WEEKLY TEST OYM TEST - 31 RAJPUR
SOLUTION Date 08-12-2019

[PHYSICS]

1. First two gates are NOT gates and the last gate is NOR gate.

Thus, $Y_1 = \overline{A}$, $y_2 = \overline{B}$ and $y = \overline{y_1 + y_2}$

The truth table corresponding to this is as follows:

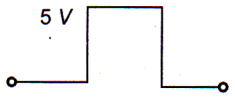
A	B	$y_1 = \overline{A}$	$y_2 = \overline{B}$	$y_1 + y_2$	$y = \overline{y_1 + y_2}$	$A.B$
0	0	1	1	1	0	0
0	1	1	0	1	0	0
1	0	0	1	1	0	0
1	1	0	0	0	1	1

Thus the combination of gate represents AND gate.

2. Here *P-N* junction diode rectifies half of the *ac* wave, i.e., acts as half wave rectifier.

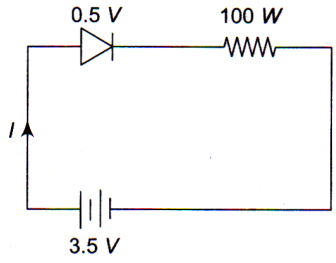
During + ve half cycle

Diode → forward biased output across will be



During –ve half cycle

Diode → reverse biased output will not obtained.

3. 

$$I = \frac{(3.5 - 0.5)\ \text{V}}{100\ \Omega} = 30\ \text{mA}$$

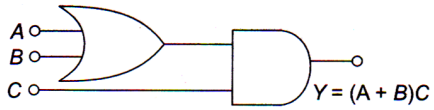
4. Since diode is in forward bias

$$i = \frac{\Delta V}{R} = \frac{4-(-6)}{1\times10^3} = \frac{10}{10^3} = 10^{-2}\ \text{A}$$

$$A_v = \alpha \cdot \frac{R_L}{R_P} = 0.96 \times \frac{800}{192} = 4$$

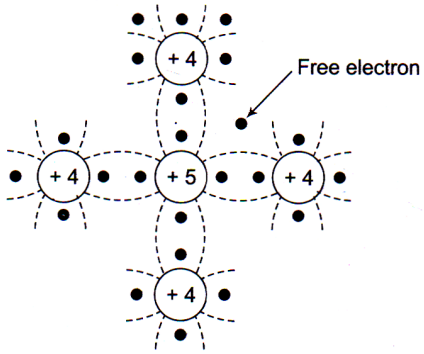
Power gain for common base configuration

$P_v = A_v\alpha = 4 \times 0.96 = 3.84$

5. 

$(A + B)C = 1 \Rightarrow C + 1$

6. Silicon has 4 valence electrons, when phosphorous with 5 valence electrons in its outermost orbit is added, then four of the five valence electrons of the impurity atom form covalent bonds with each valence electron of four silicon atoms and fifth valence electrons becomes free to move in the crystal. As the electrons are charge carriers they are called *n*-type.



Note: Aluminium has three valence electrons which give rise to *p*-type crystal.

7. Conductors are those through which electric charge can easily flow, while insulators are those through which electric charge is difficult to flow. Solids whose electrical conductivity is intermediate between conductors and insulators are called semiconductors. At absolute zero a *p*-type semiconductor which has holes as charge carriers behaves like an ideal insulator and hence it has a few holes in valence band but no free electrons.

8. Current gain is defined as the ratio of collector current to base current, that is

$$\beta = \frac{i_C}{i_B} = \frac{V_o}{V_i}$$

where V_o is output voltage and V_i is input voltage.

Given, $\beta = 100$, $V_i = 10^{-2}$ V

$\therefore$ $V_o = \beta V_i = 100 \times 10^{-2} = 1$ V

9. The given graph represents V–I characteristics of solar cell.

10. Voltage gain of the given operational amplifier is defined as ratio of output voltage to input voltage.

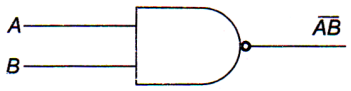
$$A_v = \frac{V_o}{V_i}$$

From Ohm's law $V = iR$, where i is current, R is resistance.

$$\therefore \quad A_V = \frac{R_f}{R_i} = \frac{100\ \text{k}\Omega}{1\ \text{k}\Omega} = 100$$

11. The NAND gate and the NOR gate can be said to be universal gates since combinations of them can be used to accomplish any of the basic operations and can thus, produce and inverter, an OR gate or an AND gate. The non-inverting gates do not have this versatility since they can't produce an invert.

Note: The basic symbol and truth table of NAND gate are shown.



A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

12. $$\text{Current gain} = \frac{\text{change in collector current}}{\text{change in base current}}$$

$$\beta = \frac{\Delta i_C}{\Delta i_B}$$

Also $i_E = i_B + i_C \quad \Rightarrow \quad \Delta i_E = \Delta i_B + \Delta i_C$

$$\beta = \frac{\Delta i_C}{\Delta i_E - \Delta i_C}$$

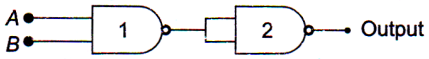
Given, $\beta = 100$, $\Delta i_C = 1$ mA

$$\therefore \quad 100 = \frac{1}{\Delta i_E - 1} \qquad \Delta i_E - 1 = \frac{1}{100} = 0.01$$

$\Delta i_E = 1 + 0.01 = 1.01$ mA

13. The circuit is a tuned filter circuit. It utilizes one or more tuned circuits (resonant or anti–resonant circuits) to seperate signals in relatively narrow bands of frequencies from signals wider frequency spectrums. Most transmitters and receivers incorporate many tuned filters. The given LCR tuned filter (also known as RLC tuned filter) is the most flexible of all frequency or frequency non-linear circuits. It is preferred for its frequency selection property.

14. Let two inputs are A and B. The circuit can be shown as



The two gates shown are NAND gates.

The output of gate 1, $Y_1 = \overline{A \,.\, B}$

The output of gate 2, $Y = \overline{Y_1 \,.\, Y_1}$

or $Y = \overline{\overline{A \,.\, B} \,.\, \overline{A \,.\, B}} = \overline{\overline{A \,.\, B}} = A \,.\, B$

Thus, the combination behaves as it is an AND gate.

15. The term 'LED' is abbreviated as 'Light Emitting Diode'. It is forward–biased p–n junction which emits spontaneous radiation. Current in the circuit = 10 m A $= 10 \times 10^{-3}$A and voltage in the circuit = 6 – 2 = 4 V

From Ohm's law.

$V = IR$

$$\therefore \quad R = \frac{V}{I} = \frac{4}{10 \times 10^{-3}} = 400\ \Omega$$

16. $i_e = i_b + i_c \Rightarrow i_c = i_e - i_b$

17. For 'OR' gate $X = A + B$

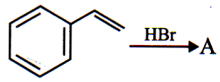
i.e., 0 + 0 = 0, 0 + 1 = 1, 1 + 0 = 1, 1 + 1 = 1

18. Arsenic has five valence electrons, so it is a donor impurity. Hence X becomes N-type semiconductor. Indium has only three outer electrons, so it is an acceptor impurity. Hence Y becomes P-type semiconductor. Also N (i.e., X) is connected to positive terminal of battery and P(i.e. Y) is connected to negative terminal of battery so PN-junction is reverse biased.

19. In the given condition diode is in reverse biasing so it acts as open circuit. Hence potential difference between A and B is 6 V.

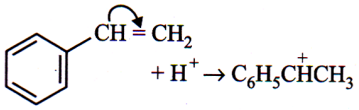
20. In Figs. 2, 4 and 5. P-crystals are more positive as compared to N-crystals.

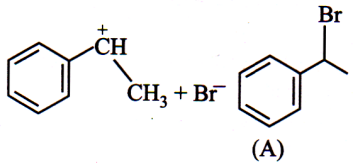
[CHEMISTRY]

21. **(c)** 

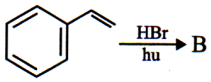
Formation of A is an electrophilic addition reaction

(i) $HBr \rightarrow H^+ + Br^-$

(ii) 

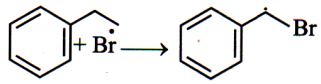


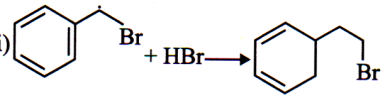
(A)



Formation of B is a free radical addition reaction

(i) $HBr \xrightarrow{h\nu} \dot{H} + \dot{B}r$

(ii) 

(iii) 

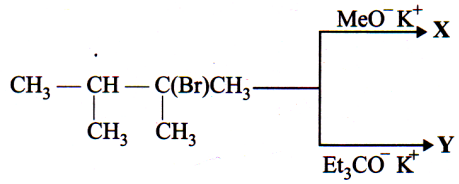
22. **(a)** Only 1° alkyl halides, *i.e.* CH_3Br undergoes S_N2 reaction.

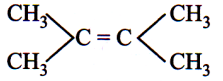
23. **(d)**

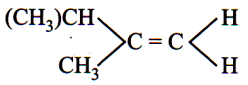
24. **(d)** The order of reactivity of alkyl halides in SN^1 or SN^2 reaction is:

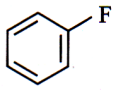
$(R - I) > (R - Br) > (R - Cl) > (R - F)$

$I^{\ominus}$ is a better nucleophile and a better leaving group. Leaving group order: $I^{\ominus} > Br^{\ominus} > Cl^{\ominus} > F^{\ominus}$

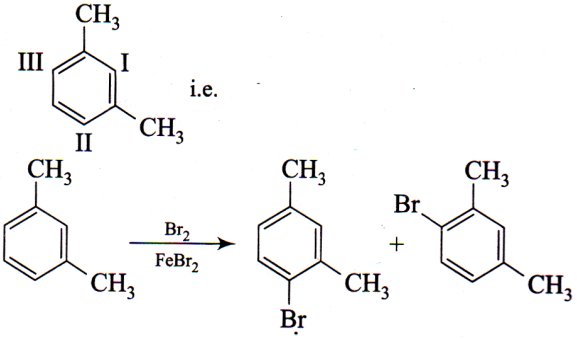
25. **(a)** 

X =  (Saytzeff)

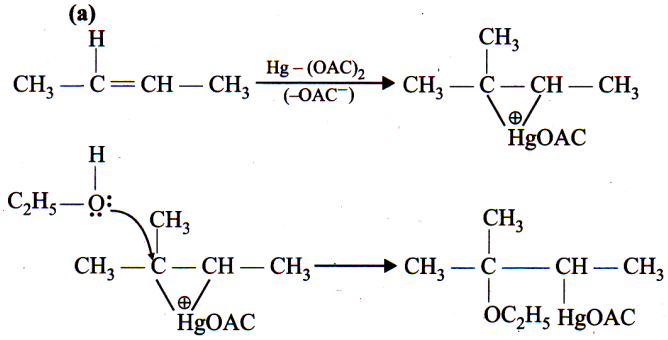
Y =  (Hoffmann)

26. **(a)** Fluoro benzene 

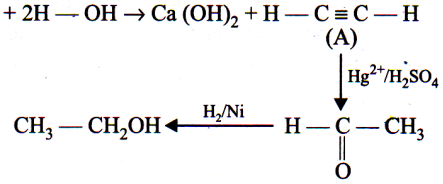
27. **(c)** Methyl group is ortho para directing but due to steric hindrance effect, generated by two CH_3 groups substitution will not take place on position (I). Hence only two products are possible.



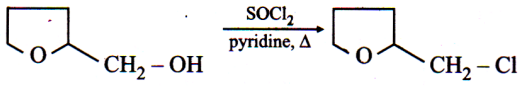
28. **(a)**



29. **(c)** $CaC_2 + 2H — OH \rightarrow Ca(OH)_2 + H — C \equiv C — H$ (A)

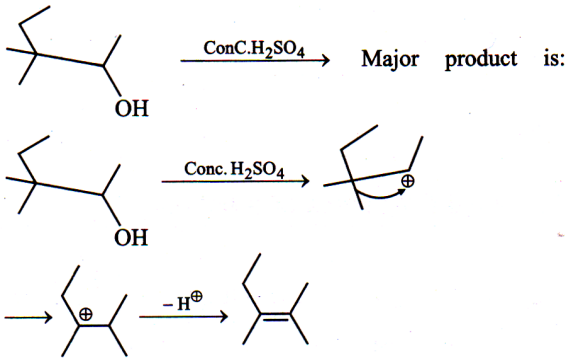


30. **(c)** This reaction proceeds via carbocation
$-OCH_3$ group has +R effect. It increases the stability of the carbocation.

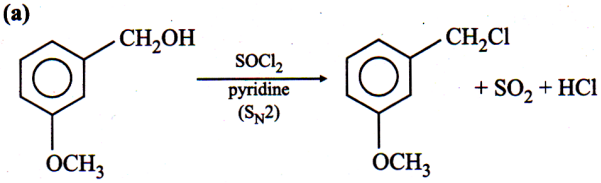
31. **(a)** 

It is S_N2 reaction.

32. **(c)**



33. **(a)**

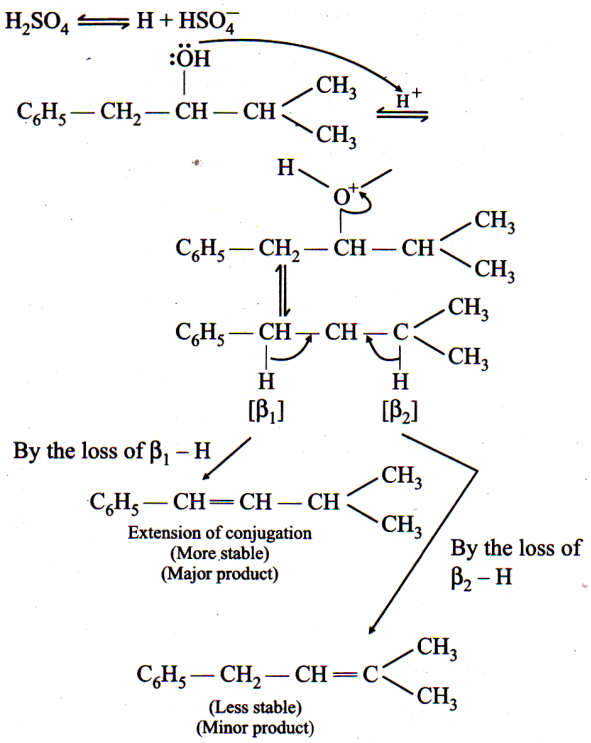


34. **(b)** $R-CH_2CH_2OH \xrightarrow[350°C]{Al_2O_3} R-CH=CH_2 \xrightarrow[(ii)\ Zn,H_3O^{\oplus}]{(i)\ O_3}$

$R-CHO + CH_2O$ (A)

$R-CHO \xrightarrow[Reduce]{Methanal} R-CH_2OH$

35. **(a)**



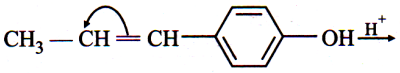
36. **(c)** $CH_3CH_2OH \xrightarrow{P+I_2} \underset{(A)}{CH_3CH_2I} \xrightarrow[\text{dry ether}]{Mg} \underset{(B)}{CH_3CH_2MgI}$

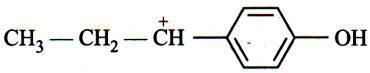
$$\xrightarrow{H-\underset{H}{\overset{|}{C}}=O} \underset{(C)}{CH_3-CH_2-CH_2OMgI} \xrightarrow{H_2O}$$

$$\underset{(D)}{CH_3CH_2CH_2OH} + Mg(OH)I$$

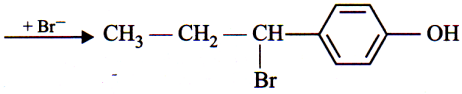
The compound D is n-propyl alcohol.

37. **(b)** The mechanism of this reaction is represented as follows.

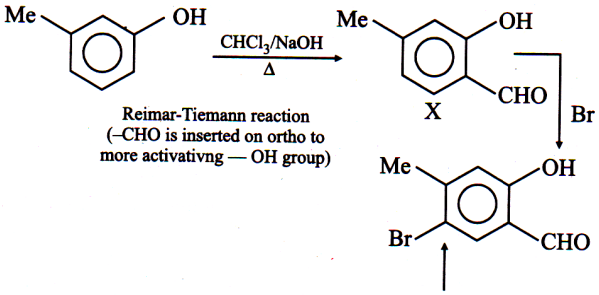




Benzylic carbonium ion (stable)



38. **(b)**



89. **(d)** Electron-withdrawing effect of a group increases the acidity of phenols and electron-releasing group has the opposite effect.

In (II), there is a (+I) effect of $-CH_3$ group. [decreases acidity]

In (III), there is a (–I) effect of $-NO_2$ group [increase acidity]

In (IV), there is (–I) and (–R) effect of $-NO_2$ group. [strongly increases acidity]

90. **(a)** Phenols capable of forming intermolecular hydrogen bonding have a high boiling point. But (a) has intramolecular rather than intermolecular H–bonding and is the most volatile compound.