HINTS AND SOLUTIONS

PHYSICS (PART-I)

1 50 Hz for half-wave, 100 Hz for full-wave

2. we know

$$\sigma = \frac{ne^2\tau}{m}$$

$$\frac{\sigma_{Cu}}{\sigma_{Au}} = \frac{\eta_{Cu}\tau_{Cu}}{\eta_{Au}\tau_{Au}} = 1.4 \times \frac{50}{49} = 10/7$$

3. Without charged plate, frequency is given by

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{\ell}}$$

When charged plate is placed under simple pendulum, due to opposite charge, the attraction between charged block and metal ball will be there. So effective force will increase. Hence frequency (new) will increases.

4. $$Y = \frac{\text{longitudinal stress}}{\text{longitudinal strain}} = \frac{15\times10^7}{5\times10^{-4}} = 3\times10^{11}\,\text{N/m}^2$$

5. $v = \omega\sqrt{A^2 - x^2}$, $x = \frac{\sqrt{3}}{2}A$

6. As there will be no loss in internal energy of the gas

$$n_1C_VT_1 + n_2C_VT_2 = (n_1 + n_2)C_VT$$

$$\Rightarrow \frac{P_1V_1}{RT_1}T_1 + \frac{P_2V_2}{RT_2}T_2 = \left(\frac{P_1V_1}{RT_1} + \frac{P_2V_1}{RT_2}\right)T$$

$$\Rightarrow T = \frac{(P_1V_1 + P_2V_2)T_1T_2}{P_1V_1T_2 + P_2V_2T_1}$$

As number of moles of the gas will be constant

$n_1 + n_2 = n$

$$\left(\frac{P_1V_1}{RT_1} + \frac{P_2V_2}{RT_2}\right) = \left(\frac{PV_1}{RT} + \frac{PV_2}{RT}\right)$$

$$\Rightarrow P = \frac{P_1V_1T_2 + P_2V_2T_1}{T_1T_2(V_1+V_2)} \times \frac{(P_1V_1 + P_2V_2)T_1T_2}{P_1V_1T_2 + P_2V_2T_1} = \frac{P_1V_1 + P_2V_2}{V_1 + V_2}$$

7. $$q = \frac{\Delta\phi}{R}$$

$\Rightarrow \Delta\phi = qR = ItR = 10^{-3} \times 5 \times 0.5T = 25$ mWb

8. $\Delta Q = nC\Delta T = 600$

$\Delta U = nC_V\Delta T = 450$

$$\Rightarrow \frac{C}{C_V} = \frac{4}{3} \Rightarrow C = \frac{4}{3}C_V = \frac{4}{3}\times\frac{3R}{2} = 2R$$

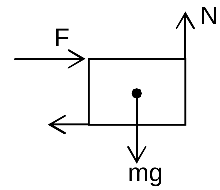
9. $$P_0 + \frac{1}{2}(2\delta)v^2 = P_0 + 2\delta gh + 2\delta gh$$

So, $v = 2\sqrt{gh}$

10. $$\frac{\Delta g}{g}\times100 = 2\frac{\Delta T}{T} + \frac{\Delta\ell}{\ell}$$

11. Large surface area helps in releasing most of the heat from transistor and only collector is the region which can be compensated in its width.

12. Let the block is in translational equilibrium and ready to topple.



f = F

f = F
N = mg
Taking torque about C.O.M. = 0

$$F\left(\frac{a}{2}\right)+f\left(\frac{a}{2}\right)=N\left(\frac{a}{2}\right)$$

2F = N

$$F=\frac{N}{2}$$

$$f=\frac{N}{2}$$

but $f \le \mu N$

$$\frac{N}{2}\le \mu N$$

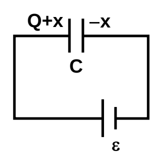
$$\mu \ge \frac{1}{2}$$

13. Number of emitted electrons $=\frac{10^{12}\times 2\times 10^{-4}\times 25}{10^{5}}$ = 5 × 10^4 electrons

q = + ne = 8 × 10^{-15} C.

14. Successive frequencies will differ by an amount v/2L

15. Electric field between the capacitor plates = $\frac{\sigma_1}{2\varepsilon_0}+\frac{(-\sigma_2)}{2\varepsilon_0}$



$$E = \frac{Q+x}{2A\varepsilon_0}+\frac{x}{2A\varepsilon_0}=\frac{1}{2A\varepsilon_0}[Q+2x]$$

$\Rightarrow$ Potential different E_d = $\frac{d}{2A\varepsilon_0}[Q+2x]=\varepsilon$

$$\Rightarrow \varepsilon=\frac{Q+2x}{2C}$$

$$\Rightarrow -x = \frac{Q}{2}-C\varepsilon$$

16. $\phi = \frac{\sqrt{3}}{4}\ell^2 B$

$$\varepsilon = \left|\frac{d\phi}{dt}\right| = \frac{\sqrt{3}}{4}\ell^2\frac{dB}{dt}$$

$$i = \frac{\varepsilon}{R}=\frac{\sqrt{3}\ell^2}{4R}$$

17. $\frac{E}{2}$ = E – ir

$\Rightarrow$ i = $\frac{E}{2r}$ . . . (i)

2E = i(3 + r) . . . (ii)

$\Rightarrow$ r = 1 Ω

18. dQ = dU + dW

$C = C_v + \frac{PdV}{ndT}$ …(i)

Differentiating $TV^2 = \text{constant}$

$\frac{dV}{dT} = -\frac{V}{2T}$ …(ii)

PV = nRT …(iii)

solving eq. (i), (ii) and (iii)

C = R

19. $Z = \sqrt{R^2 + X^2} = \sqrt{9 + X^2}$

but $\cos\phi = \frac{R}{Z} = \frac{3}{5}$

$X = 4\ \Omega$.

20. For adiabatic process, $TV^{\gamma-1}$ = constant

$T\left(\frac{m}{\rho}\right)^{\gamma-1}$ = constant

$\frac{T}{\rho^{\gamma-1}}$ = constant

$\rho \propto T^{1/(\gamma-1)} \Rightarrow \frac{1}{\gamma-1} = 3 \Rightarrow \gamma = 4/3$

$f = \frac{2}{\gamma-1} = \frac{2}{\left(\frac{4}{3}-1\right)} = 6$

21. $\Delta V = \nu V\Delta\theta = 3\alpha\, V\Delta\theta$

$\alpha = 2 \times 10^{-5}/°C$

22. $V_A - V_B = 6V$ for current in 4 Ω resistor to be zero. Potential difference 2Ω resistor = 10 – 6 = 4V

Current through 2Ω resistor = 2A

So, $2 = \frac{\text{net emf}}{\text{net resistance}} = \frac{(10-4)}{(2+R)}$

On solving, R = 1 Ω

23. $\frac{\varepsilon_0 A}{\left[d - \frac{d}{2} + \frac{d}{2K}\right]} = \frac{4}{3}\frac{\varepsilon_0 A}{d}$

Or $\frac{1}{\frac{d}{2}\left(1+\frac{1}{K}\right)} = \frac{4}{3d}$

On solving, we get K = 2

24. $q_1 + q_2 = 3Q$, $q_3 + q_4 = Q$, $q_5 + q_6 = Q$

the field inside the metal plates must be zero

$\frac{-q_1}{2\varepsilon_0} + \frac{q_2}{2\varepsilon_0} + \frac{Q}{2\varepsilon_0} + \frac{Q}{2\varepsilon_0} = 0$ …..(i)

$\frac{-3Q}{2\varepsilon_0} - \frac{q_3}{2\varepsilon_0} + \frac{q_4}{2\varepsilon_0} + \frac{Q}{2\varepsilon_0} = 0$ ……(ii)

$\frac{-3Q}{2\varepsilon_0} - \frac{Q}{2\varepsilon_0} - \frac{q_5}{2\varepsilon_0} + \frac{q_6}{2\varepsilon_0} = 0$ …..(iii)

from (i), (ii) and (iii) we get

$$q_3 = -\frac{Q}{2};\ q_5 = -\frac{3Q}{3}$$

25. In a rigid system angular velocity of a point with respect to any other point is same.

26. $\beta - \frac{d\lambda}{d} \Rightarrow d\frac{D\lambda}{\beta};\ \Delta x = \frac{dy}{D} = \frac{\lambda y}{\beta}\ \Delta\phi \frac{\Delta x}{\lambda} 2\pi$

$$\Delta\phi = \frac{Y}{\beta}2\pi = \frac{0.1}{0.25}2\pi = \frac{10}{25}(2\pi) = \frac{20}{25}\pi = \frac{4\pi}{5}$$

$\beta = 0.25 \quad y = 0.1$

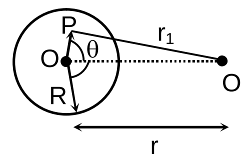
$$I = I_{max}\cos^2\frac{2\pi}{5}$$

27. $P_B = \frac{2S}{3R}, P_A = \frac{2S}{3R} + \frac{2S}{R} = \frac{8S}{3R}$

$$\frac{P_B}{P_B} = \frac{1}{4}$$

28. $V_P = V_{pindued} + V_{Pq} = V_0$

$$V_{pinduced} = \frac{kq}{r} - \frac{kq}{r_1}$$



29. When pure rolling starts friction reduces to zero. So plank does not have any acceleration so surface is horizontal.

30. Initial activity = $\lambda_A N_A + \lambda_B N_B = A_i$
final activity = $\lambda_A N'_A + \lambda_B N'_B = A_f$

$\lambda_A = 2\lambda_B$ and $N_A = N_B$ $N'_A = \frac{N_A}{2^6}, N'_B = \frac{N_B}{2^3}$

$$\frac{A_i}{A_f} = \frac{5}{96}$$

CHEMISTRY (SECTION-II)

1. **D**
$[Cr(en)_3]^{3+}$; Hyb. : d^2sp^3 ; does not exhibit geometrical isomerism but exhibits optical isomerism
$[IrF_3(H_2O)_2(NH_3)]$; Hyb. : d^2sp^3 ; exhibits geometrical isomerism but does not exhibit optical isomerism.
$[NiCl_4]^{2-}$; Hyb. : sp^3
$[Co(CN)_2(ox)_2]^{3-}$; Hyb. : d^2sp^3 ; exhibits both geometrical isomerism and optical isomerism.

2. **C**
$Ni(CO)_4$ and $[Co(CO)_4]^-$ - both are tetrahedral and diamagnetic

3. **C**
(I) $\underset{\text{(impure)}}{Ni} + 4CO \xrightarrow{50°C} \underset{\text{(volatile)}}{[Ni(CO_4)]} \xrightarrow{230°C} \underset{\text{(pure)}}{Ni} + 4CO\downarrow$

(II) $Cu_2S + \frac{1}{2}O_2 \xrightarrow{\Delta} Cu_2O + SO_2$

$Cu_2S + 2Cu_2O \xrightarrow[\text{temp.}]{\text{high}} 6Cu + SO_2$

(III) $MgCl_2(s) \xrightarrow{\text{electrolysis}} Mg^{2+}(\ell) + 2Cl^-(\ell)$

At cathode : $Mg^{2+} + 2e^- \longrightarrow Mg(s)$

At anode : $2Cl^-(\ell) \longrightarrow Cl_2(g) + 2e^-$

4. **C**

In I group only Li form nitride and all II group metals form nitride.

$Mg + N_2 \rightarrow Mg_3N_2 \xrightarrow{H_2O\text{ (moist)}} Mg(OH)_2 + NH_3$

$Ca + N_2 \rightarrow Ca_3N_2 \xrightarrow{H_2O\text{ (moist)}} Ca(OH)_2 + NH_3$

$Li + N_2 \rightarrow Li_3N \xrightarrow{H_2O\text{ (moist)}} LiOH + NH_3$

$K + N_2 \rightarrow$ no reaction

5. **A**

Thermal stability order top to bottom increases

6. **A**

Thermal stability order $NH_3 > PH_3 > AsH_3$

7. **A**

$PCl_3 + H_2O \longrightarrow H_3PO_3 + HCl$

8. **C**

Let the hydrocarbon $C_x H_y$, then it undergoes combustion in the following manner

$$C_xH_y + \left(x+\frac{y}{4}\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O \;\; C$$

	C_xH_y	O_2	CO_2
	30 mol	90 mol	60 mol
	1ml	3 ml	2 ml
or	1 mol	3 mol	2 mol

Equal volumes of all gases contain equal number of molecules at the same conditions of temperature and pressure.

Therefore, we have

$$x = 2 \text{ and } x + \frac{y}{4} = 3 \Rightarrow \frac{y}{4} = 3 - 2 = 1 \Rightarrow y = 4$$

Thus, the molecular formula = C_2H_4

9. **B**

The number of electrons in each species is

$NO^+ = 7 + 8 - 1 = 14,\; C_2^{2-} = 6 + 6 + 2 = 14$

$CN^- = 6 + 7 + 1 = 14, N_2 = 7 \times 2 = 14$

10. **B**

Using de Broglie relationship

$$\lambda = \frac{h}{m\nu} = \frac{6.63 \times 10^{-34}}{1.67 \times 10^{-27} \times 10^3} = 0.40 \text{ nm}$$

11. **D**

Higher is the charge/size ratio, higher is the polarizing power

12. **A**

CN^- and NO^+ has $14e^-$ each, hence same bond order = 3

13. **A**

We will find out the equilibrium temperature at which

$\Delta G = 0$. We know that

$\Delta G = \Delta H - T\Delta S$

$0 = \Delta H - T\Delta S$

Therefore, $\Delta h = T\Delta S$. Hence,

$$T = \frac{179.1\times 1000}{160.2} = 1118\text{ K}$$

14. **D**

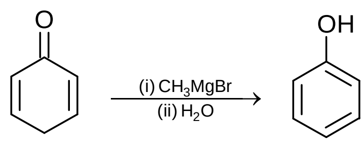
For an ideal gas, isothermal reversible process,

$$\Delta S = 2.303\, nR\log\left(\frac{v_2}{v_1}\right)$$

$$= 2.303\times 2\times 8.314\times \log\left(\frac{100}{10}\right)$$

$= 38.3\ J\ mol^{-1}\ K^{-1}$

15. **C**



16. **A**

The expression for ΔT_f is

$\Delta T_f = i \times K_f \times m$

For the reaction $Na_2SO_4 \longrightarrow 2Na^+ + SO_4^{2-},\ i = 2 + 1 = 3$

Hence, $\Delta T_f = 3 \times 1.86 \times (0.01/1) = 0.0558$ K

17. **A**

Given that

$$Ag^+ + NH_3 \rightleftharpoons [Ag(NH_3)]^+$$

$$K_1 = \frac{[Ag(NH_3)]^+}{[Ag^+][NH_3]} = 3.5\times 10^{-3}$$

and $[Ag(NH_3)]^+ + NH_3 \rightleftharpoons [Ag(NH_3)_2]^+$

Therefore, for the overall reaction

$$Ag^+ + 2NH_3 \rightleftharpoons [Ag(NH_3)_2]^+$$

$$K = \frac{[Ag(NH_3)_2]^+}{[Ag^+][NH_3]^2} = \frac{[Ag(NH_3)]^+}{[Ag^+][NH_3]}\times\frac{[Ag(NH_3)_2]^+}{[Ag(NH_3)]^+[NH_3]}$$

$= K_1 \,.\, K_2 = 3.5 \times 10^{-3} \times 1.73 \times 10^{-3} = 6.08 \times 10^{-6}$.

18. **D**

The reaction is

$$Ba(NO_3)_2 + CaCO_3 \rightleftharpoons BaCO_3 + 2NaNO_3$$

Here $[CO_3^{2-}] = [Na_2CO_3] = 10^{-4}$ M.

Therefore, the solubility product is

$$K_{sp} = [Ba^{2+}][CO_3^{2-}]$$

or $5.1\times 10^{-9} = [Ba^{2+}]\times 10^{-4}$

We get $[Ba^{2+}] = 5.1 \times 10^{-5}$. At this value, precipitation just starts.

19. **D**

The reaction are

$H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$ $\qquad K_1 = 4.2\times 10^{-7}$ …(1)

$HCO_3^- \rightleftharpoons H^+ + CO_3^{2-}$ $\qquad K_2 = 4.8\times 10^{-11}$ …(2)

As $K_2 << K_1$. All the H^+ ions (in total) are due to equation (1) only

From the first equation,

$$[H^+]_A = [HCO_3^-] = [H^+]_{total}$$

$[CO_3^{2-}]$ is negligible as compared to $[HCO_3^{2-}]$ of $[H^+]_{total}$. So, the concentrations of H^+ and HCO_3^- are approximately equal.

20. **A**

For the given cell reaction

$$E^o_{cell} = -0.14 + 0.13 = -0.01\,V$$

According to Nernst equation

$$E_{cell} = E^o_{cell} - \frac{0.0591}{2}\log\frac{[Pb^{2+}]}{[Sn^{2+}]}$$ But as

$$E_{cell} = 0 = -0.01 - \frac{0.0591}{2}\log\frac{[Pb^{2+}]}{[Sn^{2+}]}$$

$$\Rightarrow \log\frac{[Pb^{2+}]}{[Sn^{2+}]} = \frac{0.01}{-0.0296} = -0.3$$

i.e., $\frac{[Pb^{2+}]}{[Sn^{2+}]} = 0.5$

21. **A**

The rate expression is Rate = $k[P]^x\,[Q]^y$.

Substituting values for (I) and (II) from the given table and evaluating (I)/(II), we get

$$\frac{0.0012}{0.024} = \left(\frac{1\times 10^{-2}}{2\times 10^{-2}}\right)^y \Rightarrow \frac{1}{2} = \left(\frac{1}{2}\right)^y \Rightarrow y = 1$$

Substituting values for (I) and (III) and evaluating (I)/(III) we get

$$\frac{0.0012}{0.024} = \left(\frac{6\times 10^{-2}}{12\times 10^{-2}}\right)^x \Rightarrow \frac{1}{2} = \left(\frac{1}{2}\right)^x \Rightarrow x = 1$$

So, the overall order of the reaction is 1 + 1 = 2. Substituting values of x and y in the expression for (I), we get

$$0.012 = k \times (6 \times 10^{-2}) \times (1 \times 10^{-2}) \Rightarrow k = 2\ \text{min}^{-1}.$$

22. **C**

The protective power of lypophilic solution is expressed in terms of gold number, Lesser the gold number greater its protective power.

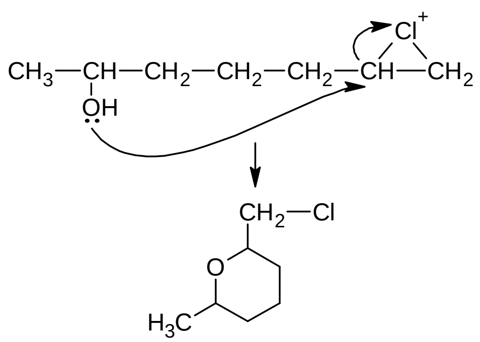
23. **B**

For the molecule $C_2(Cl)(Br)(F)I$ six geometrical isomers are possible

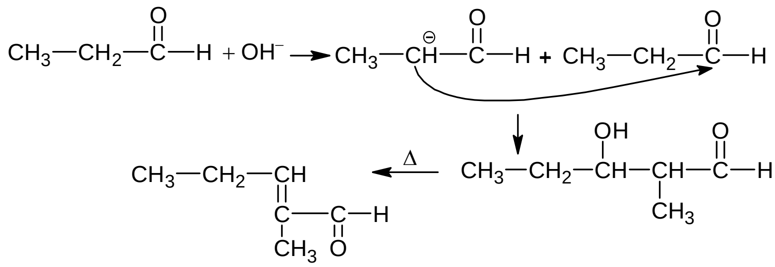
24. **C**

For the given molecule two geometrical and two optical isomers are possible

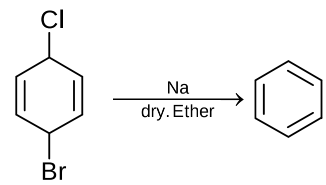
25. **D**



26. **B**

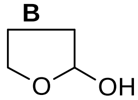


27. **C**

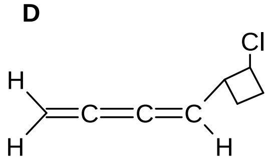


28. **A**
CH_3–CH_2–OH will give haloform test

29. **B**

 Will give the tollen's test

30. **D**

 is optically active isomer

MATHEMATICS (PART-III)

1. $1 + a_1 \geq 2\sqrt{a_1}$, $1 + a_2 \geq 2\sqrt{a_2}$, $1 + a_n \geq 2\sqrt{a_n}$
Hence, $(1 + a_1)(1 + a_2)$ ..... $(1 + a_n) \geq 2^n$

2. Let $z_e = 2z + 1 \Rightarrow z = \frac{z_e - 1}{2}$

$\therefore$ Equation whose roots are '2z + 1' is $\left(\frac{z_e - 1}{2}\right)^4 + \left(\frac{z_e - 1}{2}\right)^3 + 2 = 0$

$\Rightarrow (z_e - 1)^4 + 2(z_e - 1)^3 + 32 = 0$

3. Let $xp(x) - 1 = A(x - 1)(x - 2)$ ..... $(x - 9)$
Put $x = 0 \Rightarrow A = \frac{1}{\lfloor 9}$

$\therefore 10p(10) - 1 = \frac{1}{\lfloor 9} \times \lfloor 9$

$\Rightarrow p(10) = \frac{1}{5}$

4. $x_1 + x_2 = 6$, $x_1 \cdot x_2 = 4$ and $x_1^2 - 6x_1 + 4 = 0$

Now, $\frac{(x_1^2 - 4x_1 + 4)^8 + (-x_1)^8}{x_1^8} = \frac{2^8 \cdot x_1^8 + x_1^8}{x_1^8} = 257$

5. $p = \frac{1}{4}$, $q = \frac{3}{4}$

Mean = np, standard deviation = $\sqrt{\text{variance}} = 3 \Rightarrow$ npq = 9

$\therefore\ n \times \frac{1}{4} \times \frac{3}{4} = 9 \Rightarrow n = 48 \Rightarrow$ mean = 12

6. $r_1 \cdot r_2 = \frac{3\sqrt{5}-2}{2} \times \frac{3\sqrt{5}+2}{2} = \frac{41}{4}$

7. Let y = mx be the chord

Hence, $x^2(1 + m^2) - x(3 + 4m) - 4 = 0 \Rightarrow x_1 + x_2 = \frac{3+4m}{1+m^2} \rightarrow x_1 \cdot x_2 = \frac{-4}{1+m^2}$

But $x_2 = -4x_1 \therefore 7m^2 + 24m = 0 \Rightarrow m = 0, -\frac{24}{7}$

8. Equation of normal at (13 cos θ, 5 sin θ) is $(y - 5\sin\theta) = \frac{13\sin\theta}{5\cos\theta}(x - 13\cos\theta)$

$\therefore$ cos θ = 0, $\sin\theta = -\frac{5}{24} \Rightarrow \theta = \frac{\pi}{2},\ 2\pi - \sin^{-1}\frac{5}{24},\ \pi + \sin^{-1}\frac{5}{24}$

9. Let $x^4 = t$, $\lim\limits_{t\to 0}\frac{\sin t - t\cos t + t^5}{t(e^{2t} - 1 - 2t)} = \frac{1}{6}$, now expand it

10. $g'(x) = x^{\frac{3}{2}} \Rightarrow g(x) = \frac{x^{\frac{5}{2}}}{\frac{5}{2}} + c \ \therefore\ 1 = \frac{2}{5} + c \Rightarrow c = \frac{3}{5}$

$g(x) = \frac{x^{\frac{5}{2}}}{\frac{5}{2}} + \frac{3}{5} \Rightarrow g(4) = \frac{67}{5}$

11. f(x) < 2 for x < 1 and f(x) > 3 for x > 1

$\therefore \lambda \in [2, 3]$

12. Put $1 + x^{-\frac{1}{2}} = t \ \therefore\ I = -2\int t^{-\frac{13}{3}}dt = \frac{3}{5}\left(1 + x^{-\frac{1}{2}}\right)^{-\frac{10}{3}} + c$

13. $y = \sqrt{x+y} \Rightarrow y = \frac{1+\sqrt{1+4x}}{2}, y > 1$

$\therefore\ I = \frac{19}{6}$

14. Let $\int_0^1 f(t)dt = k \ \therefore$ f(x) = $e^x(1 + k)$

$\therefore\ \int_0^1 e^t(1+k)dt = k$

$\therefore\ k = \frac{1}{2-e}$

15. $A = \int_0^1 (a^2x^2 + ax + 1)dx = \frac{1}{3}\left(a + \frac{3}{4}\right)^2 + \frac{41}{48} \Rightarrow a = -\frac{3}{4}$

16. $y = c_1 \cos x + c_2\left(\frac{1+\cos 2x}{2}\right) + c_3\left(\frac{1-\cos 2x}{2}\right) + c_4$

17. $\alpha + 2\alpha = 3a$ and $2\alpha^2 = f(a) = 2a^2$

18. $\frac{1+a}{2} \ge \sqrt{a}$, $\frac{1+b}{2} \ge \sqrt{b}$, $\frac{1+c}{2} \ge \sqrt{c}$, $\frac{1+d}{2} \ge \sqrt{d}$

19. $3^{120} = 3\cdot 3^{119} = 3(4-1)^{119} = 3(4k-1) = 12k - 3 = 12(k-1) + 9$

20. Number of ways of selecting 'r' person from 60 men and 40 women is ${}^{100}C_r$

$\therefore$ Maximum = ${}^{100}C_{50}$

21. Number of ways of selecting atleast zero things from 'p' alike things is (p + 1)

$\therefore\ (10+1)^9 - 1 = 11^9 - 1$

22. AAA BBB can be arranged at '6' places in $\frac{\lfloor 6}{\lfloor 3 \lfloor 3} = 20$

'6' places can be selected ${}^3c_1 \times {}^3c_1 \times {}^3c_2 \times 3 = 81$

$\therefore$ 20 × 81 = 1620

23. $\frac{{}^6c_3}{6^3} = \frac{5}{54}$

24. $AB = A \Rightarrow ABA = A^2 = AB = A$

$\therefore\ A^2 = A$ and $B^2 = B$

$(A + B)^2 = A^2 + B^2 + AB + BA = 2(A + B)$

$(A + B)^3 = (A + B)^2(A + B) = 2^2(A + B)$

$(A + B)^7 = 2^6(A + B)$

25. $\vec{a}' = \frac{\vec{b}\times\vec{c}}{\left[\vec{a}\ \vec{b}\ \vec{c}\right]} = \frac{\hat{i} - \hat{j} + \hat{k}}{2}$

26. $\frac{x-1}{3} = \frac{y-2}{1} = \frac{z-3}{2} = k_1 \Rightarrow x = 1 + 3k_1,\ y = 2 + k_1$ and $z = 3 + 2k_1$

$\frac{x-3}{1} = \frac{y-1}{2} = \frac{z-2}{3} = k_2 \Rightarrow x = 3 + k_2,\ y = 1 + 2k_2$ and $z = 2 + 3k_2$

$\therefore$ P(4, 3, 5) only (B) and (C) satisfy

27. $\sin A \cos B = \frac{1}{4}$ and $\cos A \sin B = \frac{3}{4}$

$A + B = \frac{\pi}{2} \Rightarrow \sin^2 A = \frac{1}{4} \Rightarrow \cot^2 A = 3$

28. $1 + 4\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2} = \frac{7}{4}\ \left(\because R = 4r\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}\right) \Rightarrow \frac{R}{r} = \frac{3}{4}$

29. $\sin^{-1}x < \cos^{-1}x \Rightarrow \frac{\pi}{2} - \cos^{-1}x < \cos^{-1}x \Rightarrow \cos^{-1}x > \frac{\pi}{4}\ \therefore\ x \in \left(0, \frac{1}{\sqrt{2}}\right)$

30. $\left(\tan^{-1}x + \cot^{-1}x\right)^2 - 2\tan^{-1}x\left(\frac{\pi}{2} - \tan^{-1}x\right) = \frac{5\pi^2}{8} \Rightarrow \tan^{-1}x = \frac{2\pi}{3}, -\frac{\pi}{4} \Rightarrow x = -1$