

BOOKLET  
CODE



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Educational Institutions

# NEET 2023

## Question Paper, Key & Solutions

### INSTRUCTIONS

1. The answer sheet is inside this test booklet. When you are directed to open the test booklet, take out the answer sheet and fill in the particulars on original copy carefully with **blue/black** ball point pen only.
2. The test is of **3 hour 20 minutes** duration and the test booklet contains **200** multiple-choice questions (four options with a single correct answer) from **Physics, Chemistry and Biology (Botany and Zoology)**. 60 questions in each subject are divided into two sections (a and b) as per details given below:

**Section A** shall consist of **35 (thirty-five)** questions in each subject (question nos - 1 to 35, 61 to 85, 101 to 136 and 161 to 186). All questions are compulsory.

**Section B** shall consist of 15 (fifteen) questions in each subject (question nos - 36 to 50, 86 to 100, 136 to 150 and 186 to 200). In Section b, a candidate need to attempt any 10 (ten) **questions out of 15 (fifteen)** 10 each subject.

**Candidates are advised to read all 15 questions in each subject of section B** before they start attempting the question paper. In the event of a candidate attempting more than ten questions, the first ten questions answered by the candidate shall be evaluated.

3. Each question carries 4 marks. For each correct response, the candidate will get 4 marks. For each incorrect response, one mark will be deducted from the total scores. **The Maximum marks are 720.**
4. Use **Blue/Black ball point pen only** for writing particulars on this page/marking responses on Answer Sheet.
5. Rough work is to be done in the space provided for this purpose in the Test Booklet only.

## PHYSICS

### SECTION - A

1. A football player is moving southward and suddenly turns eastward with the same speed to avoid an opponent. The force that acts on the player while turning is :

- (1) along northward
- (2) along north-east
- (3) along south-west
- (4) along eastward

**Ans. (2)**

**Sol.** Initial velocity along south ( $-\hat{j}$ )

Final velocity along east ( $\hat{i}$ )

Change in velocity ( $\hat{i} - (-\hat{j})$ ) =  $\hat{i} + \hat{j}$

So, acceleration or force is along  $\hat{i} + \hat{j}$  direction.

Hence, the force acts in north-east direction.

2. An ac source is connected to a capacitor C. Due to decrease in its operating frequency :

- (1) displacement current increases.
- (2) displacement current decreases.
- (3) capacitive reactance remains constant
- (4) capacitive reactance decreases.

**Ans. (2)**

$$\text{Sol. } X_c = \frac{1}{C\omega} = \frac{1}{2\pi fC}$$

$$I = \frac{V_{\text{rms}}}{X_c} = \frac{V_{\text{rms}}}{\left(\frac{1}{2\pi fC}\right)}$$

$$I = (V_{\text{rms}})(2\pi fC)$$

$$I \propto f$$

3. The half life of a radioactive substance is 20 minutes. In how much time, the activity of substance drop to

$\left(\frac{1}{16}\right)^{\text{th}}$  of its initial value?

- (1) 40 minutes
- (2) 60 minutes
- (3) 80 minutes
- (4) 20 minutes

**Ans. (3)**

$$\text{Sol. } A = \lambda N = \lambda N_0 e^{-\lambda t}$$

$$A = A_0 e^{-\lambda t}$$

$$\frac{A_0}{16} = A_0 e^{-\lambda t}$$

$$16 = e^{\lambda t}$$

$$\ln(16) = \lambda t$$

$$\ln(2^4) = \frac{(\ln 2)}{T} t$$

$$4 = \frac{t}{T} \Rightarrow t = 4T = 80 \text{ minutes.}$$

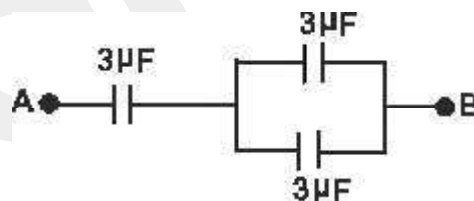
4. The net magnetic flux through any closed surface is:

- (1) Positive
- (2) Infinity
- (3) Negative
- (4) Zero

**Ans. (4)**

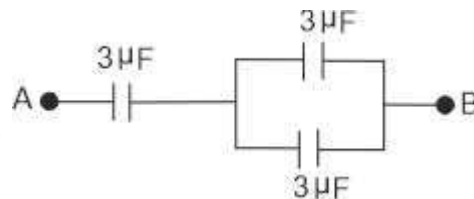
**Sol.** As magnetic lines of force are closed loop, for any closed surface, net magnetic flux is zero.

5. The equivalent capacitance of the system shown in the following circuit is:



- (1) 3 μF
- (2) 6 μF
- (3) 9 μF
- (4) 2 μF

**Ans. (4)**



**Sol.**

The two 3 μF capacitors on the right are in parallel. Their combination is in series with the 3 μF capacitor on the left.

$$C_{\text{eff}} = \frac{3 \times 6}{3 + 6} = \frac{18}{9} = 2 \mu\text{F}$$

6. The ratio of frequencies of fundamental harmonic produced by an open pipe to that of closed pipe having the same length is :

- (1) 2:1
- (2) 1:3
- (3) 3:1
- (4) 1:2

Ans. (1)

Sol. Open pipe fundamental frequency =  $f_o = \frac{v}{2l}$

Closed pipe fundamental frequency =  $f_c = \frac{v}{4l}$

$$\text{Ratio of } \frac{f_o}{f_c} = \frac{2}{1}$$

7. In hydrogen spectrum, the shortest wavelength in the Balmer series is  $\lambda$ . The shortest wavelength in the Brackett series is:

- (1)  $4\lambda$
- (2)  $9\lambda$
- (3)  $16\lambda$
- (4)  $2\lambda$

Ans. (1)

Sol. Shortest wavelength is the maximum energy, i.e., transition from infinity to 2<sup>nd</sup> ( Balmer series)

$$\frac{hc}{\lambda} = 13.6 \left( \frac{1}{4} - \frac{1}{\infty} \right) = \frac{13.6}{4}$$

(For Brackett series,  $n=4$ )

$$\frac{hc}{\lambda^1} = 13.6 \left( \frac{1}{16} - \frac{1}{\infty} \right) = \frac{13.6}{16}$$

dividing the two,

$$\lambda^1 = 4\lambda$$

8. A 12 V, 60 W lamp is connected to the secondary of a step down transformer, whose primary is connected to ac mains of 220 V. Assuming the transformer to be ideal, what is the current in the primary winding?

- (1) 2.7 A
- (2) 3.7 A
- (3) 0.37 A

(4) 0.27 A

Ans. (4)

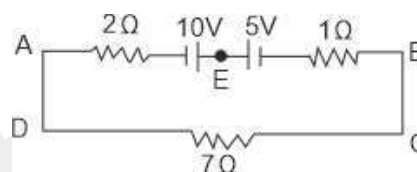
Sol. As it is an ideal transformer

input power = output power.

$$60 = 220 i$$

$$i = \frac{60}{220} = 0.27 \text{ A}$$

9. The magnitude and direction of the current in the following circuit is



(1) 0.5 A from A to B through E

(2)  $\frac{5}{9}$  A from A to B through E

(3) 1.5 A from B to A through E

(4) 0.2 A from B to A through E

Ans. (1)

Sol.  $E_{\text{net}} = 10\text{V} - 5\text{V} = 5\text{V}$

$$\text{Current, } I = \frac{5}{2+1+7} = \frac{5}{10} = 0.5 \text{ A}$$

From A to B through E.

10. The magnetic energy stored in an inductor of inductance  $4\mu\text{H}$  carrying a current of 2 A is :

- (1) 4 mJ
- (2) 8 mJ
- (3)  $8\mu\text{J}$
- (4) 4μ J

Ans. (3)

Sol. Magnetic energy,

$$E = \frac{1}{2} Li^2$$

$$= \frac{1}{2} 4 \times 10^{-6} \times 2^2$$

$$= 8 \times 10^{-6} \text{ J} = 8 \mu\text{J}$$

11. The potential energy of a long spring when stretched by 2 cm is  $U$ . If the spring is stretched by 8 cm, potential energy stored in it will be:

- (1)  $4U$
- (2)  $8U$
- (3)  $16U$
- (4)  $2U$

Ans. (3)

Sol.  $U = \frac{1}{2}kx^2$

$$U_1 = \frac{1}{2}k(2)^2$$

$$U_2 = \frac{1}{2}k(8)^2$$

$$\frac{U_2}{U_1} = \frac{8^2}{2^2} = 16$$

$$U_2 = 16U_1 = 16U$$

12. The errors in the measurement which arise due to unpredictable fluctuations in temperature and voltage supply are:

- (1) Personal errors
- (2) Least count errors
- (3) Random errors
- (4) Instrumental errors

Ans. (3)

Sol. The random errors are those errors, which occur irregularly and hence are random with respect to sign and size. These can arise due to random and unpredictable fluctuations in experimental conditions (e.g. unpredictable fluctuations in temperature, voltage supply, mechanical vibrations of experimental set-ups, etc).

13. Resistance of a carbon resistor determined from colour codes is  $(22000 \pm 5\%)\Omega$ . The colour of third band must be:

- (1) Green
- (2) Orange
- (3) Yellow
- (4) Red

Ans. (2)

Sol.  $22000\Omega \pm 5\%$

First colour – first digit red (2)

Second colour – second digit red (2)

Third colour – power of ten to be multiplied  $10^3 - 3$  (orange)

5% tolerance – gold.

So, third band should be orange.

14. A metal wire has mass  $(0.4 \pm 0.002)$  g, radius  $(0.3 \pm 0.001)$  mm and length  $(5 \pm 0.02)$  cm. The maximum possible percentage error in the measurement of density will nearly be:

- (1) 1.3%
- (2) 1.6%
- (3) 1.4%
- (4) 1.2%

Ans. (2)

Sol. We Know  $d = \frac{M}{V} = \frac{M}{\pi r^2 l}$

Proportional error,  $\frac{\Delta d}{d} = \frac{\Delta M}{M} + \frac{2\Delta r}{r} + \frac{\Delta l}{l}$

$$= \frac{0.002}{0.4} + \frac{2 \times 0.001}{0.3} + \frac{0.02}{5} = \frac{0.02}{4} + \frac{0.02}{3} + \frac{0.02}{5}$$

$$= \frac{0.3 + 0.4 + 0.24}{60} = \frac{0.94}{60}$$

$$\% \text{ error} = \frac{0.94}{60} \times 100 = \frac{94}{60}$$

$$= 1.6\%$$

15. Light travels a distance  $x$  in time  $t_1$  in air and  $10x$  in time  $t_2$  in another denser medium. What is the critical angle for this medium?

- (1)  $\sin^{-1}\left(\frac{10t_2}{t_1}\right)$

- (2)  $\sin^{-1}\left(\frac{t_1}{10t_2}\right)$

- (3)  $\sin^{-1}\left(\frac{10t_1}{t_2}\right)$

- (4)  $\sin^{-1}\left(\frac{t_2}{t_1}\right)$

Ans. (3)

Sol. Velocity of light in air =  $\frac{x}{t_1} = C$

Velocity of light in denser medium =  $\frac{10x}{t_2} = v$

If critical angle is  $C$ ,

$$\sin C = \frac{\text{Velocity in denser}}{\text{Velocity in rarer}} = \frac{\frac{10x}{t_2}}{\frac{x}{t_1}} = \frac{10t_1}{t_2}$$

$$C = \sin^{-1}\left(\frac{10t_1}{t_2}\right)$$

16. In a plane electromagnetic wave travelling in free space, the electric field component oscillates sinusoidally at a frequency of  $2.0 \times 10^{10}$  Hz and amplitude  $48 \text{ Vm}^{-1}$ . Then the amplitude of oscillating magnetic field is : (Speed of light in free space  $= 3 \times 10^8 \text{ ms}^{-1}$ )

- (1)  $1.6 \times 10^{-8} \text{ T}$
- (2)  $1.6 \times 10^{-7} \text{ T}$
- (3)  $1.6 \times 10^{-6} \text{ T}$
- (4)  $1.6 \times 10^{-9} \text{ T}$

Ans. (2)

Sol. We know, in an EM wave,  $\frac{E_0}{B_0} = C$

$$B_0 = \frac{E_0}{C}$$

given  $E_0 = 48 \text{ Vm}^{-1}$

$$B_0 = \frac{48}{3 \times 10^8} = 16 \times 10^{-8} = 1.6 \times 10^{-7} \text{ T}$$

17. The ratio of radius of gyration of a solid sphere of mass M and radius R about its own axis to the radius of gyration of the thin hollow sphere of same mass and radius about its axis is:

- (1) 5 : 3
- (2) 2 : 5
- (3) 5 : 2
- (4) 3 : 5

Ans. (4)

$$\text{Sol. } I_{\text{SS}} = \frac{2}{5} MR^2 = MK_{\text{SS}}^2 \Rightarrow K_{\text{SS}} = \sqrt{\frac{2}{5}} R$$

$$I_{\text{HS}} = \frac{2}{3} MR^2 = MK_{\text{HS}}^2 \Rightarrow K_{\text{HS}} = \sqrt{\frac{2}{3}} R$$

$$\frac{K_{\text{SS}}}{K_{\text{HS}}} = \sqrt{\frac{2}{5}} \times \sqrt{\frac{3}{2}} = \sqrt{\frac{3}{5}}$$

18. The amount of energy required to form a soap bubble of radius 2 cm from a soap solution is nearly: (surface tension of soap solution  $= 0.03 \text{ Nm}^{-1}$ )

- (1)  $5.06 \times 10^{-4} \text{ J}$
- (2)  $3.01 \times 10^{-4} \text{ J}$
- (3)  $50.1 \times 10^{-4} \text{ J}$
- (4)  $30.16 \times 10^{-4} \text{ J}$

Ans. (2)

Sol.  $U = \text{surface tension} \times \text{surface area}$

Soap bubble has 2 surfaces

$$U = T \times 2(4\pi R^2)$$

$$= 8\pi R^2 T$$

$$= 8 \times \pi \times (2 \times 10^{-2})^2 \times 0.03$$

$$= 3.01 \times 10^{-4} \text{ J}$$

19. In a series LCR circuit, the inductance L is 10mH, capacitance C is  $1 \mu\text{F}$  and resistance R is  $100 \Omega$ . The frequency at which resonance occurs is :

- (1) 15.9 KHz
- (2) 1.59 rad/s
- (3) 1.59 KHz
- (4) 15.9 rad/s

Ans. (3)

Sol. Resonant frequency,

$$f = \frac{1}{2\pi\sqrt{LC}}$$

$$= \frac{1}{2\pi\sqrt{(10 \times 10^{-3})(1 \times 10^{-6})}}$$

$$= \frac{10^4}{2\pi} = 1.59 \text{ kHz}$$

20. If  $\oint_s \vec{E} \cdot d\vec{S} = 0$  over a surface, then:

- (1) the magnitude of electric field on the surface is constant.
- (2) all the charges must necessarily be inside the surface.
- (3) the electric field inside the surface is necessarily uniform.
- (4) the number of flux lines entering the surface must be equal to the number of flux lines leaving it.

Ans. (4)

Sol.  $\oint \vec{E} \cdot d\vec{s}$  indicates total flux passing through a closed surface. If it is zero, net flux passing through the surface is zero.

21. The venturi-meter works on:

- (1) Bernoulli's principles
- (2) The principle of parallel axes
- (3) The principle of perpendicular axes
- (4) Hyugen's principles

Ans. (1)

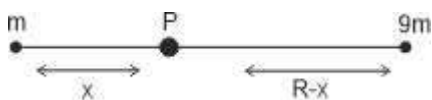
Sol. The venturi-meter works on Bernoulli's principle.

22. Two bodies of mass  $m$  and  $9m$  are placed at a distance  $R$ . The gravitational potential on the line joining the bodies where the gravitational field equals zero, will be ( $G$  = gravitational constant):

- (1)  $-\frac{12Gm}{R}$
- (2)  $-\frac{16Gm}{R}$
- (3)  $-\frac{20Gm}{R}$
- (4)  $-\frac{8Gm}{R}$

Ans. (2)

Sol. Let gravitational field intensity be zero at point P



$$\frac{Gm}{x^2} = \frac{G(9m)}{(R-x)^2}$$

$$\frac{R-x}{x} = 3$$

$$x = \frac{R}{4}$$

Gravitational potential,

$$V_p = \frac{-Gm}{x} + \frac{-G(9m)}{R-x}$$

$$= \frac{-Gm}{\left(\frac{R}{4}\right)} + \frac{-G(9m)}{\left(R - \frac{R}{4}\right)}$$

$$= \frac{-16Gm}{R}$$

23. The temperature of a gas is  $-50^\circ\text{C}$ . To what temperature the gas should be heated so that the rms speed is increased by 3 times?

- (1)  $3295^\circ\text{C}$
- (2)  $3097\text{K}$
- (3)  $223\text{K}$
- (4)  $669^\circ\text{C}$

Ans. (1)

Sol. If speed increases by 3 times, final speed will be 4 times

$$\text{We know } V_{\text{rms}} = \sqrt{\frac{3RT}{M}}$$

$$\frac{V_1}{V_2} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{V_1}{4V_1} = \sqrt{\frac{T_1}{T_2}}$$

$$T_2 = 16 T_1 = 16 (273-50) = 3568\text{K}$$

$$T_2 = 3568 - 273 = 3295^\circ\text{C}$$

24. The minimum wavelength of X-rays produced by an electron accelerated through a potential difference of  $V$  volts is proportional to:

- (1)  $\frac{1}{V}$
- (2)  $\frac{1}{\sqrt{V}}$
- (3)  $V^2$
- (4)  $\sqrt{V}$

Ans. (1)

Sol. Kinetic energy of incident electrons is equal to maximum energy of X-rays generated.

$$\frac{1}{2} m_e v_e^2 = eV = h\nu_{\text{max}} = \frac{hc}{\lambda_{\text{min}}}$$

$$\lambda_{\text{min}} = \frac{hc}{eV} \propto \frac{1}{V}$$

25. A vehicle travels half the distance with speed  $v$  and the remaining distance with speed  $2v$ . Its average speed is:

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

Ans. (2)

Sol. Let the total distance travelled be  $2x$ .

$$\text{Average speed} = \frac{\text{total distance}}{\text{total time}}$$

$$= \frac{x+x}{\frac{x}{v} + \frac{x}{2v}} = \frac{2x}{\frac{x}{v} \left(1 + \frac{1}{2}\right)}$$

$$= \frac{2v}{\left(\frac{3}{2}\right)} = \frac{4v}{3}$$

26. The angular acceleration of a body, moving along the circumference of a circle, is :
- (1) along the radius towards the centre
  - (2) along the tangent to its position
  - (3) along the axis of rotation
  - (4) along the radius, away from centre

Ans. (3)

Sol. Angular acceleration always along the axis of rotation.

27. Let a wire be suspended from the ceiling (rigid support) and stretched by a weight  $W$  attached at its free end. The longitudinal stress at any point of cross-sectional area  $A$  of the wire is:
- (1)  $W/A$
  - (2)  $W/2A$
  - (3) Zero
  - (4)  $2W/A$

Ans. (1)

Sol. Stress =  $\frac{F}{A} = \frac{W}{A}$

28. A full wave rectifier circuit consists of two p-n junction diodes, a centre-tapped transformer, capacitor and a load resistance. Which of these components remove the ac ripple from the rectified output?
- (1) p-n junction diodes
  - (2) Capacitor
  - (3) Load resistance
  - (4) A centre-tapped transformer

Ans. (2)

Sol. AC ripple can be removed by using capacitor.

29. An electric dipole is placed at an angle of  $30^\circ$  with an electric field of intensity  $2 \times 10^5 \text{ NC}^{-1}$ . It experiences a torque equal to 4 N m. Calculate the magnitude of charge on the dipole, if the dipole length is 2 cm.
- (1) 6 mC
  - (2) 4 mC
  - (3) 2 mC
  - (4) 8 mC

Ans. (3)

Sol. Couple acting on dipole

$$C = pE \sin \theta$$

$$= 2 lq E \sin \theta$$

$$4 = 2 \times 10^{-2} \times q \times 2 \times 10^5 \times \frac{1}{2}$$

$$q = 2 \times 10^{-3} \text{C} = 2 \text{ mC}$$

30. A Carnot engine has an efficiency of 50% when its source is at a temperature  $327^\circ \text{C}$ . The temperature of the sink is:

- (1)  $15^\circ \text{C}$
- (2)  $100^\circ \text{C}$
- (3)  $200^\circ \text{C}$
- (4)  $27^\circ \text{C}$

Ans. (4)

Sol.  $\eta = 1 - \frac{T_2}{T_1}$

$$0.5 = 1 - \frac{T_2}{327 + 273}$$

$$0.5 = 1 - \frac{T_2}{600}$$

$$\frac{T_2}{600} = \frac{1}{2}$$

$$T_2 = 300 \text{ K}$$

$$= 300 - 273$$

$$= 27^\circ \text{C}$$

31. For Young's double slit experiment, two statements are given below:

**Statement-I** : If screen is moved away from the plane of slits, angular separation of the fringes remains constant.

**Statement-II** : If the monochromatic source is replaced by another monochromatic source of larger wavelength, the angular separation of fringes decreases.

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

- (1) Both Statement I and Statement II are false.
- (2) Statement I is true but Statement II is false.
- (3) Statement I is false but Statement II is true.
- (4) Both Statement I and Statement II are true.

Ans. (2)

Sol.  $\theta = \frac{\beta}{D} = \frac{\lambda}{d} = \text{constant}$ , statement 1 is true.

$$\theta = \frac{\beta}{D} = \frac{\lambda}{d} \propto \lambda$$

Statement 2 is false.

32. The work functions of Caesium (Cs), Potassium (K) and Sodium (Na) are 2.14 eV, 2.30 eV and 2.75 eV respectively. If incident electromagnetic radiation has an incident energy of 2.20 eV, which of these photosensitive surfaces may emit photoelectrons?

- (1) Both Na and K
- (2) K only
- (3) Na only
- (4) Cs only

Ans. (4)

Sol. Incident photon should have an energy more than work function.

So, only Cs has work function less than photon energy.

33. Given below are two statements:

**Statement-I** : Photovoltaic devices can convert optical radiation into electricity.

**Statement-II** : Zener diode is designed to operate under reverse bias in breakdown region.

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

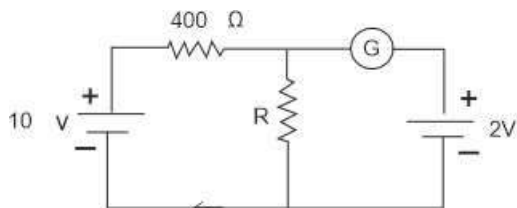
- (1) Both Statement I and Statement II are incorrect.
- (2) Statement I is correct but Statement II is incorrect.
- (3) Statement I is incorrect but Statement II is correct.
- (4) Both Statement I and Statement II are correct.

Ans. (4)

Sol. Photovoltaic devices convert light energy to electrical energy.

Zener diode operates in reverse bias in the breakdown region.

34. If the galvanometer G does not show any deflection in the circuit shown, the value of R is given by:



- (1) 50  $\Omega$
- (2) 100  $\Omega$
- (3) 400  $\Omega$
- (4) 200  $\Omega$

Ans. (2)

Sol. For the galvanometer to read zero potential across, R must be 2 V.

Now, potential drop across 400  $\Omega$  must be 8 V, current

$$\text{in the loop} = \frac{8}{400} \text{ A} = \frac{1}{50} \text{ A}.$$

$$\text{Voltage across R, } 2 \text{ V} = \frac{1}{50} \times R$$

$$R = 100 \Omega$$

35. A bullet is fired from a gun at the speed of 280  $\text{ms}^{-1}$  in the direction  $30^\circ$  above the horizontal. The maximum height attained by the bullet is ( $g = 9.8 \text{ms}^{-2}$ ,  $\sin 30^\circ = 0.5$ )

- (1) 2000 m
- (2) 1000 m
- (3) 3000 m
- (4) 2800 m

Ans. (2)

$$\text{Sol. } H = \frac{u^2 \sin^2 \theta}{2g}$$

$$= \frac{(280)^2 \times \left(\frac{1}{2}\right)^2}{2 \times 9.8}$$

$$= 1000 \text{ m}$$

## SECTION - B

36. A satellite is orbiting just above the surface of the earth with period T. If d is the density of the earth and G is the universal constant of gravitation, the quantity

$\frac{3\pi}{Gd}$  represents:

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

Ans. (1)

Sol. The centripetal force of the satellite is given by gravitational force.

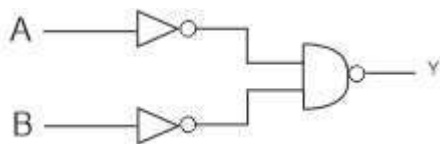
$$\Rightarrow \frac{GM_e m}{R^2} = mR\omega^2$$

$$\left(\text{here } \omega = \frac{2\pi}{T}, M_e = \frac{4\pi}{3} R^3 d\right)$$

$$\Rightarrow \frac{G}{R^2} \cdot \frac{4\pi}{3} R^3 \cdot d \cdot m = m \cdot R \left(\frac{2\pi}{T}\right)^2 \Rightarrow T^2 = \frac{3\pi}{Gd}$$



37. For the following logic circuit, the truth table is:



|     | A | B | Y |
|-----|---|---|---|
| (1) | 0 | 0 | 0 |
|     | 0 | 1 | 1 |
|     | 1 | 0 | 1 |
|     | 1 | 1 | 1 |

|     | A | B | Y |
|-----|---|---|---|
| (2) | 0 | 0 | 1 |
|     | 0 | 1 | 0 |
|     | 1 | 0 | 1 |
|     | 1 | 1 | 0 |

|     | A | B | Y |
|-----|---|---|---|
| (3) | 0 | 0 | 0 |
|     | 0 | 1 | 0 |
|     | 1 | 0 | 0 |
|     | 1 | 1 | 1 |

|     | A | B | Y |
|-----|---|---|---|
| (4) | 0 | 0 | 1 |
|     | 0 | 1 | 1 |
|     | 1 | 0 | 1 |
|     | 1 | 1 | 0 |

Ans. (1)

Sol.  $\overline{\overline{A} \cdot \overline{B}} \Rightarrow \overline{\overline{A} + \overline{B}} = A + B$  (OR gate)

| A | B | Y |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 1 | 1 |

38. The radius of inner most orbit of hydrogen atom is  $5.3 \times 10^{-33}$  m. What is the radius of third allowed orbit of hydrogen atom?

- (1)  $1.06 \text{ \AA}$
- (2)  $1.39 \text{ \AA}$
- (3)  $4.77 \text{ \AA}$
- (4)  $0.53 \text{ \AA}$

Ans. (3)

Sol. Radius of 1<sup>st</sup> orbit  $r_1 = 5.3 \times 10^{-11}$  m

Radius of n<sup>th</sup> orbit  $r_n = n^2 r_1 = n^2 \times 5.3 \times 10^{-11}$

$$\Rightarrow \text{If } n = 3 \Rightarrow r_3 = 9 \times 5.3 \times 10^{-11}$$

$$= 4.77 \times 10^{-10} \text{ m} = 4.77 \text{ \AA}$$

39. A wire carrying a current I along the positive x-axis has length L. It is kept in a magnetic field  $\vec{B} = (2\hat{i} + 3\hat{j} - 4\hat{k})$  T. The magnitude of the magnetic force acting on the wire is :

- (1)  $\sqrt{5} IL$
- (2)  $5 IL$
- (3)  $\sqrt{3} IL$
- (4)  $3 IL$

Ans. (2)

Sol. Force acting on the current carrying wire is given by

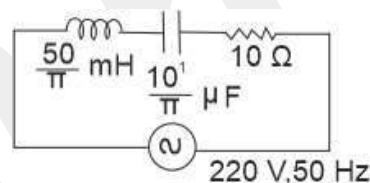
$$\vec{F} = I\vec{L} \times \vec{B}$$

$$= IL(\hat{i}) \times (2\hat{i} + 3\hat{j} - 4\hat{k})$$

$$\vec{F} = IL[3\hat{k} + 4\hat{j}]$$

$$\Rightarrow |\vec{F}| = 5IL$$

40. The net impedance of circuit (as shown in figure) will be:



- (1)  $15 \Omega$
- (2)  $5\sqrt{5} \Omega$
- (3)  $25 \Omega$
- (4)  $10\sqrt{2} \Omega$

Ans. (2)

Sol.  $X_c = \frac{1}{C\omega}$ ,  $X_L = L\omega$ ,  $R = 10 \Omega$

$$X_c = \frac{1}{\frac{10^3}{\pi} \times 10^{-6} \times 100\pi}$$

$$X_c = 10 \Omega$$

$$X_L = \frac{50}{\pi} \times 10^{-3} \times 100\pi$$

$$X_L = 5 \Omega$$

$$z = \sqrt{R^2 + (X_c - X_L)^2}$$

$$= \sqrt{10^2 + (10 - 5)^2} = \sqrt{125} = 5\sqrt{5} \Omega$$

41. 10 resistors, each of resistance R are connected in series to a battery of emf E and negligible internal resistance. Then those are connected in parallel to the same battery, the current is increased n times. The value of n is :

- (1) 100
- (2) 1
- (3) 1000
- (4) 10

Ans. (1)

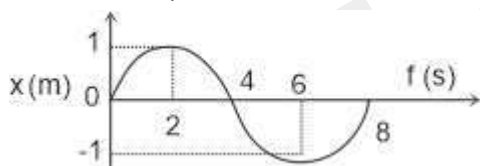
Sol. Initial current =  $\frac{E}{10R}$

Final current =  $\frac{E}{\left(\frac{R}{10}\right)} = \frac{10E}{R}$

Ratio =  $n = \frac{10E/R}{E/10R} = 100$

$\Rightarrow n = 100$

42. The  $x-t$  graph of a particle performing simple harmonic motion is shown in the figure. The acceleration of the particle at  $t=2$  s is:



- (1)  $-\frac{\pi^2}{8} \text{ms}^{-2}$
- (2)  $\frac{\pi^2}{16} \text{ms}^{-2}$
- (3)  $-\frac{\pi^2}{16} \text{ms}^{-2}$
- (4)  $\frac{\pi^2}{8} \text{ms}^{-2}$

Ans. (3)

Sol. Here, from the graph

Time period = 8 s

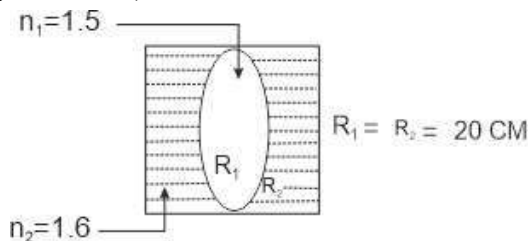
Amplitude of oscillation = 1 m

$\Rightarrow$  Angular frequency =  $\frac{2\pi}{8} = \frac{\pi}{4} \text{rads}^{-1}$

$\Rightarrow$  Maximum acceleration =  $-A\omega^2$

$= -(1) \cdot \left(\frac{\pi}{4}\right)^2 = -\frac{\pi^2}{16} \text{ms}^{-2}$

43. In the figure shown here, what is the equivalent focal length of the combination of lenses (Assume that all layers are thin)?



- (1) -40 cm
- (2) -100 cm
- (3) -50 cm
- (4) 40 cm

Ans. (2)

Sol. This will be a combination of 3 lenses placed in air

$\frac{1}{f_1} = (1.6 - 1) \left[ \frac{1}{\infty} - \frac{1}{20} \right] = \frac{-0.6}{20} \text{cm}$

$\frac{1}{f_2} = (1.5 - 1) \left[ \frac{1}{20} - \left( \frac{1}{-20} \right) \right] = \frac{0.5}{10} \text{cm}$

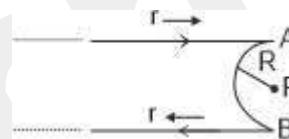
$\frac{1}{f_3} = (1.6 - 1) \left[ \frac{1}{(-20)} - \frac{1}{\infty} \right] = \frac{-0.6}{20} \text{cm}$

The combined focal length is given by

$\frac{1}{f_{\text{eq}}} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} = \frac{-0.6}{20} + \frac{0.5}{10} + \frac{-0.6}{20}$

$\frac{1}{f_{\text{eq}}} = \frac{-0.1}{10} \Rightarrow f_{\text{eq}} = -100 \text{cm}$

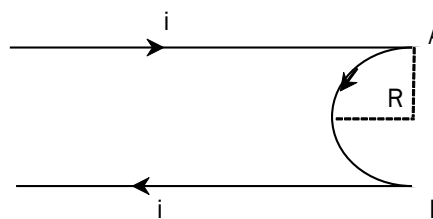
44. A very long conducting wire is bent in a semi-circular shape from A to B as shown in figure. The magnetic field at point P for steady current configuration is given by:



- (1)  $\frac{\mu_0 i}{4R}$  pointed away from the page
- (2)  $\frac{\mu_0 i}{4R} \left[ 1 - \frac{2}{\pi} \right]$  pointed away from page
- (3)  $\frac{\mu_0 i}{4R} \left[ 1 - \frac{2}{\pi} \right]$  pointed into the page
- (4)  $\frac{\mu_0 i}{4R}$  pointed into the page

Ans. (2)

Sol.



$\vec{B}_P = \vec{B}_A + \vec{B}_{AB} + \vec{B}_B$

$\Rightarrow \vec{B}_P = \frac{\mu_0 i}{4\pi R} (\otimes) + \frac{\mu_0 i}{4R} (\bullet) + \frac{\mu_0 i}{4\pi R} (\otimes)$

$\Rightarrow \vec{B}_P = \frac{\mu_0 i}{4R} \left[ 1 - \frac{2}{\pi} \right]$  away from the page

45. Calculate the maximum acceleration of a moving car so that a body lying on the floor of the car remains stationary. The coefficient of static friction between the body and the floor is 0.15 ( $g = 10 \text{ m s}^{-2}$ )

- (1)  $150 \text{ m s}^{-2}$
- (2)  $1.5 \text{ m s}^{-2}$
- (3)  $50 \text{ m s}^{-2}$
- (4)  $1.2 \text{ m s}^{-2}$

Ans. (2)

Sol. Pseudo force should be balanced by friction

$$\Rightarrow f = ma$$

$$\Rightarrow \mu mg = ma$$

$$\Rightarrow a = (0.15) \times 10 = 1.5 \text{ ms}^{-2}$$

46. Two thin lenses are of same focal lengths ( $f$ ) but one is convex and the other one is concave. When they are placed in contact with each other, the equivalent focal length of the combination will be:

- (1)  $f / 4$
- (2)  $f / 2$
- (3) Infinite
- (4) Zero

Ans. (3)

Sol. The focal length of the combination is given by

$$\frac{1}{f_{\text{combination}}} = \frac{1}{f_{\text{concave}}} + \frac{1}{f_{\text{convex}}}$$

$$\frac{1}{f_{\text{combination}}} = \frac{1}{f} + \frac{1}{-f} = 0$$

$$f_{\text{combination}} = \infty$$

47. A horizontal bridge is built across a river. A student standing on the bridge throws a small ball vertically upwards with a velocity  $4 \text{ ms}^{-1}$ . The ball strikes the water surface after 4 s. The height of bridge above water surface is (Take  $g = 10 \text{ m s}^{-2}$ ):

- (1) 60 m
- (2) 64 m
- (3) 68 m
- (4) 56 m

Ans. (2)

Sol. Using equation of motion, considering the upward

direction

Total displacement =  $-H$  (Height of bridge)

Time taken = 4 s

$$\Rightarrow -H = ut + \frac{1}{2}(-g)t^2$$

Substituting the value of  $t=4$

$$\Rightarrow -H = 4(4) + \frac{1}{2}(-10)(4)^2$$

$$\Rightarrow H = 64 \text{ m}$$

$\therefore$  Height of bridge = 64 m

48. The resistance of platinum wire at  $0^\circ\text{C}$  is  $2\Omega$  and  $6.8\Omega$  at  $80^\circ\text{C}$ . The temperature coefficient of resistance of the wire is :

- (1)  $3 \times 10^{-3} \text{ }^\circ\text{C}^{-1}$
- (2)  $3 \times 10^{-2} \text{ }^\circ\text{C}^{-1}$
- (3)  $3 \times 10^{-1} \text{ }^\circ\text{C}^{-1}$
- (4)  $3 \times 10^{-4} \text{ }^\circ\text{C}^{-1}$

Ans. (2)

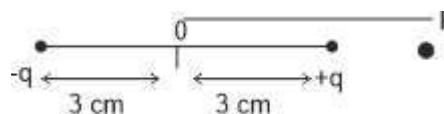
$$\text{Sol. } R = R_0 [1 + \alpha \Delta\theta]$$

$$6.8 = 2[1 + 80\alpha]$$

$$\Rightarrow 3.4 - 1 = 80\alpha$$

$$\Rightarrow \alpha = 3 \times 10^{-2} / ^\circ\text{C}$$

49. An electric dipole is placed as shown in the figure.



The electric potential (in  $10^2\text{V}$ ) at point P due to the dipole is ( $\epsilon_0 =$  permittivity of free space and

$$\frac{1}{4\pi\epsilon_0} = K$$
);

- (1)  $\left(\frac{5}{8}\right)qK$
- (2)  $\left(\frac{8}{5}\right)qK$
- (3)  $\left(\frac{8}{3}\right)qK$
- (4)  $\left(\frac{3}{8}\right)qK$

Ans. (4)

Sol. The electric potential at P will be superposition of

potential due to  $+q$  and  $-q$ . (Since the dimensions of dipole is large)

$$\Rightarrow V_p = V_{-q} + V_{+q}$$

$$= \frac{K(-q)}{8 \times 10^{-2}} + \frac{K(q)}{2 \times 10^{-2}}$$

$$= \frac{-100Kq}{8} + \frac{100Kq}{2}$$

$$= \frac{300Kq}{8}$$

$$\Rightarrow V_p = \left(\frac{3}{8}\right)qK \times 10^2 \text{ V}$$

50. A bullet from a gun is fired on a rectangular wooden block with velocity  $u$ . When bullet travels 24 cm through the block along its length horizontally, velocity of bullet

becomes  $\frac{u}{3}$ . Then it further penetrates into the block in the same direction before coming to rest exactly at the other end of the block. The total length of the block is

- (1) 24 cm
- (2) 28 cm
- (3) 30 cm
- (4) 27 cm

Ans. (4)

Sol. Assuming the acceleration is constant

using equation of motion

$$\left(\frac{u}{3}\right)^2 - u^2 = 2a(24)$$

$$\Rightarrow \frac{-8u^2}{9} = 2(a)(24)$$

$$\Rightarrow a = \frac{-u^2}{54}$$

If the velocity is changing from  $\frac{u}{3}$  to zero in a distance of  $s'$

$$(0)^2 - \left(\frac{u}{3}\right)^2 = 2as'$$

$$\frac{-u^2}{9} = 2\left(\frac{-u^2}{54}\right)s'$$

$$s' = 3 \text{ cm}$$

So the total distance penetrated =  $s + s' = 24 + 3$

$$= 27 \text{ cm}$$

## CHEMISTRY

### SECTION - A

51. The element expected to form largest ion to achieve the nearest noble gas configuration is

- (1) F
- (2) N
- (3) Na
- (4) O

Ans. (2)

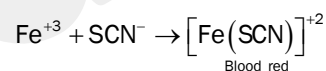
Sol. For isoelectronic ions, more the -ve charge, more will be the size.

52. In Lassaigne's extract of an organic compound, both nitrogen and sulphur are present which gives blood red colour with  $\text{Fe}^{3+}$  due to the formation of

- (1) NaSCN
- (2)  $[\text{Fe}(\text{CN})_5\text{NOS}]^{4-}$
- (3)  $[\text{Fe}(\text{SCN})]^{2+}$
- (4)  $\text{Fe}_4[(\text{CN})_6]_3 \cdot x \cdot \text{H}_2\text{O}$

Ans. (3)

Sol.  $\text{Na} + \text{C} + \text{N} + \text{S} \rightarrow \text{NaSCN}$



53. The relation between  $n_m$  ( $n_m$  = the number of permissible values of magnetic quantum number ( $m$ )) for a given value of azimuthal quantum number ( $l$ ), is

- (1)  $l = 2n_m + 1$
- (2)  $n_m = 2l^2 + 1$
- (3)  $n_m = l + 2$
- (4)  $l = \frac{n_m - 1}{2}$

Ans. (4)

Sol. Total number of  $m$  values =  $2l + 1$

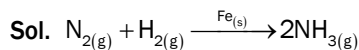
$$n_m = 2l + 1$$

$$l = \frac{n_m - 1}{2}$$

54. Which one is an example of heterogenous catalysis?

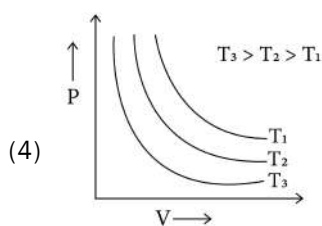
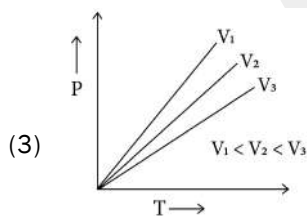
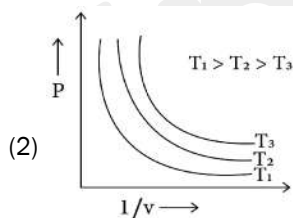
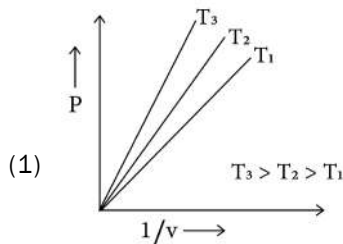
- (1) Hydrolysis of sugar catalysed by  $H^+$  ions.
- (2) Decomposition of ozone in presence of nitrogen monoxide.
- (3) Combination between dinitrogen and dihydrogen to form ammonia in the presence of finely divided iron.
- (4) Oxidation of sulphur dioxide into sulphur trioxide in the presence of oxides of nitrogen.

Ans. (3)



Here, the catalyst and the reactants are in different physical states.

55. Which amongst the following options is correct graphical representation of Boyle's Law?

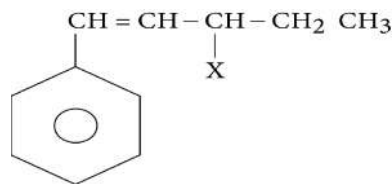


Ans. (1)

Sol. At constant temperature.  $P \propto \frac{1}{V}$

This was proved by the graph 3.

56. The given compound



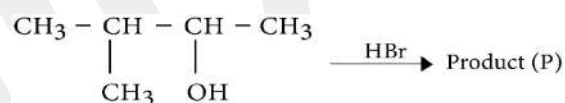
is an example of \_\_\_\_\_

- (1) aryl halide
- (2) allylic halide
- (3) vinylic halide
- (4) benzylic halide

Ans. (2)

Sol. Halogen attached next to the double bonded carbon.

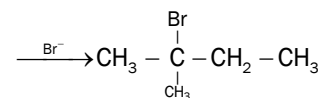
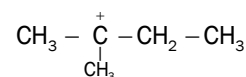
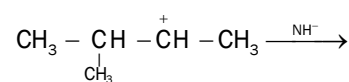
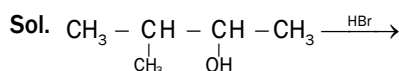
57. Consider the following reaction and identify the product.



3-Methylbutan-2-ol

- (1)  $\text{CH}_3\text{CH} = \text{CH} - \text{CH}_3$
- (2)  $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH} - \text{CH}_3 \\ | \quad | \\ \text{CH}_3 \quad \text{Br} \end{array}$
- (3)  $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} - \text{CH}_2 - \text{Br} \\ | \\ \text{CH}_3 \end{array}$
- (4)  $\begin{array}{c} \text{Br} \\ | \\ \text{CH}_3 - \text{C} - \text{CH}_2 - \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$

Ans. (4)



58. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**:

**Assertion (A)** : Helium is used to dilute oxygen in diving apparatus.

**Reasons (R)** : Helium has high solubility in  $O_2$ .

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

- (1) Both A and R are true and R is NOT the correct explanation of A.
- (2) A is true but R is false.
- (3) A is false but R is true.
- (4) Both A and R are true and R is the correct explanation of A.

**Ans. (1)**

**Sol.** Helium is used instead of nitrogen. Helium has high solubility due to low Henry's constant value.

59. The conductivity of centimolar solution of KCl at  $25^\circ C$  is  $0.0210 \text{ ohm}^{-1}\text{cm}^{-1}$  and the resistance of the cell containing the solution at  $25^\circ C$  is 60 ohm . The value of cell constant is -

- (1)  $3.28 \text{ cm}^{-1}$
- (2)  $1.26 \text{ cm}^{-1}$
- (3)  $3.34 \text{ cm}^{-1}$
- (4)  $1.34 \text{ cm}^{-1}$

**Ans. (2)**

**Sol.** Given  $K = 0.0210 \text{ ohm}^{-1}\text{cm}^{-1}$

Resistance  $R = 60 \text{ ohm}$

Cell constant  $\left(\frac{l}{a}\right) = ?$

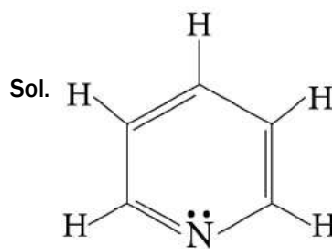
$$K = \frac{1}{R} \times \frac{l}{a}$$

$$\frac{l}{a} = K \times R = 0.0210 \times 60 = 1.26 \text{ cm}^{-1}$$

60. The number of  $\sigma$  bonds,  $\pi$  bonds and lone pair of electrons in pyridine, respectively are :

- (1) 12,3,0
- (2) 11,3,1
- (3) 12,2,1
- (4) 11,2,0

**Ans. (2)**



No. of ' $\sigma$ ' bonds = 11

$\pi$  bonds = 3

lone pairs = 1

61. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**:

**Assertion A** : Metallic sodium dissolves in liquid ammonia giving a deep blue solution, which is paramagnetic.

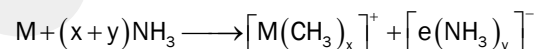
**Reasons R** : The deep blue solution is due to the formation of amide.

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

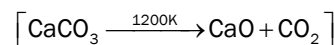
- (1) Both A and R are true but R is NOT the correct explanation of A.
- (2) A is true but R is false.
- (3) A is false but R is true.
- (4) Both A and R are true and R is the correct explanation of A.

**Ans. (2)**

**Sol.** The colour of the solution is due to the ammoniated electron.

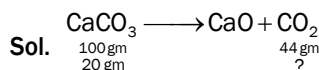


62. The right option for the mass of  $CO_2$  produced by heating of 20 g of 20% pure limestone is (Atomic mass of Ca = 40)



- (1) 1.76 g
- (2) 2.64 g
- (3) 1.32 g
- (4) 1.12 g

**Ans. (1)**



Mass of  $CO_2$  liberated from 100% pure

$$CaCO_3 = \frac{20}{100} \times 44 = \frac{44}{5} \text{ gm}$$

Mass of  $CO_2$  from 20%

$$= \frac{20}{100} \times \frac{44}{5} = 1.76 \text{ gm}$$

63. Intermolecular forces are forces of attraction and repulsion between interacting particles that will include:

- (A) dipole-dipole force
- (B) dipole-induced dipole force
- (C) hydrogen bond
- (D) covalent bond
- (E) dispersion forces

Choose the most appropriate answer from the options given below :

- (1) A, B, C, D are correct.
- (2) A, B, C, E are correct.
- (3) A, C, D, E are correct.
- (4) B, C, D, E are correct.

Ans. (2)

**Sol.** Intermolecular forces do not include the electrostatic forces that exist between two oppositely charged ions and the forces that hold atoms of a molecule together, i.e., covalent bonds.

64. For a certain reaction, the rate =  $k[A]^2[B]$ , when the initial concentration of A is tripled keeping concentration of B constant, the initial rate would

- (1) increase by a factor of six.
- (2) increase by a factor of nine.
- (3) increase by a factor of three.
- (4) decrease by a factor of nine.

Ans. (4)

**Sol.** Rate =  $K[A]^2[B]$

If 'A' is doubled, then rate increases by  $2^2 = 4$  times.

65. Taking stability as the factor, which one of the following represents correct relationship?

- (1)  $TlI > TlI_3$
- (2)  $TlCl_3 > TlCl$
- (3)  $InI_3 > InI$
- (4)  $AlCl > AlCl_3$

Ans. (3)

**Sol.** According to inert pair effect, the stability of higher o.s decrease and lower o.s increases down the group.

Hence :  $Tl^{+1} > Tl^{+3}$

66. Which of the following statements are **NOT** correct?

- (A) Hydrogen is used to reduce heavy metal oxides to metals.
- (B) Heavy water is used to study reaction mechanism.
- (C) Hydrogen is used to make saturated fats from oils.
- (D) The H-H bond dissociation enthalpy is lowest as compared to a single bond between two atoms of any element.
- (E) Hydrogen reduces oxides of metals that are more active than iron.

Choose the most appropriate answer from the options given below:

- (1) B, D only
- (2) D, E only
- (3) A, B, C only
- (4) B, C, D, E only

Ans. (2)

**Sol.** H-H bond dissociation enthalpy is highest (435.88 kJ mol<sup>-1</sup>) as compared to single bond between two atoms of any elements.

Hydrogen reduces oxides of metals which are below in reactivity series (which are less reactive than H)

Iron oxide is more reactive, hence hydrogen cannot reduce it and is more active than it.

67. Weight (g) of two moles of the organic compound, which is obtained by heating sodium ethanoate with sodium hydroxide in presence of calcium oxide is:

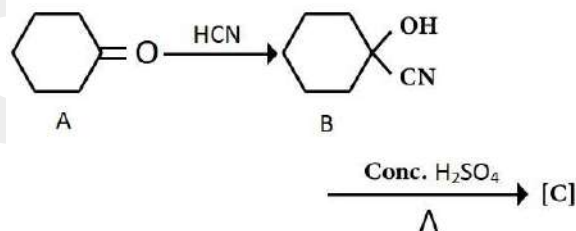
- (1) 32
- (2) 30
- (3) 18
- (4) 16

Ans. (1)

**Sol.**  $CH_3COONa + NaOH \xrightarrow[\Delta]{CaO} CH_4 + Na_2CO_3$

Weight of 2 moles of  $CH_4 = 2(16) = 32$  gm

68. Complete the following reaction



[C] is

- (1)
- (2)
- (3)
- (4)

Ans. (3)



69. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R:

**Assertion A:** In equation  $\Delta_r G = -nFE_{\text{cell}}$ , value of  $\Delta_r G$  depends on n.

**Reasons R:**  $E_{\text{cell}}$  is an intensive property and  $\Delta_r G$  is an extensive property.

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

- (1) Both A and R are true and R is NOT the correct explanation of A.
- (2) A is true but R is false.
- (3) A is false but R is true.
- (3) Both A and R are true and R is the correct explanation of A.

**Ans. (4)**

**Sol.** Cell potential is an intensive property as it does not depend on size or mass of the system.

70. Amongst the following, the total number of species NOT having eight electrons around central atom in its outer most shell, is  $\text{NH}_3, \text{AlCl}_3, \text{BeCl}_2, \text{CCl}_4, \text{PCl}_5$ :

- (1) 2
- (2) 4
- (3) 1
- (4) 3

**Ans. (4)**

**Sol.**  $\text{AlCl}_3, \text{BeCl}_2$  and  $\text{PCl}_5$ .

71. The correct order of energies of molecular orbitals of  $\text{N}_2$  molecule, is

- (1)  $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$
- (2)  $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < \sigma^* 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y)$
- (3)  $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma 2p_z < \sigma^* 2p_z$
- (4)  $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi 2p_x = \pi 2p_y) < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$

**Ans. (1)**

**Sol.** For molecules having  $\leq 14e^-$

$$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \pi 2p_x = \pi 2p_y < \sigma 2p_z < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$$

72. A compound is formed by two elements A and B. The element B forms cubic close packed structure and atoms of A occupy 1/3 of tetrahedral voids. If the formula of the compound is  $\text{A}_x\text{B}_y$ , then the value of  $x + y$  is.

- (1) 4
- (2) 3
- (3) 2
- (4) 5

**Ans. (4)**

**Sol.** No. of atoms of 'B' per unit cell in CCP = 4

No. of 'A' atoms =  $1/3 (8) = 8/3$

A : B =  $8/3 : 4 = 2 : 3 = x : y$

$x + y = 2 + 3 = 5$

73. The stability of  $\text{Cu}^{2+}$  is more than  $\text{Cu}^+$  salts in aqueous solution due to

- (1) enthalpy of atomization.
- (2) hydration energy.
- (3) second ionisation enthalpy.
- (4) first ionisation enthalpy.

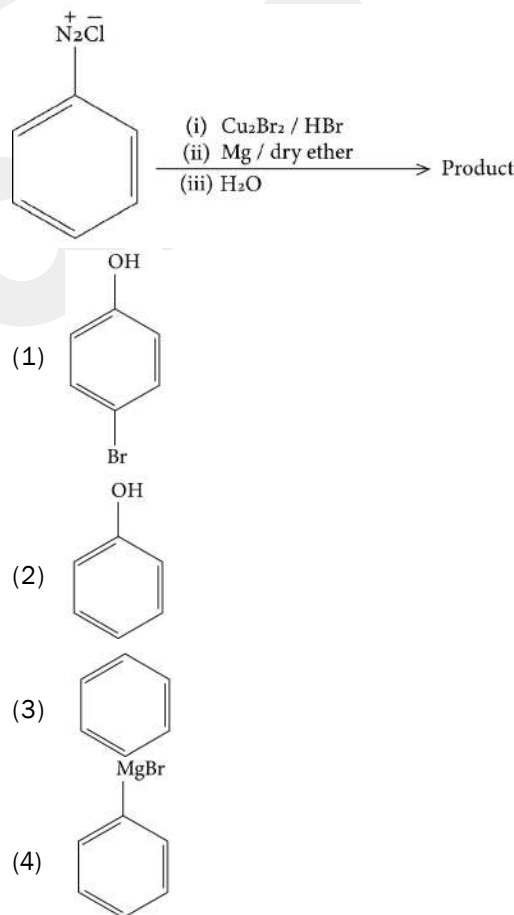
**Ans. (2)**

**Sol.** Stability depends on hydration energy of the ions in aqueous solutions.

As hydration energy  $\uparrow$  stability  $\uparrow$

It releases more energy.

74. Identify the product in the following reaction.



**Ans. (1)**

**Sol.** Diazonium salt first forms bromo benzene, which on reaction with magnesium forms Grignard reagent, which, on hydrolysis, gives benzene.



75. Given below are two statements :

**Statement I** : A unit formed by the attachment of a base to 1' position of sugar is known as nucleoside.

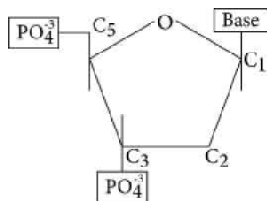
**Statement II** : When nucleoside is linked to phosphorous acid at 5' - position of sugar moiety, we get nucleotide.

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

- (1) Both **Statement I** and **Statement II** are false.
- (2) **Statement I** is true but **Statement II** is false
- (3) **Statement I** is false but **Statement II** is true
- (4) Both **Statement I** and **Statement II** are true.

Ans. (2)

Sol. Statement II is incorrect because phosphoric acid is used, not phosphorous acid.



76. Which one of the following statements is correct?

- (1) All enzymes that utilise ATP in phosphate transfer require Ca as the cofactor.
- (2) The bone in human body is an inert and unchanging substance.
- (3) Mg plays roles in neuromuscular function and interneuronal transmission.
- (4) The daily requirement of Mg and Ca in the human body is estimated to be 0.2 - 0.3 g

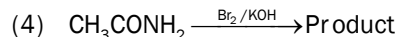
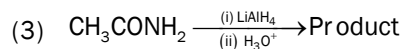
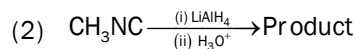
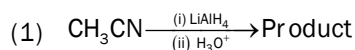
Ans. (4)

Sol. \*'Ca' plays an important role in neuromuscular function.

\* ATP in phosphate transfer requires K as the cofactor.

\* The bone is not on inert and unchanging substance in the human body.

77. Which of the following reactions will **NOT** give primary amine as the product?



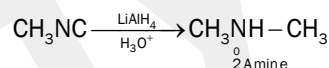
Ans. (2)

Sol. (i) Amide, on reduction, gives primary amine with same number of carbon atoms.

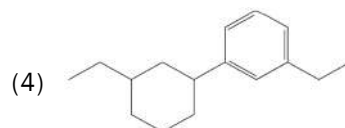
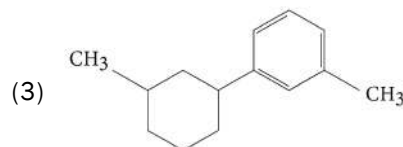
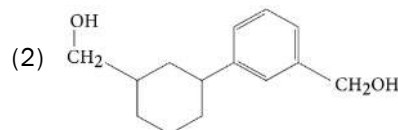
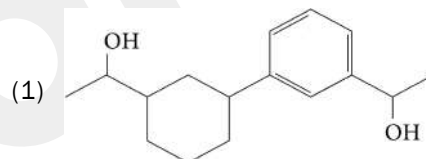
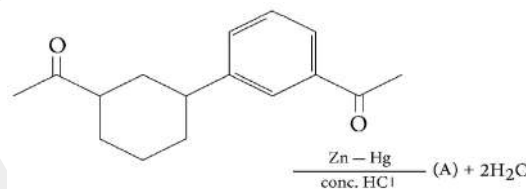
(ii) Primary amide gives primary amine with 1 carbon less - Hoffmann Bromamide reaction.

(iii) Nitriles on reduction gives primary amine with same number of carbon atoms.

(iv) Isocyanides, on reduction, gives secondary amine.



78. Identify product (A) in the following reaction.



Ans. (4)

Sol. A = 2

It is Clemmenson reduction.

79. Match List - I with List - II:

| List - I     | List - II                              |
|--------------|--|
| a) Coke      | i) Carbon atoms are $sp^3$ hybridised. |
| b) Diamond   | ii) Used as a dry lubricant            |
| c) Fullerene | iii) Used as a reducing agent          |
| d) Graphite  | iv) Cage like molecules                |

Choose the **correct** answer from the options given below:

- (1) a-iv, b-i, c-ii, d-iii
- (2) a-iii, b-i, c-iv, d-ii
- (3) a-iii, b-iv, c-i, d-ii
- (4) a-ii, b-iv, c-i, d-iii

**Ans. (2)**
**Sol.** Coke: used as reducing agent

 Diamond:  $sp^3$  hybridized carbon atoms

Fullerene: cage like molecules

Graphite: used as dry lubricant.

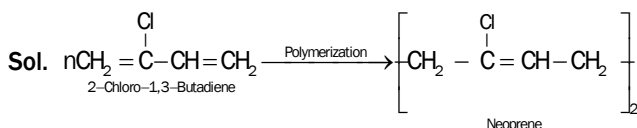
80. Amongst the given options which of the following molecules / ion acts as a Lewis acid?

- (1)  $H_2O$
- (2)  $BF_3$
- (3)  $OH^-$
- (4)  $NH_3$

**Ans. (2)**
**Sol.**  $BF_3$  has vacant orbital.

81. Which amongst the following molecules on polymerization produces neoprene?

- (1)  $H_2C = \overset{\text{Cl}}{\underset{|}{C}} - CH = CH_2$
- (2)  $H_2C = CH - C \equiv CH$
- (3)  $H_2C = \overset{\text{CH}_3}{\underset{|}{C}} - CH = CH_2$
- (4)  $H_2C = CH - CH - CH_2$

**Ans. (1)**


82. Some tranquilizers are listed below. Which one of the following belongs to barbiturates?

- (1) Meprobamate
- (2) Valium
- (3) Veronal
- (4) Chlordiazepoxide

**Ans. (3)**
**Sol.** Veronal - barbiturates (derivative of barbituric acid)

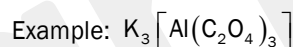
Chlordiazepoxide - mild tranquilizer suitable for relieving tension.

Meprobamate - mild tranquilizer suitable for relieving tension.

Valicum - tranquilizer but not barbiturates.

83. Homoleptic complex from the following complexes is :

- (1) Diamminechloridonitrito - N - platinum (II)
- (2) Pentaammine carbonatocobalt (III) chloride
- (3) Triamminetriaquachromium (III) chloride
- (4) Potassium trioxalatoaluminate (III)

**Ans. (4)**
**Sol.** Complex in which a metal is bound to only one kind of ligand.

 84. Given below are two statements : one is labelled as **Assertion (A)** and other is labelled as **Reason (R)**.

**Assertion (A)** : A reaction can have zero activation energy.

**Reason (R)** : The minimum extra amount of energy absorbed by reactant molecules so that their energy becomes equal to the threshold value is called activation energy.

 In the light of above statements, choose the **correct** answer from the option given below

- (1) Both A and R are true and R is NOT the correct explanation of A.
- (2) A is true but R is false.
- (3) A is false but R is true.
- (4) Both A and R are true and R is the correct explanation of A.

**Ans. (3)**

## SECTION - B

85. Select the **correct** statement from the following :

- A. Atoms of all elements are composed of two fundamental particles.
- B. The mass of the electron is  $9.10939 \times 10^{-31}$  kg.
- C. All the isotopes of a given element show same chemical properties.
- D. Protons and electrons are collectively known as nucleons.
- E. Dalton's atomic theory, regarded the atom as an ultimate particle of matter.

Choose the correct answer from the options given below:

- (1) C, D and E only
- (2) A and E only
- (3) B, C and E only
- (4) A, B and C only

Ans. (3)

**Sol.** → Atoms of all elements are composed of 3 fundamental particles, i.e., electron, proton & neutron.  
→ Protons and neutrons are collectively known as nucleons.

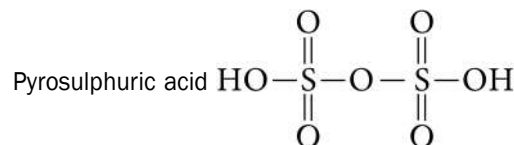
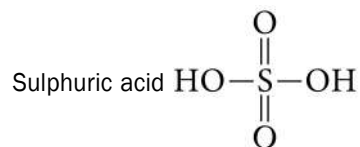
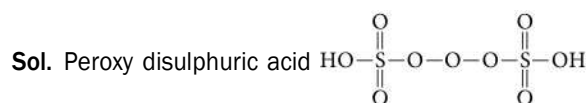
86. Match List - I with List - II :

| List - I                  | List - II                          |
|---------------------------|------------------------------------|
| (Oxoacids of sulphur)     | (Bonds)                            |
| A. Peroxodisulphuric acid | I. Two S-OH, Four S=O, One S-O-S   |
| B. Sulphuric acid         | II. Two S-OH, One S=O              |
| C. Pyrosulphuric acid     | III. Two S-OH, four S=O, One S-O-S |
| D. Sulphurous acid        | IV. Two S-OH, Two S=O              |

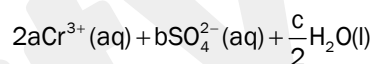
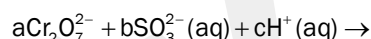
Choose the correct answer from the options given below:

- (1) A-III, B-IV, C-I, D-II
- (2) A-I, B-III, C-IV, D-II
- (3) A-III, B-IV, C-II, D-I
- (4) A-I, B-III, C-II, D-IV

Ans. (1)



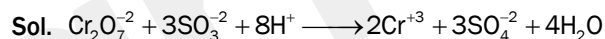
87. On balancing the given redox reaction,



The coefficients a, b and c are found to be, respectively

- (1) 3, 8, 1
- (2) 1, 8, 3
- (3) 8, 1, 3
- (4) 1, 3, 8

Ans. (4)



$$a = 1, b = 3, c = 8$$



88. What fraction of one edge centred octahedral void lies in one unit cell of fcc?

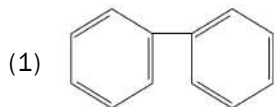
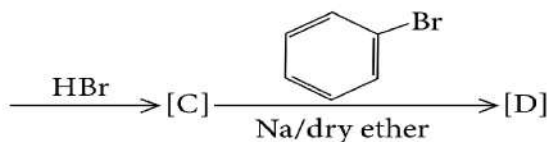
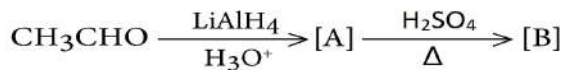
- (1)  $\frac{1}{3}$
- (2)  $\frac{1}{4}$
- (3)  $\frac{1}{12}$
- (3)  $\frac{1}{2}$

Ans. (2)

**Sol.** Octahedral voids are present on edge centres and body centre. Every edge centre is shared among four unit cells.

$$\therefore \frac{1}{4} \text{th per unit cell}$$

89. Identify the final product [D] obtained in the following sequence of reactions.

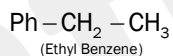
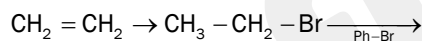
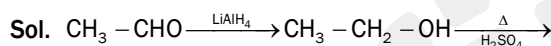


(2)  $\text{C}_4\text{H}_{10}$

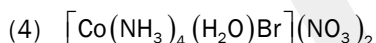
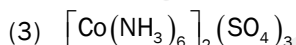
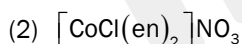
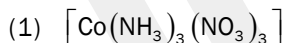
(3)  $\text{HC} \equiv \text{C}^- \text{Na}^+$



Ans. (4)



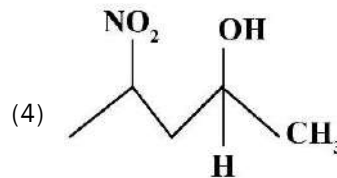
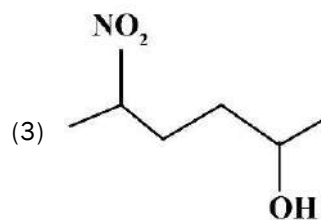
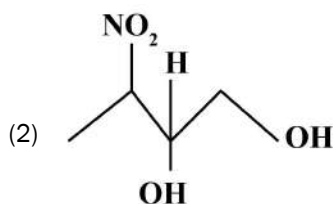
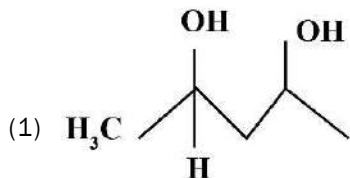
90. Which complex compound is most stable?



Ans. (2)

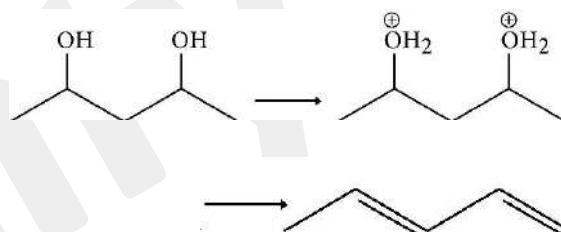
Sol. Ethylene diamine, shows chelation with central metal, and hence, gives more stability.

91. Which amongst the following will be most readily dehydrated under acidic conditions?



Ans. (1)

Sol. Most easily dehydrated is the one which can form stable carbo cation.



92. Given below are two statements:

**Statement I:** The nutrient deficient water bodies lead to eutrophication.

**Statement II:** Eutrophication leads to decrease in the level of oxygen in the water bodies.

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

(1) Both **Statement I** and **Statement II** are false.

(2) **Statement I** is correct but **Statement II** is false.

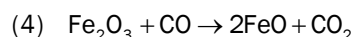
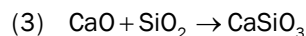
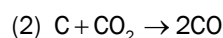
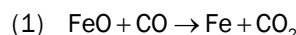
(3) **Statement I** is incorrect but **Statement II** is true.

(4) Both **Statement I** and **Statement II** are true.

Ans. (3)

Sol. Eutrophication is due to excess of nutrients in the lake due to which  $\text{O}_2$  level falls.

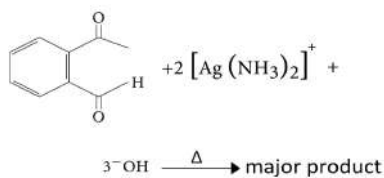
93. The reaction that does NOT take place in a blast furnace between 900K to 1500 K temperature range during extraction of iron is :



Ans. (4)

Sol.  $\text{Fe}_2\text{O}_3 + \text{CO} \rightarrow 2\text{FeO} + \text{CO}_2$  will occur at a temperature 500 - 800 K.

94. Identify the major product obtained in the following reaction :



- (1)
- (2)
- (3)
- (4)

Ans. (2)

Sol. Tollen's reagent oxidises only aldehyde, but not ketone.



95. Which amongst the following options is the correct relation between change in enthalpy and change in internal energy?

- (1)  $\Delta H = \Delta U + \Delta n_g RT$
- (2)  $\Delta H - \Delta U = -\Delta n RT$
- (3)  $\Delta H + \Delta U = \Delta n R$
- (4)  $\Delta H = \Delta U - \Delta n_g RT$

Ans. (1)

Sol. The relation between enthalpy and internal energy

$$\Delta H = \Delta U + \Delta n_g RT$$

96. Which of the following statements are **INCORRECT**?

- A. All the transition metals except scandium form MO oxides which are ionic.
- B. The highest oxidation number corresponding to the group number in transition metal oxides is attained is  $Sc_2O_3$  to  $Mn_2O_7$ .
- C. Basic character increases from  $V_2O_3$  to  $V_2O_4$  to  $V_2O_5$ .
- D.  $V_2O_4$  dissolves in acids to give  $VO_4^{3-}$  salts.

E.  $CrO$  is basic but  $Cr_2O_3$  is amphoteric.

Choose the **correct** answer from the options given below.

- (1) B and D only
- (2) C and D only
- (3) B and C only
- (4) A and E only

Ans. (2)

Sol. (C)  $V_2O_4$  dissolves in acids to give  $VO_2^+$  salts

(D) Basic character decreases from  $V_2O_3$  to  $V_2O_4$  and to amphoteric  $V_2O_5$ .

97. The equilibrium concentrations of the species in the  $A + B \rightleftharpoons C + D$  are 2, 3, 10 and  $6 \text{ mol L}^{-1}$ , respectively at 300 K.  $\Delta G^\circ$  for the reaction is ( $R = 2 \text{ cal/mol K}$ )

- (1) -137.26 cal
- (2) -1381.80 cal
- (3) -13.73 cal
- (4) 1372.60 cal

Ans. (2)

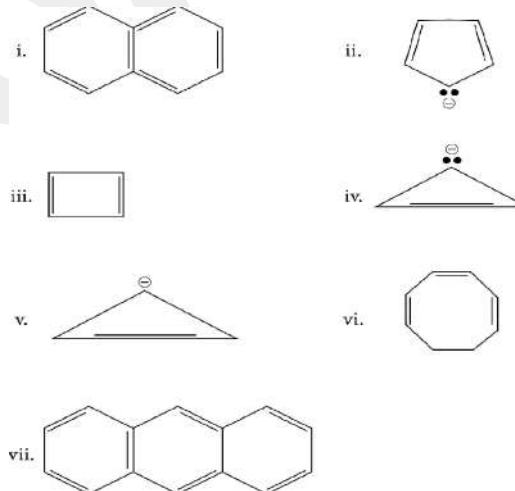
Sol.  $\Delta G = -2.303 RT \log k_{eq}$

$$\Delta G = -2.303 RT \log \frac{[C][D]}{[A][B]}$$

$$\Delta G = -2.303 \times 2 \times 300 \times \log \frac{10 \times 6}{2 \times 3}$$

$$\Delta G = -1381.80 \text{ cal}$$

98. Consider the following compounds/species:

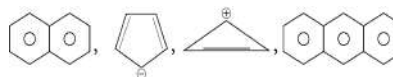


The number of compounds/species which obey Huckel's rule is

- (1) 6
- (2) 2
- (3) 5
- (4) 4

Ans. (4)

Sol. Huckel's rule =  $(4n + 2) \pi e^-$



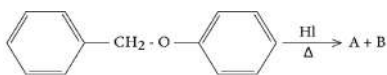
99. Pumice stone is an example of

- (1) gel
- (2) solid sol
- (3) foam
- (4) sol

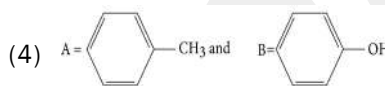
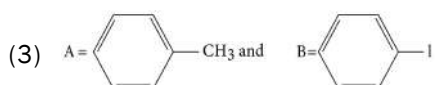
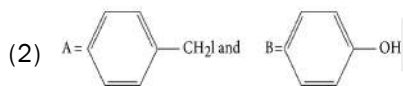
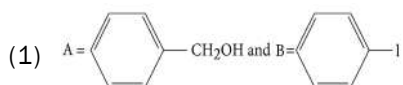
Ans. (2)

Sol. Pumice stone is an example of gas dispersed phase, in solid dispersion medium.

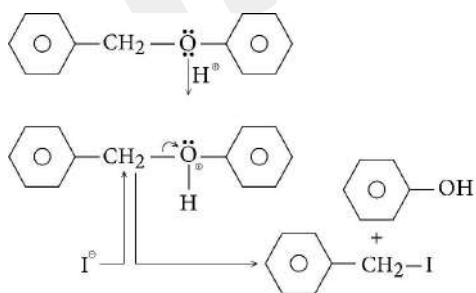
100. Consider the following reaction:



Identify products A and B.



Ans. (2)



Sol.

**BOTANY**

**SECTION - A**

101. The phenomenon of pleiotropism refers to

- (1) presence of two alleles, each of the two genes controlling a single trait
- (2) a single gene affecting multiple phenotypic expression
- (3) more than two genes affecting single character.
- (4) presence of several alleles of a single gene controlling a single crossover

Ans. (2)

Sol. The phenomenon of pleiotropism refers to a single gene affecting multiple phenotypic expressions. This occurs because genes do not act in isolation but can have cascading effects on many different biological processes.

102. In tissue culture experiments, leaf mesophyll cells are put in a culture medium to form callus. This phenomenon may be called as:

- (1) Dedifferentiation
- (2) Development
- (3) Senescence
- (4) Differentiation

Ans. (1)

Sol. The phenomenon of leaf mesophyll cells forming callus in a culture medium is called dedifferentiation. Dedifferentiation refers to the ability of differentiated cells, such as mesophyll cells in a leaf, to revert back to meristematic cells.

Differentiation in plants refers to the process by which cells become specialized and acquire distinct morphological and functional characteristics to perform specific roles in the organism.

Development is the sum of growth and differentiation.

Senescence in plants refers to the natural process of aging or deterioration of cells, tissues, and organs of a plant, ultimately leading to death.

103. Movement and accumulation of ions across a membrane against their concentration gradient can be explained by

- (1) Facilitated Diffusion
- (2) Passive Transport
- (3) Active Transport
- (4) Osmosis

Ans. (3)

Sol. Movement and accumulation of ions across a membrane against their concentration gradient is explained by active transport.

Osmosis is the movement of water molecules from an area of high water concentration to an area of low water concentration across a selectively permeable membrane. It is a passive process and does not require energy expenditure.

Facilitated diffusion is a type of passive transport that involves the movement of molecules or ions across a membrane from an area of higher concentration to an area of lower concentration, with the help of specific membrane proteins called transporters or channels. Passive transport refers to the movement of molecules or ions across a cell membrane from an area of higher concentration to an area of lower concentration, without the use of energy. This process occurs spontaneously, driven by the concentration gradient.

104. Among 'The Evil Quarter', which one is considered the most important cause driving extinction of species?

- (1) Over-exploitation for economic gain
- (2) Alien species invasions
- (3) Co-extinctions
- (4) Habitat loss and fragmentation

**Ans. (4)**

**Sol.** Evil quarter is a term related to four major causes of biodiversity losses. A) habitat loss and fragmentation, b) Alien species invasion, c) Co-extinction, d) over - exploitation.

Among these habitat loss and fragmentation is considered the most important cause driving extinction of species.

105. Upon exposure to UV radiation, DNA stained with ethidium bromide will show

- (1) Bright blue colour
- (2) Bright yellow colour
- (3) Bright orange colour
- (4) Bright red colour

**Ans. (3)**

**Sol.** In agarose gel electrophoresis ,the separated DNA fragments can be visualised only after staining the DNA with a compound known as ethidium bromide followed by exposure to UV radiation . We can see bright orange coloured bands of DNA in a ethidium bromide stained gel exposed to UV light.

106. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R:

**Assertion (A) :** The first stage of gametophyte in the life cycle of moss is protonema stage.

**Reason (R) :** Protonema develops directly from spores produced in capsule.

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 the NOT correct explanation of A.
- (2) A is correct but R is not correct
- (3) A is not correct but R is correct.
- (4) Both A and R are correct and R is the correct explanation of A.

**Ans. (4)**

**Sol.** The assertion A is true. The first stage of gametophyte in the life cycle of moss is the protonema stage. The protonema is a thread-like structure that develops from the germinating spore of the moss and grows into a branching system of filaments. The protonema stage is followed by the development of leafy gametophores that bear the sex organs of the moss.

The reason R is true. The protonema develops directly from the spores produced in the capsule, which is the sporangium of the sporophyte generation in mosses. The capsule contains diploid cells, which undergo meiosis to produce haploid spores. These spores are released and can germinate under favorable conditions to form the protonema, which is the first stage in the development of the haploid gametophyte generation in mosses.

Both A and R are correct and R is the correct explanation of A.

107. What is the role of RNA polymerase III in the process of transcription in Eukaryotes?

- (1) Transcription of tRNA, 5 srRNA and snRNA
- (2) Transcription of precursor of mRNA
- (3) Transcription of only snRNAs
- (4) Transcription of rRNAs (28S, 18S and 5.8S)

**Ans. (1)**

**Sol.** RNA polymerase III is an enzyme that plays a key role in the transcription of genes that code for tRNA, 5S rRNA, and some other small RNAs (snRNA and some snoRNAs) in eukaryotes.

The RNA polymerase I transcribes rRNAs (28S, 18S, and 5.8S).

The RNA polymerase II transcribes precursor of mRNA, the heterogeneous nuclear RNA (hnRNA).

108. The historic Convention on Biological Diversity, 'The Earth Summit' was held in Rio de Janeiro in the year:

- (1) 1992
- (2) 1986
- (3) 2002
- (4) 1985

**Ans. (1)**

**Sol.** The historic Convention on Biological Diversity ('The Earth Summit') held in Rio de Janeiro in 1992, called upon all nations to take appropriate measures for conservation of biodiversity and sustainable utilisation of its benefits.

109. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R:

**Assertion (A) :** ATP is used at two steps in glycolysis.

**Reason (R) :** First ATP is used in converting glucose into glucose-6-phosphate and second ATP is used in conversion of fructose-6-phosphate into fructose-1,6-diphosphate.

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

- (1) Both A and R are true but R is the NOT correct explanation of A.
- (2) A is true but R is not false.
- (3) A is false but R is true.
- (4) Both A and R are true and R is the correct explanation of A.

**Ans. (4)**

**Sol.** The assertion A states that ATP is used at two steps in glycolysis, which is true. The reason R states that the first ATP is used in converting glucose into glucose-6-phosphate, and the second ATP is used in converting fructose-6-phosphate into fructose-1,6-diphosphate, which is also true and is the correct explanation for the assertion A.

Reason R is also true. During glycolysis, glucose is converted into pyruvate, which involves a series of enzymatic reactions. The first step of glycolysis is the conversion of glucose to glucose-6-phosphate, which is catalyzed by the enzyme hexokinase and requires the input of one molecule of ATP. The second step involves the conversion of fructose-6-phosphate to fructose-1,6-bisphosphate, which is catalyzed by the enzyme phosphofructokinase and also requires the input of one molecule of ATP.

Thus, ATP is used at two steps in glycolysis: once in the conversion of glucose to glucose-6-phosphate and once in the conversion of fructose-6-phosphate to fructose-1,6-bisphosphate.

Both A and R are true and R is the correct explanation of A.

110. The thickness of ozone in a column of air in the atmosphere is measured in terms of:

- (1) Decibels
- (2) Decameter
- (3) Kilobase
- (4) Dobson units

**Ans. (4)**

**Sol.** The Dobson Unit is a way to describe how much ozone there would be in the column if it were all squeezed into a single layer. The average amount of ozone in the atmosphere is roughly 300 Dobson Units, equivalent to a layer 3 millimeters (0.12 inches) thick—the height of 2 pennies stacked together.

111. Given below are two statements:

**Statement I :** Endarch and exarch are the terms often used for describing the position of secondary xylem in the plant body.

**Statement II :** Exarch condition is the most common feature of the root xylem.

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

- (1) Both statement I and statement II are false.
- (2) Statement I is correct but statement II is false.
- (3) Statement I is incorrect but statement II is true.
- (4) Both statement I and statement II are true.

**Ans. (3)**

**Sol.** In roots, the protoxylem lies towards periphery and metaxylem lies towards the centre. Such arrangement of primary xylem is called exarch. Exarch condition is the most common feature of the root xylem, while endarch condition is found in the stem of many plants.

112. Identify the pair of heterosporous pteridophytes among the following:

- (1) *Selaginella* and *Salvinia*
- (2) *Psilotum* and *Salvinia*
- (3) *Equisetum* and *Salvinia*
- (4) *Lycopodium* and *Selaginella*

**Ans. (1)**

**Sol.** Pair of heterosporous pteridophytes are *Selaginella* and *Salvinia*. *Psilotum*, *Lycopodium* and *Equisetum* are homosporous.

113. Identify the correct statements:

- A. Detritivores perform fragmentation.
- B. The humus is further degraded by some microbes during mineralization.
- C. Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.
- D. The detritus food chain begins with living organisms.
- E. Earthworms break down detritus into smaller particles by a process called catabolism.

Choose the correct answer from the options given below:

- (1) B, C, D only
- (2) C, D, E only
- (3) D, E, A only
- (4) A, B, C only

**Ans. (4)**

**Sol.** The detritus food chain begins with dead organic matter. Detritivores (e.g., earthworm) break down detritus into smaller particles. This process is called fragmentation.



114. Axile placentation is observed in

- (1) China rose, Beans and Lupin
- (2) Tomato, Dianthus and Pea
- (3) China rose, Petunia and Lemon
- (4) Mustard, Cucumber and Primrose

**Ans. (3)**

**Sol.** conceptual

115. Family Fabaceae differs from Solanaceae and Liliaceae. With respect to the stamens, pick out the characteristics specific to family Fabaceae but not found in Solanaceae or Liliaceae.

- (1) Polyadelphous and epipetalous stamens
- (2) Monoadelphous and Monothealous anthers
- (3) Epiphyllous and Dithecous anthers
- (4) Diadelphous and Dithecous anthers

**Ans. (4)**

**Sol.** In the flowers of Fabaceae, the stamens are fused into two groups (called diadelphous stamens), with one group having 9 stamens and the other group having only 1 stamen. The anthers are also typically dithecous, meaning they consist of two separate lobes or sacs. In contrast, the stamen features of Solanaceae include the presence of epipetalous stamens (stamens attached to the petals) and the absence of anthers with separate sacs. Liliaceae, on the other hand, typically have six stamens that are either free or fused to the perianth, and the anthers are usually monothealous (consisting of a single lobe or sac).

116. The reaction centre in PS II has an absorption maxima at

- (1) 700 nm
- (2) 660 nm
- (3) 780 nm
- (4) 680 nm

**Ans. (4)**

**Sol.** The reaction center in Photosystem II (PS II) has chlorophyll a molecules called P680, which have an absorption maximum at a wavelength of about 680 nm. These pigments are responsible for capturing light energy and exciting electrons that are used in the primary photochemical reaction of PS II, which involves the splitting of water molecules and the release of oxygen.

PS I is responsible for absorbing light with a wavelength

of 700 nm, which is then used to transfer electrons from plastocyanin to ferredoxin, leading to the production of ATP and NADPH.

117. During the purification process for recombinant DNA technology, addition of chilled ethanol precipitates out

- (1) DNA
- (2) Histones
- (3) Polysaccharides
- (4) RNA

**Ans. (1)**

**Sol.** During the purification process for recombinant DNA technology, addition of chilled ethanol precipitates out DNA.

118. Among eukaryotes, replication of DNA take place in

- (1) S phase
- (2) G<sub>1</sub> phase
- (3) G<sub>2</sub> phase
- (4) M phase

**Ans. (1)**

**Sol.** Among eukaryotes, replication of DNA takes place in the S phase.

During G<sub>1</sub> phase the cell is metabolically active and continuously grows but does not replicate its DNA.

During the G<sub>2</sub> phase, proteins are synthesised in preparation for mitosis while cell growth continues.

M phase is the most dramatic period of the cell cycle, involving a major re-organisation of virtually all components of the cell.

119. The process of appearance of recombination nodules occurs at which sub stage of prophase I in meiosis?

- (1) Pachytene
- (2) Diplotene
- (3) Diakinesis
- (4) Zygotene

**Ans. (1)**

**Sol.** Recombination nodules, also known as synaptonemal complexes, appear during the pachytene stage of prophase I in meiosis. At this stage, the homologous chromosomes are paired and crossing over occurs between them, resulting in the exchange of genetic material. The synaptonemal complexes are involved in holding the paired chromosomes together during recombination.

120. How many ATP and  $\text{NADPH}_2$  are required for the synthesis of one molecule of Glucose during Calvin cycle?

- (1) 18 ATP and 12  $\text{NADPH}_2$
- (2) 12 ATP and 16  $\text{NADPH}_2$
- (3) 18 ATP and 16  $\text{NADPH}_2$
- (4) 12 ATP and 12  $\text{NADPH}_2$

**Ans. (1)**

**Sol.** The Calvin cycle, also known as the light-independent reactions of photosynthesis, uses ATP and NADPH generated by the light-dependent reactions to fix carbon dioxide and synthesize glucose.

To synthesize one molecule of glucose, the Calvin cycle uses 18 ATP and 12  $\text{NADPH}+\text{H}^+$ .

121. In the equation  $\text{GPP} - \text{R} = \text{NPP}$

GPP is Gross Primary Productivity

NPP is Net Primary Productivity

R here is \_\_\_\_\_.

- (1) Respiratory quotient
- (2) Respiratory loss
- (3) Reproductive allocation
- (4) Photosynthetically active radiation

**Ans. (2)**

**Sol.** In the equation  $\text{GPP} - \text{R} = \text{NPP}$ . R represents respiratory losses.

When plants take in sunlight, some of the energy is always lost through respiration. This means that, when an organism converts glucose from the sun into energy, some of it is rendered unusable since it escapes into the atmosphere.

122. Large, colourful, fragrant flowers with nectar are seen in:

- (1) bird pollinated plants
- (2) bat pollinated plants
- (3) wind pollinated plants
- (4) insect pollinated plants

**Ans. (4)**

**Sol.** Large, colourful, fragrant flowers with nectar are seen in insect-pollinated plants. The colorful and fragrant attributes of the flower attract the insect pollinators, while nectar serves as a reward for their visitation, and in return, the pollinators transfer the pollen from the anther to the stigma, leading to fertilization.

123. Spraying of which of the following phytohormone on juvenile conifers helps in hastening the maturity period, that leads to early seed production?

- (1) Gibberellic Acid
- (2) Zeatin
- (3) Abscisic Acid
- (4) Indole-3-butyric Acid

**Ans. (1)**

**Sol.** Spraying GA on juvenile conifers can help in hastening the maturity period, leading to early seed production. GA is a phytohormone that is involved in promoting stem elongation, germination, and flowering in plants. In conifers, GA can stimulate the formation of reproductive structures and help in the transition from the juvenile to the adult phase of growth.

ABA plays a role in regulating plant responses to stress and maintaining plant water balance. ABA is synthesized in response to stress conditions such as drought, high salinity, and extreme temperatures, and it helps plants to cope with these stresses by reducing water loss and promoting water uptake. ABA also plays a role in seed dormancy and germination, as well as in the regulation of stomatal aperture.

Indole-3-butyric Acid is often used as a rooting hormone to stimulate root formation in plant cuttings.

Zeatin is involved in various physiological processes, such as nutrient uptake, seed germination, and stress responses. It also delays senescence by promoting chloroplast development and the synthesis of photosynthetic pigments, which helps to increase the yield of crops.

124. Which micronutrient is required for splitting of water molecule during photosynthesis?

- (1) Molybdenum
- (2) Magnesium
- (3) Copper
- (4) Manganese

**Ans. (4)**

**Sol.** Manganese is a micronutrient required for splitting the water molecule during photosynthesis. In photosystem II of the thylakoid membrane, the energy from absorbed light is used to split water molecules into oxygen, hydrogen ions (protons), and electrons. This process is called photolysis of water and requires the presence of a manganese-containing enzyme complex known as the oxygen-evolving complex (OEC). The OEC plays a crucial role in the photolysis of water by catalyzing the oxidation of water molecules to produce oxygen and protons. Thus, manganese is essential for the process of photosynthesis, as it is required for the initial step of water splitting.

125. Expressed Sequence Tags (ESTs) refers to

- (1) All genes that are expressed as proteins.
- (2) All genes whether expressed or unexpressed.
- (3) Certain important expressed genes.
- (4) All genes that are expressed as RNA.

**Ans. (4)**

**Sol.** Expressed Sequence Tags or ESTs are genes that are expressed as RNA in the body. ESTs represent portions of expressed genes.

126. Frequency of recombination between gene pairs on same chromosome as a measure of the distance between genes to map their position on chromosome, was used for the first time by

- (1) Sutton and Boveri
- (2) Alfred Sturtevant
- (3) Henking
- (4) Thomas Hunt Morgan

**Ans. (2)**

**Sol.** The frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes to map their position on chromosome was first proposed by Alfred Sturtevant in 1913.

Henking, also known as Gustav Hennig, was a German biologist who first discovered the presence of sex chromosomes in insects. In 1891, while studying the testes of the mealworm beetle *Tenebrio molitor*, Henking observed that some of the cells contained an unusual body that was not present in other cells. He named this body the "X-element", as he could not determine its function at the time.

Thomas Hunt Morgan (1866-1945) was an American geneticist who made significant contributions to the field of genetics. Morgan is best known for his pioneering work on the fruit fly *Drosophila melanogaster*, which he used to study the inheritance of traits and the mechanisms of genetic recombination.

Walter Sutton (1877-1916) and Theodor Boveri (1862-1915) were two pioneering geneticists who independently proposed the chromosome theory of inheritance.

127. Given below are two statements:

**Statement-I :** The forces generated by transpiration can lift a xylem-sized column of water over 130 meters height.

**Statement-II :** Transpiration cools leaf surfaces sometimes 10 to 15 degrees, by evaporative cooling.

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

- (1) Both statement I and statement II are incorrect.
- (2) Statement I is correct but statement II is incorrect.
- (3) Statement I is incorrect but statement II is correct.
- (4) Both statement I and statement II are correct.

**Ans. (4)**

**Sol.** Transpiration generates the forces that lift a column of water in xylem up to a height of 130 meters or more in some tall trees. This phenomenon is called the cohesion-tension theory.

Transpiration creates a water potential gradient from the soil to the atmosphere through the plant, causing water to move from roots to leaves. During this process, water molecules in the leaf evaporate into the atmosphere, which removes heat energy from the leaf and cools it down. This is called evaporative cooling.

128. In gene gun method used to introduce alien DNA into host cells, microparticles of \_\_\_\_\_metal are used.

- (1) Zinc
- (2) Tungsten or gold
- (3) Silver
- (4) Copper

**Ans. (2)**

**Sol.** In gene gun method used to introduce alien DNA into host cells, microparticle of tungsten or gold is used.

129. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R :

**Assertion (A) :** Late wood has fewer xylary elements with narrow vessels

**Reason (R) :** Cambium is less active in winters.

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

- (1) Both A and R are true but R is NOT the correct explanation of A.
- (2) A is true but R is false.
- (3) A is false but R is true
- (4) Both A and R are true and R is the correct explanation of A

**Ans. (4)**

**Sol.** Assertion is true , In winter, the cambium is less active and forms fewer xylary elements that have narrow vessels, and this wood is called autumn wood or late wood. In the spring season, cambium is very active and produces a large number of xylary elements having vessels with wider cavities. The wood formed during this season is called spring wood or early wood.

Reason is true , Cambium is less active in winters so that fewer xylem vessels are forming and vessels are narrow

130. What is the function of tassels in the corn cob?

- (1) To trap pollen grains
- (2) To disperse pollen grains
- (3) To protect seeds
- (4) To attract insects

**Ans. (1)**

**Sol.** Tassels in the corn cob trap pollen grains.

131. In angiosperm, the haploid, diploid and triploid structures of fertilised embryo sac sequentially are:

- (1) Antipodals, synergids, and primary endosperm nucleus
- (2) Synergids, zygote and primary endosperm nucleus
- (3) Synergids, antipodals and polar nuclei
- (4) Synergids, primary endosperm nucleus and zygote

**Ans. (2)**

**Sol.** In angiosperm, the haploid, diploid, and triploid structures of the fertilized embryo sac sequentially are synergids, primary endosperm nucleus, and zygote.

The two sperm cells from the pollen tube enter the embryo sac in the angiosperm. One of the sperm cells fuses with the egg cell and forms a diploid zygote. The other sperm cell fuses with the two polar nuclei to form a triploid primary endosperm nucleus. The synergids, along with the egg cell, are located at the micropylar end of the embryo sac and are haploid.

132. Which hormone promotes internode/petiole elongation in deep water rice?

- (1) Kinetin
- (2) Ethylene
- (3) 2, 4-D
- (4) GA<sub>3</sub>

**Ans. (2)**

**Sol.** Deepwater rice is a variety of rice that grows in flooded or deep water conditions. Ethylene is a plant hormone that promotes internode and petiole elongation in deep water rice, allowing the plant to keep its leaves above the water surface. Ethylene is produced by the plant in response to flooding, and it diffuses throughout the plant to promote elongation growth.

The accumulation of ethylene in deep water rice triggers the elongation of internodes and petioles, which

allows the plant to grow taller and keep its leaves above the water. Ethylene stimulates cell elongation by promoting the breakdown of cell wall components such as cellulose and hemicellulose, which loosens the cell walls and allows the cells to expand. Thus, ethylene plays a crucial role in promoting the growth and survival of deep water rice in flooded conditions.

133. Which of the following stages of meiosis involves division of centromere?

- (1) Metaphase II
- (2) Anaphase II
- (3) Telophase
- (4) Metaphase I

**Ans. (2)**

**Sol.** During meiosis II, the sister chromatids of each chromosome are separated from each other, which involves division of the centromere. This separation of sister chromatids results in the formation of four haploid daughter cells, each with a single set of chromosomes. Anaphase II is the stage of meiosis II in which the sister chromatids are pulled apart by the spindle fibers towards opposite poles of the cell. The spindle fibers exert force on the centromeres, causing them to divide and separate the sister chromatids. As a result, each daughter cell receives one copy of each chromosome.

134. Unequivocal proof that DNA is the genetic material was first proposed by

- (1) Alfred Hershey and Martha Chase
- (2) Avery, Macleoid and McCarthy
- (3) Wilkins and Franklin
- (4) Frederick Griffith

**Ans. (1)**

**Sol.** Avery, Macleod, and McCarty were the scientists who first proposed the unequivocal proof that DNA is the genetic material.

Wilkins and Franklin contributed to the discovery of DNA's structure through their work on X-ray crystallography.

Frederick Griffith conducted an experiment with *Streptococcus pneumoniae* bacteria that led to the discovery of transformation.

Avery, Macleoid and McCarty made a significant contribution to the understanding of DNA as the genetic material. They conducted biochemical experiment to understand the genetic material.

135. Cellulose does not form blue colour with Iodine because

- (1) It is a helical molecule.
- (2) It does not contain complex helices and hence cannot hold iodine molecules.
- (3) It breaks down when iodine reacts with it.
- (4) It is a disaccharide.

Ans. (2)

**Sol.** Cellulose is a polymer of glucose and is a major structural component of plant cell walls. It is composed of linear chains of glucose molecules that are linked together by  $\beta(1 \rightarrow 4)$  glycosidic bonds. Cellulose does not form a blue color with iodine because it does not contain complex helices that can hold iodine molecules. The blue color that is observed with iodine is due to the formation of a complex between iodine and the helical structure of amylose, which is a component of starch. Since cellulose does not have a similar helical structure, it does not form a blue color with iodine.

136. Match List-I with List-II:

| List-I                       | List-II                        |
|------------------------------|--------------------------------|
| A. Oxidative decarboxylation | I. Citrate synthase            |
| B. Glycolysis                | II. Pyruvate dehydrogenase     |
| C. Oxidative phosphorylation | III. Electron transport system |
| D. Tricarboxylic acid cycle  | IV. EMP pathway                |

Choose the correct answer from the options given below:

|     | (A) | (B) | (C) | (D) |
|-----|-----|-----|-----|-----|
| (1) | II  | IV  | I   | III |
| (2) | III | I   | II  | IV  |
| (3) | II  | IV  | III | I   |
| (4) | III | IV  | II  | I   |

Ans. (3)

**Sol.**

|                           |                           |
|---------------------------|---------------------------|
| Oxidative decarboxylation | Pyruvate dehydrogenase    |
| Glycolysis                | EMP pathway               |
| Oxidative phosphorylation | Electron transport system |
| Tricarboxylic acid cycle  | Citrate synthase          |

137. Which of the following combinations is required for chemiosmosis?

- (1) membrane, proton pump, proton gradient, NADP synthase

- (2) proton pump, electron gradient, ATP synthase
- (3) proton pump, electron gradient, NADP synthase
- (4) membrane, proton pump, proton gradient, ATP synthase

Ans. (4)

**Sol.** Chemiosmosis requires a membrane, a proton pump, a proton gradient and ATP synthase. Energy is used to pump protons across a membrane, to create a gradient or a high concentration of protons within the thylakoid lumen. ATP synthase has a channel that allows diffusion of protons back across the membrane; this releases enough energy to activate ATP synthase enzyme that catalyses the formation of ATP.

138. Melonate inhibits the growth of pathogenic bacteria by inhibiting the activity of

- (1) Amylase
- (2) Lipase
- (3) Dinitrogenase
- (4) Succinic dehydrogenase

Ans. (4)

**Sol.** Melonate inhibits the growth of pathogenic bacteria by inhibiting the activity of succinic dehydrogenase.

139. Given below are two statements : One is labelled as Assertion A and the other is labelled as Reason R:

**Assertion (A) :** In gymnosperms the pollen grains are released from the microsporangium and carried by air currents.

**Reason (R) :** Air currents carry the pollen grains to the mouth of the archegonia where the male gametes are discharged and pollen tube is not formed.

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

- (1) Both A and R are true but R is NOT the correct explanation of A.
- (2) A is true but R is false.
- (3) A is false but R is true.
- (4) Both A and R are true and R is the correct explanation of A.

Ans.(2)

**Sol.** Assertion is true . In gymnosperms microspore mother cells are developing in microsporangium . Microspore mother cells undergoes meiosis and forms microspores. Microspores carried by wind currents.

Reason is false . Pollen grains are carried by pollen tube in gymnosperms and angiosperms , such kind of fertilization is called as siphonogamous oogamy .

140. Main steps in the formation of Recombinant DNA are given below. Arrange these steps in a correct sequence.

- A. Insertion of recombinant DNA into the host cell.
- B. Cutting of DNA at specific location by restriction enzyme.
- C. Isolation of desired DNA fragment.
- D. Amplification of gene of interest using PCR.

Choose the correct answer from the options given below:

- (1) C, A, B, D
- (2) C, B, D, A
- (3) B, D, A, C
- (4) B, C, D, A

Ans. (4)

**Sol.** Recombinant DNA technology involves several steps in specific sequence such as isolation of DNA, fragmentation of DNA by restriction endonucleases, isolation of a desired DNA fragment, amplification of gene of interest using PCR. ligation of the DNA fragment into a vector, transferring the recombinant DNA into the host, culturing the host cells in a medium at large scale and extraction of the desired product.

So the sequence would be Cutting of DNA at specific location by restriction enzyme.

Isolation of desired DNA fragment.

Amplification of gene of interest using PCR.

Insertion of recombinant DNA into the host cell.

141. Match List-I with List-II:

| List-I             | List-II                                     |
|--------------------|---|
| A. Cohesion        | I. More attraction in liquid phase          |
| B. Adhesion        | II. Mutual attraction among water molecules |
| C. Surface tension | III. Water loss in liquid phase             |
| D. Guttation       | IV. Attraction towards polar surfaces       |

Choose the correct answer from the options given below:

|     | (A) | (B) | (C) | (D) |
|-----|-----|-----|-----|-----|
| (1) | IV  | III | II  | I   |
| (2) | III | I   | IV  | II  |
| (3) | II  | I   | IV  | III |
| (4) | II  | IV  | I   | III |

Ans. (4)

**Sol.**

Cohesion – Mutual attraction among water molecules

Adhesion – Attraction towards polar surfaces

Surface tension – More attraction in liquid phase

Guttation – Water loss in liquid phase

142. Which one of the following statements is NOT correct?

- (1) Algal blooms caused by excess of organic matter in water improve water quality and promote fisheries.
- (2) Water hyacinth grows abundantly in eutrophic water bodies and leads to an imbalance in the ecosystem dynamics of the water body.
- (3) The amount of some toxic substances of industrial waste water increases in the organisms at successive trophic levels.
- (4) The micro-organisms involved in biodegradation of organic matter in a sewage polluted water body consume a lot of oxygen causing the death of aquatic organisms.

Ans. (1)

**Sol.** Algal bloom imparts a distinct colour to the water bodies, causes deterioration of the water quality and fish mortality. Some bloom-forming algae are extremely toxic to human beings and animals.

143. How many different proteins does the ribosome consist of?

- (1) 60
- (2) 40
- (3) 20
- (4) 80

Ans. (4)

**Sol.** Ribosomes in eukaryotes contain 79–80 proteins and four ribosomal RNA (rRNA) molecules.

144. Match List I with List II :

| List I<br>(Interaction) | List II<br>(Species A and B) |
|-------------------------|------------------------------|
| A. Mutualism            | I. +(A), O(B)                |
| B. Commensalism         | II. -(A), O(B)               |
| C. Amensalism           | III. +(A), -(B)              |
| D. Parasitism           | IV. +(A), +(B)               |

Choose the correct answer from the options given below:

|     | (A) | (B) | (C) | (D) |
|-----|-----|-----|-----|-----|
| (1) | IV  | I   | II  | III |
| (2) | IV  | III | I   | II  |
| (3) | III | I   | IV  | II  |
| (4) | IV  | II  | I   | III |

Ans. (1)

Sol. Mutualism (+,+)

Commensalism (+,0)

Amensalism (-,0)

Parasitism (+,-)

145. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R:

**Assertion (A)** : A flower is defined as modified shoot wherein the shoot apical meristem changes to floral meristem.

**Reason (R)** : Internode of the shoot gets condensed to produce different floral appendages laterally at successive nodes instead of leaves.

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

- (1) Both A and R are true but R is the NOT correct explanation of A.
- (2) A is true but R is not false.
- (3) A is not false but R is true.
- (4) Both A and R are true and R is the correct explanation of A.

Ans. (4)

Sol. Assertion - A flower is defined as modified shoot wherein the shoot apical meristem changes to floral meristem.

The thalamus of a flower is the enlarged and condensed axis. It has nodes and very short internodes. It bears the floral whorls at the nodes. These whorls are arranged in a definite sequence. Hence, flower is called as modified shoot.

Reason -Internode of the shoot gets condensed to produce different floral appendages laterally at successive nodes instead of leaves.

A flower is a modified shoot wherein the shoot apical meristem changes to floral meristem. Internodes do not elongate and the axis gets condensed. The apex produces different kinds of floral appendages laterally at successive nodes instead of leaves. Both assertion and reason are correct , but reason is not correct explanation

146. Identify the **correct** statements :

- A. Lenticels are the lens-shaped openings permitting the exchange of gases.
- B. Bark formed early in the season is called hard bark.
- C. Bark is a technical term that refers to all tissues exterior to vascular cambium.
- D. Bark refers to periderm and secondary phloem.
- E. Phellogen is single-layered in thickness.

Choose the correct answer from the options given below:

- (1) A and D only
- (2) A, B and D only
- (3) B and C only
- (4) B, C and E only

Ans. (1)

Sol. Lenticels are the lens-shaped openings formed during secondary growth ,permitting the exchange of gases.

Bark that is formed early in the season is called early or soft bark. Towards the end of the season, late“or hard bark is formed

Bark is a non- technical term that refers to all tissues exterior to vascular cambium( phloem + periderm)

Bark refers to all the tissue present outside the vascular cambium ( periderm and secondary phloem) primary phloem crushed by pericycle cells.

Phellogen is a couple of layers thick. It is made of narrow, thin-walled and nearly rectangular cells. Phellogen cuts off cells on both sides. The outer cells differentiate into cork or phellem while the inner cells differentiate into secondary cortex or phelloderm.

147. Given below are two statements:

**Statement-I** : Gause's 'Competitive Exclusion Principle' states that two closely related species competing for the same resources cannot co-exist indefinitely and competitively inferior one will be eliminated eventually.

**Statement-II** : In general, carnivores are more adversely affected by competition than herbivores.

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

- (1) Both statement I and statement II are false.
- (2) Statement I is correct but statement II is false.
- (3) Statement I is incorrect but statement II is true.
- (4) Both statement I and statement II are true.

Ans. (2)

**Sol.** In general, herbivores are more adversely affected by competition than carnivores because herbivores do not have alternative resources on which they can survive. But carnivores can survive on other alternate resources.

148. Which of the following statements are correct about Klinefelter's Syndrome?

- A. This disorder was first described by Langdon Down (1866).
- B. Such an individual has overall masculine development. However, the feminine development is also expressed.
- C. The affected individual is short statured.
- D. Physical, psychomotor and mental development is retarded.
- E. Such individuals are sterile.

Choose the correct answer from the options given below:

- (1) C and D only
- (2) B and E only
- (3) A and E only
- (4) A and B only

Ans. (2)

**Sol.** Klinefelter's syndrome is caused due to the presence of an additional copy of X chromosome resulting into a karyotype of 47, XXY. Such an individual has overall masculine development, however, the feminine development (development of breast, i.e., Gynaecomastia) is also expressed. Such individuals are sterile.

149. Match List I with List II:

| List I         | List II   |
|----------------|---|
| A. M Phase     | I. Proteins are synthesized   |
| B. $G_2$ Phase | II. Inactive phase  |
| C. Quiescent   | III. Interval between stage mitosis and initiation of DNA replication |
| D. $G_1$ Phase | IV. Equational division   |

Choose the correct answer from the options given below:

|     | (A) | (B) | (C) | (D) |
|-----|-----|-----|-----|-----|
| (1) | IV  | II  | I   | III |
| (2) | IV  | I   | II  | III |
| (3) | II  | IV  | I   | III |
| (4) | III | II  | IV  | I   |

Ans. (2)

**Sol.** Mitotic phase is equational division, because daughter cells receive same number of chromosomes from parent cell, it occurs due to splitting of centromere.

Tubulin protein, which is involved in spindle formation and other proteins are synthesizing in  $G_2$  phase  $G_1$  phase is Interval between stage mitosis and initiation of DNA replication, cell growth, duplication of organelles and synthesis of proteins takes place in  $G_1$  phase

Cells in quiescent stage are inactive for division and metabolically active

150. Match List I with List II:

| List I        | List II                                 |
|---------------|---|
| A. Iron       | I. Synthesis of auxin                   |
| B. Zinc       | II. Component of nitrate reductase      |
| C. Boron      | III. Activator of catalase              |
| D. Molybdenum | IV. Cell elongation and differentiation |

Choose the correct answer from the options given below:

|     | (A) | (B) | (C) | (D) |
|-----|-----|-----|-----|-----|
| (1) | II  | III | IV  | I   |
| (2) | III | I   | IV  | II  |
| (3) | II  | IV  | I   | III |
| (4) | III | II  | I   | IV  |

Ans. (2)

**Sol.** Iron: Plants obtain iron in the form of ferric ions ( $Fe^{3+}$ ). It is required in larger amounts in comparison to other micronutrients. It is an important constituent of proteins involved in the transfer of electrons like ferredoxin and cytochromes. It is reversibly oxidised from  $Fe^{2+}$  to  $Fe^{3+}$  during electron transfer. It activates catalase enzyme, and is essential for the formation of chlorophyll. Zinc: Plants obtain zinc as  $Zn^{2+}$  ions. It activates various enzymes, especially carboxylases. It is also needed in the synthesis of auxin.

Molybdenum It is a component of several enzymes, including nitrogenase and nitrate reductase both of which participate in nitrogen metabolism.

Boron is required for uptake and utilisation of  $Ca^{2+}$ , membrane functioning, pollen germination, cell elongation, cell differentiation and carbohydrate translocation.



## ZOOLOGY

### SECTION - A

151. Given below are two statements.

**Statement I :** In prokaryotes, the positively charged DNA is held with some negatively charged proteins in a region called nucleoid.

**Statement II :** In eukaryotes, the negatively charged DNA is wrapped around the positively charged histone octamer to form nucleosome.

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

- (1) Both statement I and statement II are false.
- (2) Statement I is correct but statement II is false.
- (3) Statement I is incorrect but statement II is true.
- (4) Both statement I and statement II are true.

**Ans. (3)**

**Sol.** Statement -I is false - Most prokaryotes do not have histone proteins except for some of the members of the domain Archaeobacteria. DNA is negatively charged.

Statement -II is true - In eukaryotes, the negatively charged DNA is wrapped around the positively charged histone octamer to form nucleosome. Histone proteins are of five types ( $H_2A$ ,  $H_2B$ ,  $H_3$ ,  $H_4$  and  $H_1$ ) four types of histone proteins forms octamer,  $H_1$  will be present outside the octamer. Total number of histone proteins are nine ( $H_2A-2$ ,  $H_2B-2$ ,  $H_3-2$ ,  $H_4-2$  and  $H_1-1$ )

152. In which blood corpuscles, the HIV undergoes replication and produces progeny viruses?

- (1) B-lymphocytes
- (2) Basophils
- (3) Eosinophils
- (4)  $T_H$  cells

**Ans. (4)**

**Sol.** After infection, HIV attacks and destroys the CD4 cells (CD4 T lymphocyte) of the immune system. CD4 cells are  $T_H$  cells, macrophages or dendritic cells and undergoes replication and produces progeny viruses.

153. Which of the following statements is correct?

- (1) Biomagnification refers to increase in concentration of the toxicant at successive trophic levels.
- (2) Presence of large amount of nutrients in water restricts 'algal bloom'.

(3) Algal bloom decreases fish mortality.

(4) Eutrophication refers to increase in domestic sewage and waste water in lakes.

**Ans. (1)**

**Sol.** Biomagnification refers to increase in concentration of the toxicant at successive trophic levels. These toxicants are neither metabolised nor excreted.

Algal Bloom **increases** fish mortality. Harmful algal blooms cause thick, green muck that impacts clear water. As it produces various toxins it leads to the death of aquatic organisms. The overgrowth of algae also consumes oxygen and blocks sunlight from underwater plants. When the algae eventually dies, the oxygen in the water is consumed. The lack of oxygen makes it impossible for aquatic life to survive.

Eutrophication refers to **aging** of lake due to enrichment of water bodies with the nutrients.

Presence of large amounts of nutrients in water causes **excessive** growth of planktonic algae, called algal bloom.

154. Match **List I** with **List II**.

| List I         | List II                          |
|----------------|----------------------------------|
| A. P - wave    | I. Beginning of systole          |
| B. Q - wave    | II. Repolarisation of ventricles |
| C. QRS complex | III. Depolarisation of atria     |
| D. T - wave    | IV. Depolarisation of ventricles |

Choose the **correct** answer from the options given below.

|     | A   | B   | C   | D   |
|-----|-----|-----|-----|-----|
| (1) | IV  | III | II  | I   |
| (2) | II  | IV  | I   | III |
| (3) | I   | II  | III | IV  |
| (4) | III | I   | IV  | II  |

**Ans. (4)**

**Sol.**

|             |                              |
|-------------|------------------------------|
| P - wave    | Beginning of systole         |
| Q - wave    | Repolarisation of ventricles |
| QRS complex | Depolarisation of atria      |
| T - wave    | Depolarisation of ventricles |

155. Broad palm with single palm crease is visible in a person suffering from

- (1) Turner's syndrome
- (2) Klinefelter's syndrome
- (3) Thalassemia
- (4) Down's syndrome

**Ans. (4)**

**Sol.** Broad palm with single palm crease is visible in a person suffering from Down's syndrome. The cause of this genetic disorder is the presence of an additional copy of the chromosome number 21 (trisomy of 21). This disorder was first described by Langdon Down (1866). The affected individual is short statured with small round head, furrowed tongue and partially open mouth. Physical, psychomotor and mental development is retarded.

Thalassemia is quantitative problem of synthesising too few globin molecules.

People with Klinefelter's syndrome exhibit overall masculine development with feminine characteristic like gynecomastia.

Turner's syndrome is characterised by rudimentary ovaries, sterility and absence of secondary sexual characteristics.

156. Given below are two statements.

**Statement I** : RNA mutates at a faster rate.

**Statement II** : Viruses having RNA genome and shorter life span mutate and evolve faster.

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

- (1) Both statement I and statement II are false.
- (2) Statement I is true but statement II is false.
- (3) Statement I is false but statement II is true.
- (4) Both statement I and statement II are true.

**Ans. (4)**

**Sol.** Statement -I is true - Both DNA and RNA are able to mutate. In fact, RNA being unstable, mutate at a faster rate.

Statement -II is true - Consequently, viruses having RNA genome and having shorter life span mutate and evolve faster. RNA can directly code for the synthesis of proteins, hence can easily express the characters. DNA, however, is dependent on RNA for synthesis of proteins. The protein synthesising machinery has evolved around RNA.

157. Given below are two statements.

**Statement I** : Ligaments are dense irregular tissue.

**Statement II** : Cartilage is dense regular tissue.

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

- (1) Both statement I and statement II are false.
- (2) Statement I is true but statement II is false.
- (3) Statement I is false but statement II is true.
- (4) Both statement I and statement II are true.

**Ans. (1)**

**Sol.** Ligaments are dense regular connective tissue.

Bone and Cartilage are specialised connective tissue

158. Given below are statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

**Assertion (A):** Nephrons are of two types: cortical and juxta medullary, based on their relative position in cortex and medulla.

**Reason (R) :** Juxta medullary nephrons have short loop of Henle whereas, cortical nephrons have longer loop of Henle.

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

- (1) Both (A) and (R) are true and (R) is not the correct explanation of (A).
- (2) (A) is true but (R) is false.
- (3) (A) is false but (R) is true.
- (4) Both (A) and (R) are true and (R) is the correct explanation of (A).

**Ans. (2)**

**Sol.** Nephrons are of two types: Cortical and juxta medullary, based on their relative position in cortex and medulla. Juxta medullary nephrons have **long** loop of Henle. The loop of Henle is too **short** and extends only very little into the medulla longer loop of Henle in cortical nephrons.

159. Which of the following is **not** a cloning vector?

- (1) YAC
- (2) pBR322
- (3) Probe
- (4) BAC

**Ans. (3)**

**Sol.** A vector is a substance, usually a piece of DNA that carries a sequence of DNA or other genetic material and introduces it into a new cell. BAC, YAC, pBR 322 are vectors.

A probe is a single-stranded sequence of DNA or RNA used to search for its complementary sequence in a sample genome.

160. Given below are two statements.

**Statement I :** A protein is imagined as a line, the left end represented by first amino acid (C-terminal) and the right end represented by last amino acid (N-terminal).

**Statement II :** Adult human haemoglobin, consists of 4 subunits (two subunits of  $\alpha$  type and two subunits of  $\beta$  type.)

In the light of the above statements choose the **correct** answer from the options given below.

- (1) Both statement I and statement II are false.
- (2) Statement I is true but statement II is false.
- (3) Statement I is false but statement II is true.
- (4) Both statement I and statement II are true.

**Ans. (3)**

**Sol.** Statement I is false - A protein is imagined as a line, the left end represented by the first amino acid and the right end represented by the last amino acid. The first amino acid is called as N-terminal amino acid and the last amino acid is called the C-terminal amino acid.

Statement II is true - Some proteins are an assembly of more than one polypeptide or subunits. The manner in which these individual folded polypeptides or subunits are arranged with respect to each other is the architecture of a protein otherwise called the quaternary structure of a protein. Adult human haemoglobin consists of 4 subunits. Two of these are identical to each other. Hence, two subunits of alpha type and two subunits of beta type together constitute the human haemoglobin(Hb).

161. Once the undigested and unabsorbed substances enter the caecum, their backflow is prevented by

- (1) ileo-caecal valve
- (2) gastro-oesophageal sphincter
- (3) pyloric sphincter
- (4) sphincter of Oddi

**Ans. (1)**

**Sol.** The undigested, unabsorbed substances called faeces enters into the caecum of the large intestine through ileo-caecal valve, which prevents the back flow of the faecal matter.

162. Match **List I** with **List II**.

| List - I              | List - II            |
|-----------------------|----------------------|
| A) Vasectomy          | I) Oral method       |
| B) Coitus interruptus | II) Barrier method   |
| C) Cervical caps      | III) Surgical method |
| D) Saheli             | IV) Natural method   |

Choose the **correct** answer from the options given below.

|     | (A) | (B) | (C) | (D) |
|-----|-----|-----|-----|-----|
| (1) | III | IV  | II  | I   |
| (2) | II  | III | I   | IV  |
| (3) | IV  | II  | I   | III |
| (4) | III | I   | IV  | II  |

**Ans. (1)**

**Sol.**

|                    |                 |
|--------------------|-----------------|
| Vasectomy          | Surgical method |
| Coitus interruptus | Natural method  |
| Cervical caps      | Barrier method  |
| Saheli             | Oral method     |

163. Which of the following functions is carried out by cytoskeleton in a cell?

- (1) Protein synthesis
- (2) Motility
- (3) Transportation
- (4) Nuclear division

**Ans. (2)**

**Sol.** An elaborate network of filamentous proteinaceous structures consisting of microtubules, microfilaments and intermediate filaments present in the cytoplasm is collectively referred to as the cytoskeleton. The cytoskeleton in a cell are involved in many functions such as mechanical support, motility, maintenance of the shape of the cell.

164. Which one of the following common sexually transmitted diseases is completely curable when detected early and treated properly?

- (1) Gonorrhoea
- (2) Hepatitis-B
- (3) HIV Infection
- (4) Genital herpes

**Ans. (1)**

**Sol.** Except for hepatitis-B, genital herpes and HIV infections, other STIs are completely curable if detected early and treated properly.

165. Vital capacity of lung is \_\_\_\_\_

- (1) IRV + ERV + TV + RV
- (2) IRV + ERV + TV - RV
- (3) IRV + ERV + TV
- (4) IRV + ERV

**Ans. (3)**

**Sol.** The maximum volume of air a person can breathe in after a forced expiration is called vital capacity. This includes sum of ERV, TV and IRV or the maximum volume of air a person can breathe out after a forced inspiration.

166. Which of the following are **not** considered as the part of endomembrane system?

- (A) Mitochondria
- (B) Endoplasmic reticulum
- (C) Chloroplasts
- (D) Golgi complex
- (E) Peroxisomes

Choose the **most appropriate** answer from the options given below.

- (1) A, C and E only
- (2) A and D only
- (3) A, D and E only
- (4) B and D only

**Ans. (1)**

**Sol.** Endoplasmic reticulum, golgi complex, lysosomes and vacuoles included in endomembrane system because their functions are coordinated.

Mitochondria, Chloroplasts and Peroxisomes functions are individual not coordinated so that these organelles are not included in endomembrane system.

167. Match **List I** with **List II**.

| List - I | List - II          |
|----------|--------------------|
| A) CCK   | I) Kidney          |
| B) GIP   | II) Heart          |
| C) ANF   | III) Gastric gland |
| D) ADH   | IV) Pancreas       |

Choose the **correct** answer from the options given below.

|     | (A) | (B) | (C) | (D) |
|-----|-----|-----|-----|-----|
| (1) | III | II  | IV  | I   |
| (2) | II  | IV  | I   | III |
| (3) | IV  | II  | III | I   |
| (4) | IV  | III | II  | I   |

**Ans. (4)**

**Sol.**

|     |               |
|-----|---------------|
| CCK | Pancreas      |
| GIP | Gastric gland |
| ANF | Heart         |
| ADH | Kidney        |

168. Match **List I** with **List II**.

| List - I    | List - II                 |
|-------------|---------------------------|
| A) Gene 'a' | I) $\beta$ -galactosidase |
| B) Gene 'y' | II) Transacetylase        |
| C) Gene 'i' | III) Permease             |
| D) Gene 'z' | IV) Repressor protein     |

Choose the **correct** answer from the options given below.

|     | (A) | (B) | (C) | (D) |
|-----|-----|-----|-----|-----|
| (1) | II  | III | IV  | I   |
| (2) | III | IV  | I   | II  |
| (3) | III | I   | IV  | II  |
| (4) | II  | I   | IV  | III |

**Ans. (1)**

**Sol.** The lac operon consists of one regulatory gene that is i gene – here the term i does not refer to inducer, rather it is derived from the word inhibitor and three structural genes (z, y, and a). The i gene codes for the repressor of the lac operon. The z gene codes for beta-galactosidase (b-gal), which is primarily responsible for the hydrolysis of the disaccharide, lactose into its monomeric units, galactose and glucose. The y gene codes for permease, which increases permeability of the cell to b-galactosides. The a gene encodes a transacetylase.

169. Match **List-I** with **List-II** with respect to human eye.

| List - I      | List - II   |
|---------------|---|
| A) Fovea      | I) Visible coloured portion of eye that regulates diameter of pupil.                |
| B) Iris       | II) External layer of eye formed of dense connective tissue.                        |
| C) Blind spot | III) Point of greatest visual acuity or resolution.                                 |
| D) Sclera     | IV) Point where optic nerve leaves the eyeball and photo receptor cells are absent. |

Choose the **correct** answer from the options given below.

|     | (A) | (B) | (C) | (D) |
|-----|-----|-----|-----|-----|
| (1) | IV  | III | II  | I   |
| (2) | I   | IV  | III | II  |
| (3) | II  | I   | III | IV  |
| (4) | III | I   | IV  | II  |

**Ans. (4)**

**Sol.**

|            |  |
|------------|--|
| Fovea      | Point of greatest visual acuity of resolution                                  |
| Iris       | Visible coloured portion of eye that regulates diameter of pupil.              |
| Blind spot | Point where optic nerve leaves the eyeball and photoreceptor cells are absent. |
| Sclera     | External layer of eye formed of dense connective tissue.                       |

170. Select the correct group/set of Australian marsupials exhibiting adaptive radiation.

- (1) Numbat, Spotted cuscus, Flying phalanger
- (2) Mole, Flying squirrel, Tasmanian tiger cat
- (3) Lemur, Anteater, Wolf
- (4) Tasmanian wolf, Bobcat, Marsupial mole

Ans. (1)

**Sol.** Numbat, spotted cuscus, flying phalanger are Australian marsupials exhibiting adaptive radiation.

Lemur, wolf, mole and bobcat are placental mammals.

171. Given below are two statements.

**Statement I :** Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

**Statement II :** The cavity of the cervix is called cervical canal which along with vagina forms birth canal.

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

- (1) Both statement I and statement II are false.
- (2) Statement I is correct but statement II is false.
- (3) Statement I is incorrect but statement II is true.
- (4) Both statement I and statement II are true.

Ans. (4)

**Sol.** The cavity of the cervix is called cervical canal which along with the vagina forms birth canal.

Vas deferens receives a duct from seminal vesicle and opens into urethra as the ejaculatory duct.

172. Match List I with List II.

| List I       | List II                                  |
|--------------|--|
| A. Heroin    | I. Effect on cardiovascular system       |
| B. Marijuana | II. Slow down body function              |
| C. Cocaine   | III. Painkiller                          |
| D. Morphine  | IV. Interfere with transport of dopamine |

Choose the **correct** answer from the options given below.

|     | A   | B   | C   | D   |
|-----|-----|-----|-----|-----|
| (1) | I   | II  | III | IV  |
| (2) | IV  | III | II  | I   |
| (3) | III | IV  | I   | II  |
| (4) | II  | I   | IV  | III |

Ans. (4)

**Sol.**

|           |                                      |
|-----------|--------------------------------------|
| Heroin    | Slow down body function              |
| Marijuana | Effect on cardiovascular system      |
| Cocaine   | Interfere with transport of dopamine |
| Morphine  | Painkiller                           |

173. Match List I with List II.

| List I        | List II                          |
|---------------|----------------------------------|
| A. Ringworm   | I. <i>Haemophilus influenzae</i> |
| B. Filariasis | II. <i>Trichophyton</i>          |
| C. Malaria    | III. <i>Wuchereria bancrofti</i> |
| D. Pneumonia  | IV. <i>Plasmodium vivax</i>      |

Choose the **correct** answer from the options given below.

|     | A   | B   | C  | D  |
|-----|-----|-----|----|----|
| (1) | II  | III | I  | IV |
| (2) | III | II  | I  | IV |
| (3) | III | II  | IV | I  |
| (4) | II  | III | IV | I  |

Ans. (4)

**Sol.**

| Disease    | Causative agents  |
|------------|---|
| Ringworm   | <i>Trichophyton, Epidermophyton, Microsporum</i>              |
| Filariasis | <i>Wuchereria bancrofti, Wuchereria malayi</i>                |
| Malaria    | <i>Plasmodium vivax, P. ovale, P. malariae, P. falciparum</i> |
| Pneumonia  | <i>Haemophilus influenzae, Streptococcus pneumoniae</i>       |

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

**Assertion (A):** Amniocentesis for sex determination is one of the strategies of Reproductive and Child Health Care Programme.

**Reason (R) :** Ban on amniocentesis checks increasing menace of female foeticide.

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

- (1) Both (A) and (R) are true but (R) is not the correct explanation of (A).
- (2) (A) is true but (R) is false.
- (3) (A) is false but (R) is true.
- (4) Both (A) and (R) are true and (R) is the correct explanation of (A).

Ans. (3)

**Sol.** Amniocentesis is not use for sex determination but to check if baby has a genetic or chromosomal condition, such as Down's syndrome. It involves removing and testing a small sample of cells from amniotic fluid, the fluid that surrounds the baby in the womb (uterus).

Ban on amniocentesis checks increasing menace of female foeticide.

175. Radial symmetry is **not** found in adults of phylum\_\_\_\_\_.

- (1) Hemichordata
- (2) Coelenterata
- (3) Echinodermata
- (4) Ctenophora

Ans. (1)

**Sol.** Coelenterates and Ctenophora exhibit radial symmetry both in larva and adult stage.

Larvae of Echinodermata shows bilateral symmetry and adults exhibit pentaradial symmetry.

Hemichordate primarily and secondarily exhibit bilateral symmetry.

176. Given below are two statements.

**Statement I :** Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat.

**Statement II :** When the inhibitor closely resembles the substrate in its molecular structure and inhibits the activity of the enzyme, it is known as competitive inhibitor.

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

- (1) Both statement I and statement II are false.
- (2) Statement I is true but statement II is false.
- (3) Statement I is false but statement II is true.
- (4) Both statement I and statement II are true.

Ans. (4)

**Sol.** Statement I is true - Enzymes generally function in a narrow range of temperature and pH. Each enzyme shows its highest activity at a particular temperature and pH called the optimum temperature and optimum pH. Activity declines both below and above the optimum value. Low temperature preserves the enzyme in a temporarily inactive state whereas high temperature destroys enzymatic activity because proteins are denatured by heat.

Statement II is true -When the inhibitor closely resembles the substrate in its molecular structure and inhibits the activity of the enzyme, it is known as competitive inhibitor. Due to its close structural similarity with the substrate, the inhibitor competes with the substrate for the substratebinding site of the enzyme. Consequently, the substrate cannot bind and as a result, the enzyme action declines, e.g., inhibition of succinic dehydrogenase by malonate which closely resembles the substrate succinate in structure.

177. Match List I with List II.

**List - I**

**List - II**

- |                       |                         |
|-----------------------|-------------------------|
| A) <i>Taenia</i>      | I) Nephridia            |
| B) <i>Paramoecium</i> | II) Contractile vacuole |
| C) <i>Periplaneta</i> | III) Flame cells        |
| D) <i>Pheretima</i>   | IV) Urecose gland       |

Choose the **correct** answer from the options given below.

- |     | (A) | (B) | (C) | (D) |
|-----|-----|-----|-----|-----|
| (1) | I   | II  | IV  | III |
| (2) | III | II  | IV  | I   |
| (3) | II  | I   | IV  | III |
| (4) | I   | II  | III | IV  |

Ans. (2)

**Sol.**

- |             |                     |
|-------------|---------------------|
| Taenia      | Flame cells         |
| Paramoecium | Contractile vacuole |
| Periplaneta | Uricose gland       |
| Pheretima   | Nephridia           |

178. Which of the following statements are correct regarding female reproductive cycle?

- (A) In non-primate mammals cyclical changes during reproduction are called oestrus cycle.
- (B) First menstrual cycle begins at puberty and is called menopause.
- (C) Lack of menstruation may be indicative of pregnancy.
- (D) Cyclic menstruation extends between menarche and menopause.

Choose the **most appropriate** answer from the options given below.

- (1) A and B only
- (2) A, B and C only
- (3) A, C and D only
- (4) A and D only

Ans. (3)

**Sol.** First menstrual cycle begins at puberty is called menarche.

179. Given below are two statements.

**Statement I :** Electrostatic precipitator is most widely used in thermal power plant.

**Statement II :** Electrostatic precipitator in thermal power plant removes ionising radiations.

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

- (1) Both statement I and statement II are incorrect.
- (2) Statement I is correct but statement II is incorrect.
- (3) Statement I is incorrect but statement II is correct.
- (4) Both statement I and statement II are correct.

**Ans. (2)**

**Sol.** Electrostatic precipitator is most widely used in thermal power plant. It removes 99% of the **particulate matter**. It imparts negative charge to the dust particles which settle down due to the electrical attraction to the collecting plates. Particulate matter is a pollutant as it can cause breathing and respiratory symptoms, irritation, inflammations and damage to the lungs and premature deaths.

180. Match **List I** with **List II**.

| <b>List - I</b>  | <b>List - II</b>   |
|------------------|--|
| <b>(Cells)</b>   | <b>(Secretion)</b>   |
| A) Peptic cells  | I) Mucus   |
| B) Goblet cells  | II) Bile juice   |
| C) Oxyntic cells | III) Proenzyme pepsinogen  |
| D) Hepatic cells | IV) HCl and intrinsic factor for absorption of vitamin B <sub>12</sub> |

Choose the **correct** answer from the options given below.

|     | <b>(A)</b> | <b>(B)</b> | <b>(C)</b> | <b>(D)</b> |
|-----|------------|------------|------------|------------|
| (1) | II         | I          | III        | IV         |
| (2) | III        | I          | IV         | II         |
| (3) | II         | IV         | I          | III        |
| (4) | IV         | III        | II         | I          |

**Ans. (2)**

**Sol.**

|               |  |
|---------------|--|
| Peptic cells  | Pro enzyme pepsinogen  |
| Goblet cells  | Mucus  |
| Oxyntic cells | HCL and intrinsic factor for absorption of vitamin B <sub>12</sub> |
| Hepatic cells | Bile juice   |

181. Given below are statements: one is labelled as assertion (A) and the other is labelled as Reason (R).

**Assertion (A):** Endometrium is necessary for implantation of blastocyst.

**Reason (R) :** In the absence of fertilisation, the corpus luteum degenerates that causes disintegration of endometrium.

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

- (1) Both (A) and (R) are true but (R) is not the correct explanation of (A).
- (2) (A) is true but (R) is false.
- (3) (A) is false but (R) is true.
- (4) Both (A) and (R) are true and (R) is the correct explanation of (A).

**Ans. (1)**

**Sol.** The corpus luteum secretes large amounts of progesterone which is essential for maintenance of the endometrium. Endometrium is necessary for implantation of the fertilised ovum and other events of pregnancy.

In the absence of fertilisation, the corpus luteum degenerates. This causes disintegration of the endometrium leading to menstruation, marking a new cycle.

182. Match **List I** with **List II**.

| <b>List - I</b>          | <b>List - II</b>                                   |
|--------------------------|--|
| <b>(Type of Joint)</b>   | <b>(Found between)</b>                             |
| A) Cartilaginous joint   | I) Between flat skull bones                        |
| B) Ball and socket joint | II) Between adjacent vertebrae in vertebral column |
| C) Fibrous joint         | III) Between carpal and metacarpal of thumb        |
| D) Saddle joint          | IV) Between humerus and pectoral girdle            |

Choose the correct answer from the options given below.

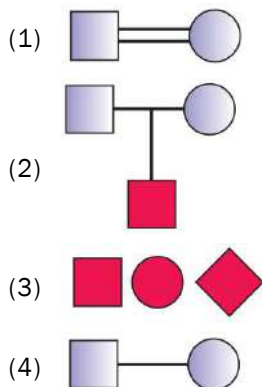
|     | <b>(A)</b> | <b>(B)</b> | <b>(C)</b> | <b>(D)</b> |
|-----|------------|------------|------------|------------|
| (1) | II         | IV         | I          | III        |
| (2) | I          | IV         | III        | II         |
| (3) | II         | IV         | III        | I          |
| (4) | III        | I          | II         | IV         |

**Ans. (1)**

**Sol.**

|                       |  |
|-----------------------|--|
| Cartilaginous Joint   | Between adjacent vertebral column      |
| Ball and Socket Joint | Between Humerus and Pectoral girdle    |
| Fibrous Joint         | Between flat skull bones               |
| Saddle Joint          | Between carpal and metacarpal of thumb |

183. Which one of the following symbols represents mating between relatives in human pedigree analysis?



Ans. (1)

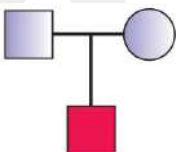
Sol. Mating between relatives is represented by a double horizontal line between square (male) and circle (female).



A single line indicates mating between male and female



The following represents normal parents with an affected male offspring



Solid square - Affected male, Solid circle - Affected female, Solid rhombus - Affected (sex unspecified)



184. Which one of the following techniques does **not** serve the purpose of early diagnosis of a disease for its early treatment?

- (1) Serum and Urine analysis
- (2) Polymerase Chain Reaction (PCR) technique.
- (3) Enzyme Linked Immuno-Sorbent Assay (ELISA) technique.
- (4) Recombinant DNA Technology

Ans. (1)

Sol. Using conventional methods of diagnosis like serum and urine analysis, etc. early detection is not possible. Recombinant DNA technology, Polymerase Chain Reaction (PCR) and Enzyme Linked Immuno-sorbent Assay (ELISA) are some of the techniques that serve the purpose of early diagnosis.

185. Match List I with List II.

List - I

List - II

(Interacting species)

(Name of Interaction)

- |  |                      |
|--|----------------------|
| A) A leopard and a lion in a forest /grassland     | I) Competition       |
| B) A cuckoo laying egg in a crow's nest            | II) Brood parasitism |
| C) Fungi and root of a higher plant in mycorrhizae | III) Mutualism       |
| D) A cattle egret and a cattle in a field          | IV) Commensalism     |

Choose the **correct** answer from the options given below.

|     | (A) | (B) | (C) | (D) |
|-----|-----|-----|-----|-----|
| (1) | I   | II  | IV  | III |
| (2) | III | IV  | I   | II  |
| (3) | II  | III | I   | IV  |
| (4) | I   | II  | III | IV  |

Ans. (4)

Sol.

|   |                  |
|---|------------------|
| A leopard and a lion in a forest /grassland     | Competition      |
| A Cuckoo laying egg in a crow's nest            | Brood parasitism |
| Fungi and root of a higher plant in mycorrhizae | Mutualism        |
| A Cattle egret and a cattle in a field          | Commensalism     |

### SECTION - B

186. Given below are two statements.

**Statement I** : During  $G_0$  phase of cell cycle, the cell is metabolically inactive.

**Statement II** : The centrosome undergoes duplication during S phase of interphase.

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

- (1) Both statement I and statement II are incorrect.
- (2) Statement I is correct but statement II is incorrect.
- (3) Statement I is incorrect but statement II is correct.
- (4) Both statement I and statement II are correct.

Ans. (3)

Sol. Statement I is false - During quiescent stage ( $G_0$ ) of the cell cycle, cells lose the capacity of division and exits from  $G_1$  phase. Cells in this stage remain metabolically active but no longer proliferate unless called on to do so depending on the requirement of the organism.

Statement II is true - During S phase duplication of centrioles occurs in cytoplasm and replication of DNA takes place in nucleus.



187. Match List I with List II.

| List I                   | List II   |
|--------------------------|---|
| A. Logistic growth       | I. Unlimited resource availability condition  |
| B. Exponential growth    | II. Limited resource availability condition   |
| C. Expanding age pyramid | III. The percent individuals of pre-reproductive age is largest followed by reproductive and post reproductive age groups |
| D. Stable age pyramid    | IV. The percent individuals of pre-reproductive and reproductive age group are same                                       |

 Choose the **correct** answer from the options given below.

|     | A  | B   | C   | D   |
|-----|----|-----|-----|-----|
| (1) | II | III | I   | IV  |
| (2) | II | IV  | I   | III |
| (3) | II | IV  | III | I   |
| (4) | II | I   | III | IV  |

**Ans. (4)**
**Sol.**

|                        |  |
|------------------------|--|
| Logistic growth        | Limited resource availability condition  |
| Exponential growth     | Unlimited resource availability condition  |
| Expanding age pyramid  | The percent individuals of pre-reproductive age is largest followed by reproductive and post reproductive age groups |
| Stable age pyramid and | The percent individuals of pre-reproductive reproductive age group are same  |

188. In cockroach, excretion is brought about by

- A. Phallic gland
- B. Urecose gland
- C. Nephrocytes
- D. Fat body
- E. Colleterial glands

 Choose the **correct** answer from the options given below.

- (1) A, B and E only
- (2) B, C and D only
- (3) B and D only
- (4) A and E only

**Ans. (2)**
**Sol.** In cockroach, excretion is brought about by uricose gland, nephrocytes and fat body.

Phallic gland forms the outermost layer of spermatophore in the male cockroach.

Colleterial glands secrete cementing substance for the formation of ootheca in the male cockroach.

189. Select the correct statements.

- A. Tetrad formation is seen during Leptotene.
- B. During Anaphase, the centromeres split and chromatids separate.
- C. Terminalisation takes place during Pachytene.
- D. Nucleolus, Golgi complex and ER are reformed during Telophase.
- E. Crossing over takes place between sister chromatids of homologous chromosome.

 Choose the **correct** answer from the options given below.

- (1) B and D only
- (2) A, C and E only
- (3) B and E only
- (4) A and C only

**Ans. (1)**
**Sol.** Tetrad formation takes place in zygotene, but clearly visible in pachytene stage.

During anaphase, due to splitting of centromere chromatids are getting separating and act as individual chromosomes, it is responsible of doubling of chromosomes.

The final stage of meiotic prophase I is diakinesis. This is marked by terminalisation of chiasmata.

The nuclear membrane, nucleolus, golgi complex and ER are reformed during Telophase.

During pachytene stage, the four chromatids of each bivalent chromosomes becomes distinct and clearly appears as tetrads. This stage is characterised by the appearance of recombination nodules, the sites at which crossing over occurs between non-sister chromatids of the homologous chromosomes.

190. Which of the following are **not** under the control of thyroid hormone?

- A. Maintenance of water and electrolyte balance
- B. Regulation of basal metabolic rate
- C. Normal rhythm of sleep-wake cycle
- D. Development of immune system
- E. Support the process of R.B.Cs formation

Choose the **correct** answer from the options given below.

- (1) B and C only
- (2) C and D only
- (3) D and E only
- (4) A and D only

**Ans. (2)**

**Sol.** **Pineal** gland is responsible for the regulation of sleep-wake cycle. **Thymus** gland plays a major role in the development of the immune system.

The functions of thyroid gland include:

- Maintenance of water and electrolyte balance
- Regulation of basal metabolic rate
- Support the process of R.B.Cs formation
- Control the metabolism of carbohydrates, proteins and fats
- Regulation of the blood calcium levels

191. Which of the following is characteristic feature of cockroach regarding sexual dimorphism?

- (1) Presence of anal styles
- (2) Presence of sclerites
- (3) Presence of anal cerci
- (4) Dark brown body colour and anal cerci

**Ans. (1)**

**Sol.** Anal styles are present in male cockroach.

Dark coloured body, anal cerci and sclerites are found in both male and female cockroaches.

192. Which of the following statements are correct?

- A. Basophils are most abundant cells of the total WBCs.
- B. Basophils secrete histamine, serotonin and heparin.
- C. Basophils are involved in inflammatory response.

- D. Basophils have kidney-shaped nucleus.
- E. Basophils are agranulocytes.

Choose the **correct** answer from the options given below.

- (1) C and E only
- (2) B and C only
- (3) A and B only
- (4) D and E only

**Ans. (2)**

**Sol.** Basophils secrete histamine, serotonin and heparin.

Basophils are involved in inflammatory response.

**Neutrophils** are most abundant cells of the total WBCs.

**Monocytes** have kidney shaped nucleus.

Basophils are **granulocytes**. Neutrophils, eosinophils and basophils are different types of granulocytes, while lymphocytes and monocytes are the agranulocytes.

193. Which of the following statements are correct?

- A. An excessive loss of body fluid from the body switches off osmoreceptors.
- B. ADH facilitates water reabsorption to prevent diuresis.
- C. ANF causes vasodilation.
- D. ADH causes increase in blood pressure.
- E. ADH is responsible for decrease in GFR.

Choose the **correct** answer from the options given below.

- (1) B, C and D only
- (2) A, B and E only
- (3) C, D and E only
- (4) A and B only

**Ans. (1)**

**Sol.** ADH (Antidiuretic hormone) facilitates water reabsorption to prevent diuresis.

ANF causes vasodilation. It is secreted by the atrial walls of heart, when there is increase in blood pressure.

ADH causes increase in blood pressure, when there is fall in the blood pressure.

An excessive loss of body fluid from the body switches osmoreceptors **on**.

ADH is responsible for **increase** in GFR.

194. Match List I with List II.

| List I                         | List II                           |
|--------------------------------|-----------------------------------|
| A. Mast cells                  | I. Ciliated epithelium            |
| B. Inner surface of bronchiole | II. Areolar connective tissue     |
| C. Blood                       | III. Cuboidal epithelium          |
| D. Tubular parts of nephron    | IV. Specialised connective tissue |

Choose the **correct** answer from the options given below.

|     | A   | B   | C  | D   |
|-----|-----|-----|----|-----|
| (1) | II  | III | I  | IV  |
| (2) | II  | I   | IV | III |
| (3) | III | IV  | II | I   |
| (4) | I   | II  | IV | III |

**Ans. (2)**

**Sol.**

|                             |                               |
|-----------------------------|-------------------------------|
| Mast Cells                  | Areolar connective tissue     |
| Inner surface of bronchiole | Ciliated epithelium           |
| Blood                       | Specialised connective tissue |
| Tubular parts of nephron    | Cuboidal epithelium           |

195. Select the correct statement with reference to chordates.

- A. Presence of a mid-dorsal, solid and double nerve cord.
- B. Presence of closed circulatory system.
- C. Presence of paired pharyngeal gill slits.
- D. Presence of dorsal heart.
- E. Triploblastic pseudocoelomate animals.

Choose the **correct** answer from the options given below.

- (1) B and C only
- (2) B, D and E only
- (3) C, D and E only
- (4) A, C and D only

**Ans. (1)**

**Sol.** Chordates are characterised by:

- Presence of closed circulatory system
- Presence of paired pharyngeal gill slits
- Triploblastic organisation
- Presence of coelom

Non chordates are characterised by:

- Presence of a ventral, solid and double nerve cord
- Presence of dorsal heart (if present)

Members of Aschelminthes (Non-chordata) are pseudocoelomate animals.

196. The unique mammalian characteristics are

- (1) hairs, pinna and mammary glands
- (2) hairs, pinna and indirect development
- (3) pinna, monocondylic skull and mammary glands
- (4) hairs, tympanic membrane and mammary glands

**Ans. (1)**

**Sol.** Hair, pinna and mammary glands are the unique features of mammals. They have dicondylic skull. They exhibit direct development.

Tympanum is observed in amphibians and reptiles.

197. The parts of human brain that helps in regulation of sexual behaviour, expression of excitement, pleasure, rage, fear etc., are

- (1) corpora quadrigemina and hippocampus
- (2) brain stem and epithalamus
- (3) corpus callosum and thalamus
- (4) limbic system and hypothalamus

**Ans. (4)**

**Sol.** The parts of human brain that help in the regulation of sexual behaviour, expression of excitement, pleasure, rage, fear etc. are limbic system and hypothalamus.

Corpus callosum connect left and right cerebral hemispheres.

Corpora quadrigemina of mid brain control the position of the head and eyes in response to visual, auditory, and somatic stimuli as well as transmits auditory signals to the auditory center in the cerebral cortex.

The function of the epithalamus is to connect the limbic system to other parts of the brain. Some functions of its components include the secretion of melatonin by the pineal gland (involved in circadian rhythms), and regulation of motor pathways and emotions.

Hippocampus is a complex brain structure embedded deep into temporal lobe. It has a major role in learning and memory. Hippocampus along with amygdala form the limbic system.

The brainstem is the structure that connects the cerebrum of the brain to the spinal cord and cerebellum. It is composed of three sections in descending order: the midbrain, pons, and medulla oblongata. Brain stem is responsible for many vital functions of life, such as breathing, consciousness, blood pressure, heart rate, and sleep.

198. Which one of the following is the sequence on corresponding coding strand, if the sequence on mRNA formed is as follows

5' AUCGAUCGAUCGAUCGAUCGAUCG 3'?

- (1) 3' UAGCUAGCUAGCUAGCUAGCUAGC 5'
- (2) 5' ATCGATCGATCGATCGATCGATCG 3'
- (3) 3' ATCGATCGATCGATCGATCGATCG 5'
- (4) 5' UAGCUAGCUAGCUAGCUAGCUAGCUAGC 3'

Ans. (2)

**Sol.** The strand that has the polarity 3'-5' acts as a template, and is also referred to as template strand. The other strand which has the polarity (5'-3') and the sequence same as RNA (except thymine at the place of uracil), is displaced during transcription this strand (which does not code for anything) is referred to as coding strand.

So if the sequence on mRNA is 5' AUCGAUCGAUCGAUCGAUCGAUCG 3' the sequence on coding strand would be 5' ATCGATCGATCGATCGATCGATCG 3'.

199. Which of the following statements are correct regarding skeletal muscle?

- A. Muscle bundles are held together by collagenous connective tissue layer called fascicle.
- B. Sarcoplasmic reticulum of muscle fibre is a store house of calcium ions.

- C. Striated appearance of skeletal muscle fibre is due to distribution pattern of actin and myosin proteins.
- D. M line is considered as functional unit of contraction called sarcomere.

Choose the **most appropriate** answer from the options given below.

- (1) B and C only
- (2) A, C and D only
- (3) C and D only
- (4) A, B and C only

Ans. (1)

**Sol.** Sarcoplasmic reticulum of muscle fibre is a store house of calcium ions.

Striated appearance of skeletal muscle fibre is due to distribution pattern of actin and myosin proteins.

Muscle bundles are held together by 200 collagenous connective tissue layer called **fascia**.

**Sarcomere** is the structural and functional unit of muscle contraction. M-line is in the middle of A-band.

200. Which one of the following is **not** an advantage of inbreeding?

- (1) It exposes harmful recessive genes that are eliminated by selection.
- (2) Elimination of less desirable genes and accumulation of superior genes takes place due to it.
- (3) It decreases the productivity of inbred population, after continuous inbreeding.
- (4) It decreases homozygosity.

Ans. (3)

**Sol.** Inbreeding decreases the productivity of inbred population, after continuous inbreeding. It is termed inbreeding depression. It is a disadvantage with inbreeding. Inbreeding depression can be overcome by outcrossing.

