I. Design of the Sample Question Paper

BLUE PRINT OF SAMPLE QUESTION PAPER (CHEMISTRY)
CLASS XI

TIME : 3 HOURS **MAX. MARKS : 70**

Unit/Questions Type	Weightage to Content Unit (Marks)	Unitwise Weightage to Different Forms of Questions							Total Number of Questions of Each Type	Distribution of Different Types of Questions over the Units						
		MCQ		Short Answer			Assertion Reason	Long Answer		MCQ 1	MCQ 2	SA 1	SA 2	SA 3	AR	LA
		1 mark	2 mark	1 mark	2 mark	3 mark										
1. Some Basic Concepts of Chemistry	1			1×1=**1**								1				
2. Structure of Atom	5		1×2=**2**			1×3=**3**					1			1		
3. Classification of Elements and Periodicity in Properties	5					1×3=**3**	1×2=**2**							1	1	
4. Chemical Bonding and Molecular Structure	5				1×2=**2**	1×3=**3**							1	1		
5. States of Matter	5							1×5=**5**								1
6. Thermodynamics	6	1×1=**1**			1×2=**2**	1×3=**3**				1			1	1		
7. Equilibrium	6	1×1=**1**			1×2=**2**	1×3=**3**				1			1	1		
8. Redox Reactions	5				1×2=**2**	1×3=**3**							1	1		
9. Hydrogen	5				1×2=**2**	1×3=**3**							1	1		
10. The *s*-Block Elements	5	1×1=**1**		1×1=**1**		1×3=**3**				1		1		1		
11. The *p*-Block Elements	5							1×5=**5**								1
12. Organic Chemistry - Some Basic Principles and Techniques	7		1×2=**2**					1×5=**5**			1					1
13. Hydrocarbons	7	1×1=**1**		1×1=**1**		1×3=**3**	1×2=**2**			1		1		1	1	
14. Environmental Chemistry	3			1×1=**1**			1×2=**2**					1			1	
TOTAL	**70**	**4**	**4**	**4**	**10**	**27**	**6**	**15**		**4**	**2**	**4**	**5**	**9**	**3**	**3**

II. Expected Length of Answer and Time Required for Each Form of Question shall be as Follows :

Sl. No.	Forms of Questions	Expected Length	Expected Time for Each Question	Total Number of Questions	Total Time Expected
1.	MCQ (I)	-	2 minutes	4	08 minutes
2.	MCQ (II)	-	3 minutes	2	06 minutes
3.	SA (I)	one line	3 minutes	4	12 minutes
4.	SA (II)	20-30 words	4 minutes	5	20 minutes
4.	SA (III)	30-50 words	7 minutes	9	63 minutes
6.	Assertion-Reason	-	3 minutes	3	09 minutes
7.	Long Answer Type	70-100 words	15 minutes	3	45 minutes
8.	Revision	-			17 minutes
		TOTAL	**-**	**30**	**180 minutes**

III. Weightage to Difficulty Level of Questions

Sl. No.	Estimated Difficulty Level of Questions	Percentage
1.	Easy	18
2.	Average	64
3.	Difficult	18

MODEL QUESTION PAPER

CHEMISTRY

Class XI

Time : 3 Hours *Maximum Marks : 70*

General Instructions :

(i) *All the questions are compulsory.*
(ii) *Questions 1 to 4, carry one mark each and questions 5 and 6, carry 2 marks.*
(iii) *Questions 7 to 10 are short answer questions carrying one mark each.*
(iv) *Questions 11 to 15 are also short answer questions carrying two marks each.*
(v) *Questions 16 to 24 are also short answer questions carrying three marks each.*
(vi) *Questions 25 to 27 are assertion- reason questions carry two marks each.*
(vii) *Questions 28 to 30 are long answer questions and carry five marks each.*
(viii) *Use log tables for calculations if necessary.*

Note : Choose one correct option for questions 1 to 4.

1. The pressure volume work for an ideal gas can be calculated by using the expression;

$$w = -\int_{V_i}^{V_f} p_{ex} dV$$

The work can also be calculated from the pV plot by using the area under the curve within the specified limit. When an ideal gas is compressed reversibly or irreversibly from volume V_i to V_f, which of the following is correct?

(i) $w_{rev} = w_{irrev}$
(ii) $w_{rev} < w_{irrev}$
(iii) $w_{rev} > w_{irrev}$
(iv) $w_{rev} = w_{irrev} + p_{ex}.\ dV$ **(1)**

2. When hydrochloric acid is added to cobalt nitrate solution at room temperature, the following reaction takes place :

$$\underset{\text{Pink}}{[Co(H_2O)_6]^{+}_{3}(aq)} + 4Cl^{-}(aq) \rightleftharpoons \underset{\text{blue}}{[CoCl_4]^{2-}(aq)} + 6H_2O\ (l)$$

The solution is blue at room temperature. However, it turns pink when cooled in a freezing mixture. Based upon this information, which of the following expression is correct for the forward reaction?

(i) $\Delta H > 0$
(ii) $\Delta H < 0$
(iii) $\Delta H = 0$
(iv) The sign of ΔH cannot be predicted on the basis of this information. **(1)**

3. Which of the following elements does not form hydride by direct heating with dihydrogen?

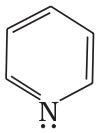
(i) Be

(ii) Mg

(iii) Sr

(iv) Ba **(1)**

4. Which of the following species should be aromatic in character?

(i)  (ii)  (iii)  (iv)  **(1)**

Note : Choose two correct options for questions 5 and 6.

5. Identify the pairs which are of isotopes?

(i) $^{12}_{6}X$, $^{13}_{6}Y$

(ii) $^{35}_{17}X$, $^{37}_{17}Y$

(iii) $^{14}_{6}X$, $^{14}_{7}Y$

(iv) $^{8}_{4}X$, $^{8}_{5}Y$ **(2)**

6. Electrophiles are electron seeking species. Which of the following sets consist of electrophiles only.

(i) BF_3, NH_3, H_2O

(ii) $AlCl_3$, SO_3, $\overset{\oplus}{N}O_2$

(iii) $\overset{\oplus}{N}O_2$, $\overset{\oplus}{C}H_3$, $CH_3—\overset{\oplus}{C}=O$

(iv) $C_2H_5^{\ominus}$, $\dot{C}_2H_5$, $\overset{\oplus}{C}_2H_5$ **(2)**

7. How many significant figures should be present in the answer of the following calculations?

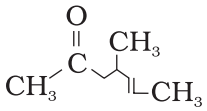
$$\frac{2.5 \times 1.25 \times 3.5}{2.01}$$ **(1)**

8. Complete the following reactions **(1)**

(i) $O_2^{2-} + H_2O \longrightarrow$

(ii) $O_2^{-} + H_2O \longrightarrow$

9. Give IUPAC name of the compound whose line formula is given below: **(1)**



10. Green house effect leads to global warming. Which substances are responsible for green house effect? **(1)**

11. Using molecular orbital theory, compare the bond energy and magnetic character of O_2^+ and O_2^- species. **(2)**

12. Consider the reaction given below : **(2)**

$$CaCO_3\,(s) \longrightarrow CaO\,(s) + CO_2\,(g)$$

Predict the effect of increase in temperature on the equilibrium constant of this reaction.

Given that $\Delta_f H^{\ominus}\,[CaO(s)] = -635.1\ kJ\ mol^{-1}$

$\Delta_f H^{\ominus}\,[CO_2(g)] = -393.5\ kJ\ mol^{-1}$

$\Delta_f H^{\ominus}\,[CaCO_3(s)] = -1206.9\ kJ\ mol^{-1}$

13. pH of 0.08 mol dm^{-3} HOCl solution is 2.85. Calculate its ionization constant. **(2)**

14. Nitric acid is an oxidising agent and reacts with PbO but it does not react with PbO_2. Explain why? **(2)**

15. Calculate the strength of 5 volume H_2O_2 solution. **(2)**

16. According to de Broglie, matter should exhibit dual behaviour, that is both particle and wave like properties. However, a cricket ball of 100g does not move like a wave when it is thrown by a bowler at a speed of 100km/h. Calculate the wavelength of the ball and explain why it does not show wave nature. **(3)**

17. Explain why nitrogen has positive electron gain enthalpy whereas oxygen has negative, although first ionisation enthalpy of oxygen is lower than that of nitrogen. Justify your answer. **(3)**

18. Write Lewis structure of the following compounds and show formal charge on each atom.

HNO_3, NO_2, H_2SO_4 **(3)**

19. Although heat is a path function, even then heat absorbed by the system under certain conditions is independent of path. What are those conditions? Explain. **(3)**

20. The solubility product of $Al(OH)_3$ is 2.7×10^{-11}. Calculate its solubility in g L^{-1} and also find out pH of this solution. (Atomic mass of Al is 27 u). **(3)**

21. Calculate the oxidation number of each sulphur atom in the following compounds:

(a) $Na_2S_2O_3$ (b) $Na_2S_4O_6$ **(3)**

22. (i) Dihydrogen reacts with dioxygen to form water. Name the product and write its formula when the isotope of hydrogen, which has one proton and one neutron in its nuclus, is treated with dioxygen? **(1)**

(ii) Will the reactivity of both the isotopes of hydrogen be the same towards oxygen ? Justify your answer. **(2)**

23. (i) Beryllium sulphate and magnesium sulphate are readily soluble in water whereas the sulphates of barium, calcium and strontium are only sparingly soluble. Explain. **(2)**

(ii) Why is the temperature maintained around 393 K during the preparation of plaster of paris? **(1)**

24. Give the reactions involved in the preparation of propane from the following : **(3)**

(i) $CH_3—CH = CH_2$

(ii) $CH_3\ CH_2\ CH_2\ Cl$

(iii) $CH_3\ CH_2\ CH_2\ COO^-\ Na^+$

25. ***Assertion (A) :*** The first ionization enthalpy of alkali metals decreases down the group.

Reason (R) : Increase in number of orbitals increases the shielding effect which outweighs the increasing nuclear charge, therefore, the removal of outermost electron requires less energy on moving down the group. **(2)**

(i) A and R both are correct but R is not the explanation of A.

(ii) A is false but R is correct.

(iii) A and R both are correct and R is the correct explanation of A.

(iv) A and R both are incorrect.

26. ***Assertion (A) :*** Nitration of benzene requires the use of concentrated sulphuric acid and nitric acid.

Reason (R) : The mixture of acids produces the electrophile for the reaction. **(2)**

(i) A and R both are correct but R is not the explanation of A.

(ii) A is false but R is correct.

(iii) A and R both are correct and R is the correct explanation of A.

(iv) A and R both are incorrect.

27. ***Assertion (A) :*** Ozone is destroyed by solar radiations in upper stratosphere.

Reason (R) : Thinning of ozone layer allows excessive UV radiations to reach the surface of earth. **(2)**

(i) A and R both are correct but R is not the explanation of A.

(ii) A is false but R is correct.

(iii) A and R both are correct and R is the correct explanation of A.

(iv) A and R both are incorrect.

28. (a) Liquids can be considered as very dense gases. When a liquid phase changes to gas phase, the liquid and the gas phases are in equilibrium and a surface separates the two phases. This surface is visible if both phases are in equilibrium and are below critical tempertaure and pressure. However, it is possible to interconvert liquid and gas wherein two phases are never present together.

With the help of a well-labled diagram show that CO_2 gas can be liquified by changing the pressure and temperature without passing through the situation when both gaseous and liquid CO_2 are at equilibrium. **(3)**

(b) Arrange the following liquids in increasing order of their viscosities. Give reason for your answer. **(2)**

Water, benzene, ethane-1,2-diol.

29. (a) Explain why :

(i) BCl_3 is a Lewis acid.

(ii) Boric acid is a monobasic acid. **(2)**

(b) Compound 'A' of boron reacts with excess NH_3 to give a compound 'B'. Compound 'B' on heating gives cyclic compound 'C'. Compound C is called inorganic benzene.

(i) Identify compounds 'A', 'B' and 'C'

(ii) Give the reactions involved in these processes. **(3)**

30. (a) Write two important differences between inductive and resonance effects. **(2)**

(b) Give reasons to explain the following observations:

(i) Carbon number '2' in CH_3CH_2Cl has more positive charge than that in CH_3CH_2Br.

(ii) $CH_3–CH = CH–CH = CH_2$ (I) is more stable than $CH_3–CH = CH–CH_2–CH = CH_2$ (II). **(3)**

Guidelines for Evaluation (Marking Scheme)

1. (ii) (1)

2. (i) (1)

3. (i) (1)

4. (iv) (1)

   • For questions 5 and 6 two marks for both correct answers, otherwise zero mark

5. (i) and (ii) (2)

6. (ii) and (iii) (2)

7. Two (1)

8. (i) $O_2^{2-} + 2H_2O \longrightarrow 2OH^- + H_2O_2$

   (ii) $2O_2^- + 2H_2O \longrightarrow 2OH^- + H_2O_2 + O_2$ (½ + ½) (1)

9. 4-Methylhept–5–en–2–one (1)

10. Trapping of heat by green house gases, namely carbon dioxide, methane, nitrous oxide, ozone and chlorofluorocarbons. (1)

11. According to molecular orbital theory electronic configurations of O_2^+ and O_2^- species are as follows :

    $O_2^+ : (\sigma 1s)^2 (\overset{*}{\sigma} 1s^2)(\sigma 2s)^2 (\overset{*}{\sigma} 2s^2) (\sigma 2p_z)^2 (\pi 2p_x^2, \pi 2p_y^2) (\pi^* 2p_x^1)$

    $O_2^- : (\sigma 1s)^2 (\overset{*}{\sigma} 1s^2)(\sigma 2s)^2 (\overset{*}{\sigma} 2s^2) (\sigma 2p_z)^2 (\pi 2p_x^2, \pi 2p_y^2) (\pi^* 2p_x^2, \pi^* 2p_y^1)$

    Bond order of $O_2^+ = \frac{10-5}{2} = \frac{5}{2} = 2.5$

    Bond order of $O_2^- = \frac{10-7}{2} = \frac{3}{2} = 1.5$ (½ × 2)

    • Higher bond order of O_2^+ shows that its bond energy is more than that of O_2^- hence it is more stable than O_2^-.

    • Both the species have unpaired electrons. So both are paramagnetic in nature. (½ × 2)

12. $\Delta_r H^\ominus = \Delta_f H^\ominus [CaO(s)] + \Delta_f H^\ominus [CO_2(g)] - \Delta_f H^\ominus [CaCO_3(s)]$

    $\Delta_r H^\ominus = +178.3 \text{ kJ mol}^{-1}$

    Since reaction is endothermic, according to Le Chatelier's principle, increase of temperature will increase the value of *K*.

- Use of correct formula (½)
- Correct substitution of values (½)
- Correct value of $\Delta_r H^{\ominus}$ (½)
- Correct interpretation (½)

13. pH of HOCl = 2.85

But, $-$ pH = log $[H^+]$

$\therefore -2.85 = \log [H^+]$

$\Rightarrow \bar{3}.15 = \log [H^+]$

$\Rightarrow [H^+] = 1.413 \times 10^{-3}$

For weak mono basic acid $[H^+] = \sqrt{K_a \times C}$

$$\Rightarrow K_a = \frac{[H^+]^2}{C} = \frac{(1.413 \times 10^{-3})^2}{0.08}$$

$$= 24.957 \times 10^{-6} = 2.4957 \times 10^{-5}$$

- Correct calculations of $[H^+]$ (1)
- Correct calculations of K_a (1)

14. PbO is basic oxide and simple acid base reaction takes place between PbO and HNO_3. On the other hand in PbO_2 lead is in +4 oxidation state and can not be oxidised further. Therefore no reaction takes place. Thus PbO_2 is passive, only PbO reacts with HNO_3.

$2PbO + 4HNO_3 \longrightarrow 2Pb(NO_3)_2 + 2H_2O$

- Correct reason (1½)
- Chemical equation (½)

15. 5 volume H_2O_2 solution means that hydrogen peroxide contained in 1 volume of this solution will decompose to give 5 volumes of oxygen at STP i.e. if 1L of this solution is taken, then 5 L of oxygen can be produced from this at STP. Chemical equation for the decomposition of H_2O_2 is $2H_2O_2(l) \longrightarrow O_2(g) + H_2O(l)$.

It shows that 68 g H_2O_2 gives 22.7 L of O_2 at STP, so 5 L oxygen will be obtained from :

$$\frac{68g \times 5L}{22.7L} = \frac{3400}{227} g\ H_2O_2 = 14.9\ g \approx 15\ g\ H_2O_2$$

i.e., 15 g H_2O_2 dissolved in 1 L solution will give 5 L oxygen or 1.5 g H_2O_2/100 mL solution will give 500 mL oxygen. Thus 15 g/L or 1.5% solution is known as 5V solution of H_2O_2.

- Correct chemical equation (1)
- Correct Chemical formula (½)
- Correct value (½)

16. $\lambda = \dfrac{h}{mv}$

m = 100 g = 0.1 kg.

$v = 100 \text{ km/h} = \dfrac{100 \times 1000 \text{ m}}{60 \times 60 \text{ s}} = \dfrac{1000}{36} \text{ m s}^{-1}$

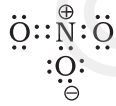
$h = 6.626 \times 10^{-34}$ Js

$$\lambda = \frac{6.626 \times 10^{-34} \text{ Js}}{0.1 \text{ kg} \times \frac{1000}{36} \text{ ms}^{-1}} = 6.626 \times 10^{-36} \times 36 \text{ m}^{-1} = 238.5 \times 10^{-36} \text{m}^{-1}$$

Since the wavelength is very small, the wave nature cannot be detected.

- Using correct formula (½)
- Putting correct values (½)
- Correct answer (½)
- Correct interpretation (1½)

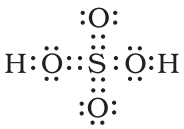
17. The outermost electronic configuration of nitrogen $2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$ is very stable due to half filled *p*-orbital. Addition of extra electron to any of the 2*p* orbital requires energy. Oxygen has 4 electrons in 2*p* orbitals and acquires stable configuration $2p^3$ after removing one electron. (3)

18. (i) 

(Oxygen attached with double bond, oxygen attached with single bond and hydrogen atom have zero formal charge)

(ii) 

(Oxygen attached to nitrogen with double bond has no formal charge)

(iii) 

(formal charge on each atom is zero)

- Correct Lewis structure for each compound (½×3)
- Showing correct formal charge on atom(s) in each structure (½×3)

19. **At constant volume**

By first law of thermodynamics:

$$q_V = \Delta U + (-w)$$

but $(-w) = p\Delta V$

$$\therefore \quad q_V = \Delta U + p\Delta V$$

ΔV = 0, since volume is constant.

$\therefore \quad q_V = \Delta U + 0$

$\Rightarrow \quad q_V = \Delta U$ = change in internal energy

At constant pressure

$q_p = \Delta U + p\Delta V$

But, $\Delta U + p\Delta V = \Delta H$

$\therefore \quad q_p = \Delta H$ = change in enthalpy.

So, at a constant volume and at constant pressure heat change is state function because it is equal to change in internal energy and change in enthalpy respectively which are state functions.

- Derivation for constant volume (1)
- Derivation for constant pressure (1)
- Correct interpretation (1)

20. Let S be the solubility of $Al(OH)_3$ in mol L^{-1}.

	$Al(OH)_3$	$\rightleftharpoons$	$Al^{3+}(aq)$	+	$3OH^-(aq)$
Concentration of species at t = 0 in mol L^{-1}	1		0		0
Concentration of various species at equilibrium in mol L^{-1}	1–S		S		3S

$K_{sp} = [Al^{3+}][OH^-]^3 = (S)(3S)^3 = 27\ S^4$

$$S^4 = \frac{K_{sp}}{27} = \frac{2.7 \times 10^{-11}}{27} = \frac{27 \times 10^{-11}}{27 \times 10} = 1 \times 10^{-12}$$

$S = 1 \times 10^{-3}$ mol L^{-1}

(i) Molar mass of $Al(OH)_3$ is 78 g mol^{-1}. Therefore,

Solubility of $Al(OH)_3$ in g L^{-1} = (1 × 10^{-3} mol L^{-1}) × (78 g L^{-1})

= 78 × 10^{-3} g L^{-1}

= 7.8 × 10^{-2} g L^{-1}

- Putting correct values in equation (1)
- Correct answer (1)

(ii) **pH of the solution**

$S = 1 \times 10^{-3}$ mol L^{-1}

$[OH^-] = 3S = 3 \times 1 \times 10^{-3} = 3 \times 10^{-3}$ mol L^{-1}

pOH = 3 – log 3

pH = 14 – pOH = 11 + log 3 = 11.4771 ≈ 11.5

- Using correct formula (½)
- Correct answer (½)

21. (a) +2 (b) +5, 0, 0, +5 (1+2)

22. (i) Heavy water, (D_2O) [½ ×2]

(ii) No, the reactivity of both the isotopes will not be the same. (1)

Justification: The reactivity depends upon enthalpy of bond dissociation. Due to the difference in the enthalpy of bond dissociation for two isotopes, the rate of reaction will be different. (1)

23. (i) $BeSO_4$ and $MgSO_4$ are readily soluble in water because greater hydration enthalpies of Be^{2+} and Mg^{2+} ions overcome the lattice enthalpy factor. (2)

(ii) If the temperature is raised above 393 K, plaster of paris is further dehydrated to form anhydrous calcium sulphate. (1)

24. (i) $CH_3CH = CH_2 + H_2 \xrightarrow{Pt/Pd/Ni} CH_3CH_2CH_3$

(ii) $CH_3CH_2CH_2Cl + H_2 \xrightarrow{Zn, H^+} CH_3CH_2CH_3 + HCl$

(iii) $CH_3CH_2CH_2COO^-Na^+ + NaOH \xrightarrow[\Delta]{CuO} CH_3CH_2CH_3 + Na_2CO_3$

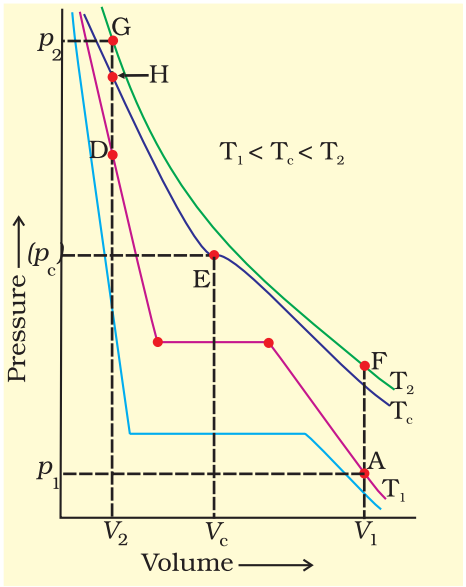
- 1 mark for each part for writing correct chemical equation for the reaction (1×3)

25. (iii) (2)

26. (iii) (2)

27. (ii) (2)

28. (a) Suppose gas is at point 'A' on isotherm T_1. First increase the temperature of the gas above critical temperature (T_c) keeping the volume constant. Suppose the gas reaches the point 'F' on isotherm T_2 where it is at volume V_1 and pressure p_1. Now compress the gas upto Volume V_2. In this compression the pressure and volume of the gas will move along the curve FG (Boyle law) at point G, let the pressure at point G be p_2. Now start cooling the gas. As soon as gas will reach the point 'H' located on isotherm of critical temperature, it will liquify without passing



through equilibrium state. The gas will not pass through two phases because volume (V_2) of the gas is less than critical volume i.e. molecules are closer to each other. Gas is at a higher pressure than critical pressure. Cooling slows down the molecular motion and intermolecular forces can hold the molecules together.

- Correct graph with proper labelling (1)
- Explanation (2)

(b) benzene < water < ethane-1, 2-diol

Reason : Ethane-1, 2-diol has more hydogen bonding than water while in benzene hydrogen bonding is absent.

- Correct order (1)
- Correct reason (1)

29. (a) (i) BCl_3 is an electron deficient compound. In order to complete its octet, boron has a tendency to accept a pair of electrons.

$BCl_3 + NH_3 \longrightarrow BCl_3 : NH_3$ (1)

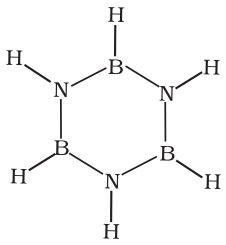
(ii) It is not an acid according to proton concept, However it accepts one OH^- from water to form $B(OH_4)^-$. (1)

(b) (i) $A = B_2H_6$; $B = B_2H_6.2NH_3$; $C=B_3N_3H_6$

(ii) **Reactions :**

$B_2H_6 + 2NH_3 \longrightarrow B_2H_6.2NH_3$ (1½)

A **B**

$3B_2H_6 . 6NH_3 \xrightarrow{\Delta}$ 2.  $+ 12H_2$ (1½)

30. (a)

	Inductive effect	**Resonance effect**
(i)	Involves σ-electrons	involves π- electrons or lone pair of electrons
(ii)	vanishes beyond third carbon atom	present all along the length if system is conjugated
(iii)	Exhibited by even non-planar compounds	Exhibited by only planar compounds

- (Any two) (1 mark each) (2)

(b) Polarisation of CH_3CH_2Cl and CH_3CH_2Br can be shown as follows:

$\overset{\delta\delta+}{CH_3}—\overset{\delta+}{CH_2}—\overset{\delta-}{Cl}$ and $\overset{\delta\delta+}{CH_3}—\overset{\delta+}{CH_2}—\overset{\delta-}{Br}$ (½)

- Chlorine is more electronegative than bromine. Therefore C—Cl bond is more polar than C—Br bond. Hence inductive effect is greater on second carbon atom in CH_2CH_2Cl. (1)

(c) • Resonating structures of $CH_3–CH=CH–CH=CH_3$

$CH_3–CH=CH–CH=CH_2 \leftrightarrow CH_3–\overset{\oplus}{C}H–CH=CH–\overset{\ominus}{C}H_2$ (1)

- Due to resonance effect, I is more stable. There is no conjugation in

$CH_3CH = CH—(CH_2)_2—CH = CH_2$ (½)