1. **(b)** According to law of conservation of momentum,

$$100v = -\frac{10}{1000} \times 10 \times 800$$
$$\text{i.e., } v = 0.8\ \text{ms}^{-1}$$

2. **(b)**

$$\text{(i) } v = u + at_1$$
$$40 = 0 + a \times 20$$
$$a = 2\ \text{m/s}^2$$
$$v^2 - u^2 = 2as$$
$$40^2 - 0 = 2 \times 2\ s_1$$
$$s_1 = 400\ \text{m}$$
$$\text{(ii) } s_2 = v \times t_2 = 40 \times 20 = 800\ \text{m}$$
$$\text{(iii) } v = u + at$$
$$0 = 40 + a \times 40$$
$$a = -1\ \text{m/s}^2$$
$$0^2 - 40^2 = 2(-1)s_3$$
$$s_3 = 800\ \text{m}$$
$$\text{Total distance travelled } = s_1 + s_2 + s_3$$
$$= 400 + 800 + 800 = 2000\ \text{m}$$
$$\text{Total time taken } = 20 + 20 + 40 = 80\ \text{s}$$
$$\text{Average velocity } = \frac{2000}{80} = 25\ \text{m/s}$$

3. **(c)** Initially $u = \cos\theta\hat{i} + u\sin\theta\hat{j}$.
At highest point $v = u\cos\theta\hat{i}$
$\therefore$ difference is $u\sin\theta$.
4. **(a)**

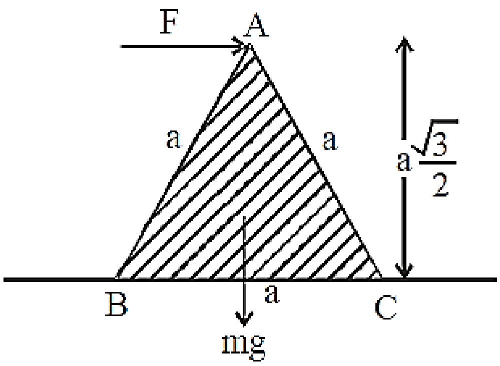
$$[MLT^{-2}] = [L^{2a}] \times [L^bT^{-b}][M^cL^{-3c}]$$
$$= [M^c\, L^{2a+b-3c}T^{-b}]$$

Comparing powers of M, L and T, on both sides, we get

$c = 1, 2a + b - 3c = 1, -b = -2$ or $b = 2$

Also, $2a + 2 - 3(1) = 1 \Rightarrow 2a = 2$ or $a = 1$
$\therefore$ This is 1,2,1

5. **(b)** Since surface (ice) is frictionless, so the centripetal force required for skating will be provided by inclination of boy with the vertical and that angle is given as $\tan\theta = \frac{v^2}{rg}$ where v is speed of skating & r is radius of circle in which he moves.
6. **(c)**
7. **(a)** The tendency of rotation will be about the point C.



For minimum force, the torque of F about C has to be equal to the torque of mg about C.

$$\therefore\ F\left(a\frac{\sqrt{3}}{2}\right) = mg\left(\frac{a}{2}\right) \Rightarrow F = \frac{mg}{\sqrt{3}}$$

8. (c)

9. (d)

10. (b) $\Delta W \quad = S \times \Delta A = 0.06 \times 4\pi(r_2^2 - r_1^2)$
$= 0.003168\,J$

11. (d)

12. (d)

13. (c)

Given $\Delta Q = -20\,J, W = -8\,J$
Using Ist law $\Delta Q = \Delta U + \Delta W$
$\Rightarrow \Delta Q = -20 + 8 = -12\,J$
$Uf\ = -12 + 30 = 18\,J$

14. (d)

15. (b) Assuming the balloons have the same volume, as $pV = nRT$. If P, V and T are the same, n the number of moles present will be the same, whether it is He or air. Hence, number of molecules per unit volume will be same in both the balloons.

16. (b)

$x_1 = a\sin(\omega t + \phi_1), x_2 = a\sin(\omega t + \phi_2)$

$\Rightarrow\ |x_1 - x_2| = 2a\sin\left(\omega t + \frac{\phi_1 + \phi_2}{2}\right)\cos\left(\frac{\phi_1 - \phi_2}{2}\right)$

Tomaximize $|x_1 - x_2|: \sin\left(\omega t + \frac{\phi_1 + \phi_2}{2}\right) = 1$

$\Rightarrow a\sqrt{2} = 2a \times 1 \times \cos\left(\frac{\phi_1 - \phi_2}{2}\right)$

$\Rightarrow \frac{1}{\sqrt{2}} = \cos\left(\frac{\phi_1 - \phi_2}{2}\right) \Rightarrow \frac{\pi}{4} = \frac{\phi_1 - \phi_2}{2}$

$\Rightarrow \phi_1 - \phi_2 = \frac{\pi}{2}$

17. (d)

$$T = 2\pi\sqrt{\frac{R}{g}} = 2\pi\sqrt{\frac{64\times10^6}{9.8}}$$
$$= 2\times\frac{22}{7}\times\frac{8\times10^3}{7\times\sqrt{2}}$$

$$= \frac{\sqrt{2}\times22\times8\times1000}{49\times60}\text{ min} = 84.6\text{ min}$$

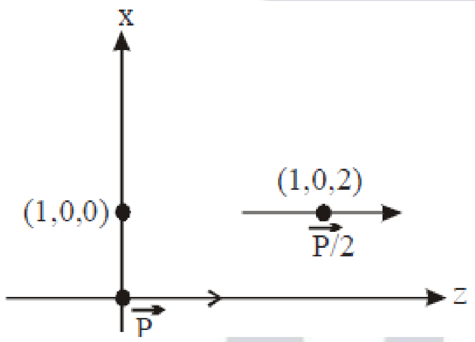
18. (d)

19. (c) Fundamental frequency is given by

$$v = \frac{1}{2l}\sqrt{\frac{T}{\mu}} \Rightarrow v \propto \frac{1}{l} \Rightarrow P \propto \frac{1}{v}$$

Since, P divided into l_1, l_2 and l_3 segments
Here $l = l_1 + l_2 + l_3$
So $\frac{1}{v} = \frac{1}{v_1} + \frac{1}{v_2} + \frac{1}{v_3}$

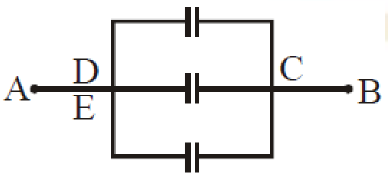
20. (b)



The given point is at axis of $\frac{\vec{P}}{2}$ dipole and at equatorial line of $\vec{p}$ dipole so that field at given point.

21. (a) $V = -\int_{\infty}^{x} E.dr = -\int_{\infty}^{x}\frac{M}{x^3}dx = \frac{M}{2x^2}$

22. (d) $C_{eq} = (1+2+3)\mu F = 6\mu F$



23. (c) $V = \int_a^b E.d\ell = \frac{\lambda}{2\pi\varepsilon_0 r}\ln\left(\frac{b}{a}\right)$

Now, $I = \sigma\int\vec{E}\cdot\overrightarrow{dA} = \sigma\int\frac{\lambda}{2\pi\varepsilon_0 r}\cdot 2\pi dr = \frac{\sigma\lambda}{\varepsilon_0}$
From (1): $I = \frac{2\sigma\pi\varepsilon_0}{\varepsilon_0\ln(b/a)} = \frac{2\pi\sigma}{\ln(b/a)}v$

24. (c) $R \propto \frac{\ell}{D^2} \Rightarrow \frac{Rx}{Ry} = \frac{2}{1}$

25. **(b)** Since, the radius of circular path of a charged particle in magnetic field is $r=\frac{mv}{qB}=\frac{\rho}{qB}$ Now, the radius of circular path of charged particle of given momentum ρ and magnetic field B is given by $r \propto \frac{1}{q}$

But charge on both charged particles, protons and deuterons, is same. Therefore,

$$\frac{r_\rho}{r_D}=\frac{q_D}{q_\rho}=\frac{1}{1}$$

26. **(c)** $R_G=60.00\Omega$, shunt resistance, $r_s=0.02\Omega$

Total resistance in the circuit is $R_G+3=63\Omega$

Hence, $I=3/63=0.048\ A$

Resistance of the galvanometer converted to an ammeter is,

$$\frac{R_G r_s}{R_G+r_s}=\frac{60\Omega\times 0.02\Omega}{(60+0.02)\Omega}=0.02\Omega$$

Total resistance in the circuit $=0.02+3$

$=3.02\Omega$

Hence, $I=3/3.02=0.99\ A$

27. **(b)**

$$\chi=\frac{C}{T}$$

$$\Rightarrow \frac{\chi_1}{\chi_2}=\frac{T_2}{T_1}\Rightarrow\frac{1.2\times10^{-5}}{1.8\times10^{-5}}=\frac{T_2}{300}$$

$$\Rightarrow T_2\Rightarrow\frac{12}{18}\times300=200\ K$$

28. **(c)**

Given : $n=10$ turns, $R_{coil}=20\Omega, R_G=30\Omega$,

Total resistance in the circuit $=20+30$

$=50\Omega.$

$A=10^{-2}\ m^2, B=10^{-2}\ T, \phi_1=0^\circ, \phi_2=60^\circ$

$$q=\frac{\phi_1-\phi_2}{R}=\frac{BnA\cos\theta_1-BnA\cos\theta_2}{R}$$

$$=\frac{BnA(\cos 0-\cos 60)}{R}=\frac{BnA(1-0.5)}{R}$$

$$=\frac{0.5\times10^{-2}\times10\times10^{-2}}{50}=\frac{50\times10^{-5}}{50}$$

$=1\times10^{-5}C$ (Charge induced in a coil)

29. **(c)** Given $V=50\sin(50t)V$

Maximum voltage, $V_0=50\ V$,

$$i=\left(50t+\frac{\pi}{3}\right)mA.$$

Maximum current, $i_0=50\ mA=50\times10^{-3}\ A$

Power dissipated, $P=\frac{i_0}{\sqrt2}\times\frac{V_0}{\sqrt2}$

$$=\frac{50\times50\times10^{-3}}{2}=\frac{2500\times10^{-3}}{2}=1.25\ W$$

30. **(a)**

31. (a)

$$\frac{f_0}{f_e} = 9, \quad \therefore f_0 = 9f_e$$

Also $f_0 + f_e = 20$ ($\because$ final image is at infinity)

$9f_e + f_e = 20, f_e = 2$ cm, $\therefore f_0 = 18$ cm

32. (b) Angular size of central maxima is

$$2 \times \left(\frac{\lambda}{a}\right) = \frac{2\lambda}{a}$$

33. (d) From the first polaroid

$$I' = \frac{I_0}{2}$$

From second polaroid

$$\begin{aligned} I'' &= I'\cos^2\theta = \frac{I_0}{2}\cos^2(60^\circ) \\ &= \frac{I_0}{2} \times \left(\frac{1}{2}\right)^2 = \frac{I_0}{8} \end{aligned}$$

34. (a)

$$K_{max} = h\nu - h\nu_0 = hc\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$$

$$1.24 \times 10^{-6}\left(\frac{10^8}{18} - \frac{10^8}{23}\right) = 1.49\text{eV}$$

35. (c)

36. (d) Radius of the orbit, $r_n \propto n^2$

$$\begin{aligned} \frac{r_{n\text{ big}}}{r_{n\text{ small}}} &= \frac{n_{\text{big}}^2}{n_{\text{small}}^2} = \frac{4}{1} \\ \Rightarrow \frac{n_{\text{big}}}{n_{\text{small}}} &= 2 \\ \Rightarrow \frac{n_{\text{small}}}{n_{\text{big}}} &= \frac{1}{2} \end{aligned}$$

(given)

Velocity of electron in n^{th} orbit

$$\begin{aligned} v_n &\propto \frac{1}{n} \\ \frac{v_{n\text{ big}}}{v_{n\text{ small}}} &= \frac{n_{\text{small}}}{n_{\text{big}}} = \frac{1}{2} \\ \Rightarrow v_{n\text{ small}} &= 2(v_{n\text{ big}}) = 2v \end{aligned}$$

37. (d) In an explosion a body breaks up into two pieces of unequal masses both part will have numerically equal momentum and lighter part will have more velocity.

$U \rightarrow Th + He$

$KE_{Th} = \frac{P^2}{2\ m_{Th}}, KE_{He} = \frac{P^2}{2\ m_{He}}$

sinc m_{He} is less so KE_{He} will be more.

38. (d) $r = r_0(A)^{1/3}$

r increases with increasing A mass number

So, $r_A < r_B$ as mass number of A is smaller

E_{bn} decreases with increasing A for $A > 56$, ^{56}Fe has highest E_{bn} value.

So, E_{bn} for $A = 64$ is larger as compared to E_{bn} for nucleus with $A = 125$

$E_{bnA} > E_{bnB}$

39. (a) The output ac voltage is 2.0 V. So, the ac collector current $i_C = 2.0/2000 = 1.0$ mA. The signal current through the base is, therefore given by $i_B = i_C/\beta = 1.0\ mA/100 = 0.010$ mA.

The dc base current has to be $10 \times 0.010 = 0.10$ mA.

$R_B = (V_{BB} - V_{BE})/I_B$.

Assuming $V_{BE} = 0.6\ V, R_B = (2.0.0.6)/0.10$

$= 14k\Omega$.

40. (a) The final boolean expression is, $X = \overline{(\bar{A} \cdot \bar{B})} = \bar{\bar{A}} + \bar{\bar{B}} = A + B \Rightarrow$ OR gate

41. (c) Formation of CO and CO_2 illustrates the law of multiple proportion that is constant mass of C reacts with different masses of oxygen. These masses here bears simple ratio of 1: 2.

42. (b) $R_H = 109678\ cm^{-1}$

Wave number of the limiting line in Balmer series of He^+

$= R_H \cdot Z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$= 109678 \times (2)^2 \left[\frac{1}{(2)^2} - \frac{1}{\infty}\right]$

$= 109678\ cm^{-1}$

43. (c) The element A is ns^2p^1 and B is ns^2p^4. They can form compound of the type $A_2\ B_3$.

44. (b) Heat needed too be supplied

per mol $= 330 + 580 + 1820 + 2740$

$= 5470$ kJ

No. of mols of Al taken $= \frac{13.5}{27} = 0.5$ mol Heat required $= 0.5 \times 5470$ kJ $= 2735$ kJ

45. (d) BF_4^-hybridisation sp^3, tetrahedral structure.

NH_4^+hybridisation sp^3, tetrahedral structure.

46. (b) We know that in O_2 bond, the order is 2 and in O_2^-bond, the order is 1.5. Therefore, the wrong statements is (b).

47. (a) Given enthalpy of vaporization,

$\Delta H = 186.5\ kJ\ mol^{-1}$

Boiling point of water

$= 100°C = 100 + 273 = 373$ K

Entropy change,

$$\Delta S = \frac{\Delta H}{T} = \frac{186.5 \text{ kJ mol}^{-1}}{373 \text{ K}}$$
$$= 0.5 \text{ kJ mol}^{-1} \text{ K}^{-1}$$

48. (a) The greater the (negative value) of heat of neutralisation, the more is the strength of the acid. Hence,

$HCOOH > CH_3COOH > H_2S > HCN$

49. (d)

50. (b)

KCl$x = -1$
potassium chloride

$KClO_3$
$+1 + x - 6 = 0$
$x = +5$
potassium chlorate

$$\therefore \text{ Ratio of oxidation state of Cl} = \frac{-1}{5}$$

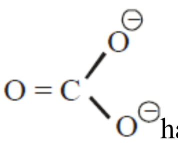
51. (d) Amongst alkali metals, Cs is most reactive because of its lowest IE.

52. (c)

53. (b)

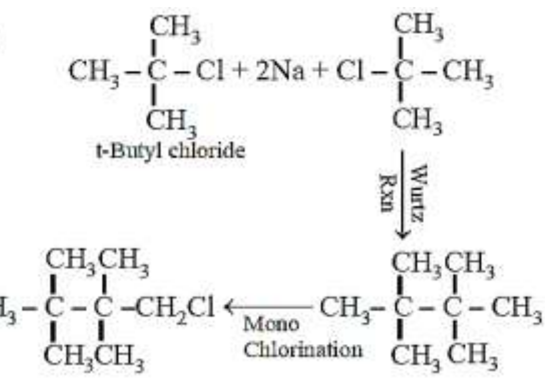
$$\underset{\text{tertiary alcohol}}{(CH_3)_3C-OH} \xrightarrow[-H_2O]{+H^+} \underset{\substack{3° \text{ carbocation} \\ \text{(more stable)}}}{(CH_3)_3C^+}$$

54. (a) $C \equiv O$ has lowest bond length due to highest bond order. $O = C = O$ has second lowest bond length due to double bond.


has highest has bond length due to lowest bond order which is due to resonance.

55.

(a)



56. (a) Normal rain water has pH 5.6. Thunderstorm results in the formation NO and HNO_3 which lowers the pH.

57. (a) The packing efficiency $=0.68$, means the given lattice is BCC.
The closest distance of approach $=2r$

$$2r = 2.86\text{Å} = a\sqrt{3}$$
$$\text{or } a = \frac{2 \times 2.86}{\sqrt{3}} = 3.30\text{Å}$$

Let atomic weight of the element $= a$

$$\therefore \frac{2 \times 9}{36 \times 10^{23} \times (3.3)^3 \times 10^{-24}} = 8.57$$
$$a = 8.57 \times 3 \times (3.3)^3 \times 0.1$$
$$= 92.39 \simeq 93\text{amu}$$

58. (d) The correct order of solublity of sulphides is $Na_2S > ZnS > CuS$

59. (d)

60. (c)

$$2Cu^+ \longrightarrow Cu^{+2} + Cu$$
$$2e^- + Cu^{+2} \longrightarrow Cu; E_1^\circ = 0.34\text{ V};$$
$$e^- + Cu^{+2} \longrightarrow Cu^+; E_2^\circ = 0.15\text{ V};$$
$$Cu^+ + e^- \rightarrow Cu; E_3^\circ = ?$$

Now, $\Delta G_1^\circ = -nFE_1^\circ = -2 \times 0.34\text{ F}$

$\Delta G_2^\circ = -1 \times 0.15\text{ F}, \ \Delta G_3^\circ = -1 \times E_3^\circ F$

Again, $\Delta G_1^\circ = \Delta G_2^\circ + \Delta G_3^\circ$

$$\Rightarrow -0.68\text{ F} = -0.15\text{ F} - E_3^\circ F$$
$$0 \Rightarrow E_3^\circ = 0.68 - 0.15 = 0.53\text{ V}$$
$$E_{cell}^\circ = E_{cathode}^\circ (Cu^+/Cu)$$
$$-E_{anode}^\circ (Cu^{+2}/Cu^+)$$
$$= 0.53 - 0.15 = 0.38\text{ V}.$$

61. (a)

$$\frac{1}{2}\frac{d[SO_4^{2-}]}{dt} = \frac{1}{3}\left(-\frac{d(I^-)}{dt}\right)$$
$$\frac{1}{2} \times \frac{d[SO_4^{2-}]}{dt} = \frac{1}{3} \times \frac{9}{2} \times 10^{-3}$$
$$\therefore \frac{d[SO_4^{2-}]}{dt} = 3 \times 10^{-3}\text{ molLit}^{-1}\text{ s}^{-1}$$

62. (a) The increase in pressure shows the increase in conc. of Z. Rate of appearance of Z $= \frac{120-100}{5} = 4\text{ mm min}^{-1}$
Rate of disappearance of $X_2 = 2 \times$ rate of appearance of Z

$= 2 \times 4\text{ mm min}^{-1} = 8\text{ mm min}^{-1}$

63. (a)

Substance R Substance S
2k k rate constant
$t_{1/2}$ $2t_{1/2}$ Half life period
$T' = n \times t_{1/2}$

where n $\overset{=}{=}$ number of half life period
Amount of R left $= \frac{0.5}{(2)^{T/t_{1/2}}}$;
Amount of S left $= \frac{0.25}{(2)^{T/2t_{1/2}}}$
Equating both $\frac{0.5}{0.25} = \frac{(2)^{T/t_{1/2}}}{(2)^{T/2t_{1/2}}}$
or $2 = (2)^{T/t_{1/2}}$
$\therefore T = 2t_{1/2} \cdot 2t_{1/2}$ is half life of S and twice the half-life of R

64. (b) At isoelectric point there is no migration of dispersed phase in an electric field.
65. (c) Fluorine, since it is the most electronegative element.
66. (c) I_2 gives blue colour with starch.
67. (d) The amount of energy released when an electron is added to an isolated gaseous atom to produce a monovalent anion is called electron gain enthalpy.

Electron affinity value generally increase on moving from left to right in a period however there are exceptions of this rule in the case of those atoms which have stable configuration. These atoms resist the addition of extra electron, therefore the low value of electron affinity

$\underset{-1.48}{O} < \underset{-2.0}{S} < \underset{-3.6}{F} < Cl$

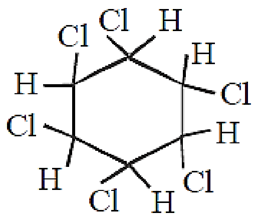
On the other hand Cl, because of its comparatively bigger size than F, allow the addition of an extra electron more easily.

68. (d) Most of the transition metal compounds (ionic as well as covalent) are coloured both in the solid state and in aqueous solution in contrast to the compounds of s and p-block elements due to the presence of incomplete d-subshell.
69. (c) Number of unpaired electrons in central atom

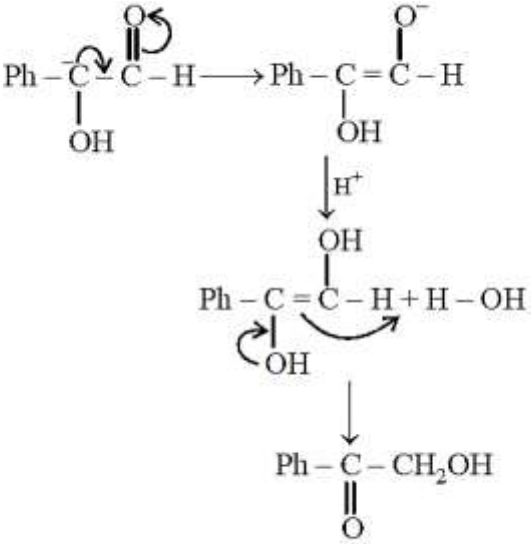
$\underset{\text{zero}}{[Fe(CN)_6]^{4-}}, \underset{\text{three}}{[CoCl_4]^{2-}}, \underset{\text{five}}{[MnCl_4]^{2-}}$

The greater the number of unpaired electrons, the higher the value of magnetic moment

70. (a) Gammexane is $C_6H_6Cl_6$ or (6,6,6). It is a saturated compound so no double bond is there in it.



71. (d)



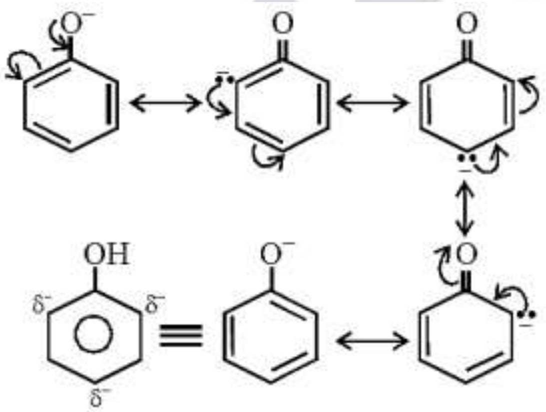
72. (a) Electron withdrawing group $(-NO_2)$ increases the acidity while electron releasing group $(-CH_3, -H)$ decreases acidity. Also effect will be more if functional group is present at para position than ortho and meta position

73. (c) The acidic nature of phenol is due to the formation of stable phenoxide ion in solution

$$C_6H_5OH + H_2O \rightleftharpoons \underset{\text{Phenoxide ion}}{C_6H_5O^-} + H_3O^+$$

The phenoxide ion is stable due to resonance.

The phenoxide ion is stable due to resonance.



The negative charge is delocalized in the benzene ring which is a stabilizing factor in the phenoxide ion and increase acidity of phenol. wheras no resonance is possible in alkoxide ions (RO^-)derived from alcohol. The negative charge is localized on oxygen atom. Thus, alcohols are not acidic.

74. (b)

$$C_6H_5NH_2 + COCl_2 \longrightarrow C_6H_5NH.COCl$$

$$+HCl \xrightarrow{\Delta} C_6H_5NCO + HCl$$

75. (d)

76. (d)

$$nCH_2 = CH - \underset{\text{Chloroprene}}{\overset{Cl}{\overset{|}{C}}} = CH_2 \xrightarrow{K_2S_2O_8}$$

$$\left(CH_2 - CH = \overset{Cl}{\overset{|}{C}} - CH_2 \right)_n$$

Neoprene

77. (b)

78. (b) Oxytocin is a hormone (nanopetide) which contracts uterus after the child birth and produces lactation in the mammary glands

79. (c) Cu^{2+} is of group II and Al^{3+} is of group III of cation analysis.

80. (a) Eq of $KMnO_4$ used $= \frac{50\times1}{1000\times10} = 0.005$

$\therefore$ Eq of FAS reacted $= 0.005$

$\therefore$ weight of FAS needed

$= 0.005 \times 392 = 1.96$ g

Thus percentage purity of FAS is 50%

81. (b) Given set can be written as

$(A - B) \cup (B - A) = (A \cup B) - (A \cap B)$

(By definition of symmetric difference) Hence, $(A \setminus B) \cup (B \setminus A) = (A \cup B) \setminus (A \cap B)$

82. (a)

$f(x)$ is defined if

$$-\log_{1/2}\left(1 + \frac{1}{x^{1/4}}\right) - 1 > 0$$
$$\Rightarrow \log_{1/2}\left(1 + \frac{1}{x^{1/4}}\right) < -1$$
$$\Rightarrow 1 + \frac{1}{x^{1/4}} > \left(\frac{1}{2}\right)^{-1}$$
$$\Rightarrow \frac{1}{x^{1/4}} > 1$$
$$\Rightarrow 0 < x < 1$$

83. (a)

$$\cos^2\left(\frac{\pi}{6} + \theta\right) - \sin^2\left(\frac{\pi}{6} - \theta\right)$$
$$= \cos\left(\frac{\pi}{6} + \theta + \frac{\pi}{6} - \theta\right)\cos\left(\frac{\pi}{6} + \theta - \frac{\pi}{6} + \theta\right)$$
$$= \cos\frac{2\pi}{6}\cos 2\theta = \frac{1}{2}\cos 2\theta$$

84. (b) We have $(2\cos x - 1)(3 + 2\cos x) = 0$

If $2\cos x - 1 = 0$, then $\cos x = \frac{1}{2} \therefore\ x = \pi/3, 5\pi/3$

If $3 + 2\cos x = 0$, the $\cos x = -3/2$ which is not possible.

85. (c)

$2^{3n}-7n-1$
$2^{6}-7\times 2-1$ Taking $n=2$;
$=64-15=49$

Therefore, this is divisible by 49.

86. (c) The product of r consecutive integers is divisible by r ! . Thus $n(n+1)(n+2)(n+3)$ is divisible by $4!=24$.

87. (d)

$$z^{1/3}=a-ib \Rightarrow z=(a-ib)^3$$
$$\therefore\ x+iy=a^3+ib^3-3ia^2b-3ab^2$$
$$\Rightarrow x=a^3-3ab^2 \Rightarrow \frac{x}{a}=a^2-3b^2$$

and $y=b^3-3a^2b \Rightarrow \frac{y}{b}=b^2-3a^2$
So, $\frac{x}{a}-\frac{y}{b}=4(a^2-b^2)$

88. (a)

$$i^{57}+\frac{1}{i^{25}}=(i^4)^{14}\cdot i \quad +\frac{1}{(i^4)^6\cdot i}$$
$$=i+\frac{1}{i}(\because i^4=1) \quad =i-i\left(\because \frac{1}{i}=-i\right)$$
$$=0$$

89. (a) $\left|\frac{z-3i}{z+3i}\right|=1 \Rightarrow |z-3i|=|z+3i|$
[if $|z-z_1|=|z+z_2|$, then it is a perpendicular bisector of z_1 and z_2] Hence, perpendicular bisector of $(0,3)$ and $(0,-3)$ is X-axis.

90. (c) The number of three elements subsets containing a_3 is equal to the number of ways of selecting 2 elements out of $n-1$ elements. So, the required number of subsets is ${}^{n-1}C_2$.

91. (a) A committee of 5 out of $6+4=10$ can be made in ${}^{10}C_5=252$ ways.
If no woman is to be included, thennumber of ways $={}^{5}C_5=6$
$\therefore$ the required number $=252-6=246$

92. (c)

Wehave coefficient of x^4 in $(1+x+x^2+x^3)^{11}$
$=$ coefficient of x^4 in $(1+x^2)^{11}(1+x)^{11}$
$=$ coefficient of x^4 in $(1+x)^{11}+$ coefficient of x^2 in
$11.(1+x)^{11}+$ constant term is ${}^{11}C_2\cdot(1+x)^{11}$
$={}^{11}C_4+11.\,{}^{11}C_2+{}^{11}C_2=990.$

93. (b) From the given condition, replacing a by ai and - ai respectively, we get

$(x+ai)^n=(T_0-T_2+T_4-\cdots\ldots)+i(T_1-T_3+T_5-\cdots.)$

and

$(x-ai)^n=(T_0-T_2+T_4-\cdots\ldots.)-i(T_1-T_3+T_5-\cdots.)$

Multiplying (ii) and (i) we get required result i.e.,

$(x^2+a^2)^n=(T_0-T_2+T_4-\cdots.)^2+(T_1-T_3+T_5-\cdots.)^2$

94. (d) If a is the first term and d is the common difference of the associated A.P.

$$\frac{1}{q}=\frac{1}{a}+(2p-1)d,\frac{1}{p}=\frac{1}{a}+(2q-1)d$$
$$\Rightarrow d=\frac{1}{2pq}$$

Ifh is the $2(p+q)^{\text{th}}$ term $\frac{1}{h}=\frac{1}{a}+(2p+2q-1)d$

$=\frac{1}{q}+\frac{1}{p}=\frac{p+q}{pq}$.

95. (a)

$$\frac{1}{\mathrm{a}}-\frac{1}{\mathrm{b}}=\frac{1}{\mathrm{b}}-\frac{1}{\mathrm{c}}$$
$$\therefore\left(\frac{1}{\mathrm{a}}+\frac{1}{\mathrm{b}}-\frac{1}{\mathrm{c}}\right)\left(\frac{1}{\mathrm{b}}+\frac{1}{\mathrm{c}}-\frac{1}{\mathrm{a}}\right)$$
$$=\left(\frac{2}{\mathrm{a}}-\frac{1}{\mathrm{b}}\right)\left(\frac{2}{\mathrm{c}}-\frac{1}{\mathrm{b}}\right)=\frac{4}{\mathrm{ac}}-\frac{1}{\mathrm{b}}\left(\frac{2}{\mathrm{a}}+\frac{2}{\mathrm{c}}\right)+\frac{1}{\mathrm{b}^2}$$
$$=\frac{4}{\mathrm{ac}}-\frac{2}{\mathrm{b}}\left(\frac{2}{\mathrm{b}}\right)+\frac{1}{\mathrm{b}^2}=\frac{4}{\mathrm{ac}}-\frac{3}{\mathrm{b}^2}$$

96. (d) Since, product of n positive number is unity.

$\Rightarrow x_1x_2x_3\ldots\ldots x_n=1$

UsingA.M. $\geq$ GM

$$\Rightarrow\frac{x_1+x_2+\cdots.+x_n}{n}\geq(x_1x_2\ldots\ldots x_n)^{\frac{1}{n}}$$
$$\Rightarrow x_1+x_n+\cdots\ldots+x_n\geq n(1)^{\frac{1}{n}}[\text{ From eq e}^{\text{n}}(\text{i})]$$

97. (a) We have $\mathrm{P}_1=$ length of perpendicular from $(0,0)$ on $\mathrm{x}\sec\theta+\mathrm{y}\operatorname{cosec}\theta=\mathrm{a}$ i.e.

$$\mathrm{P}_1=\left|\frac{\mathrm{a}}{\sqrt{\sec^2\theta+\operatorname{cosec}^2\theta}}\right|=|\mathrm{a}\sin\theta\cos\theta|$$
$$=\left|\frac{\mathrm{a}}{2}\sin2\theta\right|\text{ or }2\mathrm{P}_1=|\mathrm{a}\sin2\theta|$$

$\mathrm{P}_2=$ Length of the perpendicular from $(0,0)$ on

$$\mathrm{x}\cos\theta-\mathrm{y}\sin\theta=\mathrm{a}\cos2\theta$$
$$\mathrm{P}_2=\left|\frac{\mathrm{a}\cos2\theta}{\sqrt{\cos^2\theta+\sin^2\theta}}\right|=|\mathrm{a}\cos2\theta|$$

Now, $4{\mathrm{P}_1}^2+{\mathrm{P}_2}^2=\mathrm{a}^2\sin^22\theta+\mathrm{a}^2\cos^22\theta=\mathrm{a}^2$.

98. (d) Here circles are

$$x^2+y^2-2x-2y=0$$
$$x^2+y^2=4$$

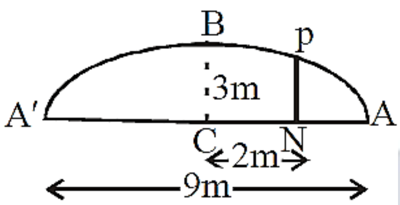
Now, $C_1(1,1), r_1=\sqrt{1^2+1^2}=\sqrt{2}$

$C_2(0,0), r_2=2$

If θ is the angle of intersection then

$$\cos\theta=\frac{r_1^2+r_2^2-(c_1c_2)^2}{2r_1r_2}$$
$$=\frac{2+4-(\sqrt{2})^2}{2\cdot\sqrt{2}2.2}=\frac{1}{\sqrt{2}}\Rightarrow\theta=45^\circ$$

99. (b)



The equation of the ellipse is

$$\frac{x^2}{\left(\frac{9}{2}\right)^2}+\frac{y^2}{9}=1.$$

Where centre is assumed as origin and base as x-axis. Put $x=2$, we get

$$\frac{16}{81}+\frac{y^2}{9}=1\Rightarrow y=\frac{\sqrt{65}}{3}\approx\frac{8}{3}m$$

(approximately)

100. **(c)** Let $y=\lim_{x\to 0}(\operatorname{cosec} x)^{1/\log x}$
Taking log on both sides, we get

$$\log y=\lim_{x\to 0}\frac{\log\operatorname{cosec} x}{\log x}\left[\frac{\infty}{\infty}\text{ form}\right]$$
$$=\lim_{x\to 0}\frac{-\cot x}{1/x}\quad(\text{By} \text{L}'\text{Hospital rule})$$
$$=-\lim_{x\to 0}\frac{x}{\tan x}\left(\because \cot x=\frac{1}{\tan x}\right)$$
$$\Rightarrow\log y=-1$$
$$\Rightarrow y=e^{-1}=\frac{1}{e}$$

Hence, required limit $=\frac{1}{e}$

101. **(a)** We know that $Q\cdot D=\frac{5}{6}\times M\cdot D\cdot=\frac{5}{6}\times 12=10$

$\therefore \text{S. D} = \frac{3}{2} \times \text{Q. D.} = \frac{3}{2} \times 10 \Rightarrow \text{S. D.} = 15.$

102. **(a)** Let A ≡ event of two socks being brown. B ≡ event of two socks being white.

$$\text{Then } P(A) = \frac{{}^5C_2}{{}^9C_2} = \frac{5.4}{9.8} = \frac{5}{18}, P(B)$$
$$= \frac{{}^4C_2}{{}^9C_2} = \frac{4.3}{9.8} = \frac{3}{18}$$

Now, since A and B are mutually exclusive events, so required probability

$$= P(A) + P(B) = \frac{5}{18} + \frac{3}{18} = \frac{4}{9}$$

103. **(c)**

$(3,3), (6,6), (9,9), (12,12), \in R.$

R isnot symmetric as $(6,12) \notin R$ but $(12,6) \in R$

R is transitive as the only pair which

needs verification is $(3,6)$ and $(6,12) \in R$.

$\Rightarrow (3,12) \in R$

104. **(b)** Let f: R → R be a function defined by

$$f(x) = \frac{x-m}{x-n}$$

For any $(x, y) \in R$

Let $f(x) = f(y)$

$$\Rightarrow \frac{x-m}{x-n} = \frac{y-m}{y-n} \Rightarrow x = y$$

∴ f is one - one

Let $\alpha \in R$ such that $f(x) = \alpha$

$$\Rightarrow \alpha = \frac{x-m}{x-n} \Rightarrow (x-n)\alpha = x-m$$
$$\Rightarrow x\alpha - n\alpha = x - m$$
$$\Rightarrow x\alpha - x = n\alpha - m$$
$$\Rightarrow x(\alpha - 1) = n\alpha - m$$
$$\Rightarrow x = \frac{n\alpha - m}{\alpha - 1} \cdot \text{ for } \alpha = 1, x \notin R$$

So, f is not onto.

105. **(b)**

$$2\tan^{-1}\frac{1}{5}=\tan^{-1}\frac{1}{5}+\tan^{-1}\frac{1}{5}$$

$$=\tan^{-1}\frac{\frac{1}{5}+\frac{1}{5}}{1-\frac{1}{5}\cdot\frac{1}{5}}=\tan^{-1}\frac{2/5}{24/25}=\tan^{-1}\frac{5}{12}$$

$$=\tan\left(2\tan^{-1}\frac{1}{5}-\frac{\pi}{4}\right)=\tan\left(\tan^{-1}\frac{5}{12}-\frac{\pi}{4}\right)$$

$$=\frac{\tan\left(\tan^{-1}\frac{5}{12}\right)-\tan\frac{\pi}{4}}{1+\tan\left(\tan^{-1}\frac{5}{12}\right)\tan\frac{\pi}{4}}=\frac{-\frac{7}{12}}{\frac{17}{12}}=-\frac{7}{17}$$

106. **(d)**

$$\begin{bmatrix}\alpha & \beta\\ \gamma & -\alpha\end{bmatrix}=\sqrt{I_2};$$

$$\begin{bmatrix}\alpha & \beta\\ \gamma & -\alpha\end{bmatrix}\begin{bmatrix}\alpha & \beta\\ \gamma & -\alpha\end{bmatrix}=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$$

$$\Rightarrow \alpha^2+\beta\gamma=1$$

107. **(b)** For concurrency of 3 lines the determinant of coefficients of equations should be 0 .

i.e., $\begin{vmatrix}3 & -4 & -13\\ 8 & -11 & -33\\ 2 & -3 & \lambda\end{vmatrix}=0$

$$\Rightarrow 3(-11\lambda-99)+4(8\lambda+66)-13(-24+22)=0$$

$$\Rightarrow -33\lambda-297+32\lambda+264+312-286=0$$

$$\Rightarrow -\lambda-583+576=0\Rightarrow \lambda=-7$$

108. **(b)** We have; $\mathrm{f(x)}=\begin{cases}(x-1)\sin\left(\frac{1}{x-1}\right) & \text{if } x\neq 1\\ 0 & \text{if } x=1\end{cases}$

$$\mathrm{Rf'(1)}=\lim_{h\to 0}\frac{f(1+h)-f(1)}{h}$$

$$=\lim_{h\to 0}\frac{h\sin\frac{1}{h}-0}{h}=\lim_{h\to 0}\sin\frac{1}{h}$$

which does not exist.

∴ fis not differentiable at $x=1$

Also

$$f'(0)=\sin\frac{1}{(x-1)}-\frac{x-1}{(x-1)^2}\cos\left(\frac{1}{x-1}\right)\Bigg]_{x=0}$$

$$=-\sin 1+\cos 1$$

∴ is differentiable at $x=0$

109. **(b)** Let $f(x)=2x^3+15$ and $g(x)=9x^2-12x$ then $f'(x)=6x^2\forall x\in R$

∴ f(x) is increasing function $\forall x\in R$

Also, $g'(x)>0\Rightarrow 18x-12>0\Rightarrow x>\frac{2}{3}$

Thus, $f(x)$ and $g(x)$ both increases for $x>\frac{2}{3}$

Let $F(x)=f(x)-g(x), F'(x)<0$

(∵ f(x) increases less rapidly than the function g(x))

$$\Rightarrow 6x^2-18x+12<0\Rightarrow 1<x<2$$

110. **(d)**

111. **(c)** $I=\int \frac{1}{1+3\sin^2 x+8\cos^2 x}dx$

Dividing the numerator and denominator by $\cos^2 x$, we get

$$I=\int \frac{\sec^2 x}{\sec^2 x+3\tan^2 x+8}dx=\int \frac{\sec^2 x}{4\tan^2 x+9}dx$$

Putting $\tan x=t \Rightarrow \sec^2 xdx=dt$, we get

$$I=\int \frac{dt}{4t^2+9}=\frac{1}{4}\int \frac{dt}{t^2+(3/2)^2}=\frac{1}{4}\times\frac{1}{3/2}\tan^{-1}\left(\frac{t}{3/2}\right)+C$$
$$\Rightarrow I=\frac{1}{6}\tan^{-1}\left(\frac{2t}{3}\right)+C=\frac{1}{6}\tan^{-1}\left(\frac{2\tan x}{3}\right)+C$$

112. **(b)**

$$\text{Let } I=\int_0^{10}\frac{x^{10}}{(10-x)^{10}+x^{10}}dx$$
$$I=\int_0^{10}\frac{(10-x)^{10}}{(10-x)^{10}+x^{10}}dx$$

Adding (1) and (2), we get

$$2I=\int_0^{10}dx \Rightarrow 2I=10 \Rightarrow I=5$$

113. **(d)** Given $\int_1^b f(x)dx=\sqrt{b^2+1}-\sqrt{2}$

Differentiate with respect to b

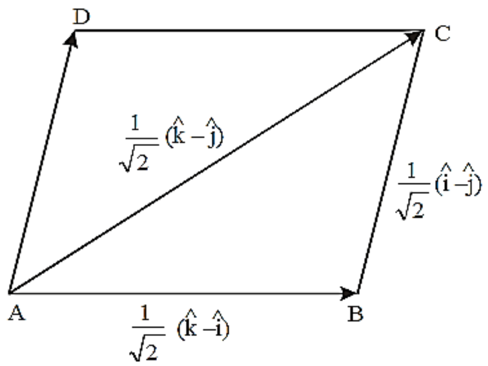
$$f(b)=\frac{b}{\sqrt{b^2+1}} \Rightarrow f(x)=\frac{x}{\sqrt{x^2+1}}$$

114. **(a)**

$$x^2=e^{\left(\frac{x}{y}\right)^{-1}\left(\frac{dy}{dx}\right)} \Rightarrow x^2=e^{\left(\frac{y}{x}\right)\left(\frac{dy}{dx}\right)}$$
$$\Rightarrow \ln x^2=\frac{y}{x}\frac{dy}{dx} \text{ or } \int x\ln x^2dx=\int ydy$$
$$\text{Put } x^2=t \Rightarrow 2xdx=dt \therefore \frac{1}{2}\int \ln tdt=\frac{y^2}{2}$$
$$C+t\ln t-t=y^2 \text{ or } y^2=x^2(\ln x^2-1)+C$$

115. **(d)** The position vector of points D, E, F are respectively

$$\frac{\hat{\imath}+\hat{\jmath}}{2}+\hat{k},\hat{\imath}+\frac{\hat{k}+\hat{\jmath}}{2} \text{ and } \frac{\hat{\imath}+\hat{k}}{2}+\hat{\jmath}$$

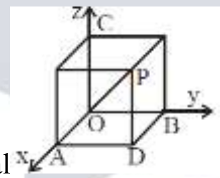


So, position vector of centre of $\triangle$ DEF

$$= \frac{1}{3}\left[\frac{\hat{\imath}+\hat{\jmath}}{2}+\hat{k}+\hat{\imath}\frac{\hat{k}+\hat{\jmath}}{2}+\frac{\hat{\imath}+\hat{k}}{2}+\hat{\jmath}\right]$$
$$= \frac{2}{3}[\hat{\imath}+\hat{\jmath}+\hat{k}]$$

116. **(d)** for a unit cube unit vector along the diagonal

$$OP = \frac{1}{\sqrt{3}}(\hat{\imath}+\hat{\jmath}+\hat{k})$$

unit vector along the diagonal 

$$CD = \frac{1}{\sqrt{3}}(\hat{\imath}+\hat{\jmath}-\hat{k})$$
$$\therefore \cos\theta = \frac{1}{3}(1+1-1) = \frac{1}{3} \quad \therefore \tan\theta = 2\sqrt{2}$$

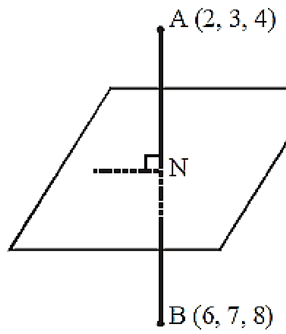
117. **(a)** Let θ be the angle between the line and the normal to the plane. Converting the given equations into vector form, we have

$\vec{r} = (-\hat{\imath}+3\hat{k}) + \lambda(2\hat{\imath}+3\hat{\jmath}+6\hat{k})$ and $\vec{r}\cdot(10\hat{\imath}+2\hat{\jmath}-11\hat{k}) = 3$

Here, $\vec{b} = 2\hat{\imath}+3\hat{\jmath}+6\hat{k}$ and $\vec{n} = 10\hat{\imath}+2\hat{\jmath}-11\hat{k}$

$$\sin\phi = \left|\frac{(2\hat{\imath}+3\hat{\jmath}+6\hat{k})\cdot(10\hat{\imath}+2\hat{\jmath}-11\hat{k})}{\sqrt{2^2+3^2+6^2}\sqrt{10^2+2^2+11^2}}\right|$$
$$= \left|\frac{-40}{7\times 15}\right| = \left|\frac{-8}{21}\right| = \frac{8}{21} \text{ or } \phi = \sin^{-1}\left(\frac{8}{21}\right)$$

118. **(b)** If the given points be A(2,3,4) and B (6,7,8), then their mid-point N(4,5,6) must lie on the plane. The direction ratios of AB are 4,4,4, i.e. 1,1,1.



$\therefore$ The required plane passes through N(4,5,6) and is normal to AB. Thus its equation is

$1(x-4)+1(y-5)+1(z-6)=0 \Rightarrow x+y+z=15$

119. **(c)** Let E_1 denote the event "a coin with head on both sides is selected" and E_2 denotes the event " a fair coin is selected". Let A be the event " he toss, results in heads".

$$\therefore P(E_1)=\frac{1}{n+1}, P(E_2)=\frac{n}{n+1} \text{ and}$$
$$P\left(\frac{A}{E_1}\right)=1, P\left(\frac{A}{E_2}\right)=\frac{1}{2}$$
$$\therefore P(A)=P(E_1)P\left(\frac{A}{E_1}\right)+P(E_2)P\left(\frac{A}{E_2}\right)$$
$$\Rightarrow \frac{7}{12}=\frac{1}{n+1}\times 1+\frac{n}{n+1}\times\frac{1}{2}$$
$$\Rightarrow 14n+14=24+12n \Rightarrow n=5$$

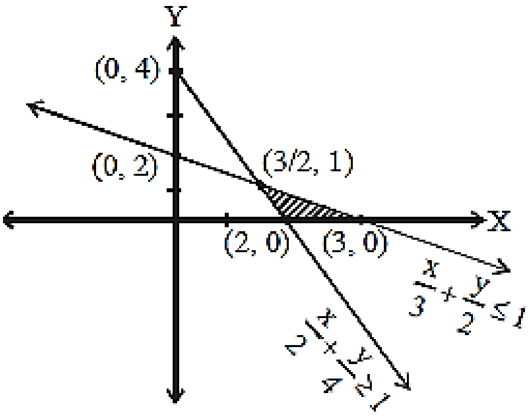
120. **(b)** The man has to win at least 4 times.

$\therefore$ Reqd. probability =

$$ {}^7C_4\left(\frac{1}{2}\right)^4\cdot\left(\frac{1}{2}\right)^3+{}^7C_5\left(\frac{1}{2}\right)^5\cdot\left(\frac{1}{2}\right)^2 + {}^7C_6\left(\frac{1}{2}\right)^6\cdot\frac{1}{2}+{}^7C_7\left(\frac{1}{2}\right)^7$$
$$=({}^7C_4+{}^7C_5+{}^7C_6+{}^7C_7)\cdot\frac{1}{2^7}=\frac{64}{2^7}=\frac{1}{2}$$

121. **(c)** Consider $\frac{x}{2}+\frac{y}{4}\geq 1, \frac{x}{3}+\frac{y}{2}\leq 1,$

$x, y \geq 0$ convert them into equation and solve them and draw the graph of these equations we get $y=1$ and $x=3/2$



From graph region is finite but numbers of possible solutions are infinite because for different values of x and y we have different or infinite no. of solutions.

122. **(b)**

123. **(c)** $\begin{vmatrix} p & q-y & r-z \\ p-x & q & r-z \\ p-x & q-y & r \end{vmatrix} = 0$

Apply $R_1 \to R_1 - R_3$ and $R_2 \to R_2 - R_3$, we get

$$\begin{vmatrix} x & 0 & -z \\ 0 & y & -z \\ p-x & q-y & r \end{vmatrix} = 0$$

$\Rightarrow \quad x[yr + z(q-y)] - z[0 - y(p-x)] = 0$

[Expansion along first row]

$\Rightarrow xyr + zxq + yzp = 2xyz \Rightarrow \frac{p}{x} + \frac{q}{y} + \frac{r}{z} = 2$

124. **(c)** Given parabola is $y^2 = 4x$

Let $P \equiv (t_1^2, 2t_1)$ and $Q \equiv (t_2^2, 2t_2)$
Slope of $OP = \frac{2t_1}{t_1^2} = \frac{2}{t_1}$ and slope of $OQ = \frac{2}{t_2}$
Since $OP \perp OQ, \therefore \frac{4}{t_1 t_2} = -1$ or $t_1 t_2 = -4$.
Let $R(h, k)$ be the middle point of PQ, then

$$h = \frac{t_1^2 + t_2^2}{2}$$

...(3) and $k = t_1 + t_2$...
From (4), $k^2 = t_1^2 + t_2^2 + 2t_1 t_2 = 2h - 8$ [From (2) and (3)]

Hence locus of $R(h, k)$ is $y^2 = 2x - 8$.

125. **(c)**

$$f[(\pi/2)^-] = \lim_{h\to 0} \frac{1-\sin^3[(\pi/2)-h]}{3\cos^2[(\pi/2)-h]}$$

$$= \lim_{h\to 0} \frac{1-\cos^3 h}{3\sin^2 h} = \frac{1}{2}$$

$$f[(\pi/2)^+] = \lim_{h\to 0} \frac{q[1-\sin\{(\pi/2)+h\}]}{[\pi-2\{(\pi/2)+h\}]^2}$$

$$= \lim_{h\to 0} \frac{q(1-\cos h)}{4h^2} = \frac{q}{8}$$

$\therefore p = \frac{1}{2} = \frac{q}{8} \Rightarrow p = \frac{1}{2}, q = 4.$

126. **(a)** Augment means make greater, so increase is the correct option.

127. **(a)** Consolation means 'comfort received by a person after a loss or disappointment', so comfort is correct option.

128. **(b)** Auxiliary means 'providing additional help', so supplemental is correct option.

129. **(b)** Auspicious means 'favourable', so 'unfavourable' is best opposite word for it.

130. **(d)** Recompense means 'reward given for loss, so 'penalty' is the correct opposite word for it.

131. **(c)** Impede means 'hinder' or 'obstruct', so 'push' is correct opposite word for it.

132. **(b)** Here a sense of command is depicted in sentence, so we should use 'ordered' for proper meaning of sentence.

133. **(c)** Sentence is in past tense and V_1 is used in those- sentence which contain 'did', so option (c) is correct.

134. **(d)** No improvement is needed as sentence is right.

135. **(d)** Afraid agrees with preposition 'of', so option (d) is correct.

136. **(c)** Normally, company signs a contract or deal, so use of 'deal' is proper here.

137. **(c)** The question gives a sense of query about normal routine of some special/specific day, so use of 'plan' is more proper here.

138. **(b)**

139. **(a)**

140. **(c)**

141. **(c)**

142. **(b)** From the given responses,

$4 \times 2 \times 3 \times 3 = 72$
$9 \times 4 \times 2 \times 10 = 720$

Similarly, $6 \times 20 \times 1 \times 6 = 720$

143. **(b)** Since, consecutive two letters are interchanged. Therefore,

$$\begin{array}{ccccc} \underline{DE} & \underline{PR} & \underline{ES} & \underline{SI} & \underline{ON} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ ED & R\boxed{P} & SE & IS & NO \end{array}$$

7th from Right.

144. **(a)** Every day of week repeats after seven days.

Hence, $59 = 7 \times 8 + 3 = 56 + 3$

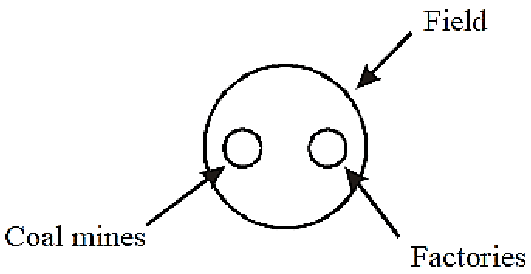
$\therefore$ It will be Thursday after 56 days.

$\therefore$ 57 th day = Thursday $\Rightarrow$ 58th day = Friday

59th day = Saturday $\Rightarrow$ 60 th day = Sunday

$\therefore$ It will be Sunday after 59 days.

145. **(b)**



Both coal mines and factories are located in the fields.

146. **(c)** From the given series,

$1^3 \rightarrow 1$
$2^3 \rightarrow 8$
$3^3 \rightarrow 27$
$4^3 \rightarrow 64$
$5^3 \rightarrow 125$
$6^3 \rightarrow 216$

Therefore, 64 will come in place of questions mark.

147. **(c)** Interchanging the symbols as given in the above question, the above equation becomes.

$$6 + 9 \times 8 \div 3 - 20 \quad = 6 + 9 \times \frac{8}{3} - 20$$
$$= 6 + 24 - 20 = 10$$

148. **(d)**
149. **(b)**
150. **(b)**