NEET Exam - 17 July 2022

Instructions:

1. The total duration of this test is **200 minutes**.
2. This test is of **720 marks**.
3. There will be **200** questions in the test, out of which **180** questions are mandatory.
4. The following are the sections in the test:
    1. **Section 1** is **Physics Section A** consisting of **35** questions.
        1. This section contains **35 questions of Single Choice**.
        2. **For Single Choice** questions, **4** mark(s) is allotted for each correct response and **1** mark(s) will be deducted for each incorrect response.
    2. **Section 2** is **Physics Section B** consisting of **15** questions.
        1. This section contains **15 questions of Single Choice**.
        2. Out of **15** questions only **10** questions need to be attempted.
        3. **For Single Choice** questions, **4** mark(s) is allotted for each correct response and **1** mark(s) will be deducted for each incorrect response.
    3. **Section 3** is **Chemistry Section A** consisting of **35** questions.
        1. This section contains **35 questions of Single Choice**.
        2. **For Single Choice** questions, **4** mark(s) is allotted for each correct response and **1** mark(s) will be deducted for each incorrect response.
    4. **Section 4** is **Chemistry Section B** consisting of **15** questions.
        1. This section contains **15 questions of Single Choice**.
        2. Out of **15** questions only **10** questions need to be attempted.
        3. **For Single Choice** questions, **4** mark(s) is allotted for each correct response and **1** mark(s) will be deducted for each incorrect response.
    5. **Section 5** is **Botany Section A** consisting of **35** questions.
        1. This section contains **35 questions of Single Choice**.
        2. **For Single Choice** questions, **4** mark(s) is allotted for each correct response and **1** mark(s) will be deducted for each incorrect response.
    6. **Section 6** is **Botany Section B** consisting of **15** questions.
        1. This section contains 15 **questions of Single Choice**.
        2. Out of **15** questions only **10** questions need to be attempted.
        3. **For Single Choice** questions, **4** mark(s) is allotted for each correct response and **1** mark(s) will be deducted for each incorrect response.
    7. **Section 7** is **Zoology Section A** consisting of **35** questions.
        1. This section contains **35 questions of Single Choice**.
        2. **For Single Choice** questions, **4** mark(s) is allotted for each correct response and **1** mark(s) will be deducted for each incorrect response.
    8. **Section 8** is **Zoology Section B** consisting of **15** questions.
        1. This section contains **15 questions of Single Choice**.
        2. Out of **15** questions only **10** questions need to be attempted.
        3. **For Single Choice** questions, **4** mark(s) is allotted for each correct response and **1** mark(s) will be deducted for each incorrect response.

Physics Section A

Q.1. If a soap bubble expands, the pressure inside the bubble

A) increases

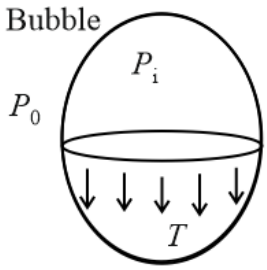
B) remains the same

C) is equal to the atmospheric pressure

D) decreases

Answer: decreases

Solution:



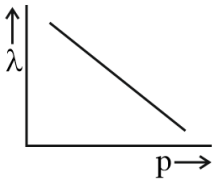
A soap bubble has two liquid surfaces in contact with air, one inside the bubble and the other outside the bubble.

For pressure, we can write:

$P_i = P_o + \frac{4T}{r}$, so as r increases, pressure inside the bubble decreases.

Q.2. The graph which shows the variation of the de Broglie wavelength (λ) of a particle and its associated momentum (p) is :

A)



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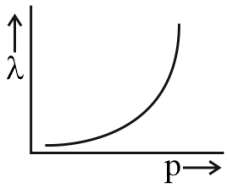

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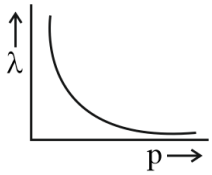
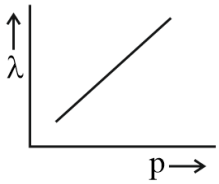
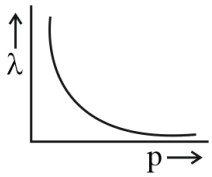


D)

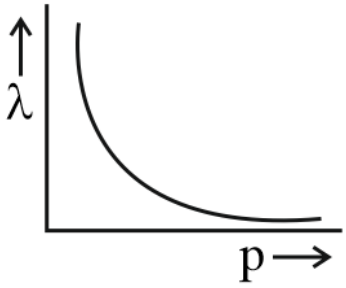


Answer:



Solution: As per de Broglie,

$\lambda = \frac{h}{p}$ which is similar to $y \propto \frac{1}{x}$expression.



Q.3. A body of mass 60 g experiences a gravitational force of 3.0 N, when placed at a particular point. The magnitude of the gravitational field intensity at that point is

A) 50 N kg^{-1}

B) 20 N kg^{-1}

C) 180 N kg^{-1}

D) 0.05 N kg^{-1}

Answer: 50 N kg^{-1}

Solution: $\because$ Gravitational force, $F_G = E_g \times m$, where $E_g =$ Gravitational field at the given point.

$E_g = \frac{F_G}{m} = \frac{3}{60 \times 10^{-3}} = 50 \text{ N kg}^{-1}$

Q.4. Given below are two statements:

Statement I : Biot-Savart's law gives us the expression for the magnetic field strength of an infinitesimal current element (Idl) of a current carrying conductor only.

Statement II : Biot-Savart's law is analogous to Coulomb's inverse square law of charge q, with the former being related to the field produced by a scalar source, $I\text{d}l$ while the latter being produced by a vector source, q.

In light of above statements choose the most appropriate answer from the options given below:

A) Both Statement I and Statement II are incorrect

B) Statement I is correct and Statement II is incorrect

C) Statement I is incorrect and Statement II is correct

D) Both Statement I and Statement II are correct

Answer: Both Statement I and Statement II are incorrect

Solution: Biot–Savart's law is an equation describing the magnetic field generated by a constant electric current(through conductor OR due to charges moving in space like a beam). It relates the magnetic field to the magnitude, direction, length, and proximity of the electric current.

Statement II is false as charge q is not a vector.

Q.5. The ratio of the distances travelled by a freely falling body in the 1^{st} , 2^{nd} , 3^{rd} and 4^{th} second

A) $1:4:9:16$

B) $1:3:5:7$

C) $1:1:1:1$

D) $1:2:3:4$

Answer: $1:3:5:7$

Solution: Galileo's law of odd numbers states that the distance covered by a falling object in successive equal time intervals is linearly proportional to the odd numbers. That is, if a body falling from rest covers one unit of distance in the first arbitrary time interval, it covers 3, 5, 7, etc. units of distance in subsequent time intervals of the same length.

Q.6. In half wave rectification, if the input frequency is 60 Hz, then the output frequency would be

A) 30 Hz

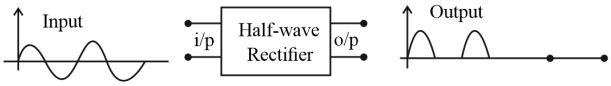
B) 60 Hz

C) 120 Hz

D) zero

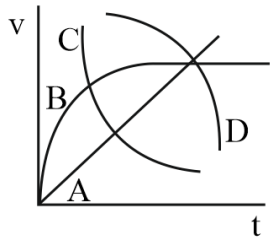
Answer: 60 Hz

Solution:



As we can see from graph, frequency remains same that is 60 Hz.

Q.7. A spherical ball is dropped in a long column of a highly viscous liquid. The curve in the graph shown, which represents the speed of the ball (v) as a function of time (t) is



A) B

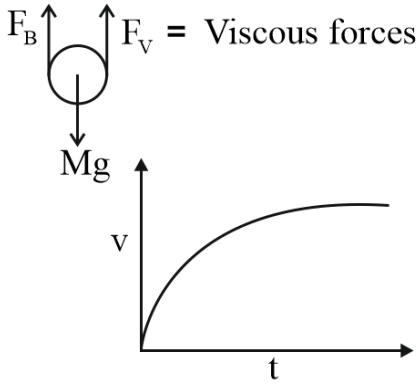
B) C

C) D

D) A

Answer: B

Solution: Viscous force increases with increase in velocity and becomes constant after attaining terminal velocity.



Q.8. The angle between the electric lines of force and the equipotential surface is

A) 45°

B) 90°

C) 180°

D) 0°

Answer: 90°

Solution: Electric lines of force are the electric field lines and electric field lines are perpendicular to equipotential surfaces

Q.9. As the temperature increases, the electrical resistance

A) decreases for both conductors and semiconductors

B) increases for conductors but decreases for semiconductors

C) decreases for conductors but increases for semiconductors

D) increases for both conductors and semiconductors

Answer: increases for conductors but decreases for semiconductors

Solution: For conductors, on increasing temperature, thermal agitation of free electrons increases. Hence, resistance increases.

For Semiconductors, number of holes or charge carriers increases with increase in temperature.

Hence, resistance increases for conductors but decreases for semiconductors.

$\Rightarrow$ Answer is (b)

Q.10. In the given nuclear reaction, the element X is $^{22}_{11}\mathrm{Na} \rightarrow \mathrm{X} + \mathrm{e}^{+} + v$

A) $^{23}_{10}\mathrm{Ne}$

B) $^{22}_{10}\mathrm{Ne}$

C) $^{22}_{12}\mathrm{Mg}$

D) $^{23}_{11}\mathrm{Na}$

Answer: $^{22}_{10}\mathrm{Ne}$

Solution: As positron is emitting, it is positive beta decay with equation,

$^{A}_{z}X \longrightarrow {}_{z-1}^{A}Y + e^{+} + \nu$

Hence, $\Rightarrow {}^{22}_{11}\mathrm{Na} \longrightarrow {}^{22}_{10}\mathrm{Ne} + e^{+} + \nu$

Q.11. Let T_1 and T_2 be the energy of an electron in the first and second excited states of hydrogen atom, respectively. According to the Bohr's model of an atom, the ratio $T_1 : T_2$ is

A) $4 : 1$

B) $4 : 9$

C) $9 : 4$

D) $1 : 4$

Answer: $9 : 4$

Solution: Given $T_1 \Rightarrow$ Energy of 1^{st} excited state

For $T_1 \Rightarrow n = 2$

For $T_2 \Rightarrow n = 3$

We know, Energy $\propto \frac{1}{n^2}$

$\therefore \frac{T_1}{T_2} = \frac{3^2}{2^2} = \frac{9}{4}$

Q.12. The ratio of the radius of gyration of a thin uniform disc about an axis passing through its centre and normal to its plane to the radius of gyration of the disc about its diameter is

A) $\sqrt{2} : 1$

B) $4 : 1$

C) $1 : \sqrt{2}$

D) $2:1$

Answer: $\sqrt{2}:1$

Solution: For a thin uniform disc.

Radius of gyration

Case 1: $K_1 = \frac{R}{\sqrt{2}}$

Case 2: $K_2 = \frac{R}{2}$

$Q \Rightarrow \frac{K_1}{K_2} = ?$

$\therefore \frac{K_1}{K_2} = \frac{\frac{R}{\sqrt{2}}}{\frac{R}{2}} = \sqrt{2}$

Q.13. When light propagates through a miaterial medium of relative permittivity ϵ_r and relative permeability μ_r, the velocity of light, v is given by : (c - velocity of light in vacuum)

A) $v = \sqrt{\frac{\mu_r}{\epsilon_r}}$

B) $v = \sqrt{\frac{\epsilon_r}{\mu_r}}$

C) $v = \frac{c}{\sqrt{\epsilon_r \mu_r}}$

D) $v = \mathrm{c}$

Answer: $v = \frac{c}{\sqrt{\epsilon_r \mu_r}}$

Solution: We know, $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

for any medium

$v = \frac{1}{\sqrt{\mu \varepsilon}}$ bat $\mu = \mu_r \mu_0$ and $\varepsilon = \varepsilon_r \varepsilon_0$

$\therefore \quad v = \frac{1}{\sqrt{\mu_r \mu_0 \varepsilon_r \varepsilon_0}}$

$= \frac{1}{\sqrt{\mu_r \varepsilon_r}} \times \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = \frac{c}{\sqrt{\mu_r \varepsilon_r}}$

Q.14. The energy that will be ideally radiated by a $100\ \mathrm{kW}$ transmitter in 1 hour is

A) $36 \times 10^4\ \mathrm{J}$

B) $36 \times 10^5\ \mathrm{J}$

C) $1 \times 10^5\ \mathrm{J}$

D) $36 \times 10^7\ \mathrm{J}$

Answer: $36 \times 10^7\ \mathrm{J}$

Solution: Energy $= Pt$

$= 100 \times 10^3 \times 1$ hr

$= 10^5 \times 3600 = 36 \times 10^7\ \mathrm{J}$

Q.15. An electric lift with a maximum load of $2000\ \mathrm{kg}$ (lift + passengers) is moving up with a constant speed of $1.5\ \mathrm{ms}^{-1}$. The frictional force opposing the motion is $3000\ \mathrm{N}$. The minimum power delivered by the motor to the lift in watts is : $\left(g = 10\ \mathrm{ms}^{-2}\right)$

A) 20000

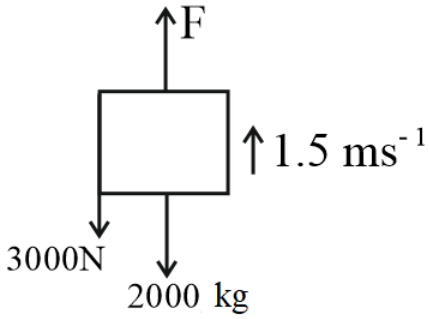
B) 34500

C) 23500

D) 23000

Answer: 34500

Solution:



Since the speed is constant the motor has to give equal and opposite upward force.

$\therefore \quad F = 3000N + 2000 \times 10 = 23000 \text{ N}$

$P = FV = 23000 \times 1.5 = 34500 \text{ W}$

Q.16. Two resistors of resistance, $100\ \Omega$ and $200\ \Omega$ are connected in parallel in an electrical circuit. The ratio of the thermal energy developed in $100\ \Omega$ to that in $200\ \Omega$ in a given time is

A) $2:1$

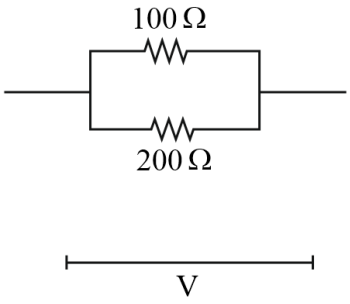
B) $1:4$

C) $4:1$

D) $1:2$

Answer: $2:1$

Solution:



Heat $= \frac{V^2}{R}t$

Here, the potential is constant tor parallel combination.

Here $R_1 = 100\ \Omega$, $R_2 = 200\ \Omega$

$\frac{H_1}{H_2} = \frac{R_2}{R_1} = \frac{200}{100} = 2:1$

Q.17. The peak voltage of the ac source is equal to

A) the rms value of the ac source

B) $\sqrt{2}$ times the rms value of the ac source

C) $\frac{1}{\sqrt{2}}$ times the rms value of the ac source

D) the value of voltage supplied to the circuit

Answer: $\sqrt{2}$ times the rms value of the ac source

Solution: $e_{RMS} = \frac{e_0}{\sqrt{2}}$

$\therefore\ e_0 = \sqrt{2} e_{RMS}$

Q.18. A shell of mass m is at rest initially. It explodes into three fragments having mass in the ratio $2:2:1$. If the fragments having equal mass fly off along mutually perpendicular directions with speed v, the speed of the third (lighter) fragment is:

A) $\sqrt{2}v$

B) $2\sqrt{2}v$

C) $3\sqrt{2}v$

D) v

Answer: $2\sqrt{2}v$

Solution: The speed of the third particle will be along angle bisector of the other two velocities. Applying the conservation of momentum,

$mv' = 2mv\cos 45^\circ + 2mv\cos 45^\circ$

$\Rightarrow v' = 2\sqrt{2}v$

Q.19. If the initial tension on a stretched string is doubled, then the ratio of the initial and final speeds of a transverse wave along the string is:

A) $\sqrt{2}:1$

B) $1:\sqrt{2}$

C) $1:2$

D) $1:1$

Answer: $1:\sqrt{2}$

Solution: Case 1:

$T_1 = T$

Case 2:

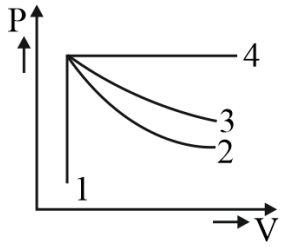
$T_2 = 2\mathrm{T}$

We know, speed of transverse wave is related to tension by

$v = \sqrt{\frac{T}{\mu}}$, here, μ is mass per unit length of the string.

$\therefore\ \frac{v_1}{v_2} = \sqrt{\frac{T_1}{T_2}} = \sqrt{\frac{T}{2\mathrm{T}}} = \frac{1}{\sqrt{2}} = 1:\sqrt{2}$

Q.20. An ideal gas undergoes four different processes from the same initial state as shown in the figure below. Those processes are adiabatic, isothermal, isobaric and isochoric. The curve which represents the adiabatic process among $1,\ 2, 3$ and 4 is:



A) 2

B) 3

C) 4

D) 1

Answer: 2

Solution: For adiabatic process,

$P \propto \frac{1}{V^{\gamma}}$

For isothermal process,

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

For isobaric process, P =constant

For isochoric process, V =constant

∴ Graphs for different processes

Adiabatic $\Rightarrow 2$

Isothermal $\Rightarrow 3$

Isobaric $\Rightarrow 1$

∴The graph for adiabatic process is 2.

Q.21. The angular speed of a fly wheel moving with uniform angular acceleration changes from $1200\ \text{rpm}$ to $3120\ \text{rpm}$ in 16 seconds. The angular acceleration in rad s^{-2} is:

A) 4π

B) 12π

C) 104π

D) 2π

Answer: 4π

Solution: For uniform angular acceleration we can write,

$\omega = \omega_0 + \alpha t$

$\Rightarrow \alpha = \frac{\omega - \omega_0}{t}$

Given, $\omega = 3120\ \text{rpm} = \frac{3120 \times 2\pi}{60} = 104\pi\ \text{rad s}^{-1}$

and $\omega_0 = 1200\ \text{rpm} = \frac{1200 \times 2\pi}{60} = 40\pi\ \text{rad s}^{-1}$

Therefore, $\alpha = \frac{104\pi\ \text{rad s}^{-1} - 40\pi\ \text{rad s}^{-1}}{16} = 4\pi\ \text{rad s}^{-2}$

Q.22. Plane angle and solid angle have:

A) Dimensions but no units

B) No units and no dimensions

C) Both units and dimensions

D) Units but no dimensions

Answer: Units but no dimensions

Solution: SI unit of plane angle is radian & Unit of solid angle is steradian.

For dimension of plane angle:

Arc length, $l = r\theta$

$\Rightarrow \theta = \frac{l}{r} = \frac{[M^0L^1T^0]}{[M^0L^1T^0]} = [M^0L^0T^0]$

Clearly, it is a ratio of two quantities of the same dimension, hence it is dimensionless.

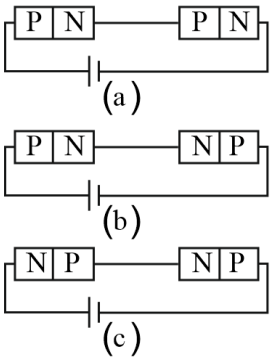
For dimension of solid angle:

Solid angle can be considered as a 3D analogue of a plane angle. It is given by the equation,

$\Omega = \frac{A}{r^2}$, where A is the area and R is the radius.

Therefore, its dimensions will be, $= \frac{[M^0L^2T^0]}{[M^0L^2T^0]} = [M^0L^0T^0]$, hence it is also dimensionless.

Q.23.



In the given circuits (a), (b) and (c), the potential drop across the two $p-n$ junctions are equal in:

A) Circuit (b) only

B) Circuit (c) only

C) Both circuits (a) and (c)

D) Circuit (a) only

Answer: Both circuits (a) and (c)

Solution: In circuit(a), both p-n junctions are in forward bias, hence current will flow and potential drop will be equal.

In circuit(c), both p-n junctions are in reverse bias and hence negligible current will flow through the circuit and potential drop will be equal.

In circuit(b), one p-n junctions is in reverse bias and one in forward bias. So, they will show different resistances. Also, negligible current will flow through the circuit. Hence, potential drop will be different.

Q.24. In a Young's double slit experiment, a student observes 8 fringes in a certain segment of screen when a monochromatic light of $600\ \text{nm}$ wavelength is used. If the wavelength of light is changed to $400\ \text{nm}$, then the number of fringes he would observe in the same region of the screen is:

A) 8

B) 9

C) 12

D) 6

Answer: 12

Solution: Wavelength of light used is inversely proportional to number of fringes observed.

Hence, we can write:

$$n_1\lambda_1 = n_2\lambda_2$$

$$\Rightarrow n_2 = \frac{n_1\lambda_1}{\lambda_2} = \frac{8\times(600\times10^{-9})}{(400\times10^{-9})} = 12$$

Q.25. When two monochromatic lights of frequency, ν and $\frac{\nu}{2}$ are incident on a photoelectric metal, their stopping potential becomes $\frac{V_S}{2}$ and V_s respectively. The threshold frequency for this metal is:

A) 3ν

B) $\frac{2}{3}\nu$

C) $\frac{3}{2}\nu$

D) 2ν

Answer: $\frac{3}{2}\nu$

Solution: Using Einstein's photoelectric equation we can write,

For first case:

$h\nu = \phi + e\left(\frac{V_S}{2}\right) \quad \ldots(1)$

For second case:

$h\frac{\nu}{2} = \phi + e(V_S) \quad \ldots(2)$

Using value of $e(V_S)$ from equation(2) in equation(1), we can write,

$h\nu = \phi + \frac{1}{2}\left(\frac{h\nu}{2} - \phi\right)$

$\Rightarrow h\nu = \phi + \frac{h\nu}{4} - \frac{\phi}{2}$

$\Rightarrow \frac{\phi}{2} = \frac{3h\nu}{4}$

$\Rightarrow \phi = \frac{3h\nu}{2}$

As we know, $\phi = h\nu_0$

Therefore, $\nu_0 = \frac{3v}{2}$

Q.26. A square loop of side $1\ \mathrm{m}$ and resistance 1Ω is placed in a magnetic field of $0.5\ \mathrm{T}$. If the plane of loop is perpendicular to the direction of magnetic field, the magnetic flux through the loop is:

A) 0.5 weber

B) 1 weber

C) zero weber

D) 2 weber

Answer: 0.5 weber

Solution: As plane of loop is perpendicular to the direction of magnetic field, therefore direction of area vector will be parallel to magnetic field.

Magnetic flux is given by,

$\phi = \vec{B} \cdot \vec{A}$

$= 0.5(1)^2 \cos 0^\circ$

$= 0.5\ \ \mathrm{Wb}$

Q.27. Two hollow conducting spheres of radii R_1 and R_2 $(R_1 \gg R_2)$ have equal charges. The potential would be:

A) more on smaller sphere

B) equal on both the spheres

C) dependent on the material property of the sphere

D) more on bigger sphere

Answer: more on smaller sphere

Solution: Potential at the surface of the spheres will be given by, $V = \frac{kQ}{R}$. As charge on both the spheres is equal, therefore, smaller sphere will have higher potential.

Q.28. A copper wire of length $10\ \mathrm{m}$ and radius $\left(\frac{10^{-2}}{\sqrt{\pi}}\right)\mathrm{m}$ has electrical resistance of 10Ω. The current density in the wire for an electric field strength of $10\ \mathrm{V\ m^{-1}}$ is:

A) $10^6\ \mathrm{A\ m^{-2}}$

B) $10^{-5}\ \mathrm{A\ m^{-2}}$

C) $10^5\ \mathrm{A\ m^{-2}}$

D) $10^4\ \mathrm{A\ m^{-2}}$

Answer: $10^5\ \mathrm{A\ m^{-2}}$

Solution: Length $= 10\ \mathrm{m}$

Radius $= \left(\frac{10^{-2}}{\sqrt{\pi}}\right)\ \mathrm{m}$

Electrical resistance $= 10\ \Omega$

Electric field strength $= 10\ \mathrm{V\ m^{-1}}$

Current density, $J = \frac{I}{A} = \frac{V}{RA} = \frac{EL}{RA}$

$\Rightarrow J = \frac{10 \times 10}{10 \times \pi\left(10^{-2}/\sqrt{\pi}\right)^2} = 10^5\ \mathrm{A\ m^{-2}}$

Q.29. A long solenoid of radius $1\ \mathrm{mm}$ has $100\ \mathrm{turns\ per\ mm}$. If $1\ \mathrm{A}$ current flows in the solenoid, the magnetic field strength at the centre of the solenoid is:

A) $12.56 \times 10^{-2}\ \mathrm{T}$

B) $12.56 \times 10^{-4}\ \mathrm{T}$

C) $6.28 \times 10^{-4}\ \mathrm{T}$

D) $6.28 \times 10^{-2}\ \mathrm{T}$

Answer: $12.56 \times 10^{-2}\ \mathrm{T}$

Solution: Radius $= 1\ \mathrm{mm}$

$N = 100\ \mathrm{turns\ per\ mm}$

Current $= 1\ \mathrm{A}$

Magnetic field strength at the centre of the solenoid is,

$B = \mu_0 ni = 4\pi \times 10^{-7} \times 100 \times 10^3 \times 1$

$\Rightarrow B = 12.56 \times 10^{-2}\ \mathrm{T}$

Q.30. Two objects of mass $10\ \mathrm{kg}$ and $20\ \mathrm{kg}$ respectively are connected to the two ends of a rigid rod of length $10\ \mathrm{m}$ with negligible mass. The distance of the center of mass of the system from the $10\ \mathrm{kg}$ mass is:

A) $\frac{20}{3}\mathrm{m}$

B) $10\ \mathrm{m}$

C) $5\ \mathrm{m}$

D) $\frac{10}{3}\ \mathrm{m}$

Answer: $\frac{20}{3}\mathrm{m}$

Solution: Let's consider the location of $10\ \mathrm{kg}$ mass to be origin.
Then location of COM will be,

$x_{\mathrm{com}} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2} = \frac{10 \times 0 + 20 \times 10}{10 + 20}$

$\Rightarrow x_{\mathrm{com}} = \frac{20}{3}\ \mathrm{m}$

Q.31. A light ray falls on a glass surface of refractive index $\sqrt{3}$, at an angle 60°. The angle between the refracted and reflected rays would be:

A) 60°

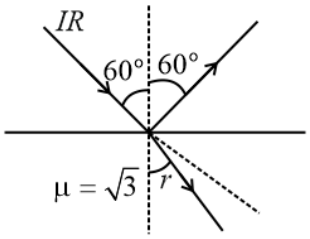
B) 90°

C) 120°

D) 30°

Answer: 90°

Solution:



From Snell's law,

$\mu_1 \sin i = \mu_2 \sin r$

$\Rightarrow 1 \times \sin 60^\circ = \sqrt{3} \sin r$

$\Rightarrow \quad r = 30^\circ$

Angle between the refracted say and reflected say is

$\theta = 180^\circ - (i + r) = 90^\circ$

Q.32. The dimensions $\left[\mathrm{MLT}^{-2}\mathrm{A}^{-2}\right]$ belong to the

A) self inductance

B) magnetic permeability

C) electric permittivity

D) magnetic flux

Answer: magnetic permeability

Solution: Force, $F = \frac{q_1 q_2}{4\pi\varepsilon_0 r^2}$ or $\varepsilon_0 = \frac{q_1 q_2}{4\pi r^2 F}$

Charge = current $\times$ time

Force = mass $\times$ acceleration

Thus, dimensional formula of electric permittivity,

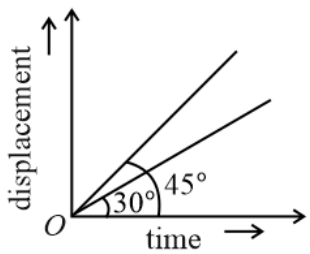
$[\varepsilon_0] = \frac{(IT)(IT)}{(\mathrm{L}^2)\left(\mathrm{MLT}^{-2}\right)} = \mathrm{M}^{-1}\mathrm{L}^{-3}\mathrm{T}^4\mathrm{I}^2$

Since speed of light, $c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$

Therefore, dimensional formula of magnetic permeability, $[\mu_0] = \frac{1}{[c^2 \varepsilon_0]} = \frac{1}{(L^2T^{-2})(\mathrm{M}^{-1}\mathrm{L}^{-3}\mathrm{T}^4\mathrm{I}^2)}$

$\Rightarrow [\mu_0] = \mathrm{MLT}^{-2}\mathrm{I}^{-2}$

Q.33. The displacement-time graphs of two moving particles make angles of 30° and 45° with the x-axis as shown in the figure. The ratio of their respective velocity is:



A) $1:1$

B) $1:2$

C) $1:\sqrt{3}$

D) $\sqrt{3}:1$

Answer: $1:\sqrt{3}$

Solution: Slope of displacement-time graph is velocity.

$$\frac{v_1}{v_2}=\frac{\tan(\theta_1)}{\tan(\theta_2)}=\frac{\tan(30^\circ)}{\tan(45^\circ)}=\frac{1}{\sqrt{3}}$$

$$\Rightarrow v_1:v_2=1:\sqrt{3}$$

Q.34. A biconvex lens has radii of curvature $20\ \text{cm}$ each. If the refractive index of the material of the lens is 1.5, the power of the lens is:

A) $+20\ \text{D}$

B) $+5\ \text{D}$

C) infinity

D) $+2\ \text{D}$

Answer: $+5\ \text{D}$

Solution: Power of the lens is,

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

$$\Rightarrow P=(1.5-1)\left(\frac{1}{0.2}-\frac{1}{-0.2}\right)=0.5\times 10$$

$$\Rightarrow P=+5\ \text{D}$$

Q.35. Match List - I with List - II:

List - I (Electromagnetic waves)		List - II (Wavelength)	
(a)	AM radio waves	(i)	$10^{-10}\ \text{m}$
(b)	Microwaves	(ii)	$10^{2}\ \text{m}$
(c)	Infrared radiations	(iii)	$10^{-2}\ \text{m}$
(d)	X-rays	(iv)	$10^{-4}\ \text{m}$

Choose the correct answer from the options given below:

A) (a) - (iii), (b) - (ii), (c)-(i), (d) - (iv)

B) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

C) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

D) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

Answer: (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

Solution:

List - I (Electromagnetic waves)		List - II (Wavelength)	
(a)	AM radio waves	(ii)	$10^{2}\ \text{m}$
(b)	Microwaves	(iii)	$10^{-2}\ \text{m}$
(c)	Infrared radiations	(iv)	$10^{-4}\ \text{m}$
(d)	X-rays	(i)	$10^{-10}\ \text{m}$

Physics Section B

Q.36. A nucleus of mass number 189 splits into two nuclei having mass number 125 and 64. The ratio of radius of two daughter nuclei respectively is:

A) $4:5$

B) $5:4$

C) $25:16$

D) $1:1$

Answer: $5:4$

Solution: The relation between radius (R) of nuclei and mass number (A) is given by, $R = R_0 A^{\frac{1}{3}}$, where R_0 is fermi constant.

Thus, $\frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{\frac{1}{3}} = \left(\frac{125}{64}\right)^{\frac{1}{3}} = \frac{5}{4}$.

Q.37. Two transparent media A and B are separated by a plane boundary. The speed of light in those media are $1.5 \times 10^8\ \mathrm{m\ s^{-1}}$ and $2.0 \times 10^8\ \mathrm{m\ s^{-1}}$, respectively. The critical angle for a ray of light for these two media is:

A) $\sin^{-1}(0.750)$

B) $\tan^{-1}(0.500)$

C) $\tan^{-1}(0.750)$

D) $\sin^{-1}(0.500)$

Answer: $\sin^{-1}(0.750)$

Solution: Refractive index (μ) in terms of speed of light (c) in vacuum and wave speed (v) in medium is given by, $\mu = \frac{c}{v}$.

So, for medium A, $\mu_A = \frac{c}{v_A} = \frac{3\times10^8}{1.5\times10^8} = 2$ and for medium B, $\mu_B = \frac{c}{v_B} = \frac{3\times10^8}{2\times10^8} = 1.5$

For critical angle, angle of refraction $r = 90^\circ$.

Using Snell's law,

$\mu_1 \sin i = \mu_2 \sin r$

$\Rightarrow 2\sin i = 1.5 \sin 90^\circ$
$\Rightarrow \sin i = \frac{1.5}{2} = 0.750$
$\Rightarrow i = \sin^{-1}(0.750)$

Q.38. A big circular coil of 1000 turns and average radius $10\ \mathrm{m}$ is rotating about its horizontal diameter at $2\ \mathrm{rad\ s^{-1}}$. If the vertical component of earth's magnetic field at that place is $2 \times 10^{-5}\ \mathrm{T}$ and electrical resistance of the coil is $12.56\ \Omega$, then the maximum induced current in the coil will be:

A) $1.5\ \mathrm{A}$

B) $1\ \mathrm{A}$

C) $2\ \mathrm{A}$

D) $0.25\ \mathrm{A}$

Answer: $1\ \mathrm{A}$

Solution: The magnetic flux is given by,

$\phi = BA\cos\omega t$. Therefore, induced EMF,

$\varepsilon = -\frac{\mathrm{d}\phi}{\mathrm{d}t} = -BA\omega\sin\omega t$

For maximum current $\sin\omega t = 1$

$\Rightarrow i_{max} = \frac{BA\omega}{R} = \frac{BN\pi r^2\omega}{R} = \frac{2\times10^{-5}\times1000\times3.14\times100\times2}{12.56} = 1\ \mathrm{A}$

Q.39. Match List - I with List - II :

List - I		List - II	
(a)	Gravitational constant (G)	(i)	$\left[\mathrm{L}^2\ \mathrm{T}^{-2}\right]$
(b)	Gravitational potential energy	(ii)	$\left[\mathrm{M}^{-1}\ \mathrm{L}^3\ \mathrm{T}^{-2}\right]$
(c)	Gravitational potential	(iii)	$\left[\mathrm{LT}^{-2}\right]$
(d)	Gravitational intensity	(iv)	$\left[\mathrm{ML}^2\ \mathrm{T}^{-2}\right]$

Choose the correct answer from the options given below:

A) (a) - (ii), (b) - (iv), (c) - (i), (d) - (iii)

B) (a) - (ii), (b) - (iv), (c) - (iii), (d) - (i)

C) (a) - (iv), (b) - (ii), (c) - (i), (d) - (iii)

D) (a)-(ii), (b)-(i), (c) - (iv), (d) - (iii)

Answer: (a) - (ii), (b) - (iv), (c) - (i), (d) - (iii)

Solution:

List - I		List - II	
(a)	Gravitational constant (G)	(ii)	$\left[\mathrm{M}^{-1}\ \mathrm{L}^3\ \mathrm{T}^{-2}\right]$
(b)	Gravitational potential energy	(iv)	$\left[\mathrm{ML}^2\ \mathrm{T}^{-2}\right]$
(c)	Gravitational potential	(i)	$\left[\mathrm{L}^2\ \mathrm{T}^{-2}\right]$
(d)	Gravitational intensity	(iii)	$\left[\mathrm{LT}^{-2}\right]$

Hence, (a) - (ii), (b) - (iv), (c) - (i), (d) - (iii).

Q.40. Given below are two statements : One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): The stretching of a spring is determined by the shear modulus of the material of the spring.

Reason (R): A coil spring of copper has more tensile strength than a steel spring of same dimensions.

In the light of the above statements, choose the most appropriate answer from the options given below :

A) Both (A) and (R) are true and (R) is not the correct explanation of (A)

B) (A) is true but (R) is false

C) (A) is false but (R) is true

D) Both (A) and (R) are true and (R) is the correct explanation of (A)

Answer: (A) is true but (R) is false

Solution: When a coil spring is stretched, neither its length nor its volume changes, there is only the change in its shape. Therefore, stretching of coil spring is determined by shear modulus of the material of spring.

Steel is stronger than copper. Hence, the tensile strength of steel spring is more than copper spring of same dimensions.

Hence, (A) is true but (R) is false.

Q.41. The area of a rectangular field (in m^2) of length $55.3\ \mathrm{m}$ and breadth $25\ \mathrm{m}$ after rounding off the value for correct significant digits is:

A) 1382

B) 1382.5

C) 14×10^2

D) 138×10^1

Answer: 14×10^2

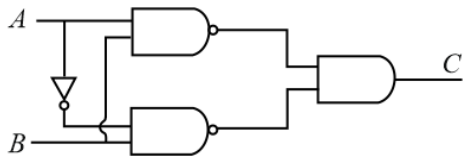
Solution: Length has 3 significant digits and breadth has 2 significant digits, hence the product should have least number of significant digits which is 2.

Area of rectangular field is, $A = \text{length} \times \text{breadth}$

$= 55.3\ \text{m} \times 25\ \text{m} = 1382.5\ \text{m}^2$

Thus, area of rectangular field upto correct significant figure is 14×10^2.

Q.42.



The truth table for the given logic circuit is:

A)

A	B	C
0	0	1
0	1	0
1	0	0
1	1	1

B)

A	B	C
0	0	1
0	1	0
1	0	1
1	1	0

C)

A	B	C
0	0	1
0	1	1
1	0	0
1	1	1

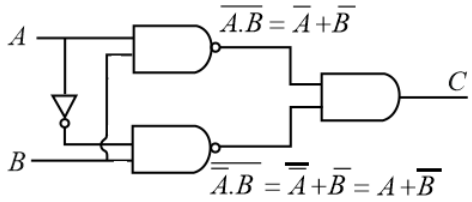
D)

A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

Answer:

A	B	C
0	0	1
0	1	0
1	0	1
1	1	0

Solution:



Here, output

$C = (\overline{A} + \overline{B}) \cdot (A + \overline{B})$

The truth table for the given logic circuit is

A	B	$\overline{A}$	$\overline{B}$	$(\overline{A} + \overline{B})$	$(A + \overline{B})$	C
0	0	1	1	1	1	1
0	1	1	0	1	0	0
1	0	0	1	1	1	1
1	1	0	0	0	1	0

Q.43. The volume occupied by the molecules contained in 4.5 kg water at STP, if the intermolecular forces vanish away is

A) $5.6 \times 10^{3}\ \mathrm{m}^3$

B) $5.6 \times 10^{-3}\ \mathrm{m}^3$

C) $5.6\ \mathrm{m}^3$

D) $5.6 \times 10^{6}\ \mathrm{m}^3$

Answer: $5.6\ \mathrm{m}^3$

Solution: Molecular mass of water is $18\ \mathrm{g\ mol}^{-1}$

Therefore, number of moles in 4.5 kg of water will be,

$n = \frac{4500}{18} = 250$

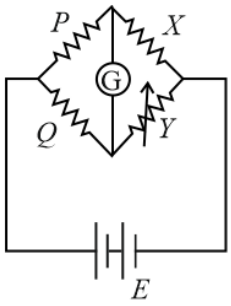
Volume occupied by one mole of gas at STP is 22.4 Litre

Therefore, volume occupied by 250 mol of water will be

$V = 22.4 \times 10^{-3} \times 250$

$\Rightarrow \quad V = 5.6\ \mathrm{m}^3$

Q.44. A Wheatstone bridge is used to determine the value of unknown resistance X by adjusting the variable resistance Y as shown in the figure. For the most precise measurement of X, the resistances P and Q



A) should be approximately equal and are small

B) should be very large and unequal

C) do not play any significant role

D) should be approximately equal to $2X$

Answer: should be approximately equal and are small

Solution: For precise measurement of X, value of X should be close to Y. Therefore, resistances P and Q should be equal. If P and Q are large the current in the galvanometer will be small, and it will be difficult to find the null point. Therefore, P and Q should be small.

Q.45. A series LCR circuit with inductance $10\ \mathrm{H}$, capacitance $10\ \mu\mathrm{F}$, resistance $50\ \Omega$ is connected to an AC source of voltage, $V = 200\sin(100t)$ volt. If the resonant frequency of the LCR circuit is ν_0 and the frequency of the AC source is ν, then

A) $\nu_0 = \nu = \frac{50}{\pi}\mathrm{Hz}$

B) $\nu_0 = \frac{50}{\pi}\mathrm{Hz},\ \nu = 50\ \mathrm{Hz}$

C) $\nu = 100\ \mathrm{Hz};\ \nu_0 = \frac{100}{\pi}\mathrm{Hz}$

D) $\nu_0 = \nu = 50\ \mathrm{Hz}$

Answer: $\nu_0 = \nu = \frac{50}{\pi}\mathrm{Hz}$

Solution: From the given equation $V = 200\sin 100t$, the angular frequency of the source is

$\omega = 100\ \mathrm{rad\ s^{-1}}$

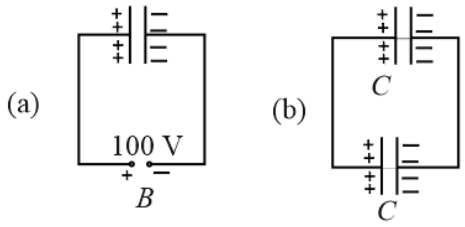
$\Rightarrow \nu = \frac{\omega}{2\pi} = \frac{100}{2\pi} = \frac{50}{\pi}\mathrm{Hz}$

For resonance

$\nu_0 = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{10\times10\times10^{-6}}}$

$\Rightarrow \nu_0 = \frac{100}{2\pi} = \frac{50}{\pi}\mathrm{Hz}$

Q.46. A capacitor of capacitance $\mathrm{C} = 900\ \mathrm{pF}$ is charged fully by $100\ \mathrm{V}$ battery B as shown in figure (a). Then it is disconnected from the battery and connected to another uncharged capacitor of capacitance $C = 900\ \mathrm{pF}$ as shown in figure (b). The electrostatic energy stored by the system (b) is



A) $3.25\times10^{-6}\ \mathrm{J}$

B) $2.25\times10^{-6}\ \mathrm{J}$

C) $1.5\times10^{-6}\ \mathrm{J}$

D) $4.5\times10^{-6}\ \mathrm{J}$

Answer: $2.25\times10^{-6}\ \mathrm{J}$

Solution: Initial charge on $900\ \mathrm{pF}$ capacitor will be $q = CV$

When the two equal capacitors are joined together as shown in figure (b). The charge will be equally divided among them. Therefore,

$q' = \frac{q}{2} = \frac{CV}{2}$

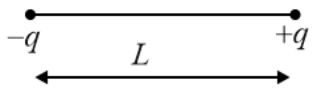
Now the energy stored in them will be

$E = \frac{(q')^2}{2C} + \frac{(q')^2}{2C}$

$\Rightarrow E = \left(\frac{CV}{2}\right)^2 \times \frac{1}{C} = \frac{CV^2}{4} = \frac{900\times10^{-12}\times(100)^2}{4}$

$\Rightarrow E = 2.25\times10^{-6}\ \mathrm{J}$

Q.47. Two point charges $-q$ and $+q$ are placed at a distance of L, as shown in the figure.



The magnitude of electric field intensity at a distance $R(R \gg L)$ varies as

A) $\frac{1}{R^3}$

B) $\frac{1}{R^4}$

C) $\frac{1}{R^6}$

D) $\frac{1}{R^2}$

Answer: $\frac{1}{R^3}$

Solution: The given arrangement of charges forms a dipole.
Electric field due to a dipole.

$E \propto \frac{1}{R^3}$

Q.48. A ball is projected with a velocity, $10\ \mathrm{m\ s^{-1}}$, at an angle of 60° with the vertical direction. Its speed at the highest point of its trajectory will be

A) $5\sqrt{3}\ \mathrm{m\ s^{-1}}$

B) $5\ \mathrm{m\ s^{-1}}$

C) $10\ \mathrm{m\ s^{-1}}$

D) Zero

Answer: $5\sqrt{3}\ \mathrm{m\ s^{-1}}$

Solution: The speed of a projectile at highest point is equal to the component of velocity of projection along the horizontal direction. The angle given with the vertical is 60° therefore, the angle with the horizontal will be 30°

Therefore,

$V = u\cos\theta \Rightarrow V = 10\cos 30^\circ = 10 \times \frac{\sqrt{3}}{2}$

$\Rightarrow V = 5\sqrt{3}\ \mathrm{m\ s^{-1}}$

Q.49. From Ampere's circuital law for a long straight wire of circular cross-section carrying a steady current, the variation of magnetic field in the inside and outside region of the wire is

A) a linearly increasing function of distance upto the boundary of the wire and then linearly decreasing for the outside region.

B) a linearly increasing function of distance $r$upto the boundary of the wire and then decreasing one with $\frac{1}{r}$ dependence for the outside region.

C) a linearly decreasing function of distance upto the boundary of the wire and then a linearly increasing one for the outside region

D) uniform and remains constant for both the regions.

Answer: a linearly increasing function of distance $r$upto the boundary of the wire and then decreasing one with $\frac{1}{r}$ dependence for the outside region.

Solution: If the current density in the wire is J then

For $r < R$

$\oint \vec{B} \cdot \mathrm{d}\vec{l} = \mu_0 i$

$\Rightarrow \quad B2\pi r = \mu_0 J \pi r^2$

$\Rightarrow \quad B = \frac{\mu_0 J}{2} r$

$\Rightarrow B \propto r$

For $r > R$

$\oint \vec{B} \cdot \mathrm{d}\vec{l} = \mu_0 \vec{i}$

$\Rightarrow \quad B2\pi r = \mu_0 \pi R^2 J$

$\Rightarrow \quad B = \frac{\mu_0 R^2 J}{2r}$

$\Rightarrow B \propto \frac{1}{r}$

Q.50. Two pendulums of length $121 \ \mathrm{cm}$ and $100 \ \mathrm{cm}$ start vibrating in phase. At some instant, the two are at their mean position in the same phase. The minimum number of vibrations of the shorter pendulum after which the two are again in phase at the mean position is

A) 9

B) 10

C) 8

D) 11

Answer: 11

Solution: Time period of a pendulum,

$T \propto \sqrt{l}$

$\Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}}$

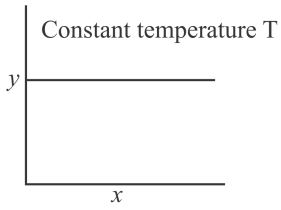
If n is the number of vibrations after which the pendulums are again in phase, the number of vibration of the longer pendulum will be $(n-1)$. Therefore,

$\frac{T_1 \times (n-1)}{T_2 \times n} = 1 \Rightarrow \frac{\sqrt{121}(n-1)}{\sqrt{100}(n)} = 1$

$\Rightarrow 11n - 11 = 10n \Rightarrow n = 11$

Chemistry Section A

Q.51. The given graph is a representation of kinetics of a reaction.



The y and x axes for zero and first order reactions, respectively are

A) zero order (y = concentration and x = time), first order (y = rate constant and x = concentration)

B) zero order (y = rate and x = concentration), first order ($y = t_{1/2}$ and x = concentration)

C) zero order (y = rate and x = concentration), first order (y = rate and $x = t_{1/2}$

D) zero order (y = concentration and x =time),
first order ($y = t_{1/2}$ and x = concentration)

Answer: zero order (y = rate and x = concentration), first order ($y = t_{1/2}$ and x = concentration)

Solution: In zero order, rate is independent of Concentration of reactants

Rate $= K$

In first order, half life $\left(t_{1/2}\right)$ is dependent only on K

$t_{1/2} = \frac{0.693}{K}$

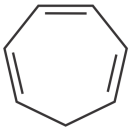
So no change with respect to concentration.

Q.52. Which compound amongst the following is not an aromatic compound?

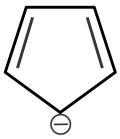
A)

B)

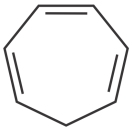
C)



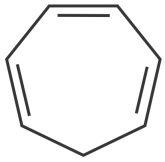
D)



Answer:



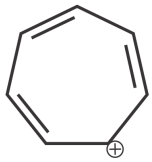
Solution: German chemist and physicist Erich Hückel proposed a theory to help determine if a planar ring molecule would have aromatic properties. His rule states that **if a cyclic, planar molecule has 4n+2 π electrons, it is considered aromatic** . This rule would come to be known as Hückel's Rule



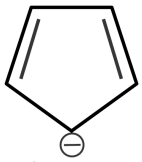
In the above molecule,There is an sp^3 hybridized carbon in the ring.Hence, it is not involved in conjugation. As delocalization of π electrons is not there throughout the ring.It is not an aromatic species.

It does not follow Huckel's rule.

But in the other options the species given that is



,



and

are aromatic as they obey Huckel's rule

Q.53. $\mathrm{RMgX} + \mathrm{CO_2} \xrightarrow[\text{ether}]{\text{dry}} \mathrm{Y} \xrightarrow{\mathrm{H_3O^+}} \mathrm{RCOOH}$

What is Y in the above reaction

A) $\mathrm{R_3CO^-Mg^+X}$

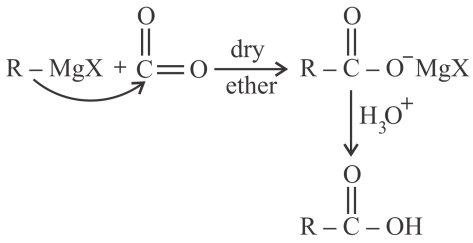
B) $\mathrm{RCOO^-X^+}$

C) $\mathrm{(RCOO)_2Mg}$

D) $\mathrm{RCOO^-Mg^+X}$

Answer: $\mathrm{RCOO^-Mg^+X}$

Solution: Grignard reagent on reaction with carbondioxide in presence of dry ether forms an addition product which on hydrolysis produces carboxylic acid.



Hence, Y in the above reaction is $\mathrm{RCOO^-Mg^+X}$

Q.54. Which of the following statement is not correct about diborane?

A) The four terminal $\mathrm{B-H}$ bonds are two centre two electron bonds.

B) The four terminal Hydrogen atoms and the two Boron atoms lie in one plane.

C) Both the Boron atoms are $\mathrm{sp^2}$ hybridised.

D) There are two 3-centre-2-electron bonds.

Answer: Both the Boron atoms are $\mathrm{sp^2}$ hybridised.

Solution: Boron atoms form 4 bonds and are $\mathrm{sp^3}$ hybridised.

The four terminal $\mathrm{B-H}$ bonds are two centre two electron bonds.While There are two 3-centre-2-electron bonds in between both B atoms. The four terminal Hydrogen atoms and the two Boron atoms lie in the same plane.

Q.55. Gadolinium has a low value of third ionisation enthalpy because of

A) high exchange enthalpy

B) high electronegativity

C) high basic character

D) small size

Answer: high exchange enthalpy

Solution: Exchange energy is the energy released when two or more electrons with the same spin exchange their positions in the degenerate orbitals of a subshell. On losing third $\mathrm{e^-}$, Gadolinium achieves half filled $4\mathrm{f}$-orbital configuration, which has higher exchange enthalpy.

$\mathrm{Gd} = [\mathrm{Xe}]\ 4\mathrm{f}^7 5\mathrm{d}^1 6\mathrm{s}^2$.

Q.56. Which one is not correct mathematical equation for Dalton's Law of partial pressure? Here P = total pressure of gaseous mixture

A) $\mathrm{P} = \mathrm{n_1}\frac{\mathrm{RT}}{\mathrm{V}} + \mathrm{n_2}\frac{\mathrm{RT}}{\mathrm{V}} + \mathrm{n_3}\frac{\mathrm{RT}}{\mathrm{V}}$

B) $\mathrm{P_i} = \mathrm{X_i P}$, where $\mathrm{P_i}$ = partial pressure of $\mathrm{i^{th}}$ gas

$\mathrm{X_i}$ = mole fraction $\mathrm{i^{th}}$ gas in gaseous mixture

C) $\mathrm{P_i} = \mathrm{X_i P_i^o}$, where $\mathrm{X_i}$ = mole fraction of $\mathrm{i^{th}}$ gas in gaseous mixture

$\mathrm{P_i^o}$ = pressure of $\mathrm{i^{th}}$ gas in pure state

D) $\mathrm{P} = \mathrm{P_1} + \mathrm{P_2} + \mathrm{P_3}$

Answer: $\mathrm{P_i} = \mathrm{X_i P_i^o}$, where $\mathrm{X_i}$ = mole fraction of $\mathrm{i^{th}}$ gas in gaseous mixture

$\mathrm{P_i^o}$ = pressure of $\mathrm{i^{th}}$ gas in pure state

Solution: Dalton's law of partial pressures is a gas law which states that the total pressure exerted by a mixture of gases is equal to the sum of the partial pressures exerted by each individual gas in the mixture.

$P = P_1 + P_2 + P_3$

P_1, P_2 and P_3 are the partial pressures and P is the total pressure.

According to ideal gas equation

$P_1 = \frac{n_1 RT}{V}$, $P_2 = \frac{n_2 RT}{V}$ and $P_3 = \frac{n_3 RT}{V}$

Partial pressure of the individual gas can be expressed as follows,

$P_i = X_i P$, P is total pressure.

Q.57. Given below are two statements:

Statement I: The boiling points of the following hydrides of group 16 elements increases in the order - $H_2O < H_2S < H_2Se < H_2Te$.

Statement I: The boiling points of these hydrides increase with increase in molar mass.

In the light of the above statements, choose the most appropriate answer from the options given below:

A) Both Statement I and Statement II are incorrect

B) Statement I is correct but Statement II is incorrect

C) Statement I is incorrect but Statement II is correct

D) Both Statement I and Statement II are correct

Answer: Both Statement I and Statement II are incorrect

Solution: Boiling point increases with molar mass of the compound, and it is also effected by hydrogen bonding.

By considering both the factors, the correct order of boiling points of 16th group hydrides is,

$H_2S < H_2Se < H_2Te < H_2O$

H_2O have the highest boiling point because of hydrogen bonding.

Q.58. Given below are two statements:

Statement I: The acidic strength of mono substituted nitrophenol is higher than phenol because of electron withdrawing nitro group.

Statement II: o-nitrophenol, m-nitrophenol and p-nitrophenol will have same acidic strength as they have one nitro group attached to the phenolic ring.

In the light of the above statements, choose the most appropriate answer from the options given below :

A) Both Statement I and Statement II are incorrect.

B) Statement I is correct but Statement II is incorrect.

C) Statement I is incorrect but Statement II is correct.

D) Both Statement I and Statement II are correct.

Answer: Statement I is correct but Statement II is incorrect.

Solution: The presence of the Nitro group in the ortho or para position decreases the electron density in the $-OH$ bond. As a result, it is easier to lose a proton from mono substituted nitro phenol Hence, ortho and para nitrophenols are stronger acids than phenol.

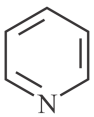
The acidic nature of nitrophenols increases in the order: meta $<$ ortho $<$ para.

Meta position shows only -I effect. Hence, it is less acidic than the para and ortho isomers.

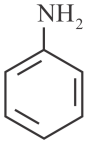
Between para and ortho nitrophenols, para is more acidic due to the presence of an intramolecular hydrogen bonding that locks hydrogen of $-OH$ bond in ortho isomer.

Q.59. The Kjeldahl's method for the estimation of nitrogen can be used to estimate the amount of nitrogen in which one of the following compounds?

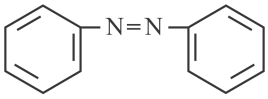
A)



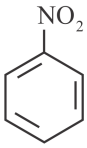
B)



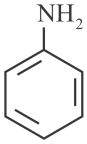
C)



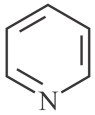
D)



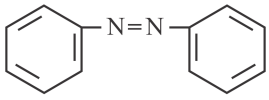
Answer:



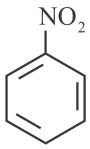
Solution: Kjeldahl's method cannot be used for nitrogen determination of compounds having nitro group, azo group or nitrogen present in the rings.



In the pyridine, nitrogen present in the ring.



The above molecule is azo benzene.



The above molecule is nitro benzene.

Q.60. Match List - I with List - II.

List -I (Drug class)		List -II (Drug molecule)	
(a)	Antacids	(i)	Salvarsan
(b)	Antihistamines	(ii)	Morphine
(c)	Analgesics	(iii)	Cimetidine
(d)	Antimicrobials	(iv)	Seldane

Choose the correct answer from the options given below:

A) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

B) (a)-(i), (b)-(iv), (c)-(ii), (d)-(iii)

C) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

D) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

Answer: (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

Solution: Antacids - Cimetidine

Antihistamines - Seldane

Analgesics - Morphine

Antimicrobials - Salvarsan

Q.61. The IUPAC name of an element with atomic number 119 is

A) unnilennium

B) unununnium

C) ununoctium

D) ununennium

Answer: ununennium

Solution: According to IUPAC nomenclature, an element with atomic number of 119 is ununennium. Hence option 4 is correct.

"un" is used for number 1. "enn" is used for number 9 and at the end ium is added.

Q.62. Amonggst the following which one will have maximum 'lone pair - lone pair' electron repulsions?

A) IF_5

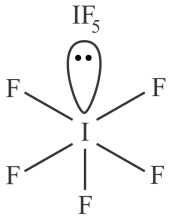
B) SF_4

C) XeF_2

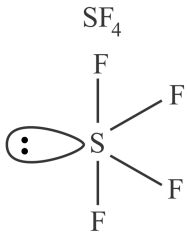
D) ClF_3

Answer: XeF_2

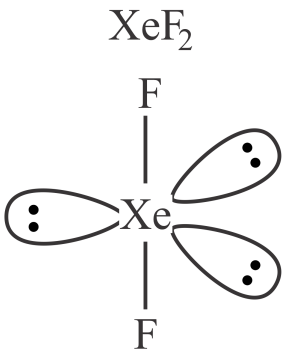
Solution:



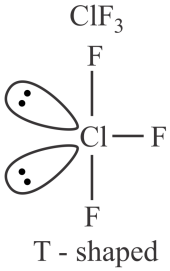
Square Pyramidal



See - Saw



Linear



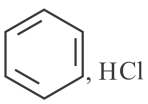
T - shaped

As we can see that maximum number of lone pairs are present in XeF_2 So maximum 'lone pair-lone pair' electrons repulsions will be in XeF_2. Hence option 3 is correct.

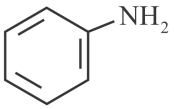
Q.63. Which of the following sequence of reactions is suitable to synthesise chlorobenzene?

A) $\text{Phenol, } NaNO_2, \text{ HCl, CuCl}$

B)



C)

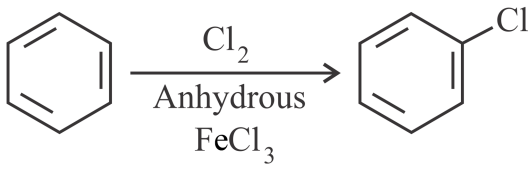


, HCI, Heating

D) Benzene, Cl_2, anhydrous $FeCl_3$

Answer: Benzene, Cl_2, anhydrous $FeCl_3$

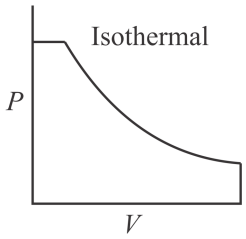
Solution: The suitable reaction to synthesize chlorobenzene among the given options is option D.



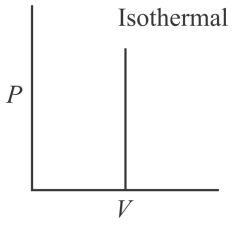
This reaction is an example of aromatic electrophile substitution reaction.

Q.64. Which of the following $p - V$ curve represents maximum work done?

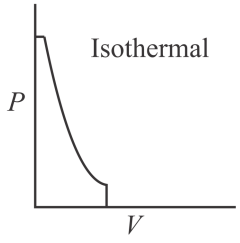
A)



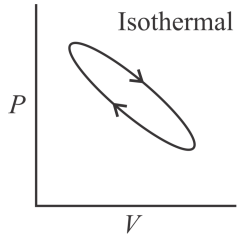
B)



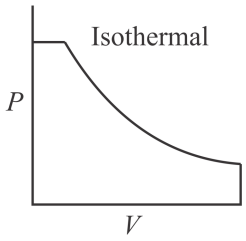
C)



D)



Answer:



Solution: The area under the $P-V$ curve represents the work done. Work can be calculated by calculating area between P-V graph and volume axis. Among the given graphs, the area under the curve is maximum for graph A.

Option B represent isochoric process so, work done will be zero.

Option C and option D has less area under the curve.

Q.65. Given below are half cell reactions :

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O,$

$E^o_{Mn^{2+}/MnO_4^-} = -1.510\ V$

$\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O$

$E^o_{O_2/H_2O} = +1.223\ V$

Will the permanganate ion, MnO_4^- liberate O_2 from water in the presence of an acid?

A) No, because $E^o_{cell} = -0.287\ V$

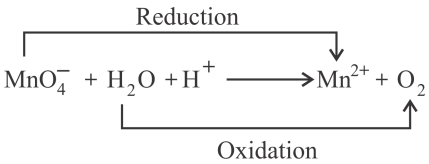
B) Yes, because $E^o_{cell} = +2,733\ V$

C) No, because $E^o_{cell} = -2.733\ V$

D) Yes, because $E^o_{cell} = +0.287\ V$

Answer: Yes, because $E^o_{cell} = +0.287\ V$

Solution: The reaction between MnO_4^- and H_2O is



E^o for the cell reaction:-

$E^\circ = E^o_{MnO_4^-/Mn^{+2}} + E^o_{H_2O/O_2}$

$= 1.510\ V - 1.223\ V$

$E^o = +0.287\ V$

As E° of the cell reaction is positive, so this reaction is feasible. Therefore permanganate ion MnO_4^- liberate O_2 from water in presence of an acid.

Hence, option D is correct.

Q.66. The IUPAC name of the complex -

$[Ag(H_2O)_2]\ [Ag(CN)_2]$ is

A) diaquasilver(II) dicyanidoargentate(II)

B) dicyanidosilver(I) diaquaargentate(I)

C) diaquasilver(I) dicyanidoargentate(I)

D) dicyanidosilver(II) diaquaargentate(II)

Answer: diaquasilver(I) dicyanidoargentate(I)

Solution: The correct IUPAC name of the complex

$\left[\mathrm{Ag}\left(\mathrm{H_2O}\right)_2\right]\left[\mathrm{Ag}\left(\mathrm{CN}\right)_2\right]$ is

diaquasilver(I) dicyanidoargentate(I)

Here both Ag atoms are in +1 oxidation state. water is neutral ligand and cynide is negative ligand.

Hence option 3 is correct.

Q.67. Identify the incorrect statement from the following

A) The oxidation number of K in $\mathrm{KO_2}$ is $+4$.

B) Ionisation enthalpy of alkali metals decreases from top to bottom in the group.

C) Lithium is the strongest reducing agent among the alkali metals.

D) Alkali metals react with water to form their hydroxides.

Answer: The oxidation number of K in $\mathrm{KO_2}$ is $+4$.

Solution: The oxidation number for alkali metals is 1. As potassium (K) is also on alkali metal, so its oxidation state will be 1 in all of its compounds. $\mathrm{KO_2}$ is potassium superoxide. Here oxygen is $\mathrm{in}\ -\frac{1}{2}$ oxidation state.

Q.68. What mass of 95% pure $\mathrm{CaCO_3}$ will be required to neutralise $50\ \mathrm{mL}$ of $0.5\ \mathrm{M}\ \mathrm{HCl}$ solution according to the following reaction?

$\mathrm{CaCO_{3(s)} + 2\,HCl_{(aq)} \rightarrow CaCl_{2(aq)} + CO_{2(g)} + 2H_2O_{(l)}}$

[Calculate upto second place of decimal point]

A) $1.32\ \mathrm{g}$

B) $3.65\ \mathrm{g}$

C) $9.50\ \mathrm{g}$

D) $1.25\ \mathrm{g}$

Answer: $1.32\ \mathrm{g}$

Solution:

$$\mathrm{CaCO_3}\left(\mathrm{s}\right) + \overset{\mathrm{2\,HCl(aq)}}{\underset{\mathrm{50\ mL,\ 0.5\ M}}{}} \longrightarrow \mathrm{CaCl_2}\left(\mathrm{aq}\right) + \mathrm{CO_2}\left(\mathrm{g}\right) + \mathrm{2H_2O}\left(\mathrm{l}\right)$$

the number of moles of HCl taken $= 0.5 \times 0.05$

$= 0.025$ moles

As we can see that from the above balanced equation is one more of $\mathrm{CaCO_3\,(s)}$ requires 2 moles of $\mathrm{HCl\,(aq)}$ therefore, for 0.025 moles of $\mathrm{HCl\,(aq)}$, 0.0125 moles of $\mathrm{CaCO_3\,(s)}$ will be required.

Mass of 0.0125 moles of $\mathrm{CaCO_3(\ s)} = 0.0125 \times \mathrm{molar\ \ mass\ \ of\ \ CaCO_3}$

$= 0.0125 \times 100$

$= 1.25\ \mathrm{g}$

But purity of $\mathrm{CaCO_3\,(s)}$ is 95%. Therefore, the actual amount of $\mathrm{CaCO_3\,(s)}$ required is

$\frac{\text{Actual mass of } \mathrm{CaCO_3(s)} \times 95}{100} = 1.25\ \mathrm{g}$

Actual mass of $\mathrm{CaCO_3\,(s)} = \frac{1.25 \times 100}{95} = 1.32\mathrm{g}$

Hence option 1 is correct.

Q.69. Given below are two statements:
Statement I:
Primary aliphatic amines react with $\mathrm{HNO_2}$ to give unstable diazonium salts.
Statement II :
Primary aromatic amines react with $\mathrm{HNO_2}$ to form diazonium salts which are stable even above $300\ \mathrm{K}$. In the light of the above statements, choose the most appropriate answer from the options given below

A) Both Statements I and Statement II are is incorrect.

B) Statement I is correct but Statement II is incorrect.

C) Statement I is incorrect but Statement II is correct.

D) Both Statement I and Statement II are correct.

Answer: Statement I is correct but Statement II is incorrect.

Solution: When primary aliphatic amines react with HNO_2 then unstable diazonium salt, which result in the formation of alcohol and N_2 gas.

And when primary aromatic amines react with HNO_2 the diazonium salts formed are stable due to resonance stabilization of the aromatic ring of aryl diazomiun salts.But these are stable only at 273-277 K, at higher temperatures they are unstable.

Hence, Statement I is correct but Statement II is incorrect.

Q.70. Which statement regarding polymers is not correct?

A) Fibers possess high tensile strength.

B) Thermoplastic polymers are capable of repeatedly softening and hardening on heating and cooling respectively.

C) Thermosetting polymers are reusable.

D) Elastomers have polymer chains held together by weak intermolecular forces.

Answer: Thermosetting polymers are reusable.

Solution: A thermosetting polymer, often called a thermoset, is a polymer that is obtained by irreversibly hardening a soft solid or viscous liquid prepolymer.

They can't be reused.

Thermoplastic polymers are capable of repeatedly softening and hardening on heating and cooling respectively.They can be re-used.

Fibres have high tensile strength.

Elastomers have polymer chains held together by weak intermolecular forces, they have high elasticity.

Hence, option C is the correct answer.

Q.71. The incorrect statement regarding chirality is :

A) The product obtained by S_N2 reaction of haloalkane having chirality at the reactive site shows inversion of configuration.

B) Enantiomers are superimposable mirror images on each other.

C) A racemic mixture shows zero optical rotation.

D) S_N1 reaction yields $1:1$ mixture of both enantiomers.

Answer: Enantiomers are superimposable mirror images on each other.

Solution: The product obtained by S_N2 reaction of haloalkane having chirality at the reactive site shows inversion of configuration because incoming nucleophile attacks from opposite side of the leaving group.
Enantiomers are non superimposable mirror images of each other. A racemic mixture shows zero optical rotation due to external compensation of optical rotation of the mixture.

Q.72. Given below are two statements :
Statement I :
In the coagulation of a negative sol, the flocculating power of the three given ions is in the order -
$Al^{3+} > Ba^{2+} > Na^{+}$
Statement II :
In the coagulation of a positive sol, the flocculating power of the three given salts is in the order -
$NaCl > Na_2SO_4 > Na_3PO_4$
In the light of the above statements, choose the most appropriate answer from the options given below:

A) Both Statement I and Statement II are incorrect.

B) Statement I is correct but Statement II is incorrect.

C) Statement I is incorrect but Statement II is correct.

D) Both Statement I and Statement II are correct.

Answer: Statement I is correct but Statement II is incorrect.

Solution: The flocculating power of an ion is directly proportional to its charge present. So flocculating power of

$$\mathrm{Al}^{3+} > \mathrm{Ba}^{2+} > \mathrm{Na}^{+}$$

and similarly flocculating power of

$$\mathrm{PO}_4^{3-} > \mathrm{SO}_4^{2-} > \mathrm{Cl}^{-}$$

Q.73. Match List - I with List - II.

List - I (Hydrides)		List - II (Nature)	
(a)	$\mathrm{MgH_2}$	(i)	Electron precise
(b)	$\mathrm{GeH_4}$	(ii)	Electron deficient
(c)	$\mathrm{B_2H_6}$	(iii)	Electron rich
(d)	HF	(iv)	Ionic

Choose the correct answer from the options given below:

A) (a)-(iii),(b)-(i),(c)-(ii),(d)-(iv)

B) (a) - (i), (b) - (iii), (c) - (iv), (d) - (ii)

C) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

D) (a)-(v), (b)-(i), (c)-(ii), (d)-(iii)

Answer: (a)-(v), (b)-(i), (c)-(ii), (d)-(iii)

Solution: Ionic hydrides are compounds form between hydrogen and the most active metals, especially with the alkali and alkaline-earth metals of group one and two elements.

Covalent hydrides are formed when hydrogen reacts group 13 to group 17 elements. All the group 13 elements form electron deficient compounds with hydrogen. All group 14 elements form electron precise compounds. Elements from groups 15 through 17 form such bonds that have excess electrons which are present as lone pairs.

(a) $\mathrm{MgH_2}$ is an ionic compound.

(b) $\mathrm{GeH_4}$ has sufficient number of electrons required for forming covalent bonds, so it is electron precise compound.

(c) $\mathrm{B_2H_6}$ is electron deficient compound as it has incomplete octet.

(d) HF is elctron rich compound as fluorine has 3 pair of unpaired electrons.

Q.74. Match List - I with List - II.

List - I		List -II	
(a)	Li	(i)	absorbent for carbon dioxide
(b)	Na	(ii)	electrochemical cells
(c)	KOH	(iii)	coolant in fast breeder reactors
(d)	Cs	(iv)	photoelectric cell

Choose the correct answer from the options given below:

A) (a)-(iii),(b)-(iv),(c)-(ii),(d)-(i)

B) (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)

C) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

D) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

Answer: (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)

Solution: (a) Li is used in many electrochemical cells

(b) Liquid metallic sodium is used as coolant carrying heat from the core.

(c) KOH is used to absorb CO_2 gas since KOH reacts CO_2 to form K_2CO_3

(d) Cs is used in photoelectric cell because it has very low value of work function. During its exposure to direct sunlight, the electons that are there in Cs atom get stimulated and starts moving around.

Q.75. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): In a particular point defect, an ionic solid is electrically neutral, even if few of its cations are missing from its unit cells.
Reason (R): In an ionic solid, Frenkel defect arises due to dislocation of cation from its lattice site to interstitial site, maintaining overall electrical neutrality.

In the light of the above statements, choose the most appropriate answer from the options given below:

A) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

B) (A) is correct but (R) is not correct

C) (A) is not correct but (R) is correct

D) Both (A) and (R) are correct and (R) is the correct explanation of (A)

Answer: Both (A) and (R) are correct but (R) is not the correct explanation of (A)

Solution: In point defects, an ionic solid always maintain its electrical neutrality, even if few of its cations are missing from its unit cells. Frenkel defect arises due to dislocation of cation from its lattice site to interstitial site, maintaining overall electrical neutrality.

Q.76. The incorrect statement regarding enzymes is:

A) Like chemical catalysts enzymes reduce the activation energy of bio processes.

B) Enzymes are polysaccharides.

C) Enzymes are very specific for a particular reaction and substrate.

D) Enzymes are biocatalysts.

Answer: Enzymes are polysaccharides.

Solution: Almost all known enzymes are proteins and not carbohydrates. So, enzymes are not polysaccharides. Enzymes reduce activation energy of bio process and are very set specific for a perticular reaction and substrate. Enzymes are also acts as biocatalysts.

Q.77. Match List - I with List - II.

List - I (Products formed)		List - II (Reaction of carbonyl compound with)	
(a)	Cyanohydrin	(i)	NH_2OH
(b)	Acetal	(ii)	RNH_2
(c)	Schiff's base	(iii)	alcohol
(d)	Oxime	(iv)	HCN

Choose the correct answer from the options given below:

A) (a)-(i), (b)-(iii), (c)-(iv), (d)-(i)

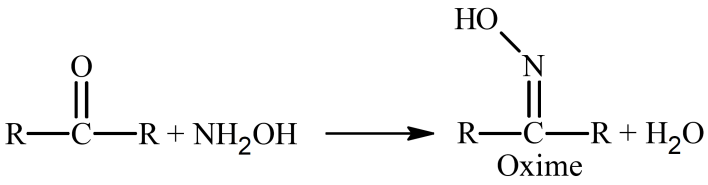
B) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

C) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

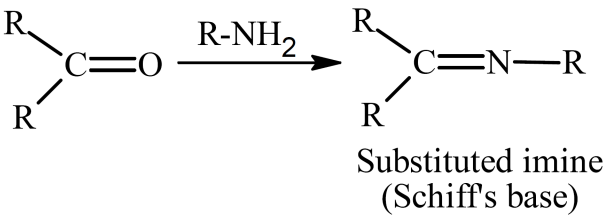
D) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

Answer: (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

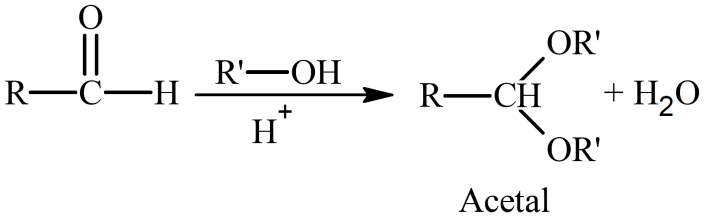
Solution: Reaction of carbonyl Compound with NH_2OH:



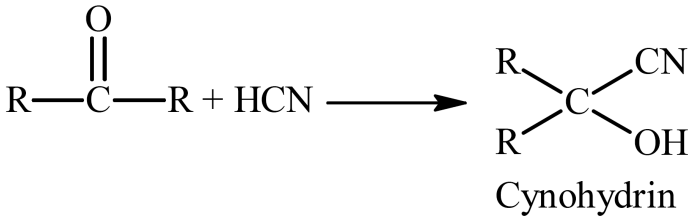
Reaction of carbonyl compound with RNH_2:



Reaction of carbonyl compound with alcohol:



Reaction of carbonyl compound with HCN:



Q.78. In one molal solution that contains 0.5 mole of a solute, there is

A) 500 g of solvent

B) 100 mL of solvent

C) 1000 g of solvent

D) 500 mL of solvent

Answer: 500 g of solvent

Solution: Molality $= \frac{n_{solute}}{\text{Mass of Solvent (kg)}}$

Mass of solvent $= \frac{n_{solute}}{\text{Molality}}$

Mass of solvent $= \frac{0.5}{1} = 0.5$ kg or 500 gm.

Q.79. Choose the correct statement:

A) Diamond is covalent and graphite is ionic.

B) Diamond is sp^3 hybridised and graphite is sp^2 hybridized.

C) Both diamond and graphite are used as dry lubricants.

D) Diamond and graphite have two dimensional network.

Answer: Diamond is sp^3 hybridised and graphite is sp^2 hybridized.

Solution: Both diamond and graphite are covalent. Diamond is sp^3 hybridised and has $3\ -D$ network. Graphite is sp^2 hybridised and has planar structure Only Graphite is used as dry lubricants.

Q.80. Which amongst the following is incorrect statement?

A) C_2 molecule has four electrons in its two degenerate π molecular orbitals.

B) H_2^+ ion has one electron.

C) O_2^+ ion is diamagnetic.

D) The bond orders of $O_2^+,\ O_2,\ O_2^-$ and O_2^{2-} are $2.5,\ 2,\ 1.5$ and 1, respectively.

Answer: O_2^+ ion is diamagnetic.

Solution: 1. Electronic configuration of C_2 molecule is $\left(\sigma\ 1s^2\right)\ \left(\sigma^*1s^2\right)\ \left(\sigma 2S^2\right)\ \left(\sigma^*2S^2\right)\ \left(\pi 2P_x^2=\pi 2\,py^2\right)$

Hence it has 4 electrons in π molecular orbitals.

2. $H_2{}^+$ has one electron as one electron is removed from H_2 molecule.

3. Electronic configuration of $O_2{}^+$ ion is

$\sigma 2s^2\ \sigma^*2s^2\ \sigma 2p_2^2\ \left(\pi_{2P_x^2}=\pi_{2Py^2}\right)\pi^*2p_x^1\pi^*2P_y^0$

It has one unpaired electron so it is para-magnetic.

4. Bond orders of $O_2^+,\ O_2,\ O_2^-$ and O_2^{2-} are $2.5,\ 2,\ 1.5$ and 1 respectively.

Q.81. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): ICl is more reactive than I_2.

Reason (R): $I-Cl$ bond is weaker than $I-I$ bond. In the light of the above statements, choose the most appropriate answer from the options given below: (1) Both (A) and (R) are correct but (R) is not the correct explanation of (A).

A) Both (A) and (R) are correct but (R) is not the correct explanation of (A).

B) (A) is correct but (R) is not correct.

C) (A) is not correct but (R) is correct.

D) Both (A) and (R) are correct and (R) is the correct explanation of (A).

Answer: Both (A) and (R) are correct and (R) is the correct explanation of (A).

Solution: Interhalogen compounds are more reactive than halogens (except fluorine). This is because $X-X'$ bond in interhalogens is weaker than $X-X$ bond in halogens except $F-F$ bond. All the interhalogen compounds undergo hydrolysis readily. ICl is more reactive than I_2 because $I-\ Cl$ bond is weaker than $I-\ I$ bond.

Q.82. Given below are two statements:
Statement I: The boiling points of aldehydes and ketones are higher than hydrocarbons of comparable molecular masses because of weak molecular association in aldehydes and ketones due to dipole - dipole interactions.
Statement II: The boiling points of aldehydes and ketones are lower than the alcohols of similar molecular masses due to the absence of H-bonding.

In the light of the above statements, choose the most appropriate answer from the options given below :

A) Both Statement I and Statement II are incorrect.

B) Statement I is correct but Statement II is incorrect.

C) Statement I is incorrect but Statement II is correct.

D) Both Statement I and Statement II are correct.

Answer: Both Statement I and Statement II are correct.

Solution: The boiling points of aldehydes and ketones are higher than hydrocarbons of comparable molecular masses. It is due to weak molecular association in aldehydes and ketones arising out of the dipole-dipole interactions. Also, their boiling points are lower than those of alcohols of similar molecular masses due to absence of intermolecular hydrogen bonding.

Q.83. The pH of the solution containing $50\ \mathrm{mL}$ each of $0.10\ \mathrm{M}$ sodium acetate and $0.01\ \mathrm{M}$ acetic acid is [Given $\mathrm{pK_a}$ of $\mathrm{CH_3COOH} = 4.57$]

A) 3.57

B) 4.57

C) 2.57

D) 5.57

Answer: 5.57

Solution: The given solution is an acidic buffer solution.

According to the Henderson equation for acidic buffer,

$$\mathrm{pH} = \mathrm{pK_a} + \log_{10}\frac{[\mathrm{salt}]}{[\mathrm{acid}]}$$

Given that,

$$\mathrm{pK_a} = 4.57$$
$$[\mathrm{salt}] = [\mathrm{sodium\ \ acetate}] = 0.1\mathrm{M}$$
$$[\mathrm{Acid}] = [\mathrm{Acetic\ \ acid}] = 0.01\mathrm{M}$$

Hence, the

$$\mathrm{pH} = 4.57 + \log\frac{0.1}{0.01} = 4.57 + 1 = 5.57$$

Q.84. Identify the incorrect statement from the following.

A) All the five $4\mathrm{d}$ orbitals have shapes similar to the respective $3\mathrm{d}$ orbitals.

B) In an atom, all the five $3\mathrm{d}$ orbitals are equal in energy in free state.

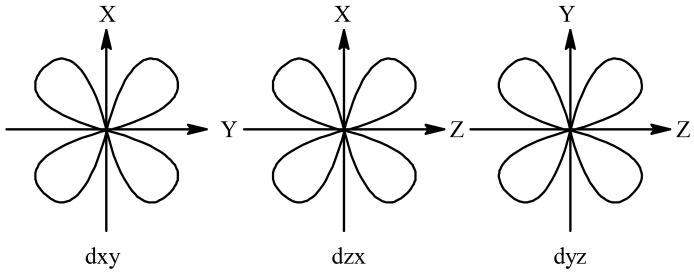
C) The shapes of $\mathrm{d_{xy}}$, $\mathrm{d_{yz}}$, and $\mathrm{d_{zx}}$ orbitals are similar to each other; and $\mathrm{d_{x^2-y^2}}$ and $\mathrm{d_{z^2}}$ are similar to each other.

D) All the five $5\mathrm{d}$ orbitals are different in size when compared to the respective 4d orbitals.

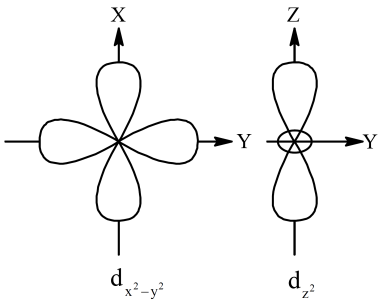
Answer: The shapes of $\mathrm{d_{xy}}$, $\mathrm{d_{yz}}$, and $\mathrm{d_{zx}}$ orbitals are similar to each other; and $\mathrm{d_{x^2-y^2}}$ and $\mathrm{d_{z^2}}$ are similar to each other.

Solution: The shapes of 3d orbital are same as respective 4d and 5d orbitals, only the size of the orbital changes, when the respective shell number increases. All the d-orbitals are degenerate(equal energy) orbitals in the free state.

The shapes of the d_{xy}, d_{yz} and d_{xz} are same.



The shapes of the $d_{x^2-y^2}$ and d_{z^2} are different.



Q.85. At 298 K, the standard electrode potentials of Cu^{2+}/Cu, Zn^{2+}/Zn, Fe^{2+}/Fe and Ag^{+}/Ag are 0.34 V, −0.76 V, −0.44 V and 0.80 V, respectively.

On the basis of standard electrode potential, predict which of the following reaction cannot occur?

A) $CuSO_4(aq) + Fe(s) \rightarrow FeSO_4(aq) + Cu(s)$

B) $FeSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Fe(s)$

C) $2\,CuSO_4(aq) + 2\,Ag(s) \rightarrow 2\,Cu(s) + Ag_2SO_4(aq)$

D) $CuSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Cu(s)$

Answer: $2\,CuSO_4(aq) + 2\,Ag(s) \rightarrow 2\,Cu(s) + Ag_2SO_4(aq)$

Solution: The given standard reduction potentials of $Zn,\ Cu,\ Ag$ and Fe are;

$E^{\circ}_{Zn^{2+}/Zn} = -0.76\ V,\ E^{\circ}_{Cu^{2+}/cu} = 0.34\ V$

$E^{\circ}_{Ag^{+}/Ag} = 0.80\ V,\ \text{and}\ E^{\circ}_{Fe^{2+}/Fe} = -0.44\ V$

The condition for reaction to occur, $E^{\circ}_{Cell} = (E^{\circ}_{SRP})_{\text{reduction reaction}} - (E^{\circ}_{SRP})_{\text{oxidation reaction}}$ must have the positive value.

$(A)\ Cu^{2+}(aq) + Fe \rightarrow Cu\ + Fe^{2+}(aq)$

$E^{\circ}_{Cell} = 0.34 + 0.44$
$E^{\circ}_{Cell} = 0.78\ V$

$(B)\ Zn\ + Fe^{2+}(aq) \rightarrow Zn^{2+}(aq) + Fe$

$E^{\circ}_{Cell} = -0.44 + 0.76$
$E^{\circ}_{Cell} = +0.32\ V$

$(C)\ Cu^{2+}(aq) + 2Ag \rightarrow 2\,Ag^{+}(aq) + Cu$

$E^{\circ}_{Cell} = 0.34 - 0.80$
$E^{\circ}_{Cell} = -0.46\ V$

$(D)\ Zn + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu$

$E^{\circ}_{Cell} = 0.34 + 0.76$
$E^{\circ}_{Cell} = +1.10\ V$

Hence, the reaction given in C option is not possible.

Chemistry Section B

Q.86. The order of energy absorbed which is responsible for the color of complexes

(A) $\left[\mathrm{Ni}\left(\mathrm{H_2O}\right)_2\left(\mathrm{en}\right)_2\right]^{2+}$

(B) $\left[\mathrm{Ni}\left(\mathrm{H_2O}\right)_4\left(\mathrm{en}\right)\right]^{2+}$ and

(C) $\left[\mathrm{Ni}\left(\mathrm{en}\right)_3\right]^{2+}$ is

A) $(\mathrm{C}) > (\mathrm{B}) > (\mathrm{A})$

B) $(\mathrm{C}) > (\mathrm{A}) > (\mathrm{B})$

C) $(\mathrm{B}) > (\mathrm{A}) > (\mathrm{C})$

D) $(\mathrm{A}) > (\mathrm{B}) > (\mathrm{C})$

Answer: $(\mathrm{C}) > (\mathrm{A}) > (\mathrm{B})$

Solution: The complexes with strong filed ligands absorbs the highest energy light than complexes with weak field ligands.

Ethylene diamine(en) is strong field ligand and $\mathrm{H_2O}$ is the weak field ligand.

Hence, the correct order of energy absorbed is

$\left[\mathrm{Ni}\left(\mathrm{en}\right)_3\right]^{2+} > \left[\mathrm{Ni}\left(\mathrm{H_2O}\right)_2\left(\mathrm{en}\right)_2\right]^{2+} > \left[\mathrm{Ni}\left(\mathrm{H_2O}\right)_4\left(\mathrm{en}\right)\right]^{2+}$

Q.87. A $10.0\ \mathrm{L}$ flask contains $64\ \mathrm{g}$ of oxygen at $27^{\circ}\mathrm{C}$. (Assume $\mathrm{O_2}$ gas is behaving ideally). The pressure inside the flask in bar is

(Given $\mathrm{R} = 0.0831\ \mathrm{L\ bar\ K^{-1}\ mol^{-1}}$)

A) 498.6

B) 49.8

C) 4.9

D) 2.5

Answer: 4.9

Solution: From the ideal gas equation,

$\mathrm{P} = \frac{\mathrm{nRT}}{\mathrm{V}}$

$\mathrm{P} = \mathrm{pressure\ of\ oxygen}$

$\mathrm{V} = \mathrm{Volume\ of\ oxygen}$

$\mathrm{T} = \mathrm{temperature\ of\ oxygen\ in\ K}$

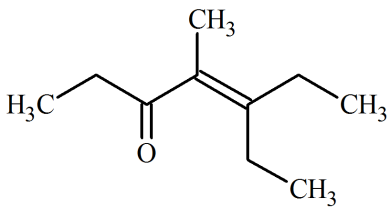
$\mathrm{n} = \mathrm{Number\ of\ moles\ of\ oxygen\ gas}$

$\mathrm{n} = \frac{64}{32} = 2$

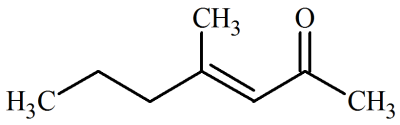
$\mathrm{P} = \frac{2 \times 0.0831 \times 300}{10} = 4.986\ \mathrm{bar}$

Q.88. Which one of the following is not formed when acetone reacts with 2-pentanone in the presence of dilute NaOH followed by heating?

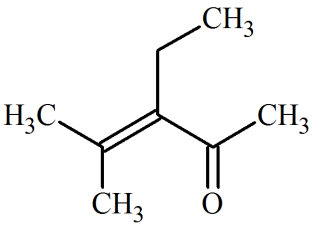
A)



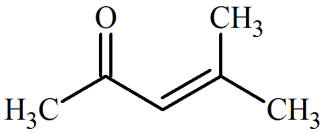
B)



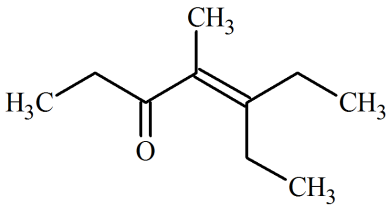
C)



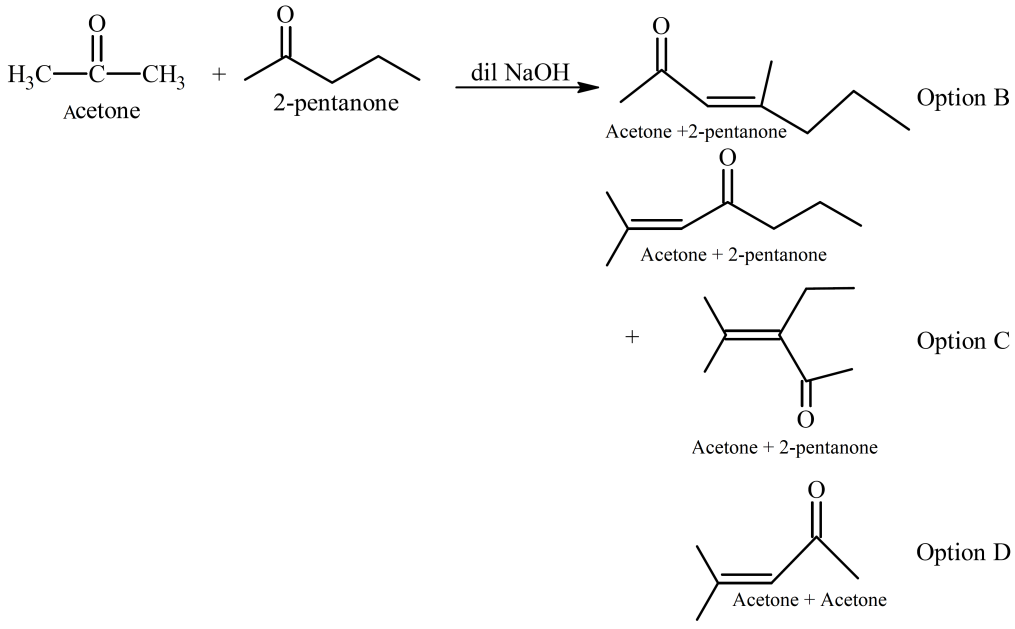
D)



Answer:



Solution: This reaction is an example of cross aldol condensation reaction. In this reaction mixture of products will be formed by two different reactants. Two diffrent alpha hydrogen are present in 2-pentanone and one alpha hydrogen is present in acetone. Hence, three cross aldol and three self aldol products are possible. Few products are shown below.



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Q.89. Find the emf of the cell in which the following reaction takes place at $298\ \mathrm{K}$

$$\mathrm{Ni(s) + 2\,Ag^{+}(0.001\ M) \rightarrow Ni^{2+}(0.001M) + 2\,Ag(s)}$$

(Given that $\mathrm{E^{\circ}_{cell} = 1.05\ V}$, $\frac{2.303\ \mathrm{RT}}{\mathrm{F}} = 0.059$ at $298\ \mathrm{K}$)

Note: Question is modified little bit for academic accuracy. $\mathrm{E^{\circ}_{cell} = 1.05\ V\ in\ place\ of\ E^{\circ}_{cell} = 10.5\ V.}$

A) $1.385\ \mathrm{V}$

B) $0.9615\ \mathrm{V}$

C) $1.05\ \mathrm{V}$

D) $1.0385\ \mathrm{V}$

Answer: $0.9615\ \mathrm{V}$

Solution: Given reaction: $\mathrm{Ni(s) + 2\,Ag^{+}(0.001\ M) \rightarrow Ni^{2+}(0.001M) + 2\,Ag(s)}$

Applying Nernst equation we have:

$$\mathrm{E_{(cell)} = E^{0}_{(cell)} - \frac{2.303\ RT}{nF} \log \frac{[Ni^{2+}][Ag]}{[Ag^{+}]^{2}[Ni]}}$$

Active mass of solid is taken to be unity so $\mathrm{[Ni(s)] = [Ag(s)] = 1}$

$$\mathrm{E_{(cell)} = E^{0}_{(cell)} - \frac{0.059}{n} \log \frac{[Ni^{2+}]}{[Ag^{+}]^{2}}}$$

$$= 1.05 - \frac{0.0591}{2} \log \frac{(0.001)}{(0.001)^{2}}$$

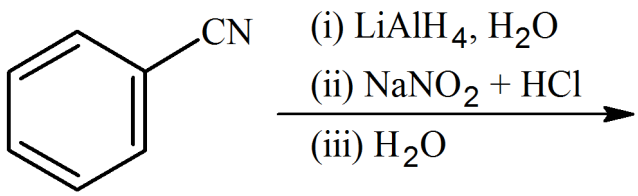
$$= 1.05 - 0.0295\ \log(1 \times 10^{3})$$

$$= 1.05 - 0.0295\ \times 3$$

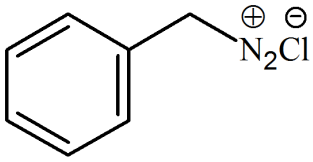
$$= 0.9615\ \mathrm{V}$$

Therefore, the emf of the cell is $0.9615\ \mathrm{V}$.

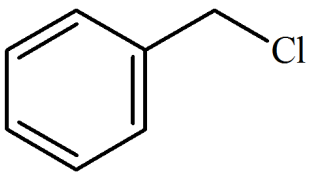
Q.90. The product formed from the following reaction sequence is



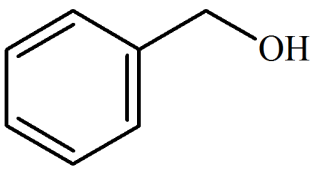
A)



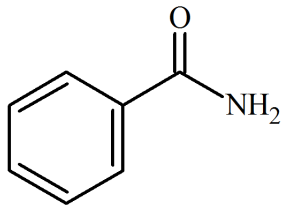
B)



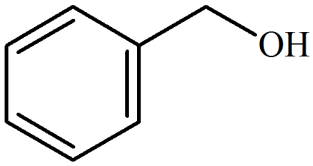
C)



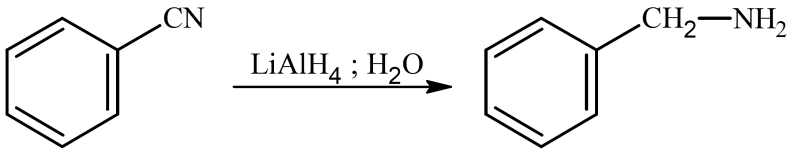
D)



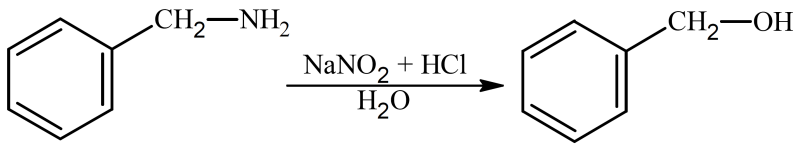
Answer:



Solution: The first stop consist of reduction in this cynide group will be reduce to primary amine.



In 2^{nd} and 3^{rd} step primery amine will be converted into alcohol.



So, find product will be benzyl alcohol.

Q.91. Copper crystallizes in an FCC unit cell with cell edge of 3.608×10^{-8} cm. The density of copper is $8.92\ \mathrm{g/cm^3}$, Calculate the atomic mass of copper.

A) $63.1\ \mathrm{u}$

B) $65\ \mathrm{u}$

C) $60\ \mathrm{u}$

D) $31.55\ \mathrm{u}$

Answer: $63.1\ \mathrm{u}$

Solution: The number of effective atoms in a FCC unit cell, $\mathrm{Z} = 4$ atoms

$$\mathrm{M} = \frac{\mathrm{d} \times \mathrm{N_0} \times \mathrm{a}^3}{\mathrm{Z}}$$

Where,

M is atomic mass of copper

d is density of copper= $8.92\ \mathrm{g/cm^3}$,

$\mathrm{N_0}$ is the Avogadro number $= 6.022 \times 10^{23}\ \mathrm{mol^{-1}}$
a is the edge length $= 3.608 \times 10^{-8}\mathrm{cm}$

Substituting the values in the formula,

$$\Rightarrow \mathrm{M} = \frac{8.92\mathrm{g/cm^3} \times 6.022 \times 10^{23}\mathrm{atom/mol} \times (3.608 \times 10^{-8}\mathrm{cm})^3}{4\,\mathrm{atoms}}$$

$$\Rightarrow \mathrm{M} = 63.1\ \mathrm{g/mol}$$

Atomic mass of copper $= 63.1\ \mathrm{u}$

Q.92. $3O_2(g) \rightleftharpoons 2O_3(g)$

for the above reaction at $298\ K$, K_c is found to be 3.0×10^{-59}. If the concentration of O_2 at equilibrium is $0.040\ M$ then concentration of O_3 in M is

A) 1.9×10^{-63}

B) 2.4×10^{31}

C) 1.2×10^{21}

D) 4.38×10^{-32}

Answer: 4.38×10^{-32}

Solution: $K_c = 3.0 \times 10^{-59}$
$[O_2(g)] = 4 \times 10^{-2}$.
The given reaction $3O_2(g) \rightleftharpoons 2O_3(g)$

$$K_c = \frac{\text{product of molar concentration of products}}{\text{product of molar concentration of reactants}} = \frac{[O_3(g)]^2}{[O_2(g)]^3}$$

Put all the given values in the expression of Kc

$$3.0 \times 10^{-59} = \frac{[O_3(g)]^2}{[4 \times 10^{-2}]^3}$$
$$\Rightarrow [O_3(g)]^2 = 3.0 \times 10^{-59} \times (4 \times 10^{-2})^3$$
$$\Rightarrow [O_3(g)]^2 = 192 \times 10^{-65}$$

Hence, the concentration of O_3 = 4.38×10^{-32} M

Q.93. Given below are two statements:

Statement I: In Lucas test, primary, secondary and tertiary alcohols are distinguished on the basis of their reactivity with conc. $HCl + ZnCl_2$, known as Lucas Reagent.

Statement II: Primary alcohols are most reactive and immediately produce turbidity at room temperature on reaction with Lucas Reagent.

In the light of the above statements, choose the most appropriate answer from the options given below:

A) Both Statement I and Statement II are incorrect.

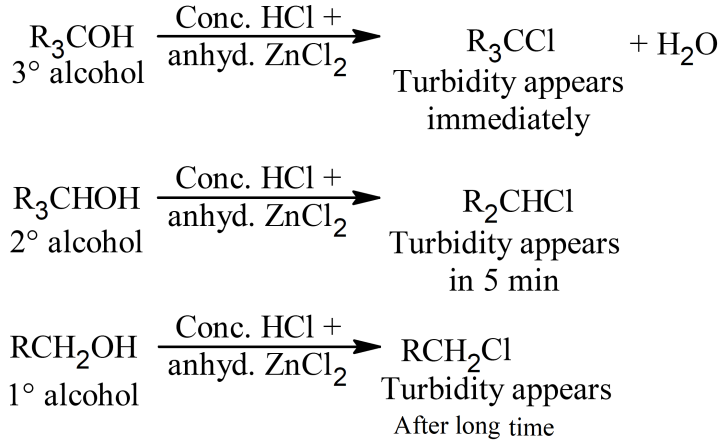
B) Statement I is correct but Statement II is incorrect.

C) Statement I is incorrect but Statement II is correct.

D) Both Statement I and Statement II are correct.

Answer: Statement I is correct but Statement II is incorrect.

Solution: Lucas reagent helps in the distinction of primary, secondary and tertiary alcohols. A small quantity of unknown alcohol is added to Lucas reagent (anhyd. $ZnCl_2$ + conc. HCl) at room temperature and the mixture is shaken. A tertiary alcohol forms turbidity immediately, secondary alcohol forms turbidity within five minutes and primary alcohol shows no turbidity at room temperature.



So, Statement I is correct, but Statement II is incorrect.

Q.94. In the neutral or faintly alkaline medium, $KMnO_4$ oxidises iodide into iodate. The change in oxidation state of manganese in this reaction is from

A) $+6$ to $+4$

B) $+7$ to $+3$

C) $+6$ to $+5$

D) $+7$ to $+4$

Answer: $+7$ to $+4$

Solution: $KMnO_4$ acts as an oxidising agent. In neutral or faintly alkaline medium When alkaline $KMnO_4$ is treated with KI, iodide ion is oxidised to iodate $\left(IO_3^-\right)$ and$KMnO_4$ is reduced to MnO_2. The chemical reaction can be given as,

$$2\,KMnO_4 + H_2O + KI \rightarrow 2\,MnO_2 + 2KOH + KIO_3$$

The change in oxidation state of manganese in this reaction is from $+7$ to $+4$.

Q.95. Match List-I with List-II.

List-I (Ores)		List-II (Composition)	
(a)	Haematite	(i)	Fe_3O_4
(b)	Magnetite	(ii)	$ZnCO_3$
(c)	Calamine	(iii)	Fe_2O_3
(d)	Kaolinite	(iv)	$[Al_2(OH)_4Si_2O_5]$

Choose the correct answer from the options given below:

A) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

B) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

C) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

D) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

Answer: (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

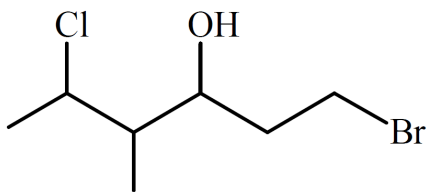
Solution: **Haematite** is a common iron oxide compound with the formula, Fe_2O_3 and is widely found in rocks and soils.

Magnetite is a mineral and one of the main iron ores, with the chemical formula $Fe^{2+}Fe^{3+}{}_2O_4(Fe_3O_4)$.

Calamine is an ore of zinc. It is zinc carbonate($ZnCO_3$).

Kaolinite is a clay mineral, with the chemical composition $Al_2(OH)_4Si_2O_5$. It is an important industrial mineral.

Q.96. The correct IUPAC name of the following compound is:



A) 6-bromo-2-chloro-4-methylhexan-4-ol

B) 1-bromo-4-methyl-5-chlorohexan-3-ol

C) 6-bromo-4-methyl-2-chlorohexan-4-ol

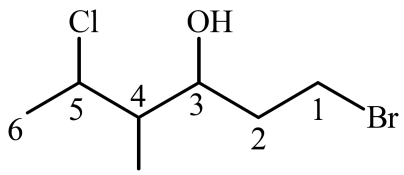
D) 1-bromo-5-chloro-4-methylhexan-3-ol

Answer: 1-bromo-5-chloro-4-methylhexan-3-ol

Solution: The root word in the given structure should be hex and alcoholic group forms the suffix and as per the least sum rule of the substituents the position of the substituents that is bromo, chloro and methyl groups should be 1,5 and 4 respectively.

The functional group with highest priority should be getting least possible number in position.

Hence,The correct IUPAC name of the given molecule is 1-bromo-5-chloro-4-methylhexan-3-ol.



Q.97. If radius of second Bohr orbit of the He^{+} ion is $105.8\ pm$, what is the radius of third Bohr orbit of Li^{2+} ion?

A) $15.87\ pm$

B) $1.587\ pm$

C) $158.7\ Å$

D) $158.7\ pm$

Answer: $158.7\ pm$

Solution: According to bohr's model, radius of nth orbit is given by

$$r_n = a_0\frac{n^2}{Z}$$

$$r_n = 52.9\frac{n^2}{Z} in\ pm$$

$$a_0 = 52.9\,pm$$

$$\frac{r_1}{r_2} = \frac{r_{He^+}}{r_{Li^{2+}}}$$

$$\frac{r_1}{r_2} = \frac{n_1^2}{n_2^2}\frac{Z_2}{Z_1}$$

$$= \frac{2^2}{3^2}\frac{3}{2} = \frac{2}{3}$$

$$\frac{r_1}{r_2} = \frac{r_{He^+}}{r_{Li^{2+}}} = \frac{2}{3}$$

$$r_{He^+}\ of\ second\ orbit = 105.8\,pm$$

$$r_{Li^{2+}}\ of\ third\ orbit = \frac{105.8 \times 3}{2} = 158.7\,pm$$

Q.98. Compound X on reaction with O_3 followed by Zn/H_2O gives formaldehyde and 2-methyl propanal as products. The compound X is:

A) 2-Methylbut-1-ene

B) 2-Methylbut-2-ene

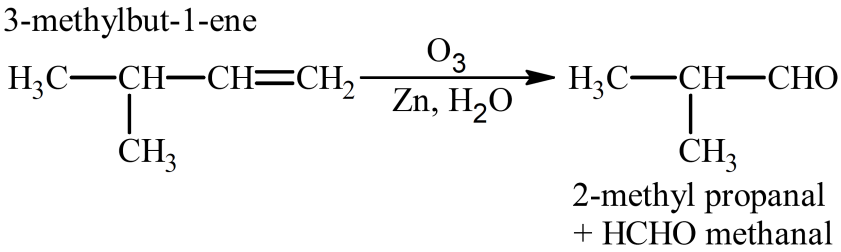
C) Pent-2-ene

D) 3-Methylbut-1-ene

Answer: 3-Methylbut-1-ene

Solution: Reductive Ozonolysis of alkenes gives aldehydes and ketones.

3-Methylbut-1-ene on ozonolysis gives $2-\text{methyl propanal}$ and methanal on reductive ozonolysis.



Q.99. For a first order reaction $A \rightarrow$ Products, initial concentration of A is $0.1\ M$, which becomes $0.001\ M$ after 5 minutes. Rate constant for the reaction in min^{-1} is

A) 0.9212

B) 0.4606

C) 0.2303

D) 1.3818

Answer: 0.9212

Solution: The integrated rate equation for a first order reaction is given by

$$k = \frac{2.303}{t}\log\frac{a}{a-x}$$

Where

$k = \text{Rate constant}$
$a = \text{initial concentration of the reactants}$
$a - x = \text{concentration of reactants left after time, t.}$

$$k = \frac{2.303}{5}\log\frac{0.1}{0.001}$$
$$= \frac{4.606}{5} = 0.9212\ \text{min}^{-1}$$

Hence, the rate constant of the given reaction is $0.9212\ \text{min}^{-1}$

Q.100. The pollution due to oxides of sulphur gets enhanced due to the presence of:

(a) particulate matter
(b) ozone
(c) hydrocarbons
(d) hydrogen peroxide

Choose the most appropriate answer from the options given below:

A) (a), (b), (d) only

B) (b), (c), (d) only

C) (a), (c), (d) only

D) (a), (d) only

Answer: (a), (b), (d) only

Solution: Sulphur dioxide causes irritation to the eyes, resulting in tears and redness. High concentration of SO_2 leads to stiffness of flower buds which eventually fall off from plants. Uncatalysed oxidation of sulphur dioxide is slow. However, the presence of particulate matter in polluted air catalyses the oxidation of sulphur dioxide to sulphur trioxide.
$2SO_2\ (g) + O_2\ (g) \rightarrow 2SO_3(g)$ The reaction can also be promoted by ozone and hydrogen peroxide.
$SO_2\ (g) + O_3\ (g) \rightarrow SO_3(g) + O_2\ (g)\ SO_2(g) + H_2O_2(l) \rightarrow H_2SO_4(aq)$

Botany Section A

Q.101. Which of the following is not a method of *ex situ* conservation?

A) National Parks

B) Micropropagation

C) Cryopreservation

D) *In vitro* fertilization

Answer: National Parks

Solution: *Ex-situ* conservation is off-site conservation in which the animals are conserved in a protected environment under special care. It is conservation of selected rare plants/animals in places outside their natural homes. *Ex-situ* conservation includes offsite botanical gardens, zoo, seed banks, micropropagation, cryopreservation, *In vitro* fertilization, etc. An area where animal habitats and their surroundings are protected from any sort of disturbance is known as *in situ* conservation, National parks are examples of this.

Q.102. Given below are two statements:
Statement I: The primary CO_2 acceptor in C_4 plants is phosphoenolpyruvate and is found in the mesophyll cells.
Statement II : Mesophyll cells of C_4 plants lack RuBisCo enzyme.
In the light of the above statements, choose the correct answer from the options given below :

A) Both Statement I and Statement II are incorrect

B) Statement I is correct but Statement II is incorrect

C) Statement I is incorrect but Statement II is correct

D) Both Statement I and Statement II are correct

Answer: Both Statement I and Statement II are correct

Solution: Phosphoenolpyruvate or PEP is the 3C compound and acts as the primary carbon dioxide acceptor in the mesophyll cells of C_4 plants, leading to the formation of OAA, C_4 acid. Ribulose-1,5-bisphosphate carboxylase oxygenase (RuBisCO) is an enzyme found in the mesophyll cells present within the C_3 plants. In C_4 plants, this enzyme is found in the bundle sheath cells.

Q.103. XO type of sex determination can be found in:

A) Birds

B) Grasshoppers

C) Monkeys

D) *Drosophila*

Answer: Grasshoppers

Solution: An example of an XO type of sex determination is Grasshopper in which the males have only one X-chromosome besides the autosomes, whereas females have a pair of X-chromosomes.
XX-XY sex-determination system is seen in Man and *Drosophila* whereas the ZZ-ZW sex-determination system is present in the birds.

Q.104. In old trees the greater part of secondary xylem is dark brown and resistant to insect attack due to:
(a) secretion of secondary metabolites and their deposition in the lumen of vessels.
(b) deposition of organic compounds like tannins and resins in the central layers of stem.
(c) deposition of suberin and aromatic substances in the outer layer of stem.
(d) deposition of tannins, gum, resin and aromatic substances in the peripheral layers of stem.
(e) presence of parenchyma cells, functionally active xylem elements and essential oils.
Choose the correct answer from the options given below:

A) (c) and (d) Only

B) (d) and (e) Only

C) (b) and (d) Only

D) (a) and (b) Only

Answer: (a) and (b) Only

Solution: In old trees, the greater part of secondary xylem is dark brown due to deposition of organic compounds like tannins, resins, oils, gums, aromatic substances and essential oils in the central or innermost layers of the stem. These substances make it hard, durable and resistant to the attacks of microorganisms and insects. This region comprises dead elements with highly lignified walls and is called heartwood.

Q.105. Which of the following is not observed during the apoplastic pathway?

A) The movement does not involve crossing of cell membrane

B) The movement is aided by cytoplasmic streaming

C) Apoplast is continuous and does not provide any barrier to water movement

D) Movement of water occurs through intercellular spaces and walls of the cells

Answer: The movement is aided by cytoplasmic streaming

Solution: Inside a plant, the apoplast is the space outside the plasma membrane within which material can diffuse freely. It is interrupted by the Casparian strip in roots, by air spaces between plant cells and by the plant cuticle.The apoplast pathway comprises of non living components of a plant body i.e., intercellular spaces and cell wall. Apoplastic pathway the movement does not involve crossing of cell membrane, symplastic movement is aided by cytoplasmic streaming. Apoplast is continuous and does not provide any barrier to water movement and the movement of water occurs through intercellular spaces and walls of the cells.

Q.106. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): Polymerase chain reaction is used in DNA amplification
Reason (R): The ampicillin resistant gene is used as a selectable marker to check transformation
In the light of the above statements, choose the correct answer from the options given below :

A) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

B) (A) is correct but (R) is not correct

C) (A) is not correct but (R) is correct

D) Both (A) and (R) are correct and (R) is the correct explanation of (A)

Answer: Both (A) and (R) are correct but (R) is not the correct explanation of (A)

Solution: The polymerase chain reaction (PCR) is an artificial method of the gene amplification by which several copies of the desired DNA segment can be obtained in a short period. This technique was developed by Kary Mullis in 1985. This technique is based on a principle that the DNA undergoes denaturation at high temperature. Selectable markers are used to select for successful transformants from untransformed cells. The ampicillin resistant gene in the plasmid is one of the example of this.

Q.107. Which one of the following statement is not true regarding gel electrophoresis technique?

A) The separated DNA fragments are stained by using ethidium bromide.

B) The presence of chromogenic substrate gives blue coloured DNA bands on the gel.

C) Bright orange coloured bands of DNA can be observed in the gel when exposed to UV light.

D) The process of extraction of separated DNA strands from gel is called elution.

Answer: The presence of chromogenic substrate gives blue coloured DNA bands on the gel.

Solution: Isolation of the DNA (or gene of interest) followed by the separation of digested fragment of the DNA is one of the crucial steps of Recombinant DNA Technology. The separation is based on the technique called gel electrophoresis.

Gel electrophoresis is a method for separation and analysis of macromolecules (DNA, RNA and proteins) and their fragments, based on their size and charge.

The separated DNA segments are stained with ethidium bromide for visualisation after exposure to UV light in gel electrophoresis. Bright orange coloured bands of DNA can be observed in the gel when exposed to UV light. The separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is called elution. Chromogenic substance are used as a selectable marker.

Q.108. The gaseous plant growth regulator is used in plants to:

A) promote root growth and roothair formation to increase the absorption surface

B) help overcome apical dominance

C) kill dicotyledonous weeds in the fields

D) speed up the malting process

Answer: promote root growth and roothair formation to increase the absorption surface

Solution: Ethylene is a gaseous plant growth regulator, synthesised by most ripening fruits and ageing tissues. Ethylene is used as both plant growth promoters and plant growth inhibitors. It is mainly used to stimulate the ripening of fruits. It also promotes root growth and root hair formation to increase the absorption surface. Cytokinin can overcome apical dominance caused by auxin. Synthetic auxin kill dicotyledonous weeds in the fields. Gibberellins are used to speed up the malting process in brewing industry.

Q.109. What amount of energy is released from glucose during lactic acid fermentation?

A) More than 18%

B) About 10%

C) Less than 7%

D) Approximately 15%

Answer: Less than 7%

Solution: Lactic acid fermentation is a type of anaerobic metabolic process. This usually takes place in some bacteria and even in muscle cells of animals and human beings. In lactic acid fermentation $NADH.H^+$ transfers its electrons directly to pyruvate, generating lactate as a by-product. Less than seven percent of the energy in glucose is released in this process.

Q.110. Read the following statements about the vascular bundles:
(a) In roots, xylem and phloem in a vascular bundle are arranged in an alternate manner along the different radii.
(b) Conjoint closed vascular bundles do not possess cambium.
(c) In open vascular bundles, cambium is present in between xylem and phloem.
(d) The vascular bundles of dicotyledonous stem possess endarch protoxylem.
(e) In monocotyledonous root, usually there are more than six xylem bundles present.

Choose the correct answer from the options given below :

Options were not academically correct, so rectified.

A) (b), (c), (d) and (e) Only

B) (a), (b), (c), (d) and (e)

C) (a), (c), (d) and (e) Only

D) (a), (b) and (d) Only

Answer: (a), (b), (c), (d) and (e)

Solution: The vascular system consists of complex tissues,
the phloem and the xylem.The xylem and
phloem together constitute vascular bundles. In roots, xylem and phloem in a vascular bundle are arranged in an alternate manner along the different radii the arrangement is called radial. Conjoint closed vascular bundles do not possess cambium. In open vascular bundles, cambium is present in between xylem and phloem. The vascular bundles of dicotyledonous stem possess endarch protoxylem. In monocotyledonous root, usually there are more than six xylem bundles present.

Q.111. Identify the correct set of statements :
(a) The leaflets are modified into pointed hard thorns in *Citrus* and *Bougainvillea*
(b) Axillary buds form slender and spirally coiled tendrils in cucumber and pumpkin
(c) Stem is flattened and fleshy in *Opuntia* and modified to perform the function of leaves
(d) *Rhizophora* shows vertically upward growing roots that help to get oxygen for respiration
(e) Subaerially growing stems in grasses and strawberry help in vegetative propagation
Choose the correct answer from the options given below:

A) (a) and (d) Only

B) (b), (c), (d) and (e) Only

C) (a), (b), (d) and (e) Only

D) (b) and (c) Only

Answer: (b), (c), (d) and (e) Only

Solution: The thorn is a hard, straight and pointed structure. In *Citrus* and *Bougainvillea* the axillary bud is modified into a thorn. Cucumber and pumpkins have long slender and coiled stem tendrils which develop from axillary buds. Stem is flattened and fleshy in *Opuntia* and modified to perform photosynthesis. *Rhizophora* shows vertically upward growing roots which is known as pneumatophore help to get oxygen for respiration. Subaerially growing stems in grasses and strawberry help in vegetative propagation.

Q.112. Which one of the following plants does not show plasticity?

A) Coriander

B) Buttercup

C) Maize

D) Cotton

Answer: Maize

Solution: Plants follow different pathways in response to environment or phases of life to form different kinds of structures. This ability is called plasticity. Example heterophylly in cotton, coriander and larkspur. In such plants, the leaves of the juvenile plant are different in shape from those in mature plants. Maize plants do not show plasticity.

Q.113. Given below are two statements :
Statement I: Cleistogamous flowers are invariably autogamous
Statement II: Cleistogamy is disadvantageous as there is no chance for cross pollination
In the light of the above statements, choose the correct answer from the options given below :

A) Both Statement I and Statement II are incorrect

B) Statement I is correct but Statement II is incorrect

C) Statement I is incorrect but Statement II is correct

D) Both Statement I and Statement II are correct

Answer: Both Statement I and Statement II are correct

Solution: Cleistogamous flowers mean anther and stigma present close each other in the closed flower. They are bisexual which cannot open even at maturity and thus self-pollination occurs. For this reason these type of flowers are invariably autogamous. Cleistogamous flowers undergo self-pollination only, which reduces the chances of variation and evolution of genetically superior progeny.

Q.114. "Girdling Experiment" was performed by Plant Physiologists to identify the plant tissue through which:

A) food is transported

B) for both water and food transportation

C) osmosis is observed

D) water is transported

Answer: food is transported

Solution: "Girdling Experiment" was performed by Plant Physiologists to identify the plant tissue through which food is transported. On the trunk of a tree a ring of bark up to a depth of the phloem layer, can be carefully removed. In the absence of downward movement of food the portion of the bark above the ring on the stem becomes swollen after a few weeks. This simple experiment shows that phloem is the tissue responsible for translocation of food and that transport takes place in one direction, i.e., towards the roots.

Q.115. Hydrocolloid carrageen is obtained from:

A) Phaeophyceae and Rhodophyceae

B) Rhodophyceae only

C) Phaeophyceae only

D) Chlorophyceae and Phaeophyceae

Answer: Rhodophyceae only

Solution: Carrageenan is a polysaccharide obtained from the cell wall of *Chondrus crispus* (Irish moss). It is used in the stabilization of emulsions in paints and cosmetics and in the alcohol and sugar industry. Hydrocolloid carrageen is obtained from Rhodophyceae.

Q.116. Given below are two statements :
Statement I : Mendel studied seven pairs of contrasting traits in pea plants and proposed the Laws of Inheritance
Statement II : Seven characters examined by Mendel in his experiment on pea plants were seed shape and colour, flower colour, pod shape and colour, flower position and stem height
In the light of the above statements, choose the correct answer from the options given below :

A) Both Statement I and Statement II are incorrect

B) Statement I is correct but Statement II is incorrect

C) Statement I is incorrect but Statement II is correct

D) Both Statement I and Statement II are correct

Answer: Both Statement I and Statement II are correct

Solution: Mendel worked on the garden pea and selected 7 pairs of contrasting characters of this plant. These characters were from seed shape, seed colour, pod shape, pod colour, flower colour, plant height, flower position.

Q.117. Production of Cucumber has increased manifold in recent years. Application of which of the following phytohormones has resulted in this increased yield as the hormone is known to produce female flowers in the plants :

A) Gibberellin

B) Ethylene

C) Cytokinin

D) ABA

Answer: Ethylene

Solution: The gaseous hormone ethylene is used to increase the number of female flowers in cucumber plants. Besides this function, this hormone also promotes root growth and root hair formation, thus helping the plants to increase their absorption surface.

Q.118. The process of translation of mRNA to proteins begins as soon as :

A) The larger subunit of ribosome encounters mRNA

B) Both the subunits join together to bind with mRNA

C) The tRNA is activated and the larger subunit of ribosome encounters mRNA

D) The small subunit of ribosome encounters mRNA

Answer: The small subunit of ribosome encounters mRNA

Solution: The cellular factory responsible for synthesising proteins is the ribosome. The ribosome consists of structural RNAs and about 80 different proteins.
In its inactive state, it exists as two subunits; a large subunit and a small subunit. When the small subunit encounters an mRNA, the process of translation of the mRNA to protein begins.

Q.119. Habitat loss and fragmentation, over exploitation, alien species invasion and co-extinction are causes for:

A) Competition

B) Biodiversity loss

C) Natality

D) Population explosion

Answer: Biodiversity loss

Solution: The accelerated rates of species extinctions that the world is facing now are largely due to human activities. There are four major causes:

- Habitat loss and fragmentation.
- Over-exploitation.
- Co-extinction
- Alien species invasion.

Q.120. Read the following statements and choose the set of correct statements :
(a) Euchromatin is loosely packed chromatin
(b) Heterochromatin is transcriptionally active
(c) Histone octomer is wrapped by negatively charged DNA in nucleosome
(d) Histones are rich in lysine and arginine
(e) A typical nucleosome contains 400 bp of DNA helix

Choose the correct answer from the options given below :

A) (a), (c), (d) Only

B) (b), (e) Only

C) (a), (c), (e) Only

D) (b), (d), (e) Only

Answer: (a), (c), (d) Only

Solution: In a typical nucleus, some region of chromatin are loosely packed (and stains light) and are referred to as euchromatin. The chromatin that is more densely packed and stains dark are called as Heterochromatin. Euchromatin is said to be transcriptionally active chromatin, whereas heterochromatin is inactive.

In eukaryotes, this organisation is much more complex. There is a set of positively charged, basic proteins called histones. A protein acquires charge depending upon the abundance of amino acids residues with charged side chains. Histones are rich in the basic amino acid residues lysine and arginine.

Q.121. Which of the following is incorrectly matched?

A) *Ulothrix* - Mannitol

B) *Porphyra* - Floridian Starch

C) *Volvox* - Starch

D) *Ectocarpus* - Fucoxanthin

Answer: *Ulothrix* - Mannitol

Solution: *Ulothrix* belongs to green algae and has starch as the reserve food.

Porphyra has Floridian starch as the reserve food as its red alga.

Volvox have chlorophyll-a, b and reserve food as starch. This is a Chlorophyceae member.

Fucoxanthin is found in brown algae *Ectocarpus* is a brown alga.

Q.122. The device which can remove particulate matter present in the exhaust from a thermal power plant is:

A) Incinerator

B) Electrostatic Precipitator

C) Catalytic Convertor

D) STP

Answer: Electrostatic Precipitator

Solution: There are several ways of removing particulate matter; the most widely used of which is the electrostatic precipitator, which can remove over 99% of particulate matter present in the exhaust from a thermal power plant.

It has electrode wires that are maintained at several thousand volts, which produce a corona that releases electrons. These electrons attach to dust particles giving them a net negative charge. The collecting plates are grounded and attract the charged dust particles.

Q.123. DNA Polymorphism forms the basis of:

A) DNA finger printing

B) Both genetic mapping and DNA finger printing

C) Translation

D) Genetic mapping

Answer: Both genetic mapping and DNA finger printing

Solution: As polymorphism in DNA sequence is the basis of genetic mapping of human genome as well as of DNA fingerprinting. Polymorphism (variation at genetic level) arises due to mutations. New mutations may arise in an individual either in somatic cells or in the germ cells. If a germ cell mutation does not seriously impair individual's ability to have offspring who can transmit the mutation, it can spread to the other members of population (through sexual reproduction).

Q.124. Which one of the following statements cannot be connected to Predation?

A) It might lead to extinction of a species

B) Both the interacting species are negatively impacted

C) It is necessitated by nature to maintain the ecological balance

D) It helps in maintaining species diversity in a community

Answer: Both the interacting species are negatively impacted

Solution: Predation is a type of antagonistic interaction in which the predator is benefited, and the other species is harmed. This maintains ecological balance and the species diversity in the ecosystem.

Q.125. Which one of the following never occurs during mitotic cell division?

A) Movement of centrioles towards opposite poles

B) Pairing of homologous chromosomes

C) Coiling and condensation of the chromatids

D) Spindle fibres attach to kinetochores of chromosomes

Answer: Pairing of homologous chromosomes

Solution: Mitosis doesn't have a pairing of homologous chromosomes, it occurs in prophase 1 of meiosis 1 where bivalent and tetrad are formed

Q.126. Exoskeleton of arthropods is composed of:

A) Cellulose

B) Chitin

C) Glucosamine

D) Cutin

Answer: Chitin

Solution: The largest phylum Arthropoda has certain salient features:

- The body has distinct parts, like head, thorax, abdomen.
- There is excosketeton made up of chitin.
- There are jointed appendages.
- Blood vascular system is open type.

Q.127. What is the net gain of ATP when each molecule of glucose is converted to two molecules of pyruvic acid?

A) Six

B) Two

C) Eight

D) Four

Answer: Eight

Solution: Glycolysis is the step-wise breakdown of glucose into 3-carbon pyruvic acid. There are many enzymatically controlled steps. There are 2 ATP molecules which are consumed. The net gain of ATP in glycolysis is 8 ATP.

Q.128. Which one of the following plants shows vexillary aestivation and diadelphous stamens?

A) *Pisum sativum*

B) *Allium cepa*

C) *Solanum nigrum*

D) *Colchicum autumnale*

Answer: *Pisum sativum*

Solution:

- Inflorescence: racemose
- Flower: bisexual, zygomorphic
- Calyx: sepals five, gamosepalous; valvate/imbricate aestivation
- Corolla: petals five, polypetalous, papilionaceous, consisting of a posterior standard, two lateral wings, two anterior ones forming a keel (enclosing stamens and pistil), vexillary aestivation.
- Androecium: ten, diadelphous, anther dithecous
- Gynoecium: ovary superior, mono carpellary, unilocular with many ovules, style single.

Q.129. Identify the incorrect statement related to Pollination:

A) Pollination by wind is more common amongst abiotic pollination

B) Flowers produce foul odours to attract flies and beetles to get pollinated

C) Moths and butterflies are the most dominant pollinating agents among insects

D) Pollination by water is quite rare in flowering plants

Answer: Moths and butterflies are the most dominant pollinating agents among insects

Solution: Honeybees are the most common biotic pollinators in Angiosperms. Wind is the most common abiotic pollinator for plants. Flowers are known to attract beetles by producing foul smell. Rare pollinator for plants is water.

Q.130. Given below are two statements:

Statement I: Decomposition is a process in which the detritus is degraded into simpler substances by microbes.

Statement II: Decomposition is faster if the detritus is rich in lignin and chitin

In the light of the above statements, choose the correct answer from the options given below:

A) Both Statement I and Statement II are incorrect

B) Statement I is correct but Statement II is incorrect

C) Statement I is incorrect but Statement II is correct

D) Both Statement I and Statement II are correct

Answer: Statement I is correct but Statement II is incorrect

Solution: During decomposition, the detritus is digested by the enzymes released by microbes, like bacteria, fungus, etc. Decomposition is faster in humid condition and on cellulosic material.

Q.131. The appearance of recombination nodules on homologous chromosomes during meiosis characterizes:

A) Bivalent

B) Sites at which crossing over occurs

C) Terminalization

D) Synaptonemal complex

Answer: Sites at which crossing over occurs

Solution: Prophase I in meiosis-I is divided into 5 subphases:

- In Pachytene there is recombination of chromosomes. This is accomplished by the formation of recombination nodule.
- There is chiasmata formation in Diplotene which depicts the past recombination event.
- Terminalisation takes place of chiasmata.

Q.132. Which one of the following produces nitrogen fixing nodules on the roots of *Alnus* ?

A) *Frankia*

B) *Rhodospirillum*

C) *Beijernickia*

D) *Rhizobium*

Answer: *Frankia*

Solution: The most common association on roots is nodules. These nodules are small outgrowths on the roots. *Frankia* is a genus of nitrogen-fixing, free-living, filamentous bacteria. It produces nitrogen-fixing nodules on the roots of non-leguminous plants (e.g., *Alnus*).

The species of rod-shaped *Rhizobium* forms nodules with the roots of several legumes and helps in nitrogen fixation.

Q.133. Which one of the following is not true regarding the release of energy during ATP synthesis through chemiosmosis? It involves :

A) Breakdown of electron gradient

B) Movement of protons across the membrane to the stroma

C) Reduction of $NADP$ to $NADPH_2$ on the stroma side of the membrane

D) Breakdown of proton gradient

Answer: Breakdown of electron gradient

Solution: An electron transport chain (ETC) is a series of compounds that couples electron transfer with the transfer of protons across a membrane and transfer electrons from electron donors to electron acceptors with the help of redox reactions. This generates chemical energy in the form of adenosine triphosphate (ATP) by creating an electrochemical proton gradient, that drives ATP synthesis. The breakdown of proton gradient along the concentration gradient forms the ATP molecules.

F_0 protein complex of ATP synthase forms the channel through which protons cross the inner membrane during. For each ATP produced, $2H^+$ passes through F_0 from the intermembrane space to the matrix down the electrochemical proton gradient.

Q.134. The flowers are Zygomorphic in :

(a) Mustard

(b) Gulmohar

(c) *Cassia*

(d) *Datura*

(e) Chilly

Choose the correct answer from the options given below:

A) (b), (c) Only

B) (d), (e) Only

C) (c), (d), (e) Only

D) (a), (b), (c) Only

Answer: (b), (c) Only

Solution: In symmetry, the flower may be actinomorphic (radial symmetry) or zygomorphic (bilateral symmetry). When a flower can be divided into two equal radial halves in any radial plane passing through the centre, it is said to be actinomorphic, e.g., mustard, datura, chilli. When it can be divided into two similar halves only in one particular vertical plane, it is zygomorphic, e.g., pea, gulmohur, bean, Cassia.

Q.135. Match List -I with List-II.

	List - I		List - II
(a)	Manganese	(i)	Activates the enzyme catalase
(b)	Magnesium	(ii)	Required for pollen germination
(c)	Boron	(iii)	Activates enzymes of respiration
(d)	Iron	(iv)	Functions in splitting of water during photosynthesis

Choose the correct answer from the options given below:

A) (a) — (iv), (b) — (iii), (c) — (ii), (d) — (i)

B) (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)

C) (a) — (iii), (b) — (i), (c) — (ii), (d) — (iv)

D) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)

Answer: (a) — (iv), (b) — (iii), (c) — (ii), (d) — (i)

Solution:

	List - I		List - II
(a)	Manganese	(iv)	Functions in splitting of water during photosynthesis
(b)	Magnesium	(iii)	Activates enzymes of respiration
(c)	Boron	(ii)	Required for pollen germination
(d)	Iron	(i)	Activates the enzyme catalase

Botany Section B

Q.136. Addition of more solutes in a given solution will:

A) lower its water potential

B) make its water potential zero

C) not affect the water potential at all

D) raise its water potential

Answer: lower its water potential

Solution: The greater the concentration of water in a system, the greater is its water potential. If more solute is dissolved in water, the solution has less free water molecules and hence the water potential is decreased.

Q.137. Read the following statements on lipids and find out correct set of statements:

(a) Lecithin found in the plasma membrane is a glycolipid

(b) Saturated fatty acids possess one or more $c = c$ bonds

(c) Gingely oil has lower melting point, hence remains as oil in winter

(d) Lipids are generally insoluble in water but soluble in some organic solvents

(e) When fatty acid is esterified with glycerol, monoglycerides are formed

Choose the correct answer from the options given below:

A) (a), (d) and (e) only

B) (c), (d) and (e) only

C) (a), (b) and (d) only

D) (a), (b) and (c) only

Answer: (c), (d) and (e) only

Solution: (i) Lecithin found in plasma membrane is a phospholipid not glycolipid.

(ii) Saturated fatty acids do not possess $c = c$ bonds.

Q.138. What is the role of large bundle shealth cells found around the vascular bundles in C_4 plants?

A) To increase the number of chloroplast for the operation of Calvin cycle

B) To enable the plant to tolerate high temperature

C) To protect the vascular tissue from high light intensity

D) To provide the site for photorespiratory pathway

Answer: To increase the number of chloroplast for the operation of Calvin cycle

Solution: C_4 plants show:

- Chloroplast dimorphism.
- Presence of Kranz anatomy.
- Two times carboxylation process.
- No photorespiration.

The large bundle sheath cells around the vascular bundles in the C_4 plants have numerous chloroplasts for the operation of calvin cycle.

Q.139. The entire fleet of buses in Delhi were converted to CNG from diesel. In reference to this, which one of the following statements is false?

A) The same diesel engine is used in CNG buses making the cost of conversion low

B) It is cheaper than diesel

C) It can not be adulterated like diesel

D) CNG burns more efficiently than diesel

Answer: The same diesel engine is used in CNG buses making the cost of conversion low

Solution: The true statements are:

(i) CNG is cheaper than diesel.

(ii) It can not be adulterated like diesel or petrol.

(iii) CNG burns more efficiently than diesel.

Q.140. Transposons can be used during which one of the following?

A) Gene silencing

B) Autoradiography

C) Gene sequencing

D) Polymerase Chain Reaction

Answer: Gene silencing

Solution: Transposons are a group of mobile genetic elements that are defined as a DNA sequence. Transposons can jump into different places of the genome; for this reason, they are called jumping genes. However, some transposons are always kept at the insertion site in the genome.

Transposons are a class of genetic elements that are also called the jumping genes which can be used during gene silencing.

Q.141. Match List -I with list -II.

	List - I		List - II
(a)	Metacentric chromosome	(i)	Centromere situated close to the end forming one extremely short and one very long arms
(b)	Acrocentric chromosome	(ii)	Centromere at the terminal end
(c)	Sub-metacentric	(iii)	Centromere in the middle forming two equal arms of chromosomes
(d)	Telocentric chromosomes	(iv)	Centromere slightly away from the middle forming one shorter arm and one longer arm

Choose the correct answer from the options given below:

A) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

B) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

C) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

D) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

Answer: (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

Solution:

	List - I		List - II
(a)	Metacentric chromosome	(iii)	Centromere in the middle forming two equal arms of chromosomes.
(b)	Acrocentric chromosome	(i)	Centromere situated close to the end forming one extremely short and one very long arms
(c)	Sub-metacentric	(iv)	Centromere slightly away from the middle forming one shorter arm and one longer arm
(d)	Telocentric chromosomes	(iv)	Centromere at the terminal end

Q.142. Match the plant with the kind of life cycle it exhibits:

	List-I		List-II
(a)	*Spirogyra*	(i)	Dominant diploid sporophyte vascular plant, with highly reduced male or female gametophyte
(b)	*Fern*	(ii)	Dominant haploid free-living gametophyte
(c)	*Funaria*	(iii)	Dominant diploid sporophyte alternating with reduced gametophyte called prothallus
(d)	*Cycas*	(iv)	Dominant haploid leafy gametophyte alternating with partially dependent mutlicellular sporophyte

Choose the correct answer from the options given below:

A) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

B) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

C) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

D) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

Answer: (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

Solution:

	List-I		List-II
(a)	*Spirogyra*	(ii)	Dominant haploid free-living gametophyte
(b)	*Fern*	(iii)	Dominant diploid sporophyte alternating with reduced gametophyte called prothallus
(c)	*Funaria*	(iv)	Dominant haploid leafy gametophyte alternating with partially dependent mutlicellular sporophyte
(d)	*Cycas*	(i)	Dominant diploid sporophyte vascular plant, with highly reduced male or female gametophyte

Q.143. Which of the following occurs due to the presence of autosome linked dominant trait?

A) Myotonic dystrophy

B) Haemophilia

C) Thialessemia

D) Sickle cell anaemia

Answer: Myotonic dystrophy

Solution: Thalessemia and sickle cell anaemia are autosome linked recessive blood diseases.

Haemophilia is a sex-linked recessive disease.

Myotonic dystrophy is an autoomal dominant trait. Myotonic dystrophy is part of a group of inherited disorders called muscular dystrophies. It is the most common form of muscular dystrophy that begins in adulthood. Myotonic dystrophy is characterized by progressive muscle wasting and weakness.

Q.144. The anatomy of springwood shows some perculiar features. Identify the correct set of statements about springwood.

(a) It is also called as the earlywood

(b) In spring season cambium produces xylem elements with narrow vessels

(c) It is lighter in colour

(d) The springwood along with autumnwood shows alternate concetric rings forming annual rings

(e) It has lower density

Choose the correct answer from the options given below:

A) (a), (c), (d) and (e) only

B) (a), (b) and (d) only

C) (c), (d) and (e) only

D) (a), (b), (d) and (e) only

Answer: (a), (c), (d) and (e) only

Solution: The true statements are:

1. It is also called as the early wood.

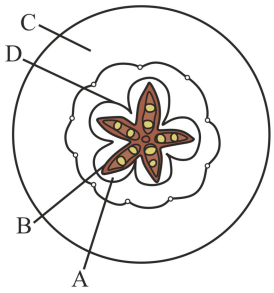
2. In spring season cambium produces xylem elements with wider vessels.

3. Spring wood is lighter in colour

4. The spring wood along with autumn wood shows alternate concentric rings forming annual rings.

5. It has lower density

Q.145. Which part of the fruit, labelled in the given figure make it a false fruit



A) B → Endocarp

B) C → Thalamus

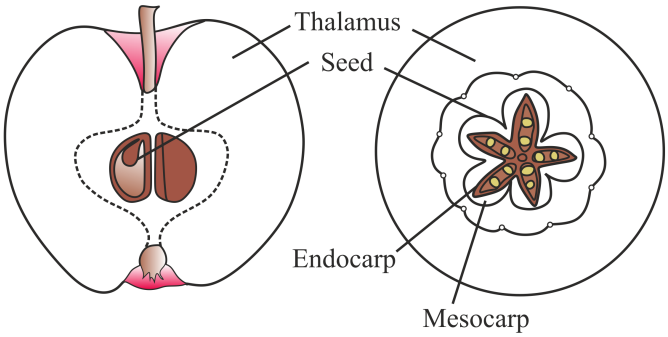
C) D → Seed

D) A → Mesocarp

Answer: C → Thalamus

Solution: The fruit is a characteristic feature of the flowering plants. It is a mature or ripened ovary, developed after fertilisation. If a fruit is formed without fertilisation of the ovary, it is called a parthenocarpic fruit.

In few species of plants, the thalamus also contributes to fruit formation, such fruits are called false fruits. The fleshy thalamus is edible in these cases. Example is Apple.



Q.146. In the following palindromic base sequences of DNA, which one can be cut easily by particular restriction enzyme?

A) 5' G A A T T C 3'

3' C T T A A G 5'

B) 5' C T C A G T 3'

3' G A G T C A 5'

C) 5' G T A T T C 3'

3' C A T A A G 5'

D) 5' G A T A C T 3'

3' C T A T G A 5'

Answer: 5' G A A T T C 3'

3' C T T A A G 5'

Solution: A sequence of base pairs that reads same on the two strands when orientation of reading is kept the same, is called a palindromic nucleotide sequence in the DNA.

For example restriction enzyme EcoRI recognises a particular palindromic sequence:-

5' G A A T T C 3'

3' C T T A A G 5'

Q.147. While explaining interspecific interaction of population, $(+)$ sign is assigned for beneficial interaction, $(-)$ sign is assigned for detrimental interaction and (0) for neutral interaction. Which of the following interactions can be assigned $(+)$ for one species and $(-)$ for another species involved in the interaction?

A) Amensalism

B) Commensalism

C) Competition

D) Predation

Answer: Predation

Solution: In predation and parasitism type of interactions only one species benefits and the other species is harmed.

Species A	Species B	Name of interaction
$+$	$+$	Mutualism
$-$	$-$	Competition
$+$	$-$	Predation
$+$	$-$	Parasitism
$+$	0	Commensalism
$-$	0	Amensalism

Q.148. Which one of the following will accelerate phosphorus cycle?

A) Volconic activity

B) Weathering of rocks

C) Rain fall and storms

D) Burning of fossil fuels

Answer: Weathering of rocks

Solution: Rocks are the natural reservoir of phosphorous. They contain phosphorous in the form of phosphates, which is related in the soil with the weathering of rocks.

When rocks are weathered, minute amounts of these phosphates dissolve in soil solution and are absorbed by the roots of the plants.

Q.149. Given below are two statements one is labelled as: Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Mendel's law of independent assortments does not hold good for the genes that are located closely on the same chromosome.

Reason (R); Closely located genes assort independently.

In the light of the above statements, choose the correct answer from the options given below:

A) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

B) (A) is correct but (R) is not correct

C) (A) is not correct but (R) is correct

D) Both (A) and (R) are correct and (R) is the correct explanation of (A)

Answer: (A) is correct but (R) is not correct

Solution: Mendel's law of independent assortment states that, when two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent of the other pair of characters. The genes that are located closely on the same chromosomes do not assort independently due to linkage.

Q.150. If a geneticist uses the blind approach for sequencing the whole genome of an organism, followed by assignment of function to different segments, the methodology adopted by him is called as:

A) Gene mapping

B) Expressed sequence tags

C) Bioinformatics

D) Sequence annotation

Answer: Sequence annotation

Solution: In sequence annotation, the whole set of genome containing all coding and non-coding sequences is sequenced and the functions are assigned to different segments.

It could be used for marking specific features in a DNA, RNA or protein sequence with descriptive information about structure or function.

It helps in describing regions or sites of interest in the protein sequence, such as enzyme active sites, secondary structure or other characteristics reported in the cited references.

Zoology Section A

Q.151. Given below are two statements:

Statement I: Autoimmune disorder is a condition where body defense mechanism recognises its own cells as foreign bodies.

Statement II: Rheumatoid arthritis is a condition where body does not attack self cells.

In the light of the above statements, choose the most appropriate answer from the options given below:

A) Both statement I and statement II are incorrect

B) Statement I is correct but statement II is incorrect

C) Statement I is incorrect but statement II is correct

D) Both statement I and statement II are correct

Answer: Statement I is correct but statement II is incorrect

Solution: Autoimmunity, which is an abnormal immune response against self-antigens. The body cells (self) act as antigens and are termed as an autoantigen. The immune system is unable to differentiate between self and non-self tissue in case of auto-immune disorders. The immune system produces antibodies against tissues of the own body or self.

For example, in rheumatoid arthritis, a type of immunoglobulin IgM is diagnosed and it is due to autoimmunity of the synovial membrane. These antibodies destroy the synovial membrane, which is the autoantigen in this case. This leads to swollen, painful, and deformed joints.

Q.152. Given below are two statements:

Statement I: The coagulum is formed of network of threads called thrombins.

Statement II: Spleen is the graveyard of erythrocytes.

In the light of the above statements, choose the most appropriate answer from the options given below:

A) Both statement I and statement II are incorrect

B) Statement I is correct but statement II is incorrect

C) Statement I is incorrect but statement II is correct

D) Both statement I and statement II are correct

Answer: Statement I is incorrect but statement II is correct

Solution: Blood coagulation or clotting is a mechanism to prevent excessive loss of blood. The clot or coagulam is a dark reddish brown scum formed at the site of an injury. It is formed mainly of a network of threads called **fibrins** in which dead and damaged formed elements of blood are trapped. Fibrins are formed by the conversion of inactive fibrinogens present in the plasma by the enzyme thrombin.

Erythrocytes or red blood cells are the most abundant of all the cells in blood. They have a red coloured, iron containing haemoglobin protein complex. RBCs have an average life span of 120 days after which they are destroyed in the spleen which is known as graveyard of RBCs.

Q.153. Identify the asexual reproductive structure associated with *Penicillium*:

A) Conidia

B) Gemmules

C) Buds

D) Zoospores

Answer: Conidia

Solution: The ascomycetes are commonly known as sac-fungi. They are mostly multicellular, e.g., *Penicillium*, or rarely unicellular, e.g., yeast (*Saccharomyces*).

The asexual spores produced by them are called as conidia. They are produced exogenously on the special mycelium named as conidiophores. Conidia on germination produce mycelium.

Q.154. Given below are two statements:

Statement I: The release of sperms into the seminiferous tubules is called spermiation.

Statement II: Spermiogenesis is the process of formation of sperms from spermatogonia.

In the light of the above statements, choose the most appropriate answer from the options given below:

A) Both statement I and statement II are incorrect

B) Statement I is correct but statement II is incorrect

C) Statement I is incorrect but statement II is correct

D) Both statement I and statement II are correct

Answer: Both statement I and statement II are incorrect

Solution: The process of spermatogenesis occurs in testis, in which the immature male germ cells or spermatogonia are converted to sperms. The spermatogonia present on the inside wall of seminiferous tubules undergoes mitosis. Some spermatogonia periodically undergo meiosis. These spermatogonia are called as primary spermatocytes (2n). A primary spermatocyte completes the first meiotic division and forms secondary spermatocytes (n). The secondary spermatocytes undergo the second meiotic division to produce spermatids.

The spermatids are then, transformed into spermatozoa or sperms by the process called spermiogenesis. After spermiogenesis, sperm heads become embedded in the Sertoli cells. These spermatozoa are finally released from the seminiferous tubules by the process called spermiation.

Q.155. Under normal physiological conditions in human being every $100\ \text{ml}$ of oxygenated blood can deliver _____ ml of O_2 to the tissues.

A) $5\ \text{ml}$

B) $4\ \text{ml}$

C) $10\ \text{ml}$

D) $2\ \text{ml}$

Answer: $5\ \text{ml}$

Solution: Haemoglobin is a red coloured iron containing pigment present in the RBCs. It binds to oxygen in a reversible manner to form oxyhaemoglobin. Each haemoglobin molecule can carry a maximum of four molecules of oxygen.

The amount of oxygen that binds to the hemoglobin within erythrocytes is primarily related to the oxygen tension which is expressed as the partial pressure of oxygen (pO_2). The relationship between the partial pressure of oxygen (pO_2) and percentage saturation of the hemoglobin with oxygen (O_2) is graphically represented by the **oxygen hemoglobin dissociation curve** which is **sigmoidal** under normal conditions.

Every 100 ml of oxygenated blood can deliver around 5 ml of O_2 to the tissues under normal physiological conditions.

Q.156. *In situ* conservation refers to:

A) Conserve only high risk species

B) Conserve only endangered species

C) Conserve only extinct species

D) Protect and conserve the whole ecosystem

Answer: Protect and conserve the whole ecosystem

Solution: In the *in situ* conservation, the protection of an organism will automatically take place, since the natural habitat of the organisms is protected in this sort of conservation. For example, announcing Kanha forest as a tiger reserve. It is nothing but conservation 'at home'. This helps in conserving biodiversity hotspots. India has three of the world's biodiversity hotspots, Western ghats, Indo Burma and Eastern-Himalayas.

Q.157. Natural selection where more individuals acquire specific character value other than the mean character value, leads to:

A) Directional change

B) Disruptive change

C) Random change

D) Stabilising change

Answer: Directional change

Solution: If the organisms/individuals at one extreme of the distribution contribute more offspring to the next generation than other individuals do, then the mean of the population will change. This changes the normal distribution into one tailed-distribution. This is the case of directional selection. If directional selectional operates for many generations, an evolutionary trend within the population results.

Q.158. Breedings crops with higher levels of vitamins and minerals or higher proteins and healthier fats is called:

A) Bio-remediation

B) Bio-fortification

C) Bio-accumulation

D) Bio-magnification

Answer: Bio-fortification

Solution: Bio-fortification refers to the idea of breeding crops to increase their nutritional value. This can be done in two ways, either through conventional selective breeding, or through genetic engineering.

For example, a rice variety, rich in pro-vitamin A, named as ' **golden rice**' was developed by introducing three genes involved in biosynthetic pathway for carotenoids, the precursor for vitamin A.

Q.159. Which of the following is present between the adjacent bones of the vertebral column?

A) Cartilage

B) Aerolar tissue

C) Smooth muscle

D) Intercalated discs

Answer: Cartilage

Solution: The joint between adjacent vertebrae is an example of cartilaginous joint. In this, bones involved are joined with the help of cartilage and it allows limited movement.

These are also called as amphiarthroses. These joints are neither fixed nor freely movable. Articulating bones are held together by hyaline or fibrocartilages.

Q.160. Nitrogenous waste is excreted in the form of pellet or paste by:

A) *Salamandra*

B) Hippocampus

C) *Pavo*

D) Ornithorlnychus

Answer: *Pavo*

Solution: There are three types of animals classified on the basis of excretory waste:

A. Ammonotelic animals (major excretory waste is ammonia) - Many bony fishes, aquatic amphibians, aquatic insects.

B. Ureotelic animals (major excretory waste is urea) - Marine fishes, many terrestrial amphibians (like a frog), and mammals.

C. Uricotelic animals (major excretory waste is uric acid) – Insects, land snails, reptiles, and birds.

Uric acid is water-insoluble and is excreted in the form of a white paste or powder. The production of uric acid is energetically costlier, but it includes much-reduced water loss.

Among the given examples, *Pavo* is the genus of birds and peacock belongs to the same genus. So, it will be releasing the nitrogenous waste in the form of pellets or paste.

Q.161. Which of the following statements with respect to the endoplasmic reticulum is incorrect?

A) SER is devoid of ribosomes

B) In prokaryotes only RER are present

C) SER are the sites for lipid synthesis

D) RER has ribosomes attached to ER

Answer: In prokaryotes only RER are present

Solution: Presence of membranous organelles is an exclusive property of eukaryotic cells.

Endoplasmic reticulum is an example of membranous organelles, so, it will always be found in eukaryotic cells only and never in the prokaryotes.

This is true for SER and RER both.

Q.162. Which of the following statements are true for spermatogenesis but do not hold true for Oogenesis?

(a) It results in the formation of haploid gametes

(b) Differentiation of gamete occurs after the completion of meiosis

(c) Meiosis occurs continuously in a mitotically dividing stem cell population

(d) It is controlled by the Luteinising hormone (LH) and Follicle Stimulating Hormone (FSH) secreted by the anterior pituitary

(e) It is initiated at puberty

Choose the most appropriate answer from the options given below:

A) (b) and (c) only

B) (b), (d) and (e) only

C) (b), (c) and (e) only

D) (c) and (e) only

Answer: (c) and (e) only

Solution: Following features of spermatogenesis are not applicable on the oogenesis:

- Meiosis occurs continuously in a mitotically dividing stem cell population.
- In case of oogenesis, gamete formation is held at meiosis-I till puberty and then held at meiosis-II till fertilization of ovum by sperm.
- Oogenesis is initiated during embryonic development while spermatogenesis is initiated at puberty.

So, statements c and e are not applicable to the oogenesis.

Q.163. Given below are two statements: one is labelled as Assertion and the other is labelled as Reason.

Assertion: All vertebrates are chordates, but all chordates are not vertebrates.

Reason: Notochord is replaced by a vertebral column in the adult vertebrates.

In the light of the above statements, choose the most appropriate answer from the options given below:

A) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

B) Assertion is correct but Reason is not correct

C) Assertion is not correct but Reason is correct

D) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

Answer: Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

Solution: The phylum Chordata is divided into 3 subphyla i.e., Urochordata or Tunicata, Cephalochordata, and Vertebrata. So, we can clearly say that all vertebrates are chordates, but all chordates are not vertebrates.

Thus, the Assertion is correct.

It is true that in adult vertebrates, the notochord is replaced by the vertebral column. This statement is telling us why all chordates are not vertebrates, but it is not telling us why other chordates are considered as chordates only but not as vertebrates.

Thus, the Reason is correct, but it is not an exact or complete explanation for the Assertion.

Q.164. In which of the following animals, digestive tract has additional chambers like crop and gizzard?

A) *Bufo, Balaenoptera, Bangarus*

B) *Catla, Columba, Crocodilus*

C) *Pavo, Psittacula, Corvus*

D) *Corvus, Columba, Chameleon*

Answer: *Pavo, Psittacula, Corvus*

Solution: Gizzard is found in all the birds. In the given options, only option 3 has all options given as birds.

Pavo is the peacock family, *Psittacula* is parakeet family and *Corvus* is crow family.

Q.165. Given below are two statements: one is labelled as Assertion and the other is labelled as Reason.

Assertion: Osteoporosis is characterised by decreased bone mass and increased chances of fractures.

Reason: Common cause of osteoporosis is increased levels of estrogen.

In the light of the above statements, choose the most appropriate answer from the options given below:

A) Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

B) Assertion is correct but Reason is not correct

C) Assertion is not correct but Reason is correct

D) Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

Answer: Assertion is correct but Reason is not correct

Solution: Osteoporosis is characterised by decreased bone density and mass. This makes the bones prone to fracture.

So, the Assertion is correct.

In women undergoing menopause, a decrease in estrogen levels is responsible for osteoporosis. But non only this factor even the intake of many drugs, less calcium levels, and stress acts in causing osteoporosis

So, the Reason is wrong.

Q.166. In gene therapy of adenosine deaminase (ADA) deficiency, the patient requires a periodic infusion of genetically engineered lymphocytes because:

A) Gene isolated from marrow cells producing ADA is introduced into cells at embryonic stages

B) Lymphocytes from patient's blood are grown in culture, outside the body.

C) Genetically engineered lymphocytes are not immortal cells.

D) Retroviral vector is introduced into these lymphocytes.

Answer: Genetically engineered lymphocytes are not immortal cells.

Solution: In gene therapy of the ADA, we transform the lymphocytes with the functional copy of the ADA. This process is done inside the lab in the cell culture set up.

These cells are then injected back in the patient. However, these cells are not immortal and will die after their life span is over.

Thus, the patient will need periodic infusion of the genetically engineered lymphocytes.

Q.167. Select the incorrect statement with reference to mitosis:

A) Spindle fibres attach to centromere of chromosomes.

B) Chromosomes decondense at telophase.

C) Splitting of centromere occurs at anaphase.

D) All the chromosomes lie at the equator at metaphase.

Answer: Spindle fibres attach to centromere of chromosomes.

Solution: A kinetochore is a disc-shaped protein structure associated with duplicated chromatids in eukaryotic cells where the spindle fibers attach during cell division to pull sister chromatids apart. Spindle fibres attach to the kinetochores which is a proteinaceous assembly formed over the centromere.

Q.168. In the taxonomic categories which hierarchial arrangement in ascending order is correct in case of animals?

A) Kingdom, Class, Phylum, Family, Order, Genus, Species

B) Kingdom, Order, Class, Phylum, Family, Genus, Species

C) Kingdom, Order, Phylum, Class, Family, Genus, Species

D) Kingdom, Phylum, Class, Order, Family, Genus, Species

Answer: Kingdom, Phylum, Class, Order, Family, Genus, Species

Solution:

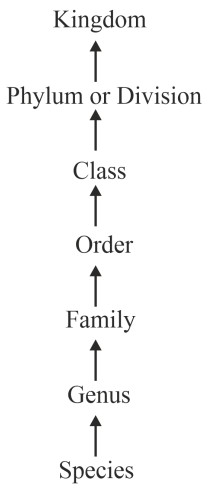


Figure: Taxonomic categories showing hierarchical arrangement in ascending order.

In the case of animals, we use the term phylum not division.

Q.169. Given below are two statements:

Statement I: Restriction endonucleases recognise specific sequence to cut DNA known as palindromic nucleotide sequence.

Statement II: Restriction endonucleases cut the DNA strand a little away from the centre of the palindromic site.

In the light of the above statements, choose the most appropriate answer from the options given below:

A) Both Statement I and Statement II are incorrect

B) Statement I is correct but Statement II is incorrect

C) Statement I is incorrect but Statement II is correct

D) Both Statement I and Statement II are correct

Answer: Both Statement I and Statement II are correct

Solution: Statement I: Restriction endonucleases do recognise unique sequences to cut the DNA. These sequences are arranged in the form of a palindrome.

So, statement I is correct.

Statement II: Restriction endonucleases cut the DNA strand a little away from the centre of the palindromic site. This helps generate sticky ends.

So, statement II is correct.

Option 4 is correct.

Note: Statement II is correct as per NCERT but is not correct scientifically as a general statement for restriction endonucleases.

Q.170. Given below are two statements:

Statement I: Mycoplasma can pass through less than 1 micron filter size.

Statement II: Mycoplasma are bacteria with cell wall.
In the light of the above statements, choose the most appropriate answer from the options given below:

A) Both Statement I and Statement II are incorrect

B) Statement I is correct but Statement II is incorrect

C) Statement I is incorrect but Statement II is correct

D) Both Statement I and Statement II are correct

Answer: Statement I is correct but Statement II is incorrect

Solution: Statement I: Mycoplasma can pass through even 0.22 micron filters which are smaller than 1 micron.

So, the statement I is correct.

Statement II: Mycoplasma is a pleomorphic bacterium without a cell wall and hence it can easily change its shape, due to which it can pass through the filters easily.

So, statement II is incorrect.

Q.171. Which of the following is not a connective tissue?

A) Adipose tissue

B) Cartilage

C) Neuroglia

D) Blood

Answer: Neuroglia

Solution: Examples of connective tissue are blood, adipose tissue, cartilage, bone and lymph.

The neuroglia refers to the collection of non-neuronal cells found in the CNS. They are not an example of connective tissue.

Q.172. Lippe's loop is a type of contraceptive used as:

A) Vault barrier

B) Non-Medicated IUD

C) Copper releasing IUD

D) Cervical barrier

Answer: Non-Medicated IUD

Solution: Lippe's loop is an example of a non-medicated intra-uterine device or IUD used in female contraception.

Lippes loop is a plastic double "s" loop. It attracts the macrophages stimulating them to accumulate in the uterine cavity. Macrophages increase phagocytosis of sperms within the uterus and act as a contraceptive.

Q.173. At which stage of life the oogenesis process is initiated?

A) Embryonic development stage

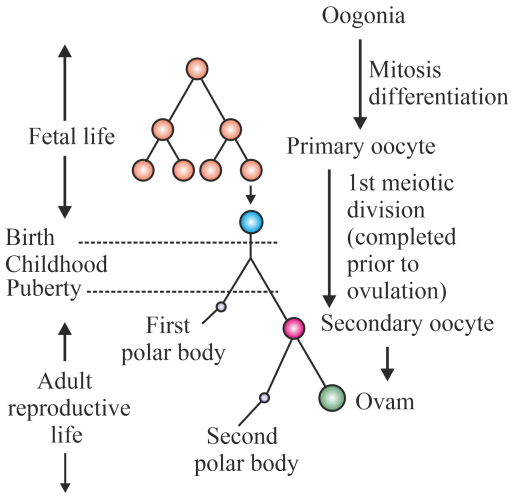
B) Birth

C) Adult

D) Puberty

Answer: Embryonic development stage

Solution: Oogenesis is a discontinuous process of formation of ova or egg in females.



As you can see in the figure above, the oogenesis starts during embryonic development and is at pause from birth till puberty and is resumed again at puberty.

Q.174. Identify the microorganism which is responsible for the production of an immunosuppressive molecule cyclosporin A:

A) *Clostridium butylicum*

B) *Aspergillus niger*

C) *Saccharomyces cerevisiae*

D) *Trichoderma polysporum*

Answer: *Trichoderma polysporum*

Solution: *Trichoderma* species are free-living fungi found in the root ecosystem (rhizosphere). The fungus *Trichoderma polysporum* is responsible for the production of cyclosporin A.

It is used as an immunosuppressive drug and is used by organ transplant patients to avoid graft rejection.

Q.175. Given below are two statements :
Statement I : Fatty acids and glycerols cannot be absorbed into the blood.
Statement II : Specialized lymphatic capillaries called lacteals carry chylomicrons into lymphatic vessels and ultimately into the blood.
In the light of the above statements, choose the most appropriate answer from the options given below :

A) Both Statement I and Statement II are incorrect

B) Statement I is correct but Statement II is incorrect

C) Statement I is incorrect but Statement II is correct

D) Both Statement I and Statement II are correct

Answer: Both Statement I and Statement II are correct

Solution: Statement I: Fatty acids and glycerols cannot be absorbed into the blood due to their insoluble nature.
So, statement I is correct.

Statement II: Fatty acids and glycerols are absorbed into intestinal cells with the help of micelles.

Once inside the intestinal cells, they are packed into protein fat globules called chylomicrons.

These then enter the lymph capillaries called lacteals and the lymph when draining in the blood transports fat into the blood.

So, statement II is correct.

Q.176. In an *E. coli* strain, *i* gene gets mutated, and its product cannot bind the inducer molecule. If the growth medium is provided with lactose, what will be the outcome?

A) z, y, a genes will be transcribed

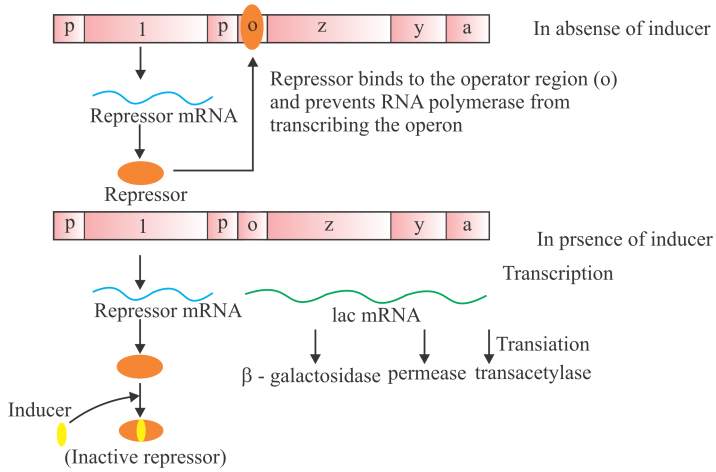
B) z, y, a genes will not be translated

C) RNA polymerase will bind the promoter region

D) Only z gene will get transcribed

Answer: z, y, a genes will be transcribed

Solution:



Given above is the functioning of the normal lac operon in *E. coli*.

The question says that due to mutation, the product of *i* gene which is the repressor, cannot bind to the inducer molecule which is lactose.

The repressor gene binds to the operator region and does not allow the binding of RNA polymerase to the promoter region in the mRNA molecule.

If the repressor is absent, then it will not bind to the operator, the binding of RNA polymerase to the promoter region will be open always and there will be the transcription of lac z, y, and a genes.

Q.177. Tegmina in cockroach, arises from:

A) Mesothorax

B) Metathorax

C) Prothorax and Mesothorax

D) Prothorax

Answer: Mesothorax

Solution: Two pairs of wings, forewings, and hindwings are present on the dorsal side. Forewings are the first pair of dark, opaque, thick, leathery wings that are protective in function. Hindwings are thin, broad, membranous, delicate, and transparent. These are attached to the tergum of the metathorax. These are helpful in flight and hence are also called true wings

Tegmina is the forewing of cockroaches and is called mesothoracic due to its origin.

Q.178. Which of the following is not the function of conducting part of respiratory system?

A) Inhaled air is humidified

B) Temperature of inhaled air is brought to body temperature

C) Provides surface for diffusion of O_2 and CO_2

D) It clears inhaled air from foreign particles

Answer: Provides surface for diffusion of O_2 and CO_2

Solution: External nostrils to terminal bronchioles are called the conducting part of the respiratory system.

It serves the following functions

- Transports the air to alveoli.
- Clears foreign particles from the air.
- Humidifies the incoming air.
- Brings the air to body temperature.

Providing large surface area is not the function of the conducting part and is done by alveoli.

Q.179. Which of the following is a correct match for disease and its symptoms?

A) Tetany - high Ca^{2+} level causing rapid spasms.

B) Myasthenia gravis - Genetic disorder resulting in weakening and paralysis of skeletal muscle

C) Muscular dystrophy - An auto immune disorder causing progressive degeneration of skeletal muscle

D) Arthritis - Inflammed joints

Answer: Arthritis - Inflammed joints

Solution: In tetanus, there are low calcium levels which cause muscle spams.

Mysatheia gravis is an autoimmune disorder not a genetic disorder,

Muscular dystrophy is a genetic disorder and not an autoimmune disorder. Multiple sclerosis is an autoimmune disorder which also leads to weakening of skeletal muscles of the affected region.

Arthritis is caused due to inflammation of joints.

Q.180. Regarding meiosis, which of the statements is incorrect?

A) DNA replication occurs in S phase of meiosis-II

B) Pairing of homologous chromosomes and recombination occurs in meiosis-I

C) Four haploid cells are formed at the end of meiosis-II

D) There are two stages in meiosis, meiosis-I and II

Answer: DNA replication occurs in S phase of meiosis-II

Solution: In meiosis there are two consecutive cell division events without intervening G_1, S and G_2 phases between meiosis I and meiosis II.

So, there is no S phase before meiosis II and no DNA replication will happen before meiosis II.

Q.181. Detritivores breakdown detritus into smaller particles. This process is called:

A) Fragmentation

B) Humification

C) Decomposition

D) Catabolism

Answer: Fragmentation

Solution: Decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients, and the process is called decomposition. Decomposition is one of the important processes in the ecosystem which helps in nutrient cycling. Dead plant remains such as leaves, bark, flowers and dead remains of animals, including faecal matter of animals constitute detritus. This is the raw material for decomposition.

The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification, and mineralization.

The detritivores, like earthworms, break down detritus into smaller particles. This process is called fragmentation.

Q.182. If the length of a DNA molecule is 1.1 metres, what will be the approximate number of base pairs?

A) 6.6×10^9 bp

B) 3.3×10^6 bp

C) 6.6×10^6 bp

D) 3.3×10^9 bp

Answer: 3.3×10^9 bp

Solution: The two chains of DNA are coiled in a right-handed helicle fashion. The pitch of the helix is 3.4 nm and has a diameter of 2 nm. In the B-form of DNA, the distance between a bp in a helix is approximately 0.34 nm which means there are about 10 nucleotides present in a complete turn.

The total length of DNA molecule in nm = 1.1×10^9 nm.

The approximate number of base pairs =
$= {}^{1.1\times10^9}/_{0.34}$

$= 3.3 \times 10^9$

Q.183. Which of the following functions is not performed by secretions from salivary glands?

A) Digestion of complex carbohydrates

B) Lubrication of oral cavity

C) Digestion of disaccharides

D) Control bacterial population in mouth

Answer: Digestion of disaccharides

Solution:
- Salivary glands are one of the most important glands in our digestive systems which produces saliva. Saliva contains a carbohydrate digesting enzyme called salivary amylase (ptyalin). This enzyme help in the digestion of starch in the oral cavity. Starches are complex carbohydrates formed by longer saccharide chains of amylose and amylopectin.
- Saliva also helps in lubrication of the buccal cavity.
- Lysozymes present in saliva protects against bacterial invasion.
- The digestion of disaccharides and some oligosaccharides is undertaken by a number of small intestinal brush border enzymes like sucrase-isomaltase, lactase, maltase-glycoamylase and trehalase.

Q.184. A dehydration reaction links two glucose molecules to produce maltose. If the formula for glucose is $C_6H_{12}O_6$ then what is the formula for maltose?

A) $C_{12}H_{24}O_{12}$

B) $C_{12}H_{22}O_{11}$

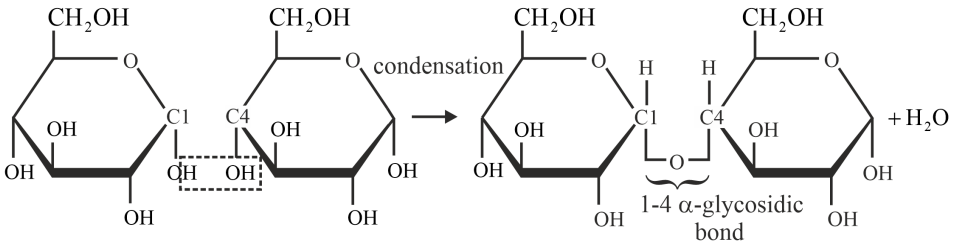
C) $C_{12}H_{24}O_{11}$

D) $C_{12}H_{20}O_{10}$

Answer: $C_{12}H_{22}O_{11}$

Solution: Maltose is a common disaccharide that is formed by the dehydration reaction of two glucose molecules. The glycosidic bond present in maltose is $\alpha - 1,4$. During the formation, from two glucose molecules, one molecule of water is removed.

Thus, the formula of maltose becomes $C_{12}H_{22}O_{11}$



Q.185. If '8' *Drosophila* in a laboratory population of '80' died during a week, the death rate in the population is ____ individuals per *Drosophila* per week.

A) 10

B) 1.0

C) zero

D) 0.1

Answer: 10

Solution: Mortality rate is also known as death rate. It is a measure of the number of deaths in a particular population per unit of time. Generally, mortality rate is expressed in units of deaths per 1,000 individuals per year. As given in the question, '8' *Drosophila* have died out of the population of '80' during a week. It means the death rate would be
$= ({}^{8}/_{80}) \times 100$

$= 10\ \%$

Zoology Section B

Q.186. Given below are two statements:

Statement I: In a scrubber, the exhaust from the thermal plant is passed through the electric wires to charge the dust particles.

Statement II: Particulate matter (PM 2.5) cannot be removed by a scrubber but can be removed by an electrostatic precipitator.

In the light of the above statements, choose the most appropriate answer from the options given below:

A) Both Statement I and Statement II are incorrect

B) Statement I is correct but Statement II is incorrect

C) Statement I is incorrect but Statement II is correct

D) Both Statement I and Statement II are correct

Answer: Statement I is incorrect but Statement II is correct

Solution: There are several ways of removing particulate matter from the polluted air.

A scrubber is generally used, can remove gases like sulphur dioxide. In this scrubber, the exhaust is passed through a spray of water or lime.

Electrostatic precipitators can capture fine particles like those that are smaller than 2.5 microns in diameter, which are especially dangerous if released because they can be drawn deep into the lungs and can trigger inflammatory reactions. Scrubber cannot separate these.

Q.187. Which of the following is a correct statement?

A) Bacteria are exclusively heterotrophic organisms.

B) Slime moulds are saprophytic organisms classified under Kingdom Monera.

C) Mycoplasma have DNA, Ribosome and cell wall.

D) Cyanobacteria are a group of autotrophic organisms classified under Kingdom Monera.

Answer: Cyanobacteria are a group of autotrophic organisms classified under Kingdom Monera.

Solution: Cyanobacteria or BGA are the members of kingdom Monera which show the following characteristic features:

- Cell wall is present.
- Chlorophyll-a is present and they are photoautotrophic.
- Heterocysts are present in some forms for nitrogen fixation.
- They lack membrane bound organelles.

Q.188. Ten *E. coli* cells with $^{15}\mathrm{N}$-dsDNA are incubated in medium containing $^{14}\mathrm{N}$ nucleotide. After 60 minutes, how many *E. coli* cells will have DNA totally free from $^{15}\mathrm{N}$?

A) 40 cells

B) 60 cells

C) 80 cells

D) 20 cells

Answer: 60 cells

Solution: *E. coli* has a doubling time of 20 minutes. Thus, in 60 minutes, there would be 3 cycles of doubling. That means, after 60 minutes, there would be 80 *E. coli* cells, if we start from 10 initial cells.

In the first cycle, all 20 cells would be hybrid DNA containing $\mathrm{N}^{15}/\mathrm{N}^{14}\ \mathrm{state}$. The second cycle would yield some 40 cells and out of those, 20 cells would be totally free from N^{15} DNA. In the last cycle, there would be 80 cells created and 60 would have $\mathrm{N}^{14}/\mathrm{N}^{14}$ state and only 20 cells would have $\mathrm{N}^{15}/\mathrm{N}^{14}\ \mathrm{state}$.

Q.189. Select the incorrect statement with respect to acquired immunity.

A) Anamnestic response is elicited on subsequent encounters with the same pathogen

B) Anamnestic response is due to memory of first encounter

C) Acquired immunity is non-specific type of defense present at the time of birth

D) Primary response is produced when our body encounters a pathogen for the first time

Answer: Acquired immunity is non-specific type of defense present at the time of birth

Solution: There are two main types of immunity in human body:

1. Innate immunity is the non-specific immunity present at the time of birth. This works on physical, physiological, cytological and chemical barriers.
2. Acquired immunity is the adaptive or specific immunity which a person develops during his/her lifetime. This works by B-cell and T-cells of the body.

Q.190. Statements related to human Insulin are given below: Which statement(s) is/are correct about genetically engineered Insulin?

(a) Pro-hormone insulin contain extra stretch of C-peptide.

(b) A-peptide and B-peptide chains of insulin were produced separately in *E. coli*, extracted and combined by creating disulphide bond between them.

(c) Insulin used for treating Diabetes was extracted from cattle and pigs.

(d) Pro-hormone Insulin needs to be processed for converting into a mature and functional hormone.

(e) Some patients develop allergic reactions to the foreign insulin.

Choose the most appropriate answer from the options given below.

A) (b) only

B) (c) and (d) only

C) (c), (d) and (e) only

D) (a), (b) and (d) only

Answer: (b) only

Solution: In the year 1983, the American company Eli Lilly prepared two DNA sequences corresponding to A and B, chains of human insulin and introduced them in plasmids of *E. coli* to produce insulin chains. Chains A and B were produced separately, extracted and combined by creating disulfide bonds to form human insulin.

Q.191. Which of the following are not the effects of parathyroid hormone?

(a) Stimulates the process of bone resorption.

(b) Decreases Ca^{2+} level in blood.

(c) Reabsorption of Ca^{2+} by renal tubules.

(d) Decreases the absorption of Ca^{2+} from digested food.

(e) Increases metabolism of carbohydrates.

Choose the most appropriate answer from the options given below:

A) (b), (d) and (e) only

B) (a) and (e) only

C) (b) and (c) only

D) (a) and (c) only

Answer: (b), (d) and (e) only

Solution: PTH, also known as parathormone, is made by the parathyroid glands. PTH is directly involved in the functioning of bones, kidneys, and the small intestine.

- In the bones, PTH stimulates the release of calcium in an indirect process through osteoclasts which ultimately leads to resorption of the bones.
- Parathyroid hormone regulates calcium levels in the blood, largely by increasing the levels when they are too low.
- In the kidney, parathyroid hormone blocks the reabsorption of phosphate in the proximal tubule while promoting calcium reabsorption in the ascending loop of Henle, distal tubule, and collecting tubule.
- PTH indirectly increases calcium absorption from food in the intestine, via its effects on vitamin D metabolism.
- PTH has no effect on carbohydrate metabolism.

Q.192. Select the incorrect statement regarding synapses:

A) Electrical current can flow directly from one neuron into the other across the electrical synapse

B) Chemical synapses use neurotransmitters

C) Impulse transmission across a chemical synapse is always faster than that across an electrical synapse

D) The membranes of presynaptic and postsynaptic neurons are ibn close proximity in an electrical synapse

Answer: Impulse transmission across a chemical synapse is always faster than that across an electrical synapse

Solution: The major difference between a chemical and an electrical synapse is that in a chemical synapse, the nerve impulse is transmitted chemically via neurotransmitters, whereas in an electrical synapse a nerve impulse is transmitted electrically via channel proteins.

Chemical synapses use the release of chemical neurotransmitters to propagate signals from one neuron (presynaptic) to another (postsynaptic). The electrical synapses are specialised connections between neurons that facilitate direct ionic and small metabolite communication. Hence, the electrical synapses are very faster and are found in all nervous systems, especially in the human brain.

Q.193. Match list - I with the list - II.

	List-I		List-II
(a)	Bronchioles	(i)	Dense regular connective tissue
(b)	Goblet cell	(ii)	Loose connective tissue
(c)	Tendons	(iii)	Glandular tissue
(d)	Adipose tissue	(Iv)	Ciliated epithelium

Choose the correct answer from the options given below:

A) (a) - (i), (b) - (ii), (c) - (iii), (d) - (iv

B) (a) - (ii), (b) - (i), (c) - (iv), (d) - (iii)

C) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

D) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

Answer: (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

Solution:

- The bronchioles are lined by simple columnar to the cuboidal epithelium.
- Goblet cells are simple columnar epithelial cells that secrete mucus on the surface of mucous membranes of organs and are glandular in nature.
- Tendons and ligaments are made of dense regular connective tissue because they need a strong structure.
- Adipose tissues are loose connective tissues that are made up of fat cells called adipose cells or adipocytes.

Q.194. The recombination frequency between the genes a and c is 5%, b and c is 15%, b and d is 9%, a and b is 20%, c and d is 24% and a and d is 29%. What will be the sequence of these genes on a linear chromosome?

A) d,b,a,c

B) a,b,c,d

C) a,c,b,d

D) a,d,b,c

Answer: a,c,b,d

Solution: The recombination frequency is directly proportional to the distance between genes, and the recomination values are used to locate the genes on a chromosome. Here, four genes a, b, c, and d are present with their recombination frequency of a - c = 5%, b – c = 15%, b - d = 9%, a – b = 20%, c – d = 24%, a – d = 29%.

The correct sequence of genes is **a-c-b-d**, and this is in accordance with the recombination frequency. 29% is the highest recombination frequency present between a and d, this signifies a and d are very far apart, and they are present at the endpoint. The distance between a and c is very less of 5%, which means they are very nearby and next to each other. Likewise, the distance between b and d is very less of 9%, which means they are very nearby and next to each other.

Q.195. If a colour blind female marries a man whose mother was also colour blind, what are the chances of her progeny having colour blindness?

A) 50%

B) 75%

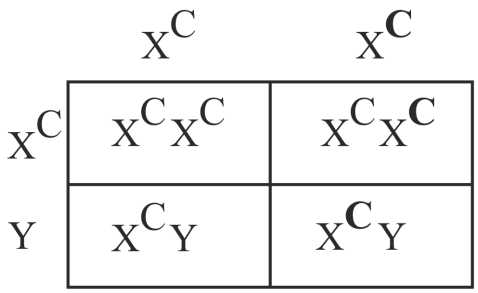
C) 100%

D) 25%

Answer: 100%

Solution: Colour blindness is an X-linked disorder. For colour blindness to be effective, all X chromosomes within an individual must be affected, and since men only have one X chromosome and women have two, the chances of men being impacted are exponentially higher.

However, in this case, the mother is colour-blind and hence she carries X^CX^C genotype. Father's mother is also colour-blind and hence even she will be having the genotype as X^CX^C, and she will be transferring her X^C chromosome to her son and hence, even the son will be colour-blind (X^CY). So, by this, we can tell all the X chromosomes are coding for colour-blind gene, and they inherit this gene to all their children, and hence, the chances of their child being colour-blind would be 100%.



Q.196. Match List-I with List-II

List-I (Biological Molecules)		List-II (Biological functions)	
(a)	Glycogen	(i)	Hormone
(b)	Globulin	(ii)	Biocatalyst
(c)	Steroids	(iii)	Antibody
(d)	Thrombin	(iv)	Storage product

Choose the correct answer from the options given below:

A) (a) - (iv), (b) - (ii), (c) - (i), (d) - (iii)

B) (a) - (ii), (b) - (iv), (c) - (iii), (ii) - (i)

C) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

D) (a) - (iii), (b) - (ii), (c) - (iv), (d) - (i)

Answer: (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

Solution:
- Glycogen is a polymer of glucose. This is a storage polysaccharide.
- Globulin is a protein associated with the immunology. Antibodies are gamma-globulins.
- Many hormones are steroid in nature, like testosterone.
- Thrombin is a protein enzyme and is called as biocatalyst.

Q.197. Which of the following is not a desirable feature of a cloning vector?

A) Presence of a marker gene

B) Presence of single restriction enzyme site

C) Presence of two or more recognition sites

D) Presence of origin of replication

Answer: Presence of two or more recognition sites

Solution: The term cloning vectors refer to the DNA molecules that act as transporting vehicle which carries foreign DNA into a host cell for cloning and expression.

An ideal cloning vector should have the desired characteristics like small size (less than 10 kb), polylinker sequence, presence of selectable marker genes, and 'Ori' sequence.

The 'Ori' sequence, stands for origin of replication, is responsible for the initiation of replication process.

In order to link the foreign DNA, the vector needs to have very few, preferably single, recognition sites for the commonly used restriction enzymes. Presence of more than one recognition sites within the vector will generate several fragments, which will complicate the gene cloning process.

Q.198. Which of the following statements is not true ?

A) Sweet potato and potato is an example of analogy

B) Homology indicates common ancestry

C) Flippers of penguins and dolphins are a pair of homologous organs

D) Analogous structures are a result of convergent evolution

Answer: Flippers of penguins and dolphins are a pair of homologous organs

Solution: Convergent evolution is the independent evolution of similar features in different and un-related species. Homology is based on divergent evolution whereas analogy/analogous structures are a result of convergent evolution. Analogous organs have different structures, but they evolve for the same function and thus have similarity. For examples, the eye of the octopus and of mammals or the flippers of Penguins and Dolphins.

Q.199. Which one of the following statements is correct?

A) The tricuspid and the bicuspid valves open due to the pressure exerted by the simultaneous contraction of the atria

B) Blood moves freely from atrium to the ventricle during joint diastole

C) Increased ventricular pressure causes closing of the semilunar valves

D) The atrio-ventricular node (AVN) generates an action potential to stimulate atrial contraction

Answer: The tricuspid and the bicuspid valves open due to the pressure exerted by the simultaneous contraction of the atria

Solution: Contraction of heart chambers is called systole and relaxation is called diastole. Atria and ventricles contract alternately.

Right atrium receives deoxygenated blood and left atrium receives oxygenated blood. When both the atria are completely filled with blood, pressure is exerted on the wall due to which SA node gets excited and generates cardiac impulse. This leads to atrial systole. During atrial systole, blood is pumped into ventricles.

The opening between the right atrium and the right ventricle is guarded by the tricuspid valve, whereas a bicuspid valve guards the opening between the left atrium and the left ventricle.

So, during atrial systole, the bicuspid and tricuspid valves are open, and the pulmonary/aortic semilunar valves are closed.

Q.200. Match List-I with List-II with respect to methods of Contraception and their respective actions.

List-I (Biological Molecules)		List-II (Biological functions)	
(a)	Diaphragms	(i)	Inhibit ovulation and Implantation
(b)	Contraceptive Pills	(ii)	Increase phagocytosis of sperm within Uterus
(c)	Intra Uterine Devices	(iii)	Absence of Menstrual cycle and ovulation following parturition
(d)	Lactational Amenorrhea	(iv)	They cover the cervix blocking the entry of sperms

Choose the correct answer from the options given below:

A) (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)

B) (a) - (ii), (b) - (iv), (c) - (i), (d) - (iii)

C) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)

D) (a) - (iv), (b) - (i), (c) - (iii), (d) - (ii)

Answer: (a) - (iv), (b) - (i), (c) - (ii), (d) - (iii)

Solution: Diaphragm are dome-shaped rubber plastic covers that have to be fitted on the cervix in the female's vagina to check the entry of sperms into the uterus.

Oral pills are the hormonal tablets are taken orally. These pills contain a combination of synthetic hormones like progesterone and estrogen. These hormones inhibit ovulation and implantation by inhibiting the secretion of FSH and LH from the pituitary gland.

IUDs (Intrauterine Devices) are made of plastic, metal, or a combination of the two and are inserted into the uterus to prevent conception.

IUDs increase phagocytosis of sperms within the uterus and the hormone releasing IUDs make the uterus unsuitable for implantation and the cervix hostile to the sperms.

Lactational amenorrhea is also a natural method of birth control where there is no menstrual cycle and therefore ovulation does not occur during intense lactation following parturition.