**1. (30)** $u = 0$, Say acceleration is a

For ts $10 = \frac{1}{2}at^2$

For 2ts $10 + x = \frac{1}{2}a(2t)^2$

$$\frac{10 + x}{10} = \frac{4}{1}$$

$x = 30$ m

**2. (b)** $\Delta\ell = 6.241 - 6.230 = 0.011$ cm

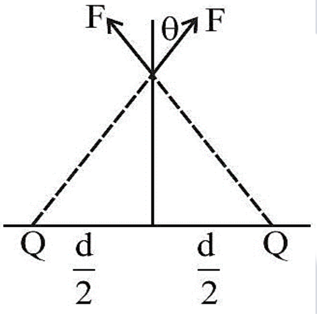
$\Delta\ell = \ell\alpha\Delta\theta$

$0.011 = 6.230 \times 1.4 \times 10^{-5}(\theta - 27)$

$$\theta - 27 = \frac{0.011 \times 10^5}{6.230 \times 1.4}$$

$\theta \approx 153.11$ nearest is $152.7°C$.

**3. (d)**




$$F = \frac{KQq}{\left(x^2 + \frac{d^2}{4}\right)}$$

Net force on g = 2 $F\cos\theta$

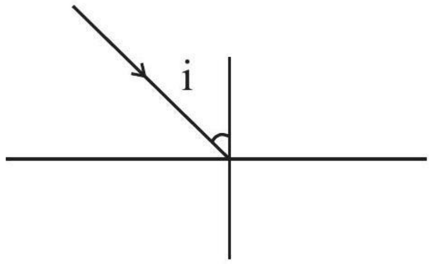
$$F_{net} = \frac{2KQqx}{\left(x^2 + \frac{d^2}{4}\right)^{3/2}}$$

For maximum $F_{net}$

$$\frac{dF_{net}}{dx} = 0$$

we get $x = \frac{d}{2\sqrt{2}}$

**4. (d)** $\sin i_c = \frac{n_r}{n_d} = \frac{C_d}{C_r} = \frac{1.5\times10^{10}}{2\times10^{10}}$




$\sin i_c = \frac{3}{4}$

$i_c = \sin^{-1}\left(\frac{3}{4}\right)$

for TIR $\theta > i_c$

$\theta > \sin^{-1}\left(\frac{3}{4}\right)$

**5. (a)**

Say for $D_4$ Atomic No $= Z$

Mass Number $= A$

$A = 182 - 4 - 4 = 174$

$Z = 74 - 2 + 1 - 2 = 71$

**6. (d)** For maximum KE we will take

higher frequency $\left(f = \frac{9\times10^{15}}{2\pi} \text{Hz}\right)$

$K_{max} = hf - \phi$

$= \frac{9 \times 10^{15} \times 4.14 \times 10^{-15}}{2\pi} - 2.50$

3.43eV nearest is 3.42eV

**7. (d)** In $t_1$ time energy becomes half so charge will become $\frac{1}{\sqrt{2}}$ time

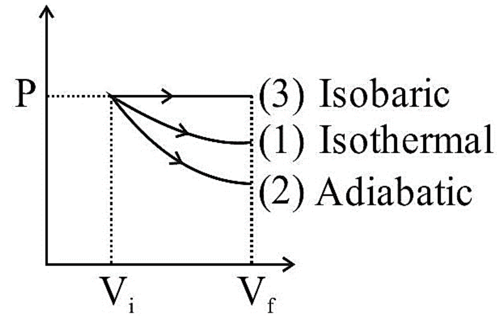
$q = Q_0 e^{-\frac{t_1}{RC}} = \frac{Q_0}{\sqrt{2}}$

and $q = Q_0 e^{-\frac{t_1}{RC}} = \frac{Q_0}{8} = \left(\frac{Q_0}{\sqrt{2}}\right)^6$

$t_2 = 6t_1$

$\frac{t_1}{t_2} = \frac{1}{6}$

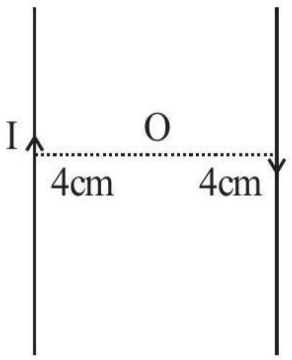
**8. (d)**




Area under curve is work

$W_2 < W_1 < W_3$

**9. (b)**




B at O $= 2\frac{\mu_0 I}{2\pi r}$

$\frac{2 \times 4\pi \times 10^{-7} I}{2\pi 4 \times 10^{-2}} = 3 \times 10^{-4}$ T

I = 30 A in opp. direction

**10. (b)**

$T = \frac{2\pi}{\sqrt{GM}} r^{3/2}$

$\frac{T_1}{T_2} = \left(\frac{r_1}{r_2}\right)^{3/2} = \left(\frac{1}{3}\right)^{3/2}$

$T_2 = T_1 3\sqrt{3} = 21\sqrt{3}$ hours

$\approx 36$ hours

**11. (c)** Range $d = \sqrt{2Rh}$

$d_2 = 2\ d_1$

$\sqrt{2Rh_2} = 2\sqrt{2Rh_1}$

$h_2 = 4\ h_1 = 500$ m

$\Delta h = 500\text{ m} - 125\text{ m} = 375\text{ m}$

**12. (c)** $\omega = \sqrt{\frac{g}{\ell}} = \pi$

$\frac{g}{\ell} = \pi^2 \Rightarrow \ell = \frac{g}{\pi^2}$

$\ell = \frac{980}{\pi^2} \approx 99.4 \text{ cm}$

**13. (c)**

No of moles of $H_2 = 8$ moles

No of moles of $O_2 = 4$ moles

Total moles $= 12$ moles

At STP 1 mole occupy $= 22.4\ell = 22.4 \times 10^3 \text{ cm}^3$

12 moles will occupy $= 12 \times 22.4 \times 10^3 \text{ cm}^3$

$\approx 26.8 \times 10^4 \text{ cm}^3$

**14. (c)** Electric field can change speed and kinetic energy but magnetic field cannot change speed $\Delta$KE. Because magnetic force is always $\perp$ to velocity.

**15. (d)** For 4 kg block

$4\text{ g} - T = 4a$

For 40 kg block

$T - 40\text{ g} \times 0.02 = 40a$

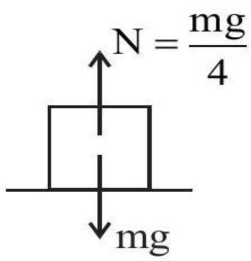
Adding both eq.

$40 - 8 = 44a$

$a = \frac{32}{44} = \frac{8}{11} \text{ m/s}^2$

**16. (d)** Work done by gravity $= K_B - K_A$ $mgy_0 = K_B - 0$ $K_B = mgy_0$

**17. (c)**




$mg - N = ma$

$a = g - \frac{g}{4}$

$a = \frac{3g}{4}$

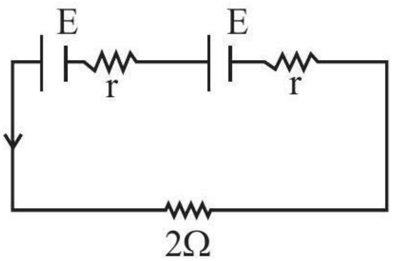
**18. (d)**

$E_x = -\frac{\partial V}{\partial x} = -6x$

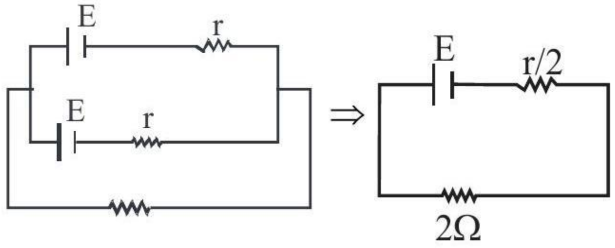
At (1,0,3)

$\vec{E} = -6\ V/m\hat{i}$

**19. (a)**




$I_1 = \frac{2E}{2r+2}$




$I_2 = \frac{E}{\frac{r}{2}+2} = \frac{2E}{r+4}$

$I_1 = I_2$

$2r + 2 = r + 4$

$2r - r = 2\Omega \Rightarrow r = 2\Omega$

**20. (b)**

$\mathbf{R} = \frac{u^2 \sin 2\theta}{g} R_{max} = \frac{u^2}{g} = 100$

$H_{max} = \frac{u^2}{2\,g} = \frac{100}{2} = 50\ m$

**21. (180)**

Measured diameter $= MSR + VSR \times VC$

$= 1.7 + 0.01 \times 5$

$= 1.75$

Corrected = Measured - Error

$= 1.75 - (-0.05)$

$= 1.80 \text{ cm}$

$= 180 \times 10^{-2} \text{ cm}$

180

**22. (20)** Speed after falling through height h

Should be equal to terminal velocity

$$\sqrt{2gh} = \frac{2}{9}\frac{r^2(d-\rho)g}{\eta}$$

$$\sqrt{2gh} = \frac{2}{9}\frac{10^{-8}(10000-1000)\times 10}{10^{-5}}$$

$$= \frac{2}{9} \times 10^{-8}\frac{9\times 10^4}{10^{-5}} = 20$$

$2 \times 10 \times h = 400$

$h = 20 \text{ m}$

**23. (104)** For first resonance

$$\ell_1 + e = \frac{\lambda}{4}$$

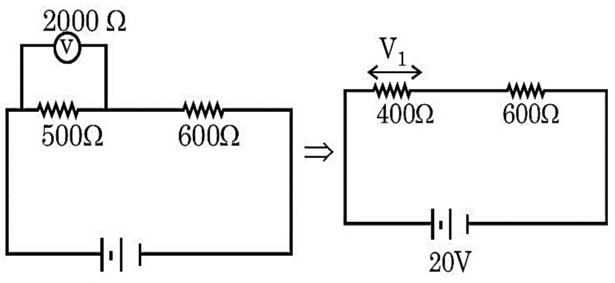
$$\lambda = \frac{336}{400} \times 100 \text{ cm} = 84 \text{ cm} \Rightarrow \frac{\lambda}{4} = 21 \text{ cm}$$

$e = 21 - 20 = 1 \text{ cm}$

For third resonance

$$\ell_3 + e = \frac{5\lambda}{4} = 105 \text{ cm} \Rightarrow \ell_3 = 104 \text{ cm}$$

**24. (8)**

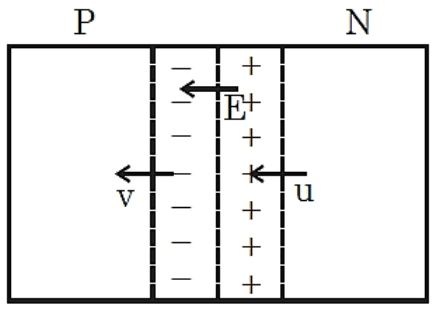



$$I = \frac{20}{1000} \text{ A}$$

$V_1 = I \times 400 = \frac{20}{1000} \times 400$

$= 8\ V$

**25. (14)**




Work done by Electric field $= K_f - K_i$

$\frac{1}{2}mv^2 - \frac{1}{2}mu^2 = -1.6 - 10^{-19} \times 0.4$

$\frac{1}{2}9 \times 10^{-31}(v^2 - u^2) = -0.64 \times 10^{-19}$

$u^2 - v^2 = \frac{2 \times 0.64 \times 10^{12}}{9}$

$v^2 = \left(36 - \frac{128}{9}\right) \times 10^{10}$

$v = \frac{14}{3} \times 10^5\ m/s$

$x = 14$

**26. (8)** Displacement Current = Conduction Current

$= \frac{dq}{dt}$

$I_d = \frac{\epsilon_0\ A}{d}\frac{dV}{dt}$

$d = \frac{8.85 \times 10^{-12} \times 4 \times 10^{-3} \times 10^6}{4.425 \times 10^{-6}}$

$= 8\ mm$

$X = 8$

**27. (8)**

**28. (20)**

$T1/2 = 5$ year

$N = N_0\left(\frac{1}{2}\right)^{\text{No of half lives}}$

$\frac{N}{N_0} = \frac{1}{16} = \left(\frac{1}{2}\right)^4$

Time = 4 half lives = 20 years

**29. (600)**

$\beta = \frac{\lambda D}{d}$

$\Delta\beta = \frac{\lambda}{d}\Delta D$

$\lambda = \frac{\Delta\beta \cdot d}{\Delta D}$

$= \frac{3 \times 10^{-5} \times 1 \times 10^{-3}}{5 \times 10^{-2}}$

$= 60 \times 10^{-8} = 600 \times 10^{-9}$ m

$= 600$ nm

**30. (5)** If Current is in phase with emf then the frequency of source $= \frac{1}{2\pi\sqrt{LC}}$ (Resonant frequency)

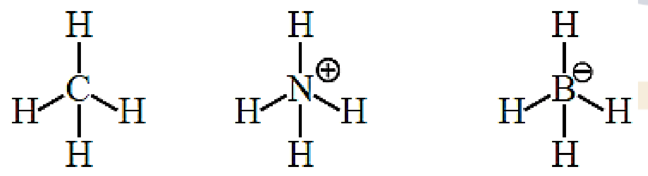
$\frac{1}{2\pi\sqrt{\frac{1}{2} \times 10^{-3} \times 2 \times 10^{-4}}}$

$= \frac{1}{2\pi} \times \sqrt{10} \times 1000 = 500$ Hz

**31. (b)** Reported answer should not be more precise than least precise term in calculations, so there should be three significant figures in reported answer.

**32. (b)** For 2 s, number of radial nodes $= 2 - 0 - 1 = 1$ and value of $\psi^2$ is always positive.

**33. (b)**



All are tetrahedral and each have 10 electrons.

**34. (a)** $PCl_5 = 5$ mole

$Ar = 4$ mole

$P_{Total} = \frac{9 \times 0.82 \times 610}{100} = 4.5$ atm

$P_{PCl_5} = \frac{5 \times 4.5}{9} = 2.5; P_{Ar} = \frac{4 \times 4.5}{9} = 2$

$PCl_5 \rightleftharpoons PCl_3 + Cl_2$

$2.5-P \quad P \quad P$

$P_{total} = 2.5 - P + P + P + P_{Ar} = 6$

$P = 1.5$

$K_p = \frac{1.5 \times 1.5}{1} = 2.25$

**35. (d)** Data insufficient.

**36. (a)** Ionisation energy $= N > O$.

In oxygen atom, 2 of the 42p electrons must occupy the same 2p orbital resulting in an increased electron electron-repulsion.

**37. (a)**

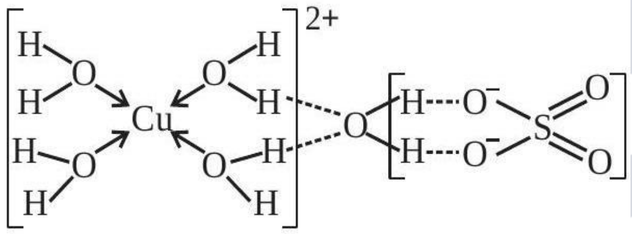
Siderite $-FeCO_3$

Malachite $-CuCO_3 \cdot Cu(OH)_2$

Calamine $-ZnCO_3$

Sphalerite - ZnS

**38. (c)**



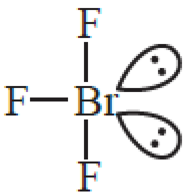
**39. (a)**

Baking soda $\rightarrow NaHCO_3$

Washing soda $\rightarrow Na_2CO_3 \cdot 10H_2O$

Caustic soda $\rightarrow NaOH$

**40. (c)**



Steric no. $= 5(sp^3\ d)$, lone pair $= 2$

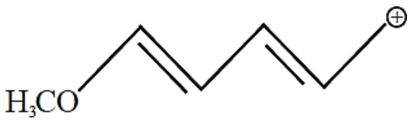
Bent T shape.

**41. (d)** $Na_2\ B_4O_7$ gives $H_3BO_3$ and NaOH (strong base) in water.

**42. (d)**

$2SO_2 + O_2 + 2H_2O \rightarrow 2H_2SO_4$ (Acid rain)

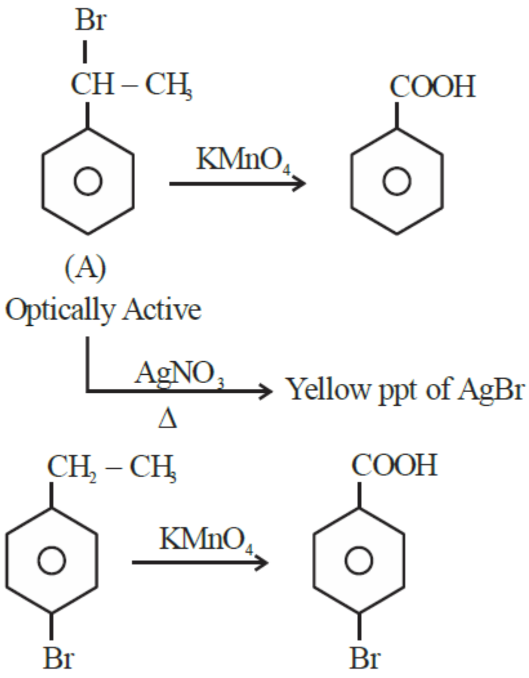
**43. (d)**



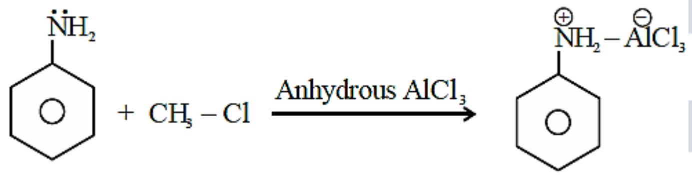
Is most stable carbocation

**44. (c)** $CH_3\overset{\oplus}{C}H - CH_3$ is formed in the above reaction

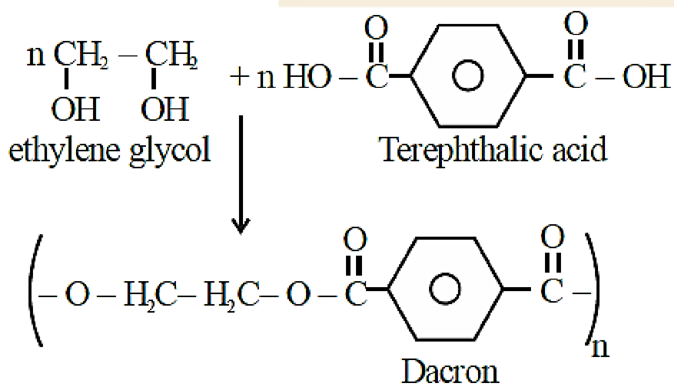
**45. (c)**



**46. (d)**



**47. (a)**



**48. (c)** Primary structure of protein is unaffected by physical 'or' chemical changes.

**49. (a)** Antiseptic Dettol is mixture of chloroxylenol and terpineol.

**50. (b)**

$$BaCl_2 + SO_3^{2-} \rightarrow BaSO_3 \downarrow \xrightarrow{\text{dil.HCl}} SO_2 \uparrow$$

white burning sulphur like smell

**51. (29)**

$$V = \frac{nRT}{P} = \frac{0.90 \times 0.82 \times 300 \times 760}{18 \times 32} = 29.21$$

**52. (195)** $N_2O$ moles $= \frac{2.2}{44} = \frac{1}{20}$

$$\Delta H = nC_p\Delta T = \frac{1}{20} \times 100(-40) = -200\ J$$
$$\Delta U = q_p + w$$
$$w = -P_{ext.}\ \Delta V$$
$$W = -1\frac{(167.75 - 217.1)}{1000} \times 101.3\ J$$
$$w = +5\ J$$
$$\Delta U = -200 + 5 = -195\ J$$

**53. (3)**

$$\Delta T_b = iK_b m$$
$$\Delta T_f = iK_f m$$
$$\frac{4}{4} = \frac{K_b 1.5}{K_f 4.5}$$
$$\frac{K_b}{K_f} = 3$$

**54. (7)**

$$H_2(\ g) + Cu^{2+}(\ aq.\ ) \rightarrow 2H^+(aq.\ ) + Cu(s)$$

$$0.31 = 0.34 - \frac{0.06}{2}\log\frac{[H^+]^2}{[Cu^{2+}]}$$

$$[Cu^{2+}] = 10^{-7}M$$

$$x = 7$$

**55. (216)**

$$K = Ae^{-Ea/RT} = (6.5 \times 10^{12}\ s^{-1})e^{-26000\ K/T}$$

$$\frac{Ea}{8.314} = 26000$$

$$Ea = 216.164\ kJ/mol.$$

**56. (6)** $Mn^{2+} \rightarrow t_{2\ g^{111}} e_{g^{11}}$

$$\mu_s = \sqrt{35}$$

$= 5.91$

$= 6$

**57. (5)**

$CoCl_3 \cdot xNH_3 + AgNO_3 \rightarrow AgCl \downarrow$
$\qquad\qquad\qquad\qquad\qquad\qquad 2\ mol$

$[Co(NH_3)_5Cl]Cl_2 + AgNO_3 \rightarrow AgCl \downarrow$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad 2\ mol$

$x = 5$

**58. (1)**

$CH_3 - CH_2 - CH_2 - CH_2 - OH$

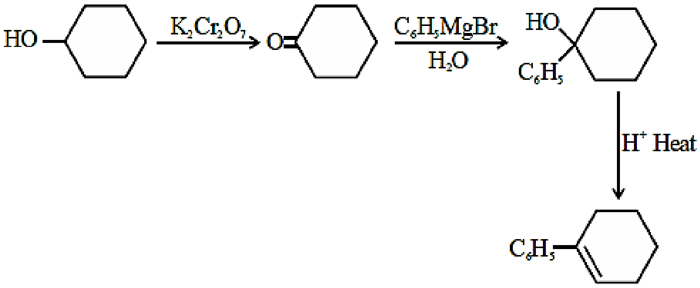
$CH_3 - \overset{\star}{C}H(OH) - CH_2 - CH_3 \quad (\pm)$

$CH_3 - CH(CH_3) - CH_2 - OH$

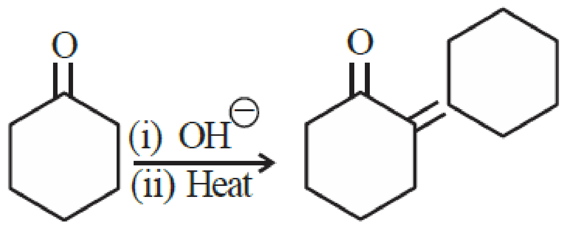
$CH_3 - C(CH_3)(OH) - CH_3$

Out of which only two are chiral

**59. (8)**




**60. (4s)**




**61. (a)**

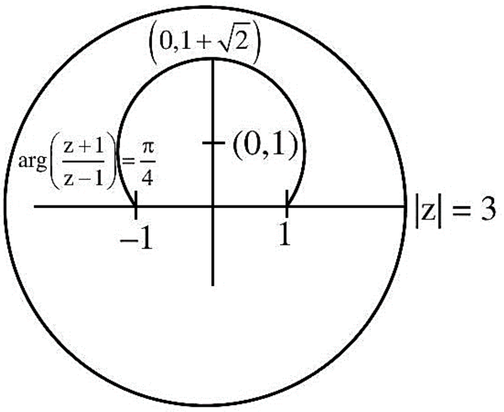
$x^4 + x^2 + 1 = 0$

$\Rightarrow (x^2 + x + 1)(x^2 - x + 1) = 0$

$\Rightarrow x = \pm\omega, \pm\omega^2$ where $\omega = 1^{1/3}$ and imaginary.

So $\alpha^{1011} + \alpha^{2022} - \alpha^{3033} = 1 + 1 - 1 = 1$

**62. (c)**




**63. (c)** $B = (I - \operatorname{adj} A)^5 = \begin{bmatrix} -1 & -1 \\ 0 & -1 \end{bmatrix}^5 = \begin{bmatrix} -1 & -5 \\ 0 & -1 \end{bmatrix}$

Sum of its all elements $= -7$.

**64. (c)** $S = 1 + \frac{5}{6} + \frac{12}{6^2} + \frac{22}{6^3} + \frac{35}{6^4} + \cdots.$

$\frac{S}{6} = \frac{1}{6} + \frac{5}{6^2} + \frac{12}{6^3} + \frac{22}{6^4} + \cdots.$

on subtraction

$\frac{5}{6}S = 1 + \frac{4}{6} + \frac{7}{6^2} + \frac{10}{6^3} + \frac{13}{6^4} + \cdots.$

$$\frac{5}{36}S = 1 + \frac{4}{6^2} + \frac{7}{6^3} + \frac{10}{6^4} + \frac{13}{6^5} + \cdots$$

on subtraction

$$\frac{25}{36}S = 1 + \frac{3}{6} + \frac{3}{6^2} + \frac{3}{6^3} + \cdots. = \frac{8}{5}$$

$$S = \frac{288}{125}$$

**65. (d)** $\lim_{x\to1} \frac{(x^2-1)\sin^2 \pi x}{(x^2-1)(x-1)^2} = \lim_{x\to1} \left(\frac{\sin((1-x)\pi))}{\pi(1-x)}\right)^2 \pi^2 = \pi^2$

**66. (c)**

$$f'(x) = (x-3)^{n_1-1}(x-5)^{n_2-1}(n_1+n_2)\left(x - \frac{5n_1+3n_2}{n_1+n_2}\right)$$

Option (3) is incorrect since

for $n_1 = 3, n_2 = 5$

$$f'(x) = 8(x-3)^2(x-5)^4\left(x - \frac{30}{8}\right)$$

minima at $x = \frac{30}{8}$

**67. (d)** $f(x) = \left(1 + \int_0^1 f(t)dt\right)x - \int_0^1 tf(t)dt$

$f(x) = Ax - B$

$A = 1 + \int_0^1 f(t)dt = 1 + \int_0^1 (At - B)dt$

$\Rightarrow A = 2(1 - B)$

Also $B = \int_0^1 tf(t)dt = \int_0^1 (At^2 - Bt)dt$

$A = \frac{9}{2}B$

From (2), (3)

$A = \frac{18}{13}, B = \frac{4}{13}$

so $f(6) = 8$

**68. (c)**

$\text{LHS} = \int_0^2 (\sqrt{2x} - \sqrt{2x - x^2})dx = \frac{8}{3} - \frac{\pi}{2}$

$\text{RHS} = \int_0^1 \left(1 - \sqrt{1 - y^2} - \frac{y^2}{2}\right)dy + \int_1^2 \left(2 - \frac{y^2}{2}\right)dy + I$

$I + \frac{5}{3} - \frac{\pi}{4}$

So, $I = 1 - \frac{\pi}{4} = \int_0^1 \left(1 - \sqrt{1 - y^2}\right)dy$

**69. (c)** $\frac{dy}{1+y^2} + \frac{2e^x}{1+e^{2x}}dx = 0$

on integration

$\tan^{-1} y + 2\tan^{-1} e^x = c$

$\because y(0) = 0$

so, $C = \frac{\pi}{2} \Rightarrow \tan^{-1} y + 2\tan^{-1} e^x = \frac{\pi}{4}$

from eq.(i), $\left(\frac{dy}{dx}\right)_{x=0} = -1$

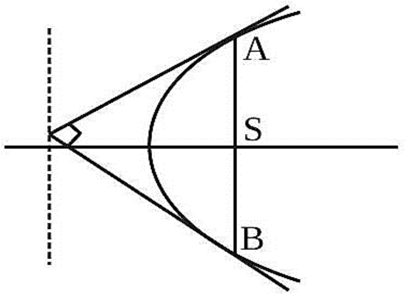
$\arg y(\ln\sqrt{3}) = -\frac{1}{\sqrt{3}}$

$6\left[y'(0) + (y(\ln\sqrt{3})^2\right] = 6\left[-1 + \frac{1}{3}\right] = -4$

**70. (d)** Lines making angle $\frac{\pi}{4}$ with $y = 3x + 5$

have slope $-2\&1/2$.

Which are perpendicular to each-other so, A, S, Bare collinear for all $a > 0$.




**71. (d)**

**72. (b)** $(2, -1, -3)$ satisfy the given plane.

So $2p + q = 8$

Also given line is perpendicular to normal plane so $3p + 2q - 1 = 0$
$\Rightarrow p = 15, q = -22$

Eq. of plane $15x - 22y + z - 5 = 0$

its distance from origin $= \frac{6}{\sqrt{710}} = \sqrt{\frac{5}{142}}$

**73. (c)** $AB \equiv x - 2y + 1 = 0$

$AC \equiv 2x - y - 1 = 0$

So $A(1,1)$

Altitude from B is $BH = x + 2y - 7 = 0 \Rightarrow B(3,2)$

Altitude from C is $CH = 2x + y - 7 = 0 \Rightarrow C(2,3)$

Centroid of $\triangle ABC = E(2,2) OE = 2\sqrt{2}$

**74. (b)** Image of $P(1,2,1)$ in $x + 2y + 2z - 16 = 0$ is given by $Q(4,8,7)$

Eq. of plane $T = \begin{vmatrix} x & y & z+1 \\ 4 & 8 & 6 \\ 1 & 1 & 2 \end{vmatrix} = 0$

$\Rightarrow 2x - z = 1$ so $B(1,2,1)$ lies on it.

**75. (a)**

$\overrightarrow{AB} \parallel \overrightarrow{AC}$ if $\frac{1}{2} = \frac{\alpha - 4}{-6} = \frac{1}{2} \Rightarrow \alpha = 1$

$\vec{a}, \vec{b}, \vec{c}$ are non-collinear for $\alpha = 2$ (smallest positive integer)

Mid-point of BC $= M\left(\frac{5}{2}, 0, \frac{9}{2}\right)$

$$AM = \sqrt{\frac{9}{4} + 16 + \frac{9}{4}} = \frac{\sqrt{82}}{2}$$

**76. (a)** Total no. of relations $= 2^{2\times 2} = 16$

Fav. relation $= \phi, \{(x,x)\}, \{(y,y)\}, \{(x,x)(y,y)\}$

$\{(x,x), (y,y), (x,y)(y,x)\}$

Prob. $= \frac{5}{16}$

**77. (a)** Mean $= 13$

Variance $= \frac{9+49+144+a^2+(43-a)^2}{5} - 13^2 \in N$

$$\Rightarrow \frac{2a^2 - a + 1}{5} \in N$$

$\Rightarrow 2a^2 - a + 1 - 5n = 0$ must have solution as

natural numbers

its $D = 40n - 7$ always has 3 at unit place

$\Rightarrow$ D can't be perfect square

So, a can't be integer.

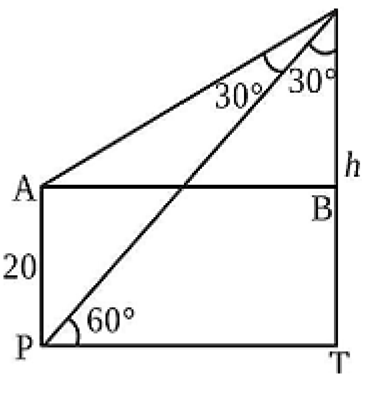
**78. (d)**

$$PT = \frac{h}{\sqrt{3}} = AB$$

$$\frac{AB}{h - 20} = \sqrt{3}$$

$h = 3(h - 20)$

$h = 30$




**79. (c)** $P \vee q \Rightarrow (\sim r \vee p)$

$\equiv \sim (p \vee q) \vee (\sim r \vee p)$

$\equiv (\sim p \wedge \sim q) \vee (p \vee \sim r)$

$\equiv [\sim p \vee p) \wedge (\sim q \vee p)] \vee \sim r$

$\equiv [\sim q \vee p) \vee \sim r$

Its negation is $\sim p \wedge q \wedge r$

**80. (c)** $\alpha = \frac{(1+8)^n - 8n - 1}{64} = {}^nC_2 + {}^nC_3 8 + {}^nC_4 8^2 + \cdots$

$\beta = {}^nC_2 + {}^nC_3 5 + {}^nC_4 5^2 + \cdots.$

***81.*** $\vec{a} + \vec{b} \times \vec{c} = 0$

$\vec{a} \times \vec{b} + |\vec{b}|^2 \vec{c} - 5\vec{b} = 0$

*It gives* $\vec{c} = \frac{1}{3}(10\hat{\imath} + 3\hat{\jmath} + 2\hat{k})$

*so* $3\vec{a} \cdot \vec{c} = 10$

*But it does not satisfy* $\vec{a} + \vec{b} \times \vec{c} = 0.$

**82. (14)**

$\frac{dy}{dx} + \frac{2x}{x-1} \cdot y = \frac{1}{(x-1)^2}$

$$y = \frac{1}{(x-1)^2}\left[\frac{e^{2x} + 1}{2e^{2x}}\right]$$

$$y(3) = \frac{e^6 + 1}{8e^6}$$

$\alpha + \beta = 14$

**83. (2223)** For series of common terms

$a = 9, d = 12, n = 19$

$$S_{19} = \frac{19}{2}[2(9) + 18(12)] = 2223$$

**84. (4)**

$\sin^2 x + \sin x - 1 = 0$

$$\sin x = \frac{-1 + \sqrt{5}}{2} = +\text{ve}$$

Only 4 roots

**85. (12)** given $\pi a^2 - \pi ab = 30\pi$ and $\pi ab - \pi b^2 = 18\pi$ on subtracting, we get $(a-b)^2 = a^2 - 2ab + b^2 = 12$

**86. (4)** Let $h(x) = f(x)g'(x) \rightarrow 5$ roots

$\because$ f(x) is even $\Rightarrow$

$f\left(\frac{1}{4}\right)=f\left(\frac{1}{2}\right)=f\left(-\frac{1}{2}\right)=f\left(\frac{1}{4}\right)=0$

g(x) is even $\Rightarrow g\left(\frac{3}{4}\right)=g\left(-\frac{3}{4}\right)=0$

$g'(x)=0$ has minimum one root

$h'(x)$ has at last 4 roots

**87. (5)** $T_{r+1}=(-1)^r\cdot{}^{15}C_r\cdot 2^{15-r}x^{\frac{15-2r}{5}}$

$m={}^{15}C_{10}2^5$

$n=-1$

so $mn^2={}^{15}C_5 2^5$

**88. (1086)** Let the number is abcd, where a,b,c are divisible by d.

No. of such numbers

$d=1,$

$9\times10\times10=900$

$d=2$

$4\times5\times5=100$

$d=3$

$3\times4\times4=48$

$d=4$

$2\times3\times3=18\ 1\times2\times2=4$

$d=6,7,8,9\ 4\times4=16$

1086

**89. (1)**

$M=\begin{bmatrix}0 & -\alpha\\ \alpha & 0\end{bmatrix}; M^2=\begin{bmatrix}-\alpha^2 & 0\\ 0 & -\alpha^2\end{bmatrix}=-\alpha^2 I$

$N=M^2+M^4+\cdots\ldots.+M^{98}=[-\alpha^2+\alpha^4-\alpha^6+\cdots.]I$

$=-\alpha^2\frac{\left(1-(-\alpha^2)^{49}\right)}{1+\alpha^2}\cdot I$

$I-M^2=(1+\alpha^2)I$

$(I-M^2)N=-\alpha^2(\alpha^{98}+1)=-2$

$\alpha = 1$

**90. (18)**

$f(g(x)) = 8x^2 - 2x$

$g(f(x)) = 4x^2 + 6x + 1$

So, $g(x) = 2x - 1 \;\; g(2) = 3$

$\&f(x) = 2x^2 + 3x + 1$

$f(2) = 8 + 6 + 1 = 15$

Ans. 18