Q.1 Two cars A and B are moving away from each other in opposite directions. Both the cars are moving with a speed of 20 ms\(^{-1}\) with respect to the ground. If an observer in car A detects a frequency 2000 Hz of the sound coming from car B, what is the natural frequency of the sound source in car B?

(speed of sound in air = 340 ms\(^{-1}\))

Options

1. 2150 Hz
2. 2300 Hz
3. 2250 Hz \(\checkmark\)
4. 2060 Hz

Q.2 A particle of mass ‘m’ is moving with speed ‘2v’ and collides with a mass ‘2m’ moving with speed ‘v’ in the same direction. After collision, the first mass is stopped completely while the second one splits into two particles each of mass ‘m’, which move at angle 45° with respect to the original direction.

The speed of each of the moving particle will be:

Options

1. \(\sqrt{2} v\)
2. $v/\sqrt{2}$  
3. $2\sqrt{2}v$  
4. $v/(2\sqrt{2})$  

Q.3 A convex lens of focal length 20 cm produces images of the same magnification 2 when an object is kept at two distances $x_1$ and $x_2$ ($x_1 > x_2$) from the lens. The ratio of $x_1$ and $x_2$ is:

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

Q.4 The parallel combination of two air filled parallel plate capacitors of capacitance $C$ and $nC$ is connected to a battery of voltage, $V$. When the capacitors are fully charged, the battery is removed and after that a dielectric material of dielectric constant $K$ is placed between the two plates of the first capacitor. The new potential difference of the combined system is:

Options  
1. $\frac{(n+1)V}{(K+n)}$  
2. $\frac{nV}{K+n}$
3. \( \frac{V}{K + n} \)

4. \( V \)

Q.5 Two materials having coefficients of thermal conductivity ‘3K’ and ‘K’ and thickness ‘d’ and ‘3d’, respectively, are joined to form a slab as shown in the figure. The temperatures of the outer surfaces are \( \theta_2 \) and \( \theta_1 \) respectively, \( (\theta_2 > \theta_1) \). The temperature at the interface is:

\[
\frac{d}{3K} \quad \frac{3d}{K} \quad \theta_1
\]

Options:
1. \( \frac{\theta_2 + \theta_1}{2} \)
2. \( \frac{\theta_1}{6} + \frac{5\theta_2}{6} \)
3. \( \frac{\theta_1}{3} + \frac{2\theta_2}{3} \)
4. \( \frac{\theta_1}{10} + \frac{9\theta_2}{10} \)

Q.6

https://cdn3.digialm.com///per/g21/pub/2083/touchstone/AssessmentQPHTMLMode1//2083O1951/2083O1951S6D34318/15548981592836205/GJ01...
A metal wire of resistance 3 Ω is elongated to make a uniform wire of double its previous length. This new wire is now bent and the ends joined to make a circle. If two points on this circle make an angle 60° at the centre, the equivalent resistance between these two points will be:

Options
1. \( \frac{5}{3} \Omega \sqrt{\text{ }} \)
2. \( \frac{12}{5} \Omega \)
3. \( \frac{7}{2} \Omega \)
4. \( \frac{5}{2} \Omega \)

Q.7 Four point charges \(-q\), +q, +q and \(-q\) are placed on y-axis at \(y = -2d\), \(y = -d\), \(y = +d\) and \(y = +2d\), respectively. The magnitude of the electric field \(E\) at a point on the x-axis at \(x = D\), with \(D >> d\), will behave as:

Options
1. \(E \propto \frac{1}{D^4}\) \(\sqrt{\text{ }} \)
2. \(E \propto \frac{1}{D}\)
3. \(E \propto \frac{1}{D^3}\)
4. \(E \propto \frac{1}{D^2}\)
Q. 8
A particle ‘P’ is formed due to a completely inelastic collision of particles ‘x’ and ‘y’ having de-Broglie wavelengths \( \lambda_x \) and \( \lambda_y \) respectively. If x and y were moving in opposite directions, then the de-Broglie wavelength of ‘P’ is:

Options
1. \( \lambda_x - \lambda_y \)
2. \( \frac{\lambda_x \lambda_y}{\lambda_x + \lambda_y} \)
3. \( \frac{\lambda_x}{|\lambda_x - \lambda_y|} \) ✓
4. \( \lambda_x + \lambda_y \)

Q. 9
A He\(^+\) ion is in its first excited state. Its ionization energy is:

Options
1. 13.60 eV ✓
2. 48.36 eV
3. 54.40 eV
4. 6.04 eV

Q. 10
A moving coil galvanometer has a coil with 175 turns and area 1 cm². It uses a torsion band of torsion constant $10^{-6}$ N-m/rad. The coil is placed in a magnetic field $B$ parallel to its plane. The coil deflects by $1^\circ$ for a current of 1 mA. The value of $B$ (in Tesla) is approximately:

Options 1. $10^{-2}$
2. $10^{-4}$
3. $10^{-3}$ √
4. $10^{-1}$

Q.11 The resistance of a galvanometer is 50 ohm and the maximum current which can be passed through it is 0.002 A. What resistance must be connected to it in order to convert it into an ammeter of range 0 – 0.5 A?

Options 1. 0.2 ohm √
2. 0.5 ohm
3. 0.002 ohm
4. 0.02 ohm
The logic gate equivalent to the given logic circuit is:

A → Y
B → Y

Options:
1. NAND
2. AND
3. NOR
4. OR

Q.13 The position of a particle as a function of time t, is given by
\[ x(t) = at + bt^2 - ct^3 \]
where a, b and c are constants. When the particle attains zero acceleration, then its velocity will be:

Options:
1. \( a + \frac{b^2}{3c} \)
2. \( a + \frac{b^2}{2c} \)
3. \( a + \frac{b^2}{c} \)
4. \( a + \frac{b^2}{4c} \)

Q.14

Question Type: MCQ
Question ID: 41652912877
Option 1 ID: 41652950287
Option 2 ID: 41652950288
Option 3 ID: 41652950289
Option 4 ID: 41652950286
Status: Answered
Chosen Option: 1
A thin smooth rod of length $L$ and mass $M$ is rotating freely with angular speed $\omega_0$ about an axis perpendicular to the rod and passing through its center. Two beads of mass $m$ and negligible size are at the center of the rod initially. The beads are free to slide along the rod. The angular speed of the system, when the beads reach the opposite ends of the rod, will be:

- $\frac{M \omega_0}{M + 3m}$
- $\frac{M \omega_0}{M + 2m}$
- $\frac{M \omega_0}{M + 6m}$ $\checkmark$
- $\frac{M \omega_0}{M + m}$

Q.15 The physical sizes of the transmitter and receiver antenna in a communication system are:

- proportional to carrier frequency
- independent of both carrier and modulation frequency
- inversely proportional to modulation frequency
- inversely proportional to carrier frequency $\checkmark$
Q.16

The specific heats, $C_p$ and $C_V$ of a gas of diatomic molecules, A, are given (in units of J mol$^{-1}$ K$^{-1}$) by 29 and 22, respectively. Another gas of diatomic molecules, B, has the corresponding values 30 and 21. If they are treated as ideal gases, then:

Options

1. A has one vibrational mode and B has two.
2. A has a vibrational mode but B has none.
3. Both A and B have a vibrational mode each.
4. A is rigid but B has a vibrational mode.

Chosen Option: --

Q.17

A wooden block floating in a bucket of water has $\frac{4}{5}$ of its volume submerged. When a certain amount of an oil is poured into the bucket, it is found that the block is just under the oil surface with half of its volume under water and half in oil. The density of oil relative to that of water is:

Options

1. 0.8
2. 0.7
3. 0.5
4. 0.6 $\checkmark$
Q.18  
The area of a square is 5.29 cm². The area of 7 such squares taking into account the significant figures is:

Options
1. 37.03 cm² ✓
2. 37.030 cm²
3. 37.0 cm²
4. 37 cm²

Q.19  
50 W/m² energy density of sunlight is normally incident on the surface of a solar panel. Some part of incident energy (25%) is reflected from the surface and the rest is absorbed. The force exerted on 1 m² surface area will be close to (c = 3 × 10⁸ m/s):

Options
1. 15 × 10⁻⁸ N
2. 20 × 10⁻⁸ N ✓
3. 10 × 10⁻⁸ N
4. 35 × 10⁻⁸ N

Q.20  
In a conductor, if the number of conduction electrons per unit volume is 8.5 × 10²⁸ m⁻³ and mean free time is 25 fs (femtosecond), it’s approximate resistivity is:

(mₑ = 9.1 × 10⁻³¹ kg)

Options
1. 10⁻⁷ Ωm

2. $10^{-6}$ Ωm
3. $10^{-5}$ Ωm
4. $10^{-8}$ Ωm √

Q.21 A string 2.0 m long and fixed at its ends is driven by a 240 Hz vibrator. The string vibrates in its third harmonic mode. The speed of the wave and its fundamental frequency is:

Options
1. 320 m/s, 120 Hz
2. 320 m/s, 80 Hz ✓
3. 180 m/s, 80 Hz
4. 180 m/s, 120 Hz

Q.22 A wedge of mass $M = 4m$ lies on a frictionless plane. A particle of mass $m$ approaches the wedge with speed $v$. There is no friction between the particle and the plane or between the particle and the wedge. The maximum height climbed by the particle on the wedge is given by:

Options
1. $\frac{v^2}{g}$
2. $\frac{v^2}{2g}$
3. \( \frac{2 \cdot v^2}{5g} \)  ✓

4. \( \frac{2 \cdot v^2}{7g} \)

Q.23  Moment of inertia of a body about a given axis is 1.5 kg m². Initially the body is at rest. In order to produce a rotational kinetic energy of 1200 J, the angular acceleration of 20 rad/s² must be applied about the axis for a duration of :

Options 1. 3 s
2. 2 s ✓
3. 2.5 s
4. 5 s

Q.24  Two coils ‘P’ and ‘Q’ are separated by some distance. When a current of 3 A flows through coil ‘P’, a magnetic flux of \( 10^{-3} \) Wb passes through ‘Q’. No current is passed through ‘Q’. When no current passes through ‘P’ and a current of 2 A passes through ‘Q’, the flux through ‘P’ is :

Options 1. \( 3.67 \times 10^{-3} \) Wb
2. \( 6.67 \times 10^{-4} \) Wb ✓
3. \( 3.67 \times 10^{-4} \) Wb
4. \( 6.67 \times 10^{-3} \) Wb
Question Type: MCQ

Q.25 A test particle is moving in a circular orbit in the gravitational field produced by a mass density $\rho(r) = \frac{K}{r^2}$. Identify the correct relation between the radius R of the particle’s orbit and its period T:

- 1. TR is a constant
- 2. $T^2/R^3$ is a constant
- 3. $T/R$ is a constant
- 4. $T/R^2$ is a constant

Option 1 ID: 41652950365, Option 2 ID: 41652950362, Option 3 ID: 41652950364, Option 4 ID: 41652950363
Status: Answered
Chosen Option: 2

Q.26 A thin convex lens L (refractive index = 1.5) is placed on a plane mirror M. When a pin is placed at A, such that OA = 18 cm, its real inverted image is formed at A' itself, as shown in figure. When a liquid of refractive index $\mu_l$ is put between the lens and the mirror, the pin has to be moved to A', such that OA' = 27 cm, to get its inverted real image at A' itself. The value of $\mu_l$ will be:

\[ \frac{4}{3} \sqrt{ } \]

Options
- 1. $\frac{4}{3}$
- 2. $\frac{2}{3}$
- 3. $\frac{1}{3}$
- 4. $\frac{4}{9}$

Option 1 ID: 41652950312, Option 2 ID: 41652950310, Option 3 ID: 41652950313, Option 4 ID: 41652950311
Status: Answered
Chosen Option: 3
2. \( \sqrt{3} \)
3. \( \frac{3}{2} \)
4. \( \sqrt{2} \)

Q.27 Diameter of the objective lens of a telescope is 250 cm. For light of wavelength 600 nm. coming from a distant object, the limit of resolution of the telescope is close to:

Options 1. \( 1.5 \times 10^{-7} \) rad
2. \( 3.0 \times 10^{-7} \) rad✓
3. \( 2.0 \times 10^{-7} \) rad
4. \( 4.5 \times 10^{-7} \) rad

Q.28 The position vector of a particle changes with time according to the relation \( \mathbf{r}(t) = 15t^2 \mathbf{i} + (4-20t^2) \mathbf{j} \). What is the magnitude of the acceleration at \( t = 1 \)?

Options 1. 40
2. 25
3. 100
4. 50 ✓
Q.29
A massless spring (k = 800 N/m), attached with a mass (500 g) is completely immersed in 1 kg of water. The spring is stretched by 2 cm and released so that it starts vibrating. What would be the order of magnitude of the change in the temperature of water when the vibrations stop completely? (Assume that the water container and spring receive negligible heat and specific heat of mass = 400 J/kg K, specific heat of water = 4184 J/kg K)

Options
1. $10^{-5}$ K  ✓
2. $10^{-1}$ K
3. $10^{-3}$ K
4. $10^{-4}$ K

Q.30
A very long solenoid of radius R is carrying current $I(t) = kte^{-at}$ (k>0), as a function of time ($t \geq 0$). Counter clockwise current is taken to be positive. A circular conducting coil of radius 2R is placed in the equatorial plane of the solenoid and concentric with the solenoid. The current induced in the outer coil is correctly depicted, as a function of time, by:

Options
1. $t = 0$
2. Increasing order of reactivity of the following compounds for $S_N1$ substitution is:

CH$_3$CH$_2$Cl   \[ \text{CH}_3 \]

(A)   \[ \text{H}_3\text{C} \]

(B)   \[ \text{Cl} \]

(C)   \[ \text{Cl} \]

(D)   \[ \text{H}_3\text{CO} \]

Options:
1. \((\text{B}) < (\text{C}) < (\text{D}) < (\text{A})\)
2. \((\text{B}) < (\text{A}) < (\text{D}) < (\text{C})\) \(\checkmark\)
3. \((\text{A}) < (\text{B}) < (\text{D}) < (\text{C})\)
4. \((\text{B}) < (\text{C}) < (\text{A}) < (\text{D})\)
Q.2 The correct statements among I to III regarding group 13 element oxides are,
(I) Boron trioxide is acidic.
(II) Oxides of aluminium and gallium are amphoteric.
(III) Oxides of indium and thallium are basic.

Options
1. (I) and (III) only
2. (I) and (II) only
3. (I), (II) and (III) ✓
4. (II) and (III) only

Q.3 The amorphous form of silica is:

Options
1. quartz
2. kieselguhr ✓
3. tridymite
4. cristobalite

Q.4 HF has highest boiling point among hydrogen halides, because it has:

Options
1. lowest dissociation enthalpy
2. strongest van der Waals' interactions
3. strongest hydrogen bonding ✓
4. lowest ionic character
Q.5 The maximum possible denticities of a ligand given below towards a common transition and inner-transition metal ion, respectively, are:

\[ \text{OOC} \quad \text{N} \quad \text{N} \quad \text{COO} \]
\[ \text{OOC} \]

Options
1. 8 and 6
2. 6 and 6
3. 8 and 8
4. 6 and 8

Q.6 Molal depression constant for a solvent is 4.0 K kg mol\(^{-1}\). The depression in the freezing point of the solvent for 0.03 mol kg\(^{-1}\) solution of K\(_2\)SO\(_4\) is:

(Assume complete dissociation of the electrolyte)

Options
1. 0.36 K
2. 0.24 K
3. 0.18 K
4. 0.12 K
Q.7 During compression of a spring the work done is 10 kJ and 2 kJ escaped to the surroundings as heat. The change in internal energy, \( \Delta U \) (in kJ) is:

- 8
- 8 \( \checkmark \)
- 12
- -12

Q.8 The maximum number of possible oxidation states of actinoids are shown by:

Options 1. nobelium (No) and lawrencium (Lr)
2. berkelium (Bk) and californium (Cf)
3. actinium (Ac) and thorium (Th)
4. neptunium (Np) and plutonium (Pu) \( \checkmark \)

Q.9 Which of the following potential energy (PE) diagrams represents the \( S_N^1 \) reaction?

Options

\[ \text{PE} \]

Progress of reaction \( \checkmark \)
Q.10  The layer of atmosphere between 10 km to 50 km above the sea level is called as:

Options
1. stratosphere ✓
2. troposphere
3. mesosphere
4. thermosphere

Q.11  The major products A and B for the following reactions are, respectively:

\[
\begin{align*}
\text{HO} & \quad \text{CN} \\
\text{I} & \quad \text{KCN} \\
\text{DMCSO} & \quad [A] \\
\text{H}_2/\text{Pd} & \quad [B]
\end{align*}
\]

Options
1. \(\text{HO} \quad \text{CN} \)
2. \(\text{HO} \quad \text{CN} \)
3. \(\text{CH}_2 \quad \text{NH}_2 \quad \text{H} \)
4. \(\text{HO} \quad \text{CN} \)

Question Type: MCQ
Question ID: 41652912913
Option 1 ID: 41652950432
Option 2 ID: 41652950433
Option 3 ID: 41652950430
Option 4 ID: 41652950431
Status: Answered
Chosen Option: 1

Question Type: MCQ
Question ID: 41652912925
Option 1 ID: 41652950478
Option 2 ID: 41652950479
Option 3 ID: 41652950480
Option 4 ID: 41652950481
Status: Answered
Chosen Option: 1
Q.12 The structures of beryllium chloride in the solid state and vapour phase, respectively, are:

Options
1. chain and chain
2. dimeric and chain
3. chain and dimeric ✓
4. dimeric and dimeric

Q.13 Noradrenaline is a / an:

Options
1. Antihistamine
2. Neurotransmitter ✓
3. Antacid
4. Antidepressant
Q.14 The major product of the following reaction is:

\[
\text{CH}_2\text{OH} \quad \text{CO}_2\text{Et} \quad \xrightarrow{\text{H}_2\text{SO}_4\text{(cat.)} \quad \text{CHCl}_3} \quad \text{OH}
\]

Options

1. ![Option 1 Image]
2. ![Option 2 Image]
3. ![Option 3 Image]
4. ![Option 4 Image]

Chosen Option: 4

Q.15 A solution of \( \text{Ni(NO}_3\text{)}_2 \) is electrolysed between platinum electrodes using 0.1 Faraday electricity. How many mole of Ni will be deposited at the cathode?

Options

1. 0.10
2. 0.15

Chosen Option: 1
3. 0.05 ✓
4. 0.20

Q.16
At a given temperature T, gases Ne, Ar, Xe and Kr are found to deviate from ideal gas behaviour. Their equation of state is given as

\[
p = \frac{RT}{V-b}\]
at T.

Here, b is the van der Waals constant. Which gas will exhibit steepest increase in the plot of Z (compression factor) vs p?

Options
1. Ne
2. Kr
3. Ar
4. Xe ✓

Q.17
\[\text{carbonyl compound} + \text{MeOH} \xrightarrow{\text{HCl}} \text{acetal}\]
Rate of the reaction is the highest for:

1. Acetone as substrate and methanol in stoichiometric amount
2. Acetone as substrate and methanol in excess
3. Propanal as substrate and methanol in stoichiometric amount
4. Propanal as substrate and methanol in excess ✓
Q.18 Among the following species, the diamagnetic molecule is:

Options 1. CO ✓
2. \( \text{B}_2 \)
3. \( \text{O}_2 \)
4. \( \text{NO} \)

Q.19 10 mL of 1 mM surfactant solution forms a monolayer covering 0.24 cm\(^2\) on a polar substrate. If the polar head is approximated as a cube, what is its edge length?

Options 1. 1.0 pm
2. 0.1 nm
3. 2.0 pm ✓
4. 2.0 nm

Q.20 p-Hydroxybenzophenone upon reaction with bromine in carbon tetrachloride gives:

Options
Q.21  Hinsberg’s reagent is:

Options

1. \( \text{C}_6\text{H}_5\text{SO}_2\text{Cl} \)  
2. \( \text{SOCl}_2 \)
3. \( \text{(COCI)}_2 \)
4. \( \text{C}_6\text{H}_5\text{COCl} \)

Q.22
In an acid-base titration, 0.1 M HCl solution was added to the NaOH solution of unknown strength. Which of the following correctly shows the change of pH of the titration mixture in this experiment?

Options
1. (A) ✓
2. (B)
3. (D)
4. (C)

Q.23 The peptide that gives positive ceric ammonium nitrate and carbylamine tests is:
1. Gln - Asp
2. Asp - Gln
3. Lys - Asp
4. Ser - Lys ✓

Q.24
Which of the following compounds is a constituent of the polymer

\[ \left( \text{HN} - \text{C} - \text{NH} - \text{CH}_2 \right)_n \]?

Options

1. Methylamine
2. Ammonia
3. Formaldehyde ✓
4. N-Methyl urea

Q.25 Which one of the following about an electron occupying the 1s orbital in a hydrogen atom is incorrect? (The Bohr radius is represented by \( a_0 \)).

Options

1. The total energy of the electron is maximum when it is at a distance \( 2a_0 \) from the nucleus.
2. The electron can be found at a distance \( 2a_0 \) from the nucleus.
3. The probability density of finding the electron is maximum at the nucleus.
4. The magnitude of the potential energy is double that of its kinetic energy on an average.

Q.26 The one that is not a carbonate ore is:

Options

1. malachite
2. bauxite ✓
3. calamine
4. siderite

Q.27  Consider the given plot of enthalpy of the following reaction between A and B.
\[ A + B \rightarrow C + D. \]

Identify the incorrect statement.

Options
1. Formation of A and B from C has highest enthalpy of activation.
2. D is kinetically stable product.
3. C is the thermodynamically stable product.
4. Activation enthalpy to form C is 5 kJ mol\(^{-1}\) less than that to form D. ✓

Q.28
The correct statements among I to III are:

(I) Valence bond theory cannot explain the color exhibited by transition metal complexes.

(II) Valence bond theory can predict quantitatively the magnetic properties of transition metal complexes.

(III) Valence bond theory cannot distinguish ligands as weak and strong field ones.

Options
1. (I) and (II) only
2. (II) and (III) only
3. (I) and (III) only
4. (I), (II) and (III)

Q.29 What would be the molality of 20% (mass/mass) aqueous solution of KI?
(molar mass of KI = 166 g mol⁻¹)

Options
1. 1.35
2. 1.51
3. 1.08
4. 1.48
### Q.1
The total number of matrices

\[
A = \begin{pmatrix}
0 & 2y & 1 \\
2x & y & -1 \\
2x & -y & 1
\end{pmatrix}, \quad (x, y \in \mathbb{R}, \ x \neq y)
\]

for which \(A^T A = 3I_3\) is:

Options 1. 6  
2. 3  
3. 4  
4. 2

### Q.2
Section: Mathematics

Assertion:
For the extraction of iron, haematite ore is used.

Reason:
Haematite is a carbonate ore of iron.

Options:
1. Only the assertion is correct. ☑
2. Only the reason is correct.
3. Both the assertion and reason are correct and the reason is the correct explanation for the assertion.
4. Both the assertion and reason are correct, but the reason is not the correct explanation for the assertion.

Question Type: MCQ  
Question ID: 41652912916  
Option 1 ID: 41652950442  
Option 2 ID: 41652950443  
Option 3 ID: 41652950444  
Option 4 ID: 41652950445  
Status: Answered  
Chosen Option: 1

Question Type: MCQ  
Question ID: 41652912939  
Option 1 ID: 41652950536  
Option 2 ID: 41652950537  
Option 3 ID: 41652950535  
Option 4 ID: 41652950534  
Status: Answered  
Chosen Option: 3
If \( p \Rightarrow (q \lor r) \) is false, then the truth values of \( p, q, r \) are respectively:

1. \( T, F, F \) \( \checkmark \)
2. \( F, T, T \)
3. \( F, F, F \)
4. \( T, T, F \)

Q.3
The vertices B and C of a \( \Delta ABC \) lie on the line, \( \frac{x+2}{3} = \frac{y-1}{0} = \frac{z}{4} \) such that \( BC = 5 \) units. Then the area (in sq. units) of this triangle, given that the point \( A(1, -1, 2) \), is:

Options 1. \( 6 \)
2. \( 2\sqrt{34} \)
3. \( \sqrt{34} \) \( \checkmark \)
4. \( 5\sqrt{17} \)

Q.4
A rectangle is inscribed in a circle with a diameter lying along the line \( 3y = x + 7 \). If the two adjacent vertices of the rectangle are \((-8, 5)\) and \((6, 5)\), then the area of the rectangle (in sq. units) is:

Options 1. 72
2. 98
3. 56
4. 84 \( \checkmark \)
Q.5  The sum of the series 
\[1 + 2 \times 3 + 3 \times 5 + 4 \times 7 + \ldots \text{upto } 11^{\text{th}}\text{ term}\]
is:

Options 1. 945  
2. 916  
3. 946  \checkmark  
4. 915

Q.6  A water tank has the shape of an inverted right circular cone, whose semi-vertical angle is \(\tan^{-1}\left(\frac{1}{2}\right)\). Water is poured into it at a constant rate of 5 cubic meter per minute. Then the rate (in m/min.), at which the level of water in the tank is 10 m, is:

Options 1. 1/10\(\pi\)  
2. 1/15\(\pi\)  
3. 1/5\(\pi\)  \checkmark  
4. 2/\(\pi\)
Q.7

If \( \cos x \frac{dy}{dx} - y \sin x = 6x \), \((0 < x < \frac{\pi}{2})\) and

\( y\left(\frac{\pi}{3}\right) = 0 \), then \( y\left(\frac{\pi}{6}\right) \) is equal to:

Options
1. \(-\frac{\pi^2}{4\sqrt{3}}\)
2. \(-\frac{\pi^2}{2\sqrt{3}}\)
3. \(-\frac{\pi^2}{2}\)
4. \(-\frac{\pi^2}{2\sqrt{3}} \checkmark\)

Q.8

Two newspapers A and B are published in a city. It is known that 25% of the city population reads A and 20% reads B while 8% reads both A and B. Further, 30% of those who read A but not B look into advertisements and 40% of those who read B but not A also look into advertisements, while 50% of those who read both A and B look into advertisements. Then the percentage of the population who look into advertisements is:

Options
1. 13.5
2. 12.8
3. 13.9 \checkmark
4. 13
### Q.9

If
\[\int e^{\sec x} (\sec x \tan x \ f(x) + (\sec x \ tan x + \sec^2 x)) \, dx\]
\[= e^{\sec x} \ f(x) + C,\]
then a possible choice of \(f(x)\) is:

1. \(\sec x - \tan x - \frac{1}{2}\)
2. \(\sec x + \tan x + \frac{1}{2}\) \(\checkmark\)
3. \(x \sec x + \tan x + \frac{1}{2}\)
4. \(\sec x + x \tan x - \frac{1}{2}\)

### Q.10

The common tangent to the circles \(x^2 + y^2 = 4\) and \(x^2 + y^2 + 6x + 8y - 24 = 0\) also passes through the point:

<table>
<thead>
<tr>
<th>Options</th>
<th>1. ((4, -2))</th>
<th>2. ((-4, 6))</th>
<th>3. ((6, -2)) (\checkmark)</th>
<th>4. ((-6, 4))</th>
</tr>
</thead>
</table>

### Q.11

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
<th>1. ((-2, 4))</th>
<th>2. ((-4, 6))</th>
<th>3. ((-6, 4))</th>
<th>4. ((-8, 1))</th>
</tr>
</thead>
</table>

**Question Type:** MCQ  
**Question ID:** 41652912954  
**Option 1 ID:** 41652950600  
**Option 2 ID:** 41652950601  
**Option 3 ID:** 41652950599  
**Option 4 ID:** 41652950598  
**Status:** Answered  
**Chosen Option:** 3
If the system of equations $2x + 3y - z = 0$, $x + ky - 2z = 0$ and $2x - y + z = 0$ has a non-trivial solution $(x, y, z)$, then
\[
\frac{x}{y} + \frac{y}{z} + \frac{z}{x} + k
\] is equal to:

Options

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

Q.12 Some identical balls are arranged in rows to form an equilateral triangle. The first row consists of one ball, the second row consists of two balls and so on. If 99 more identical balls are added to the total number of balls used in forming the equilateral triangle, then all these balls can be arranged in a square whose each side contains exactly 2 balls less than the number of balls each side of the triangle contains. Then the number of balls used to form the equilateral triangle is:

Options

1. 262
2. 190
3. 225
4. 157
Q.13  The value of the integral
\[
\int_{0}^{1} x \cot^{-1}(1-x^{2}+x^{4}) \, dx
\]
is:

Options

1. \( \frac{\pi}{4} - \frac{1}{2} \ln 2 \sqrt{\frac{\pi}{2}} \)
2. \( \frac{\pi}{4} - \ln 2 \sqrt{\frac{\pi}{2}} \)
3. \( \frac{\pi}{2} - \frac{1}{2} \ln 2 \sqrt{\frac{\pi}{2}} \)
4. \( \frac{\pi}{2} - \frac{1}{2} \ln 2 \sqrt{\frac{\pi}{2}} \)

Q.14  The area (in sq. units) of the smaller of the two circles that touch the parabola, \( y^{2} = 4x \) at the point \( (1, 2) \) and the x-axis is:

Options

1. \( 8\pi (3 - 2\sqrt{2}) \) \( \checkmark \)
2. \( 8\pi (2 - \sqrt{2}) \)
3. \( 4\pi (3 + \sqrt{2}) \)
4. \( 4\pi (2 - \sqrt{2}) \)

Q.15  If \( f(x) = [x] - \left[ \frac{x}{4} \right] \), \( x \in \mathbb{R} \), where \([x]\) denotes the greatest integer function, then:

Options

\( \lim_{x \to 4^+} f(x) \) exists but \( \lim_{x \to 4^-} f(x) \) does not exist.
2. $f$ is continuous at $x = 4$. √

3. \[ \lim_{{x \to 4^-}} f(x) \text{ exists but } \lim_{{x \to 4^+}} f(x) \text{ does not exist.} \]

4. Both \[ \lim_{{x \to 4^-}} f(x) \] and \[ \lim_{{x \to 4^+}} f(x) \] exist but are not equal.

Q.16 The area (in sq. units) of the region
\[ A = \{(x, y) : \frac{y^2}{2} \leq x \leq y + 4\} \text{ is:} \]

Options 1. 30
2. 18 √
3. \[ \frac{53}{3} \]
4. 16

Q.17 If $m$ is chosen in the quadratic equation
\[ (m^2 + 1)x^2 - 3x + (m^2 + 1)^2 = 0 \]
such that the sum of its roots is greatest, then the absolute difference of the cubes of its roots is:

Options 1. $4\sqrt{3}$
2. $10\sqrt{5}$
3. $8\sqrt{3}$
4. $8\sqrt{5}$ √
Q.18
Let \( z \in \mathbb{C} \) be such that \( |z| < 1 \). If \( \omega = \frac{5 + 3z}{5(1 - z)} \), then:

- 1. \( 5 \text{ Re}(\omega) > 1 \) \( \checkmark \)
- 2. \( 5 \text{ Im}(\omega) < 1 \)
- 3. \( 5 \text{ Re}(\omega) > 4 \)
- 4. \( 4 \text{ Im}(\omega) > 5 \)

Q.19
If the function \( f(x) = \begin{cases} a|x - \pi| + 1, & x \leq 5 \\ b|x - \pi| + 3, & x > 5 \end{cases} \) is continuous at \( x = 5 \), then the value of \( a - b \) is:

- 1. \( \frac{2}{\pi - 5} \) \( \checkmark \)
- 2. \( \frac{-2}{\pi + 5} \)
- 3. \( \frac{2}{\pi + 5} \)
- 4. \( \frac{2}{\pi - 5} \)

Q.20
If a unit vector $\vec{a}$ makes angles $\pi/3$ with $\hat{i}$, $\pi/4$ with $\hat{j}$ and $\theta \in (0, \pi)$ with $\hat{k}$, then $\theta$ is:

### Options

1. $\frac{5\pi}{6}$
2. $\frac{5\pi}{12}$
3. $\frac{\pi}{4}$
4. $\frac{2\pi}{3}$ \[ \checkmark \]

Q.21 The value of $\sin10^\circ \sin30^\circ \sin50^\circ \sin70^\circ$ is:

### Options

1. $\frac{1}{36}$
2. $\frac{1}{16}$ \[ \checkmark \]
3. $\frac{1}{18}$
4. $\frac{1}{32}$

Q.22 If the two lines $x + (a - 1)y = 1$ and $2x + ay = 1$ ($a \in \mathbb{R} - [0, 1]$) are perpendicular, then the distance of their point of intersection from the origin is:

### Options

1. $\frac{2}{\sqrt{5}}$
2. \( \frac{\sqrt{2}}{5} \)
3. \( \frac{2}{5} \)
4. \( \frac{2}{\sqrt{5}} \) \( \checkmark \)

Q.23 The domain of the definition of the function

\[ f(x) = \frac{1}{4 - x^2} + \log_{10}(x^3 - x) \text{ is:} \]

Options 1. \((-1, 0) \cup (1, 2) \cup (2, \infty)\) \(\checkmark\)
2. \((1, 2) \cup (2, \infty)\)
3. \((-2, -1) \cup (-1, 0) \cup (2, \infty)\)
4. \((-1, 0) \cup (1, 2) \cup (3, \infty)\)

Q.24 If the sum and product of the first three terms in an A.P. are 33 and 1155, respectively, then a value of its 11th term is:

Options 1. \(-25\) \(\checkmark\)
2. \(-35\)
3. \(25\)
4. \(-36\)
Q.25  The mean and the median of the following
ten numbers in increasing order
10, 22, 26, 29, 34, x, 42, 67, 70, y
are 42 and 35 respectively, then \( \frac{y}{x} \) is equal
to:

Options 1. 9/4
2. 7/3 \( \checkmark \)
3. 7/2
4. 8/3

Q.26  If \( f : \mathbb{R} \to \mathbb{R} \) is a differentiable function and
\[
f(2) = 6, \quad \lim_{x \to 2} \frac{1}{6} \int_6^{f(x)} \frac{2t \, dt}{(x-2)} \text{ is :}
\]

Options 1. 0
2. 2\( f'(2) \)
3. 24\( f'(2) \)
4. 12\( f'(2) \) \( \checkmark \)

Q.27  If the tangent to the parabola \( y^2 = x \) at a
point \((\alpha, \beta)\), \((\beta > 0)\) is also a tangent to the
ellipse, \( x^2 + 2y^2 = 1 \), then \( \alpha \) is equal to:

Options 1. \( \sqrt{2} - 1 \)
2. \( 2\sqrt{2} + 1 \)
3. $\sqrt{2} + 1 \quad \checkmark$

4. $2\sqrt{2} - 1$

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**Q.28** If some three consecutive coefficients in the binomial expansion of $(x + 1)^n$ in powers of $x$ are in the ratio $2:15:70$, then the average of these three coefficients is:

Options
1. 227
2. 964
3. 625
4. 232 \checkmark

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**Q.29** Let $P$ be the plane, which contains the line of intersection of the planes, $x + y + z - 6 = 0$ and $2x + 3y + z + 5 = 0$ and it is perpendicular to the $xy$-plane. Then the distance of the point $(0, 0, 256)$ from $P$ is equal to:

Options
1. $205 \sqrt{5}$
2. $17\sqrt{5}$ \checkmark
3. $11 \sqrt{5}$
4. $63 \sqrt{5}$
Q.30  Two poles standing on a horizontal ground are of heights 5 m and 10 m respectively. The line joining their tops makes an angle of 15° with the ground. Then the distance (in m) between the poles, is :

Options

1. \(10(\sqrt{3} - 1)\)

2. \(\frac{5}{2}(2 + \sqrt{3})\)

3. \(5(2 + \sqrt{3})\)  ✓

4. \(5(\sqrt{3} + 1)\)