

PRINCIPAL'S OBSERVATION
       : 48
Number of Pages in Booklet : 48
Pustak Makan in Pravach : 100
No. of Questions in Booklet : 100

Subject Code : OE
Division : SSD-91

DOCUMENTS DIVISION

<table>
<thead>
<tr>
<th>Part-A</th>
<th>Part-B</th>
<th>Part-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics</td>
<td>Chemistry</td>
<td>Forensic Sc.</td>
</tr>
<tr>
<td>Attempt Either Physics or Chemistry</td>
<td></td>
<td>Compulsory for all</td>
</tr>
</tbody>
</table>

Maximum Marks : 100

The candidate should ensure that Question Paper Booklet No. of the Question Paper Booklet and Answer Sheet must be same after opening the Paper Seal / Polythene bag. In case they are different, a candidate must obtain another Question Paper. Candidate himself shall be responsible for ensuring this.

INSTRUCTIONS FOR CANDIDATES

1. Answer all questions.
2. All questions carry equal marks.
3. Only one answer is to be given for each question.
4. If more than one answers are marked, it would be treated as wrong answer.
5. Each question has four alternative responses marked serially as 1, 2, 3, 4. You have to darken only one circle or bubble indicating the correct answer on the Answer Sheet using BLUE BALL POINT PEN.
6. The OMR Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully with blue ball point pen only.
7. 1/3 part of the mark(s) of each question will be deducted for each wrong answer. A wrong answer means an incorrect answer or more than one answers for any question. Leaving all the relevant circles or bubbles of any question blank will not be considered as wrong answer.
8. Mobile Phone or any other electronic gadget in the examination hall is strictly prohibited. A candidate found with any of such objectionable material with him/her will be strictly dealt with as per rules.
9. Please correctly fill your Roll Number in O.M.R. Sheet. 5 Marks can be deducted for filling wrong or incomplete Roll Number.
10. If there is any sort of ambiguity/mistake either of printing or factual nature then out of Hindi and English Version of the question, the English Version will be treated as standard.

Warning: If a candidate is found copying or if any unauthorized material is found in his/her possession, F.I.R. would be lodged against him/her in the Police Station and he/she would liable to be prosecuted. Department may also debar him/her permanently from all future examinations.

Do not open this Test Booklet until you are asked to do so.

OE □
1. Figure shows a string of linear mass density 1.0 g cm\(^{-1}\) on which a wave pulse is travelling. The time taken by the pulse in travelling through a distance of 50 cm on the string is (take \(g = 10\) m/s\(^2\)).

(1) 0.005 s  (2) 0.05 s  
(3) 5 s  
(4) 10 s

2. The dispersion relation for water waves of very short wavelength in shallow water is \(w^2 = \frac{S}{\rho} R^3\), where \(S\) is the surface tension and \(\rho\) is the density of water. The relation between group velocity \(v_g\) and the phase velocity \(v_p\) of these waves is

(1) \(v_g = \frac{3}{2} v_p\)  
(2) \(v_g = \frac{2}{3} v_p\)  
(3) \(v_g = \frac{v_p}{2}\)  
(4) \(v_g = v_p\)

3. The position of a particle moving along \(x\) axis is determined by the equation \(\frac{d^2x}{dt^2} + 2 \frac{dx}{dt} + 8x = 16 \cos 2t\). The frequency of driving force is

(1) 2 Hz  
(2) 4 Hz  
(3) \(\frac{2}{\pi}\) Hz  
(4) \(\frac{1}{\pi}\) Hz
4. The width of one of the two slits in a Young’s double slit experiment is double of the other slit. Assuming that the amplitude of the light coming from a slit is proportional to the slit width, the ratio of maximum to the minimum intensity in the interference pattern is

\[
\begin{align*}
(1) & \quad 34 : 1 \\
(2) & \quad 9 : 1 \\
(3) & \quad 4 : 1 \\
(4) & \quad 2 : 1
\end{align*}
\]

5. The radius of 10th dark ring in Newton’s rings apparatus changes from 60 mm to 50 mm when a liquid is introduced between the lens and the plate. The refractive index of the liquid is

\[
\begin{align*}
(1) & \quad 1.44 \\
(2) & \quad 1.20 \\
(3) & \quad 1.55 \\
(4) & \quad 1.66
\end{align*}
\]

6. In Michelson interferometer 100 fringes cross the field of view when the movable mirror is displaced through 0.03000 mm. The wavelength of monochromatic light used is

\[
\begin{align*}
(1) & \quad 3000 \, \text{Å} \\
(2) & \quad 6000 \, \text{Å} \\
(3) & \quad 1500 \, \text{Å} \\
(4) & \quad 4000 \, \text{Å}
\end{align*}
\]

7. A small source of sound moves in a circle as shown in figure and an observer is sitting at O (in the plane of circle). Let \( f_1, f_2, f_3 \) be the frequencies heard by the observer when the source is at A, B and C respectively. Then

\[
\begin{align*}
(1) & \quad f_1 > f_2 > f_3 \\
(2) & \quad f_1 = f_2 > f_3 \\
(3) & \quad f_2 > f_3 > f_1 \\
(4) & \quad f_1 > f_3 > f_2
\end{align*}
\]
8. The electric potential at a distance $Z$ above the centre of a horizontal circular loop of radius $R$, which carries a uniform linear charge density $\lambda$ is given by

\[
V = \frac{2\lambda R}{\varepsilon_0 (Z^2 + R^2)^{1/2}}
\]

(1)

\[
V = \frac{\lambda R}{2\varepsilon_0 (Z^2 + R^2)^{1/2}}
\]

(2)

\[
V = \frac{\lambda R}{2\pi\varepsilon_0 (Z^2 + R^2)^{3/2}}
\]

(3)

\[
V = \frac{\lambda R}{2\varepsilon_0 (Z^2 + R^2)}
\]

(4)

9. An insulating spherical shell of inner radius $r_1$ and outer radius $r_2$ is charged so that its volume charge density is given by

\[
P(r) = \begin{cases} 
A & 0 \leq r \leq r_1 \\
\frac{A}{r} (r_1^2 - r^2) & r_1 \leq r \leq r_2 \\
0 & r > r_2 
\end{cases}
\]

where $A$ is a constant and $r$ is radial distance from the centre of the shell. The electric field at a point external to the sphere will be

\[
E = \begin{cases} 
0 & r < r_1 \\
\frac{A}{r^2} (r_1^2 - r^2) & r_1 \leq r < r_2 \\
\frac{A}{r^2} (r_2^2 - r^2) & r > r_2 
\end{cases}
\]

10. A beam of light contains a mixture of wavelengths $\lambda_1$ and $\lambda_2$, when the light is incident on a single slit the first diffraction minimum of $\lambda_1$ coincides with the second minimum of $\lambda_2$. The relation between $\lambda_1$ and $\lambda_2$ is

\[
\begin{align*}
\lambda_2 &= 2\lambda_1 \\
\lambda_1 &= 2\lambda_2 \\
\lambda_2 &= 4\lambda_1 \\
\lambda_2 &= \frac{\lambda_1}{4}
\end{align*}
\]
11. The circuit shown here is in a uniform magnetic field that is acting into the page and is decreasing at the rate of 150 T/s. The ammeter reads

\[ \begin{align*}
(1) & \ 0.15 \ A \\
(2) & \ 0.35 \ A \\
(3) & \ 0.50 \ A \\
(4) & \ 0.65 \ A
\end{align*} \]

12. A solenoid of inductance 50 mH and resistance 10 \( \Omega \) is connected to a battery of 6 V. The time elapsed before the current acquires half its steady state value is nearly

\[ \begin{align*}
(1) & \ 5 \ ms \\
(2) & \ 12.5 \ ms \\
(3) & \ 3.5 \ ms \\
(4) & \ 10 \ ms
\end{align*} \]

13. For an electromagnetic wave travelling in free space the electric field is given by

\[ \begin{align*}
\vec{E} & = 100 \cos \left(10^6 t + kx\right) \hat{y} \ V/m
\end{align*} \]

(Here \( \hat{y} \) is unit vector along positive y direction). Which of the following statement is NOT true?

\[ \begin{align*}
(1) & \text{ The wavelength of the wave in meter is } 6 \pi. \\
(2) & \text{ The poynting vector is directed along the positive z direction.} \\
(3) & \text{ The corresponding magnetic field is directed along the negative z direction.} \\
(4) & \text{ The wave is linearly polarised.}
\end{align*} \]

14. The electric potential in some region of space is given by \( V = x^2 - y^2 + z^2 \). The volume charge density will be

\[ \begin{align*}
(1) & \ 0 \ e_0 \\
(2) & \ 2e_0 \\
(3) & \ -2e_0 \\
(4) & \ -6e_0
\end{align*} \]
15. The wave equation for electric field in a dielectric medium is given by

\[ \nabla^2 E - \mu_0 \varepsilon_0 \frac{\partial^2 E}{\partial t^2} - \mu_0 \sigma \frac{\partial E}{\partial t} = 0 \]

where symbols have their usual meaning. If a travelling wave is given by \( E = E_0 \exp i (kx - \omega t) \), then the correct dispersion relation is

(1) \( k^2 = \mu_0 \varepsilon_0 w^2 + i \mu_0 \sigma w \)

(2) \( k^2 = \mu_0 \varepsilon_0 w^2 + i \mu_0 \sigma w \)

(3) \( k^2 = \mu_0 \varepsilon_0 \frac{\varepsilon_r}{\varepsilon_0} w^2 + i \mu_0 \sigma w \)

(4) \( k^2 = \mu_0 \varepsilon_0 w^2 + i \mu_0 \varepsilon_0 \sigma w \)

16. For normal incidence the reflection coefficient \( R \), at the planar surface between two dielectric media is given by

\[ R = \frac{(n_1 - n_2)^2}{(n_1 + n_2)^2} \]

where \( n_1 \) and \( n_2 \) are refractive indices of the media. If \( T \) is the transmission coefficient and \( x = n_1/n_2 \), then

(1) \( T = \left( \frac{x-1}{x+1} \right)^2 \)

(2) \( T = \frac{4x}{(x+1)^2} \)

(3) \( T = \frac{x-1}{x+1} \)

(4) \( T = \frac{2\sqrt{x}}{x+1} \)

17. The magnetic field at some point is represented by \( \mathbf{B} = (4x + 2y) \hat{i} + (2y - 2z) \hat{j} + (7x + 8bz) \hat{k} \) the value of \( b \) is

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

(3) \(-\frac{1}{2}\) (4) \(\frac{1}{2}\)
18. A proton and an electron are accelerated by the same potential difference. Let $\lambda_e$ and $\lambda_p$ denote the de Broglie wavelengths of electron and protons respectively, then

(1) $\lambda_p > \lambda_e$
(2) $\lambda_p = \lambda_e$
(3) $\lambda_e > \lambda_p$
(4) The relation between $\lambda_p$ and $\lambda_e$ depends on the accelerating potential difference.

19. If the frequency of light in a photoelectric experiment is doubled, the stopping potential will

(1) be doubled
(2) be halved
(3) become more than double
(4) become less than double

20. In the circuit shown in figure both the bulbs $B_1$ and $B_2$ are identical and inductor is ideal, then

(1) their brightness will be same.
(2) $B_2$ will be brighter than $B_1$
(3) as the frequency of applied source is increased brightness of bulb $B_1$ will decrease and that of $B_2$ will increase.
(4) Only $B_2$ will glow because capacitor offers infinite impedance.
21. किसी प्रयोग में परमाणुविक इलेक्ट्रॉनों को इलेक्ट्रॉनों के एक पूर्व से टकराने के द्वारा किसी उल्टिमित अवस्था में से जाया जाता है। यह पाया जाता है कि वाष्पी पूंज में इलेक्ट्रॉन एकल ऊर्जा के हैं और परमाणुविक इलेक्ट्रॉनों से टकराने के बाद पूंज के इलेक्ट्रॉनों की ऊर्जा में कुछ विस्तार है। किसी प्रयोग में यह विस्तार $10^{-6}$ eV पाया जाता है। उल्टिमित अवस्था का आयुक्त है:

1. $1.64 \times 10^{-10}$
2. $3.28 \times 10^{-10}$
3. $1.05 \times 10^{-28}$
4. $0.55 \times 10^{-28}$

22. एक क्वार्टन कण भूमि L के घनीब बॉक्स के भीतर निरंतर है, की मूल अवस्था $E_0$ से दो जाती है। प्रथम उल्टिमित अवस्था की ऊर्जा है:

1. $2E_0$
2. $\sqrt{2}E_0$
3. $3E_0$
4. $6E_0$

23. हाइड्रोजन स्प्रेक्ट्रम के अध्ययन हेतु हाइड्रोजन का एक प्रतिष्ठान किसी उल्टिमित अवस्था A में भरा गया है। 2.55 eV ऊर्जा के प्रोटन इस प्रतिष्ठान द्वारा अकार्योत्पादित किए जाते हैं जिससे कुछ इलेक्ट्रॉन एक अन्य उल्टिमित अवस्था B में पहुँच जाते हैं। अवस्थाओं A तथा B की क्वार्टन संख्याएं हैं:

1. $n_A = 2$, $n_B = 3$
2. $n_A = 2$, $n_B = 4$
3. $n_A = 3$, $n_B = 4$
4. $n_A = 3$, $n_B = 5$

24. तरंगदैर्थ्य $\lambda$ का एक प्रोटन विप्रय में स्थित एक मुक्त इलेक्ट्रॉन पर आपत्ति होता है तथा पश्चिम दिशा में प्रभावित होता है। इसकी तरंगदैर्थ्य में अस्तित्व परिवर्तन इलेक्ट्रॉन की कॉम्प्लेक्स तरंगदैर्थ्य $\lambda_c$ के पदों में है:

1. $\frac{\lambda}{2\lambda}$
2. $\frac{2\lambda}{3\lambda}$
3. $\frac{3\lambda}{2\lambda}$
4. $\frac{2\lambda}{\lambda}$

25. In some experiment atomic electrons are raised to an excited state by colliding with a beam of electrons. It is found that even if the beam of electrons is monoenergetic after the collision with atomic electron the energy of the electrons in the beam has a certain spread. If in a particular experiment the energy spread is found to be $10^{-6}$ eV, the lifetime of the excited state is:

1. $1.64 \times 10^{-10}$
2. $3.28 \times 10^{-10}$
3. $1.05 \times 10^{-28}$
4. $0.55 \times 10^{-28}$

26. For a quantum particle confined inside a cubic box of side L, the ground state energy is given by $E_0$. The energy of the first excited state is:

1. $2E_0$
2. $\sqrt{2}E_0$
3. $3E_0$
4. $6E_0$

27. For studying hydrogen spectra, a hydrogen spectrum is prepared in a particular excited state A. Photons of energy 2.55 eV get absorbed into the sample to take some of the electrons to a further excited state B. The quantum numbers of states A and B are:

1. $n_A = 2$, $n_B = 3$
2. $n_A = 2$, $n_B = 4$
3. $n_A = 3$, $n_B = 4$
4. $n_A = 3$, $n_B = 5$

28. A photon of wavelength $\lambda$ is incident on a free electron at rest and is scattered in backward direction. The fractional shift in its wavelength in terms of the Compton wavelength $\lambda_c$ of electron is:

1. $\frac{\lambda}{2\lambda}
2. \frac{2\lambda}{3\lambda}
3. \frac{3\lambda}{2\lambda}
4. \frac{2\lambda}{\lambda}$
25. A photon of wavelength $\lambda$ (less than threshold wavelength $\lambda_0$) is incident on a metal surface of work function $\phi$. The minimum de Broglie wavelength of ejected electron of mass $m$ is

\[
\begin{align*}
(1) & \quad \frac{\hbar}{2m} \left( \frac{hc}{\lambda} - \phi \right) \\
(2) & \quad \frac{\hbar}{2m} \left( \frac{hc}{\lambda} - \phi \right) \\
(3) & \quad \frac{\hbar}{\sqrt{2m}} \left( \frac{hc}{\lambda} - \phi \right) \\
(4) & \quad \frac{1}{\sqrt{2m}} \left( \frac{hc}{\lambda} - \phi \right)
\end{align*}
\]

26. An x-ray tube operates at 20 kV. A particular electron loses 5% of its kinetic energy to emit an x-ray photon at the first collision with target. The wavelength of this photon is

\[
\begin{align*}
(1) & \quad 12.4 \text{ nm} \\
(2) & \quad 1.24 \text{ nm} \\
(3) & \quad 124 \text{ nm} \\
(4) & \quad 1240 \text{ nm}
\end{align*}
\]

27. The normalized wave function for a particle is given as

\[
\psi(x) = \sqrt{\frac{2}{a}} \sin \frac{\pi x}{a}, \quad 0 \leq x \leq a
\]

\[
\psi(x) = 0 \text{ elsewhere}
\]

The expectation value for the momentum of the particle is

\[
\begin{align*}
(1) & \quad 0 \\
(2) & \quad \frac{1}{2} a^2 \\
(3) & \quad \frac{1}{4} a^2 \\
(4) & \quad 1
\end{align*}
\]
28. The Bloch theorem states that within a crystal, the wave function of an electron has the form

\[ \psi(\mathbf{r}) = u(\mathbf{r}) e^{i \mathbf{k} \cdot \mathbf{r}} \]  

where \( u(\mathbf{r}) \) is an arbitrary function and \( \mathbf{k} \) is an arbitrary vector.

(1) \( \psi(\mathbf{r}) = u(\mathbf{r}) e^{i \mathbf{k} \cdot \mathbf{r}} \)

(2) \( \psi(\mathbf{r}) = u(\mathbf{r}) e^{i \mathbf{G} \cdot \mathbf{r}} \)

(3) \( \psi(\mathbf{r}) = u(\mathbf{r}) e^{i \mathbf{G} \cdot \mathbf{r}} \)

(4) \( \psi(\mathbf{r}) = u(\mathbf{r}) e^{i \mathbf{k} \cdot \mathbf{r}} \)

29. A particle with energy \( E \) is incident from left on a potential step given by

\[ V(x) = \begin{cases} 
V_0 & \text{for } x < 0 \\ 0 & \text{for } x > 0 
\end{cases} \]

as shown in figure. For \( E < V_0 \) the space part of the wave function for \( x > 0 \) is of the form

\[ (\text{here } \alpha = \sqrt{\frac{2m(V_0 - E)}{\hbar^2}} \text{ and } A \text{ is some constant}) \]

(1) \( Ae^{\alpha x} \)  \hspace{1cm} (2) \( Ae^{-\alpha x} \)

(3) \( Ae^{i\alpha x} \)  \hspace{1cm} (4) \( Ae^{-i\alpha x} \)
30. Consider a doped semiconductor having the electron and hole mobilities \( \mu_n \) and \( \mu_p \), respectively. Its intrinsic carrier density is \( n_i \). The hole concentration \( p \) for which the conductivity is minimum at a given temperature is

\[
\begin{align*}
(1) & \quad n_i \left( \frac{\mu_n}{\mu_p} \right)^{1/2} \\
(2) & \quad n_i \left( \frac{\mu_p}{\mu_n} \right)^{1/2} \\
(3) & \quad n_i \left( \frac{\mu_n}{\mu_p} \right) \\
(4) & \quad n_i \left( \frac{\mu_p}{\mu_n} \right)
\end{align*}
\]

31. At very low temperatures the lattice specific heat of a solid is given as

\[
C_v = 100 \frac{T^3}{\theta_D^3} \text{ cal/mol – k}
\]

If the Debye temperature \( \theta_D = 100 \text{ K} \), then the heat required to raise temperature of 1 mole from 10 K to 20 K is

\[
\begin{align*}
(1) & \quad 3.75 \text{ cal} \\
(2) & \quad 7.5 \text{ cal} \\
(3) & \quad 15 \text{ cal} \\
(4) & \quad 30 \text{ cal}
\end{align*}
\]

32. At low temperatures (T) the specific heat of common metals is described by

\[
\begin{align*}
(1) & \quad AT + BT^3 \\
(2) & \quad AT + BT^2 \\
(3) & \quad A \exp(-B/T) \\
(4) & \quad AT + BT^2
\end{align*}
\]

33. The group velocity of a Bloch electron in a crystal is given by (symbols have their usual meanings)

\[
\begin{align*}
(1) & \quad \hbar \frac{dE}{dk} \\
(2) & \quad \frac{1}{\hbar} \frac{dE}{dk} \\
(3) & \quad \hbar^2 \frac{d^2E}{dk^2} \\
(4) & \quad \hbar^2 \left( \frac{d^2E}{dk^2} \right)^{-1}
\end{align*}
\]
34. Let K and σ be the thermal and electrical conductivities of a metal respectively of absolute temperature T, and L is Lorentz number, then according to Wiedemann-Franz law

\[ \frac{K}{T} = L \quad \frac{\sigma}{T} = L \]

35. An electric field of 100 Vm\(^{-1}\) is applied to a specimen of an N type semiconductor for which the Hall coefficient is \(-0.0125 \text{ m}^3\text{C}^{-1}\). If the mobility of majority charge carriers is 0.4 m\(^2\text{V}^{-1}\text{s}^{-1}\) then the magnitude of current density in specimen will be (neglect current density due to minority carriers).

\[ \text{(1) } 3200 \text{ Am}^{-2} \quad \text{(2) } 2880 \text{ Am}^{-2} \]
\[ \text{(3) } 2400 \text{ Am}^{-2} \quad \text{(4) } 1600 \text{ Am}^{-2} \]

36. For some alkali metal A the Fermi energy is \(E_f\) and free electron concentration is \(N_1\). If for another alkali metal B the Fermi level is \(E_{F_2}\) then free electrons concentration \(N_2\) in B is given by

\[ N_2 = N_1 \left( \frac{E_{F_2}}{E_n} \right) \]
\[ N_2 = N_1 \left( \frac{E_{F_2}}{E_f} \right)^2 \]
\[ N_2 = N_1 \left( \frac{E_{F_2}}{E_f} \right)^{3/2} \]
\[ N_2 = N_1 \left( \frac{E_{F_2}}{E_f} \right)^{1/2} \]
37. The relative magnetic permeability of a type I super-conductor is

(1) 1  (2) -1  
(3) 0  (4) 2π

38. Figure shows three resistors connected with a switch. Initially the switch is open. When the switch S is closed, the current passed through it is

(1) 9 A  (2) 4.5 A  
(3) 18 A  (4) 12.5 A

39. The following are the plots of temperature dependence of the magnetic susceptibility for three different samples.

The plots A, B and C corresponds to-

(1) ferromagnetic, paramagnetic and diamagnetic materials respectively.
(2) paramagnetic, diamagnetic and ferromagnetic material respectively.
(3) ferromagnetic, diamagnetic and paramagnetic materials respectively.
(4) diamagnetic, paramagnetic and ferromagnetic materials respectively.
40. A germanium diode with reverse saturation current $I_s = 10 \mu A$ at room temperature is to be used. The forward voltage at which the diode current is 100 mA at room temperature is nearly (Given $\frac{K}{e} = 25 \text{ mV at room temperature}$)

(1) 0.46 V (2) 0.23 V (3) 4.6 V (4) 2.3 V

41. For the circuit shown the voltage drop across $R$ ($V_R$) and load current $I_L$ are respectively

(1) 10 V, 8.33 mA (2) 6 V, 8.33 mA (3) 6 V, 13.33 mA (4) cannot be determined since the value of $R$ is not given.

42. For a circuit shown if the 5 Ω resistor connected between points A and B is considered as load resistor then the Thevenin equivalent Voltage ($E_{Th}$) and Thevenin equivalent resistance ($R_{Th}$) of the circuit are respectively

(1) 5V, 5/6 Ω (2) 5V, 6 Ω (3) $\frac{60}{11} \text{ V}, \frac{10}{11} \Omega$ (4) $\frac{60}{11} \text{ V}, \frac{5}{6} \Omega$
43. नीचे दिए गए चित्र के परिपथ के निवेशी पर एक ज्वाक्षीय संकेत उपस्थित है।

44. किसी ट्रांजिस्टर के लिए $\beta = 100$ है। संग्रहालय के श्रेणीक्रम में जुड़े 5 kΩ प्रतिरोध पर योग्यता 5 V है। ट्रांजिस्टर की आधार धंरा है:

(1) 1 mA  (2) 100 µA
(3) 10 µA  (4) 1 µA

43. A sinusoidal signal is at input to the following circuit:

Which of the following graphs best describes the output waveform?

(1)  (0,0)  (2)  (0,0)  (3)  (0,0)  (4)  (0,0)
45. Which one of the following does not represent an XOR operation for inputs A and B?

(1) \((A + B) \overline{AB}\)
(2) \(\overline{A}B + B \overline{A}\)
(3) \((A + B)(\overline{A} + B)\)
(4) \((A + B) AB\)

46. For the digital circuit shown below, the output X is

\[
\begin{align*}
\text{A} & \rightarrow \text{AND} \rightarrow X \\
\text{B} & \rightarrow \text{XOR} \rightarrow X
\end{align*}
\]

(1) \(\overline{A} + B + C\)
(2) \(A \cdot (B + C)\)
(3) \(\overline{A} \cdot (B + C)\)
(4) \(A + (B + C)\)

47. If the peak output voltage of a full wave rectifier is 10 V, its dc voltage is

(1) 10 V
(2) 7.07 V
(3) 6.36 V
(4) 3.18 V

48. In a transistor

(1) the emitter is most lightly doped.
(2) the collector is most lightly doped.
(3) the base is most lightly doped.
(4) all the three regions have equal amount of doping.
49. A block of mass $m = 2\text{kg}$ is on a wedge of mass $M$. All surfaces are frictionless. Suppose the wedge is accelerated toward the right by an external force at $a_0 = 5\text{m/s}^2$. The acceleration of the block relative to the wedge is ($\theta = 37^\circ$, $g = 10\text{m/s}^2$)

![Diagram of wedge and block]

(1) $5\text{m/s}^2$  
(2) $2\text{m/s}^2$  
(3) $4\text{m/s}^2$  
(4) $8\text{m/s}^2$

50. The potential energy of a 3 kg particle moving along the $x$-axis is given by $U(x) = (8J/\text{m}^2)x^2 + (2J/\text{m}^4)x^4$.

When the particle is at $x = 1\text{m}$ it is travelling in the positive $x$ direction with a speed of 6 m/s. It next stops momentarily to turn at $x =

(1) $+1.8\text{m}$  
(2) $-2.0\text{m}$  
(3) $+2.0\text{m}$  
(4) $+4.0\text{m}$

51. An example of an inertial reference frame is

(1) any reference frame that is not rotating.  
(2) a frame attached to a particle on which there are no forces.  
(3) any reference frame that is at rest.  
(4) a reference frame attached to earth.
52. \( m \) द्रव्यमान का एक कण वेग \( \mathbf{v} = v_0 \left( \hat{i} + \hat{j} \right) \) से चलकर \( 2 m \) द्रव्यमान के एक अन्य कण जो प्रारंभ में विशारद में है से प्रत्यावर्त टकराकर करता है। यहाँ \( v_0 \) एक नियतांक है। निम्नलिखित में से सत्य कथन है:

1. निकार के द्रव्यमान केन्द्र का वेग
   \[ \frac{v_0 \left( \hat{i} + \hat{j} \right)}{2} \]

2. टकराकर से पहले \( m \) द्रव्यमान के कण की द्रव्यमान केन्द्र निर्देश तंत्र में चाल \( \sqrt{2} v_0 \) है।

3. टकराकर के पश्चात \( 2 m \) द्रव्यमान के कण की द्रव्यमान केन्द्र निर्देश तंत्र में चाल \( \frac{\sqrt{2}}{3} v_0 \) है।

4. टकराकर से पहले \( 2 m \) द्रव्यमान के कण की द्रव्यमान केन्द्र निर्देश तंत्र में चाल \( \sqrt{2} v_0 \) है।

53. चित्र में दर्शा एंव अनुसार 1 व 2 से चिह्नित समान द्रव्यमान \( m \) की दो गेंदें तथा 3 से चिह्नित \( M \) द्रव्यमान की तीसरी गेंद एक चित्रीकृत लघुत्त पर चालक है। गेंद 1 एवं 2, \( M \) गेंद 3 जो कि प्रारंभ में विशारद में हैं, की ओर चलती है। सभी टकराकर प्रत्यावर्त भागी गई हैं। यदि \( m < M \) तब गेंदों के मध्य टकराकर की संख्या होगी

<table>
<thead>
<tr>
<th>(1) एक</th>
<th>(2) दो</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3) तीन</td>
<td>(4) चार</td>
</tr>
</tbody>
</table>

52. A particle of mass \( m \) moving with a velocity \( \mathbf{v} = v_0 \left( \hat{i} + \hat{j} \right) \), collides elastically with another particle of mass \( 2 m \) which is at rest initially. Here \( v_0 \) is a constant. Which of the following statement is correct?

1. Velocity of the centre of mass of the system is \( \frac{v_0 \left( \hat{i} + \hat{j} \right)}{2} \).

2. The speed of the particle of mass \( m \) before collision in the centre of mass frame is \( \sqrt{2} v_0 \).

3. After collision the speed of the particle of mass \( 2 m \) in the centre of mass frame is \( \frac{\sqrt{2}}{3} v_0 \).

4. The speed of the particle of mass \( 2 m \) before collision in centre of mass frame is \( \sqrt{2} v_0 \).

53. Two balls marked 1 and 2 of the same mass \( m \) and a third ball marked 3 of mass \( M \) are arranged over a smooth horizontal surface as shown in figure. Ball 1 moves with a velocity \( v \) towards balls 2 and 3, which are initially at rest. All collisions are assumed to be elastic. If \( m < M \) the number of collisions between the balls will be.

<table>
<thead>
<tr>
<th>(1) One</th>
<th>(2) Two</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3) Three</td>
<td>(4) Four</td>
</tr>
</tbody>
</table>
54. The angular momentum of a particle about origin is varying with time as 
\[ L = 4t + 8 \] (SI units) when it moves along a straight line \( y = x - 4 \) (\( x, y \) in metres). The force acting on the particle is

(1) \( 1 \) N  
(2) \( 2 \) N  
(3) \( \sqrt{2} \) N  
(4) \( \sqrt{3} \) N

55. Consider a classical particle subjected to an inverse square force field. The total energy of the particle is \( E \) and the eccentricity of its trajectory is \( \epsilon \). The particle will follow a parabolic path if

(1) \( E > 0 \), and \( \epsilon = 1 \)  
(2) \( E < 0 \), and \( \epsilon < 1 \)  
(3) \( E = 0 \), and \( \epsilon = 1 \)  
(4) \( E < 0 \), and \( \epsilon = 1 \)

56. Four particles, each of mass \( m \) are placed in X-Y plane at points \((a, -a, 0)\), \((a, a, 0)\), \((-a, a, 0)\) and \((-a, -a, 0)\) respectively. In the moment of inertia matrix \( I \) of this particle system

(1) only \( I_{x'y'} \) is zero.  
(2) only \( I_{xz} \) and \( I_{yz} \) are zero.  
(3) all the products of inertia terms are zero.  
(4) none of the product of inertia term is zero.
57. At what speed the kinetic energy of an electron becomes equal to its rest mass energy (c is speed of light in free space)?

\( v = \frac{c}{2} \) (2) \( v = \frac{c}{3} \)

\( v = \sqrt{\frac{3}{4}} c \) (4) \( v = \sqrt{\frac{3}{2}} c \)

58. A block of mass 5 kg executes simple harmonic motion under the restoring force of a spring. The amplitude and the time period of motion are 0.1 m and \( \pi \) s respectively. The maximum force exerted by the spring on the block is

(1) 4 N (2) 3 N
(3) 2 N (4) 1 N

59. The equation of motion for a damped harmonic oscillator is given by

\( \frac{d^2x}{dt^2} + r \frac{dx}{dt} + 32 x = 0 \)

The value of \( r \) for which the motion is critically damped, is

(1) \( 32\sqrt{2} \) (2) \( 16\sqrt{2} \)
(3) \( 8\sqrt{2} \) (4) \( 4\sqrt{2} \)

60. The area of a disc in its rest frame \( S \) is equal to unity (in some units). The disc will appear to be distorted to an observer moving with a speed \( u \) with respect to \( S \) along the plane of the disc. The area of the disc measured in the rest frame of observer is (c is the speed of light in free space).

(1) \( (1 - u^2/c^2)^{-1/2} \) (2) \( (1 - u^2/c^2)^{1/2} \)
(3) \( \left(1 - \frac{u^2}{c^2}\right)^{-1} \) (4) \( (1 - u^2/c^2)^{-1} \)
### Part - B

The method used for quantitative analysis of halogen is

1. **Dumas’s method**
2. **Kjeldahl’s method**
3. **Casella’s method**
4. **Kjeldahl’s method**

#### 1. The method used for quantitative analysis of halogen is

- **Dumas’s method**
- **Kjeldahl’s method**
- **Casella’s method**
- **Kjeldahl’s method**

#### 2. Which of the following is not a member of group IV elements?

- (1) Na⁺
- (2) Mg²⁺
- (3) Zn²⁺
- (4) Co²⁺

#### 3. In analysis of cations, which green flame shows the confirmation of group cations:

- (1) NH₄⁺ in presence of NH₄Cl and H₂S gas
- (2) Mg²⁺ and Cu²⁺
- (3) S²⁻ and Fe²⁺
- (4) H⁺ and NO₃⁻

#### 4. A set of measurement of an experimental data shows the values 8.7, 8.9, and 8.8, while the true value is 8.4, thus the experimental data shows

- (1) more accurate more precise
- (2) less accurate more precise
- (3) more accurate less precise
- (4) less accurate less precise

#### 5.  *(Translation note: The content is not entirely clear due to the image quality. The structure seems to be discussing chemical reactions and analysis methods.)*

- (1) NH₄Cl in presence of NH₄Cl and H₂S gas
- (2) Cu²⁺ and Mn²⁺
- (3) Zn²⁺ and Fe²⁺
- (4) CO²⁻ and NO₃⁻

### Notes

- The image contains a mix of chemical reactions and analysis methods, possibly related to the qualitative analysis of halogen elements.
- The text is fragmented and requires careful reading due to the quality of the image.
6. On performing ‘Starch Iodide test’ deep blue colour shows the confirmation of anion.
   (1) NO₂⁻  (2) NO₃⁻  (3) SO₄²⁻  (4) SO₃²⁻

7. Benedict’s test is used for analysis of functional group.
   (1) > C = O  (2) –CHO  (3) –CONH₂  (4) –NO₂

8. In which of the following reagent sodium potassium tartrate is used?
   (1) Tollen’s reagent
   (2) Fehling ‘A’
   (3) Bayer’s reagent
   (4) Fehling ‘B’

9. The formula of Prussian blue is
   (1) Fe₄[Fe(CN)₆]₃
   (2) K₂Fe₆[Fe(III)CN]₆
   (3) K₄[Fe(III)CN]₆
   (4) K₄[Fe(CN)₆]

10. Tollen’s reagent is
    (1) Ammonical solution of silver nitrate.
    (2) Alkaline solution of cupric ions.
    (3) Alkaline solution of sodium potassium tartrate.
    (4) Aqueous solution of K₂Cr₂O₇.

11. On performing cobalt nitrate test a green ash shows the confirmation of cation.
    (1) Mg²⁺  (2) A³⁺  (3) Zn²⁺  (4) Ca²⁺
12. If \( \lambda_{\max} \) shifts towards longer wavelength, the shift is known as
   (1) Red shift
   (2) Blue shift
   (3) Hypsochromic effect
   (4) Hyperchromic effect

13. Which one of the following region in IR spectroscopy is known as finger print region?
   (1) 4000 – 650 cm\(^{-1}\)
   (2) 1500 – 500 cm\(^{-1}\)
   (3) 650 – 900 cm\(^{-1}\)
   (4) 1300 – 1380 cm\(^{-1}\)

14. Nitrogen rule is related to
   (1) Mass spectroscopy
   (2) ESR spectroscopy
   (3) IR spectroscopy
   (4) UV spectroscopy

15. The correct order of the energy required during the formation of molecular ion in mass spectrum is :
   (1) Non-conjugated \( \pi \) < Conjugated \( \pi \) < Lone pair < \( \sigma \)
   (2) Conjugated \( \pi \) < Lone pair < Non-conjugated \( \pi \) < \( \sigma \)
   (3) Lone pair < Conjugated \( \pi \) < Non-conjugated \( \pi \) < \( \sigma \)
   (4) Conjugated \( \pi \) < Non-conjugated \( \pi \) < Lone pair < \( \sigma \)

16. Conjugate base of \( \text{H}_3\text{PO}_4 \) is
    (1) \( \text{H}_2\text{PO}_4^- \)
    (2) \( \text{HPO}_4^{2-} \)
    (3) \( \text{H}_2\text{PO}_4^- \)
    (4) \( \text{PO}_4^{3-} \)

17. The transition with lowest energy is
    (1) \( \sigma - \sigma^* \)
    (2) \( \pi - \pi^* \)
    (3) \( n - \sigma^* \)
    (4) \( n - \pi^* \)
18. $H^+ = 10^{-9}$ m वाले विलयन का pH होगा 
   (1) - 5  (2) - 9  
   (3) 9  (4) 5 

19. मूल शासकों के गुण का चयन कीजिए : 
   (1) $H^+$, OH$^-$ (2) $H^+$, CN$^-$  
   (3) NO$_3^-$, I$^-$ (4) NH$_3$, CN$^-$

20. शरीरीय बाफर का उदाहरण है 
   (1) NH$_2$OH तथा NH$_2$Cl  
   (2) CH$_3$COOH तथा CH$_3$COONa  
   (3) HCOOH तथा HCOONa  
   (4) HCN तथा KCN

21. निम्नलिखित में से वह विलयन जिसकी 
   विश्लेषण अभिकर्षण अनुपात मूल्यांक है : 
   (1) CCl$_4$ (2) रिनीज़न  
   (3) बेंजीन (4) एथेनाल

22. वैचारीक वर्णलेख में शासक रूप से प्रयुक्त होने 
   वाला इलेक्ट्रोड है :  
   (1) कैल्सि मेल इलेक्ट्रोड  
   (2) मर्स्ची इलेक्ट्रोड  
   (3) प्लेविस्म इलेक्ट्रोड  
   (4) जिस्क इलेक्ट्रोड

23. ऐतिहासिक अम्ल में सामान्य अम्लों का समान्तर 
   घटने क्रम में है : 
   (1) H$_2$SO$_4$ > HBr > HClO$_4$ > HNO$_3$  
   (2) HBr > H$_2$SO$_4$ > HClO$_4$ > HNO$_3$  
   (3) HClO$_4$ > HBr > H$_2$SO$_4$ > HNO$_3$  
   (4) HBr > HNO$_3$ > H$_2$SO$_4$ > HClO$_4$

24. The pH of a solution whose $H^+ = 10^{-9}$ m 
   will be 
   (1) - 5  (2) - 9  
   (3) 9  (4) 5

25. Select the pair of soft bases : 
   (1) $H^+$, OH$^-$ (2) $H^+$, CN$^-$  
   (3) NO$_3^-$, I$^-$ (4) NH$_3$, CN$^-$

26. The example of basic buffer is 
   (1) NH$_4$OH and NH$_2$Cl  
   (2) CH$_3$COOH and CH$_3$COONa  
   (3) HCOOH and HCOONa  
   (4) HCN and KCN

27. Solvent among the following having 
   maximum eluting power is 
   (1) CCl$_4$ (2) Pyridine  
   (3) Benzene (4) Ethanol

28. The electrode widely used in electro 
   chromatography is 
   (1) Calomel electrode  
   (2) Mercury electrode  
   (3) Platinum electrode  
   (4) Zinc electrode

29. Common acids in the order of 
   decreasing strength in acetic acid is 
   (1) H$_2$SO$_4$ > HBr > HClO$_4$ > HNO$_3$  
   (2) HBr > H$_2$SO$_4$ > HClO$_4$ > HNO$_3$  
   (3) HClO$_4$ > HBr > H$_2$SO$_4$ > HNO$_3$  
   (4) HBr > HNO$_3$ > H$_2$SO$_4$ > HClO$_4$
24. The detector not used in Gas chromatography is
   (1) Thermal conductivity detector
   (2) Flame ionisation detector
   (3) Flame photometric detector
   (4) Refractive index detector

25. Strongly acidic cation exchanger used in ion exchange chromatography is
   (1) R–SO₃H
   (2) R–COOH
   (3) R–OH
   (4) R–NH₂OH

26. The fixed or stationary phase in Gas solid chromatography is
   (1) Liquid
   (2) Gas
   (3) Solid
   (4) Liquid SO₂

27. ‘Bulk property detector’ among the following is
   (1) Refractive index detector
   (2) U.V. detector
   (3) Fluorescence detector
   (4) Electro-chemical detector

28. For which of the following compound spraying reagent Dragendorff’s reagent is used?
   (1) Amino acids
   (2) Aldehyde and Ketones
   (3) Alkaloids
   (4) Steroids
29. The gas among the following having maximum thermal conductivity is
   (1) N₂     (2) He
   (3) H₂     (4) CO₂

30. The correct order for ease of elution of the adsorbate is
   (1) Alkanes > Alkenes > Esters > Amines
   (2) Alkenes > Alkanes > Amines > Esters
   (3) Esters > Alkanes > Alkenes > Amines
   (4) Amines > Alkenes > Alkanes > Esters

31. Mechanism involved in Kolbe’s Electrolytic method is
   (1) Electrophilic substitution mechanism.
   (2) Ionic mechanism.
   (3) Free radical mechanism.
   (4) Both ionic and free radical mechanism.

32. Most acidic compound among the following is
   (1) O-Nitrophenol (2) m-Nitrophenol
   (3) p-Nitrophenol (4) m-Cresol

33. The reaction intermediate formed in dehydration of alcohol is
   (1) Carbocation (2) Free radical
   (3) Carboxation (4) Carbene

34. The most common carrier gas used in Gas liquid chromatography is
   (1) He     (2) Cl₂
   (3) Br₂     (4) F₂
35. यह एल्ड्राइड जो एल्ड्रोल संयमन अभिक्रिया
   देता है -
   (1) CH₃ - CHO
   (2) C₆H₅CHO
   (3) CCl₃ - CHO
   (4) (CH₃)₃ - C - CHO

36. निम्नलिखित में से सबसे अधिक अम्लीय
    यौगिक है:
    (1) NO₂ - CH₂ - COOH
    (2) NC - CH₂ - COOH
    (3) F - CH₂ - COOH
    (4) CI - CH₂ - COOH

37. नाइट्रोबेंजीन जिस तथा NaOH के साथ
    अधचन करने पर देता है -
    (1) अजोबेंजीन (2) एजेसीबेंजीन
    (3) हाइड्रोबेंजीन (4) नाइट्रोबेंजीन

38. निम्नलिखित में से सबसे अधिक शारीरीय
    यौगिक है:
    (1) m - नाइट्रोएनिलीन
    (2) p - नाइट्रोएनिलीन
    (3) o - नाइट्रोएनिलीन
    (4) 2, 4 - डाइनाइट्रोएनिलीन

39. वह अभिक्रिया जो एल्ड्रोल में द्विअंबंध की पुष्टि
    करते में प्रयुक्त होता है
    (1) अम्लीय K₂Cr₂O₇
    (2) तत्व शारीरीय KMnO₄
    (3) अम्लीय KMnO₄
    (4) जलीय K₂Cr₂O₇

40. फ्रीडेल क्राफ्ट्स एल्किलीकरण अभिक्रिया में
    बनने वाला अभिक्रिया मद्यवात है
    (1) कार्बनियम \ (2) कार्बोनियम आकाश
    (3) मुक्त मूलक (4) नाइट्रोम
41. The example of conjugated protein is
   (1) Albumin  (2) Collagen
   (3) Keratin  (4) Haemoglobin

42. Proteins when heated or treated with acids lose their physiological activity
    this is known as
   (1) Tyndall effect  (2) Denaturation
   (3) Dialysis  (4) Precipitation

43. The test shown by protein is
   (1) Molisch’s test
   (2) Millon’s test
   (3) Mulliken-Barker test
   (4) Tollen’s test

44. Oils having iodine value more than 150 are called as
   (1) Drying oils
   (2) Semidrying oils
   (3) Non-drying oils
   (4) None of these

45. \[ \text{CH}_3 - C \equiv C - \text{CH}_3 + \text{H}_2 \xrightarrow{\text{Pd/c}} [A] \]

45. \[ \text{CH}_3 - C \equiv C - \text{CH}_3 + \text{H}_2 \xrightarrow{\text{Pd/c}} [A] \]

The product [A] formed in the above reaction is
   (1) \[ \text{CH}_3 \]
   (2) \[ \text{CH}_3 \]
   (3) \[ \text{CH}_3 \]
   (4) \[ \text{CH}_3 \]
46. A freshly prepared solution of glucose has specific rotation of $+112^\circ$ but on keeping for sometime it changes to $+52.7^\circ$. This phenomenon is known as
(1) Epimerisation (2) Mutarotation (3) Racemisation (4) Inversion

47. The product obtained by the reaction of glucose with concentrated nitric acid is
(1) Glyoxal (2) Gluconic acid (3) Glycollic acid (4) Glucaric acid

48. Sanger’s reagent is
(1) 2,4-Dinitrophenylhydrazine (2) 2,4-Dinitrochlorobenzene (3) 2,4-Dinitrofluorobenzene (4) 2,4-Dinitrobenzene

49. The example of Quinoline alkaloids is
(1) Nicotine (2) Cocaine (3) Quinine (4) Morphine

50. Atropine on hydrolysis in presence of Ba(OH)$_2$ forms
(1) $\pm$ Tropic acid + Tropine (2) Tropidine (3) Tropinic acid (4) Acetic acid + Picric acid

51. Invert sugar is
(1) Mixture of Glucose and Fructose (2) Mixture of Glucose and Sucrose (3) Mixture of Glucose and Lactose (4) Mixture of Glucose and Mannose
52. Coefficient of variation can be expressed by the formula
   \[ CV = \frac{S \times 100\%}{\bar{x}} \]
   (1) \( CV = \frac{S \times 100\%}{\bar{x}} \)
   (2) \( CV = S \times \bar{x} \)
   (3) \( CV = \frac{\bar{x} \times 100\%}{S} \)
   (4) \( CV = \frac{S^2 \times 100\%}{\bar{x}} \)

53. Which of the following is an Indeterminate error?
   (1) Instrumental error
   (2) Method error
   (3) Personal error
   (4) Accidental error

54. Precision expresses the
   (1) correctness of an experiment.
   (2) reproducibility of an experiment.
   (3) deviation from experiment.
   (4) feasibility of an experiment.

55. The square of the standard deviation is known as
   (1) Mean deviation
   (2) Deviation
   (3) Variance
   (4) Coefficient of variance

56. The median of the following values is:
    37, 31, 42, 43, 46, 25, 39, 45, 32
   (1) 25
   (2) 46
   (3) 39
   (4) 43
57. With the increase in absolute error the value of the relative error
(1) decreases
(2) increases
(3) has no effect
(4) first decreases then increases

58. The method which is not used to minimize error is
(1) correct calibration of the apparatus.
(2) performing blank determination.
(3) running parallel determination.
(4) use of one method for analysis.

59. On analysis of 3.35 g substance the observed value found is 3.27 g, the relative accuracy is
(1) 94.4%    (2) 94.6%
(3) 97.6%    (4) 97.2%

60. The formula of standard deviation is
(1) \( S = \sqrt{\frac{\sum(x_i)^2}{n}} \)
(2) \( S = \sqrt{\frac{\sum(x_i)^2}{n+1}} \)
(3) \( S = \sqrt{\frac{\sum(x_i)^2}{n^2}} \)
(4) \( S = \sqrt{\frac{\sum(x_i)^2}{n-1}} \)
61. Name the chemical which is not commonly used for carrying out erasures on documents, from the given codes:

(1) Sodium Hypochlorite
(2) Oxalic Acid
(3) Potassium Permanganate
(4) Potassium Dichromate

62. Match the contents of ‘List-I’ with the respective contents given in ‘List-II’ and select the correct answer from the given codes:

List – I List – II

(A) Alignment of J. Reduced writing
(B) Indicator of fast K. Presence of abbreviations
(C) Effect of L. Actual increase in imaginary writing speed
(D) Indicator of M. Simplification of letter forms

Codes:

(A) (B) (C) (D)

(1) K L J M
(2) L J M K
(3) M M K J
(4) J K L L
63. Electrostatic Detection Apparatus (ESDA) cannot be used for problems involving:
   (1) Decipherment of Writing Impressions
   (2) Ink-dating
   (3) Detection of indented writing
   (4) Differentiation in dielectric properties of paper

64. Which is the most common and economical method which can be used to detect and decipher indented writings on paper surface?
   (1) Incident Light Examination
   (2) U.V. Fluorescence
   (3) Oblique Light Examination
   (4) Transmitted Light Examination

65. Subsequent writing, on the erased surface, with a fluid ink may result in
   (1) Spreading and Feathering of Ink
   (2) Gooping and Blobbing of Ink
   (3) Thinning of Paper
   (4) Obliteration of Document
66. नीचे दिए गए दावे (A) और कारण (R) का मूल्यांकन करें और दिए गए कोडों में से सही उत्तर का चयन करें:

दावा (A) : जैसे ही बॉल प्लाइट पेन स्वादी में मीठू रंग ‘रोडामाइन-वी’ का शिर्षिकीय शरीर (degradation) होता है, वैसे ही वह अपने इथाइल समूहों को खो देती है।

कारण (R) : इन इथाइल समूहों को हाइड्रोजन परमाणुओं द्वारा प्रतिस्थापित किया जाता है।

कोडः

(1) (A) सत्य है, तथा (R) असत्य है।
(2) (A) और (R) दोनों सत्य है।
(3) (A) और (R) दोनों असत्य है।
(4) (A) असत्य है, तथा (R) सत्य है।

67. ऐसा साल्वेंट सिस्टम चुनें जो नीती बॉल प्लाइट पेन स्वादी की Thin Layer Chromatography (TLC) के लिए सर्वोत्तम हैः

(1) इथेनॉल : एसिटोन : एसिटिक अम्ल (4:1:5)
(2) क्रेमील अल्कोहोल : एसिटिक अम्ल : पिरिदीन (6:1:2)
(3) इथाइल एथेनॉल : इथेनॉल : पानी (7:3:5:3)
(4) क्रेमील अल्कोहोल : एसिटिक अम्ल : क्लोरोफ़ोर्म (6:1:2)

68. Evaluate the Assertion (A) and Reason (R) and select the correct answer from the given codes:

Assertion (A) : As the Rhodamine-B in ball point pen ink degrades, it loses the Ethyl groups.

Reason (R) : The Ethyl groups are replaced by the Hydrogen atoms.

Codes :

(1) (A) is true, but (R) is false.
(2) Both (A) and (R) are true.
(3) Both (A) and (R) are false.
(4) (A) is false, but (R) is true.

67. Select the solvent system that is most suitable for Thin Layer Chromatography (TLC) of blue ball point pen inks:

(1) Ethanol: Acetone: Acetic Acid (4:1:5)
(2) Amyl Alcohol: Acetic Acid: Pyridine (6:1:2)
(3) Ethyl Acetate: Ethanol: Water (7:3:5:3)
(4) Amyl Alcohol: Acetic Acid: Chloroform (6:1:2)
Reason 68. Match the description given in ‘List-I’ with the respective type of writing instrument from the ‘List-II, and select the correct answer from the given codes:

<table>
<thead>
<tr>
<th>List-I</th>
<th>List-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) The pen uses a J. Ball Point pen as a writing tip and inks that are water based.</td>
<td>(A) Pen</td>
</tr>
<tr>
<td>(B) The pen uses K. Fiber Tip metallic nib as a writing element and water based inks as the writing media.</td>
<td>(B) Pen</td>
</tr>
<tr>
<td>(C) The pen uses L. Gel Pen writing tips that are fibrous and inks that are water based.</td>
<td>(C) Pen</td>
</tr>
<tr>
<td>(D) The pen uses M. Fountain based inks which often have a thick lustrous appearance, and produces striation marks in the ink-line.</td>
<td>(D) Pen</td>
</tr>
</tbody>
</table>

Codes:

<table>
<thead>
<tr>
<th></th>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L</td>
<td>M</td>
<td>K</td>
<td>J</td>
</tr>
<tr>
<td>2</td>
<td>J</td>
<td>K</td>
<td>L</td>
<td>M</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>L</td>
<td>J</td>
<td>K</td>
</tr>
<tr>
<td>4</td>
<td>K</td>
<td>J</td>
<td>M</td>
<td>L</td>
</tr>
</tbody>
</table>
69. Which of the following statements is not true?

(1) The influence of alcohol or drug may cause variation in handwriting of a person.

(2) The handwriting of an individual remains unaffected with the advancing age.

(3) The handwriting of a person always shows natural variations.

(4) An individual’s handwriting may vary as a result of stress or illness.

70. Two inks similar in shade but with different composition can be distinguished by

(1) Transmitted Light Examination

(2) Stereomicroscopic Examination

(3) Infra Red Luminescence

(4) U.V. Fluorescence
71. लिए गए कोडों में से उपयुक्त कोड का चयन करें
जिसके अनुसार कागज की वह इरादत शर्तें हैं जो उपयोग होने वाली सामग्री से प्राप्त नहीं हैं:
(1) कागज की मोटाई और वजन (GSM)
(2) तन्तुला शक्ति (Tensile Strength)
(3) अम्ल स्वाभाविक शक्ति
(4) स्वाभाविक अधर को हटाने या भागाने (repel) की शक्ति

72. नीचे लिए गए दो (A) और (R) का
मुल्यांकन करें और लिए गए कोडों में से सही
उत्तर का चयन करें:
दावा (A) : दो या दो से अधिक हस्ताक्षरों का
सटीक सुपरमोजिशन, अनुरूपतम द्वारा नर्तकीय,
जालसाजी का एक निर्मित संकेत है।
कारण (R) : त्रंकूल हस्ताक्षर अनुरूपतम प्रतिक्ष्या
(Tracing) द्वारा पैदा किया गया था, अतः उनमें
जालसाजी के सामान्य लक्षण, जैसे कि रेखा
गुणवत्ता दोष (line quality defects) नहीं पाये
जाते हैं।
कोड:
(1) (A) और (R) दोनों सत्य हैं।
(2) (A) और (R) दोनों असत्य हैं।
(3) (A) सत्य है, परंतु (R) असत्य है।
(4) (A) असत्य है, परंतु (R) सत्य है।

73. चुनिए तुम्हें उपलब्ध के दो (A) और (R) के निर्देशन के
निर्देशात्मक कारण के अनुसार चुनिए और लिए गए कोडों में से सही
उत्तर का चयन करें:
दावा (A) : दो या दो से अधिक हस्ताक्षरों का
सटीक सुपरमोजिशन, अनुरूपतम द्वारा नर्तकीय,
जालसाजी का एक निर्मित संकेत है।
कारण (R) : त्रंकूल हस्ताक्षर अनुरूपतम प्रतिक्ष्या
(Tracing) द्वारा पैदा किया गया था, अतः उनमें
जालसाजी के सामान्य लक्षण, जैसे कि रेखा
गुणवत्ता दोष (line quality defects) नहीं पाये
जाते हैं।
कोड:
(1) (A) और (R) दोनों सत्य हैं।
(2) (A) और (R) दोनों असत्य हैं।
(3) (A) सत्य है, परंतु (R) असत्य है।
(4) (A) असत्य है, परंतु (R) सत्य है।

74. चुनिए तुम्हें उपलब्ध के दो (A) और (R) के निर्देशन के
निर्देशात्मक कारण के अनुसार चुनिए और लिए गए कोडों में से सही
उत्तर का चयन करें:
दावा (A) : दो या दो से अधिक हस्ताक्षरों का
सटीक सुपरमोजिशन, अनुरूपतम द्वारा नर्तकीय,
जालसाजी का एक निर्मित संकेत है।
कारण (R) : त्रंकूल हस्ताक्षर अनुरूपतम प्रतिक्ष्या
(Tracing) द्वारा पैदा किया गया था, अतः उनमें
जालसाजी के सामान्य लक्षण, जैसे कि रेखा
गुणवत्ता दोष (line quality defects) नहीं पाये
जाते हैं।
कोड:
(1) (A) और (R) दोनों सत्य हैं।
(2) (A) और (R) दोनों असत्य हैं।
(3) (A) सत्य है, परंतु (R) असत्य है।
(4) (A) असत्य है, परंतु (R) सत्य है।
73. How can you distinguish between several impressions taken from two similar rubber seals prepared from the same die?

1. By matching physical defects due to wear and tear.
2. By matching physical dimensions.
3. Both by matching physical defects due to wear and tear and by matching physical dimensions above.
4. From materials used in the preparation of cast or die.

74. A charred document becomes completely black at a temperature of

1. 90 °C
2. 400 °C
3. 350 °C
4. 280 °C

75. The ‘header’ appearing at the top of a facsimile transmission indicating its origin is usually referred to as

1. Optical Terminal Transfer (OTT)
2. Transmission Terminal Transfer (TTT)
3. Transmit Terminal Identifier (TTI)
4. Both Optical Terminal Transfer (OTT) and Transmission Terminal Transfer (TTT)

76. Watermark designs introduced in the paper during manufacturing process do not normally indicate:

1. Manufacturer’s identity
2. Date of introduction of watermarks
3. Any Secret or coded information
4. Expiry date of paper
77. A new kind of paper containing plastic filaments known for its strength and inability to tear is called
(1) Safety Paper
(2) Tissue Paper
(3) Tyvek Paper
(4) Kraft Paper

78. Evaluate the Assertion (A) and Reason (R) and select the correct answer from the given codes:

**Assertion (A):** Information regarding chronological history of paper constituents indicating their first time introduction in the world market can be helpful in assessing the age of a document.

**Reason (R):** On the basis of availability of information as stated in the above Assertion, it becomes possible to establish the exact date of preparation of any document.

**Codes:**
(1) Both (A) and (R) are correct.
(2) (A) is correct, but (R) is incorrect.
(3) (A) is incorrect, but (R) is correct.
(4) Both (A) and (R) are incorrect.

79. Name the type of information which cannot be found from a photocopy without having access to its original:
(1) Characteristics of ink and paper used to prepare the original document.
(2) Image of handwriting, signature, or printing
(3) Indentation marks and pressure patterns
(4) Both Characteristics of ink and paper used to prepare the original document and Indentation marks and pressure patterns
80. सूची-I में दी गई मोड़ों को सूची-II के विचरणों से मिलाए और लिख गए कोडों में से सही उत्तर का चयन करें:

सूची - I           सूची - II
(A) सूक्ष्म प्रिंटिंग          J. डैंडी रोल
(Micro-printing)
(B) वाटरमार्क          K. 3-डी लेजर मुद्रित छवि
(3D Laser Printed Image)
(C) होलोग्राम          L. पासपोर्ट के लिए, बायोमार्कर सामग्री
(Binding material)
(D) फ्लोरिसेंट          M. नम अंधियों से प्रभाव

कोड:
(A) (B) (C) (D)
(1) M   J  K   L
(2) J   K  L   M
(3) K   L  M   J
(4) L   M  J   K

81. एक फ्रेंट हुए कागज के कई टुकड़ों की सहायता से उसके मूल कागज होने का संकेत किया, फिर प्रक्रियाओं पर निर्भर होता है?
(1) कागज की गुणवत्ता और लेखन इंडेंसियां
(2) अनियमित फ्रेंट भागों की याँत्रिक प्रक्रिया से मिलान
(3) फ्रेंट हुए भागों के किनारों को साथ-साथ रखकर भौतिक मिलान करके अनियमित फ्रेंट भागों को याँत्रिक प्रक्रिया से मिलान और फ्रेंट हुए भागों के किनारों को साथ-साथ रखकर भौतिक मिलान करके उन्हें

82. Match items given in ‘List-I’ with their description in ‘List-II’ and select the correct answer from the given codes:

<table>
<thead>
<tr>
<th>List - I</th>
<th>List - II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Micro-printing</td>
<td>J. Dandy Roll</td>
</tr>
<tr>
<td>(B) Watermarks</td>
<td>K. 3D Laser</td>
</tr>
<tr>
<td></td>
<td>Printed Image</td>
</tr>
<tr>
<td>(C) Hologram</td>
<td>L. Binding</td>
</tr>
<tr>
<td></td>
<td>material for</td>
</tr>
<tr>
<td></td>
<td>passports</td>
</tr>
<tr>
<td>(D) Fluorescent</td>
<td>M. Difficult</td>
</tr>
<tr>
<td>Thread</td>
<td>be read by</td>
</tr>
<tr>
<td></td>
<td>naked eye</td>
</tr>
</tbody>
</table>

Codes:
(A) (B) (C) (D)
(1) M   J  K   L
(2) J   K  L   M
(3) K   L  M   J
(4) L   M  J   K

83. The common origin of multiple pieces of a torn paper can be indicated by -
(1) Paper quality and writing indentations.
(2) Mechanical fits of irregular tear patterns.
(3) Physical matching of torn edges in juxtaposition.
(4) Both Mechanical fits of irregular tear patterns and Physical matching of torn edges in juxtaposition.

84.
82. The Heat Applied Ultra Violet film (HAUV) used in Indian Passports is laminated at a temperature of
(1) 160 – 180 °C
(2) 140 – 160 °C
(3) 180 – 220 °C
(4) 230 °C

83. A digital signature, usually, means to indicate
(1) Scanned Signature
(2) Pen – Paper Signature
(3) Photocopied Signature
(4) Digital equivalent of a handwritten Signature

84. The type style of standard manual typewriters is consistent with
(1) Pica with 8 letters to an inch.
(2) Elite with 10 letters to an inch.
(3) Pica with 10 characters or Elite with 12 characters to an inch.
(4) Proportional spacing resembling printing.
85. Name the type of printing in which ‘Doctor Blade’ is used to remove excess ink from the plate of the printing surface.

1. Intaglio printing
2. Screen printing
3. Letterpress printing
4. Lithography

86. The terminology “off its feet” relate to

1. Ink-jet printing
2. Offset printing
3. Handwriting examination
4. Typewriting examination

87. Plastic Money is considered to be a substitute for cash transactions. Select the type of card, which cannot be used for such purposes:

1. Prepaid Cash Cards and Store Cards
2. Prepaid Travel Cards
3. Credit Card, Debit Cards etc.
4. Access Control Card

88. The security thread on both sides of Indian currency notes is covered by

1. Polythene film
2. Polyester film
3. PVC film
4. Transparent Cello tape
89. Match the security features of Indian Currency Notes (List-I) with their respective denominations (List-II) and select the correct answer from the given codes:

<table>
<thead>
<tr>
<th>List - I</th>
<th>List - II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Four</td>
<td>J. ₹ 2,000</td>
</tr>
<tr>
<td>(B) Seven</td>
<td>K. ₹ 500</td>
</tr>
<tr>
<td>(C) Five</td>
<td>L. ₹ 200</td>
</tr>
<tr>
<td>(D) Four</td>
<td>M. ₹ 100</td>
</tr>
</tbody>
</table>

Bleeding lines

Codes:

<table>
<thead>
<tr>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>J</td>
<td>K</td>
<td>L</td>
</tr>
<tr>
<td>K</td>
<td>M</td>
<td>L</td>
<td>J</td>
</tr>
<tr>
<td>L</td>
<td>M</td>
<td>J</td>
<td>K</td>
</tr>
<tr>
<td>J</td>
<td>K</td>
<td>L</td>
<td>M</td>
</tr>
</tbody>
</table>

80. In India, the paper used for currency notes mainly manufactured at

(1) Hoshangabad & Mysore
(2) Nasik
(3) Dewas
(4) Hyderabad
91. सूची-I में दिए गए प्रिंटरों को सूची-II में दी गई विशेषताओं से मिलाएं तथा दिए गए कोडों में से सही उत्तर का चयन करें।

<table>
<thead>
<tr>
<th>सूची - I</th>
<th>सूची - II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) लेजर प्रिंटर</td>
<td>J. स्थायी या टोनर का उपयोग नहीं करता है।</td>
</tr>
<tr>
<td>(B) इंकजेट प्रिंटर</td>
<td>K. डाटम का संयोजन</td>
</tr>
<tr>
<td>(C) डॉट मैट्रिक्स प्रिंटर</td>
<td>L. कुरकुरा (Crisp), कॉपी के सीधे किनारे</td>
</tr>
<tr>
<td>(D) प्रत्येक थर्मल प्रिंटर</td>
<td>M. पूंछाई, डाटम के रंग किनारे, मुद्रित लाइन के साथ-साथ स्थायी के छोटे-छोटे हिटे</td>
</tr>
</tbody>
</table>

कोड:

<table>
<thead>
<tr>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>J</td>
<td>K</td>
<td>L</td>
</tr>
<tr>
<td>(2)</td>
<td>M</td>
<td>J</td>
<td>M</td>
</tr>
<tr>
<td>(3)</td>
<td>L</td>
<td>M</td>
<td>K</td>
</tr>
<tr>
<td>(4)</td>
<td>K</td>
<td>L</td>
<td>J</td>
</tr>
</tbody>
</table>

92. Match the printers (List-I) with their respective characteristics (List-II) and select the correct answer from the given codes:

<table>
<thead>
<tr>
<th>List – I</th>
<th>List – II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Laser Printer</td>
<td>J. Does not use ink or toner.</td>
</tr>
<tr>
<td>(B) Inkjet Printer</td>
<td>K. Combination of dots.</td>
</tr>
<tr>
<td>(C) Dot Matrix Printer</td>
<td>L. Crisp, straight edges of the copy.</td>
</tr>
<tr>
<td>(D) Direct Thermal Printer</td>
<td>M. Blurred, rough edges of the dots and small spatters of ink along the printed line.</td>
</tr>
</tbody>
</table>

Codes:

<table>
<thead>
<tr>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>J</td>
<td>K</td>
<td>L</td>
</tr>
<tr>
<td>(2)</td>
<td>M</td>
<td>J</td>
<td>M</td>
</tr>
<tr>
<td>(3)</td>
<td>L</td>
<td>M</td>
<td>K</td>
</tr>
<tr>
<td>(4)</td>
<td>K</td>
<td>L</td>
<td>J</td>
</tr>
</tbody>
</table>
92. What happens to the paper as it ages?

1. It becomes brittle and discolored.
2. Its thickness increases.
3. Its watermarks become clear and transparent.
4. Its strength decreases.

Select the correct answer from the codes given below:

94. Which of the following codes is best related with the production of natural handwriting by the writer concerned?

1. Law of Natural Variations
2. Law of Individuality
3. Law of Mathematical Probability
4. Law of Correspondence

Name the type of document whose authenticity is under cloud of suspicion. Select the correct answer from the codes given below:

1. Admitted Document
2. Cloud Computing
3. Standard Document
4. Questioned Document
96. Evaluate the Assertion (A) and Reason (R) given below and select the correct answer from the given codes:

**Assertion (A):** Identification authorship of a simulated signature forgery is a difficult task.

**Reason (R):** Simulation is a double disguise wherein the writing habits of the forger get automatical elminated while copying the habits of the real person.

**Codes:**
1. Both (A) and (R) are false.
2. (A) is true, but (R) is false.
3. (A) is false, but (R) is true.
4. Both (A) and (R) are true.

97. Which of the following statements is not true?
1. No one can write better than his own skill and capability.
2. A person's handwriting shows variation over the course of his/her life.
3. Handwriting cannot be identified because writing characteristics of a person are subject to frequent change as a result of natural variations.
4. Natural variations are essential ingredients of handwriting of a person written over a period of time.

98. What are the usual indicators of level of handwriting skill of a writer? Select the correct answer from the following codes:
1. Simplifications
2. Line Quality and Rhythm
3. Skilful Imitation
4. Embellishments
100. In the context of the term 'documents', quality is used to indicate:
(a) Continuity of handwritten strokes
(b) Visible record of handwritten strokes
(c) Quality of Initials and Terminal strokes
(d) Oscillation of strokes

Codes:

<table>
<thead>
<tr>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>L</td>
<td>K</td>
<td>M</td>
</tr>
<tr>
<td>L</td>
<td>M</td>
<td>K</td>
<td>J</td>
</tr>
</tbody>
</table>

(D) Wilful using of Section 489E
(C) Possession of Section 489B
(B) Forgery or 'L' Section 489A
(A) Counterfeiting J Section 489C

List-I

List-II

[Table with the respective Section of the Indian Penal Code (IPC) given in List-I and select the correct answer from the given codes:]

99. List the type of offences given in List-I with the respective Section of the Indian Penal Code (IPC) given in List-II and select the correct answer from the given codes: