

**Questions with Solutions****Time: 3 Hours****Total Marks: 720**

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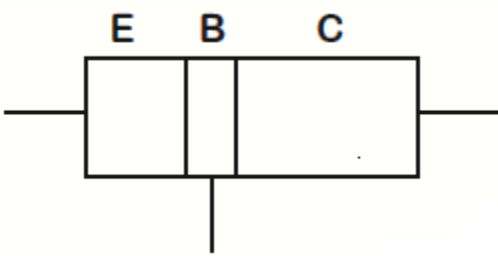
**General Instructions:**

1. The test is of 3 hours duration and Test Booklet contains 180 questions. 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.
  2. Use Blue / Black Ball point Pen only for writing particulars on this page/markings responses.
  3. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
  4. On completion of the test, the candidate must handover the Answer Sheet to the Invigilator before leaving the Room / Hall. The candidates are allowed to take away this Test Booklet with them.
  5. The CODE for this Booklet is F3.
  6. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet.
  7. Each candidate must show on demand his/her Admission Card to the Invigilator.
  8. No candidate, without special permission of the Superintendent or Invigilator, would leave his/her seat.
  9. Use of Electronic/Manual Calculator is prohibited.
  10. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination.
  11. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.
  12. The candidates will write the Correct Test Booklet Code as given in the Test Booklet / Answer Sheet in the Attendance Sheet.
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**PHYSICS****Q 1. For transistor action, which of the following statements is correct?**

- Option A Both emitter junction as well as the collector junction are forward biased.
- Option B The base region must be very thin and lightly doped.
- Option C Base, emitter and collector regions should have same doping concentrations.
- Option D Base, emitter and collector regions should have same size.

**Correct Option B****Solution:**



As we know, for Bi-polar junction transistor

The length of each section of transistor is in order as shown above.

i.e.,  $L_C > L_E > L_B$

and doping profile is Emitter > Collector > Base

Whereas, for transistor action Base-emitter junction is forward biased and Base-collector junction is reversed biased.

Hence from this we can conclude that, for transistor action the base region must be very thin and lightly doped.

**Q 2. A spherical conductor of radius 10 cm has a charge of  $3.2 \times 10^{-7}$  C distributed uniformly. What is the magnitude of electric field at a point 15 cm from the centre of the sphere?**

$$\left( \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2 / \text{C}^2 \right)$$

Option A  $1.28 \times 10^6$  N/C

Option B  $1.28 \times 10^7$  N/C

Option C  $1.28 \times 10^4$  N/C

Option D  $1.28 \times 10^5$  N/C

**Correct Option D**

**Solution:**

For a conducting sphere the electric field outside will be given as

$$\begin{aligned} E &= \frac{1}{4\pi\epsilon_0} \frac{Q}{r^2} \\ &= \frac{9 \times 10^9 \times 3.2 \times 10^{-7}}{225 \times 10^{-4}} \\ &= 0.128 \times 10^6 \\ &= 1.28 \times 10^5 \text{ N/C} \end{aligned}$$

**Q 3. Assume that light of wavelength 600 nm is coming from a star. The limit of resolution of telescope whose objective has a diameter of 2 m is \_\_\_\_\_.**

Option A  $7.32 \times 10^{-7}$  rad

Option B  $6.00 \times 10^{-7}$  rad

Option C  $3.66 \times 10^{-7}$  rad

Option D  $1.83 \times 10^{-7}$  rad

**Correct Option C**

**Solution:**

As we know,

The limit of resolving power is given as

$$\theta_R = 1.22 \frac{\lambda}{d}; \quad \lambda = 600 \times 10^{-9} \text{ m } d = 2 \text{ m}$$

$$= \frac{1.22 \times 600 \times 10^{-9}}{2}$$

$$\theta = 3.66 \times 10^{-7} \text{ rad}$$

**Q 4. Dimensions of stress are:**

Option A  $[ML^0T^{-2}]$

Option B  $[ML^{-1}T^{-2}]$

Option C  $[MLT^{-2}]$

Option D  $[ML^2T^{-2}]$

**Correct Option B**

**Solution:**

$$\begin{aligned} \text{Stress} &= \frac{\text{Force}}{\text{Area}} \\ &= \frac{[MLT^{-2}]}{L^2} \\ &= [ML^{-1}T^{-2}] \end{aligned}$$

**Q 5. A screw gauge has least count of 0.01 mm and there are 50 divisions in its circular scale.**

**The pitch of the screw gauge is \_\_\_\_\_.**

Option A 0.5 mm

Option B 1.0 mm

Option C 0.01 mm

Option D 0.25 mm

**Correct Option A**

**Solution:**

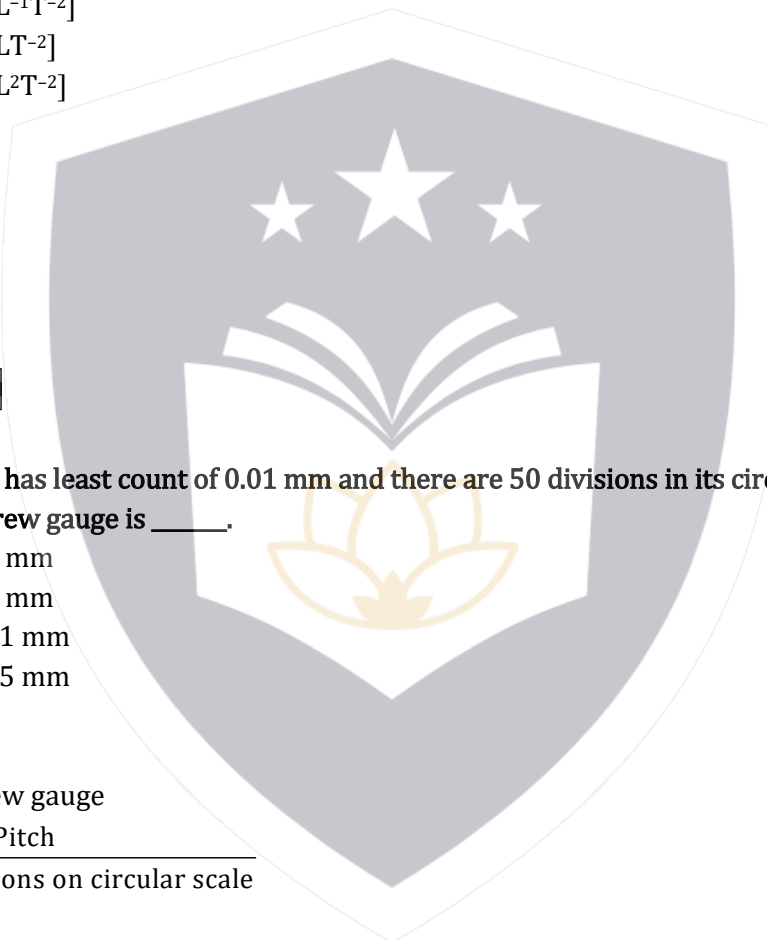
Least count of screw gauge

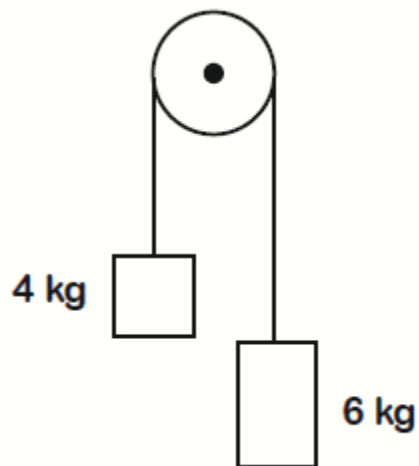
$$= \frac{\text{Pitch}}{\text{Number of divisions on circular scale}}$$

$$0.01 \text{ mm} = \frac{\text{Pitch}}{50}$$

$$\text{Pitch} = 0.5 \text{ mm}$$

**Q 6. Two bodies of mass 4 kg and 6 kg are tied to the ends of a massless string. The string passes over a pulley which is frictionless (see figure). The acceleration of the system in terms of acceleration due to gravity (g) is \_\_\_\_\_.**





- Option A  $g/5$   
 Option B  $g/10$   
 Option C  $g$   
 Option D  $g/2$

**Correct Option A**

**Solution:**

For the given case, the acceleration of given system will be expressed as

$$a = \frac{(m_1 - m_2)g}{(m_1 + m_2)}; \text{ where } m_1 > m_2$$

$$a = \frac{(6 - 4)g}{6 + 4}$$

$$a = \frac{g}{5}$$

**Q 7. An electron is accelerated from rest through a potential difference of V volt. If the de Broglie wavelength of the electron is  $1.227 \times 10^{-2}$  nm, the potential difference is :**

- Option A 103 V  
 Option B 104 V  
 Option C 10 V  
 Option D 102 V

**Correct Option B**

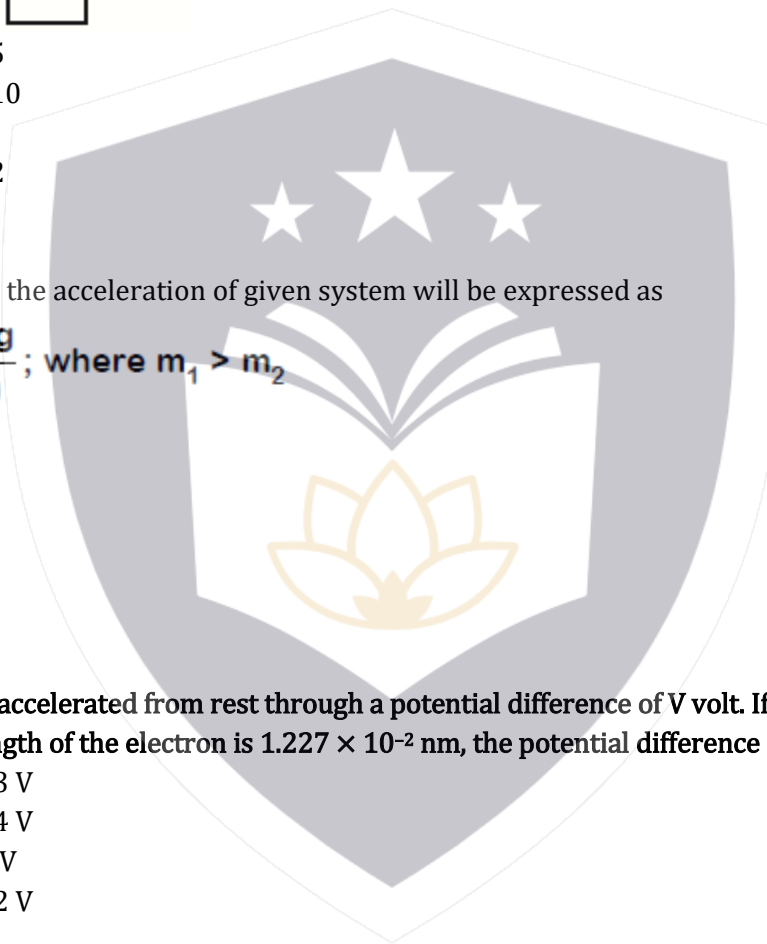
**Solution:**

According to de Broglie equation, the wavelength of electron will be given as

$$\lambda = \frac{12.27}{\sqrt{V}} \text{ \AA}$$

$$\sqrt{V} = \frac{12.27 \times 10^{-10}}{1.227 \times 10^{-11}} = 10^2$$

$$\therefore V = 10^4 \text{ volts}$$



**Q 8.** In a certain region of space with volume  $0.2 \text{ m}^3$ , the electric potential is found to be  $5 \text{ V}$  throughout. The magnitude of electric field in this region is :

- Option A       $1 \text{ N/C}$
- Option B       $5 \text{ N/C}$
- Option C      zero
- Option D       $0.5 \text{ N/C}$

**Correct Option C**

**Solution:**

For the given case, since electric potential is found constant throughout the region. Hence by using the equation of electric field.

$$\text{i.e., } E = - \frac{dV}{dr} = 0$$

We can conclude that the magnitude of electric field in the given region will be zero

**Q 9.** A cylinder contains hydrogen gas at pressure of  $249 \text{ kPa}$  and temperature  $27^\circ\text{C}$ . Its density is : ( $R = 8.3 \text{ J mol}^{-1} \text{ K}^{-1}$ )

- Option A       $0.1 \text{ kg/m}^3$
- Option B       $0.02 \text{ kg/m}^3$
- Option C       $0.5 \text{ kg/m}^3$
- Option D       $0.2 \text{ kg/m}^3$

**Correct Option D**

**Solution:**

$$PM = \rho RT \quad \Rightarrow \quad \rho = \frac{PM}{RT}$$

$$P = 249 \times 10^3 \text{ N/m}^2$$

$$M = 2 \times 10^{-3} \text{ kg}$$

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

$$\therefore \rho = \frac{(249 \times 10^3)(2 \times 10^{-3})}{8.3 \times 300} = \frac{0.2 \text{ kg}}{\text{m}^3}$$

**Q 10.** The mean free path for a gas, with molecular diameter  $d$  and number density  $n$  can be expressed as :

Option A       $\frac{1}{\sqrt{2} n^2 \pi d^2}$

Option B       $\frac{1}{\sqrt{2} n^2 \pi^2 d^2}$

Option C       $\frac{1}{\sqrt{2} n \pi d}$

Option D       $\frac{1}{\sqrt{2} n \pi d^2}$

**Correct Option D**

**Solution:**

According to the kinetic theory of gases, the mean free path is linearly proportional to temperature and inversely proportional to pressure and molecular diameter.

$$\text{i.e., } \lambda = \frac{kT}{\sqrt{2}n\pi d^2}$$

$$\therefore \lambda \propto \frac{1}{\sqrt{2}n\pi d^2}$$

**Q 11. A ball is thrown vertically downward with a velocity of 20 m/s from the top of a tower. It hits the ground after some time with a velocity of 80 m/s. The height of the tower is : ( $g = 10 \text{ m/s}^2$ )**

Option A 320 m

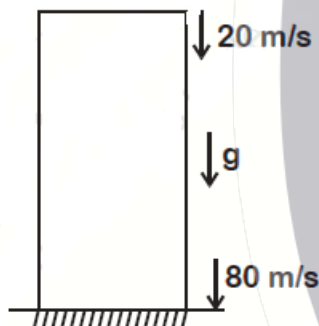
Option B 300 m

Option C 360 m

Option D 340 m

**Correct Option B**

**Solution:**



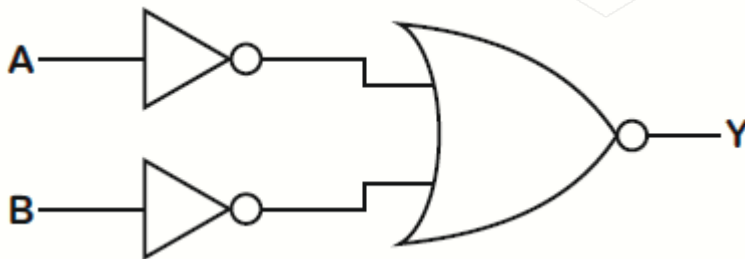
$$v^2 = u^2 + 2gh$$

$$v = 80 \text{ m/s}$$

$$u = 20 \text{ m/s}$$

$$h = \frac{v^2 - u^2}{2g} = \frac{6400 - 400}{20} = 300 \text{ m}$$

**Q 12. For the logic circuit shown, the truth table is:**



Option A

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

Option B

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

Option C

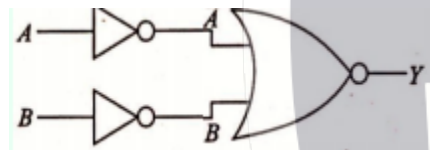
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

Option D

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

Correct Option C

Solution:



$$Y = \overline{\overline{A} + \overline{B}}$$

$$= \overline{\overline{A \cdot B}}$$

$$= A \cdot B \Rightarrow \text{AND Gate}$$

Truth Table

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

Q 13. A short electric dipole has a dipole moment of  $16 \times 10^{-9} \text{ C m}$ . The electric potential due to the dipole at a point at a distance of 0.6 m from the centre of the dipole, situated on a line making an angle of  $60^\circ$  with the dipole axis is :

$$\left( \frac{1}{4\pi \epsilon_0} = 9 \times 10^9 \text{ N m}^2 / \text{C}^2 \right)$$

Option A      400 V

Option B      Zero

Option C      50 V

Option D      200 V

Correct Option D

Solution:

$$V = \frac{kp \cos \theta}{r^2}$$

$$V = \frac{9 \times 10^9 \times 16 \times 10^{-9} \times \cos 60}{0.36}$$

$$V = 200 \text{ V}$$

Q 14. A capillary tube of radius  $r$  is immersed in water and water rises in it to a height  $h$ . The mass of the water in the capillary is 5 g. Another capillary tube of radius  $2r$  is immersed in water. The mass of water that will rise in this tube is :

Option A 10.0 g

Option B 20.0 g

Option C 2.5 g

Option D 5.0 g

**Correct Option A**

**Solution:**

Given that,

Mass of water in capillary of radius  $r$ ,  $m = 5 \text{ g}$

Now, the force of surface tension balances the weight of water in capillary tube.

$$F_s = 2\pi r T \cos \theta = mg$$

Here,  $T$  and  $\theta$  are constant

So,  $m \propto r$

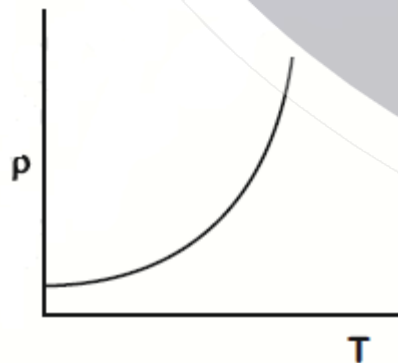
Hence,

$$\frac{m_2}{5.0} = \frac{2r}{r}$$

$$\Rightarrow m_2 = 10.0 \text{ g}$$

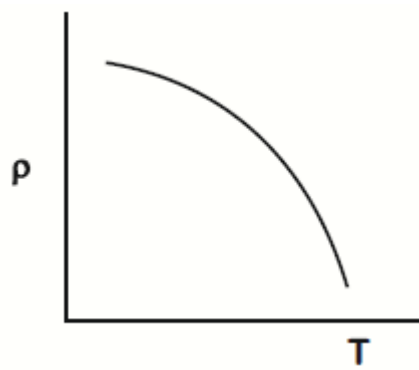
Q 15. Which of the following graph represents the variation of resistivity ( $\rho$ ) with temperature ( $T$ ) for copper?

Option A

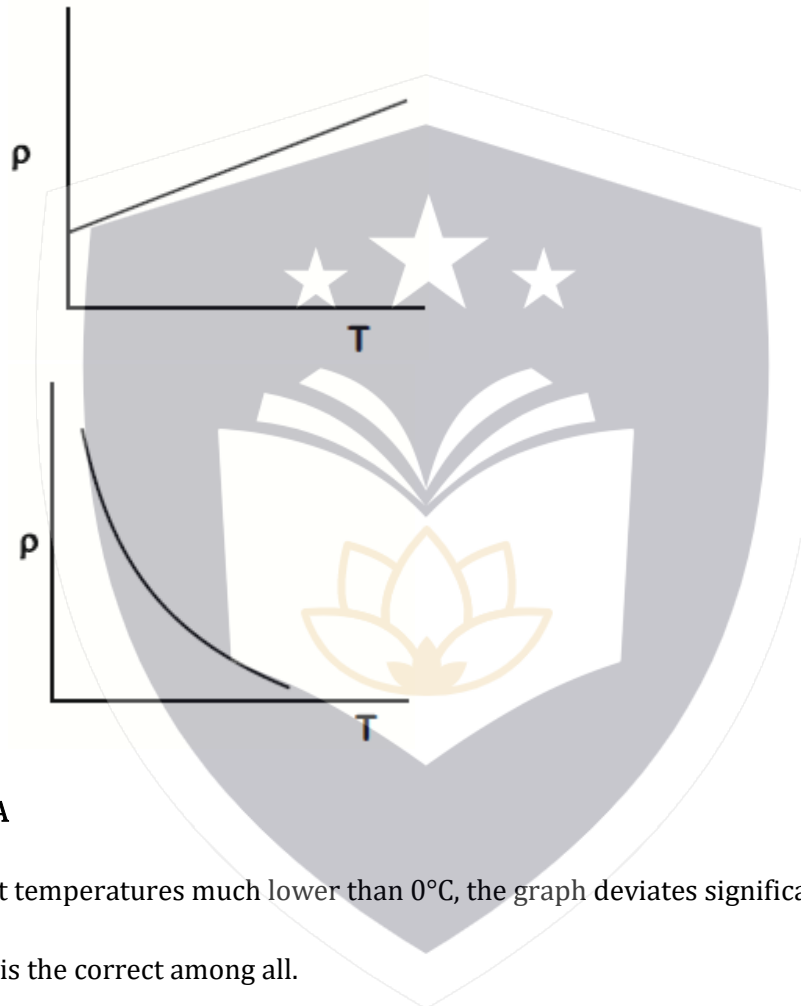




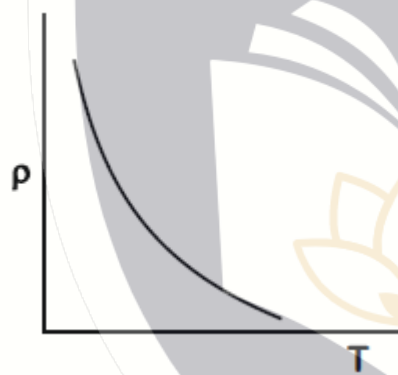
Option B



Option C



Option D



**Correct Option A**

**Solution:**

We know that at temperatures much lower than  $0^{\circ}\text{C}$ , the graph deviates significantly from a straight line.

Hence option A is the correct among all.

**Q 16. The ratio of contributions made by the electric field and magnetic field components to the intensity of an electromagnetic wave is :**

**( $c$  = speed of electromagnetic waves)**

Option A      1:  $c$

Option B      1:  $c^2$

Option C       $c$ : 1

Option D      1: 1

**Correct Option D**

**Solution:**

For the given case, the electric field provides half of the intensity in an electromagnetic wave, and the magnetic field provides the other half.

Hence required ratio should be 1: 1

**Q 17. A long solenoid of 50 cm length having 100 turns carries a current of 2.5 A. The magnetic field at the centre of the solenoid is :**

$$(\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1})$$

Option A  $6.28 \times 10^{-5} \text{ T}$

Option B  $3.14 \times 10^{-5} \text{ T}$

Option C  $6.28 \times 10^{-4} \text{ T}$

Option D  $3.14 \times 10^{-4} \text{ T}$

**Correct Option C**

**Solution:**

Given that,

Length of solenoid,  $L = 50 \text{ cm}$

Number of turns,  $N = 100$

Current,  $I = 2.5 \text{ A}$

Now,

Magnetic field at centre of solenoid,  $B = \mu_0 n I$

$$n = \frac{N}{L} = \frac{100}{50 \times 10^{-2}} = 200 \text{ turns / m}$$

$$I = 2.5 \text{ A}$$

By substituting the value of  $I$  in the equation of magnetic field we get

$$B = 4\pi \times 10^{-7} \times 200 \times 2.5$$

$$= 6.28 \times 10^{-4} \text{ T}$$

**Q 18. For which one of the following, Bohr model is not valid?**

Option A Deuteron atom

Option B Singly ionised neon atom ( $\text{Ne}^+$ )

Option C Hydrogen atom

Option D Singly ionised helium atom ( $\text{He}^+$ )

**Correct Option B**

**Solution:**

According to Bohr model, as we all know, is only valid for single electron species. In contrast, a single electron in orbit of a singly ionised neon atom.

Hence, Bohr model is not valid.

**Q 19. The energy equivalent of 0.5 g of a substance is :**

Option A  $1.5 \times 10^{13} \text{ J}$

Option B  $0.5 \times 10^{13} \text{ J}$

Option C  $4.5 \times 10^{16} \text{ J}$

Option D  $4.5 \times 10^{13} \text{ J}$

**Correct Option D**

**Solution:**

According to mass-energy equivalence.

$$E = mc^2$$

$$= 0.5 \times 10^{-3} \times (3 \times 10^8)^2$$

$$= 4.5 \times 10^{13} \text{ J}$$

**Q 20. Taking into account of the significant figures, what is the value of  $9.99 \text{ m} - 0.0099 \text{ m}$ ?**

- Option A 9.980 m
- Option B 9.9 m
- Option C 9.9801 m
- Option D 9.98 m

**Correct Option D**

**Solution:**

Given that,

$$9.99 \text{ m} - 0.0099 \text{ m} = 9.9801 \text{ m}$$

In subtraction, the answer should be reported to the fewest number of decimal places possible, so the answer should be approximately 9.98 m.

**Q 21. In a guitar, two strings A and B made of same material are slightly out of tune and produce beats of frequency 6 Hz. When tension in B is slightly decreased, the beat frequency increases to 7 Hz. If the frequency of A is 530 Hz, the original frequency of B will be:**

- Option A 536 Hz
- Option B 537 Hz
- Option C 523 Hz
- Option D 524 Hz

**Correct Option D**

**Solution:**

Given that,

Difference of  $f_A$  and  $f_B$ ,  $\Delta f = 6 \text{ Hz}$

If tension decreases,  $f_B$  decreases and becomes  $f'_B$ .

Now, difference of  $f_A$  and  $f'_B$ ,  $\Delta f' = 7 \text{ Hz}$  (

$$\therefore f_A > f_B$$

$$f_A - f_B = 6 \text{ Hz}$$

Now, since  $f_A = 530 \text{ Hz}$

$$\therefore f_B = 524 \text{ Hz}$$

**Q 22. A series LCR circuit is connected to an ac voltage source. When L is removed from the circuit, the phase difference between current and voltage is  $\frac{\pi}{3}$ . If instead C is removed from the circuit, the**

**phase difference is again  $\frac{3}{\pi}$  between current and voltage. The power factor of the circuit is:**

- Option A 1.0
- Option B -1.0
- Option C Zero
- Option D 0.5

**Correct Option A**

**Solution:**

When L is removed,

$$\tan \phi = \frac{|X_C|}{R} \Rightarrow \tan \frac{\pi}{3} = \frac{X_C}{R} \quad \dots(i)$$

When C is removed,

$$\tan \phi = \frac{|X_L|}{R} \Rightarrow \tan \frac{\pi}{3} = \frac{X_L}{R} \quad \dots(ii)$$

From (i) and (ii),  $X_L = X_C$

Since,  $X_L = X_C$ , the circuit is in resonance.

$$Z = R$$

$$\text{Power factor} = \cos \phi = \frac{R}{Z} = 1$$

Q 23. The quantities of heat required to raise the temperature of two solid copper spheres of radii  $r_1$  and  $r_2$  ( $r_1 = 1.5 r_2$ ) through 1 K are in the ratio:

Option A  $\frac{3}{2}$

Option B  $\frac{5}{3}$

Option C  $\frac{27}{8}$

Option D  $\frac{9}{4}$

Correct Option C

Solution:

$$\Delta Q = ms\Delta T$$

$$\Delta Q = \frac{4}{3}\pi r^3 \rho s \Delta T$$

$$\frac{\Delta Q_1}{\Delta Q_2} = \left(\frac{r_1}{r_2}\right)^3$$

$$= (1.5)^3$$

$$= \frac{27}{8}$$

Q 24. The Brewster's angle  $i_b$  for an interface should be

Option A  $45^\circ < i_b < 90^\circ$

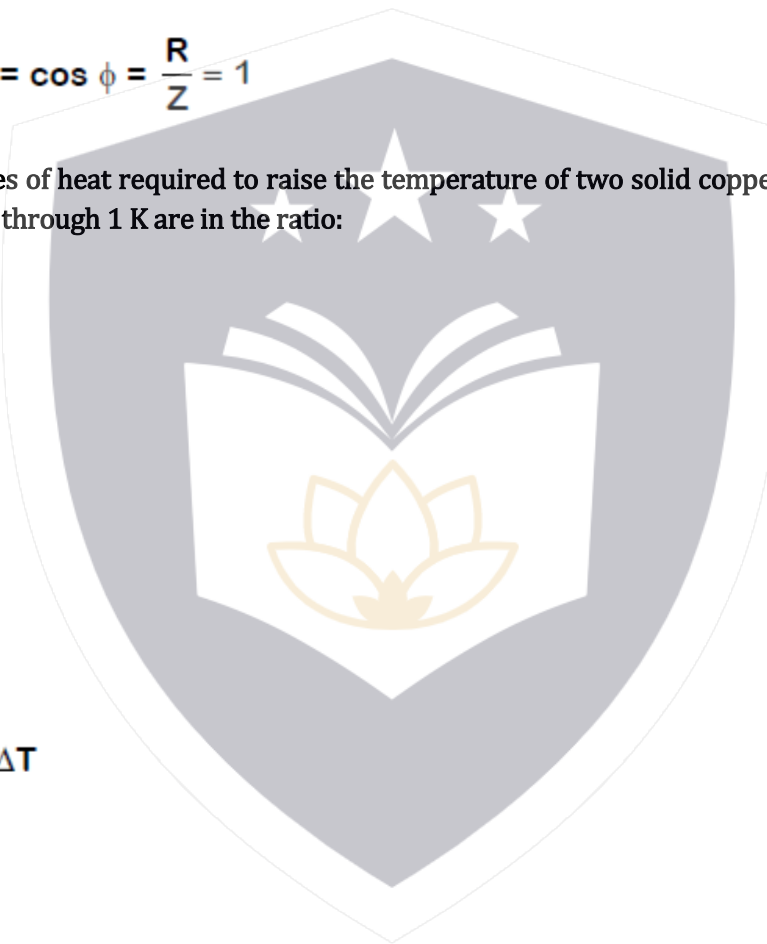
Option B  $i_b = 90^\circ$

Option C  $0^\circ < i_b < 30^\circ$

Option D  $30^\circ < i_b < 45^\circ$

Correct Option A

Solution:



$$\mu = \tan i_b$$

$$1 < \mu < \infty$$

$$1 < \tan i_b < \infty$$

$$\tan^{-1}(1) < i_b < \tan^{-1}(\infty)$$

$$45^\circ < i_b < 90^\circ$$

**Q 25. Two cylinders A and B of equal capacity are connected to each other via a stop cock. A contains an ideal gas at standard temperature and pressure. B is completely evacuated. The entire system is thermally insulated. The stop cock is suddenly opened. The process is :**

- Option A      isochoric  
 Option B      isobaric  
 Option C      isothermal  
 Option D      adiabatic

**Correct Option D**

**Solution:**

The entire system is now thermally insulated in accordance with the given conditions. As a result, no heat exchange will occur. As a result, the process will be adiabatic.

**Q 26. An iron rod of susceptibility 599 is subjected to a magnetising field of  $1200 \text{ A m}^{-1}$ . The permeability of the material of the rod is ( $\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$ )**

- Option A       $2.4\pi \times 10^{-5} \text{ T m A}^{-1}$   
 Option B       $2.4 \pi \times 10^{-7} \text{ T m A}^{-1}$   
 Option C       $2.4 \pi \times 10^{-4} \text{ T m A}^{-1}$   
 Option D       $8.0 \times 10^{-5} \text{ T m A}^{-1}$

**Correct Option C**

**Solution:**

Given that,

$$X_m = 599$$

$$B = 1200 \text{ A m}^{-1}$$

$$\mu_r = 1 + X_m = 600$$

$$\mu = \mu_r \mu_0$$

$$\mu = 600 \times 4\pi \times 10^{-7}$$

$$\mu = 2400\pi \times 10^{-7}$$

$$\mu = 2.4\pi \times 10^{-4} \text{ T m A}^{-1}$$

**Q 27. The capacitance of a parallel plate capacitor with air as medium is  $6 \mu\text{F}$ . With the introduction of a dielectric medium, the capacitance becomes  $30 \mu\text{F}$ . The permittivity of the medium is :**

$$(\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2})$$

- Option A       $0.44 \times 10^{-10} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$   
 Option B       $5.00 \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$   
 Option C       $0.44 \times 10^{-13} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$   
 Option D       $1.77 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$

**Correct Option A**

**Solution:**

Now for parallel plate capacitor,

$$C = KC_0$$

$$K = \frac{C}{C_0} = \frac{30}{6} = 5$$

$$K = \frac{\epsilon}{\epsilon_0}$$

$$\epsilon = K \epsilon_0$$

$$= 5 \times 8.85 \times 10^{-12}$$

$$= 0.44 \times 10^{-10} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$$

**Q 28. A charged particle having drift velocity of  $7.5 \times 10^{-4} \text{ m s}^{-1}$  in an electric field of  $3 \times 10^{-10} \text{ Vm}^{-1}$ , has a mobility in  $\text{m}^2 \text{ V}^{-1} \text{ s}^{-1}$  of :**

Option A  $2.5 \times 10^{-6}$

Option B  $2.25 \times 10^{-15}$

Option C  $2.25 \times 10^{15}$

Option D  $2.5 \times 10^6$

**Correct Option D**

**Solution:**

$$\mu = \frac{V_d}{E}$$

$$= \frac{7.5 \times 10^{-4}}{3 \times 10^{-10}}$$

$$= 2.5 \times 10^6 \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1}$$

**Q 29. The color code of a resistance is given below**



**Yellow Violet Brown Gold**

**The values of resistance and tolerance, respectively, are**

Option A  $4.7 \text{ k}\Omega, 5\%$

Option B  $470 \Omega, 5\%$

Option C  $470 \text{ k}\Omega, 5\%$

Option D  $47 \text{ k}\Omega, 10\%$

**Correct Option B**

**Solution:** According to colour coding

Yellow  $\Rightarrow 4$

Violet  $\Rightarrow 7$

Brown  $\Rightarrow 1$

Gold  $\Rightarrow 5\%$

So, from the given data we know that

$$R = 47 \times 10^1 \pm 5\%$$

$$R = 470 \pm 5\% \Omega$$

**Q 30. The solids which have the negative temperature coefficient of resistance are:**

Option A semiconductors only

Option B insulators and semiconductors

- Option C metals  
 Option D insulators only

**Correct Option B**

**Solution:**

As we know, for the given case the temperature coefficient of resistance for metals is positive, whereas the temperature coefficient of resistance for insulators and semiconductors is negative.

**Q 31. A body weighs 72 N on the surface of the earth. What is the gravitational force on it, at a height equal to half the radius of the earth?**

- Option A 30 N  
 Option B 24 N  
 Option C 48 N  
 Option D 32 N

**Correct Option D**

**Solution:**

Now, the acceleration due to gravity at height  $h$  is given as

$$mg_h = \frac{mg_0}{\left(1 + \frac{h}{R}\right)^2}$$

$$W = \frac{72}{\left(1 + \frac{R/2}{R}\right)^2}$$

$$W = \frac{72}{(3/2)^2} = \frac{4}{9} \times 32 \text{ N}$$

**Q 32. A 40  $\mu\text{F}$  capacitor is connected to a 200 V, 50 Hz ac supply. The rms value of the current in the circuit is, nearly:**

- Option A 2.5 A  
 Option B 25.1 A  
 Option C 1.7 A  
 Option D 2.05 A

**Correct Option A**

**Solution:**  $i_{\text{rms}} = C\omega \times \epsilon_{\text{rms}}$

$$C = 40 \times 10^{-6} \text{ F}$$

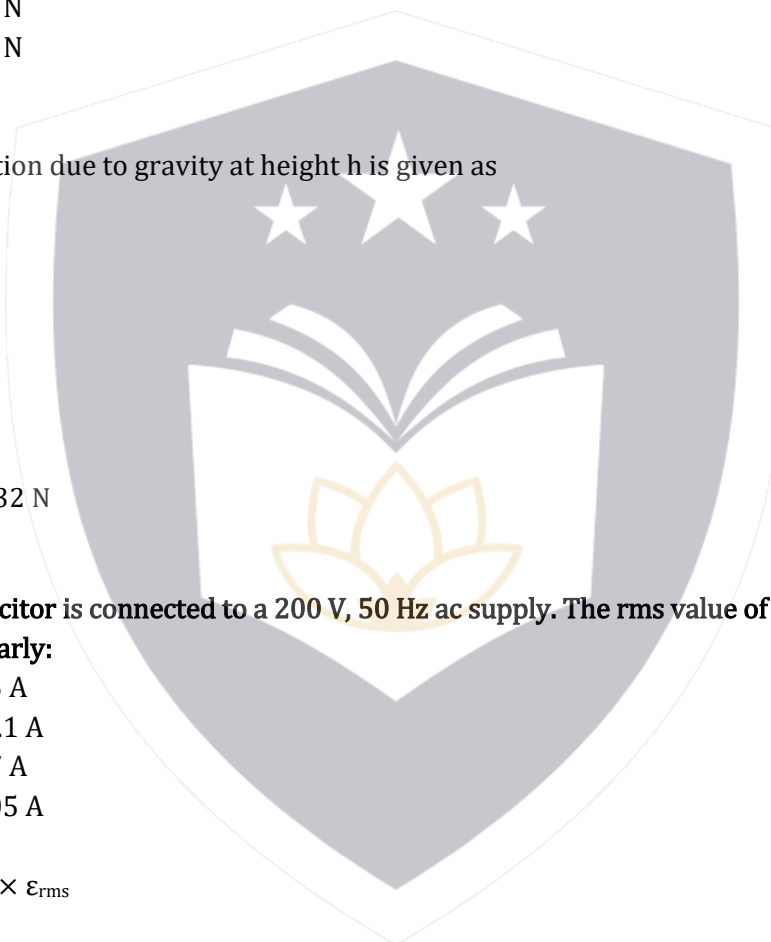
$$\omega = 2\pi f = 100\pi$$

$$\epsilon_{\text{rms}} = 200 \text{ V}$$

$$\therefore i_{\text{rms}} = 200 \times 40 \times 10^{-6} \times 2\pi \times 50 \\ = 2.5 \text{ A}$$

**Q 33. The phase difference between displacement and acceleration of a particle in a simple harmonic motion is :**

- Option A  $\frac{\pi}{2}$  rad  
 Option B zero  
 Option C  $\pi$  rad



Option D  $\frac{3\pi}{2}$  rad

**Correct Option C**

**Solution:** If  $y = A \sin \omega t$

then  $v = \frac{dy}{dt}$

$v = A\omega \cos \omega t$

$a = \frac{dv}{dt}$

$a = -A\omega^2 \sin(\omega t)$

$a = A\omega^2 \sin(\omega t + \pi)$

So, phase difference between displacement and acceleration is  $\pi$ .

**Q 34. The average thermal energy for a mono-atomic gas is : ( $k_B$  is Boltzmann constant and T, absolute temperature)**

Option A  $\frac{5}{2} k_B T$

Option B  $\frac{7}{2} k_B T$

Option C  $\frac{1}{2} k_B T$

Option D  $\frac{3}{2} k_B T$

**Correct Option D**

**Solution:** For monoatomic gases, degree of freedom is 3.

Hence average thermal energy per molecule is  $\frac{3}{2} k_B T$

i.e.,  $KE_{avg} = \frac{3}{2} k_B T$

**Q 35. Light of frequency 1.5 times the threshold frequency is incident on a photosensitive material. What will be the photoelectric current if the frequency is halved and intensity is doubled?**

Option A one-fourth

Option B zero

Option C doubled

Option D four times

**Correct Option B**

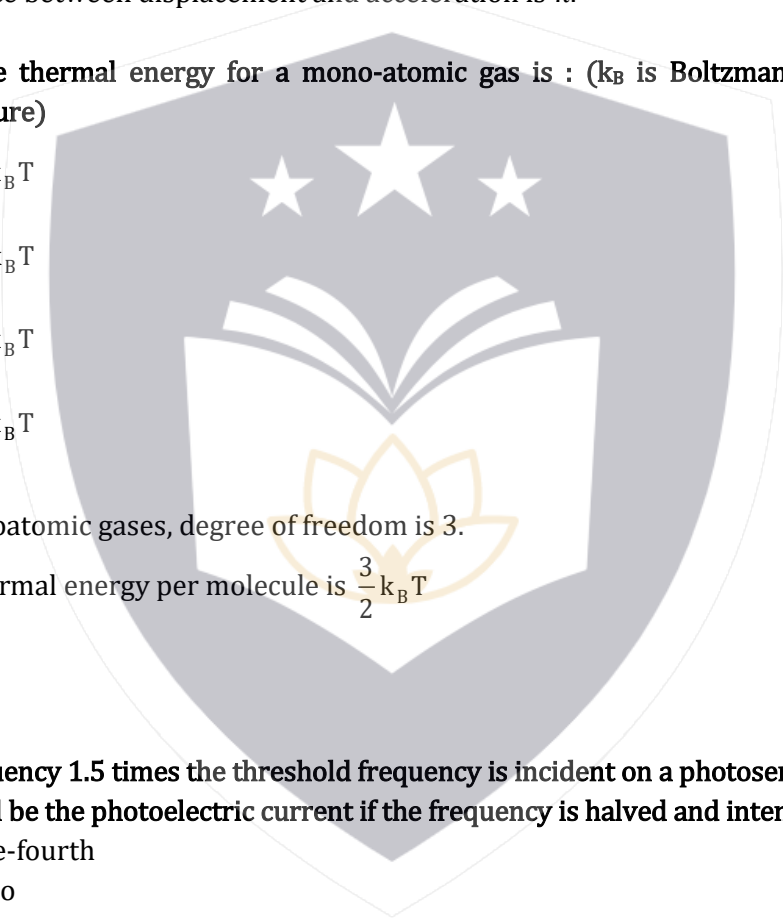
**Solution:**

$v = \frac{3}{2} v_0$

$v' = \frac{v}{2} = \frac{3}{4} v_0$

$\therefore v' < v_0$

$\therefore$  No photo electric emission will take place.





Q 36. A wire of length  $L$ , area of cross section  $A$  is hanging from a fixed support. The length of the wire changes to  $L_1$  when mass  $M$  is suspended from its free end. The expression for Young's modulus is :

Option A  $\frac{MgL}{AL_1}$

Option B  $\frac{MgL}{A(L_1 - L)}$

Option C  $\frac{MgL_1}{AL}$

Option D  $\frac{Mg(L_1 - L)}{AL}$

**Correct Option B**

**Solution:**

Now, As we know the expression for longitudinal stress and strain are

$$\text{Stress} = \frac{Mg}{A}$$

$$\text{Strain} = \frac{\Delta L}{L} = \frac{L_1 - L}{L}$$

Hence, the formula for Young's Modulus will be expressed as

$$\text{Young's modulus} = \frac{\text{Stress}}{\text{Strain}} = \frac{MgL}{A(L_1 - L)}$$

Q 37. A ray is incident at an angle of incidence  $i$  on one surface of a small angle prism (with angle of prism  $A$ ) and emerges normally from the opposite surface. If the refractive index of the material of the prism is  $\mu$ , then the angle of incidence is nearly equal to :

Option A  $\mu A$

Option B  $\frac{\mu A}{2}$

Option C  $\frac{A}{2\mu}$

Option D  $\frac{2A}{\mu}$

**Correct Option A**

**Solution:** Light ray emerges normally from another surface, hence, angle of emergence,  $e = 0$

Angle of refraction across second surface,  $r_2 = 0$

$$\therefore r_1 + r_2 = A$$

$$\Rightarrow r_1 = A$$

Applying Snell's law on first surface, we get.

$$1 \times \sin i = \mu \times \sin r_1$$

$$\Rightarrow \sin i = \mu \sin A$$

Now, for small angle the angle of incidence will be

$$\therefore i = \mu A (\because \sin \theta \approx \theta)$$

Q 38. Find the torque about the origin when a force of  $3 \hat{j}$  N acts on a particle whose position vector is  $2 \hat{k}$  m

- Option A  $-6 \hat{i} \text{ Nm}$
- Option B  $6 \hat{k} \text{ Nm}$
- Option C  $6 \hat{i} \text{ Nm}$
- Option D  $6 \hat{j} \text{ Nm}$

**Correct Option A**

**Solution:**

The relation between torque and force can be expressed as

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$\vec{\tau} = 2\hat{k} \times 3\hat{j}$$

$$\vec{\tau} = -6\hat{i} \text{ Nm}$$

**Q 39. In Young's double slit experiment, if the separation between coherent sources is halved and the distance of the screen from the coherent sources is doubled, then the fringe width becomes :**

- Option A four times
- Option B one-fourth
- Option C double
- Option D half

**Correct Option A**

**Solution:**

$$\text{Fringe width } \beta = \frac{\lambda D}{d}$$

$$\text{Now, } d' = \frac{d}{2} \text{ and } D' = 2D$$

$$\text{So, } \beta' = \frac{\lambda(2D)}{d/2} = \frac{4\lambda D}{d}$$

$$\beta' = 4\beta$$

**Q 40. The energy required to break one bond in DNA is  $10^{-20}$  J. This value in eV is nearly:**

- Option A 0.06
- Option B 0.006
- Option C 6
- Option D 0.6

**Correct Option A**

**Solution:**

As we know,  $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$

Thus,

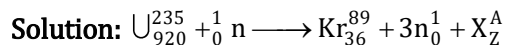
$$1 \text{ J} = \frac{1}{1.6 \times 10^{-19}} \text{ eV}$$

$$\begin{aligned} 10^{-20} \text{ J} &= \frac{10^{-20}}{1.6 \times 10^{-19}} \text{ eV} \\ &= 0.06 \text{ eV} \end{aligned}$$

**Q 41. When a uranium isotope  ${}_{92}^{235}\text{U}$  is bombarded with a neutron, it generates  ${}_{36}^{89}\text{Kr}$ , three neutrons and :**

- Option A  ${}_{36}^{101}\text{Kr}$   
 Option B  ${}_{36}^{103}\text{Kr}$   
 Option C  ${}_{56}^{144}\text{Ba}$   
 Option D  ${}_{40}^{91}\text{Zr}$

**Correct Option C**



$$92 + 0 = 36 + Z$$

$$\Rightarrow Z = 56$$

$$235 + 1 = 89 + 3 + A$$

$$\Rightarrow A = 144$$

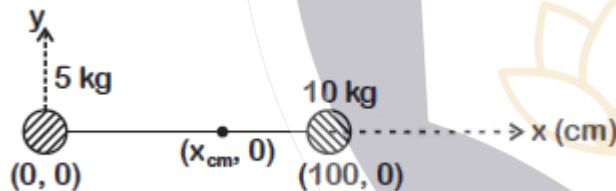
Hence for the given reaction  ${}_{56}^{144}\text{Ba}$  will be generated.

**Q 42.** Two particles of mass 5 kg and 10 kg respectively are attached to the two ends of a rigid rod of length 1 m with negligible mass. The centre of mass of the system from the 5 kg particle is nearly at a distance of :

- Option A 67 cm  
 Option B 80 cm  
 Option C 33 cm  
 Option D 50 cm

**Correct Option A**

**Solution:**



$$X_{\text{cm}} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}$$

$$= \frac{5 \times 0 + 100 \times 10}{5 + 10} = \frac{200}{3} = 66.66 \text{ cm}$$

$$X_{\text{cm}} \approx 67 \text{ cm}$$

**Q 43.** Light with an average flux of 20 W/cm<sup>2</sup> falls on a non-reflecting surface at normal incidence having surface area 20 cm<sup>2</sup>. The energy received by the surface during time span of 1 minute is :

- Option A  $24 \times 10^3 \text{ J}$   
 Option B  $48 \times 10^3 \text{ J}$   
 Option C  $10 \times 10^3 \text{ J}$   
 Option D  $12 \times 10^3 \text{ J}$

**Correct Option A**

**Solution:**

Given that,

$$\text{Intensity, } I = 20 \text{ W/cm}^2$$

$$\text{Area of cross section, } A = 20 \text{ cm}^2$$

$$\text{Time, } t = 1 \text{ min} = 60 \text{ sec}$$

Now,

Energy received = Intensity  $\times$  Area  $\times$  Time

$$E = IAt$$

$$= 20 \times 20 \times 60$$

$$= 24 \times 10^3 \text{ J}$$

**44. The increase in the width of the depletion region in a p-n junction diode is due to :**

Option A both forward bias and reverse bias

Option B increase in forward current

Option C forward bias only

Option D reverse bias only

**Correct Option: D**

**Solution.**

As we know, the width of the depletion region increases across the p and n junctions due to reverse biasing.

**45. A resistance wire connected in the left gap of a metre bridge balances a  $10 \Omega$  resistance in the right gap at a point which divides the bridge wire in the ratio 3 : 2. If the length of the resistance wire is 1.5 m, then the length of  $1 \Omega$  of the resistance wire is :**

Option A  $1.5 \times 10^{-1}$  m

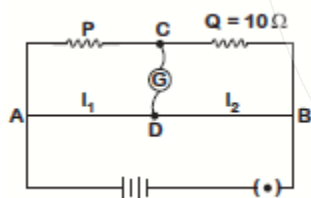
Option B  $1.5 \times 10^{-2}$  m

Option C  $1.0 \times 10^{-2}$  m

Option D  $1.0 \times 10^{-1}$  m

**Correct Option: D**

**Solution.**



$$\text{Initially, } \frac{P}{10} = \frac{l_1}{l_2} = \frac{3}{2}$$

$$\Rightarrow P = \frac{30}{2} = 15 \Omega$$

$$\text{Now Resistance, } R = \frac{\rho l}{A}$$

$$\frac{R_1}{R_2} = \frac{l_1}{l_2}$$

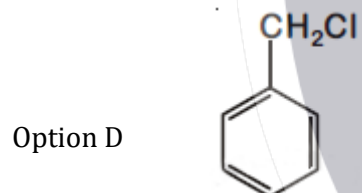
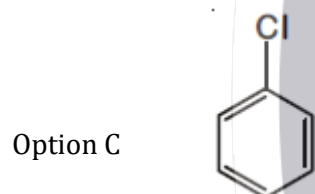
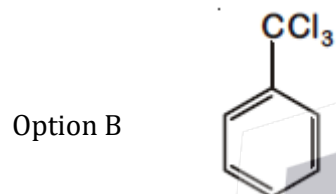
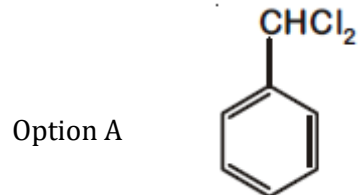
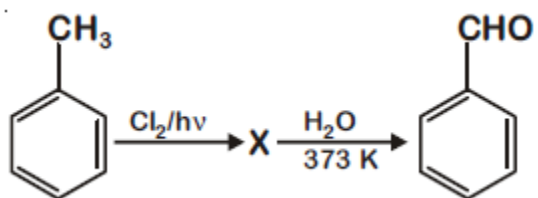
$$\Rightarrow \frac{15}{1} = \frac{1.5}{l_2}$$

$$l_2 = 0.01 \text{ m}$$

$$= 1.0 \times 10^{-1} \text{ m}$$

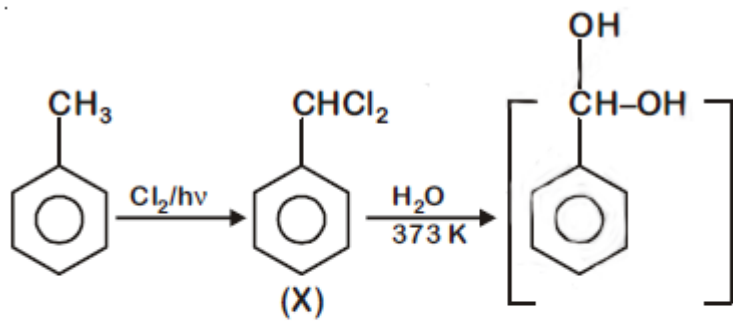
## CHEMISTRY

**Q 46. Identify compound X in the following sequence of reactions**



**Correct Option A**  
**Solution:**

Formation of X is halogenation reaction.



**Q 47. Identify a molecule which does not exist.**

- Option A  $\text{C}_2$   
 Option B  $\text{O}_2$   
 Option C  $\text{He}_2$   
 Option D  $\text{Li}_2$

**Correct Option C**

**Solution:**

Electronic configuration for  $\text{He}_2$  molecule is  $\sigma 1s^2, \sigma^* 1s^2$

Bond order is calculated by  $= \frac{1}{2} [N_b - N_a]$

$$\begin{aligned}
 &= \frac{1}{2} [2 - 2] \\
 &= 0
 \end{aligned}$$

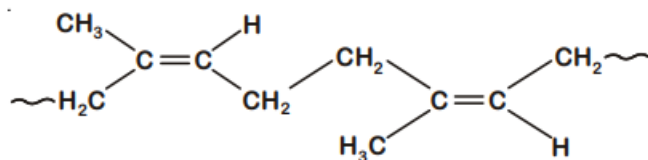
Since, bond order is zero, so  $\text{He}_2$  molecule does not exist.

**Q 48. Which of the following is a natural polymer?**

- Option A polybutadiene  
 Option B poly (Butadiene-acrylonitrile)  
 Option C cis-1, 4-polyisoprene  
 Option D poly (Butadiene-styrene)

**Correct Option C**

**Solution:** cis-1, 4- polyisoprene is natural polymer. It is known as natural polymer.



**Q 49. An increase in the concentration of the reactants of a reaction leads to change in**

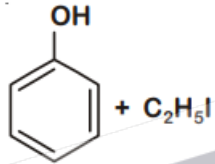
- Option A threshold energy
- Option B collision frequency
- Option C activation energy
- Option D heat of reaction

**Correct Option D**

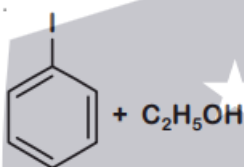
**Solution:** Heat of reaction is an extensive property. Hence, on change of amount/concentration of reactants heat of reaction changes.

**Q 50. Anisole on cleavage with HI gives**

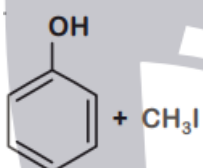
Option A



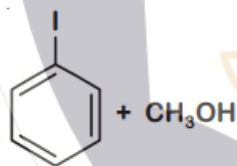
Option B



Option C



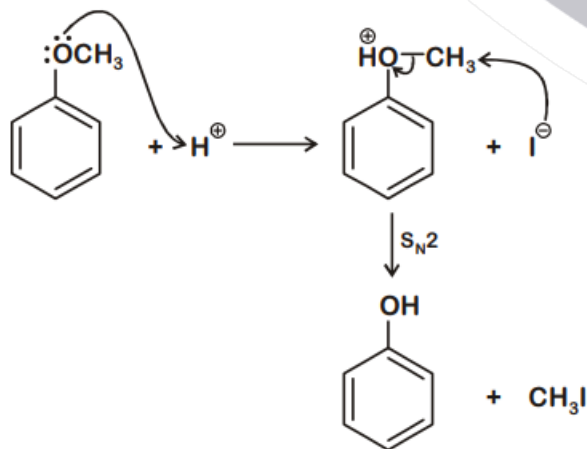
Option D



**Correct Option C**

**Solution:**

It shows  $S_N2$  mechanism.



**Q 51. The number of protons, neutrons and electrons in  ${}_{71}^{175}\text{Lu}$ , respectively, are**

- Option A 71, 71 and 104
- Option B 175, 104 and 71
- Option C 71, 104 and 71
- Option D 104, 71 and 71

**Correct Option C**

**Solution:**  ${}_{71}^{175}\text{Lu}$

No. of Protons = Atomic number = 71 = No. of Electrons

No. of Neutrons = Mass no. - No. of Protons

= 175 - 71

= 104

**Q 52. The calculated spin only magnetic moment of  $\text{Cr}^{2+}$  ion is**

- Option A 5.92 BM
- Option B 2.84 BM
- Option C 3.87 BM
- Option D 4.90 BM

**Correct Option D**

**Solution:**

Electronic configuration of Cr -  $[\text{Ar}] 3d^5 4s^1$

Electronic configuration of  $\text{Cr}^{2+}$  -  $[\text{Ar}] 3d^4$

1	1	1	1	
---	---	---	---	--

Number of unpaired  $e^-$  = 4

Spin only magnetic moment is calculated by =  $\sqrt{n(n+2)}$

n = number of unpaired  $e^-$  is calculated by-

So, Spin only magnetic moment =  $\sqrt{4(4+2)}$

$$= \sqrt{24}\text{BM}$$

$$= 4.90 \text{ BM}$$

**Q 53. Match the following:**

Oxide	Nature
(a) CO	(i) Basic
(b) BaO	(ii) Neutral
(c) $\text{Al}_2\text{O}_3$	(iii) Acidic
(d) $\text{Cl}_2\text{O}_7$	(iv) Amphoteric

**Which of the following is correct option?**

- (a) (b) (c) (d)
- Option A (iii) (iv) (i) (ii)
- Option B (iv) (iii) (ii) (i)
- Option C (i) (ii) (iii) (iv)
- Option D (ii) (i) (iv) (iii)

**Correct Option D**

**Solution:**



Generally metallic oxide is basic and non-metallic oxide is acidic.

CO: Neutral oxide

BaO: Basic oxide

Al<sub>2</sub>O<sub>3</sub>: Amphoteric oxide

Cl<sub>2</sub>O<sub>7</sub>: Acidic oxide

**Q 54. Urea reacts with water to form A which will decompose to form B. B when passed through Cu<sup>2+</sup> (aq), deep blue colour solution C is formed. What is the formula of C from the following?**

Option A Cu(OH)<sub>2</sub>

Option B CuCO<sub>3</sub>Cu(OH)<sub>2</sub>

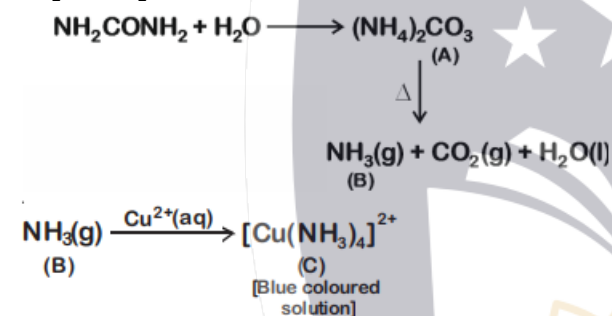
Option C CuSO<sub>4</sub>

Option D [Cu(NH<sub>3</sub>)<sub>4</sub>]<sup>2+</sup>

**Correct Option D**

**Solution:**

NH<sub>2</sub>CONH<sub>2</sub> is urea.



**Q 55. Match the following and identify the correct option.**

(a) CO(g) + H<sub>2</sub>(g)

(b) Temporary hardness of water

(c) B<sub>2</sub>H<sub>6</sub>

(d) H<sub>2</sub>O<sub>2</sub>

(i) Mg(HCO<sub>3</sub>)<sub>2</sub> + Ca(HCO<sub>3</sub>)<sub>2</sub>

(ii) An electron deficient hydride

(iii) Synthesis gas

(iv) Non-planar structure

(a) (b) (c) (d)

Option A (iii) (iv) (ii) (i)

Option B (i) (iii) (ii) (iv)

Option C (iii) (i) (ii) (iv)

Option D (iii) (ii) (i) (iv)

**Correct Option C**

**Solution:**

- Mixture of CO and H<sub>2</sub> gases is known as water gas or synthesis gas.
- Temporary hardness of water is due to bicarbonates of calcium and magnesium.
- Diborane (B<sub>2</sub>H<sub>6</sub>) is an electron deficient hydride..
- H<sub>2</sub>O<sub>2</sub> is non-planar molecule having open book like structure.

**Q 56. The mixture which shows positive deviation from Raoult's law is**

Option A Acetone + Chloroform

Option B Chloroethane + Bromoethane

- Option C Ethanol + Acetone  
 Option D Benzene + Toluene

**Correct Option C**

**Solution:** Hydrogen bond is present in pure ethanol. On adding acetone, its molecules get in between the ethanol molecules and break some of the hydrogen bonds between them. This weakens the intermolecular attractive interactions and the solution shows positive deviation from Raoult's law.

**Q 57. The freezing point depression constant ( $K_f$ ) of benzene is  $5.12 \text{ K kg mol}^{-1}$ . The freezing point depression for the solution of molality  $0.078 \text{ m}$  containing a non-electrolyte solute in benzene is (rounded off upto two decimal places) :**

- Option A 0.40 K  
 Option B 0.60 K  
 Option C 0.20 K  
 Option D 0.80 K

**Correct Option A**

**Solution:**

Depression of freezing point is calculated by-

$$\begin{aligned} \Delta T_f &= k_f m \\ &= 5.12 (\text{K.kg mol}^{-1}) \times 0.078 (\text{mol kg}^{-1}) \\ &= 0.399 \text{ K} \\ &\approx 0.40 \text{ K} \end{aligned}$$

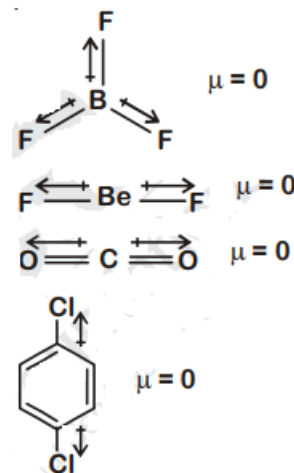
**Q 58. Which of the following set of molecules will have zero dipole moment?**

- Option A Nitrogen trifluoride, beryllium difluoride, water, 1,3-dichlorobenzene  
 Option B Boron trifluoride, beryllium difluoride, carbon dioxide, 1,4-dichlorobenzene  
 Option C Ammonia, beryllium difluoride, water, 1,4-dichlorobenzene  
 Option D Boron trifluoride, hydrogen fluoride, carbon dioxide, 1,3-dichlorobenzene

**Correct Option B**

**Solution:**

Dipole moment is observed by drawing structure of these molecules.



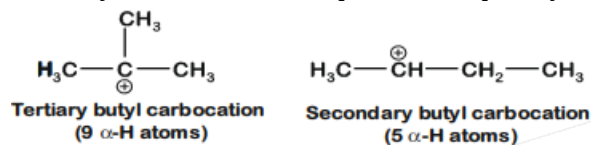
**Q 59. A tertiary butyl carbocation is more stable than a secondary butyl carbocation because of which of the following?**

- Option A – R effect of – CH<sub>3</sub> groups  
 Option B Hyper conjugation  
 Option C – I effect of – CH<sub>3</sub> groups  
 Option D + R effect of – CH<sub>3</sub> groups

**Correct Option B**

**Solution:**

Stability of carbocation depends on alpha hydrogen.



More the number of α-H atoms, more will be the hyperconjugation effect hence more will be the stability of carbocation.

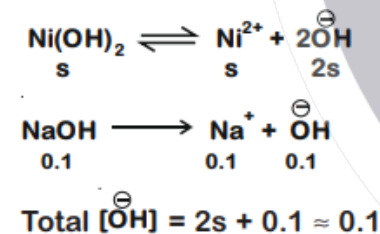
**Q 60. Find out the solubility of Ni(OH)<sub>2</sub> in 0.1 M NaOH. Given that the ionic product of Ni(OH)<sub>2</sub> is 2 × 10<sup>-15</sup>**

- Option A 1 × 10<sup>-13</sup> M  
 Option B 1 × 10<sup>8</sup> M  
 Option C 2 × 10<sup>-13</sup> M  
 Option D 2 × 10<sup>-8</sup> M

**Correct Option C**

**Solution:**

Product of concentrations of ions in product is known as Ionic product.



$$\text{Ionic product} = [\text{Ni}^{2+}] [\text{OH}^-]^2$$

$$2 \times 10^{-15} = s(0.1)^2$$

$$s = 2 \times 10^{-13}$$

$$\text{Solubility of Ni(OH)}_2 = 2 \times 10^{-13} \text{ M}$$

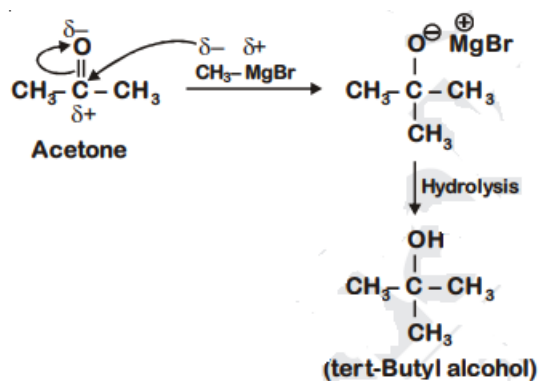
**Q 61. Reaction between acetone and methylmagnesium chloride followed by hydrolysis will give:**

- Option A Tert. butyl alcohol  
 Option B Isobutyl alcohol  
 Option C Isopropyl alcohol  
 Option D Sec. butyl alcohol

**Correct Option A**

**Solution:**

Methylmagnesium chloride is Grignard reagent (R-MgX).

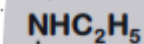


Q 62. Which of the following amine will give the carbylamine test?

Option A



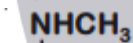
Option B



Option C



Option D

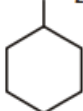
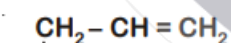


**Correct Option C**

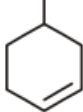
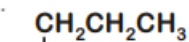
**Solution:** Aliphatic and aromatic primary amines give carbylamine test.

Q 63. An alkene on ozonolysis gives methanal as one of the product. Its structure is

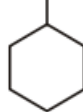
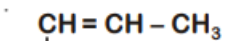
Option A



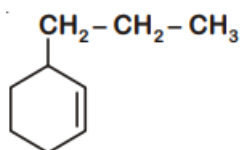
Option B



Option C



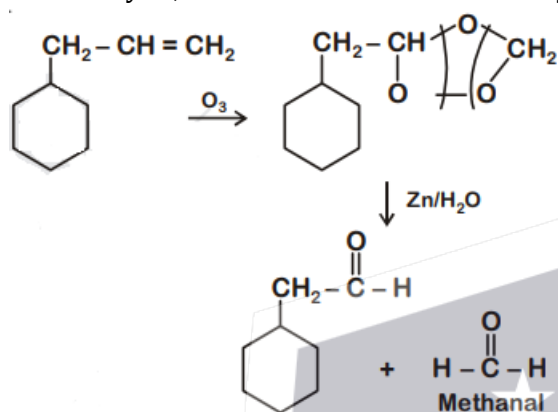
Option D



**Correct Option A**

**Solution:**

In ozonolysis, double bond is broken and oxygen is added.



**Q 64. A mixture of N<sub>2</sub> and Ar gases in a cylinder contains 7 g of N<sub>2</sub> and 8 g of Ar. If the total pressure of the mixture of the gases in the cylinder is 27 bar, the partial pressure of N<sub>2</sub> is : [Use atomic masses (in g mol<sup>-1</sup>) : N = 14, Ar = 40]**

Option A 15 bar

Option B 18 bar

Option C 9 bar

Option D 12 bar

**Correct Option A**

**Solution:**

Number of moles of N<sub>2</sub> and Ar will be-

$$n_{\text{N}_2} = \frac{7}{28} = \frac{1}{4} = 0.25$$

$$n_{\text{Ar}} = \frac{8}{40} = \frac{1}{5} = 0.20$$

Now, Applying Dalton's law of partial

Pressure,  $P_{\text{N}_2} = (x_{\text{N}_2})P_{\text{Total}}$

$$= \frac{0.25}{0.45} \times 27 \text{ Bar}$$

$$= \frac{5}{9} \times 27 = 15 \text{ Bar}$$

**Q 65. Which of the following is the correct order of increasing field strength of ligands to form coordination compounds?**

Option A  $\text{F}^- < \text{SCN}^- < \text{C}_2\text{O}_4^{2-} < \text{CN}^-$

Option B  $\text{CN}^- < \text{C}_2\text{O}_4^{2-} < \text{SCN}^- < \text{F}^-$

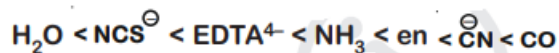
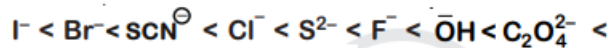
Option C  $\text{SCN}^- < \text{F}^- < \text{C}_2\text{O}_4^{2-} < \text{CN}^-$

Option D  $\text{SCN}^- < \text{F}^- < \text{CN}^- < \text{C}_2\text{O}_4^{2-}$

**Correct Option C**

**Solution:**

Spectrochemical series of ligands is-



**Q 66. Paper chromatography is an example of**

Option A Thin layer chromatography

Option B Column chromatography

Option C Adsorption chromatography

Option D Partition chromatography

**Correct Option D**

**Solution:** It is a type of partition chromatography in which a special quality paper known as chromatography paper is used.

**Q 67. Sucrose on hydrolysis gives**

Option A  $\alpha\text{-D-Glucose} + \beta\text{-D-Fructose}$

Option B  $\alpha\text{-D-Fructose} + \beta\text{-D-Fructose}$

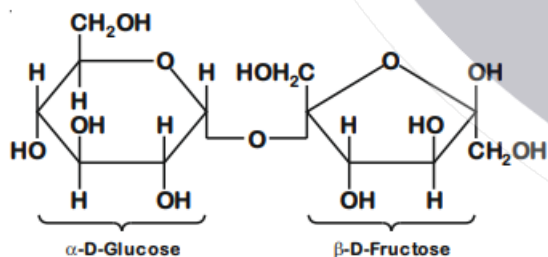
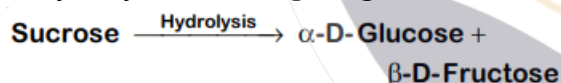
Option C  $\beta\text{-D-Glucose} + \alpha\text{-D-Fructose}$

Option D  $\alpha\text{-D-Glucose} + \beta\text{-D-Glucose}$

**Correct Option A**

**Solution:**

On hydrolysis, Sucrose gives glucose and fructose.



**Q 68. The rate constant for a first order reaction is  $4.606 \times 10^{-3} \text{ s}^{-1}$ . The time required to reduce 2.0 g of the reactant to 0.2 g is:**

Option A 500 s

Option B 1000 s

Option C 100 s

Option D 200 s

**Correct Option A**

**Solution:**

Rate constant of first order is calculated by-

$$k = \frac{2.303}{t} \log \frac{A_0}{A} \quad (\text{First order rate equation})$$

$$4.606 \times 10^{-3} = \frac{2.303}{t} \log \frac{2}{0.2}$$

$$t = \frac{2.303}{4.606 \times 10^{-3}} \times \log 10$$

$$= \frac{10^3}{2} = 500 \text{ sec}$$

**Q 69. Reaction between benzaldehyde and acetophenone in presence of dilute NaOH is known as**

Option A Cross Cannizzaro's reaction

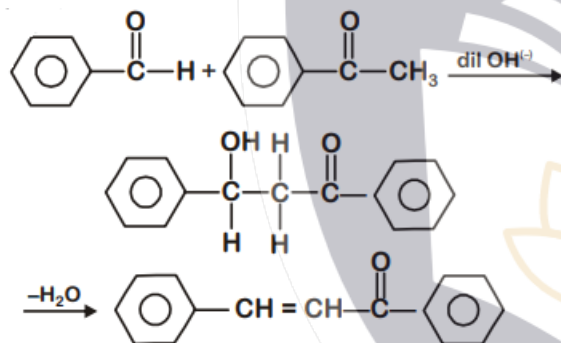
Option B Cross Aldol condensation

Option C Aldol condensation

Option D Cannizzaro's reaction

**Correct Option**

**Solution:**



In the presence of  $\text{dil. OH}^-$ , benzaldehyde and acetophenone will react to undergo aldol condensation. This kind of aldol condensation is known as cross-aldol condensation.

**Q 70. Which of the following is not correct about carbon monoxide?**

Option A The carboxyhaemoglobin (haemoglobin bound to CO) is less stable than ox haemoglobin.

Option B It is produced due to incomplete combustion.

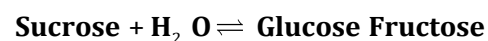
Option C It forms carboxyhaemoglobin

Option D It reduces oxygen carrying ability of blood.

**Correct Option A**

**Solution:** The carboxyhaemoglobin is more stable than oxyhaemoglobin. So, this statement is not correct.

**Q 71. Hydrolysis of sucrose is given by the following reaction.**



If the equilibrium constant ( $K_C$ ) is  $2 \times 10^{13}$  at 300 K, the value of  $\Delta_r G^\ominus$  at the same temperature will be:

Option A  $8.314 \text{ J mol}^{-1}\text{K}^{-1} \times 300 \text{ K} \times \ln(3 \times 10^{13})$

- Option B  $-8.314 \text{ J mol}^{-1}\text{K}^{-1} \times 300 \text{ K} \times \ln(4 \times 10^{13})$   
 Option C  $-8.314 \text{ J mol}^{-1}\text{K}^{-1} \times 300 \text{ K} \times \ln(2 \times 10^{13})$   
 Option D  $8.314 \text{ J mol}^{-1}\text{K}^{-1} \times 300 \text{ K} \times \ln(2 \times 10^{13})$

**Correct Option C**

**Solution:**

Gibbs free energy is calculated by-

$$\Delta G = \Delta G^\circ + RT \ln Q$$

At equilibrium  $\Delta G = 0$ ,  $Q = K_{\text{eq}}$

So  $\Delta_r G^\circ = -RT \ln K_{\text{eq}}$

$$\Delta_r G^\circ = -8.314 \text{ J mol}^{-1} \text{K}^{-1} \times 300 \text{ K} \times \ln (2 \times 10^{13})$$

**Q 72. HCl was passed through a solution of  $\text{CaCl}_2$ ,  $\text{MgCl}_2$  and  $\text{NaCl}$ . Which of the following compound(s) crystallise(s)?**

- Option A Only  $\text{MgCl}_2$   
 Option B  $\text{NaCl}$ ,  $\text{MgCl}_2$  and  $\text{CaCl}_2$   
 Option C Both  $\text{MgCl}_2$  and  $\text{CaCl}_2$   
 Option D Only  $\text{NaCl}$

**Correct Option**

**Solution:** Since  $\text{CaCl}_2$  and  $\text{MgCl}_2$  are more soluble than  $\text{NaCl}$ , on passing  $\text{HCl}_{(\text{g})}$  through a solution containing  $\text{CaCl}_2$ ,  $\text{MgCl}_2$  and  $\text{NaCl}$  then  $\text{NaCl}$  crystallizes out.

**Q 73. An element has a body centered cubic (bcc) structure with a cell edge of 288 pm. The atomic radius is**

- Option A  $\frac{4}{\sqrt{3}} \times 288 \text{ pm}$   
 Option B  $\frac{4}{\sqrt{2}} \times 288 \text{ pm}$   
 Option C  $\frac{\sqrt{3}}{4} \times 288 \text{ pm}$   
 Option D  $\frac{\sqrt{2}}{4} \times 288 \text{ pm}$

**Correct Option C**

**Solution:**

For BCC,

Relation between atomic radius and cell edge is-

$$\sqrt{3}a = 4r \quad \text{a edge length}$$

$$r = \frac{\sqrt{3}a}{4} \quad \text{r radius}$$

Given,  $a = 288 \text{ pm}$

$$r = \frac{\sqrt{3}}{4} \times 288 \text{ pm}$$

**Q 74. Which of the following oxoacid of sulphur has - O - O - linkage?**

- Option A  $\text{H}_2\text{S}_2\text{O}_8$ , peroxodisulphuric acid  
 Option B  $\text{H}_2\text{S}_2\text{O}_7$ , pyrosulphuric acid



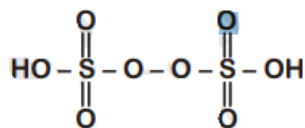
Option C  $\text{H}_2\text{SO}_3$ , sulphurous acid

Option D  $\text{H}_2\text{SO}_4$ , sulphuric acid

**Correct Option**

**Solution:**

From the structure of Peroxodisulphuric acid, you can see one -o-o- linkage is present.



Peroxodisulphuric acid

**Q 75. Identify the incorrect statement.**

Option A Interstitial compounds are those that are formed when small atoms like H, C or N are trapped inside the crystal lattices of metals.

Option B The oxidation states of chromium in  $\text{CrO}_4^{2-}$  and  $\text{Cr}_2\text{O}_7^{2-}$  are not the same.

Option C  $\text{Cr}^{2+}$  ( $d^4$ ) is a stronger reducing agent than  $\text{Fe}^{2+}$  ( $d^6$ ) in water.

Option D The transition metals and their compounds are known for their catalytic activity due to their ability to adopt multiple oxidation states and to form complexes.

**Correct Option B**

**Solution:**

Oxidation state of Cr in  $\text{CrO}_4^{2-}$  is 6.

$$x - 8 = -2$$

$$x = +8 - 2$$

$$x = +6$$

Oxidation state of Cr in  $\text{Cr}_2\text{O}_7^{2-}$  is +6

$$2x - 16 = -2$$

$$2x = +14 - 2$$

$$x = +6$$

**Q 76. Which of the following is a cationic detergent?**

Option A Cetyltrimethyl ammonium bromide

Option B Sodium dodecylbenzene sulphonate

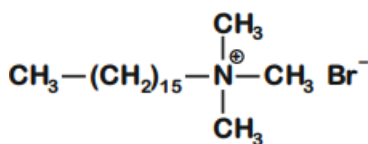
Option C Sodium lauryl sulphate

Option D Sodium stearate

**Correct Option A**

**Solution:**

Cetyltrimethyl ammonium bromide is a cationic detergent.



**Q 77. The correct option for free expansion of an ideal gas under adiabatic condition is**

Option A  $q < 0, \Delta T = 0$  and  $w = 0$

Option B  $q > 0, \Delta T > 0$  and  $w > 0$

Option C  $q = 0, \Delta T = 0$  and  $w = 0$

Option D  $q = 0, \Delta T < 0$  and  $w > 0$

**Correct Option C**

**Solution:** Free expansion  $\Rightarrow P_{\text{ex}} = 0$

Work is calculated by-

$$\therefore w = -P_{\text{ex}} \Delta V = 0$$

$\therefore$  Adiabatic process  $\Rightarrow q = 0$

also,  $\Delta U = q + w$  [ first law of thermodynamics]

$$\therefore \Delta U = 0$$

$\therefore$  Internal energy of an ideal gas is a function of temperature

$\therefore$  If internal energy remains constant

$$\Delta T = 0$$

**Q 78. On electrolysis of dil. sulphuric acid using Platinum (Pt) electrode, the product obtained at anode will be**

Option A  $\text{H}_2\text{S}$  gas

Option B  $\text{SO}_2$  gas

Option C Hydrogen gas

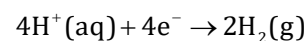
Option D Oxygen gas

**Correct Option D**

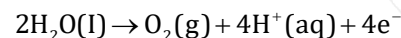
**Solution:**

During the electrolysis of dil. sulphuric acid using Pt electrodes following reaction will take place.

At cathode:



At anode:



So, product obtained at anode is  $\text{O}_2$ .

**Q 79. Identify the correct statement from the following:**

Option A Vapour phase refining is carried out for Nickel by Van Arkel method.

Option B Pig iron can be moulded into a variety of shapes.

Option C Wrought iron is impure iron with 4% carbon.

Option D Blister copper has blistered appearance due to evolution of  $\text{CO}_2$ .

**Correct Option B**

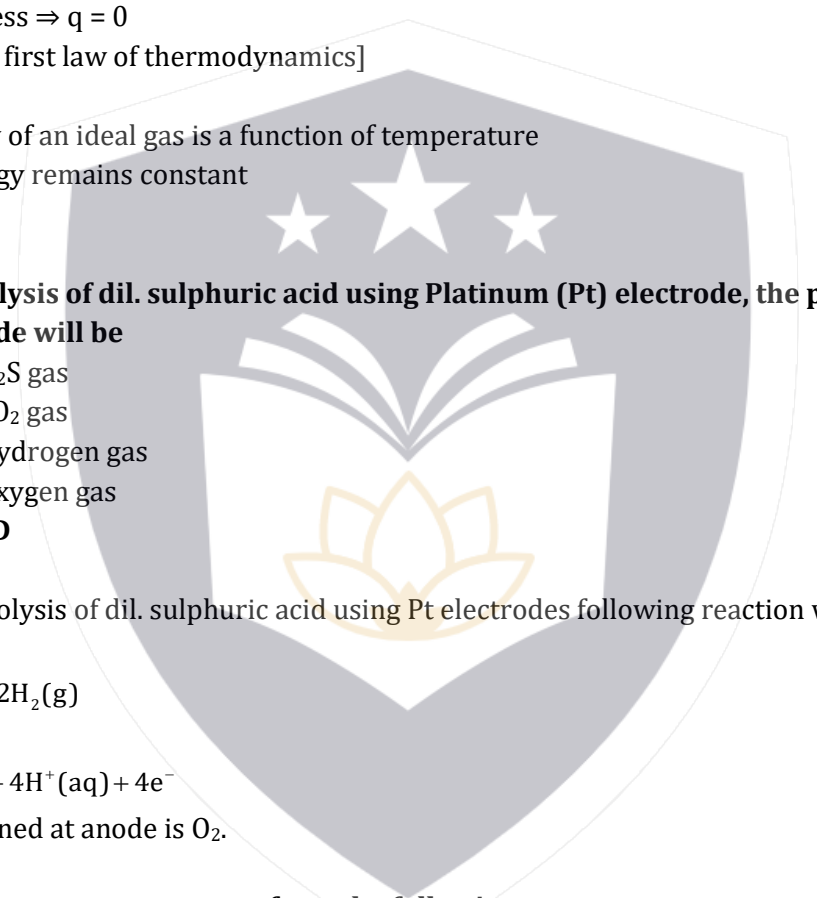
**Solution:** The iron obtained from blast furnace contains about 4% carbon and many impurities like S, P, Si, Mn in smaller amount. This is known as pig iron and cast into variety of shapes.

**Q 80. Which of the following is a basic amino acid ?**

Option A Tyrosine

Option B Lysine

Option C Serine

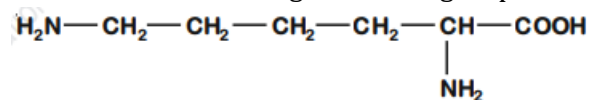


Option D Alanine

**Correct Option B**

**Solution:**

Bases which are having more  $\text{NH}_2$  group than  $\text{COOH}$  group that is basic.



**(Structure of Lysine)**

Lysine is a basic amino acid

**Q 81. Identify the incorrect match.**

Name	IUPAC Official Name
(a) Unnilunium	(i) Mendeleevium
(b) Unniltrium	(ii) Lawrencium
(c) Unnilhexium	(iii) Seaborgium
(d) Unununnium	(iv) Darmstadtium

Option A (c), (iii)

Option B (d), (iv)

Option C (a), (i)

Option D (b), (ii)

**Correct Option B**

**Solution:**

Unununium

Atomic number = 111

IUPAC official name: Roentgenium

**Q 82. Which of the following alkane cannot be made in good yield by Wurtz reaction?**

Option A n-Heptane

Option B n-Butane

Option C n-Hexane

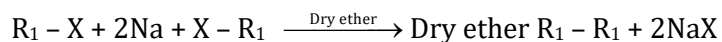
Option D 2,3-Dimethylbutane

**Correct Option A**

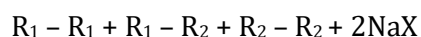
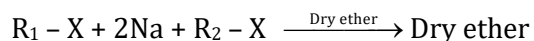
**Solution:**

Wurtz reaction is used to prepare symmetrical

Alkanes like  $\text{R}_1 - \text{R}_1$ , as



If  $\text{R}_1$  and  $\text{R}_2$  are different, then mixture of alkanes may be obtained as



n-Heptane is unsymmetrical .

**Q 83. Elimination reaction of 2-Bromo-pentane to form pent-2-ene is**

(a)  $\beta$ -Elimination reaction

(b) Follows Zaitsev rule

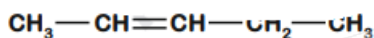
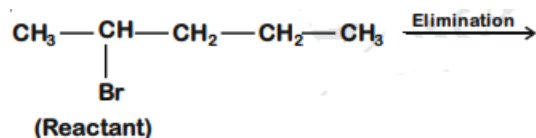
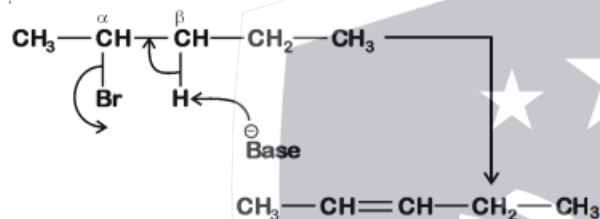
**(c) Dehydrohalogenation reaction****(d) Dehydration reaction**

Option A (b), (c), (d)

Option B (a), (b), (d)

Option C (a), (b), (c)

Option D (a), (c), (d)

**Correct Option B****Solution:****Mechanism:**

Since  $\beta$ -hydrogen is abstracted it is  $\beta$ -elimination.

Since more substituted alkene is formed, it follows zaitsev's rule.

Since 'H' and 'Br' are removed, it is dehydrohalogenation.

**Q 84. The number of Faradays(F) required to produce 20 g of calcium from molten  $\text{CaCl}_2$  (Atomic mass of Ca = 40 g mol<sup>-1</sup>) is**

Option A 3

Option B 4

Option C 1

Option D 2

**Correct Option C**

**Solution:** 1 equivalent of any substance is deposited by 1 F of charge.

We have, 20 g calcium

$$\text{Number of equivalents} = \frac{\text{Given mass}}{\text{Equivalent mass}}$$

$$= \frac{20}{20} = 1$$

$$\text{Equivalent mass of Ca} = \frac{40}{2} = 20$$

So, 1 faraday of charge is required.

**Q 85. Which one of the followings has maximum number of atoms?**

Option A 1 g of  $\text{O}_2$ (g) [Atomic mass of O = 16]

Option B 1 g of Li(s) [Atomic mass of Li = 7]

Option C 1 g of Ag(s) [Atomic mass of Ag = 108]

Option D 1 g of Mg(s) [Atomic mass of Mg = 24]

**Correct Option B**

**Solution:**

Number of atoms = Number of moles  $\times$   $N_A$

- Number of Mg atoms =  $\frac{1}{24} \times N_A$
- Number of O atoms =  $\frac{1}{32} \times 2 \times N_A$
- Number of Li atoms =  $\frac{1}{7} \times N_A$
- Number of Ag atoms =  $\frac{1}{108} \times N_A$

**Q 86. For the reaction,  $2\text{Cl}_{(g)} \rightarrow \text{Cl}_{2(g)}$ , the correct option is :**

- Option A  $\Delta_r H < 0$  and  $\Delta_r S > 0$   
Option B  $\Delta_r H < 0$  and  $\Delta_r S < 0$   
Option C  $\Delta_r H > 0$  and  $\Delta_r S > 0$   
Option D  $\Delta_r H > 0$  and  $\Delta_r S < 0$

**Correct Option B**

**Solution:** Given reaction,  $2\text{Cl}_2(g) \rightarrow \text{Cl}_2(g)$

We know that,

$\text{Cl}_2(g) \rightarrow 2\text{Cl}(g)$  is endothermic reaction because it requires energy to break bond.

So reverse reaction is exothermic  $\Delta_r H < 0$

Also, two gaseous atom combine together to form 1 gaseous molecule.

So, randomness  $\Delta_r S < 0$

**Q 87. Identify the correct statements from the following:**

- (a)  $\text{CO}_2(g)$  is used as refrigerant for ice-cream and frozen food.  
(b) The structure of  $\text{C}_{60}$  contains twelve six carbon rings and twenty five carbon rings.  
(c) ZSM-5, a type of zeolite, is used to convert alcohols into gasoline.  
(d) CO is colorless and odourless gas.

- Option A (b) and (c) only  
Option B (c) and (d) only  
Option C (a), (b) and (c) only  
Option D (a) and (c) only

**Correct Option B**

**Solution:**

- Dry ice,  $\text{CO}_2(s)$ , is used as refrigerant for ice-cream and frozen food.
- $\text{C}_{60}$  contains 20 six membered rings, 12 five membered rings.

**Q 88. Measuring Zeta potential is useful in determining which property of colloidal solution?**

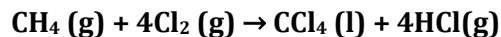
- Option A Stability of the colloidal particles  
Option B Size of the colloidal particles  
Option C Viscosity  
Option D Solubility

**Correct Option A**

**Solution:** In colloidal solution, the potential difference between the fixed layer and the diffused layer of opposite charge is known as Zeta potential.

The presence of equal and similar charges on colloidal particles is largely responsible in providing stability to the colloidal solution.

**Q 89. What is the change in oxidation number of carbon in the following reaction?**



Option A      - 4 to + 4

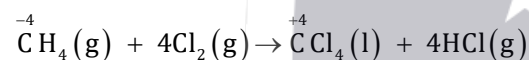
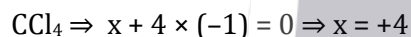
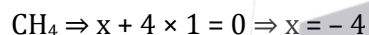
Option B      0 to - 4

Option C      + 4 to + 4

Option D      0 to + 4

**Correct Option A****Solution:**

Oxidation number is calculated by-



Change in oxidation state of carbon is from

-4 to +4

**Q 90. The following metal ion activates many enzymes, participates in the oxidation of glucose to produce ATP and with Na, is responsible for the transmission of nerve signals.**

Option A      Calcium

Option B      Potassium

Option C      Iron

Option D      Copper

**Correct Option B**

**Solution:** Potassium (K) activates many enzymes, participates in oxidation of glucose to produce ATP and helps in the transmission of nerve signal along with Na.

**BIOLOGY**

**Q 91. Presence of which of the following conditions in urine are indicative of Diabetes Mellitus?**

Option A      Ketonuria and Glycosuria

Option B      Renal calculi and Hyperglycaemia

Option C      Uremia and Ketonuria

Option D      Uremia and Renal Calculi

**Correct Option A**

**Solution:** Presence of ketone bodies in urine (Ketonuria) and presence of glucose in urine (Glycosuria) are indicative of diabetes mellitus.

**Q 92. Match the following columns and select the correct option.**

**Column-I**

**Column-II**

- |                    |   |
|--------------------|---|
| (a) Placenta       | (i) Androgens                           |
| (b) Zona pellucida | (ii) Human Chorionic Gonadotropin (hCG) |
| (c) Bulbo-urethral | (iii) Layer of the ovum glands          |
| (d) Leydig cells   | (iv) Lubrication of the Penis           |

	a	b	c	d
Option A	(iii)	(ii)	(iv)	(i)
Option B	(ii)	(iii)	(iv)	(i)
Option C	(iv)	(iii)	(i)	(ii)
Option D	(i)	(iv)	(ii)	(iii)

**Correct Option B**

**Solution:**

- (a) Placenta secretes human chorionic gonadotropin (hCG).  
 (b) Zona pellucida is a primary egg membrane secreted by the secondary oocyte.  
 (c) The secretions of bulbourethral glands help in lubrication of the penis.  
 (d) Leydig cells synthesise and secrete testicular hormones called androgens.

**Q 93. Match the following columns and select the correct option.**

	Column-I		Column-II	
(a) Bt cotton			(i) Gene therapy	
(b) Adenosine deaminase deficiency			(ii) Cellular defence	
(c) RNAi			(iii) Detection of HIV infection	
(d) PCR			(iv) <i>Bacillus thuringiensis</i>	
	(a)	(b)	(c)	(d)
Option A	(ii)	(iii)	(iv)	(i)
Option B	(i)	(ii)	(iii)	(iv)
Option C	(iv)	(i)	(ii)	(iii)
Option D	(iii)	(ii)	(i)	(iv)

**Correct Option C**

**Solution:**

- (a) In Bt cotton the specific Bt toxin gene was isolated from *Bacillus thuringiensis*.  
 (b) The first clinical gene therapy was given in 1990 to a 4-year old girl with adenosine deaminase (ADA) deficiency.  
 (c) RNAi (RNA interference) takes place in all eukaryotic organisms as a method of cellular defence.  
 (d) PCR is now routinely used to detect HIV in suspected AIDS patients.

**Q 94. The sequence that controls the copy number of the linked DNA in the vector, is termed**

- Option A Palindromic sequence  
 Option B Recognition site  
 Option C Selectable marker  
 Option D Ori site

**Correct Option D**

**Solution:** Ori sequence is responsible for controlling the copy number of the linked DNA in the vector. Ori i.e. origin of replication is responsible for initiation of replication.

**Q 95. Match the following columns and select the correct option.**

**Column-I**

- (a) 6-15 pairs of gill slits
- (b) Heterocercal caudal fin
- (c) Air Bladder
- (d) Poison sting

**Column-II**

- (i) Trygon
- (ii) Cyclostomes
- (iii) Chondrichthyes
- (iv) Osteichthyes

	(a)	(b)	(c)	(d)
Option A	(iv)	(ii)	(iii)	(i)
Option B	(i)	(iv)	(iii)	(ii)
Option C	(ii)	(iii)	(iv)	(i)
Option D	(iii)	(iv)	(i)	(ii)

**Correct Option C**

**Solution:** Cyclostomes have an elongated body bearing 6-15 pairs of gill slits for respiration. Air bladder is present in bony fishes belonging to class Osteichthyes which regulates buoyancy. Trygon, a cartilaginous fish, possesses poison sting. Heterocercal caudal fin is present in members of class Chondrichthyes.

**Q 96. In which of the following techniques, the embryos are transferred to assist those females who cannot conceive?**

- Option A ICSI and ZIFT
- Option B GIFT and ICSI
- Option C ZIFT and IUT
- Option D GIFT and ZIFT

**Correct Option C**

**Solution:** ART in which embryos are transferred, include ZIFT and IUT i.e. Zygote Intrafallopian Transfer and Intra Uterine Transfer respectively, both are embryo transfer (ET) methods. In GIFT (Gamete Intrafallopian Transfer), gamete is transferred into the fallopian tube of female who cannot produce ova. ICSI is Intra cytoplasmic sperm injection in which sperm is directly injected into the ovum.

**Q 97. Select the correct events that occur during inspiration.**

- (a) Contraction of diaphragm
- (b) Contraction of external inter-costal muscles
- (c) Pulmonary volume decreases
- (d) Intra pulmonary pressure increases

- Option A (a), (b) and (d)
- Option B only (d)
- Option C (a) and (b)
- Option D (c) and (d)

**Correct Option C**

**Solution:** Inspiration is initiated by the contraction of diaphragm, which increases the volume of thoracic chamber in the antero-posterior axis. The contraction of external intercostal muscles increase the volume of the thoracic chamber in the dorsoventral axis.

**Q 98. The QRS complex in a standard ECG represents**

- Option A Depolarisation of ventricles
- Option B Repolarisation of ventricles



- Option C Repolarisation of auricles  
Option D Depolarisation of auricles

**Correct Option A**

**Solution:** QRS complex represents the depolarisation of ventricles.

**Q 99. The enzyme enterokinase helps in conversion of**

- Option A caseinogen into casein  
Option B pepsinogen into pepsin  
Option C protein into polypeptides  
Option D trypsinogen into trypsin

**Correct Option D**

**Solution:** Trypsinogen is activated into active trypsin by an enzyme, enterokinase, secreted by the intestinal mucosa. Trypsinogen is a zymogen from pancreas.

**Q 100. Identify the correct statement with reference to human digestive system.**

- Option A Ileum is a highly coiled part.  
Option B Vermiform appendix arises from duodenum.  
Option C Ileum opens into small intestine.  
Option D Serosa is the innermost layer of the alimentary canal.

**Correct Option A**

**Solution:** Ileum is a highly coiled tube. Serosa is the outermost layer of the alimentary canal. A narrow finger-like tubular projection, the vermiform appendix arises from caecum part of large intestine. Ileum opens into the large intestine.

**Q 101. Ray florets have**

- Option A Hypogynous ovary  
Option B Half inferior ovary  
Option C Inferior ovary  
Option D Superior ovary

**Correct Option C**

**Solution:** Ray florets have inferior ovary. Epigynous flowers are formed in family Asteraceae (e.g., Sunflower).

**Q 102. Which of the following is put into anaerobic sludge digester for further sewage treatment?**

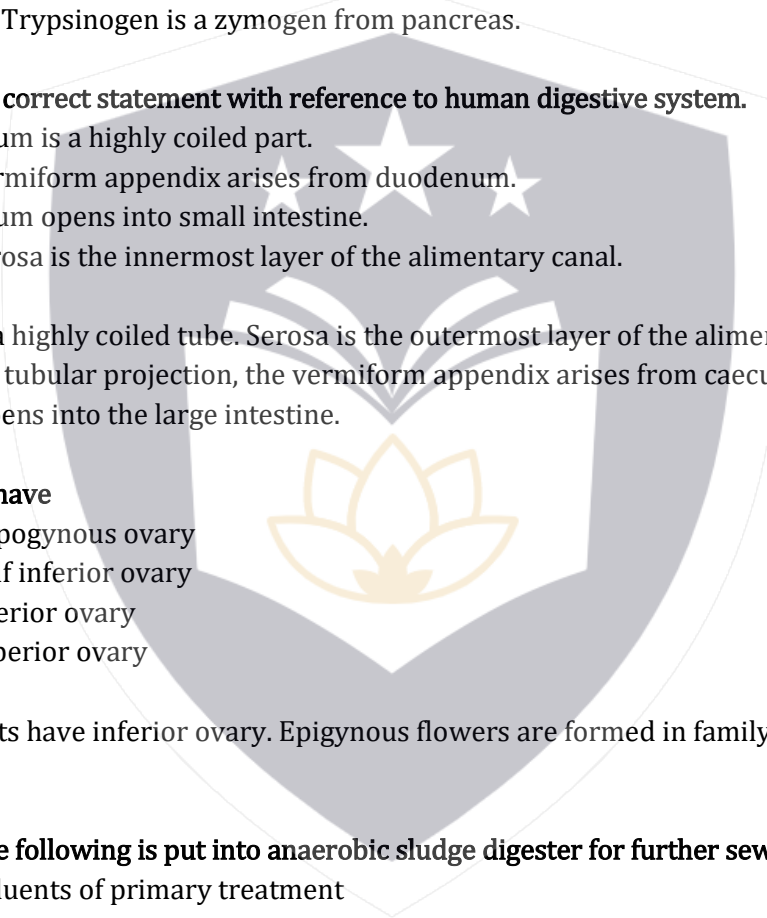
- Option A Effluents of primary treatment  
Option B Activated sludge  
Option C Primary sludge  
Option D Floating debris

**Correct Option B**

**Solution:** The sediment in settlement tank is called activated sludge. A small part of the activated sludge is pumped back into aeration tank. Remaining major part of the sludge is pumped into large tank called anaerobic sludge digesters.

**Q 103. The number of substrate level phosphorylations in one turn of citric acid cycle is**

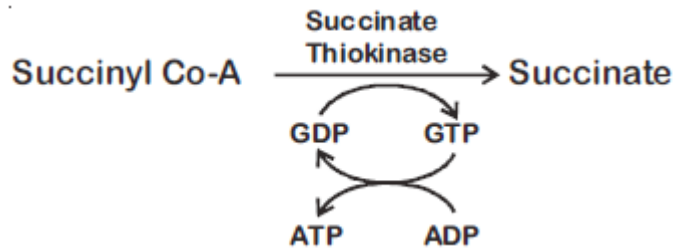
- Option A Two  
Option B Three  
Option C Zero



Option D One

**Correct Option D**

**Solution:** One substrate level phosphorylation in one turn of citric acid cycle occurs as per the following reaction:



**Q 104. Identify the correct statement with regard to G<sub>1</sub> phase (Gap<sub>1</sub>) of interphase.**

Option A Cell is metabolically active, grows but does not replicate its DNA.

Option B Nuclear Division takes place.

Option C DNA synthesis or replication takes place.

Option D Reorganisation of all cell components takes place.

**Correct Option A**

**Solution:** During G<sub>1</sub> phase the cell is metabolically active and continuously grows but does not replicate its DNA. DNA synthesis takes place in S phase. Nuclear division occurs during karyokinesis. Reorganisation of all cell components takes place in M-Phase.

**Q 105. Which of the following pairs is of unicellular algae?**

Option A *Anabaena* and *Volvox*

Option B *Chlorella* and *Spirulina*

Option C *Laminaria* and *Sargassum*

Option D *Gelidium* and *Gracilaria*

**Correct Option B**

**Solution:** *Chlorella* and *Spirulina* are unicellular algae. *Gelidium*, *Gracilaria*, *Laminaria* and *Sargassum* are multicellular. *Volvox* is colonial.

**Q 106. Identify the wrong statement with reference to immunity.**

Option A Active immunity is quick and gives full response.

Option B Foetus receives some antibodies from mother, it is an example for passive immunity.

Option C When exposed to antigen (living or dead) antibodies are produced in the host's body. It is called "Active immunity".

Option D When ready-made antibodies are directly given, it is called "Passive immunity".

**Correct Option A**

**Solution:** Active immunity is slow and takes time to give its full effective response in comparison to passive immunity where pre-formed antibodies are administered.

**Q 107. Match the following columns and select the correct option.**

Column-I	Column-II
(a) Floating Ribs	(i) Located between second and seventh ribs
(b) Acromion	(ii) Head of the humerus

(c) Scapula	(iii) Clavicle
(d) Glenoid cavity	(iv) Do not connect with the sternum

	(a)	(b)	(c)	(d)
Option A	(iii)	(ii)	(iv)	(i)
Option B	(iv)	(iii)	(i)	(ii)
Option C	(ii)	(iv)	(i)	(iii)
Option D	(i)	(iii)	(ii)	(iv)

**Correct Option B**

**Solution:**

- (a) 11<sup>th</sup> and 12<sup>th</sup> pairs of ribs are not connected ventrally and are therefore, called floating ribs.  
 (b) Acromion is a flat expanded process of spine of scapula. The lateral end of clavicle articulates with acromion process.  
 (c) Scapula is a flat triangular bone in the dorsal part of the thorax between 2<sup>nd</sup> and the 7<sup>th</sup> rib.  
 (d) Glenoid cavity of scapula articulates with head of the humerus to form the shoulder joint.

**Q 108. Identify the basic amino acid from the following.**

- Option A Lysine  
 Option B Valine  
 Option C Tyrosine  
 Option D Glutamic Acid

**Correct Option A**

**Solution:** Lysine is a basic amino acid. Valine is a neutral amino acid. Glutamic acid is an acidic amino acid while Tyrosine is an aromatic amino acid.

**Q 109. The plant parts which consist of two generations - one within the other**

- (a) Pollen grains inside the anther  
 (b) Germinated pollen grain with two male gametes  
 (c) Seed inside the fruit  
 (d) Embryo sac inside the ovule

- Option A (c) and (d)  
 Option B (a) and (d)  
 Option C (a) only  
 Option D (a), (b) and (c)

**Correct Option B**

**Solution:** The plant parts which consist of two generations one within the other are pollen grains inside the anther and embryo sac inside the ovule. Pollen grain is haploid inside the diploid anther. Embryo sac is haploid inside the diploid ovule.

**Q 110. Identify the wrong statement with reference to transport of oxygen.**

- Option A Higher H<sup>+</sup> conc. in alveoli favours the formation of oxyhaemoglobin  
 Option B Low pCO<sub>2</sub> in alveoli favours the formation of oxyhaemoglobin  
 Option C Binding of oxygen with haemoglobin is mainly related to partial pressure of O<sub>2</sub>  
 Option D Partial pressure of CO<sub>2</sub> can interfere with O<sub>2</sub> binding with haemoglobin

**Correct Option A**

**Solution:** Higher  $H^+$  concentration favours the dissociation of oxygen from oxyhaemoglobin in tissues. In the alveoli, high  $pO_2$ , low  $pCO_2$ , lesser  $H^+$  concentration and lower temperature favour formation of oxyhaemoglobin.

**Q 111. Match the following columns and select the correct option.**

Column-I	Column-II
(a) Organ of Corti	(i) Connects middle ear and pharynx
(b) Cochlea	(ii) Coiled part of the labyrinth
(c) Eustachian tube	(iii) Attached to the oval window
(d) Stapes	(iv) Located on the basilar membrane

	(a)	(b)	(c)	(d)
Option A	(iv)	(ii)	(i)	(iii)
Option B	(i)	(ii)	(iv)	(iii)
Option C	(ii)	(iii)	(i)	(iv)
Option D	(iii)	(i)	(iv)	(ii)

**Correct Option A**

**Solution:**

- Organ of Corti is located on the basilar membrane.
- The coiled portion of the labyrinth is called cochlea.
- The Eustachian tube connects the middle ear cavity with the pharynx.
- The middle ear contains ossicle called stapes that is attached to the oval window of the cochlea.

**Q 112. Name the plant growth regulator which upon spraying on sugarcane crop, increases the length of stem, thus increasing the yield of sugarcane crop.**

Option A	Ethylene
Option B	Absciscic acid
Option C	Cytokinin
Option D	Gibberellin

**Correct Option D**

**Solution:** Spraying sugarcane crop with gibberellins increases the length of the stem, thus increasing the yield by as much as 20 tonnes per acre.

**Q 113. The roots that originate from the base of the stem are**

Option A	Prop roots
Option B	Lateral roots
Option C	Fibrous roots
Option D	Primary roots

**Correct Option C**

**Solution:** The roots that originate from the base of the stem are fibrous roots.

**Q 114. If the head of cockroach is removed, it may live for few days because**

Option A	the head holds a small proportion of a nervous system while the rest is situated along the ventral part of its body.
Option B	the head holds a 1/3rd of a nervous system while the rest is situated along the dorsal part of its body.

Option C the supra-oesophageal ganglia of the cockroach are situated in ventral part of abdomen.

Option D the cockroach does not have nervous system.

**Correct Option A**

**Solution:** The head holds a small proportion of a nervous system while the rest is situated along the ventral part of its body.

**Q 115. Strobili or cones are found in**

Option A *Marchantia*

Option B *Equisetum*

Option C *Salvinia*

Option D *Pteris*

**Correct Option B**

**Solution:** Strobili or cones are found in *Equisetum*.

**Q 116. Dissolution of the synaptonemal complex occurs during**

Option A Diplotene

Option B Leptotene

Option C Pachytene

Option D Zygotene

**Correct Option A**

**Solution:** Dissolution of the synaptonemal complex occurs during Diplotene stage of Prophase-I of Meiosis-I.

**Q 117. Match the following diseases with the causative organism and select the correct option.**

Column-I	Column-II
(a) Typhoid	(i) <i>Wuchereria</i>
(b) Pneumonia	(ii) <i>Plasmodium</i>
(c) Filariasis	(iii) <i>Salmonella</i>
(d) Malaria	(iv) <i>Haemophilus</i>

	(a)	(b)	(c)	(d)
Option A	(ii)	(i)	(iii)	(iv)
Option B	(iv)	(i)	(ii)	(iii)
Option C	(i)	(iii)	(ii)	(iv)
Option D	(iii)	(iv)	(i)	(ii)

**Correct Option D**

**Solution:** Typhoid fever in humans is caused by pathogenic bacterium *Salmonella typhi*. Pneumonia is caused by *Streptococcus pneumoniae* and *Haemophilus influenzae*. Filariasis or elephantiasis is caused by the filarial worm, *Wuchereria bancrofti* and *Wuchereria malayi*. Malaria is caused by different species of *Plasmodium*.

**Q 118. The first phase of translation is**

Option A Aminoacylation of tRNA

Option B Recognition of an anti-codon

Option C Binding of mRNA to ribosome

Option D Recognition of DNA molecule

**Correct Option A**

**Solution:** The first phase of translation involves activation of amino acid in the presence of ATP and linked to their cognate tRNA – a process commonly called charging of tRNA or aminoacylation of tRNA.

**Q 119. Match the following columns and select the correct option.**

Column-I	Column-II
(a) <i>Clostridium butylicum</i>	(i) Cyclosporin-A
(b) <i>Trichoderma polysporum</i>	(ii) Butyric Acid
(c) <i>Monascus purpureus</i>	(iii) Citric Acid
(d) <i>Aspergillus niger</i>	(iv) Blood cholesterol lowering agent

	<b>(a)</b>	<b>(b)</b>	<b>(c)</b>	<b>(d)</b>
Option A	(i)	(ii)	(iv)	(iii)
Option B	(iv)	(iii)	(ii)	(i)
Option C	(iii)	(iv)	(ii)	(i)
Option D	(ii)	(i)	(iv)	(iii)

**Correct Option D**

**Solution:**

Column-I	Column-II
(a) <i>Clostridium butylicum</i>	(i) Butyric acid
(b) <i>Trichoderma polysporum</i>	(ii) Cyclosporin-A
(c) <i>Monascus purpureus</i>	(iii) Blood cholesterol lowering agent
(d) <i>Aspergillus niger</i>	(iv) Citric acid

**Q 120. The oxygenation activity of RuBisCo enzyme in photorespiration leads to the formation of**

Option A	1 molecule of 6-C compound
Option B	1 molecule of 4-C compound and 1 molecule of 2-C compound
Option C	2 molecules of 3-C compound
Option D	1 molecule of 3-C compound

**Correct Option D**

**Solution:** In photorespiration, O<sub>2</sub> binds to RubisCo. As a result RuBP instead of being converted to 2 molecules of PGA bind with O<sub>2</sub> to form one molecule each of phosphoglycerate (3 carbon compound) and phosphoglycolate (2 carbon compound).

**Q 121. Match the following concerning essential elements and their functions in plants**

Column-I	Column-II
(a) Iron	(i) Photolysis of water
(b) Zinc	(ii) Pollen germination
(c) Boron	(iii) Required for chlorophyll biosynthesis
(d) Manganese	(iv) IAA biosynthesis

	<b>(a)</b>	<b>(b)</b>	<b>(c)</b>	<b>(d)</b>
Option A	(iii)	(iv)	(ii)	(i)
Option B	(iv)	(i)	(ii)	(iii)
Option C	(ii)	(i)	(iv)	(iii)
Option D	(iv)	(iii)	(ii)	(i)

**Correct Option A**

**Solution:**

- (a) Iron – Essential for the formation of chlorophyll
- (b) Zinc – Needed for synthesis of auxin
- (c) Boron – Have a role in pollen grain germination
- (d) Manganese – Is involved in the splitting of water to liberate  $O_2$  during photosynthesis

**Q 122. Name the enzyme that facilitates opening of DNA helix during transcription.**

- Option A DNA polymerase
- Option B RNA polymerase
- Option C DNA ligase
- Option D DNA helicase

**Correct Option B**

**Solution:** RNA polymerase facilitates opening of DNA helix during transcription.

**Q 123. From his experiments, S.L. Miller produced amino acids by mixing the following in a closed flask.**

- Option A  $CH_4$ ,  $H_2$ ,  $NH_3$  and water vapor at  $600^\circ C$
- Option B  $CH_3$ ,  $H_2$ ,  $NH_3$  and water vapor at  $600^\circ C$
- Option C  $CH_4$ ,  $H_2$ ,  $NH_3$  and water vapor at  $800^\circ C$
- Option D  $CH_3$ ,  $H_2$ ,  $NH_4$  and water vapor at  $800^\circ C$

**Correct Option C**

**Solution:** In 1953, S.L. Miller, an American scientist created electric discharge in a closed flask containing  $CH_4$ ,  $H_2$ ,  $NH_3$  and water vapor at  $800^\circ C$ .

**Q 124. Goblet cells of alimentary canal are modified from**

- Option A Chondrocytes
- Option B Compound epithelial cells
- Option C Squamous epithelial cells
- Option D Columnar epithelial cells

**Correct Option D**

**Solution:** Goblet cells of alimentary canal are modified from columnar epithelial cells which secrete mucus.

**Q 125. Cuboidal epithelium with brush border of microvilli is found in**

- Option A Proximal convoluted tubule of nephron
- Option B Eustachian tube
- Option C Lining of intestine
- Option D Ducts of salivary gland

**Correct Option A**

**Solution:** Cuboidal epithelium with brush border of microvilli is found in proximal convoluted tubule of nephron (PCT).

**Q 126. In light reaction, plastoquinone facilitates the transfer of electrons from**

- Option A PS-I to  $NADP^+$
- Option B PS-I to ATP synthase
- Option C PS-II to Cytb<sub>6</sub>f complex

Option D Cyt<sub>b</sub>f complex to PS-I

**Correct Option C**

**Solution:** After excitement, e<sup>-</sup> is passed from PS-II (P<sub>680</sub>) to primary electron acceptor (Pheophytin). From primary e<sup>-</sup> acceptor, e<sup>-</sup> is passed to plastoquinone. Plastoquinone (PQ) in turn transfer its e<sup>-</sup> to Cyt b<sub>6</sub>f complex. Therefore plastoquinone facilitates the transfer of electrons from PS-II to Cyt b<sub>6</sub>f complex.

**Q 127. If the distance between two consecutive base pairs is 0.34 nm and the total number of base pairs of a DNA double helix in a typical mammalian cell is  $6.6 \times 10^9$  bp, then the length of the DNA is approximately**

Option A 2.2 meters

Option B 2.7 meters

Option C 2.0 meters

Option D 2.5 meters

**Correct Option A**

**Solution:** Distance between 2 base pairs in DNA helix = 0.34 nm =  $0.34 \times 10^{-9}$  m.

Total number of base pairs =  $6.6 \times 10^9$  bp

Therefore, length of DNA =  $[0.34 \times 10^{-9}] \text{ m} \times 6.6 \times 10^9 \text{ bp} = 2.2 \text{ m}$ .

**Q 128. Which is the important site of formation of glycoproteins and glycolipids in eukaryotic cells?**

Option A Golgi bodies

Option B Polysomes

Option C Endoplasmic reticulum

Option D Peroxisomes

**Correct Option A**

**Solution:** Golgi bodies are site of formation of glycoproteins and glycolipids in eukaryotic cells.

**Q 129. Which of the following statements is not correct?**

Option A The functional insulin has A and B chains linked together by hydrogen bonds.

Option B Genetically engineered insulin is produced in *E.coli*.

Option C In man insulin is synthesised as proinsulin.

Option D The proinsulin has an extra peptide called C-peptide.

**Correct Option A**

**Solution:** The functional insulin has A and B chains linked together by disulphide bridges.

**Q 130. Identify the incorrect statement.**

Option A Sapwood is the innermost secondary xylem and is lighter in colour

Option B Due to deposition of tannins, resins, oils etc., heart wood is dark in colour

Option C Heart wood does not conduct water but gives mechanical support

Option D Sapwood is involved in conduction of water and minerals from root to leaf

**Correct Option A**

**Solution:** Sapwood is the outermost secondary xylem.

**Q 131. Floridean starch has structure similar to**

Option A Mannitol and algin

Option B Laminarin and cellulose

Option C Starch and cellulose



Option D Amylopectin and glycogen

**Correct Option D**

**Solution:** Floridean starch is a stored food material in red algae. Its structure is similar to amylopectin and glycogen.

**Q 132. Match the following with respect to meiosis.**

- |                |                     |
|----------------|---------------------|
| (a) Zygotene   | (i) Terminalization |
| (b) Pachytene  | (ii) Chiasmata      |
| (c) Diplotene  | (iii) Crossing over |
| (d) Diakinesis | (iv) Synapsis       |

- |          | (a)   | (b)   | (c)  | (d)   |
|----------|-------|-------|------|-------|
| Option A | (iii) | (iv)  | (ii) | (i)   |
| Option B | (iv)  | (i)   | (ii) | (iii) |
| Option C | (ii)  | (i)   | (iv) | (iii) |
| Option D | (iv)  | (iii) | (ii) | (i)   |

**Correct Option D**

**Solution:**

- |            |   |                     |
|------------|---|---------------------|
| Zygotene   | → | Synapsis            |
| Pachytene  | → | Crossing over       |
| Diplotene  | → | Chiasmata formation |
| Diakinesis | → | Terminalisation     |

**Q 133. Match the following columns and select the correct option.**

Column-I	Column-II
(a) Eosinophils	(i) Immune response
(b) Basophils	(ii) Phagocytosis
(c) Neutrophils	(iii) Release histaminase, destructive enzymes
(d) Lymphocytes	(iv) Release granules containing histamine

- |          | (a)   | (b)  | (c)   | (d)   |
|----------|-------|------|-------|-------|
| Option A | (i)   | (ii) | (iv)  | (iii) |
| Option B | (ii)  | (i)  | (iii) | (iv)  |
| Option C | (iii) | (iv) | (ii)  | (i)   |
| Option D | (iv)  | (i)  | (ii)  | (iii) |

**Correct Option C**

**Solution:** Eosinophils are associated with allergic reactions and release histaminase, destructive enzymes. Basophils secrete histamine, serotonin, heparin etc. and are involved in inflammatory reactions. Neutrophils are phagocytic cells. Both B and T lymphocytes are responsible for immune responses of the body.

**Q 134. The process of growth is maximum during**

- Option A Senescence  
Option B Dormancy  
Option C Log phase  
Option D Lag phase

**Correct Option C**

**Solution:** In exponential growth, the initial growth is slow (lag phase) and it increases rapidly thereafter at an exponential rate in log or exponential phase.

**Q 135. Match the following**

- |                                     |               |
|-------------------------------------|---------------|
| (a) Inhibitor of catalytic activity | (i) Ricin     |
| (b) Possess peptide bonds           | (ii) Malonate |
| (c) Cell wall material in fungi     | (iii) Chitin  |
| (d) Secondary metabolite            | (iv) Collagen |

Choose the correct option from the following

- |          | (a)   | (b)   | (c)   | (d)  |
|----------|-------|-------|-------|------|
| Option A | (iii) | (iv)  | (i)   | (ii) |
| Option B | (ii)  | (iii) | (i)   | (iv) |
| Option C | (ii)  | (iv)  | (iii) | (i)  |
| Option D | (iii) | (i)   | (iv)  | (ii) |

**Correct Option C**

**Solution:** Malonate is the competitive inhibitor of catalytic activity of succinic dehydrogenase. Collagen is proteinaceous in nature and possesses peptide bonds. Chitin is a homopolymer present in the cell wall of fungi and exoskeleton of arthropods. Abrin and ricin are toxins, secondary metabolites.

**Q 136. Some dividing cells exit the cell cycle and enter vegetative inactive stage. This is called quiescent stage ( $G_0$ ). This process occurs at the end of**

- Option A S phase  
Option B  $G_2$  phase  
Option C M phase  
Option D  $G_1$  phase

**Correct Option C**

**Solution:** Some dividing cells exit the cell cycle and enter vegetative inactive stage, called quiescent stage ( $G_0$ ). This process occurs at the end of M-phase and beginning of  $G_1$  phase.

**Q 137. Which of the following would help in prevention of diuresis?**

- Option A Atrial natriuretic factor causes vasoconstriction  
Option B Decrease in secretion of renin by JG cells  
Option C More water reabsorption due to undersecretion of ADH  
Option D Reabsorption of  $Na^+$  and water from renal tubules due to aldosterone

**Correct Option D**

**Solution:** Adrenal cortex secretes mineralocorticoids like aldosterone which increase the reabsorption of  $Na^+$  and water from renal tubule that prevent diuresis.

**Q 138. Which of the following is correct about viroids?**

- Option A They have DNA with protein coat  
Option B They have free DNA without protein coat  
Option C They have RNA with protein coat  
Option D They have free RNA without protein coat

**Correct Option D**

**Solution:** Viroids have free RNA without protein coat.

**Q 139. The infectious stage of *Plasmodium* that enters the human body is**

- Option A Female gametocytes
- Option B Male gametocytes
- Option C Trophozoites
- Option D Sporozoites

**Correct Option D**

**Solution:** *Plasmodium* enters the human body as sporozoites (infectious stage) through the bite of infected female *Anopheles* mosquito.

**Q 140. Which of the following statements is correct?**

- Option A Adenine pairs with thymine through three H-bonds
- Option B Adenine does not pair with thymine
- Option C Adenine pairs with thymine through two H-bonds
- Option D Adenine pairs with thymine through one H-bond

**Correct Option C**

**Solution:** Adenine pairs with thymine through two H-bonds i.e., A = T

**Q 141. Flippers of Penguins and Dolphins are examples of**

- Option A Industrial melanism
- Option B Natural selection
- Option C Adaptive radiation
- Option D Convergent evolution

**Correct Option D**

**Solution:** Flippers of Penguins and Dolphins are an example of analogous organs. Analogous structures are a result of convergent evolution.

**Q 142. Montreal protocol was signed in 1987 for control of**

- Option A Release of Green House gases
- Option B Disposal of e-wastes
- Option C Transport of Genetically modified organisms from one country to another
- Option D Emission of ozone depleting substances

**Correct Option D**

**Solution:** Montreal protocol was signed in 16 Sep, 1987 (Ozone day) and came into force on 1 Jan, 1989. It was aimed at stopping the production and import of ozone depleting substances (ODS) and reduce their concentration in the atmosphere.

**Q 143. Identify the wrong statement with regard to Restriction Enzymes.**

- Option A They are useful in genetic engineering.
- Option B Sticky ends can be joined by using DNA ligases.
- Option C Each restriction enzyme functions by inspecting the length of a DNA sequence.
- Option D They cut the strand of DNA at palindromic sites.

**Correct Option B**

**Solution:** Restriction endonucleases make cuts at specific positions within the DNA. They function by inspecting the length of a DNA sequence. Restriction endonuclease bind to the DNA and cut the two strands of double helix at specific points in their sugar-phosphate backbones. They are used in genetic engineering to form recombinant molecules of DNA. DNA ligases join the DNA fragments.

**Q 144. By which method was a new breed 'Hisardale' of sheep formed by using Bikaneri ewes and Marino rams?**

- Option A Cross breeding  
Option B Inbreeding  
Option C Out crossing  
Option D Mutational breeding

**Correct Option A**

**Solution:** Hisardale is a new breed of sheep developed in Punjab by crossing Bikaneri ewes and Marino rams. In cross-breeding, superior males of one breed are mated with superior females of another breed.

**Q 145. Which of the following refer to correct example(s) of organisms which have evolved due to changes in environment brought about by anthropogenic action?**

- (a) Darwin's Finches of Galapagos islands.  
(b) Herbicide resistant weeds.  
(c) Drug resistant eukaryotes.  
(d) Man-created breeds of domesticated animals like dogs.

- Option A (b), (c) and (d)  
Option B only (d)  
Option C only (a)  
Option D (a) and (c)

**Correct Option A**

**Solution:**

- Herbicide resistant weeds, drug resistant eukaryotes and man-created breeds of domesticated animals like dogs are examples of evolution by anthropogenic action.
- Darwin's Finches of Galapagos islands are example of natural selection, adaptive radiation and founder's effect.

**Q 146. Meiotic division of the secondary oocyte is completed**

- Option A After zygote formation  
Option B At the time of fusion of a sperm with an ovum  
Option C Prior to ovulation  
Option D At the time of copulation

**Correct Option B**

**Solution:** Meiotic division of secondary oocyte is completed after the entry of sperm in secondary oocyte which lead to the formation of a large ovum and a tiny 2<sup>nd</sup> polar body.

**Q 147. In relation to Gross primary productivity and Net primary productivity of an ecosystem, which one of the following statements is correct?**

- Option A Gross primary productivity and Net primary productivity are one and same  
Option B There is no relationship between Gross primary productivity and Net primary productivity  
Option C Gross primary productivity is always less than net primary productivity  
Option D Gross primary productivity is always more than net primary productivity

**Correct Option D**

**Solution:** Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis. Net primary productivity is  $GPP - \text{respiration}$ , hence gross primary productivity is always more than NPP

**Q 148. Identify the wrong statement with reference to the gene 'I' that controls ABO blood groups.**

- Option A When  $I^A$  and  $I^B$  are present together, they express same type of sugar.  
Option B Allele 'i' does not produce any sugar.  
Option C The gene (I) has three alleles.  
Option D A person will have only two of the three alleles.

**Correct Option A**

**Solution:** ABO blood groups are controlled by the gene I. The gene I has three alleles  $I^A$ ,  $I^B$  and i. The alleles  $I^A$  and  $I^B$  produce a slightly different form of the sugar while allele i does not produce any sugar. Because humans are diploid organisms, each person can possess at the most any two of the three I gene alleles.

**Q 149. Match the following columns and select the correct option.**

**Column-I**

- (a) Pituitary gland  
(b) Thyroid gland  
(c) Adrenal gland  
(d) Pancreas

**Column-II**

- (i) Grave's disease  
(ii) Diabetes mellitus  
(iii) Diabetes insipidus  
(iv) Addison's disease

- |          |       |       |      |       |
|----------|-------|-------|------|-------|
|          | (a)   | (b)   | (c)  | (d)   |
| Option A | (iii) | (i)   | (iv) | (ii)  |
| Option B | (ii)  | (i)   | (iv) | (iii) |
| Option C | (iv)  | (iii) | (i)  | (ii)  |
| Option D | (iii) | (ii)  | (i)  | (iv)  |

**Correct Option A**

**Solution:** Graves' disease is due to excess secretion of thyroid hormones ( $T_3$  &  $T_4$ ). Diabetes mellitus is due to hyposecretion of insulin from  $\beta$ -cells of pancreas. Diabetes insipidus is due to hyporelease of ADH from posterior pituitary. Addison's disease is due to hyposecretion of hormone from adrenal cortex

**Q 150. According to Robert May, the global species diversity is about**

- Option A 50 million  
Option B 7 million  
Option C 1.5 million  
Option D 20 million

**Correct Option B**

**Solution:** Robert May estimated global species diversity at about 7 million. Although some extreme estimates range from 20 to 50 million.

**Q 151. The body of the ovule is fused within the funicle at**

- Option A Nucellus  
Option B Chalaza  
Option C Hilum  
Option D Micropyle

**Correct Option C**

**Solution:** The attachment point of funicle and body of ovule is known as hilum.

**Q 152. Match the following columns and select the correct option.**

**Column-I**

- (a) Gregarious polyphagous pest
- (b) Adult with radial symmetry and larva with bilateral symmetry
- (c) Book lungs
- (d) Bioluminescence

**Column-II**

- (i) Asterias
- (ii) Scorpion
- (iii) Ctenoplana
- (iv) Locusta

	(a)	(b)	(c)	(d)
Option A	(iii)	(ii)	(i)	(iv)
Option B	(ii)	(i)	(iii)	(iv)
Option C	(i)	(iii)	(ii)	(iv)
Option D	(iv)	(i)	(ii)	(iii)

**Correct Option D**

**Solution:**

- (a) Locusta is a gregarious pest.
- (b) In Echinoderms, adults are radially symmetrical but larvae are bilaterally symmetrical.
- (c) Scorpions respire through book lungs.
- (d) Bioluminescence is well marked in ctenophores.

**Q 153. Embryological support for evolution was disapproved by**

- Option A Charles Darwin
- Option B Oparin
- Option C Karl Ernst von Baer
- Option D Alfred Wallace

**Correct Option C**

**Solution:** Embryological support for evolution was disapproved by Karl Ernst von Baer. He noted that embryos never pass through the adult stages of other animals during embryonic development.

**Q 154. Match the organism with its use in biotechnology.**

- |                                      |  |
|--------------------------------------|--|
| (a) <i>Bacillus thuringiensis</i>    | (i) Cloning vector                       |
| (b) <i>Thermus aquaticus</i>         | (ii) Construction of first rDNA molecule |
| (c) <i>Agrobacterium tumefaciens</i> | (iii) DNA polymerase                     |
| (d) <i>Salmonella typhimurium</i>    | (iv) Cry proteins                        |

**Select the correct option from the following:**

	(a)	(b)	(c)	(d)
Option A	(iii)	(ii)	(iv)	(i)
Option B	(iii)	(iv)	(i)	(ii)
Option C	(ii)	(iv)	(iii)	(i)
Option D	(iv)	(iii)	(i)	(ii)

**Correct Option D**

**Solution:**

- (a) *Bacillus thuringiensis* is a source of Cryproteins.
- (b) *Thermus aquaticus* is a source of thermostable DNA polymerase (*Taq* polymerase) used in PCR.
- (c) *Agrobacterium tumefaciens* is a cloning vector.

(d) The construction of 1<sup>st</sup> recombinant DNA molecule was performed using native plasmid of *Salmonella typhimurium*.

**Q 155. Which of the following is not an inhibitory substance governing seed dormancy?**

- Option A Phenolic acid
- Option B Para-ascorbic acid
- Option C Gibberellic acid
- Option D Abscisic acid

**Correct Option C**

**Solution:** Gibberellic acid breaks seed dormancy. It activates synthesis of  $\alpha$ -amylase which breaks down starch into simple sugar.

**Q 156. Which of the following statements about inclusion bodies is incorrect?**

- Option A They lie free in the cytoplasm
- Option B These represent reserve material in cytoplasm
- Option C They are not bound by any membrane
- Option D These are involved in ingestion of food particles

**Correct Option D**

**Solution:** Inclusion bodies are not involved in ingestion of food particles.

**Q 157. The ovary is half inferior in:**

- Option A Sunflower
- Option B Plum
- Option C Brinjal
- Option D Mustard

**Correct Option B**

**Solution:** The ovary is half inferior in Plum.

**Q 158. Match the trophic levels with their correct species examples in grassland ecosystem.**

- (a) Fourth trophic level (i) Crow
- (b) Second trophic level (ii) Vulture
- (c) First trophic level (iii) Rabbit
- (d) Third trophic level (iv) Grass

**Select the correct option**

- |          | (a)   | (b)   | (c)   | (d)  |
|----------|-------|-------|-------|------|
| Option A | (iv)  | (iii) | (ii)  | (i)  |
| Option B | (i)   | (ii)  | (iii) | (iv) |
| Option C | (ii)  | (iii) | (iv)  | (i)  |
| Option D | (iii) | (ii)  | (i)   | (iv) |

**Correct Option C**

**Solution:** Grassland ecosystem is a terrestrial ecosystem. It includes various trophic levels-

1. First trophic level ( $T_1$ ) – Grass
2. Second trophic level ( $T_2$ ) – Rabbit
3. Third trophic level ( $T_3$ ) – Crow
4. Fourth trophic level ( $T_4$ ) – Vulture

**Q 159. The process responsible for facilitating loss of water in liquid form from the tip of grass blades at night and in early morning is**

- Option A Imbibition
- Option B Plasmolysis
- Option C Transpiration
- Option D Root pressure

**Correct Option D**

**Solution:** Root pressure is positive hydrostatic pressure. It develops in tracheary elements at night and in early morning.

**Q 160. Choose the correct pair from the following.**

- Option A Nucleases - Separate the two strands of DNA
- Option B Exonucleases - Make cuts at specific positions within DNA
- Option C Ligases - Join the two DNA molecules
- Option D Polymerases - Break the DNA into fragments

**Correct Option C**

**Solution:** Ligases join the two DNA molecules.

**Q 161. The transverse section of a plant shows following anatomical features:**

- (a) Large number of scattered vascular bundles surrounded by bundle sheath
- (b) Large conspicuous parenchymatous ground tissue
- (c) Vascular bundles conjoint and closed
- (d) Phloem parenchyma absent

**Identify the category of plant and its part:**

- Option A Dicotyledonous stem
- Option B Dicotyledonous root
- Option C Monocotyledonous stem
- Option D Monocotyledonous root

**Correct Option C**

**Solution:** All the given features are related to monocotyledonous stems.

**Q 162. Experimental verification of the chromosomal theory of inheritance was done by**

- Option A Boveri
- Option B Morgan
- Option C Mendel
- Option D Sutton

**Correct Option B**

**Solution:** Experimental verification of the chromosomal theory of inheritance was done by Morgan. (Note: Sutton and Boveri proposed chromosomal theory of inheritance but it was experimentally verified by T.H. Morgan.)

**Q 163. Bt cotton variety that was developed by the introduction of toxin gene of *Bacillus thuringiensis* (Bt) is resistant to**

- Option A Plant nematodes
- Option B Insect predators
- Option C Insect pests
- Option D Fungal diseases



**Correct Option C**

**Solution:** Bt cotton is resistant to cotton bollworm (Insect pest). *Cry I Ac* and *Cry II Ab* genes have been introduced in cotton to protect it from cotton bollworm. This makes Bt cotton a biopesticide.

**Q 164. . Select the correct statement.**

- Option A Insulin acts on pancreatic cells and adipocytes.
- Option B Insulin is associated with hyperglycemia.
- Option C Glucocorticoids stimulate gluconeogenesis.
- Option D Glucagon is associated with hypoglycemia.

**Correct Option C**

**Solution:** Glucocorticoids stimulate gluconeogenesis, so increase blood sugar level. Glucagon is associated with hyperglycemia. Insulin acts on hepatocytes and adipocytes and is associated with hypoglycemia.

**Q 165. The specific palindromic sequence which is recognized by *EcoRI* is**

- Option A 5' - CTTAAG - 3'  
3' - GAATTC - 5'
- Option B 5' - GGATCC - 3'  
3' - CCTAGG - 5'
- Option C 5' - GAATTC - 3'  
3' - CTTAAG - 5'
- Option D 5' - GGAACC - 3'  
3' - CCTTGG - 5'

**Correct Option C**

**Solution:** The specific palindromic sequence which is recognised by *EcoRI* is  
5' - GAATTC - 3'  
3' - CTTAAG - 5'

**Q 166. Identify the substances having glycosidic bond and peptide bond, respectively in their structure.**

- Option A Cellulose, lecithin
- Option B Inulin, insulin
- Option C Chitin, cholesterol
- Option D Glycerol, trypsin

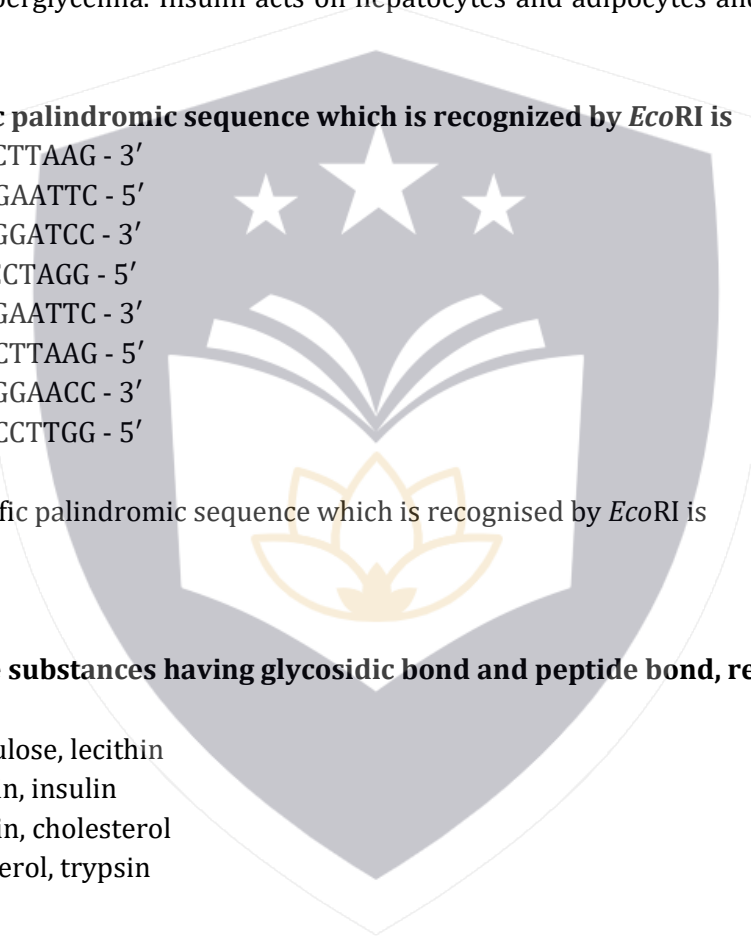
**Correct Option B**

**Solution:** Inulin is a fructan (polysaccharide of fructose). Adjacent fructose units are linked through glycosidic bonds. Insulin is a protein composed of 51 amino acids. Adjacent amino acids are attached through peptide bonds.

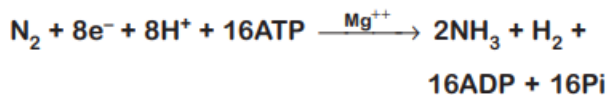
**Q 167. The product(s) of reaction catalyzed by nitrogenase in root nodules of leguminous plants is/are**

- Option A Ammonia and oxygen
- Option B Ammonia and hydrogen
- Option C Ammonia alone
- Option D Nitrate alone

**Correct Option B**



**Solution:** The product(s) of reaction catalyzed by nitrogenase in root nodules of leguminous plants are ammonia and hydrogen.



**Q 168. Which of the following hormone levels will cause release of ovum (ovulation) from the graffian follicle?**

- Option A Low concentration of LH
- Option B Low concentration of FSH
- Option C High concentration of Estrogen
- Option D High concentration of Progesterone

**Correct Option C**

**Solution:** High level of estrogen will send positive feedback to anterior pituitary for release of LH. FSH, LH and estrogen are at peak level during mid of menstrual cycle (28 day cycle). LH surge leads to ovulation.

**Q 169. Which of the following statements are true for the phylum Chordata?**

- (a) In Urochordata notochord extends from head to tail and it is present throughout their life.
- (b) In Vertebrata notochord is present during the embryonic period only.
- (c) Central nervous system is dorsal and hollow.
- (d) Chordata is divided into 3 subphyla: Hemichordata, Tunicata and Cephalochordata.

- Option A (a) and (b)
- Option B (b) and (c)
- Option C (d) and (c)
- Option D (c) and (a)

**Correct Option B**

**Solution:** In vertebrata, notochord is present during embryonic period only as it is replaced by vertebral column. In chordates, central nervous system is dorsal and hollow.

**Q 170. Bilaterally symmetrical and acoelomate animals are exemplified by**

- Option A Aschelminthes
- Option B Annelida
- Option C Ctenophora
- Option D Platyhelminthes

**Correct Option D**

**Solution:** Platyhelminthes are bilaterally symmetrical, triploblastic and acoelomate animals with organ level of organisation.

**Q 171. Which of the following regions of the globe exhibits highest species diversity?**

- Option A Himalayas
- Option B Amazon forests
- Option C Western Ghats of India
- Option D (4) Madagascar

**Correct Option B**

**Solution:** The largely tropical Amazonian rain forests in South America have the greatest biodiversity on earth.

**Q 172. Select the correct match**

Option A Sickle cell anaemia – Autosomal recessive trait, chromosome-11

Option B Thalassaemia – X linked

Option C Haemophilia – Y linked

Option D Phenylketonuria – Autosomal dominant trait

**Correct Option A**

**Solution:** Phenylketonuria – Autosomal recessive disorder

Thalassaemia – Autosomal recessive disorder

Haemophilia – X linked recessive disorder

Sickle cell anaemia – Autosomal recessive trait, caused due to mutation in gene present on chromosome no. 11

**Q 173. Which one of the following is the most abundant protein in the animals?**

Option A Lectin

Option B Insulin

Option C Haemoglobin

Option D Collagen

**Correct Option D**

**Solution:** Collagen is the most abundant protein in animal world and RuBisCO is the most abundant protein in the whole of the Biosphere.

**Q 174. Select the option including all sexually transmitted diseases.**

Option A AIDS, Malaria, Filaria

Option B Cancer, AIDS, Syphilis

Option C Gonorrhoea, Syphilis, Genital herpes

Option D Gonorrhoea, Malaria, Genital herpes

**Correct Option C**

**Solution:** Gonorrhoea, Syphilis, Genital herpes are sexually transmitted diseases. Gonorrhoea is caused by a bacterium *Neisseria gonorrhoeae*. Syphilis is caused by a bacterium *Treponema pallidum*. Genital herpes is caused by a virus Type-I Herpes simplex virus.

**Q 175. In water hyacinth and water lily, pollination takes place by:**

Option A Wind and water

Option B Insects and water

Option C Insects or wind

Option D Water currents only

**Correct Option C**

**Solution:** In majority of aquatic plants, the flowers emerge above the level of water. These may be pollinated by insects or wind as in water hyacinth and water lily.

**Q 176. In gel electrophoresis, separated DNA fragments can be visualized with the help of**

Option A Acetocarmine in UV radiation

Option B Ethidium bromide in infrared radiation

Option C Acetocarmine in bright blue light

Option D Ethidium bromide in UV radiation

**Correct Option D**

**Solution:** The separated DNA fragments can be visualised only after staining the DNA with ethidium bromide followed by exposure to UV radiation.

**Q 177. Secondary metabolites such as nicotine, strychnine and caffeine are produced by plants for their**

Option A Defence action

Option B Effect on reproduction

Option C Nutritive value

Option D Growth response

**Correct Option A**

**Solution:** A wide variety of chemical substances that we extract from plants on a commercial scale (nicotine, caffeine, quinine, strychnine, opium, etc.) are produced by them (plants) as defences against grazers and browsers.

**Q 178. How many true breeding pea plant varieties did Mendel select as pairs, which were similar except in one character with contrasting traits?**

Option A 14

Option B 8

Option C 4

Option D 2

**Correct Option A**

**Solution:** Mendel selected 14 true breeding plant varieties for his experiments.

**Q 179. Which of the following is not an attribute of a population?**

Option A Mortality

Option B Species interaction

Option C Sex ratio

Option D Natality

**Correct Option B**

**Solution:** Natality, mortality and sex ratio are population attributes while species interaction comes under population interactions.

**Q 180. Snow-blindness in Antarctic region is due to**

Option A High reflection of light from snow

Option B Damage to retina caused by infra-red rays

Option C Freezing of fluids in the eye by low temperature

Option D Inflammation of cornea due to high dose of UV-B radiation

**Correct Option D**

**Solution:** UV-B radiations damage DNA and can cause mutations. In human eye, cornea absorbs UV-B radiations, and a high dose of UV-B causes inflammation of cornea called snow blindness, cataract, etc.