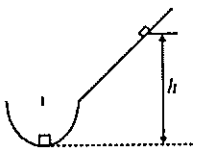
SOLUTIONS

PHYSICS

1. (b) : For the body to complete the vertical circle, the speed at the bottom of the circular track must equal $\sqrt{5gR}$, where R is the radius of the circle. If the body falls through a height h until it reaches the bottom of the track,



$$\sqrt{5g\frac{D}{2}} = \sqrt{2gh} \text{ (From energy conservation)}$$

or, $h = \frac{5D}{4}$.

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2. (a) : Gravitational constant comes in the formula

$$F = \frac{Gm_1m_2}{r^2} \quad \text{or} \quad G = \frac{Fr^2}{m_1m_2} = \frac{\text{kg}\frac{\text{meter}}{\text{sec}^2}(\text{meter})^2}{\text{kg}^2}$$

$\equiv \text{kg}^{-1}(\text{meter})^3(\text{sec})^{-2} \equiv M^{-1}L^3T^{-2}$.

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3. (d) : $u = \frac{p}{m} = \frac{10}{5} = 2$ m/s, $a = \frac{0.2}{5}$ m/s^2

$$v = u + at = 2 + \frac{0.2}{5} \times 10 = 2.4 \text{ m/s.}$$

$$\Delta K = \frac{1}{2}mv^2 - \frac{1}{2}mu^2 = \frac{1}{2} \times 5 \times (2.4)^2 - \frac{1}{2} \times 5 \times 2^2$$

$= 4.4$ J.

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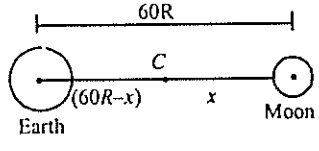
4. (c) : Let C be the point where the gravitational field due to earth and the moon be equal. C is at a distance x from the moon and $(60R - x)$ from the earth. We know that the gravitational field at a distance r from mass M is given by

$$E = G\frac{M}{r^2}$$



In our case $E_1 = E_2$

$$\Rightarrow G\frac{M}{(60R-x)^2} = G\frac{\frac{M}{81}}{x^2}$$

$$\Rightarrow 81x^2 = (60R - x)^2$$

$$\Rightarrow (9x)^2 = (60R - x)^2$$

$$\therefore 9x = \pm(60R - x)$$

$$\therefore 9x = 60R - x \quad \text{or} \quad 9x = x - 60R$$

$$\Rightarrow 10x = 60R \quad \text{or} \quad 8x = -60R$$

$$\Rightarrow x = 6R \quad \text{or} \quad x = -\frac{60}{8}R$$

which is not possible as distance cannot be negative.

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5. (d) : On doubling the kinetic energy, the velocity becomes $\sqrt{2}$ times the initial velocity. As the escape velocity is $\sqrt{2}$ times that of the orbital velocity, the satellite will escape out of the earth's gravitational field.

The orbital velocity is given by

$$v_o = \sqrt{\frac{GM}{R}}$$

K.E. $K = \frac{1}{2}mv_o^2 \Rightarrow v_o = \sqrt{\frac{2K}{m}}$

if *K.E.* is doubled, then

$$v'_o = \sqrt{\frac{2 \times 2K}{m}} = \sqrt{2}\sqrt{\frac{2K}{m}} = \sqrt{2}\,v_o$$

Since escape velocity $v_e = \sqrt{\frac{2GM}{R}} = \sqrt{2}\,v_o$.

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6. (c) : As per Bohr's model of hydrogen atom, the angular momentum of the electron in allowed orbits is given by $L = \frac{nh}{2\pi}$, $n = 1, 2, 3, \ldots$..

For the second orbit $n = 2$, $L = 2\frac{h}{2\pi} = \frac{h}{\pi}$.

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7. (b) : Let N_0 be the number of nuclei at the beginning. Number of undecayed nuclei after 33% decay = $0.67\ N_0$

Number of undecayed nuclei after 67% decay = $0.33\ N_0$

Also $0.33\ N_0 \approx \frac{0.67N_0}{2}$. And in one half life the number of undecayed nuclei becomes half.

Exact calculation :

Let number of nucler at the beginning = N_0

Let the time required for 33% decay = t_1

Then $0.67\ N_0 = N_0\ e^{-\lambda t_1}$

$$\Rightarrow e^{-\lambda t_1} = 0.67 \quad \ldots\ldots\ldots\ldots(1)$$

Time required for 67% decay = t_2

$$\therefore \quad e^{-\lambda t_2} = 0.33 \quad \ldots\ldots\ldots\ldots(2)$$

[Since after 33% decay, 67% will remain and after 67% decay, 33% will remain].

$\therefore \quad (2) \div (1) \Rightarrow e^{-\lambda(t_2-t_1)} = \frac{0.33}{0.67} = \frac{1}{2}$

$\therefore \quad -\lambda (t_2 - t_1) = -ln\left(\frac{1}{2}\right)$

$\therefore \quad t_2 - t_1 = -\frac{ln\left(\frac{1}{2}\right)}{\lambda} = -\frac{ln\left(\frac{1}{2}\right) \times T_{1/2}}{0.693}$

$= -\frac{ln\left(\frac{1}{2}\right) \times 20}{-ln\left(\frac{1}{2}\right)} = 20$ minutes

8. **(d) :** When a ray of light enters a glass-slab its frequency does not change. This is because frequency is the property of the source emitting the radiation. And once the light is emitted, its frequency remains same in all the media it propagates through.

9. **(b) :** For myopia (shortsightedness) a convex lens is used. For hypermetropia, we need concave or diverging lens for the ray of light to be focused on the retina. For presbyopia bifocal lens is used and astigmatism is cleared with cylindrical lenses. Therefore the correct alternative is (b)

10. **(b) :** Power of the resultant combination is given by

$$P = P_1 + P_2$$

First lens is a convex lens with power

$$P_1 = +\frac{1}{0.40} = +2.5 \text{ D}$$

The second lens is a concave lens with power

$$P_2 = -\frac{1}{0.25} = -4 \text{ D}$$

$\therefore$ The total power of the combination

$$P = P_1 + P_2 = 2.5 - 4 = -1.5 \text{ D}$$

11. **(b) :** Transformers are used for stepping-up or stepping down an A.C current (A.C voltage source).

Leclanche cell gives a D.C. voltage. As the input from a Leclanche cell does not change with time, the magnetic flux linked with the secondary also does not change and hence the induced *emf* is zero. Hence the output will be zero.

12. **(b) :** From Wien displacement Law,

$\lambda_m T \cong$ constant

$\therefore 510 \times T_{sun} = 350 \times T_{star}$ or $\frac{T_{sun}}{T_{star}} = \frac{350}{510} = 0.68$.

13. **(c) :** $\frac{H_A}{H_B} = \left(\frac{T_A}{T_B}\right)^4 = \left(\frac{727+273}{327+273}\right)^4 = \frac{625}{81}$.

14. **(c) :** Ratio of the intensities = 9 : 1

$\therefore$ Ratio of the amplitudes = 3 : 1

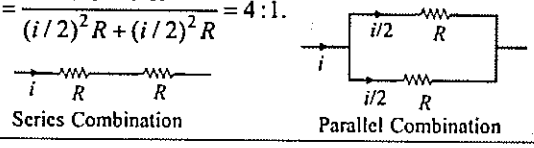
On superposition,

$$\frac{\text{Maximum Intensity}}{\text{Minimum Intensity}} = \frac{(3+1)^2}{(3-1)^2} = 4:1.$$

15. **(c) :** As there is no external force acting on the system, the momentum of the system remains conserved in a collision but the kinetic energy is conserved only in elastic collisions.

16. **(b) :** Required ratio

$$= \frac{i^2R + i^2R}{(i/2)^2R + (i/2)^2R} = 4:1.$$



17. **(c) :** Let m capacitors are joined in series and n such groups are joined in parallel.

So, $C = 8/m$ and $C_{equi.} = n \times \frac{8}{m} = 16$

or, $n = 2m$.

Potential of arrangement, $mV = 1000$

or, $m = \frac{1000}{250} = 4$. $\therefore \quad n = 2 \times 4 = 8$.

So, total number of capacitors required

$= nm = 8 \times 4 = 32$.

18. **(a) :** For the rotational energy to be minimum the moment of inertia of the system about the axis through the point must be minimum. If this point in at a distance of x from 0.3 kg mass, $I = 0.3x^2 + 0.7(1.4 - x)^2$

$\frac{dI}{dx} = 0$ gives $x = 0.98$ m.

19. **(b)**

20. **(b) :** The power of the incandescent lamp $P = 60$ W

Operating voltage V = 120 V

$\therefore$ Current through the filament $I = \frac{P}{V} = \frac{60}{120} = \frac{1}{2}$ A

Now $Q = I \times t$

For $t = 1$ sec, $Q = I = \frac{1}{2}$ C

$\Rightarrow \quad ne = \frac{1}{2}$

where e = electronic charge, and n = number of electrons.

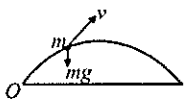
$\therefore n = \frac{1}{2e} = \frac{1}{2 \times 1.6 \times 10^{-19}} = 3.12 \times 10^{18}$

21. **(d) :** In steady state condition the current at each cross-section will be the same. Drift velocity and electric field depend on the current density, $\vec{M}$ which varies from one cross-section to another.

22. **(a) :** Each point of the sphere must be at the same

potential and at any point interior to the sphere, the potential is same as that at the surface.

23. (b) : About point O, the angular momentum of the projectile is in clockwise sense. The torque on the projectile about point O (moment of mg) is also in clockwise sense. Hence the angular momentum increases.



24. (d) : Given that the field at the centre of the ring $B = 7 \times 10^{-9}$ Wb/m^2

We know that $B = \dfrac{\mu_0 I}{2r}$

$$\Rightarrow I = \frac{2Br}{\mu_0}$$

$$= \frac{2\times 7\times 10^{-9}\times 0.05}{4\pi\times 10^{-7}}$$

$$= 5.57 \times 10^{-4} \text{ A}$$

25. (b) : Inside the magnet the lines go from south pole to the north pole.

26. (b) : $E_{\text{axial}} = \dfrac{1}{4\pi\varepsilon_0}\dfrac{2p}{r^3}$; $E_{\text{equatorial}} = \dfrac{1}{4\pi\varepsilon_0}\dfrac{p}{r^3}$.

$\therefore E_a = 2E_{eq}$.

27. (d)

28. (c) : Alternatives (a) and (b) are dimensionally incorrect. When $d \to 0, I \to I_0$. Alternative (c) meets this requirement.

29. (b) : υ does not change, λ changes. The frequency υ is a property of the source of radiation but λ is a function of the refractive index of the medium.

30. (d) : Due to waving of the arms, the centre of gravity remains at a comfortable position, so it helps to walk comfortably.

31. (a) : $y = 10 \sin\pi(0.02x - 2.00t)$

$$\frac{\partial y}{\partial t} = -20\pi\cos\pi(0.02x - 2.00t)$$

$$\left(\frac{\partial y}{\partial t}\right)_{\max} = 20\pi = 63 \text{ units.}$$

32. (a) : 5 capacitors in parallel gives 5×2 mF = 10 mF.

The 2 capacitors in series give 1 mF.

When they are connected in series, total capacitance will be $\dfrac{10\times 1}{10+1} = \dfrac{10}{11}$ mF.

33. (a) : Since voltage across L, C and R is same, equal to 10 V, therefore $R = X_L = X_C$.

Also total voltage in the circuit is

$$I\,[R^2 + (X_L - X_C)^2]^{1/2} = I\,R = 10 \text{ V.}$$

When capacitor is short circuited current in the circuit

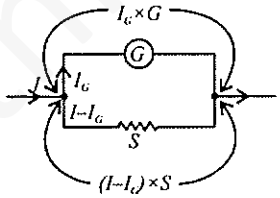
$$I = \frac{10}{(R^2 + X_L^2)^{1/2}} = \frac{10}{\sqrt{2}\,R}.$$

Potential drop across inductance

$$= IX_L = IR = 10/\sqrt{2} \text{ V.}$$

34. (a) : Suppose a metal plate is kept in a magnetic field. On the surface of the metal plate, we can imagine a loop, which will be associated with a magnetic flux due to the magnetic field. As the magnetic field is changing, there is change of magnetic flux through this loop and so an electric current is going to be induced in the loop, which is known as the eddy current.

35. (b) :



Here $I_g = I/10$. Now $I_g G = (I - I_g)S$.

$\therefore \quad S = \dfrac{I_g G}{I - I_g}$.

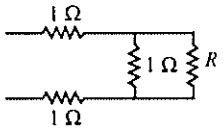
In this case $G = 900\ \Omega$. Hence $S = 100\ \Omega$.

36. (d) : In magnetic dipole, Force $\propto 1/r^4$

$\therefore$ New force $= \dfrac{4.8}{2^4} = \dfrac{4.8}{16} = 0.3$ N.

37. (b) : Non-uniform magnetic field causes change in flux.

38. (c) : The equivalent circuit may be shown as :



where R may be treated as the total resistance.

Hence $1 + \dfrac{1\times R}{1+R} + 1 = R$.

This gives $R = 1 \pm \sqrt{3}$.

Since $1 - \sqrt{3}$ gives –ve value,

therefore $R = 1 + \sqrt{3}$.

39. (d) : The potential energy is given by

$$U_P = \frac{1}{4\pi\varepsilon_0} \times \frac{q_1 q_2}{r}$$

$$= 9 \times 10^9 \times \frac{1\times 10^{-6}\times 1\times 10^{-6}}{1}$$

$$= 9 \times 10^{-3} \text{ J}$$

40. (b) : Charge on ions $= 2.9 \times 10^{18} \times 1.6 \times 10^{-19}$ C
Charge on electrons $= 1.2 \times 10^{18} \times 1.6 \times 10^{-19}$ C
Total charge $= 4.1 \times 1.6 \times 10^{-1}$ C
$= 6.56 \times 10^{-1}$ C $= 0.66$ C.

$$\text{Current} = \frac{\text{Charge}}{\text{Time}} = \frac{0.66\,(\text{C})}{1\,(\text{s})} = 0.66 \text{ A}.$$

The direction of current in a circuit is, by convention, taken along the direction in which positive charges flow. Hence the current in the discharge tube flows towards right.

41. (b) : $H = 7 \times 10^{-5} = \frac{\mu_0}{4\pi}\frac{2\pi I}{R}$

Here $R = 5$ cm $= 0.05$ m and $\frac{\mu_0}{4\pi} = 10^{-7}$.
Hence $I = 5.6$ A.

42. (c)

43. (c) : The electric potential at any point (x, y, z) in space is given as

$$V = 6Z^2$$

We know that electric field

$$\vec{E} = -\vec{\Delta}V$$

$$\Rightarrow \quad \vec{E} = -\left[\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k}\right] = -12Z\,\hat{k}$$

$$\therefore E\,(2, -1, 3) = -12 \times 3 = -36$$

44. (b) : First law of thermodynamics gives
$\Delta Q = \Delta U + \Delta W$. Here $\Delta U = -\Delta W$.
Hence $\Delta Q = 0$. Therefore the process is adiabatic.

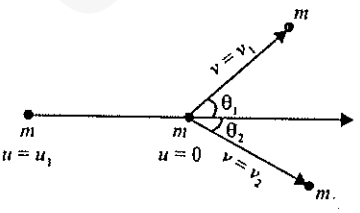
45. (d) : $\frac{P_1}{T_1} = \frac{P_2}{T_2}$. Here $P_1 = 1$, $P_2 = 2.5$, $T_1 = 300$ K.
This gives $T_2 = 750$ K.

46. (b) : $\rho = M/V$. Hence $\frac{\Delta\rho}{\rho} = \frac{\Delta M}{M} + \frac{\Delta V}{V}$

$$= \frac{0.01}{20.00} + \frac{0.1}{5.0} = 0.0205 \cong 2\%.$$

47. (d) : Intensity varies inversely as the square of the distance. When distance is doubled, the time required for good print will be 4 times.

48. (d) : Since the given collision is elastic, so we can use both. The principles of conservation of linear momentum and conservation of kinetic energy. And as the mass of the two bodies are equal and considering one body to be initially at rest, we have



$$u_1 = v_1\cos\theta_1 + v_2\cos\theta_2 \quad \text{... (i)}$$

$$v_1\sin\theta_1 = v_2\sin\theta_2$$

$$\Rightarrow \quad v_1\sin\theta_1 - v_2\sin\theta_2 = 0 \quad \text{... (ii)}$$

$$u_1^2 = v_1^2 + v_2^2 \quad \text{... (iii)}$$

Squaring and adding (i) and (ii), we have

$$v_1^2 + v_2^2 + 2v_1v_2(\cos\theta_1\cos\theta_2 - \sin\theta_1\sin\theta_2) = u_1^2$$

$$\Rightarrow \quad \cos(\theta_1 + \theta_2) = 0 \text{ using (iii)}$$

$$\Rightarrow \quad \cos\theta = 0 \text{ where } \theta = \theta_1 + \theta_2$$

$$\Rightarrow \quad \theta = 90°.$$

49. (b) :

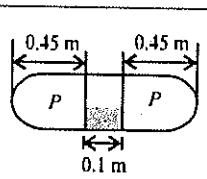


figure (a)

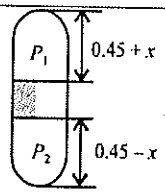


figure (b)

Figure (a) shows the horizontal position and figure (b) shows the vertical position of the tube.
When the tube is horizontal, the volume of air at the two sides of mercury column $= 0.45 \times \alpha$, where α is the area of cross-section of the tube.
The pressure of air at each side = 76 cm of Hg
= 0.76 m of Hg
Now, for the vertical position of the tube, let the mercury be displaced by x metre.
Then, the volume of the air at the upper part $= (0.45 + x)\alpha$
If the new pressure of air at the upper part be p_1, then from Boyle's law, we get

$$0.76 \times 0.45 \times \alpha = p_1 \times (0.45 + x) \times \alpha$$

$$\text{or,} \quad p_1 = \frac{0.76 \times 0.45}{0.45 + x} \quad \text{... (i)}$$

Volume of air at the lower part of the tube $= (0.45 - x)\alpha$
If the new pressure of air at this part be p_2, then applying Boyle's law, we get

$$0.76 \times 0.45 \times \alpha = p_2 \times (0.45 - x) \times \alpha$$

$$\text{or,} \quad P_2 = \frac{0.76 \times 0.45}{0.45 - x} \quad \text{... (ii)}$$

Now, obviously, $p_2 > p_1$ and the difference in pressure between the lower and upper parts of the tube, *i.e.* $(p_2 - p_1)$ will be due to the mercury column of 0.1 m in its vertical position.

$$\therefore \quad p_2 - p_1 = 0.1 \quad \text{... (iii)}$$

From (i) and (ii), we get

$$p_2 - p_1 = \frac{0.76 \times 0.45}{0.45 - x} - \frac{0.76 \times 0.45}{0.45 + x}$$

$$= \frac{(0.76 \times 0.45)(0.45 + x) - (0.76 \times 0.45)(0.45 - x)}{(0.45)^2 - x^2}$$

$$= \frac{0.76 \times 0.45 \times 2x}{(0.45)^2 - x^2} \quad \text{... (iv)}$$

Now, from (iii) and (iv), we get

$$\frac{0.76\times0.45\times2x}{(0.45)^2-x^2}=0.1$$

or, $x^2 + 6.84x - 0.2025 = 0$

or, $x=\frac{-6.84\pm\sqrt{(6.84)^2-4\times1\times(0-0.2025)}}{2\times1}$

or, $x = 0.029, -6.87.$

Negative value of x is discarded as it is absurd.

$\therefore$ $x = 0.029 = 2.9$ cm.

So, mercury will be displaced by 2.9 cm (nearly).

50. (b) : Length of the pendulum is $l = 1$ m.

$\therefore$ Time period $T=2\pi\sqrt{\frac{l}{g}}=2\pi\sqrt{\frac{1}{10}}$

$\therefore$ Frequency $f=\frac{1}{T}=\frac{1}{2\pi}\sqrt{10}=0.5032$ Hz.

Now since the pendulum thread is caught by a thread 1/4 m from the original point of suspension, so the new length of the pendulum is

$$l'=1-\frac{1}{4}=\frac{3}{4}\text{ m}$$

$\therefore$ Time period, $T'=2\pi\sqrt{\frac{3/4}{10}}$

$\therefore$ Frequency $f'=\frac{1}{2\pi}\sqrt{\frac{10}{3/4}}=\frac{2}{\sqrt{3}}\frac{1}{2\pi}\sqrt{10}=0.5811$ Hz.

$\therefore$ Change in frequency, $\Delta f = 0.5811 - 0.5032$

$= 0.0779$ Hz.

51. (a) : Experimentally, it is found that the average radius of a nuleus is given by

$R = R_0A^{1/3}$ where

$R_0 = 1.1 \times 10^{-15}$ m $= 1.1$ fm

and A = mass number

The volume of a nucleus is

$$V=\frac{4}{3}\pi R^3=\frac{4}{3}\pi R_0^3A.$$

Now as the masses of a proton and a neutron are roughly equal, say m, the mass of a nucleus is also roughly proportional to the mass number A, $M=mA$

Hence density within a nucleus $\rho=M/V=\frac{mA}{\frac{4}{3}\pi R_0^3A}$

$=\frac{m}{\frac{4}{3}\pi R_0^3}$ is independent of the mass number A.

52. (c) : Red colour is always used for danger signals, because as red colour is having the longest wavelength, it is the least scattered. So, this signal can be seen from a very long distance.

53. (a) : A physical quantity to be treated as a vector, it is necessary for it to have both magnitude and direction. But this is not a sufficient condition for the physical quantity to be treated as a vector. A vector quantity has to follow the laws of vector addition. That's why, even though current and time have both magnitude and direction, they are not considered as vectors.

54. (a) : As the polar ice melts, it will flow towards the equator thereby increasing the moment of inertia of earth. Hence the angular velocity decreases. So, the day length will become longer.

55. (a)

56. (d) : Any charged particle can be accelerated with the help of a cyclotron but in the case of an electron, being very light, the process of accelerating the electron with a cyclotron is relativistically unfavourable. Very easily it will attain a velocity at which it will show relativistic effects.

57. (a) : Metals are good conductors of electricity. It is because of the presence of a large number of free electrons in metals. And for metals electrons are the main cause for thermal conduction. That's why all good conductors of heat are also good conductors of electricity.

58. (a) : The air surrounding the fire becomes hot and its density decreases. That's why this less dense air rises up and the cold air comes down. So below the fire, only cold air can be present.

59. (a) : The focal length of a lens in a medium of refractive index μ_m is given by

$$\frac{1}{f_m}=\left(\frac{\mu-\mu_m}{\mu_m}\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$ where μ is the refractive index of glass.

In air

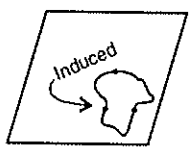
$$\frac{1}{f_a}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$

From these two expressions it is clear that

$f_m > f_a$

That is the focal length of the convex lens in water increases thereby reducing its convergent power.

60. (d) : Eddy currents are produced when a metal sheet is placed in a changing magnetic field. In the metal sheet, we can consider closed loops as shown in the figure, through which an induced current flows due to a change of magnetic flux. This current is called eddy current and it gives rise to loss of thermal energy.



CHEMISTRY

61. (d) : Oxidation state of S in $S_8 = 0$

Oxidation state of S in H_2S $\Rightarrow +2 + x = 0$

$\Rightarrow x = -2$

Oxidation state of S in S_2F_2 $\Rightarrow 2x + 2(-1) = 0$

$\Rightarrow x = +1$

62. (a) : NO_2 is paramagnetic due to the presence of unpaired electron on the nitrogen atom.

63. (c) : $NH_3 + H_2O \rightarrow NH_4OH$

$CuSO_4 + NH_4OH \rightarrow Cu(OH)_2 + (NH_4)_2SO_4$

$Cu(OH)_2 + 2NH_4OH + (NH_4)_2SO_4 \rightarrow [Cu(NH_2)_4]\,SO_4 + 4H_2O$

Tetrammine cuprie sulphate

The complex is called as Schotzer's reagent which is used for dissolving cellulose in the manufacture of artificial silk.

64. (c) Let the alkaline earth metal be A

$\therefore \quad 3A + N_2 \rightarrow A_3N_2$

$$\Rightarrow \quad \frac{\text{Molecular mass of compd.}}{\text{Atomic mass of metal}} = \frac{\text{Wt. of compd.}}{\text{Wt. of metal}}$$

Let Atomic mass of metal be x

$\Rightarrow$ Molecular mass of compound $= 3x + 28$

$$\Rightarrow \quad \frac{3x+28}{3x} = \frac{14.8}{12} \Rightarrow x = 40$$

65. (b) : Mg has a greater covalent compound forming tendency than Na, Ca and Ba.

This is due to the small size and strong positive nuclear charge attraction due to which ion formation involve higher energies.

66. (a) : More is the value of reduction potential, more is the tendency to get reduced. So as z gas has lowest reduction potential, therefore, z will be oxidised easily.

67. (a) : x atoms are at the corners of the cube, therefore,

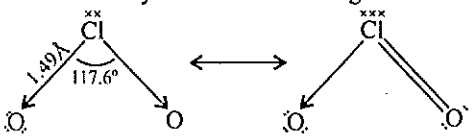
number of x-atoms per unit cell $= \frac{1}{8} \times 8 = 1$

y-atoms are at the face centre of cube

$\therefore$ Number of y-atoms per unit cell $= \frac{1}{2} \times 6 = 3$

$\Rightarrow$ The formula of the molecule is xy_3

68. (a) : ClO_2 molecule has an angular structure with O–Cl–O bond angle of 117.6°. The molecule is supposed to contain a three electron bond. Its structure is believed to be a resonance hybrid of the following two structures :



The structure arises from sp^3d hybridisation of Cl–atom. The molecule is paramagnetic due to the presence of three electron bond.

69. (d) : Microcosmic salt is $Na(NH_4)HPO_4$.

$Na(NH_4)HPO_4 \xrightarrow{\Delta} NaPO_3 + H_2O + NH_3$

It is prepared by :

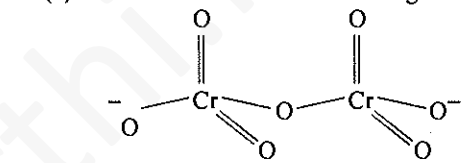
$NH_4Cl + Na_2HPO_4 + 4H_2O \rightarrow Na(NH_4)HPO_4.4H_2O + NaCl$

70. (b) : Carboxylic acids react with carbonates forming corresponding salts thus evolutation of CO_2 must be from carbonates.

$2RCOOH + Na_2CO_3 \rightarrow 2RCOONa + H_2O + CO_2 \uparrow$

71. (b) : NCl_3 cannot be hydrolysed as there is no vacant d-orbitals available. All other group V elements can expand their coordination sphere due to the availability of vacant orbital.

72. (c) : Dichromate has the following structure,



Therefore, all the Cr – O bond lengths are found to be equal.

73. (c) : Lewis acids are those molecules which can accept electron pair and those who can donate electron pairs are called Lewis base.

CCl_4 molecule does not have any vacant orbital where it can accept pair of electrons so CCl_4 cannot act as Lewis acid.

74. (b) : Methane is also called as Marsh gas as it is found in marshy areas. In coal gas methane composition ranges from 25 to 35%.

75. (c) : $Ba(OH)_2 + H_2SO_{4(aq)} \rightarrow BaSO_{4(s)} + 2H_2O_{(l)}$

In this reaction, neutralisation of dibasic acid by $Ba(OH)_2$ base is happening. So neutralisation reactions involving two protons should be about double as that of neutralisation reactions involving one proton.

76. (d) : Sodium chloride ; NaCl

Copper chloride ; Cu_2Cl_2

Magnesium sulphate ; $MgSO_4$

Chromium sulphate ; $Cr_2(SO_4)_3$

As maximum number of particles (*i.e.* ions) will be obtained when $Cr_2(SO_4)_3$ is dissolved in water.

Therefore, maximum boiling point will be observed in this case as elevation in boiling point is a colligative property and depends on the number of particles.

77. (c) : Ni : $\underset{3d^8}{\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{1}\boxed{1}}\ \underset{4s^2}{\boxed{\uparrow\downarrow}}$

Ni^{2+} : $\underset{3d^8}{\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{1}\boxed{1}}\ \underset{4s^0}{\boxed{\ }}$

$[Ni(CN)_4^{2-}]$: $\underset{3d}{\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{xx}}\ \underset{4s}{\boxed{xx}}\ \underset{4p}{\boxed{xx}\boxed{xx}\boxed{\ }}$

$\Rightarrow$ Hybridisation is dsp^2.

78. (d) : Barium phosphate when dissolved in water:

$Ba_3(PO_4)_2 \rightarrow 3Ba^{2+} + 2PO_4^{3-}$

Let the solubility of $Ba_3(PO_4)_2$ be s mol dm^{-3}

$\Rightarrow$ Solubility product = $(Ba^{2+})^3\ (PO_4^{3-})^2$

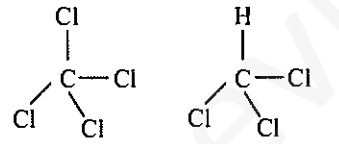
$= s^5\ mol^5\ dm^{-15}$

79. (b) : Average kinetic energy per mole does not depend on the nature of the gas, it depends only on temperatrue.

Average kinetic energy per molecule = $\frac{3}{2}kT$

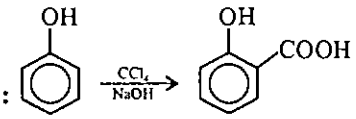
k = Boltzman constant, T = temperature.

80. (c) :



There is a stronger van der Waal's forces of attraction between the molecuIer in CCl_4 compound than in $CHCl_3$.

81. (a) :



Phenol Salicylic Acid

Reaction is called as Riemer-Tiemann reaction. It involves the attack of dichloro carbene on benzene ring.

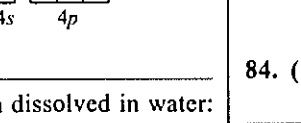
82. (a) : According to Absolute reaction rate theory, the bimolecular reaction between the two molecules A_2 and B_2 passes through the formation of the so called activated complex, whieh then decomposes to yield product AB.

$A_2 + B_2 \rightleftharpoons (A_2B_2)^{\#} \rightarrow 2\ AB$

83. (c) : Composition of portland cement is as follows:

Calcium oxide	CaO	61.5%
Silica	SiO_2	22.5%
Alumina	Al_2O_3	7.5%
Magnesium oxide	MgO	2.5%
Ferric oxide	Fe_2O_3	2.0%
Potassium oxide	K_2O	1.5%
Sulphur trioxide	SO_3	1.0%
Sodium oxide	NaO_2	1.5%

84. (c) :



(Dichromate ion $Cr_2O_7^{2-}$)

85. (b) : Acetamide in the presence of NaOH and heat changes to acetic acid while ethylamine does not undergo any reaction.

$CH_3CONH_2 \rightarrow CH_3COOH + NH_3 \uparrow$

acetamide

86. (d) :

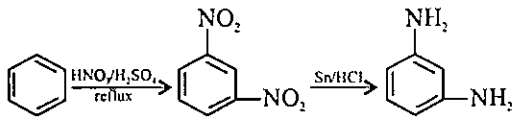
	$2SO_3(g)$	$\rightleftharpoons$	$2SO_2(g)$	+	$O_2(g)$
Inital conc. $\rightarrow$	1.0 mole		0.0 mole		0.0 mole
Equilibrium $\rightarrow$	0.4 mole		0.6 mole		0.3 mole

$\Rightarrow$ Equilibrium constant is given by :

$$K = \frac{[SO_2]^2[O_2]}{[SO_3]^2} = \frac{(0.6)^2(0.3)}{(0.4)^2} = 0.75$$

87. (b)

88. (d) :



m-dinitro benzene 3-amino aniline

89. (c) : Tempering of steel is a process of heating the steel to a temperature below redness and then cooling it slowly. A thin film of the oxide is formed on the surface of steel.

90. (d) : As small compact cations are solvated more in the solution which cause their ionic mobility to slow down. Li^+, Mg^{2+} and Na^+ are heavily solvated, so lesser ionic mobility.

91. (b) : Root mean square velocity is given by :

$$V_{rms} = \sqrt{\frac{3kT}{m}} \Rightarrow V_{rms} \propto \sqrt{T}$$

$$\Rightarrow \frac{V_{rms}(\text{at } 27^\circ\text{ C})}{V_{rms}(\text{at } 327^\circ\text{ C})} = \sqrt{\frac{(27+273)K}{(327+273)K}} = \sqrt{\frac{300}{600}} = \frac{1}{\sqrt{2}}$$

$\therefore$ V_{rms} (at 327°C) = $100\sqrt{2} \times \sqrt{2} = 200$ ms^{-1}

92. (c) : In photography, AgBr is mainly used as the light sensitive material. The unchanged AgBr after devoloping the film is treated with $Na_2S_2O_3$ to solution. Solution of sodium thiosulphate is used as fixer and forms a soluble complex with silver halide.

$$AgBr + 2Na_2S_2O_3 \rightarrow Na_3[Ag(S_2O_3)_2] + NaBr$$

93. (c) : As nitrogen and oxygen atoms are small and highly electronegative with no vacant *d*-orbitals available for bonding multiple bonds are formed between oxygen-oxygen and nitrogen-nitrogen atoms.

$N \equiv N \qquad O = O$

As the size of P and S atoms is large so multiple bonds are not strong enough, also catenation is possible due to vacant *d*-orbitals.

94. (b) : 1 2 3 4 5

$CH \equiv C - CH = CH - CH_3$

IUPAC name : Pent–3–ene–1–yne.

95. (c) : As : $\boxed{\uparrow\downarrow}$ $\boxed{1}\boxed{1}\boxed{1}$ $\boxed{1}\boxed{\ }\boxed{\ }\boxed{\ }\boxed{\ }$

Hybridisation involved is sp^3d involving *s*, p_x, p_y, p_z *and* d_{z^2}.

96. (d) : Anions are always larger as compared to the corresponding parent atom as the effective nuclear force of attraction decreases per electron while on losing an electron (cation formation) size shrinking as effective nuclear charge increases per electron.

97. (a) : When Philosopher's wool (*i.e.* ZnO) is heated with BaO at 1100°C, It gives $BaO + ZnO \rightarrow BaZnO_2$.

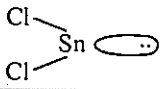
98. (a) : $[H^+][OH^-] = 10^{-14}$

Concentration of OH^- *i.e.* $[OH^-]$ in 0.1 M NaOH solution, $[OH^-] = 10^{-1}$ M

$$\Rightarrow [H^+] = \frac{10^{-14}}{10^{-1}} = 10^{-13}$$

$$\Rightarrow pH = -\log[H^+] = 13$$

99. (c) : $SnCl_2$ is non linear due to the presence of lone pair of electrons on the ccentral tin atom.



100. (d) : Transition elements are those elements which posses partly filled *d*-subshells in their elementary form or their commonly occurring ions *i.e.* $(n-1)d^{1-10}ns^{1-2}$.

101. (c) : In face centred unit cubic cell, the edge length can be written as :

$a = 2(r_+ + r_-)$

a = edge length, r_+ = radius of cation, r_- = radius of anion

$\Rightarrow 508 = 2(110 + r_-) \Rightarrow r_- = 144$ pm

102. (c) : 20% $FeCl_3$ solution means 100 g of solution contains 20 g $FeCl_3$.

$$\Rightarrow \text{Volume of 100 g solution} = \frac{100 \text{ g}}{1.1 \text{ g/mL}} = 90.91 \text{ mL}$$

$$\text{moles of 20 g } FeCl_3 = \frac{20}{162} = 0.1234 \text{ mole}$$

$\Rightarrow$ Molar concentration of solution

$$= \frac{0.1234}{90.91} \times 1000 = 1.357 \text{ M}$$

103. (c) : Combustion of carbon;

$C(s) + O_2(s) \rightarrow CO_2(g)$; $\Delta H_1 = -395.5$ kJ/mol

Combustion of Hydrogen;

$$H_2(g) + \frac{1}{2}O_2(s) \rightarrow H_2O(g); \Delta H_2 = -284.8 \text{ kJ/mol}$$

Combustion of Methane;

$CH_4(g) + 2O_2(g) \rightarrow CO_2 + 2H_2O$; $\Delta H_3 = -890.4$

Formation of Methane;

$C(s) + 2H_2(g) \rightarrow CH_4(g)$; $\Delta H = ?$

From the above equations,

$\Delta H = \Delta H_1 + 2\Delta H_2 - \Delta H_3$

$= -395.5 - 2 \times 284.8 + 890.4$

$= -74.7$ kJ/mole

104. (b) : $^{23}_{11}Na + {}^{1}_{1}H \rightarrow {}^{32}_{12}Mg + {}^{1}_{0}n$

${}^{1}_{1}H$ represents proton (or *p*)

${}^{1}_{0}n$ represents neutron (or *n*)

The reaction is of (*p*, *n*) type.

105. (d) : Baking soda is sodium bicarbonate ($NaHCO_3$). It is obtained as the intermediate product in the solvay ammonia soda process. Normal carbonate can be changed bicarbonate by passing CO_2 through its saturated solution.

$$Na_2CO_3 + H_2O + CO_2 \rightarrow 2NaHCO_3.$$

106. (b) : A sodium chloride solution contains Na^+, Cl^-, H^+ and OH^- ions. On passing electricity, Na^+ and H^+ move toward cathode and Cl^- and OH^- ions towards anode. The discharge potintial of H^+ is less than Na^+, therefore hydrogen ions get discharged easily similarly at anode, Cl^- ions easily discharged as Cl_2. Solution becomes rise in Na^+ and OH^- ions.

107. (c) : Le-Blanc process : It involves the following steps :

$$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$$

$$NaHSO_4 + NaCl \rightarrow Na_2SO_4 + HCl$$

$$Na_2SO_4 + CaCO_3 + 4C \rightarrow \underbrace{Na_2CO_3}_{\text{(coke)}} + \underbrace{CaS}_{\text{Black}} + 4CO$$

Na_2CO_3 is separated from CaS by dissolving it in water.

108. (d) : Elemental sodium can lose electrons very easily so it acts as strong reducing agent.

$Na_{(s)} \rightarrow Na^+ + e^-$

It dissolves in liquid ammonia giving out a conducting and reducing solution. It cannot be prepared by electrolysing sodium chloride solution in water as sodium reacts violently with water.

109. (a) : Carnallite ore is $KCl.MgCl_2.6H_2O$.

110. (a) : Since the alkali metals are highly electropositive, their carbonates are highly stable towards heat. As the electropositivety increases down the group, the stability is in order of :

$$Cs_2CO_3 > Rb_2CO_3 > K_2CO_3 > Na_2CO_3 > Li_2CO_3$$

Lithium carbonate decomposes on heating.

111. (b) : Formic acid behaves as reducing agent as it is oxidised to an unstable acid. Carbonic acid, which decomposes into CO_2 and H_2O.

$$HCOOH + 2HgCl_2 \rightarrow Hg_2Cl_2 + CO_2 + 2HCl$$

$$HCOOH + Hg_2Cl_2 \rightarrow CO_2 + 2HCl + \underset{\text{(Black)}}{2Hg}$$

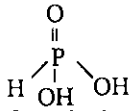
Acetic acid remains unaffected by mercuric chloride, as it does not show reducing properties.

112. (a) : Bond order is the half of the difference between bonding and anti-bonding electrons. Bond order =

$$\frac{1}{2}\left[\begin{pmatrix}\text{no. of } e^- \text{ in}\\ \text{bonding M.O.}\end{pmatrix} - \begin{pmatrix}\text{no. of } e^- \text{ in}\\ \text{antibonding M.O.}\end{pmatrix}\right]$$

Higher the value of bond order, stronger is the bond.

113. (c) : Structure of H_3PO_3 is :

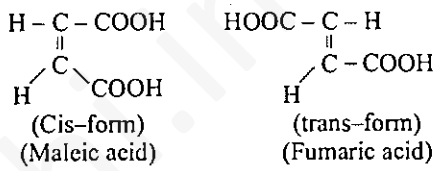


Due to the presence of two hydroxyl protons, H_3PO_3 is dibasic acid.

114. (a) : NaOH is strong electrolyte and dissociates fully in solution into its ions.

115. (b) : When ns^2 electrons of outermost shell do not participate in bonding, it is called inert pair effect. Since the inert pair effect increases down the group, therefore pb^{2+} compounds are more stable than pb^{4+} compounds. Pb^{4+} compounds thus, act as oxidizing agent.

116. (a) : Geometrical isomerism is possible when different groups are attached to the double bonded carbon atoms. *e.g.* Maleic acid and Fumaric acid are geometrical isomers.



(Cis–form) (Maleic acid) (trans–form) (Fumaric acid)

117. (a) : Depression in freezing point is a colligative property, depends on the number of particles present in the solution. As both 0.1 M solution of Glucose and 0.1 M solution of urea contain same number of moles (number of particles) therefore, both have same K_f.

118. (c) : Positron emission :

$$^b_aX \rightarrow {}^b_{a-1}X + {}^0_1\beta$$

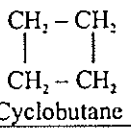
positron

Therefore, after positron emission, atomic number of the atom decreases by one and mass number remains uneffected.

119. (a) : Alkenes have general formula as C_nH_{2n} same as that of cycloalkanes.

e.f. $CH_3CH = CHCH_3 \Rightarrow C_4H_8 \quad (\equiv C_nH_{2n})$

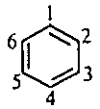
2–butene



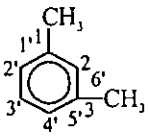
$\Rightarrow C_4H_8 \ (= C_nH_{2n})$

Cyclobutane

120. (b) : Nomenclature in benzene ring :



For only one substituent, no numbering is required. For two substituents on the ring, numbering is done to sure that the smallest total of the positions is there.



1, 3–dimethyl benzene is prefered as it corresponds to smallest total of number of positions.

BIOLOGY

121. (b) : *Wuchereria,* the causative agent of filariasis is found in lymph nodes. The embryos or micro-filariae passing through the lymph nodes, find their way into the main lymphatic duct and go to circulatory system. But the adult worms harbour the lymphatic system, they settle down at some spot–inguinal, scrotal and abdominal lymphatics. *Plasmodium,* causative agent of malaria can be found in human R.B.C., liver etc. *Taenia* causing cysticercosis found in small intestine (mainly) in man. *Diplococcus,* producing pneumonia, in man is found in lung, blood etc.

122. (c) : "Gametes are never hybrid". This is a statement of law of segregation.

Mendel's principle of segregation is inherent in the results of Mendel. Though in F_1, the dominant phenotype appears, the recessive phenotype is not lost but reappears in F_2. This suggested that there is no blending of Mendelian factors in F_1, but that they stay together and only one is expressed. At the time of the formation of gametes, these two factors obviously separate or regregate, otherwise recessive type will not appear in F_1. The gametes which are formed are always pure for a particular character. A gamete may carry either the dominant or the recessive factor but not both. This is why it is called either as "principle of segregation" or as "law of purity of gametes."

123. (c) : Mendel was not able to say anything about recombination and crossing over because traits he chose, were not linked and present on different chromosomes or were far apart.

(i) In each of the seven pairs of character, studied by Mendel, there are only 2 alternative forms for each character–one dominant over the other. The independent assortment of characters is based on independent assortment of non-homologous chromosome. But for recombination and crossing over to occur the linked genes should be present in homologous chromosome. Thus crossing over and recombination are the deviation of Mendel's law.

124. (c) : Sprain is due to excessive pulling of ligament. A sprain is a stretch or tear in the ligament resulting from a sudden movement that causes the neck to extend to an extreme position.

125. (c) : A man suddenly sees a tiger. His heart beat goes up, blood pressure increases, etc. Adrenaline is released at this time in his body. Increased adrenal medullary secretion in the part of the diffused sympathetic discharge provoked in emergency situations. Thus a man, after being excited starts to secrete adrenaline in large amount. It increases blood sugar, and blood lactic acid levels, along with these it increases heat production, metabolic rate and body temperature. Its coordinated actions help the body reactions in stress. This is why adrenal medulla is sometimes called the gland for 'fight, fright and flight'.

126. (d) : Apical meristems or shoot tip meristems are always free of viral infections, therefore, for virus-free cultures shoot tips are preferred in tissue culture.

127. (b) : A man has enlarged breasts, sparse hair on body and sex compliment as XXY. He then suffers from Klinefelters syndnome. It is a disease due to chromosomal aberration. Klinefelters syndrome is characterised by trisomic (XXY) male. These are male individulas which are phenotypically fairly normal but have a very low sperm count and are therefore sterile. Chromosome constituents of Klinefelters syndrome are following :

Sex chromosome	*Sex*	*Phenotype*
XXY (trisomic)	male	Klinefelter's syndrome
XXYY (tetrasomic)	male	Klinefelter's syndrome
XXXY (tetrasomic)	male	Extreme Klinefelter's syndrome
XXXXY (pentasomic)	male	Extreme Klinefelter's syndrome

128. (c) : "They have raised cheek bones, oblique eyes and yellowish skin colours". Here they refer to mongoloids. This syndrome was described by Langdon-Down in 1866 and was popularly called mongolian idiots or Down's syndrome. Trisomy 21 is responsible for it. Phenotypic abnormalities associated with this syndrome resembles mongoloids-thus called mongolian idiots. The features are slant of eyes, thick tongue, sagging mouth, unusual palm and feet, obesity and slow mental growth. The life expectancy of these idiots is about 8 to 12 years.

129. (c) : Urea is transported by blood plasma. Urea present in the urine is the ultimate product of excretion. Excretion or renal clearance is done through the blood plasma. Not only urea, but creatine, insulin all are transported by the blood plasma.

130. (d) : In fast swimming fishes, propulsion is due to caudal fin. Caudal fin has an important role in fish movement. As they pass backward, a progressively greater transverse amplitude of the waves propel them forward. One wave created due to caudal fin is followed by the

another and so an. This transmits a backward momentum to push the water baekwards. Thus the whole body operates as a single self propelling system, and the fish is thrust forward.

131. (b) : While disseeting a rat, at the time of pinning in the disseeting tray, ventral side of the rat should face the person dissecting it. As rat is a chordate (vertebrate), it has its nerve cord at dorsal position. To keep the nerve cord intact (because, if disseetion affects the nervous system, whole body system would be disturbed) dissection is not done dorsally, but it is done ventrally.

132. (b) : The transfer of light energy may be from one chlorophyll *a* molecule to another, from chlorophyll *b* to chlorophyll *a*, from carotenoids to chlorophyll *a* or from phycobilins to chlorophyll *a*. Chlorophyll *a* shows the two photo systems PS I and PS II. Chlorophyll *a* exists in two forms, one form with an absorption maximum at 673 nm (chl. *a* 673) and the other with an absorption maximum at 683 nm (ehl *a* 683).

133. (b) : Presence of cytokinin in an area causes preferential movement of nutrients towards it when applied to lateral buds, they help in their growth despite the presence of apical bud. They thus act antagonistically to auxin which promotes apical dominanee.

134. (a) : Thickening of arteries due to cholesterol deposition is arteriosclerosis. This 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.

135. (a) : Blood vessels of *Pheretima,* which have valves are dorsal. Dorsal blood vessel in *Pheretima* is situated mid dorsally. It has a thiek, mascular wall. Blood passes from backward to forward direction. To prevent the backward flow of the blood, valves are present infront of each septum.

136. (a) : *Ganong's potometer* is an apparatus for measuring the rate of transpiration. *Porometer* is an apparatus for knowing the relative sizes of stomata. *Auxanometer* is used to measure plant growth. *Respirometer* is used to measure the rate of respiration.

137. (b) : If we take food rich in lime juice, then action of ptyalin on starch is reduced. Starch is attacked by ptyalin, the α –amylase in saliva. However, the optimal pH for this enzyme is 6.7 and its action is inhibited by the additon of lime juice. Because, lime juice makes the medium more acidic which is not suitable for ptyalin action.

138. (c) : We move our hands while walking. We do so to maintain equilibrium against force of gravity. Body has to maintain a balance at the time of walking, otherwise there would be a chance to fall down. Gravitational force always acts on our body and attracts the body towards it. Thus there is a downward force acting on the body. To reduce the force and to maintain a balance while walking, movement of hands is necessary.

139. (c) : Pink is the colour of safranin. Plant cell walls are stained with safranin.

140. (a) : The phenomenon by which a gene suppresses the phenotypic expression of a nonallelic gene is called epistasis. 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.

141. (a) : Resolving power is the ability to distinguish two close points as distinct points. Human eye has a resolving power of 1 minute (1′).

142. (b) : The root cap if it is independent in origin arises from a special layer called the calyptrogen. In case it is not independent in origin, it arises from the dermatogen.

143. (c) : Aminocentesis is taking out of cells near the foetus. It is a technique of drawing amniotic fluid and testing it to find out the sex and disorders of the foetus. The amniotic fluid is usually taken in the 14th or 15th week after conception. It prevents accidental damage of the foetus and placenta. Nowadays, this technique has been banned because of its misuse by some persons.

144. (c) : Malignant tertian malaria is caused by *P. falciparum.* It is also known as pernicious malaria. The fever cycle is 48 hours. The fever is often fatal to the patient as it affects the brain. Its incidence follows that of *P. vivax.*

145. (d) : Baeteria becomes double in every minute. Therefore, in 59th minute, they must be present in half cup and in next minute by their doubling the cup become full of them.

146. (a) : The role of fungi in producing antibiotic substances was first established by Sir Alexander Fleming in 1929. He extracted the great antibiotic drug penicillin from *Penicillium notatum.*

147. (a) : Genes control various traits in an organism through a control exercise on the developmental process. If genes are recessive, they fail to perform the function. Phenylketonuria and albinism is caused due to presence of recessive autosomal genes. *Phenylketonuria* is due to accumulation of phenylpyruvic acid and causes mental disorders. *Albinism* is due to absence of melanin pigment and individuals suffering with this disease are incapable of converting dihydroxyphenylalanine into melanin.

148. (c)

149. (c) : DNA finger printing is the best way to determine paternity. Polymorphism at the DNA level is a genetic variation that is being used to advantage. DNA fingerprinting looks directly at persons genetic make up. The test is done by extracting DNA from the nuclei of white blood cells, spermatozoa or hair follicle cells. Every individuals has unique band pattern. Paternity is determined by comparing the accused man's DNA fingerprint with that of the child.

150. (b) : Bending of tendrils after coming in contact of support is called *thigmonasty.* Opening and closing of flowers in response to light and darkness is called *photonasty,* e.g. *Calendula.* Greater growth on one side causes the organ to bend to the opposite side, *e.g.* circinate coiling and opening of fern leaf are called nyctinasty. Hydronasty is the nastic movement in which the stimulus is water.

151. (a) : A person suffering from hyperthyroidism has bulging/protruding eyes, tachycardia and higher body temperature. It is also known as thyrotoxicosis. Besides the mentioned symptoms, hyperthyroidism has a considerable load on cardiovascular system. Graves' disease and Hashimoto thyroiditis are also due to hyperthyroidism.

152. (d) : In primitive atmosphere, the external sources of energy were – (i) solar radiations such as ultra-violet light, X-rays, etc., (ii) energy from electrical discharges like lightening, (iii) high energy radiations are other sources of energies.

153. (a) : Molecular hydrogen acts as a specific inhibitor of nitrogen fixation.

154. (d) : Colchicine inhibits metaphase. Colchicine inhibits the formation of mitotic spindles and are used to increase the percentage of metaphase cells for chromosome analysis. Metaphase arresting solution is effective with bone marrows, difficult tumor samples and problematic tissues.

155. (a) : Blood pressure is measured by sphygmomano meter. Two curved metal tubes are opened by a rubber pressure pad. The device has a registering manometer.
Stethoscope is used to measure pulse rate.
Electrocardiogram is an electrical recording of heart and is used to investigate heart disease.
Phonocardiogram is a recording of heart sounds, which leaves a permanent record in the form of a tracing recorded on paper.

156. (a) : The ATP-ADP system functions as a carrier of chemical energy because ADP is able to accept a phosphate group during coupled energy-yielding reaction of catabolism and the ATP so formed is able to donate its terminal phosphate group in coupled energy-requiring reactions.

157. (b) : In *transduction,* a virus (bacteriophage) when released from a host bacterial strain may carry with it a part of genetic material of the host strain and may transfer it to another strain, which in turn is infected by this virus. In *transformation,* genetic material is released from one strain and a part may be acquired from another strain, which thus gets transformed without coming in contact with the other strain. In *conjugation* genetic material is transferred through a conjugation tube, when two strains come in contact. In *transcription* *m*RNAs are formed from DNA.

158. (d) : A person is suffering from impaired nervous system and madness after prolonged consumption of polluted water. Studies on the effects of lead in human especially in children have demonstrated a relationship between exposure to lead and a variety of adverse health effects. These effects include impaired mental and physical development, decreased heme biosynthesis, elevated hearing threshold and decreased serum levels of Vit D. The neurotoxicity of lead is of particular concern.

159. (b) : Body temperature of cold blooded animals fluctuates with surrounding temperature. Cold blooded animals do not have any temperature regulating mechanism or homeostasis. Thus their body temperature fluctuate with the environmental temperature. It is seen mostly in lower group of vertebrates. They make their own physiological mechanism (like hibernation/diapause) to get rid of the extremity of temperature.

160. (b) : The method of growing plants in aqueous

nutrient solutions as employed by Sacks and Knop is used experimentally and commercially today and is known as hydroponic culture.

161. (a) : A part of brain of frog which helps to respire and locomote is called medulla oblongata. It is a part of hind brain. Diencephalon helps in metabolism of carbohydrate, fat and proteins. The temperature and reproductive activity of the body are also controlled by it. Cerebellum helps in maintaining equilibrium. Cerebral hemispheres help in controlling intelligence, memory, thought etc.

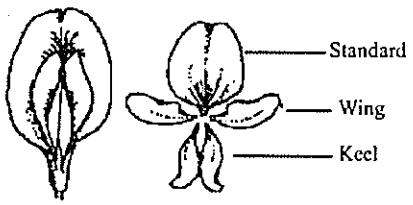
162. (c) : Peptidase digests the peptide bond. Endopeptidase can split certain peptide linkages at any point in a peptide chain, in contrast to the exopeptidases, which can split only terminal peptide bonds.

163. (b) : Cyanobacteria fix atmospheric nitrogen to nitrogen oxides (nitrate and nitrites). These oxides reduce the acidity of soil.

164. (a) : Parkinson's disease is a progressive neuro-degenerative disorder which affects movement or control of movements. The causes of Parkinson's is not completely understood but a known cause is the degeneration of a group of nerves in the centre of the brain. These nerves produce a chemical messenger called dopamine. When 80% of dopamine is lost, the symptoms of the disease is produced.

165. (d) : Succession starting on a site previously occupied by a community forest clearcut or abundoned crop field, for example is known as secondary succession.

166. (a) : Corolla is papilionaceous, petals 5, the posterior odd petal (outer most) is called standard, two lateral ones the wings and the two anterior ones fused to form a keel or carina (a boat-shaped structure).



Corolla of family Palpilonaceae

167. (d) : Cauliflower is an example of inflorescence with condensed shoot. All florets are edible.

168. (c) : Tonoplast is inner plasma-memberane enclosing vacuole. Plasmodesmata is extremely fine cytoplasmic threads one to few tenths of a micrometer wide passing through walls of living plant cells and connecting cytoplasm of adjacent cells. Hydathode is water-excreting gland occurring on the edges or tips of leaves of many plants. These perform guttation.

169. (a) : Pneumolaxis and inhibitory centres are associated with breathing. Pneumolaxis centre is pons. Stimulation inhibits inspiratory centre activity thereby control rate and depth of ventilation. This area is important for regulating the amount of air one takes in with each breath.

170. (b)

171. (c) : Hearing aids help the hearing impaired to hear. Hearing impairment means deafness. It can be classified as conductive loss of hearing which occurs when bones of the middle ear do not function properly and sensorineural deafness which results from long exposure to excessive noise levels. The function of hearing aid is to remove these difficulty by acting on those specific areas.

172. (c) : Cyanobacteria are autotrophic in nature. Photosynthetic pigments include chlorophyll *a* carotenoids and phycobilins. Photosynthetic thylakoids occur freely in the outer part of protoplast called chromoplasm. Cyanobacteria are prokaryotic due to lack of membrane bound cell organelles and distinct nucleus.

173. (c) : Growth regulators are organic substances, other than nutrients, which in low concentration regulate growth, differentiation and development by promoting or inhibiting the same. Plant growth regulators are also called phytohormones. Technically a plant hormone is a chemical substance produced naturally in plants is translocated to another region for regulating one or more physiological reactions when present in low concentration.

174. (c) : Usually nonleguminous crops like wheat, rice, millets etc. are rotated with leguminous crops like Gram, Pea, Pulses, Beans, Groundnut, Alfalfa, Clover, etc. Leguminous plants bear nodulated roots. The root nodules contain nitrogen fixing bacteria of the genus *Rhizobium.* The bacteria convert molecular nitrogen into salts of nitrogen. The latter enrich the leguminous crop as well as soil. Therefore, crop rotation maintains the nitrogen fertility of the soil when legume crop is rotated with others.

175. (d) : Cancer is not contagious, but the cancerous cells are highly differentiated cells. Cancer is the result of a continuous, abnormal and relatively autonomous cell proliferation, which is due to the permanent alteration of some cells that gets transmitted to cell family. It is a disease caused by the loss of control over a cell's reproduction capacity. Rather than dividing in a controlled

and programmed manner, the cell continues to divide and multiple abnormally, until a detectable lump of tumor develops.

176. (c) : Spoilage of fruit juice occurs due to fermentation. Fermentation is the major energy yielding process of several different microorganisms. They are capable of existing and breaking down organic compounds in the absence of oxygen.

177. (c) : Amphibians have evolved from fishes but *Archaeopteryx* can not give any proof in favour of this. *Archaeopteryx* is the connecting link between birds and reptiles. The class Amphibia includes all those animals which live partly in fresh water as well as partly on land. They are the lowest and earliest tetrapods which first of all successfully descended on land from some fish like ancestors possibly in Devonian time. They are characterised by their outstanding features and thus stand in between the fishes and reptiles.

178. (d) : Secondary vascular tissues are formed by vascular combium. Vascular combium is produced by two types of meristems, fascicular or intrafascicular and interfascicular cambium. Only one type of primary lateral meristem is found in plants. It is interfascicular cambium.

179. (a) : Person with blood group AB can take blood from any other person. Blood group incompatibility is due to antigen antibody reaction. Blood group AB has no anitibody and thus the antigen of the other group is not affected. On the other hand group AB blood, with both A and B antigens can be given safely only to group AB people.

180. (b)

GENERAL KNOWLEDGE

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

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