

VITEEE 2016 Question Paper

GENERAL INSTRUCTIONS

- This question paper contains total 125 questions divided into four parts :
Part I : Physics Q. No - 1 to 40
Part II : Chemistry Q. No - 41 to 80
Part III : Mathematics Q. No - 81 to 120
Part IV : English Q. No - 121 to 125
- All questions are multiple choice questions with four options, only one of them is correct.
- For each correct response, the candidate will get 1 mark.
- There is no negative marking for the wrong answer.
- The test is of 2½ hours duration.

PART - I (PHYSICS)

1. The potential energy of a system increases if work is done
 - upon the system by a non conservative force
 - by the system against a conservative force
 - by the system against a non conservative force
 - upon the system by a conservative force
2. In photoelectric effect, initially when energy of electrons emitted is E_0 , de-Broglie wavelength associated with them is λ_0 . Now, energy is doubled then associated de-Broglie wavelength λ' is
 - $\lambda' = \frac{\lambda_0}{\sqrt{2}}$
 - $\lambda' = \sqrt{2}\lambda_0$
 - $\lambda' = \lambda_0$
 - $\lambda' = \frac{\lambda_0}{2}$
3. In Wheatstone bridge, 4 resistors $P = 10\Omega$, $Q = 5\Omega$, $R = 4\Omega$, $S = 4\Omega$ are connected in cyclic order. To ensure no current through galvanometer

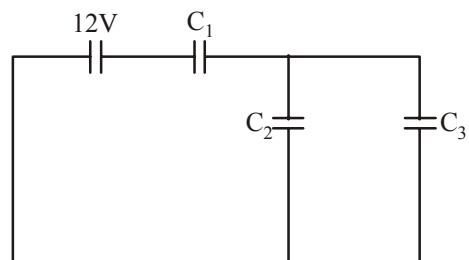
(a) 5Ω resistance is connected in series with Q

(b) 4Ω resistance is connected parallel to S

(c) 10Ω resistance is connected in series with P

(d) 4Ω resistance is connected in series with R

4. In given circuit, $C_1 = C_2 = C_3 = C$ initially. Now, a dielectric slab of dielectric constant $K = \frac{3}{2}$ is inserted in C_2 .



The equivalent capacitance become

(a) $\frac{5C}{7}$

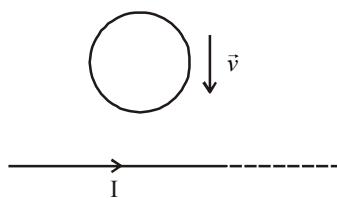
(b) $\frac{7C}{5}$

(c) $\frac{2C}{3}$

(d) $\frac{C}{2}$

5. If the terminal speed of a sphere of gold (density = 19.5 kg/m^3) is 0.2 m/s in a viscous liquid (density = 1.5 kg/m^3), find the terminal speed of a sphere of silver (density = 10.5 kg/m^3) of the same size in the same liquid
 (a) 0.4 m/s (b) 0.133 m/s
 (c) 0.1 m/s (d) 0.2 m/s

6. In shown fig, the circular loop of wire is moved with velocity towards the infinite current carrying wire. Then



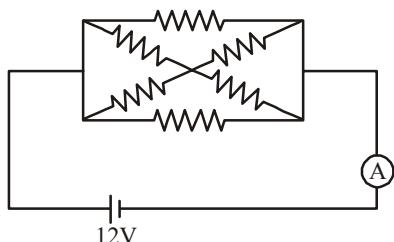
(a) no current is induced in loop
 (b) current is induced in loop clockwise
 (c) current is induced in loop anticlockwise
 (d) extra charges are induced on the wire loop

7. For a current carrying inductor, emf associated is 20 mV . Now, current through it changes from 6 A to 2 A in 2 s . The coefficient of mutual inductance is
 (a) 20 mH (b) 10 mH
 (c) 1 mH (d) 2 mH

8. A square current carrying loop is changed to a circular loop in time t_1 . Then
 (a) emf is induced in loop for time $t < t_1$
 (b) emf is induced in loop for time $t > t_1$
 (c) no emf is induced in loop during whole process
 (d) emf is induced due to change in magnetic field

9. Hologram is based on phenomenon of
 (a) diffraction
 (b) polarisation
 (c) interference
 (d) total internal reflection

10. In given circuit, all resistances are of 10Ω . Current flowing through ammeter is



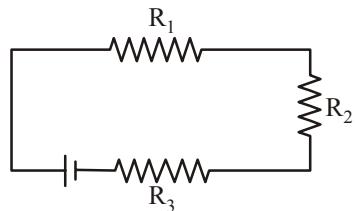
(a) 3.6 A (b) 1.8 A
 (c) 2 A (d) 1 A

11. The wavelength of an electron for transition from a state n_1 to n_2 is $\frac{9}{8R}$. Which of the following wavelengths is possible for a transition from n_2 to n_1

(a) $\frac{16}{15R}$ (b) $\frac{4}{3R}$
 (c) $\frac{9}{8R}$ (d) $\frac{36}{5R}$

12. Two solenoids are given – 1st has 1 turn per unit length and 2nd has n turns per unit length. Ratio of magnetic fields at their centres is
 (a) $n : 1$ (b) $1 : n$
 (c) $1 : n^2$ (d) $n^2 : 1$

13. Which statement is correct for the given circuit?



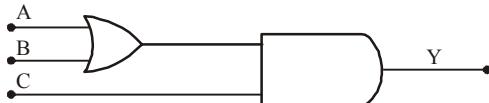
(a) I through $R_1 > I$ through R_2
 (b) I through $R_3 > I$ through R_2 and R_1
 (c) I through $R_2 > I$ through R_3 and R_1
 (d) I is same in R_1 , R_2 and R_3

14. A (+)vely charged particle is placed near an infinitely long straight conductor where there is zero gravity. Then
 (a) the charged particle will not move
 (b) it will move parallel to the straight conductor
 (c) it will move perpendicular to the straight conductor
 (d) it will move with constant acceleration

15. A metallic bar is heated from 0°C to 100°C . The coefficient of linear expansion is 10^{-5} K^{-1} . What will be the percentage increase in length?
 (a) 0.01% (b) 0.1%
 (c) 1% (d) 10%

16. If the wavelength is brought down from 6000 \AA to 4000 \AA in a photoelectric experiment then what will happen?
 (a) The work function of the metal will increase
 (b) The threshold frequency will decrease
 (c) No change will take place
 (d) Cut off voltage will increase

17. For what value of A, B and C, the output Y = 1



(a) 0 0 1 (b) 1 0 1
 (c) 1 0 0 (d) 0 1 0

18. Let the energy of an emitted photoelectron be E and the wavelength of incident light be λ . What will be the change in E if λ is doubled?
 (a) E (b) E/2
 (c) 2E (d) E/4

19. A solid sphere of radius R carries a uniform volume charge density ρ . The magnitude of electric field inside the sphere at a distance r from the centre is

$$\begin{array}{ll} (a) \frac{r\rho}{3\epsilon_0} & (b) \frac{R\rho}{3\epsilon_0} \\ (c) \frac{R^2\rho}{r\epsilon_0} & (d) \frac{R^3\rho}{r^2\epsilon_0} \end{array}$$

20. Two point dipoles $p\hat{k}$ and $\frac{p}{2}\hat{k}$ are located at $(0, 0, 0)$ and $(1\text{m}, 0, 2\text{m})$ respectively. The resultant electric field due to the two dipoles at the point $(1\text{m}, 0, 0)$ is
 (a) $\frac{9p}{32\pi\epsilon_0}\hat{k}$ (b) $\frac{-7p}{32\pi\epsilon_0}\hat{k}$
 (c) $\frac{7p}{32\pi\epsilon_0}\hat{k}$ (d) none of these

21. An iron rod of length 2m and cross-sectional area of 50 mm^2 stretched by 0.5 mm, when a mass of 250 kg is hung from its lower end. Young's modulus of iron rod is

$$\begin{array}{l} (a) 19.6 \times 10^{20} \text{ N/m}^2 \\ (b) 19.6 \times 10^{18} \text{ N/m}^2 \\ (c) 19.6 \times 10^{10} \text{ N/m}^2 \\ (d) 19.6 \times 10^{15} \text{ N/m}^2 \end{array}$$

22. Two resistances equal at 0°C with temperature coefficient of resistance α_1 and α_2 joined in series

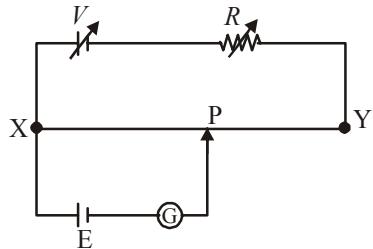
act as a single resistance in a circuit. The temperature coefficient of their single resistance will be

$$\begin{array}{ll} (a) \alpha_1 + \alpha_2 & (b) \frac{\alpha_1\alpha_2}{\alpha_1 + \alpha_2} \\ (c) \frac{\alpha_1 - \alpha_2}{2} & (d) \frac{\alpha_1 + \alpha_2}{2} \end{array}$$

23. The current density varies with radial distance r as $J = a r^2$, in a cylindrical wire of radius R . The current passing through the wire between radial distance $R/3$ and $R/2$ is

$$\begin{array}{ll} (a) \frac{65\pi a R^4}{2592} & (b) \frac{25\pi a R^4}{72} \\ (c) \frac{65\pi a^2 R^3}{2938} & (d) \frac{81\pi a^2 R^4}{144} \end{array}$$

24. A potentiometer circuit shown in the figure is set up to measure emf of cell E. As the point P moves from X to Y, the galvanometer G shows deflection always in one direction, but the deflection decreases continuously until Y is reached. The balance point between X and Y may be obtained by



(a) decreasing the resistance R and decreasing V
 (b) decreasing the resistance R and increasing V
 (c) increasing the resistance R and increasing V
 (d) increasing the resistance R and decreasing V .

25. A current I flows in the anticlockwise direction through a square loop of side a lying in the xoy plane with its center at the origin. The magnetic induction at the center of the square loop is

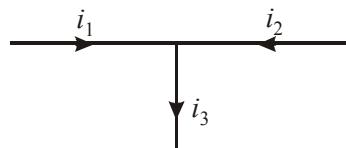
$$\begin{array}{ll} (a) \frac{2\sqrt{2}\mu_0 I}{\pi a}\hat{e}_x & (b) \frac{2\sqrt{2}\mu_0 I}{\pi a}\hat{e}_z \\ (c) \frac{2\sqrt{2}\mu_0 I}{\pi a^2}\hat{e}_z & (d) \frac{2\sqrt{2}\mu_0 I}{\pi a^2}\hat{e}_x \end{array}$$

26. A particle of charge q and mass m moves in a circular orbit of radius r with angular speed ω . The ratio of the magnitude of its magnetic moment to that of its angular momentum depends on
 (a) ω and q (b) ω, q and m
 (c) q and m (d) ω and m

27. A long straight wire of radius R carries current i . The magnetic field inside the wire at distance r from its centre is expressed as :

(a) $\left(\frac{\mu_0 i}{\pi R^2}\right) \cdot r$ (b) $\left(\frac{2\mu_0 i}{\pi R^2}\right) \cdot r$
 (c) $\left(\frac{\mu_0 i}{2\pi R^2}\right) \cdot r$ (d) $\left(\frac{\mu_0 i}{2\pi R}\right) \cdot r$

28. If $i_1 = 3 \sin \omega t$ and $i_2 = 4 \cos \omega t$, then i_3 is



(a) $5 \sin(\omega t + 53^\circ)$ (b) $5 \sin(\omega t + 37^\circ)$
 (c) $5 \sin(\omega t + 45^\circ)$ (d) $5 \cos(\omega t + 53^\circ)$

29. The equation of AC voltage is $E = 220 \sin(\omega t + \pi/6)$ and the A.C. current is $I = 10 \sin(\omega t + \pi/6)$. The average power dissipated is
 (a) 150 W (b) 550 W
 (c) 250 W (d) 50 W

30. The current in an $L-R$ circuit builds up to $(3/4)^{\text{th}}$ of its steady state value in 4 seconds. The time constant of this circuit is

(a) $\frac{1}{\ln 2} \text{ sec}$ (b) $\frac{2}{\ln 2} \text{ sec}$
 (c) $\frac{3}{\ln 2} \text{ sec}$ (d) $\frac{4}{\ln 2} \text{ sec}$

31. The magnetic flux in a closed circuit of resistance 10Ω varies with time as $\phi = (2t - 4t^2 + 1)$. The current in the loop will change its direction after a time of
 (a) 0.25 sec (b) 0.5 sec
 (c) 1 sec (d) none

32. A fish looking up through the water sees the outside world contained in a circular horizon. If

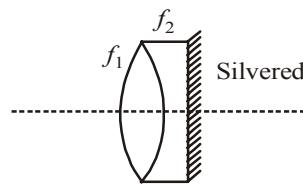
the refractive index of water is $4/3$ and the fish is 12 cm below the surface, the radius of this circle (in cm) is

(a) $36\sqrt{5}$ (b) $4\sqrt{5}$
 (c) $36\sqrt{7}$ (d) $36/\sqrt{7}$

33. A metal ball of mass 2 kg moving with a velocity of 36 km/h has a head on collision with a stationary ball of mass 3 kg. If after the collision, the two balls move together, the loss in kinetic energy due to collision is

(a) 140 J (b) 100 J
 (c) 60 J (d) 40 J

34. Two lenses of focal length $f_1 = 10 \text{ cm}$ and $f_2 = -20 \text{ cm}$ are kept as shown. The resultant power of combination will be



(a) -10D (b) 5D
 (c) 0 (d) 10D

35. When a plastic thin film of refractive index 1.45 is placed in the path of one of the interfering waves then the central fringe is displaced through width of five fringes. The thickness of the film, if the wavelength of light is 5890\AA , will be

(a) $6.544 \times 10^{-4} \text{ cm}$ (b) $6.544 \times 10^{-4} \text{ m}$
 (c) $6.54 \times 10^{-4} \text{ cm}$ (d) $6.5 \times 10^{-4} \text{ cm}$

36. An unpolarised beam of intensity I_0 is incident on a pair of nicols making an angle of 60° with each other. The intensity of light emerging from the pair is

(a) I_0 (b) $I_0/2$
 (c) $I_0/4$ (d) $I_0/8$

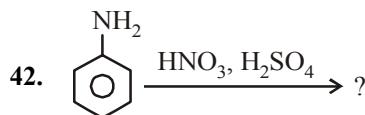
37. The half life of radioactive Radon is 3.8 days.

The time at the end of which $\frac{1}{20}$ th of the radon sample will remain undecayed is (given $\log_{10} e = 0.4343$)

(a) 3.8 days (b) 16.5 days
 (c) 33 days (d) 76 days.

PART - II (CHEMISTRY)

41. IUPAC name of valeric acid is
(a) Propanoic acid (b) Butanoic acid
(c) Ethanoic acid (d) Pentanoic acid



The product P for the above given reaction will be

44. Which of the following complex will show fac & mer isomerism?

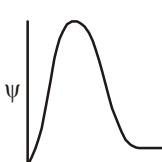
- (a) $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$
- (b) $[\text{CoCl}_2(\text{en})_2]^+$
- (c) $[(\text{Co}(\text{NH}_3)\text{Cl}(\text{en})_2)]^{2+}$
- (d) $[\text{Co}(\text{NH}_3)_2\text{Cl}_2(\text{en})]^+$

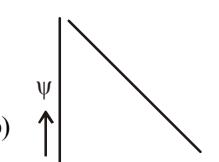
45. Which of these undergo polymerisation?

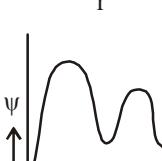
(a) CH_3OH (b) $\text{C}_2\text{H}_5\text{OH}$

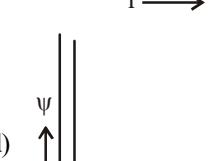
(c) $\text{CH}_3 - \overset{\text{O}}{\underset{\parallel}{\text{C}}} - \text{CH}_3$ (d) CH_3CHO

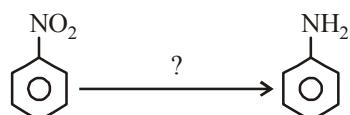
46. Which of the following graph represents variation of 2p-orbital wave function with distance from the nucleus?

(a) 

(b) 

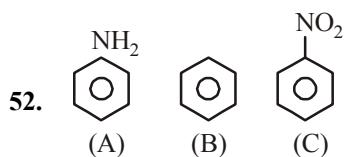
(c) 

(d) 



51. Among the following the incorrect statement is

- Density of crystals remains unaffected due to Frenkel defect.
- In BCC unit cell the void space is 32%.
- Density of crystals decreases due to Schottky defect.
- Electrical conductivity of semiconductors and metals increases with increase in temperature.



The correct order of electrophilic substitution for the compounds given above will be

- $A > B > C$
- $C > B > A$
- $B > C > A$
- $B > A > C$

53. For mesotartaric acid, the correct configuration for chiral carbon is

- 2R, 3S
- 2R, 3R
- 2S, 3R
- 1D, 2L

54. Which of the two acids form anhydrides?

- Oxalic acid
- Succinic acid
- Benzoic acid
- Phthalic acid

- I & III
- II & IV
- II & III
- III & IV

55. By which reaction ketal is formed?

- Glycol with acetone
- Hydration of glycol
- Condensation of glycol
- Glycol with acetaldehyde

56. Which one of the following show stereoisomerism?

- 2-Butene
- 3-Methyl but-1-ene
- 2-Methyl butene
- Butanol

57. Acetophenone and Benzophenone can be distinguished by which of the following test

- Knoeveangel reaction
- Canizzaro's reaction
- Aldol condensation
- HVZ Reaction



The product P in this reaction is

- $R - NH_2$
- $R - \underset{H}{N} - CH_3$
- $R - CH_3$
- $R - N - (CH_3)_2$

59. The protein present in the hair is

- Lysine
- Myosine
- Keratin
- Alanine

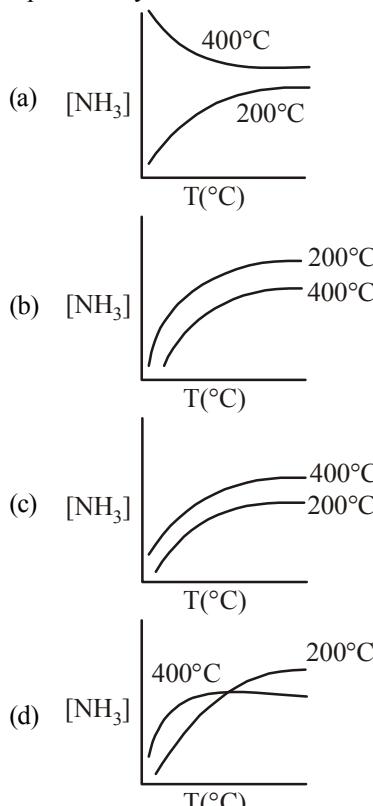
60. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litres. Then ΔS (cal $\text{deg}^{-1} \text{mol}^{-1}$) for this process is : ($R = 2 \text{ cal K}^{-1} \text{ mol}^{-1}$)

- 7.12
- 8.314
- 4.6
- 3.95

61. For a reaction $A \rightarrow B$; $\Delta H = 20 \text{ kJ mol}^{-1}$ the activation energy of the forward reaction is 85 kJ/mol. The activation energy of the backward reaction will be

- 105 kJ/mol
- 65 kJ/mol
- 45 kJ/mol
- 75 kJ/mol

62. If the reaction $N_2 + 3H_2 = 2NH_3$ occurs at 200°C and 1000 atm then the graph showing the correct equilibrium yield at 400°C is



63. Group 15 elements have more electron gain enthalpy than group 16-elements. The correct reason for this is

(a) Half-filled stability of gp. 15 elements.
 (b) Poor shielding in gp. 15
 (c) Poor shielding in gp. 16
 (d) Half-filled stability of gp. 16 elements

64. t-butyl $\text{--CH}=\text{CH}--\underset{\substack{\parallel \\ \text{O}}}{\text{C}}\text{--OH}$ can't give decarboxylation while normally α - β unsaturated acid give this reaction because
 (a) t-butyl gp. has large size and does not let the COOH group to leave.
 (b) t-butyl gp. can't extract H from COOH.
 (c) t-butyl gp. stabilise carbanion formed.
 (d) t-butyl gp. does not allow this composition to convert to β - γ -unsaturated acid

65. Which type of carbocation is/are formed when  is treated with an acid?
 (a) 1° (b) 2°
 (c) 3° (d) All the three

66. For hydrogen-oxygen fuel cell, the cell reaction is

$$2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{H}_2\text{O}(\ell)$$

 If $\Delta G_f^\circ(\text{H}_2\text{O}) = -237.2 \text{ kJ mol}^{-1}$, then emf of this cell is
 (a) +2.46 V (b) -2.46 V
 (c) +1.23 V (d) -1.23 V

67. At 298 K, the conductivity of a saturated solution of AgCl in water is $2.6 \times 10^{-6} \text{ S cm}^{-1}$. Its solubility product at 298 K.
 Given : $\lambda^\infty(\text{Ag}^+) = 63.0 \text{ S cm}^2 \text{ mol}^{-1}$,
 $\lambda^\infty(\text{Cl}^-) = 67.0 \text{ S cm}^2 \text{ mol}^{-1}$
 (a) $2.0 \times 10^{-5} M^2$ (b) $4.0 \times 10^{-10} M^2$
 (c) $4.0 \times 10^{-16} M^2$ (d) $2 \times 10^{-8} M^2$

68. Standard entropy of X_2 , Y_2 and XY_3 are 60, 40 and $50 \text{ JK}^{-1} \text{ mol}^{-1}$, respectively. For the reaction,

$$\frac{1}{2}\text{X}_2 + \frac{3}{2}\text{Y}_2 \rightarrow \text{XY}_3, \Delta H = -30 \text{ kJ}$$
, to be at equilibrium, the temperature will be
 (a) 1250 K (b) 500 K
 (c) 750 K (d) 1000 K

69. The enthalpy change for a given reaction at 298 K is $-x \text{ J mol}^{-1}$. For the reaction to be spontaneous at 298 K, the entropy change at that temperature
 (a) can be negative, but numerically greater than $\frac{x}{298} \text{ J K}^{-1}$
 (b) can be negative, but numerically smaller than $\frac{x}{298} \text{ J K}^{-1}$
 (c) can not be negative
 (d) can not be positive

70. a moles of PCl_5 is heated in a closed container to equilibrate $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$ at a pressure of P atm. If x moles of PCl_5 dissociate at equilibrium, then
 (a) $\frac{x}{a} = \frac{K_p}{K_p + P}$ (b) $\frac{x}{a} = \left(\frac{K_p + P}{K_p} \right)^{1/2}$
 (c) $\frac{x}{a} = \left(\frac{K_p}{P} \right)^{1/2}$ (d) $\frac{x}{a} = \left(\frac{K_p}{K_p + P} \right)^{1/2}$

71. A plot of $\ln K$ against $\frac{1}{T}$ (abscissa) is expected to be a straight line with intercept on ordinate axis equal to
 (a) $\frac{\Delta S^\circ}{2.303R}$ (b) $\frac{\Delta S^\circ}{R}$
 (c) $-\frac{\Delta S^\circ}{R}$ (d) $R \times \Delta S^\circ$

72. In a reaction $A \rightarrow \text{Products}$, when start is made from $8.0 \times 10^{-2} M$ of A , half-life is found to be 120 minute. For the initial concentration $4.0 \times 10^{-2} M$, the half-life of the reaction becomes 240 minute. The order of the reaction is :
 (a) zero (b) one
 (c) two (d) 0.5

73. A reaction : $\text{A}_2 + \text{B} \rightarrow \text{Products}$, involves the following mechanism :

$$\text{A}_2 \rightleftharpoons 2\text{A} \text{ (fast)}$$

$$(\text{A} \text{ being the intermediate})$$

$$\text{A} + \text{B} \xrightarrow{k_2} \text{Products} \text{ (slow)}$$
. The rate law consistent to this mechanism is :
 (a) rate = $k[\text{A}_2][\text{B}]$ (b) rate = $k[\text{A}_2]^2[\text{B}]$
 (c) rate = $k[\text{A}_2]^{1/2}[\text{B}]$ (d) rate = $k[\text{A}_2][\text{B}]^2$

74. The following data were obtained for a given reaction at 300 K.

Reaction	Energy of activation (kJ mol ⁻¹)
(i) uncatalysed	76
(ii) catalysed	57

The factor by which rate of catalysed reaction is increased, is

(a) 21 (b) 2100
(c) 2000 (d) 1200

75. The wave number of the first emission line in the Balmer series of H-Spectrum is :

(R = Rydberg constant) :

(a) $\frac{5}{36}R$ (b) $\frac{9}{400}R$
(c) $\frac{7}{6}R$ (d) $\frac{3}{4}R$

76. Which one of the following reactions of xenon compounds is not feasible?

(a) $3\text{XeF}_4 + 6\text{H}_2\text{O} \longrightarrow 2\text{Xe} + \text{XeO}_3 + 12\text{HF} + 1.5\text{O}_2$
(b) $2\text{XeF}_2 + 2\text{H}_2\text{O} \longrightarrow 2\text{Xe} + 4\text{HF} + \text{O}_2$
(c) $\text{XeF}_6 + \text{RbF} \longrightarrow \text{Rb}[\text{XeF}_7]$
(d) $\text{XeO}_3 + 6\text{HF} \longrightarrow \text{XeF}_6 + 3\text{H}_2\text{O}$

77. Anisole is treated with HI under two different conditions.



The nature of A to D will be

(a) A and B are CH_3I and $\text{C}_6\text{H}_5\text{OH}$, while C and D are CH_3OH and $\text{C}_6\text{H}_5\text{I}$
(b) A and B are CH_3OH and $\text{C}_6\text{H}_5\text{I}$, while C and D are CH_3I and $\text{C}_6\text{H}_5\text{OH}$
(c) Both A and B as well as both C and D are CH_3I and $\text{C}_6\text{H}_5\text{OH}$
(d) A and B are CH_3I and $\text{C}_6\text{H}_5\text{OH}$, while there is no reaction in the second case.

78. Phenol undergoes electrophilic substitution more easily than benzene because

(a) $-\text{OH}$ group exhibits $+M$ effect and hence increases the electron density on the *o*- and *p*-positions.
(b) oxocation is more stable than the carbocation
(c) both (a) and (b)
(d) $-\text{OH}$ group exhibits acidic character

79. Which of the following name reaction is not used for introducing a $-\text{COOH}$ group?

(a) Cannizzaro reaction
(b) Benzilic acid rearrangement
(c) Baeyer – Villiger oxidation
(d) Iodoform reaction

80. Esterification of acid chloride with ethanol is usually carried out in the presence of pyridine. The function of pyridine is

(a) to remove HCl formed in the reaction
(b) to react with acid chloride to form an acylpyridinium ion
(c) both (a) and (b)
(d) as a catalyst

PART - III (MATHEMATICS)

81. The solution of the differential equation

$$(1 + y^2) + (x - e^{\tan^{-1} y}) \frac{dy}{dx} = 0$$

(a) $(x - 2) = ke^{-\tan^{-1} y}$
(b) $2xe^{\tan^{-1} y} = e^{2\tan^{-1} y} + k$
(c) $xe^{\tan^{-1} y} = \tan^{-1} y + k$
(d) $xe^{2\tan^{-1} y} = e^{\tan^{-1} y} + k$

82. A tetrahedron has vertices at O (0, 0, 0), A (1, 2, 1) B (2, 1, 3) and C (-1, 1, 2). Then the angle between the faces OAB and ABC will be

(a) 120° (b) $\cos^{-1}\left(\frac{17}{31}\right)$
(c) 30° (d) 90°

83. The foci of the ellipse $\frac{x^2}{16} + \frac{y^2}{b^2} = 1$ and the

hyperbola $\frac{x^2}{144} - \frac{y^2}{81} = \frac{1}{25}$ coincide then value of b^2 is

(a) 1 (b) 5
(c) 7 (d) 9

84. If the tangent to the function $y = f(x)$ at (3, 4)

makes an angle of $\frac{3\pi}{4}$ with the positive direction of x-axis in anticlockwise direction then $f'(3)$ is

(a) -1 (b) 1
 (c) $\frac{1}{\sqrt{3}}$ (d) $\sqrt{3}$

85. The probability of India winning a test match against Australia is $\frac{1}{2}$ assuming independence from match to match. The probability that in a match series India's second win occurs at third test match is

(a) $\frac{1}{8}$ (b) $\frac{1}{4}$ (c) $\frac{1}{2}$ (d) $\frac{2}{3}$

86. If $|\vec{a}| = 3, |\vec{b}| = 2, |\vec{c}| = 1$ then the value of $|\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}|$ is (given that $\vec{a} + \vec{b} + \vec{c} = 0$)

(a) -7 (b) 7 (c) 14 (d) -14

87. If $f(x) = x^2, g(x) = 2x, 0 \leq x \leq 2$ then the value of $I(x) = \int_0^2 \max(f(x), g(x)) dx$ is

(a) $\frac{10}{3}$ (b) $\frac{1}{3}$ (c) $\frac{11}{3}$ (d) 32

88. If A and B are matrices and $B = ABA^{-1}$ then the value of $(A + B)(A - B)$ is

(a) $A^2 + B^2$ (b) $A^2 - B^2$
 (c) $A + B$ (d) $A - B$

89. The value of $(1 + \omega - \omega^2)^7$ is

(a) $128\omega^2$ (b) $-128\omega^2$
 (c) 128ω (d) -128ω

90. The moment about the point $\hat{i} + 2\hat{j} + 3\hat{k}$ of a force represented by $\hat{i} + \hat{j} + \hat{k}$ acting through the point $2\hat{i} + 3\hat{j} + \hat{k}$ is

(a) $3\hat{i} + 3\hat{j}$ (b) $3\hat{i} + \hat{j}$
 (c) $-\hat{i} + \hat{j}$ (d) $3\hat{i} - 3\hat{j}$

91. If $g(x)$ is a polynomial satisfying $g(x)g(y) = g(x) + g(y) + g(xy) - 2$ for all real x and y and $g(2) = 5$ then $\lim_{x \rightarrow 3} g(x)$ is

(a) 9 (b) 10
 (c) 25 (d) 20

92. The equation of one of the common tangents to the parabola $y^2 = 8x$ and $x^2 + y^2 - 12x + 4 = 0$ is

(a) $y = -x + 2$ (b) $y = x - 2$
 (c) $y = x + 2$ (d) None of these

93. If $e^x = y + \sqrt{1 + y^2}$, then the value of y is

(a) $\frac{1}{2}(e^x + e^{-x})$ (b) $\frac{1}{2}(e^x - e^{-x})$
 (c) $e^x - e^{\frac{-x}{2}}$ (d) $e^x + e^{\frac{-x}{2}}$

94. What is the area of a loop of the curve $r = \sin 3\theta$?

(a) $\frac{\pi a^2}{6}$ (b) $\frac{\pi a^2}{8}$
 (c) $\frac{\pi a^2}{12}$ (d) $\frac{\pi a^2}{24}$

95. Convert the hexadecimal numeral ABCD into binary numeral

(a) $(1010101111001101)_2$
 (b) $(1001000011111111)_2$
 (c) $(111111000010001)_2$
 (d) $(1000100100111100)_2$

96. The normal at the point $(at_1^2, 2at_1)$ on the parabola, cuts the parabola again at the point whose parameter is

(a) $t_2 = t_1 - \frac{2}{t_1}$ (b) $t_2 = t_1 + \frac{2}{t_1}$
 (c) $t_2 = -\left(t_1 + \frac{2}{t_1}\right)$ (d) None of these

97. The distance moved by the particle in time t is given by $s = t^3 - 12t^2 + 6t + 8$. At the instant, when its acceleration is zero the velocity is :

(a) 42 (b) -42
 (c) 48 (d) -48

98. The logical expression X , in its simplest form for the truth table

a	b	X
1	0	0
1	1	1
0	1	0
0	0	0

is

(a) $X = a \cdot b$ (b) $X = a + b$
 (c) $X = a' \cdot b$ (d) $X = a \cdot b'$

99. The value of $\cos\left(\frac{1}{2}\cos^{-1}\frac{1}{8}\right)$ is equal to

(a) $-3/4$ (b) $3/4$
 (c) $1/16$ (d) $1/4$

100. Consider the objective function $Z = 40x + 50y$. The minimum number of constraints that are required to maximize Z are

(a) 4 (b) 2
 (c) 3 (d) 1

101. In a culture the bacteria count is 1,00,000. The number is increased by 10% in 2 hours. In how many hours will the count reach 2,00,000 if the rate of growth of bacteria is proportional to the number present.

(a) $\frac{2}{\log \frac{11}{10}}$

(b) $\frac{2 \log 2}{\log \left(\frac{11}{10}\right)}$

(c) $\frac{\log 2}{\log 11}$

(d) $\frac{\log 2}{\log \left(\frac{11}{10}\right)}$

102. The value of $\sin^{-1} \left(\frac{1}{\sqrt{5}} \right) + \cot^{-1}(3)$ is

(a) $\frac{\pi}{6}$

(b) $\frac{\pi}{4}$

(c) $\frac{\pi}{3}$

(d) $\frac{\pi}{2}$

103. If $a = \cos 2\alpha + i \sin 2\alpha$, $b = \cos 2\beta + i \sin 2\beta$, $c = \cos 2\gamma + i \sin 2\gamma$ and $d = \cos 2\delta + i \sin 2\delta$, then

$$\sqrt{abcd} + \frac{1}{\sqrt{abcd}} =$$

(a) $\sqrt{2} \cos(\alpha + \beta + \gamma + \delta)$
 (b) $2 \cos(\alpha + \beta + \gamma + \delta)$
 (c) $\cos(\alpha + \beta + \gamma + \delta)$
 (d) None of these

104. If the mean of a binomial distribution is 25, then its standard deviation lies in the interval

(a) $[0, 5]$ (b) $(0, 5]$
 (c) $[0, 25]$ (d) $(0, 25]$

105. Number of ways of selecting three squares on a chessboard so that all the three be on a diagonal line of the board or parallel to it is

(a) 196 (b) 126
 (c) 252 (d) 392

106. If A and B are two matrices such that rank of A = m and rank of B = n, then

(a) $\text{rank}(AB) = mn$
 (b) $\text{rank}(AB) \geq \text{rank}(A)$
 (c) $\text{rank}(AB) \geq \text{rank}(B)$
 (d) $\text{rank}(AB) \leq \min(\text{rank } A, \text{rank } B)$

107. A variable plane remains at constant distance p from the origin. If it meets coordinate axes at points A, B, C then the locus of the centroid of $\triangle ABC$ is

(a) $x^{-2} + y^{-2} + z^{-2} = 9p^{-2}$

(b) $x^{-3} + y^{-3} + z^{-3} = 9p^{-3}$

(c) $x^2 + y^2 + z^2 = 9p^2$

(d) $x^3 + y^3 + z^3 = 9p^3$

108. While shuffling a pack of 52 playing cards, 2 are accidentally dropped. The probability that the missing cards to be of different colours is

(a) $\frac{29}{52}$ (b) $\frac{1}{2}$ (c) $\frac{26}{51}$ (d) $\frac{27}{51}$

109. Which of the following is INCORRECT for the hyperbola $x^2 - 2y^2 - 2x + 8y - 1 = 0$

(a) Its eccentricity is $\sqrt{2}$
 (b) Length of the transverse axis is $2\sqrt{3}$
 (c) Length of the conjugate axis is $2\sqrt{6}$
 (d) Latus rectum is $4\sqrt{3}$

110. A box contains 20 identical balls of which 10 are blue and 10 are green. The balls are drawn at random from the box one at a time with replacement. The probability that a blue ball is drawn 4th time on the 7th draw is

(a) $\frac{27}{32}$ (b) $\frac{5}{64}$ (c) $\frac{5}{32}$ (d) $\frac{1}{2}$

111. The number of common tangents to the circles $x^2 + y^2 - 6x - 14y + 48 = 0$ and $x^2 + y^2 - 6x = 0$ is

(a) 1 (b) 2
 (c) 0 (d) 4

112. The solution of the equation $\cos^2 \theta + \sin \theta + 1 = 0$, lies in the interval

(a) $\left(-\frac{\pi}{4}, \frac{\pi}{4}\right)$ (b) $\left(\frac{\pi}{4}, \frac{3\pi}{4}\right)$
 (c) $\left(\frac{3\pi}{4}, \frac{5\pi}{4}\right)$ (d) $\left(\frac{5\pi}{4}, \frac{7\pi}{4}\right)$

113. If $f(x) = (1 + x)^{2/x}$ for $x \neq 0$ and $f(0) = e^2$ is

(a) left continuous only at $x = 0$
 (b) right continuous only at $x = 0$
 (c) continuous at $x = 0$
 (d) discontinuous at $x = 0$

114. If $y = 2^{x/\ln x}$ then $\frac{dy}{dx}$ at $x = e$ is

(a) e (b) $2^e \log 2$
 (c) $\log 2$ (d) 0

PART - IV (ENGLISH)

115. $\int \frac{1}{x^2(x^4+1)^{3/4}} dx$ is equal to

(a) $\left(1+\frac{1}{x^4}\right)^{1/4} + C$ (b) $(x^4+1)^{1/4} + C$
 (c) $\left(1-\frac{1}{x^4}\right)^{1/4} + C$ (d) $-\left(1+\frac{1}{x^4}\right)^{1/4} + C$

116. If the letters of the word KRISNA are arranged in all possible ways and these words are written out as in a dictionary, then the rank of the word KRISNA is

(a) 324 (b) 341
 (c) 359 (d) None of these

117. The shortest distance between the lines $x = y + 2 = 6z - 6$ and $x + 1 = 2y = -12z$ is

(a) $\frac{1}{2}$ (b) 2
 (c) 1 (d) $\frac{3}{2}$

118. The domain and range of the function f given by $f(x) = 2 - |x - 5|$ is

(a) Domain = \mathbb{R}^+ , Range = $(-\infty, 1]$
 (b) Domain = \mathbb{R} , Range = $(-\infty, 2]$
 (c) Domain = \mathbb{R} , Range = $(-\infty, 2)$
 (d) Domain = \mathbb{R}^+ , Range = $(-\infty, 2]$

119. The number of surjective functions from A to B where $A = \{1, 2, 3, 4\}$ and $B = \{a, b\}$ is

(a) 14 (b) 12
 (c) 2 (d) 15

120. If $f(a+b-x) = f(x)$, then $\int_a^b x f(x) dx$ is

equal to

(a) $\frac{a+b}{2} \int_a^b f(b-x) dx$
 (b) $\frac{a+b}{2} \int_a^b f(b+x) dx$
 (c) $\frac{b-a}{2} \int_a^b f(x) dx$
 (d) $\frac{a+b}{2} \int_a^b f(x) dx$

Direction (Qs. 121-123) Read the passage carefully and answer the questions given below.

Laws of nature are not commands but statements of acts. The use of the word "law" in this context is rather unfortunate. It would be better to speak of uniformities in nature. This would do away with the elementary fallacy that a law implies a law giver. If a piece of matter does not obey a law of nature it is punished. On the contrary, we say that the law has been incorrectly started.

121. If a piece of matter violates nature's law, it is not punished because

(a) it is not binding to obey it
 (b) there is no superior being to enforce the law of nature
 (c) it cannot be punished
 (d) it simply means that the facts have not been correctly stated by law

122. Laws of nature differ from man-made laws because

(a) the former state facts of Nature
 (b) they must be obeyed
 (c) they are natural
 (d) unlike human laws, they are systematic

123. The laws of nature based on observation are

(a) conclusion about the nature of the universe.
 (b) true and unfalsifiable.
 (c) figments of the observer's imagination.
 (d) subject to change in the light of new facts.

124. **Direction:** This question presents a sentence, part of which or all of which is underlined. Beneath the sentence you will find four ways of phrasing the underlined part. The first of these repeats the original; the other three are different. If you think the original is best, choose the first answer; otherwise choose one of the others.

The administration discussed whether the number of students studying European languages was likely to decline when the senior lecturer retired.

(a) whether the number of students studying European languages was likely
 (b) whether the number of students studying European languages were likely
 (c) if the students studying European languages were likely
 (d) if the number of European language students were likely

125. Choose the best pronunciation of the word, Restaurant, from the following options.

(a) res-trawnt (b) res-tuh-rawnt
 (c) rest-rant (d) resto-raunt