Q.1 Imagine that a reactor converts all given mass into energy and that it operates at a power level of $10^9$ watt. The mass of the fuel consumed per hour in the reactor will be: (velocity of light, $c$ is $3 \times 10^8$ m/s)

**Options**
1. $4 \times 10^{-2}$ gm
2. $6.6 \times 10^{-5}$ gm
3. 0.8 gm
4. 0.96 gm

Q.2 A negative test charge is moving near a long straight wire carrying a current. The force acting on the test charge is parallel to the direction of the current. The motion of the charge is:

**Options**
1. parallel to the wire opposite to the current
2. parallel to the wire along the current
3. away from the wire
4. towards the wire
Q.3
Two particles A and B of equal mass M are moving with the same speed \( v \) as shown in the figure. They collide completely inelastically and move as a single particle C. The angle \( \theta \) that the path of C makes with the X-axis is given by:

\[
\tan \theta = \frac{\sqrt{3} + \sqrt{2}}{1 - \sqrt{2}}
\]

Options:
1. \( \tan \theta = \frac{\sqrt{3} + \sqrt{2}}{1 - \sqrt{2}} \)
2. \( \tan \theta = \frac{1 - \sqrt{3}}{1 + \sqrt{2}} \)
3. \( \tan \theta = \frac{\sqrt{3} - \sqrt{2}}{1 - \sqrt{2}} \)
4. \( \tan \theta = \frac{1 - \sqrt{2}}{\sqrt{2} (1 + \sqrt{3})} \)

Q.4
A combination of parallel plate capacitors is maintained at a certain potential difference.

When a 3 mm thick slab is introduced between all the plates, in order to maintain the same potential difference, the distance between the plates is increased by 2.4 mm. Find the dielectric constant of the slab.

Options:
1. 6
2. 5
3. 4
4. 3
Q.5  A signal is to be transmitted through a wave of wavelength $\lambda$, using a linear antenna. The length $l$ of the antenna and effective power radiated $P_{\text{eff}}$ will be given respectively as:

(K is a constant of proportionality)

Options

1. $\frac{\lambda}{5}, P_{\text{eff}} = K \left( \frac{1}{\lambda} \right)^2$

2. $\lambda, P_{\text{eff}} = K \left( \frac{1}{\lambda} \right)^2$

3. $\frac{\lambda}{16}, P_{\text{eff}} = K \left( \frac{1}{\lambda} \right)^3$

4. $\frac{\lambda}{8}, P_{\text{eff}} = K \left( \frac{1}{\lambda} \right)$

Q.6  Four closed surfaces and corresponding charge distributions are shown below.

Let the respective electric fluxes through the surfaces be $\Phi_1, \Phi_2, \Phi_3$ and $\Phi_4$. Then:

Options

1. $\Phi_1 = \Phi_2 = \Phi_3 = \Phi_4$

2. $\Phi_1 > \Phi_3, \Phi_2 < \Phi_4$

3. $\Phi_1 > \Phi_2 > \Phi_3 > \Phi_4$

4. $\Phi_1 < \Phi_2 = \Phi_3 > \Phi_4$
Q.7 In a meter bridge experiment resistances are connected as shown in the figure. Initially resistance P = 4 \( \Omega \) and the neutral point N is at 60 cm from A. Now an unknown resistance R is connected in series to P and the new position of the neutral point is at 80 cm from A. The value of unknown resistance R is:

Options:
1. \( \frac{20}{3} \) \( \Omega \)
2. \( \frac{33}{5} \) \( \Omega \)
3. 6 \( \Omega \)
4. 7 \( \Omega \)

Q.8 In an experiment to determine the period of a simple pendulum of length 1 m, it is attached to different spherical bobs of radii \( r_1 \) and \( r_2 \). The two spherical bobs have uniform mass distribution. If the relative difference in the periods, is found to be \( 5 \times 10^{-4} \) s, the difference in radii, \( r_1 - r_2 \) is best given by:

Options:
1. 0.1 cm
2. 0.01 cm
3. 0.5 cm
4. 1 cm

Q.9 A single slit of width 0.1 mm is illuminated by a parallel beam of light of wavelength 6000 Å and diffraction bands are observed on a screen 0.5 m from the slit. The distance of the third dark band from the central bright band is:
Q.10
N moles of a diatomic gas in a cylinder are at a temperature T. Heat is supplied to the cylinder such that the temperature remains constant but n moles of the diatomic gas get converted into monoatomic gas. What is the change in the total kinetic energy of the gas?

Options
1. \(0\)
2. \(\frac{5}{2} nRT\)
3. \(\frac{1}{2} nRT\)
4. \(\frac{3}{2} nRT\)

Status: Not Attempted
Chosen Option: --

Q.11
The figure shows three circuits I, II and III which are connected to a 3V battery. If the powers dissipated by the configurations I, II and III are \(P_1\), \(P_2\) and \(P_3\) respectively, then:

Options
1. \(P_3 > P_2 > P_1\)
2. \(P_2 > P_1 > P_3\)
3. \(P_1 > P_3 > P_2\)
4. \(P_1 > P_2 > P_3\)

Status: Answered
Chosen Option: 

Q.12
A Laser light of wavelength 660 nm is used to weld Retina detachment. If a Laser pulse of width 60 ms and power 0.5 kW is used the approximate number of photons in the pulse are:

[Take Planck's constant \(h = 6.62 \times 10^{-34}\) Js]
Q.13 A standing wave is formed by the superposition of two waves travelling in opposite directions. The transverse displacement is given by
\[ y(x, t) = 0.5 \sin\left(\frac{5\pi}{4}x\right)\cos(200\pi t). \]
What is the speed of the travelling wave moving in the positive x direction?
(x and t are in meter and second, respectively.)

Options
1. 180 m/s
2. 160 m/s
3. 120 m/s
4. 90 m/s

Q.14 The machine as shown has 2 rods of length 1 m connected by a pivot at the top. The end of one rod is connected to the floor by a stationary pivot and the end of the other rod has a roller that rolls along the floor in a slot. As the roller goes back and forth, a 2 kg weight moves up and down. If the roller is moving towards right at a constant speed, the weight moves up with a speed which is \(\frac{3}{4}\)th of that of the roller when the weight is 0.4 m above the ground.

Options
1. 1
2. constant speed
3. decreasing speed
4. increasing speed

Q.15
A conical pendulum of length 1 m makes an angle $\theta = 45^\circ$ w.r.t. Z-axis and moves in a circle in the XY plane. The radius of the circle is 0.4 m and its center is vertically below O. The speed of the pendulum, in its circular path, will be: (Take $g = 10 \text{ ms}^{-2}$)

![Diagram of a conical pendulum]

Options 1. 0.4 m/s
2. 2 m/s
3. 0.2 m/s
4. 4 m/s

Q.16
A circular hole of radius $\frac{R}{4}$ is made in a thin uniform disc having mass M and radius R, as shown in figure. The moment of inertia of the remaining portion of the disc about an axis passing through the point O and perpendicular to the plane of the disc is:

![Diagram of a disc with a circular hole]

Options 1. $\frac{219 MR^2}{256}$
Q.17 A block of mass 0.1 kg is connected to an elastic spring of spring constant 640 N m\(^{-1}\) and oscillates in a damping medium of damping constant 10\(^{-2}\) kg s\(^{-1}\). The system dissipates its energy gradually. The time taken for its mechanical energy of vibration to drop to half of its initial value, is closest to:

Options
1. 2 s
2. 3.5 s
3. 7 s
4. 5 s

Q.18 In an experiment, a convex lens of focal length 15 cm is placed coaxially on an optical bench in front of a convex mirror at a distance of 5 cm from it. It is found that an object and its image coincide, if the object is placed at a distance of 20 cm from the lens. The focal length of the convex mirror is:

Options
1. 27.5 cm
2. 20.0 cm
3. 25.0 cm
4. 30.5 cm

Q.19 A sinusoidal voltage of peak value 283 V and angular frequency 320/\(s\) is applied to a series LCR circuit. Given that \(R = 5 \ \Omega\), \(L = 25 \ mH\) and \(C = 1000 \ \mu F\). The total impedance, and phase difference between the voltage across the source and the current will respectively be:

Options
1. 10 \(\Omega\) and \(\tan^{-1}\left(\frac{5}{3}\right)\)
2. \(10 \, \Omega \) and \( \tan^{-1}\left(\frac{8}{3}\right) \)

3. \(7 \, \Omega \) and \( \tan^{-1}\left(\frac{5}{3}\right) \)

4. \(7 \, \Omega \) and 45°

Q.20
Two tubes of radii \(r_1\) and \(r_2\), and lengths \(l_1\) and \(l_2\), respectively, are connected in series and a liquid flows through each of them in streamline conditions. \(P_1\) and \(P_2\) are pressure differences across the two tubes.

If \(P_2\) is 4\(P_1\) and \(l_2\) is \(\frac{1}{4}\), then the radius \(r_2\) will be equal to:

- 1. \(2r_1\)
- 2. \(\frac{r_1}{2}\)
- 3. \(4r_1\)
- 4. \(r_1\)

Q.21
For the P-V diagram given for an ideal gas, out of the following which one correctly represents the T-P diagram?

Options

1. \(T\)
2. \(P\)
The mass density of a spherical body is given by \( \rho (r) = \frac{k}{r} \) for \( r \leq R \) and \( \rho (r) = 0 \) for \( r > R \), where \( r \) is the distance from the centre.

The correct graph that describes qualitatively the acceleration, \( a \), of a test particle as a function of \( r \) is:
Q.23 The current gain of a common emitter amplifier is 69. If the emitter current is 7.0 mA, collector current is:

Options:
1. 0.69 mA
2. 6.9 mA
3. 69 mA
4. 9.6 mA

Status: Not Attempted
Chosen Option: --

Q.24 A physical quantity \( P \) is described by the relation

\[ P = a^{1/2} b^2 c^3 d^{-4} \]

If the relative errors in the measurement of \( a, b, c \) and \( d \) respectively, are 2%, 1%, 3% and 5%, then the relative error in \( P \) will be:

Options:
1. 25%
2. 12%
3. 8%
4. 32%
Q.25
The electric field component of a monochromatic radiation is given by
\[ \vec{E} = 2E_0 \hat{i} \cos k z \cos \omega t \]
Its magnetic field \( \vec{B} \) is then given by:

Options 1. \( \frac{2E_0}{c} \hat{j} \cos k z \cos \omega t \)
2. \( \frac{2E_0}{c} \hat{j} \sin k z \cos \omega t \)
3. \( \frac{2E_0}{c} \hat{j} \sin k z \sin \omega t \)
4. \( -\frac{2E_0}{c} \hat{j} \sin k z \sin \omega t \)

Q.26
A uniform wire of length \( l \) and radius \( r \) has a resistance of 100 \( \Omega \). It is recast into a wire of radius \( \frac{r}{2} \). The resistance of new wire will be:

Options 1. 400 \( \Omega \)
2. 100 \( \Omega \)
3. 200 \( \Omega \)
4. 1600 \( \Omega \)

Q.27
A uniform magnetic field \( B \) of 0.3 T is along the positive \( Z \)-direction. A rectangular loop (abcd) of sides 10 cm \( \times \) 5 cm carries a current \( I \) of 12 A. Out of the following different orientations which one corresponds to stable equilibrium?

Options
1. [Diagram of orientations]
Q.28 A car is standing 200 m behind a bus, which is also at rest. The two start moving at the same instant but with different forward accelerations. The bus has acceleration 2 m/s² and the car has acceleration 4 m/s². The car will catch up with the bus after a time of:

Options
1. \( \sqrt{120} \) s
2. 15 s
3. 10 \( \sqrt{2} \) s
4. \( \sqrt{110} \) s
Q.29
A steel rail of length 5 m and area of cross section 40 cm\(^2\) is prevented from expanding along its length while the temperature rises by 10°C. If the coefficient of linear expansion and Young’s modulus of steel are \(1.2 \times 10^{-5}\) K\(^{-1}\) and \(2 \times 10^{11}\) Nm\(^{-2}\) respectively, the force developed in the rail is approximately:

1. \(2 \times 10^9\) N
2. \(3 \times 10^{-5}\) N
3. \(2 \times 10^7\) N
4. \(1 \times 10^5\) N

Q.30
The acceleration of an electron in the first orbit of the hydrogen atom (n = 1) is:

1. \(\frac{\hbar^2}{\pi^2 m^2 r^3}\)
2. \(\frac{\hbar^2}{4\pi^2 m^2 r^3}\)
3. \(\frac{\hbar^2}{4\pi m^2 r^3}\)
4. \(\frac{\hbar^2}{8\pi^2 m^2 r^3}\)

Q.1
At 300 K, the density of a certain gaseous molecule at 2 bar is double to that of dinitrogen (N\(_2\)) at 4 bar. The molar mass of gaseous molecule is:

1. 56 g mol\(^{-1}\)
2. 112 g mol\(^{-1}\)
3. 224 g mol\(^{-1}\)
4. 28 g mol\(^{-1}\)

Q.2
Which one of the following is an oxide?
1. BaO\(_2\)
2. SiO\(_2\)
3. KO\(_2\)
4. \( \text{CsO}_2 \)

Q.3  
In the following reaction sequence:

\[
\text{I (C}_3\text{H}_6\text{Cl}_2) \xrightarrow{\text{KOH(aq)}} \text{II (i) CH}_3\text{MgBr} \xrightarrow{(\text{ii) H}_2\text{O/H}^+) \text{III Anhy. ZnCl}_2 + \text{Con. HCl}} \text{gives turbidity immediately}
\]

The compound I is:

Options
1. \( \text{CH}_2 - \text{CH} - \text{CH}_3 \)
   \( \text{Cl} \quad \text{Cl} \)
2. \( \text{CH}_3 - \text{C} - \text{CH}_3 \)
   \( \text{Cl} \)
3. \( \text{Cl} - \text{CH} - \text{CH}_2 - \text{CH}_3 \)
   \( \text{Cl} \)
4. \( \text{CH}_2 - \text{CH}_2 - \text{CH}_2 \)
   \( \text{Cl} \quad \text{Cl} \)

Q.4  
Which of the following compounds will show highest dipole moment?

Options
1. (I)
2. (III)
3. (II)
4. (IV)
Q.5
In the following structure, the double bonds are marked as I, II, III and IV.

Geometrical isomerism is **not** possible at site (s):

**Options**
1. I
2. III
3. I and III
4. III and IV

Q.6
A gas undergoes a change from state A to state B. In this process, the heat absorbed and work done by the gas is 5 J and 8 J, respectively. Now gas is brought back to A by another process during which 3 J of heat is evolved. In this reverse process of B to A:

1. 10 J of the work will be done by the surrounding on gas.
2. 10 J of the work will be done by the gas.
3. 6 J of the work will be done by the surrounding on gas.
4. 6 J of the work will be done by the gas.

Q.7
An ideal gas undergoes isothermal expansion at constant pressure. During the process:

**Options**
1. enthalpy increases but entropy decreases.
2. enthalpy remains constant but entropy increases.
3. enthalpy decreases but entropy increases.
4. Both enthalpy and entropy remain constant.

Q.8
[Co₂(CO)₈] displays:

1. one Co–Co bond, four terminal CO and four bridging CO
2. one Co–Co bond, six terminal CO and two bridging CO
3. no Co–Co bond, four terminal CO and four bridging CO
4. no Co–Co bond, six terminal CO and two bridging CO

Q.9
The correct sequence of decreasing number of π-bonds in the structures of H₂SO₃, H₂SO₄ and H₂S₂O₇ is:

1. H₂SO₃ > H₂SO₄ > H₂S₂O₇
2. H₂SO₄ > H₂S₂O₇ > H₂SO₃
3. H₂S₂O₇ > H₂SO₃ > H₂SO₄
4. H₂S₂O₇ > H₂SO₄ > H₂SO₃

Q.10
A compound of molecular formula C₈H₈O₂ reacts with acetophenone to form a single cross-aldo product in the presence of base. The same compound on reaction with conc. NaOH forms benzyl alcohol as one of the products. The structure of the compound is:

Options

1. 
   CH₃O
   CHO

2. 
   CH₃
   OH
3. \( \text{XeF}_6 \) on partial hydrolysis with water produces a compound ‘X’. The same compound ‘X’ is formed when \( \text{XeF}_6 \) reacts with silica. The compound ‘X’ is:

Options:
1. \( \text{XeO}_3 \)
2. \( \text{XeF}_4 \)
3. \( \text{XeF}_2 \)
4. \( \text{XeOF}_4 \)

4. The incorrect statement among the following is:

Options:
1. \( \alpha\)-D-glucose and \( \beta\)-D-glucose are anomers.
2. The penta acetate of glucose does not react with hydroxyl amine.
3. Cellulose is a straight chain polysaccharide made up of only \( \beta\)-D-glucose units.
4. \( \alpha\)-D-glucose and \( \beta\)-D-glucose are enantiomers.

Q.13
The electron in the hydrogen atom undergoes transition from higher orbitals to orbital of radius 211.6 pm. This transition is associated with:

Options:
1. Paschen series
2. Brackett series
3. Lyman series
4. Balmer series
Q.14  Among the following compounds, the increasing order of their basic strength is:

(I) \[\text{NH}_2\]
(II) \[\text{N}\]
(III) \[\text{CH}_3\]
(IV) \[\text{NH}_2\]

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

Q.15  The group having triangular planar structures is:

Options
1. \[\text{NCl}_3,\ \text{BCl}_3,\ \text{SO}_3\]
2. \[\text{CO}_3^{2-},\ \text{NO}_3^-,\ \text{SO}_3\]
3. \[\text{NH}_3,\ \text{SO}_3^-,\ \text{CO}_3^{2-}\]
4. \[\text{BF}_3,\ \text{NF}_3,\ \text{CO}_3^{2-}\]

Q.16  The number of P–OH bonds and the oxidation state of phosphorus atom in pyrophosphoric acid \((\text{H}_4\text{P}_2\text{O}_7)\) respectively are:

Options
1. five and four
2. four and five
3. four and four
4. five and five

Q.17  The following reaction occurs in the Blast Furnace where iron ore is reduced to iron metal:

\[
\text{Fe}_2\text{O}_3(s) + 3\ \text{CO}(g) \rightleftharpoons 2\ \text{Fe}(l) + 3\ \text{CO}_2(g)
\]

Using the Le Chatelier’s principle, predict which one of the following will not disturb the equilibrium?

Options
1. Addition of \(\text{Fe}_2\text{O}_3\)
2. Removal of CO₂
3. Removal of CO
4. Addition of CO₂

Q.18 Adsorption of a gas on a surface follows Freundlich adsorption isotherm. Plot of

$$\log \frac{x}{m} \text{ versus } \log p$$

with slope equal to 0.5, then:

$$\frac{x}{m}$$ is the mass of the gas adsorbed per gram of adsorbent

Options
1. Adsorption is proportional to the pressure.
2. Adsorption is proportional to the square root of pressure.
3. Adsorption is proportional to the square of pressure.
4. Adsorption is independent of pressure.

Q.19 The major product of the following reaction is:

$$\text{Br}_2/\text{hv}$$

Options
1. 
2. 
3. 
4. 

Status: Answered
Chosen Option:
Q.20 The increasing order of the boiling points for the following compounds is:

\[ \text{C}_2\text{H}_5\text{OH} \quad \text{C}_2\text{H}_5\text{Cl} \quad \text{C}_2\text{H}_5\text{CH}_3 \quad \text{C}_2\text{H}_5\text{OCH}_3 \]

(I) (II) (III) (IV)

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

Q.21 Which of the following ions does not liberate hydrogen gas on reaction with dilute acids?

Options
1. Mn\textsuperscript{2+}
2. Ti\textsuperscript{2+}
3. V\textsuperscript{2+}
4. Cr\textsuperscript{2+}

Q.22 The rate of a reaction quadruples when the temperature changes from 300 to 310 K. The activation energy of this reaction is:

(Assume activation energy and pre-exponential factor are independent of temperature; \( \ln 2 = 0.693 \); \( R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} \))

Options
1. 53.6 \text{ kJ mol}^{-1}
2. 26.8 \text{ kJ mol}^{-1}
3. 107.2 kJ mol\(^{-1}\)
4. 214.4 kJ mol\(^{-1}\)

Q.23 The electronic configuration with the highest ionization enthalpy is:

Options:
1. [Ne] 3s\(^2\) 3p\(^1\)
2. [Ne] 3s\(^2\) 3p\(^2\)
3. [Ne] 3s\(^2\) 3p\(^3\)
4. [Ar] 3d\(^{10}\) 4s\(^2\) 4p\(^3\)

Q.24 What quantity (in mL) of a 45% acid solution of a mono-protic strong acid must be mixed with a 20% solution of the same acid to produce 800 mL of a 29.875% acid solution?

Options:
1. 330
2. 316
3. 320
4. 325

Q.25 50 mL of 0.2 M ammonia solution is treated with 25 mL of 0.2 M HCl. If pK\(_b\) of ammonia solution is 4.75, the pH of the mixture will be:

Options:
1. 4.75
2. 3.75
3. 9.25
4. 8.25

Q.26 A solution is prepared by mixing 8.5 g of CH\(_2\)Cl\(_2\) and 11.95 g of CHCl\(_3\). If vapour pressure of CH\(_2\)Cl\(_2\) and CHCl\(_3\) at 298 K are 415 and 200 mmHg respectively, the mole fraction of CHCl\(_3\) in vapour form is:

(Molar mass of Cl = 35.5 g mol\(^{-1}\))

Options:
1. 0.675
2. 0.162
3. 0.486
4. 0.325
Q.27 Which of the following is a biodegradable polymer?

Options:
1. \[
\left[ \text{HN}-(\text{CH}_2)_6\text{NHCO}-(\text{CH}_2)_4\text{C} \right]_n
\]
2. \[
\left[ \text{HN}-(\text{CH}_2)_5\text{CONH}-(\text{CH}_2)\text{C} \right]_n
\]
3. \[
\left[ \text{HN}-(\text{CH}_2)_5\text{C} \right]_n
\]
4. \[
\left[ \text{C}-(\text{H}_2)_7\text{COO}-(\text{CH}_2)_3\text{O} \right]_n
\]

Q.28 Which of the following compounds is most reactive to an aqueous solution of sodium carbonate?

Options:
1.
2.
3.
4.

Q.29 To find the standard potential of \( M^{3+} / M \) electrode, the following cell is constituted:

\[
\text{Pt}/M/M^{3+}/(0.001 \text{ mol L}^{-1})/Ag^+/\text{(0.01 mol L}^{-1})/Ag
\]

The emf of the cell is found to be 0.421 volt at 298 K. The standard potential of half reaction \( M^{3+} + 3e^- \to M \) at 298 K will be:

(Given \( E_{Ag^+/Ag}^0 \) at 298 K = 0.80 Volt)

Options:
1. 0.32 Volt
2. 0.66 Volt
3. 0.38 Volt
4. 1.28 Volt

Q.30
Which of the following is a set of green house gases?

Options
1. CO₂, CH₄, N₂O, O₃
2. O₃, NO₂, SO₂, Cl₂
3. CH₄, O₃, N₂, SO₂
4. O₃, N₂, CO₂, NO₂

Status: Answered
Chosen Option: 

Q.1
Let
\[ S_n = \frac{1}{1^3} + \frac{1+2}{1^3 + 2^3} + \frac{1+2+3}{1^3 + 2^3 + 3^3} + \]
...... + \[\frac{1+2+.....+n}{1^3 + 2^3 + ..... + n^3}\]. If 100 \( S_n = n \), then \( n \) is equal to:

Options
1. 99
2. 199
3. 200
4. 199

Status: Not Attempted
Chosen Option: 

Q.2
If a variable plane, at a distance of 3 units from the origin, intersects the coordinate axes at A, B and C, then the locus of the centroid of \( \triangle ABC \) is:

Options
1. \[\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = 1\]
2. \[\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = 3\]
3. \[\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = 9\]
4. \[\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = \frac{1}{9}\]

Status: Not Attempted
Chosen Option: 

24 of 33
Q.3 If \( x = a, y = b, z = c \) is a solution of the system of linear equations:
\[
\begin{align*}
x + 8y + 7z &= 0 \\
9x + 2y + 3z &= 0 \\
x + y + z &= 0
\end{align*}
\]
such that the point \((a, b, c)\) lies on the plane \(x + 2y + z = 6\), then \(2a + b + c\) equals:

1. 1
2. 2
3. \(-1\)
4. 0

Q.4 A value of \( x \) satisfying the equation \( \sin^{-1}(1 + x) = \cos^{-1}(x) \), is:

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

Q.5 The function \( f : \mathbb{N} \to \mathbb{N} \) defined by \( f(x) = x - 5\left\lfloor \frac{x}{5} \right\rfloor \), where \( \mathbb{N} \) is the set of natural numbers and \( [x] \) denotes the greatest integer less than or equal to \( x \), is:
1. one-one and onto.
2. onto but not one-one.
3. neither one-one nor onto.
4. one-one but not onto.

Q.6 The equation
\[
\text{Im}\left(\frac{iz - 2}{z - i}\right) + 1 = 0, \ z \in \mathbb{C}, \ z \neq i
\]
represents a part of a circle having radius equal to:

1. 1
Q.7
If the line, \(\frac{x - 3}{1} = \frac{y + 2}{-1} = \frac{z + \lambda}{-2}\) lies in the plane, \(2x - 4y + 3z = 2\), then the shortest distance between this line and the line, \(\frac{x - 1}{12} = \frac{y}{9} = \frac{z}{4}\) is:

Options
1. 0
2. 3
3. 1
4. 2

Q.8
If three positive numbers a, b and c are in A.P. such that abc = 8, then the minimum possible value of b is:

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

Q.9
If \(f\left(\frac{3x - 4}{3x + 4}\right) = x + 2, x \neq -\frac{4}{3},\) and \(\int f(x)\, dx = A \log|1 - x| + Bx + C,\) then the ordered pair \((A, B)\) is equal to:

(Where C is a constant of integration)

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

Q.10

If

\[ \lim_{n \to \infty} \frac{1^a + 2^a + \ldots + n^a}{(n+1)^{a-1}[(na+1) + (na+2) + \ldots + (na+n)]} = \frac{1}{60} \]

for some positive real number \( a \), then \( a \) is equal to:

Options
1. \( \frac{17}{2} \)
2. 8
3. 7
4. \( \frac{15}{2} \)

Q.11

If \( 2x = y^\frac{1}{5} + y^{-\frac{1}{5}} \) and

\( (x^2 - 1) \frac{d^2 y}{dx^2} + \lambda x \frac{dy}{dx} + ky = 0 \), then \( \lambda + k \)

is equal to:

Options
1. \(-23\)
2. \(-24\)
3. 26
4. \(-26\)

Q.12

The two adjacent sides of a cyclic quadrilateral are 2 and 5 and the angle between them is 60°. If the area of the quadrilateral is \( 4 \sqrt{3} \), then the perimeter of the quadrilateral is:

Options
1. 12
2. 12.5
3. 13
4. 13.2
Q.13
A square, of each side 2, lies above the x-axis and has one vertex at the origin. If one of the sides passing through the origin makes an angle 30° with the positive direction of the x-axis, then the sum of the x-coordinates of the vertices of the square is:

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

Q.14
Let \(f\) be a polynomial function such that \(f(3x) = f'(x) \cdot f''(x)\), for all \(x \in \mathbb{R}\). Then:

Options
1. \(f(2) - f'(2) + f''(2) = 10\)
2. \(f''(2) - f(2) = 4\)
3. \(f''(2) - f'(2) = 0\)
4. \(f(2) + f'(2) = 28\)

Q.15
The coefficient of \(x^5\) in the binomial expansion of \(\left(\frac{x + 1}{x^3 - x^{\frac{1}{3}} + 1} \cdot \frac{x - 1}{x - x^{\frac{1}{2}}}\right)^{10}\), where \(x \neq 0, 1\), is:

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

Q.16
If the vector \(\vec{b} = 3\hat{j} + 4\hat{k}\) is written as the sum of a vector \(\vec{b}_1\), parallel to \(\vec{a} = \hat{i} + \hat{j}\) and a vector \(\vec{b}_2\), perpendicular to \(\vec{a}\), then \(\vec{b}_1 \times \vec{b}_2\) is equal to:

Options
1. \(3\hat{i} - 3\hat{j} + 9\hat{k}\)
2. \(-3 \hat{i} + 3 \hat{j} - 9 \hat{k}\)
3. \(-6 \hat{i} + 6 \hat{j} - \frac{9}{2} \hat{k}\)
4. \(6 \hat{i} - 6 \hat{j} + \frac{9}{2} \hat{k}\)

Q.17
A line drawn through the point P(4,7) cuts the circle \(x^2 + y^2 = 9\) at the points A and B. Then PA-PB is equal to:

Options
1. 56
2. 74
3. 65
4. 53

Q.18
Contrapositive of the statement ‘If two numbers are not equal, then their squares are not equal’, is:

Options
1. If the squares of two numbers are not equal, then the numbers are equal.
2. If the squares of two numbers are equal, then the numbers are not equal.
3. If the squares of two numbers are equal, then the numbers are equal.
4. If the squares of two numbers are not equal, then the numbers are not equal.

Q.19
The eccentricity of an ellipse having centre at the origin, axes along the co-ordinate axes and passing through the points (4, -1) and (-2, 2) is:

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

4. \( \frac{1}{2} \)

Q.20  The number of ways in which 5 boys and 3 girls can be seated on a round table if a particular boy \( B_1 \) and a particular girl \( G_1 \) never sit adjacent to each other, is:

Options
1. \( 7! \)
2. \( 5 \times 6! \)
3. \( 6 \times 6! \)
4. \( 5 \times 7! \)

Q.21  The sum of 100 observations and the sum of their squares are 400 and 2475, respectively. Later on, three observations, 3, 4 and 5, were found to be incorrect. If the incorrect observations are omitted, then the variance of the remaining observations is:

Options
1. 8.00
2. 8.25
3. 9.00
4. 8.50

Q.22  For two \( 3 \times 3 \) matrices \( A \) and \( B \), let \( A + B = 2B' \) and \( 3A + 2B = I_3 \), where \( B' \) is the transpose of \( B \) and \( I_3 \) is \( 3 \times 3 \) identity matrix. Then:

Options
1. \( 10A + 5B = 3I_3 \)
2. \( 5A + 10B = 2I_3 \)
3. \( 3A + 6B = 2I_3 \)
4. \( B + 2A = I_3 \)

Q.23  A tangent to the curve, \( y = f(x) \) at \( P(x, y) \) meets \( x \)-axis at \( A \) and \( y \)-axis at \( B \). If \( AP : BP = 1 : 3 \) and \( f(1) = 1 \), then the curve also passes through the point:
Q.24 Let E and F be two independent events. The probability that both E and F happen is $\frac{1}{12}$ and the probability that neither E nor F happens is $\frac{1}{2}$, then a value of $\frac{P(E)}{P(F)}$ is:

Options
1. $\frac{1}{3}$
2. $\frac{5}{12}$
3. $\frac{3}{2}$
4. $\frac{4}{3}$

Status: Answered
Chosen Option: --

Q.25 The value of k for which the function

$$f(x) = \begin{cases} \frac{4}{5}, & 0 < x < \frac{\pi}{2} \\ k + \frac{2}{5}, & x = \frac{\pi}{2} \end{cases}$$

is continuous at $x = \frac{\pi}{2}$, is:

Options
1. $\frac{17}{20}$
2. $\frac{3}{5}$
3. $-\frac{2}{5}$

Status: Not Attempted
Chosen Option: --
4. \( \frac{2}{5} \)

Q.26 If \( y = mx + c \) is the normal at a point on the parabola \( y^2 = 8x \) whose focal distance is 8 units, then \(|c|\) is equal to:

Options
1. \( 8\sqrt{3} \)
2. \( 2\sqrt{3} \)
3. \( 16\sqrt{3} \)
4. \( 10\sqrt{3} \)

Q.27 If \( \int_{1}^{2} \frac{dx}{(x^2 - 2x + 4)^{\frac{3}{2}}} = \frac{k}{k + 5} \), then \( k \) is equal to:

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

Q.28 The sum of all the real values of \( x \) satisfying the equation \( 2(x-1)(x^2 + 5x - 50) = 1 \) is:

Options
1. -5
2. 14
3. -4
4. 16

Q.29 The function \( f \) defined by \( f(x) = x^3 - 3x^2 + 5x + 7 \), is:

Options
1. decreasing in \( \mathbb{R} \).
2. increasing in \( \mathbb{R} \).
3. decreasing in \((0, \infty)\) and increasing in \((-\infty, 0)\).
4. increasing in \((0, \infty)\) and decreasing in \((-\infty, 0)\).
Q.30 From a group of 10 men and 5 women, four member committees are to be formed each of which must contain at least one woman. Then the probability for these committees to have more women than men, is:

Options
1. \( \frac{1}{11} \)
2. \( \frac{21}{220} \)
3. \( \frac{2}{23} \)
4. \( \frac{3}{11} \)