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Question Paper
Solutions

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PHYSICS

1. Which of the following gives a reversible operation?

   1)  
   2)  
   3)  
   4)  

Ans: 3

2. A 60 HP electric motor lifts an elevator having a maximum total load capacity of 2000 kg. If the frictional force on the elevator is 4000N, the speed of the elevator at full load is close to: (1HP = 746W, g = 10ms⁻²)

   1) 1.9m/s  
   2) 1.7m/s  
   3) 2.0m/s  
   4) 1.5m/s

Ans: 1

3. A LCR circuit behaves like a damped harmonic oscillator. Comparing it with a physical spring mass damped oscillator having damping constant ‘b’, the correct equivalence would be

   1)  
   2)  
   3)  
   4)  

Ans: 1

4. As shown in the figure, a bob of mass m is tied by a massless string whose other end portion is wound on a fly wheel (disc) of radius r and mass m. When released from rest the bob starts falling vertically. When it has cornered a distance of h, the angular speed of the wheel will be

   1)  
   2)  
   3)  
   4)  

Ans: 1
5. Three points particles of masses 1.0kg, 1.5kg and 2.5kg are placed at three corners of right angle triangle of sides 4.0cm, 3.0cm and 5.0cm as shown in the figure. The centre of mass of the system is at a point.

![Diagram of a right-angled triangle with masses](image)

1) 0.6cm right and 2.0cm above 1kg mass
2) 0.9cm right and 2.0cm above 1kg mass
3) 2.0cm right and 0.9cm above 1kg mass
4) 1.5cm right and 1.2cm above 1kg mass

Ans: 2

6. A parallel plate capacitor has plates of area A separated by distance ‘d’ between them. It is filled with a dielectric which has a dielectric constant that varies as $k(x) = K(1 + \alpha x)$ where ‘x’ is the distance measured from one of the plates. If $(\alpha d) << 1$, the total capacitance of the system is best given by the expression

1) $A \frac{\epsilon_0 K}{d} \left[ 1 + \left( \frac{\alpha d}{2} \right)^2 \right]$
2) $A \frac{\epsilon_0 K}{d} \left[ 1 + \frac{\alpha^2 d^2}{2} \right]$
3) $AK \frac{\epsilon_0}{d} (1 + \alpha d)$
4) $AK \frac{\epsilon_0}{d} \left[ 1 + \frac{\alpha d}{2} \right]$

Ans: 4

7. The time period of revolution of electron in its ground state orbit in a hydrogen atom is $1.6 \times 10^{-16}$s. The frequency of revolution of the electron in its first excited state ($in s^{-1}$) is

1) $7.8 \times 10^{14}$
2) $5.6 \times 10^{12}$
3) $6.2 \times 10^{15}$
4) $1.6 \times 10^{14}$

Ans: 1
8. The current $I_1$ (in A) flowing through 1$\Omega$ resistor in the following circuit is

\[ \begin{array}{c}
\text{1$\Omega$} \\
\text{1$\Omega$} \\
\text{2$\Omega$} \\
\text{2$\Omega$} \\
\text{IV} \\
\end{array} \]

1) 0.2  2) 0.4  3) 0.5  4) 0.25

Ans: 1

9. A satellite of mass $m$ is launched vertically upwards with as initial speed $u$ from the surface of the earth. After it reaches height $R (R =$ radius of the earth), it ejects a rocket of mass $\frac{m}{10}$ so that subsequently the satellite moves in a circular orbit. The kinetic energy of the rocket is ($G$ is the gravitational constant; $M$ is the mass of the earth):

1) $\frac{3m}{8} \left[u + \sqrt{\frac{5GM}{6R}}\right]^2$

2) $\frac{m}{20} \left[u - \sqrt{\frac{2GM}{3R}}\right]^2$

3) $5m \left(\frac{u^2 - \frac{119}{200} \frac{GM}{R}}{R}\right)$

4) $\frac{m}{20} \left(\frac{u^2 + \frac{113}{200} \frac{GM}{R}}{R}\right)$

Ans: 3

10. A long solenoid of radius $R$ carries a time ($t$) - dependent current $I(t) = I_0(1-t)$. A ring of radius 2$R$ is placed coaxially near its middle. During the time interval $0 \leq t \leq 1$, the induced current ($I_R$) and the induced EMF ($V_R$) in the ring changes as:

1) Direction of $I_R$ remains unchanged and $V_R$ is maximum at $t=0.5$

2) At $t=0.5$ direction of $I_R$ reverses and $V_R$ is zero

3) Direction of $I_R$ remains unchanged and $V_R$ is zero at $t=0.25$

4) At $t=0.25$ direction of $I_R$ reverses and $V_R$ is maximum

Ans: 2
11. The radius of gyration of a uniform rod of length \( l \), about an axis passing through a point \( \frac{l}{4} \) away from the centre of the rod, and perpendicular to it is

1) \( \frac{\sqrt{7}}{48} l \)  
2) \( \frac{3}{8} l \)  
3) \( \frac{l}{8} \)  
4) \( \frac{l}{4} \)

Ans: 1

12. Two moles of an ideal gas with \( \frac{C_p}{C_v} = \frac{5}{3} \) are mixed with 3 moles of another ideal gas with \( \frac{C_p}{C_v} = \frac{4}{3} \). The values of \( \frac{C_p}{C_v} \) for the mixture is

1) 1.50  
2) 1.42  
3) 1.47  
4) 1.45

Ans: 2

13. A little of dry air at STP expands adiabatically to a volume of 3litres. If \( \gamma = 1.40 \), the work done by air is: \( 3^{\gamma} = 4.6555 \) [Take air to be an ideal gas)

1) 100.8J  
2) 90.5J  
3) 60.7J  
4) 48J

Ans: 2

14. If the magnetic field in a plane electromagnetic wave is given by

\[
\vec{B} = 3 \times 10^{-8} \sin(1.6 \times 10^3 x + 48 \times 10^10t) \hat{J} T
\]

then what will be the expression for the electric field?

\[
\vec{E} = (9 \sin(1.6 \times 10^3 x + 48 \times 10^10t) \hat{K} V/m)
\]

1) \( \vec{E} = (3 \times 10^{-8} \sin(1.6 \times 10^3 x + 48 \times 10^10t) \hat{J} V/m) \)

2) \( \vec{E} = (3 \times 10^{-8} \sin(1.6 \times 10^3 x + 48 \times 10^10t) \hat{V} / m) \)

3) \( \vec{E} = (3 \times 10^{-8} \sin(1.6 \times 10^3 x + 48 \times 10^10t) \hat{J} V / m) \)

4) \( \vec{E} = (60 \sin(1.6 \times 10^3 x + 48 \times 10^10t) \hat{K} V / m) \)

Ans: 1
15. A polarizer-analyser set is adjusted such that the intensity of light coming out of the analyser is just 10% of the original intensity. Assuming that the polarizer-analyser set does not absorb any light, the angle by which of the analyser need to be rotated further to reduce the output intensity to be zero is

1) 45º  
2) 71.6º  
3) 90º  
4) 18.4º  

Ans: 4

16. Speed of transverse wave of a straight wire (mass 6.0g, length 60cm and area of cross section 1.0 mm²) in 90 ms⁻¹. If the young’s modulus of wire in 16 × 10¹¹ Nm⁻² the extension of wire over its natural length is.

1) 0.03mm  
2) 0.02mm  
3) 0.01mm  
4) 0.04mm  

Ans: 1

17. Two infinite planes each with uniform surface charge density +σ are kept in such a way that the angle but them is 30⁰. The electric field in the region shown between them is given by

\[ \begin{align*}
1) & \quad \frac{\sigma}{2\varepsilon_0} \left[ \left(1 - \frac{\sqrt{3}}{2}\right) \hat{y} + \hat{x} \right] \\
2) & \quad \frac{\sigma}{2\varepsilon_0} \left[ \left(1 + \frac{\sqrt{3}}{2}\right) \hat{y} \right] \\
3) & \quad \frac{\sigma}{\varepsilon_0} \left[ \left(1 + \frac{\sqrt{3}}{2}\right) \hat{y} \right] \\
4) & \quad \frac{\sigma}{2\varepsilon_0} \left[ \left(1 + \sqrt{3}\right) \hat{y} - \frac{\hat{x}}{2} \right] \\
\end{align*} \]

Ans: 1

18. If we need a magnification of 375 from a compound microscope of tube length 150 mm and an objective of focal length 5mm, the focal length of the eye-piece, should be close to :

1) 12 mm  
2) 33mm  
3) 22mm  
4) 2 mm  

Ans: 3
19. Visible light of wavelength $6000 \times 10^{-8}$ cm falls normally on a single slit and produces a diffraction pattern. It is found that the second diffraction minimum is at $60^0$ from the central maximum. If the first minimum is produced at $\theta_1$, then $\theta_1$, is close to,

1) $25^0$   2) $45^0$   3) $20^0$   4) $30^0$

Ans: 1

20. Consider a coil of wire carrying constant current $I$, forming a magnetic dipole. The magnetic flux through an infinite plane that contains the circular coil and excluding the circular coil area is given by $\phi_i$. The magnetic flux through the area of the circular coil is given by $\phi_0$. Which of the following option is correct?

1) $\phi_i = -\phi_0$   2) $\phi_i > \phi_0$   3) $\phi_i < \phi_0$   4) $\phi_i = \phi_0$

Ans: 1

Sol: As magnetic field lines always form a closed loop, hence every magnetic field line creating magnetic flux in the inner region must be passing through the outer region. Since flux in two regions are in opposite direction

$\therefore \phi_i = -\phi_0$

21. A particle ($m = 1$ kg) slides down a frictionless track (AOC) starting from rest at a point A (height 2 cm). After reaching C, the particle continues to move freely in air as a projectile. When it reaching its highest point P (height 1 m), the kinetic energy of the particle (in J) is: (Figure drawn is schematic and not to scale; take $g = 10 \text{ ms}^{-2}$)

Ans: 10

22. A Carnot engine operates between two reservoirs of temperature $900$ K and $300$ K. The engine performs $1200$ J of work per cycle. The heat energy (in J) delivered by the engine to the low temperature reservoir, in a cycle is

Ans: 600
23. A loop ABCDEFA of straight edges has six corner points A(0,0,0), B(5,0,0), C(5,5,0), D(0,5,0), E(0,5,5) and F(0,0,5). The magnetic field in this region is \( \vec{B} = (3\hat{i} + 4\hat{k}) \) T. The quantity of flux through the loop ABCDEFA (in Wb) is _____.

Ans: 175

24. A beam of electromagnetic radiation of intensity \( 6.4 \times 10^{-5} \) W/cm\(^2\) is comprised of wavelength, \( \lambda = 310 \) nm. It falls normally on a metal (work function \( \phi = 2 \) eV) of surface area 1 cm\(^2\). If one in \( 10^3 \) photons ejects an electron, total number of electrons ejected in 1 s is \( 10^x \) (hc = 1240 eV nm, \( 1 \) eV = \( 1.6 \times 10^{-19} \) J), then \( x \) is _____.

Ans: 10

25. A non-isotropic solid metal cube has coefficients of linear expansion as: \( 5 \times 10^{-5} / ^{\circ}\)C along the x-axis and \( 5 \times 10^{-6} / ^{\circ}\)C along the y and the z-axis. If coefficient of volume expansion of the solid \( C \times 10^{-6} / ^{\circ}\)C then the value of \( C \) is ________

Ans: 60
26. The relative strength of interionic/intermolecular forces in decreasing order is:
   1) ion-dipole > dipole –dipole > ion-ion
   2) dipole-dipole>ion – dipole > ion – ion
   3) ion-ion > ion –dipole > dipole – dipole
   4) ion-dipole > ion-ion > dipole-dipole

   Ans: 3

27. Oxidation number of potassium in $K_2O$, $K_2O_2$ and $KO_2$, respectively is:
   1) +1,+2 and +4
   2) +1,+4 and +2
   3) +2, +1 and $+\frac{1}{2}$
   4) +1,+1 and +1

   Ans: 4

28. At 35ºC, the vapour pressure of $CS_2$ is 512 mm Hg and that of acetone is 344 mm Hg. A solution of $CS_2$ in acetone has a total vapour pressure of 600 mm Hg. The false statement amongst the following is:
   1) $CS_2$ and acetone are less attracted to each other than to themselves
   2) heat must be absorbed in order to produce the solution at 35ºC
   3) Raoult’s law is not obeyed by this system
   4) a mixture of 100 mL $CS_2$ and 100 mL acetone has a volume of <200 mL

   Ans: 4

29. The atomic radius of Ag is closest to:
   1) Ni
   2) Cu
   3) Au
   4) Hg

   Ans: 3

30. The dipole moments of $CCl_4$, $CHCl_3$ and $CH_4$ are in the orders:
   1) $CH_4 < CCl_4 < CHCl_3$
   2) $CHCl_3 < CH_4 = CCl_4$
   3) $CH_4 = CCl_4 < CHCl_3$
   4) $CCl_4 < CH_4 < CHCl_3$

   Ans: 3
31. In comparison to the zeolite process for the removal of permanent hardness, the synthetic resin method is:
   1) less efficient as the resins cannot be regenerated
   2) more efficient as it can exchange only cations
   3) less efficient as it exchanges only anions
   4) more efficient as it can exchange both cations as well as anions

   Ans: 4

   Sol: Synthetic resins are advantageous for removal of permanent hardness as they exchange both cations and anions.

32. Among the following statements that which was not proposed by Dalton was
   1) chemical reactions involve reorganization of atoms. These are neither created nor destroyed in a chemical reaction.
   2) when gases combine or reproduced in a chemical reaction they do so in a simple ratio by volume provided all gases are at the same T & P.
   3) matter consists of indivisible atoms.
   4) all the atoms of a given element have identical properties including identical mass.

   Atoms of different elements differ in mass.

   Ans: 2

   Sol: (b) is Gay Lussac’s law of combining gas volumes.

33. The increasing orders of \( pK_b \) for the following compounds will be:

   \[
   NH_2-CH=NH \quad (A) \quad , \quad \text{CH}_3\text{NHCH}_3 \quad (C)
   \]

   1) (B) < (C) < (A)  2) (B) < (A) < (C)  3) (C) < (A) < (B)  4) (A) < (B) < (C)

   Ans: 2
34. What is the product of following reaction?

\[
\text{HeX} - 3 - \text{ynal} \xrightarrow{\text{i) NaBH}_4, \text{ii) PBr}_3, \text{iii) Mg/ether, iv) CO}_2/\text{H}_2\text{O}^+} \]

\[
\begin{align*}
1) & \quad \begin{array}{c}
\text{COOH} \\
\text{HO-RCOOH}
\end{array} \\
2) & \quad \begin{array}{c}
\text{COOH} \\
\text{COOH}
\end{array} \\
3) & \quad \begin{array}{c}
\text{COOH} \\
\text{COOH}
\end{array} \\
4) & \quad \begin{array}{c}
\text{COOH}
\end{array}
\end{align*}
\]

Ans: 1

35. The number of orbitals associated with quantum numbers \( n = 5, m_s = \pm \frac{1}{2} \) is:

1) 11  
2) 50  
3) 25  
4) 15

Ans: 3

36. The purest form of commercial iron is:

1) wrought iron  
2) pig iron  
3) cast iron  
4) scrap iron and pig iron

Ans: 1

37. The theory that can completely/properly explain the nature of bonding in \( [\text{Ni}(\text{Co})_4] \) is:

1) Werner’s theory  
2) Crystal field theory  
3) Molecular orbital theory  
4) Valence bond theory

Ans: 3
38. The IUPAC name of the complex \( \left[ pt\left( NH_3 \right)_2 Cl\left( NH_2CH_3 \right) \right] Cl \) is:

1) Diammine(methanamine)chlorido platinum(II) chloride
2) Bisammine(methanamine)chlorido platinum(II) chloride
3) Diamminechlorido(aminomethane) platinum(II) chloride
4) Diamminechlorido(methanamine) platinum(II) chloride

Ans: 4

39. 1-methyl ethylene oxide when treated with an excess of HBr produces:

1) \( \text{Br} \quad \text{CH}_3 \)
2) \( \text{Br} \quad \text{Br} \)
3) \( \text{Br} \quad \text{CH}_3 \)
4) \( \text{C}_3 \text{H}_3 \quad \text{Br} \)

Ans: 3

40. Consider the following reaction

\[
\begin{align*}
\text{N} & \quad \text{CH}_3 \\
\text{N} & \quad \text{CH}_3 \\
\text{Br} & \quad \text{Br}
\end{align*}
\]

The product ‘X’ is used

1) in proteins estimation as an alternative to ninhydrin
2) as food grade colourant
3) in laboratory test for phenols
4) in acid basetitration as an indicator

Ans: 4

41. Match the following

i) Riboflavin    a) Beriberi
ii) Thiamine    b) Scurvy
iii) Pyridoxine  c) Cheilosis
iv) Ascorbic acid  d) Convulsions
1) (i) – (a); (ii) – (d); (iii) – (c); (iv) – (b)
2) (i) – (d); (ii) – (b); (iii) – (a); (iv) – (c)
3) (i) – (c); (ii) – (d); (iii) – (a); (iv) – (b)
4) (i) – (c); (ii) – (a); (iii) – (d); (iv) – (b)

Ans: 4

42. Given that the standard potential (E°) of \( \text{Cu}^{2+} / \text{Cu} \) and \( \text{Cu}^+ / \text{Cu} \) are 0.34 V and 0.522 V respectively, the E° of \( \text{Cu}^{2+} / \text{Cu}^+ \) is:
   1) 0.182V  2) -0.158V  3) -0.182 V  4) +0.158 V

Ans: 4

43. A solution of m-chloroaniline, m-chlorophenol and m-chlorobenzoic acid in ethyl acetate was extracted initially with a saturated solution of NaHCO₃ to give fraction A. The leftover organic phase was extracted with dilute NaOH solution to give fraction B. The final organic layer was labelled as fraction C. Fractions A, B and C contain respectively:
   1) m-chlorophenol, m-chlorobenzoic acid and m-chloroaniline
   2) m-chlorobenzoic acid, m-chloroaniline and m-chlorophenol
   3) m-chloroaniline, m-chlorobenzoic acid and m-chlorophenol
   4) m-chlorobenzoic acid, m-chlorophenol and m-chloroaniline

Ans: 4

44. The electron gain enthalpy (in kJ/mol) of fluorine, chlorine, bromine and iodine, respectively are:
   1) -333, -325, -349 and -296  2) -333, -349, -325 and -296
   3) -349, -333, -325 and -296  4) -296, -325, -333 and -349

Ans: 2

45. Consider the following reaction:
   a) \( (\text{CH}_3)_3(\text{CH(OH)CH}_3) \xrightarrow{\text{conc.H}_2\text{SO}_4} \)  
   b) \( (\text{CH}_3)_2\text{CHCH(Br)CH}_3 \xrightarrow{\text{alcohol KOH}} \)  
   c) \( (\text{CH}_3)_2\text{CHCH(Br)CH}_3 \xrightarrow{(\text{CH}_3)_3\text{C}^-} \)  
   d) \( (\text{CH}_3)_2\text{CHCH(Br)CH}_3 \xrightarrow{\text{O}^-\text{K}^+} \)

Which of these reaction(s) will not produce Saytzeff product?
   1) a), c) and d)  2) d) only  3) b) and d)  4) c) only

Ans: 4
46. Two solutions, A and B, each of 100 L was made by dissolving 4g of NaOH and 9.8 g of H₂SO₄ in water, respectively. The pH of the resultant solution obtained from mixing 40 L of solution A and 10 L of solution B is _____.

Ans: 10.6

47. During the nuclear explosion, one of the products is ⁹⁰Sr with half life of 6.93 years, if 1µg of ⁹⁰Sr was absorbed in the bones of a newly born baby in place of Ca, how much time, in years, is required to reduce it by 90% if it is not lost metabolically _____.

Ans: 23.00 to 23.03

48. Chlorine reacts with hot and concentrated NaOH and produces compounds (X) and (Y). Compound (X) gives white precipitate with silver nitrate solution. The average bond order between Cl and O atoms in (Y) is _____.

Ans: 1.66 to 1.67

49. The number of chiral carbons in chloramphenicol is____

Ans: 2

50. For the reaction \( A(l) \rightarrow 2B(g) \)

\[ \Delta U = 2.1\text{Kcal}, \Delta S = 20\text{calK}^{-1} \text{ at } 300K.\] Hence \( \Delta G \) is Kcal is _____.

Ans: -2.7
MATHEMATICS

51. If $f(a+b+1-x) = f(x)$, for all $x$, where $a$ and $b$ are fixed positive real numbers, then

$$\frac{1}{a+b} \int_a^b x(f(x)) + f(x+1)dx$$

is equal to

1) $\int_a^b f(x)dx$ 2) $\int_a^b f(x+1)dx$ 3) $\int_a^b f(x+1)dx$ 4) $\int_a^b f(x)dx$

Ans: 1

52. Let $\alpha$ and $\beta$ be two real roots of the equation $(k+1)\tan^2 x - \sqrt{2} \lambda \tan x = (1-k)$, where $k \neq -1$ and $\lambda$ are real numbers. If $\tan^2(\alpha + \beta) = 50$ then a value of $\lambda$ is:

1) 10 2) 5 3) $\sqrt{2}$ 4) $10\sqrt{2}$

Ans: 1

53. Total number of 6-digit numbers in which only and all the five digits 1, 3, 5, 7 and 9 appear is:

1) $6!$ 2) $\frac{5}{2}(6!)$ 3) $\frac{1}{2}(6!)$ 4) $5^6$

Ans: 2

54. If $y = mx + 4$ is tangent to both the parabolas, $y^2 = 4x$ and $x^2 = 2by$, then $b$ is equal to

1) -64 2) -32 3) -128 4) 128

Ans: 3

55. Let $\alpha$ be a root of the equation $x^2 + x + 1 = 0$ and the matrix $A = \frac{1}{\sqrt{3}} \begin{bmatrix} 1 & 1 & 1 \\ 1 & \alpha & \alpha^2 \\ 1 & \alpha^2 & \alpha^4 \end{bmatrix}$, then the matrix $A^{31}$ is equal to

1) $A$ 2) $A^2$ 3) $A^3$ 4) $I_3$

Ans: 3

56. If $y = y(x)$ is the solution of the differential equation, $e^y \left( \frac{dy}{dx} - 1 \right) = e^x$, such that $y(0) = 0$, then $y(1)$ is equal to:

1) $2e$ 2) $2 + \log_e 2$ 3) $1 + \log_e 2$ 4) $\log_e 2$

Ans: 3
57. If \( y(\alpha) = \sqrt{2 \left[ \frac{\tan \alpha + \cot \alpha}{1 + \tan^2 \alpha} \right] + \frac{1}{\sin^2 \alpha}}, \alpha \in \left[ \frac{3\pi}{4}, \pi \right], \) then \( \frac{dy}{d\alpha} \) at \( \alpha = \frac{5\pi}{6} \) is:

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

Ans: 1

58. Let the function \( f : [-7,0] \to \mathbb{R} \) be continuous on \([-7,0]\) and differentiable on \((-7,0)\). If 
\( f(-7) = -3 \) and \( f'(x) \leq 2 \) for all \( x \in (-7,0) \), then for all such function \( f \), \( f(-1)+f(0) \) is in the interval:

1) \([-3,11]\)  
2) \((-\infty,20]\)  
3) \((-6,20]\)  
4) \((-\infty,11]\)

Ans: 2

59. A vector \( \mathbf{a} = a\mathbf{i} + 2\mathbf{j} + \beta\mathbf{k}, (a, \beta \in \mathbb{R}) \) lies in the plane of the vectors \( \mathbf{b} = \mathbf{i} + \mathbf{j} \) and \( \mathbf{c} = \mathbf{i} - \mathbf{j} + 4\mathbf{k} \).

If \( \mathbf{a} \) bisects the angle between \( \mathbf{b} \) and \( \mathbf{c} \). Then

1) \(a\mathbf{i} + 1 = 0\)  
2) \(a\mathbf{i} + 3 = 0\)  
3) \(a\mathbf{k} + 4 = 0\)  
4) \(a\mathbf{k} + 2 = 0\)

Ans: 4

60. If the distance between the foci of an ellipse is 6 and the distance between its directrices is 12, then the length of its latus rectum is:

1) \(\sqrt{3}\)  
2) \(\frac{3\sqrt{3}}{2}\)  
3) \(\frac{3}{\sqrt{2}}\)  
4) \(2\sqrt{3}\)

Ans: 2

61. The greatest positive integer \( k \), for which \( 49^k + 1 \) is a factor of the sum 
\( 49^{125} + 49^{124} + \ldots + 49^2 + 49 + 1 \), is

1) 65  
2) 32  
3) 60  
4) 63

Ans: 4

62. Let \( P \) be a plane passing through the points \((2, 1, 0), (4, 1, 1)\) and \((5, 0,1)\) and \( R \) be any point \((2, 1,6)\). Then the image of \( R \) in the plane \( P \) is:

1) \((6,5,-2)\)  
2) \((6,5,2)\)  
3) \((4,3,2)\)  
4) \((3,4,-2)\)

Ans: 1
63. If the system of linear equations

\[ \begin{align*}
2x + 2ay + az &= 0 \\
2x + 3by + bz &= 0 \\
2x + 4cy + cz &= 0 
\end{align*} \]

Where \( a, b, c \in \mathbb{R} \) are non-zero and distinct; has non-zero solution, then,

1) \( \frac{1}{a}, \frac{1}{b}, \frac{1}{c} \) are in A.P.  
2) \( a, b, c \) are in A.P.  
3) \( a, b, c \) are in G.P.  
4) \( a + b + c = 0 \)

Ans: 1

64. The area of the region, enclosed by the circle \( x^2 + y^2 = 2 \) which is not common to the region bounded by the parabola \( y^2 = x \) and the straight line \( y = x \), is:

1) \( \frac{1}{6}(24\pi - 1) \)  
2) \( \frac{1}{6}(12\pi - 1) \)  
3) \( \frac{1}{3}(6\pi - 1) \)  
4) \( \frac{1}{3}(12\pi - 1) \)

Ans: 2

65. The logical statement \((p \Rightarrow q) \land (q \Rightarrow \neg p)\) is equivalent to:

1) \( \neg q \)  
2) \( \neg p \)  
3) \( p \)  
4) \( q \)

Ans: 2

66. An unbiased coin is tossed 5 times. Suppose that a variable \( X \) is assigned the value \( k \) when \( k \) consecutive heads are obtained for \( k = 3, 4, 5 \), otherwise \( X \) takes the value -1. The expected value of \( X \), is:

1) \( \frac{1}{8} \)  
2) \( -\frac{1}{8} \)  
3) \( \frac{3}{16} \)  
4) \( -\frac{3}{16} \)

Ans: 2

67. Let \( x^k + y^k = a^k, (a, k > 0) \) and \( \frac{dy}{dx} + \left( \frac{y}{x} \right)^{\frac{1}{3}} = 0 \), then \( K \) is

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

Ans: 2
68. If \( \text{Re} \left( \frac{z-1}{2z+i} \right) = 1 \), where \( z = x + iy \), then the point \((x, y)\) lies on a

1) straight line whose slope is \( -\frac{2}{3} \)  
2) circle whose diameter is \( \frac{\sqrt{5}}{2} \)

3) straight line whose slope is \( \frac{3}{2} \)  
4) circle whose centre is at \( \left( -\frac{1}{2}, -\frac{3}{4} \right) \)

Ans: 2

69. If \( g(x) = x^2 + x - 1 \) and \( (g \circ f)(x) = 4x^2 - 10x + 5 \), then \( f \left( \frac{5}{4} \right) \) is equal to:

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

Ans: 2

70. Five numbers are in A.P. whose sum is 25 and product is 2520, if one of these five numbers is \( -\frac{1}{2} \), then the greatest number amongst them is:

1) \( \frac{21}{2} \)  
2) 16  
3) 27  
4) 7

Ans: 2

71. Let \( A(1, 0), B(6, 2) \) and \( C \left( \frac{3}{2}, 6 \right) \) be the vertices of a triangle ABC. If P is a point inside the \( \triangle ABC \) such that \( \triangle APC, \triangle APB & \triangle BPC \) have equal areas, then the length of the line segment PQ, where Q is the point \( \left( \frac{-7}{6}, \frac{-1}{3} \right) \) is______.

Ans: \( PQ = 5 \)

72. If the variance of the first ‘n’ natural numbers is 10 and the variance of the first ‘m’ even natural numbers is 16, then \( m + n \) is equal to _____.

Ans: 18

73. \( \lim_{x \to 2} \frac{3^x + 3^{3-x} - 12}{3^x - 3^{1-x}} \) is equal to ________.

Ans: 36
74. If the sum of the coefficients of all even powers of $x$ in the product
\[(1 + x + x^2 + \ldots + x^{2n})(1 - x + x^2 - x^3 + \ldots + x^{2n})\]
is 61, then $n$ is equal to _______.

Ans: 30

75. Let $S$ be the set of points where the functions $f(x) = |2 - |x - 3||$, $x \in \mathbb{R}$, is not differentiable. Then $\sum_{x \in S} f(x)$ is equal to _____.

Ans: 3

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