons in radioactive isotope of hydrogen is (1)
   (a) 0
   (b) 2
   (c) 1
   (d) 3

4. Dry ice is (1)
   (a) solid NH_3
   (b) solid SO_2
   (c) solid CO_2
   (d) solid N_2

5. Name the reaction which can be used to prepare hexane from 1-bromopropane. (1)

6. Label the following properties as intensive or extensive: (1)

   (a) Density

   (b) Internal energy

7. Write down the expression for K_p and K_c for the reaction given below: (1)

   $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

8. A student noted the values –120.4 kJ mol^{-1} and –124.6 kJ mol^{-1} at 500K from the literature for the reaction:

   $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

   One of these is the value of $\Delta_r U^\circ$ and the other of $\Delta_r H^\circ$. Find out which one is the value of $\Delta_r H^\circ$. (1)

9. What is syn gas? How is it obtained? (2)

10. What is smog? Write one difference between classical smog and photochemical smog. (2)

11. What mass of carbon tetrachloride contains 1.0×10^{25} chlorine atoms? (2)

12. An open vessel contains 200 mg of air at 17°C . What mass of air would be expelled if the vessel is heated to 117°C? (2)

13. Why $BaSO_4$ is insoluble where as $BeSO_4$ is soluble in water? (2)

14. How will you prepare the following compounds? (2)

    (a) 3-Methylbut-1-yne from ethyne

    (b) *m*-Bromonitrobenzene from benzene

15. A gas phase endothermic reaction is non-spontaneous at all temperatures. What is the sign of Δn_g for this reaction. Explain. (2)

Or

Indicate whether you would expect the entropy of the system to increase or decrease in the following changes. Give reasons for your answer.

(a). $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

(b). $I_2(g, 350K) \rightarrow I_2(g, 400K)$

16. What are buffer solutions? Pick up two pairs of substances from the following list, such that one pair would make an acidic buffer and the other one a basic buffer: (2)

NaCl, HF, HNO_3, $(NH_4)_2SO_4$, KF, NH_4OH, K_2SO_4 and $Al(OH)_3$

Or

K_c for the following reaction is 1.00 at 1100 K.

CO (g) + H_2O (g) $\square$ CO_2 (g) + H_2 (g)

2.00 mol each of CO and H_2O and 1.00 mol each of CO_2 and H_2 are taken in a vessel at this temperature. In which direction would the reaction occur in order to attain the equilibrium.

17. Draw graphs for 1*s* and 2*s* orbitals showing variations of radial probability density $\Psi^2(r)$ as a function of distance '*r*' of electron from the nucleus. (2)

18. Draw orbital diagrams showing the formation of a double bond between carbon atoms in C_2H_4 molecule and also label σ and π bonds. (2)

19. Explain, what are quantum numbers? Write values of all the quantum numbers for 3*d* orbitals. (3)

20. (i) (a) Write balanced chemical equation for the preparation of plaster of Paris. (1)

(b) Why is the temperature maintained around 393K during its preparation. (1)

(ii) Why are alkali metals not found free in Nature. (1)

21. Write balanced chemical equations for the following reactions. (3)

(a) Ethene is reacted with cold dilute $KMnO_4$ at 273K.

(b) Oxidation of propene with ozone.

(c) Chlorination of methane in the presence of ultraviolet light.

Or

Write chemical equations for the following reactions in case of benzene.

(a) sulphonation (b) nitration

(c) Friedel Craft's reaction

22. Give reasons for the following: (3)

(a) Sodium has very high value of second ionisation enthalpy in comparison to the first ionization enthalpy.

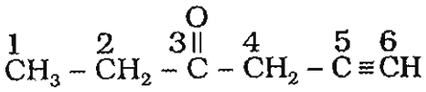
(b) Iodine has metallic character.

(c) Sulphur has greater electron affinity than oxygen.

23. Standard enthalpies of formation of $CO_2(g)$, $H_2O(l)$ and $CH_4(g)$ are –393.5, –286.2 and –74.8 kJ mol^{-1} respectively. Calculate the enthalpy of combustion of methane. (3)

24. How much marble of 89.28% purity would be required to prepare 10 litres of carbon dioxide at 0°C and 1 atmosphere pressure when it is acted upon by dilute hydrochloric acid? (3)

25. Consider the structure given below and answer the following questions: (3)



(a) The number of electrons involved in sigma and pi bonds in 0.1 mol of the compound.

(b) Arrange C_2, C_3 and C_5 atoms in decreasing order of *s* character.

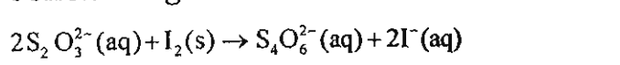
(c) Select the carbon atoms in the structure given above which have sp^3 hybridisation.

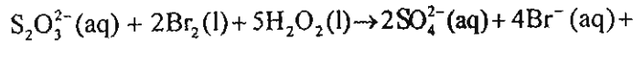
Or

Find out the magnetic character of following species.

O_2, O_2^- (superoxide), O_2^{2-} (peroxide)

26. Considering the reactions: (3)





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

27. Draw Maxwell-Boltzmann distribution curve for an ideal gas at three different temperatures ($T_1 > T_2 > T_3$). Explain the changes taking place in the number of molecules that have low energy when temperature is decreased. (3)

28. State Le Chatelier's principle. Explain the effect of (i) concentration, (ii) pressure, (iii) temperature and (iv) addition of an inert gas at constant pressure on the following reaction: (5)

$N_2(g) + 3H_2 \rightleftharpoons 2NH_3(g)$; $\Delta_r H^\circ = -92$ kJ mol^{-1}

29. (a) With the help of a suitable diagram explain the method of purification of an organic liquid which decomposes at its boiling point.

(b) With the help of suitable examples explain nucleophilic and electrophilic addition reactions. (2, 3)

30. (a) What happens when boric acid is heated? Give the reactions involved.

(b) Why does BCl_3 act as a Lewis acid? (3, 2)

Or

Explain the following: (1 × 5)

(a) $PbCl_4$ is less stable than $PbCl_2$.

(b) CCl_4 is immiscible in water, where as $SiCl_4$ is easily hydrolysed.

(c) Carbon shows greater catenation property than Si.

(d) $AlCl_3$ is a Lewis acid.

(e) BH_3 dimerises to B_2H_6.

QUESTION WISE ANALYSIS

Subject : Chemistry **Class : XI**

Time : 3 Hours **Maximum Marks :70**

Q. NUMBER	UNIT	FORM	Assessment Objective	Difficulty level	Time
1.	3	MCQ	K	E	2
2.	4	MCQ	K	E	2
3.	9	MCQ	K	AV	2
4.	11	MCQ	K	AV	2
5.	13	OBJECTIVE	K	D	2
6.	6	OBJECTIVE	U	AV	2
7.	7	OBJECTIVE	U	D	2
8.	6	OBJECTIVE	A	D	3
9.	9	VSA	K	D	4
10.	14	VSA	K	AV	4
11.	1	VSA	U	AV	5
12.	5	VSA	U	D	5
13.	10	VSA	U	AV	4
14.	13	VSA	U	AV	6
15.	6	VSA	A	D	6
16.	7	VSA	A	D	6
17.	2	VSA	S	AV	5
18.	4	VSA	S	AV	5
19.	2	SA	K	E	4
20.	10	SA	K	E	7
21.	13	SA	K	E	6
22.	3	SA	U	AV	6
23.	6	SA	U	AV	8
24.	1	SA	A	AV	7
25.	4	SA	A	AV	8
26.	8	SA	A	D	6
27.	5	SA	S	AV	8
28.	7	LA	K	E	9
29.	12	LA	K	E	10
30.	11	LA	U	AV	9

INDEX

K – Knowledge
U- Understanding
A – Application
S- Skill

LA -Long Answer
SA – Short Answer
VSA- Very Short Answer
MCQ- Multiple Choice Question

E - Easy
AV- Average
D - Difficult

Marking Scheme

Answer 1 (c) (1)

Answer 2 (a) (1)

Answer 3 (b) (1)

Answer 4 (c) (1)

Answer 5 Wurtz Reaction (1)

Answer 6 Density: Intensive
Internal energy: Extensive
} ½ × 2 = 1

Answer 7 $K_p = p_{CO_2}$

$K_c = [CO_2]$
} ½ × 2 = 1

Answer 8 $\Delta_r H^\circ = -120.4\,kJmol^{-1}$ (1)

Solution

$\Delta_r H^\circ = \Delta_r U^\circ + \Delta n_g RT$

For the given reaction, $\Delta n_g = +1$

$\therefore$ $\Delta_r H^\circ$ would have a value which is less negative of the two, i.e. -120.4 kJ mol^{-1}

Answer 9 A mixture of CO and H_2 is called syn gas or synthesis gas. (1)

It is obtained by the action of steam over coke

$C(s) + H_2O(g) \rightarrow CO(g) + H_2(g)$
} (1)

Answer 10 Combination of smoke and fog. (1)
Any one difference between classical and photochemical smog. (1)

Answer 11 Molar mass of $CCl_4 = 154$ g mol^{-1}

154g of CCl_4 contains = $4 \times 6.023 \times 10^{23}$ atoms of Cl
} (1)

or $4 \times 6.023 \times 10^{23}$ Cl atoms are present in 154 g of CCl_4

1.0×10^{25} Cl atoms are present in $\frac{154 \times 10^{25} g}{4 \times 6.023 \times 10^{23}} = 639.3$ g (1)

Answer 12 Let the volume of 200 mg of air at 17° C be = V mL.

As the pressure is constant (open vessel), applying Charle's Law i.e.

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ therefore $\frac{V_1}{290} = \frac{V_2}{390} \Rightarrow V_2 = \frac{390}{290} V_1 = 1.34 V_1$ (½)

Volume of air expelled = $1.34\ V_1 - V_1$

$= 0.34 V_1$ (½)

Mass of $1.34 V_1$ air at 17° C = 200 mg

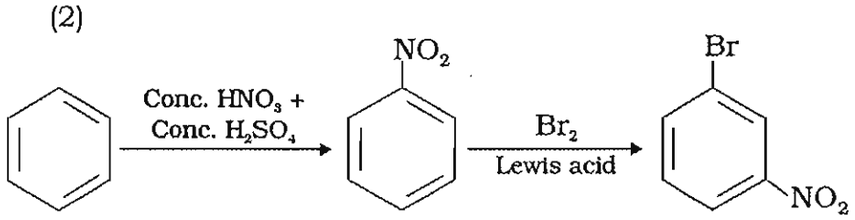
Mass of $0.34\ V_1$ air at 117° = $\frac{200}{1.34} \times 0.34$ mg

= 50.75 mg (1)

Answer 13 The lattice enthalpy of $BaSO_4$ is much higher than its hydration enthalpy and hence, it is insoluble in water but hydration enthalpy of $BeSO_4$ is much higher than its lattice enthalpy. (1+1)

Answer 14 (1) $CH \equiv CH \xrightarrow{NaNH_2} CH \equiv CNa \xrightarrow{CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - Br} CH \equiv C - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3$ (½+½)

(2)



(½+½)

Answer 15 Δn_g = negative

(1)

Explanation:

For any process which is non-spontaneous at all temperatures ΔH = positive and ΔS = negative. (½)

In a gas phase reaction entropy would decrease only if there is a decrease in the number of moles (of gases) during the reaction.

Δn_g = negative (½)

OR

- Entropy would decrease;

  Reason: It is because there is decrease in the number of moles of gases (½+½)

- Entropy would increase;

  Reason: Entropy of a substance increases with rise in temperature (½+½)

Answer 16 Buffer solutions are the ones that resist a change in their pH when a small amount of an acid or a base is added. (1)

Acidic buffer : HF and KF (½)

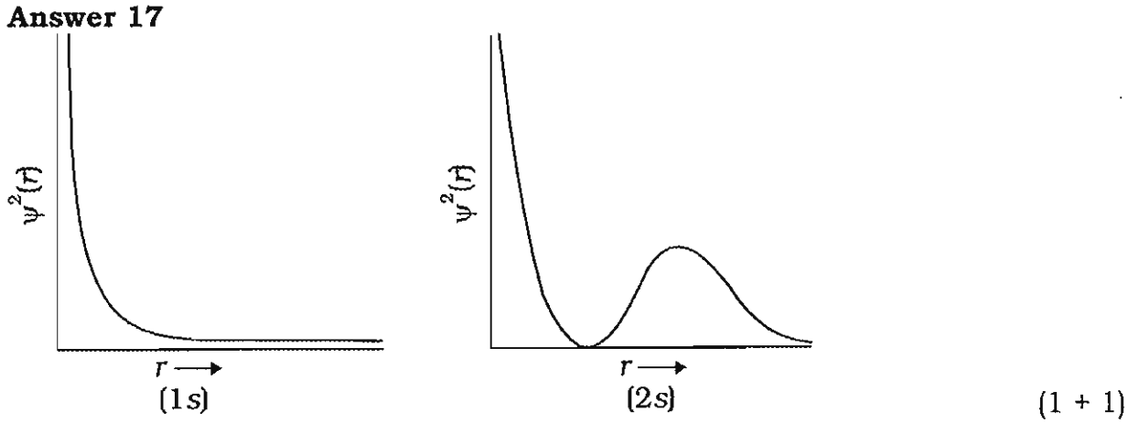
Basic buffer : NH_4OH and $(NH_4)_2SO_4$ (½)

OR

Solution $$Q_c = \frac{[CO_2][H_2]}{[CO][H_2O]} = \frac{\left(\frac{1.00}{V}\right)\left(\frac{1.00}{V}\right)}{\left(\frac{2.00}{V}\right)\left(\frac{2.00}{V}\right)} = 0.25$$ (1)

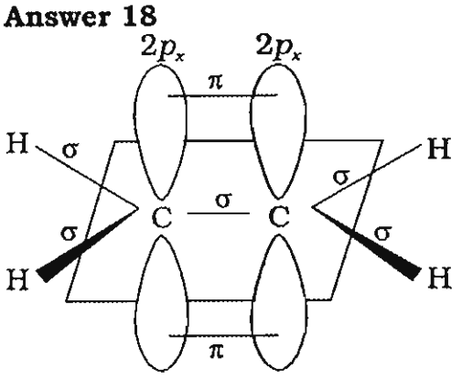
Since $Q_c < K_c$, the reaction would occur in forward direction (1)

Answer 17



(1 + 1)

Answer 18



(2)

Answer 19 These are a set of four numbers which are required to describe different orbitals in an atom based on their energy, size, shape and orientation. (1)

$3d$ $n=3$, $l=2$, $m=-2,-1,0,1,2$, $s=+\frac{1}{2},-\frac{1}{2}$ (½ × 4=2)

Answer 20(i) (a) $2CaSO_4.2H_2O \xrightarrow{393K} 2CaSO_4.\frac{1}{2}H_2O + 3H_2O$ (1)

(b) If the temperature is raised, it is further dehydrated (½)

$2CaSO_4.\frac{1}{2}H_2O \xrightarrow{>393K} 2CaSO_4 + H_2O$ (½)

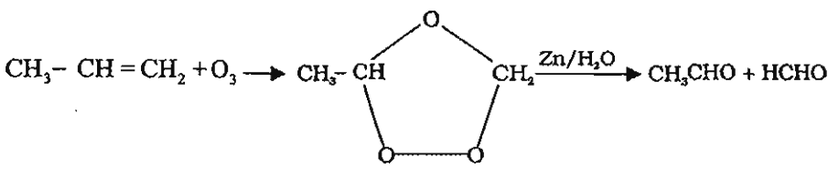
(ii) Alkali metals are highly reactive and hence they do not occur in free state in nature. (1)

Answer 21 (a) (1)

$CH_2 = CH_2 + H_2O + O \xrightarrow[273K]{\text{Cold dil.}KMnO_4}$ $CH_2(OH)-CH_2(OH)$

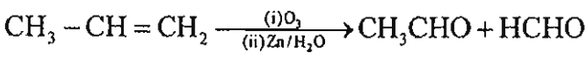
Ethane –1, 2–diol

(b)



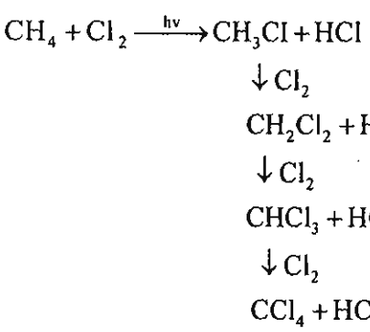
(1)

OR



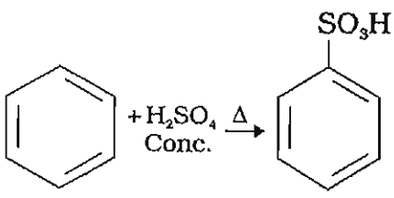
(1)

(c)



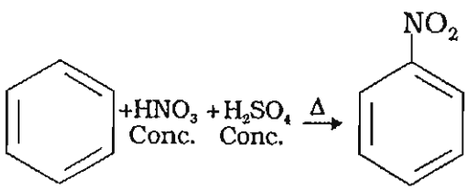
(1)

OR



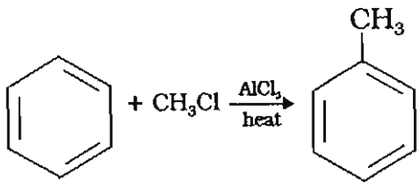
(1)

(b)



(1)

(c)



(1)

Answer 22 (a) Sodium has very high value of second ionization enthalpy as compaired to first ionization enthalpy, because second electron in case of sodium has to be removed from noble gas configuration and positively-charged ion.

(b) Metallic character increases down the group.

(c) Sulphur has greater electron affinity than oxygen because oxygen atom is smaller in size and incoming electron faces repulsion from the valence electrons.

Answer 23 Combustion reaction of methane is:

$$CH_4(g)+2O_2(g)\rightarrow CO_2(g)+2H_2O(l)$$

(1)

$$\Delta_{comb.}H^0=\Delta_fH^0(CO_2,g)+2\Delta_fH^0(H_2O,l)-\Delta_fH^\circ(CH_4,g)$$

$$(\text{since } \Delta_fH^0(O_2,g)=0)$$

$$\Delta_{comb.}H^0=[\{(-393.5)+2(-286.2)\}-(-74.8)]\,kJ\,mol^{-1}=-891.1\,kJ\,mol^{-1}$$

(1)

Answer 24 $CaCO_3+2HCl\rightarrow CaCl_2+H_2O+CO_2$

(1)

$100g\,CaCO_3$ gives 22.4L CO_2 at 0°C and 1 atm pressure

$$\therefore \text{for 10L } CO_2\text{, weight of pure } CaCO_3 \text{ needed}=\frac{100\times10}{22.4}=\frac{1000}{22.4}=44.64\,g$$

(½)

89.28 g pure $CaCO_3$ is present is 100g impure $CaCO_3$.

$$\therefore \text{ Impure marble required}=\frac{100}{89.28}\times44.64=50\,g$$

(1)

Answer 25 (i) Number of sigma (σ) electrons $=14\times2\times6.022\times10^{23}\times0.1$ (1)

Number of pi (π) electrons $=3\times2\times6.022\times10^{23}\times0.1$ (1)

(ii) $C_5(sp)>C_3(sp^2)>C_2(sp^3)$ (½)

(iii) C_1, C_2 and C_4 atoms are sp^3 hybridised. (½)

Or

In dioxygen, each oxygen atom has 8 electrons; therefore, O_2 molecule has 16 electrons. The electronic configuration of oxygen molecule can be written as–

O_2 has 16 electrons

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^1 \pi^* 2p_y^1$ (½)

Unpaired electron = 2, Paramagnetic nature (½)

O_2^- has 17 electrons

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^2 \pi^* 2p_y^1$ (½)

Unpaired electron = 1, Paramagnetic nature (½)

O_2^{2-} has 18 electrons

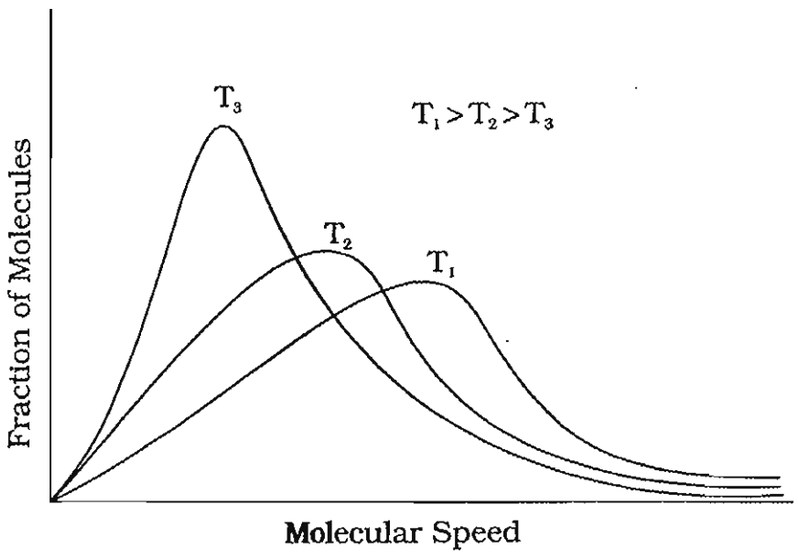
$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^2 \pi^* 2p_y^2$ (½)

No unpaired electron, Diamagnetic nature (½)

Answer 26 In both the reactions, $S_2O_3^{2-}$ ions are reducing agent while I_2 and Br_2 are oxidising agents. Br_2 is stronger oxidising agent than I_2. (½+½)

The stronger oxidising agent Br_2 results in the higher oxidation state of sulphur (+6) in $S_2O_3^{2-}$ whereas the weaker one, I_2 results in the lower oxidation state (+2.5) (1)

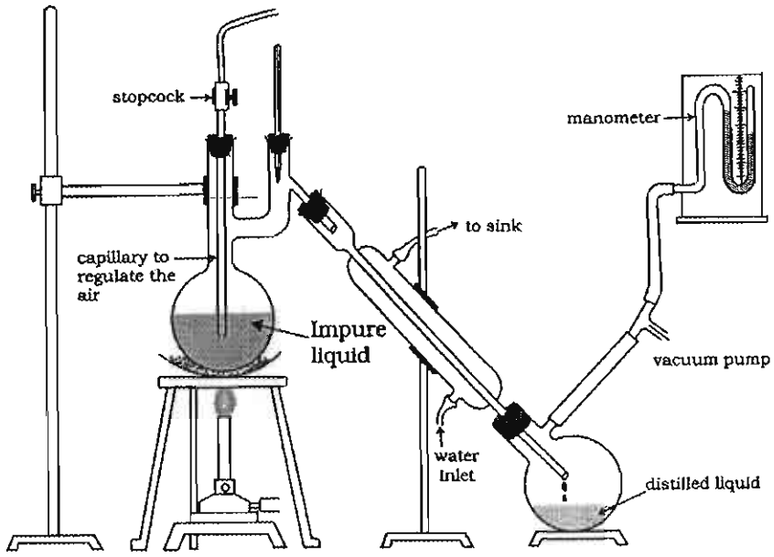
Answer 27 (2)



When temperature is decreased; the height of the peak increases. Hence, the fraction of molecules having lower speeds (lower energy) increases. (1)

Answer 28 Statement of Le Chatelier's principle (1)
Effect of each factor ½ × 4 = (2)
Explanation of each effect ½ × 4 = (2)

Answer 29 (a) Distillation under reduced pressure (½)

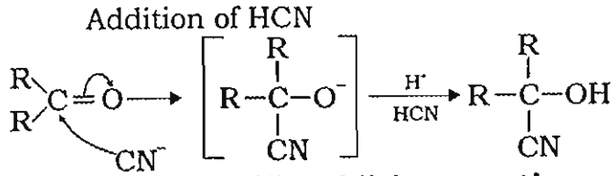


(1½)

The liquid which decomposes at its boiling point is purified by distillation under reduced pressure. When pressure is reduced, the boiling point of the liquid decreases as a result of which the organic liquid distils out at a lower temperature than its normal boiling point without decomposition. (1)

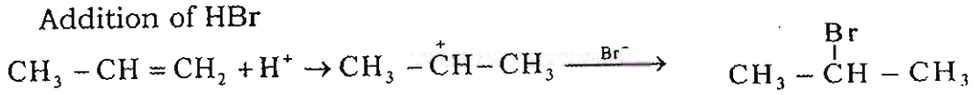
(b)(i) **Nucleophilic addition reaction:** The addition reactions which are brought about by nucleophiles are called nucleophilic addition reactions: (1½)

Addition of HCN



(ii) **Electrophilic addition reactions:** Addition reactions brought about by electrophiles are called electrophilic addition reactions (1½)

Addition of HBr



Answer 30 (a) Explanation (1)

Reaction:

$$4H_3BO_3 \xrightarrow[-4H_2O]{370K} 4HBO_2 \xrightarrow[-H_2O]{410K} H_2B_4O_7 \xrightarrow{\text{Red heat}} 2B_2O_3 + H_2O$$

(3)

(b) BCl_3 is an electron deficient compound. (1)

OR

(a) Due to inert pair effect +2 oxidation state is more stable, Hence $PbCl_2$ is more stable.

(b) CCl_4 is a covalent compound. Carbon does not have *d*-orbitals to accommodate the electrons donated by oxygen atom of water molecule, but in silicon *d*-orbitals are present which can accommodate the lone pair of electrons donated by water molecule.

(c) Catenation depends upon strength of element-element bond, which depends on the size of atom. Since size of carbon is much smaller, C–C bond strength is much higher than that of Si–Si bond.

(d) Aluminum has only 6 electrons in outermost shell. It is electron deficient compound and hence is Lewis acid.

(e) BH_3 dimerises due to deficiency of electrons in boron and acceptance of electron from H from a bond in between B–H–B.

(1 × 5)