Q.1 Determine the charge on the capacitor in the following circuit:

\[ \begin{array}{c}
\text{72 V} \\
6 \Omega \\
4 \Omega \quad 2 \Omega \\
10 \Omega \\
10 \mu F
\end{array} \]

Options:
1. 60 \mu C
2. 2 \mu C
3. 10 \mu C
4. 200 \mu C

Q.2 The following bodies are made to roll up (without slipping) the same inclined plane from a horizontal plane: (i) a ring of radius \( R \), (ii) a solid cylinder of radius \( R/2 \), and (iii) a solid sphere of radius \( R/4 \). If, in each case, the speed of the center of mass at the bottom of the incline is same, the ratio of the maximum heights they climb is:

Options:
1. 4 : 3 : 2
2. 10 : 15 : 7
3. 14 : 15 : 20
4. 2 : 3 : 4
Q.3  A simple pendulum oscillating in air has period $T$. The bob of the pendulum is completely immersed in a non-viscous liquid. The density of the liquid is $\frac{1}{16}$th of the material of the bob. If the bob is inside liquid all the time, its period of oscillation in this liquid is:

Options
1. $2T\sqrt{\frac{1}{10}}$
2. $2T\sqrt{\frac{1}{14}}$
3. $4T\sqrt{\frac{1}{15}}$
4. $4T\sqrt{\frac{1}{14}}$

Q.4  An HCl molecule has rotational, translational and vibrational motions. If the $\text{rms}$ velocity of HCl molecules in its gaseous phase is $\bar{v}$, $m$ is its mass and $k_B$ is Boltzmann constant, then its temperature will be:

Options
1. $\frac{m\bar{v}^2}{6k_B}$
2. $\frac{m\bar{v}^2}{3k_B}$
3. $\frac{m\bar{v}^2}{7k_B}$
4. $\frac{m\bar{v}^2}{5k_B}$
Q.5 A uniform cable of mass 'M' and length 'L' is placed on a horizontal surface such that its \( \left( \frac{1}{n} \right) \) th part is hanging below the edge of the surface. To lift the hanging part of the cable up to the surface, the work done should be:

Options
1. \( \frac{MgL}{2n^2} \)
2. \( \frac{MgL}{n^2} \)
3. \( \frac{2MgL}{n^2} \)
4. \( nMgL \)

Q.6 Taking the wavelength of first Balmer line in hydrogen spectrum (\( n = 3 \) to \( n = 2 \)) as 660 nm, the wavelength of the 2nd Balmer line (\( n = 4 \) to \( n = 2 \)) will be:

Options
1. 889.2 nm
2. 488.9 nm
3. 642.7 nm
4. 388.9 nm
A system of three charges are placed as shown in the figure:

If $D \gg d$, the potential energy of the system is best given by:

Options

1. \[
\frac{1}{4\pi\varepsilon_0}\left(-\frac{q^2}{d} - \frac{q Q d}{2D^2}\right)
\]

2. \[
\frac{1}{4\pi\varepsilon_0}\left(-\frac{q^2}{d} + \frac{2q Q d}{D^2}\right)
\]

3. \[
\frac{1}{4\pi\varepsilon_0}\left(+\frac{q^2}{d} + \frac{q Q d}{D^2}\right)
\]

4. \[
\frac{1}{4\pi\varepsilon_0}\left(-\frac{q^2}{d} - \frac{q Q d}{D^2}\right)
\]

Q.8 Following figure shows two processes A and B for a gas. If \(\Delta Q_A\) and \(\Delta Q_B\) are the amount of heat absorbed by the system in two cases, and \(\Delta U_A\) and \(\Delta U_B\) are changes in internal energies, respectively, then:

Options

1. \(\Delta Q_A < \Delta Q_B, \Delta U_A < \Delta U_B\)

2. \(\Delta Q_A > \Delta Q_B, \Delta U_A > \Delta U_B\)

3. \(\Delta Q_A > \Delta Q_B, \Delta U_A = \Delta U_B\)

4. \(\Delta Q_A = \Delta Q_B; \Delta U_A = \Delta U_B\)
Q.9  The electric field of light wave is given as
\[
\vec{E} = 10^{-3} \cos\left(\frac{2\pi x}{5 \times 10^{-7}} - 2\pi \times 6 \times 10^{14} t\right) \hat{x} \frac{N}{C}
\]

This light falls on a metal plate of work function 2eV. The stopping potential of the photo-electrons is:

Given, \( E \) (in eV) = \( \frac{12375}{\lambda (in \text{ Å})} \)

Options:
1. 2.0 V
2. 0.72 V
3. 0.48 V
4. 2.48 V

Q.10  A body of mass 2 kg makes an elastic collision with a second body at rest and continues to move in the original direction but with one fourth of its original speed. What is the mass of the second body?

Options:
1. 1.0 kg
2. 1.5 kg
3. 1.8 kg
4. 1.2 kg

Q.11  In the density measurement of a cube, the mass and edge length are measured as (10.00 ± 0.10) kg and (0.10 ± 0.01) m, respectively. The error in the measurement of density is:
Q.12  A string is clamped at both the ends and it is vibrating in its 4th harmonic. The equation of the stationary wave is $Y = 0.3 \sin(0.157x) \cos(200\pi t)$. The length of the string is: (All quantities are in SI units.)

Options 1. 20 m  
2. 80 m  
3. 40 m  
4. 60 m

Q.13  A capacitor with capacitance 5 μF is charged to 5 μC. If the plates are pulled apart to reduce the capacitance to 2 μF, how much work is done?

Options 1. $6.25 \times 10^{-6}$ J  
2. $3.75 \times 10^{-6}$ J  
3. $2.16 \times 10^{-6}$ J  
4. $2.55 \times 10^{-6}$ J
Q.14 The total number of turns and cross-section area in a solenoid is fixed. However, its length $L$ is varied by adjusting the separation between windings. The inductance of solenoid will be proportional to:

Options 1. $L$
2. $L^2$
3. $1/L^2$
4. $1/L$

Question Type: MCQ
Question ID: 41652913796
Option 1 ID: 41652953962
Option 2 ID: 41652953963
Option 3 ID: 41652953964
Option 4 ID: 41652953965
Status: Answered
Chosen Option: 3

Q.15 If ‘M’ is the mass of water that rises in a capillary tube of radius ‘r’, then mass of water which will rise in a capillary tube of radius ‘2r’ is:

Options 1. $M$
2. $M/2$
3. $4M$
4. $2M$

Question Type: MCQ
Question ID: 41652913804
Option 1 ID: 41652953996
Option 2 ID: 41652953997
Option 3 ID: 41652953994
Option 4 ID: 41652953995
Status: Answered
Chosen Option: 1

Q.16 A stationary horizontal disc is free to rotate about its axis. When a torque is applied on it, its kinetic energy as a function of $\theta$, where $\theta$ is the angle by which it has rotated, is given as $k\theta^2$. If its moment of inertia is $I$ then the angular acceleration of the disc is:

Options 1. $\frac{k}{4I}\theta^2$
2. \( \frac{k}{\theta} \)

3. \( \frac{k}{2\theta} \)

4. \( \frac{2k}{\theta} \)

Q.17 A wire of resistance R is bent to form a square ABCD as shown in the figure. The effective resistance between E and C is: (E is mid-point of arm CD)

A B

D E C

Options

1. \( R \)

2. \( \frac{7}{64} R \)

3. \( \frac{3}{4} R \)

4. \( \frac{1}{16} R \)

Q.18 The pressure wave,

\[ P = 0.01 \sin(1000t - 3\pi) \text{ Nm}^{-2} \]

corresponds to the sound produced by a vibrating blade on a day when atmospheric temperature is 0°C. On some other day when temperature is T, the speed of sound produced by the same blade and at the same frequency is found to be 336 ms\(^{-1}\). Approximate value of T is:
Q.19 A solid sphere of mass 'M' and radius 'a' is surrounded by a uniform concentric spherical shell of thickness 2a and mass 2M. The gravitational field at distance '3a' from the centre will be:

Options
1. \(\frac{2GM}{9a^2}\)
2. \(\frac{GM}{9a^2}\)
3. \(\frac{GM}{3a^2}\)
4. \(\frac{2GM}{3a^2}\)

Q.20 For a given gas at 1 atm pressure, rms speed of the molecules is 200 m/s at 127 °C. At 2 atm pressure and at 227 °C, the rms speed of the molecules will be:

Options
1. 100 m/s
2. \(80\sqrt{5}\) m/s
3. \(100\sqrt{5}\) m/s
4. 80 m/s
Q.21  The magnetic field of a plane electromagnetic wave is given by:
\[ \mathbf{B} = B_0 \hat{\mathbf{r}} \cos(kz - \omega t) + B_1 \hat{\mathbf{r}} \cos(kz + \omega t) \]
where \( B_0 = 3 \times 10^{-5} \text{T} \) and \( B_1 = 2 \times 10^{-6} \text{T} \).
The rms value of the force experienced by a stationary charge \( Q = 10^{-4} \text{C} \) at \( z = 0 \) is closest to:

Options
1. 0.6 N
2. 0.1 N
3. 0.9 N
4. \( 3 \times 10^{-2} \text{N} \)

Q.22  A moving coil galvanometer has resistance 50 \( \Omega \) and it indicates full deflection at 4 mA current. A voltmeter is made using this galvanometer and a 5 k\( \Omega \) resistance. The maximum voltage, that can be measured using this voltmeter, will be close to:

Options
1. 40 V
2. 15 V
3. 20 V
4. 10 V

Q.23
The stream of a river is flowing with a speed of 2 km/h. A swimmer can swim at a speed of 4 km/h. What should be the direction of the swimmer with respect to the flow of the river to cross the river straight?

Options
1. 90°
2. 150°
3. 120°
4. 60°

Q.24 An NPN transistor is used in common emitter configuration as an amplifier with 1 kΩ load resistance. Signal voltage of 10 mV is applied across the base-emitter. This produces a 3 mA change in the collector current and 15 μA change in the base current of the amplifier. The input resistance and voltage gain are:

Options
1. 0.33 kΩ, 1.5
2. 0.67 kΩ, 300
3. 0.67 kΩ, 200
4. 0.33 kΩ, 300

Q.25 A rectangular coil (Dimension 5 cm × 2.5 cm) with 100 turns, carrying a current of 3 A in the clock-wise direction, is kept centered at the origin and in the X-Z plane. A magnetic field of 1 T is applied along X-axis. If the coil is tilted through 45° about Z-axis, then the torque on the coil is:
Q.26 A signal $A \cos \omega t$ is transmitted using 
$v_0 \sin \omega_0 t$ as carrier wave. The correct 
amplitude modulated (AM) signal is:

Options
1. $v_0 \sin \omega_0 t + \frac{A}{2} \sin(\omega_0 - \omega)t + \frac{A}{2} \sin(\omega_0 + \omega)t$
2. $v_0 \sin[\omega_0(1 + 0.01 \sin \omega_0 t)]$
3. $v_0 \sin \omega_0 t + A \cos \omega t$
4. $(v_0 + A) \cos \omega_0 t$

Q.27 A rigid square loop of side ‘a’ and carrying 
current $I_2$ is lying on a horizontal surface 
proximity to a long current $I_1$ carrying wire in the 
same plane as shown in figure. The net 
force on the loop due to the wire will be:

Options
1. Repulsive and equal to $\frac{\mu_0 I_1 I_2}{2\pi}$
2. Attractive and equal to $\frac{\mu_0 I_1 I_2}{3\pi}$
3. Repulsive and equal to $\frac{\mu_0 I_1 I_2}{4\pi}$
4. Zero
Q.28 A concave mirror for face viewing has focal length of 0.4 m. The distance at which you hold the mirror from your face in order to see your image upright with a magnification of 5 is:

Options
1. 0.24 m
2. 1.60 m
3. 0.32 m
4. 0.16 m

Q.29 A ball is thrown vertically up (taken as +z-axis) from the ground. The correct momentum-height (p-h) diagram is:

Options
1. 
2. 
3. 
4. 

Question Type: MCQ
Question ID: 41652913795
Option 1 ID: 41652953961
Option 2 ID: 41652953959
Option 3 ID: 41652953960
Option 4 ID: 41652953958
Status: Answered
Chosen Option: 1

Question Type: MCQ
Question ID: 41652913798
Option 1 ID: 41652953973
Option 2 ID: 41652953971
Option 3 ID: 41652953972
Option 4 ID: 41652953970
Status: Answered
Chosen Option: 3

Question Type: MCQ
Question ID: 41652913778
Option 1 ID: 41652953890
Option 2 ID: 41652953891
Q.30 The figure shows a Young’s double slit experimental setup. It is observed that when a thin transparent sheet of thickness t and refractive index μ is put in front of one of the slits, the central maximum gets shifted by a distance equal to n fringe widths. If the wavelength of light used is λ, t will be:

![Diagram of Young's double slit experiment]

Options
1. \( \frac{2nD\lambda}{a(\mu - 1)} \)
2. \( \frac{nD\lambda}{a(\mu - 1)} \)
3. \( \frac{D\lambda}{a(\mu - 1)} \)
4. \( \frac{2D\lambda}{a(\mu - 1)} \)

Section: Chemistry

Q.1 The element having greatest difference between its first and second ionization energies, is:

Options
1. Ca
2. Sc
3. Ba
4. K

Question Type: MCQ
Question ID: 41652913816
Option 1 ID: 41652954043
Option 2 ID: 41652954045
Option 3 ID: 41652954044
Q.2 The increasing order of reactivity of the following compounds towards aromatic electrophilic substitution reaction is:

![Chemical structures](image)

Options 1. D < A < C < B  
2. B < C < A < D  
3. A < B < C < D  
4. D < B < A < C

Q.3 Consider the van der Waals constants, a and b, for the following gases.

<table>
<thead>
<tr>
<th>Gas</th>
<th>Ar</th>
<th>Ne</th>
<th>Kr</th>
<th>Xe</th>
</tr>
</thead>
<tbody>
<tr>
<td>a/(atm dm$^3$ mol$^{-2}$)</td>
<td>3.2</td>
<td>1.7</td>
<td>1.0</td>
<td>5.0</td>
</tr>
<tr>
<td>b/(10$^{-2}$ dm$^3$ mol$^{-1}$)</td>
<td>0.2</td>
<td>0.2</td>
<td>5.1</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Which gas is expected to have the highest critical temperature?

Options 1. Kr  
2. Ne  
3. Xe  
4. Ar

Q.4
The given plots represent the variation of the concentration of a reactant $R$ with time for two different reactions (i) and (ii). The respective orders of the reactions are:

(i) \[
\ln[R] \quad \text{time}
\]

(ii) \[
[R] \quad \text{time}
\]

Options:
1. $1, 0$
2. $1, 1$
3. $0, 1$
4. $0, 2$

Q.5 Among the following, the set of parameters that represents path functions, is:

(A) $q + w$
(B) $q$
(C) $w$
(D) $H - TS$

Options:
1. (B) and (C)
2. (B), (C) and (D)
3. (A) and (D)
4. (A), (B) and (C)

Q.6 The ore that contains the metal in the form of fluoride is:

Options:
1. cryolite
2. malachite
3. magnetite
4. sphalerite

Q.7  Excessive release of CO₂ into the atmosphere results in:
Options
1. global warming
2. polar vortex
3. formation of smog
4. depletion of ozone

Q.8  Aniline dissolved in dilute HCl is reacted with sodium nitrite at 0°C. This solution was added dropwise to a solution containing equimolar mixture of aniline and phenol in dil. HCl. The structure of the major product is:
Options
1. \[ \text{N} = \text{N} \quad \text{H} \]
2. \[ \text{N} = \text{N} - \text{NH} \]
3. \[ \text{N} = \text{N} \quad \text{NH}_2 \]
4. \[ \text{N} = \text{N} \quad \text{O} \]
Q.9 Among the following, the molecule expected to be stabilized by anion formation is:
C₂O₂, NO, F₂

Options 1. C₂
2. F₂
3. NO
4. O₂

Q.10 The correct order of the oxidation states of nitrogen in NO, N₂O, NO₂ and N₂O₃ is:

Options 1. NO₂ < NO < N₂O₃ < N₂O
2. NO₂ < N₂O₃ < NO < N₂O
3. N₂O < N₂O₃ < NO < NO₂
4. N₂O < NO < N₂O₃ < NO₂

Q.11 Liquid ‘M’ and liquid ‘N’ form an ideal solution. The vapour pressures of pure liquids ‘M’ and ‘N’ are 450 and 700 mmHg, respectively, at the same temperature. Then correct statement is:

\( x_M = \text{Mole fraction of ‘M’ in solution}; \)
\( x_N = \text{Mole fraction of ‘N’ in solution}; \)
\( y_M = \text{Mole fraction of ‘M’ in vapour phase}; \)
\( y_N = \text{Mole fraction of ‘N’ in vapour phase}; \)

Options 1. \( \frac{x_M}{x_N} = \frac{y_M}{y_N} \)
2. \( (x_M - y_M) < (x_N - y_N) \)
3. \( \frac{x_M}{x_N} < \frac{y_M}{y_N} \)
4. \( \frac{x_M}{x_N} > \frac{y_M}{y_N} \)

Q.12 The osmotic pressure of a dilute solution of an ionic compound XY in water is four times that of a solution of 0.01 M BaCl₂ in water. Assuming complete dissociation of the given ionic compounds in water, the concentration of XY (in mol L⁻¹) in solution is:

Options 1. \( 4 \times 10^{-2} \)
2. \( 6 \times 10^{-2} \)
3. \( 4 \times 10^{-4} \)
4. \( 16 \times 10^{-4} \)

Q.13 The number of water molecule(s) not coordinated to copper ion directly in CuSO₄ · 5H₂O, is:

Options 1. 2
2. 3
3. 1
4. 4
Q.14
The standard Gibbs energy for the given cell reaction in kJ mol\(^{-1}\) at 298 K is:

\[ \text{Zn}(s) + \text{Cu}^{2+}(aq) \rightarrow \text{Zn}^{2+}(aq) + \text{Cu}(s), \]

\( E^0 = 2 \text{ V at 298 K} \)

(Faraday's constant, \( F = 96000 \text{ C mol}^{-1} \))

Options
1. \(-384\)
2. \(384\)
3. \(192\)
4. \(-192\)

Q.15
The major product of the following reaction is:

\[ \text{CH}_2\text{CH}_3 \xrightarrow{\text{(i) alkaline KMnO}_4, \text{(ii) H}_3\text{O}^+} \]

Options
1. \(\text{COOH}\)
2. \(\text{CH}_2\text{CHO}\)
3. \(\text{CH}_2\text{COOH}\)
4. \(\text{COCH}_3\)
Q.16 For any given series of spectral lines of atomic hydrogen, let $\Delta \nu = \nu_{\text{max}} - \nu_{\text{min}}$ be the difference in maximum and minimum frequencies in cm$^{-1}$. The ratio $\Delta \nu_{\text{Lyman}} / \Delta \nu_{\text{Balmer}}$ is:

Options
1. 4 : 1
2. 9 : 4
3. 5 : 4
4. 27 : 5

Q.17 The organic compound that gives following qualitative analysis is:

Test | Inference
---|---
(a) Dil. HCl | Insoluble
(b) NaOH solution | soluble
(c) Br$_2$/water | Decolourization

Options
1. \[
\begin{array}{c}
\text{O} \\
\end{array}
\]
2. \[
\begin{array}{c}
\text{N} \\
\text{H}_2
\end{array}
\]
3. \[
\begin{array}{c}
\text{N} \\
\text{H}_2
\end{array}
\]
4. \[
\begin{array}{c}
\text{O} \\
\end{array}
\]
Q. 18

\( \text{C}_{60} \) an allotrope of carbon contains:

1. 12 hexagons and 20 pentagons.
2. 18 hexagons and 14 pentagons.
3. 16 hexagons and 16 pentagons.
4. 20 hexagons and 12 pentagons.

Q. 19

The major product of the following reaction is:

\[
\text{CH}_3
\]

\[
\text{Cl}
\]

\[
\text{Cl}
\]

\[
\text{OH}
\]

(1) KOH (alc.)
(2) Free radical polymerisation

Options

1.

2.

3.
Q.20 The one that will show optical activity is:
(en = ethane-1,2-diamine)

Options

1. 

2. 

3. 

4. 

Q.21
The correct IUPAC name of the following compound is:

\[
\begin{array}{c}
\text{NO}_2 \\
\text{Cl} \\
\text{CH}_3
\end{array}
\]

Options:
1. 5-chloro-4-methyl-1-nitrobenzene
2. 2-chloro-1-methyl-4-nitrobenzene
3. 3-chloro-4-methyl-1-nitrobenzene
4. 2-methyl-5-nitro-1-chlorobenzene

Q.22 Match the catalysts (Column I) with products (Column II).

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalyst</td>
<td>Product</td>
</tr>
<tr>
<td>(A) V$_2$O$_5$</td>
<td>(i) Polyethylene</td>
</tr>
<tr>
<td>(B) TiCl$_4$/Al(Me)$_3$</td>
<td>(ii) ethanol</td>
</tr>
<tr>
<td>(C) PdCl$_2$</td>
<td>(iii) H$_2$SO$_4$</td>
</tr>
<tr>
<td>(D) Iron Oxide</td>
<td>(iv) NH$_3$</td>
</tr>
</tbody>
</table>

Options:
1. (A)-(iii); (B)-(iv); (C)-(i); (D)-(ii)
2. (A)-(i); (B)-(iii); (C)-(i); (D)-(iv)
3. (A)-(iii); (B)-(i); (C)-(ii); (D)-(iv)
4. (A)-(iv); (B)-(iii); (C)-(ii); (D)-(i)

Q.23 Which of the following statements is not true about sucrose?

Options:
1. It is a non-reducing sugar
The glycosidic linkage is present
2. between C₁ of α-glucose and C₁ of β-fructose
3. It is also named as invert sugar
4. On hydrolysis, it produces glucose and fructose
Q.26  The major product of the following reaction is:

\[ \text{CH}_3\text{C} \equiv \text{CH} \xrightarrow{\text{(i) DCl (1 equiv.)}} \frac{\text{(ii) DI}}{} \]

Options:
1. CH₃CD(l)CHD(Cl)
2. CH₃CD(Cl)CHD(l)
3. CH₃CD₂CH(Cl)(l)
4. CH₃C(l)(Cl)CHD₂

Q.27  The major product of the following reaction is:

\[ \text{CH}_3\text{CH} = \text{CHCO}_2\text{CH}_3 \xrightarrow{\text{LiAlH}_4} \]

Options:
1. CH₃CH₂CH₂CO₂CH₃
2. CH₃CH = CHCH₂OH
3. CH₃CH₂CH₂CH₂OH
4. CH₃CH₂CH₂CHO

Q.28
The degenerate orbitals of \([\text{Cr(H}_2\text{O)}_6]**\) are:

1. \(d_{x^2-y^2}\) and \(d_{xy}\)
2. \(d_{yz}\) and \(d_{x^2}\)
3. \(d_{z^2}\) and \(d_{xz}\)
4. \(d_{x^2-y^2}\) and \(d_{xy}\)

**Q.29** The aerosol is a kind of colloid in which:

1. solid is dispersed in gas
2. gas is dispersed in solid
3. gas is dispersed in liquid
4. liquid is dispersed in water

**Q.30** For a reaction,

\[
\text{N}_2(g) + 3 \text{H}_2(g) \rightarrow 2 \text{NH}_3(g)
\]

identify dihydrogen (H\(_2\)) as a limiting reagent in the following reaction mixtures.

1. 56 g of N\(_2\) + 10 g of H\(_2\)
2. 35 g of N\(_2\) + 8 g of H\(_2\)
3. 28 g of N\(_2\) + 6 g of H\(_2\)
4. 14 g of N\(_2\) + 4 g of H\(_2\)
Q.1 Slope of a line passing through P(2, 3) and intersecting the line, \( x + y = 7 \) at a distance of 4 units from P, is:

Options
1. \( \frac{1-\sqrt{5}}{1+\sqrt{5}} \)
2. \( \frac{1-\sqrt{7}}{1+\sqrt{7}} \)
3. \( \frac{\sqrt{7}-1}{\sqrt{7}+1} \)
4. \( \frac{\sqrt{5}-1}{\sqrt{5}+1} \)

Question Type: MCQ
Question ID: 41652913854
Option 1 ID: 41652954195
Option 2 ID: 41652954197
Option 3 ID: 41652954196
Option 4 ID: 41652954194
Status: Answered
Chosen Option: 2

Q.2 If the standard deviation of the numbers \(-1, 0, 1, k\) is \( \sqrt{5} \) where \( k > 0 \), then \( k \) is equal to:

Options
1. \( 2\sqrt{6} \)
2. \( 2\sqrt{\frac{10}{3}} \)
3. \( 4\sqrt{\frac{5}{3}} \)
4. \( \sqrt{6} \)

Question Type: MCQ
Question ID: 41652913862
Option 1 ID: 41652954228
Option 2 ID: 41652954227
Option 3 ID: 41652954229
Option 4 ID: 41652954226
Status: Answered
Chosen Option: 1

Q.3 If \( f(x) \) is a non-zero polynomial of degree four, having local extreme points at \( x = -1, 0, 1 \); then the set
\[ S = \{ x \in \mathbb{R} : f(x) = f(0) \} \]
contains exactly:
Options 1. four irrational numbers.
2. four rational numbers.
3. two irrational and two rational numbers.
4. two irrational and one rational number.

Q.4

The integral \( \int \sec^{2/3} x \csc^{4/3} x \, dx \) is equal to:
(Here \( C \) is a constant of integration)

Options
1. \( -3 \tan^{-1/3} x + C \)
2. \( -\frac{3}{4} \tan^{-4/3} x + C \)
3. \( -3 \cot^{-1/3} x + C \)
4. \( 3 \tan^{-1/3} x + C \)

Q.5

Four persons can hit a target correctly with probabilities \( \frac{1}{2} \), \( \frac{1}{3} \), \( \frac{1}{4} \) and \( \frac{1}{8} \) respectively.

If all hit at the target independently, then the probability that the target would be hit, is:

Options
1. \( \frac{25}{192} \)
2. \( \frac{7}{32} \)
3. \( \frac{1}{192} \)
4. \( \frac{25}{32} \)
Q.6
If the line, \( \frac{x-1}{2} = \frac{y+1}{3} = \frac{z-2}{4} \) meets the plane, \( x + 2y + 3z = 15 \) at a point P, then the distance of P from the origin is:

Options:
1. \( \sqrt{5} / 2 \)
2. \( 2\sqrt{5} \)
3. \( 9/2 \)
4. \( 7/2 \)

Q.7
If the tangent to the curve, \( y = x^3 + ax - b \) at the point \( (1, -5) \) is perpendicular to the line, \( -x + y + 4 = 0 \), then which one of the following points lies on the curve?

Options:
1. \((-2, 1)\)
2. \((-2, 2)\)
3. \((2, -1)\)
4. \((2, -2)\)

Q.8
The value of \( \int_{0}^{\pi/2} \frac{\sin^3 x}{\sin x + \cos x} \, dx \) is:

Options:
1. \( \frac{\pi - 2}{8} \)
2. \(\frac{\pi - 1}{4}\)
3. \(\frac{\pi - 2}{4}\)
4. \(\frac{\pi - 1}{2}\)

Q.9
The value of \(\cos^210^\circ - \cos10^\circ \cos50^\circ + \cos^250^\circ\) is:

Options
1. \(\frac{3}{4} + \cos20^\circ\)
2. \(\frac{3}{4}\)
3. \(\frac{3}{2}(1 + \cos20^\circ)\)
4. \(\frac{3}{2}\)

Q.10
If the line \(y = mx + 7\sqrt{3}\) is normal to the hyperbola \(\frac{x^2}{24} - \frac{y^2}{18} = 1\), then a value of \(m\) is:

Options
1. \(\frac{\sqrt{5}}{2}\)
2. \(\frac{\sqrt{15}}{2}\)
3. \(\frac{2}{\sqrt{5}}\)
4. \(\frac{3}{\sqrt{5}}\)
Q.11 The solution of the differential equation
\[ x \frac{dy}{dx} + 2y = x^2 \quad (x \neq 0) \] with \( y(1) = 1 \), is:

Options
1. \( y = \frac{4}{5} x^3 + \frac{1}{5x^2} \)
2. \( y = \frac{x^3}{5} + \frac{1}{5x^2} \)
3. \( y = \frac{x^2}{4} + \frac{3}{4x^2} \)
4. \( y = \frac{3}{4} x^2 + \frac{1}{4x^2} \)

Q.12 For any two statements \( p \) and \( q \), the negation of the expression \( p \lor (\sim p \land q) \) is:

Options
1. \( \sim p \land \sim q \)
2. \( p \land q \)
3. \( p \Rightarrow q \)
4. \( \sim p \lor \sim q \)

Q.13 All the points in the set
\[ S = \left\{ \frac{\alpha + i}{\alpha - i} : \alpha \in \mathbb{R} \right\} \quad (i = \sqrt{-1}) \] lie on a:

Options
1. straight line whose slope is 1.
2. circle whose radius is 1.
3. circle whose radius is $\sqrt{2}$.
4. straight line whose slope is $-1$.

Q.14 If the fourth term in the Binomial expansion

$$\left(\frac{2}{x} + x^{\log x}\right)^6 \quad (x > 0)$$

is $20 \times 8^2$, then a value of $x$ is:

Options
1. $8^3$
2. $8^2$
3. 8
4. $8 - 2$

Q.15 If the function $f$ defined on $\left(\frac{\pi}{6}, \frac{\pi}{3}\right)$ by

$$f(x) = \begin{cases} 
\sqrt{2} \cos x - 1, & x = \frac{\pi}{4} \\
\cot x - 1, & x = \frac{\pi}{4} \\
k, & x = \frac{\pi}{4} 
\end{cases}$$

is continuous, then $k$ is equal to:

Options
1. 2
2. $\frac{1}{2}$
3. 1
4. $\frac{1}{\sqrt{2}}$
Q.16
If the function $f : \mathbb{R} \rightarrow \{1, -1\}$ defined by $f(x) = \frac{x^2}{1-x^2}$ is surjective, then $A$ is equal to:

Options 1. $\mathbb{R} \setminus \{1\}$
2. $(0, \infty)$
3. $\mathbb{R} \setminus \{1, 0\}$
4. $\mathbb{R} \setminus \{1, 0\}$

Q.17
A plane passing through the points $(0, -1, 0)$ and $(0, 0, 1)$ and making an angle $\frac{\pi}{4}$ with the plane $y - z + 5 = 0$, also passes through the point:

Options 1. $(-\sqrt{2}, 1, -4)$
2. $(\sqrt{2}, -1, 4)$
3. $(-\sqrt{2}, -1, -4)$
4. $(\sqrt{2}, 1, 4)$

Q.18
Let the sum of the first $n$ terms of a non-constant A.P., $a_1, a_2, a_3, \ldots \ldots$ be $50n + \frac{n(n-7)}{2}A$, where $A$ is a constant.

If $d$ is the common difference of this A.P., then the ordered pair $(d, a_{50})$ is equal to:

Options 1. $(50, 50 + 46A)$
2. $(50, 50 + 45A)$
3. $(A, 50 + 45A)$
4. $(A, 50 + 46A)$

Q.19 Let $S = \{ \theta | -2\pi, 2\pi \} : 2 \cos^2 \theta + 3 \sin \theta = 0 \}$. Then the sum of the elements of $S$ is:

Options
1. $\frac{13\pi}{6}$
2. $\frac{5\pi}{3}$
3. $2\pi$
4. $\pi$

Q.20 Let $p, q \in \mathbb{R}$. If $2 - \sqrt{3}$ is a root of the quadratic equation, $x^2 + px + q = 0$, then:

Options
1. $p^2 - 4q + 12 = 0$
2. $q^2 - 4p - 16 = 0$
3. $q^2 + 4p + 14 = 0$
4. $p^2 - 4q - 12 = 0$

Q.21 Let $f(x) = 15 - |x - 10|; x \in \mathbb{R}$. Then the set of all values of $x$, at which the function, $g(x) = f(f(x))$ is not differentiable, is:
Options
1. 2. 3. 4.

Question Type: MCQ

Q.22 Let S be the set of all values of $x$ for which the tangent to the curve $y = f(x) = x^3 - 2x$ at $(x, y)$ is parallel to the line segment joining the points $(1, f(1))$ and $(-1, f(-1))$, then $S$ is equal to:

Options
1. \[ \{3\} \]
2. \[ \{\frac{1}{2}\} \]
3. \[ \{\frac{1}{3}\} \]
4. \[ \{-1\} \]

Q.23 If a tangent to the circle $x^2 + y^2 = 1$ intersects the coordinate axes at distinct points $P$ and $Q$, then the locus of the midpoint of $PQ$ is:

Options
1. $2x + y^2 - 4y = 0$
2. $x^2 + y^2 - 2y = 0$
3. $x^2 + y^2 - 4x = 0$
4. $2x^2 + y^2 - 2x = 0$
Q.24

Let \( \vec{\alpha} = 3\hat{i} + \hat{j} \) and \( \vec{\beta} = 2\hat{i} - \hat{j} + 3\hat{k} \). If
\( \vec{\beta} = \vec{\beta}_1 - \vec{\beta}_2 \), where \( \vec{\beta}_1 \) is parallel to \( \vec{\alpha} \)
and \( \vec{\beta}_2 \) is perpendicular to \( \vec{\alpha} \), then
\( \vec{\beta}_1 \times \vec{\beta}_2 \) is equal to:

Options
1. \( -3\hat{i} + 9\hat{j} + 5\hat{k} \)
2. \( 3\hat{i} - 9\hat{j} - 5\hat{k} \)
3. \( \frac{1}{2} (-3\hat{i} + 9\hat{j} + 5\hat{k}) \)
4. \( \frac{1}{2} (3\hat{i} - 9\hat{j} + 5\hat{k}) \)

Q.25

The area (in sq. units) of the region
\( A = \{(x, y) : x^2 \leq y \leq x + 2 \} \) is:

Options
1. \( \frac{10}{3} \)
2. \( \frac{9}{2} \)
3. \( \frac{31}{6} \)
4. \( \frac{13}{6} \)
If
\[
\begin{bmatrix}
1 & 1 & 1 & 2 & 1 & 3 \\
0 & 1 & 0 & 1 & 0 & 1
\end{bmatrix}
\cdots
\begin{bmatrix}
1 & n-1 \\
0 & 1
\end{bmatrix}
= \begin{bmatrix} 1 & 78 \\
0 & 1
\end{bmatrix},
\]
then the inverse of \( \begin{bmatrix} 1 & n \\
0 & 1
\end{bmatrix} \) is:

Options
1. \( \begin{bmatrix} 1 & 0 \\
12 & 1
\end{bmatrix} \)
2. \( \begin{bmatrix} 1 & -13 \\
0 & 1
\end{bmatrix} \)
3. \( \begin{bmatrix} 1 & -12 \\
0 & 1
\end{bmatrix} \)
4. \( \begin{bmatrix} 1 & 0 \\
13 & 1
\end{bmatrix} \)

Q.27

\[
\sum_{k=1}^{10} f(a+k) = 16(2^{10} - 1),
\]
where the function \( f \) satisfies \( f(x + y) = f(x)f(y) \) for all natural numbers \( x, y \) and \( f(1) = 2 \). Then the natural number ‘\( a \)’ is:

Options
1. 2
2. 16
3. 4
4. 3

Q.28
A committee of 11 members is to be formed from 8 males and 5 females. If \( m \) is the number of ways the committee is formed with at least 6 males and \( n \) is the number of ways the committee is formed with at least 3 females, then:

Options:
1. \( m + n = 68 \)
2. \( m = n = 78 \)
3. \( n = m - 8 \)
4. \( m = n = 68 \)

Question Type: MCQ
Question ID: 41652913841
Option 1 ID: 41652954145
Option 2 ID: 41652954143
Option 3 ID: 41652954142
Option 4 ID: 41652954144
Status: Answered
Chosen Option: 2

Q.29 Let \( \alpha \) and \( \beta \) be the roots of the equation \( x^2 + x + 1 = 0 \). Then for \( y \neq 0 \) in \( \mathbb{R} \),

\[
\begin{vmatrix}
 y + 1 & \alpha & \beta \\
\alpha & y + \beta & 1 \\
\beta & 1 & y + \alpha \\
\end{vmatrix}
\]

is equal to:

Options:
1. \( y(y^2 - 1) \)
2. \( y(y^2 - 3) \)
3. \( y^3 \)
4. \( y^3 - 1 \)

Question Type: MCQ
Question ID: 41652913839
Option 1 ID: 41652954136
Option 2 ID: 41652954134
Option 3 ID: 41652954137
Option 4 ID: 41652954135
Status: Not Answered
Chosen Option: --

Q.30 If one end of a focal chord of the parabola, \( y^2 = 16x \) is at \((1, 4)\), then the length of this focal chord is:

Options:
1. 25
2. 22
3. 24
4. 20

Question Type: MCQ