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DSSSB TGT
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SCIENCE
MALE & FEMALE
SOLVED PAPERS

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Delhi Subordinate Service Selection Board Exam 2014

TGT Natural Science

SOLVED PAPER

(Exam date : 28.12.2014 Tier-I)

1. For a harmonic oscillator the graph between momentum 'p' and displacement 'x' would come out as

एक हरात्मक दोलक के लिए 'p' संवेग और 'x' विस्थापन के बीच का आलेख होगा

- (a) a straight line/एक सीधी रेखा
(b) a parabola/परवलय
(c) a circle/वृत्त
(d) an ellipse/दीर्घवृत्त

Ans. (d) : $x = A \sin \omega t$

$$\sin \omega t = \frac{x}{A}$$

$$V = \frac{dx}{dt} = A\omega \cos \omega t$$

$$\cos \omega t = \frac{V}{A\omega}$$

Thus, using the equation

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$\frac{x^2}{A^2} + \frac{V^2}{A^2\omega^2} = 1, \text{ which gives the equation of ellipse.}$$

2. A bullet is fired vertically up from a 400 m tall tower with a speed 80 m/s. If 'g' is taken as 10 m/s², the time taken by the bullet to reach the ground will be

400 m ऊँचे एक टावर से समलम्ब ऊपर की ओर 80 m/s गति से एक गोली दागी जाती है। यदि 'g' को 10 m/s², लिया गया है, तो उस गोली को टावर के तल तक पहुँचने में समय लगेगा

- (a) 8 s (b) 16 s
(c) 20 s (d) 24 s

Ans. (c) : Speed of bullet = 80 m/s

Height of tower = 400 m

Gravitational acceleration = 10 m/s²

If bullet is fired upward, the maximum height

$$h = \frac{v^2 - u^2}{2g} \text{ (taking negative)}$$

$$h = \frac{(80)^2}{2 \times 10}$$

$$h = 6400 / 20$$

$$= 320 \text{ meter}$$

Time taken to reach the maximum point

$$t = \frac{u}{g}$$

$$= \frac{80}{10} = 8 \text{ second}$$

$$\text{Now, total height covered by bullet} = 320 + 400$$

$$= 720 \text{ m}$$

Hence, time taken by bullet to reach the ground,

$$t = \sqrt{\frac{720 \times 2}{10}}$$

$$= 12 \text{ second}$$

So, total time taken by bullet to reach the ground will be

$$= 12 + 8$$

$$= 20 \text{ seconds}$$

3. With rise of temperature the coefficient of electrical resistance

तापमान बढ़ने के साथ विद्युत प्रतिरोध का गुणांक

- (a) decreases for a thermistor
थर्मिस्टर के लिए कम होता है
(b) increases for a doped semiconductor
रोगनवाले अर्द्धचालक के लिए बढ़ता है
(c) decreases for tungsten wire
टंगस्टन वायर के लिए कम होता है
(d) may increase or decrease for a pure semiconductor/शुद्ध अर्द्धचालक के लिए या तो बढ़ेगा या कम होगा

Ans. (a) : The resistance change factor per degree celcius of temperature change is called the temperature coefficient of resistance. This factor is represented by the Greek lower case letter alpha (α).

* Thermosistors are non-linear resistors, which alter resistance characteristics with temperature.

The resistance of thermistors will decrease with the temperature increases.

* The pure semiconductors and insulating material are having a negative temperature coefficient of resistance. Therefore, the resistance of semiconductors and insulators decreases with rising in temperature.

Temperature coefficient of resistance of a doped semiconductor positive or negative depending on the level of doping.

* The resistance tungsten increases with temperature.

4. With 'p' for proton and 'n' for neutron, the nuclear forces have strengths in the order प्रोटॉन के लिए 'p' और न्यूट्रॉन के लिए 'n' के साथ, केन्द्र बलों की शक्ति का क्रम है

- (a) $p - n > p - n > n - n$
(b) $n - n > p - n > p - p$
(c) $n - n > p - p > p - n$
(d) $n - n = p - p = p - n$

Ans. (d) : Nucleons in the nucleus of an atom are bonded together by a strong force of attraction called nuclear force. The nuclear force is short-ranged force that acts when nucleons are at distance in the range of fermi ($1 \text{ fermi} = 10^{-15} \text{ m}$).

The nuclear force acts between proton-proton, proton-neutron and neutron-neutron. The force is so strong that it overcomes the electrostatic force of repulsion between proton - proton (like charges).

The strength of the force is the same between any of the two nucleons.

So, the order of nuclear forces strength is

$$n - n = p - p = p - n$$

5. **A beam of protons and a beam of helium nuclei have identical de-Broglie wavelengths. Then they have –**

प्रोटॉन का एक किरण और हीलियम नाभिक किरणों का डी ब्रॉग्ली तरंग-दैर्घ्य एक जैसा है। तब वे रखते हैं—

- (a) Velocity ratio 4/वेग अनुपात 4
 (b) KE ratio 2/KE अनुपात 2
 (c) Momenta ratio 1/2/संवेग अनुपात 1/2
 (d) None of above/उपर्युक्त में से कोई नहीं

Ans. (a) : Mass of proton (m_p) is approximately equal to the mass of neutron (m_n)

$$m_p = m_n \dots\dots (1)$$

A Helium atom contains 2 protons and 2 neutrons.

Total mass of Helium atom,

$$m_{\text{He}} = 2m_p + 2m_n = 4m_p \dots (2)$$

Now, both have an identical wavelength.

Let the speed of proton is V_p and Helium is V_{He} .

So, de-Broglie wavelength of the proton is

$$\lambda_p = \frac{1}{m_p V_p} \dots\dots(3)$$

de-Broglie wavelength of Helium is

$$\lambda_{\text{He}} = \frac{h}{m_{\text{He}} V_{\text{He}}} \dots\dots(4)$$

Putting equation (2) in equation (4)

$$\lambda_{\text{He}} = \frac{h}{4m_p V_{\text{He}}} \dots\dots(5)$$

On dividing equation (3) and equation (5)

$$\frac{\lambda_p}{\lambda_{\text{He}}} = \frac{4V_p}{V_p} = 4$$

$$m_p : m_v = 4$$

So, the velocity ratio is 4.

6. **The diamagnetism of an atom arises due to परमाणु की प्रति-चुम्बकीयता इस कारण उत्पन्न होती है**

- (a) orbital motion of electrons
इलेक्ट्रॉन की कक्षीय गति
 (b) spin motion of electrons
इलेक्ट्रॉन की चक्रीय गति
 (c) motion of protons in the nucleus
नाभिक में प्रोटॉन की गति
 (d) permanent dipole moment of the atom
परमाणु का स्थायी द्विध्रुव आघूर्ण

Ans. (a) : The diamagnetism arises due to the orbital motion of electrons. The presence of an external magnetic field, affects the orbital, the orbital motion of the electrons in an atom in such a way generates a magnetic field that opposes the external field. This is referred to as diamagnetism.

7. **The particles that makeup lattices of the Vander Waals crystals, ionic crystals and covalent crystals are respectively**

जिन कणों से वॉडरवाल का क्रिस्टल, आयनी क्रिस्टल और सहसंयोजक क्रिस्टल की जालक बनती है, वे क्रमशः होते हैं

- (a) atoms, electrons, molecules
परमाणु, इलेक्ट्रॉन, अणु
 (b) molecules, ions, atoms
अणु, आयन, परमाणु
 (c) atoms, ions, molecules
परमाणु, आयन, अणु
 (d) permanent dipole moment of the atom
अणु, इलेक्ट्रॉन, परमाणु

Ans. (b) : * Molecules make up the lattices of Vander Waals crystals.

* Ions make up the lattices of ionic crystals.

* Atoms make up the lattice of covalent crystals.

So, the particles that make up lattices of the Van der Waals crystals, ionic crystals and covalent crystals are respectively molecules, ions, atoms.

8. **Compare the energy of recoil of an atom when it emits an X-ray photon ($\lambda = 1 \text{ \AA}$) to that when it emits a photon of visible light of wavelength 5000 \AA —**

परमाणु के X-किरण फोटॉन ($\lambda = 1 \text{ \AA}$) उत्सर्जित करने की ऊर्जा और उसके दृश्य 5000 \AA तरंग-दैर्घ्यवाले फोटॉन को उत्सर्जित करने की ऊर्जा की तुलना कीजिए—

- (a) 1 : 5000 (b) 5000 : 1
 (c) $\sqrt{5000} : 1$ (d) $(5000)^2 : 1$

Ans. (b) : mass of atom = m

wavelength (I) = $\lambda_1 = 1 \text{ \AA}$

wavelength (II) = $\lambda_2 = 5000 \text{ \AA}$

Energy of recoil of atom

When it emits a certain λ is given by,

$$\text{Recoil energy} = E = \frac{hc}{\lambda} = \frac{p^2}{2m}$$

where, h = Plank's constant,

m = mass of particle,

λ_1 = wavelength emitted

$$\text{Recoil energy of } \lambda_1 = \frac{hc}{\lambda_1} = hc \dots\dots (I)$$

$$\text{Recoil energy of } \lambda_2 = \frac{hc}{5000} \dots\dots (II)$$

Dividing eq. (I) and (II)

$$\frac{E_1}{E_2} = \frac{5000}{1} = 5000 : 1$$

9. Which one of the following is not an electromagnetic wave ?

निम्न में से कौन सी विद्युत-चुम्बकीय तरंग नहीं है?

- (a) Light wave/प्रकाश तरंग
 (b) Radio wave/रेडियो तरंग
 (c) Sound wave/ध्वनि तरंग
 (d) Micro wave/माइक्रो तरंग

Ans. (c) : A wave is just a disturbance in a medium or field that propagates energy and momentum from one place to the other without the transport of matter.

Light waves, radio waves, and microwaves are part of electromagnetic waves with the difference in their energy distribution while sound wave is a mechanical wave.

10. For exciting line with $\lambda = 5000 \text{ \AA}$, the Stokes Raman line for a substance fall at 5100 \AA . For the same substance with exciting line at $\lambda = 4000 \text{ \AA}$, anti-stokes line should fall nearest to wavelength

$\lambda = 5000 \text{ \AA}$ वाली उत्तेजक लाइन के लिए, उपादान की स्टोक्स रामन लाइन 5100 \AA पर पतन होती है। उसी उपादान के लिए $\lambda = 4000 \text{ \AA}$ वाली उत्तेजक लाइन के प्रति-स्टोक्स लाइन का पतन इस तरंग-दैर्घ्य के करीब होगा

- (a) 3940 \AA (b) 3900 \AA
 (c) 4060 \AA (d) 4100 \AA

Ans. (a) : Given that,

Wavelength of Rayleigh line (exciting line)

$$(\lambda_R)_1 = 5000 \text{ \AA}$$

Wavelength of Stokes line $\lambda_s = 5100 \text{ \AA}$

We know that wavenumber

$$\begin{aligned} \bar{\nu} &= \frac{1}{\lambda} \text{ \AA}^{-1} \\ &= \frac{1}{\lambda} \times 10^8 \text{ cm}^{-1} \end{aligned}$$

Hence, Raman shift for first exciting line $\Delta\bar{\nu} = \frac{1}{\lambda_R} - \frac{1}{\lambda_s}$

$$\begin{aligned} \Rightarrow \Delta\bar{\nu} &= \frac{1}{5000} - \frac{1}{5100} \\ \Rightarrow \Delta\bar{\nu} &= 20000 - 19607.84 \text{ cm}^{-1} \end{aligned}$$

$$\Rightarrow \Delta\bar{\nu} = 392.16 \text{ cm}^{-1}$$

As we know that, material is same for both exciting line, hence Raman shift will also remain same.

Let wavelength of anti-stokes line = λ , therefore for new exciting line having wavelength $(\lambda_R)_2 = 4000 \text{ \AA}$

$$\Rightarrow \Delta\bar{\nu} = 392.16 = \frac{1}{\lambda} - \frac{1}{4000}$$

$$\Rightarrow 392.16 = \frac{1}{\lambda} - \frac{10^8}{4000}$$

$$\frac{1}{\lambda} = \frac{10^8}{25392.16}$$

$$\lambda = 3938.22 \approx 3940 \text{ \AA}$$

11. A transducer is a device which converts ऊर्जापरिवर्तक (ट्रांसड्यूसर) वह साधन है जो इसे परिवर्तित करता है

- (a) Sound signals into electrical ones
ध्वनि संकेत को विद्युत संकेत में
 (b) electrical signals into acoustics ones
विद्युत संकेत को ध्वनिक संकेत में
 (c) optical signals into electrical ones
प्रकाशीय संकेत को विद्युत संकेत में
 (d) any one form of signals into another form
किसी एक प्रकार के संकेत को दूसरे प्रकार के संकेत में

Ans. (d) : Transducer is a device which converts signal in one form of energy signal in another form of energy.

The process of converting energy from one form to another is known as transduction.

Ex- Loudspeakers, microphones, thermometers and LEDs.

12. The temperature at which root mean square speed of nitrogen molecule is equal to the escape velocity from earth's surface is closest to जिस तापमान पर नाइट्रोजन अणु की वर्गमाध्य मूल गति पृथ्वी के पृष्ठ से उन्मुक्ति वेग जितनी होती है वह लगभग होता है

- (a) 10^8 K (b) 10^6 K
 (c) 10^5 K (d) 10^4 K

Ans. (c) : Given,

$$\begin{aligned} \text{Root mean square velocity} \\ \text{of } N_2 \text{ molecules} &= \text{escape velocity} \\ &= 11.2 \text{ km/s} \\ &= 11200 \text{ m/s} \end{aligned}$$

We know that,

$$\begin{aligned} \text{molar mass of } N_2 \text{ molecule} &= 28 \text{ gram/mole} \\ \text{mass of one } N_2 \text{ molecule} &= \frac{28}{6.022 \times 10^{23}} \text{ gram} \\ &= 4.65 \times 10^{-23} \text{ gram} \\ &= 4.65 \times 10^{-26} \text{ kg} \end{aligned}$$

$T = ?$

Root mean square velocity for one N_2 molecule

$$\begin{aligned} V_{\text{rms}} &= \sqrt{\frac{3RT}{mN_A}}, \left(\frac{R}{N_A} = k \right) \\ &= \sqrt{\frac{3kT}{M}} \end{aligned}$$

$$11200 \text{ m/s} = \sqrt{\frac{3 \times 1.38 \times 10^{-23} \times T}{4.65 \times 10^{-26}}}$$

(Where $K = 1.38 \times 10^{-23} \text{ m}^2 \text{ kg s}^{-2} \text{ K}^{-1}$, boltzmann constant)

$$\boxed{T = 10^5 \text{ K}}$$

13. A surface has work-function 2.4 eV. The kinetic energies of fastest photo electrons emitted from its surface under radiations of photon energies 3.00 eV and 4.00 eV will bear the ratio

एक सतह का कार्यफलन 2.4 eV है। फोटोन ऊर्जा 3.00 eV और 4.00 eV के विकिरण के अंतर्गत उसकी सतह से उत्सर्जित तीव्रतम फोटो इलेक्ट्रॉन्स की गतिज ऊर्जा का अनुपात होगा

- (a) 27 : 32 (b) 3 : 4
(c) 1 : 2 (d) 3 : 8

Ans. (d) : Work function = 2.4 eV
Incident radiation of Ist photo electron = 3 eV
Incident radiation of IInd photo electron = 4 eV
KE_{max} = Incident radiation – Work function
KE_{max} for I = 3 eV – 2.4 eV = 0.6 eV
KE_{max} for II = 4 eV – 2.4 eV = 1.6 eV
Ratio = 0.6 : 1.6 = 3 : 8

14. The dimensions of $\epsilon_0 \mu$ are the same as those of $\epsilon_0 \mu$ का परिमाण, इसके परिणाम के जितना ही होता है

- (a) (velocity)⁻²/(वेग)⁻²
(b) (velocity)²/(वेग)²
(c) velocity/वेग
(d) (velocity)^{-1/2}/(वेग)^{-1/2}

Ans. (a) : $\because C = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$, where C = speed of light

$$\therefore \mu_0 \epsilon_0 = \frac{1}{C^2}$$

So, dimensions of $\mu_0 \epsilon_0$ will be same as of (velocity)⁻²
Hence, option (a) is correct.

15. Two coherent sources of intensity ratio 25 : 4 are used in an interference experiment. Find the ratio of intensities of maxima and minima in the interference pattern.

व्यतिकरण परीक्षण में 25 : 4 अनुपात के प्रबलता के दो संगत स्रोतों का उपयोग किया गया है। व्यतिकरण पैटर्न में महत्तम और न्यूनतम प्रबलता का अनुपात पता कीजिए।

- (a) 49 : 9 (b) 25 : 16
(c) 4 : 9 (d) 7 : 3

Ans. (a) : As given,

$$\frac{I_1}{I_2} = \frac{25}{4} = \frac{a_1^2}{a_2^2}$$

$$\frac{a_1}{a_2} = \frac{5}{2} \dots\dots(1)$$

We know that,

$$\left(\frac{a_1 + a_2}{a_1 - a_2} \right)^2 = \frac{I_{\max}}{I_{\min}}$$

$$\left(\frac{5 + 2}{5 - 2} \right)^2 = \frac{I_{\max}}{I_{\min}}$$

$$\frac{I_{\max}}{I_{\min}} = \frac{49}{9}$$

16. The half life of an elementary particle moving with speed 0.9 C is measured to be 5×10^{-8} sec., in the laboratory. Its proper half life will be प्रयोगशाला में 0.9 (गति से चलने वाले एक तत्वीय कण का अर्द्ध-आयु 5×10^{-8} सेकण्ड मापा गया। उसका वास्तविक अर्द्ध-आयु होगा

- (a) 2.2 sec/2.2 सेकंड
(b) 2.2×10^{-8} sec/ 2.2×10^{-8} सेकण्ड
(c) 0.22×10^{-8} sec/ 0.22×10^{-8} सेकण्ड
(d) 22×10^{-8} sec/ 22×10^{-8} सेकण्ड

Ans. (*) : Given,

$$\text{speed of elementary particle} = 0.9 c = 0.9 \times 3 \times 10^8 \text{ m/s}$$

$$\text{Half life of the particle measured in laboratory} = 5 \times 10^{-8} \text{ sec}$$

Actual Half life = ?

$$\text{Formula, } T = \frac{T_0}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}$$

where, T = time internal in moving frme

T_0 = time internal in rest frame

c = velocity of light in vacuum of free space

v = velocity of the moving frame

Putting the given values in respective formula

$$\begin{aligned} T &= \frac{5 \times 10^{-8}}{\sqrt{1 - \left(\frac{0.9c}{c}\right)^2}} \\ &= \frac{5 \times 10^{-8}}{\sqrt{1 - 0.81}} \\ &= \frac{5 \times 10^{-8}}{\sqrt{0.19}} \\ &= \frac{5 \times 10^{-8}}{0.436} \\ &= 1.15 \times 10^{-7} \end{aligned}$$

17. A crystal belongs to a face cubic lattice with four atoms in unit cell. The size of crystal is 1 cm and its unit cell dimension is 1 nm. Then the number of atoms in the crystal is in unit of 10^{21} is?

एक जालक फलक घनीय लैटिस से संबंध रखता है। जालक का आकार 1 cm एवं एकक सेल की विमा 1 nm है। तब 10^{21} इकाई वाले जालक में परमाणुओं की संख्या क्या होगी?

- (a) 6 (b) 4
(c) 3 (d) 2

Ans. (b) : Crystal size = 1 cm

size of unit cell = 1 nm

$$\text{So, no. of unit cell} = \frac{(1 \text{ cm})^3}{(1 \text{ nm})^3} = 10^{21}$$

For face structure no. of atoms per unit cell = 4

18. A circuit having a resistance R in series with a parallel combination L and C, driven by an ac source of frequency $\frac{1}{2\pi\sqrt{LC}}$. The impedance offered by the circuit is एक परिपथ जिसका प्रतिरोध R सामांतर क्रम में लगे L एवं C से श्रेणीक्रम में जुड़ा है, $\frac{1}{2\pi\sqrt{LC}}$ आवृत्ति के स्रोत द्वारा संचालित है। परिपथ द्वारा उत्पन्न बाधा है—
- (a) purely ohmic and very large
पूर्णतः ओमिक (ohmic) और बहुत बड़ी
- (b) inductive and low/प्रेरणात्मक और निम्न
- (c) capacitive and high/धारिता और उच्च
- (d) complex and low/समिश्र और निम्न

Ans. (a) : The circuit will become purely resistive if $X_L = X_C$, that is inductive reactance equals capacitive reactance.

In this case, current

$$\Rightarrow i = \frac{V}{Z} = \frac{V}{\sqrt{R^2 + (X_L - X_C)^2}} = \frac{V}{\sqrt{R^2}} = \frac{V}{R}$$

That means the net impedance is R.

$$\frac{1}{2\pi f C} = 2\pi f L$$

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

So, at this frequency, the circuit becomes purely resistive/ohmic.

This is also known as resonate frequency.

19. The truth table for two input logic gate is an given below

दो आदान (इनपुट) लॉजिक गेट की सत्य सारणी इस प्रकार है

A	B	Output
0	0	1
0	1	1
1	0	1
1	1	0

Then the logic gate is लॉजिक गेट है

- (a) NAND gate/NAND गेट
(b) AND gate/AND गेट
(c) OR gate/OR गेट
(d) NOR gate/NOR गेट

Ans. (a) : The NAND Gate is formed by the combination of AND gate and NOT gate. The output obtained from AND gate is simply reversed.

A	B	Output
0	0	1
0	1	1
1	0	1
1	1	0

The output of the NAND gate is similar to the output in the question.

So, the correct option is NAND gate.

20. When a JFET is operated above pitch-off voltage, the drain current?

जब JFET को उसके पराकाष्ठा (पिच ऑफ) वोल्टेज पर चलाया जाता है, तब निकास करंट

- (a) increase sharply/तीव्रता से बढ़ता है
(b) becomes constant/स्थिर होता है
(c) starts decreasing/कम होने लगता है
(d) becomes zero/शून्य हो जाता है

Ans. (b) : In JFET after pitch off the drain current becomes almost constant.

Shockley's equation is given as,

$$I_D = I_{DSS} \left(1 - \frac{V_{GS}}{V_P} \right)^2$$

where,

V_{GS} = Gate of source voltage

I_{DSS} = Drain to source saturation current

V_P = Pitch - off voltage

When the pitch-off occurs ($V_{DS} = V_P$), the current I_{DS} saturated at a particular level I_{DSS} , during which the device acts as a constant current sources.

21. The ionisation enthalpy of hydrogen atoms is $1.312 \times 10^6 \text{ J Mol}^{-1}$. The energy required to excite the electron in the atom from level $n = 1$ to $n = 2$ is

हाइड्रोजन परमाणु की आयनीकरण समग्र ऊष्मा (एन्थैल्पी) $1.312 \times 10^6 \text{ J Mol}^{-1}$ है। स्तर $n = 1$ से स्तर $n = 2$ तक परमाणु में स्थित इलेक्ट्रॉन को उत्तेजित करने के लिए लगने वाली ऊर्जा है

- (a) $9.84 \times 10^5 \text{ J Mol}^{-1}$
(b) $6.56 \times 10^5 \text{ J Mol}^{-1}$
(c) $8.51 \times 10^5 \text{ J Mol}^{-1}$
(d) $3.56 \times 10^5 \text{ J Mol}^{-1}$

Ans. (a) : Given,

The ionisation enthalpy of Hydrogen atom

$$= 1.312 \times 10^6 \text{ J Mol}^{-1}$$

It suggest that the energy of an electron in the ground state is $1.312 \times 10^6 \text{ J mol}^{-1}$.

$$\text{i.e., } E_0 = 1.312 \times 10^6 \text{ J mol}^{-1}$$

We know that the Energy level of a Hydrogen atom is given by

$$E_n = E_0 \frac{Z^2}{n^2}$$

For Hydrogen atom $Z = 1$

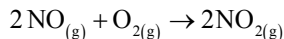
Therefore, the energy required when an electron makes the transition from $n = 1$ to $n = 2$ is given by

$$\Delta E = E_2 - E_1$$

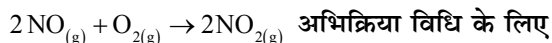
$$\Delta E = \left(\frac{1.312 \times 10^6}{2^2} \right) - \left(\frac{1.312 \times 10^6}{1^2} \right)$$

$$\Delta E = 9.84 \times 10^5 \text{ J Mol}^{-1}$$

22. For the reaction system



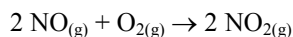
the volume is suddenly reduced to half of its original value by increasing the pressure on it. If the reaction is first order with respect to O_2 and second order with respect to NO , the rate of reaction will



अभिक्रिया विधि के लिए उस पर दाब बढ़ाकर आयतन का मूल्य एकाएक आधा कर दिया गया है। यदि O_2 के लिए अभिक्रिया पहले श्रेणी की और NO के लिए दूसरे श्रेणी की है, तो अभिक्रिया का दर

- increase to four times of its initial value
उसके आरम्भिक मूल्य से चार गुना अधिक होगा।
- decrease to one-fourth of its initial value
उसके आरम्भिक मूल्य से एक-चौथाई तक कम होगा।
- decrease to one-eights of its initial value
उसके आरम्भिक मूल्य से 1/8 तक कम होगा।
- increases to eight times of its initial value
उसके आरम्भिक मूल्य से आठ गुना अधिक होगा।

Ans. (d) : For the given reaction,



$$\text{Rate (1)} = k[\text{NO}]^2[\text{O}_2]$$

Here, the volume is reduced to half since volume is related to concentration by the equation :

$$\rightarrow C = n/V$$

So, when the volume is reduced to 1/2, then concentration becomes doubled, hence the rate of the reaction becomes $\text{Rate (2)} = k[2\text{NO}]^2[2\text{O}_2]$

So,

$$\frac{\text{rate(1)}}{\text{rate(2)}} = \frac{k[\text{NO}]^2[\text{O}_2]}{k[2\text{NO}]^2[2\text{O}_2]} = \frac{1}{8}$$

$$\text{i.e. } \frac{\text{rate(1)}}{\text{rate(2)}} = \frac{1}{8}$$

$$\text{rate (2)} = 8 \times \text{rate (1)}$$

So, here when the volume is suddenly reduced to half of its original value by increasing the pressure on it, the rate of the reaction increases to eight times its initial value.

23. In an ionic compound, atoms of element Y form cubical closest packing and those of element X occupy 2/3 of tetrahedral voids. The formula of the compound will be

एक आयनिक यौगिक में तत्व Y के परमाणु घनीय बंद संरचना बनाते हैं और X मूलतत्त्व वाले परमाणु 2/3 चतुष्फलकीय रिक्तियों में जगह लेते हैं। यौगिक का सूत्र होगा

- X_3Y
- X_2Y_3
- X_4Y_3
- X_2Y

Ans. (c) : For a cubic closed packing (CCP) system

Effective no. of atom, $N = 4$

$$\begin{aligned} \text{So, no. of tetrahedral voids} &= 2N \\ &= 2 \times 4 \\ &= 8 \end{aligned}$$

From question –

No. of atoms of element Y = 4

No. of atoms of element X occupied tetrahedral

$$\text{voids} = \frac{2}{3} \times 8$$

$$= \frac{16}{3}$$

$$\frac{X}{Y} = \frac{16}{3}$$

$$\frac{X}{Y} = \frac{4}{3}$$

or Formula of compound is X_4Y_3

24. Which of the following statements is wrong ?
निम्न में से कौन सा कथन गलत है ?

- Carbon with sp hybrid orbital is more electronegative than sp^2 hybrid orbital/ sp^2 संकरित कक्षीय से sp संकरित कक्षीय वाला कार्बन अधिक ऋणविद्युती होता है।
- The size of sp^3 hybrid orbitals of carbon is smaller than that of sp hybrid orbitals/ sp संकरित कक्षीय से sp^3 संकरित कक्षीय के कार्बन का आकार छोटा होता है।
- Amongst CH_4 , C_2H_4 , C_2H_2 , the C – H bond length is maximum in methane
 CH_4 , C_2H_4 , C_2H_2 में C – H बन्ध लम्बाई मीथेन में अधिकतम होती है।
- The resonating structures do not differ in the number of unpaired electrons
अनुनादी संरचनाएं अयुग्मित इलेक्ट्रॉन जोड़ों के सन्दर्भ में भिन्न नहीं होती हैं।

Ans. (b) : As the p-character increases, the size of the hybrid orbital increases. so, the increasing order of the size of hybrid orbital is $\text{sp} < \text{sp}^2 < \text{sp}^3$.

Hence, option (b) is wrong statement.

25. Consider the acidity of carboxylic acid
कार्बोक्सिलिक अम्लों की अम्लता के संदर्भ में :

- $\text{C}_6\text{H}_5\text{COOH}$
- $\text{O} - \text{NO}_2\text{C}_6\text{H}_4\text{COO}$
- $\text{p} - \text{NO}_2\text{C}_6\text{H}_4\text{COOH}$
- $\text{m} - \text{NO}_2\text{C}_6\text{H}_4\text{COOH}$

Which of the following is in the right order ?

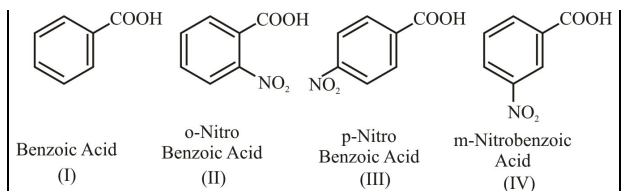
निम्न में से कौन-सा क्रम सही है?

- $i > ii > iii > iv$
- $ii > iv > iii > i$
- $ii > iv > i > iii$
- $ii > iii > iv > i$

Ans. (d) : The acidity of carboxylic acid is given, as

$$ii > iii > iv > i$$

The groups attached to benzene either -I or -R/-M reduces the electron density in conjugation system and make carboxylic group attached to benzene ring more acidic.



- * In case of ortho-nitrobenzoic acid both -I effect and -R effect strongly applied and making it most acidic among all.
- * In para-nitrobenzoic acid -I effect is weaker than ortho-nitrobenzoic acid, only -R effect is stronger. So, acidic strength of it follows ortho-nitro benzoic acid.
- * In case of m-nitrobenzoic acid -I effect is stronger than p-nitrobenzoic acid but -R effect is not so effective as in p-nitrobenzoic acid, so it follows para-nitrobenzoic acid.
- * Benzoic acid has no -I or -R effect so, it is least acidic among all.

26. The increasing order of stability of following free radicals is

निम्न मुक्त मूलकों के स्थिरता का बढ़ता हुआ क्रम है

- (a) $(\text{CH}_3)_2\dot{\text{C}}\text{H} < (\text{CH}_3)_3\dot{\text{C}} < (\text{C}_6\text{H}_5)_3\dot{\text{C}} < (\text{C}_6\text{H}_5)_2\dot{\text{C}}\text{H}$
- (b) $(\text{CH}_3)_2\dot{\text{C}}\text{H} < (\text{CH}_3)_3\dot{\text{C}} < (\text{C}_6\text{H}_5)_2\dot{\text{C}}\text{H} < (\text{C}_6\text{H}_5)_3\dot{\text{C}}$
- (c) $(\text{C}_6\text{H}_5)_3\dot{\text{C}} < (\text{C}_6\text{H}_5)_2\dot{\text{C}}\text{H} < (\text{CH}_3)_3\dot{\text{C}} < (\text{CH}_3)_2\dot{\text{C}}\text{H}$
- (d) $(\text{C}_6\text{H}_5)_2\dot{\text{C}}\text{H} < (\text{C}_6\text{H}_5)_3\dot{\text{C}} < (\text{CH}_3)_3\dot{\text{C}} < (\text{CH}_3)_2\dot{\text{C}}\text{H}$

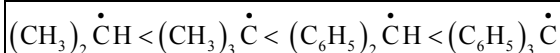
Ans. (b) : Free radicals are hypovalent organic species having $7e^-$ in hybridised central carbon. They are very reactive species. The order of reactivity of free radicals can be determined by no. of α -Hydrogen through hyper conjugation or resonance method.

The more the number of α -Hydrogens more will be stability of free radical.

In general term stability of primary, secondary and tertiary free radicals is as follows— $3^\circ > 2^\circ > 1^\circ$.

Resonance is also a good stabilizing factor and is given preference than hyper conjugation.

So, the increasing order of stability of the given free radicals is –

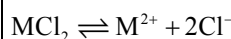
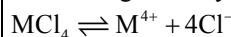


27. A metal M forms chlorides in its +2 and +4 oxidation states. Which of the following statements about these chlorides are correct ?

उसके + 2 और + 4 ऑक्सीकरण स्थिति में M धातु क्लोराइड्स उत्पन्न करता है। निम्न में से इन क्लोराइड्स के बारे में कौन सा कथन सही है ?

- (a) MCl_2 is more easily hydrolyses than MCl_4
 MCl_2 और MCl_4 से अधिक आसानी से जल-अपघटित होता है
- (b) MCl_2 is more volatile than MCl_4
 MCl_2 , MCl_4 से अधिक वोलाटाइल है।
- (c) MCl_2 is more soluble in anhydrous ethanol than MCl_4 / MCl_2 यह MCl_4 से एनहाइड्रस एथेनॉल में अधिक विलेय है।
- (d) MCl_2 has higher melting point than MCl_4
 MCl_2 का द्रवणांक MCl_4 से अधिक है।

Ans. (d) : According Fajan's rule the compound having central atom with higher charge density becomes more covalent than compound having central atom with lesser charge density.



Hence, MCl_4 is more covalent than MCl_2 in nature, i.e. MCl_2 is more ionic in nature.

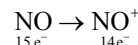
As we know ionic compounds have higher m.p. and b.p. then covalent compounds, hence statement (d) is correct.

28. In which of the following conversions, both bond order and magnetic property of the species increases ?

निम्न में से किस रूपान्तरण में स्पीशीज का बन्ध क्रम और चुम्बकीय विशेषताएँ दोनों अधिक होती है?

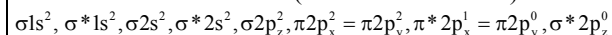
- (a) $\text{CO} \rightarrow \text{CO}^+$ (b) $\text{O}_2 \rightarrow \text{O}_2^-$
(c) $\text{N}_2^- \rightarrow \text{N}_2^+$ (d) $\text{NO} \rightarrow \text{NO}^+$

Ans. (d) : Consider the given conversion



* Molecular orbital diagram formula for NO

(15 valence electron)



There is one unpaired electron in $\pi^* 2p_x$.

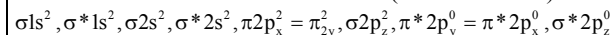
So, it is paramagnetic.

$$\text{Bond order} = \frac{N_b - N_a}{2}$$

$$= \frac{10 - 5}{2} = 2.5$$

* Molecular orbital diagram formula for NO^+

(14 Valence e^-)



There is no unpaired electrons hence, diamagnetic in nature

$$\text{Bond order} = \frac{N_b - N_a}{2}$$

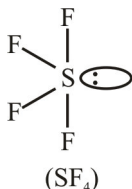
$$= \frac{10 - 4}{2} = 3$$

29. In which of the following molecules/ions all bonds are not equal?

निम्न में से कौन से अणु/आयन में सभी बन्ध समान नहीं होते ?

- (a) BF_4^- (b) SiF_4
(c) SF_4 (d) XeF_4

Ans. (c) : In SF_4 molecules the central atom 'S' undergoes sp^3d hybridization. It has one lone pair and 4 bond pairs of electrons which results in see-saw geometry. Out of four bond pairs, two are axial and two are equatorial. Hence, in SF_4 all bonds are not of equal length.



sp^3d hybridisation, Trigonal bipyramidal geometry.

30. Select the correct statements among the following

निम्न में से सही कथन का चयन कीजिए

- (a) Ortho- $\text{C}_6\text{H}_4(\text{OH})$ (CHO) molecules have intermolecular hydrogen bonding/Ortho- $\text{C}_6\text{H}_4(\text{OH})$ (CHO) अणु के अन्तराण्विक हाइड्रोजन बन्ध होते हैं।
(b) If an electron has magnetic quantum number value $m = 0$, then it must be present in 's' orbital/यदि किसी इलेक्ट्रॉन की चुम्बकीय प्रमात्रा (क्वॉन्टम) संख्या मूल्य $m = 0$ है, तो वह 's' कक्षा होता ही है।
(c) The number of oxygen atoms in 1 gm of O_2 and 1 gm of O_3 are same/1 ग्राम O_2 में और 1 ग्राम O_3 में ऑक्सीजन परमाणुओं की संख्या एकसमान होती है।
(d) ClF_3 is a non polar, planar molecule ClF_3 यह एक अध्रुवीय, समतल अणु है।

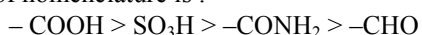
Ans. (b) : If an electron has magnetic quantum number value $m = 0$, then it must be present in s-orbital. Magnetic quantum number (m) determines the orientation of the orbital in space it goes from $-l$ to $+l$.

31. The correct decreasing order of priority for the functional group of organic compounds in the IUPAC system of nomenclature is

IUPAC पद्धति नामावली में कार्बनिक यौगिकों के क्रियाशील समूह के अग्रता का सही घटता क्रम है

- (a) $-\text{CONH}_2, -\text{CHO}, -\text{SO}_3\text{H}, -\text{COOH}$
(b) $-\text{COOH}, -\text{SO}_3\text{H}, -\text{CONH}_2, -\text{CHO}$
(c) $-\text{SO}_3\text{H}, -\text{COOH}, -\text{CONH}_2, -\text{CHO}$
(d) $-\text{CHO}, -\text{COOH}, -\text{SO}_3\text{H}, -\text{CONH}_2$

Ans. (b) : The correct decreasing order of priority for the functional groups of organic compounds in IUPAC system of nomenclature is :



32. The pK_a of a weak acid, HA is 4.8 and pK_b of a weak base, BOH is 4.78. Then the pH of an aqueous solution of the corresponding salt BA will be

एक दुर्बल अम्ल HA का pK_a मान 4.8 एवं दुर्बल क्षार BOH का pK_b मान 4.78 है। तब सापेक्ष लवण BA के जलीय विलयन का pH मान क्या होगा?

- (a) 9.22 (b) 9.58
(c) 4.79 (d) 7.01

Ans. (d) : Let, the salt of weak acid and base like $\text{CH}_3\text{COONH}_4$

Now,

Salt hydrolysis formula is :

$$K_h = \frac{K_w}{K_a K_b}$$

$$h = \sqrt{\frac{K_w}{K_a K_b}}$$

$$\text{pH} = \frac{1}{2}[\text{pK}_w + \text{pK}_a - \text{pK}_b]$$

So, pH of Salt is,

$$\text{pH} = \frac{1}{2}(14 + 4.80 - 4.78) = 7.01$$

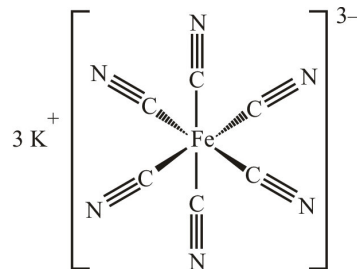
33. Which of the following statements is correct with regard to the complex potassium ferricyanide?

कॉम्प्लेक्स पोटैशियम फेरिसाइनाइड के बारे में निम्न में से कौन सा कथन सही है?

- (a) The central metal atom in the complex obeys EAN rule/कॉम्प्लेक्स में स्थित केन्द्रीय धातु परमाणु EAN नियम पालन करता है।
(b) It is less stable than potassium ferrocyanide वह पोटैशियम फेरोसाइनाइड से कम स्थिर होता है।
(c) It is paramagnetic octahedral, spin complex वह अनुचुम्बकीय, अष्टफलकीय, निम्न चक्रण कॉम्प्लेक्स होता है।
(d) The primary valency of iron is satisfied by 3 K^+ ions/3 K^+ आयन के द्वारा आयरन की प्राथमिक संयोजकता पूरी होती है।

Ans. (c) : Potassium ferricyanide $\text{K}_3[\text{Fe}(\text{CN})_6]$ is an octahedral complex.

It has low spin complex due to strong ligand field but due to presence of 1 unpaired electron it has paramagnetic.



Potassium ferricyanide

34. The gold number of protective colloids A, B, C, D are 0.5, 0.01, 0.10 and 0.0 respectively. The correct order of the protective power is संरक्षक कोलाइड A, B, C, D की स्वर्ण संख्या क्रमशः 0.5, 0.01, 0.10 और 0.005 है। उनके संरक्षक शक्ति का सही क्रम है—

- (a) $B < D < A < C$ (b) $D < A < C < B$
(c) $C < B < D < A$ (d) $A < C < B < D$

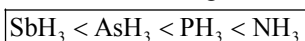
Ans. (d) : Gold numbers of protective colloids A, B, C and D are 0.50, 0.01, 0.10 and 0.005 respectively. The correct order of their protective powers is $A(0.50) < C(0.10) < B(0.01) < D(0.005)$
Higher is the value of gold number, lower is the protective power.

35. In which of the following arrangements the sequence is not strictly observed according to the property written against it

निम्न में से किस आयोजन में क्रम को उसके सामने लिखी गई विशेषता का सख्ती से पालन नहीं किया गया है —

- (a) $NH_3 < PH_3 < AsH_3 < SbH_3$ – increasing basic strength
 $NH_3 < PH_3 < AsH_3 < SbH_3$ बढ़ती क्षारीय शक्ति
(b) $B < C < O < N$ – increasing I^{st} – ionisation energy
 $B < C < O < N$ बढ़ती I^{st} आयनीकरण ऊर्जा
(c) $HF < HCl < HBr < HI$ – increasing acid strength
 $HF < HCl < HBr < HI$ बढ़ती अम्ल शक्ति
(d) $NF_3 < NH_3 < H_2O$ – increasing dipole moment
 $NF_3 < NH_3 < H_2O$ बढ़ता द्विध्रुव आघूर्ण

Ans. (a) : In hydrides of 15^{th} group elements, the basic strength decreases down the group because electron density is more in NH_3 due to small size of N and hence, it has high tendency to donate lone pair.
So, the correct order of increasing basic strength is



36. The polymer containing strong intermolecular force of attraction (i.e. Hydrogen bonding) is प्रबल अंतर अणुक आकर्षण बल (हाइड्रोजन बन्ध) रखने वाला बहुलक है।

- (a) Natural rubber/प्राकृतिक रबड़
(b) Teflon/टेफ्लॉन
(c) Nylon-6, 6/नाइलॉन-6, 6
(d) Polystyrene/पॉलीस्टाइरीन

Ans. (c) : The polymer containing strong intermolecular force of attraction i.e. – (Hydrogen bonding) is Nylon-6, 6.

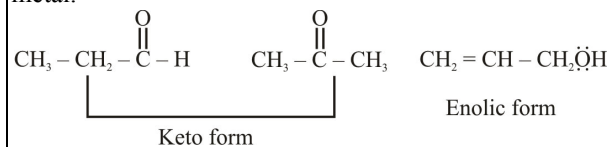
Nylon-6, 6 is made of two monomers each containing 6 carbon atoms, is a polyamide. It can form hydrogen bonds as the H-atom is attached to amide N-atom.

37. An organic compound C_3H_6O does not give a precipitate with 2, 4 – dinitrophenylhydrazine and does not react with sodium metal. The compound may be

कार्बनिक यौगिक C_3H_6O , 2, 4-dinitrophenylhydrazine के साथ अवक्षेपण नहीं देता और सोडियम धातु से प्रतिक्रिया नहीं करता। वह यौगिक हो सकता है

- (a) $CH_3 - CH_2 - CHO$
(b) $CH_2 = CH - O - CH_3$
(c) $CH_3 - CO - CH_3$
(d) $CH_2 = CH - CH_2 OH$

Ans. (b) : Carbonyl compounds either in keto or enolic form give reaction with phenyl hydrazine and sodium metal.



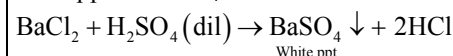
While $CH_2 = CH - \ddot{\text{O}} - CH_3$ is an ether. So, it does not give reactions (precipitate) with phenyl hydrazine and sodium metal.

38. An inorganic salt 'A' gives a white precipitate with dil. H_2SO_4 , yellow precipitate with potassium chromate in presence of acetic acid and a clear solution in dilute HCl. The compound 'A' may be

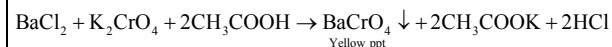
'A' अकार्बनिक लवण तनु H_2SO_4 के साथ श्वेत अवक्षेप देता है, एसिटिक अम्ल के मौजूदगी में पोटैसियम क्रोमेट के साथ पीला अवक्षेप और तनु HCl में स्पष्ट विलयन देता है। यौगिक 'A' हो सकता है

- (a) Lead carbonate/लेड कार्बोनेट
(b) Silver nitrate/सिल्वर नाइट्रेट
(c) Barium chloride/बेरियम क्लोराइड
(d) Calcium bromide/कैल्शियम ब्रोमाइड

Ans. (c) : When $BaCl_2$ reacts with dil. H_2SO_4 it gives white ppt of $BaSO_4$.



$BaCl_2$ reacts with Potassium chromate in presence of acetic acid as follows.



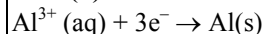
There is no visible chemical reaction between $BaCl_2$ and dil. HCl, hence clear solution appears.

39. Aluminium oxide may be electrolysed at 1000°C to furnish aluminium metal (Atomic mass $Al = 27 \text{ amu}$). The cathodic reaction is $Al^{3+} + 3e^- \rightarrow Al$. If one Faraday is 96500 C mol^{-1} , the electricity required to prepare 5.12 Kg of aluminium is

1000°C पर एल्युमिनियम ऑक्साइड को विद्युत अपघट्य कर एल्युमिनियम धातु को पाया जा सकता है (परमाण्वीय द्रव्यमान : $Al = 27 \text{ amu}$)। कैथोडिक अभिक्रिया है : $Al^{3+} + 3e^- \rightarrow Al$ । यदि एक फेरेड (Farad) यह 96500 C mol^{-1} है, तो 5.12 Kg एल्युमिनियम बनाने के लिए लगने वाली विद्युत् है

- (a) $5.49 \times 10^4 \text{ C}$ (b) $5.49 \times 10^7 \text{ C}$
(c) $5.49 \times 10^2 \text{ C}$ (d) $5.49 \times 10^{10} \text{ C}$

Ans. (b) : Half Cell Reaction :-



1 mole 3 mole 1 mole

From above equation,

1 mole Aluminium (27 gram) is obtained by consumption of 3 mole electrons.

$$\therefore 27 \text{ gram Al} = 3 \text{ mole e}^{-}$$

$$\therefore 5.12 \text{ kg Al} = \frac{3 \times 5.12 \times 10^3 \text{ g}}{27 \text{ gram}}$$

$$= 0.568 \times 10^3 \text{ mole of e}^{-}$$

$$= 5.68 \times 10^2 \text{ mole of e}^{-}$$

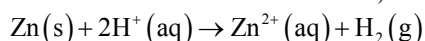
1 mole e^{-} = 1 Faraday = 96500 coulomb

$$5.68 \times 10^3 \text{ mole e}^{-} = 96500 \times 5.68 \times 10^2 \text{ C}$$

$$= 548120 \times 10^2 \text{ C}$$

$$= 5.48 \times 10^7 \text{ C}$$

40. In a cell that utilizes the reaction,



addition of H_2SO_4 to Cathode compartment will

जो सेल इस प्रतिक्रिया :

$\text{Zn}(\text{s}) + 2\text{H}^{+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{H}_2(\text{g})$ का उपयोग करता है, कैथोड कक्ष में H_2SO_4 मिलाने से

- Lower the 'E' and shift the equilibrium to the left/'E' को घटाकर संतुलन को बायीं ओर स्थानांतरित करता है।
- Lower the 'E' and shift the equilibrium to the right/'E' को घटाकर संतुलन को दाहिनी ओर स्थानांतरित करता है।
- Increase the 'E' and shift the equilibrium to the right/'E' को बढ़ाकर संतुलन को दाहिनी ओर स्थानांतरित करता है।
- Increase the 'E' and shift the equilibrium to the left/'E' को बढ़ाकर संतुलन को बायीं ओर स्थानांतरित करता है।

Ans. (c) : $\text{Zn}(\text{s}) + 2\text{H}^{+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{H}_2(\text{g})$

$$E = E^0 - \frac{0.059}{2} \log \frac{[\text{Zn}^{2+}]}{[\text{H}^{+}]^2}$$

So, as we add sulphuric acid, conc. of hydrogen ion increases and equilibrium shifts to right.

Also according to the equation EMF of the cell will be increased by adding acid.

41. Which one among the following lipids is not found in the plasma membrane?

निम्न में से कौन-सा लिपिड प्लाज्मा झिल्ली में नहीं पाया जाता ?

- Phosphoglycerides/फॉस्फोग्लिसराइड्स
- Sphingolipids/स्फिंगोलिपिड
- Phytanic acid/फाइटेनिक अम्ल
- Cholesterol/कोलेस्ट्रॉल

Ans. (c) : Phospholipids, cholesterol & glycolipids are found in cell's plasma membrane. Sphingolipids are found in nerve cells membrane but the phytanic acid does not found in any membrane. It is direct poison to mitochondria.

Cholesterol is a waxy, fat-like substance made by the liver. It serve as a precursor for the synthesis of substance like-vitamin D, bile acids and hormones which are vital for the organism.

Its main function is to maintain fluidity of cell membranes and cell integrity.

42. Which one of the following best explains the role of G₁ phase during the Cell cycle ?

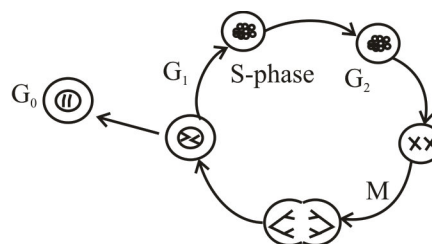
कोशिका चक्र के दौरान निम्न में से क्या G₁ अवस्था की भूमिका उत्तम तरीके से स्पष्ट कर सकता है?

- Cell grows and carries out normal metabolism/कोशिका विकसित होती है और सामान्य चयापचय करती है
- DNA replication and chromosome duplication/DNA की प्रतिकृति और क्रोमोसोम द्विगुणीकरण
- Cell grows and prepares for mitosis कोशिका विकसित होती है और सूत्री विभाजन (mitosis) के लिए तैयारी करती है
- Cytokinesis/कोशिका द्रव्य विभाजन

Ans. (a) : Cell cycle is the formation of new cells from old ones. All the phases in cell cycle are equally important.

There are 5 phases at all -

- G₁ phase** – During the G-1 phase, the cell is metabolically active and continuously grows but does not replicate its DNA. The cell grows maximum in the G₁ phase.
- S-phase (Synthesis)** - DNA replication take place during this phase. During this time the amount of DNA per cell doubles. If the initial amount of DNA is denoted as 2C then it increases 4C.
- G₂ phase** – Cell grows, make organelles & proteins. Cell also begins to reorganise its genetic content in preparation for mitosis.



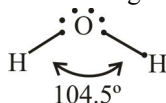
- M - phase** - Cell divides its DNA and cytoplasm.
- G₀ phase** – Cell exits from cell cycle and goes into quiescent stage. That means cell will not perform division in future.

G₁, S, G₂ phases together are known as Interphase. During these phases cell prepares itself for mitosis.

43. Which of the following statements does not explain the structure of water?/निम्न में से कौन-सा कथन पानी की संरचना को स्पष्ट नहीं करता?

- (a) The oxygen nucleus attracts electrons more strongly than does the hydrogen nucleus
ऑक्सीजन के नाभिक इलेक्ट्रॉन को हाइड्रोजन नाभिक तुलना में अधिक प्रबलता से आकर्षित करते हैं।
- (b) The sharing of electrons between H and O is unequal/H और O के बीच में इलेक्ट्रॉन का बँटवारा असमान होता है।
- (c) It is a linear molecule/यह एक रैखिक अणु है।
- (d) The H-O-H bond angle is 104.5°
H-O-H बन्ध कोण 104.5° होता है।

Ans. (c) : Water is the molecule made up of 2-hydrogen and 1-oxygen molecule. The central oxygen atom is sp^3 hybridised, and contains two non-bonded lone pair electrons. Being more electronegative than hydrogen it attracts electron more strongly. The sharing of electrons between the atoms is unequal. Water molecule have angular structure with 104.5° angle.



44. Which one of the following is a suitable example for a non-polar molecule ?

अधुवीय अणु का निम्न में से कौन-सा योग्य उदाहरण है?

- (a) Glucose/ग्लूकोज
- (b) Honey wax/शहद का मोम
- (c) Lactate/लैक्टेट
- (d) Phenyl alanine/फिनाइल एलानिन

Ans. (b) : Only honey wax is non-polar molecule. Glucose, lactate and phenylalanine all have oxygen, hydrogen and nitrogen in their chemical formula. So, they are polar molecules.

A polar molecule is a molecule in which one end of the molecule is slightly positive, while the other end is slightly negative.

45. How a eukaryotic cell-wall differs from that of a prokaryote ? It is by the presence of प्रोकैरियोट से यूकैरियोट कोशिका-भित्ति किस तरह से अलग है ? वह इसके होने से है

- (a) Cellulose/सेलुलोज
- (b) diaminopimelic acid/डायमिनोपेमेरिक अम्ल
- (c) muramic acid/म्यूरैमिक अम्ल
- (d) Peptidoglycan/पेप्टाइडोग्लाइकैन

Ans. (a) : Most prokaryotic cells have a rigid cell wall that surrounds the plasma membrane and gives shape to the organism. In eukaryotes, vertebrates don't have a cell wall but plants do. The cell walls of prokaryotes differ chemically from the eukaryotic cell walls of plant cells, which are primarily made of cellulose while the muramic acid, peptidoglycan and diaminopimelic acid (DAP) are found in bacterial cell wall which is a prokaryotic organism.

46. Which one of the following helps to collect and focus the light rays on the specimen in a light microscope ?

प्रकाश सूक्ष्मदर्शी में निम्न में से क्या प्रकाश किरणों को एकत्रित कर नमूने पर केन्द्रित करने के लिए मदद करता है?

- (a) Eye piece/आँखों का भाग
- (b) Nose piece/नाक का भाग
- (c) Condenser lens/संग्राही लेन्स
- (d) Coarse adjustment knob/खुरदरा समायोजना दस्ता

Ans. (c) : The condenser lens is present between the light source and the specimen which collects the light and focuses on the specimen.

The eyepiece (or ocular) magnifies the primary image produced by the objective.

Nosepiece is a part of microscope that holds objective lenses (can be two or many)

Coarse adjustment knob allows for quick focusing by moving the objective lens stage up and down.

47. Which one among the entire group fits to give example of carbohydrates?

निम्न में से कौन-सा समूह कार्बोहाइड्रेट्स का उदाहरण देने के लिए सक्षम है?

- (a) Glucose, Mannose, Maltose, Lactate
ग्लूकोज, मैनोज, माल्टोज, लैक्टेट
- (b) Phosphoglyceraldehyde Erythrose, Sucrose, Lactose/फॉसफोग्लिसरेल्डीहाइड, एरिथ्रोस, सुक्रोज, लैक्टोज
- (c) Dihydroxyacetone Phosphate, Arabinose, Fructose, Succinate/डाइहाइड्रॉक्सिएसीटोन फॉस्फेट, अरेबिनोज, फ्रक्टोज, सक्सिनेट
- (d) Glycine, Glycan, Glucose, Gluconate
ग्लाइसीन, ग्लाइकैन, ग्लूकोज, ग्लूकोनेट

Ans. (a) : Carbohydrates are carbon, hydrogen and oxygen based biological compounds. Carbohydrates are the most prevalent biomolecules on the planet. The empirical formula of carbohydrates is $(CH_2O)_n$.

Carbohydrates are 3-types

- (1) Monosaccharide – Glucose, mannose
- (2) Oligosaccharide – Maltose, lactose
- (3) Polysaccharide – Cellulose, glycogen

Lactate is an organic molecule, technically it's not a carbohydrate but generally is a carbohydrate with formula $C_3H_5O_3$.

The correct answer to this question is- Glucose, Mannose, Maltose, Lactate.

48. Which one of the following stages is identified when the chromatids are separated and attached to the spindle?

निम्न में से कौन-सी स्थिति में क्रोमेटिड्स अलग होते हैं और स्पिंडल से जुड़ जाते हैं ?

- (a) Prophase/पूर्णावस्था
- (b) Metaphase/मध्यावस्था
- (c) Anaphase/पश्चावस्था
- (d) Telophase/अन्त्यावस्था

Ans. (c) : Anaphase stage is identified when the chromatids are separated and attached to the spindle.

Meiotic cell division phases are –

- (A) Prophase – Nuclear membrane disappears, formation of spindle fibres and DNA condenses into chromosomes.
- (B) Metaphase – Sister chromatids aligns at equator by attaching their centromeres of the spindle fibres.
- (C) Anaphase – Sister chromatids separated at centromere and pulled towards opposite poles of cell by spindle fibres.
- (D) Telophase – Chromosomes arrives at opposite poles. Unwind into DNA strands. Spindle fibres disappears and nuclear membrane appears.
- (E) Cytokinesis – Splitting of cell into two new daughter cells. Division of cytoplasm takes place.

49. Which one of the following is classified under sponges ?

निम्न में किसे स्पंज में वर्गीकृत किया जाता है ?

- (a) Venus's flower basket is a glass sponges
विनस का फ्लावर बास्केट एक ग्लास स्पंज है
- (b) Hydra is simple invertebrate of kingdom animalia
हाइड्रा जन्तु जगत का साधारण अकशेरुकीय है।
- (c) Portuguese man-of-war is a blue bottle jelly fish/पोर्तुगीज मैन ऑफ वॉर एक ब्लू बॉटल जेली फिश है।
- (d) Sea anemone/समुद्री एनीमॉन

Ans. (a) : Venus's flower basket is a glass sponge which is classified under sponges in the phylum Porifera.

It builds its skeleton in a way that entraps a certain species of crustacean inside for life.

Sponges are hollow cylinders with a large opening at the top through which water and wastes are expelled out.

The body of sponge is radially symmetrical & they exhibit holozoic nutrition.

50. In one of the cytological slides, the homologous chromosomes are seen in synapsis; a protein containing synaptonemal complex is formed to facilitate crossing over. In which stage the above state of the cell is identified?

कोशिकीय स्लाइड में से एक में, सूत्रयुग्मन में समरूप गुणसूत्र देखे जाते हैं, एक प्रोटीन जिसमें युग्मसूत्री संमिश्र होता है जो जीन विनिमय की सुविधा के लिए बनता है। कोशिका की उपरोक्त अवस्था को किस अवस्था में पहचाना जाता है?

- (a) Leptotene/तनुसूत्रावस्था
- (b) Zygotene/युग्मनजावस्था
- (c) Pachytene/स्थूलसूत्रावस्था
- (d) Diplotene/डिप्लोटीन

Ans. (b) : Zygotene - This stage is characterized by the pairing of homologous chromosomes (synapsis). There develops a structure between the homologous chromosomes called the synaptonemal complex. It is a tripartite structure. i.e. it is made up of 3 thick lines of DNA and protein, Hence, the stage identified is zygotene.

Leptotene - During leptotene, the chromatin condenses to form the chromosomes. Chromosomes are the longest and thinnest in this stage.

Pachytene - Non-sister chromatids of the homologous chromosomes exchange their genetic parts (crossing over).

Diplotene - X-shaped structure called chiasmata is clearly visible in this stage.

51. An organism under observation is found to be spindle shaped and single celled. It has long flagellum showing contractile locomotion in pure water. There appears a single nucleus and many chloroplast. To which one of the following kingdoms this organism fits into ?

एक निरीक्षण में रखा हुआ जीव स्पिण्डल के आकार का है और एक-कोशिकीय है। इसमें लम्बी कशाभिका है, शुद्ध पानी में संकुचन संचरण दिखाई पड़ता है। उसमें एक नाभिक और बहुत सारे हरितकण दिखते हैं। निम्न में से किस किस्म से वह जीव सम्बन्धित है?

- (a) Monera/मोनेरा
- (b) Protista/प्रोटिस्टा
- (c) Mycota/माइकोटा
- (d) Plantae/पादप जगत

Ans. (b) : Protista is the kingdom with eukaryotic unicellular organisms. Some of them possess cilia and flagella to perform locomotion. They are usually aquatic. Symbiosis is also prominent in these organisms.

52. Nostoc cell differs from that of E. coli in the following features :

निम्न विशेषता में नास्टॉक कोशिका ई.कोलाई से भिन्न है-

- (a) Having photosynthetic pigments
प्रकाशसंश्लेषणी रंजक होना
- (b) Heterocysts/विषम कोष
- (c) Autotrophic nutrition/स्व-पोषित आहार
- (d) All the above/उपरोक्त सभी

Ans. (d) : Nostoc is a cyanobacterium that have photosynthetic pigment chlorophyll - a similar to green plants. The E.coli does not have any photosynthetic pigments. Nostoc are autotrophic but E.coli is a heterotroph i.e. it depends on other organisms for its food requirement.

Nostoc has specialised cells called the heterocysts, which can fix the atmospheric nitrogen. The E.coli does not have any heterocysts present.

53. The most abundant gaseous element in the atmosphere is

वायुमंडल में सबसे पर्याप्त मात्रा में पाया जाने वाला गैसीय मूलतत्व है-

- (a) Nitrogen/नाइट्रोजन
- (b) Fluorine/फ्लोरीन
- (c) Hydrogen/हाइड्रोजन
- (d) Chlorine/क्लोरीन

Ans. (a) : Gaseous Elements in atmosphere – Nitrogen – 78%, Oxygen – 21%, Other gases – 0.96%, Carbon dioxide – 0.04%.

Thus, Nitrogen is most abundant gaseous element in atmosphere.

54. Find out the correct answer from the following statements

निम्न कथनों में से सही उत्तर का पता लगाइए

- (a) Rhizopus reproduces by conidia and ascospores/राइजोपस विबीजुक और अस्को बीजाणुओं का पुनरुत्पादन करता है
- (b) Marchantia has a sporophyte with capsule only/मार्केशिया बीजकोष वाला बीजाणुधार (स्पोरोफाइट) होता है
- (c) Selaginella is a heterosporous pteridophyte सिलेजिनेला विषमबीजाणुक टेरिडोफाइट होता है
- (d) Pinus produces the apogeotropic coralloid roots/ पाइनस भूअनुवर्ती प्रवालाभ मूल उत्पन्न करता है।

Ans. (c) : Selaginella is a heterosporous pteridophyte, because it produces two types of male & female spores that are known as micro & megaspores respectively. Microspores are males spores that are smaller in size and larger in number. Microspores are produced in microsporangium.

Megaspores are the female spores that are larger in size and smaller in number. Megaspores are produced in megasporium, these spores on germination produce the female gametophyte.

55. Identify the brown algae from the following list निम्नलिखित में से भूरा शैवाल पहचानिए—

- (a) Oedogonium/उडोगोनियम
- (b) Vaucheria/वाउचेरिया
- (c) Polysiphonia/पॉलीसाइफोनिया
- (d) Fucus/फ्यूकस

Ans. (d) : Fucus is a genus of brown algae of the phylum Gyrista. It is commonly known as rockweed common on rocky seacoasts and in salt marshes of northern temperate regions.

It is used for obesity, constipation, thyroid disorders and ageing skin etc.

- Oedogonium – Green algae
Vaucheria – Green yellow algae.
Polysiphonia – Red algae

56. Hypogynous flower has :

अवकिंज (Hypogynous) फूल में होता है—

- (a) A conspicuous thalamus with a disc विशिष्ट चक्र के साथ पुष्पासन
- (b) A superior ovary seated on the thalamus पुष्पासन पर स्थित प्रवर अण्डाशय
- (c) Half superior and half inferior ovary seated on the cup shaped thalamus/कप के आकार के पुष्पासन पर स्थित अर्द्ध प्रवर और अर्द्ध अवर अण्डाशय
- (d) An inferior ovary/अवर अण्डाशय

Ans. (b) : Hypogynous flower - Gynoecium occupies the highest position while the other parts are situated below it. The ovary in such flowers is said to be superior. E.g. china rose, mustard, tomato and brinjal etc.

Perigynous flowers - The gynoecium is in the center and the other parts of the flower are virtually at the same level as the thalamus rim. Flower with half - superior and half inferior ovary.

e.g. - Plum rose, peach etc.

Epigynous flower - The hypanthium is joined to gynoecium and the free portions of the petals, sepals and stamens seem to be connected to the top of the gynoecium. The ovary are inferior type.

57. Which one of the following classifications best explains Bentham and Hooker's system ?

निम्न में से कौन-सा वर्गीकरण बेंथम और हुकर्स पद्धति का उत्तम स्पष्टीकरण है ?

- (a) Angiosperms are divided into Gymnosperm and Dicots/सपुष्प वनस्पति यह प्रकटबीज वनस्पति (जिमनोस्पर्म) और द्विबीज पत्री वनस्पति में विभाजित होती है
- (b) Polypetalae has - Thalamiflorae, Calyciflorae and Monochlamydeae, as series/पोलिपिटैली थैलेमीफ्लोरी, कैल्सीफ्लोरी और मोनोक्लेमाइडेज शृंखला में होते हैं
- (c) Gamopetalae includes series - Gentianales, Polemoniales, Personales and Lamiales गैमोपिटैली में जेन्शिनैल्स, पोलेमोनिएल्स, पर्सेनेल्स और लैमिएल्स शृंखला में होते हैं
- (d) Polypetalae, Gamopetalae and Monochlamydeae are placed phylogenetically पोलिपिटैली, गैमोपिटैली और मोनोक्लेमाइडी अनुवंशिकता के अनुसार रखे गये हैं

Ans. (d) : George Bentham and Joseph Dalton Hooker, both of whom were closely involved with the Royal Botanic Garden at Kew, England, provided a systematic classification of the plant kingdom, notably the Angiosperms.

* It is a natural classification system.

* Polypetalae, Gamopetalae and Monochlamydeae are placed phylogenetically. This is true statement.

* Bentham and Hooker were committed to placing the classes and sub-classes according to their evolutionary relationships.

* The plant kingdom was separated into two section - cryptogamia (non-flowering plants) and Phaerogamia (flowering plant).

58. Which one of the following states the features of Myxomycetes ?

निम्नलिखित में से कौन मिक्जोमाइसेटीज की विशेषता बताता है?

- (a) Sexual reproduction is oogamous; Gametes non flagellate, Zoospores are biflagellate लिंगी पुनरुत्पादन विषमयुग्मकी होता है, युग्मक कशाभी होते हैं, चलबीजाणु द्विकशाभी होते हैं।
- (b) Unicellular or acellular; Pseudopodia present; cilia for locomotion/एककोशिकीय या अकोशिकीय, पादाभ होता है, गमन के लिए पक्ष्माभिका।
- (c) Plasmodium is the somatic phase; holocarpic; sporangia form capillitium प्राकल्पुंज कायिक स्थिति में, होलोकार्पिक बीजुककोश कैपिटिलियम बनाता है।
- (d) A ventral muscular foot; lamellate gills; soft unsegmented body/उदरीय पेशीय पाँव, पटलीय गिल, नरम अखंड शरीर।

Ans. (c) : Slime moulds are multinucleate organisms. They live in dead and decaying organisms under cold and shaded localities. They perform an isogamous type of sexual reproduction. The capillitium is a part of the myxomycetes, or slime moulds, sporophores or fruiting bodies. Capillitium is a typical structure formed by them in their somatic phase.

59. Which one of the following exhibits polymorphism?

निम्नलिखित में से कौन बहुरूपता दर्शाता है ?

- (a) Halistemma/हेलिस्टेमा (b) Hydra/हाइड्रा
(c) Obelia/ओबेलिया (d) Sycon/साइकॉन

Ans. (*) : If two or more than two structurally and functionally different organisms occurs in a population, then this phenomenon is called polymorphism.

* Obelia shows polymorphism with three distinct types of zooids - Polyp, blastostyles & medusae.

* The polyp forms provide nutrition to the colony, blastostyles is for budding and the medusae perform the dissemination of gametes.

* It also exhibits alternation of generation (Metagenesis), i.e. polyp produce medusae asexually and medusae form the polyps asexually.

* Halistemma – it belongs to suborder physophorida of the order siphonophera. This genus occurs in mediterranean and other seas. The colony exhibits great degree of polymorphism, coenosora is modified into a long, slender, flating, axial tube or stem to which polymorphic zooids are attached all along its length.

option (a) and (c) both are correct.

60. A common endoparasite, in the livers of sheep; 25 mm long and 13 mm at the broadest part; flat leaf like body, with two suckers-anterior and posterior. Identify this animal.

भेड़ के यकृत में एक सामान्य अंतःपरजीवी 25 mm लम्बा और 13 mm अति चौड़े हिस्से में चपटे पत्ते जैसा शरीर, अग्रवर्ती और परवर्ती ऐसे दो अन्तर्भूस्त्री। प्राणी को पहचानिए।

- (a) Planaria/प्लेनेरिया
(b) Schistosoma/सिस्टोसोमा
(c) Taenia sodium/टीनिया सोलियम
(d) Fasciola/फैशिलोला

Ans. (d) : Fasciola hepatica is a common endoparasite, in the livers of sheep 25 mm long and 13mm at the broadest part flat leaf like body with two suckers-anterior and posterior.

Fasciola hepatica is also known as liver fluke or sheep liver fluke is a parasitic trematode of the class Trematoda of the phylum Platyhelminthes.

61. Which one among the following is not a true coelomate ?

निम्न में से कौन सही उदरगुही (coelomate) नहीं है?

- (a) Platyhelminthes/प्लेटीहेल्मिन्थीज
(b) Aschelminthes/एस्केहेल्मिन्थीज
(c) Cnidaria/निडेरिया
(d) Annelida/एनीलिडा

Ans. (b) : Coelom is the cavity formed during embryonic development from 3 germinal layers on the basis of coelom animals are of 3 types –

(1) Acoelomates – Coelom is absent. Blastocoel is completely occupied by mesoderm. eg – porifera coelenterata and platyhelminthes.

(2) Pseudocoelomate – True coelom is not present. Blastocoel is partially filled by mesoderm. eg – Aschelminthes.

(3) Eucoelomate – Animals possessing true coelom. The coelom is lined by mesoderm. eg – Annelida, Arthropoda, Mollusca, Chordata.

62. What are ommatidia ?

नेत्रांशक (ommatidia) क्या होते हैं ?

(a) A part of the mouth part of an insect
कीट के मुख भाग का एक हिस्सा

(b) Elongate simple eye with a sheath of black pigment/काले रंजक आवरण से सामान्य आँख को लम्बा करना

(c) Eyes, labium and labrum
आँख, अधरोष्ठ और उत्तरोष्ठ

(d) Olfactory organs of an insect/कीट के प्राणेन्द्रिय

Ans. (b) : Ommatidia is the part of compound eye present in cockroach and other arthropods for mosaic vision. They are highly sensitive with low resolution power.

Ommatidia is made up of pigmented photoreceptor cells, which adjust the intensity of light.

Each ommatidium can act as a separate eye and is capable of responding to its own visual field.

63. The type of migration in which the fishes in fresh waters descend to the sea for spawning is termed

अण्डजनन के लिए मीठे पानी से समुद्र में नीचे आने वाली मछलियों के स्थानांतरण को कहते हैं—

- (a) Macropodus/मैक्रोपोडस
(b) Anadromous/एनैड्रोमस
(c) Catadromous/कैटाड्रोमस
(d) Anguilla/एंगुइला

Ans. (c) : Catadromous migration is a type of migration in which fish move from fresh water to the ocean and back again. Example- Salmon, Eels and Sturgeon.

Anadromous fishes are those that spawn in fresh water, migrate to the ocean to forage and mature and return to fresh water to spawn and begin the cycle again.

Example – Oncorhynchus, Salmon fish.

Macropodus and Anguilla both are names of fishes.

64. Which one of the following is the correct answer for the type of respiration that Frog undertakes?

मेंढक के श्वसन के प्रकार का निम्न में से कौन-सा सही उत्तर है?

- (a) Pulmonary and gills
फुफ्फुसीय और गलफड़ा (गिल)
(b) Cutaneous and gills/त्वचीय और गिल