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QUESTIONS & SOLUTIONS OF AIPMT-2010 (SCREENING) TEST PAPER

Duration : 3 Hours **Max. Marks : 800**

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

IMPORTANT INSTRUCTIONS

1. The Test Booklet consists of one paper containing **200** objective type questions (four options with single correct answer) from Physics, Chemistry and Biology (Botany & Zoology).

2. There are three parts in the question paper (Physics, Chemistry and Biology (Botany & Zoology)). The distribution of marks subjectwise in each part is as under for each correct response.

3. **Scoring and Negative Marking** : **Each question carries 4 marks. For each incorrect response one mark will be deducted from the total score.** No deduction from the total score will, however, be made if no response is indicated for a question in the Answer Sheet. The candidates are advised not to attempt such question in the Answer Sheet, if they are not sure of the correct response. **More than one answer indicated against a question will be deemed as incorrect response and will be negatively marked.**

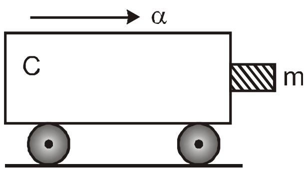
Part A — PHYSICS (200 marks) – 50 Questions

Part B — CHEMISTRY (200 marks) – 50 Questions

Part C — BIOLOGY (400 marks) – 100 Questions

PART- A (PHYSICS)

1. A block of mass m is in contact with the cart C as shown in the figure.

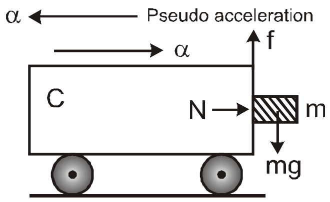


The coefficient of static friction between the block and the cart is μ. The acceleration α of the cart that will prevent the block from falling satisfies

(1) $\alpha > \frac{mg}{\mu}$ (2) $\alpha > \frac{g}{\mu m}$ (3) $\alpha \geq \frac{g}{\mu}$ (4) $\alpha < \frac{g}{\mu}$

Ans. **(3)**

Sol.



Pseudo force or fictitious force, $F_{fic} = m\alpha$
Force of friction, $f = \mu N = \mu m\alpha$,
The block of mass m will not fall as long as
$f \geq mg$
$\mu m\alpha \geq mg$

$$\alpha \geq \frac{g}{\mu}$$

2. The mass of a ${}^{7}_{3}Li$ nucleus is 0.042 u less than the sum of the masses of all its nucleons. The binding energy per nucleon of ${}^{7}_{3}Li$ nucleus is nearly

(1) 46 MeV (2) 5.6 MeV (3) 3.9 MeV (4) 23 MeV

Ans. **(2)**

Sol. For ${}^{7}_{3}Li$ nucleus,
Mass defect, $\Delta M = 0.042$ u
$\therefore$ 1 u = 931.5 MeV/c^2
$\therefore$ $\Delta M = 0.042 \times 931.5$ MeV/c^2
$= 39.1$ MeV/c^2
Binding energy, $E_b = \Delta Mc^2$

$$= \left(39.1\frac{MeV}{c^2}\right)c^2$$

= 39.1 MeV

Binding energy per nucleon, E_{bn} = $\frac{E_b}{A} = \frac{39.1\,\text{MeV}}{7}$

= 5.6 MeV

3. A circular disk of moment of inertia I_t is rotating in a horizontal plane, about its symmetry axis, with a constant angular speed ω_r. Another disk of moment of inertia I_b is dropped coaxially onto the rotating disk. Initially the second disk has zero angular speed. Eventually both the disks rotate with a constant angular speed ω_f. The energy lost by the initially rotating disc to friction is

(1) $\frac{1}{2}\frac{I_b^2}{(I_t+I_b)}\omega_i^2$ (2) $\frac{1}{2}\frac{I_t^2}{(I_t+I_b)}\omega_i^2$ (3) $\frac{I_b-I_t}{(I_t+I_b)}\omega_i^2$ (4) $\frac{1}{2}\frac{I_bI_t}{(I_t+I_b)}\omega_i^2$

Ans. **(4)**

Sol. As no external torque is applied to the system, the angular momentum of the system remains conserved.

$\therefore$ $L_i = L_f$

According to given problem,

$I_t\omega_i = (I_t + I_b)\omega_f$

or $\omega_f = \frac{I_t\,\omega_i}{(I_t+I_b)}$ ....(i)

Initial energy, $E_i = \frac{1}{2}I_t\omega_i^2$ ....(ii)

Final energy, $E_f = \frac{1}{2}(I_t+I_b)\omega_f^2$ ....(iii)

Substituting the value of ω_f from equation (i) in equation (iii) we get

Final energy, $E_f = \frac{1}{2}(I_t+I_b)\left(\frac{I_t\omega_i}{I_t+I_b}\right)^2$

$= \frac{1}{2}\frac{I_t^2\omega_i^2}{(I_t+I_b)}$ ....(iv)

Loss of energy, $\Delta E = E_i - E_f$

$= \frac{1}{2}I_t\omega_i^2 - \frac{1}{2}\frac{I_t^2\omega_i^2}{(I_t+I_b)}$ (Using (ii) and (iv))

$= \frac{\omega_i^2}{2}\left(I_t - \frac{I_t^2}{(I_t+I_b)}\right) = \frac{\omega_i^2}{2}\left(\frac{I_t^2+I_bI_t-I_t^2}{(I_t+I_b)}\right)$

$= \frac{1}{2}\frac{I_bI_t}{(I_t+I_b)}\omega_i^2$

4. Which one of the following statement is false?

(1) Pure Si doped with trivalent impurities gives a p-type semiconductor.

(2) Majority carriers in a n-type semiconductor are holes.

(3) Minority carriers in a p-type semiconductor are electrons.

(4) The resistance of intrinisic semiconductor decreases with increase of temperature.

Ans. (2)

Sol. In a n-type semiconductors, electrons are majority carriers and holes are minority carriers.

5. The displacement of a particle along the x axis is given by $x = a\sin^2\omega t$. The motion of the particle corresponds to

(1) simple harmonic motion of frequency ω/π (2) simple harmonic motion of frequency $3\omega/2\pi$

(3) non simple harmonic motion (4) simple harmonic motion of frequency $\omega/2\pi$

Ans. (1)

Sol. $x = a\sin^2\omega t$

$$= a\left(\frac{1-\cos 2\omega t}{2}\right) \qquad (\because \cos 2\theta = 1 - 2\sin^2\theta)$$

$$= \frac{a}{2} - \frac{a\cos 2\omega t}{2}$$

$\therefore$ Velocity, $u = \frac{dx}{dt} = \frac{2\omega a \sin 2\omega t}{2}$

$= \omega a \sin 2\omega t$

Acceleration, $a = \frac{du}{dt} = 2\omega^2 a\cos 2\omega t$

For the given displacement $x = \frac{a}{2} - \frac{a\cos 2\omega t}{2}$

$a \propto -x$ is satisfied.

Hence, the motion of the particle is simple harmonic motion.

Note : The given motion is a simple harmonic motion with a time period $T = \frac{2\pi}{2\omega} = \frac{\pi}{\omega}$

6. The radii of circular orbits of two satellites A and B of the earth, are 4R and R, respectively. If the speed of satellite A is 3V, then the speed of satellite B will be

(1) $\frac{3V}{4}$ (2) 6V (3) 12 V (4) $\frac{3V}{2}$

Ans. (2)

Sol. Orbit speed of the satellite around the earth is

$$u = \sqrt{\frac{GM}{r}}$$

where,

G = Universal gravitational constant

M = Mass of earth

r = Radius of the orbit of the satellite

For satellite A

$r_A = 4R$, $u_A = 3V$ $\quad u_A = \sqrt{\dfrac{GM}{r_A}}$ ....(i)

For satellite B

$r_B = R$, $u_B = ?$ $\quad u_B = \sqrt{\dfrac{GM}{r_B}}$ ....(ii)

Dividing equation (ii) by equation (i), we get

$\therefore \quad \dfrac{u_B}{u_A} = \sqrt{\dfrac{r_A}{r_B}} \qquad u_B = u_A\sqrt{\dfrac{r_A}{r_B}}$

Substituting the given values, we get

$u_B = 3V\sqrt{\dfrac{4R}{R}} \qquad u_B = 6\ V$

7. A beam of cathode rays is subjected to crossed electric (E) and magnetic fields (B). The fields are adjusted such that the beam is not deflected. The specific charge of the cathode rays is given by

(1) $\dfrac{B^2}{2VE^2}$ (2) $\dfrac{2VB^2}{E^2}$ (3) $\dfrac{2VE^2}{B^2}$ (4) $\dfrac{E^2}{2VB^2}$

(Where V is the potential difference between cathode and anode)

Ans. (4)

Sol. When a beam of cathode rays (or electrons) are subjected to crossed electric (E) and magnetic (B) fields, the beam is not deflected, if

Force on electron due to magnetic field = Force on electron due to electric field

$Beu = eE$ or $u = \dfrac{E}{B}$ ....(i)

If V is the potential difference between the anode and the cathode, then

$\therefore \quad \dfrac{1}{2}mu^2 = eV \qquad \dfrac{e}{m} = \dfrac{u^2}{2V}$ ....(ii)

Substituting the value of u from equation (i) in equation (ii), we get

$$\frac{e}{m} = \frac{E^2}{2VB^2}$$

Specific charge of the cathode rays $\dfrac{e}{m} = \dfrac{E^2}{2VB^2}$

8. A ball is dropped from a high platform at t = 0 starting from rest. After 6 seconds another ball is thrown downwards from the same platform with a speed v. The two balls meet at t = 18 s. What is the value of v? (Take $g = 10\ m/s^2$)

(1) 75 m/s (2) 55 m/s (3) 40 m/s (4) 60 m/s

Ans. (1)

Sol. Let the two balls meet after t s at distance x from the platform.

For the first ball

$u = 0,\ t = 18\ s,\ g = 10\ m/s^2$

Using $h = ut + \frac{1}{2}gt^2$

$\therefore \quad x = \frac{1}{2}gt^2$ ....(i)

$u \times 12 + \frac{1}{2} \times 10 \times (12)^2$

For the second ball

$u = u,\ t = 12\ s,\ g = 10\ m/s^2$

Using $h = ut + \frac{1}{2} \times 10 \times 10^2$ ....(ii)

From equations (i) and (ii), we get

$$\frac{1}{2} \times 10 \times 18^2 = 12u + \frac{1}{2} \times 10 \times (12)^2$$

or $\quad 12u = \frac{1}{2} \times 10 \times [(18)^2 - (12)^2]$

$= \frac{1}{2} \times 10 \times [(18 + 12)\ (18 - 12)]$

$12u = \frac{1}{2} \times 10 \times 30 \times 6$

or $\quad u = \frac{1 \times 10 \times 30 \times 6}{2 \times 12} = 75\ m/s$

9. A ray of light travelling in a transparent medium of refractive index μ, falls on a surface separating the medium from air at an angle of incidence of 45º. For which of the following value of μ the ray can undergo total internal reflection?

(1) $\mu = 1.33$ (2) $\mu = 1.40$ (3) $\mu = 1.50$ (4) $\mu = 1.25$

Ans. (3)

Sol. For total internal reflection,

$\sin i > \sin C$

where,

i = angle of incidence

C = critical angle

But, $\sin C = \frac{1}{\mu}$

$\therefore \quad \sin i > \frac{1}{\mu} \quad$ or $\quad \mu > \frac{1}{\sin i}$

$\mu > \frac{1}{\sin 45^\circ} \quad$ (i = 45° (Given))

$\mu > \sqrt{2}$

Hence, option (c) is correct

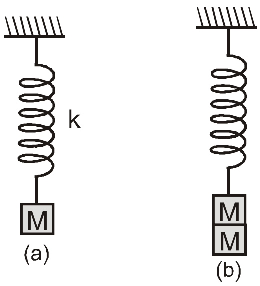
10. The period of oscillation of a mass m suspended from a spring of negligible mass is T. If along with it another mass M is also suspended the period of oscillation will now be

(1) T (2) $\frac{T}{\sqrt{2}}$ (3) 2T (4) $\sqrt{2}T$

Ans. (4)

Sol. A mass M is suspended from a massless spring of spring constant k as shown in figure (a). Then,

Time period of oscillation is $T = 2\pi\sqrt{\frac{M}{k}}$ ......(i)



When a another mass M is also suspended with it as shown in figure (b). Then,

Time period of oscillation is $T' = 2\pi\sqrt{\frac{M+M}{k}} = 2\pi\sqrt{\frac{2M}{k}}$

$= \sqrt{2}\left(2\pi\sqrt{\frac{M}{k}}\right) = \sqrt{2}\,T$ (Using (i))

11. A cylindrical metallic rod in thermal contact with two reservoirs of heat at its two ends conducts an amount of heat Q in time t. The metallic rod is melted and the material is formed into a rod of half the radius of the original rod. What is the amount of heat conducted by the new rod, when placed in thermal contact with the two reservoirs in time t?

(1) $\frac{Q}{4}$ (2) $\frac{Q}{16}$ (3) 2Q (4) $\frac{Q}{2}$

Ans. (2)

Sol. The amount of heat flows in time t through a cylindrical metallic rod of length L and uniform area of cross-section A (= πR^2) with its ends maintained at temperatures T_1 and T_2 ($T_1 > T_2$) is given by

$$Q = \frac{KA(T_1 - T_2)}{L} t \qquad ....(i)$$

where K is the thermal conductivity of the material of the rod.

Area of cross-section of new rod A' = $\pi\left(\frac{R}{2}\right)^2 = \frac{\pi R^2}{4} = \frac{A}{4}$ ....(ii)

As the volume of the rod remains unchanged

$\therefore$ AL = A'L'

where L' is the length the new rod

or $L' = L \frac{A}{A'}$ ....(iii)

$= 4L$ (Using (ii))

Now, the amount of heat flows in same time t in the new rod with its ends maintained at the same temperatures T_1 and T_2 is given by

$$Q' = \frac{KA'(T_1 - T_2)t}{L'} \qquad ....(iv)$$

Substituting the values of A' and L' from equations (ii) and (iii) in the above equation, we get

$$Q' = \frac{K(A/4)(T_1 - T_2)t}{4L} = \frac{1}{16}\frac{KA(T_1 - T_2)t}{L}$$

$$= \frac{1}{16} Q \quad \text{(Using (i))}$$

12. A ball moving with velocity 2 m/s collides head on with another stationary ball of double the mass. If the coefficient of restitution is 0.5, then their velocities (in m/s) after collision will be

(1) 0, 1 (2) 1, 1 (3) 1, 0.5 (4) 0, 2

Ans. **(1)**

Sol. Here, $m_1 = m$, $m_2 = 2m$

$u_1 = 2$ m/s, $u_2 = 0$

coefficient of restitution, e = 0.5

Let v_1 and v_2 be their respective velocities after collision.

Applying the law of conservation of linear momentum, we get

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

$\therefore$ $m \times 2 + 2m \times 0 = m \times v_1 + 2m \times v_2$

or $2m = mv_1 + 2mv_2$

or $2 = (v_1 + 2v_2)$ ...(i)

By definition of coefficient of restitution,

$$e = \frac{v_2 - v_1}{u_1 - u_2}$$

or $e(u_1 - u_2) = v_2 - v_1$

$0.5(2 - 0) = v_2 - v_1$ ...(ii)

$1 = v_2 - v_1$

Solving equations (i) and (ii), we get

$v_1 = 0$ m/s, $v_2 = 1$ m/s

13. A transverse wave is represented by $y = A\sin(\omega t - kx)$. For what value of the wavelength is the wave velocity equal to the maximum particle velocity?

(1) $\pi A/2$ (2) πA (3) $2\pi A$ (4) A

Ans. (3)

Sol. The given wave euqation is

$$y = A\sin(\omega t - kx)$$

Wave velocity, $v = \frac{\omega}{k}$ ...(i)

Particle velocity, $v_p = \frac{dy}{dt} = A\omega\cos(\omega t - kx)$

Maximum particle velocity, $(v_p)_{max} = A\omega$ ...(ii)

According to the given question

$v = (v_p)_{max}$

$\frac{\omega}{k} = A\omega$ (Using (i) and (ii)

$\frac{1}{k} = A$ or $\frac{\lambda}{2\pi} = A$ $\left(\because k = \frac{2\pi}{\lambda}\right)$

$\lambda = 2\pi A$

14. A particle has initial velocity $(3\hat{i} + 4\hat{j})$ and has acceleration $(0.4\hat{i} + 0.3\hat{j})$. Its speed after 10 s is

(1) 7 units (2) $7\sqrt{2}$ units (3) 8.5 units (4) 10 units

Ans. (2)

Sol. Here,

Initial velocity, $\vec{u} = 3\hat{i} + 4\hat{j}$

Acceleration, $\vec{a} = 0.4\hat{i} + 0.3\hat{j}$

Time, t = 10s

Let $\vec{v}$ be velocity of a particle after 10s.

Using, $\vec{v} = \vec{u} + +\vec{a}t$

$\therefore \quad \vec{v} = (3\hat{i} + 4\hat{j}) + (0.4\hat{i} + 0.3\hat{j})(10)$

$= 3\hat{i} + 4\hat{j} + 4\hat{i} + 3\hat{j} = 7\hat{i} + 7\hat{j}$

Speed of the particle after 10s = $|\vec{v}| = \sqrt{(7)^2 + (7)^2}$

$= 7\sqrt{2}$ units

15. An engine pumps water through a hose pipe. Water passes through the pipe and leaves it with a velocity of 2 m/s. The mass per unit length of water in the pipe is 100 kg/m. What is the power of the engine?

(1) 400 W (2) 200 W (3) 100 W (4) 800 W

Ans. (4)

Sol. Here,

Mass per unit length of water, μ = 100 kg/m

Velocity of water, v = 2m/s

Power of engine, $P = \mu v^3$

$= (100 \text{ kg/m})(2\text{m/s})^3$

$= 800\text{W}$

16. A thin ring of radius R meter has charge q coulomb uniformly spread on it. The ring rotates about its axis with a constant frequency of f revolutions/s. The value of magnetic induction in Wb/m^2 at the centre of the ring is

Ans. (4)

(1) $\frac{\mu_0 qf}{2\pi R}$ (2) $\frac{\mu_0 q}{2\pi fR}$ (3) $\frac{\mu_0 q}{2fR}$ (4) $\frac{\mu_0 qf}{2R}$

Sol. Current produced due to circular motion of charge q is

$I = qf$

Magnetic field induction at the centre of the ring of radius R is

$$B = \frac{\mu_0 2\pi I}{4\pi R} = \frac{\mu_0 I}{2R} = \frac{\mu_0 qf}{2R} \qquad \text{(Using (i))}$$

17. Which one of the following bonds produces a solid that reflects light in the visible region and whose electrical conductivity decreases with temperature and has high melting point?

(1) metallic bonding (2) van der Wall's bonding

(3) ionic bonding (4) covalent bonding

Ans. (1)

18. A particle moves a distance x in time t according to equation $x = (t + 5)^{-1}$. The acceleration of particle is proportional to

(1) $(\text{velocity})^{3/2}$ (2) $(\text{velocity})^{2}$ (3) $(\text{velocity})^{-2}$ (4) $(\text{velocity})^{2/3}$

Ans. (1)

Sol. Distance, $x = (t + 5)^{-1}$ ...(i)

Velocity, $v = \frac{dx}{dt} = \frac{d}{dt}(t+5)^{-1}$

$= -(t + 5)^{-2}$ ...(ii)

Acceleration, $a = \frac{dv}{dt} = \frac{d}{dt}[-(t+5)^{-2}]$

$= 2(t + 5)^{-3}$ ...(iii)

From equation (ii), we get

$v^{3/2} = -(t + 5)^{-3}$ ...(iv)

Substituting this in equation (iii) we get

Acceleration, $a = -2v^{3/2}$

or $a \propto (\text{velocity})^{3/2}$

From equation (i), we get

$$x^3 = (t + 5)^{-3}$$

Substituting this in equation (iii), we get

Acceleration, $a = 2x^3$

or $a \propto (\text{distance})^3$

Hence option (a) is correct

19. A conducting circular loop is placed in a uniform magnetic field, B = 0.025 T with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of 1 mm s^{-1}. The induced emf when the radius is 2 cm, is

(1) $2\pi\ \mu$ V (2) $\pi\ \mu V$ (3) $\frac{\pi}{2}\mu V$ (4) $2\mu V$

Ans. (2)

Sol. Here,

Magnetic field B = 0.025 T

Radius of the loop, $r = 2cm = 2 \times 10^{-2}$ m

Constant rate at which radius of the loop shrinks

$$\frac{dr}{dt} = 1 \times 10^{-3}\ ms^{-1}$$

Magnetic flux linked with the loop is

$\phi = BA\cos\theta = B(\pi r^2)\cos 0° = B\pi r^2$

The magnitude of the induced emf is

$$|\varepsilon| = \frac{d\phi}{dt} = \frac{d}{dt}(B\pi r^2) = B\pi 2r\frac{dr}{dt}$$

$$= 0.025 \times \pi \times 2 \times 2 \times 10^{-2} \times 1 \times 10^{-3}$$

$$= \pi \times 10^{-6} V = \pi\ \mu V$$

20. The activity of a radioactive sample is measured as N_0 counts per minute at t = 0 and N_0/e counts per minute at t = 5 minutes. The time (in minutes) at which the activity reduces to half its value is

(1) $\log_e \frac{2}{5}$ (2) $\frac{5}{\log_e 2}$ (3) $5\log_{10}2$ (4) $5\log_e 2$

Ans. (4)

Sol. According to activity law

$R = R_0 e^{-\lambda t}$ ...(i)

where,

R_0 = initial activity at t = 0

R = activity at time t

λ = decay constant

According to given problem,

$R_0 = N_0$ counts per minute

$R = \frac{N_0}{e}$ counts per minute

t = 5 minutes

Substituting these values in equation (i), we get

$$\frac{N_0}{e} = N_0 e^{-5\lambda}$$

$e^{-1} = e^{-5\lambda}$

$5\lambda = 1$ or $\lambda = \frac{1}{5}$ per minute

At $t = T_{1/2}$, theactivity R reduces to $\frac{R_0}{2}$.

where $T_{1/2}$ = half life of a radioactive sample

From equation (i), we get

$$\frac{R_0}{2} = R_0 e^{-\lambda T_{1/2}}$$

$e^{\lambda T_{1/2}} = 2$

Taking natural logarithms of both sides of above equation, we get

$\lambda T_{1/2} = \log_e 2$

or $T_{1/2} = \frac{\log_e 2}{\lambda} = \frac{\log_e 2}{\left(\frac{1}{5}\right)} = 5\log_e 2$ minutes

21. Two particles which are initially at rest, move towards each other under the action of their internal attraction. If their speeds are v and 2v at any instant, then the speed of centre of mass of the system will be

(1) 2v (2) zero (3) 1.5 v (4) v

Ans. **(2)**

Sol. As no external force is acting on the system, the centre of mass must be at rest i.e. $v_{CM} = 0$.

22. A particle of mass M is situated at the center of a spherical shell of same mass and radius a. The gravitational potential at a point situated at $\frac{a}{2}$ distance from the centre, will be

(1) $-\frac{3GM}{a}$ (2) $-\frac{2GM}{a}$ (3) $-\frac{GM}{a}$ (4) $-\frac{4GM}{a}$

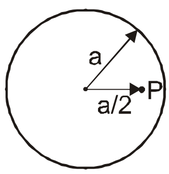
Ans. **(1)**

Sol. Here, Mass of the particle = M

Mass of the spherical shell = M

Radius of the spherical shell = a

Point P is at a distance $\frac{a}{2}$ from the centre of the shell as shown in figure



Gravitational potential at point P due to particle at O is

$$V_1 = -\frac{GM}{(a/2)}$$

Gravitational potential at point P due to spherical shell is

$$V_2 = -\frac{GM}{a}$$

Hence, total gravitational potential at the point P is

$$V = V_1 + V_2$$

$$= -\frac{GM}{(a/2)} + \left(-\frac{GM}{a}\right) = -\frac{2GM}{a} - \frac{GM}{a} = -\frac{3GM}{a}$$

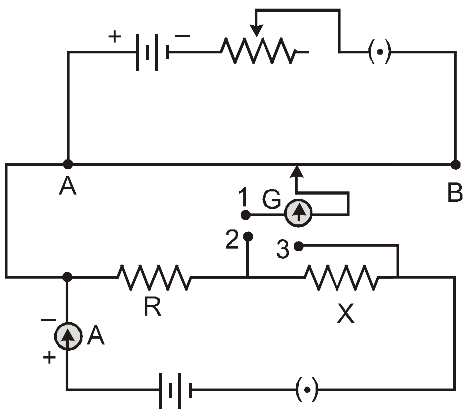
23. The device that act as a complete electronic circuit is

(1) junction diode (2) integrated circuit (3) junction transistor (4) zener diode

Ans. (2)

Sol. The device that can act as a complete circuit is integrated circuit (1C).

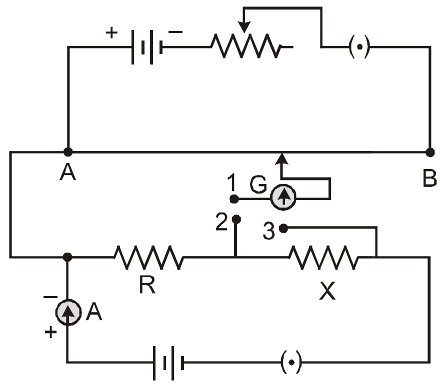
24. A potentiometer circuit is set up as shown. The potential gradient, across the potentiometer wire, is k volt/cm and the ammeter, present in the circuit reads 1.0 A when two way key is switched off. The balance points, when the key between the terminals (i) 1 and 2 (ii) 1 and 3, is plugged in, are found to be at length l_1 cm and l_2 cm respectively. The magnitudes, of the resistors R and X, in ohms, are then, equal, respectively, to



(1) $k(l_2 - l_1)$ and kl_2 (2) kl_1 and $k(l_2 - l_1)$ (3) $k(l_2 - l_1)$ and kl_1 (4) kl_1 and kl_2

Ans. (2)

Sol.



When the two way key is switched off, then

The current flowing in the resistors R and X is $I = 1A$ ...(i)

When the key between the terminals 1 and 2 is plugged in, then

Potential difference across R = $IR = k\ell_1$ ...(ii)

where k is the potneital gradient across the potentiometer wire

When the key between the terminals 1 and 3 is plugged in, then

Potential difference across (R + X) = $I(R + X) = k\ell_2$ ...(iii)

From equation (ii), we get

$$R = \frac{k\ell_1}{I} = \frac{k\ell_1}{1} = k\ell_1\Omega$$

From equation (iii), we get

$$R + X = \frac{k\ell_2}{I} = \frac{k\ell_2}{1} = k\ell_1 \qquad \text{(Using (i))}$$

$X = k\ell_2 - R$

$= k\ell_2 - k\ell_1$ (Using (ii))

$= k(\ell_2 - \ell_1)\ \Omega$

25. A tuning fork of frequency 512 Hz makes 4 beats per second with the vibrating string of a piano. The beat frequency decreases to 2 beats per sec when the tension in the piano string is slightly increased. The frequency of the piano string before increasing the tension was

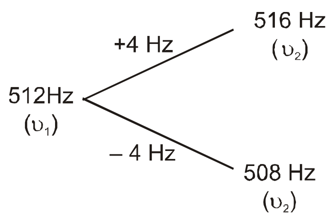
(1) 510 Hz (2) 514 Hz (3) 516 Hz (4) 508 Hz

Ans. (4)

Sol. Let the frequencies of tuning fork and piano string be υ_1 and υ_2 respectively.

$\therefore\ \upsilon_2 = \upsilon_1 \pm 4 = 512 \text{ Hz} \pm 4$

$= 516$ Hz or 508 Hz



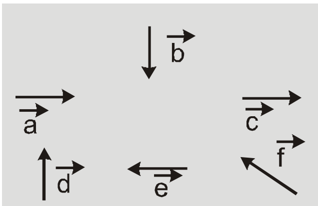
Increase in the tension of a piano string increases its frequecy.

If υ_2 = 516 Hz, further increase in υ_2, resulted in an increase in the beat frequency. But this is not given in the question.

If υ_2 = 508 Hz, further increase in υ_2 resulted in decrease in the beat frequency. This is given in the question. when the beat frequency decreases to 2 beats per second.

Therefore, the frequency of the piano string before increasing the tension was 508 Hz.

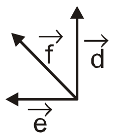
26. Six vectors, $\vec{a}$ through $\vec{f}$ have the magnitudes and directions indicated in the figure. Which of the following statements is true?



(1) $\vec{b}+\vec{c}=\vec{f}$ (2) $\vec{d}+\vec{c}=\vec{f}$ (3) $\vec{d}+\vec{e}=\vec{f}$ (4) $\vec{b}+\vec{e}=\vec{f}$

Ans. (3)

Sol.



From figure, $\vec{d}+\vec{e}=\vec{f}$

27. A galvanometer has a coil of resistance 100 ohm and gives a full scale deflection for 30mA current. If it is to work as a voltmeter of 30 volt range, the resistance required to be added will be

(1) 900 Ω (2) 1800 Ω (3) 500 Ω (4) 1000 Ω

Ans. (1)

Sol. Here,

Resistance of galvanometer, G = 100Ω

Current for full scale deflection, I_g = 30mA

$= 30 \times 10^{-3}$ A

Range of voltmeter, V = 30V

To convert the galvanometer into an voltmeter of a given range, a resistance R is connected in series with it as shown in the figure.

28. A gramophone record is revolving with an angular velocity ω. A coin is placed at a distance r from the centre of the record. The static coefficient of friction is μ. The coin will revolve with the record if

(1) $r = \mu g \omega^2$ (2) $r = \frac{\omega^2}{\mu g}$ (3) $r \le \frac{\mu g}{\omega^2}$ (4) $r \ge \frac{\mu g}{\omega^2}$

Ans. (3)

Sol. The coin will revolve with the record, if Force of friction $\geq$ Centrifugal force

$\mu mg \geq mr\omega^2$

or $r \geq \dfrac{\mu g}{\omega^2}$

29. Which of the following statement is false for the properties of electromagnetic waves?

(1) Both electric and magnetic field vectors attain the maxima and minima at the same place and same time.

(2) The energy in electromagnetic wave is divided equally between electric and magnetic vectors.

(3) Both electric and magnetic field vectors are parallel to each other perpendicular to the direction of propagation of wave.

(4) These waves do not require any material medium for propagation.

Ans. (3)

Sol. In an electromagnetic wave both electric and magnetic vectors are perpendicular to each other as well as perpendicular to the direction of propagation of wave.

30. The energy of a hydrogen atom in the ground state is –13.6 eV. The energy of a He^+ ion in the first excited state will be

(1) – 13.6 eV (2) – 27.2 eV (3) – 54.4 eV (4) – 6.8 eV

Ans. (1)

Sol. Energy of an hydrogen like atom like He^+ in an n^{th} orbit is given by

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

For hydrogen atom, Z = 1

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

For ground state, n = 1

$$\therefore \quad E_1 = -\frac{13.6}{1^2}\ \text{eV} = -13.6\ \text{eV}$$

For He^+ ion, Z = 2

$$E_n = -\frac{4(13.6)}{(2)^2}\ \text{eV} = -13.6\ \text{eV}$$

For first excited state, n = 2

$$\therefore \quad E_2 = -\frac{4(13.6)}{(2)^2}\ \text{eV} = -13.6\ \text{eV}$$

Hence, the energy in He^+ ion in first excited state is same that of energy of the hydrogen atom in ground state i.e., – 13.6 eV

31. The dimension of $\frac{1}{2}\varepsilon_0 E^2$, where ε_0 is permittivity of free space and E is electric field, is

(1) ML^2T^{-2} (2) $ML^{-1}T^{-2}$ (3) ML^2T^{-1} (4) MLT^{-1}

Ans. (2)

Sol. Energy density of an electric field E is

$$u_E = \frac{1}{2}\varepsilon_0 E^2$$

where ε_0 permittivity of free space

$$\frac{\text{Energy}}{\text{Volume}} = \frac{ML^2T^{-2}}{L^3}$$

$= ML^{-1}T^{-2}$

Hence, the dimension of $\frac{1}{2}\varepsilon_0 E^2$ is $ML^{-1}T^{-2}$

32. In producing chlorine by electrolysis 100 kW power at 125 V is being consumed. How much chlorine per minute is liberated (E.C.E. of chlorine is 0.367×10^{-6} kg/C)

(1) 1.76×10^{-3} kg (2) 9.67×10^{-3} kg (3) 17.61×10^{-3} kg (4) 3.67×10^{-3} kg

Ans. (3)

Sol. Current, $I = \frac{P}{V} = \frac{100 \times 10^3 \, W}{125V} = 800$ A

According to the Faraday's first law of electrolysis Mass of chlorine liberated, m = zIt

m = $(0.367 \times 10^{-6}$ kg/C) (800 A) (60 s)

$$= \left(0.367 \times 10^{-6}\frac{kg}{C}\right)\left(800\frac{C}{s}\right)(60\text{ s})$$

$= 17.6 \times 10^{-3}$ kg

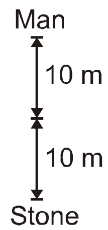
33. A man of 50 kg mass is standing in a gravity free space at a height of 10 m above the floor. He throws a stone of 0.5 kg mass downwards with a speed 2 m/s. When the stone reaches the floor, the distance of the man above the floor will be

(1) 9.9 m (2) 10.1 m (3) 10 m (4) 20 m

Ans. (2)

Sol. Since the man is in gravity free space, force on man + stone system is zero

Therefore centre of mass of the system remains at rest. Let the man goes x m above when the stone reaches the floor, then



$M_{man} \times x = M_{stone} \times 10$

$$x = \frac{0.5}{50} \times 10$$

$x = 0.1$ m

Therefore final height of man above

floor = 10 + x

= 10 + 0.1 = 10.1 m

34. An alpha nucleus of energy $\frac{1}{2}mu^2$ bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to

(1) $\frac{1}{Ze}$ (2) u^2 (3) $\frac{1}{m}$ (4) $\frac{1}{u^4}$

Ans. (3)

Sol. At the distance of closest approach d, Kinetic energy = Potential energy

$$\frac{1}{2}mv^2 = \frac{1}{4\pi\varepsilon_0}\frac{(2e)(Ze)}{r_0}$$

where,

Ze = charge of target nucleus
2e = charge of alpha nucleus

$\frac{1}{2}m\upsilon^2$ = kinetic energy of alpha nucleus of mass m moving with velocity v

or $d = \dfrac{2Ze^2}{4\pi\varepsilon_0\left(\frac{1}{2}m\upsilon^2\right)}$ $\therefore$ $d \propto \frac{1}{m}$

35. A lens having focal length f and aperture of diameter d forms an image of intensity I. Aperture of diameter $\frac{d}{2}$ in central region of lens is covered by a block paper. Focal length of lens and intensity of image now will be respectively

(1) f and $\frac{I}{4}$ (2) $\frac{3f}{4}$ and $\frac{I}{2}$ (3) f and $\frac{3I}{4}$ (4) $\frac{f}{2}$ and $\frac{I}{2}$

Ans. (3)

Sol. Focal length of the lens remains same. Intensity of image formed by lens is proportional to area exposed to incident light from object.
i.e., intensity $\propto$ area

i.e., $\frac{I_2}{I_1} = \frac{A_2}{A_1}$

Initial area, $A_1 = \left(\frac{d}{2}\right)^2 = \frac{\pi d^2}{4}$

After blocking, exposed area,

$$A_2 = \frac{\pi d^2}{4} - \frac{\pi(d/2)^2}{4}$$

$$= \frac{\pi d^2}{4} - \frac{\pi d^2}{16} = \frac{3\pi d^2}{16}$$

$\therefore$ $\frac{I_2}{I_1} = \frac{A_2}{A_1} = \dfrac{\frac{3\pi d^2}{16}}{\frac{\pi d^2}{16}} = \frac{3}{4}$ or $I_2 = \frac{3}{4}I_1 = \frac{3}{4}I$ $(\because\ I_2 = I)$

Hence focal length of a lens = f_1 intensity of the image = $\frac{3I}{4}$

36. If ΔU and ΔW represent the increase in internal energy and work done by the system respectively in a thermodynamical process, which of the following is true?

(1) $\Delta U = -\Delta W$, in a adiabatic process (2) $\Delta U = \Delta W$, in a isothermal process

(3) $\Delta U = \Delta W$, in a adiabatic process (4) $\Delta U = -\Delta W$, in a isothermal process

Ans. (1)

Sol. According to first law of thermodynamics $\Delta Q = \Delta U + \Delta W$ ....(i)

where,

ΔQ = Heat supplied to the system

Δu = Increase in internal energy of the system

ΔW = Work done by the system

For an adiabatic process

$\Delta Q = 0$

From equation (i), we get

$\Delta u = -\Delta W$

For an isothermal process

$\Delta u = 0$

Hence, option (a) is true,

37. The total radiant energy per unit area, normal to the direction of incidence, received at a distance R from the centre of a star of radius r, whose outer surface radiates as a black body at a temperature TK is given by (where σ is Stefan's constant)

(1) $\frac{\sigma r^2 T^4}{R^2}$ (2) $\frac{\sigma r^2 T^4}{4\pi r^2}$ (3) $\frac{\sigma r^4 T^4}{r^4}$ (4) $\frac{4\pi\sigma r^2 T^4}{R^2}$

Ans. (1)

Sol. According to the stefan Boltzmann law, the power radiated by the star whose outer surface radiates as a black body at temperature T K is given by

$P = 4\pi r^2 \sigma T^4$

where,

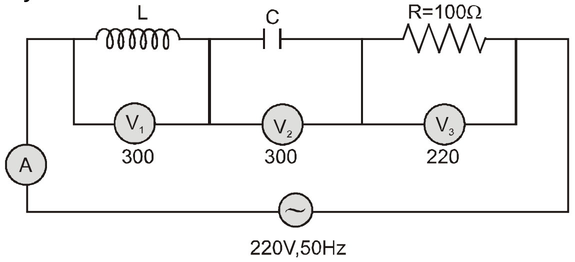
r = radius of the star

s = Stefan's constant

The radiant power per unit area received at a distance R from the centre of a star is

$$S = \frac{P}{4\pi R^2} = \frac{4\pi r^2 \sigma T^4}{4\pi R^2} = \frac{\sigma r^2 T^4}{R^2}$$

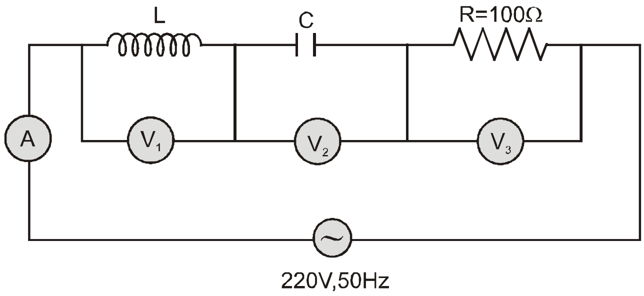
38. In the given circuit the reading of voltmeter V_1 and V_2 are 300 volts each. The reading of the voltmeter V_3 and ammeter A are respectively



(1) 150 V, 2.2 A (2) 220 V, 2.2 A (3) 220 V, 2.0 A (4) 100 V, 2.0 A

Ans. (2)

Sol.



As $V_L = V_C = 300$ V, therefore the givne series LCR circuit is in resonance.

$\therefore \quad V_R = V = 220$ V

$Z = R = 100\ \Omega$

Current, $I = \dfrac{V}{Z} = \dfrac{220\text{ V}}{100\,\Omega} = 2.2$ A

Hence, the reading of the voltmeter V_3 is 220 V and the reading of ammeter A is 2.2 A.

39. A 220 volt input is supplied to a transformer. The output circuit draws a current of 2.0 ampere at 440 volts. If the efficiency of the transformer is 80% the current drawn by the primary windings of the transformer is

(1) 3.6 ampere (2) 2.8 ampere (3) 2.5 ampere (4) 5.0 ampere

Ans. (4)

Sol. Here,

Input voltage, $V_p = 220$ V

Output voltage, $V_s = 440$ V

Input current, $I_p = ?$

Output voltage, $I_s = 2$ A

Efficiency of the transformer, $\eta = 80$ %

Efficiency of the transformer, $\eta = \dfrac{\text{Output power}}{\text{Input power}}$

$$\eta = \frac{V_s I_s}{V_p I_p}$$

or $$I_p = \frac{V_s I_s}{\eta V_p} = \frac{(440\text{ V})(2\text{A})}{\left(\frac{80}{100}\right)(220\text{ V})} = \frac{(440\text{ V})(2\text{A})(100)}{(80)(220\text{ V})} = 5\text{A}$$

40. A source S_1 is producing 10^{15} photons per second of wavelength 5000Å. Another sorce S_2 is producing 1.02 × 10^{15} photons per second of wavelength 5100 Å. Then (power of S_2)/(power of S_1) is equal to

(1) 1.00 (2) 1.02 (3) 1.04 (4) 0.98

Ans. (1)

Sol. For a source S_1,

Wavelength, $\lambda_1 = 5000$ Å

Number of photons emitted per second, $N_{1 = 10}{}^{15}$

Energy of each photon, $E_1 = \dfrac{hc}{\lambda_1}$

Power of source S_1, $P_1 = E_1 N_1 = \dfrac{N_1 hc}{\lambda_1}$

For a source S_2,
Wavelength, $\lambda_2 = 5100$ Å
Number of photons emitted per second, $N_2 = 1.02 \times 10^{15}$

Energy of each photon, $E_2 = \frac{hc}{\lambda_2}$

Power of source S_2, $P_2 = N_2 E_2 = \frac{N_2 hc}{\lambda_2}$

$$\therefore \qquad \frac{\text{Power of } S_2}{\text{Power of } S_1} = \frac{P_2}{P_1} = \frac{\dfrac{N_2 hc}{\lambda_2}}{\dfrac{N_2 hc}{\lambda_2}} = \frac{N_2 \lambda_1}{N_2 \lambda_2}$$

$$\frac{(1.02 \times 10^{15} \text{ photons/s}) \times (5000\text{Å})}{(10^{15} \text{photons/s}) \times (5100\text{Å})} = \frac{51}{51} = 1$$

41. A common emitter amplifier has a voltage gain of 50, an input impedance of 100 Ω and an output impedance of 200 Ω. The power gain of the amplifier is

(1) 500 (2) 1000 (3) 1250 (4) 50

Ans. (3)

Sol. Here,
Voltage gain = 50
Input resistance, $R_i = 100\Omega$
Output resistance, $R_0 = 200\Omega$

Resistance gain = $\frac{R_0}{R_i} = \frac{200\Omega}{100\Omega} = 2$

Power gain = $\frac{(\text{Voltage gain})^2}{\text{Resistance gain}} = \frac{50 \times 50}{2} = 1250$

42. A vibration magnetometer placed in magnetic meridian has a small bar magnet. The magnet executes oscillations with a time period of 2 sec in earth's horizontal magnetic field of 24 microtesla. When a horizontal field of 18 microtesla is produced opposite to the earth's field by placing a current carrying wire, the new time period of magnet will be

(1) 1 s (2) 2 s (3) 3 s (4) 4 s

Ans. (4)

Sol. The time period T of oscillation of a magnet is given by

$$T = 2\pi\sqrt{\frac{I}{MB}}$$

where,
I = Moment of inertia of magnet about the axis of rotation
M = Magnetic moment of the magnet

B = Uniform magnetic field

As the I, B remains the same

$\therefore$ $T \propto \frac{1}{\sqrt{B}}$ or $\frac{T_2}{T_1} = \sqrt{\frac{B_1}{B_2}}$

According to given problem,

$B_1 = 24\ \mu T$

$B_2 = 24\ \mu T - 18\mu T = 6\mu T$

$T_1 = 2s$

$\therefore$ $T_2 = (2s)\sqrt{\frac{(24\mu T)}{(6\mu T)}} = 4s$

43. Two positive ions, each carrying a charge q, are separated by a distance d. If F is the force of repulsion between the ions, the number of electrons missing from each ion will be (e being the charge on an electron)

(1) $\frac{4\pi\varepsilon_0 Fd^2}{e^2}$ (2) $\sqrt{\frac{4\pi\varepsilon_0 Fe^2}{d^2}}$ (3) $\sqrt{\frac{4\pi\varepsilon_0 Fd^2}{e^2}}$ (4) $\frac{4\pi\varepsilon_0 Fd^2}{q^2}$

Ans. (3)

Sol. According to Coulomb's law, the force of repulsion between the two positive ions each of charge q, separated by a distance d is given by

$$F = \frac{1}{4\pi\varepsilon_0}\frac{(q)(q)}{d^2}$$

$$F = \frac{q^2}{4\pi\varepsilon_0 d^2}$$

$$q^2 = 4\pi\varepsilon_0 Fd^2$$

$$q = \sqrt{4\pi\varepsilon_0 Fd^2} \qquad ...(i)$$

Since, q = ne

where,

n = number of electrons missing from each ion

e = magnitude of charge on electron

$\therefore$ $n = \frac{q}{e}$

$$n = \frac{\sqrt{4\pi\varepsilon_0 Fd^2}}{e} \qquad \text{(using (i))}$$

$$= \sqrt{\frac{4\pi\varepsilon_0 Fd^2}{e^2}}$$

44. The potential difference that must be applied to stop the fastest photoelectrons emitted by a nickel surface, having work function 5.01 eV, when ultraviolet light of 200 nm falls on it, must be

(1) 2.4 V (2) –1.2 V (3) – 2.4 V (4) 1.2 V

Ans. (4)

Sol. Here,

Incident wavelength, $\lambda = 200$ nm

Work function, $\phi_0 = 5.01$ eV

According to Einstein's photoelectric equation

$$eV_s = h\nu - \phi_0$$

$$eV_s = \frac{hc}{\lambda} - \phi_0$$

where V_s is the stopping potential

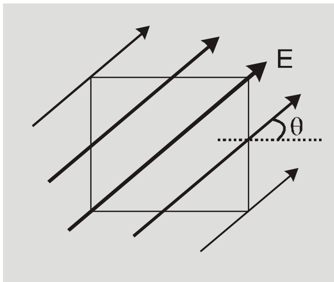
$$eV_s = \frac{(1240\ \text{eV nm})}{(200\ \text{nm})} - 5.01\ \text{eV}$$

$$= 6.2\ \text{eV} - 5.01\ \text{eV} = 1.2\ \text{eV}$$

Stopping potential, $V_s = 1.2$ V

The potential difference that must be applied to stop photoelectrons = $-V_s = -1.2$ V

45. A square surface of side L meter in the plane of the paper is placed in a uniform electric field E (volt/m) acting along the same plane at an angle θ with the horizontal side of the square as shown in figure. The electric flux linked to the surface in units of volt × meter is



(1) EL^2 (2) $EL^2\cos\theta$ (3) $EL^2\sin\theta$ (4) zero

Ans. **(4)**

Sol. Flux passing through area A

$\phi = E.\ A \cos\theta$

$\phi = \vec{E}.\vec{A} = 0$

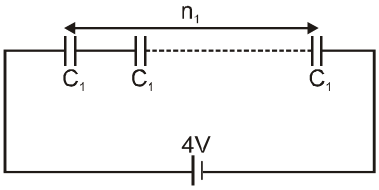
lines are parallel to the surfaces

46. A series combination of n_1 capacitors, each of value C_1 is charged by a source of potential difference 4V. When another parallel combination of n_2 capacitors, each of value C_2, is charged by a source of potential difference V, it has the same (total) energy stored in it, as the first combination has. The value of C_2, in terms of C_1, is then

(1) $\frac{2C_1}{n_1n_2}$ (2) $16\frac{n_2}{n_1}C_1$ (3) $2\frac{n_2}{n_1}C_1$ (4) $\frac{16C_1}{n_1n_2}$

Ans. **(4)**

Sol. A series combination of n_1 capacitors each of capacitance C_1 are connected to 4V source as shown in the figure.



Total capacitance of the series combination of the capacitors is

$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_1} + \frac{1}{C_1} + \text{......... upto } n_1 \text{ terms} = \frac{n_1}{C_1}$$

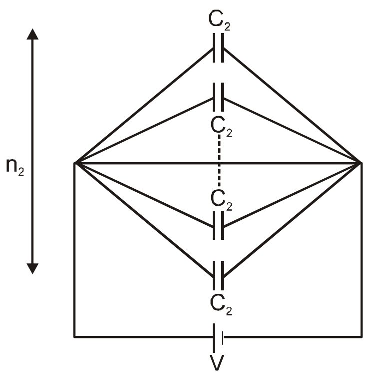
or $C_s = \dfrac{C_1}{n_1}$

Total energy stored in a series combination of the capacitors is

$$u_s = \frac{1}{2}C_s(4V)^2$$

$$= \frac{1}{2}\left(\frac{C_1}{n_1}\right)(4V)^2 \qquad \text{(using (i))...(ii)}$$

A parallel combination of n_2 capacitors each of capacitance C_2 are connected to V source as shown in the figure.



Total capacitance of the parallel combination of capacitors is

$C_p = C_2 + C_2 + \text{.....} + \text{upto } n_2 \text{ terms} = n_2C_2$

or $C_p = n_2C_2$ ...(iii)

Total energy stored in a parallel combination of capacitors is

$$u_p = \frac{1}{2}C_pV^2$$

$$= \frac{1}{2}(n_2C_2)(V)^2 \qquad \text{(Using (iii))....(iv)}$$

According to the given problem,

$U_s = U_p$

Substituting the values of u_s and u_p from equations (ii) and (iv), we get

$$\frac{1}{2}\frac{C_1}{n_1}(4V)^2 = \frac{1}{2}(n_2C_2)(V)^2$$

or $\frac{C_1 16}{n_1} = n_2C_2$ or $C_2 = \frac{16C_1}{n_1n_2}$

47. Electromagnets are made of soft iron because soft iron has

(1) low retentivity and high coercive force
(2) high retentivity and high coercive force
(3) low retentivity and low coercive force
(4) high retentivity and low coercive force

Ans. **(3)**

Sol. Electromagnetics are made of soft iron because soft iron has low retentivity and low coercive force or low coercivity. Soft iron is a soft magnetic material.

48. A square current carrying loop is suspended in a uniform magnetic field acting in the plane of the loop. If the force on one arm of the loop is $\vec{F}$, the net force on the remaining three arms of the loop is

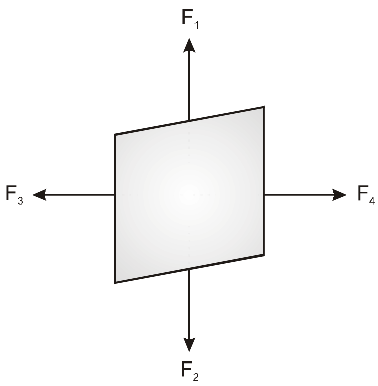
(1) $3\vec{F}$ (2) $-\vec{F}$ (3) $-3\vec{F}$ (4) $\vec{F}$

Ans. **(2)**

Sol. When loop is placed in the magnetic field then magnetic moment of coil

τ = NiBA sin θ

τ_{max} = NiBA



Force $\vec{F}_1$ and $\vec{F}_2$, which are acting on coil, are equal in magnitude but opposite in direction

Force $\vec{F}_3$ and $\vec{F}_4$ are equal in magnitude but opposite in direction, create magnetic moment. In this way force F acting on one side of loop and force –F acting on remaining side of loop.

49. Consider the following two statements.

(A) Kirchhoff's junction law follows from the conservation of charge

(B) Kirchhoff's loop law follows from the conservation of energy

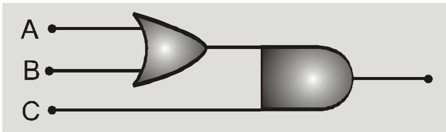
Which of the following is correct?

(1) Both (A) and (B) are wrong
(2) (A) is correct and (B) is wrong
(3) (A) is wrong and (B) is correct
(4) Both (A) and (B) are correct

Ans. **(4)**

Sol. **(d) :** Kirchoff's junction law or Kirchhoff's first law is based on the conservation of charge.
Kirchhoff's loop law or Kirchhoff's second law is based on the conservation of energy.
Hence both statements (A) and (B) are correct

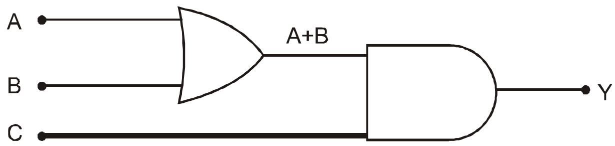
50. To get an output Y = 1 from the circuit shown below the input must be



	A	**B**	**C**
(1)	0	1	0
(2)	0	0	1
(3)	1	0	1
(4)	1	0	0

Ans. **(3)**

Sol.



The Boolean expression of the given circuit is

$$Y = (A + B) . C$$

The table truth of the given input signals as shown in the table

A	**B**	**C**	**A + B**	**Y = (A + B) .C**
0	1	0	1	0
0	0	1	0	0
1	0	1	1	1
1	0	0	1	0

From the table truth we conclude that output Y = 1, for the inputs A = 1, B = 0, C = 1
for the inputs A = 1, B = 0, C = 1
Hence option (c) is correct

PART- B (CHEMISTRY)

51. For the reaction,

$$N_2O_5(g) \longrightarrow 2NO_2(g) + \frac{1}{2} O_2(g)$$

the value of rate of disappearance of N_2O_5 is given as 6.25×10^{-3} mol L^{-1} s^{-1}. The rate of formation of NO_2 and O_2 is given respectively as:

(1) 6.25×10^{-3} mol $L^{-1}s^{-1}$ and 6.25×10^{-3} mol $L^{-1}s^{-1}$

(2) 1.25×10^{-2} mol $L^{-1}s^{-1}$ and 3.125×10^{-3} mol $L^{-1}s^{-1}$

(3) 6.25×10^{-3} mol $L^{-1}s^{-1}$ and 3.125×10^{-3} mol $L^{-1}s^{-1}$

(4) 1.25×10^{-2} mol $L^{-1}s^{-1}$ and 6.25×10^{-3} mol $L^{-1}s^{-1}$

Ans. **(2)**

Sol. Rate of disappearance of reactant = rate of appearance of product

or $$-\frac{1}{\text{stoichiometric coefficient of reactant}} \frac{d\,[\text{reactant}]}{dt}$$

$$= + \frac{1}{\text{stoichiometric coefficient of product}} \frac{d\,[\text{product}]}{dt}$$

For the reaction,

$$N_2O_5(g) \longrightarrow 2NO_2(g) + \frac{1}{2} O_2(g)$$

$$\frac{-d[N_2O_5]}{dt} = +\frac{1}{2}\frac{d[NO_2]}{dt}$$

$$= +\frac{2d[O_2]}{dt}$$

$$\therefore \quad \frac{d[NO_2]}{dt} = -\frac{2d[N_2O_5]}{dt}$$

$= 2 \times 6.25 \times 10^{-3}$ mol L^{-1} s^{-1}

$= 12.5 \times 10^{-3}$ mol L^{-1} s^{-1}

$= 1.25 \times 10^{-2}$ mol L^{-1} s^{-1}

$$\frac{d[O_2]}{dt} = -\frac{d[N_2O_5]}{dt} \times \frac{1}{2}$$

$$= \frac{6.25 \times 10^{-3}\ \text{mol}L^{-1}s^{-1}}{2} = 3.125 \times 10^{-3}\ \text{mol}\ L^{-1}s^{-1}$$

52. Liquid hydrocarbons can be converted to a mixture of gaseous hydrocarbons by:

(1) Oxidation
(2) Cracking
(3) Distillation under reduced pressure
(4) Hydrolysis

Ans. **(2)**

Sol. Lower hydrocarbons exist in gaseous state while higher ones are in liquid state or solid state.
On cracking or pyrolysis, the hydrocarbon with higher molecular mass gives a mixture of hydrocarbons having lower molecular mass. Hence, we can say that by cracking a liquid hydrocarbon can be converted into a mixture of gaseous hydrocarbons.

53. In which of the following pairs of molecules/ions, the central atoms have sp^2 hybridization ?

(1) NO_2^- and NH_3 (2) BF_3 and NO_2^- (3) NH_2^- and H_2O (4) BF_3 and NH_2^-

Ans. (2)

Sol. For sp^2 hybridisation, there must be 3σ-bonds or 2σ-bonds along with a long pair of electrons.

(i) $NO_2^- \Rightarrow 2\sigma + 1\ \ell p = 3$, i.e., sp^2 hybridisation (ii) $NH_3 \Rightarrow 3\sigma + 1\ \ell p = 4$, i.e., sp^3 hybridisation

(iii) $BF_3 \Rightarrow 3\sigma + 0\ \ell p = 3$, i.e., sp^2 hybridisation (iv) $NH_2^- \Rightarrow 2\sigma + 2\ell p = 4$, i.e., sp^3 hybridisation

(v) $H_2O \Rightarrow 2\sigma + 2\ \ell p = 4$, i.e., sp^3 hybridisation

Thus, among the given pairs, only BF_3 and NO_2^- have sp^2 hybridisation.

54. Which one of the following does not exhibit the phenomenon of mutarotation?

(1) (+) Sucrose (2) (+) Lactose (3) (+) Maltose (4) (–) Fructose

Ans. (1)

Sol. Reducing sugars that exist in hemiacetal and hemiketal forms, undergo mutarotation in aqueous solution. Among the given carbohydrates, only sucrose is a non-reducing sugar as in it the hemiacetal and hemiketal groups of glucose and fructose are linked together through O-atom and thus, not free. Due to the absence of free hemiacetal or hemiketal group, sucrose does not exhibit mutarotation.

55. Which one of the following species does not exist under normal conditions ?

(1) Be_2^+ (2) Be_2 (3) B_2 (4) Li_2

Ans. (2)

Sol. Molecules with zero bond order, do not exist.

(a) Be_2^+ $(4 + 4 - 1 = 7) = \sigma 1s^2, \sigma 1s^2, \sigma 2s^2, \sigma 2s^1$

$$BO = \frac{4-3}{2} = 0.5$$

(b) Be_2 $(4 + 4 = 8) = \sigma 1s^2, \sigma 1s^2, \sigma 2s^2, \sigma 2s^2$

$$BO = \frac{4-4}{2} = 0$$

(c) B_2 $(5 + 5 = 10) = \sigma 1s^2, \sigma 1s^2, \sigma 2s^2, \sigma 2s^2, \pi 2p_x^1 \approx \pi 2p_y^1$

$$BO = \frac{6-4}{2} = 1$$

(d) Li_2 $(3 + 3 = 6) = \sigma 1s^2, \sigma 1s^2, \sigma 2s^2$

$$BO = \frac{4-2}{2} = 1$$

Thus, Be_2 does not exist under normal conditions.

56. Which of the following complex ions is not expected to absorb visible light ?

(1) $[Ni(CN)_4]^{2-}$ (2) $[Cr(NH_3)_6]^{3+}$ (3) $[Fe(H_2O)_6]^{2+}$ (4) $[Ni(H_2O)_6]^{2+}$

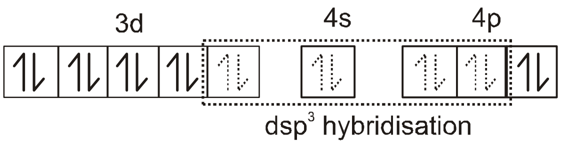
Ans. (1)

Sol. For the absorption of visible light, presence of unapried d-electrons is the necessity.

(1) $[Ni(CN)_4]^{2-}$, Ni is present as Ni^{2+}.

$Ni^{2+} = [Ar]\ 3d^8\ 4s^0$

∴ $[Ni(CN)_4]^{2-} =$



(Pairing occurs because CN^- is a strong field ligand).

Since, in $[Ni(CN)_4]^{2-}$, no unpaired electron is present in d-orbitals, it does not absorb visible lights.

(2) In $[Cr(NH_3)_6]^{3+}$, Cr is present as Cr^{3+}.

Cr^{3+} = [Ar] $3d^3\ 4s^0$ (Three unpaired electrons)

(3) In $[Fe(H_2O)_6]^{2+}$, Fe is present as Fe^{3+}.

Fe^{2+} = [Ar] $3d^6\ 4s^0$ (Four unpaired electrons)

(4) In $[Ni(H_2O)_6]^{2+}$, Ni is present as Ni^{2+}.

Ni^{2+} = [Ar] $3d^3\ 4s^0$ (Two unpaired electrons)

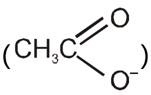
57. Given are cyclohexanol (I), acetic acid (II), 2, 4, 6-trinitrophenol (III) and phenol (IV). In these the order of decreasing acidic character will be:

(1) III > II > IV> I (2) II > III > I > IV (3) II > III > IV > I (4) III > IV > II > I

Ans. (1)

Sol. Higher the tendency to give a proton, higher is the acidic character, and tendency to lose a proton depends upon the stability of intermediate, i.e., carbanion formed.

2, 4, 6-trinitrophenol after the loss of a proton gives 2,4,6-trinitrophenoxide ion which is stabilised by resonance, –I effect and –M effect, thus is most acidic among the given compounds.

Phenol after losing a proton form phenoxide ion which is also stabilised by resonance, –M and –I effects but is less stabilised as compared to 2, 4, 6-trinitrophenoxide ions. Thus, it is less acidic as compared to 2,4,6-trinitrophenol. (CH_3COOH) after losing a proton gives acetate () ion which is stabilised by only resonance. However, it is more resonance stabilised as compared to a phenoxide ion, thus more acidic as compared to phenol. 2,4,6-trinitrophenol, however, is more acidic than acetic acid due to the presence of three electron withdrawing $–NO_2$ groups. Cyclohexanol gives an anion that is least stable among the given, thus, it is least acidic.

Hence, the correct order of acidic strength is 2, 4, 6-trinitrophenol > acetic acid > phenol > cyclohexanol.

58. If pH of a saturated solution of $Ba(OH)_2$ is 12, the value of its K_{sp} is:

(1) 4.00×10^{-6} M^3 (2) 4.00×10^{-7} M^3 (3) 5.00×10^{-6} M^3 (4) 5.00×10^{-7} M^3

Ans. (4)

Sol. Given, pH of $Ba(OH)_2 = 12$

$\therefore \quad [H^+] = [1 \times 10^{-12}]$

and $\quad [OH^-] = \dfrac{1\times10^{-14}}{1\times10^{-12}} \qquad [\because \quad [H^+]\,[OH^-] = 1 \times 10^{-14}]$

$= 1 \times 10^2$ mol/L

$$Ba(OH)_2 \longrightarrow \underset{s}{Ba^{2+}} + \underset{2s}{2OH^-}$$

$K_{sp} = [Ba^{2+}]\,[OH^-]^2$

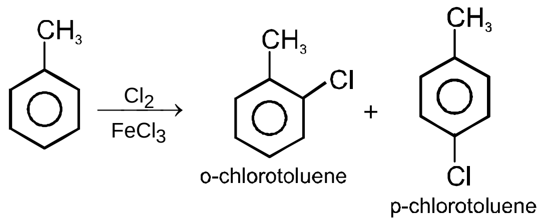
$$= [s]\,[2s]^2 = \left[\frac{1\times10^{-2}}{2}\right](1 \times 10^{-2})^2 = 0.5 \times 10^{-6} = 5.0 \times 10^{-7}\ M^3$$

59. The reaction of toluene with Cl_2 in presence of $FeCl_3$ gives 'X' and reaction in presence of light gives 'Y'. Thus, 'X' and 'Y' are:

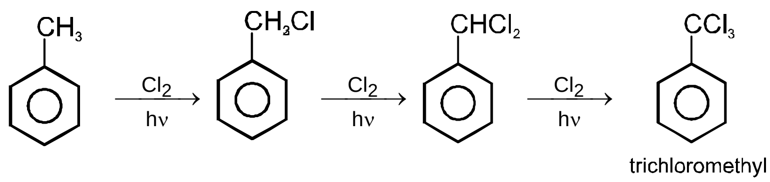
(1) X = Benzal chloride, Y = o-chlorotoluene
(2) X = m-chlorotoluene, Y = p-chlorotoluene
(3) X = o-and p-chlorotoluene, Y = Trichloromethyl benzene
(4) X = Benzyl chloride, Y = m-chlorotoluene

Ans. **(3)**

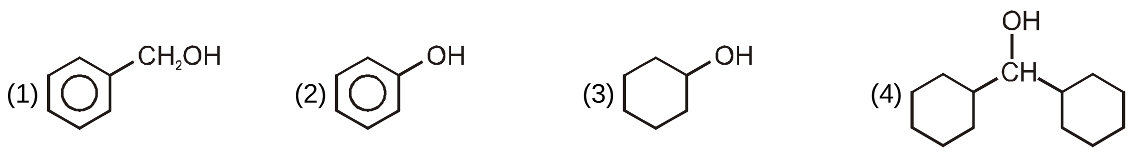
Sol. In the presence of halogen carrier, electrophilic substitution occurs while in the presence of sunlight, substitution occurs at the dide chain.



($\because$ $-CH_3$ is an o/p directing group.)



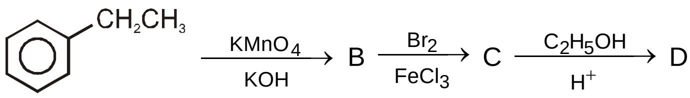
60. Which one of the following compounds has the most acidic nature?



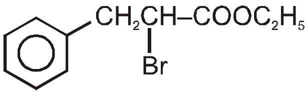
Ans. **(2)**

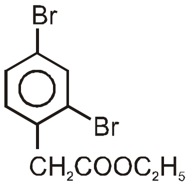
Sol. Presence of electron withdrawing substituent increases the acidity while electron relasing substituent, when present, decreases the acidity.
Phenyl is an electron withdrawing substituent while $-CH_3$ is an electron releasing substituent. Moreover, phenoxide ion is more resonance stabilised as compared to benzyloxide ion, thus releases proton more easily. That's why is a strong acid among the given.

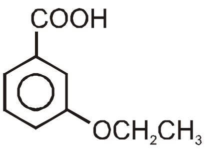
61. In a set of reactions, ethyl benzene yielded a product D.

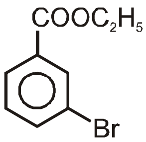


'D' would be :

(1) 

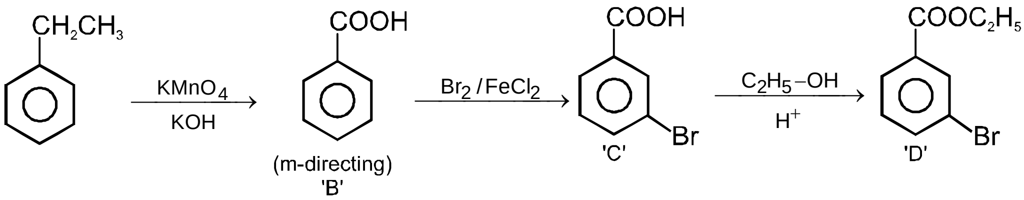
(2) 

(3) 

(4) 

Ans. (4)

Sol. Alkaline $KMnO_4$ converts complete carbon chain that is directly attached to benzene nucleus, to –COOH group. Br_2 in the presence of halogen carrier causes bromination and ehtyl alcohol in acidic medium results in esterification.



62. What is $[H^+]$ in mol/L of a solution that is 0.20 M in CH_3COONa and 0.10 M in CH_3COOH ? (K_a for CH_3COOH = 1.8×10^{-5})

(1) 3.5×10^{-4} (2) 1.1×10^{-5} (3) 1.8×10^{-4} (4) 9.0×10^{-6}

Ans. (4)

Sol. CH_3COOH (weak acid) and CH_3COONa (conjugated salt) form acidic buffer and for acidic buffer,

$$pH = pK_a + \log \frac{[salt]}{[acid]} \text{ and } [H^+] = -\text{ antilog pH}$$

$$pH = -\log K_a + \log \frac{[salt]}{[acid]} \quad [\because pK_a = -\log K_a]$$

$$= -\log(1.8 \times 10^{-5}) + \log \frac{(0.20)}{(0.10)} = 4.74 + \log 2 = 4.74 + 0.3010 = 5.041$$

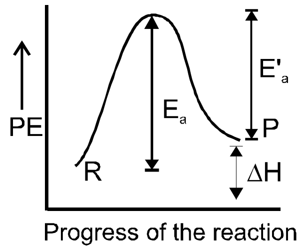
Now, $[H^+]$ = antilog (– 5.045) = 9.0×10^{-6} mol/L

63. For an endothermic reaction, energy of activation is E_a and enthalpy of reaction is ΔH (both of these in kJ/mol). Minimum value of E_a will be:

(1) less than ΔH (2) equal to ΔH (3) more than ΔH (4) equal to zero

Ans. (3)

Sol. In endothermic reactions, energy of reactants is less than that of the products. Potential energy diagram for endothermic reactions is,

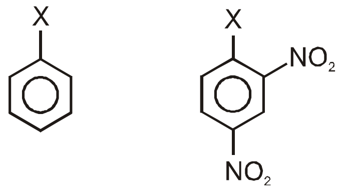


where, E_a = activation energy of forward reaction
E'_a = activation energy of backward reaction
ΔH = enthalpy of the reaction
From the above diagram,

$E'_a = E'_a + \Delta H$

Thus, $E_a > \Delta H$

64. The correct order of increasing reactivity of C – X bond towards nucleophile in the following compounds is:



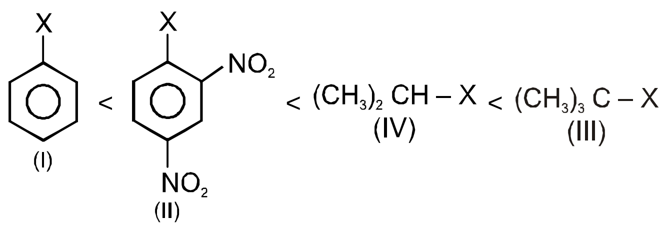
I II

$(CH_3)_3C–X$ III $(CH_3)_2CH–X$ IV

(1) I < II < IV < III (2) II < III < I < IV (3) IV < III < I < II (4) III < II < I < IV

Ans. (1)

Sol. Alkyl halides are more reactive twoward nucleophilic substitution. Reactivity depends upon the stability of carbocation intermedicate formed.
Among the given halides, aryl halide (C_6H_5X) is least reactive towards nucleophile as in it the C – X bond acquire some double bond character due to resonance. Presence of electron withdrawing groups like $–NO_2$ at ortho and para positions facilitate the nucleophilic displancent of –X of aryl halide. Among alkyl halides, 3° halides are more reactive as compared to 2° halides due to the formation of more stable carbocation. Hence, the order of reactivity of C – X bond towards nucleophile is as



65. For the reduction of silver ions with copper metal, the standard cell potential was found to be + 0.46 V at 25°C. The value of standard Gibbs energy ΔG^o will be (F = 96500 C mol^{-1})

(1) – 89.0 kJ (2) – 89.0 J (3) – 44.5 kJ (4) – 98.0 kJ

Ans. (1)

Sol. We know that,

standard Gibbs energy, $\Delta G^o = -nEF^o_{cell}$

For the cell reaction,

$2Ag^+ + Cu \longrightarrow Cu^{2+} + 2Ag$

$\Delta G^o = -2 \times 96500 \times 0.46$

$= -88780$ J

$= -88.7$ kJ ≈ -89.0 kJ

66. In which of the following equilibrium K_c and K_p are not equal?

(1) $2NO(g) \rightleftharpoons N_2(g) + O_2(g)$ (2) $SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$

(3) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ (4) $2C(s) + O_2(g) \rightleftharpoons 2CO_2(g)$

Ans. (4)

Sol. $K_p = K_c(RT)^{\Delta n}$.

67. Which of the following ions will exhibit colour in aqueous solutions ?

(1) La^{3+} (Z = 57) (2) Ti^{3+} (Z = 22) (3) Lu^{3+} (Z = 71) (4) Sc^{3+} (Z = 21)

Ans. (2)

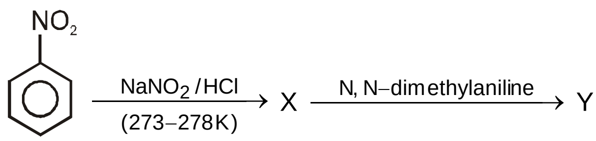
Sol. Ti^{3+} (Z = 22)

Ions which have unpaired electrons exhibit colour in solution. Ti^{3+} has an outer electronic configuration of $4s^0 3d^1$, i.e., 1 unpaired electron. Thus its solution will be coloured.

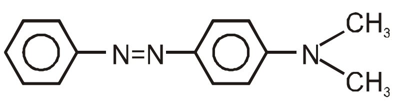
$Sc^{3+} \rightarrow d^0$

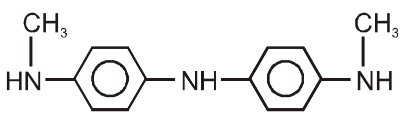
In case of La^{3+}, $4f^0$ configuration is present and in Lu^{3+}, $4f^{14}$ is present. So, there is no possibility of f-f transition, hence these ions do not appear coloured.

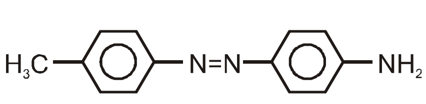
68. Aniline in a set of the following reactions yielded a coloured product 'Y'.

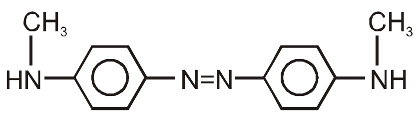


The structure of 'Y' would be :

(1) 

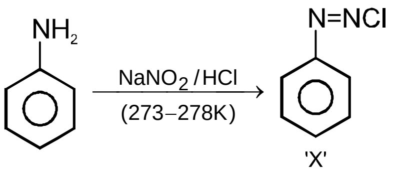
(2) 

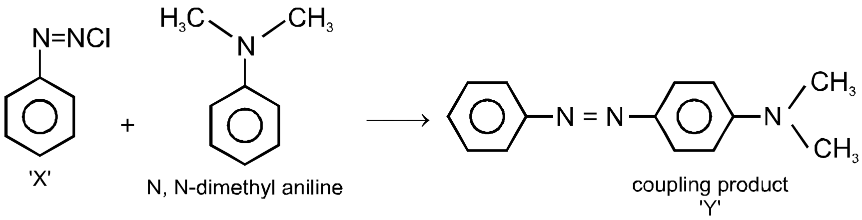
(3) 

(4) 

Ans. (1)

Sol. $NaNO_2$ / HCl causes diazotisation of – NH_2 group and the diazonium chloride gives a coupling product with active aryl nucleus.





69. Acetamide is treated with the following reagents separately. Which one of these would yield methyl amine ?

(1) NaOH-Br_2 (2) Sodalime (3) Hot conc. H_2SO_4 (4) PCl_5

Ans. (1)

Sol. The reagent which can convert –$CONH_2$ group into –NH_2 group is used for this reaction.

Among the given reagents only NaOH /Br_2 converts –$CONH_3$ group to –NH_2 group, thus it is used for converting acetamide to methyl amine. This reaction is called Hoffmann bromamide reaction.

$$CH_3CONH_2 + NaOH + Br_2 \longrightarrow \underset{\text{methyl amine}}{CH_2NH_2} + NaBr + Na_2CO_3 + H_2O$$

70. An aqueous solution is 1.00 molal in KI. Which change will cause the vapour pressure of the solution to increase?

(1) Addition of NaCl (2) Addition of Na_2SO_4

(3) Addition of 1.00 molal KI (4) Addition of water

Ans. (4)

Sol. Vapour pressure depends upon the surface area of the solution. Larger the surface area, higher is the vapour pressure.

Addition of solute decreases the vapour pressure as some dites of the surface are occupied by solute particles, resulting in decreased surface area. However, addition of solvent, ie, dilution, increases the surface area of the liquid surface, thus results in increased vapour pressure.

Hence, addition of water to the aqueous solution of (1 molal) KI, results in increased vapour pressure.

71. A solution of sucrose (molar mass = 342 g mol^{-1}) has been prepared by dissolving 68.5 g of sucrose in 1000 g of water. The freezing point of the solution obtained will be: (K_f for water = 1.86 K kg mol^{-1})

(1) – 0.372ºC (2) – 0.520ºC (3) + 0.372ºC (4) – 0.570ºC

Ans. (3)

Sol. Depression in freezing point,

$$\Delta T_f = k_f \times m$$

where, m = molality = $\dfrac{W_B \times 1000}{M_B . W_A} = \dfrac{68.5 \times 1000}{342 \times 1000} = \dfrac{68.5}{342}$

$$\Delta T_f = 1.86 \times \frac{68.5}{342} = 0.372ºC$$

$$\Delta T_f = T^o - T_s = 0 - 0.372ºC = 0.372ºC$$

72. Which of the following alkaline earth metal sulphates has hydration enthalpy higher than the lattice enthalpy?

(1) $CaSO_4$ (2) $BeSO_4$ (3) $BaSO_4$ (4) $SrSO_4$

Ans. (2)

Sol. Hydration energy varies inversely with size and in sulphates of alkaline earth metals lattice energy remains almost constant. The order of size of alkaline earth metals is

$$Be^{2+} < Ca^{2+} < Sr^{2+} < Ba^{2+}$$

Thus, the order of hydration energy is

$$Be^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+}$$

Hence, $BeSO_4$ has the hydration enthalpy higher than the lattice enthalpy.

73. Which of the following ions has electronic configuration $[Ar]3d^6$?

(1) Ni^{3+} (2) Mn^{3+} (3) Fe^{3+} (4) Co^{3+}

Ans. (4)

Sol. Write the electronic configurations of given ions and find the correct answer.

NH^{3+} (28) = [Ar] $3d^7$

Mn^{3+} (25) = [Ar] $3d^4$

Fe^{3+} (26) = [Ar] $3d^5$

Co^{3+} (27) = [Ar] $3d^6$

74. An increase in equivalent conductance of a strong electrolyte with dilution is mainly due to:

(1) increase in ionic mobility of ions.

(2) 100% ionisation of electrolyte at normal dilution.

(3) increase in both i.e. number of ions and ionic mobility of ions.

(4) increase in number of ions.

Ans. (1)

Sol. $\lambda_{eq} = \kappa \times V = \dfrac{\kappa \times 1000}{\text{normality}}$

On dilution, the number of current carrying particles per cm^3 decreases but the volume of solution increases. Consequently, the ionic mobility increases, which in turn increases the equivalent conductance of strong electrolyte.

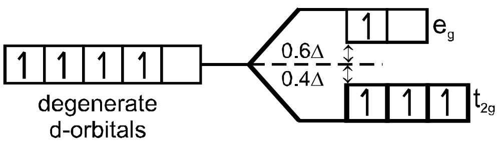
75. Crystal filed stabilization energy for high spin d^4 octahedral complex is :

(1) $-1.8\ \Delta_0$ (2) $-1.6\ \Delta_0 + P$ (3) $-1.2\ \Delta_0$ (4) $-0.6\ \Delta_0$

Ans. (4)

Sol. In case of high spin complex, Δ_0 is small. Thus, the energy required to pair up the fourth electron with the electrons of lower energy d-orbitals would be higher than that required to place the electrons in the higher d-orbital. Thus, pairing does not occur.

For high spin d^4 octahedral complex,



$\therefore$ Crystal field stabilisation energy

$= (-3 \times 0.4 + 1 \times 0.6)\ \Delta_0$

$= (-1.2 + 0.6)\ \Delta_0$

$= -0.6\ \Delta_0$

AIPMT (SCREENING)-2010

76. Oxidation states of P in $H_4P_2O_5$, $H_4P_2O_6$, $H_4P_2O_7$ are respectively :

(1) +3, +5, +4 (2) +5, +3, +4 (3) +5, +4, +3 (4) +3, +4, +5

Ans. (4)

Sol. Oxidation state of H is + 1 and that of O is –2.

Let the oxidation state of P in the given compounds is x.

In $H_4P_2O_5$, $(+1) \times 4 + 2 \times x + (-2) \times 5 = 0$

$4 + 2x - 10 = 0$

$2x = 6$

$\therefore$ $x = +3$

In $H_4P_2O_6$, $(+1) \times 4 + 2 \times x + (-2) \times 6 = 0$

$4 + 2x - 12 = 0$

77. Which of the following statements about primary amines is 'False'?

(1) Alkyl amines are stronger bases than aryl amines

(2) Alkyl amines react with nitrous acid to produce alcohols

(3) Aryl amines react with nitrous acid to produce phenols

(4) Alkyl amines are stronger bases than ammonia

Ans. (3)

Sol. (i) Presence of electron withdrawing substiuent decreases the basicity while the presence of electron releasing substituent like, - CH_3, - C_2H_5 etc increases the acidity.

(ii) HNO_2 converts - NH_2 group of alphatic amine into - OH while that of aromatic amines into - N = NCL

Since, phenyl group is a electron withdrawing group, it decreases the basicity. Alkyl group, on the other hand, being electron releasing, increases the basicity. Thus, alkyl amines are more basic as compared to aryl amines as well as ammonia.

$R\text{-}NH_2 \xrightarrow{HNO_2} R\text{-}OH$

Thus, HNO_2 (nitrous acid) converts alkyl amines to alcohols.

But $C_6H_5NH_2 \xrightarrow{HNO_2} C_6H_5N=NCl$

benzene
diazonium chloride

Thus, HNO_2 does not convert aryl amines into phenol.

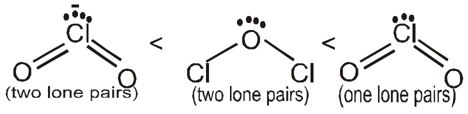
78. The correct order of increasing bond angles in the following species are :

(1) $Cl_2O < ClO_2 < ClO_2^-$ (2) $ClO_2 < Cl_2O < ClO_2^-$

(3) $Cl_2O < ClO_2^- < ClO_2$ (4) $ClO_2^- < Cl_2O < ClO_2$

Ans. (4)

Sol. As the number of lone pairs of electrons increases, bond angle decreases due to repulsion between 1p - 1p. Moreover, as the electronegativity of central atom decreases, bond angle decreases. Hence, the order of bond angle is



(Cl is less electronegative as compared to O.)

79. Among the given compounds, the most susceptible to nucleophilic attack at the carbonyl group is:

(1) CH_3COOCH_3 (2) CH_3CONH_2 (3) $CH_3COOCOCH_3$ (4) CH_3COCl

Ans. (4)

Sol. Lesser the electron density of acyl carbon atom, more will be the susceptiblity of nucleophile to attack it. The Cl atom has strong -I effect because of the weak p-bond between the small sized C-atom and large sized Cl atom. Thus in CH_3COCl, acyl carbon has least electron density and hence, more suceptible for nucleophilic attack.

80. 25.3 g of sodium carbonate, Na_2CO_3 is dissolved in enough water to make 250 mL of solution. If sodium carbonate dissociates completely, molar concentration of sodium ion, Na^+ and carbonate ions, CO_3^{2-} are respectively (Molar mass of Na_2CO_3 = 106 g mol^{-1})

(1) 0.955 M and 1.910 M (2) 1.910 M and 0.955 M

(3) 1.90 M and 1.910 M (4) 0.477 M and 0.477 M

Ans. (2)

Sol. Molarity = $\frac{\text{number of moles of solute}}{\text{volume of solution (in mL)}} \times 1000 = \frac{25.3 \times 1000}{106 \times 250}$ = 0.9547 $\approx$ 0.955 M

Na_2CO_3 in aquesous solution remains dissociated as

$$\underset{x}{Na_2CO_3} \rightleftharpoons \underset{2x}{2Na^+} + \underset{x}{CO_3^{2-}}$$

Since, the molarity of Na_2CO_3 is 0.955 M, the molartiy of CO_3^{2-} is also 0.955 M and that of Na+ is 2 × 0.955 = 1.910 M

81. In a buffer solution containing equal concentration of B^- and HB, the K_b for B^- is 10^{-10}. The pH of buffer solution is:

(1) 10 (2) 7 (3) 6 (4) 4

Ans. (4)

Sol. (i) For basic buffer

$$pOH = pK_b + \log \frac{[salt]}{[base]}$$

(ii) pH + pOH = 14

Given, $K_b = 1 \times 10^{-10}$, [salt] = [base]

$$pOH = -\log K_b + \log \frac{[salt]}{[base]}$$

$\therefore$ pOH = - log (1×10^{-10}) + log 1

= 10

pH + POH = 14

pH = 14 - 10 = 4

82. The existance of two different coloured complexes with the composition of $[Co(NH_3)_4Cl_2]^+$ is due to :

(1) linkage isomerism (2) geometrical isomerism

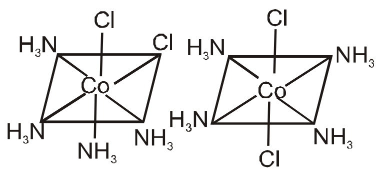
(3) coordination isomerism (4) ionization isomerism

Ans. (4)

Sol. Complexes of $[MA_4B_2]$ type exhibit geometrical isomerism.

The complex $[Co(NH_3)_4Cl_2]$+ is a $[MA_4B_2]$ type complex and thus, fulfills the conditions that are necessary to exhibit geometrical isomerism. Hence, it has two geometrical isomers of different colours as :

The structure of the geometrical isomers is are



cis - form trans-form

For linkage isomerism, presence of ambidetance ligand is necessary. For coordination isomerism, both the cation and anion of the complex must be complex ions. For ionisation isomerism, an anion different to the ligands must be present outside the coordination sphere. All these condtions are not satisfied by this complex. Hence, it does not exhibit other given isomerisms.

83. Property of the alkaline earth metals that increases with their atomic number:

(1) Solubility of their hydroxides in water (2) Solubility of their sulphates in water

(3) Ionization energy (4) Electronegativity

Ans. (1)

Sol. Electronegativity as well as ionisation energy both usually decrease on moving downward a group with increase in atomic number. The hydroxides and sulphates of alkaline earth metals are ionic solids and the solubility of ionic solids and the solubility of ionic solids is governed by two factors, viz, lattice energy and hydration energy. For solubility, hydration energy > lattice energy.

Hydration energy varies inversely with size, ie, decreases with increase in size. However, lattice energy in case of sulphates, remains almost same with increase in the atomic number of alkaline earth metals, due to large size of sulphate ion. Hence, hydration energy only governs the solubility in this case. Thus, solubility of alkaline earth metal sulphates decreases on moving downward the group II A group.

On the other hand, in case of hydroxides, the lattice energies are different because of medium size of hydroxide ions, and decreases on moving from Be to Ba. This tends to increase the solubility and to overcome the counter-effect produced by the decrease in hydration energy. Hence, the solobility of alkaline earth metal hydroxides increases with increase in the atomic number of alkaline earth metals.

84. During the kinetic study of the reaction, $2A + B \rightarrow C + D$, following results were obtained:

Run	[A]/mol L^{-1}	[B]/mol L^{-1}	Initial rate of formation of D/mol L^{-1} min^{-1}
I	0.1	0.1	6.0×10^{-3}
II	0.3	0.2	7.2×10^{-2}
III	0.3	0.4	2.88×10^{-1}
IV	0.4	0.1	2.40×10^{-2}

Based on the above data which one of the following is correct?

(1) rate = k $[A]^2$ [B] (2) rate = k [A] [B] (3) rate = k $[A]^2$ $[B]^2$ (4) rate = k [A] $[B]^2$

Ans. (4)

Sol. Let order of reaction with respect to A is x and with respect to B is y. Thus,

$$rate = k[A]^x [B]^y$$

For the given cases,

(I) rate = $k(0.1)^x (0.1)^y = 6.0 \times 10^{-3}$ (II) rate = $k(0.3)^x (0.2)^y = 7.2 \times 10^{-2}$

(III) rate = $k(0.3)^x (0.40)^y = 2.88 \times 10^{-1}$ (IV) rate = $(0.4)^x (0.1)^y = 2.40 \times 10^{-2}$

On dividing Eq. (i) by (IV), we get

$$\left(\frac{0.1}{0.4}\right)^x \left(\frac{0.1}{0.1}\right)^y = \frac{6.0\times10^{-3}}{2.4\times10^{-2}} \quad \text{or} \quad \left(\frac{1}{4}\right)^x = \left(\frac{1}{4}\right)^1$$

$x = 1$

On dividing Eq. (II) by (III), we get

$$\left(\frac{0.3}{0.3}\right)^x \left(\frac{0.2}{0.4}\right)^y = \frac{7.2\times10^{-2}}{2.88\times10^{-1}} \quad \text{or} \quad \left(\frac{1}{2}\right)^y = \frac{1}{4}$$

$$\text{or} \quad \left(\frac{1}{2}\right)^y = \left(\frac{1}{2}\right)^2$$

$\therefore \quad y = 2$

Thus, rate law is,

rate = $k[A]^1 [B]^2$ or = $k[A] [B]^2$

85. Which of the following pairs has the same size ?

(1) Fe^{2+}, Ni^{2+} (2) Zr^{4+}, Ti^{4+} (3) Zr^{4+}, Hf^{4+} (4) Zn^{4+}, Hf^{4+}

Ans. (3)

Sol. In general, the atomic and ionic radii increases on moving down a group. But the elements of second series (eg, Zr, Nb, Mo etc.) have the almost same radii as the elements of third transition serries (eg,Hf, Ta, W etc). This is because of lanthanide contraction ie, imperfect sheilding of one 4f - electron by another.

86. The correct order of the decreasing ionic radii among the following is electronic species are:

(1) $Ca^{2+} > K^+ > S^{2-} > Cl^-$ (2) $Cl^- > S^{2-} > Ca^{2+} > K^+$

(3) $S^{2-} > Cl^- > K^+ > Ca^{2+}$ (4) $K^+ > Ca^{2+} > Cl^- > S^{2-}$

Ans. (3)

Sol. Ionic radii $\propto$ charge on anion $\propto \dfrac{1}{\text{charge on cation}}$

During the formation of a cation, the electrons are lost from the outer shell and the remaining electrons experience a great force of attraction by the nucleous, ie, attracted more towards the nucleous. In other words, nucleous hold the remaining electrons more tightly and this results in decreased radii.

However, in case of anion formation, the addition of electron(s) takes place in the same outer shell, thus the hold of nucleous on the electrons of outer shell decreases and this results in increased ionic radii.

Thus, the correct order of ionic radii is

$S^{2-} > Cl^- > K^+ > Ca^{2+}$

87. In which one of the following species the central atom has the type of hybridization which is not the same as that present in the other three?

(1) SF_4 (2) I_3^- (3) $SbCl_5^{2-}$ (4) PCl_5

Ans. (3)

Sol. Molecules having the same number of hybrid orbitals, have same hybridisation and number of hybrid orbitals,

$$H = \frac{1}{2} [V + X - C + A]$$

where, V = no. of valence electrons of central atom

X = no. monovalent atoms

C = charge on cation

A = Charge on anion.

(1) In SF_4, $H = \frac{1}{2}[6 + 4 - 0 + 0) = 5$

(2) In I^-_3, $H = \frac{1}{2}[7 + 2 + 1] = 5$

(3) In $SbCl_5^{2-}$, $H = \frac{1}{2}[5 + 5 + 2) = 6$

(4) In PCl_5, $H = \frac{1}{2}[5 + 5 + 0 - 0] = 5$

Since, only $SbCl_5^{2-}$ has different number of hybrid orbitals (ie, 6) from the other given species, its hybrisation is different from the others, ie, sp^3d^2. (The hybridsation of other species is sp^3d).

88. Standard entropies of X_2, Y_2 and XY_3 are 60, 40 and 50 JK^{-1} mol^{-1} respectively. For the reaction

$$\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightleftharpoons XY_3; \qquad \Delta H = -30 \text{ kJ},$$

to be at equilibrium, the temperature should be:

(1) 750 K (2) 1000 K (3) 1250 K (4) 500 K

Ans. (1)

Sol. For the reaction,

$$\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightleftharpoons XY_3 : \Delta H = -30 \text{ kJ}$$

$$\Delta S° = S°(XY_3) - \left[\frac{1}{2}S°x_2 + \frac{3}{2}S°y_2\right] = 50 - \left[\frac{1}{2}\times 60 + \frac{3}{2}\times 40\right]$$

$$= 50 - [30 + 60] = 50 - 90 = -40 \text{ kJ}^{-1} \text{ mol}^{-1}$$

We know that,

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

At equilibrium,

$$\Delta G° = 0$$

$$\Delta H = T\Delta S°$$

$$T = \frac{\Delta H}{\Delta S°} = \frac{-30\times 10^3 \text{ J}}{-40 \text{ JK}^{-1}\text{mol}^{-1}} = 750 \text{ K}$$

89. Which of the following represents the correct order of increasing electron gain enthalpy with negative sign for the elements O, S, F and Cl ?

(1) Cl < F < O < S (2) O < S < F < Cl (3) F < S < O < Cl (4) S < O < Cl < F

Ans. (2)

Sol. Electron gain enthalpy, generally, increases in a period from left to right and decreases in a group on moving downwards. However, members of III period have samewhat higher electron gain enthalpy as compared to the coressponding members of second period, because of their small size.

O and S belong to VI A (16) group and Cl and F belong to VII A (17) group. Thus, the electron gain enthalpy of Cl and F is higher as compared to O and S.

Cl and F > O and S

Between Cl and F, Cl has higher electron gain enthalpy as in F, the incoming electron experiences a greater force of repulsion because of small size of F atom. Similar is true in case of O and S ie, the electron gain enthalpy of S is higher as compared to O due to its small size. Thus, the correct order of electron gain enthalpy of given elements is

O < S < F< Cl

90. Which one of the following compounds is a peroxide ?

(1) KO_2 (2) BaO_2 (3) MnO_2 (4) NO_2

Ans. (2)

Sol. In peroxides, the oxidation state of O is -1 and they give H_2O_2, with dilute acids, and have peroxide linkage.

In KO_2,

$$+1 + (X \times 2) = 0$$

$x = -\frac{1}{2}$ (thus, it is a superoxide, not a peroxide.)

In BaO_2, $+2 + (x \times 2) = 0$

$x = -1$

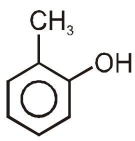
Thus, it is a perioxide. Only it gives H_2O_2 when reacts with dilute acids and has peroxide linkage as

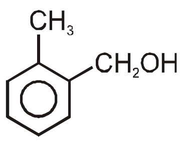
Ba^{2+} $[O - O]^{2-}$

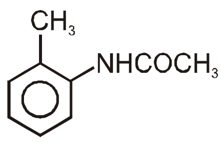
peroxide linkage

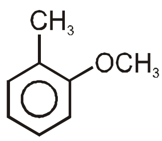
In MnO_2 and NO_2, Mn and N exhibit variable oxidation states, thus, the oxidation state of O in these is - 2. Hence, these are not peroxides. Thus, it is clear, that among the given molecules only BaO_2 is a peroxide.

91. Which one is most reactive towards electrophilic reagent ?

(1) 

(2) 

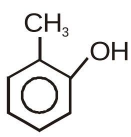
(3) 

(4) 

Ans. (1)

Sol. Electron withdrawing substituent deactivates the benzene nucleous towards electrophilic substitution while electron releasing substituent activates the ring towards electrophilic substitution.

Among the given, - OH has the higher electron donating tendency and thus, activates the ring more towards electrophilic substitution. Hence, is more reactive towards electrophilic reagent.



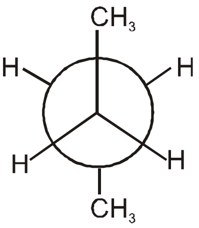
92. Which one of the following is employed as a Tranquilizer drug?

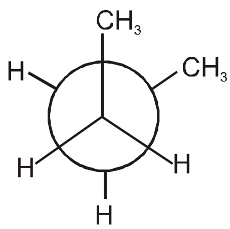
(1) Promethazine (2) Valium (3) Naproxen (4) Mifepristone.

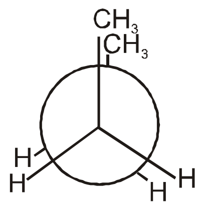
Ans. (2)

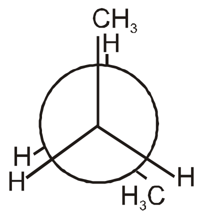
Sol. Tranquilizer are the chemicals that reduce anxiety and mental tension. Thus, they are sometimes called psychotherapteutic drugs. Equanil, valium and serotonin are some commonly used transquilizers.

93. In the following the most stable conformation of *n*-butane is :

(1) 

(2) 

(3) 

(4) 

Ans. (1)

Sol. The conformation in which the heavier groups are present at maximum possible distances, so that the forces of repulsion get weak, is more stable.
Among the given conformation of n-butane, the conformation is most stable as in it the bulkier group (ie, CH_3 group) are present at maximum possible distance.

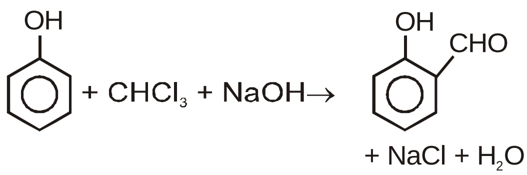
94. Which of the following reactions will not result in the formation of carbon-carbon bonds?

(1) Reimer-Tieman reaction (2) Cannizaro reaction

(3) Wurtz reaction (4) Friedel-Crafts acylation

Ans. (2)

Sol. (a) Reimer - Tiemann reaction,



(Here, a new C - C bond is formed.)

(b) Cannizaro reaction,

$$2HCHO \xrightarrow{\text{Conc.NaOH}} CH_3OH + HCOONa$$

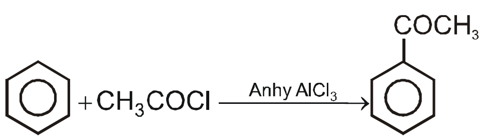
(No new C - C bond is formed in this reaction.)

(c) Wrutz reaction,

$$2RX + \text{dry Na} \xrightarrow{\text{Ether}} R-R$$

(one new C - C bond is formed.)

(d) Friedel - crafts acylation,



(New C - C bond is formed.)

Thus, among the given reactions, only cannizaro reaction does not involve the formation of a new C - C bond.

95. Which of the following structures represents Neoprene polymer ?

(1) $\left(-CH_2-\underset{\underset{Cl}{|}}{C}=CH-CH_2-\right)_n$ (2) $\left(-CH_2-\overset{\overset{CN}{|}}{CH}-\right)_n$

(3) $\left(-CH_2-\overset{\overset{Cl}{|}}{CH}-\right)_n$ (4) $\left(-\underset{\underset{C_6H_5}{|}}{CH}-CH_2-\right)_n$

Ans. **(1)**

Sol. Neoprene (synthetic rubber) is a polymer of chloroprene (ie, 2-chloro -1, 3 - butadiene).

$$nH_2C=\underset{\underset{Cl}{|}}{C}-\underset{\underset{H}{|}}{C}=CH_2 \xrightarrow{\text{Polymerisation}} \left[-CH_2-\underset{\underset{Cl}{|}}{C}=\underset{\underset{H}{|}}{C}-CH_2-\right]_n$$

2 - cholro - 1,3 - butadiene neoprene
(chloroprene) (synthetic rubber)

96. Which one is most reactive towards S_N1 reaction?

(1) $C_6H_5CH(C_6H_5)Br$ (2) $C_6H_5CH(CH_3)Br$ (3) $C_6H_5C(CH_3)(C_6H_5)Br$ (4) $C_6H_5CH_2Br$

Ans. **(3)**

Sol. Key Idea: S_N1 reaction involves the formation of carbocation intermediate. More the stability of carbocation, more is the reactivity of alkyl/aryl haldies towards S_N1 reaction.
The intermediate carbocations formed by given haldies are as :

(1) $C_6H_5CH(C_6H_5)Br \rightarrow (C_6H_5)_2\overset{+}{C}H + Br^-$

(2) $C_6H_5CH(CH_3)Br \rightarrow C_6H_5\overset{+}{C}H(CH_3) + Br^-$

(3) $C_6H_5C(CH_3)(C_6H_5)Br \rightarrow (C_6H_5)_2\overset{+}{C}(CH_3) + Br^-$

(4) $C_6H_5CH_2Br \rightarrow C_6H_5\overset{+}{C}H_2 + Br^-$

The order of stability of these carbocations is as $(C_6H_5)_2C^+(CH_3) > (C_6H_5)_2C^+H > C_6H_5)_2\overset{+}{C}H(CH_3) > \overset{+}{C}H_2$

Thus, $C_6H_5C\,(CH_3)\,(CH_3)\,(C_6H_5)$ Br is most reactive towards S_N1 reaction.

97. AB crystallizes in a body centred cubic lattice with edge length 'a' equal to 387 pm. The distance between two oppositively charged ions in the lattice is:

(1) 335 pm (2) 250 pm (3) 200 pm (4) 300 pm

Ans. **(1)**

Sol. For body centred cubic (bcc) lattice, distance between two oppositely charged ions,

$$d = \frac{\sqrt{3}a}{2} = \frac{\sqrt{3}\times 387}{2}\ \text{pm}$$

$= 335.15$ pm

98. The number of atoms in 0.1 mol of a triatomic gas is: ($N_A = 6.02 \times 10^{23}$ mol^{-1})

(1) 6.026×10^{22} (2) 1.806×10^{23} (3) 3.600×10^{23} (4) 1.800×10^{22}

Ans. **(2)**

Sol. Number of atoms = number of moles × N_A × atomicity
$= 0.1 \times 6.02 \times 10^{23} \times 3$
$= 1.806 \times 10^{23}$ atoms.

99. Which one of the following molecular hydrides acts as a Lewis acid ?

(1) NH_3 (2) H_2O (3) B_2H_6 (4) CH_4

Ans. (3)

Sol. Electron deficient molecules behave as Lewis acid.

Among the given molecules, only dibroane is electron deficient, i.e. does not have complete octet. Thus, it acts as a Lewis acid.

NH_3 and H_2O being electron rich molecules behave as Lewis base.

100. The tendency of BF_3, BCl_3 and BBr_3 to behave as Lewis acid decreases in the sequence :

(1) $BCl_3 > BF_3 > BBr_3$ (2) $BBr_3 > BCl_3 > BF_3$ (3) $BBr_3 > BF_3 > BCl_3$ (4) $BF_3 > BCl_3 > BBr_3$

Ans. (2)

Sol. As the size of halogen atom increases, the acidic strength of boron halides increases. Thus, BF_3 is the weakest Lewis acid. This is because of the $p\pi - p\pi$ back bonding between the fully-filled unutilised 3p orbitals of F and vacant 2p orbitals of boron which makes BF_3 less electron deficient. Such back donation is not possible in case of BCl_3 or BBr_3 due to larger energy difference between their orbitals. Thus, these are more electron deficient. Since on moving down the group the energy difference increases, the Lewis the acid character also increases. Thus, the tendency to behave as Lewis acid follows the order

$BBr_3 > BCl_3 > BF_3$

PART- C (BIOLOGY)

101. Apomictic embryos in citrus arise form :

(1) Maternal sporophytic tissue in ovule (2) Antipodal cells

(3) Diploid egg (4) Synergids

Ans. (1)

102. If due to some injury the chordae tendinae of the tricuspid valve of the human heart is partially non-functional, what will be the immediate effect

(1) The pacemaker will stop working

(2) The blood will tend to flow into the leftatrium

(3) The flow of blood into the pulmonary artery will be reduced

(4) The flow of blood into the aorta will be slowed down

Ans. (3)

103. The nerve centres which control the body temperature and the urge for eating are contained in

(1) Pons (2) Cerebellum (3) Thalamus (4) Hypothalamus

Ans. (1)

104. The plasma membrane consists mainly of

(1) Proteins embedded in a phospholipid bilayer (2) Proteins embedded in a polymer of glucose molecules

(3) Proteins embedded in a carbohydrate bilayer (4) Phospholipids embedded in protein bilayer

Ans. (1)

105. In unilocular ovary with a single ovule the placentation is

(1) Basal (2) Free Central (3) Axile (4) Marginal

Ans. (1)

106. The genetically-modified (GM) brinjal in India has been developed for
(1) Enhancing shelf life (2) Enhanicing mineral content
(3) Drought-resistance (4) Insect-resistance
Ans. (4)

107. Ringworm is humans is caused by
(1) Fungi (2) Nematodes (3) Viruses (4) Bacteria
Ans. (1)

108. Which one of the following pair is incorrectly matched
(1) Somatostatin - Delta cells (Source) (2) Corpusluteum - Relaxin (secretion)
(3) Insulin - Diabetes mellitus (disease) (4) Glucagon - Beta cells (source)
Ans. (4)

109. Widal test is used for the diagnosis of
(1) Pneumonia (2) Tuberculosis (3) Typhoid (4) Malaria
Ans. (3)

110. Which one of the following is an example of ex-situ conseryation
(1) Seed bank (2) Sacred groves (3) National park (4) Wildlife sanctuary
Ans. (1)

111. Whcih one of the following symbols and its representation used in human pedigree analysis is correct
(1) ○ = Unaffected male (2) □ = unaffected female
(3) ◆ = male affected (4) □═○ = mating between relatives
Ans. (4)

112. The permissible use of the technique amniocentesis is for
(1) Artificial insemination
(2) Transjfer of embryo into the uterus of a surrogate mother
(3) Detecting any genetic abnormality
(4) Detecting sex of the unborn foetus
Ans. (3)

113. Some hyperthermophilic organisms that grow in highly acidic (pH2) habitats belong to the two groups
(1) Cyanobacteria and diatoms (2) Protists and mosses
(3) Liverworts and yeasts (4) Eubacteria and archaea
Ans. (4)

114. Which one of the following statements in regard to the excretion by the human kidneys is correct
(1) Distal convoluted tubule is incapable of reabsorbing HCO_2^-
(2) Nearly 99 per cent of the glomerular filtrate is reabsorbed by the renal tubules
(3) Ascending limb of loop of Henle is impermeable to electrolytes
(4) Descending limb of loop of Henle is impermeable to water
Ans. (2)

115. Which one of the following is not lateral meristem
(1) Interfascicular cambium (2) Phellogen
(3) Intercalary meristem (4) Intrafascicular cambium
Ans. (3)

116. Single-celled eukaryotes included in
(1) Fungi (2) Archaea (3) Monera (4) Protista
Ans. (4)

117. C_4 plants are more efficient in photosynthesis than C_3 plants due to
(1) Presence of larger number of chloroplasts in the leaf cells
(2) Presence of thin cuticle
(3) Lower rate fo photorespiration
(4) Higher leaf area
Ans. (1)

118. Which one of the following is used as vector for cloning genes into higher organisms
(1) Salmonell typhimurium (2) Rhizopus nigricans
(3) Retrovirus (4) Baculovirus
Ans. (3)

119. Which one of the following is not a micronutrient
(1) Magnesium (2) Zinc (3) Boron (4) Molybdenum
Ans. (1)

120. One example of animal having a single opening to the ouside that serves both as mouth as well as anus is
(1) Asterias (2) Ascidia (3) Fasciola (4) Octopus
Ans. (3)

121. Which one of the following structure between two adjacent cells is an effective transport pathway
(1) Plastoquinones (2) Endoplasmic reticulum
(3) Plasmalemma (4) Plasmodesmata
Ans. (4)

122. Which one of the following does not follow the central dogma of molecular biology
(1) Mucor (2) Chlamydomonas (3) HIV (4) Pea
Ans. (3)

123. Which one of the following is not used in organic farming
(1) Earthworm (2) Oscillatoria (3) Snail (4) Glomus
Ans. (3)

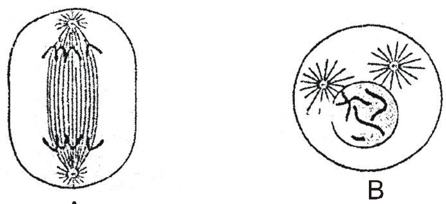
124. Study the four statements (a-d) given below and select the two correct ones out of them
(a) A lion eating a deer and a sparrow feeding on grain are ecologically similar in being consumers
(b) Predator star fish pisaster helps in maintaining species diverstiy of some invertebrates
(c) Predators ultimately lead to the extinction of pery species
(d) Production of chemicals such as nicotine, strychnine by the plants are metabolic disorders
The two correct statements are
(1) (c) and (d) (2) (a) and (d) (3) (a) and (b) (4) (b) and (c)
Ans. (3)

125. Toxic agents present in food which interfere with thyroxine synthesis lead ot the development of

(1) cretinism (2) simple goitre (3) thyrotoxicosis (4) toxic goitre

Ans. (2)

126. Which stages of cell division do the following figures A and B represent respectively



A
Fig. A

B
Fig. B

(1) Telophase – Metaphase (2) Late Anaphase – Prophase
(3) Prophase – Anaphase (4) Metaphase – Telophase

Ans. (2)

127. A common biocontrol agent for the control of plant disease is

(1) Bacillus thruingiensis (2) Glomus (3) Trichoderma (4) Baculovirus

Ans. (3)

128. Carrior ions like Na^+ facilitate the absorption of substances like

(1) glucose and fatty acids (2) fatty acids and glycerol
(3) fructose and some amino acids (4) amino acids and glucose

Ans. (3)

129. The first movements of the foetus and appearance of hair on its head are usually observed during which month of pregnancy

(1) Fifth month (2) Sixth month (3) Third month (4) Fourth month

Ans. (1)

130. Which two of the following changes (a-d) usually tend to occur in the plain dwellers when they move to high altitudes (3,500 m or more)

(a) Increase in red blood cell size
(b) Increase in red blood cell production
(c) Increased breathing rate
(d) Increase in the thrombocyte count

Changes occurring are

(1) (c) and (d) (2) (a) and (d) (3) (a) and (b) (4) (b) and (c)

Ans. (4)

131. Which one of the following kinds of animals are triploblastic

(1) Sponges (2) Ctenophores (3) Corals (4) Flat worms

Ans. (4)

132. Stirred-tank bioreactors have been designed for

(1) Purification of the product
(2) Ensuring anaerobic conditions in the culture vessel
(3) Availability of oxygen thronghout the process
(4) Addition of preservatives to the product

Ans. (3)

133. The kind of epithelium which forms the inner walls of blood vessels is

(1) columnar epithelium
(2) ciliated columnar epithelium
(3) squamous epithelium
(4) cuboidal epithelium

Ans. (3)

134. Some of the characteristics of Bt cotton are

(1) Medium yield, long fibre and resistance to beetle pests
(2) High yield and production of toxic protein crystals which kill dipteran pests
(3) High yield and resistance to bollworms
(4) Long fibre and resistance to aphids

Ans. (3)

135. Which one of the following statments about certain given animals is correct

(1) Molluscs are acoelomates
(2) Insects are pseudocoelomates
(3) Flat worms (Platyhelminthes) are coelomates
(4) Round worms (Aschelminthes) are pseudocoelomates

Ans. (4)

136. Cu ion released from copper-releasing Intra Uterine Devices (IUDs)

(1) increase phagocytosis of sperms
(2) suppress sperm motility
(3) prevent ovulation
(4) make uterus unsuitable for implantation

Ans. (2)

137. The second maturation division of the mammalian ovum occurs

(1) Until after the ovum has been penetrated by a sperm
(2) Until the nucleus of the sperm has fused with that of the ovum
(3) In the Graafian follicle after the first maturation division
(4) Shortly after ovulation before the ovum makes entry into the fallopian tube

Ans. (1)

138. Infectious proteins are present in

(1) Prions
(2) Viroids
(3) Satellite viruses
(4) Geminal viruses

Ans. (1)

139. Low Ca^{++} in the body fluid may be the cause of

(1) Anaemia
(2) Angina pectoris
(3) Gout
(4) Tetany

Ans. (4)

140. Which one of the following statements about morula in humans is correct

(1) It has far less cytoplasm as well as less DNA than in an uncleaved zygote
(2) It has more or less equal quantity of cytoplasm and DNA as in uncleaved zygote
(3) It has more cytoplasm and more DNA than an uncleaved zygote
(4) It has almost equal quantiity of cytoplasm as an uncleaved zygote but much more DNA

Ans. (4)

141. Select the two correct statements out of the four (a-d) given below about lac operon.
(a) Glucose or galactose may bind with the repressor and inactivate it
(b) In the absence of lactose the repressor binds with the operator region
(c) The Z- gene codes for permease
(d) This was elucidated by Francois Jacob and jacque Monod
The correct statements are
(1) (a) and (c) (2) (b) and (d) (3) (a) and (b) (4) (b) and (c)
Ans. (2)

142. During mitosis ER and nucleolus begin to disappear at
(1) Early metaphase (2) Late metaphase (3) Early Prophase (4) Late prophase
Ans. (4)

143. Seminal plasma in human males is rich in
(1) glucose and calcium (2) DNA and testosterone
(3) ribose and potassium (4) fructose and calcium
Ans. (4)

144. Virus envelope is known as
(1) Virion (2) Nucleoprotein (3) Core (4) Capsid
Ans. (4)

145. Satellite DNA is useful tool in
(1) Sex determination (2) Foretic engineering (3) Genetic engineering (4) Organ transplantation
Ans. (2)

146. An element playing important role in nitrogen fixation is
(1) Copper (2) Manganese (3) Zinc (4) Molybdenum
Ans. (4)

147. Breeding of crops with high level of minerals, vitamins and proteins is called
(1) Biofortification (2) Biomagnification (3) Micropropagation (4) Somatic hybridisation
Ans. (1)

148. Keel is characteristic of the frowers of
(1) Cassia (2) Calotropis (3) Bean (4) Gulmohur
Ans. (3)

149. Which one of the following cannot be explained on the basis of Mendel's Law of Dominance
(1) Out of one pair of factors one is dominant, and the other recessive
(2) Alleles do not show any blending and both the characters recover as such in F_2 generation.
(3) Factors occur in pairs
(4) The discrete unit controlling a particular character is called a factor
Ans. (2)

150. ABO blood groups in humans are controlled by the gene I. It has three alleles - I^A, I^B and i. Since there are three different alleles, six different genotypes are possible. How many phenotyes can occur
(1) One (2) Four (3) Two (4) Three
Ans. (2)

151. The one aspect which is not a salient feature of genetic code, is its being

(1) Ambiguous (2) Universal (3) Specific (4) Degenerate

Ans. (1)

152. Consider the following four statements (a-d) regarding kidney transplant and select the two correctones out of these.

(a) Even if a kidney transplant is proper the recipient may need to take immunosuppresants for a long time

(b) The cell-mediated immune response is responsible for the graft regection

(c) The B- lymphocytes are responsible for rejection of the graft

(d) The acceptance or rejection of a kidney transplant depends on specific interferons

The two correct statements are

(1) (c) and (d) (2) (a) and (c) (3) (a) and (b) (4) (b) and (c)

Ans. (3)

153. Sertoli cells are found in

(1) adrenal cortex and secrete adrenaline

(2) Seminiferous tubules and provide nutrition to germ cells

(3) Pancreas and secrete progesterone

(4) Ovaries and secrete progesterone

Ans. (2)

154. Which one of the following palindromic base sequences in DNA can be easily cut at about the middle by some particular restriction enzyme

(1) 5' ——— GATATG ——— 3' , 3' ——— CTACTA ——— 5'

(2) 5' ——— GAATTC ——— 3' , 3' ——— CTTAAG ——— 5'

(3) 5' ——— CACGTA ——— 3' , 5' ——— CTCAGT ——— 3'

(4) 5' ——— CGTTCG ——— 3' , 3' ——— ATGGTA ——— 5'

Ans. (2)

155. The two gases making highest relative contribution to the greenhouse gases are

(1) CH_4 and N_2O (2) CFC_5 and N_2O (3) CO_2 and N_2O (4) CO_2 and CH_4

Ans. (4)

156. Select the correct statement form the ones given below with resprect to dihybrid cross.

(1) Genes far apart on the same chromosomes show very few recombinations

(2) Genes loosely linked on the same chromosome show similar recombinations as the tightly linked ones

(3) Tightly linked genes one the same chromosome show very few recombinations

(4) Tightly linked genes on the same chromosomes show higher recombinations

Ans. (3)

157. The energy-releasing metabolic process in which substrate is oxidised without an external electron acceptor is called.

(1) Fermentation (2) Aerobic respiration (3) Photorespiration (4) Glycolysis

Ans. (4)

158. Phototropic curvature is the result of uneven distribution of

(1) Phytochrome (2) Cytokinins (3) Auxin (4) Gibberellin

Ans. (3)

159. Select the correct statement from the following

(1) Methanobaeterium is aerobic bacterium found in rumen of cattle

(2) Biogas, commonly called gobar gas, is pure methane

(3) Activated sludge-sediment in settlement tanks of sewage treatment plant is a rich source of aearobic bacteria

(4) Biogas is produced by the activity of aerobic bacteria on animal waste

Ans. (3)

160. dB is a standard abbreviation used for the quantitative expression of

(1) A particular pollutant (2) The dominant Bacillus in a culture

(3) A certain pesticide (4) The density of bacteria in a medium

Ans. (1)

161. Male and female gametophytes are independent and free-living in

(1) Castor (2) Pinus (3) Sphagnum (4) Mustard

Ans. (3)

162. The biomass available for consumption by the herbivores and decomposers is called

(1) Secondary productivity (2) Standing crop

(3) Gross primary productivity (4) Net primary productivity

Ans. (4)

163. The principal nitrogenous excretroy compound in humans is synthesised

(1) In kidneys as well eliminated by kidneys

(2) In liver and also eliminated by the same throught bile

(3) In the liver, but eliminated mostly through kidneys

(4) In kidneys but eliminated mostly through liver

Ans. (3)

164. The chief water conducting elements of xylem in gymnosperms are

(1) Fibres (2) Transfusion tissue (3) Tracheids (4) Vessels

Ans. (3)

165. Injury to adrenat cortex is not likely to affect the secretion of which of the following

(1) Both Androstendione and Dehydroepiandroserone

(2) Adrenaline

(3) Cortisol

(4) Aldosterone

Ans. (2)

166. The technical term used for the androecium in a flower of China rose (Hibiscus rosa-sinensis) is

(1) Diadelphous (2) Polyandrous (3) Polyadelphous (4) Monadelphous

Ans. (4)

167. PGA as the first CO_2 fixation product was discovered in photosynthesis of

(1) Gymnosperm (2) Angiosperm (3) Alga (4) Bryophyta

Ans. (3)

168. The main arena of various types of activities of a cell is

(1) Mitochondria (2) Cytoplasm (3) Nucleus (4) Plasma membrane

Ans. (3)

169. Darwin's finches are a good example of

(1) Connecting link (2) Adaptive radiation (3) Convergent evolution (4) Industrial melanism

Ans. (2)

170. Which one of the following statements about all the four of Spongilla, Leech, Dolphin and Penguin is currect

(1) Leech is a fresh water form while all others are marine

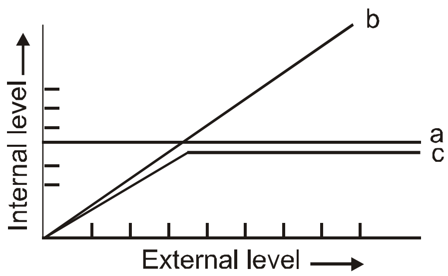
(2) Spongilla has special collared cells called choano cytes, not found in the remaining three

(3) All are bilaterally symmetrical

(4) Penguin is homoiothermic while the remaining three are poikilothermic

Ans. (2)

171. The figure given below is a diagrammatic representation of response of organisms to abiotic factors. What do a, b and c represent respectively



(a)	(b)	(c)
(1) regulator	partial regulator	Conformer
(2) parital regulator	regulator	Conformer
(3) regulator	conformer	partial regulator
(4) conformer	regulator	partial regulator

Ans. (3)

172. Algae have cell wall made up of

(1) Hemicellulose, pectins and proteins (2) pectins, celluose and proteins

(3) Cellulose, hemicellulose and pectins (4) Cellulose, galactans and mannans

Ans. (4)

173. An improved variety of transgenic basmati rice

(1) gives high yield and is rich in vitamin A

(2) is completely resistant to all insect pests and diseases of paddy

(3) gives high yield but has no characteristic aroma

(4) does not require chemical fertilizers and growth hormones

Ans. (1)

174. In vitro ferilisation is a technique that involves transfer of which one of the following into the fallopian tube

(1) Either zygote or early embryo upto 8 cell stage

(2) Embryo of 32 cell stage

(3) Zygote only

(4) Embryo only, upto 8 cell stage

Ans. (1)

175. Listed below are four respiratory capacities (a-d) and four jumbled respiratory volumes of a normal human adult

Respiratory capacites	Respiratory volumes
(a) Residual volume	2500 mL
(b) Vital capacity	3500 mL
(c) Inspiratory reserve volume	1200 mL
(d) Inspiratory capacity	4500 mL

Which one of the following is the correct matching of two capacities and volumes

(1) (c) 1200 mL, (d) 2500 mL

(2) (d) 3500 mL, (a) 1200 mL

(3) (a) 4500 mL, (b) 3500 mL

(4) (b) 2500 mL, (c) 4500 mL

Ans. (2)

176. Membrane - bound organelles are absent in

(1) Streptococcus (2) Chlamydomonas (3) Plasmoldium (4) Saccharomyces

Ans. (1)

177. The scutellum observed in a grain of wheat or maize is comparable to which part of the seed in other monocotyledons

(1) Endosperm (2) Aleurone layer (3) Plumule (4) Cotyledon

Ans. (4)

178. Coiling of garden pea tendrils around any support is an example of

(1) Thigmonasty (2) Thigmotropism (3) Thermotaxis (4) Thigmotaxis

Ans. (2)

179. Restriction endonucleases are enzymes which

(1) Recognize a specific nueleotide sequence for binding of DNA ligase

(2) Restrict the action of the enyme DNA polymerase

(3) Remove nucleotides from the ends of the DNA molecule

(4) Make cuts at specific positions within the DNA molecule

Ans. (4)

180. If for some reason our goblet cells are non-functional, this will adversely affect

(1) secretion of sebum from the sebaceous glands

(2) maturation of sperms

(3) smooth movement of food down the intestine

(4) production of somatostatin

Ans. (4)

181. Transfer of pollen grains from the anther to the stigma of another flower of the same plant is called
(1) Geitonogamy (2) Karyogamy (3) Autogamy (4) Xenogamy
Ans. (1)

182. One of the free-living anaerobic nitrogen-fixer is
(1) Rhodospirillum (2) Rhizobium (3) Azotobacter (4) Beijernickia
Ans. (3)

183. Photoperiodism was first characterised in
(1) Potato (2) Tomato (3) Cotton (4) Tobacco
Ans. (4)

184. Vasa efferentia are the ductules leading from
(1) Rete testis to vas deferens (2) Vas deferens to epididymis
(3) Epididymis to urethra (4) Testicular lobules to rete testis
Ans. (1)

185. Which one of the following has its own DNA
(1) Dictyosome (2) Lysosome (3) Peroxisome (4) Mitochondria
Ans. (4)

186. Select the correct statement from the ones given below
(1) Morphine is often given to persons who have undergone surgery as a pain killer
(2) Chewing tobacco lowers blood pressure and heart rate
(3) Cocaine is given to patients after surgery as it stimulates recovery
(4) Barbiturates when given to criminals make them tell the truth
Ans. (1)

187. What is true about RBCs in humans
(1) They transport 99.5 per cent of O_2
(2) They transport about 80 per cent oxygen only and the rest 20 per cent of it is transported in dissolved state in blood plasma
(3) They do not carry CO_2 at all
(4) They carry about 20-25 per cent of CO_2
Ans. (4)

188. Which one of the following statements about human sperm is correct.
(1) The sperm lysins in the acrosome dissolve the egg envelope facilitating fertilisation
(2) Acrosome serves as a sensory structure leading the sperm towards the ovum
(3) Acrosome seves no particular function
(4) Acrosome has a conical pointed structure used for piercing and penetrating the egg resulting in fertilisation.
Ans. (1)

189. The signals for parturition originate from
(1) Placenta as well as fully developed foetus (2) Oxytocin released from maternal pituitary
(3) Fully developed foetus only (4) Placenta only
Ans. (2)

AIPMT (SCREENING)-2010

190. The common nitrogen- fixer in paddy fields is

(1) Azospirillum (2) Oscillatoria (3) Frankia (4) Rhizobium

Ans. (1)

191. Wind pollinated flowers are

(1) Small, producing large number of dry pollen grains

(2) Large producing abunant nectar and pollen

(3) Small, producing nectar and dry pollen

(4) Small, brightly coloured, producing large number of pollen grains

Ans. (1)

192. Ovary is half-inferior in the flowers of

(1) Plum (2) Brinjal (3) Cucumber (4) Guava

Ans. (4)

193. Genetic engineering has been successfully used for producing

(1) Transgenic models for studying new treatments for certain cardiac diseases

(2) Transgenic Cow-Rosie which produces high fat milk for making ghee

(3) Animals like bulls for farm work as they have super power

(4) Transgenic mice for testing safety of polio vaccine before use is humans

Ans. (2)

194. Which one of the following is one of the characteristics of a biological community

(1) Natality (2) Mortality (3) Sex-ratio (4) Stratification

Ans. (3)

195. The genotype of a plant showing the dominant Pheotype can be determined by

(1) Dihybrid cross (2) Pedigree analysis (3) Back cross (4) Test cross

Ans. (4)

196. DNA or RNA segment tagged with a radioactive molecule is called

(1) Probe (2) Clone (3) Plasmid (4) Vector

Ans. (1)

197. Which one of following statements is correct with respect of AIDS

(1) Drug addicts are least suceptible to HIV infection

(2) AIDS patinets are being fully cured cent per cent with proper care and nutrition

(3) The causative HIV retrovirus enters helper T-lymphocyte thus reducing their numbers

(4) The HIV can be transmitted through eating food together with an infected person.

Ans. (3)

198. Heartwood differs from sapwood in

(1) Absence of vessels and parenchyma (2) Having dead and non-conducing elements

(3) Being susceptible to pests and pathogens (4) Presence of rays and fibres

Ans. (2)

199. A renewable exhaustible natural resource is

(1) Petroleum (2) Minerals (3) Forest (4) Coal

Ans. (3)

200. The part of Fallopian tube closest to the ovary is

(1) Infundibulum (2) Cervix (3) Ampulla (4) Isthmus

Ans. (1)