PART-I PHYSICS

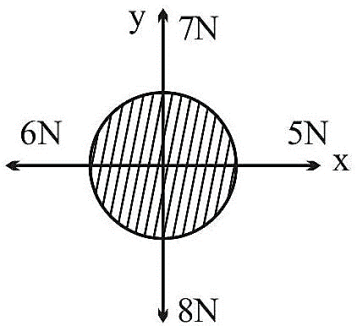
SECTION-A

1. **In AM modulation, a signal is modulated on a carrier wave such that maximum and minimum amplitude are found to be 6 V and 2 V respectively. The modulation index is**
   (a) 100% (b) 80%
   (c) 60% (d) 50%
2. **The electric current in a circular coil of 2 turns produces a magnetic induction B_1 at its centre. The coil is unwound and is rewound into a circular coil of 5 turns and the same current produces a magnetic induction B_2 at its centre.**

The ratio of $\frac{B_2}{B_1}$ is:

(a) $\frac{5}{2}$ (b) $\frac{25}{4}$
(c) $\frac{5}{4}$ (d) $\frac{25}{2}$

3. **A drop of liquid of density ρ is floating half immersed in a liquid of density σ and surface tension $7.5 \times 10^{-4}\text{Ncm}^{-1}$. The radius of drop in cm will be : (Take : $g = 10\ \text{m/s}^2$)**
   (a) $\frac{15}{\sqrt{2\rho-\sigma}}$ (b) $\frac{15}{\sqrt{\rho-\sigma}}$
   (c) $\frac{3}{2\sqrt{\rho-\sigma}}$ (d) $\frac{3}{20\sqrt{2\rho-\sigma}}$
4. **Two billiard balls of mass 0.05 kg each moving in opposite directions with $10\ \text{ms}^{-1}$ collide and rebound with the same speed. If the time duration of contact is $t = 0.005$ s, then what is the force exerted on the ball due to each other?**
   (a) 100 N (b) 200 N
   (c) 300 N (d) 400 N
5. **For a free body diagram shown in the figure, the four forces are applied in the ' x ' and ' y ' directions. What additional force must be applied and at what angle with positive x-axis so that the net acceleration of body is zero?**



(a) $\sqrt{2}$ N, 45° (b) $\sqrt{2}$ N, 135°
(c) $\frac{2}{\sqrt{3}}$ N, 30° (d) 2 N, 45°

6. **Capacitance of an isolated conducting sphere of radius R_1 becomes n times when it is enclosed by a concentric conducting sphere of radius R_2 connected to earth. The ratio of their radii $\left(\frac{R_2}{R_1}\right)$ is:**
   (a) $\frac{n}{n-1}$ (b) $\frac{2n}{2n+1}$
   (c) $\frac{n+1}{n}$ (d) $\frac{2n+1}{n}$
7. **The ratio of wavelengths of proton and deuteron accelerated by potential V_p and V_d is $1:\sqrt{2}$. Then, the ratio of V_p to V_d will be**
   (a) 1:1 (b) $\sqrt{2}:1$
   (c) 2:1 (d) 4:1
8. **For an object placed at a distance 2.4 m from a lens, a sharp focused image is observed on a screen placed at a distance 12 cm from the lens. A glass plate of refractive index 1.5 and thickness 1 cm is introduced**

between lens and screen such that the glass plate plane faces parallel to the screen. By what distance should the object be shifted so that a sharp focused image is observed again on the screen?

(a) 0.8 m (b) 3.2 m
(c) 1.2 m (d) 5.6 m

9. Light wave traveling in air along x-direction is given by $E_y = 540\sin\pi \times 10^4(x - ct)Vm^{-1}$. Then, the peak value of magnetic field of wave will be (Given $c = 3 \times 10^8\ ms^{-1}$)

(a) 18×10^{-7} T (b) 54×10^{-7} T
(c) 54×10^{-8} T (d) 18×10^{-8} T

10. When you walk through a metal detector carrying a metal object in your pocket, it raises an alarm. This phenomenon works on

(a) Electromagnetic induction

(b) Resonance in ac circuits

(c) Mutual induction in ac circuits

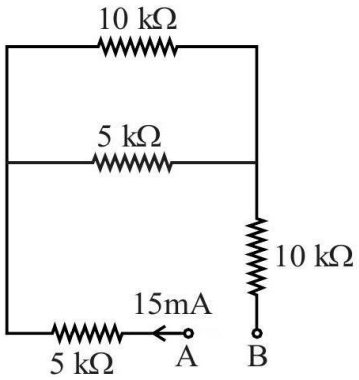
(d) interference of electromagnetic waves

11. An electron with energy $0.1keV$ moves at right angle to the earth's magnetic field of $1 \times 10^{-4}Wbm^{-2}$. The frequency of revolution of the electron will be

(Take mass of electron $= 9.0 \times 10^{-31}$ kg)

(a) 1.6×10^5 Hz (b) 5.6×10^5 Hz
(c) 2.8×10^6 Hz (d) 1.8×10^6 Hz

12. A current of 15 mA flows in the circuit as shown in figure. The value of potential difference between the points A and B will be



(a) 50 V (b) 75 V
(c) 150 V (d) 275 V

13. The length of a seconds pendulum at a height $h = 2R$ from earth surface will be: (Given: R = Radius of earth and acceleration due to gravity at the surface of earth $g = \pi^2\ m/s^{-2}$)

(a) $\frac{2}{9}$ m (b) $\frac{4}{9}$ m
(c) $\frac{8}{9}$ m (d) $\frac{1}{9}$ m

14. Sound travels in a mixture of two moles of helium and n moles of hydrogen. If rms speed of gas molecules in the mixture is $\sqrt{2}$ times the speed of sound, then the value of n will be

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

15. Let η_1 is the efficiency of an engine at $T_1 = 447^\circ C$ and $T_2 = 147^\circ C$ while η_2 is the efficiency at $T_1 = 947^\circ C$ and $T_2 = 47^\circ C$. The ratio $\frac{\eta_1}{\eta_2}$ will be:

(a) 0.41 (b) 0.56
(c) 0.73 (d) 0.70

16. An object is taken to a height above the surface of earth at a distance $\frac{5}{4}$R from the centre of the earth. Where radius of earth, R = 6400 km. The percentage decrease in the weight of the object will be
(a) 36% (b) 50%
(c) 64% (d) 25%

17. A bag of sand of mass 9.8 kg is suspended by a rope. A bullet of 200 g travelling with speed 10 ms^{-1} gets embedded in it, then loss of kinetic energy will be
(a) 4.9 J (b) 9.8 J
(c) 14.7 (d) 19.6 J

18. A ball is projected from the ground with a speed 15 ms^{-1} at an angle θ with horizontal so that its range and maximum height are equal, then'tan θ′ will be equal to
(a) $\frac{1}{4}$ (b) $\frac{1}{2}$
(c) 2 (d) 4

19. The maximum error in the measurement of resistance, current and time for which current flows in an electrical circuit are 1%,2% and 3% respectively. The maximum percentage error in the detection of the dissipated heat will be:
(a) 2 (b) 4
(c) 6 (d) 8

20. Hydrogen atom from excited state comes to the ground by emitting a photon of wavelength λ. The value of principal quantum number ' n ' of the excited state will be:

(R : Rydberg constant)

(a) $\sqrt{\frac{\lambda R}{\lambda-1}}$ (b) $\sqrt{\frac{\lambda R}{\lambda R-1}}$

(c) $\sqrt{\frac{\lambda}{\lambda R-1}}$ (d) $\sqrt{\frac{\lambda R^2}{\lambda R-1}}$

SECTION-B

21. A particle is moving in a straight line such that its velocity is increasing at 5 ms^{-1} per meter. The acceleration of the particle is ms^{-2} at a point where its velocity is 20 ms^{-1}

22. Three identical spheres each of mass M are placed at the corners of a right -angled triangle with mutually perpendicular sides equal to 3 m each. Taking point of intersection of mutually perpendicular sides as origin, the magnitude of position vector of centre of mass of the system will be $\sqrt{x}$m. The value of x is

23. A block of ice of mass 120 g at temperature 0°C is put in 300gm of water at 25°C. The xg of ice melts as the temperature of the water reaches 0°C. The value of x is [Use: Specific heat capacity of water = 4200 Jkg^{-1} K^{-1}, Latent heat of ice = $3.5 \times 10^5 Jkg^{-1}$]

24. $\frac{x}{x+4}$ is the ratio of energies of photons produced due to transition of an electron of hydrogen atom from its

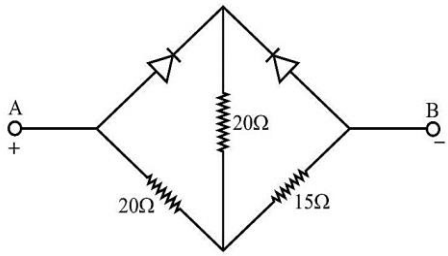
(i) third permitted energy level to the second level and

(ii) the highest permitted energy level to the second permitted level.

The value of x will be

25. In a potentiometer arrangement, a cell of emf 1.20 V gives a balance point at 36 cm length of wire. This cell is now replaced by another cell of emf 1.80 V. The difference in balancing length of potentiometer wire in above conditions will be cm.

26. Two ideal diodes are connected in the network as shown in figure. The equivalent resistance between A and B is Ω.



27. Two waves executing simple harmonic motion travelling in the same direction with same amplitude and frequency are superimposed. The resultant amplitude is equal to the $\sqrt{3}$ times of amplitude of individual motions. The phase difference between the two motions is (degree)

28. Two parallel plate capacitors of capacity C and 3C are connected in parallel combination and charged to a potential difference 18 V. The battery is then disconnected and the space between the plates of the capacitor of capacity C is completely filled with a material of dielectric constant 9. The final potential difference across the combination of capacitors will be V

29. A convex lens of focal length 20 cm is placed in front of convex mirror with principal axis coinciding each other. The distance between the lens and mirror is 10 cm. A point object is placed on principal axis at a distance of 60 cm from the convex lens. The image formed by combination coincides the object itself. The focal length of the convex mirror is cm.

30. Magnetic flux (in weber) in a closed circuit of resistance 20Ω varies with time t(s) as $\phi = 8t^2 - 9t + 5$. The magnitude of the induced current at $t = 0.25$ s will be mA

PART-II CHEMISTRY

SECTION-A

31. Match List I with List II:

List-I (molecule)	List-II (hybridization; shape)
A. XeO_3	I. sp^3 d; linear
B. XeF_2	II. sp^3; pyramidal
C. $XeOF_4$	III. sp^3 d^3; distorted octahedral
D. XeF_6	IV. sp^3 d^2; square pyramidal

Choose the correct answer from the options given below:

(a) A-II, B-I, C-IV, D-III (b) A-II, B-IV, C-III, D-I

(c) A-IV, B-II, C-III, D-I (d) A-IV, B-II, C-I, D-III

32. Two solutions A and B are prepared by dissolving 1 g of non-volatile solutes X and Y. respectively in 1 kg of water. The ratio of depression in freezing points for A and B is found to be 1:4. The ratio of molar masses of X and Y is:

(a) 1:4 (b) 1:0.25

(c) 1:0.20 (d) 1:5

33. Ka_1, Ka_2 and Ka_3 are the respective ionization constants for the following reactions (a),(b), and (c).

(a) $H_2C_2O_4 \rightleftharpoons H^+ + HC_2O_4^-$

(b) $HC_2O_4^- \rightleftharpoons H^+ + HC_2O_4^{2-}$

(c) $H_2C_2O_4 \rightleftharpoons 2H^+ + C_2O_4^{2-}$

The relationship between K_{a_1}, K_{a_2} and K_{a_3} is given as

(a) $K_{a_3} = K_{a_1} + K_{a_2}$ (b) $K_{a_3} = K_{a_1} - K_{a_2}$

(c) $K_{a_3} = K_{a_1}/K_{a_2}$ (d) $K_{a_3} = K_{a_1} \times K_{a_2}$

34. The molar conductivity of a conductivity cell filled with 10 moles of 20 mLNaCl solution is Λ_{m1} and that of 20 moles another identical cell heaving 80 mLNaCl solution is Λ_{m2}, The conductivities exhibited by these two cells are same.

The relationship between Λ_{m2} and Λ_{m1} is

(a) $\Lambda_{m2} = 2\Lambda_{m1}$ (b) $\Lambda_{m2} = \Lambda_{m1}/2$

(c) $\Lambda_{m2} = \Lambda_{m1}$ (d) $\Lambda_{m2} = 4\Lambda_{m1}$

35. For micelle formation, which of the following statements are correct?

(A) Micelle formation is an exothermic process.

(B) Micelle formation is an endothermic process.

(C) The entropy change is positive.

(D) The entropy change is negative.

(a) A and D only (b) A and C only

(c) B and C only (d) B and D only

36. The first ionization enthalpies of Be, B, N and O follow the order

(a) O < N < B < Be (b) Be < B < N < O

(c) B < Be < N < O (d) B < Be < O < N

37. Given below are two statements.

Statement I: Pig iron is obtained by heating cast iron with scrap iron.

Statement II: Pig iron has a relatively lower carbon content than that of cast iron. In the light of the above statements, choose the correct answer from the options given below.

(a) Both Statement I and Statement II are correct.

(b) Both Statement I and Statement II are not correct.

(c) Statement I is correct but Statement II is not correct

(d) Statement I is not correct but Statement II is correct.

38. High purity ($> 99.95\%$) dihydrogen is obtained by

(a) reaction of zinc with aqueous alkali.

(b) electrolysis of acidified water using platinum electrodes.

(c) electrolysis of warm aqueous barium hydroxide solution between nickel electrodes.

(d) reaction of zinc with dilute acid.

39. The correct order of density is

(a) Be > Mg > Ca > Sr (b) Sr > Ca > Mg > Be

(c) Sr > Be > Mg > Ca (d) Be > Sr > Mg > Ca

40. The total number of acidic oxides from the following list is: $NO, N_2O, B_2O_3, N_2O_5, CO, SO_3, P_4O_{10}$

(a) 3 (b) 4

(c) 5 (d) 6

41. The correct order of energy of absorption for the following metal complexes is

A: $[Ni(en)_3]^{2+}$, B: $[Ni(NH_3)_6]^{2+}$, C: $[Ni(H_2O)_6]^{2+}$

(a) C < B < A (b) B < C < A

(c) C < A < B (d) A < C < B

42. Match List I with List II.

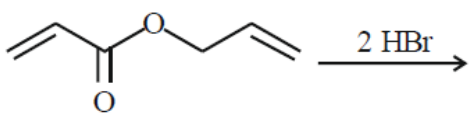
List-I		List-II	
A.	**Sulphate**	**I.**	**Pesticide**
B.	**Fluoride**	**II.**	**Bending of bones**
C.	**Nicotine**	**III.**	**Laxative effect**
D.	**Sodium arsinite**	**IV.**	**Herbicide**

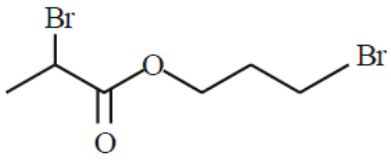
Choose the correct answer from the options given below:

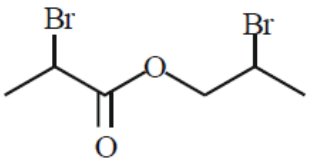
(a) A-II, B-III. C-IV, D-I (b) A-IV, B-III, C-II, D-I

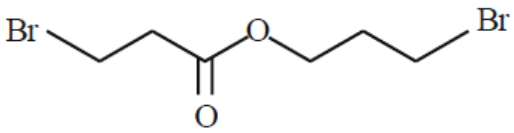
(c) A-III, B-II, C-I, D-IV (d) A-III, B-II, C-IV, D-I

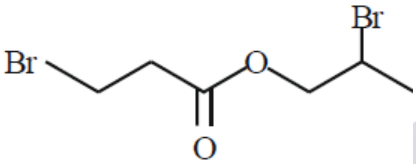
43. Major product of the following reaction is



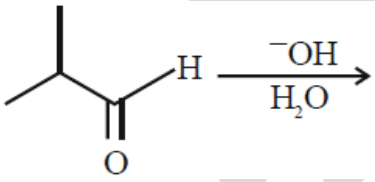
(a) 

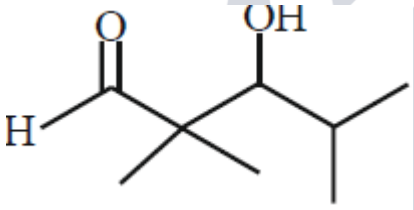
(b) 

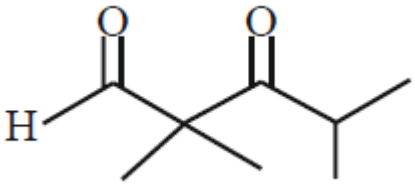
(c) 

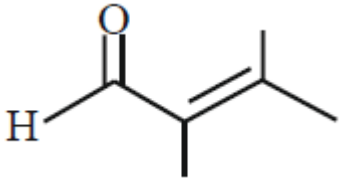
(d) 

44. What is the major product of the following reaction?

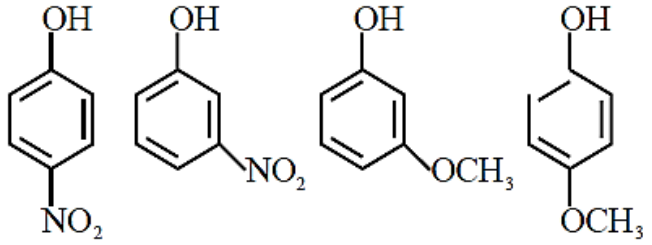
(a) 

(b) 

(c) 

(d) 

45. Arrange the following in decreasing acidic strength



(A) (B) (C) (D)

(a) A > B > C > D (b) B > A > C > D
(c) D > C > A > B (d) D > C > B > A

46.

$$CH_3-CH_2-CN \xrightarrow[Ether]{CH_3MgBr} A \xrightarrow{H_3O^+} B \xrightarrow[HCl]{Zn-Hg} C$$

The correct structure of C is

(a) $CH_3—CH_2—CH_2—CH_3$

(b) $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

(c) $CH_3-CH_2-\overset{\overset{OH}{|}}{CH}-CH_3$

(d) $CH_3—CH_2—CH=CH_2$

47. Match List I with List II:

List-I Polymer	List-II used for items
A. Nylon 6,6	I. Buckets
B. Low density polythene	II. Non-stick utensils
C. High density polythene	III. Bristles of brushes
D. Teflon	IV. Toys

Choose the correct answer from the options given below:

(a) A-III, B-I, C-IV, D-II (b) A-III, B-IV, C-I, D-II

(c) A-II, B-I, C-IV, D-III (d) A-II, B-IV, C-I, D-III

48. Glycosidic linkage between C_1 of α-glucose and C_2 of β-fructose is found in
(a) maltose (b) sucrose
(c) lactose (d) amylose

49. Some drugs bind to a site other than, the active site of an enzyme. This site is known as
(a) non-active site (b) allosteric site
(c) competitive site (d) therapeutic site

50. In base vs. Acid titration, at the end point methyl orange is present as
(a) quinonoid form (b) heterocyclic form
(c) phenolic form (d) benzenoid form

SECTION-B

51. 56.0 L of nitrogen gas is mixed with excess of hydrogen gas and it is found that 20 L of ammonia gas is produced. The volume of unused nitrogen gas is found to be L.

52. A sealed flask with a capacity of $2dm^3$ contains 11 g of propane gas. The flask is so weak that it will burst if the pressure becomes $2MPa$. The minimum temperature at which the flask will burst is ˚C. [Nearest integer] (Given: $R = 8.3\ J\ K^{-1}\ mol^{-1}$. Atomic masses of C and H are $12u$ and $1u$ respectively.) (Assume that propane behaves as an ideal gas.)

53. When the excited electron of a H atom from $n = 5$ drops to the ground state, the maximum number of emission lines observed are

54. While performing a thermodynamics experiment, a student made the following observations,

$$HCl + NaOH \rightarrow NaCl + H_2O \Delta H = -57.3\ kJ\ mol^{-1}$$

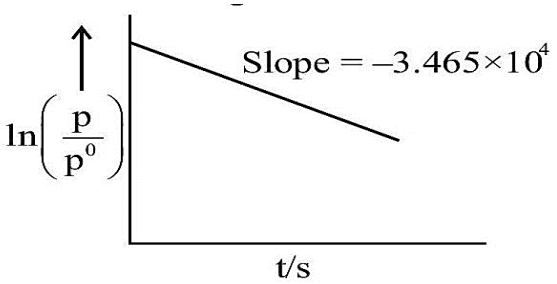
$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$

$$\Delta H = -55.3\ kJ\ mol^{-1}.$$

The enthalpy of ionization of CH_3COOH as calculated by the student is $kJmol^{-1}$. (nearest integer)

55. For the decomposition of azomethane.

$CH_3\ N_2CH_3(g) \rightarrow CH_3CH_3(g) + N_2(g)$ a first order reaction, the variation in partial pressure with time at 600 K is given as



The half- life of the reaction is $\times 10^{-5}$ s.

[Nearest integer]

56. The sum of number of lone pairs of electrons present on the central atoms of $XeO_3, XeOF_4$ and XeF_6 is

57. The spin-only magnetic moment value of M^{3+} ion (in gaseous state) from the pairs Cr^{3+}/Cr^{2+}, $Mn^{3+}/Mn^{2}, Fe^{3+}/Fe^{2+}$ and Co^{3+}/Co^{2+} that has negative standard electrode potential, is B.M. [Nearest integer]

58. A sample of 4.5mg of an unknown monohydric alcohol, $R-OH$ was added to methylmagnesium iodide. A gas is evolved and is collected and its volume measured to be 3.1 mL. The molecular weight of the unknown alcohol is g/mol. [Nearest integer]

59. The separation of two coloured substances was done by paper chromatography. The distances travelled by solvent front, substance A and substance B from the base line are 3.25 cm. 2.08 cm and 1.05 cm. respectively. The ratio of R_f values of A to B is

60. The total number of monobromo derivatives formed by the alkanes with molecular formula C_5H_{12} is (excluding stereo isomers)

PART-III MATHEMATICS

SECTION-A

61. For $z \in \mathbb{C}$ if the minimum value of $(|z-3\sqrt{2}|+|z-p\sqrt{2}i|)$ is $5\sqrt{2}$, then a value of p is
(a) 3 (b) $\frac{7}{2}$
(c) 4 (d) $\frac{9}{2}$

62. The number of real values λ, such that the system of linear equations

$2x-3y+5z=9$

$x+3y-z=-18$

$3x-y+(\lambda^2-|\lambda|)z=16$

has no solution, is:-
(a) 0 (b) 1
(c) 2 (d) 4

63. The number of bijective functions $f:\{1,3,5,7,\ldots\ldots99\} \to \{2,4,6,8\ 100\}$, such that $f(3) \geq f(9) \geq f(15) \geq f(21) \geq \cdots\ldots \geq f(99)$, is
(a) ${}^{50}P_{17}$ (b) ${}^{50}P_{33}$
(c) $33! \times 17!$ (d) $\frac{50!}{2}$

64. The remainder when $(11)^{1011}+(1011)^{11}$ is divided by 9 is
(a) 1 (b) 4
(c) 6 (d) 8

65. The sum $\sum_{n=1}^{21} \frac{3}{(4n-1)(4n+3)}$ is equal to
(a) $\frac{7}{87}$ (b) $\frac{7}{29}$
(c) $\frac{14}{87}$ (d) $\frac{21}{29}$

66. $\lim_{x\to\frac{\pi}{4}} \frac{8\sqrt{2}-(\cos x+\sin x)^7}{\sqrt{2}-\sqrt{2}\sin 2x}$ is equal to
(a) 14 (b) 7
(c) $14\sqrt{2}$ (d) $7\sqrt{2}$

67. $\lim_{n\to\infty} \frac{1}{2^n}\left(\frac{1}{\sqrt{1-\frac{1}{2^n}}}+\frac{1}{\sqrt{1-\frac{2}{2^n}}}+\frac{1}{\sqrt{1-\frac{3}{2^n}}}+\cdots..+\frac{1}{\sqrt{1-\frac{2^n-1}{2^n}}}\right)$ is equal to
(a) $\frac{1}{2}$ (b) 1
(c) 2 (d) -2

68. If A and B are two events such that $P(a)=\frac{1}{3}, P(b)=\frac{1}{5}$ and $P(A\cup B)=\frac{1}{2}$, then $P(A \mid B')+P(B \mid A')$ is equal to
(a) $\frac{3}{4}$ (b) $\frac{5}{8}$
(c) $\frac{5}{4}$ (d) $\frac{7}{8}$

69. Let [t] denote the greatest integer less than or equal to t. Then the value of the integral $\int_{-3}^{101}\left([\sin(\pi x)]+e^{[\cos(2\pi x)]}\right)dx$ is equal to
(a) $\frac{52(1-e)}{e}$ (b) $\frac{52}{e}$
(c) $\frac{52(2+e)}{e}$ (d) $\frac{104}{e}$

70. Let the point $P(\alpha,\beta)$ be at a unit distance from each of the two lines $L_1: 3x-4y+12=0$, and $L_2: 8x+6y+11=0$. If P lies below L_1 and above L_2, then $100(\alpha+\beta)$ is equal to
(a) -14 (b) 42
(c) -22 (d) 14

71. Let a smooth curve $y=f(x)$ be such that the slope of the tangent at any point (x,y) on it is directly proportional to $\left(\frac{-y}{x}\right)$. If the curve passes through the point $(1,2)$ and $(8,1)$, then $\left|y\left(\frac{1}{8}\right)\right|$ is equal to
(a) $2\log_e 2$ (b) 4
(c) 1 (d) $4\log_e 2$

72. If the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ meets the line $\frac{x}{7}+\frac{y}{2\sqrt{6}}=1$ on the x-axis and the line $\frac{x}{7}-\frac{y}{2\sqrt{6}}=1$ on the y-axis, then the eccentricity of the ellipse is
(a) $\frac{5}{7}$ (b) $\frac{2\sqrt{6}}{7}$
(c) $\frac{3}{7}$ (d) $\frac{2\sqrt{5}}{7}$

73. The tangents at the point $A(1,3)$ and $B(1,-1)$ on the parabola $y^2-2x-2y=1$ meet at the point P. Then the area (in unit ^{2}) of the triangle PAB is:-
(a) 4 (b) 6
(c) 7 (d) 8

74. Let the foci of the ellipse $\frac{x^2}{16}+\frac{y^2}{7}=1$ and the hyperbola $\frac{x^2}{144}-\frac{y^2}{\alpha}=\frac{1}{25}$ coincide. Then the length of the latus rectum of the hyperbola is: -
(a) $\frac{32}{9}$ (b) $\frac{18}{5}$
(c) $\frac{27}{4}$ (d) $\frac{27}{10}$

75. A plane E is perpendicular to the two planes $2x-2y+z=0$ and $x-y+2z=4$, and passes through the point $P(1,-1,1)$. If the distance of the plane E from the point $Q(a,a,2)$ is $3\sqrt{2}$, then $(PQ)^2$ is equal to
(a) 9 (b) 12
(c) 21 (d) 33

76. The shortest distance between the lines $\frac{x+7}{-6}=\frac{y-6}{7}=z$ and $\frac{7-x}{2}=y-2=z-6$ is
(a) $2\sqrt{29}$ (b) 1
(c) $\sqrt{\frac{37}{29}}$ (d) $\frac{\sqrt{29}}{2}$

77. Let $\vec{a}=\hat{i}-\hat{j}+2\hat{k}$ and $\vec{b}$ be a vector such that $\vec{a}\times\vec{b}=2\hat{i}-\hat{k}$ and $\vec{a}\cdot\vec{b}=3$. Then the projection of $\vec{b}$ on the vector $\vec{a}-\vec{b}$ is:-

(a) $\frac{2}{\sqrt{21}}$ (b) $2\sqrt{\frac{3}{7}}$

(c) $\frac{2}{3}\sqrt{\frac{7}{3}}$ (d) $\frac{2}{3}$

78. If the mean deviation about median for the number $3, 5, 7, 2k, 12, 16, 21, 24$ arranged in the ascending order, is 6 then the median is

(a) 11.5 (b) 10.5

(c) 12 (d) 11

79. $2\sin\left(\frac{\pi}{22}\right)\sin\left(\frac{3\pi}{22}\right)\sin\left(\frac{5\pi}{22}\right)\sin\left(\frac{7\pi}{22}\right)\sin\left(\frac{9\pi}{22}\right)$ is equal to

(a) $\frac{3}{16}$ (b) $\frac{1}{16}$

(c) $\frac{1}{32}$ (d) $\frac{9}{32}$

80. Consider the following statements:

P : Ramu is intelligent

Q : Ramu is rich

R : Ramu is not honest

The negation of the statement "Ramu is intelligent and honest if and only if Ramu is not rich" can be expressed as:

(a) $((P \wedge (\sim R)) \wedge Q) \wedge ((\sim Q) \wedge ((\sim P) \vee R))$

(b) $((P \wedge R) \wedge Q) \vee ((\sim Q) \wedge ((\sim P) \vee (\sim R)))$

(c) $((P \wedge R) \wedge Q) \wedge ((\sim Q) \wedge ((\sim P) \vee (\sim R)))$

(d) $((P \wedge (\sim R)) \wedge Q) \vee ((\sim Q) \wedge ((\sim P) \vee R))$

SECTION-B

81. Let $A: \{1, 2, 3, 4, 5, 6, 7\}$. Define $B = \{T \subseteq A : \text{either } 1 \notin T \text{ or } 2 \in T\}$ and $C = \{T \subseteq A : T \text{ the sum of all the elements of } T \text{ is a prime number}\}$. Then the number of elements in the set $B \cup C$ is

82. Let $f(x)$ be a quadratic polynomial with leading coefficient 1 such that $f(0) = p, p \neq 0$ and $f(1) = \frac{1}{3}$. If the equation $f(x) = 0$ and $fofof(x) = 0$ have a common real root, then $f(-3)$ is equal to

83. Let $A = \begin{bmatrix} 1 & a & a \\ 0 & 1 & b \\ 0 & 0 & 1 \end{bmatrix}, a, b \in \mathbb{R}$. If for some $n \in N$, $A^n = \begin{bmatrix} 1 & 48 & 2160 \\ 0 & 1 & 96 \\ 0 & 0 & 1 \end{bmatrix}$ then $n + a + b$ is equal to

84. The sum of the maximum and minimum values of the function $f(x) = |5x - 7| + [x^2 + 2x]$ is the interval $\left[\frac{5}{4}, 2\right]$, where $[t]$ is the greatest integer $\leq t$ is

85. Let $y = y(x)$ be the solution of the differential equation $\frac{dy}{dx} = \frac{4y^3 + 2yx^2}{3xy^2 + x^3}, y(1) = 1$. If for some $n \in N, y(2) \in [n - 1, n)$, then n is equal to

86. Let f be a twice differentiable function on R.

If $f'(0) = 4$ and

$f(x)+\int_0^x (x-t)f'(t)dt=\left(e^{2x}+e^{-2x}\right)\cos 2x+\frac{2}{a}x,$

then $(2a+1)^5a^2$ is equal to

87. Let $a_n=\int_{-1}^{n}\left(1+\frac{x}{2}+\frac{x^2}{2}+\frac{x^3}{3}+\cdots\ldots+\frac{x^{n-1}}{n}\right)dx$ for $n\in N$. Then the sum of all the elements of the set $\{n\in N: a_n\in(2,30)\}$ is

88. If the circles $x^2+y^2+6x+8y+16=0$ and $x^2+y^2+2(3-\sqrt{3})x+x+2(4-\sqrt{6})y=k+6\sqrt{3}+8\sqrt{6}, k>0$, touch internally at the point $P(\alpha,\beta)$, then $(\alpha+\sqrt{3})^2+(\beta+\sqrt{6})^2$ is equal to

89. Let the area enclosed by the x-axis, and the tangent and normal drawn to the curve $4x^3-3xy^2+6x^2-5xy-8y^2+9x+14=0$ at the point $(-2,3)$ be A. Then 8 A is equal to

90. Let $x=\sin\left(2\tan^{-1}\alpha\right)$ and $y=\sin\left(\frac{1}{2}\tan^{-1}\frac{4}{3}\right)$. If $S=\{\alpha\in R: y^2=1-x\}$, then $\sum_{\alpha\in S}16\alpha^3$ is equal to