

SOLUTIONS

PHYSICS

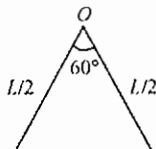
1. (c)
2. (d) : Acceleration is independent of mass in kinematics.

3. (b) : Moment of inertia of uniform

$$\text{rod about one end} = \frac{ML^2}{3}$$

\therefore Moment of inertia of a rod about an axis passing through O and perpendicular to the plane of the rod will be

$$= 2 \left(\frac{M}{2} \right) \frac{(L/2)^2}{3} = \frac{ML^2}{4 \times 3} = \frac{ML^2}{12}$$



4. (c) : $\lambda = 100 \text{ m}$, $v = 25 \text{ m/s}$

$$\therefore v = \frac{25}{100} = 0.25 \text{ Hz} \quad \therefore T = 4 \text{ s}$$

5. (c) : Pressure difference between lungs and atmosphere = $760 \text{ mm} - 750 \text{ mm} = 10 \text{ mm} = 1 \text{ cm}$ of Hg.

$$\text{Pressure difference} = l \times 13.6 \times g = l \times 1 \times g \text{ of water}$$

i.e., one can draw from a depth of 13.6 cm of water.

6. (c) : Electric field between the sheets is

$$E = \frac{\sigma}{\epsilon_0} = \frac{26.4 \times 10^{-12}}{8.85 \times 10^{-12}} \approx 3 \text{ N/C}$$

7. (b) : The S.I. unit of magnetic moment is Am^2 . Therefore its dimensions is $[\text{L}^2\text{A}]$.

8. (a) : $u = -8 \text{ cm}$, $f = 10 \text{ cm}$

$$\text{As, } \frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\therefore \frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{10} + \frac{1}{-8} = \frac{1}{10} - \frac{1}{8} = \frac{4-5}{40} = \frac{-1}{40}$$

$$\text{or, } v = -40 \text{ cm}$$

Magnification produced by the lens,

$$m = \frac{v}{u} = \frac{-40}{-8} = 5$$

This is a virtual image, erect and on the same side as the object.

9. (b) : $\lambda_{\min} = \frac{hc}{eV} = \frac{1.242 \times 10^{-6}}{V}$

$$V = \frac{1.242 \times 10^{-6}}{10^{-11}} = 124.2 \text{ kV}$$

The accelerating voltage for electrons in X-ray machine should be greater than 124.2 kV.

10. (b) : Minimum energy *i.e.* minimum frequency is needed.

11. (b) : Let f be focal length of lens.

$$\frac{1}{f} = (\mu_g - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right) = (1.5 - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

$$\text{or, } \frac{1}{f} = 0.5 \left(\frac{1}{R_1} - \frac{1}{R_2} \right) \quad \text{or, } \frac{1}{R_1} - \frac{1}{R_2} = \frac{1}{0.5f} \dots (i)$$

Let f' be focal length of the lens when immersed in a liquid.

$$\frac{1}{f'} = (\mu_l - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right) = \left(\frac{1.5}{1.25} - 1 \right) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

$$= \left(\frac{0.25}{1.25} \right) \left(\frac{1}{R_1} - \frac{1}{R_2} \right) = \frac{0.25}{1.25} \times \frac{1}{0.5f} \quad (\text{using (i)})$$

$$\frac{1}{f'} = \frac{1}{2.5f} \quad \text{or, } f' = 2.5f$$

i.e. focal length of lens when immersed in a liquid is increased by a factor of 2.5.

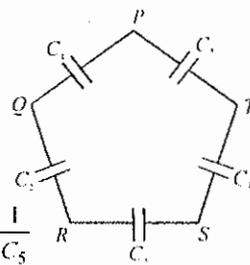
12. (a) : Work done = charge \times potential difference

$$W = 4 \times (4 \times 10^6 - 0) = 16 \times 10^6 \text{ J}$$

$$\text{Power of the lightning strike, } P = \frac{W}{t}$$

$$= \frac{16 \times 10^6}{100 \times 10^{-3}} = 160 \text{ MW}$$

13. (c) : Between the points P and Q , a capacitor C_1 and series combination of C_2, C_3, C_4, C_5 are connected in parallel.



$$\therefore \frac{1}{C_s} = \frac{1}{C_2} + \frac{1}{C_3} + \frac{1}{C_4} + \frac{1}{C_5}$$

$$= \frac{1}{C} + \frac{1}{C} + \frac{1}{C} + \frac{1}{C} = \frac{4}{C}$$

or, $C_s = C/4$.

The equivalent capacitance between P and Q is

$$C' = C_1 + C_s = C + \frac{C}{4} = \frac{5C}{4}$$

Between the points P and R a series combination of C_1, C_2 and a series combination of C_3, C_4, C_5 are connected in parallel.

$$\therefore \frac{1}{C_s'} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{C} + \frac{1}{C} = \frac{2}{C} \quad \text{or, } C_s' = \frac{C}{2}$$

$$\frac{1}{C_s''} = \frac{1}{C_3} + \frac{1}{C_4} + \frac{1}{C_5} = \frac{1}{C} + \frac{1}{C} + \frac{1}{C} = \frac{3}{C} \quad \text{or, } C_s'' = \frac{C}{3}$$

The equivalent capacitance between P and R is

$$C'' = C_s' + C_s'' = \frac{C}{2} + \frac{C}{3} = \frac{5C}{6}$$

$$\therefore \frac{C''}{C'} = \frac{(5C/6)}{(5C/4)} = \frac{4}{6} = \frac{2}{3}$$

14. (a) : For circular wave, intensity $I \propto \frac{1}{r}$.

$$\text{Amplitude, } A \propto \sqrt{I}, \quad A \propto \sqrt{\frac{1}{r}} \quad \text{or, } A \propto r^{-1/2}.$$

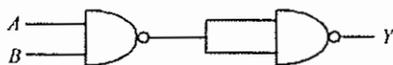
15. (d) : In inelastic collision linear momentum is conserved, but total kinetic energy is not conserved.

16. (b) : In reverse biased, the depletion region of p - n diode is increased.

17. (b) : By superposition of two perpendicular waves polarised and having a phase difference of $\pi/2$ will result in circular polarisation of light.

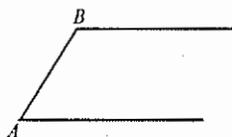
18. (a) : If it is less than one, reaction can be sustained and if the multiplication factor is more than one, the reaction becomes uncontrolled. It is an explosion.

19. (a) : $Y = \overline{A \cdot B} = A \cdot B$



The given circuit is AND gate.

20. (c) : First a force is used to move the body when it has to be more than the static friction. Then the body starts moving and is getting accelerated. Then



suddenly the force is decreased to match the kinetic friction. The body then moves with a constant velocity.

Force $> \mu_s \cdot N$.

Constant acceleration, velocity increases proportionately with time. Then suddenly force applied is just equal to $\mu_k N$. It is just sufficient to cancel friction. Whatever be the earlier maximum velocity attained will be continued.

21. (b) : Black object. That which can absorb maximum can also emit maximum. (Kirchhoff's law).

22. (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 *i.e.* nitrogen will be the same.

23. (d) : If the voltage is not sufficient to heat it to white hot temperature, the filament will become red. But the intensity will be very much reduced because of low voltage. But if the voltage is only reduced a little only intensity will be reduced. It can be (a) also.

24. (a) : The lines proceed from the positive and lines will reach B , if B is negative.

The number of lines/unit area *i.e.* the density of lines is greater for the greater charge.

A is +ve, B is -ve and $|A| > |B|$.

25. (a) : Magnetic field due to a circular loop at the

$$\text{centre of the loop is } B_1 = \frac{\mu_0 2\pi I_c}{4\pi R}$$

Magnetic field due to a straight line at the centre

$$\text{of the loop is } B_2 = \frac{\mu_0 2I_c}{4\pi H}$$

Both these fields act in opposite direction hence total magnetic field at the centre of the loop is

$$B = B_1 - B_2 = \frac{\mu_0 2\pi I_c}{4\pi R} - \frac{\mu_0 2I_c}{4\pi H}$$

$B = 0$ (given).

$$\therefore \frac{\mu_0 2\pi I_c}{4\pi R} = \frac{\mu_0 2I_c}{4\pi H} \quad \text{or, } H = \frac{I_c R}{\pi I_c}$$

26. (a) : Pattern A is more sturdy because the moment of the tension about the fulcrum is maximum in A to counterbalance the moment of mg acting from the centre of mass of the rod.

27. (b) : Emission of alpha particle, decrease the mass

number by 4 and charge number by 2.

∴ Decrease in mass number = $238 - 4 = 234$

Decrease in charge number = $92 - 2 = 90$

${}_{90}^{234}\text{Th}$ is emitted.

28. (c) : After 5730 years, the number of C^{14} remaining

is $\frac{1}{2}^{\text{th}}$ original. To have $(1/16)$ original value, it takes $(1/2)^4$, 4 half lives.

Therefore, the bone is 4×5730 years
= 22920 years old.

29. (c) : According to conservation of mass number

$$10 + 4 = 13 + 1$$

According to conservation of charge number,

$$5 + 2 \neq 7 + 1$$

Hence (a) is not possible.

According to conservation of charge number,

$$93 = 94 - 1$$

According to conservation of mass number,

$$239 = 239$$

Hence (c) is possible.

According to conservation of mass number,

$$11 + 1 = 12$$

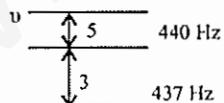
According to conservation of charge number,

$$7 + 1 \neq 6 - 1$$

Hence (d) is not possible.

${}_{11}^{23}\text{Na} + {}_1^1\text{H}$ also satisfies both the conservation of mass number and charge. However, ${}^{23}\text{Na}$ is a very stable isotope and nuclear reaction will be very difficult. The formation of Pu from Np is well known. It satisfies the conditions of conservations and Np is also very unstable. Therefore (c) is the only correct answer.

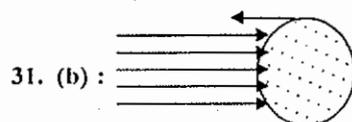
30. (a) : $\nu - 5 = 440$ Hz



$$\nu - 8 = 437$$
 Hz

∴ $\nu = 445$ Hz by both the methods.

It could have been 435 Hz. It would have satisfied $440 - \nu = 5$. But this would not have satisfied 437 Hz.



1. When the ring is just entering the magnetic field, emf is induced and the current flows in one direction.

2. When the whole ring is surrounding the flux inside, there is no change in the flux.

Induced emf = 0, current is zero.

3. When the ring just goes out of the region of flux, a pulse of current is produced which is opposite to that of 1 given above.

(b) is the only figure that describes this.

32. (d) : If the momentum of α and β particles are p , if this is also equal to $h\nu/c$ of the photon - γ -rays,

$$\lambda_{\text{de Broglie}} = h/p$$

As p is the same, the wavelength will be the same.

For α and β particles, they are de Broglie waves and in the case of photons (γ -rays), it is the wavelength of the associated electromagnetic wave.

33. (b) : Voltage gain in dB = $20 \log_{10} A_V$

$$= 20 \log_{10}(1000) = 60 \text{ B.}$$

34. (c) : Entropy is a measure of disorder.

When water is converted to ice, disorder decreases, entropy decreases.

35. (b) : When the bimetallic strip is kept in a cold bath, the length of X decreases faster and therefore the strip bends towards the left.

36. (c) : As $\nu = c/\lambda$, the velocity = frequency \times wavelength.

When light is travelling in a medium, ν is assumed to be the same and the velocity of light in the medium

is less. λ gets adjusted so that $\frac{c'}{\lambda'} = \nu$. Here ν is independent.

It is frequency of light *i.e.* energy that is a constant. Wavelength and velocity change. ∴ $c/\lambda = \text{constant}$.

37. (b)

38. (d) : As LED is connected to a battery through a resistance in series.

The current flowing, 10 mA is the same.

The voltage drop across LED = 2 V

∴ As the battery has 6 V, the potential difference across $R = 4$ V.

$$\therefore iR = 4 \text{ V} \Rightarrow R = \frac{4 \text{ V}}{10 \times 10^{-3} \text{ A}} = 400 \Omega.$$

39. (a) : Base to emitter in Si transistor is 1 V.

40. (d) : For good demodulation,

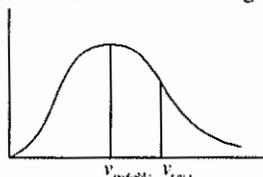
$$\frac{1}{f} \ll RC \text{ or, } RC \gg \frac{1}{f}.$$

41. If the frequencies of the waves are less than that of the critical frequency. They will be reflected back as the ionosphere has refractive index less than free space. This is the principle of sky wave propagation. Therefore the assertion is wrong.
The statement given in the reason that the refractive index becomes high is correct. But the reason given is not true for the assertion.
Assertion is wrong. Reason-statement is correct. But not the reason. We have to put (c) as this is a rare case where the assertion itself is wrong.
42. (b) : The decrease in binding energy per nucleon for heavy nuclei ($A > 100$) due to increase in coulomb repulsion between the protons inside the nucleus.
43. (c) : The common base configuration of npn transistor is used for voltage amplification. The current amplification is very small. Assertion is true.
The collector is reverse biased for voltage amplification. The reason given has not mentioned that it is voltage amplification. The reason is therefore incomplete by itself. It is wrong.
44. (b) : In an isolated system the entropy increases in accordance with the second law of thermodynamics.
45. (a) : Magnetic Resonance Imaging is based on the nuclear magnetic resonance of protons.
Therefore both assertion and reason are correct.
46. (a) : Rotation of the opponent makes it difficult for the person rotated to resist. Any torque given by a force by pushing the person about an axis will be resisted but not the torque by rotation. By bringing him close to the hip, the opponents moment of inertia is reduced.

$$47. (d) : v_{r.m.s} = \sqrt{\frac{3kT}{m}} \quad \text{or,} \quad \sqrt{\frac{3RT}{M}}$$

$$v_{\text{probable}} = \sqrt{\frac{2kT}{m}} \quad \text{or,} \quad \sqrt{\frac{2RT}{M}}$$

\therefore Assertion is wrong.



This is asymmetric.
Therefore reason is also wrong.

48. (c) : Assertion is correct. But ball bearing is used

for reducing friction.

49. (a)

50. (d) : Diamagnetic materials have $L = 0, S = 0, J = 0$. They have no magnetic moment. Reason given is wrong.

51. (b) : If a man inside a lift which is falling freely *i.e.* with acceleration g , the relative acceleration of the man with respect to the lift
= acceleration of man with respect to earth (g)
- acceleration of lift with respect to earth, g
= $g - g = 0$. Assertion is correct.

The statement given by the reason is correct but not what is given is the reason for the assertion.

52. (c) : Statement is correct, but the work function only depends on the photoelectric metal.

53. (a) 54. (a) 55. (c) 56. (b) 57. (a)

58. (b) : A thin stainless steel needle on a still water may float due to surface tension as upward force due to surface tension balances the weight of the needle.

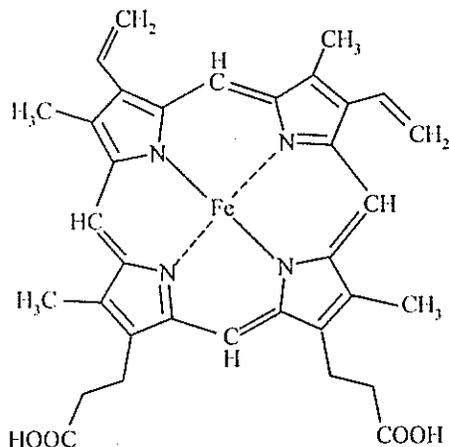
59. (a)

60. (a) : Total internal reflection will be for rays incident at an angle greater than C . If the fibres are thin, only rays almost parallel will pass, further for non-paraxial rays, the angle of incidence is large and therefore they also will be totally internally reflected. Both are right.

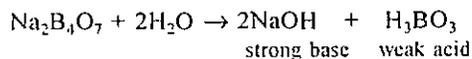
CHEMISTRY

61. (b) : Spin only magnetic moment, $\mu_s = \sqrt{n(n+2)}$ where n = number of unpaired electrons.
Number of unpaired electrons in Cr^{2+} ($[\text{Ar}] 3d^4$) is 4, in Co^{2+} ($[\text{Ar}] 3d^7$) is 3, in Fe^{2+} ($[\text{Ar}] 3d^6$) is 4, in Mn^{2+} ($[\text{Ar}] 3d^5$) is 5.
As the number of unpaired electrons in Cr^{2+} and Fe^{2+} are same, hence $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ will have same magnetic moment.
62. (d) : Cytochromes are conjugated proteins consisting of an apoprotein and a prosthetic group (heme). The heme consists of a porphyrin with a central iron atom.
The name haemoglobin is the concatenation of heme and globin, reflecting the fact that each subunit of haemoglobin is a globular protein with an embedded

heme (or haem) group; each heme group contains an iron atom, and this is responsible for the binding of oxygen. The most common types of haemoglobin contains four such subunits, each with one heme group.



63. (a) : Borax dissolves in water to give alkaline solutions.



Borax is therefore used as a water softener and cleansing agent.

64. (c) : The different allotropic forms of sulphur arises partly from the extent to which S has polymerised and partly from the crystal structures adopted. The two common crystalline forms are α or rhombic sulphur and β or monoclinic sulphur. A third modification is γ -monoclinic sulphur. All three forms contain puckered S_8 rings with a crown conformation.

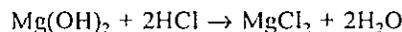
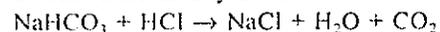
Engel's sulphur (ϵ -sulphur) contains S_6 rings.

S_7 , S_9 , S_{10} , S_{11} , S_{12} , S_{18} and S_{20} rings have been made by Schmidt and his group.

Plastic or γ -sulphur contains spiral chains and sometimes S_8 and other rings.

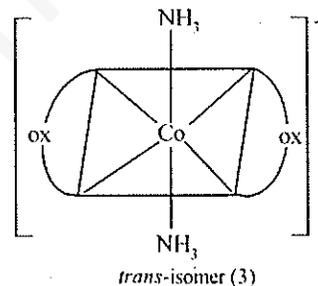
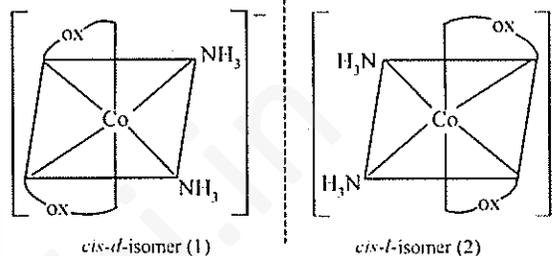
The other allotropic forms of sulphur are milk of sulphur and colloidal or δ -sulphur.

65. (a) : Intestine is acidic due to formation of HCl during digestion. Excessive acidity in the intestine creates problem of intestinal ulcer, gastric reflux and oesophagitis. The compound which reduced or neutralise acidity are called antacids.

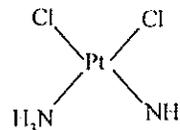


66. (b) : Glass is an amorphous and transparent or translucent solid obtained by solidification of a mixture of silicates of different metals, one of which is always an alkali metal. Addition of small amounts of transition metal salts to the glass mixture imparts colour to the glass. For example, addition of small amounts of Fe^{3+} , Fe^{2+} , Co^{2+} , Cr^{3+} and Mn^{4+} salts imparts yellow-brown, light blue, deep blue, green or violet colour respectively.

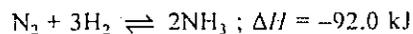
67. (c) : $[\text{Co}(\text{C}_2\text{O}_4)_2(\text{NH}_3)_2]^-$



68. (a) : *Cis*-diamminedichloroplatinum(II) (cisplatin) is a widely used anticancer drug. Ligands in cisplatin are NH_3 and Cl .



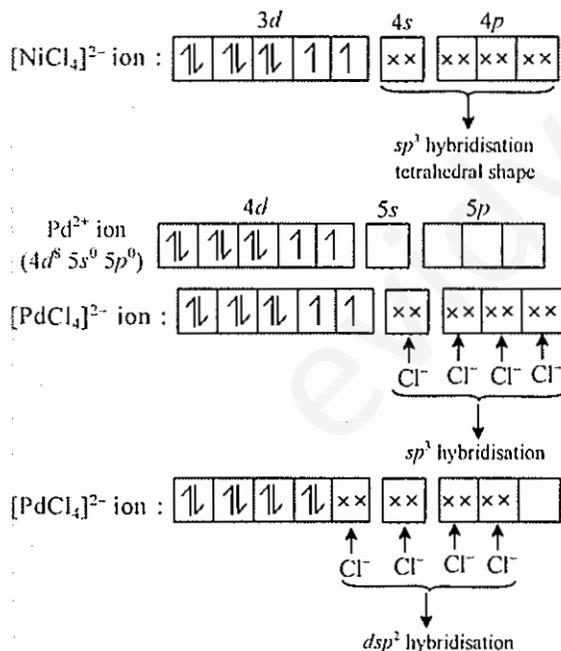
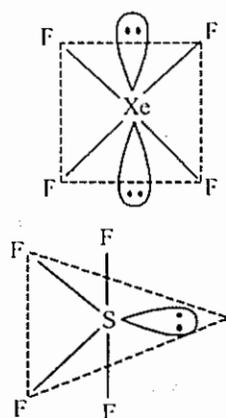
69. (c) : Haber-Bosch process is used for the synthesis of ammonia.



The best catalyst for this reaction is highly porous finely divided iron containing small amounts of promoters usually molybdenum or oxides of potassium and aluminium.

70. (a) : XeF_3 : sp^3d^2 hybridisation, shape is square

planar instead of octahedral due to presence of two lone pair of electrons on Xe atom. SF_4 : SF_4 molecule shows sp^3d hybridisation but its expected trigonal bipyramidal geometry gets distorted due to presence of a lone pair of electrons and it becomes distorted tetrahedral or see-saw with the bond angles equal to 89° and 177° instead of the expected angles of 90° and 180° respectively.

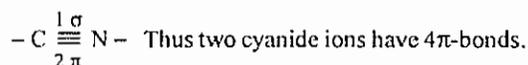


Experiments have, however, shown that 4-coordinated complexes of Pd(II) are diamagnetic ($n = 0$). Thus it is dsp^2 hybridisation which is involved in the formation of $[\text{PdCl}_4]^{2-}$ ion i.e. 4-coordinated complexes of Pd(II) have square planar geometry with $n = 0$ (diamagnetic).

71. (b) : Tincture of iodine is an aqueous solution of I_2 in KI, and French iodine is a solution in alcohol.

72. (c) : Cyanide is considered, in a broad sense, to be

the most potent ligand for many transition metals. The very high affinities of metals for cyanide can be attributed to its negative charge, compactness and ability to engage in π -bonding. The dicyanides $[\text{M}(\text{CN})_2]^-$ ($\text{M} = \text{Cu}, \text{Ag}, \text{Au}$) are linear in geometry.



73. (a) : PCl_5 is molecular in the gas phase but exists as $[\text{PCl}_4]^+ [\text{PCl}_6]^-$ in the crystalline solid.

74. (a) : When traces of iodide in the form of KIO_3/KI is added to the salt, iodised salt is obtained.

75. (a) : The fuel used in nuclear power plant is enriched uranium-235 in the form of U_3O_8 .

76. (a) : Kinetic energy = $\frac{1}{2}mv^2$
[$m = \text{mass}, v = \text{velocity}$]

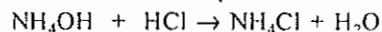
$$\text{or, } 0.5 = \frac{1}{2} \times 1 \times v^2 \quad \text{or, } v = 1 \text{ ms}^{-1}.$$

$$\text{de Broglie wavelength, } \lambda = \frac{h}{mv}$$

$$\text{or, } \lambda = \frac{6.626 \times 10^{-34} \text{ Js}}{1 \text{ kg} \times 1 \text{ ms}^{-1}} = 6.626 \times 10^{-34} \text{ m.}$$

77. (b) : When the value of $Z < 1$, it is due to attractive forces between molecules. At high pressure, when $Z > 1$, it is due to repulsive forces between electron clouds of the molecules of gases.

78. (c) : 40 ml of 0.1 M ammonia solution = 40×0.1
= 4 milli equivalent ammonia solution
20 ml of 0.1 M HCl = 20×0.1
= 2 milli equivalent of HCl



Initial milli-eqv.	4	2	0
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Milli-eqv. after	4 - 2	0	2
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reaction	= 2		
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$$\therefore \text{pOH} = \text{p}K_b + \log \frac{[\text{NH}_4\text{Cl}]}{[\text{NH}_4\text{OH}]} = 4.74 + \log \frac{2}{2}$$

$$= 4.74 + \log 1 = 4.74$$

$$\therefore \text{pH} = 14 - 4.74 = 9.26$$

79. (d) : $\Delta S_{\text{total}} = \Delta S_{\text{system}} + \Delta S_{\text{surroundings}}$

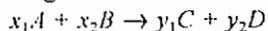
For a spontaneous process ΔS_{total} must be positive.

i.e. $\Delta S_{\text{total}} > 0$.

80. (a) : In CaF_2 crystal, the Ca^{2+} ions are present at all corners and at the centre of each face of the cube and the F^- ions occupy all the tetrahedral sites.

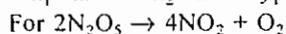
81. (b) : $\text{MnO}_4^- + 2\text{H}_2\text{O} + 3e^- \rightarrow \text{MnO}_2 + 4\text{OH}^-$
Charge required for the reduction of 1 mol of MnO_4^- to $\text{MnO}_2 = 3 \text{ F}$.

82. (c) : In general for a reaction,



The rate expression may be expressed as

$$-\frac{1}{x_1} \frac{d[A]}{dt} = -\frac{1}{x_2} \frac{d[B]}{dt} = \frac{1}{y_1} \frac{d[C]}{dt} = \frac{1}{y_2} \frac{d[D]}{dt}$$



$$\frac{1}{2} \frac{d[\text{N}_2\text{O}_5]}{dt} = \frac{1}{4} \frac{d[\text{NO}_2]}{dt} = \frac{d[\text{O}_2]}{dt}$$

83. (a) : $\Delta G^\circ = -RT \ln K$

[$\Delta G^\circ =$ standard free energy change, $K =$ equilibrium constant]

If a substance is in equilibrium between two phases at constant temperature and pressure, its chemical potential must have the same value in both the phases.

$$\therefore \Delta G^\circ = 0.$$

84. (c) : K_f for water = $\frac{\Delta T_f \times W \times m}{1000 \times w}$

(where $W =$ wt. of water, $w =$ wt. of cane sugar, $m =$ molecular wt. of cane sugar)

$$= \frac{2.15 \times 1000 \times 342}{1000 \times 5} = 14.7$$

Now, for 5% glucose,

$$\Delta T_f = \frac{K_f \times 1000 \times w'}{W \times m'} \quad (\text{where } w' = \text{wt. of glucose, } m' = \text{molecular wt. of glucose})$$

$$= \frac{14.7 \times 1000 \times 5}{100 \times 180} = 4.08$$

\therefore Freezing point of glucose solution

$$= 273.15 - 4.08 = 269.07 \text{ K}.$$

85. (a) : Semiconductors are solids where there is only a small difference in energy, called a 'band gap', between the filled valence band of electrons and a conduction band.

Compound	Energy gap (kJ mol^{-1})
Diamond	579
Silicon	106
Germanium	68

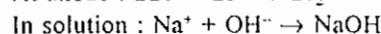
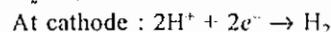
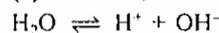
86. (b) : $\Delta H = \Delta U + \Delta nRT$

[where $\Delta n =$ no. of molecules of products
- no. of molecules of reactants]

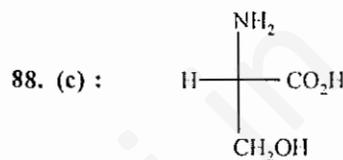
$$\text{or, } -92.38 \times 1000 = \Delta U - 2 \times 8.314 \times 298$$

$$\text{or, } \Delta U = -87424 \text{ J} = -87.424 \text{ kJ}.$$

87. (c) : $\text{NaBr} \rightleftharpoons \text{Na}^+ + \text{Br}^-$



As discharge potential of H^+ ions is lower than that of Na^+ ions and discharge potential of Br^- ions is lower than that of OH^- ions, H_2 is liberated at cathode and Br_2 is liberated at anode.

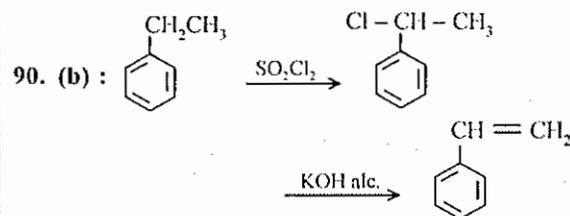
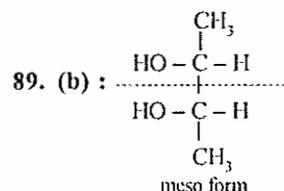


L-serine

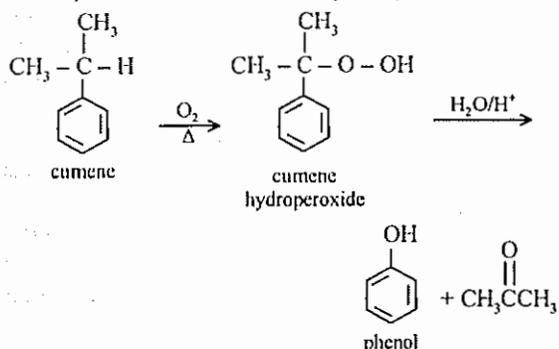
The laevorotatory isomer of
2-amino-3-hydroxypropanoic acid

A rule of thumb for determining D/L isomeric form of an amino acid is the **corn rule**.

The groups: COOH , R , NH_2 and H (where R is an unnamed carbon chain) are arranged around the chiral center carbon atom. Sighting from the hydrogen atom, if these groups are arranged counter-clockwise around the carbon atom, then it is the D-form. If clockwise, it is the L-form. According to priority order : $-\text{NH}_2$, $-\text{COOH}$, $-\text{CH}_2\text{OH}$, $-\text{H}$.

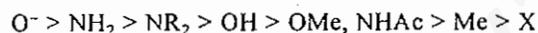


91. (d) : Isopropyl benzene or cumene on air oxidation in presence of dilute acid gives phenol.



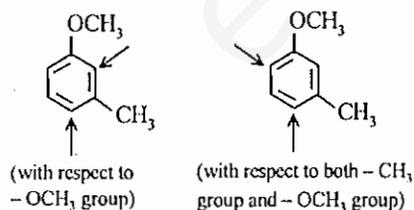
92. (b) : The position taken up by a third group entering the ring depends on the nature of the two groups already present.

When both groups show *o*- and *p*-directing nature, the directive power of each group is generally in the following order :

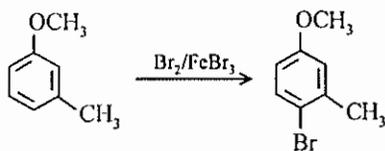


In case of compound A , the

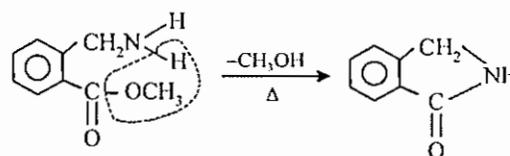
arrows are used to indicate the possible positions that may be taken up by an incoming group.



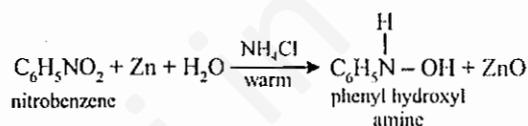
Due to presence of bulky group, steric effect works, and the favourable product will be this.



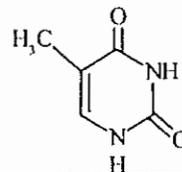
93. (c) :



94. (d) : When reduced with a neutral reducing agent like zinc dust and aqueous ammonium chloride, nitrobenzene gives phenyl hydroxyl amine.

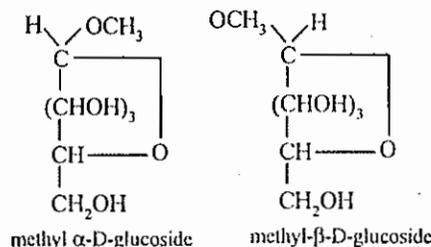


95. (a) : Thymine, also known as 5-methyluracil, is a pyrimidine nucleobase. As the name implies, thymine may be derived by methylation of uracil at the 5th carbon.



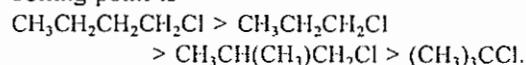
96. (d) : Any amino acid has its lowest solubility on its isoelectronic point and the isoelectric point is the pH at which the amino acid carries no charge.

97. (b) : Methyl- α -D-glucoside and methyl- β -D-glucoside differs at C-1, hence are called anomers.



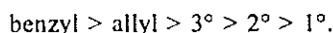
98. (b) : For the same halogen, boiling point of alkyl halide decreases as the size of the alkyl group decreases.

For isomeric alkyl halides, boiling point decreases as branching increases. So the decreasing order of boiling point is

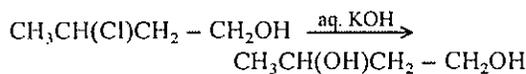


99. (a) : Reactivity of halides towards $\text{S}_{\text{N}}1$ mechanism

is



100. (d) : Halogenated compounds on treatment with aq. KOH form alcohols. The halogen atom is substituted by - OH group.



Here OH^- acts as a nucleophile.

101. (b) : Starch ($\text{C}_6\text{H}_{10}\text{O}_5$)_n is a polysaccharide. It consists of two fractions - one is known as α -amylose and the other is β -amylose or amylopectin. In iodometric and iodimetric titrations, starch solution is used as an indicator. It gives blue or violet colour with free iodine. At the end point the blue or violet colour disappears when iodine is completely changed to iodide.
102. (a) : Bond order of $\text{N}_2 = 3$, bond order of $\text{O}_2 = 2$. Higher the bond order, higher is the bond dissociation energy. *i.e.* higher stability or less reactivity. Thus N_2 is less reactive than O_2 . Higher the bond order, shorter is the bond length. Shorter bond length of N_2 shows its higher bond order.
103. (a) : The essential requirement for a substance to be optically active is that the substance should not have a plane of symmetry in its structure.
104. (b) : It is known that the value of E° becomes more negative down the series. As the chromium is present below in electrochemical series than Mn, so Mn has more positive E° value than Cr.
 $\text{Mn} \rightarrow 3d^5 4s^2$, $\text{Mn}^{2+} \rightarrow 3d^5 4s^0$
 $\text{Cr} \rightarrow 3d^5 4s^1$, $\text{Cr}^{2+} \rightarrow 3d^4 4s^0$
 For elimination of one electron from Mn^{2+} , more energy is required due to its stable configuration. That is why third ionization energy of Mn is larger than Cr.
105. (c) : $\text{K}_2\text{Cr}_2\text{O}_7$ is less soluble in water. $\text{K}_2\text{Cr}_2\text{O}_7$ can be found in pure state and can be accurately weighed. It is not hygroscopic in nature. So $\text{K}_2\text{Cr}_2\text{O}_7$ is used as a primary standard solution.
106. (e) : Silicones are strongly water repellent. Their water repellency arises because a silicone chain is surrounded by organic side groups and looks like an alkane from the outside.

107. (a) : $A + B \rightleftharpoons (AB)^\ddagger \rightarrow \text{products}$.

The activated complex can also be treated as a distinct chemical species in equilibrium with the reactants which then decompose into products. It is, however, a special molecule in which one vibrational degree of freedom has been converted to a translational degree of freedom along the reaction coordinate. It must be remembered that the activated complex is not merely an intermediate in process of breaking or forming of chemical bonds. It is unstable because it is situated at the maximum of the potential energy barrier separating the products from the reactants. The difference between the energy of the activated complex (E_1) and the energy of the reactants (E_2) is the activation energy, E_a .

$$E_1 - E_2 = E_a, \quad E_1 \gg E_2.$$

108. (a) : Fusion of ice is a spontaneous process, because the process again proceeds in the direction of more random state, *i.e.* liquid state is more random (higher entropy) in comparison to solid state. *i.e.* ice.
109. (d) : Sb_2S_3 is soluble in yellow ammonium sulphide.
 $\text{Sb}_2\text{S}_3 + 3(\text{NH}_4)_2\text{S} \rightarrow 2(\text{NH}_4)_3\text{SbS}_3$
 The stability of sulphides increases with increase in atomic number of the element.
110. (d) : Graphite has a two dimensional sheet structure. Each C-atom is in sp^2 hybridised state and is linked to three other carbon atoms in a hexagonal planar structure.
 For a tetragonal system, $a = b \neq c$, $\alpha = \beta = \gamma = 90^\circ$.
 For a hexagonal system, $a = b \neq c$, $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$.
111. (b) : If the opposing potential becomes slightly larger than that of the cell, the direction of current flow is reversed, and so is the cell reaction. Now zinc ions are converted to zinc at one electrode and Cu is converted into copper ion and the overall cell reaction becomes
 $\text{Zn}^{++} + \text{Cu} \rightarrow \text{Zn} + \text{Cu}^{++}$
112. (e) : When oppositely charged sols are mixed in almost equal proportions, their charges are neutralised. Both sols may be partially or completely precipitated. When negatively charged As_2S_3 sol is added to positively charged $\text{Fe}(\text{OH})_3$ sol, in suitable amounts, precipitation of both the sols take place simultaneously.

120. (a) : Freezing point of a substance is defined as the temperature at which the vapour pressure of its liquid is equal to the vapour pressure of the corresponding solid. Since the addition of a non-volatile solute always lowers the vapour pressure of solvent, therefore it will be in equilibrium with solid phase at a lower pressure and hence at a lower temperature.

BIOLOGY

121. (b) : Sympathetic and parasympathetic nervous system are the parts of autonomic nervous system. Autonomic nervous system is a part of peripheral nervous system that supplies stimulation *via* motor nerves to the smooth and cardiac muscles (the involuntary muscles) and to the glands of the body. The activity of the ANS is controlled principally by the medulla oblongata and hypothalamus of brain. Sympathetic and parasympathetic nervous system tend to work antagonistically on the same organ.

Feature	Sympathetic nervous system	Parasympathetic nervous system
(i) salivary glands	inhibit secretion	stimulate secretion
(ii) pupil of the eye	dilate	constricts
(iii) heart rate	increase strength & rate of heart beat	decrease strength & rate of heart beat
(iv) intestinal peristalsis	inhibits	stimulates

122. (b) : **Millipede** - Millipedes belongs to order or class diplopoda of myriapoda. Millipedes are called thousand leggers because of possession of numerous legs. In spite of this they move very slowly.

Silver fish - *Lepisma* is commonly known as silver fish because of its glistening silvery white fish like body. It belongs to the insect order thysanura.

Sea anemone - Sea anemone (*Admasia*), belongs to coelenterates, shows commensalism. It is found attached to the empty shell of gastropods occupied by hermit crab. Its body wall is two layered *i.e.*, outer epidermis and inner gastrodermis. In between these two layers is present mesogloea.

123. (d) : All mammals without any exception are characterized by a muscular diaphragm and milk producing glands.

124. (d) : **Oxyntic (or parietal) cell** is present in the wall of the stomach that produce HCl which forms the part of gastric juice. Oxyntic cell also produce intrinsic factor which is involved in the absorption of vitamin B₁₂ in the small intestine. The pH of gastric acid is 2-3 in the stomach of the lumen. The acidity being maintained by the proton pump, a H⁺/K⁺ ATPase.

Alpha cell of islets of langerhans secrete glucagon hormone which raises blood glucose level by stimulating liver to convert glycogen to glucose and by stimulating the conservation of fatty acids and amino acids to glucose. **Kupffer cells** are specialized macrophages that disposes of old blood cells and particulate matter. Kupffer cells, named after Karl Wilhem Von Kupffer, are found in the bloodstreams and in the liver, attached to the walls of the sinusoids.

Sebaceous gland is a simple or branched glands in the skin that secrete an oily substance, sebum which is fatty mildly antiseptic material that protects, lubricates, and waterproofs the skin and hair & help prevent dessication.

125. (b) : **Cone cell** is one of two types (other is rod) of light sensitive cells in the retina of the eye. The human retina contains 6-7 million cones which function best in bright light and are essential for active vision (receiving a sharp accurate image). The area of retina called the fovea contains the greatest concentration of cone. Cones can also distinguish colours. There are 3 types of cone, each sensitive to the wavelength of a different primary colour - red, green or blue.

126. (a) : **Polygenic inheritance** is the inheritance pattern of a trait controlled by two or more genes. Genes may be on the same or different chromosomes and each gene may have two or more alleles. The gene expression is influenced by a variety of factors including gender, nutrition, breed, rate of growth, and amount of exercise. These traits are quantitative traits - that is, there is a wide range within the population. Such traits include height, weight, character, working abilities, and some genetic defects.

One example is height in humans - there are a larger number of phenotypes, each differing slightly from the next and forming a graduated series. Some variation in height in humans is due to

environmental factors such as diet, exercise and disease. However, if the environmental factors were constant, there would still be continuous variation in height due to such things as formation and hormone levels. The more genes that control a characteristic, the more possible gene combinations exist and the more phenotypes.

Other examples of polygenic inheritance include : skin colour in humans, colour in wheat kernels, egg weight in poultry, fleece weight in sheep. Kernel colour in wheat is determined by two gene pairs, so called polygenes that produce a range of colors from white to dark red depending on the combinations of alleles. Dark red plants are homozygous *AABB* and white plants are homozygous *aabb*. When these homozygotes are crossed the F_1 offspring are all double heterozygotes *AaBb*. Thus crossing individuals with the phenotype extremes yield offspring that are a 'blend' of the two parents.

127. (b) : Test cross is a cross made to identify hidden recessive alleles in an individual of unknown genotype. This individual is crossed with one that is homozygous for the allele being investigated (*i.e.*, a homozygous recessive). The homozygous recessive individual may be the parent of the individual being investigated.

128. (c) : Rennin, helicase and hyaluronidase are all enzymes. Rennin (chymosin), secreted by the stomach is responsible for clotting milk. It acts on a soluble milk protein (caseinogen) to convert it into the insoluble form casein. Helicase unwinds double stranded helical DNA during replication. Hyaluronidase is able to digest hyaluronic acid (major glycosaminoglycan) & is therefore important in modulating the removal of cell matrix in order to facilitate cell movement or tissue organization. **Thiamine is not an amino acid**, it is vitamin B_1 , which is active in the form of thiamin pyrophosphate, a coenzyme in decarboxylation reactions in carbohydrate metabolism. A deficiency of vitamin B_1 leads to beri beri.

Myosin is a contractile protein that interacts with actin to bring about contraction of muscle or cell movement.

Among optic, oculomotor and vagus, which are cranial nerves, optic is sensory in nature, oculomotor is motor and vagus is mixed sensory nerves.

129. (d)

130. (c) : The figure shows, human sex chromosome with genes 'a' and 'b'. So, 'a' and 'b' are sexlinked genes, that are inherited through sex chromosomes. The most important character of sex linked inheritance are colourblindness and haemophilia. Both the disorders are due to recessive sex linked genes. The gene for red green colour blindness is located on X chromosomes. The person suffering from this disease is unable to distinguish red and green colours. Haemophilia, also called bleeder's disease, is due to presence of recessive gene on X-chromosome. The person suffering from this disease have blood which does not clot properly *i.e.*, lacking a factor (plasma thromboplastin) which is responsible for clotting of blood.

131. (d) : *Chamaeleon*

(or girgit) is a lizard like member of reptilia which is famous for changing its colour according to its surroundings. The phenomenon is called metachrosis. *Chamaeleon* lives on trees in south India and is insectivorous and can catch an insects

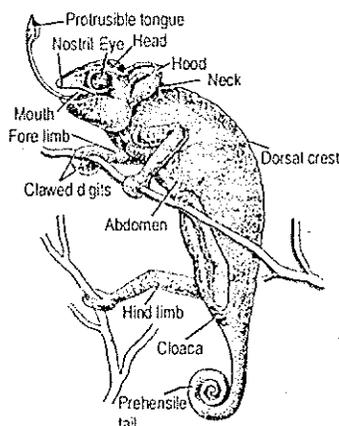


Fig. *Chamaeleon vulgaris*.

about 20 cm away by eversible tongue. Its tails is long cylindrical & prehensile (means able to grasp or grab by wrapping around).

132. (a) : Enzymes or biocatalysts are proteinaceous substance that are capable of catalysing chemical reactions of biological systems without themselves undergoing any change. In the graph *a* shows normal enzyme reaction, graph *b* shows competitive inhibition and graph *c* shows non competitive inhibition. In competitive inhibition the inhibitor, which is a substrate analogue, combines reversibly to the free enzyme at the active site. In non competitive inhibition, the inhibitor binds to enzyme at a place other than substrate binding site. It results in destruction of enzyme activity.

133. (b) : Pollution from animal excreta and organic waste from kitchen can be most profitable minimized using them in the generation of biogas. Biogas is a mixture of methane and carbon dioxide resulting from the anaerobic decomposition of such waste materials as domestic, industrial and agricultural sewage.
134. (a) : Borderline personality disorder (BPD) is a serious mental illness. Borderline describing a personality disorder characterized by unstable and intense relationships, exploiting and manipulating other people, rapidly changing moods, recurrent suicidal or self injuring acts & a pervasive inner feelings of emptiness & boredom. A mood disorder is a condition where the prevailing emotional moods is distorted or inappropriate to the circumstances. Addiction is a state of dependence produced by the habitual taking of drugs, alcohol etc. Schizophrenia is a group of severe mental disorders characterized by disturbances of languages and communications, thought disturbances that may involve distortion of reality, misperceptions, delusions and hallucination, mood changes & withdrawn etc.
135. (a) : Genes present in the cytoplasm of eukaryotic cells are found in the mitochondria & inherited *via* egg cytoplasm. Maternal inheritances are the genetic effects that are transmitted *via* the maternal line. There are many such effects some resulting from the purely maternal origin of mitochondria or chloroplasts, others from effects on the phenotype of the embryo by easily development within the female, such as maternal influence on coiling of snails.
136. (c) : Ciliated epithelium is a region of epithelium consisting of columnar or cuboidal cells bearing hairlike appendages that are capable of beating rapidly. Ciliated epithelium performs the functions of moving particles of fluids over the epithelial surface. Cubical ciliated epithelium occurs in certain parts of uriniferous tubules whereas columnar ciliated epithelium occurs in fallopian tubules, nasal passages, bronchioles, small bronchi and buccopharyngeal cavity of frog. It often occurs in the vicinity of mucus secreting goblet cells. Squamous epithelium are found in linning of alveoli in the lungs and Bowman's capsule in the kidney. Columnar epithelium are found in the lining layer of gastrointestinal tract, gall bladder, uterus etc. and cubical or cuboidal epithelium lines the salivary ducts, pancreated ducts, gastric glands, thyroid follicles, germinal epithelium of ovary, proximal part of uriniferous tubules etc.
137. (a) : Thyroxine, the principal hormone, of thyroid gland, is required for tissue differentiation and metamorphosis (the rapid transformation from the larval to the adult form) in amphibians. So in its absence of presence of antithyroid substance, eg. thiourea, tadpoles or axolotl remain in the larval stage indefinitely. Thiourea is an organic compound of carbon, nitrogen, sulphur and hydrogen, with the formula CSN_2H_4 or $(NH_2)_2CS$. It is similar to urea, except that oxygen atom is replaced by a sulphur atom. Antithyroid agents and the thiouracils and mercaptoglyoxalines owe their activity to the presence of the potentially free thiol group, which by its ready reduction of elementary iodine to iodide ion,
 $2R-S + I_2 \rightarrow R-S-S-R + 2I$
interferes with the iodination of tyrosine in the thyroid protein and hence inhibits the synthesis of the thyroid hormone.
138. (a) : Leptospirosis (also known as Weil's disease, canicola fever, canefield fever, nanukayami fever or 7-day fever) is a bacterial zoonotic disease caused by spirochaetes of the genus *Leptospira* that affects humans and a wide range of animals, including mammals, birds, amphibians, and reptiles. It was first described by Adolf Weil in 1886 when he reported an "acute infectious disease with enlargement of spleen, jaundice and nephritis. Humans become infected through contact with water, food, or soil containing urine from these infected animals. This may happen by swallowing contaminated food or water or through skin contact. Leptospirosis is common among watersport enthusiasts in certain areas as prolonged immersion in water is known to promote the entry of the bacteria. Schistosomiasis or bilharzia is also called snail fever or swimmer's itch. Schistosomiasis is a life-threatening parasitic disease caused by a worm that

lives in a host snail. Humans can become infected when they come in contact with water in ponds and rivers where the snail lives. The pathology is mostly caused by the large number of eggs becoming stuck in various body parts, in particular the liver (causing liver enlargement and malfunction) and the kidneys (causing kidney damage, detectable by blood in the urine).

139. (b) : Blue baby syndrome is a pathological condition, called methemoglobinemia, in which blood's capacity for oxygen transport is reduced, resulting in bluish skin discoloration in infants. Blue baby syndrome begins when large amounts of nitrates in water are ingested by an infant and converted to nitrite by the digestive system. The nitrite then reacts with oxyhaemoglobin (the oxygen-carrying blood protein) to form methoglobin, which cannot carry oxygen.

Pneumoconiosis is a man-made, occupational lung diseases that are contracted by prolonged breathing of coal mine dust *i.e.* caused by the inhalation of dust, characterized by formation of nodular fibrotic changes in lungs. Non-Hodgkin lymphoma (or NHL) is a cancer of lymphoid tissue, a part of the lymphatic system. NHL is a heterogenous disease. Skin cancer is a malignant tumor that grows in the skin cells. It is commonly caused by exposure to the sun's UV rays.

140. (b) : Angiogram is an X-ray diagnostic procedure used to visualize the blood vessels following injection of a contrast substance into an artery. It is used to image arteries in the brain, heart, kidneys, gastrointestinal tract, aorta, neck (carotids), chest, limbs and pulmonary circuit.

Coronary angiography is performed to detect obstruction in the coronary arteries, which can lead to heart attack. It may be performed if you have unstable angina, atypical chest pain, aortic stenosis, or unexplained heart failure.

141. (c) : The root knot disease of brinjal is quite common in all vegetative growing areas especially when the climate is warm, with short winters. The disease is caused by root knot nematode *Meloidogyne incognita*. It devitalizes root tips, develop swelling over roots and reduces flow of water and minerals to the aerial parts. As a result yield and quality of fruits are affected.

Citrus canker is a common bacterial diseases of citrus tree, caused by *Xanthomonas citri*. Late blight is a disease of potato caused by fungus *Phytophthora infestans* having blight type symptoms. Wilt of pigeon pea is caused by *Fusarium udum* (fungi) where wilting of seedlings and adult plants occur.

142. (d) : The present day wheat is hexaploid, known as triticale ($2n = 42$) with 3 genomes A, B and D *i.e.* AABBDD. The 3 genomes are obtained from 3 different diploid species.

(i) *Triticum aegilopoides* - AA ($2n = 14$)

(ii) *Aegilops speltoides* - BB ($2n = 14$)

(iii) *Aegilops squarossa* - DD ($2n = 14$)

By crossing of first two diploids sps *Triticum dicoccoides* ($2n = 28$) *i.e.*, tetraploid is produced AABB which on crossing with third species gives rise to *Triticum aestivum* ($2n = 42$) hexaploid (AABBDD).

So its haploid set will have 21 chromosomes, monosomic ($2n - 1$) will have 41 chromosomes, nullisomics ($2n - 2$) will have 40 chromosomes, and trisomic ($2n + 1$) will have 43 chromosomes.

143. (b) : Grafting is the technique of joining parts of two plants so as to form a composite plant. Grafting is carried out during period of active growth and rapid healing between two related plants having vascular cambium. One plant has strong root system and the other plant possesses better flower or fruit yield. The former is called stock and the latter is known as scion or graft. Vascular cambium are the lateral meristem found in those vascular plants that exhibit secondary growth. It forms secondary xylem and secondary phloem mostly by periclinal division.

144. (d) : Sieve elements are a component of phloem tissue and are responsible for conduction of food in plants. A sieve tube element has peripheral layer of cytoplasm without any nucleus. The central part is occupied by a network of canals which contain fibrils of *p*-protein. The protein is vibratile and is believed to actively participate in the transport of nutrients. One general property of its ability to form a gel and it functions as a puncture repair substance forming a plug at any site of damage in sieve element, thus preventing loss of food materials

being translocated by the phloem. Thus it is believed to have sealing function on wounding.

145. (b) : Myxomycetes are generally placed under fungi but are also placed under protista. They are known as slime mould and are surrounded by plasma membrane only. They are multinucleate, showing amoeboid like nature (pseudopodia for engulfing food). Both sexual and asexual mode of reproduction is found. They produce spores within sporangia. Asexual reproduction is by fragmentation and sexual reproduction by spores.
146. (d) : The system of classification of seed plants presented by Bentham and Hooker, represented the most well developed classification of natural system. The classification was published in 3 volume work '*Genera plantarum*'. The system divided phanerogams or seed plants into 3 classes - dicotyledons, gymnospermae and monocotyledons. Dicotyledons were further subdivided into 3 subclasses - polypetalae, gamopetalae and monochlamydae based on the presence or absence of petals and their fusion. They were further divided into series, orders and families. No orders were recognised within monochlamydae and monocotyledons, the series being directly divided into families. But the system had a lot of demerits within it. He did not know the affinities of the families placed under 'Ordines anomate' and the families were tentatively grouped together. So, a few orders were not placed satisfactorily in the classification. Monochlamydae is an unnatural assemblage of taxa, which belongs elsewhere. The creation of this group has resulted in the separation of many closely related families.
147. (c) : Transgenic plants are those plants in which a foreign gene has been introduced and stably integrated into the host DNA. A gene that is transferred using the tools of molecular biology is called transgene. *Brassica napas* is one of the transgenic plant species. Recently transgenic plants have been explored for production of biologically active peptides and proteins having pharmaceutical applications including use as blood proteins, enzymes, growth, hormones etc. The protein hirudin present in leech, prevents blood clotting. The gene was chemically synthesized and introduced in *Brassica napas* and later on the seeds contained the protein.
148. (b) : Grafting is the technique of joining parts of two plants so as to form a composite plant. One plant has a strong root system called the stock, and the other plant having better flower or fruit yield is known as scion. When a scion is grafted to a stock the root system of the plant has the genotype of stock and fruits produced show genotypes of the scion.
149. (d) : Chromatophores are internal membrane systems present in photosynthetic prokaryotes. These develop as membrane lined sacs or thylakoids from plasma membrane. Thylakoid membranes contain photosynthetic pigments in cyanobacteria and purple bacteria. Small sacs or granules containing pigments phycobilin are attached to these membranes. In green bacteria chromatophores are covered by non unit non lipid protein membrane. They are sometimes called chlorosomes.
150. (a) : Rust, smut and mushroom all belong to the group of pathogenic fungi. These fungi belong to the class basidiomycetes, and produce basidiospores. Mushroom are placed in the order agaricales. *Amanita* and *Marasmius* are pathogenic or disease causing fungi. *Marasmius ordeades* causes fairy rings on turf grasses. Rusts and smuts are included in the subclass teliomycetidae. Rust fungi comes under order uredinales, eg. *Puccinia graminis* causes black rust of wheat, *P. recondita* causes leaf rust of wheat. Smut fungi comes under order ustilaginales which produce teliospores, eg. *Ustilago tritici* causes loose smut of wheat.
151. (d) : *Rhizobium* is the nitrogen fixing bacteria present in root nodules of legumes. Roots of a legume secrete chemical attractants flavonoids and betaines. Bacteria collect over the root hairs, release nod factors that causes curling of root hairs around the bacteria, degradations of cell wall and formation of an infection thread enclosing bacteria. The infected cortical cells differentiate and start dividing. It produces swelling of nodules and the infected cells enlarge. Bacteria stop dividing and form irregular polyhedral structures called bacteroids. The host cells develops a pinkish coloured pigment called leg haemoglobin. It is an

oxygen scavenger and protects nitrogenase from oxygen. Symbiotic nitrogen fixation requires co-operations of 'Nod' genes of legumes, 'nod' 'nif' and 'fix' genes of bacteria.

152. (a) : Bioassay is a testing of biological activity like growth response of a substance by employing plant part. *Avena* curvature test is a bioassay for examining the activity of auxins. It is based upon experiments of Went. 10° curvature is produced by auxin concentration of $150 \mu\text{g/lit}$ at 25°C and 90% relative humidity. It can measure auxin upto $300 \mu\text{g/lit}$. Auxin from shoot tip or any other plant organ is allowed to diffuse in a standard size agar block. 15 - 30 mm long oat coleoptile grown in dark is held vertically over water. 1mm tip of coleoptile is removed without injuring the primary leaf. After 3 hrs a second decapitation is carried out for 4mm distance. Primary leaf is now pulled loose and agar block supported against it - at the tip of decapitated coleoptile. After 90 - 110 mm the coleoptile is found to have bent. The curvature is measured.

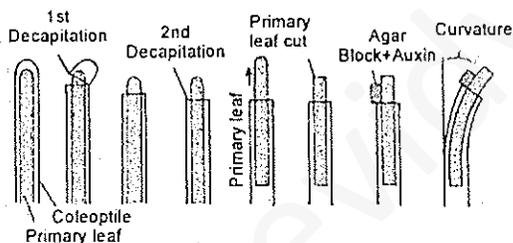


Fig. Method of *Avena* Curvature Test.

153. (d) : Chloroplast, chromoplast and leucoplast are all types of plastids which are classified on the basis of pigments they contain. Plastids are semiautonomous cell organelles bounded by two membranes and are found in only plant cells & some unicellular organisms (*Euglena*) of uncertain affinity. The common among all the three organelles are that they have ability to multiply by a fission like process because these organelles contain their own genetic material and protein synthesizing machinery, i.e., DNA, RNA and ribosomes. Plastids are thought to have arisen as a result of an endosymbiotic event in which an early photosynthetic prokaryotic invaded a primitive eukaryotic host. All plastids are derived initially from small undifferentiated plastids termed proplastids which are found in the dividing cells in

meristems. During cell differentiation, proplastids differentiate into particular plastids types according to the type of cell in which they reside.

Chloroplasts are the organelles in which photosynthesis takes place. Photosynthesis is an important process by which autotrophic cells manufacture their own food. Chloroplasts contain the green pigment chlorophyll (this is why plant leaves are green) which absorbs light to provide the energy necessary to complete photosynthesis. Chromoplasts are very similar to chloroplasts, but they do not contain the green pigment chlorophyll. Instead, they contain other pigments which give colour to flowers and to leaves during the fall. These other pigments absorb colours of light than chlorophyll. Leucoplasts are non-pigmented colourless plastids. Lacking pigments, leucoplasts are not green, so they are predictably located in roots and non-photosynthetic tissues of plants. They may become specialized for bulk storage of starch, lipid or protein and are then known as amyloplasts, elaioplasts, or proteinoplasts. These materials are released from the leucoplast when the cell requires them.

154. (d) : Pollination by birds is called ornithophily, eg. humming birds, honey eaters, sunbirds etc. are sensitive to colours and have powerful vision. Plants like *Bombax*, *Butea*, etc are ornithophilous plants. Their flowers are characterised by tubular, cup shaped corolla, bright colour to attract insect, excess of nectar and pollens. They are generally odourless. *Bauhinia* is mostly visited by hummingbirds and their propagules are dispersed by birds.

155. (c) : The Montreal protocol on substances that deplete the ozone layer was signed in Montreal, Canada, by over 150 countries at a convention in 1987 to cut use of CFCs (chlorofluorocarbons). The aim of the Protocol was to protect the ozone layer in the stratosphere by decreasing and eventually eliminating the use of ozone-depleting substances like CFCs. It is regarded as one of the most successful international treaties in modern history.

156. (d) : Keystone species is a species which has significant and disproportionately large influence on the community removal or decrease in number of keystone species causes disruption in structure

and function of community. For example in intertidal regions star fish feeds on mussels. Removal of star fish leads to dominance of mussels that excludes algae and browsing species. In tropical rain forests fig functions as keystone species as they provide fruit to a number of animals during the period of food scarcity.

157. (c) : Genetic diversity is the diversity in the number and types of genes as well as chromosomes present in different species and the variations in the genes and their alleles in the same species. Variations in the genes of a species increase with the increase in size and environmental parameters of the habitat. It helps in speciation and evolution of new species.
158. (c) : Nonsense codon is a set of three nucleotides for which there is no corresponding tRNA molecule to insert an amino acid into the polypeptide chain. Protein synthesis is hence terminated and the completed polypeptide released from the ribosome. Three stop codons are UAA (ochre), UAG (amber) and UGA (opal). Mutations which generate any of these three codons in a position which normally contains a codon specifying an amino acid are known as nonsense mutations.
159. (b) : Biosphere reserves, National Park and wild life sanctuaries are all protected areas but differ from each other in some ways. National parks are reserved for betterment of wild life. Cultivation, grazing forestry and habitat manipulations are not allowed. Sanctuaries are tracts of land with or without lake where wild life can take refuge. Harvesting of timber, collection of forest products, tilling of land, private ownership of land etc., are allowed. Biosphere reserves are multipurpose protected area which are meant for preserving genetic diversity in representative ecosystems of various national biomass and unique biological communities by protecting wild life, traditional life style of tribals and domesticated plant/animal genetic resources. Each biosphere reserve has 3 zones – (i) Natural zone - where no human activity is allowed, (ii) Buffer zone - limited human activity is allowed like education, research, (iii) Transition zone - has different parts like agriculture, tourism, and restoration regions.

160. (a) : Genetic variation present among plants cells of a culture is called somaclonal variation. The term is also used for the genetic variation present in plants regenerated from a single culture. This variation has been used to develop sexual/useful variations.

161. (a) : Tetanus is a serious and often fatal disease caused by the neurotoxin tetanospasmin which is produced by the gram positive obligate anaerobic bacterium *Clostridium tetani*. Infections begins when the bacteria are introduced into an open injury or wound where they produce tetanospasmin toxin which blocks messages from the spinal cord to the muscles, forcing muscles to go into severe spasm. Deep puncture wound or those with devitalized (dead) tissue are particularly prone to tetanus infection because the bacillus thrives in an anaerobic environment. Tetanus often begins with mild spasm in the jaw muscles (hence called lock jaw or trismus), neck muscles and facial muscles. Stiffness rapidly develops in the chest, back and abdominal muscles. Immunization against tetanus can prevent the disease. Therefore a person who has received a cut and is bleeding needs to given antitetanus treatment. Antitetanus immunoglobulin gives passive immunity. Tetanus is best prevented by active immunization with tetanus toxoid which stimulates the production of protective antitoxin.

162. (b) : Cancer is a growth disorder of cells. It starts when an apparently normal cell begins to grow in an uncontrolled and invasive way. The result is a cluster of cells, called a tumor, that constantly expands in size. Cells that leave the tumor and spread throughout the body, forming new tumors at distant sites, are called metastases. Cancer is a gene disorder of somatic tissue, in which damaged genes fail to properly control cell proliferation. The cell division cycle is regulated by a sophisticated group of proteins. Cancer results from the mutation of the genes encoding these proteins. More than one mutation is necessary for carcinogenesis. In fact, a series of several mutations to certain classes of genes is usually required before a normal cell will transform into a cancer cell. Only mutations in those certain types of genes which play vital roles in cell division, cell death, and DNA repair will cause a cell to lose control of its proliferation. Cancer can be caused by chemicals that mutate DNA or in some

instances by viruses that circumvent the cell's normal proliferation controls. Whatever the immediate cause, however, all cancers are characterized by unrestrained growth and division. Cell division never stops in a cancerous line of cells. Cancer cells are virtually immortal—until the body in which they reside dies.

163. (c) : The process of transfer of energy from producers through a series of organisms *i.e.* from primary consumers to secondary consumers to tertiary consumers by process of eating and being eaten constitute a food chain, *eg.* grassland ecosystem. Food chains can never occur independently in ecosystem but various food chains are inter-connected with each other forming an interlocked system known as food web. In grassland ecosystem food chains may be—
- (i) Grass → Rabbit → Hawk/kite
 - (ii) Grass → Mouse → Snake → Kite/Hawk
 - (iii) Grass → Grasshopper → Lizard → Kite/Hawk
- So, the food web will always include kite.

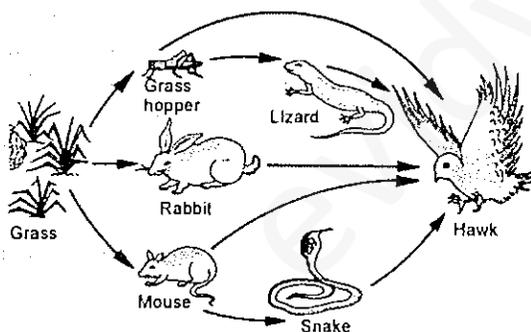


Fig. Food web in a grassland ecosystem

164. (a) : Inflammation is a process in which the body's WBCs and the chemicals released into the blood or the affected tissue to protect us from infection and foreign substances such as bacteria and viruses. This releases of chemicals increases the blood flow to the area of injury or infection. Inflammation is characterized by redness, swollen joint that's warm to touch, joint pain, joint stiffness & loss of joint function.
- The increase number of cells and inflammatory substances within the joint causes irritation, wearing down of cartilage (cushions at the end of bones) and swelling of the joint lining. Inflammation of one or more joint results in arthritis. When there is

a deposition of uric acid and crystals of sodium urates in the joints it will lead to gout arthritis. Uric acids is the end metabolism products of nitrogen containing purine nucleic acid. Gout generally affects one or two joints only. It is very painful particularly at night, and makes movement difficult. Gout generally affects great toe.

165. (b) : The first living organisms originated among organic molecules and in oxygen free atmosphere. They presumably obtained energy by fermentation of some of these organic molecules. They were non-green and anaerobes, capable of respiring in absence of oxygen. They depended on the existing organic molecules for their nutrition, hence they were heterotrophs. Then came autotrophs when the supply of existing organic molecules were exhausted. These organisms were capable of producing their own organic molecules by chemosynthesis. They synthesized food from inorganic molecules. Photoautotrophs were also anaerobic at first but later on oxygen releasing photosynthetic organism developed.

166. (b) : *E.coli*, *Shigella sp.* and *Salmonella* species are all bacteria which are responsible for the diarrhoea diseases. Diarrhoea is a frequent bowel evacuation or the passage of abnormally soft or liquid faeces. It may be caused by intestinal infections, other form of intestinal inflammation (such as Colitis or Crohn's disease), malabsorption, anxiety and the irritable bowel syndrome. Severe or prolonged diarrhoea may lead to excess losses of fluid, salts and nutrients in the faeces. Dehydration (whose symptoms includes great thirst, nausea and exhaustion) is common to all types of diarrhoeal diseases. The condition is treated by drinking plenty of water, severe cases require oral rehydration therapy or intravenous administration of water and salts. One litre of ORS (Oral rehydration solution) contains 1.5 gm glucose, 3.5 gm NaCl, 2.9 gm KCl & 2.9 gm trisodium citrate.

167. (b) : Deforestation increases atmospheric CO₂ content by releasing carbon stored in organic matter and reduced primary productivity. So deforestation is one of the main factors contributing to global warming other than green house gases. The various green house gases are CO₂ (60% effect), CH₄ (20% effect) CFC_s (14% effect) and nitrogen oxide

(N_2O , 6% effect). Due to increase of CO_2 concentration, the absorption of heat radiation also increase thus increasing the temperature. This increase in temperature may causes melting of glacier and polar ice caps, which is called global warming. This melting of glaciers and polar ice results in raising the sea level. Actually these green house gases absorbs infra red radiations (heat) of the sun like glass and thus traps the heat and does not allow it to radiate back to the space. They instead radiate the heat back to earth, thus causing increase in temperature.

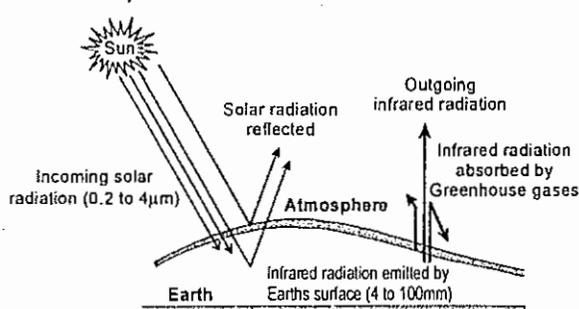


Fig. Greenhouse effect in keeping the earth warm.

168. (d) : An analgesic is any member of the diverse group of drugs used to relieve pain and to achieve analgesia. Analgesic drugs act in various ways on the peripheral and central nervous system; they include paracetamol (acetaminophen), the nonsteroidal anti-inflammatory drugs (NSAIDs) such as the salicylates, narcotic drugs such as morphine, synthetic drugs with narcotic properties such as tramadol, and various others.

LSD and marijuana are used as hallucinogens. Hallucinogens are natural and synthetic (synthesized) substances that, when ingested (taken into the body), significantly alter one's state of consciousness. Hallucinogenic compounds often cause people to see (or think they see) random colours, patterns, events, and objects that do not exist. These substances are sometimes called "psychedelic," or "mind-expanding" drugs.

Marijuana and hashish, two substances derived from the hemp plant (*Cannabis sativa*), are also considered natural hallucinogens. Marijuana (also called grass, pot, tea, weed, or reefer), a green herb from the flower of the hemp plant, is considered a mild hallucinogen. Hashish is marijuana in a more

potent, concentrated form. Both drugs are usually smoked. Their effects include a feeling of relaxation, faster heart rate, the sensation that time is passing more slowly, and a greater sense of hearing, taste, touch, and smell. LSD (Lysergic Acid Diethylamide) is the most common hallucinogen and one of the most potent mood-changing chemicals. It is manufactured from lysergic acid, found in a fungus that grows on rye and other grains. LSD users may experience flashbacks of visions they had when on the drug. Some LSD users suffer organic brain damage, which results in impaired memory and attention span, confusion, and difficulty in thinking.

169. (c) : Mutations are sudden and abrupt qualitative or quantitative change in the genetic material of an organism. According to their effects on the phenotype mutations may be classified as lethals, subvitals and supervitals. Lethal mutations results in death of the cells or organism in which they occur. The organism may not even develop beyond the zygote stage. Subvital reduces the chances of survival. Supervital mutations results in the improvement of biological fitness under certain conditions. There may also be mutations which are neither harmful nor beneficial to the organisms in which they occur.

170. (a) : Adrenaline is a catecholamine hormone, also known as epinephrine, secreted by the mammalian adrenal medulla as well as the adrenergic nerve endings. Its secretion is stimulated by the sympathetic nervous system under conditions of stress. Adrenaline stimulates blood flow to skeletal muscles and increases blood glucose levels. It also raises metabolic rate.

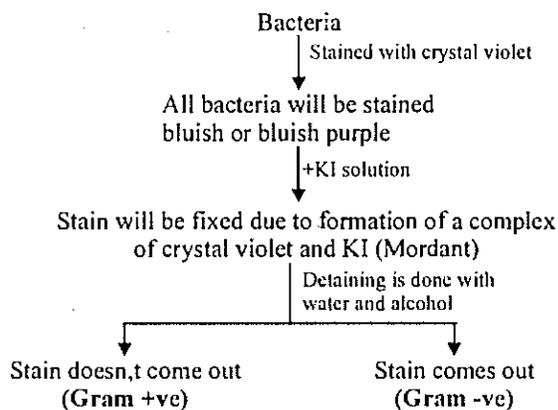
171. (d) : When the ambient temperature is high and soil contains excess water, the rate of transpiration is increased *i.e.*, loss of water takes place from leaves through stomata. Lenticular transpiration is only 0.1% of the total transpiration. It however continues day and night because lenticels have no mechanism of closure. The lenticels connect the atmospheric air with the cortical tissue of stem through intercellular spaces present amongst the complementary cells. Root pressure regulates the rate of loss of water from the stomata in some plants.

Root pressure is a positive pressure that develops in the xylem sap of the roots of some plants.

172. (c) : Xylem is the main conducting tissue in plants. It consists of 4 different components – tracheids, trachea or vessels, xylem fibre and xylem parenchyma. Tracheids are elongated cells with tapering end. They are generally present in ferns and gymnosperms for conduction of water. In angiosperms, vessels are composite structure as these are formed by dissolution of end walls of row of cells *i.e.*, vessels elements. So angiosperms, have more efficient system of conduction due to presence of vessels. Conduction of water by vessel elements is also known as ascent of sap. Water absorbed by roots, goes upward to replace the water loss by transpiration. The most accepted theory for ascent of sap is transpiration pull theory *i.e.*, when water is lost by transpiration from the leaves, a tension is created in the xylem and due to this water absorbed by roots hair is passed through vessels to the leaves. The xylem parenchyma are mainly for storage function but sometimes help in conduction.
173. (a) : Polytene chromosomes are quite common in salivary glands of insects and so are called salivary chromosomes. These chromosomes have high amount of DNA of almost 1000 times in *Drosophila* as compared to ordinary somatic chromosomes. These chromosomes are multistranded. They are in permanent prophase stage. These chromosomes are formed by somatic pairing between homologous chromosomes and repeated replication of their chromonemata without separation of chromatids. All the chromosomes may remain attached to one another at a common point called chromocentre.
174. (a) : Stratosphere zone of earth's atmosphere contains a layer of ozone (O_3) which prevents the earth surface from about 99% of incoming solar ultra violet radiations. The primary chemicals responsible for ozone depletion are a group of chlorine containing compounds called chloroflourocarbons (CFCs) used as coolants in refrigerators and air conditioners and propellants for aerosol cans and foam blowing agents for insulation and packaging and also as solvents. After their release into troposphere CFCs go to stratosphere when these are broken down by

ultraviolet radiations releasing chlorine or bromine which break O_3 molecules into O_2 and O. Due to depletion of O_3 layer, higher levels of ultra violet rays reach earth surface. Depletion in the concentration of ozone over a restricted area is called ozone hole. Ozone depletions results in problems like skin cancer, cataract animals becoming blind, mutations, inhibiting photosynthesis, decreases in productivity. Decreased photosynthetic activity will increase O_2 concentration of the atmosphere resulting in global warming.

175. (a) : Hydrocarbon are major air pollutants. Methane is produced naturally during decomposition of organic matter, incomplete biomass combustion. Its concentration was 700 ppb in pre industrial times and 1750 ppb in 2000. So the concentration has more than doubled in the last 250 years. Flooded paddy fields, marshes, cattles etc. are the major sources of this gas.
176. (b) : A cross section of well developed soil shows more or less distinct layers called horizons. O-horizon is the topmost layer of soil and A-horizon comes below O horizon. In the topmost layer, vegetation grows and various biological activities takes place. Tropical rain forests are found in tropical zone of the world and are characterized by very high temperature and abundance of rainfall. Soil in these area are red latosols and are exceedingly thick. Leaching of minerals from the top soil occurs rapidly but cycling of nutrients also occur here. The laterite soils are generally infertile because of intensive leaching and not due to growth of micro-organism.
177. (a) : The technique of staining bacteria was given by a Dutch microbiologist Christian Gram and this technique is known as Gram staining. In the cell wall of gram +ve bacteria both horizontal and vertical peptide linkages are present due to which mesh is dense and stain does not come out. Further outer layer of cell wall of Gram +ve bacteria is made up of techoic acid. In the cell wall of gram -ve bacteria, either horizontal or vertical peptide linkages are present, due to which mesh is loose and hence stain comes out when washed with alcohol. Further outermost layer of cell wall of Gram -ve bacteria is made up lipopolysaccharides.



178. (c) : Photorespiration protects the plants from photooxidative damage by dissipating excess of excitation energy. When the CO_2 supply is limited and under high light intensity photorespiration takes place thus protecting the plants. If enough CO_2 is not available to utilize light energy for carboxylation to proceed, the excess energy will cause photooxidative damage to the plants. The energy liberated should be used in photophosphorylation in presence of CO_2 . If CO_2 is less than in C_3 plants O_2 combines with RuBP to form phosphoglycolate thus utilizing the excess energy.

179. (d) : C_4 plants are those plants that produce C_4 compound like malic acid or aspartic acid as the first stable compound of CO_2 fixation cycle, eg. maize, sugar cane etc. These plants can grow in

dense tropical, forests where there is poor supply of CO_2 because there is internal supply of CO_2 . Also photorespiration is negligible or absent in these plants. So, they are photosynthetically more efficient than C_3 plants. These plants show a special type of leaf anatomy called Kranz anatomy. The C_4 pathway shows 2 carboxylation reactions one in mesophyll chloroplast and the other in bundle sheath. Chloroplasts - CO_2 acceptor is PEP and not RuBP and PEP carboxylase is the key enzyme.

180. (a) : The cytoskeleton is a fibrous network made of proteins that contributes to the structure and internal organization of eukaryotic cells within the cytoplasm. It is a dynamic structure that maintains cell shape, enables some cell motion (using structures such as flagella and cilia), and plays important roles in both intra-cellular transport (the movement of vesicles and organelles, for example) and cellular division. The cytoskeleton has three major fibre types: microfilaments made of actin protein, intermediate filaments made of various kinds of proteins (eg keratin), and microtubules made of tubulin.

GENERAL KNOWLEDGE

- | | | | |
|----------|----------|----------|----------|
| 181. (d) | 182. (d) | 183. (a) | 184. (d) |
| 185. (c) | 186. (a) | 187. (d) | 188. (b) |
| 189. (a) | 190. (b) | 191. (c) | 192. (d) |
| 193. (a) | 194. (b) | 195. (c) | 196. (a) |
| 197. (a) | 198. (a) | 199. (b) | 200. (b) |

