Physics

1. (b)

$$E = h\nu$$
$$h = \frac{E}{\nu} = \frac{[ML^2\ T^{-2}]}{[T^{-1}]} = ML^2\ T^{-1}$$

Moment of Inertia $I = mr^2 = [ML^2]$
Dividing eq. (1) and (2)

$$\left[\frac{h}{I}\right] = \frac{[ML^2\ T^{-1}]}{[ML^2]} = [T^{-1}]$$

$[T^{-1}]$ = frequency of a particle.

2. (b) Acceleration $a = \frac{\Delta v}{\Delta t}$
So, acceleration of body A $= a_A = \tan 25°$
Line B makes an angle of $50°$. So its slope is equal to $\tan 50°$.

$$a_B = \tan 50°$$
$$a_A : a_B = \tan 25° : \tan 50°$$

3. (c) Option (3) is a correct answer not matched with answer sheet
Given $R = 2H$

$$\frac{v^2 \sin 2\theta}{g} = \frac{2v^2 \sin^2 \theta}{2g}$$
$$\sin 2\theta = \sin^2 \theta$$
$$2\sin\theta\cos\theta = \sin^2\theta$$
$$2\sin\theta\cos\theta = \sin\theta\sin\theta$$
$$2 = \frac{\sin\theta\sin\theta}{\sin\theta\cos\theta}$$
$$2 = \tan\theta$$

From triangle we can say that -

$$\sin\theta = \frac{2}{\sqrt{5}}, \cos\theta = \frac{1}{\sqrt{5}}$$

So, $R = \frac{2v^2 \sin\theta\cos\theta}{g} = \frac{2v^2}{g} \times \frac{2}{\sqrt{5}} \times \frac{1}{\sqrt{5}}$

$$R = \frac{4v^2}{5g}$$

4. (b) $F = mg$
Here $m = 0.05$ kg
$F = 0.05 \times (-9.8) = -0.49$ N
$F = 0.49$ N vertically downwards

5. (c)

Given $m = 4\ kg, p = 6Ns$

$$K.E. = \frac{p^2}{2m} = \frac{6 \times 6}{2 \times 4} = \frac{0.36}{8}$$

$$K.E. = 4.5\ J$$

6. **(a)** Angular velocity $= \frac{2\lambda}{60} = \frac{\lambda}{30}$

For an hour hand to complete 1 rotation i.e. 2π radians it takes $12hrs$.

So angular velocity of an hour hand $= \frac{2\lambda}{12 \times 3600}$

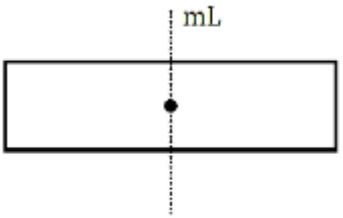
$$= \frac{\lambda}{21600}$$

Then the ratio is

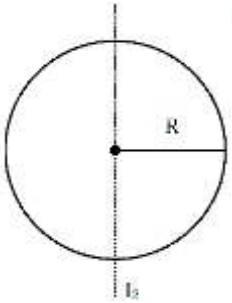
$$= \frac{\frac{\lambda}{30}}{\frac{\lambda}{21600}} = \frac{\lambda}{30} \times \frac{21600}{\lambda} = 720:1$$

7. **(b)** As we know that the value of acceleration due to gravity is independent of mass, shape, size etc. of the body and depends upon the mass and radius of the earth.

8. **(c)**



M.O.I. of ring about its diameter is given by $I_2 = \frac{mR^2}{2}$



$$I_1 = \frac{mL^2}{12}$$

$$L = 2\pi R \Rightarrow R = \frac{L}{2\pi}$$

$$I_2 = \frac{mR^2}{2} = \frac{1}{2} m \left(\frac{L}{2\pi}\right)^2 = \frac{mL^2}{8\pi^2}$$

$$\frac{I_1}{I_2} = \frac{mL^2}{12} \times \frac{8\pi^2}{mL} = \frac{8\pi^2}{12} = \frac{2\pi^2}{3}$$

9. **(b)** The ratio of hydraulic stress to the corresponding strain is known so bulk modulus. Bulk modulus $[K] = \frac{\text{hydraulic stress}}{\text{strain}}$

10. **(d)**

$T_1 = 500\ K,\ T_2 = 300\ K$

Efficiency of Carnot engine $\eta = 1 - \frac{T_2}{T_1}$

$$\eta = 1 - \frac{300}{500} = \frac{500 - 300}{500} = \frac{200}{500}$$
$$\eta = \frac{2}{5} = 0.4$$

So, the efficiency is 40%.

11. (d) When water is heated from 0°C to 4°C, there is decreasing amount in volume and density increases till it is a 4°C and than volume starts increasing to 10°C.

12. (b) (1) Ice convert into water

$Q_1 = M_1 Lf = 1 \times 80 = 80cal$

(2) Steam to convert into water

$Q_2 = M_2 Lv = 1 \times 540 = 540cal$

(3) 1 g of water at 0°C into water at 100°C

$= 1 \times 1 \times 100 = 100cal$

So clearly, whole steam is not condensed. So temperature of the mixture is 100°C.

13. (a)

$$P.E. = \frac{1}{2}Kx^2$$

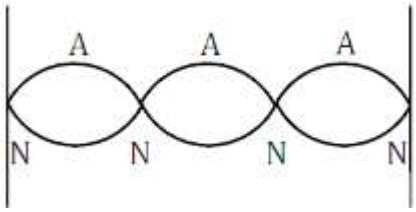
Distance is half its amplitude so

$$P.E. = \frac{1}{2}K\left(\frac{A^2}{4}\right)$$
$$K.E. = \frac{1}{2}K(A^2 - x^2)$$
$$K.E. = \frac{1}{2}K\left(A^2 - \frac{A^2}{4}\right) = \frac{1}{2}K\left[\frac{4A^2 - A^2}{4}\right]$$
$$K.E. = \frac{1}{2}K\left[\frac{3A^2}{4}\right]$$
$$\frac{K.E}{P.E.} = \frac{3}{1}$$

14. (b) Beat frequency

$$b = |v_A - v_B|$$
$$4 = v_A - 384$$
$$v_A = 388\ Hz$$

15. (a) From figure, number of nodes and antinodes will be 4 and 3.



16. (c)

$$F_1 = \frac{Kq_1q_2}{r^2} = \frac{K(9)(6)}{d^2}$$
$$\Rightarrow \frac{K}{d^2} = \frac{F_1}{54}$$

Now charges are $3\mu C$ and $6\mu C$
So, new force is $F_2 = \frac{K(6)(3)}{d^2} = \frac{18\,K}{d^2}$
Put the value of $\frac{K}{d^2}$ in F_2

$$F_2 = 18 \times \frac{F_1}{54} = \frac{F}{3}$$

17. (b) Electric field lines do not form closed loop as line can never start and end on the same change.
18. (c) The angle between electric dipole moment and electric field in the equatorial line is $180°$ as both of them are in opposite directions.
19. (d)
20. (c) Inside the spherical shell potential is same.

$$V_1 = V_2$$

$$V \propto \frac{1}{d}$$

$$V_1 = V_2 > V_3$$

21. (d) From $C = \frac{\varepsilon_0 A}{d}$

When increase the plate separation capacitance decrease and by $V = \frac{Q}{C}$

V is also increase and q is constant.

22. (c) Resistance in series connection -

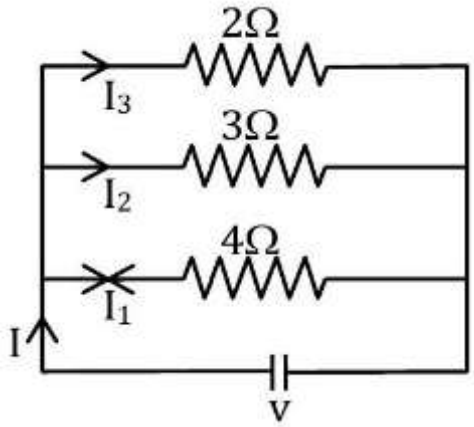
$$r_{eq} = r_1 + r_2 + r_3 + r_4 = r + r + r + r = 4r$$

emf in series connection -

$E_{eq} = E_1 + E_2 + E_3 - E_4$ (When one is connected wrong)

$$E_{eq} = E + E + E - E = 2E$$

23. (b)



Current through $4\Omega = I_1 = \frac{V}{4}$

Current though $3\Omega = I_2 = \frac{V}{3}$

Similarly, $I_3 = \frac{V}{2}$

$I_1 : I_2 : I_3 = \frac{V}{4} : \frac{V}{3} : \frac{V}{2}$

$I_1 : I_2 : I_3 = \frac{1}{4} : \frac{1}{3} : \frac{1}{2}$

$I_1 : I_2 : I_3 = 6 : 4 : 3$

24. (d) Two cells of emf E_1 and E_2 are joined in opposition $E_1 > E_2$

$$I = \frac{E_1 - E_2}{r_1 + r_2 + R}$$

$V = IR$

$$V = \left(\frac{E_1 - E_2}{r_1 + r_2 + R}\right) R$$

25. (c) $R = \frac{V}{I} = \frac{6}{3} = 2\Omega$ (For ideal ammeter and voltmeter)

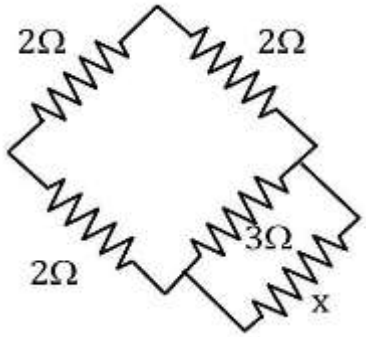
$\Rightarrow R < 2\Omega$ when A and V are infinite

$3(R + r) = 6V$

$R + r = 2$

$R = 2 - r$

26. (d)



$$\frac{2}{2} = \frac{2}{\frac{3x}{3+x}}$$

$$\Rightarrow 1 = \frac{2}{1} \times \frac{3-x}{3x}$$

$3x = 6 + 2x$

$X = 6\Omega$

27. (b)

$R = R_0(1 + \alpha\Delta T)$
$200 = 100(1 + 0.005 \cdot (T_2 - 100))$
$2 = (1 + 0.005.T_2 - 0.5)$
$2 = 0.5 + 0.005\ T_2$
$T_2 = \frac{1.5}{0.005}$
$T_2 = 300°C$

28. (c)

$$B_{net} = \sqrt{B_1^2 + B_2^2} = \frac{\mu_0}{4\pi} \times \frac{2\pi}{r}\sqrt{i_1^2 + i_2^2}$$
$$= 10^{-7} \times \frac{2\pi}{2\pi \times 10^{-2}}\sqrt{3^2 + 4^2}$$
$$= 5 \times 10^{-5} wb/m^2$$

29. (c)

Given $B = 10^{-4}\ Wb/m^2$

$Q = 10^{11} C/kg, v = 10^9\ m/sec$

Radius of circle described, $r = \frac{mV}{qB}$

$$r = \frac{1 \times 10^9}{10^{11} \times 10^{-4}} = \frac{10^{13}}{10^{11}} = 10^2$$
$r = 100\ m$

30. (d) A cyclotron is used to accelerate both positively and negatively charged particles but a neutral particle cannot be accelerated in cyclotron.

31. (d) Give

$Ig = 5 \times 10^{-4}$

$R_G = 50\Omega$

$V = 3\ V$

$$R = \frac{V}{I_g} - R_G$$

Put all these values in this formula

$$R = \frac{3}{5 \times 10^4} - 50$$

$$R = \frac{30000}{5} - 50$$

$R = 6000 - 50$

$R = 5950\Omega$

32. (a) $I_1 = 1\ A, I_2 = 3\ A, d = 1\ m$

$$F = \frac{\mu_0}{4x}\frac{2II_2}{d}$$

$$F = 10^{-7} \times \frac{2(1)(3)}{1}$$

$F = 6 \times 10^{-7}\ N/m$

Current flowing in opposite direction is repulsive in nature.

33. (c) If there is no torsion in the suspension thread, then the time period of a magnet executing

S.H.M. is $= T = 2\pi\sqrt{\frac{I}{MB}}$

34. (a) Electromagnetic cores support the formation of a magnetic field because of high permeability and low retentivity so that the magnetic field gets demagnetized easily.

35. (c) Given $x_1 = 0.0075$

$T_1 = -73◯O = 273 - 73 = 200k$

$T_2 = -173\ °C = 273 - 173 = 100k$

$X_1\ T_1 = X_2\ T_2$

$(0.0075)\ (200) = X_2\ (100)$

$X_2 = 0.015$

36. (b) $e = \frac{Mdi}{dt} = 0.005 \times \frac{d}{dt}(i_0 \sin \omega t)$

$= 0.005 \times i_0 \omega \cos \omega t$

$e = 0.005 \times 10 \times 100\pi = 5\pi$

37. (c) Given $B = 1.75 \times 10^{-5}$ T. $\ell = 40$ m

$V = 1080 \text{ km/h} = 1080 \times \frac{5}{18} = 300 \text{ m/sec}$

$E = Bv\ell$

$E = (1.75 \times 10^{-5})(300)(40)$

$E = (1.75 \times 10^{-5})12000$

$E = 2100 \times 10^{-4}$

$E = 0.21$ volt

38. (a) For resonance condition

$X_L = X_C$

In an L-C-R circuit at resonance the current and voltage are in phase.

39. (a)

$P = VI$

Efficiency of transformer $\eta = \frac{P_o}{P_i} \times 100$

$P_o = 100$ W

$P_i = V_i I_i = 220 \times 0.5 = 110$ W

$\eta = \frac{100}{110} \times 100 = 90.9\%$

So, the efficiency of the transformer is 90%

40. (d) Average power dissipated

$P_{avg} = \frac{v_0 i_0}{2} \cos\phi$

$Pavg = \frac{v_0 i_0}{2} \cos 90°$

$P_{avg} = 0$

41. (b) $\mu = \frac{C}{V}$

Here $C = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ and $V = \frac{1}{\sqrt{\mu\varepsilon}}$

So, $\mu = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} \Big| \frac{1}{\sqrt{\mu\varepsilon}}$

$\mu = \frac{\sqrt{\mu\varepsilon}}{\sqrt{\mu_0 \varepsilon_0}} = \sqrt{\frac{\mu\varepsilon}{\mu_0 \varepsilon_0}}$

42. (d) $f = \frac{R}{2} = \frac{-30}{2} = -15$ cm

$m = \frac{-v}{u}$

$\Rightarrow -3 = \frac{-v}{u}$

$v = 3u$

By mirror formula $-\frac{1}{F} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{-15} = \frac{1}{3u} + \frac{1}{u} = \frac{1+3}{3u} = \frac{4}{3u}$

$\frac{1}{-15} = \frac{4}{3u}$

So, $\frac{4\times(-15)}{3} = -20$ cm

43. (b) Here $V = -7.5$ cm

$u = -D = -25$ cm

It is Because of distinct vision-

Using lens formula

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\frac{1}{f} = \frac{1}{-75} + \frac{1}{25} = \frac{-1+3}{75} = \frac{2}{75}$

$f = \frac{75}{2} = 37.5$ cm

44. (d)

45. (d) To observe diffraction the size of the obstacle should be of the order of wavelength because of $\lambda \approx d$.

46. (b) Angle of incident $i = 57°$

So, $i = r = 57°$

the reflected and refracted rays are mutually perpendicular to each other

So angle of refraction $r' = 90° - i$

$r' = 90° - 57° = 33°$

47. (c) $h\nu = KE + \phi$

$1eV = KE_1 + \phi$ ..... (1)

$2.5eV = K_1E_2 + \phi$ ..... (2)

From equation (1) and (2)

$1eV = K.E.\,1 + 0.5eV$…….. (3)

K.E. $1 = 0.5eV$

$2.5eV = K.E.\,2 = 0.5eV$

K.E. $2 = 2eV$ …… (4)

Dividing equation (3) and (4)

$$\frac{K \cdot E._1}{K \cdot E._2} = \frac{0.5}{2.0} = \frac{1}{4}$$

$$\frac{\frac{1}{2}mv_1^2}{\frac{1}{2}mv_2^2} = \frac{{v_1}^2}{{v_2}^2} = \frac{1}{4}$$

$$\frac{v_1}{v_2} = \frac{1}{2}$$

48. (c)

$$\lambda = \frac{h}{p}$$

Here $P = \sqrt{2\,M.K.E} = \sqrt{2 \times 9 \times 10^{-31} \times 120 \times 1.6 \times 10^{-19}}$

$P = 5.88 \times 10^{-24} KgMS^{-1}$

So, de Broglie wavelength

$$\lambda = \frac{h}{p} = \frac{6.63 \times 10^{-34}}{5.88 \times 10^{-24}} = 1.13 \times 10^{-10}\ m$$

$= 1.13Å$

49. (b) Here K.E. = P.E.

$$5MeV = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r}$$

$$5 \times 10^6 \times e = \frac{(9 \times 10^9)(92e)(2e)}{r}$$

$$5 \times 10^6 = \frac{(9 \times 10^9)(92)(2e)}{r}$$

$$r = \frac{(9 \times 10^9)(92)(2 \times 1.6 \times 10^{-19})}{5 \times 10^6}$$

$r = 5.3 \times 10^{-14}\ m = 5.3 \times 10^{-12}\ cm$

50. (d) $n_1 = 2$ and $n_2 = 3$

wavelength emitted is -

$$\frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{1}{\lambda} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right]$$

$$\frac{1}{\lambda} = R\left[\frac{9-4}{36}\right] = \frac{5R}{36}$$

$$\left[v = \frac{C}{\lambda}\right]$$

So, $v = \frac{5RC}{36}$

51. (c) Given hc=1240 ev nm, R=1.09737 $\times 10^7$ per meter

Wavelength of light for least - energetic photon emitted in Lyman series of hydrogen atom

$$\frac{1}{\lambda} = R\left(\frac{1}{n_2^2} - \frac{1}{n_1^2}\right)$$

here $n_1 = 2$ and $n_2 = 1, R = 0.01097\ nm^{-1}$

$$\frac{1}{\lambda} = 0.01097\left[\frac{1}{1^2} - \frac{1}{2^2}\right]$$

$$\frac{1}{\lambda} = 0.01097\left[\frac{4-1}{4}\right]$$
$$\frac{1}{\lambda} = .01097\left[\frac{3}{4}\right]$$
$$\lambda = \frac{4}{0.01097 \times 3}$$
$$\lambda = 121.5436$$
$$\lambda = 122\ nm$$

52. (a) By conservation of linear momentum.

$m_1 V_1 = m_2 V_2$

$$\frac{v_1}{v_2} = \frac{m_2}{m_1} = \left(\frac{R_2}{R_1}\right)^3$$

$$\frac{v_1}{v_2} = \left(\frac{2}{1}\right)^3 = 8:1$$

53. (b) $T_1/2 = 20\ min$

$N_1 = 50,\ N_2 = 100 - 87.5 = 12.5$

$$\Delta\lambda - \frac{T}{\ell n_2}\ell n\left(\frac{N_1}{N_2}\right) = \frac{20}{\ell n_2}\ell n\left(\frac{50}{12.5}\right)$$

$$\frac{20}{\ell n_2}\ell n = 40\ min$$

54. (b)

$_{Z}X^{A} \xrightarrow{\alpha} {}_{Z-2}X^{A-4} \xrightarrow{2\beta} {}_{Z}X^{A-4}$

55. (c)

$E_g = 1.9eV, hc = 1240eV$

Wavelength $= \lambda = \frac{hc}{E_g} nm$

$$\lambda = \frac{1240}{1.9} = 652.63 \approx 650 \text{ nm}$$

$$= 6.5 \times 10^{-7} \text{ m}$$

56. (a) In amplitude modulation modulated signal has a carrier wave with two side band frequencies one is lower side band and other is upper side bad

57. (a) Diode D_1 is forward biased but D_2 is revered Biase(d) So no current flows through D_2 but current flows through D_1.

$$Req = 3 + 4 = 7\Omega$$

$$I = \frac{V}{R_{eq}} = \frac{12}{7} = 1.71 \text{ A}$$

58. (a) Input characteristics circle is drawn between I_B and V_{EB} at constant $V_{CE.}$.

$$R = \left[\frac{\Delta V_{BE}}{\Delta I_B}\right]_{V_{CE}= \text{ constant}}$$

59. (c) Boolean expression of NAND gate $= \overline{(A)B}$

So, NAND gate is right.

60. (b) Space waves are used for the line of sight communication.

Chemistry

61. (b)' 2 ' The unit cell with crystallographic dimensions $a \neq b \neq c; \alpha = r = 90$ and $\beta \neq 90$ is a monoclinic unit cell. Triclinic unit cell has crystallographic dimensions $a \neq b \neq c; \alpha = \beta = r = 90°$. Pentagonal unit cell has crystallographic dimensions $a \neq b \neq c; \alpha = \beta = r = 90°$.

Orthorhombic unit cell has crystallographic dimensions $a \neq b \neq c; \alpha = \beta = r = 90°$.

→ The monoclinic crystal system is one of seven crystal systems. A crystal system is described by three vectors. In the monoclinic system, the crystal is described by vectors of unequal lengths, as in the orthorhombic system. They form a rectangular prism with a parallelogram as its base. The unit cell will be monoclinic

62. (a) The charging equation is

$$2PbSO_4\,(s) + 2H_2O(l) \rightarrow Pb(s) + PbO_2\,(s) + 2H^+(aq) + 2HSO_4\,(aq)$$

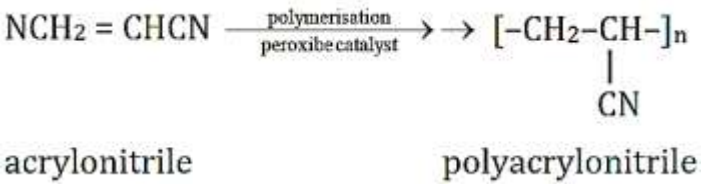
Lead storage batteries can be used in automobiles these batteries can be recharged in the charged state each cell contain negative plates of lead (Pb) and positive plates of lead (IV) inside (PbO_2) in an electrolyte of approximately 4.2 m-sulphuric acid (H_2SO_4). The charging process is driven by the forcible removal of electrons from the positive plate and the forcible introduction of them to negative plate by the charging source.

63. (d) Adenosine is a nucleoside consisting of adenine and ribose sugar linked glycosidic bon(d)

A nucleoside consists simply of a nucleoside and five carbon sugar, where as a nucleotide is composed of nucleobase, a five-carbon sugar, and one or more phosphate groups. In a nucleoside the anomeric carbon is linked through a glycoside bond to the N9 of a purine. Examples of nucleosides include. Cytidine, uridine, adenosine, guanidine etc.

64. (c)

Orlon is an example of polyacrylonitrile (PAN)

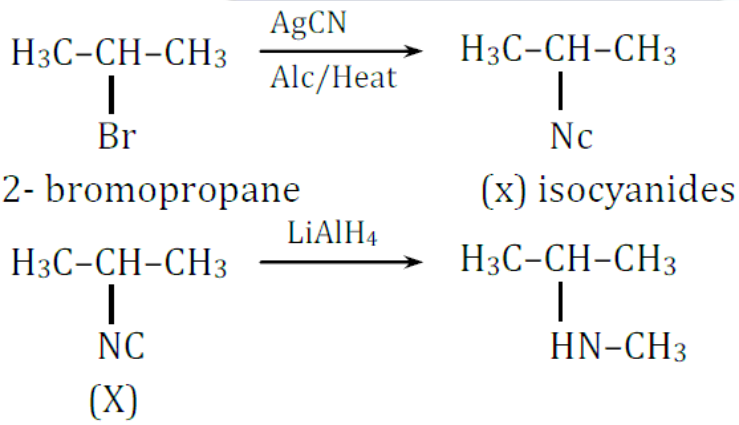


The monomer unit of orlon is acrylonitrile /vinyl cyanide.

65. (b) Orbitals are filled in order of increasing value of $(n+1)$. If 2 orbitals have same value $(n+1)$, then the orbitals with lower value of n will be filled first for $p(n+1) = 3+2 = 5$. For a $(n+l) = 3+0 = 3$. So p has greater energy than q.

66. (c) Ozone is stronger oxidizing agent than H_2O_2. Ozone is highly unstable hence, it dissociates to form O_2 molecule and nascent oxygen which extremely or highly unstable and hence it reacts quickly to oxidize anything in order to attain stability H_2O_2 can't oxidize O_3.

67. (d)



Nitrogen is free to donate electron pair forming isocyanides. Isonitrides on reduction with $LiAlH_4$ gives secondary amines.

68. (b) On heating with concentrated NaOH in an inert environment of CO_2 the reaction will be $Pu + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$

PH_3 is formed which is more basic than NH_3.

69. (d) In BCC structure the radius of sodium atom is $0.433a$

So, $0.433 \times 4.29\text{Å} = 1.86\text{Å}$

70. (c) Given: $0.06\%\text{w/v}$ solution of urea

so moles of urea $= \frac{0.06}{60} = 0.001$ mol

$\therefore$ Molality of urea solution $= \frac{0.001}{100} \times 1000 = 0.01$ m

$\because$ Reaction constant should be same for isotonic So 0.01 m glucose solution

71. (b) Assuming initial concentration is 100% concentration after three half lives $= 1205.1$

Half life $= \frac{60 \text{ min}}{3} = 20 \text{ min}$

72. (a) The electrolyte having minimum coagulating power will have maximum flocculation value. Hence, NaCl having lowest charge will have minimum coagulation power hence maximum flocculation value.

73. (a) The reactions involved during extraction of copper. From copper pyrites are

$$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$$
$$2Cu_2O + Cu_2S \rightarrow 2Cu + SO_2$$

Copper pyrites are heated in blast furnace and the principle used here is that copper has high. Affinity for oxygen than sulphur at high temperature.

74. (c) As it is known fact that tetrahedral arrangement does not show GI while square planar shows GI. But the condition is that all groups must be different. In MA_3B all the arrangements will be the same hence it will not show Gi. Therefore, only MABCD will show GI.

75. (d) ' 4 ' The electronic configuration of Gd is $[Xe]4f^7sd^16\ s^2$ then the configuration of Gd^{+2} will be $[Xe]4f^7 5\ d^1$.

76. (b)

$$MSO_4 \xrightarrow{NH_4OH} \underset{\text{(white)}}{\underset{(x)}{Zn(OH)_2}} \xrightarrow[\text{excess}]{NHClOH} \underset{(y)}{[Zn(NH_3)_4]^{2+}(aq)}$$

$$\underset{(y)}{[Zn(NH_3)_4]^{2+}aq} \xrightarrow{H_2S} \underset{\text{(zinc sulphide)}}{\underset{(z)}{Zns}}$$

The reaction of MSO_4 with NH_4OH gives a white ppt of $Zn(OH)_2$ which when reacted with excess of NH_4OH. Gives a complex $[Zn(NH_3)_4]^{2+}$. When $[Zn(NH_3)_4]^{2+}$. Complex is allowed to react with H_2 S it will give Zns. Zinc sulphide so m is zinc and z is zinc sulphide.

77. (d) The reaction of 2-Bromobutane with NaOH is:

$$CH_3\text{–}\underset{\displaystyle Br}{\underset{|}{CH}}\text{–}CH_2\text{–}CH_3 \xrightarrow{\text{aq NaOH}} CH_3\text{–}\underset{\displaystyle OH}{\underset{|}{CH}}\text{–}CH_2\text{–}CH_3 + Br^-$$

∵ The compound have chiral centre so it will be. Optically active and give $50 - 50\%$ mixture of enantiomers or racemic mixture

∵ ± butan- α-al

78. (b) Aldehydes give positive tollen's test. Methanoic acid is exception as it has a hydrogen atom as substituent not in any other group attache(d) So it will give a positive tollen's test like aldehyde. Ethanoic acid does not give tollens test.

79. (b) For H_2O_2 cell the reactions of cathode and anode are.

At cathode: $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$

At anode

$$2H_2(g) + 4OH^-(aq) + 4e^- \rightarrow 2H_2O(l)$$

So overall reaction is

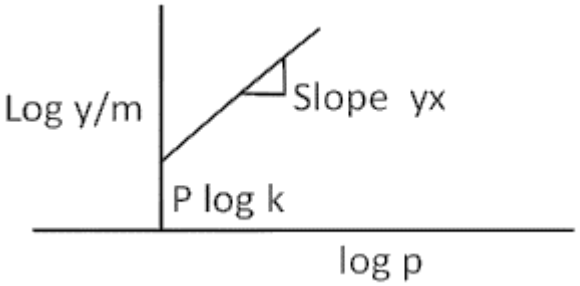
$$2H_2(g) + O_2(g) + 2H_2O(d)$$

80. (c) For Freundlich adsorption isotherm

$\frac{x}{m}\alpha P^{1/x}$ or $\frac{x}{m} = KP^{1/x}$

So, $\log\frac{x}{m} = \log k + \frac{1}{x}\log P$

Now, plotting group between $\log\left(\frac{x}{m}\right)$ and $\log P$ with slope $\frac{1}{x}$ will be



81. (b) When Mohr salt is added in water the dissociation will be as follows.

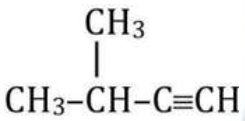
$FeSO_4 \cdot (NH_4)_2SO_4 \cdot H_2O \rightarrow fe^{+2} + 2NH_4^{\oplus} + 2SO_4^{2-} + 6H_2O$

So, total 5 ions are obtained.

82. (d) Glycogen is multibranched polysaccharide of glucose that serves as form of energy storage in animals, fungi. It is condensation polymer of α-Glucose, its formula is $C_6H_{10}O_5$.

83. (b) The total alkynes possible by formula C_5H_8 are:

$CH_3 - CH_2 - CH_2 - C \equiv CH, CH_3 - CH_2 - C \equiv C - CH_3$



so there are three possible structures

84. (b) For finding freezing point we will use the equation

$\Delta T_f = PK\ fm$ where k_f = constant

So ΔT_f depends on I i.e. van't Hoff's factor and Molarity only

$NaCl \rightarrow Na^+ + Cl^-; I = 2$

For $Na_2SO_4, i = 3$ for $C_{12}H_{22}O_{11} i = 1$

So ΔT_f will be lowest at 0.01 mNaCl

∵ it will have the highest freezing point.

85. (c) $fy_2 = \frac{0.693}{k}$ given $fy_2 = 10$ min

$K = \frac{0.693}{10}; k = 0.0693$

Rate $= K[A]$ ∵ first order reaction

$= 0.0693 \times 3 \text{ m min}^{-1}$

86. (b) $Ba(NO_3)_2 + H_2SO_4$ (dil) $\rightarrow BaSO_4$ (s) $+2H^{\oplus} + 2NO_3^{-}CaCl$

$Va(NO_3)_2 + H_2SO_4$ (conc) $\rightarrow BaSO_4$ (s) $+2NHO_3$

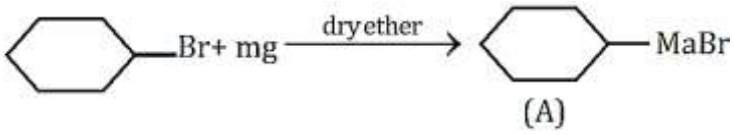
$\because Ba(NO_3)_2$ responds to both dilute and con(c) H_2SO_4.

87. (b) Heating reaction of potassium permanganate is

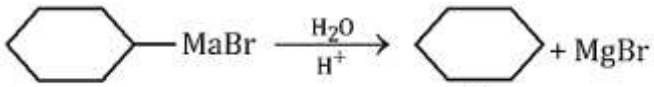
$2KMnO_4 \xrightarrow[513k]{\Delta} KaMnO_4 + MnO_2 + O_2$

$\because$ MnO is not obtained ans is 2

88. (c)



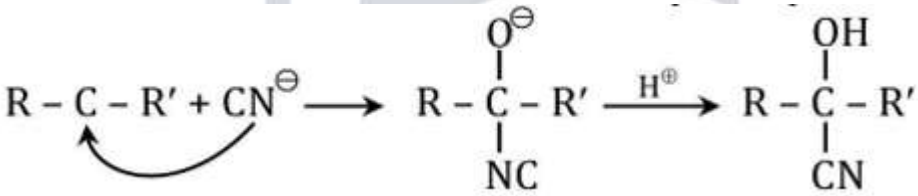
(A)



B

Cyclohexane is the final product.

89. (b) The reaction involved in formation of cyanohydrins from a ketone is



By seeing reaction mechanism we can conclude that CN^{-} is neucleophile hence it is ncuclophilic addition reaction.

90. (c) Essential amino acids are amino acids which cannot be synthesized by our body and are taken from external sources. Here isolecine is essential amino acid

91. (d) The acidic strength of oxoacids of chlorine increases with increase in chlorine's oxidation no. So finding oxidation number X of Cl

in $HClO_2$ $\quad 1 + x - 4 = 0 \quad x = +3$

in $HClO_3$ $\quad 1 + x - 6 = 0 \quad x = +5$

in $HClO_2$ $\quad 1 + x - 4 = 0 \quad x = +3$

in $HClO_4$ $\quad 1 + x - 8 = 0 \quad x = +7$

So acidic strength will be in order

$HClO_4 > HClO_3 > HClO_2 > HClO$

More the strong acid lower will be the PH so $HClO_4$ is strongest acid thus its salt $NaClO_4$ will have lowest PH.

92. (c) By seeing data, we can conclude that after ionization energy 3, ionization energies are very high which indicates that element has attained stability after ionization energy 3 , so element will be aluminum (Al)

93. (d) Moles of C = moles of CO_2

Moles of $CO_2 = \frac{\text{Given mass}}{\text{molar mass}}$

$= \frac{0.44}{44} = 0.01$ moles

Moles of $H = 2\alpha$ moles of H_2O

$= 2\alpha\frac{0.18}{18} = 0.02$ moles

Weight of oxygen $= 0.30 -$ wt e of carbon- wt of hydrogen

$= 0.3 - 0.01 \times 12 - 0.02 \times 1 = 0.16$am

Moles of $O = \frac{0.16}{16} = 0.01$moles

94. (b) Hoffman bromamide reaction is shown only by primary amide.

∴ among the following $CH_3CONHCH_3$ is not primary amide so it will not give Hoffman bromide reaction.

95. (c) Saliva collecting at the corners of the mouth can cause a build of microorganisms leading to angular cheilitis. It is caused by vitamin (B) It is a digestive Disorder. Vitamin B is also known as Riboflavin.

96. (c) $H_2O1 \rightarrow 2H^{\oplus} + O + 2e^{-}$o electrolysis if for $0 = 2$

∴ Charge required $= 2 \times 965006 = 1.93 \times 10^5 C$

97. (d) Reaction is

$CH_3COOH + CH_3OH \xrightarrow{\text{con. } H_2SO_4} CH_3COOCH_3 + H_2O$

$100\ cm^3$ $100\ cm^3$

1 m 2 m

Rate $= k(CH_3COOH)(C_2H_5OH)$

Initial Rate : $R_1 = k(a)(b)$

Final rate: $K\left(\frac{a}{2}\right)\left(\frac{b}{2}\right)$

$\frac{R_2}{R_1} = \frac{k(a/2)(b/2)}{k(a)(b)} = \frac{ab/4}{ab} = \frac{1}{4}$

$\frac{R_2}{R_1} = 0.25$

98. (c) Macro molecular colloids are a type of Lyophobic colloids. Lyophobic colloids are stable and do not easily coagulate. So answer is macromolecular colloid

99. (c) When complex contains web ligand than CFSE has lower value.

∴ CFSE decreases in order

$[CO(NH_3)_6]^{3+} > [Cr(CN)_6]^{3-} \cong [Cr(CH_2O)_6]^{3+} > [COCl_6]^{3-}$

∵ Order of field strength is $Cl^- < H_2O < NH_3 < CN^-$

CFSE $= (-0.4x + 0.6y)$ so

x = number of electrons in eg

y = number of electrons in eg

so $= 4 \times (0.4) + 2 \times 0.6$

$= -0.4\Delta 0$

Foer $Cr^{3+}cl^3$ low spin $[Cr(CN)_6]^{3-}, [Cr(H_2O)_6]^{3+}$

$\Delta_0 = 3 \times (-0.4) = 1.2\Delta_0$

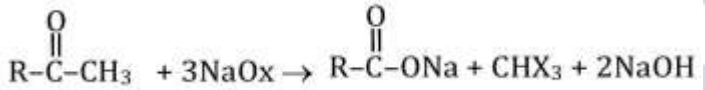
$\Delta_0 = 6 \times (-0.4) + 0 \times 0.6 = -2.4\Delta_0$

∴ for $[CoCl_6]$ compare magnitude of Δ_0 CFSE is minimum.

100. **(a)** B P increases with increase in molar mass

$CH_3Cl < CH_3Br < CH_2Br_2 < CHBr_3$ iii < i < iv < ii

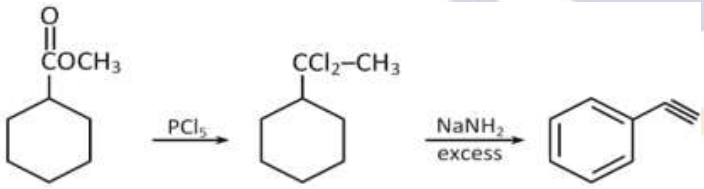
101. **(c)**



The above reaction is Iodoform test. This test is used to detect the compounds having. $RCOCH_3$ or $RCH(OH)CH_3$ structure.

∵ Propan-1-ol does not contain the required group So, it does not give iodoform test

102. **(c)**

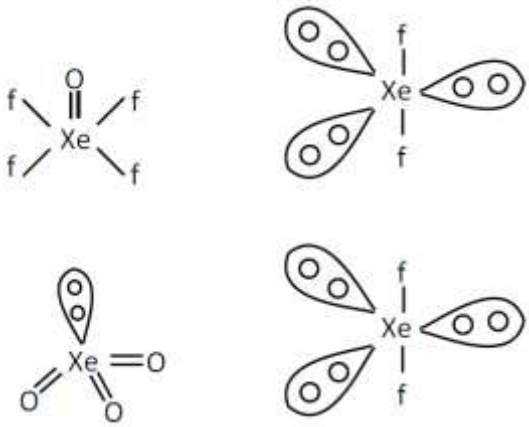


103. **(c)** Na_3Alf_6 is the formula of crinoline. It is used in electrolysis of alumina

∵ it lower down the fusion temperature from $2050°C$ to $950°C$

∴ Na_3Alf_6 is used in electrolysis of amnion for lowering.

104. **(c)**



By seeing the geometries of all compounds.

XeO_3 has pyramidal geometry.

105. **(b)** $\Delta T_f = kgm; m = \Delta T_f/K_f$

$\Delta_0\ m = \frac{0.126}{1.86} = 0.1$

$\Delta T_b = Kbm\ = 0.521 \times 0.1 = 0.0521$

106. **(c)** By seeing the plot we can conclude that on increasing the temperature, the molecular velocity increases.

$V_1 > V_2$ then $T_1 > T_2$

107. **(a)** $NaHCO_3$ is slightly acidic and NaOH is a strong base so when they both are dissolved together then they will react and the reaction is as follows

$\therefore NaHCO_3 \& NaOH$ cannot exist together.

108. **(b)** 32 g of O_2 have Na molecules

So 1.8×10^{22} molecules of O_2 will have

$\frac{32 \times 1.8 \times 10^{22}}{6.022 \times 10^{23}} = 0.955 = 0.960$

109. **(c)** For finding (B)O of O_2^+ the configuration of O_2^+ is

$\sigma 1s^2 \sigma^* 1s^2\ \sigma 2s^2 \sigma^* 2s^2 \sigma 2Pz^2 (\pi\alpha p\alpha^2 = \pi\alpha py^2)$

$\left(\pi^* 2p_x^1 = \pi^* 2P_y\right)$

Total electrons in O_2^+ ions is 15

Bond order $= \frac{Nb-Na}{2}$

Nb = No. Of electrons in BMO

Na = No. Of electrons in ABMO

$BO = \frac{10-5}{2} BO = 0.25$

Electronic configuration for O_2^- is

$\sigma s^2 \sigma^* 1\ s^2\ \sigma 2\ s^2 \sigma^* 2\ s^2 \sigma 2 P_z^2 \left(\pi \alpha p_x^2 = \pi \alpha p_y^2\right)$

$\left(\pi^* \alpha p_x^2 = \pi^* \alpha p_y^1\right)$

$$BO = \frac{10-7}{2} = 0.15$$

Ion with higher bond order will be stable. Nature of O_2^- is paramagnetic and O_2^+ is diamagnetic

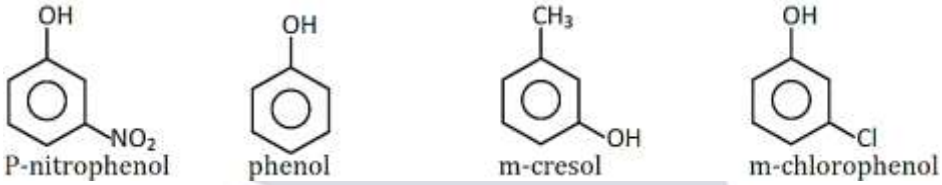
110. **(c)** Prontosil is antibacterial drug When it is taken then it will convert to sulfanilamide in body.

111. **(d)**

112. **(c)** The compound will be more acidic when it is stable after donating a proton i.e. when conjugate base is more stable then the compound will be more acidi(c)

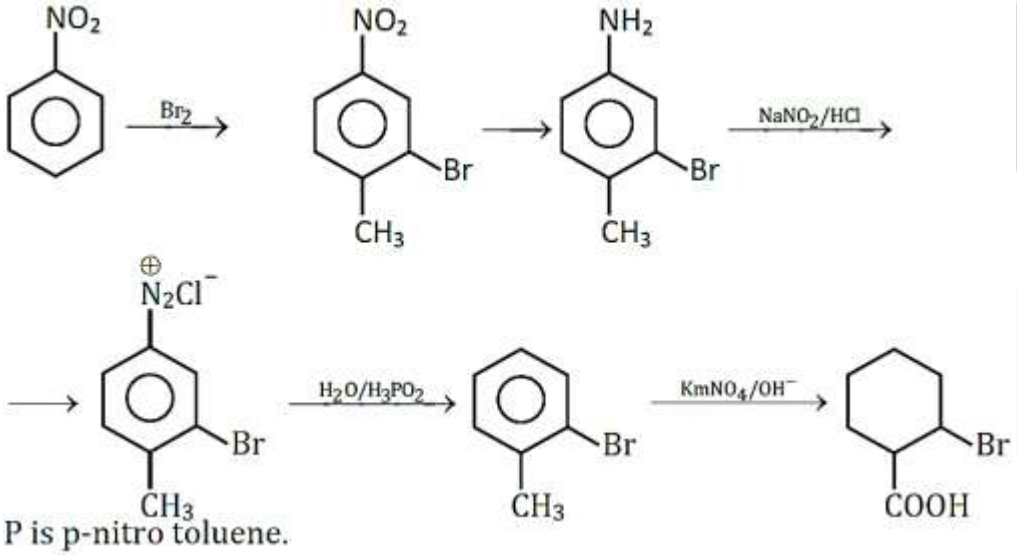
The groups such as CH_3 shows-I effect and decreases the acidic strength when attached to group.

So by analysing structures



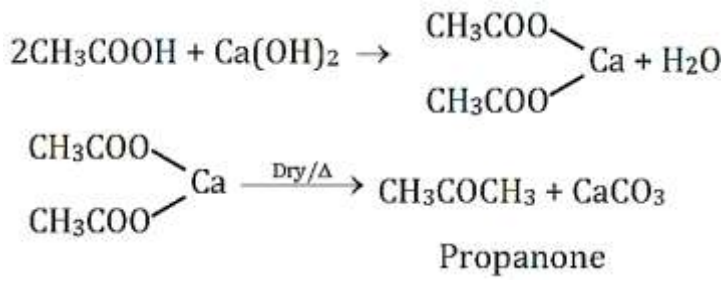
So increasing order of acidic strength will be ii < iii < iv < i

113. **(d)**



P is p-nitro toluene.

114. **(c)**



115. **(c)** The maximum $p\pi - p\pi$ back bonding exists in

Bf_3 because as the size of halogen atom increases down the group, the overlapping of the vacant 2 p-orbital of boron cannot take place easily and efficiently

$\because$ p-orbital will be of high energy levels.

116. **(a)** Toluene exhibit lowest bond dissociation energy because of involvement of $C - H$ in hyper conjugation.

117. **(c)** H_2 S is weak electrolyte

$\therefore$ it ionizes slightly but HCl is strong electrolyte.

So it can be easily ionized

$H_2\ S \rightleftharpoons 2H^+ + S^{-2}$

$HCl \rightarrow H^+ + Cl^-$

If DOD of H_2 S is low then concentration of S^{-2} will also be low

$\therefore$ sulphides with low solubility will be easily precipitated

118. **(c)** In conversion of Bf_3 to Bf_4^- the hybridisation changes since. Bf_3 has sp^2 hybridisation and Bf_4^- has sp^2 hybridization

$\therefore$ answer is 3 i.e Bf_3 to Bf_4^-

119. **(d)** Clark's process is type of water treatment used for water softening. Here calcium hydroxide is used to remove hardness i.e. calcium and magnesium ions.

The bicarbonate. Which are present in water undergoes reaction with lime to produce. Carbonates of calcium and magnesium.

$\therefore$ Clark's process uses $Ca(OH)_2 4$.

120. **(d)**

$$NaH + B_2H_6 \xrightarrow{DO\in_0} 2Na^+ [BH_4]^-$$

But since the hint is given that the reagent is extensively used so it will be $NaBH_4$ and solvent is diethyl ether.

Mathematics

121. **(a)**

$g(x) = \sqrt{3 + 4x - 4x^2}$

Domain of $g(x) \Rightarrow\ 3 + 4x - 4x^2 \geq 0$

$4x^2 - 4x - 3 \leq 0$

$(2x - 1)(2x - 3) \leq 0$

$x = -\frac{1}{2}, 3/2$

$X \in \left[-\frac{1}{2}, \frac{3}{2}\right]$

$f(x) = \frac{1}{2} - \tan\left(\frac{\pi x}{2}\right)$

$\{\because -1 < x < 1\}$

Domain of $f(x) \Rightarrow (-1,1)$

$\Rightarrow$ Domain of $(f + g)(x)$

$\Rightarrow$ Domain of $f(x) \cap$ Domain of $g(x)$

$\Rightarrow (-1,1) \cap \left[-\frac{1}{2}, \frac{3}{2}\right]$

$\Rightarrow \left[-\frac{1}{2}, -1\right)$

So Domain of $(f + g) \Rightarrow \left[-\frac{1}{2}, 1\right)$

122. **(c)** Consider the set A $\{-1,1\}$

Here -1 and 1 are the roots of the equation $x^2 - 1 = 0$

So set A in set builder form can be written as

$A = \{x: x \text{ is a root of equation } x^2 - 1 = 0\}$

123. **(d)**

Given that

$a \oplus b = a^2 + b^2$

We have

$(2 \oplus 3) \oplus 4 = (2^2 + 3^2) \oplus 4$

$= (4 + 9) \oplus 4$

$= 13 \oplus 4$ {Using given condition}

$= 13^2 + 4^2$

$= 169 + 16$

$= 185$

124. **(c)**

$$Z = \frac{(\sqrt{3}+i)^3(3i+4)^2}{(8+6i)^2}$$

$$|Z| = \left|\frac{(\sqrt{3}+i)^3(3i+4)^2}{(8+6i)^2}\right|$$

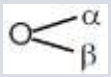
$$|Z| = \left|\frac{|\sqrt{3}+i|^3|3i+4|^2}{|8+6i|^2}\right|$$

{using the identify $|a+ib| = \sqrt{a^2+b^2}$

$$|Z| = \frac{(3+1)^{\frac{3}{2}}(9+16)^{\frac{2}{2}}}{(64+36)^{\frac{2}{2}}}$$

$$|Z| = \frac{(8)(25)}{(100)}$$

$$|Z| = 2$$

125. **(a)** Given Q. E $\Rightarrow x^2 - ax + b^2 =$ 

Sum of root $\Rightarrow \alpha + \beta = a$

Product of root $\Rightarrow \alpha\beta = b^2$

Now $\alpha^2 + \beta^2 = (\alpha+\beta)^2 - 2\alpha\beta$

$= (a)^2 - 2b^2$

126. **(a)**

2^{nd} term of G.P $\Rightarrow ar = 24 \Rightarrow a = \frac{24}{r}$…….. (1)

5 th term of G.P. $\Rightarrow ar^4 = 3$…….. (2)

Eq. (1) put in Eq (2)

$$\Rightarrow \frac{24}{r} \cdot r^4 = 3$$

$$\Rightarrow 8r^3 = 1$$

$$r = \frac{1}{2}$$

So $a = \frac{24}{1/2} = 48$

Sum of first six terms is

$$\Rightarrow a + ar + ar^2 + ar^3 + ar^4 + ar^5$$

$$\Rightarrow 48 + 24 + 12 + 6 + 3 + \frac{3}{2}$$

$\Rightarrow \frac{189}{2}$

127. **(d)** $n = 10 \Rightarrow$ even

middle terms $= \left(\frac{10}{2} + 1\right)^{th} = 6^{th}$ term

$T_6 = T_{5+1} = {}^{10}C_5 \left(\frac{10}{x}\right)^5 \left(\frac{x}{10}\right)^5 = {}^{10}C_5$

128. **(d)** Area of triangle whose vertices are

$\left(\frac{x_1}{a}, \frac{y_1}{a}\right), \left(\frac{x_2}{b}, \frac{y_2}{b}\right), \left(\frac{x_3}{c}, \frac{y_3}{c}\right)$ is

$$\Delta = \frac{1}{2}\begin{vmatrix} \frac{x_1}{a} & \frac{y_1}{a} & 1 \\ \frac{x_2}{b} & \frac{y_2}{b} & 1 \\ \frac{x_3}{c} & \frac{y_3}{c} & 1 \end{vmatrix}$$

On multiplying R_1, R_2 and R_3 by (a) b . c respectively we get

$$\Delta = \frac{1}{2abc}\begin{vmatrix} x_1 & y_1 & a \\ x_2 & y_2 & b \\ x_3 & y_3 & c \end{vmatrix}$$

On multiplying C_3 by 2 we get

$$\Delta = \frac{1}{4abc}\begin{vmatrix} x_1 & y_1 & 2a \\ x_2 & y_2 & 2b \\ x_3 & y_3 & 2c \end{vmatrix}$$

On applying $C_1 \leftrightarrow C_3$, we get

$$\Delta = \frac{1}{4abc}\begin{vmatrix} 2a & y_1 & x_1 \\ 2\,b & y_2 & x_2 \\ 2c & y_3 & x_3 \end{vmatrix}$$

Apply $C_2 \leftrightarrow C_3$

$$\Delta = \frac{1}{4abc}\begin{vmatrix} 2a & x_1 & y_1 \\ 2b & x_2 & y_2 \\ 2c & x_3 & y_3 \end{vmatrix}$$

$= \frac{1}{4abc}\left(\frac{abc}{2}\right)$

$= \frac{1}{8}$

129. **(a)**

Equation of line passing through the coordinate $(0,14)$ and $(9,14)$ is $y = 14$

Consider the equation of the line joining $(0,14)$ and $(5,0)$ applying intercept form gives us

$\Rightarrow \frac{x}{5}+\frac{y}{14}=1$

$\Rightarrow 14x+5y=70$

The equation of the line joining (5,0) and (19,14) is given by

$\Rightarrow \frac{y-14}{x-19}=\frac{y-0}{x-5}$
$\Rightarrow xy-14x-5y+70=xy-19y$
$x-y=5$

Consider the figure and observe the shaded region the inequalities can be written as $y \leq 14$

$14x+5y \geq 70$

$x-y \leq 5.$

130. **(d)**
131. **(b)**
132. **(b)** Given hyperbola has focus (ae, 0) which will lie on $2x+3y-6=0$ as it is focal chord

$\therefore 2ae-6=0$

$2ae=6$

$ae=3$

$\left[\because e=\frac{5}{4}\right]$

$a\left(\frac{5}{4}\right)=3;\ a=\frac{12}{5}$

Length of transverse axis $= 2a$

$=2\times\frac{12}{5}=\frac{24}{5}$

133. **(c)**

$a=a=\hat{i}+2\hat{j}+2\hat{k}$

$|a|=\sqrt{(1)^2+(2)^2+(2)^2}$

$|a|=\sqrt{1+4+4}$

$|a|=3$

$\therefore$ Required area $=\frac{1}{2}|a\times b|=\frac{1}{2}\times a\times b\times\sin\theta$

$=\frac{1}{2}\times 3\times 5\times\sin\frac{\pi}{6}\ \left\{\because \theta=\frac{\pi}{6}\right\}$
$=\frac{15}{4}$

134. (c)

$|\vec{a} - \vec{b}| = \sqrt{7}$

Squaring both side

$\Rightarrow |\vec{a}|^2 + |\vec{b}|^2 - 2a \cdot b = 7 \{\because \vec{a} \cdot \vec{b} = |\vec{b}|^2\}$

$\Rightarrow \left[\sqrt{(1)^2 + (-2)^2 + (3)^2}\right]^2 + |\vec{b}|^2 - 2|\vec{b}|^2 = 7$

$\Rightarrow 14 - |\vec{b}|^2 = 7$

$|\vec{b}|^2 = 7$

$|\vec{b}| = \sqrt{7}$

135. (d)

136. (b) Consider the planes

$X - 2y - Z + 5 = 0$ and $x + y + 3z = 6$

Let the DR's of the line passing through the intersection of the given plane be a, b and C

$a - 2b - C = 0$ and $a + b + 3c = 0$

Thus

$$\frac{a}{-6+1} = \frac{-6}{3+1} = \frac{C}{1+2}$$

$$\frac{a}{-5} = \frac{-b}{4} = \frac{c}{3}$$

Now the required line passes through $(2,3,1)$ and is parallel to the above line.

The equation of the required line is,

$\frac{x-2}{-5} = \frac{y-3}{-4} = \frac{z-1}{3}$.

137. (b) Consider the equation of plane,

$2x - 3y + 4z = 29$

The DR's of the line perpendicular to line form origin is $2, -3$ and 4

The equation of the line will be

$$\frac{x-0}{2} = \frac{y-0}{-3} = \frac{z-0}{4} = \lambda$$

So the coordinates of the foot is $(2\lambda, -3\lambda, 4\lambda)$

Since the foot lies on the plane, hence

$4\lambda + 9\lambda + 16\lambda = 29$

$29\lambda = 29$
$29\lambda = 1$

Thus, the coordinate of the foot are $(2, -3, 4)$

138. **(d)** Let E be the event of getting sum more than 5 .

$$E = \begin{Bmatrix} (1,5)(1,6)(2,4)(2,5)(2,6)(3,3)(3,4)(3,5)(3,6) \\ (4,2)(4,3)(4,4)(4,5)(4,6)(5,1)(5,2)(5,3)(5,4) \\ (5,5)(5,6)(6,1)(6,2)(6,3)(6,4)(6,5)(6,6) \end{Bmatrix}$$

The probability of getting sum more than 5 is calculate as

$$P(E) = \frac{26}{36} = \frac{13}{18}$$

139. **(d)**

$y = f(x^2 + 2)$

Differentiate w.r.t x

$$\frac{dy}{dx} = f'(x^2 + 2) \cdot 2x$$
$$\left.\frac{dy}{dx}\right|_{x=1} = f'(1 + 2) \times 2(1)$$
$$= f'(3) \times 2$$
$$= 2(5) = 10$$

140. **(c)** Consider the expression.

$X = a\cos^3\theta$

Differentiate w.r.t θ

$\frac{dx}{d\theta} = -3a\cos^2\theta \cdot \sin\theta$…….. (1)

and $y = a\sin^3\theta$

Differentiate w.r.t θ

$\frac{dy}{d\theta} = 3a\sin^2\theta \cdot \cos\theta$-------- (2)

Divide equation (2) by (1)

dy

$$\frac{d\theta}{dx} = \frac{3a\sin^2\theta\cos\theta}{-3a\cos^2\theta\sin\theta}$$

$d\theta$

$$\frac{dy}{dx} = -\frac{\sin\theta}{\cos\theta} = -\tan\theta$$

$\Rightarrow \left(\frac{dy}{dx}\right)^2 + 1 = (-\tan\theta)^2 + 1$

$= 1 + \tan^2\theta = \sec^2\theta$

141. (a)

$y = x^2 - \frac{1}{x^2}$

Differentiate w.r.t x

$\frac{dy}{dx} = 2x + \frac{2}{x^3}$

$\left.\frac{dy}{dx}\right|_{x=-1} = 2(-1) + \frac{2}{(-1)^3}$
$= -2 - 2 = -4$

Slope $= \frac{-1}{\frac{dy}{dx}} = \frac{-1}{-4} = \frac{1}{4}$

142. (a) Let

$I = \int \frac{1}{x^2(x^4+1)^{3/4}} dx$

$I = \int \frac{1}{x^2 \cdot x^3 \left(1 + \frac{1}{x^4}\right)^{3/4}} dx$

$I = \int \frac{1}{x^5 \left(1 + \frac{1}{x^4}\right)^{3/4}} dx$

Let $1 + \frac{1}{x^4} = t; dx = \frac{-x^5}{4} dt$

$I = \frac{-1}{4} \int \frac{1}{(t)^{3/4}} dt$

$I = \frac{-1}{4} \cdot \frac{t^{1/4}}{1/4} + C$

$I = -\left(1 + \frac{1}{x^4}\right) + C$

$I = \frac{-(x^4+1)^{\frac{1}{4}}}{x} + C$

143. (b)

$f(x) = \frac{x}{x^2+1} \Rightarrow f(f(x)) = \frac{f(x)}{[f(x)]^2+1} \Rightarrow f(f(x)) = \frac{\frac{x}{x^2+1}}{\left(\frac{x}{x^2+1}\right)^2 + 1}$

Put $x = 2 \Rightarrow f(f(2)) = \frac{\frac{2}{4+1}}{\left(\frac{2}{4+1}\right)^2+1}$

$$= \frac{\frac{2}{5}}{\frac{4}{25}+1} = \frac{2}{5} \times \frac{25}{29} = \frac{10}{29}$$

144. (b)

let $D = \begin{vmatrix} \cos 15^\circ & \sin 15^\circ \\ \cos 75^\circ & \cos 75^\circ \end{vmatrix}$

$= \cos 15^\circ \cos 75^\circ - \sin 15^\circ \sin 75^\circ$

$= \cos(15 + 75)$

$= \cos 90^\circ$

$= 0$

145. (b) One step away means a step forward or a step backward ⇒ either he took 6 forward steps and 5 backward steps or 6 backward steps and 5 forward steps

⇒ required probability

$= {}^{11}C_6(0.4)^6(0.6)^5 + {}^{11}C_5(0.4)^5(0.6)^6 = {}^{11}C_5(0.4)^5(0.6)^5[0.4 + 0.6]$

$= {}^{11}C_5(0.24)^5 = {}^{11}C_6(0.24)^5$

146. (c) Let

$$I = \int_0^{\frac{\pi}{4}} \log\left(\frac{\sin x + \cos x}{\cos x}\right) dx$$

$$I = \int_0^{\frac{\pi}{4}} \log(1 + \tan x) dx$$

Using property

$$I = \int_0^{\frac{\pi}{4}} \log\left(1 + \tan\left(\frac{\pi}{4} - x\right)\right) dx \ldots\ldots\ldots (1)$$

$$I = \int_0^{\frac{\pi}{4}} \log\left(\frac{2}{1+\tan x}\right) dx \ldots\ldots (2)$$

Add eq. (1) and (2)

$$2I = \int_0^{\frac{\pi}{4}} \left[\log(1 + \tan x) + \log\left(\frac{2}{1 + \tan x}\right)\right] dx$$

Using log property

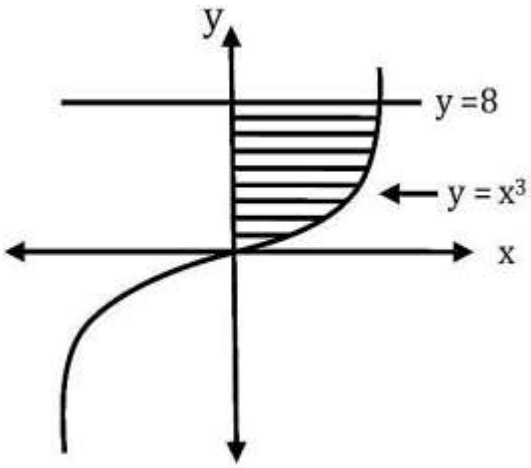
$$2I = \int_0^{\frac{\pi}{4}} \log 2 dx$$

$$2I = \log 2 [x]_0^{\frac{\pi}{4}}$$

$$2I = \log 2 \left[\frac{\pi}{4} - 0\right]$$

$$I = \frac{\pi}{8} \log 2$$

147. **(c)** Consider the graph of $y = x^3$ and $y = 8$ on the same plane.



The required area is the shaded region.

$A = \int_0^8 y^{\frac{1}{3}} dy$

$A = \frac{3}{4}[y^{4/3}]_0^8$

$A = \frac{3}{4}[16]$

$A = 12$ sq. units

148. **(d)** Given vectors,

$\vec{a} = \hat{i} + 2\hat{i} + k$ ،

$\vec{b} = \hat{i} - \hat{i} + k$

$\vec{c} = \hat{i} + j - k$

The vector r in the plane a and b is calculated as

$\vec{r} = \vec{a} + \lambda\vec{b}$

$\vec{r} = (1 + \lambda)\hat{i} + (2 - \lambda)\hat{i} + (1 + \lambda)k$…… (1)

Projection $= \frac{\vec{r}\cdot\vec{c}}{|\vec{c}|}$

$\left|\frac{1}{\sqrt{3}}\right| = \frac{[(1 + \lambda)\hat{i} + (2 - \lambda)\hat{i} + (1 + \lambda)k] \cdot [\hat{i} + \hat{i} + k]}{\sqrt{1 + 1 + 1}}$

$\left|\frac{1}{\sqrt{3}}\right| = \frac{1 + \lambda + 2 - \lambda - 1 - \lambda}{\sqrt{3}}$

$2 - \lambda = \pm 1$

$2 - \lambda = 1 \mid 2 - \lambda = -1$

$\lambda = 1\ \lambda = 3$

Value of λ put in eq. (1)

$\vec{r} = 2\hat{i} + \hat{i} + 3k, 4\hat{i} - \hat{i} + 4k$

149. (d)

Mean $= \frac{3+4+5+7+10+10+10}{7}$

$= \frac{49}{7} = 7$

Median $= \left(\frac{7+1}{2}\right)^{th}$ observation

$= 4^{th}$ observation

Median $= 7$

Mean deviation $= \frac{1}{7}[|7-3| + |7-4| + |7-5| + |7-7| + |7-10| + |7-10| + |7-10|]$

$= \frac{1}{7}[4 + 3 + 2 + 0 + 3 + 3 + 3]$

$= \frac{18}{7} = 2.57$

150. (a)

$\sum P(x) = 1$
$0.2 + k + k + 2k = 1$
$0.2 + 4k = 1$
$4k = 0.8$
$k = 0.2$

151. (a)

$g(x) = \frac{x^{200}}{200} + \frac{x^{199}}{199} + \frac{x^{198}}{198} + \cdots\ldots\ldots\ldots + \frac{x^2}{2} + x + 5$

Differentiate w.r.t x

$g'(x) = \frac{200x^{199}}{200} + \frac{199x^{198}}{199} + \frac{198x^{197}}{197} + \cdots\ldots\ldots\ldots + \frac{2x}{2} + 1$

$= x^{199} + x^{198} + x^{197} + +x + 1$

put $x = 0$

$g'(0) = 0 + 0 + 0 + \cdots\ldots\ldots + 0 + 1$

$g'(0) = 1$

152. (b) The total number of marbles are $n(S) = 6 + 4 = 10$

The number of marbles that are white and odd numbered is $n(E) = 2$

Pr obability $= \frac{n(E)}{n(S)} = \frac{2}{10} = \frac{1}{5}$

153. (c)

$\Rightarrow \lim_{x\to 0} \frac{1-\cos x}{x^2}$ $\left\{\frac{0}{0} \text{ form}\right\}$

Using L' Hospital rule

$\Rightarrow \lim_{x\to 0} \frac{\sin x}{2x}$

$\Rightarrow \frac{1}{2}\lim_{x\to 0} \frac{\sin x}{x}$

$= \frac{1}{2}(1)$

$= \frac{1}{2}$

154. (d)

$$f(x) = \begin{cases} 3x-8 & : x \le 5 \\ 2k & : x > 5 \end{cases}$$

$LHL \Rightarrow \lim_{x\to 5^-} f(x) = \lim_{x\to 5^-}(3x-8)$

$= 3(5) - 8$

$= 7$

$RHL \Rightarrow \lim_{x\to 5^+} f(x) = \lim_{x\to 5^+} 2k = 2k$

Value of function $\Rightarrow f(5) = 3\times 5 - 8 = 7$

$\because$ f(x) is continuous at $x = 5$

$\therefore$ LHL = RHL = f (5)

$7 = 2k = 7$

$k = \frac{7}{2}$

155. (c)

given that f$(x) = 2x^2$

Now

$$\frac{f(3.8)-f(4)}{3.8-4} = \frac{2(3.8)^2 - 2(4)^2}{3.8-4}$$

$$= \frac{28.88-32}{-0.2}$$

$$= \frac{-3.12}{-0.2}$$

$$= 15.6$$

156. (c) x = ct

differentiate w.r.t t

$\frac{dx}{dt}$ = c …… (1)

and

$y = \frac{c}{t}$

differentiate w.r.t t

$\frac{dy}{dt} = -\frac{c}{t^2}$ ……..(2)

divide equation (2) by (1)

$\frac{dy}{dt} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{-\frac{c}{t^2}}{c} = -\frac{1}{t^2}$

$\left.\frac{dy}{dx}\right|_{t=2} = \frac{-1}{(2)^2} = -\frac{1}{4}$

157. **(a)** The rate of pumping the gas in the balloon is $\frac{dv}{dt} = 10\ cm^3/sec$

The volume of the spherical balloon is given by $v = \frac{4}{3}\pi r^3$ differentiate w.r.t r

$\frac{dv}{dr} = \frac{4}{3}\pi(3r^2)$

$= 4\pi r^2$

$\left.\frac{dv}{dr}\right|_{r=15} = 4\pi(15)^2 = 900\pi$

Now,

$\frac{dv}{dt} = \frac{dv}{dr} \times \frac{dr}{dt}$

$10 = 900\pi \times \left(\frac{dr}{dt}\right)$

$\frac{dr}{dt} = \frac{1}{90}\pi cm/sec$

158. **(b)** Let $I = \int \frac{\sin^2 x}{1+\cos x} dx$

$I = \int \frac{(1-\cos^2 x)}{1+\cos x} dx$

$I = \int \frac{(1-\cos x)(1+\cos x)}{(1+\cos x)} dx$

$I = \int (1-\cos x) dx$

$I = x - \sin x + c$

159. **(d)**

Let $I = \int e^x \left(\frac{1+\sin x}{1+\cos x}\right) dx$

$I = \int e^x \left(\frac{1+2\sin\frac{x}{2}\cos\frac{x}{2}}{1+\cos^2\frac{x}{2}-1}\right) dx$

$\left\{\because \sin 2A = 2\sin A\cos A \atop \cos 2A = 2\cos^2 A - 1\right\}$

$I = \int e^x \left(\frac{1+2\sin\frac{x}{2}\cos\frac{x}{2}}{2\cos^2\frac{x}{2}}\right) dx$

$I = \int e^x \left(\frac{1}{2\cos^2\frac{x}{2}} + \frac{2\sin\frac{x}{2}\cos\frac{x}{2}}{2\cos^2\frac{x}{2}}\right) dx$

$I = \int e^x \left(\frac{1}{2}\sec^2\frac{x}{2} + \tan\frac{x}{2}\right) dx$

$I = e^x \tan\frac{x}{2} + c$

160. **(d)** If $1, w, w^2$ are three cube roots of unity,

then $1 + w + w^2 = 0$..... (1)

Hence

$(1-w+w^2)(1+w-w^2) = (1+w+w^2-2w)(1+w+w^2-2w^2)$

$= (0-2w)(0-2w^2) \quad form\ eq\ (1)$

$= (-2w)(-2w^2)$

$= 4w^3$

$= 4(1)$

$= 4$

161. **(d)**

$\tan^{-1}\left(\frac{1-x}{1+x}\right) = \frac{1}{2}\tan^{-1} x$

$\Rightarrow \tan^{-1}(1) - \tan^{-1} x = \frac{1}{2}\tan^{-1} x \Rightarrow \tan^{-1} x + \frac{1}{2}\tan^{-1} x = \tan^{-1}(1)$

$\Rightarrow \frac{3}{2}\tan^{-1} x = \tan^{-1}(1) \Rightarrow \frac{3}{2}\tan^{-1} x = \frac{\pi}{4}$

$\Rightarrow \tan^{-1} x = \frac{\pi}{6} \Rightarrow x = \tan\frac{\pi}{6}$

$\Rightarrow x = \frac{1}{\sqrt{3}}$

162. **(b)** Consider the given system of equations

$x + y + z = 6$ .....(1)

$x + 2y + 3z = 10$ ..... (2)

$x + 2y + az = 6$ ..... (3)

$\because$ condition of no solution, $\Delta = 0$

So $\begin{vmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 2 & a \end{vmatrix} = 0$

$\Rightarrow 1(2a - 6) - 1(a - 3) + 1(2 - 2) = 0$

$\Rightarrow 2a - 6 - a + 3 = 0$

$\Rightarrow a = 3$

Now, $b \neq 10$ then equations (2) and (3) will become identical, which will have infinite solutions. The condition is satisfied for the option $a = 3$ and $b \neq 10$.

163. **(b)** $\Rightarrow \tan(1°) + \tan(89°)$

$= \tan(1°) + \tan(90 - 1°)$

$= \tan(1°) + \cot(1°) = \frac{\sin 1°}{\cos 1°} + \frac{\cos 1°}{\sin 1°}$

$= \frac{\sin^2(1°) + \cos^2(1°)}{\sin(1°)\cos(1°)} = \frac{1}{\sin(1°)\cos(1°)}$

$= \frac{2}{2\sin(1°)\cos(1°)} = \frac{2}{\sin(2°)}$

164. **(b)**

Consider the expression

$\text{cosec}^{-1}\left(\frac{1}{A}\right) + \cot^{-1}\left(\frac{1}{B}\right) + \sec^{-1} C$ .....(1)

Also

$\Rightarrow \frac{x^2 + 2x + 1}{x(x^2 + 1)} = \frac{A}{x} + \frac{Bx + C}{x^2 + 1}$

$\Rightarrow \frac{x^2 + 1}{x(x^2 + 1)} + \frac{2x}{x(x^2 + 1)} = \frac{A}{x} + \frac{Bx + C}{x^2 + 1}$

$\Rightarrow \frac{1}{x} + \frac{2}{(x^2 + 1)} = \frac{A}{x} + \frac{Bx + C}{x^2 + 1}$

Compare the like terms of the equation

$A = 1$

$B = 0$

$C = 2$

Value of A, B, C put in equation (1)

$\Rightarrow \text{cosec}^{-1}\left(\frac{1}{1}\right) + \cot^{-1}\left(\frac{1}{0}\right) + \sec^{-1}(2) \Rightarrow \frac{\pi}{2} + \cot^{-1}(\infty) + \frac{\pi}{3}$

$= \frac{5\pi}{6} + 0 = \frac{5\pi}{6}$

165. (a)

Given that : $1!\,2! + 3! + 4! + - - - - +11\,!$

$= (1! + 2! + 3!) + (4! + 5! + 6! + - - - - +11!)$

$= (1 + 2 + 6) + (4! + 5! + 6! + - - - + 11!)$

$= 9 + (4! + 5! + 6! + - - - + 11!)$

4!, 5!, 6! ---- 11! Are divisible by 12 so, when you will divide given expression by 12 the remainder be 9 .

166. (c) For the sine function

$-\frac{\pi}{2} \leq \sin^{-1} x \leq \frac{\pi}{2}$

$0 \leq \frac{\pi}{2} + \sin^{-1} x \leq \pi$

$0 \leq \sin^{-1} x + \cos^{-1} x + \sin^{-1} x \leq \pi \left\{\because \sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}\right\}$

$0 \leq 2\sin^{-1} x + \cos^{-1} x \leq \pi$

Compare the given expression

$\alpha = 0$

$\beta = \pi$

167. (c)

$A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

$A^2 = (A)A$

$= \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

$= \begin{bmatrix} 0+1 & 0+0 \\ 0+0 & 1+0 \end{bmatrix}$

$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

168. (d) Consider the function

$F(x) = [x]$

Here, [x] denotes the greatest integer function.

[x] is always continuous at non integer value of x.

Thus, the function will be continuous at $x = 1.5$

169. (a)

$$Y = \log\left(\frac{1-x^2}{1+x^2}\right)$$

using log property

$$y = \log(1-x^2) - \log(1+x^2)$$

differentiate w.r.t x

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

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

$$= (-2x)\left[\frac{1+x^2+1-x^2}{(1-x^2)(1+x^2)}\right]\{\because (A-B)(A+B) = A^2 - B^2\}$$

$$= \frac{-4x}{(1-x^4)}$$

170. **(b)** first curve equation

$$x^3 - 3xy^2 + 2 = 0$$

differentiate w.r.t. x

$$3x^2 - 3(y^2 + 2xyy') = 0$$

$$3x^2 - 3y^2 - 6xyy') = 0$$

$$y' = \frac{3x^2 - 3y^2}{6xy} = m_1$$

second curve equation

$$3x^2y - y^3 = 2$$

Differentiate w.r.t x

$$\Rightarrow 3(2xy + x^2y') - 3y^2y' = 0$$

$$\Rightarrow 6xy + 3x^2y' - 3y^2y' = 0$$

$$\Rightarrow y^1 = \frac{-6xy}{3x^2 - 3y^2} = m_2$$

Calculate the product of slope

$$m_1 \times m_2 = \left(\frac{-6xy}{3x^2 - 3y^2}\right)\left(\frac{3x^2 - 3y^2}{6xy}\right)$$

$$m_1 \times m_2 = -1$$

The product is -1 . So the curves intersect at each other at right angle.

171. **(a)**

Let

$y = x^2 - 8x + 17$

$y = (x^2 - 8x + 16) + 1$

$y = (x - 4)^2 + 1$

so, $y \geq 1$ for all real values of x as $(x - 4)^2 \geq 0$

Thus, the minimum value of y is 1

172. **(a)** Let

$$I = \int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{dx}{1 + \cos 2x}$$

$$I = \int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{dx}{1 + 2\cos^2 x - 1}$$

$$I = \int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{1}{2}\sec^2 x$$

Let

$f(x) = \sec^2 x$

$f(-x) = \sec^2(-x)$

$f(-x) = \sec^2 x$

$f(-x) = f(x)$

so f(x) is an even function

Therefore,

$$I = 2\int_0^{\pi/4} \frac{1}{2}\sec^2 x dx$$

$$I = \int_0^{\pi/4} \sec^2 x dx$$

$$I = [\tan x]_0^{\pi/4}$$

$$I = \tan\frac{\pi}{4} - \tan 0$$

$$I = 1 - 0$$

$I = 1$

173. **(b)** Let the centre of circle be (h, k) and radius be r.

The equation of circle can now be written as,

$(x-h)^2+(y-k)^2=x^2$

Hence the differential equation is of order 2 .

174. **(d)** $x\frac{dy}{dx}+2y=x^2$

$\frac{dy}{dx}+\frac{2}{x}\cdot y=x$

The above equation is a linear equation in terms of y.

Therefore,

$I.F=e^{\int\frac{2}{x}dx}$

$=e^{2\log x}$

$=e^{\log x^2}$

$=x^2$

The required solution is

$y.x^2=\int(x.x^2)dx+c_1$

$yx^2=\frac{x^4}{4}+c_1$

$y=\frac{x^4+4c_1}{4x^2}$

$y=\frac{x^4+c}{4x^2}$

175. **(d)** $\sin x+\sin y=\frac{1}{2}$

$2\sin\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)=\frac{1}{2}$ ..... (1)

and

$\cos x+\cos y=1$

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

Divide equation (1) and (2)

$\Rightarrow\frac{2\sin\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)}{2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)}=\frac{1}{2}$

$\Rightarrow\tan\left(\frac{x+y}{2}\right)=\frac{1}{2}$

Now,

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

$$= \frac{2\left(\frac{1}{2}\right)}{1-\left(\frac{1}{2}\right)^2}$$

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

176. **(c)** Given

$$A = \begin{bmatrix} \alpha & 2 \\ 2 & \alpha \end{bmatrix}$$

$$|A| = \begin{vmatrix} \alpha & 2 \\ 2 & \alpha \end{vmatrix}$$

$$|A| = \alpha^2 - 4$$

Now,

$$|A^3| = 27$$

$$(\alpha^2-4)^3 = 3^3$$

$$\alpha^2 - 4 = 3$$

$$\alpha^2 = 7$$

So,

$$\alpha = \pm\sqrt{7}$$

177. **(d)**

$$P = \begin{vmatrix} x & 1 \\ 1 & x \end{vmatrix}$$

$$|P| = x^2 - 1$$

and

$$\theta = \begin{vmatrix} x & 1 & 1 \\ 1 & x & 1 \\ 1 & 1 & x \end{vmatrix}$$

$$\theta = x(x^2-1) - 1(x-1) + 1(1-x)$$

$$\theta = x^3 - x - x + 1 + 1 - x$$

$$\theta = x^3 - 3x + 2$$

differentiate w.r.t x

$\frac{d\theta}{dx} = 3x^2 - 3$
$= 3(x^2 - 1)$
$= 3P$

178. **(c)** The equation of line is $3x + y = 3$

slope of the line $\Rightarrow 3 + \frac{dy}{dx} = 0$

$\Rightarrow \frac{dy}{dx} = -3 = m$

slope of the perpendicular line $\Rightarrow \frac{-1}{m} = \frac{-1}{-3} = \frac{1}{3}$

The equation of line passing through $(2,2)$ and perpendicular to given line

$\Rightarrow (y - 2) = \frac{1}{3}(x - 2)$

$3y - x = 4$

$\frac{3y}{4} - \frac{x}{4} = 1$

Thus, the y-intercept is $\frac{4}{3}$

179. **(d)** consider the function

$f(x) = \frac{1}{x}\ \forall x \in R$

substitute 0 for x in the above expression

$f(x) = \frac{1}{0}$

$=$ undefined

Thus, the function $f(x)$ is not defined

180. **(c)**

$\frac{x^2 + 6x - 7}{|x + 4|} < 0$

for the above expression

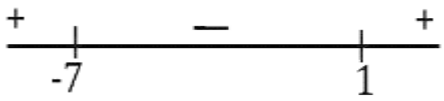
$|x + 4| > 0$

and

$x^2 + 6x - 7 < 0\ \{\because x \neq -4\}$

$(x + 7)(x - 1) < 0$

Diagram



So,

$x \leftarrow (-7,1) - \{-4\}$

$\{\because x \neq -4\}$

$x \leftarrow (-7,-4) \cup (-4,1)$

Biology

181. **(c)** Plasmid (autonomously replicating circular extra - Chromosomal DNA which carries antibiotic resistant gene and origin of replication i.e. , the ability of autonomous replication and its Size is smaller than Chromosomal DNA One of the earliest Commonly used cloning vectors is the PBR 322 plasmid

182. **(a)** Continuous self-pollination results in inbreeding depression. So, Flowering plants have developed following devices to discourage self-pollination and to encourage cross pollination: -

(i) In some Species, pollen release and Stigma receptivity are not synchronised

(ii) In Some other Species, the anther and Stigma are placed at different position, So that the pollen Cannot Come in contact with the stigma of the same flower.

(iii) The third devices to prevent inbreeding is self-incompatibility It prevents self- pollen from fertilizing the ovules by inhibiting pollen germination or pollen tube growth in the pistil.

(iv) Dicliny (unisexuality) i.e. flowers are unisexual, So that self -pollination is not possible

183. **(c)** ABO blood grouping is a type of blood grouping system in which blood is of 4 types A, B, AB and O blood group. These blood groups are Controlled by the gene l. Surface of the RBC Contains Sugar polymer. The gene 1 has 3 types of alleles A, B and i. Different forms of Sugars are present on RBC Surface of alleles I^A and I^B. However, C does not produce Sugar.

184. **(b)** Initiation Codon is the 1st codon on mRNA In Eukaryotes, AUG is the Start Codon of mRNA which Codes for amino acid methionine and modified into formyl methionine in prokaryotes. It is the first Codon at which the translation of proteins begins, it is paired during the translation with the t RNA with anticodon UAG, i.e, it acts as an initiator of protein synthesis as well as a codon for methionine and modified into formyl methionine in prokaryotes.

185. **(d)** Innate immune System is non-Specific type of defense i.e., present at the time of birth. They are providing different types of barriers to the entry of the foreign agents into our body. It Consists of 4 types of barriers: -

(A) Cytokine to cellular barrier: Virus infected Cells Secrete proteins called interferons which protect non- infected cells from further viral infection.

(B) Physiological barriers: Acid in the stomach, Saliva in the mouth tears from eyes all prevent microbial growth.

(C) Physical barriers: Skin is the main barrier which prevents entry of the micro-organism.

(D) Cellular barriers: Leukocytes (WBC) acts like polymorpho nuclear leukocytes (PMN Lneutrophils), Single - Celled organism i.e. Cellular barriers. It also include monocytes, natural killer Cells in the blood as well as Macrophages in tissue can phagocytose and destroy microbes.

186. **(c)**

187. **(c)** Eichhornia is an alien or exotic Species, these -plant are introduced in india because of its beautiful flowers and shape of leaves Since it can propagate vegetatively at a phenomenal rate and Spread all over the water body in a Short Period of time. It is the most invasive weeds found growing wherever there is Standing water. It drains

oxygen from the water, which leads to death of fishes. It adversely effects the aquatic life and increases the biological oxygen demand

A Species is defined as indigenous to a given region or ecosystem, if its presence in that region is the result of the only natural process, with no human intervention. Indigenous Species include those that are endemic i.e., naturally occurring in an area and restricted entirely to that are(a) So, eichhornia is not an indigenious Species of our Country.

188. **(b)** (i) A Special mechanism to produce seeds without fertilization called apomixis. There are several ways of development of apomictic Seeds. In some species, the diploid egg cell is formed without reduction division and develops into the embryo without fertilization.

(ii) Polyembryony is the formation of more than one embryo from a single fertilized ovum.

(iii) Parthenocarpy is the process of development of fruits without fertilization of ovules. It can be induced through the application of growth hormones and Such fruits are Seedless. For example, Banana

(iv) Seed dormancy means embryo may enter a state of inactivity Seeds are prevented from germinating even under favourable conditions. These Conditions are a Complex Combination of water, light, temperature, hormone etc.

189. **(d)** Each Seminiferous tubules is lined on its inside by two types of cell called male germ cells (Spermatogonia) and Sertoli cells. The male germ cells undergo meiotic division finally leading to sperm formation while Sertoli cells acts as neutrition to the germ cells, Leydig cells synthesise and secrete testicular hormones called androgens.

Spermiogenesis is the final stage of Spermatogenesis where the spermatids need to mature into motile sperm cells. The main hormones which regulate spermatogenesis are testosterone and FSH and the Sertoli Cells possess receptions for both these hormones. Thus, the FSH hormones acts on sertoli cells and stimulates the process of spermatogenesis, when the FSH screated by the anterior pituitary binds to its receptors.

190. **(a)** Nitrogenous base is a molecule that contains nitrogen and has the chemical properties of a base. The nitrogenous bases in DNA are adenine (A), guanine (G), thymine (T) and Cytosine (C). The nitrogenous bases in RNA are the Same, with one exception are uracil (U) is present in place of thymine (T)

Thymine is also known as 5-methylated uracil. It is found in DN(A) Uracil is found in RNA and guanine is found in DNA as well as in RN(A) Ammonium Chloride is not Considered as a nitrogenous base

191. **(b)** Cross-breeding is the process where Superior males of one breed are mated with Superior females of another breed It allows the desirable qualities of two different breeds to be Combined Hisardale is a new breed of Sheep developed by crossing Bikaneri ewes and Merino rams of Punjad

192. **(b)** (i) In 1938, fish caught in South Africa happened to be a Coelacanth which was thought to be extinct. These animals evolved into first amphibians that lived on land and water.

These were ancestors of modern- day frogs and Salamanders

(ii) Jawless fishes were ancestor of Cephalochordates and notochord extends from head to tail region and is persistent throughout their life.

(iii) Ichthyophis is a genus of Caecilians. They are limbless amphibians called asian caecilians

(iv) Amphioxus were ancestors of Chordates

193. **(d)** During Sewage treatment, Once the BOD of Sewage or waste water is reduced Significantly the effluent is then passed into a Settling tank where the bacterial 'flocs' are allowed to Sediment called activated Sludge. A Small part of the activated Sludge is pumped back into the aeration tank or remaining major part of the Sludge is pumped into large tanks called anaerobic Sludge digesters. Here, other kinds of bacteria which grow anaerobically, digest the bacteria and the fungi in the sludge. During this digestion bacteria produce a mixture of gases such as methane, hydrogen Sulphide and carbon dioxide. These gases form biogas and can be used as source of energy as it is inflammable.

194. **(a)** According to 10% law of energy flow by Raynold lindeman The total amount of energy that can be transferred to the next trophic level is the 10%. At producer level 30 J will received by plants. Energy received by other organisms are:

Plant ⟶ mice ⟶ snakes ⟶ Peacock

$30\text{J}\ \frac{30}{100} \times 100 = 3\ \text{J}\ \frac{30}{100} \times 10 = .3\ \text{J}\ \frac{.3\times10}{100} = .03\ \text{J}$

So, peacock will receive 0.03 J of energy as top Consumer

195. **(d)** (i) In Situ Conservation is the production and management of important Components of biological diversity through a network of protected areas. Invariably, the number of Species waiting to be saved from extinction exceeds the Conservation resources available. In India, ecologically unique and biodiversity- rich regions are legally protected as biosphere reserves, national parks and Sanctuaries. Sacred groves are found in khasi and jaintia In Meghalaya, sacred groves are the last refuges for a large number of rare and threatened plants.

(ii) Ex Situ conservation is the Conservation of threatened animals and plants are taken out from their natural habitat and placed in Special setting where they can be protected and given Special care. Zoological parks, botanical gardens and wildlife Safari parks serve this purpose. The gametes of threatened species can be preserved in viable and fertile Condition for long periods using Cryopreservation techniques. Seeds of different genetic Strains of Commercially important plants can be Kept for long periods in seed banks.

196. **(d)**

(i) Gibberellin is a plant hormone i.e. involved in wide range of physiological responses in the plants. Their ability to cause an increase in length axis is used to increase the length of gropes stalks. It is involved in stem elongation, germination, flowering and leaf Senescence. It hastens the maturity period in Juvenile Conifers.

(ii) Auxin are generally produced by the growing apices of the stems and roots, from where they migrate to the regions of their action. They help to initiate rooting in stem cuttings, widely used for plant propagation and it also control xylem differentiation and helps in cell division.

(iii) ABAs Stimulates the closure of stomata in the epidermis and increases the tolerance of plants to various kind of stresses. Therefore, it is also called the stress hormone. ABAs acts as an antagonist to Gibberelins. It also helps in seed development, maturation and dormancy.

197. **(a)** Magnesium is an essential mineral element. It is one of the macronutrients. It is absorbed by plants in the form of divalent Mg^{+2}. It activates the enzymes of respiration, photosynthesis and are involved in the Synthesis of DNA and RNA It is a Constituent of the ring structure of chlorophyll and helps to maintain the ribosome structure. It forms the centre of the porphyrin ring of the green plant pigment chlorophyll. It helps the plants to be able to Convert light into the usable form of energy.

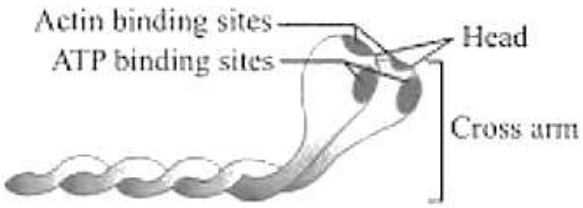
198. **(c)** (i) In Eukaryotic cell, the membrane bound organelles are organelles Surrounded by a double or a Single membrane like nucleus, mitochondria, Chloroplast et(c) are example of such organelles. In prokaryotic cells, the membrane bound organelles are absent.

(ii) Only in eukaryotic cells, membrane bound nuclei are present and they are absent in prokaryotes.

(iii) The main difference between animal cells and plant cells is the presence cell wall, it is present in plant cells via absent in all animal cells.

(iv) All living organisms are composed of cells and products of cells and all cells arise from pre-existing cells.

199. **(b)**



Each myosin filament is also a polymerized protein. Many monomeric proteins called meromyosins Constitute of thick filament. It has two important parts a globular head (A) with a short arm and a tail, the former being called the heavy meromyosin (HMM) and the latter, the light meromyosin (LMM). The HMM Component i.e., the head and short arm projects out wards at regular distance and angle from each other from the surface of a polymerized myosin filament and is known as the cross arm [B]. The globular head has an active ATPase enzyme [D] and has binding sites for ATP and active [C].

200. **(d)** Phoenix dactylifera commonly known as date or date pallam. It is a flowering plant species in the plant family Arecaceae, Cultivated for its edible sweet fruit. During excavations at the site of the Great Herod's palace in the early 1960's, archeologist unearthed a small stockpile of seeds Stowed in a clay jar dating back 2,000 years. In 2005, one day botanical researcher decided to plant and today the tree Continues to grow & thrive.

201. **(b)** In human beings, after one month of pregnancy, the embryo's heart is formed The first Sign of growing foetus is noticed the heart sound carefully. At the end of the Second month i.e. at weeks, the foetus develops limbs and digits. By the end of 12 weeks i.e. first trimester, most of the Major organ Systems are formed, For example, limbs and external genital organs are well developed During the Fifth month, the first movements of the foetus and appearance of hair on the head By the end of 24 weeks i.e. second trimester, the body is covered with fine hair, eyelids Separate and eyelashes are formed, At the end of 9 Month pregnancy, the foetus is fully developed and is ready for delivery.

202. **(c)** Phenylketonuria is caused by a defect in the gene that helps create the enzyme needed to breakdown phenylalanine, It Causes the amino acid to increase in the amount of the body. It is an autosomal recessive disorder, caused by mutations in both alleles of the gene for phenylalanine hydroxylase found on chromosome 12. Aneuploidy is the state where humans have an abnormal number of Chromosomes that cannot be related to this disease.

203. **(a)** (i) The technique of DNA fingerprinting was initially developed by Alec jeffreys. It is used a satellite DNA as probe that shows very high degree of polymorphism is known as Variable Number of Tandem Repeats (VNTR). To determine if a person has particular VNTR, a southern Blot is performed and then the southern Blot is probed through a hybridization reaction, DNA fingerprinting.

(ii) Splicing is the process in which newly made precursor messenger RNA transcript is transformed into a mature messenger RNA, During Splicing, introns are removed and exons are Joined together.

(iii) Dystrophin is a rod- shaped cytoplasmic protein and a vital part of a protein complex that connects the cytoskeleton of a muscle fibre to the Surrounding extracellular matrix through the cell membrane and it is the largest gene.

(iv) Satellite DNA Consists of a very large arrays of tandemly repeating, non-coding DNA and is basically the bulk DNA

204. **(b)** In eukaryotes, 80 S ribosomes are made up of 60 S as a large Sub unit and 45 S as a small subunit. The large subunit, the 60 S is made up of 28 SrRNA, 5.8 rRNA, 5 SrRNA Whereas the small subunit, the 40 S is comprised of 18 SrRNA During translation process, RNA polymerase gets attached to the smaller subunit of RNA

205. **(c)** Archaebacteria live in some of the harshest habitat such as extreme salty areas (homophiles), hot springs (thermoacidophiles) and marshy areas (methanogens). It differ from other bacteria in having a different cell wall structure and it responsible for their survival in extreme conditions. Mycoplasm are organism that completely lack a cell wall. They are the smallest living cells and can survive without oxygen

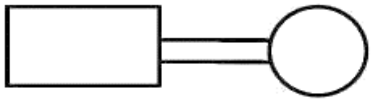
206. **(c)** Green- house crops such as tomatoes and bell pepper produce higher yields because CO_2 enriched atmosphere leads to higher yields, temperature control, reduced pest and disease exposure and humidity. Availability of concentrated CO_2 results in larger leaves, early flowering and fruiting.

207. **(a)**

208. **(b)** A meiocyte is a type of cell that differentiates into a gamete through the process of meiosis, It is reductional cell division which produces haploid gametes. The haploid gamete are produced by the meiocytes. In apple meiocyte has 34 chromosomes after meiosis the gamete has 17 chromosome

209. **(c)** Intra uterine devices (IUDS) are effective and popular method These devices are inserted by doctors or expert nurses in the uterus through vagina These Intra uterine devices are non- medicated IUDs (e.g lippes loop), copper releasing IUDS (progestasert, LNG-20). The hormone releasing IUDS turns the cervix hostile to spermatozoa and bring changes in the uterus making it unsuitable for implantation.

210. **(b)** Consanguineous marriage is a marriage between two blood related individuals.



A double line between parents indicates consanguineous marriages (mating between relatives). It increases the change of a birth defect.

211. **(b)** Heroin commonly called smack is chemically diacetylmorphine which is a white odourless, bitter crystalline compound and these by obtained by acetylation of morphine, which is extracted from the latex of poppy plant papaver somniferum. Crack is obtained from the cocaine plant erythroxylum coca It is commonly known as coke plant. Crack is the crystal form of cocaine, which normally comes in a power form.

212. **(d)** In 1963, several varieties such as sonalika and kalyan sona which were high yielding and disease resistant, were introduced all in the wheat growing belt of India

213. **(a)** BOD means the amount of biodegradable organic matter in sewage water or It is the amount of dissolved oxygen needed by aerobic biological organism to break down organic material present in given water sample of 100ml at certain temperature over a specific time period

214. **(a)** During the menstrual cycle, the cyclical changes take place in the endometrial. The menstrual flow results due to breakdown of endometrial lining of the uterus and it's blood vessels which form liquid that comes out through vagina

In $6-13^{th}$ days i.e proliferative phase, the endometrial cells in the uterus proliferate in preparation for a possible pregnancy, It's growth is stimulated by estrogen from the primary follicles and simultaneously the endometrium of uterus regenerates through proliferation.

The ovulation is followed by the luteal phase during which the remaining parts of the graafian follicle transform as the corpus luteum. It secretes large amount of progesterone which Is essential for maintenance of the endometrium. Endometrium is necessary for implantation of the fertilized ovum and events of pregnancy

In the absence of fertilization, the corpus luteum degenerates. This causes disintegration of the endometrial leading to menstruation, marking a new cycle.

215. **(c)** (1) Assisted reproductive technologies (ART) refers that the couples could be assisted to have children through certain special techniques.

(2) It include invitro fertilization and embryo-transfer, ZIFT, GIFT and artificial insemination.

(3) IVF is followed by embryo transfer. In this method, popularly known as test tube baby programme, i.e. ova from the wife/ donor (female) and sperm from the husband/donor (male) are collected and are inducted to form Zygote in laboratory.

(4) ZIFT refers to the transfer of embryos with more than 8 blastomeres into the uterus to complete 'It' further developments.

(5) Transfer of an ovum collected from donor into the following tube (GIFT) of another female who cannot produce one, but can provide suitable environment for fertilization.

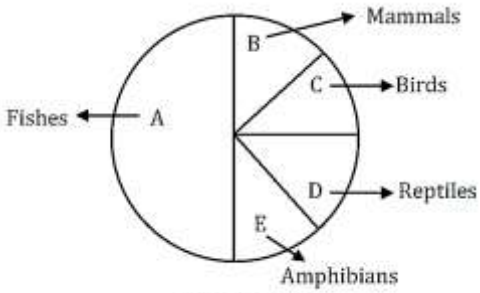
(6) In artificial insemination (AI), the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus of the female.

216. **(c)** One Kbp of DNA contains 1000 base pairs. So the total number of base pairs in 3.2 Kbp is $= 3200$bp

According to chargaff's rule, number of adenine is equal to thymine. So 820 base pairs are adenine i.e. the number of thymine will also be 820bp.

The total number of cytosine + guanosine will be $3200 - 820 \times 2 = 1560$. The number of cytosine is equal to guanine. So cytosine bases in the DNA can be calculated as $1560/2 = 780$

217. **(b)**



Vertebrates

The change in the gene pool due to the process of mutation and recombination may lead to a change in the diverse range of vertebrates. The external factors like temperature, food availability may bring certain adaptation changes which may also contribute to global diversity.

According to pie chart, fishes have maximum global diversity followed by mammals, birds, reptiles and amphibians.

218. **(c)** Pyruvate is formed in the cytoplasm, During fermentation glucose is partially broken down by glycolysis.

During the conversion of succinic COA to succinic acid, a molecule of GTP is synthesize(d)

oxygen sites at the end of the electron transport chain (ETC), where it accepts hydrogen electrons and picks up protons to form water. So, oxygen play a vital role in respiration for removal of hydrogen.

219. **(d)** Robert costanza and his colleagues have very recently tried to put price tags on nature's life support services.

Out of the total cost of various ecosystem services, the soil formation accounts for about 50 percent and contributions of other services like recreation and nutrient cycling, are less than 10 percent each. The cost of climate regulation and habitat for wildlife are about 6 percent each.

So according to him, soil formation accounts for 50% of the ecosystem service. It is the most important ecosystem service.

220. **(d)** In selectable marker, the addition to 'ori', the vector requires a selectable marker which helps in selectively permitting the growth of the transformants. Transformation is a procedure through which a piece of DNA is introduced in a host bacterium. A selectable marker gene is a gene used to determine if a nucleic acid sequence has been successfully inserted into an organism is DNA or not. Normally, the gene encoding resistance to antibiotics ampicillin, tetracycline etc. are considered useful selectable marker for E. coil. The normal E. coil cells do not carry resistance against any of these antibiotics.

221. **(a)**

Endemism - Species confined to one region and not found elsewhere else.

Clarias gariepinus is an alien species to india

Amazon rain forest is known as 'Lungs of the planet'

Regions with species richness are called hotspots'

222. **(a)** The sudden change in the genome creates variations at a genetic level which may lead to DNA polymorphism. Polymorphic DNA contains a variable sequence which may lead to expression of a various random gene which brings a remarkable change in the gene pool. Mutation is a sudden change in the genome that can be inherited from one generation to next generation.

223. **(d)** The greenhouse effect in a naturally occurring phenomenon i.e responsible for heating of earth's surface and atmosphere. The greenhouse effect can happen by redesigning the landfill dumps, so that the methane produced by the decomposition of biodegradable waste is collected effectively and it can be used for the production of biogas as methane is an integral component of it. Carbon dioxide and methane are responsible for the green- house gases, because they are responsible for the green- house effect. Increases in the level of green-house gases has led to considerable heating of earth leading to global warming.

224. **(a)** Insulin is secreted by beta cells of pancreas helps in regulating the glucose homeostasis. It stimulates conversion of glucose into glycogen i.e. glycogenesis.

Glucagon in secreted by alpha cells of pancreas helps blood It stimulates conversion of stored glycogen into glucose i.e. glycogenolysis.

Oxytocin is secreted by pituitary gland helps in contracting uterine muscles during child birth.

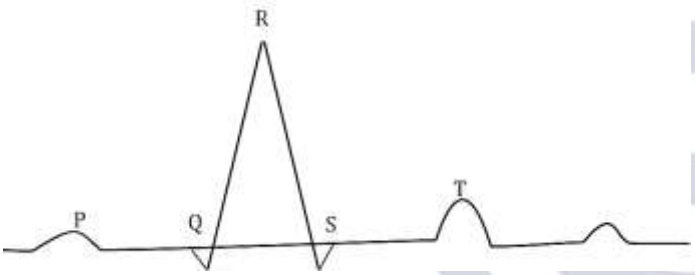
Regions with species richness are called hotspots' gland helps in stimulating the production and secretion of milk.

225. **(d)**

226. **(c)** Phloem is a conducting tissue that conducts the prepared food from the source to sink. Increase in the solute in the phloem, increases the solute potential of the sieve tubes and creates a gradient that collects water into the cells from the adjacent xylem. This increases the hydrostatic pressure from source to sink, as hydrostatic pressure in the phloem sieve tube increase, pressure flow begins and the sap moves through the phloem.

227. **(c)** Glycocalyx is a polysaccharide of the glycoprotein which mainly forms a layer on the bacterial cell wall. The regular gelatinous glycocalyx is known as capsule. It forms the structural framework of a prokaryotic cell.

228. **(b)**



Each peak in the ECG is identified with a letter from P to T that corresponds to a specific electrical activity of the heart.

The P- wave represents the electrical excitation (or depolarization) of the atria, which leads to the contraction of both the atria.

The QRS complex represents the depolarization of the ventricles which initiates the ventricular contraction. The contraction starts shortly after Q and marks the beginning of the systole.
The T- wave represents the return of the ventricles from excited to normal state. (Repolarisation). The end of the T-wave marks the end of systole..

229. **(c)** Ernst chain and howard Florey's were the scientists who followed the Alexander Fleming (discovery of penicillin) and establish the potential of penicillin as an effective antibiotic

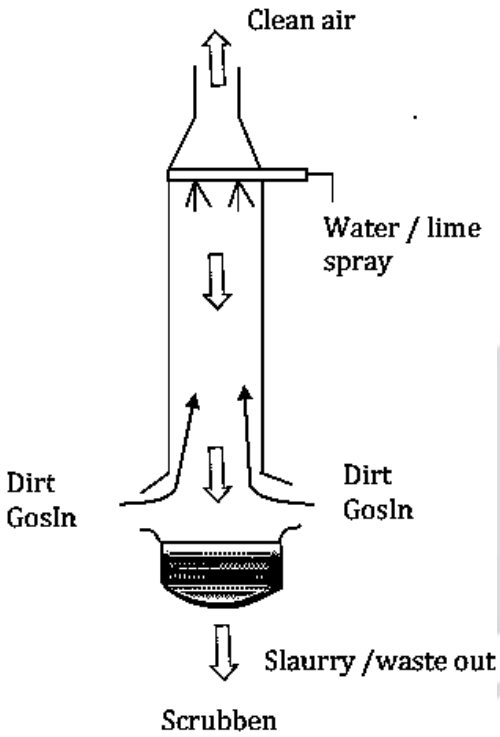
230. **(a)** Plasmodium enters the human body as sporozoites (infectious form) through the bite of infected female anopheles mosquito. The parasites initially multiply within the liver cells and then attack the red blood cells resulting in their rupture when female anopheles mosquito bites an infected person, these parasites enter the mosquito's body. The parasite multiply within them to form sporozoites that are stored in their salivary glands. and when mosquitoes bite, sporozoites are introduced into his/her body..

231. **(a)** (i) Down syndrome is the cause of genetic disorder is the presence of an additional copy of the chromosome number 21 i.e. additional copy is formed due to non-disjunction of chromosomes during meiosis.

(ii)In this case, the 2 chromosomes of the child has the same allele as the mother, so it can be concluded that the non-disjunction has taken place during maternal meiosis with duplication of maternal allele

232. **(c)** UAA is a stop codon. It does not code for any amino acid called as non-sense. Codon. Hence the polypeptide synthesis is terminated and a polypeptide of 24 amino acids is formed The polypeptide chain of 124 amino acid is formed only when the 125^{th} codon works as a stop codon, so the translation of 125 amino acid sequence so, the translation of 125 amino acids sequence will terminate at 24 amino acids.

233. **(a)**



The scrubber is an electrostatic precipitator in which the dirty air is cleaned by capturing the gas like SO_2 and other oxides in the lime spray ($CaCO_3$). The calcium in lime stone combines chemically with the sulphur to produce calcium sulphate $CaSO_4$, which is separately collected

234. **(b)** Phyletic gradualism is a model of evolution which theorizes that most speciation is slow, uniform and gradual when evolution accurse, transformation of a whole species into a new one.

Divergent evolution is caused when the difference in the groups lead to the formation of new species. Due to the divergent evolution, the structures with the common origin develop differently according to the environment need

Convergent evolution is the independent evolution of similar features is species of different periods

Allopathic speciation is speciation that results when a population is repeated by a physical barrier

235. **(d)**

Decomposition is a process by which the decomposers in the soil breaks the complex organic matter into inorganic substances.

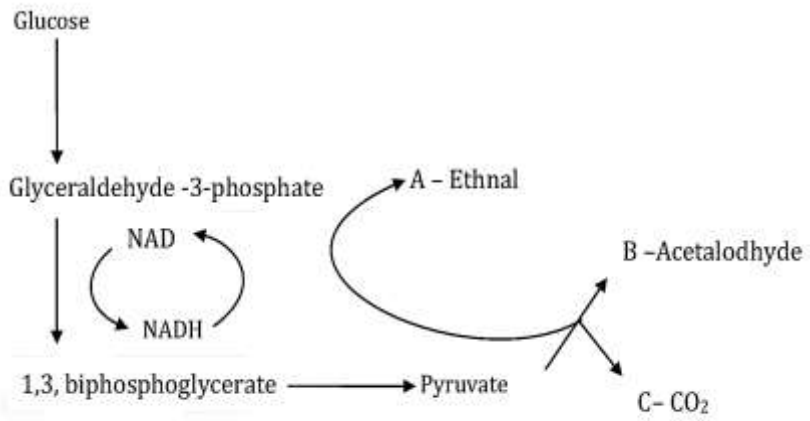
Detritivores break down detritus into smaller particles is known as fragmentation, for example -:-earthworm

Humification and mineralisation occur during decomposition is the soil. Humification leads to accumulation of a dark colored amorphous substance called humus. The humus is further degraded by some microbes and release of inorganic nutrients occur by the process known as mineralisation.

Bacterial and fungal enzymes Degrade detritus into simpler inorganic substance, these- process is known as catabolism.

In leeching, water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.

236. (d)



Glucose is converted into pyruvate by the process of glycolysis with net production of ATP. TCA and ECS(electron transport chain) leads to the production of CO_2, water and PTP in aerobic oxidation.

In an anaerobic condition, the pyruvate undergoes fermentation where the pyruvate is broken down into acetaldehyde and carbon dioxide by the enzyme pyruvate decarboxylase, followed by the conversion of acetaldehyde into ethanol

237. (a) In grasshopper, XX – XO mechanism of sex determination is present where females are homogametic (XX) but the male carries only one sex - chromosome (X, O). Hence, the male grasshopper carries XO sex chromosomes

The presence of part are full copy of one x-chromosome in the human female is "klinefilter's syndrome" but the "XO" condition is not female sex determinant.

The ratio of number of x-chromosome to that of a complete set of auto some determines the sex of drosophila, The X/A value is 0.5 for a normal male

Sex-determination in birds is of ZW-ZZ types in which females are heteromorphic (ZW) and males have homomorphic sex chromosome (ZZ).

238. (b) During hibernation, the animals metabolic rate drops significantly and thus require less for their survival. There are 2 types of adipose tissue i.e. white and brown. Brown fat cells contain a mitochondria & it produces considerable amount of heat because there lipids are respired with little or no ATP formation; most energy is released as heat

239. (c) Xerarch is a plant succession starting on bare ground or rock and culminating in a mature climax forest. The pioneer species, such as lichens and mosses, results in the gradual accumulation of soil. Hierarch is a plant succession which starts in relatively shallow water, such as ponds and lakes and culminating in a mature forest. Eg;- phytoplankton, Hydrilla etc.

240. (a) The cutting of DNA by restriction end nuclease results in the fragments of DN(A) These fragments can be separated by a technique known as gel electrophoresis. The separated DNA fragments can be visualized only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation. Bright orange colored bands of DNA in a ethidium bromide stained gel exposed to UV light. The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece is known as elution.