Q.1 Two particles are projected from the same point with the same speed $u$ such that they have the same range $R$, but different maximum heights, $h_1$ and $h_2$. Which of the following is correct?

Options:
1. $R^2 = 4h_1h_2$
2. $R^2 = 16h_1h_2$
3. $R^2 = 2h_1h_2$
4. $R^2 = h_1h_2$

Question Type: MCQ
Question ID: 41652913418
Option 1 ID: 41652952451
Option 2 ID: 41652952450
Option 3 ID: 41652952452
Option 4 ID: 41652952453
Status: Not Answered
Chosen Option: --

Q.2 In an amplitude modulator circuit, the carrier wave is given by,

\[ C(t) = 4\sin(20000\pi t) \]

while modulating signal is given by, \[ m(t) = 2\sin(2000\pi t) \]. The values of modulation index and lower side band frequency are:

Options:
1. 0.5 and 10 kHz
2. 0.4 and 10 kHz
3. 0.3 and 9 kHz
4. 0.5 and 9 kHz

Question Type: MCQ
Question ID: 41652913443
Option 1 ID: 41652952552
Option 2 ID: 41652952551
Option 3 ID: 41652952550
Option 4 ID: 41652952553
Status: Answered
Chosen Option: 1
Q.3  
Two sources of sound $S_1$ and $S_2$ produce sound waves of same frequency 660 Hz. A listener is moving from source $S_1$ towards $S_2$ with a constant speed $u$ m/s and he hears 10 beats/s. The velocity of sound is 330 m/s. Then, $u$ equals:

Options
1. 5.5 m/s
2. 15.0 m/s
3. 2.5 m/s
4. 10.0 m/s

Q.4  
Three particles of masses 50 g, 100 g and 150 g are placed at the vertices of an equilateral triangle of side 1 m (as shown in the figure). The $(x, y)$ coordinates of the centre of mass will be:

![Diagram of an equilateral triangle with masses 50 g, 100 g, and 150 g at its vertices.]

Options
1. $\left(\frac{\sqrt{3}}{4} m, \frac{5}{12} m\right)$
2. $\left(\frac{7}{12} m, \frac{\sqrt{3}}{8} m\right)$
3. $\left(\frac{7}{12} m, \frac{\sqrt{3}}{4} m\right)$
4. $\left(\frac{\sqrt{3}}{8} m, \frac{7}{12} m\right)$
Q.5 A Carnot engine has an efficiency of 1/6. When the temperature of the sink is reduced by 62°C, its efficiency is doubled. The temperatures of the source and the sink are, respectively,

Options
1. 62°C, 124°C
2. 99°C, 37°C
3. 124°C, 62°C
4. 37°C, 99°C

Q.6 A spring whose unstretched length is \( l \) has a force constant \( k \). The spring is cut into two pieces of unstretched lengths \( l_1 \) and \( l_2 \) where, \( l_1 = nl_2 \) and \( n \) is an integer. The ratio \( k_1/k_2 \) of the corresponding force constants, \( k_1 \) and \( k_2 \) will be:

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

Q.7
A transparent cube of side $d$, made of a material of refractive index $\mu_2$, is immersed in a liquid of refractive index $\mu_1 (\mu_1 < \mu_2)$. A ray is incident on the face AB at an angle $\theta$ (shown in the figure). Total internal reflection takes place at point E on the face BC.

Then $\theta$ must satisfy:

Options

1. $\theta < \sin^{-1} \frac{\mu_1}{\mu_2}$
2. $\theta > \sin^{-1} \sqrt{\frac{\mu_2}{\mu_1} - 1}$
3. $\theta < \sin^{-1} \sqrt{\frac{\mu_1}{\mu_2} - 1}$
4. $\theta > \sin^{-1} \frac{\mu_1}{\mu_2}$

Q.8 A tuning fork of frequency 480 Hz is used in an experiment for measuring speed of sound ($v$) in air by resonance tube method. Resonance is observed to occur at two successive lengths of the air column, $l_1 = 30$ cm and $l_2 = 70$ cm. Then, $v$ is equal to:

Options

1. $332 \text{ ms}^{-1}$
2. $384 \text{ ms}^{-1}$
3. $338 \text{ ms}^{-1}$
4. $379 \text{ ms}^{-1}$
Q.9 The electron in a hydrogen atom first jumps from the third excited state to the second excited state and subsequently to the first excited state. The ratio of the respective wavelengths, $\lambda_1/\lambda_2$, of the photons emitted in this process is:

Options:
1. 20/7
2. 27/5
3. 7/5
4. 9/7

Q.10 A diatomic gas with rigid molecules does 10 J of work when expanded at constant pressure. What would be the heat energy absorbed by the gas, in this process?

Options:
1. 25 J
2. 35 J
3. 30 J
4. 40 J

Q.11
Let a total charge 2 Q be distributed in a sphere of radius R, with the charge density given by $\rho(r)=kr$, where $r$ is the distance from the centre. Two charges A and B, of $-\frac{Q}{2}$ each, are placed on diametrically opposite points, at equal distance, $a$, from the centre. If A and B do not experience any force, then:

Options 1. $a=8^{-1/4}R$
2. $a=\frac{3R}{2^{1/4}}$
3. $a=2^{-1/4}R$
4. $a=R/\sqrt{3}$

**Q.12** Consider an electron in a hydrogen atom, revolving in its second excited state (having radius 4.65 Å). The de-Broglie wavelength of this electron is:

Options 1. 3.5 Å
2. 6.6 Å
3. 12.9 Å
4. 9.7 Å

**Q.13** A solid sphere, of radius R acquires a terminal velocity $v_1$ when falling (due to gravity) through a viscous fluid having a coefficient of viscosity $\eta$. The sphere is broken into 27 identical solid spheres. If each of these spheres acquires a terminal velocity, $v_2$, when falling through the same fluid, the ratio ($v_1/v_2$) equals:
Q.14 A smooth wire of length $2\pi r$ is bent into a circle and kept in a vertical plane. A bead can slide smoothly on the wire. When the circle is rotating with angular speed $\omega$ about the vertical diameter AB, as shown in figure, the bead is at rest with respect to the circular ring at position P as shown. Then the value of $\omega^2$ is equal to:

![Diagram of a circle with a bead at position P]

Options
1. $\frac{\sqrt{3}g}{2r}$
2. $2g/(r\sqrt{3})$
3. $(g\sqrt{3})/r$
4. $2g/r$

Q.15
A particle is moving with speed $v = b \sqrt{x}$ along positive x-axis. Calculate the speed of the particle at time $t = \tau$ (assume that the particle is at origin at $t = 0$).

Options

1. $\frac{b^2 \tau}{4}$
2. $\frac{b^2 \tau}{2}$
3. $b^2 \tau$
4. $\frac{b^2 \tau}{\sqrt{2}}$

Question Type: MCQ
Question ID: 41652913417
Option 1 ID: 41652952446
Option 2 ID: 41652952448
Option 3 ID: 41652952449
Option 4 ID: 41652952447
Status: Answered
Chosen Option: 1

Q.16

The ratio of the weights of a body on the Earth’s surface to that on the surface of a planet is $9 : 4$. The mass of the planet is $\frac{1}{9}$th of that of the Earth. If ‘R’ is the radius of the Earth, what is the radius of the planet? (Take the planets to have the same mass density)

Options

1. $\frac{R}{3}$
2. $\frac{R}{4}$
3. $\frac{R}{9}$
4. $\frac{R}{2}$

Question Type: MCQ
Question ID: 41652913423
Option 1 ID: 41652952471
Option 2 ID: 41652952473
Option 3 ID: 41652952472
Option 4 ID: 41652952470
Status: Answered
Chosen Option: 3

Q.17
A system of three polarizers $P_1, P_2, P_3$ is set up such that the pass axis of $P_3$ is crossed with respect to that of $P_1$. The pass axis of $P_2$ is inclined at $60^\circ$ to the pass axis of $P_3$. When a beam of unpolarized light of intensity $I_0$ is incident on $P_1$, the intensity of light transmitted by the three polarizers is $I$. The ratio $(I_0/I)$ equals (nearly):

Options
1. 5.33
2. 16.00
3. 10.67
4. 1.80

Q.18 A uniform cylindrical rod of length $L$ and radius $r$, is made from a material whose Young's modulus of Elasticity equals $Y$. When this rod is heated by temperature $T$ and simultaneously subjected to a net longitudinal compressional force $F$, its length remains unchanged. The coefficient of volume expansion, of the material of the rod, is (nearly) equal to:

Options
1. $9F/(\pi r^2 YT)$
2. $6F/(\pi r^2 YT)$
3. $3F/(\pi r^2 YT)$
4. $F/(3\pi r^2 YT)$

Question Type: MCQ
Question ID: 41652913438
Option 1 ID: 41652952531
Option 2 ID: 41652952533
Option 3 ID: 41652952532
Option 4 ID: 41652952530
Status: Answered
Chosen Option: 3

Q.19

https://cdn3.digialm.com//per/g21/pub/2083/touchstone/AssessmentQPHTMLMode1//2083O1951/2083O1951S12D38301/1555096822090737...
The number density of molecules of a gas depends on their distance r from the origin as, \( n(r) = n_0 e^{-\alpha r^4} \). Then the total number of molecules is proportional to:

1. \( n_0 \alpha^{-3/4} \)
2. \( \sqrt{n_0} \alpha^{3/2} \)
3. \( n_0 \alpha^{-1/4} \)
4. \( n_0 \alpha^{-3} \)

**Q.20** A small speaker delivers 2 W of audio output. At what distance from the speaker will one detect 120 dB intensity sound? [Given reference intensity of sound as \( 10^{-12} \text{ W/m}^2 \)]

Options 1. 40 cm 2. 20 cm 3. 10 cm 4. 30 cm

**Q.21** Half lives of two radioactive nuclei A and B are 10 minutes and 20 minutes, respectively. If, initially a sample has equal number of nuclei, then after 60 minutes, the ratio of decayed numbers of nuclei A and B will be:

Options 1. 3 : 8 2. 1 : 8 3. 8 : 1 4. 9 : 8
Q.22 An electron, moving along the x-axis with an initial energy of 100 eV, enters a region of magnetic field $\vec{B} = (1.5 \times 10^{-3} \text{T}) \hat{z}$ at S (See figure). The field extends between $x = 0$ and $x = 2 \text{ cm}$. The electron is detected at the point Q on a screen placed 8 cm away from the point S. The distance d between P and Q (on the screen) is:
(electron's charge $= 1.6 \times 10^{-19} \text{C}$, mass of electron $= 9.1 \times 10^{-31} \text{ kg}$)

Options
1. 11.65 cm
2. 12.87 cm
3. 1.22 cm
4. 2.25 cm

Q.23

https://cdn3.digialm.com//per/g21/pub/2083/touchstone/AssessmentQPHTMLMode1//2083O1951/2083O1951S12D38301/1555096...
In the given circuit, the charge on 4 μF capacitor will be:

\[
\begin{array}{c}
\text{4 μF} \\
\text{1 μF} \\
\text{3 μF} \\
\end{array}
\]

\[
\begin{array}{c}
\text{10 V} \\
\end{array}
\]

Options
1. 5.4 μC
2. 9.6 μC
3. 13.4 μC
4. 24 μC

Q.24 One kg of water, at 20°C, is heated in an electric kettle whose heating element has a mean (temperature averaged) resistance of 20 Ω. The rms voltage in the mains is 200 V. Ignoring heat loss from the kettle, time taken for water to evaporate fully, is close to:

[Specific heat of water = 4200 J/(kg °C), Latent heat of water = 2260 kJ/kg]

Options
1. 16 minutes
2. 22 minutes
3. 3 minutes
4. 10 minutes
A moving coil galvanometer, having a resistance $R_g$, produces full scale deflection when a current $I_g$ flows through it. This galvanometer can be converted into (i) an ammeter of range $0$ to $I_0$ ($I_0 > I_g$) by connecting a shunt resistance $R_A$ to it and (ii) into a voltmeter of range $0$ to $V$ ($V = GI_0$) by connecting a series resistance $R_V$ to it.

Then,

$$R_A R_V = G^2 \left( \frac{I_0 - I_g}{I_g} \right)$$

Options

1. $$R_A = \left( \frac{I_g}{I_0 - I_g} \right)^2$$

2. $$R_A R_V = G^2 \text{ and } R_A = \left( \frac{I_g}{I_0 - I_g} \right)^2$$

3. $$R_A = \left( \frac{I_0 - I_g}{I_g} \right)^2$$

4. $$R_A R_V = G^2 \text{ and } R_V = \frac{I_g}{(I_0 - I_g)}$$
Find the magnetic field at point P due to a straight line segment AB of length 6 cm carrying a current of 5 A. (See figure)

\( \mu_0 = 4\pi \times 10^{-7} \text{ N} \cdot \text{A}^{-2} \)

\[ \begin{array}{c}
\text{P} \\
\downarrow \\
5 \text{ cm} \\
\uparrow \\
5 \text{ cm} \\
\downarrow \\
A \\
\end{array} \]

Options
1. \( 2.0 \times 10^{-5} \text{ T} \)
2. \( 1.5 \times 10^{-5} \text{ T} \)
3. \( 3.0 \times 10^{-5} \text{ T} \)
4. \( 2.5 \times 10^{-5} \text{ T} \)

Q.27 A plane electromagnetic wave having a frequency \( \nu = 23.9 \) GHz propagates along the positive z-direction in free space. The peak value of the Electric Field is 60 V/m. Which among the following is the acceptable magnetic field component in the electromagnetic wave?

Options
1. \( \vec{B} = 2 \times 10^{-7} \sin(0.5 \times 10^3 z + 1.5 \times 10^{11} t) \hat{i} \)
2. \( \vec{B} = 2 \times 10^{-7} \sin(0.5 \times 10^3 z - 1.5 \times 10^{11} t) \hat{i} \)
3. \( \vec{B} = 60 \sin(0.5 \times 10^3 z + 1.5 \times 10^{11} t) \hat{k} \)
4. \( \vec{B} = 2 \times 10^{-7} \sin(1.5 \times 10^2 z + 0.5 \times 10^{11} t) \hat{j} \)
Q.28
Consider the LR circuit shown in the figure. If the switch S is closed at \( t = 0 \) then the amount of charge that passes through the battery between \( t = 0 \) and \( t = \frac{L}{R} \) is:

\[ \frac{2.7EL}{R^2} \]

Options
1. \( \frac{2.7EL}{R^2} \)
2. \( \frac{EL}{2.7R^2} \)
3. \( \frac{7.3EL}{R^2} \)
4. \( \frac{EL}{7.3R^2} \)

Q.29
Figure shows a DC voltage regulator circuit, with a Zener diode of breakdown voltage = 6V. If the unregulated input voltage varies between 10 V to 16 V, then what is the maximum Zener current?

\[ I_z \]

\[ R_s = 2 \text{ k}\Omega \]

\[ R_L = 4 \text{ k}\Omega \]

Options
1. 2.5 mA
2. 1.5 mA
3. 7.5 mA
4. 3.5 mA

Q.30 A block of mass 5 kg is (i) pushed in case (A) and (ii) pulled in case (B), by a force \( F = 20 \) N, making an angle of 30° with the horizontal, as shown in the figures. The coefficient of friction between the block and floor is \( \mu = 0.2 \). The difference between the accelerations of the block, in case (B) and case (A) will be: \( g = 10 \text{ ms}^{-2} \)

\[ \begin{align*}
\text{F} &= 20 \text{ N} \\
\text{F} &= 20 \text{ N}
\end{align*} \]

Options
1. 0.4 ms\(^{-2}\)
2. 3.2 ms\(^{-2}\)
3. 0.8 ms\(^{-2}\)
4. 0 ms\(^{-2}\)

Section: Chemistry

Q.1 Thermal decomposition of a Mn compound (X) at 513 K results in compound Y, \( \text{MnO}_2 \) and a gaseous product. \( \text{MnO}_2 \) reacts with NaCl and concentrated \( \text{H}_2\text{SO}_4 \) to give a pungent gas Z. X, Y, and Z, respectively, are:

Options
1. \( \text{K}_3\text{MnO}_4, \text{K}_2\text{MnO}_4 \) and \( \text{Cl}_2 \)
2. \( \text{K}_2\text{MnO}_4, \text{KMnO}_4 \) and \( \text{SO}_2 \)
3. KMnO₄, K₂MnO₄ and Cl₂
4. K₂MnO₄, KMnO₄ and Cl₂

Q.2 NO₂ required for a reaction is produced by the decomposition of N₂O₅ in CCl₄ as per the equation,

\[ 2 \text{N}_2\text{O}_5(g) \rightarrow 4 \text{NO}_2(g) + \text{O}_2(g) \]

The initial concentration of N₂O₅ is 3.00 mol L⁻¹ and it is 2.75 mol L⁻¹ after 30 minutes. The rate of formation of NO₂ is:

Options
1. \(4.167 \times 10^{-3} \text{ mol L}^{-1} \text{ min}^{-1}\)
2. \(1.667 \times 10^{-2} \text{ mol L}^{-1} \text{ min}^{-1}\)
3. \(8.333 \times 10^{-3} \text{ mol L}^{-1} \text{ min}^{-1}\)
4. \(2.083 \times 10^{-3} \text{ mol L}^{-1} \text{ min}^{-1}\)

Q.3 The pair that has similar atomic radii is:

Options
1. Mn and Re
2. Ti and Hf
3. Sc and Ni
4. Mo and W

Q.4 The INCORRECT statement is:

Options
1. Lithium is the strongest reducing agent among the alkali metals.
2. Lithium is least reactive with water among the alkali metals.
3. LiNO<sub>3</sub> decomposes on heating to give LiNO<sub>2</sub> and O<sub>2</sub>.
4. LiCl crystallises from aqueous solution as LiCl·2H<sub>2</sub>O.

Q.5 The C–C bond length is maximum in:

Options
1. graphite
2. C<sub>70</sub>
3. C<sub>60</sub>
4. diamond

Q.6 A solution is prepared by dissolving 0.6 g of urea (molar mass = 60 g mol<sup>−1</sup>) and 1.8 g of glucose (molar mass = 180 g mol<sup>−1</sup>) in 100 mL of water at 27 °C. The osmotic pressure of the solution is:

(R = 0.08206 L atm K<sup>−1</sup> mol<sup>−1</sup>)

Options
1. 8.2 atm
2. 2.46 atm
3. 4.92 atm
4. 1.64 atm
Q.7 In comparison to boron, beryllium has:

1. lesser nuclear charge and lesser first ionisation enthalpy.
2. greater nuclear charge and lesser first ionisation enthalpy.
3. greater nuclear charge and greater first ionisation enthalpy.
4. lesser nuclear charge and greater first ionisation enthalpy.

Q.8 The decreasing order of electrical conductivity of the following aqueous solutions is:

0.1 M Formic acid (A),
0.1 M Acetic acid (B),
0.1 M Benzoic acid (C).

1. A > C > B
2. C > B > A
3. A > B > C
4. C > A > B

Q.9 What will be the major product when m-cresol is reacted with propargyl bromide (HC = C – CH₂Br) in presence of K₂CO₃ in acetone?

Options
Q.10  The molar solubility of Cd(OH)₂ is 1.84 x 10⁻⁵ M in water. The expected solubility of Cd(OH)₂ in a buffer solution of pH = 12 is:

Options
1. 1.84 x 10⁻⁹ M
2. \( \frac{2.49}{1.84} \times 10⁻⁹ M \)
3. 6.23 x 10⁻¹¹ M
4. 2.49 x 10⁻¹⁰ M

Q.11  

Question Type: MCQ
Question ID: 41652913472
Option 1 ID: 41652952669
Option 2 ID: 41652952668
Option 3 ID: 41652952666
Option 4 ID: 41652952667
Status: Not Answered
Chosen Option: --
Benzene diazonium chloride on reaction with aniline in the presence of dilute hydrochloric acid gives:

Options
1. 
2. 
3. 
4. 

Q.12 The correct statement is:

Options
1. leaching of bauxite using concentrated NaOH solution gives sodium aluminate and sodium silicate.
2. the Hall-Heroult process is used for the production of aluminium and iron.
3. pig iron is obtained from cast iron.
4. during the metallurgical process is due to the evolution of CO₂.

Q.13 The primary pollutant that leads to photochemical smog is:

Options 1. acrolein
2. nitrogen oxides
3. ozone
4. sulphur dioxide

Q.14 The IUPAC name for the following compound is:

\[
\text{CH}_3\text{CH}_2\text{CH}==\text{CH}_2
\]

Options
1. 3-methyl-4-(3-methylprop-1-enyl)-1-heptyne
2. 3,5-dimethyl-4-propylhept-6-en-1-yne
3. 3-methyl-4-(1-methylprop-2-ynyl)-1-heptene
4. 3,5-dimethyl-4-propylhept-1-en-6-yne

Q.15 The temporary hardness of a water sample is due to compound X. Boiling this sample converts X to compound Y. X and Y, respectively, are:

Options
1. Mg(HCO\(_3\))\(_2\) and Mg(OH)\(_2\)
2. Ca(HCO\(_3\))\(_2\) and Ca(OH)\(_2\)
3. Mg(HCO\(_3\))\(_2\) and MgCO\(_3\)
4. Ca(HCO\(_3\))\(_2\) and CaO
Q.16 In the following skew conformation of ethane, $H^1 - C - C - H^1$ dihedral angle is:

\[
\begin{array}{c}
H \quad \text{H} \\
\text{H} \quad \text{H} \\
\text{H} \quad \text{H} \quad \text{H} \\
\end{array}
\]

\[
29^\circ
\]

Options
1. $58^\circ$
2. $149^\circ$
3. $151^\circ$
4. $120^\circ$

Question Type: MCQ  
Question ID: 41652913458  
Option 1 ID: 41652952610  
Option 2 ID: 41652952612  
Option 3 ID: 41652952611  
Option 4 ID: 41652952613  
Status: Answered  
Chosen Option: 2

Q.17 Among the following, the energy of 2s orbital is lowest in:

Options
1. K
2. H
3. Li
4. Na

Question Type: MCQ  
Question ID: 41652913446  
Option 1 ID: 41652952562  
Option 2 ID: 41652952564  
Option 3 ID: 41652952563  
Option 4 ID: 41652952565  
Status: Not Answered  
Chosen Option: --

Q.18 Which one of the following is likely to give a precipitate with $\text{AgNO}_3$ solution?

Options

Question Type: MCQ  
Question ID: 41652913468  
Option 1 ID: 41652952651  
Option 2 ID: 41652952650  
Option 3 ID: 41652952653  
Option 4 ID: 41652952652  
Status: Answered  
Chosen Option: 3
1. $\text{CH}_2=\text{CH}-\text{Cl}$
2. $\text{CCl}_4$
3. $\text{CHCl}_3$
4. $(\text{CH}_3)_2\text{CCl}$

**Q.19** 25 g of an unknown hydrocarbon upon burning produces 88 g of $\text{CO}_2$ and 9 g of $\text{H}_2\text{O}$. This unknown hydrocarbon contains:

Options:  
1. 20 g of carbon and 5 g of hydrogen  
2. 22 g of carbon and 3 g of hydrogen  
3. 24 g of carbon and 1 g of hydrogen  
4. 18 g of carbon and 7 g of hydrogen

**Answered**
Chosen Option: 1

**Q.20** Heating of 2-chloro-1-phenylbutane with $\text{EtOK/ EtOH}$ gives $X$ as the major product. Reaction of $X$ with $\text{Hg(OAc)}_2/\text{H}_2\text{O}$ followed by $\text{NaBH}_4$ gives $Y$ as the major product. $Y$ is:

Options:  
1. 
\[
\text{Ph} \quad \text{OH}
\]
2. 
\[
\text{Ph} \quad \text{OH}
\]
3. 
\[
\text{OH}
\]
4. 
\[
\text{Ph}
\]
Q.21 The compound used in the treatment of lead poisoning is:

Options
1. D-penicillamine
2. desferrioxime B
3. Cis-platin
4. EDTA

Question Type: MCQ
Question ID: 41652913452
Option 1 ID: 41652952586
Option 2 ID: 41652952588
Option 3 ID: 41652952587
Option 4 ID: 41652952589
Status: Answered
Chosen Option: 1

Q.22 Which of the given statements is INCORRECT about glycogen?

Options
1. It is a straight chain polymer similar to amylose.
2. Only α-linkages are present in the molecule.
3. It is present in animal cells.
4. It is present in some yeast and fungi.

Question Type: MCQ
Question ID: 41652913463
Option 1 ID: 41652952630
Option 2 ID: 41652952633
Option 3 ID: 41652952632
Option 4 ID: 41652952631
Status: Answered
Chosen Option: 3

Q.23 Consider the following reactions:

\[ \text{A} \xrightarrow{\Delta} \text{Ag}_2 \xrightarrow{\text{ppt}} \]

\[ \text{Hg}^{2+} / \text{H}^+ \xrightarrow{\text{B}} \text{NaBH}_4 \xrightarrow{\text{conc. HCl}} \text{ZnCl}_2 \]

Turbidity within 5 minutes

‘A’ is:

Options
1. \( \text{CH}_1 = \text{CH}_1 \)
2. \( \text{CH}_3\text{C} = \text{C} - \text{CH}_3 \)
3. \( \text{CH}_3\text{C} = \text{CH} \)
4. \( \text{CH}_2 = \text{CH}_2 \)

Q.24

The correct name of the following polymer is:

\[ \text{CH}_3\text{CH}_3 \]

Options

1. Polyisobutane
2. Polytetrafluoroethylene
3. Polyisoprene
4. Polyisobutylene

Q.25

An ‘Assertion’ and a ‘Reason’ are given below. Choose the correct answer from the following options:

**Assertion (A):** Vinyl halides do not undergo nucleophilic substitution easily.

**Reason (R):** Even though the intermediate carbocation is stabilized by loosely held \( \pi \)-electrons, the cleavage is difficult because of strong bonding.

Options

1. Both (A) and (R) are wrong statements.
2. Both (A) and (R) are correct statements and (R) is the correct explanation of (A).
Both (A) and (R) are correct statements but (R) is not the correct explanation of (A).

(A) is a correct statement but (R) is a wrong statement.

Q.26 The ratio of number of atoms present in a simple cubic, body centered cubic and face centered cubic structure are, respectively:

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

Q.27 In which one of the following equilibria, \( K_p \neq K_c \)?

Options 1. \( 2 \text{C(s)} + \text{O}_2(g) = 2 \text{CO}(g) \)
2. \( 2 \text{HI}(g) = \text{H}_2(g) + \text{I}_2(g) \)
3. \( \text{NO}_2(g) + \text{SO}_2(g) = \text{NO}(g) + \text{SO}_3(g) \)
4. \( 2 \text{NO}(g) = \text{N}_2(g) + \text{O}_2(g) \)
The coordination numbers of Co and Al in [Co(\(\text{Cl}\))\(_2\)(\(\text{en}\))\(_2\)]\(\text{Cl}\) and \(K_3[\text{Al}((\text{C}_2\text{O}_4))_3]\), respectively, are:

\(\text{en} = \text{ethane-1, 2-diamine}\)

Options
1. 5 and 3
2. 3 and 3
3. 6 and 6
4. 5 and 6

Q.29 The INCORRECT match in the following is:

Options
1. \(\Delta G^0 < 0, K > 1\)
2. \(\Delta G^0 = 0, K = 1\)
3. \(\Delta G^0 > 0, K < 1\)
4. \(\Delta G^0 < 0, K < 1\)

Q.30 Among the following, the INCORRECT statement about colloids is:

Options
1. They can scatter light.
2. They are larger than small molecules and have high molar mass.
   The osmotic pressure of a colloidal solution is of higher order than the true solution at the same concentration.
3. The range of diameters of colloidal particles is between 1 and 1000 nm.

Question Type: MCQ
Question ID: 41652913465
Option 1 ID: 41652952654
Option 2 ID: 41652952657
Option 3 ID: 41652952656
Option 4 ID: 41652952655
Status: Answered
Chosen Option: 4
Section: Mathematics

Q.1
The derivative of $\tan^{-1}\left(\frac{\sin x - \cos x}{\sin x + \cos x}\right)$, with respect to $\frac{x}{2}$, where $\left(x \in \left(0, \frac{\pi}{2}\right)\right)$ is:

Options:
1. 1
2. $\frac{2}{3}$
3. $\frac{1}{2}$
4. 2

Q.2
For an initial screening of an admission test, a candidate is given fifty problems to solve. If the probability that the candidate can solve any problem is $\frac{4}{5}$, then the probability that he is unable to solve less than two problems is:

Options:
1. $\frac{201}{5}\left(\frac{1}{5}\right)^{49}$
2. $\frac{316}{25}\left(\frac{4}{5}\right)^{48}$
3. $\frac{54}{5}\left(\frac{4}{5}\right)^{49}$
4. $\frac{164}{25}\left(\frac{1}{5}\right)^{48}$
Q.3
A value of $\alpha$ such that
\[ \int_{\alpha}^{\alpha+1} \frac{dx}{x+\alpha} \frac{1}{(x+\alpha)(x+\alpha+1)} = \log_e \left( \frac{9}{8} \right) \] is:

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

Q.4
Let $\alpha \in (0, \pi/2)$ be fixed. If the integral
\[ \int \frac{\tan x + \tan \alpha}{\tan x - \tan \alpha} \, dx = A(x) \cos 2\alpha + B(x) \sin 2\alpha + C, \] where $C$ is a constant of integration, then the functions $A(x)$ and $B(x)$ are respectively:

Options
1. $x + \alpha$ and $\log_e |\sin(x + \alpha)|$
2. $x - \alpha$ and $\log_e |\sin(x - \alpha)|$
3. $x - \alpha$ and $\log_e |\cos(x - \alpha)|$
4. $x + \alpha$ and $\log_e |\sin(x - \alpha)|$

Q.5
The angle of elevation of the top of a vertical tower standing on a horizontal plane is observed to be 45° from a point A on the plane. Let B be the point 30 m vertically above the point A. If the angle of elevation of the top of the tower from B be 30°, then the distance (in m) of the foot of the tower from the point A is:

Options
1. $15 \left( 3 + \sqrt{3} \right)$
2. $15 \left( 5 - \sqrt{3} \right)$
3. $15 \left( 3 - \sqrt{3} \right)$
4. $15 \left( 1 + \sqrt{3} \right)$

Q.6 Let S be the set of all $\alpha \in \mathbb{R}$ such that the equation, $\cos 2x + \sin x = 2\alpha - 7$ has a solution. Then $S$ is equal to:

Options
1. $\mathbb{R}$
2. $[1, 4]$  
3. $[3, 7]$  
4. $[2, 6]$

Q.7 A plane which bisects the angle between the two given planes $2x - y + 2z - 4 = 0$ and $x + 2y + 2z - 2 = 0$, passes through the point:

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

Q.8

\[
\lim_{x \to 0} \frac{x + 2\sin x}{\sqrt{x^2 + 2\sin x} + 1 - \sqrt{\sin^2 x - x + 1}}
\]

is:

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

Q.9

A group of students comprises of 5 boys and \(n\) girls. If the number of ways, in which a team of 3 students can randomly be selected from this group such that there is at least one boy and at least one girl in each team, is 1750, then \(n\) is equal to:

Options
1. 28
2. 27
3. 25
4. 24

Q.10

An ellipse, with foci at \((0, 2)\) and \((0, -2)\) and minor axis of length 4, passes through which of the following points?
Q.11  The Boolean expression \( \sim(p \Rightarrow (\sim q)) \) is equivalent to:

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

Question Type: MCQ  
Question ID: 41652913497  
Option 1 ID: 41652952768  
Option 2 ID: 41652952766  
Option 3 ID: 41652952769  
Option 4 ID: 41652952767  
Status: Answered  
Chosen Option: 1

Q.12  A circle touching the x-axis at (3, 0) and making an intercept of length 8 on the y-axis passes through the point:

Options
1. (3, 10)  
2. (3, 5)  
3. (2, 3)  
4. (1, 5)

Question Type: MCQ  
Question ID: 41652913505  
Option 1 ID: 41652952800  
Option 2 ID: 41652952799  
Option 3 ID: 41652952801  
Option 4 ID: 41652952798  
Status: Answered  
Chosen Option: 3

Q.13
If \( ^{20}C_1 + (2^2)^{20}C_2 + (3^2)^{20}C_3 + \ldots \) 
+ \( (2^3)^{20}C_{20} = A(2^B) \), then the ordered pair 
\((A, B)\) is equal to:

Options 1. \((420, 19)\)
2. \((420, 18)\)
3. \((380, 18)\)
4. \((380, 19)\)

Q.14 A value of \( \theta \in (0, \pi /3) \), for which 
\[
\begin{vmatrix}
1 + \cos^2\theta & \sin^2\theta & 4 \cos 6\theta \\
\cos^2\theta & 1 + \sin^2\theta & 4 \cos 6\theta \\
\cos^2\theta & \sin^2\theta & 1 + 4 \cos 6\theta \\
\end{vmatrix} = 0,
\]
is:

Options 1. \(\pi \over 9\)
2. \(\pi \over 18\)
3. \(7\pi \over 24\)
4. \(7\pi \over 36\)

Q.15 The equation of a common tangent to the curves, \(y^2 = 16x\) and \(xy = -4\), is:

Options 1. \(x - y + 4 = 0\)
2. \(x + y + 4 = 0\)
3. \(x - 2y + 16 = 0\)
4. \(2x - y + 2 = 0\)
Q.16 Let \( z \in \mathbb{C} \) with \( \text{Im}(z) = 10 \) and it satisfies
\[
\frac{2z - n}{2z + n} = 2i - 1
\]
for some natural number \( n \). Then:

Options
1. \( n = 20 \) and \( \text{Re}(z) = -10 \)
2. \( n = 40 \) and \( \text{Re}(z) = 10 \)
3. \( n = 40 \) and \( \text{Re}(z) = -10 \)
4. \( n = 20 \) and \( \text{Re}(z) = 10 \)

Question ID: 41652913496
Option 1 ID: 41652952765
Option 2 ID: 41652952763
Option 3 ID: 41652952762
Option 4 ID: 41652952764
Status: Answered
Chosen Option: 3

Q.17 A triangle has a vertex at \((1, 2)\) and the midpoints of the two sides through it are \((-1, 1)\) and \((2, 3)\). Then the centroid of this triangle is:

Options
1. \( \left(1, \frac{7}{3}\right)\)
2. \( \left(\frac{1}{3}, 2\right)\)
3. \( \left(\frac{1}{3}, 1\right)\)
4. \( \left(\frac{1}{3}, \frac{5}{3}\right)\)

Question Type: MCQ
Question ID: 41652913477
Option 1 ID: 41652952687
Option 2 ID: 41652952688
Option 3 ID: 41652952689
Option 4 ID: 41652952686
Status: Not Answered
Chosen Option: --

Q.18

Question ID: 41652913494
Option 1 ID: 41652952756
Option 2 ID: 41652952755
Option 3 ID: 41652952754
Option 4 ID: 41652952757
Status: Not Answered
Chosen Option: --
If $a_1, a_2, a_3, \ldots \ldots$ are in A.P. such that $a_1 + a_7 + a_{16} = 40$, then the sum of the first 15 terms of this A.P. is:

Options 1. 200  
2. 280  
3. 120  
4. 150

Q.19 If $[x]$ denotes the greatest integer $\leq x$, then the system of linear equations 
\[ [\sin\theta]x + [-\cos\theta]y = 0 \]
\[ [\cot\theta]x + y = 0 \]
have infinitely many solutions if

1. $\theta \in \left(\frac{\pi}{2}, \frac{2\pi}{3}\right)$ and has a unique solution if $\theta \in \left(\frac{\pi}{2}, \frac{7\pi}{6}\right)$.

2. $\theta \in \left(\frac{\pi}{2}, \frac{2\pi}{3}\right) \cup \left(\frac{7\pi}{6}, \pi\right)$.

3. and have infinitely many solutions if $\theta \in \left(\frac{\pi}{2}, \frac{7\pi}{6}\right)$.

4. $\theta \in \left(\frac{\pi}{2}, \frac{2\pi}{3}\right) \cup \left(\frac{7\pi}{6}, \pi\right)$.
Q.20
A straight line \( L \) at a distance of 4 units from the origin makes positive intercepts on the coordinate axes and the perpendicular from the origin to this line makes an angle of 60\(^\circ\) with the line \( x + y = 0 \). Then an equation of the line \( L \) is :

Options
1. \( x + \sqrt{3}y = 8 \)
2. \( (\sqrt{3} + 1)x + (\sqrt{3} - 1)y = 8\sqrt{2} \)
3. \( \sqrt{3}x + y = 8 \)
4. \( (\sqrt{3} - 1)x + (\sqrt{3} + 1)y = 8\sqrt{2} \)

Q.21
Let \( f(x) = 5 - |x - 2| \) and \( g(x) = |x + 1| \), \( x \in \mathbb{R} \). If \( f(x) \) attains maximum value at \( \alpha \) and \( g(x) \) attains minimum value at \( \beta \), then
\[
\lim_{x \to -\beta} \frac{(x-1)(\alpha^2 - 5x + 6)}{\alpha^2 - 6\alpha + 8}
\]
is equal to :

Options
1. \( 1/2 \)
2. \( -3/2 \)
3. \( -1/2 \)
4. \( 3/2 \)

Q.22
Let \( \alpha \in \mathbb{R} \) and the three vectors 
\[
\vec{a} = \alpha \hat{i} + \hat{j} + 3\hat{k}, \quad \vec{b} = 2\hat{i} + \hat{j} - \alpha \hat{k}
\]
and 
\[
\vec{c} = \alpha \hat{i} - 2\hat{j} + 3\hat{k}.
\]
Then the set
\[
S = \{\alpha : \vec{a}, \vec{b} \text{ and } \vec{c} \text{ are coplanar} \}
\]
is singleton.
2. is empty
   contains exactly two positive numbers
3. contains exactly two numbers only one of which is positive

Q.23 A person throws two fair dice. He wins Rs. 15 for throwing a doublet (same numbers on the two dice), wins Rs. 12 when the throw results in the sum of 9, and loses Rs. 6 for any other outcome on the throw. Then the expected gain/loss (in Rs.) of the person is:

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

Q.24 The tangents to the curve \( y = (x - 2)^2 - 1 \) at its points of intersection with the line \( x - y = 3 \), intersect at the point:

Options
1. \( \left( \frac{5}{2}, 1 \right) \)
2. \( \left( \frac{5}{2}, -1 \right) \)
3. \( \left( \frac{5}{2}, -1 \right) \)
Q.25
If $\alpha$, $\beta$ and $\gamma$ are three consecutive terms of a non-constant G.P. such that the equations $\alpha x^2 + 2\beta x + \gamma = 0$ and $x^2 + x - 1 = 0$ have a common root, then $\alpha(\beta + \gamma)$ is equal to:

Options:
1. 0
2. $\alpha\beta$
3. $\alpha\gamma$
4. $\beta\gamma$

Q.26
Let $A$, $B$ and $C$ be sets such that $\varnothing \neq A \cap B \subseteq C$. Then which of the following statements is not true?

Options:
1. $B \cap C \neq \varnothing$
2. If $(A - B) \subseteq C$, then $A \subseteq C$
3. $(C \cup A) \cap (C \cup B) = C$
4. If $(A - C) \subseteq B$, then $A \subseteq B$

Q.27
The general solution of the differential equation $(y^2 - x^2) \ dx - xy \ dy = 0 \ (x \neq 0)$ is:

(Where $c$ is a constant of integration)

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

Q.28 If the area (in sq. units) bounded by the parabola $y^2 = 4\lambda x$ and the line $y = \lambda x$, \( \lambda > 0 \), is $\frac{1}{9}$, then $\lambda$ is equal to:

Options
1. $2\sqrt{6}$
2. 48
3. 24
4. $4\sqrt{3}$

Q.29 The length of the perpendicular drawn from the point $(2, 1, 4)$ to the plane containing the lines $\vec{r} = (\hat{i} + \hat{j}) + \lambda(\hat{i} + 2\hat{j} - \hat{k})$ and $\vec{r} = (\hat{i} + \hat{j}) + \mu(-\hat{i} + \hat{j} - 2\hat{k})$ is:

Options
1. 3
2. $\frac{1}{3}$
3. $\sqrt{3}$
4. $\frac{1}{\sqrt{3}}$
Q.30  The term independent of \( x \) in the expansion

\[
\left( \frac{1}{60} - \frac{x^8}{81} \right) \left( 2x^2 - \frac{3}{x^2} \right)^6
\]

is equal to:

Options
1.  -72
2.  36
3.  -36
4.  -108