

WEEKLY TEST RANKER'S BATCH TEST - 11 RAJPUR
SOLUTION Date 08-12-2019

[PHYSICS]

1. -

2. Resistance R of a wire of length l and radius r with specific resistance K of its material is given by:

$$R = \frac{Kl}{\pi r^2} \quad \dots(i)$$

As the wire is stretched, mass M of the wire remains unchanged.

But $M = \pi r^2 l d$ or $l = \frac{M}{\pi r^2 d} \quad \dots(ii)$

Hence, $R = \frac{KM}{\pi^2 r^4 d} \quad \dots(iii)$

Let the resistance of the stretched wire be R' ; then

$$R' = \frac{KM}{\pi^2 d (r/2)^4} = (2)^4 \left[\frac{KM}{\pi^2 d r^4} \right] = (2)^4 R = 16R$$

3. $R_{eq} = \frac{l}{\rho_1 A} + \frac{l}{\rho_2 A} = \frac{l_{eq}}{\rho_{eq} A_{eq}} = \frac{2l}{\rho_{eq} A}$

$$\text{or } \frac{2l}{\rho_{eq} A} = \frac{l}{A} \left[\frac{1}{\rho_1} + \frac{1}{\rho_2} \right]$$

$$\text{or } \rho_{eq} = \frac{2\rho_1 \rho_2}{\rho_1 + \rho_2}$$

4. As shown in question 34,

$$R = \left(\frac{Kd}{M} \right) l^2$$

$$\therefore \frac{R'}{R} = \left(\frac{l'}{l} \right)^2$$

But $\frac{l'}{l} = \frac{100 + 0.1}{100} = 1 + \frac{1}{1000}$

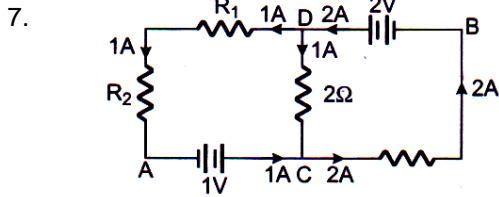
$$\frac{R'}{R} = \left(1 + \frac{1}{1000} \right)^2 = 1 + \frac{2}{1000}$$

Hence, $\frac{R' - R}{R} = \frac{2}{1000}$

$$\therefore \left(\frac{R' - R}{R} \right) \times 100 = \frac{2}{10} = 0.2\%$$

5. Here, $l = 50 \text{ cm} = 0.5 \text{ m}$
 and $A = 1 \text{ mm}^2 = 10^{-6} \text{ m}^2$
 As $R = \frac{V}{i} = \frac{\rho l}{A}$
 or $\rho = \frac{VA}{il} = \frac{2 \times 10^{-6}}{4 \times 0.5} = 10^{-6} \Omega\text{-m}$
 or $1 \times 10^{-6} \Omega\text{-m}$

6. $I = \frac{e}{T} = \frac{1.6 \times 10^{-19} \text{ C}}{10^{-19} \text{ s}} = 1.6 \text{ A}$

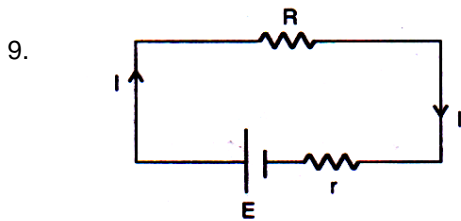


Applying Kirchhoff voltage law in the circuit as shown in the figure given below.

$$\therefore V_A + 1 + 2(1) - 2 = V_B$$

8. No current flows through the branch consisting galvanometer.
 Hence, resistance's $R_1 (= 500 \Omega)$ and $R (= 100 \Omega)$ are joined in series across the battery of $V_1 (= 12 \text{ volt})$.
 \therefore Potential drop across $R (= 100 \Omega)$

$$= V_B = \left(\frac{12}{500 + 100} \right) \times 100 = 2 \text{ volt}$$



$$I = \frac{E}{R + r}$$

or $IR + Ir = E$

Given that, $R = 10 \Omega$

$$E = 2.1 \text{ volt}, I = 0.2 \text{ amp}$$

$$\therefore 0.2 \times 10 + 0.2 \times r = 2.1$$

$$\text{or } 2 + 0.2r = 2.1$$

$$\text{or } 0.2r = 0.1 \text{ or } r = \frac{1}{2} = 0.5 \Omega$$

Hence, correct answer is (a).

10. $R = (Kl/A)$

$$K = 3 \times 10^{-7} \Omega \times \text{m}, l = 1 \text{cm} = 10^{-2} \text{m}$$

And $A = 1 \times 100 \text{ cm}^2 = 10^{-2} \text{ m}^2$

$$\therefore R = 3 \times 10^{-7} \times \frac{10^{-2}}{10^{-2}} = 3 \times 10^{-7} \text{ ohm}$$

11. -

12. $i = \frac{E}{R+r}$

or $\frac{i_1}{i_2} = \frac{R_2+r}{R_1+r}$

$$\therefore \frac{0.9}{0.3} = \frac{7+r}{2+r}$$

or $3 = \frac{7+r}{2+r}$

or $r = 0.5 \Omega$

13. Charge $Q = \int_0^2 (3t^2 + 2t + 5) dt$
 $= [t^3 + t^2 + 5t]_0^2$
 $= 8 + 4 + 10 = 22 \text{ C}$



$$V = E - ir$$

and $y = c - mx$

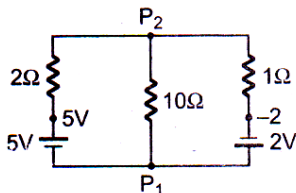
$$\therefore \text{Slope} = -r, \text{ (internal resistance)}$$

$$V_{\text{max.}} = \text{emf } E$$

15. Internal resistance of the cell,

$$r = \frac{E-V}{I} R = \frac{2.2-2}{2} \times 4 \Omega = 0.4 \Omega$$

16. Let potential of P_1 be 0 V and potential of P_2 be V_0 .
 Now, apply KCL at P_2 .



$$\frac{V_0 - 5}{2} + \frac{V_0 - 0}{10} + \frac{V_0 - (-2)}{1} = 0$$

or $V_0 = \frac{5}{16}$

17. From the given circuit,

$$V_A - (6 \times 2) - 12 - (9 \times 2) + 4 - (5 \times 2) = V_B$$

or $V_A - 12 - 12 - 18 + 4 - 10 = V_B$

or $V_A - V_B = 48 \text{ volt}$

18.

19.

As the PD between $4\ \Omega$ and $3\ \Omega$ (in parallel) are the same,

$$4 \times 1\ \text{amp} = 3 \times i_1 \text{ or } i_1 = \frac{4}{3}\ \text{A (Let } i_1 = \text{Current in}$$

$3\ \Omega$ resistance)

Total resistance of $4\ \Omega$ and $3\ \Omega = 12/7\ \Omega$

$$\text{Current in } MQP \text{ (upper branch)} = 1 + \frac{4}{3} = \frac{7}{3}\ \text{A}$$

$$\therefore \text{PD (across upper branch)} = \frac{12}{7} \times \frac{7}{3} = 4\ \text{V}$$

$$\text{Current in } MNP = \frac{4}{125} = \frac{4 \times 4}{5} = \frac{16}{5}\ \text{A}$$

$$\begin{aligned} \therefore \text{PD across } 1\ \Omega &= \frac{16}{5}\ \text{A} \times 1\ \Omega \\ &= \frac{16}{5}\ \text{volt} = 3.2\ \text{volt} \end{aligned}$$

20.

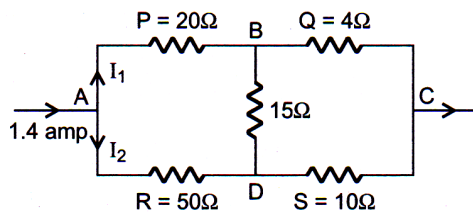


Fig. S-25.1

Here, $PS = QR$ [$\because PS = 200\ \Omega$ and $QR = 200\ \Omega$]
i.e., the bridge is balanced; hence current through $15\ \Omega$ resistor is zero. Hence, $15\ \Omega$ resistor is ineffective.

$$\begin{aligned} \therefore R_{ABC} &= 20 + 4 = 24\ \Omega \\ R_{ADC} &= 50 + 10 = 60\ \Omega \end{aligned}$$

$$R_{AC} = \frac{R_{ABC}R_{ADC}}{R_{ABC} + R_{ADC}} = \frac{24 \times 60}{24 + 60} = \frac{120}{7}\ \Omega$$

$$\text{So, } V_A - V_C = 1.4 \times \frac{120}{7} = 24\ \text{volt}$$

So, current through mesh ABC ,

$$I_1 = \frac{V_A - V_C}{R_{ABC}} = \frac{24}{24} = 1\ \text{amp}$$

Current through mesh ADC ,

$$I_2 = \frac{V_A - V_C}{R_{ADC}} = \frac{24}{60} = 0.4\ \text{amp}$$

So, current through $4\ \Omega$ resistor,

$$I_1 = 1\ \text{ampere}$$

No current will flow through $15\ \Omega$ resistor.



21.

Given that, current (i) = 8 Aelectron density (n) = $8 \times 10^{28} \text{ m}^{-3}$ Cross-sectional area of copper wire (A)

= area of square of length 2 mm

or $A = (2 \times 10^{-3})^2$

or $A = 4 \times 10^{-6} \text{ m}^2$

We know that, the relation between current and drift velocity,

$$i = n e A v_d$$

or $v_d = \frac{i}{neA}$

$$\begin{aligned} \therefore v_d &= \frac{8}{8 \times 10^{28} \times 1.6 \times 10^{-19} \times 4 \times 10^{-6}} \\ &= \frac{100}{64} \times 10^{-4} \\ &= 1.56 \times 10^{-4} \text{ m/s} \end{aligned}$$

22.

Before adding, total resistance = 5Ω

After adding, the central one is a Wheatstone network

$$\therefore \text{Total resistance} = 1 + (2 \text{ and } 2 \text{ in parallel}) + 1 = 3 \Omega$$

$$\therefore \text{Ratio of resistances} = (5/3)$$

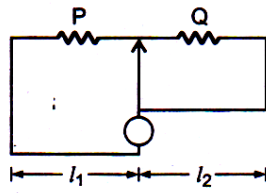
23.

$$\frac{P}{Q} = \frac{l_1}{100 - l_1}$$

or $\frac{2}{3} = \frac{l_1}{100 - l_1}$

or $5l_1 = 200$

$$l_1 = 40 \text{ cm}$$



24.

$$I = 3.2 \text{ A}; \quad t = 1 \text{ sec}$$

$$\therefore I = \frac{Q}{t} \quad \text{or} \quad Q = It \quad \text{or} \quad ne = It$$

$$n = \frac{It}{e} = \frac{3.2 \times 1}{1.6 \times 10^{-19}}$$

$$= 2 \times 10^{19}$$

25.

Potential gradient along wire

$$= \frac{\text{potential difference along wire}}{\text{length of wire}}$$

or $0.1 \times 10^{-3} = \frac{I \times 40}{1000} \text{ V/cm}$

or Current in wire, $I = (1/400) \text{ A}$

or

$$\frac{2}{40 + R} = \frac{1}{400} \quad \text{or} \quad R = 800 - 40 = 760 \Omega$$



26. Given: $R_{50} = 5 \Omega$, $R_{100} = 6 \Omega$
 $R_t = R_0(1 + \alpha t)$
 Where R_t = resistance of a wire at $t^\circ\text{C}$, R_0 = resistance of a wire at 0°C ,
 α = temperature coefficient of resistance.
 $\therefore R_{50} = R_0 [1 + \alpha \times 50]$
 and $R_{100} = R_0 [1 + \alpha \times 100]$
 or $R_{50} - R_0 = R_0 \alpha (50)$... (i)
 $R_{100} - R_0 = R_0 \alpha (100)$... (ii)
 Dividing eqn. (i) by eqn. (ii), we get;
 $R_0 = 4 \Omega$
 or $\frac{5 - R_0}{6 - R_0} = \frac{1}{2}$ or $10 - 2R_0 = 6 - R_0$
 or $R_0 = 4 \Omega$

27. When a battery of 6 V is connected to the terminals of a 3 metre long wire, then the potential difference per metre will be = 6 volt / 3 m = 2 volt /metre.
 Now, fall of potential along 50 cm or 0.5 m wire
 = potential gradient \times length
 = 2 volt/m \times 0.5 m = 1 volt

28.
$$I = \frac{2E}{R + R_1 + R_2}$$

 According to given condition, $E - IR_2 = 0$
 or $\frac{E}{R_2} = I = \frac{2E}{R + R_1 + R_2}$
 or $R_1 + R_2 + R = 2R_2$
 or $R = R_2 - R_1$

29. Current through arm CAD, $I = \frac{V}{8}$ amp
 Potential difference between C and A
 $V_C - V_A = \frac{V}{8} \times 4 = \frac{V}{2}$ Volt
 Current through CBD, $I' = \frac{V}{4}$ amp
 Potential difference between C and B
 $V_C - V_B = \frac{V}{4} \times 1 = \frac{V}{4}$ Volt
 Potential difference between A and B = $V_A - V_B$
 $\therefore V_A - V_B = (V_C - V_B) - (V_C - V_A)$
 $= \frac{V}{4} - \frac{V}{2} = -\frac{V}{4}$
 or $V_A - V_B < 0$ or $V_A < V_B$
 As $V_A < V_B$, so direction of current will be from B to A.

- Terminal voltage, $V = E - Ir$
 30. $V = 10 - 0.5 \times 3 = 10 - 1.5 = 8.5 \text{ V}$

31. Volume of wire remains constant when the wire is stretched.

Thus, $V = ls = l \times \text{area of cross-section}$

$$R = \rho \frac{l}{S} = \frac{\rho}{V} l^2$$

Where $V = \text{volume of wire}$

$$\log R = \log \rho + 2 \log l - \log V$$

Differentiating,

$$\frac{dR}{R} = 0 + \frac{2dl}{l} - 0 = 2 \frac{dl}{l}$$

Taking $\frac{dR}{R}$ and $\frac{dl}{l}$ as fractional errors (or % errors)

$$\frac{dR}{R} = 2 \times 2\% = 4\%$$

32. Current = $\frac{\text{charge}}{\text{time}} = \text{charge} \times \text{frequency}$
 $= 1.6 \times 10^{-19} \times 50 = 0.8 \times 10^{-17} \text{ A}$

33. Current, $I = \frac{ne}{t}$
 $n = \frac{It}{e} = \frac{4 \times 1}{1.6 \times 10^{-19}} = 2.5 \times 10^{19}$

34. Applying Kirchhoff's loop rule to give mgh , we get;
 $-3i - 10i - 3i - 5.2 + 10 = 0$
 or $i = 0.3 \text{ amp}$

35. Since, given circuit is in the form of Wheatstone bridge,

$$\frac{1}{R_{\text{eq}}} = \frac{1}{(4+2)} + \frac{1}{(6+3)}$$

$$\therefore R_{\text{eq}} = \frac{18}{5}$$

$$\therefore V = i R_{\text{eq}} \quad \text{or} \quad i = \frac{V}{R_{\text{eq}}} = \frac{5V}{18}$$

36. From Kirchhoff's law,
 $I \times 2 + I \times 1 = 18 - 12 = 6$

Current in the circuit,

$$I = \frac{V}{R} = \frac{6}{3} = 2 \text{ A}$$

Voltage drop across 2Ω ,

$$V_1 = 2 \times 2 = 4 \text{ V}$$

\therefore Voltmeter reading = $18 - 4 = 14 \text{ volt}$

37. Let initially resistance in the circuit is $R \Omega$. Thus,

$$V = I_1 R = 5R \quad \dots(i)$$

When additional resistance of 2.0Ω is added in the circuit, then

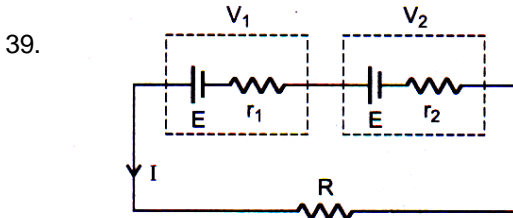
$$V = 4(R + 2) \quad \dots(ii)$$

As voltage across the resistance is same in both cases,

$$\therefore 5R = 4R + 8 \quad \text{or} \quad R = 8 \Omega$$

38. In the given circuit three resistances R_2 , R_4 and R_3 are in parallel, hence

$$\begin{aligned}\frac{1}{R} &= \frac{1}{R_2} + \frac{1}{R_4} + \frac{1}{R_3} \\ &= \frac{1}{50} + \frac{1}{50} + \frac{1}{75} = \frac{75 + 75 + 50}{50 \times 75}\end{aligned}$$



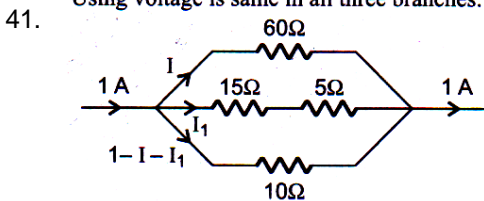
From circuit, $V_1 + V_2 = IR$
 or $E - Ir_1 + E - IR_2 = IR$
 Given, $Ir_1 = E$
 $\therefore Ir_1 - Ir_1 + Ir_1 - IR_2 = IR$
 $\therefore R = r_1 - r_2$

40. When resistances 4Ω and 12Ω are connected in series, their effective resistance $= 4 + 12 = 16 \Omega$.
 When these resistances are connected in parallel,

$$\frac{1}{R_p} = \frac{1}{4} + \frac{1}{12}$$

or $R_p = \frac{4 \times 12}{4 + 12} = 3 \Omega$

Using voltage is same in all three branches:



42. The voltmeter is in parallel with 80Ω resistance. Let equivalent resistance be R' . Here, $R' = 40 \Omega$. Now, 20Ω resistance is in series with R' . So, the equivalent resistance of the circuit $= 20 + 40 = 60 \Omega$.

Current in the circuit $= (2/60)$ amp

$$\text{Current across } 80 \Omega \text{ resistance} = \frac{1}{2} \times \frac{2}{60} = \frac{1}{60} \text{ amp}$$

$$\therefore \text{Reading of voltmeter} = 80 \times \frac{1}{60} = 1.33 \text{ volt}$$

43.
$$R = \rho \frac{l}{\pi r^2}$$
 As $l' = 2l, \quad r' = 2r \quad \text{and} \quad \rho' = \rho$

$$\therefore R' = \rho' \frac{2l}{\pi(4r^2)} = \rho \frac{l}{2\pi r^2} = \frac{R}{2}$$

44. The given network of resistances between points *A* and *B* is equivalent to a balanced Wheatstone bridge.

Hence, $R_{AB} = R$

and current flowing in *AFCEB* = $\frac{V}{2R}$

45. In a parallel combination of two wires:

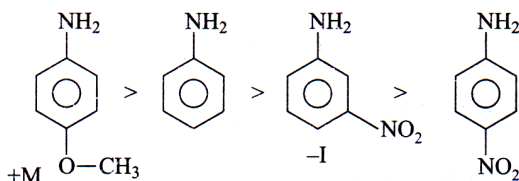
$$i_1 R_1 = i_2 R_2$$

$$\therefore \frac{i_1}{i_2} = \frac{R_2}{R_1} = \frac{l_2}{l_1} \left(\frac{r_1}{r_2}\right)^2 = \frac{3}{4} \left(\frac{2}{3}\right)^2 = \frac{1}{3}$$

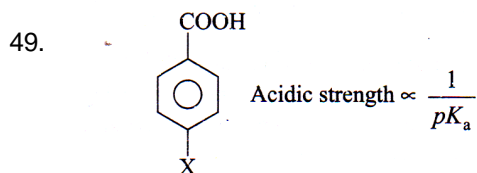
CHEMISTRY

46. EDG (+M increases stability)

47. EWG decreases basic strength
EDG increases basic strength



48. More is number of EWG



EWG increases acidic strength

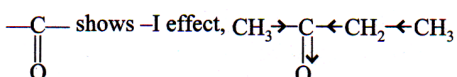
50. Due to -I effect and ortho effect.

51. $-\text{NO}_2 > -\text{CN} > -\text{F} > -\text{NH}_2$.

52. $-\text{N}^+(\text{CH}_3)_3 > -\text{NH}_3^+ > -\text{S}^+(\text{CH}_3)_2 > -\text{F}$.

53. Two Cl from same positions gives greater -I-effect than a single F from the same position hence.

Cl_2CHCOOH is stronger acid than FCH_2COOH .

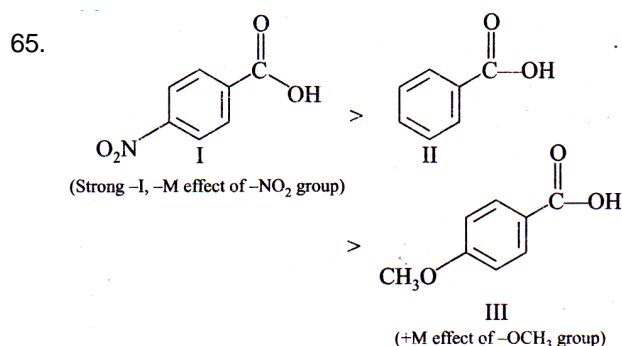
54. 

55. 1st structure is aromatic in all these examples and 2nd structure is not aromatic and resonance energy of aromatic compound is higher than non aromatic compound.

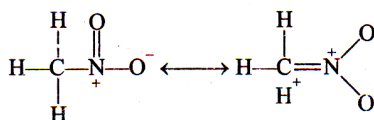
56. For resonance conjugation should be present as that conjugate site doesn't have π bond.



57. As positive charge is on electropositive carbon.
58. There are unpaired electrons, others have no unpaired electrons.
59. Rate of electrophilic substitution \propto stability of arenium ion
60. The bond order of C – N bond is 2 in III, shortest, 1 in II, longest bond. There is greater extent of delocalisation of nitrogen lone pair in IV because it brings negative charge on oxygen than in I where negative charge moves on carbon. Hence, C – N bond acquire greater partial double bond character in IV than in I. This results in greater shortening of C – N bond length in IV than in I, although I has more resonating structures.
61. A carboxylic acid is always stronger acid than phenol. However, between III and IV, III is more acidic as $-\text{CH}_3$ decreases acidic strength by +I effect. Between I and II, II is stronger acid as $-\text{Cl}$ has net electron withdrawing effect.
62. I is least acidic due to the absence of any electron withdrawing group on ring. IV is most acidic due to the electron withdrawing resonance effect of $-\text{NO}_2$ from ortho-position, although intramolecular H-bonding decreases acidic strength to some extent. III is less acidic than II due to the steric inhibition of resonance of $-\text{NO}_2$ by two adjacent methyl groups.
63. $\text{H}_3\text{N}^{\oplus}-(\text{CH}_2)_2-\text{COOH}$ has strongest acid due to strong $-I$ effect of $-\text{NH}_3^{\oplus}$
64. The acidity of phenols increases strongly due to $-I$, $-m$ group on their ortho and para positions. But para substituted phenol is more acidic than ortho substituted due to intramolecular hydrogen bonding in the ortho substituted phenol.

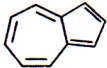


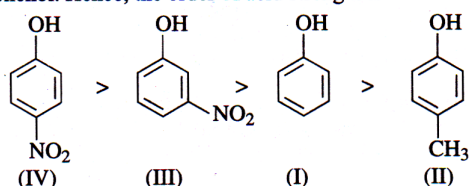
66. In nitromethane, hyperconjugation occurs significantly as

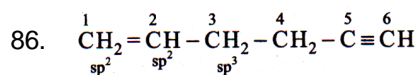


The above hyperconjugation and involved charge separation is responsible for the large dipole moment of nitromethane than calculated theoretically.

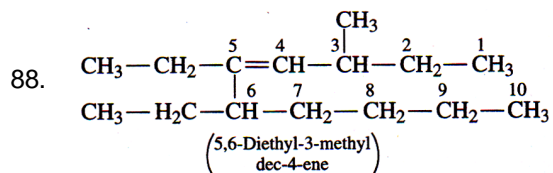
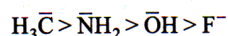
67. On the basis of stability of conjugate base due to electronic effects.
68. (c) In the present case, basicity parallels nucleophilicity. R_3C^- is the strongest base, hence strongest nucleophile. F^- is weakest base therefore weakest nucleophile. R_2N^- is stronger base and stronger nucleophile than RO^- .

69. Decreasing order of dipole moment for given compounds:
I > IV > III > II
- 70.
- 71.
72.  contain 10π electrons. Azulene is a dipolar ion and has both rings aromatic in its ionic form.
73. As it doesn't obey Huckel's rule.
74. Dipole moment, boiling point and water solubility are greater for II (cis) but melting point is greater for I (trans) isomer.
75. Mesomeric effect is applicable at ortho and para position
76. Vacant d orbital resonance
77. +M, +I stabilize carbocation
78. More stable carbocation due to delocalisation and hyperconjugation.
79. It is an aromatic carbocation, highly stable.
80. (E) 3° and resonance stabilized carbocation
(D) 2° and resonance stabilized carbocation
(B) 3° carbocation
(A) 2° carbocation
(C) 1° carbocation
81. Although NH_4^+ has positive charge, all its atoms have complete noble gas configuration, does not require electrons, hence not an electrophile.
82. $-\text{NO}_2$ has greater electron withdrawing power than $-\text{CN}$ by resonance effect, hence IV is most stable followed by III. II is least stable as delocalisation of negative charge is opposed by electron donating resonance effect of methoxy group.
- 83.
84. Carboxylic acids are stronger acid than NH_3^+ in amino acid and $-\text{NH}_3^+$ (Y). (Z) is more acidic than (Y) due to $-I$ effect of $(-\text{COOH})$ group which is nearer to (Z) than (Y). Hence, the acidic order: $X > Z > Y$.
85. Any factor which stabilizes phenoxide ion makes the corresponding phenol more acidic.
 $-\text{NO}_2$ is an electron-attracting group whereas $-\text{CH}_3$ is an electron-releasing group.
An electron-attracting substituent tends to disperse the negative charge of the phenoxide ion and thus, makes it more stable, which, in turn, increases the acid strength of phenol. The substituent in para position is more effective than in the meta-position, as the former involves a resonating structure bearing negative charge on the carbon attached to the electron-withdrawing substituent.
An electron-releasing substituent tends to intensify the negative charge of the phenoxide ion and thus makes it more unstable. which, in turn, decreases the acid strength of phenol. Hence, the order of acid strength is





87. $-\text{CH}_3$ is the best nucleophile because carbon is least electro-negative among the given options. The order is



89. Dipole moment of *p*-dichlorobenzene is zero because of symmetrical structure. *o*- and *m*-dichlorobenzene have higher dipole moments than toluene due to high electronegativity of chlorine than $-\text{CH}_3$ group. Further, the *o*-dichlorobenzene has higher dipole moment due to lower bond angle of the *m*-isomer. Hence, the order of increasing dipole moment is: *p*-dichlorobenzene (IV) < toluene (I) < *m*-dichlorobenzene (II) < *o*-dichlorobenzene (III)
90. Alkyl groups with at least one hydrogen atom on the α -carbon atom, attached to an unsaturated carbon atom, are able to release electrons in the following way.



Note that the delocalization involves σ and π bond orbitals (or *p* orbitals in case of free radicals); thus it is also known

as σ - π conjugation. This type of electron release due to the presence of the system $\text{H}-\text{C}-\text{C}=\text{C}$ is known as *hyperconjugation*. This is also known as no bond resonance.