[PHYSICS]

1.

Initial magnetic induction,
$$B_i = 0$$
Final magnetic induction,
$$B_f = 5 \times 10^{-4} \text{ tesla}$$
Area, $\qquad A = 1 \text{ m}^2$

Number of turns, $N = 1000$
Initial flux, $\qquad \phi_i = NAB_i$
Final flux, $\qquad \phi_f = NAB_f$
$$\Delta\phi = \phi_f - \phi_i = NA(B_f - B_i)$$
$$= 1000 \times 1 \times (5 \times 10^{-4} - 0)$$
$$= 0.5 \text{ weber}$$
$$\Delta t = 0.1 \text{ sec}$$
$\therefore \qquad\qquad e = -\dfrac{\Delta\phi}{\Delta t}$
$$= -\frac{5 \times 10^{-1}}{0.1} = -5 \text{ volt}$$
$$e = 5 \text{ volt (numerically)}.$$

2.

The wire ab which is moving with a velocity v is equivalent to an emf source of value Bvl with its positive terminal towards a. Further, the equivalent emf has an internal resistance R.

$\therefore$ Potential difference
$$V_a - V_b = Bvl - IR.$$

3.

$$\phi = 50t^2 + 4$$
According to Faraday's 2nd law of e.m. induction
$$e = -\frac{d\phi}{dt} = -100t$$
At $t = 2 \text{ sec}$, $e = -100 \times 2 = -200$ volt
$\therefore \quad I = [|e|/R] = \dfrac{200}{400} = 0.5$ amp.

4. $\qquad \dfrac{1}{2}mv_0^2 = \dfrac{1}{2}Li_{max}^2$

$\therefore \qquad i_{max} = \sqrt{\dfrac{m}{L}}v_0$

5.
$V_C = Bvl$

∴ $q = CV_C = BvlC =$ constant

∴ $I_C = \dfrac{dq}{dt} = 0$

$U_C = \dfrac{1}{2}CV^2 = \dfrac{1}{2}CB^2L^2v$

6.   From right hand rule, we can see that P and Q points are at higher potential than O.

7.

I_C is 90° ahead of the applied voltage and I_L lags behind the applied voltage by 90°. So, there is a phase difference of 180° between I_L and I_C.

∴ $I = I_C - I_L = 0.2$ A

8.

I_R and I_L are in same phase and phase difference between them and applied voltage lies between 0° and 90°.

9.

V function is sin function. I function is ahead of V function. Hence, the circuit should be capacitive in nature.
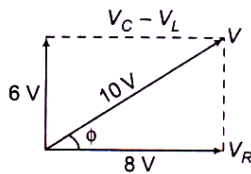
Further, $\phi = 45°$

∴ $X_C = R$ or $\omega C = R$

or $C = \dfrac{R}{\omega} = \dfrac{R}{100} = 0.01\,R$

In option (b), this condition is satisfied.

10.

$V = \sqrt{V_R^2 + (V_C - V_L)^2} = 10$ V

$V_C > V_L$, hence current leads the voltage.

Power factor = $\cos \phi = \dfrac{8}{10} = 0.8$

11.

$V_S = \sqrt{V_R^2 + V_L^2}$

$= \sqrt{(70)^2 + (20)^2} = 72.8$ V

$\tan \phi = \dfrac{X_L}{R} = \dfrac{V_L}{V_R} = \dfrac{20}{70} = \dfrac{2}{7}$

12.

$i = \dfrac{V}{R}$, i.e. circuit is in resonance. Hence,

13.

$$V_C = V_L = 200 \text{ V}$$

$$P = I_{rms}^2 R = \left(\frac{V_{rms}}{Z}\right)^2 R$$

$$= \left[\frac{(V_0/\sqrt{2})^2}{R^2 + \omega^2 L^2}\right] R$$

$$= \frac{V_0^2 R}{2(R^2 + \omega^2 L^2)}$$

14.

$$X_L = \omega L$$

If ω is very low, then $X_L \approx 0$

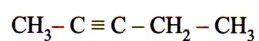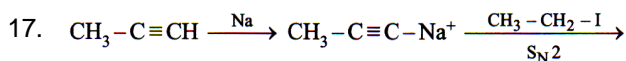$\therefore \qquad V_L \approx 0$

or $\qquad V = V_C = V_0$

15.

$$V_R = \sqrt{V^2 - V_C^2} = \sqrt{(10)^2 - (8)^2} = 6 \text{ V}$$

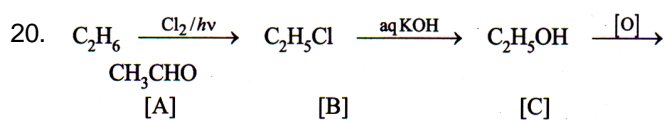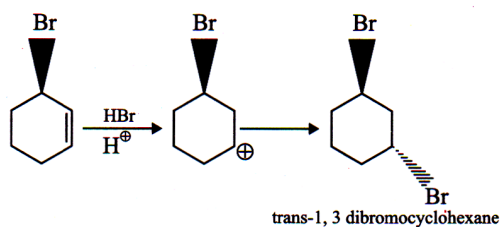$$\tan\phi = \frac{X_C}{X_R} = \frac{V_C}{V_R} = \frac{8}{6} = \frac{4}{3}$$

[CHEMISTRY]

16.   1, 2, 3, 4, 5, 6-hexachlorocylohexane.

17. $CH_3 - C \equiv CH \xrightarrow{\text{Na}} CH_3 - C \equiv C - Na^+ \xrightarrow[S_N 2]{CH_3 - CH_2 - I}$

$CH_3 - C \equiv C - CH_2 - CH_3$

18.

19.

trans-1, 3 dibromocyclohexane

20. $C_2H_6 \xrightarrow{Cl_2/h\nu} C_2H_5Cl \xrightarrow{\text{aq KOH}} C_2H_5OH \xrightarrow{[O]}$
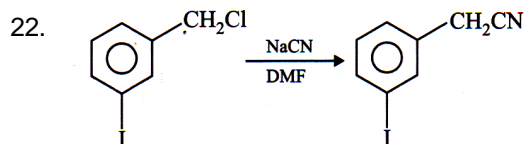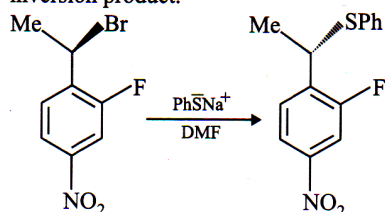
CH_3CHO

[A] \qquad [B] \qquad [C]

21. The product (a) will be formed.

Nucleophilic substitution of an alkyl halide is easier as compared to that of an aryl halide.

PhS^- is a strong nucleophile and dimethyl formamide

$$\left(\begin{array}{c} O \\ \parallel \\ HC\,NMe_2 \end{array} \right)$$ is a highly polar aprotic solvent. These

reagents favour S_N2 reaction, the major product formed is inversion product.
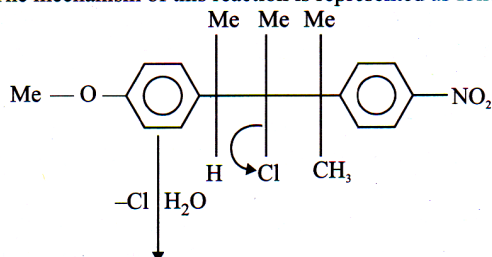

22.

(side chain is attacked)

23. The product (K) is formed through simple nucleophilic substitution while the major product (L) is formed through $1,2 - H^\ominus$ shift *viz* S_N1 reaction and the methoxy group stabilizes the carbocation intermediate of product (L).
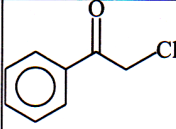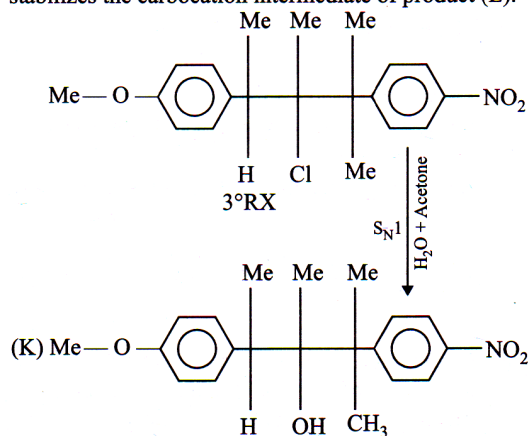
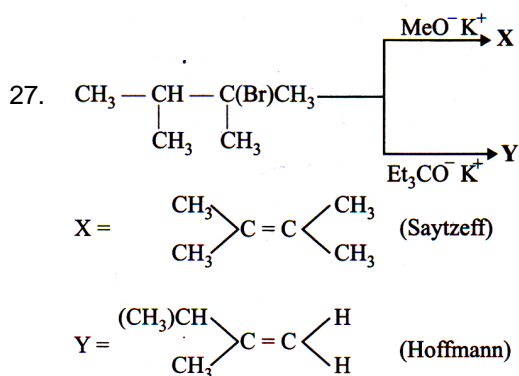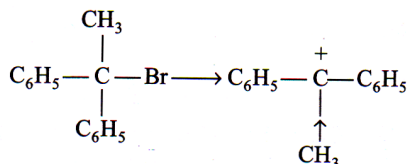

The mechanism of this reaction is represented as follows.

24 Relative reactivity for S_N2 reaction in the given structures is

Substrate	(S)	(P)	(R)	(Q)
	(phenyl ketone CH$_2$Cl) (S)	CH_3Cl (P)	$H_2C=CH$ $-CH_2Cl$ (R)	(cyclopropyl Cl) (Q)
Relative Rates Towards S_N2	100000	200	79	0.02

25. As RX is 3° so carbocation being reactive intermediate mainly racemization occurs.

26. According to stability of carbocation

27.

$$CH_3 - \underset{\underset{CH_3}{|}}{CH} - \underset{\underset{CH_3}{|}}{C(Br)CH_3}$$

$\xrightarrow{MeO^- K^+} X$

$\xrightarrow{Et_3CO^- K^+} Y$

$X = \underset{CH_3}{\overset{CH_3}{>}}C=C\underset{CH_3}{\overset{CH_3}{<}}$ (Saytzeff)

$Y = \underset{CH_3}{\overset{(CH_3)CH}{>}}C=C\underset{H}{\overset{H}{<}}$ (Hoffmann)

28. S_N1 reaction involves the formation of carbocations, hence higher the stability of carbocation, more will be the reactivity of the parent alkyl halide. Thus tertiary carbocation formed from (c) is stabilized by two phenyl groups and one methyl group, hence most stable.

$$C_6H_5 - \underset{\underset{C_6H_5}{|}}{\overset{\overset{CH_3}{|}}{C}} - Br \longrightarrow C_6H_5 - \underset{\underset{CH_3}{\uparrow}}{\overset{+}{C}} - C_6H_5$$

29. SN_1 reaction gives racemic mixture with slight predominance of that isomer which corresponds to inversion because SN_1 also depends upon the degree of 'shielding' of the front side of the reacting carbon.

30. Due to the presence of electron rich methoxy group (+I) at p-position the polarity increases on C-X bond by which it becomes more reactive towards nucleophillic attack of ethanol, *p*-nitro and chloro are electron deficient group decrease the polarity of C-X bond. Hence by them it

becomes difficult to react with ethanol due to less polarity. Methyl group is less electron rich than methoxy group.