An electron gun is placed inside a long solenoid of radius R on its axis. The solenoid has n turns/length and carries a current I. The electron gun shoots an electron along the radius of the solenoid with speed v. If the electron does not hit the surface of the solenoid, maximum possible value of v is (all symbols have their standard meaning):

\[ \frac{e\mu_0 n l R}{m} \]

\[ \frac{e\mu_0 n l R}{2m} \]

\[ \frac{2e\mu_0 n l R}{m} \]

\[ \frac{e\mu_0 n l R}{4m} \]
A rod of length $L$ has non-uniform linear

mass density given by $\rho(x) = a + b \left(\frac{x}{L}\right)^2$,

where $a$ and $b$ are constants and $0 \leq x \leq L$.

The value of $x$ for the centre of mass of the rod is at:

Options

1. $\frac{4}{3} \left(\frac{a + b}{2a + 3b}\right) L$

2. $\frac{3}{2} \left(\frac{a + b}{2a + b}\right) L$

3. $\frac{3}{2} \left(\frac{2a + b}{3a + b}\right) L$

4. $\frac{3}{4} \left(\frac{2a + b}{3a + b}\right) L$
A plane electromagnetic wave is propagating along the direction \( \frac{i + j}{\sqrt{2}} \), with its polarization along the direction \( k \).

The correct form of the magnetic field of the wave would be (here \( B_0 \) is an appropriate constant):

Options

1. \( B_0 \frac{i - j}{\sqrt{2}} \cos \left( \omega t - k \frac{i + j}{\sqrt{2}} \right) \)

2. \( B_0 \frac{i + j}{\sqrt{2}} \cos \left( \omega t - k \frac{i + j}{\sqrt{2}} \right) \)

3. \( B_0 \frac{k}{\sqrt{2}} \cos \left( \omega t - k \frac{i + j}{\sqrt{2}} \right) \)

4. \( B_0 \frac{j - i}{\sqrt{2}} \cos \left( \omega t + k \frac{i + j}{\sqrt{2}} \right) \)

Question Type : MCQ
Question ID : 4050362159
Option 1 ID : 4050367723
Option 2 ID : 4050367721
Option 3 ID : 4050367724
Option 4 ID : 4050367722
Status : Answered
Chosen Option : 3
Q.5 The current $i$ in the network is:

![Network Diagram]

Options
1. 0 A
2. 0.6 A
3. 0.3 A
4. 0.2 A

Q.6 A small spherical droplet of density $d$ is floating exactly half immersed in a liquid of density $\rho$ and surface tension $T$. The radius of the droplet is (take note that the surface tension applies an upward force on the droplet):

Options
1. $r = \sqrt{\frac{2T}{3(d + \rho)g}}$
2. $r = \sqrt{\frac{3T}{(2d - \rho)g}}$
3. $r = \sqrt{\frac{T}{(d - \rho)g}}$
4. $r = \sqrt{\frac{T}{(d + \rho)g}}$
Q.7  A small circular loop of conducting wire has radius $a$ and carries current $I$. It is placed in a uniform magnetic field $B$ perpendicular to its plane such that when rotated slightly about its diameter and released, it starts performing simple harmonic motion of time period $T$. If the mass of the loop is $m$ then:

Options

1. $T = \sqrt{\frac{\pi m}{2IB}}$
2. $T = \sqrt{\frac{2\pi m}{IB}}$
3. $T = \sqrt{\frac{\pi m}{IB}}$
4. $T = \sqrt{\frac{2m}{IB}}$

Q.8  A wire of length $L$ and mass per unit length $6.0 \times 10^{-3}$ kgm$^{-1}$ is put under tension of 540 N. Two consecutive frequencies that it resonates at are 420 Hz and 490 Hz. Then $L$ in meters is:

Options

1. 8.1 m
2. 5.1 m
3. 1.1 m
4. 2.1 m
Q.9  In LC circuit the inductance \( L = 40 \, \text{mH} \) and capacitance \( C = 100 \, \mu \text{F} \). If a voltage \( V(t) = 10\sin(314 \, t) \) is applied to the circuit, the current in the circuit is given as:

Options 1. \( 0.52 \cos 314 \, t \)
2. \( 0.52 \sin 314 \, t \)
3. \( 10 \cos 314 \, t \)
4. \( 5.2 \cos 314 \, t \)

Q.10  There is a small source of light at some depth below the surface of water (refractive index \( = \frac{4}{3} \)) in a tank of large cross sectional surface area. Neglecting any reflection from the bottom and absorption by water, percentage of light that emerges out of surface is (nearly):

[Use the fact that surface area of a spherical cap of height \( h \) and radius of curvature \( r \) is \( 2\pi rh \)]

Options 1. 17%
2. 21%
3. 34%
4. 50%
Q.11 Two gases - argon (atomic radius 0.07 nm, atomic weight 40) and xenon (atomic radius 0.1 nm, atomic weight 140) have the same number density and are at the same temperature. The ratio of their respective mean free times is closest to:

Options 1. 3.67
2. 4.67
3. 1.83
4. 2.3

Q.12 A particle starts from the origin at t = 0 with an initial velocity of $3.0 \hat{i}$ m/s and moves in the x-y plane with a constant acceleration $\left(6.0 \hat{i} + 4.0 \hat{j}\right)$ m/s$^2$. The x-coordinate of the particle at the instant when its y-coordinate is 32 m is D meters. The value of D is:

Options 1. 50
2. 32
3. 60
4. 40
Q.13
A particle of mass m is projected with a speed \( u \) from the ground at an angle \( \theta = \frac{\pi}{3} \) w.r.t. horizontal (x-axis). When it has reached its maximum height, it collides completely inelastically with another particle of the same mass and velocity \( u \) \( \hat{r} \). The horizontal distance covered by the combined mass before reaching the ground is:

Options
1. \( \frac{3\sqrt{2}}{4} \frac{u^2}{g} \)
2. \( 2\sqrt{2} \frac{u^2}{g} \)
3. \( \frac{3\sqrt{3}}{8} \frac{u^2}{g} \)
4. \( \frac{5}{8} \frac{u^2}{g} \)

Q.14
The energy required to ionise a hydrogen like ion in its ground state is 9 Rydbergs. What is the wavelength of the radiation emitted when the electron in this ion jumps from the second excited state to the ground state?

Options
1. 35.8 nm
2. 24.2 nm
3. 8.6 nm
4. 11.4 nm
Q.15 Two identical capacitors A and B, charged to the same potential 5V are connected in two different circuits as shown below at time \( t = 0 \). If the charge on capacitors A and B at time \( t = CR \) is \( Q_A \) and \( Q_B \) respectively, then (Here \( e \) is the base of natural logarithm)

\[
\text{Options}
\]

1. \( Q_A = VC, \quad Q_B = \frac{VC}{e} \)
2. \( Q_A = \frac{CV}{2}, \quad Q_B = \frac{VC}{e} \)
3. \( Q_A = VC, \quad Q_B = CV \)
4. \( Q_A = \frac{VC}{e}, \quad Q_B = \frac{CV}{2} \)
A uniformly thick wheel with moment of inertia $I$ and radius $R$ is free to rotate about its centre of mass (see fig). A massless string is wrapped over its rim and two blocks of masses $m_1$ and $m_2$ ($m_1 > m_2$) are attached to the ends of the string. The system is released from rest. The angular speed of the wheel when $m_1$ descents by a distance $h$ is:

\[
\omega = \sqrt{\frac{m_1 + m_2}{(m_1 + m_2)R^2 + l}} \cdot gh
\]

Options:
1. \[\frac{m_1 + m_2}{(m_1 + m_2)R^2 + l} \cdot \frac{1}{2} gh\]
2. \[\frac{2(m_1 - m_2)}{(m_1 + m_2)R^2 + l} \cdot \frac{1}{2} gh\]
3. \[\frac{2(m_1 + m_2)}{(m_1 + m_2)R^2 + l} \cdot \frac{1}{2} gh\]
4. \[\frac{(m_1 - m_2)}{(m_1 + m_2)R^2 + l} \cdot \frac{1}{2} gh\]
Q.17 Planet A has mass M and radius R. Planet B has half the mass and half the radius of Planet A. If the escape velocities from the Planets A and B are $v_A$ and $v_B$, respectively, then $\frac{v_A}{v_B} = \frac{n}{4}$. The value of $n$ is:

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

Q.18 Two steel wires having same length are suspended from a ceiling under the same load. If the ratio of their energy stored per unit volume is 1 : 4, the ratio of their diameters is:

Options 1. $1 : \sqrt{2}$  
2. $1 : 2$  
3. $2 : 1$  
4. $\sqrt{2} : 1$
Q.19  For the four sets of three measured physical quantities as given below. Which of the following options is correct?

(i)  \( A_1 = 24.36, B_1 = 0.0724, C_1 = 256.2 \)
(ii) \( A_2 = 24.44, B_2 = 16.082, C_2 = 240.2 \)
(iii) \( A_3 = 25.2, B_3 = 19.2812, C_3 = 236.183 \)
(iv) \( A_4 = 25, B_4 = 236.191, C_4 = 19.5 \)

Options

1. \( A_4 + B_4 + C_4 < A_1 + B_1 + C_1 < A_3 + B_3 + C_3 < A_2 + B_2 + C_2 \)
2. \( A_1 + B_1 + C_1 < A_3 + B_3 + C_3 < A_2 + B_2 + C_2 < A_4 + B_4 + C_4 \)
3. \( A_1 + B_1 + C_1 = A_2 + B_2 + C_2 = A_3 + B_3 + C_3 = A_4 + B_4 + C_4 \)
4. \( A_4 + B_4 + C_4 < A_1 + B_1 + C_1 = A_2 + B_2 + C_2 = A_3 + B_3 + C_3 \)
Q.20 An electron of mass \(m\) and magnitude of charge \(|e|\) initially at rest gets accelerated by a constant electric field \(E\). The rate of change of de-Broglie wavelength of this electron at time \(t\) ignoring relativistic effects is:

\[
\frac{\hbar}{|e|Et^2}
\]

Options
1. \(\frac{|e|Et}{h}\)
2. \(-\frac{h}{|e|Ev}\)
3. \(-\frac{h}{|e|Et}\)
4. \(-\frac{h}{|e|Et}\)

Q.21 Starting at temperature 300 K, one mole of an ideal diatomic gas \((\gamma = 1.4)\) is first compressed adiabatically from volume \(V_1\) to \(V_2 = \frac{V_1}{16}\). It is then allowed to expand isobarically to volume \(2V_2\). If all the processes are the quasi-static then the final temperature of the gas (in °K) is (to the nearest integer) __________.

Given: 1800
Answer: __________

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Question Type: MCQ
Question ID: 4050362161
Option 1 ID: 4050367729
Option 2 ID: 4050367730
Option 3 ID: 4050367731
Option 4 ID: 4050367732
Status: Answered
Chosen Option: 1

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Question Type: SA
Question ID: 4050362164
Status: Answered
Q.22 In a meter bridge experiment S is a standard resistance. R is a resistance wire. It is found that balancing length is \( l = 25 \) cm. If R is replaced by a wire of half length and half diameter that of R of same material, then the balancing distance \( l' \) (in cm) will now be ________.

Given 40
Answer :

Q.23 The circuit shown below is working as a 8 V dc regulated voltage source. When 12 V is used as input, the power dissipated (in mW) in each diode is; (considering both zener diodes are identical) ________.

Given 40
Answer :
Q.24 In a Young’s double slit experiment 15 fringes are observed on a small portion of the screen when light of wavelength 500 nm is used. Ten fringes are observed on the same section of the screen when another light source of wavelength \( \lambda \) is used. Then the value of \( \lambda \) is (in nm) ________.

Given 750
Answer:

Q.25 An electric field \( \vec{E} = 4x \hat{i} - (y^2 + 1) \hat{j} \) N/C passes through the box shown in figure. The flux of the electric field through surfaces ABCD and BCGF are marked as \( \phi_I \) and \( \phi_{II} \) respectively. The difference between \( (\phi_I - \phi_{II}) \) is (in Nm\(^2\)/C) ________.

Given -48
Answer:

Section: Chemistry
Q.1  The correct order of the spin-only magnetic moments of the following complexes is:

(I)  $[\text{Cr(H}_2\text{O)}_6]\text{Br}_2$

(II)  $\text{Na}_4[\text{Fe(CN)}_6]$  

(III)  $\text{Na}_3[\text{Fe(C}_2\text{O}_4)]_3 \ (\Delta_0 > \Gamma)$

(IV)  $\text{(Et}_4\text{N)}_2[\text{CoCl}_4]$  

Options
1. (III) > (I) > (II) > (IV)  
2. (I) > (IV) > (III) > (II)  
3. (II) ≈ (I) > (IV) > (III)  
4. (III) > (I) > (IV) > (II)

Q.2  The first and second ionisation enthalpies of a metal are 496 and 4560 kJ mol$^{-1}$, respectively. How many moles of HCl and $\text{H}_2\text{SO}_4$, respectively, will be needed to react completely with 1 mole of the metal hydroxide?

Options
1. 1 and 0.5  
2. 2 and 0.5  
3. 1 and 1  
4. 1 and 2
Q.3 Which of the following reactions will not produce a racemic product?

Options

1. \[
\text{CH}_3 - C - \text{CH} = \text{CH}_2 \xrightarrow{\text{HCl}}
\]
2. \[
\text{CH}_3 - C - \text{CH}_2 \text{CH}_3 \xrightarrow{\text{HCN}}
\]
3. \[
\text{CH}_3 \quad \text{HCl}
\]
4. \[
\text{CH}_3\text{CH}_2\text{CH} = \text{CH}_2 \xrightarrow{\text{HBr}}
\]

Question Type: MCQ
Question ID: 4050362186
Option 1 ID: 4050367816
Option 2 ID: 4050367817
Option 3 ID: 4050367815
Option 4 ID: 4050367814
Status: Answered
Chosen Option: 3
Q.4 In the following reaction A is:

(i) Br₂, hν
(ii) KOH (alc.)
(iii) O₃
(iv) (CH₃)₂S
(v) NaOH (aq) + Δ

Options

1. 

2. 

3. 

4. 

Question Type: MCQ
Question ID: 4050362187
Option 1 ID: 4050367821
Option 2 ID: 4050367820
Option 3 ID: 4050367819
Option 4 ID: 4050367818
Status: Answered
Chosen Option: 3
Q.5 A mixture of gases O₂, H₂ and CO are taken in a closed vessel containing charcoal. The graph that represents the correct behaviour of pressure with time is:

Options

1. 

\[ \text{Pressure} \]

\[ \text{Time} \]

2. 

\[ \text{Pressure} \]

\[ \text{Time} \]

3. 

\[ \text{Pressure} \]

\[ \text{Time} \]

4. 

\[ \text{Pressure} \]

\[ \text{Time} \]

Question Type: MCQ
Question ID: 4050362172
Option 1 ID: 4050367760
Option 2 ID: 4050367761
Option 3 ID: 4050367759
Option 4 ID: 4050367758
Status: Answered
Chosen Option: 4

Q.6 Which polymer has ‘chiral’ monomer(s)?

Options

1. Buna-N
2. Nylon 6, 6
3. Neoprene
4. PHBV

Question Type: MCQ
Question ID: 4050362185
Option 1 ID: 4050367811
Option 2 ID: 4050367812
Option 3 ID: 4050367810
Option 4 ID: 4050367813
Status: Answered
Chosen Option: 4
Q.7  Biochemical Oxygen Demand (BOD) is the amount of oxygen required (in ppm):

**Options**

1. Anaerobic bacteria to breakdown inorganic waste present in a water body.
2. For the photochemical breakdown of waste present in 1 m$^3$ volume of a water body.
3. By bacteria to break-down organic waste in a certain volume of a water sample.
4. For sustaining life in a water body.

Q.8  Among the statements (a)–(d), the correct ones are:

(a) Lithium has the highest hydration enthalpy among the alkali metals.
(b) Lithium chloride is insoluble in pyridine.
(c) Lithium cannot form ethynide upon its reaction with ethyne.
(d) Both lithium and magnesium react slowly with H$_2$O.

**Options**

1. (a), (b) and (d) only
2. (b) and (c) only
3. (a), (c) and (d) only
4. (a) and (d) only
Q.9  Amongst the following, the form of water with the lowest ionic conductance at 298 K is:

Options 1. distilled water
2. water from a well
3. saline water used for intravenous injection
4. sea water

Q.10  Which of the following has the shortest C–Cl bond?

Options 1. Cl–CH=CH–OCH₃
2. Cl–CH=CH–CH₃
3. Cl–CH=CH₂
4. Cl–CH=CH–NO₂
Q.11 In the figure shown below reactant A (represented by square) is in equilibrium with product B (represented by circle). The equilibrium constant is:

Options
1. 2
2. 1
3. 8
4. 4

Q.12 The decreasing order of basicity of the following amines is:

Options
1. (I) > (III) > (IV) > (II)
2. (III) > (I) > (II) > (IV)
3. (III) > (II) > (I) > (IV)
4. (II) > (III) > (IV) > (I)

Question Type: MCQ
Question ID: 4050362173
Option 1 ID: 4050367762
Option 2 ID: 4050367765
Option 3 ID: 4050367764
Option 4 ID: 4050367763
Status: Answered
Chosen Option: 1

Question Type: MCQ
Question ID: 4050362182
Option 1 ID: 4050367801
Option 2 ID: 4050367799
Option 3 ID: 4050367798
Option 4 ID: 4050367800
Status: Answered
Chosen Option: 3
Q. 13 The solubility product of Cr(OH)\(_3\) at 298 K is \(6.0 \times 10^{-31}\). The concentration of hydroxide ions in a saturated solution of Cr(OH)\(_3\) will be:

**Options**
1. \((18 \times 10^{-31})^{1/4}\)
2. \((2.22 \times 10^{-31})^{1/4}\)
3. \((4.86 \times 10^{-29})^{1/4}\)
4. \((18 \times 10^{-31})^{1/2}\)

---

Q. 14 5 g of zinc is treated separately with an excess of
(a) dilute hydrochloric acid and
(b) aqueous sodium hydroxide.

The ratio of the volumes of \(H_2\) evolved in these two reactions is:

**Options**
1. 1 : 4
2. 1 : 2
3. 2 : 1
4. 1 : 1
Q.15 Consider the following reactions,

(i) $\text{NaNO}_2/\text{HCl}, 0-5 \, ^{\circ}\text{C}$
(ii) $\beta$-naphthol/NaOH $\rightarrow$ Colored Solid

$\text{Br}_2/\text{H}_2\text{O} \rightarrow \text{C}_9\text{H}_6\text{NBr}_3$

The compound $[P]$ is:

Options

1. $\text{NH}_2\text{CH}_3$

2. $\text{NH}_2$

3. $\text{NH}_2\text{CH}_3$

4. $\text{NHCH}_3$

---

Question Type: MCQ
Question ID: 4050362188
Option 1 ID: 4050367822
Option 2 ID: 4050367823
Option 3 ID: 4050367824
Option 4 ID: 4050367825
Status: Answered
Chosen Option: 2
Q.16 A, B and C are three biomolecules. The results of the tests performed on them are given below:

<table>
<thead>
<tr>
<th></th>
<th>Molisch’s Test</th>
<th>Barfoed Test</th>
<th>Biuret Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Positive</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>B</td>
<td>Positive</td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>C</td>
<td>Negative</td>
<td>Negative</td>
<td>Positive</td>
</tr>
</tbody>
</table>

A, B and C are respectively:

1. A = Glucose, B = Fructose, C = Albumin
2. A = Lactose, B = Fructose, C = Alanine
3. A = Lactose, B = Glucose, C = Alanine
4. A = Lactose, B = Glucose, C = Albumin

Q.17 The reaction of $\text{H}_3\text{N}_2\text{B}_3\text{Cl}_3$ (A) with LiBH$_4$ in tetrahydrofuran gives inorganic benzene (B). Further, the reaction of (A) with (C) leads to $\text{H}_3\text{N}_2\text{B}_3\text{Me}_3$. Compounds (B) and (C) respectively, are:

1. Boron nitride and MeBr
2. Borazine and MeMgBr
3. Borazine and MeBr
4. Diborane and MeMgBr
Q.18 The isomer(s) of [Co(NH₃)₄Cl₂] that has/have a Cl–Co–Cl angle of 90°, is/are:

Options
1. meridional and trans
2. cis and trans
3. trans only
4. cis only

Question Type: MCQ
Question ID: 4050362179
Option 1 ID: 4050367789
Option 2 ID: 4050367788
Option 3 ID: 4050367786
Option 4 ID: 4050367787
Status: Answered
Chosen Option: 4

Q.19 The number of sp² hybrid orbitals in a molecule of benzene is:

Options
1. 24
2. 6
3. 12
4. 18

Question Type: MCQ
Question ID: 4050362174
Option 1 ID: 4050367769
Option 2 ID: 4050367766
Option 3 ID: 4050367767
Option 4 ID: 4050367768
Status: Answered
Chosen Option: 4
Q.20  The true statement amongst the following is:

Options
1. Both $\Delta S$ and $S$ are functions of temperature.
2. $S$ is not a function of temperature but $\Delta S$ is a function of temperature.
3. Both $S$ and $\Delta S$ are not functions of temperature.
4. $S$ is a function of temperature but $\Delta S$ is not a function of temperature.

Q.21  A cylinder containing an ideal gas (0.1 mol of 1.0 dm$^3$) is in thermal equilibrium with a large volume of 0.5 molal aqueous solution of ethylene glycol at its freezing point. If the stoppers $S_1$ and $S_2$ (as shown in the figure) are suddenly withdrawn, the volume of the gas in litres after equilibrium is achieved will be ________.

(Given, $K_f$ (water) = 2.0 K kg mol$^{-1}$, $R$ = 0.08 dm$^3$ atm K$^{-1}$ mol$^{-1}$)

![Diagram of the cylinder with frictionsless piston and ideal gas and aq. ethylene glycol]
Q.22
10.30 mg of O₂ is dissolved into a liter of sea water of density 1.03 g/mL. The concentration of O₂ in ppm is __________.

Given 10
Answer : 10

Q.23
A sample of milk splits after 60 min. at 300 K and after 40 min. at 400 K when the population of lactobacillus acidophilus in it doubles. The activation energy (in kJ/mol) for this process is closest to __________.

(Given, \( R = 8.3 \text{ J mol}^{-1}\text{K}^{-1} \), \( ln\left(\frac{2}{3}\right) = 0.4 \), \( e^{-3} = 0.049787\))

Given -3.98
Answer :

Q.24
The sum of the total number of bonds between chromium and oxygen atoms in chromate and dichromate ions is __________.

Given 18
Answer :

Q.25
Consider the following reactions
\[ \text{A} \xrightarrow{\text{i}} \text{CH}_2\text{MgBr} \xrightarrow{\text{ii}} \text{B} \xrightarrow{\text{Cu}} \text{2-methyl-2-butene} \]

The mass percentage of carbon in A is __________.

Given 66.67
Answer :
Q.1 Let \([t]\) denote the greatest integer \(\leq t\) and 
\[
\lim_{x \to 0} x \left[ \frac{4}{x} \right] = A. 
\]
Then the function, 
\[
f(x) = [x^2] \sin(\pi x)
\]
is discontinuous, when \(x\) is equal to:

Options
1. \(\sqrt{A + 5}\)
2. \(\sqrt{A + 1}\)
3. \(\sqrt{A}\)
4. \(\sqrt{A + 21}\)

Q.2 The following system of linear equations 
\[
7x + 6y - 2z = 0 \\
3x + 4y + 2z = 0 \\
x - 2y - 6z = 0,
\]
has

Options
1. infinitely many solutions, \((x, y, z)\)
satisfying \(x = 2z\).
2. no solution.
3. only the trivial solution.
4. infinitely many solutions, \((x, y, z)\)
satisfying \(y = 2z\).
Q.3  
If \( x = 2\sin \theta - \sin 2\theta \) and \( y = 2\cos \theta - \cos 2\theta \),
\[ \theta \in [0, 2\pi], \text{ then } \frac{d^2y}{dt^2} \text{ at } \theta = \pi \text{ is :} \]

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

Q.4  
The length of the minor axis (along \( y \)-axis)

of an ellipse in the standard form is \( \frac{4}{\sqrt{3}} \). If
this ellipse touches the line, \( x + 6y = 8 \); then
its eccentricity is :

Options
1. \( \frac{\sqrt{5}}{\sqrt{6}} \)
2. \( \frac{1}{2} \sqrt{\frac{11}{3}} \)
3. \( \frac{1}{3} \sqrt{\frac{11}{3}} \)
4. \( \frac{1}{2} \sqrt{\frac{5}{3}} \)
Q.5  Let $a, b \in \mathbb{R}, a \neq 0$ be such that the equation, 
$a x^2 - 2bx + 5 = 0$ has a repeated root $\alpha$, 
which is also a root of the equation, 
$x^2 - 2bx - 10 = 0$. If $\beta$ is the other root of 
this equation, then $\alpha^2 + \beta^2$ is equal to:

Options  
1. 26  
2. 25  
3. 28  
4. 24

---

Q.6  
Given: 
$$f(x) = \begin{cases} 
  x & 0 \leq x < \frac{1}{2} \\
  \frac{1}{2} & x = \frac{1}{2} \\
  1 - x & \frac{1}{2} < x \leq 1 
\end{cases}$$

and $g(x) = \left(x - \frac{1}{2}\right)^2$, $x \in \mathbb{R}$. Then the area 
(in sq. units) of the region bounded by the 
curves, $y = f(x)$ and $y = g(x)$ between the 
lines, $2x = 1$ and $2x = \sqrt{3}$, is:

Options  
1. $\frac{1}{3} + \frac{\sqrt{3}}{4}$  
2. $\frac{\sqrt{3}}{4} - \frac{1}{3}$  
3. $\frac{1}{2} + \frac{\sqrt{3}}{4}$  
4. $\frac{1}{2} - \frac{\sqrt{3}}{4}$
Q.7 A random variable \( X \) has the following probability distribution:

\[
\begin{align*}
X & : 1 & 2 & 3 & 4 & 5 \\
P(X) & : K^2 & 2K & K & 2K & 5K^2
\end{align*}
\]

Then \( P(X > 2) \) is equal to:

Options

1. \( \frac{7}{12} \)
2. \( \frac{23}{36} \)
3. \( \frac{1}{36} \)
4. \( \frac{1}{6} \)

Q.8 If \( x = \sum_{n=0}^{\infty} (-1)^n \tan^{2n} \theta \) and \( y = \sum_{n=0}^{\infty} \cos^{2n} \theta \),

for \( 0 < \theta < \frac{\pi}{4} \), then:

Options

1. \( y(1 + x) = 1 \)
2. \( x(1 + y) = 1 \)
3. \( y(1 - x) = 1 \)
4. \( x(1 - y) = 1 \)
Q.9 Let a function \( f: [0, 5] \rightarrow \mathbb{R} \) be continuous, \( f(1) = 3 \) and \( F \) be defined as:

\[
F(x) = \int_1^x t^2 g(t) \, dt , \quad \text{where} \quad g(t) = \int_1^t f(u) \, du .
\]

Then for the function \( F \), the point \( x = 1 \) is:

Options 1. a point of local minima.
2. not a critical point.
3. a point of inflection.
4. a point of local maxima.

Q.10 If one end of a focal chord \( AB \) of the parabola \( y^2 = 8x \) is at \( A\left(\frac{1}{2}, -2\right) \), then the equation of the tangent to it at \( B \) is:

Options 1. \( 2x + y - 24 = 0 \)
2. \( x - 2y + 8 = 0 \)
3. \( 2x - y - 24 = 0 \)
4. \( x + 2y + 8 = 0 \)
Q.11 If 10 different balls are to be placed in 4 distinct boxes at random, then the probability that two of these boxes contain exactly 2 and 3 balls is:

Options 1. \(\frac{945}{2^{11}}\)
2. \(\frac{965}{2^{11}}\)
3. \(\frac{945}{2^{10}}\)
4. \(\frac{965}{2^{10}}\)

Q.12 If \(A = \{x \in \mathbb{R} : |x| < 2\}\) and \(B = \{x \in \mathbb{R} : |x - 2| \geq 3\}\); then:

Options 1. \(A \cup B = \mathbb{R} - (2, 5)\)
2. \(A \cap B = (-2, -1)\)
3. \(B - A = \mathbb{R} - (-2, 5)\)
4. \(A - B = [-1, 2]\)
Q.13

If \( \frac{dy}{dx} = \frac{xy}{x^2 + y^2} \); \( y(1) = 1 \); then a value of

\( x \) satisfying \( y(x) = e \) is:

Options
1. \( \sqrt{2} \) e
2. \( \frac{e}{\sqrt{2}} \)
3. \( \frac{1}{2} \sqrt{3} \) e
4. \( \sqrt{3} \) e

---

Q.14

If \( \int \frac{d\theta}{\cos^2 (\tan \theta + \sec \theta)} = \lambda \tan \theta + 2 \log_e |f(\theta)| + C \) where \( C \) is a constant of integration, then the ordered pair \( (\lambda, f(\theta)) \) is equal to:

Options
1. \( (-1, 1 + \tan \theta) \)
2. \( (-1, 1 - \tan \theta) \)
3. \( (1, 1 - \tan \theta) \)
4. \( (1, 1 + \tan \theta) \)
Q.15 If \( z \) be a complex number satisfying 
\[ |\text{Re}(z)| + |\text{Im}(z)| = 4, \] then \( |z| \) cannot be:

Options
1. \( \frac{17}{2} \)
2. \( \sqrt{10} \)
3. \( \sqrt{8} \)
4. \( \sqrt{7} \)

Question Type: MCQ
Question ID: 4050362196
Option 1 ID: 4050367842
Option 2 ID: 4050367841
Option 3 ID: 4050367840
Option 4 ID: 4050367839
Status: Answered
Chosen Option: 4

Q.16 If \( p \rightarrow (p \land \neg q) \) is false, then the truth values of \( p \) and \( q \) are respectively:

Options
1. F, T
2. T, T
3. F, F
4. T, F

Question Type: MCQ
Question ID: 4050362213
Option 1 ID: 4050367909
Option 2 ID: 4050367910
Option 3 ID: 4050367907
Option 4 ID: 4050367908
Status: Answered
Chosen Option: 2
Q.17 Let \( a - 2b + c = 1. \)

\[
\begin{vmatrix}
 x + a \\
 x + b \\
 x + c
\end{vmatrix}
\begin{vmatrix}
 x + 2 \\
 x + 3 \\
 x + 4
\end{vmatrix}
\begin{vmatrix}
 x + 1 \\
 x + 2 \\
 x + 3
\end{vmatrix}
\]

If \( f(x) = \begin{vmatrix}
 x + a \\
 x + b \\
 x + c
\end{vmatrix}
\begin{vmatrix}
 x + 2 \\
 x + 3 \\
 x + 4
\end{vmatrix}
\begin{vmatrix}
 x + 1 \\
 x + 2 \\
 x + 3
\end{vmatrix}, \) then:

Options
1. \( f(-50) = 501 \)
2. \( f(-50) = -1 \)
3. \( f(50) = 1 \)
4. \( f(50) = -501 \)

Q.18 In the expansion of \( \left( \frac{x}{\cos^2 \theta} + \frac{1}{x \sin^2 \theta} \right)^{16} \), if \( l_1 \) is the least value of the term independent of \( x \) when \( \frac{\pi}{8} \leq \theta \leq \frac{\pi}{4} \) and \( l_2 \) is the least value of the term independent of \( x \) when \( \frac{\pi}{16} \leq \theta \leq \frac{\pi}{8} \), then the ratio \( l_2 : l_1 \) is equal to:

Options
1. \( 1 : 8 \)
2. \( 1 : 16 \)
3. \( 8 : 1 \)
4. \( 16 : 1 \)
Q.19
Let \( a_n \) be the \( n^{th} \) term of a G.P. of positive terms. If
\[
\sum_{n=1}^{100} a_{2n+1} = 200 \quad \text{and} \quad \sum_{n=1}^{100} a_{2n} = 100,
\]
then \( \sum_{n=1}^{200} a_n \) is equal to:

Options:
1. 225
2. 175
3. 300
4. 150

Q.20
Let \( f \) and \( g \) be differentiable functions on \( \mathbb{R} \) such that \( f \circ g \) is the identity function. If for some \( a, b \in \mathbb{R}, g'(a) = 5 \) and \( g(a) = b \), then
\( f'(b) \) is equal to:

Options:
1. \( \frac{2}{5} \)
2. 1
3. \( \frac{1}{5} \)
4. 5

Q.21
The number of terms common to the two A.P.'s 3, 7, 11, ..., 407 and 2, 9, 16, ..., 709 is

Given: 14
Answer:

Question Type: SA
Question ID: 4050362215
Status: Answered
Q.22
Let \( \vec{a}, \vec{b} \) and \( \vec{c} \) be three vectors such that 
\[
|\vec{a}| = \sqrt{3}, \quad |\vec{b}| = 5, \quad \vec{b} \cdot \vec{c} = 10 \quad \text{and the angle between} \quad \vec{b} \quad \text{and} \quad \vec{c} \quad \text{is} \quad \frac{\pi}{3}.
\]
If \( \vec{a} \) is perpendicular to the vector \( \vec{b} \times \vec{c} \), then 
\[
|\vec{a} \times (\vec{b} \times \vec{c})|\]
is equal to _________.

Given 30
Answer:

Q.23
If the distance between the plane, 
\[
23x - 10y - 2z + 48 = 0
\]
and the plane containing the lines 
\[
\frac{x + 1}{2} = \frac{y - 3}{4} = \frac{z + 1}{3}
\]
and 
\[
\frac{x + 3}{2} = \frac{y + 2}{6} = \frac{z - 1}{\lambda} \quad (\lambda \in \mathbb{R})
\]
is equal to \( \frac{k}{\sqrt{633}} \), then \( k \) is equal to _________.

Given 3
Answer:

Q.24
If \( C_r = \frac{25}{r} \) and 
\[
C_0 + 5 \cdot C_1 + 9 \cdot C_2 + \ldots + (101) \cdot C_{25} = 2^{25} \cdot k,
\]
than \( k \) is equal to _________.

Given 51
Answer:
If the curves, \( x^2 - 6x + y^2 + 8 = 0 \) and \( x^2 - 8y + y^2 + 16 - k = 0, \) \((k > 0)\) touch each other at a point, then the largest value of \( k \) is \( 36 \).