

SOLUTIONS

PHYSICS

1. (d) : Time of exposure $\propto f^2$

$$\frac{1}{60} \times \frac{1}{1} = \frac{t}{1.4^2} \Rightarrow t = 0.3266 \text{ s}$$

$$t = \frac{1}{31} \text{ s.}$$

2. (a) : For a point source, illuminance at a distance r is given by

$$\text{Illuminance } I = \frac{\text{luminous flux} \times \phi}{4\pi r^2}$$

$$\therefore \frac{I}{I'} = \left(\frac{r'}{r}\right)^2$$

$$\frac{I}{16I} = \frac{r'^2}{(1000 \text{ m})^2}$$

$$\text{or } r'^2 = \frac{(1000 \text{ m})^2}{16} \text{ or } r' = \frac{(1000 \text{ m})}{4}$$

$$r' = 250 \text{ m}$$

3. (b) : Current gain $\beta = \frac{I_C}{I_B} = \frac{(120 \text{ mA})}{(2 \text{ mA})} = 60$

$$\text{Power gain} = \text{Resistance gain} \times \beta^2 \\ = (3) \times (60)^2 = 10800$$

4. (c) : Induced emf $\varepsilon = \frac{-M dl_p}{dt}$

where M is the mutual inductance of two coils and $\frac{dl_p}{dt}$ is the rate of change of current in the primary.

$$\therefore 1000 \text{ V} = \frac{-M(OA - 2 \text{ A})}{0.01 \text{ s}}$$

$$\text{or } M = \frac{(1000 \text{ V})(0.01 \text{ s})}{(2 \text{ A})} = 5 \text{ H.}$$

5. (a) : Electric field due to a infinite long wire of linear charge density λ is given by

$$E = \frac{1\lambda}{2\pi\epsilon_0 r}$$

6. (b) : A coil of radius r carrying current I , magnetic

field at a point at a distance R from the centre of the coil is given by

$$B = \frac{\mu_0 I r^2}{2[R^2 + r^2]^{3/2}}$$

At the centre of a coil, $R = 0$

$$\therefore B = \frac{\mu_0 I r^2}{2r^3} = \frac{\mu_0 I}{2r}$$

7. (d) : $evB = \frac{mv^2}{r}$

$\frac{e}{m} \propto \frac{1}{r}$, if B and v are the same. The radius of curvature of D is minimum. Therefore $\frac{e}{m}$ is maximum.

8. (c) : For hydrogen like atoms like He^+ , Li^{++} etc, the energy in an n^{th} orbit is given by

$$E_n = \frac{-Z^2 13.6}{n^2} \text{ eV}$$

For He^+ , $Z = 2$

$$\therefore E_1 = \frac{-(2)^2 13.6}{(1)^2} \text{ eV} = -54.4 \text{ eV}$$

9. (a) : Impedance has the same dimensions as that of a resistance

$$\therefore \text{Resistance } R = \frac{\text{Voltage } V}{\text{current } I} \\ = \frac{[ML^2T^{-3}I^{-1}]}{[I]} = [ML^2T^{-3}I^{-2}]$$

10. (a) : Number of stations = $\frac{\text{Band width}}{\text{Band width/stations}}$;

$$\text{Bandwidth per station} = 2 \times 5 \text{ kHz}$$

$$\text{Total bandwidth} = 150 \text{ kHz.}$$

$$\text{Number of stations} = \frac{150}{10} = 15$$

11. (b) : Zener diode acts as an a voltage regulator.

12. (a) : Range $r = \sqrt{2Rh}$

where R is the radius of the earth and h is the height of a antenna

$$\therefore r' = \sqrt{2R(2h)} = \sqrt{2}(\sqrt{2Rh}) = \sqrt{2}r$$

13. (b) : Infrared rays or heat rays used for heating thermocouples to produce electricity.
14. (c) : One has to use higher energy to produce radiation in the visible region. In CO₂ laser two electrodes produce discharge which is used. Therefore ultraviolet rays are used to produce light in any lower energy region.
15. (c) : Even viscosity is due to shearing when flow takes place in stream lined motion. In gases, there is no shearing and therefore no shear modulus.
16. (d) : The principle of the geostationary satellite is its period of rotation is the same as that of the earth.

$$\frac{-GMm}{r^2} + m\omega^2 r = 0$$

$$\text{i.e. } \frac{GM}{(R+h)^2} = \left(\frac{2\pi}{T}\right)^2 (R+h)$$

h works out to 36000 km.

17. (c) : K.E of rolling = $\left(\frac{1}{2}mv^2 + \frac{1}{2}I\frac{v^2}{R^2}\right)$

$$\Rightarrow \text{K.E} = \frac{1}{2}mv^2 + \frac{1}{2} \cdot \frac{2}{5} \cdot \frac{mr^2 \cdot v^2}{r^2}$$

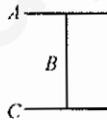
$$\text{K.E} = \frac{1}{2}mv^2 \times \frac{7}{5}$$

$$m = 1 \text{ kg}, \quad v = 1 \text{ m/s}$$

$$\text{K.E} = \frac{1}{2} \times 1 \times 1 \times \frac{7}{5} = \frac{7}{10} \text{ J}$$

18. (a) : Since the width negligible, the moment of inertia of B is zero along its length.

$$I_A + I_C = \frac{mL^2}{12} + \frac{mL^2}{12} = \frac{mL^2}{6}$$

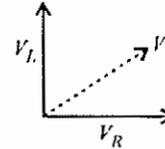


19. (b) :

In full wave a.c. or half rectified, the time interval between two peaks are the same. But in half wave rectification, the negative wave part is cut off. But as for frequency or the period, they will be the same as seen from the figures. Therefore, this also will be 50 cycles/second.

20. (b) : $V_L = 16 \text{ V}$, $V_R = 20 \text{ V}$.

In the inductor the current lags by $\frac{\pi}{2}$.



$$\therefore V = \sqrt{V_L^2 + V_R^2} = \sqrt{256 + 400}$$

$$\therefore V_{\text{total}} = 25.6 \text{ V}$$

21. (b) :

Here $v_o = L - f_e = 21.7 \text{ cm} - 2.5 \text{ cm} = +19.2 \text{ cm}$
+ve sign show that image is real.

For a objective lens $\frac{1}{u_o} + \frac{1}{v_o} = \frac{1}{f_o}$

[using real-virtual sign convention]

$$\therefore \frac{1}{u_o} = \frac{1}{f_o} - \frac{1}{v_o} \quad \therefore \frac{1}{u_o} = \frac{1}{(+1.6)} - \frac{1}{(+19.2)}$$

$$\frac{1}{u_o} = \frac{19.2 - 1.6}{(1.6)(19.2)} \quad \text{or } u_o = +1.745 \text{ cm}$$

+ve sign show that object is real

When the image is formed at infinity, the magnification is given by

$$m = \left(\frac{v_o}{u_o}\right) \left(\frac{D}{f_e}\right)$$

where D is the distance of distinct vision.

$$\therefore m = \left(\frac{19.2 \text{ cm}}{1.745 \text{ cm}}\right) \left(\frac{25 \text{ cm}}{2.5 \text{ cm}}\right) = 110.$$

22. (b) : The energy radiated per unit time by a black body at absolute temperature T is given by $H = A\sigma T^4$.

where A is the area of a black body

$$\text{or } \frac{H'}{H} = \frac{[(287 + 273) \text{ K}]^4}{[(7 + 273) \text{ K}]^4} = \left[\frac{560}{280}\right]^4 = 16$$

23. (a)

24. (c): ${}^2_1\text{H} + {}^3_1\text{H} \rightarrow {}^4_2\text{He} + {}^1_0\text{n} + Q$
Deuterium Tritium Helium neutron
 The energy released in the process is given by

$$Q = [M_{{}^2_1\text{H}} + M_{{}^3_1\text{H}} - M_{{}^4_2\text{He}} - M_{{}^1_0\text{n}}]c^2$$

$$= [2.014102 + 3.016050 - 4.002603 - 1.008665]uc^2$$

$$= (0.018884 \text{ u}) \left[931.5 \frac{\text{MeV}}{\text{u}} \right] = 17.6 \text{ MeV.}$$

25. (a): $\lambda = 6840 \text{ \AA}$

$$\therefore v = \frac{c}{\lambda} \Rightarrow h\nu = \frac{hc}{\lambda}; hc = 12400 \text{ eV\AA}$$

$$\text{Energy of the photon} = \frac{12400 \text{ eV\AA}}{6840 \text{ \AA}} = 1.81 \text{ eV}$$

26. (c): Mass of ${}^{235}_{92}\text{U}$ per second in the reactor is

$$m = \frac{2 \times 10^3}{30 \times 24 \times 60 \times 60} = 7.72 \times 10^{-4} \text{ g/sec}$$

\therefore Number of fissions reaction per second

$$= \frac{6 \times 10^{23}}{235} \times m = \frac{6 \times 10^{23} \times 7.72 \times 10^{-4}}{235}$$

$$= 1.97 \times 10^{18} / \text{sec}$$

$$\text{Power of nuclear reactor} = 1.97 \times 10^{18} \times 185 \text{ MeV/s}$$

$$= 1.97 \times 10^{18} \times 185 \times 10^6 \times 1.6 \times 10^{-19} \text{ J/s.}$$

$$= 58.3 \text{ MW.}$$

27. (c): A transistor is an semiconductor.

28. (c): A computer is working on a binary system of calculations based on zero and 1.

29. (a): For diamagnetic substance, magnetic susceptibility is $-1 \leq \chi < 0$

For ideal or perfect diamagnetic substances magnetic susceptibility is -1 .

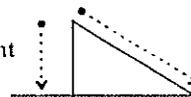
Type I - superconductors are perfect diamagnetic.

30. (d): $v = r \times \omega$.

v is the tangential. If r is in the XY plane and v is also in this plane, ω is in the Z direction. + or - is decided by whether the particle is rotating in the anticlockwise direction or clockwise direction.

31. (b): Uniform speed will not affect his weight.

$$\text{The ratio is } \frac{60 \times g}{60 \times g} = 1$$

32. (b): Conservative force
The work done is independent of the path.33. (c): Bernoulli's principle.
If one has water flowing in a horizontal tube, the pressure will be the same.

But the velocity will be more. If there is any obstruction, then pressure will also build up. Bernoulli's law is valid for luminous flow. In old age arteries get thicker and narrow.

34. (b): $\gamma = 1 + \frac{2}{f}$

$$\Rightarrow \gamma \text{ for mono atomic gas} = 1 + \frac{2}{3} = \frac{5}{3}$$

For adiabatic relation $\frac{p\gamma^{-1}}{T^\gamma} = \text{const.}$

$$P \propto T^{\frac{\gamma}{\gamma-1}} \Rightarrow P \propto T^{\frac{5}{3 \times \frac{2}{3}}}$$

$$\therefore T^C = T^{\frac{5}{2}} \Rightarrow C = \frac{5}{2}.$$

35. (a): Here, $a = 1 \text{ cm} = 0.01 \text{ m}$; The mass will remain in contact with surface, if

$$mg = m\omega^2 a \text{ or } \omega = \sqrt{g/a}$$

$$\text{or } 2\pi\nu = \sqrt{g/a} \text{ or } \nu = \frac{1}{2\pi} \sqrt{\frac{g}{a}}$$

$$\nu = \frac{7}{2 \times 22} \sqrt{\frac{980}{1}} = 4.9 \text{ s}^{-1} = 5 \text{ Hz}$$

36. (a): Here, $\nu = 800 \text{ Hz}$, $v_s = 30 \text{ m/s}$, $v = 300 \text{ m/s}$.
As the source is going away from the stationary observer, therefore,

$$\nu' = \frac{\nu \times v}{v + v_s} = \frac{300 \times 800}{300 + 30} = \frac{300 \times 800}{330} = 727.3 \text{ Hz.}$$

37. (b): Pressure and stress both have the dimensions of force/area. Strain and angle are both dimensionless. Energy and work have the same dimensions force \times distance.

Tension and surface tension refer to two different physical quantities and their dimensions are different. Tension is a force and surface tension is force per unit length.

38. (b): In the other graphs, at a particular time more than one velocity is shown which is not possible in realistic situation.

39. (b) : Surface tension, $S = \frac{\text{work done}}{\text{increase in area}}$

As the soap film has two surfaces.

$$S = \frac{3.0 \times 10^{-4} \text{ J}}{2 \times (10 \times 11 - 10 \times 6) \times 10^{-4} \text{ m}^2}$$

$$= 3 \times 10^{-2} \text{ N/m.}$$

40. (b) : $v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 19.6} = 19.6 \text{ m/s.}$

41. (a) : Both assertion and reason are true and reason is the correct explanation of assertion.

Assertion : Goggles have zero power. True

The focal length is given by $\frac{1}{f} = (\mu - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$.

For goggle lenses, both sides are curved the same way. R_1 and R_2 are positive. If they are the same,

$\frac{1}{f} = 0$ i.e. power is zero. Reason is also true and it is the explanation for the assertion.

42. (d) : Both the assertion and reason are false.

Fringe width $\beta = \frac{\lambda D}{d}$. This depends on the wavelength. Diffraction depends on the wavelength of light. Therefore if a white source of light is used, only the central fringe will be white. All the rest have different wavelengths and some orders will also overlap for different colours. Both the assertion and the reason are false because the fringe width is not independent of wavelength.

43. (b) : Both assertion and reason are true but reason is not the correct explanation of assertion.

The assertion is true. Even when the emf is switched off, the current continues to flow because its resistance becomes zero.

The Meissner effect is another property of the superconductor and not the reason for the assertion. Meissner effect repels the magnetic field lines from the interior of the superconductor. (b)

44. (c) : Assertion is true but reason is false.

The assertion is true because heavy - water is a better moderator than ordinary water. This is because heavy water absorbs fewer neutrons than normal water. The assertion is right. The reason is false.

45. (a) : Both assertion and reason are true and reason is the correct explanation of assertion.

Assertion is true. The reason is also true according to the classical theory of Maxwell. The dipole oscillation gives radiation because the charges are accelerated. (Any oscillation has acceleration).

46. (a) : Both assertion and reason are true and reason is the correct explanation of assertion.

NAND and NOR gates are treated as universal gates because all other basic gates AND gate OR gate and NOT gate can be constructed using only NAND gate (or NOR gate).

47. (a) : Both assertion and reason are true and reason is the correct explanation of assertion.

The assertion is true. From Curie Weiss law where the susceptibility $\chi = \frac{C}{(T - \theta_c)}$. If the temperature rises above the Curie temperature θ_c , ferromagnetic materials become paramagnetic materials because the domains get destroyed as stated.

48. (a) : Both assertion and reason are true and reason is the correct explanation of assertion.

Both the assertion and reason are true and the reason is the correct explanation. It is because the charges are only at the surface of a conductor; the charge enclosed in the Gaussian surface in the cavity is zero. The field is therefore zero.

49. (a) : Both assertion and reason are true and reason is the correct explanation of assertion.

A voltmeter is always connected in parallel. This has of course a large resistance. The assertion and reason are correct and it is the correct explanation.

50. (d) : Both the assertion and reason are false.

Both the assertion and reason are false. Ohms law is obeyed by metals for a certain range of temperature, not obeyed by superconductors, valves, diodes and semiconductors. It is not a universal law but it is purely empirical.

51. (c) : Assertion is true but reason is false.

Assertion is true. When a capacitor is connected to an a.c. circuit, $\epsilon_{rms} = i_{rms} \left(\frac{1}{C\omega} \right)$ where $\frac{1}{C\omega}$ is

the impedance due to capacitive resistance. The power consumed in this circuit is zero because the phase difference ϕ between *emf* and current in a pure capacitance a.c. circuit is $\frac{\pi}{2}$. Power factor $\cos \phi = 0$. It is only for d.c. that a current does not flow. Reason is false.

52. (c) : Assertion is true but reason is false.

Assertion is correct in the sense that the free electrons occupy a single energy band. But a band has a distribution of energy. One can treat assertion as correct. But the reason is false because electrons in a metal follow Pauli's exclusion principle. It is because of this, one has different bands. Therefore the answer is (c).

53. (a) : Both assertion and reason are true and reason is the correct explanation of assertion.

Optical fibers are used in communication and it is because the phenomenon of total internal reflection, taking place inside the fiber for the signal incident. Both the statements are correct and the reason given is the right explanation.

54. (d) : Both the assertion and reason are false.

A hollow metallic container with a small orifice and coated with lamp black inside is taken as a source of black-body radiation when it is heated. A closed container cannot act as a source of blackbody because it cannot absorb all radiations. All metals are not black bodies. A black body is described above. It is the hole that absorbs and emits the radiation, which is treated as a black body and not even the whole container.

Assertion is only partially correct. The statement given in the reason is wrong.

55. (a) : Both assertion and reason are true and reason is the correct explanation of assertion.

Both the assertion and the reason are correct. Special lubricants have to be used at low temperature.

56. (b) : Both assertion and reason are true but reason is not the correct explanation of assertion

Both the statements of assertion and the reason

are correct. They are independent statements. The statement given in the reason is not the reason for the weightlessness of the astronaut. The centripetal and centrifugal forces cancel out. In the case of free fall, the pseudo acceleration, g acts upwards. The body does not feel it. But all the same it will fall down to the earth. His mind which feels, is riding the lift of his body. The body is falling down with acceleration g . In the first case, the force of acceleration due to gravity is cancelled by the centrifugal force acting outwards. Both the statements are correct but the reason given is not the reason for the assertion.

57. (a) : Both assertion and reason are true and reason is the correct explanation of assertion.

Both the assertion and reason are correct because the conducting brass tumbler absorbs heat from the body. The hand feels cold when the tumbler is touched.

58. (a) : Both assertion and reason are true and reason is the correct explanation of assertion.

59. (a) : Both assertion and reason are true and reason is the correct explanation of assertion.

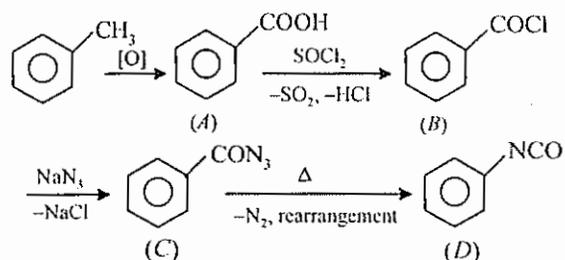
^{94}Sr from ^{235}U fission is absorbed through milk. Their emission of β^- particles will damage the bone-marrow as Sr is absorbed in bones.

60. (b) : Both assertion and reason are true but reason is not the correct explanation of assertion.

Both the assertion and reason are correct statements but the reason given is not the explanation for the assertion.

CHEMISTRY

61. (c) :



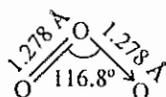
62. (b) : The number of nearest neighbour with which a given sphere is in contact is called coordination number. The C.N. in *hcp* and *ccp* arrangement is 12..

63. (a) : $2\text{CuSO}_4 + 4\text{KCN} \rightarrow (\text{CN})_2 + 2\text{CuCN} + 2\text{K}_2\text{SO}_4$
On combining solution of copper (II) salts and cyanides, an unstable copper (III) cyanide is formed which rapidly decomposes into copper (I) cyanide and cyanogen.

64. (b) : $\text{NaOH} + \text{CH}_3\text{COOH}$ forms CH_3COONa which gives basic solution with $\text{pH} > 7$.

65. (b) : There are several types of van der Waals attraction : dipole/dipole, dipole/induced-dipole and spontaneous-dipole/induced-dipole. The spontaneous-dipole/induced-dipole attractions are also known as *London dispersion forces*. LDF are surprisingly strong but are only short range forces *e.g.* surface of neutral molecules or inert gases. All molecules have LDF and strength increases with the size/surface area of the molecule. In case of halogens, LDF increases as $\text{F}_2 < \text{Cl}_2 < \text{Br}_2 < \text{I}_2$.

66. (a) : Ozone molecule is V-shaped with O - O bond length 1.278 Å.



The bond length is intermediate between that for a single bond (1.48 Å as in H_2O_2) and for a double bond (1.21 Å as in O_2).

Also, bond order $\propto \frac{1}{\text{bond length}}$

Hence, $\text{O}_2 < \text{O}_2^{2-}$.

67. (b) : Atomic as well as ionic radii increases from Li to Fr due to the presence of one extra shell of electron.

	Li	Na	K	Rb	Cs
Metallic radii (pm)	152	186	227	248	265

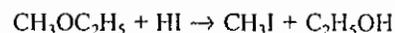
68. (d) : Bond dissociation energy increases in the order.
 $\text{HI} < \text{HBr} < \text{HCl} < \text{HF}$

HF is most stable halogen acid and HI is the least. Higher the bond dissociation energy, lower is the degree of ionisation.

As we know $\Delta T_b = ik_b m$.

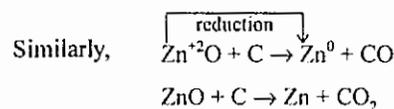
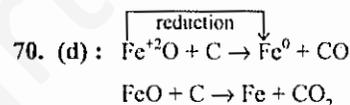
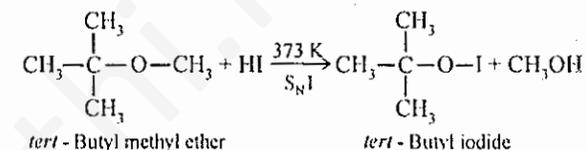
Hence ΔT_b value is largest in HI . All colligative properties depend on number of particles.

69. (a) : When mixed ethers are used, the alkyl iodide produced depends on the nature of alkyl groups. If one group is Me and the other a *pri*- or *sec*-alkyl group, then methyl iodide is produced. Here reaction occurs via $\text{S}_{\text{N}}2$ mechanism and because of the steric effect of the larger group, I^- attacks the smaller (Me) group.

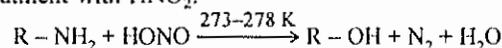


When the substrate is a methyl *t*-alkyl ether, the products are *t*-RI and MeOH. Here reaction occurs by $\text{S}_{\text{N}}1$ mechanism and formation of products is controlled by the stability of carbocation. Since carbocation stability order is $3^\circ > 2^\circ > 1^\circ > \overset{\oplus}{\text{C}}\text{H}_3$.

\therefore Alkyl halide is always derived from *tert*-alkyl group.



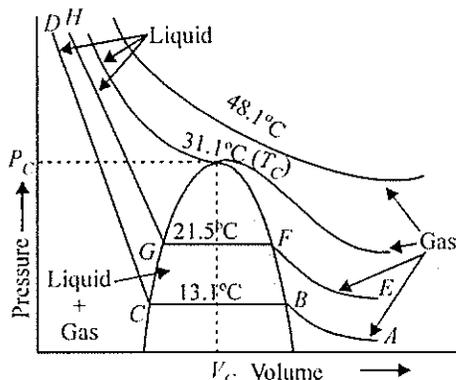
71. (d) : All aliphatic primary amines liberate N_2 gas on treatment with HNO_2 .



Since no other class of amines liberate N_2 gas on treatment with HNO_2 , this reaction is used as a test for aliphatic primary amines.

72. (c) : In certain nucleus, the nucleus captures an electron from the *K*-shell (being nearest to the nucleus). The vacancy created is filled up with the electron from the higher shells thereby emitting X-rays. As a result of *K*-electron capture, a proton in the nucleus is converted into a neutron ($p^+ + e^- \rightarrow n$).

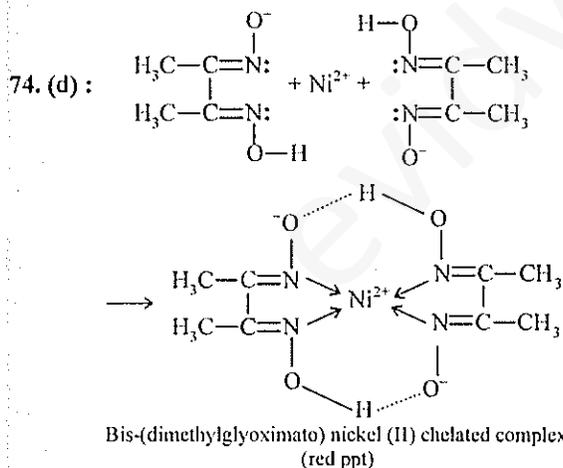
73. (c):



From the graph, at point A, CO_2 exists as a gas, As pressure is increased, the volume of the gas decreases along the curve AB. At B liquefaction of the gas starts. Hence, volume decreases rapidly along BC because liquid has much less volume than the gas. At point C, liquefaction is complete.

Amount of gas decreased = Amount of liquid formed or increased.

Because along horizontal line, gas converts into liquid.



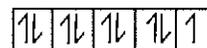
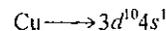
This planar complex is very poorly soluble and is used for the gravimetric determination of nickel e.g. ores.

75. (a): Critical temperature of gas may be defined as that temperature above which it cannot be liquefied how so ever high pressure may be applied on the gas.

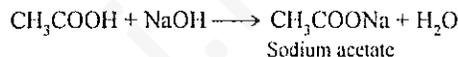
$$\text{As we know, } T_c = \frac{8a}{27Rb}$$

where a = van der Waal's constant which is a measure of intermolecular forces of attraction. Greater the value of a more easily the gas can be liquefied and hence larger T_c mean larger the value of a .

76. (c): In presence of either strong field or weak field, the number of unpaired electron remains the same in case of Cu^{2+} ion.

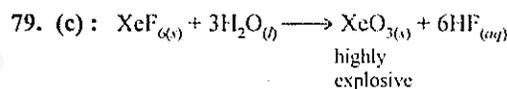


77. (a): In any type of acid-base titration, there is a sudden change in the pH value at the end point. During the titration of a weak acid with a strong base, beyond the equivalent point, the solution will contain the salt and excess of free base.



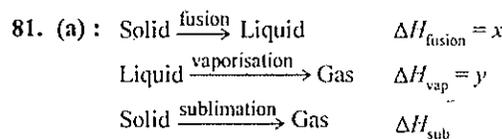
Due to the presence of free base, solution becomes alkaline in nature.

78. (d): Radiation (γ -rays) emitted by the radioactive substances (${}_{27}\text{Co}^{60}$) destroys the cells. Hence, it is used in treatment of cancer in which the malignant cells are wiped out.



80. (b): $\Delta H = \Delta E + P\Delta V$

$$\begin{aligned}
 \Delta E &= \Delta H - P\Delta V = -92.2 - 40 \times (-1) \times 101 \times 10^{-3} \\
 &= -92.2 + 4.04 = -88.16 \text{ kJ} \approx -88 \text{ kJ.}
 \end{aligned}$$



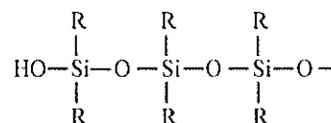
$$\text{So, } \Delta H_{\text{sub}} = \Delta H_{\text{fusion}} + \Delta H_{\text{vap}}, \Delta H_{\text{sub}} = x + y.$$

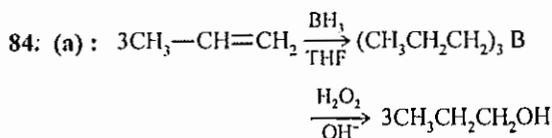
$$\text{82. (a): } 1 \xrightarrow{t_{1/2}} \frac{1}{2} \xrightarrow{t_{1/2}} \frac{1}{4} \xrightarrow{t_{1/2}} \frac{1}{8} \xrightarrow{t_{1/2}} \frac{1}{16}$$

$$\text{So, } t_{1/16} = 4t_{1/2}$$

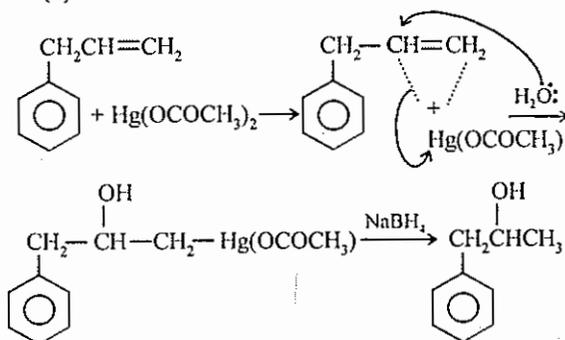
$$= 4 \times \frac{0.693}{\lambda} = 4 \times \frac{0.693}{69.3} = 4 \times 10^{-2} \text{ sec.}$$

83. (b): R_2SiO^- is the repeating unit in silicone.

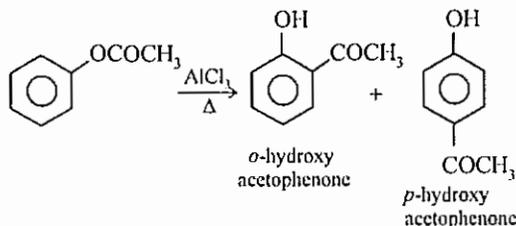




85. (a) :

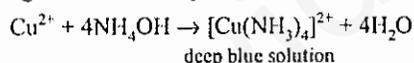


86. (c) : This reaction is Fries rearrangement -



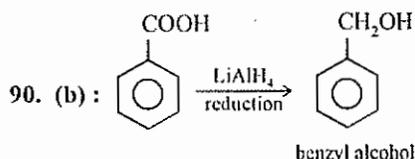
87. (a) : Oxygen is the most abundant element in the earth's crust. (above 45.5 wt %)

88. (b) : When NH_4OH is added to the solution containing Cu^{2+} ions, deep blue solution is obtained.



Hydrated cupric compounds absorb radiations corresponding to red light and the transmitted colour is greenish blue (which is complementary to red colour). Thus, cupric compounds give greenish-blue colour.

89. (b)



91. (a) : A substance that is able to cause a chain transfer in a chain polymerisation is called a chain transfer agent.

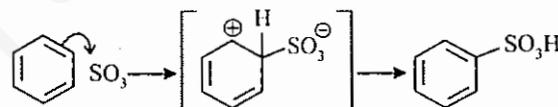
It gives an atom to the radical at the growing end of a polymer chain and in doing so it results into a radical which can start the growth of a new chain. CCl_4 is a chain transfer reagent.

92. (d) : Tricalcium aluminate $3\text{CaO} \cdot \text{Al}_2\text{O}_3$ - Calcium aluminate cements are hydraulic cements made primarily from limestone and bauxite. They are well adapted for use in refractory (high temperature resistant) concretes. e.g. furnace linings.

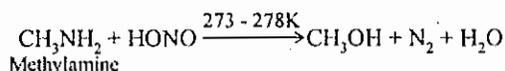
93. (b) : A substance which increases the speed of a reaction without being consumed in the reaction is called a catalyst. Catalyst reduces the height of barrier by providing an alternative path for the reaction and lowers the activation energy.

94. (c) : Only HF_2^- has H-bonding $[\text{F}-\text{H} \cdots \text{F}]^-$ rest all the molecules have coordinate bonds.

95. (b) : Most electrophilic substitution reactions are irreversible but sulphonation is an exception. Treatment of benzene with "oleum" (a solution of SO_3 in conc. sulphuric acid) will give the sulphonic acid, the electrophile is sulphur trioxide (SO_3).



96. (c) : Aliphatic 1° amines react with cold nitrous acid to give alcohols with quantitative evolution of N_2 gas.



This reaction is used as a test for aliphatic primary amines.

97. (d) : In exothermic processes, heat released by the reaction increases the entropy of the surrounding. The overall entropy change is certainly positive when the entropy of the system is positive. In some exothermic reactions, entropy of the system may decrease. If reaction is highly exothermic and increase in entropy of the surroundings is very high, the total entropy change will be positive and the reaction will be spontaneous.

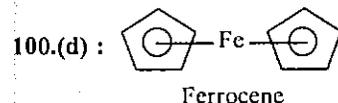
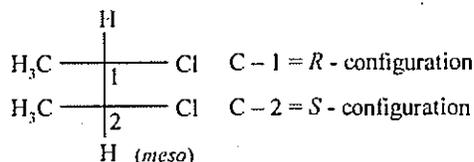
98. (c) : $P_A^\circ = 0.850 \text{ bar}$, $P_S = 0.845 \text{ bar}$
 $w = 0.5 \text{ g}$, $m = ?$
 weight of solvent (benzene) = 39.0 g
 and molecular weight of benzene = 78 g

As we know, $\frac{P_A^o - P_S}{P_A^o} = x_B = \frac{n_B}{n_A}$

$$\frac{0.850 - 0.845}{0.850} = \frac{\frac{w_B}{M_B}}{\frac{w_A}{M_A}} = \frac{0.5}{\frac{m}{78}}$$

On solving, we get
molecular mass of solid structure (m) = 170 g.

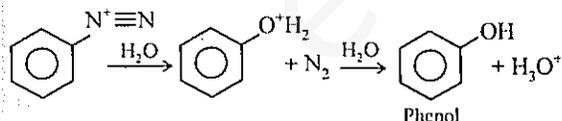
99. (c) : Due to internal compensation, this compound is strictly inactive.



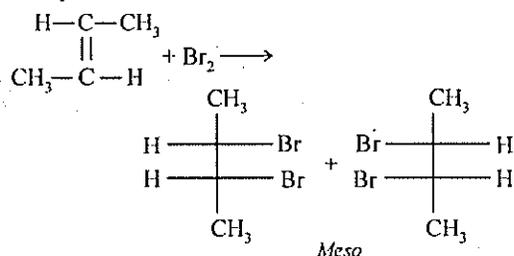
101.(a) : Electropositive elements like zinc precipitate copper from a solution of copper sulphate and finally forms a complex.



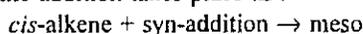
102.(b) : This is the substitution or replacement reaction of benzene diazonium salt, where nitrogen is lost as N_2 and different groups are introduced in its place.



103.(d) : With *trans*-but-2-ene, the product of Br_2 addition is optically inactive due to the formation of symmetric *meso* compounds.



In general, for symmetrical alkenes and symmetrical reagents, the addition takes place as :



trans-alkene + *syn*-addition \rightarrow racemic
cis-alkene + *anti*-addition \rightarrow racemic
trans-alkene + *anti*-addition \rightarrow meso

104.(c) : Oxygen is a colourless, odourless and tasteless gas. It is paramagnetic in gaseous, liquid and solid states. It can be liquefied to a pale blue liquid by compressing the gas at a very low temperature. Its allotropic modification is ozone.

105.(a) : The orange colour of SnI_4 is caused by the absorption of blue light, the reflected light thus containing a higher proportion of red and orange. The energy absorbed in this way causes the transfer of an electron from I to Sn. Since transferring an electron to another atom is transferring a charge, such spectra are called charge transfer spectra.

106.(a) : Weaker bases are good leaving groups. Hence, the acyl derivatives with weaker bases as leaving groups can easily rupture the bond and are more reactive. Cl^- is the weakest base while NH_2^- is the strongest base. The correct order of basicity of the leaving group and their tendency to leave is $\text{H}_2\text{N}^- > \text{RO}^- > \text{RCOO}^- > \text{Cl}^-$

107.(a) : The magnetic moment of transition elements may be calculated from the equation :

$$\mu_{S+L} = \sqrt{4S(S+1) + L(L+1)}$$

S = resultant spin quantum number

L = resultant orbital momentum quantum number

$$\mu = g\sqrt{J(J+1)}$$

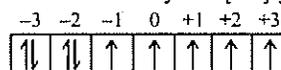
$$\text{where } g = \frac{3}{2} + \frac{S(S+1) - L(L+1)}{2J(J+1)}$$

we know, $J = L - S$ when the shell is less than half full.

$J = L + S$ when it is more than half full.

Electronic configuration of Dy = $[\text{Xe}]4f^{10}6s^2$

$$\text{Dy}^{3+} = [\text{Xe}]4f^9$$



Here $S = 5/2$ (since there are five unpaired electron)

$$L = -1 \times 1 + 0 \times 1 + 1 \times 1 + 2 \times 1 + 3 \times 1 = 5$$

$$\text{So, } J = L + S = 15/2$$

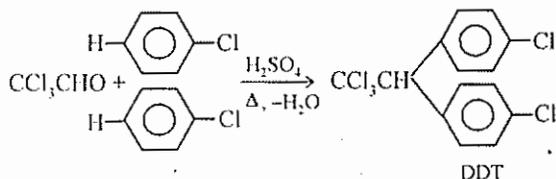
$$\text{Now, } g = \frac{3}{2} + \frac{35/4 - 30}{2 \times \frac{15}{2} \times \frac{17}{2}} = 1.334$$

$$\mu = g\sqrt{J(J+1)} = 10.65 \text{ BM}$$

Thus calculated value of magnetic moment of Dy is the highest among the lanthanoid.

108.(a) : C—O bond in metal carbonyl is long as ligated CO has lower bond order. The lower B.O. is due to the transfer of metal $d\pi$ electrons into the π^* orbitals of ligated CO.

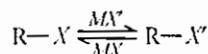
109.(c) : When chlorobenzene is heated with chloral in the presence of conc. H_2SO_4 , a powerful insecticide, DDT is formed with the elimination of water molecule.



110.(d) : CH_3COOH/CH_3COONH_4 is not an example of acidic buffer. Acidic buffer contains equimolar mixture of weak acid and its salt with strong base.

e.g. CH_3COOH/CH_3COONa .

111.(c) : This is Finkelstein reaction which involves the conversion of an alkyl chloride/bromide to an alkyl iodide by the addition of sodium iodide in acetone. Because sodium iodide is soluble in acetone and NaCl and NaBr are not, the equilibrium is shifted by the precipitation of insoluble salt.



The equilibrium position of the reaction depends on the nucleophilicity of the anion, whether a good leaving group is present and whether one anion is better stabilised than the other in a given solvent.

112.(c) : Chlorine has high electron affinity than fluorine. The less negative electron gain enthalpy of fluorine as compared to chlorine is due to very small size of the fluorine atom.

113.(a) : $HC \equiv CH + NaNH_2 \xrightarrow{\text{Ether}} HC \equiv C^-Na^+ + NH_3$
C—H bond is strongly polar due to high electronegativity of carbon atom. Hence it gives H^+ ion on reacting with a base or acetylene behaves as an acid.

114.(c) : In thermodynamic terms, formation of solution occurs with a favourable change in free energy

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

where ΔH has a small positive value and $T\Delta S$ a large positive value; thus ΔG is negative.

115.(a) : NH_2-CH_2-COOH is a typical α -amino acid. In solution it exists as, internal salt or Zwitter ion,
 $(^+NH_3-CH_2-COO^-)$

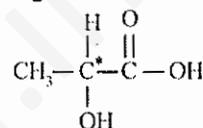
because the proton (H^+) of COOH group is captured by $-NH_2$ group as NH_2 has a lone pair of electrons on N atom.

116.(a) : Rate expression $\frac{dx}{dt} = k[A]^m[B]^n$ shows that the total order of reactions is $m + n + 0 = m + n$ as the rate of reaction is independent of concentration of C, i.e., the order with respect to C is zero. This is the reason that C does not figure in the rate expression.

117.(b) : Bond order of $N_2 = 3$, bond order of $O_2 = 2$. 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. Higher bond order of N_2 shows its shorter bond length.

118.(d) : 2-Hydroxy propanoic acid is known as lactic acid. It has following structure—



It has no carbon-carbon double bond and hence cannot show geometrical isomerism. However, it shows optical isomerism due to the presence of a chiral carbon atom.

119.(c) : The equilibrium constant is always fixed and is a characteristic of a reaction at specified temperature. It defines the composition of the final equilibrium mixture of that reaction, regardless of the starting amount of reactants and products.

120.(a) : The loss of one α -particle will reduce the mass number by four and atomic number by two. Subsequent two β -emissions will increase the atomic number by two without affecting the mass number. Hence, the new element will be only an isotope of the parent nucleide and hence its position in the periodic table remains unchanged.

BIOLOGY

121.(c) : Glaucoma is a condition in which loss of vision occurs because of an abnormally high pressure in the eye. In most cases there is no other ocular disease. This is known as primary glaucoma and there are two pathologically distinct types- acute and chronic simple. In acute (or angle-closure) glaucoma, there is an abrupt rise in pressure due to sudden closure of the angle between the cornea and iris where aqueous humour

usually drains from the eye. This is accompanied by pain and marked blurring of vision associated with inflammation of the anterior segment. In the more common chronic simple (or open-angle) glaucoma, the pressure increases gradually, usually without producing pain, and the visual loss is insidious. The same type of visual loss may rarely occur in eyes with a normal pressure, this is called low-tension glaucoma.

Hepatitis is an inflammation of the liver caused by viruses, toxic substances or immunological abnormalities. Measles (Rubeola disease) is an acute infectious eruptive viral disease of childhood (3-5 years old) caused by specific virus of the group myxoviruses. Basically it is caused by an RNA containing *Rubeola virus/Polynosa morbillorum*. Measles is the infection of respiratory tract and conjunctiva which is transmitted by contact, fomite and droplet methods. Bronchitis is the inflammation of the bronchi.

122.(c) : Night blindness is the inability to see in dim light or at night. It is due to disorder of the cells in the retina that are responsible for vision in dim light and can result from dietary deficiency of vitamin A (retinol).

Name	Sources	Effect of deficiency
Vit. C (Ascorbic acid)	Lemon, orange and other citrus fruits, tomatoes, green vegetables, potatoes, carrots, pepper etc.	Scurvy (also called <i>sailor's disease</i>) is characterised by wound - healing and growth retardation etc.
Vit. D (Ergocalciferol and Cholecalciferol)	Synthesized in skin cells in sunlight from 7-dehydrocholesterol (<i>i.e.</i> provitamin D ₃), also found in butter, liver, kidneys, egg yolk, fish, oil, etc.	Rickets , a disorder of children of 6 months to 2 years, and osteomalacia , a disorder of adults.
Vit. E (Tocopherol)	Green vegetables, oils, egg yolk, wheat, animal tissues	Reversible sterility in female. In male causes atrophy of spermatogenic tubules of testes.

123.(d) : Sucrose (cane sugar; beet sugar; saccharose) is a sugar comprising one molecule of glucose linked to a fructose molecule. It occurs widely in plants and is particularly abundant in sugar cane and sugar beet (15-20%), from which it is extracted and refined for table

sugar. If heated to 200°C, sucrose becomes caramel. Sucrose is broken down into the monosaccharides glucose and fructose with the help of carbohydrate digesting enzyme, invertase, produced in the small intestine (duodenum).

124.(d) : Lamprey (or *Petromyzon*) belongs to class cyclostomata. The lamprey has about 1 m. long greenish brown, cylindrical body with smooth, scaleless, slimy skin; anterior circular, jawless mouth; a single dorsal naris; seven pairs of circular gill slits; 2 dorsal fins and a tail fin. Its life cycle includes two quite different phases. The larval phase (called ammocoete) is a fresh water sedentary, filter feeding and microphagus creature reminiscent of the lancelet. The fish like adult lives in the sea and is parasitic on fishes.

125.(a) : The black pigment in the eye, which reduces the internal reflection is known as retina. It is the inner most coat of the eyeball and it is a thin, light sensitive nervous layer. The external coat of the eyeball is known as sclerotic but in front of the sclerotic, there is a transparent connective tissue called cornea. Iris is the pigmented part present in front of choroid.

126.(a) : Oxytocin is a hormone that causes both contraction of smooth muscle in the uterus during birth and expulsion of milk from the mammary glands during suckling. Oxytocin is produced in the neurosecretory cells of the hypothalamus but is stored and secreted by the posterior pituitary gland. Glucagon is a hormone, secreted by the α (or A) cells of the islets of Langerhans in the pancreas, that increases the concentration of glucose in the blood by stimulating the metabolic breakdown of glycogen. It thus antagonizes the effects of insulin. Adrenaline (epinephrine) is a hormone produced by the medulla of the adrenal glands, that increases heart activity, improves the power and prolongs the action of muscles, and increases the rate and depth of breathing to prepare the body for 'fright, flight, or fight'. At the same time it inhibits digestion and excretion. Thyroxine is secreted by thyroid gland. It controls the rate of all metabolic processes in the body and influence physical development and activity of the nervous system.

127.(c) : Refer answer 126

128.(b) : Hyaluronidase is a hydrolytic enzyme present in the acrosome of sperm. It lyses the glycosaminoglycans in the extracellular matrix holding the cell of the corona

radiata together. As the coronal cells become more loosely associated, sperm cells can propel themselves inward, toward the zona pellucida by making a receptive cone or fertilization cone through the cytoplasm of the egg. Hyaluronidase may also be involved in breaking down the zona pellucida.

Fertilizin is a chemical substance secreted from the cortical region of egg cytoplasm to attract the sperm towards the egg. Acrosin is released from the acrosome of a spermatozoa as a consequence of the acrosome reaction. Capacitation is the final stage in the maturation process of spermatozoa. This takes place inside the genital tract as the sperm penetrates the ovum.

129.(c) : Reproduction is an essential feature of all living organisms. It is the process by which an individual multiplies in number by producing more individuals of its own type. It maintains the continuity of race by replacing old dying members and helps in increasing the total number of individuals. *Amoeba proteus* does not reproduce sexually. The reproduction is essentially asexually and takes place by various methods such as binary fission, multiple fission and sporulation. Binary fission is the most common mode of reproduction. It results in the division of the parent *Amoeba* into two daughter amoebae. *Amoeba* reproduces by multiple fission during adverse environmental conditions. The animal secretes a three-layered protective, chitinous cyst around it and becomes inactive. Inside the cyst, the nucleus repeatedly divides to form several daughter nuclei, which arrange themselves near the periphery. When favourable conditions arrive, the cyst breaks off liberating the young pseudopodiospores, each with fine pseudopodia. They feed and grow rapidly to become adults and lead an independent life.

Form of reproduction present in the following animals are –

- Euglena* – Longitudinal binary fission
- Paramecium* – Transverse binary fission
- Plasmodium* – Multiple fission

130.(c) : Temporal lobe is one of the main divisions of the cerebral cortex in each hemisphere of the brain, lying at the side within the temple of the skull and separated from the frontal lobe by a cleft, the lateral sulcus. Areas of the cortex in this lobe are concerned with the appreciation of sound and spoken language.

131.(a) : Emphysema means air in the tissues. In pulmonary emphysema the air sacs (alveoli) of the lungs are enlarged and damaged, which reduces the surface area for the exchange of oxygen and carbon dioxide. Severe emphysema causes breathlessness, which is made worse by infections. Pneumonia is inflammation of the lung caused by bacteria, in which the air sacs (alveoli) become filled with inflammatory cells and the lung becomes solid. The symptoms include those of any infection (fever, malaise, headaches, etc.), together with cough and chest pain. Silicosis, a lung disease, is a form of pneumoconiosis produced by inhaling silica dust particles. It affects workers in hard-rock mining and tunnelling, quarrying, stone dressing, sand blasting, and boiler scaling. Silica stimulates fibrosis of lung tissue, which produces progressive breathlessness and considerably increased susceptibility to tuberculosis. Asthma is the condition of subjects with widespread narrowing of the bronchial airways, which changes in severity over short periods of time (either spontaneously or under treatment) and leads to cough, wheezing, and difficulty in breathing.

132.(d) : Scapula (shoulder blade) is the largest of the bones that make up each half of the pectoral (shoulder) girdle. It is a flat triangular bone, providing anchorage for the muscles of the forelimb and an articulation for the humerus at the glenoid cavity. It is joined to the clavicle (collar bone) in front. Clavicle is a bone that forms part of the pectoral (shoulder) girdle, linking the scapula (shoulder blade) to the sternum (breast bone). In humans it forms the collar bone and serves as a brace for the shoulders. Humerus is the long bone of the upper arm which articulates with the scapula (shoulder blade) at the glenoid cavity and with the ulna and radius (via a condyle) at the elbow. Ilium is the largest of the three bones that make up each half of the pelvic girdle. The ilium bears a flattened wing of bone that is attached by ligaments to the sacrum.

133.(a) : Humans, or human beings, are bipedal primates belonging to the mammalian species *Homo sapiens* (Latin "wise man" or "knowing man") in the family Hominidae (the great apes). It includes both archaic and modern humans, as well as the subspecies *Homo sapiens neanderthalensis*, also known as the Neanderthals. *Homo sapiens* first started appearing about 500,000 or fewer years ago.

134.(a) : Rudolf Virchow was the first to suggest that new cells are formed from the division of the pre-existing cells - *omnis-cellula-e-cellula* (every cell is derived from a cell). Robert Hooke was the first to coin the term "cell" for small structures in a piece of cork under a microscope. His observations were published in a book named *micrographia*. Leeuwenhoek was the first person to observe and describe microscopic organisms and living cell. He observed nucleus in RBC of salmon fish and used simple lens and observed nuclei and unicellular organisms including bacteria. In 1676, he described the bacteria and gave the term *animalcules*. His observations laid the foundations for the science of bacteriology and microbiology. Robert Brown (1831) described and named nucleus.

135.(a) : Turner's syndrome is characterised by the monosomy of XO type. It is characterized by a lack of ovaries and menstrual cycle. Affected women are sterile and lack secondary sexual characteristics, although the external genitalia are present. The syndrome is named after the US endocrinologist H. H. Turner (1892-1970), who first described it.

Down's syndrome is a congenital form of mental retardation due to a chromosome defect in which there are three copies of chromosome no. 21 instead of the usual two. The affected individual has a short broad face and slanted eyes (as in the Mongolian races), short fingers, and weak muscles. Down's syndrome can be detected before birth by amniocentesis. It is named after the British physician John Down (1828-96), who first studied the incidence of the disorder. Klinefelter's syndrome is characterised by trisomy (XXY). These are male individuals, who are phenotypically fairly normal but have a fairly low sperm count and therefore sterile.

136.(d) : Heparin prevents blood coagulation in the blood vessels. It is secreted by mast cells. It is an anticoagulant, blocking conversion of prothrombin to thrombin. Haemoglobin is the blood pigment necessary for oxygen transport. Plasma is the component of blood. Thrombin is the product of blood clotting.

137.(a) : Wings of pigeon, mosquito and bat show divergent evolution. It is the evolutionary process resulting in dissimilarity in structural features of organisms that occupy similar habitat.

Atavism is the regaining of same structures after a certain

gap of few generations. Convergent evolution is the development of superficially similar structures in unrelated organisms, usually because the organisms live in the same kind of environment. Examples are the wings of insects and birds and the streamlined bodies of whales and fish.

138.(d) : Endoplasmic reticulum functions as cytoskeleton or intracellular and ultrastructural skeletal framework by providing mechanical support to colloidal cytoplasmic matrix. Proteins and enzymes synthesized by ribosomes enter the channels of rough endoplasmic reticulum both for intracellular use as well as extracellular transport.

139.(a) : Thickening of arteries due to cholesterol deposition is arteriosclerosis. This is extremely widespread disease predisposes to myocardial infarction, cerebral thrombosis, and other serious illness. It is characterized by infiltration of cholesterol and appearance of foam cells in certain lesions of the arterial wall, distorting the vessels and making them rigid.

140.(a) : An example of competitive inhibition of an enzyme is the inhibition of succinic dehydrogenase by malonic acid. It is the simple type of competitive inhibition. A competitive inhibitor resembles the substrate and binds to the active site of the enzyme. The substrate is then prevented from binding to the same active site.

141.(a) : During glycolysis 1 molecule of glucose is converted to 2 molecules of pyruvic acid in the cytoplasm. These two molecules of pyruvic acid is then converted to acetyl CoA by decarboxylation. This acetyl CoA is the connecting link between glycolysis and Krebs cycle. Acetyl CoA thus formed participates in Krebs cycle and combines with oxalo acetic acid to form citric acid.

142.(c) : Lactose or milk sugar (carbohydrate) is reducing sugar formed through β -1-4 condensation between galactose and glucose. Lactose does not occur in nature except as a product of the mammary gland. It is highest in human milk as compared to that of cow, buffalo and goat.

143.(b) : Light is the visible part of electromagnetic radiations. Sunlight or solar radiations reaching the earth have wavelength between 300 nm to 2600 nm. Part of the spectrum used in photosynthesis has a wavelength between 400-700 nm. It is called photosynthetically active radiations (PAR).

144.(a) : Nitrogen containing organic ring compounds are present in the nucleotides of nucleic acid. They are of two types two ringed nitrogenous compounds eg., adenine and guanine. Purines are 9-membered double rings and each has four N-atoms at 1', 3', 7' and 9' positions. Pyrimidines are single ringed nitrogenous compounds eg., cytosine and thymine. A pyrimidine has two N-atoms at 1' and 3' positions.

145.(b) : Community and ecosystem diversity is of three types α , β and γ . β -diversity (β index diversity between community diversity) is a biodiversity which appears in a range of communities due to replacement of species with the change in community habitat due to presence of different microhabitats, niches and difference in environmental conditions.

146.(b) : Citrus canker is a bacterial disease. It is caused by bacteria *Xanthomonas citri* which is aerobic, rod shaped and monotrichous. It is a world wide disease of most *Citrus* plants but the most susceptible are grape fruits, sweet orange, lime and lemon. The symptoms first appear on the undersurface of leaves as small watery slightly raised, round light green spots that finally rupture to form corky crater like lesions or canker. Twigs, fruits, also develop lesions. The disease reduces the quantity and quality of fruits.

Powdery mildew is caused by *Erysiphe* sp, red rot of sugarcane by *Colletotrichum falcatum* and wilt disease by *Fusarium* sp. Thus, they are all fungal diseases.

147.(d) : Water is mainly absorbed by roots which goes upwards so as to replace water loss in transpiration and to be used in photosynthesis. This upward movement of water from roots to leaves through stem against force of gravity is called ascent of sap. Different theories have been put forward in support of ascent of sap. They include root pressure theory, capillary theory and transpiration pull theory. Root pressure is developed when rate of absorption is more than rate of transpiration and so water is pushed up in the tracheary elements. Capillary force theory was given by Boehm according to which xylem vessels act as minute capillaries and water rises in these capillaries due to capillary action or surface tension. According to transpiration pull theory by Dixon and Jolly, due to water loss by transpiration suction pressure is increased and water is absorbed from adjacent xylem vessels of leaves and thus sap in under tension.

148.(b) : Plants require nutrients for proper growth and development. 16 elements are necessary for plants and

are called essential elements as C, H, O, N, P, S, K, Mg, Ca, Fe, Cu, B, Zn, Mn, Mo and Cl. These essential elements are categorised into 2 groups as macro elements and micro elements. Macro elements are required by plants in larger amounts eg., C, H, O, N, S, P, K, Ca, Mg. Microelements or trace elements are required by plants in very small amounts ie in traces eg., Fe, Cu, B, Mn, Mo and Cl.

149.(c) : Some epiphytes eg., orchids have aerial roots. In these roots, the outer covering is made up of a spongy tissue called velamen which absorbs moisture from the air. Thus, the aerial plant can prepare food by photosynthesis.

150.(c) : Solution culture is being used for raising flowers and vegetables at home. This soilless production of plants is called hydroponics (Gk. *hydor* – water, *ponas* – excretion) Plants are raised in small tanks of concrete or metal; The tanks are covered over by wire netting or gauze. They are filled up with a water solution containing appropriate quantities of all mineral elements. The solution is changed from time to time. There is a mechanism for aeration and circulation. pH is checked and corrections are made regularly. Iron is added as Fe-EDTA otherwise it gets precipitated, especially in alkaline pH. The agent which keeps metals in the soluble state is called chelating agent or ligand. EDTA (Ethylene diamine tetra-acetic acid) is one such agent. Fe-EDTA complex is called chelate. As soon as the plant enlarge they are tied to the roof of the chambers by means of strings. Hydroponics is useful in areas having thin, infertile and dry soils. They conserve water. Additionally hydroponics can regulate pH optimum for a particular crop, control soil borne pathogens, avoid problems of weeding and obtain consistently better yield.

151.(b) : Leghaemoglobin is a pinkish pigment present inside the root nodules of nitrogen fixing plants like legumes. It is an oxygen scavenger and is related to blood pigment haemoglobin. It protects nitrogen fixing enzyme nitrogenase from oxygen. The most important bacteria present inside the nodules is *Rhizobium*.

152.(c) : All the given options are hydrophytes in nature which grow in extremely wet or watery conditions. But among them only in *Ceratophyllum* roots are completely absent even in embryonic stage. They remain under water completely. *Nymphaea* is a rooted hydrophyte with floating leaves, *Vallisneria* is rooted submerged hydrophyte and *Sagittaria* is rooted emergent hydrophyte.

153.(b) : Composite fruits are multiple fruits which are

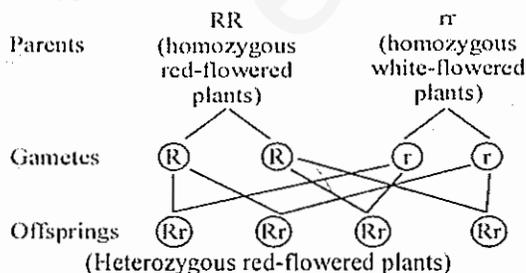
developed from the complete inflorescence and are also called as infructescence. They are of two types sorosis and syconus. Spike, spadix and catkin type of inflorescence gives rise to this type of fruit eg *Ananas*, *Artocarpus*. Syconus develops from a hypanthodium inflorescence eg *Ficus*.

154.(b) : Stratosphere zone of earth's atmosphere contains a layer of ozone (O_3) which prevents the earth surface from about 99% of incoming solar UV radiations. Ozone layer is present in the stratosphere which is also called ozonosphere. It lies at an altitude of 23-25 km over equator and its concentration is 300 dobsons.

155.(b) : Amphimixis is normal type of sexual reproduction having both meiosis and fertilization. But in some plants, the normal sexual reproduction is replaced by some abnormal type of sexual reproduction where there is no meiosis and syngamy. It is of two types vegetative reproduction and agamospermy. In vegetative reproduction plants develop from parts other than seeds. In agamospermy, plants produce seeds as means of propagation by abnormal method.

156.(c) : Cocoa or *Theobroma* belongs to family sterculiaceae, and is a native of tropical America for preparation of cocoa and chocolates, the seeds are used.

157.(d) : The red colour of flower dominates upon white colour of flower. In the present varieties both parents are of pure variety, therefore, the offsprings will be all heterozygous red flowered as shown below :



158.(a) : The phenomenon by which a gene suppresses the phenotypic expression of a nonallelic gene is called epistasis. The ratio for epistatic gene is 12 : 3 : 1 in F_2 generation. The alleles which do not show dominant recessive relationship and are able to express themselves independently when present together are called codominant alleles. Supplementary genes are a pair of nonallelic genes, one of which produces its effect independently in the dominant state while the dominant allele of the second gene is without any independent

effect but is able to modify the effect of the former to produce a new trait.

159.(c) : Pure line is true breeding genotypes, a line that has been rendered homozygous for all genes under consideration in successive generations, a line in which homozygous individuals produce only homozygous offspring like parents. Thus, pure line breed refers to homozygosity only.

160.(c) : Tropical rain forests are mainly found in central America, along Amazon and Orinoco rivers, South America, Congo river basin of Africa, Malagasy Republic and South east Asia including India. Diversity of life is so high that a hectare of the forest may have as many as 200 species of trees, 70% - 80% of all insects and 80 - 85% of all birds are known from tropical forests. Productivity of this biome is also very high and life is abundant. It has different varieties and number of plants and animals.

161.(c) : Assertion is true but reason is false.

Haemophilia (also known as bleeder disease) is an popular example of sex linked inheritance in human beings. Haemophilia is either of two hereditary disorders in which the blood clots very slowly, due to a deficiency of either of two coagulation factors – haemophilia A, due to deficiency of factor VIII (antihaemophilic factor); or haemophilia B, due to deficiency of factor IX (Christmas factor). The patient may experience prolonged bleeding following any injury or wound, and in severe cases there is spontaneous bleeding into muscles and joints. Haemophilia is controlled by a sex-linked gene, which means that it is almost exclusively restricted to males; women can carry the disease – and pass it on to their sons – without being affected themselves. The genes encoding factors VIII and IX have been used in gene therapy trials for haemophilia.

Mutation of a structural gene on chromosome 15 is the molecular basis of Marfan syndrome. This disease is due to dominant mutation resulting in the production of abnormal form of connective tissues and characteristic extreme looseness of joints.

162.(b) : Both assertion and reason are true but reason is not the correct explanation of assertion.

Astigmatism is a defect of vision in which the image of an object is distorted, usually in either the vertical or the horizontal axis, because not all the light rays come of a focus on the retina. Some parts of the object may be in

focus but light from other parts may be focused in front of or behind the retina. This is usually due to abnormal curvature of the cornea and/or lens whose surface resembles part of sphere. The defect can be corrected by wearing cylindrical lenses, which produce exactly the opposite degree of distortion and thus cancel out the distortion caused by the eye itself.

163.(b) : *Both assertion and reason are true but reason is not the correct explanation of assertion.*

Antigen is any substance that may be specifically bound by an antibody molecule. The antigens are mostly proteins, but can be polysaccharides, glycoproteins or other types of conjugated proteins, nucleic acid or such chemicals. Each antigen has many antigenic determinants (called epitopes) of the antigen. As each antibody binds with 2 or more such determinants, the one antigen can bind with many antibodies. In order to generate antibodies specific for small molecules, the latter are attached to a larger molecule before immunization. The number of different antigens recognized by lymphocytes in the body is extremely large. The recognition ability is innate and develops without exposure to the antigen. Stem cells differentiate into many million different T and B lymphocytes, each with the ability to respond to a particular antigen. When the antigen first enters the body, it can bind directly to the appropriate receptors on B cells. However, a full antibody response requires that the B cells contact helper T cells. In the case of T cells, the antigen is taken up by an antigen-presenting cells and partially digested. A peptide fragment of it is presented to the appropriate receptors on T cells. In either case, the cells are stimulated to divide, forming clones of cells that respond to this antigen.

164.(d) : *Both the assertion and reason are false.*

When a blood vessel gets injured, blood platelets get clumped at the injured spot and release certain chemicals called platelet factors, which promote blood coagulation. Injured tissues or platelets also release coagulation promoting substances called thromboplastins which help in the formation of an enzyme prothrombinase. This enzyme activates inactive protein prothrombin to active thrombin which further promotes the coagulation process. Blood normally contains an anticoagulant heparin which is released from mast cell granules that prevents the activation of prothrombin in uninjured blood vessels.

Blood also contains antithrombin which inhibits any thrombin formed accidentally. Moreover, uninjured tissues do not release thromboplastins, hence blood does not coagulate in uninjured blood vessels.

165.(b) : *Both assertion and reason are true but reason is not the correct explanation of assertion.*

The basal metabolic rate is defined as the energy requirement of the human body at rest and reflects the caloric needs of the body. BMR can be determined by total body weight and the amount of muscle mass. BMR is inversely related with the weight or volume of an organism, *i.e.* smaller the organism, higher is the basal metabolic rate and *vice versa*.

Heart rate of six month old baby is 110-112 beats/min. Though it is higher than normal adult person, but it is lower than the old person. At the age of 60, a man may have maximum heart rate of 160 beats/min (avg 120 beats/min).

166.(b) : *Both assertion and reason are true but reason is not the correct explanation of assertion.*

Ctenidium is a monopectinate gill situated on the right side of the branchial chamber. Ctenidium helps in respiration by beating of cilia, thus creating water current. Ctenidium is innervated by nerves from the left pleural and supra-intestinal ganglia. This nerve supply indicates that it is actually an organ of the left side but has shifted to the right side during development (torsion). Torsion or twisting is a development of gastropods, which rotates the visceropallium anticlockwise through out 180° from its initial position, so that mantle cavity with its pallial complex, is brought in front of the body in adult.

167.(c) : *Assertion is true but reason is false.*

The evolution of horses could be erroneously depicted as an undeviating straight line progression from the small, terriero (small dog of various breeds) sized *Hydracotherium eohippus* to the large modern horse, *Equus eohippus* originated from Eocene period. *Eohippus* (meaning "dawn horse") was the earliest-known horse. It was the size of a tiny dog. Another name for this genus is *Hyracotherium* (meaning "mole beast"). *Eohippus* was only 2 feet (60 cm) long and 8 to 9 inches (20 cm) high at the shoulder. This primitive horse had 4 hoofed toes on the front feet and 3 hoofed ant on each hind foot. It had a long skull with 44 long-crowned teeth. *Eohippus* was a grazing herbivore that ate soft leaves and plant

shoots. Eohippus lived during the early Eocene Epoch, about 50 million years ago. The major stages in evolution of horse are : (i) eohippus, (ii) mesohippus, (iii) merychippus, (iv) pliohippus, and (v) equus.

168.(d) : *Both the assertion and reason are false.*

When there is a threat of excessive water loss from the body of the animal, then the urine excreted needs to be hypertonic and not hypotonic because excessive water loss from the body poses the threat of a rise in osmoconcentration of the blood. Since hypertonic urine is more concentrated and higher in osmotic pressure than the blood, therefore it helps in reducing the loss of water with urine. Mammals and birds can excrete hypertonic urine which is more concentrated than their blood. For this, an isotonic glomerular filtrate is first filtered into the Bowman's capsules of nephrons in kidneys. The tubules of nephrons then reabsorb a large volume of water from the glomerular filtrate not accompanied by the reabsorption of proportionate amounts of solutes. This leaves the urine more concentrated than the blood which is very effective in reducing the urinary loss of water.

169.(a) : *Both assertion and reason are true and reason is the correct explanation of assertion.*

Aldosterone is a steroid hormone (mineralocorticoid) produced by the outer-section (zona glomerulosa) of the adrenal cortex in the adrenal gland to regulate sodium and potassium balance in the blood. At the late distal tubule & collecting duct, aldosterone has two main actions:

- Acting on mineralocorticoid receptors (MR) on principal cells in the distal tubule of the kidney nephron, it increases the permeability of their apical (luminal) membrane to potassium and sodium and activates their basolateral Na^+/K^+ pumps, stimulating ATP hydrolysis leading to phosphorylation of the pump and a conformational change in the pump exposes the Na^+ ions to the outside. The phosphorylated form of the pump has a low affinity for Na^+ ions, hence reabsorbing sodium (Na^+) ions and water into the blood, and secreting potassium (K^+) ions into the urine. (Chlorine anions are also reabsorbed in conjunction with sodium cations to maintain the system's electrochemical balance.)
- Aldosterone stimulates H^+ secretion by intercalated cells in the collecting duct, regulating plasma bicarbonate (HCO_3^-) levels and its acid/base balance.

Aldosterone may act on the central nervous system *via*

the posterior pituitary gland to release vasopressin (ADH) which serves to conserve water by direct actions on renal tubular resorption.

Aldosterone is responsible for the reabsorption of about 2% of filtered sodium in the kidneys, which is nearly equal to the entire sodium content in human blood under normal GFR (glomerular filtration rate).

170.(d) : *Both the assertion and reason are false.*

Pollution may be defined as an undesirable change in the physical, chemical or biological characteristics of our air, water and land that may or will harmfully affect human lives or other organism. Pollution can be natural or man made. Natural pollution comes from volcanic eruptions, emission of natural gas, soil erosion, ultraviolet rays, etc. Most of the pollution is man-made. Contamination occurs due to the presence of harmful organisms or their products or undesirable products in a desirable product causing disease or discomfort, for the organism who consume it. Therefore pollution and contamination are two different things.

171.(c) : *Assertion is true but reason is false.*

According to Eichler's classification, plant kingdom is divided into two subdivisions cryptogamae and phanerogamae. Cryptogamae has 3 divisions thallophyta, bryophyta and pteridophyta. Thallophyta in turn is divided into 2 classes, algae and fungi. As both these groups have generally undifferentiated plant body (not differentiated into true root, stem and leaves) they are called thallophyta. Also they are non vascular plants. But algae are chlorophyllous and hence show autotrophic mode of nutrition *ie* can prepare their own food. But fungi are non-chlorophyllous and cannot prepare their own food. So they are heterotrophic in nature.

172.(a) : *Both assertion and reason are true and reason is the correct explanation of assertion.*

Conifer or *Pinus* is a heterosporous plant producing mega and microspores inside megasporangium and microsporangium respectively. Each micro-sporangium is a small, sessile and elongated sac like structure having two layered wall. Inside the wall lie tapetum which is a nourishing layer. Inside the cavity are large number of dusty and two winged micro-spores present. On maturity the microsporangium wall bursts from the upper side forming a longitudinal slit. A large number of yellow pollen grains are liberated which are carried by wind due to the presence of wings.

173.(d) : Both assertion and reason are false.

Neurospora is commonly called pink/red bread mould or pink mould. It belongs to class ascomycetes fungi or sac fungi. It is used in experimental genetics as it can be grown easily in a definite medium in laboratory. It is a haploid fungus. It is a heterothallic fungus having + ve and - ve mycelia and somatic fusion of two haploid nuclei produce a diploid zygote. The zygote by one meiotic and another mitotic divisions forms 8-nuclei and hence ascospores, a characteristic structure of ascomycetes are produced.

174.(a) : Both assertion and reason are true and reason is the correct explanation of assertion.

As a result of continued secondary growth for several years, the older parts of the stem and its old branches have a part of its secondary xylem rendered non-functional. Such a modified and non-functional secondary xylem is called the heart wood or duramen, the functional outer younger rings of secondary xylem constitute the sap wood or alburnum. With the passage of time and addition of new outer rings of secondary xylem due to cambial activity more rings of the sap wood are changed into heart wood. This leads to the increase in the thickness of heart wood, whereas the sap wood remains of about the same thickness.



175.(b) : Both assertion and reason are true but reason is not the correct explanation of assertion.

Term vernalization was first given by T.D. Lysenko (1928). In colder countries, there are cereals of 2 physiological types, i.e., winter cereals and spring cereals. Winter cereals are sown in winter and flower in following summer whereas spring cereals are sown in spring and flower in summer. If winter cereal is sown in spring, it shows vegetative growth but does not flower unless it receives low temperature of winter. But winter cereal can be converted into spring cereal by providing artificial low temperature treatment, (i.e., springification.) Some plants requiring low temperature requirement (vernalization) for flowering are *Secale cereale* (European rye), *Triticum vulgare*, *Brassica oleracea*, *Beta vulgaris*, *Apium* and *Lolium perenne*, etc. Site of vernalization is apical meristem or all the meristematic cells. As a result of vernalization, a flowering hormone

called "vernalin" is formed (reported by Melchers), but vernalin has never been isolated. Once a plant is vernalized, it can be de-vernalized by exposing the plant to temperature of 30°C or above. For establishing vernalization, plant should be kept at 20°C for 4-5 days.

176.(a) : Both assertion and reason are true and reason is the correct explanation of assertion.

Organic sulphur is made available to the plant through biological oxidation through the activity of certain microorganisms. Sulphur is transformed from the organic form to the sulfate ion, the form of sulphur that higher plants absorb. Soil microorganisms oxidize not only organic sulphur but also sulphide minerals such as ferrous sulphide. The elemental sulphur is then oxidized to sulphate by sulphur bacteria.

177.(b) : Both assertion and reason are true but reason is not the correct explanation of assertion.

A slight thinning of ozone layer occurs naturally for a few months every year over Antarctica. It decreases by 67% every year. The primary chemicals responsible for ozone depletion are a group of chlorine containing compounds called chlorofluorocarbons (CFCs), used as coolants in air conditioners and refrigerators (freon) and propellants for aerosol cans and form blowing agents for insulation and packaging and also as solvents. Besides halons, methyl bromide, methyl chloroform, carbon tetrachloride and nitrous oxide are also responsible for O₃ loss. After their release into troposphere, CFCs and other chlorine containing compounds go to stratosphere where these are broken down by UV-radiations releasing chlorine. Similarly bromine is released by breakdown of halons and methyl bromide. The sunlight catalyzes the chemical reaction by which chlorine or bromine break O₃ molecules and convert them into O₂ molecules. This chemical reaction does not change chlorine or bromine and thus single chlorine or bromine atom can breakdown many thousands of O₃ molecules.

178.(c) : Assertion is true but reason is false.

Photosynthesis is actually oxidation reduction process in which water is oxidised and CO₂ is reduced to carbohydrates. Assimilatory power ATP and NADPH₂ are required for reduction of CO₂. But this reduction is independent of light i.e. occurs in presence or absence of light but production of assimilatory power is light dependent. This reaction is called light reaction or Hill's

reaction and the light independent phase is an enzymatic reaction called dark reaction. It occurs in stroma of chloroplast and is enzyme mediated one. It was first established by F.F. Blackman and so is also called Blackman's reaction. During this process CO_2 is fixed to carbohydrate.

179.(d) : Both assertion and reason are false.

Vegetable oils and fats are located in the form of small insoluble droplets within the plant cells. They occur predominantly in seeds most commonly in the endosperm and cotyledons. In most of the cereals, however, the fat occurs almost exclusively in the embryo. Olive and palm oils are two important examples that are obtained from the fleshy pericarp of the fruit. Less frequently, oils and fats are extracted from the roots, stems and foliage.

180.(a) : Both assertion and reason are true and reason is the correct explanation of assertion.

Latex of some plants containing long chain hydrocarbons is considered to be a good substitute for liquid fuels or petroleum. Such plants having large amount of latex with

long chain hydrocarbons are called petroplants. Cultivation of petroplants is also a part of energy-cropping. Cultivation of these petrocrops was first of all done by Italians in Ethiopia about fifty years back, although actual credit for identifying the petrocrops goes to Dr. Calvin. The most common petroplants belong to families of euphorbiaceae, asclepiadaceae, apocynaceae, compositae, labiatae, sapotaceae, urticaceae, etc., which have property of converting large amounts of their photosynthates into latex with hydrocarbons. Their hydrocarbon contents can be increased by genetic manipulations (genetic engineering). But commercial production of petroleum or liquid fuel alternative (through petroplants) is in early stage. The use of these petroplants may reduce the pressure on liquid fuel or petroleum.

GENERAL KNOWLEDGE

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



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Use the index for topicwise analysis of last year's
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