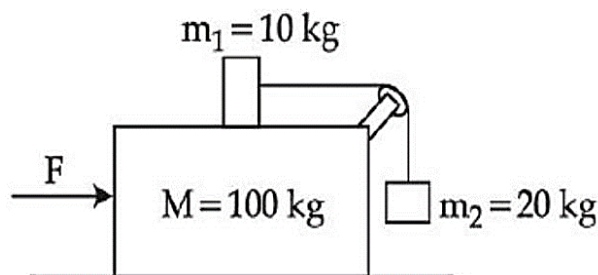


PART-I PHYSICS

SECTION-A

1. Three masses $M = 100 \text{ kg}$, $m_1 = 10 \text{ kg}$ and $m_2 = 20 \text{ kg}$ are arranged in a system as shown in figure. All the surfaces are frictionless and strings are inextensible and weightless. The pulleys are also weightless and frictionless. A force F is applied on the system so that the mass m_2 moves upward with an acceleration of 2 ms^{-2} . The value of F is:

(Take $g = 10 \text{ ms}^{-2}$)



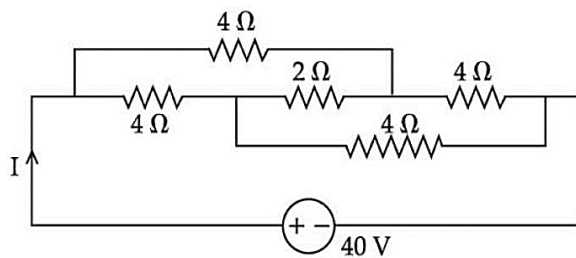
- (a) 3360 N (b) 3380 N
(c) 3120 N (d) 3240 N
2. A radio can tune to any station in 6MHz to 10MHz band. The value of corresponding wavelength bandwidth will be:
(a) 4 m (b) 20 m
(c) 30 m (d) 50 m
3. The disintegration rate of a certain radioactive sample at any instant is 4250 disintegrations per minute. 10 minutes later, the rate becomes 2250 disintegrations per minute. The approximate decay constant is:
(Take $\log_{10} 1.88 = 0.274$)
(a) 0.02 min^{-1} (b) 2.7 min^{-1}
(c) 0.063 min^{-1} (d) 6.3 min^{-1}
4. A parallel beam of light of wavelength 900 nm and intensity 100 Wm^{-2} is incident on a surface perpendicular to the beam. Tire number of photons crossing 1 cm^2 area perpendicular to the beam in one second is:
(a) 3×10^{16} (b) 4.5×10^{16}
(c) 4.5×10^{17} (d) 4.5×10^{20}
5. In young's double slit experiment, the fringe width is 12 mm. If the entire arrangement is placed in water of refractive index $\frac{4}{3}$, then the fringe width becomes (in mm)
(a) 16 (b) 9
(c) 48 (d) 12
6. The magnetic field of a plane electromagnetic wave is given by

$$\vec{B} = 2 \times 10^{-8} \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t) \hat{j} \text{ T}$$

The amplitude of the electric field would be

- (a) 6 Vm^{-1} along x-axis
(b) 3 Vm^{-1} along z-axis
(c) 6 Vm^{-1} along z-axis
(d) $2 \times 10^{-8} \text{ Vm}^{-1}$ along z-axis

7. In a series LR circuit $X_L = R$ and power factor of the circuit is P_1 . When capacitor with capacitance C such that $X_L = X_C$ is put in series, the power factor becomes P_2 . The ratio $\frac{P_1}{P_2}$ is
- (a) $\frac{1}{2}$ (b) $\frac{1}{\sqrt{2}}$
(c) $\frac{\sqrt{3}}{\sqrt{2}}$ (d) 2:1
8. A charge particle is moving in a uniform magnetic field $(2\hat{i} + 3\hat{j})T$. If it has an acceleration of $(\alpha\hat{i} - 4\hat{j})m/s^2$, then the value of α will be
- (a) 3 (b) 6
(c) 12 (d) 2
9. B_X and B_Y are the magnetic field at the centre of two coils of two coils X and Y respectively, each carrying equal current. If coil X has 200 turns and 20 cm radius and coil Y has 400 turns and 20 cm radius, the ratio of B_X and B_Y is
- (a) 1:1 (b) 1:2
(c) 2:1 (d) 4:1
10. The current I in the given circuit will be:



- (a) 10 A (b) 20 A
(c) 4 A (d) 40 A
11. The total charge on the system of capacitance $C_1 = 1\mu F$, $C_2 = 2\mu F$, $C_3 = 4\mu F$ and $C_4 = 3\mu F$ connected in parallel is (Assume a battery of 20 V is connected to the combination)
- (a) $200\mu C$ (b) 200C
(c) $10\mu C$ (d) 10C
12. When a particle executes simple Harmonic motion, the nature of graph of velocity as function of displacement will be:
- (a) Circular (b) Elliptical
(c) Sinusoidal (d) Straight line
13. 7 mole of certain monoatomic ideal gas undergoes a temperature increase of 40 K at constant pressure. The increase in the internal energy of the gas in this process is
- (Given $R = 8.3JK^{-1}mol^{-1}$)
- (a) 5810 J (b) 3486 J
(c) 11620 J (d) 6972 J
14. A monoatomic gas at pressure P and volume V is suddenly compressed to one eighth of its original volume. The final pressure at constant entropy will be:
- (a) P (b) $8P$
(c) $32P$ (d) $64P$
15. A water drop of radius 1 cm is broken into 729 equal droplets. If surface tension of water is 75dyne/cm, then the gain in surface energy upto first decimal place will be:
- [Given $\pi = 3.14$]
- (a) $8.5 \times 10^{-4} J$ (b) $8.2 \times 10^{-4} J$
(c) $7.5 \times 10^{-4} J$ (d) $5.3 \times 10^{-4} J$
16. The percentage decrease in the weight of a rocket, when taken to a height of 32 km above the surface of earth will, be:

(Radius of earth = 6400 km)

- (a) 1% (b) 3%
(c) 4% (d) 0.5%

17. As per the given figure, two blocks each of mass 250 g are connected to a spring of spring constant 2Nm^{-1} . If both are given velocity v in opposite directions, then maximum elongation of the spring is:



- (a) $\frac{v}{2\sqrt{2}}$ (b) $\frac{v}{2}$
(c) $\frac{v}{4}$ (d) $\frac{v}{\sqrt{2}}$

18. A monkey of mass 50 kg climbs on a rope which can withstand the tension (T) of 350 N. If monkey initially climbs down with an acceleration of 4 m/s^2 and then climbs up with an acceleration of 5 m/s^2 . Choose the correct option ($g = 10\text{ m/s}^2$)

- (a) $T = 700\text{ N}$ while climbing upward
(b) $T = 350\text{ N}$ while going downward
(c) Rope will break while climbing upward
(d) Rope will break while going downward

19. Two projectile thrown at 30° and 45° with the horizontal respectively, reach the maximum height in same time. The ratio of their initial velocities is

- (a) $1:\sqrt{2}$ (b) $2:1$
(c) $\sqrt{2}:1$ (d) $1:2$

20. A screw gauge of pitch 0.5 mm is used to measure the diameter of uniform wire of length 6.8 cm, the main scale reading is 1.5 mm and circular scale reading is 7. The calculated curved surface area of wire to appropriate significant figures is:

[Screw gauge has 50 divisions on the circular scale]

- (a) 6.8 cm^2 (b) 3.4 cm^2
(c) 3.9 cm^2 (d) 2.4 cm^2

SECTION-B

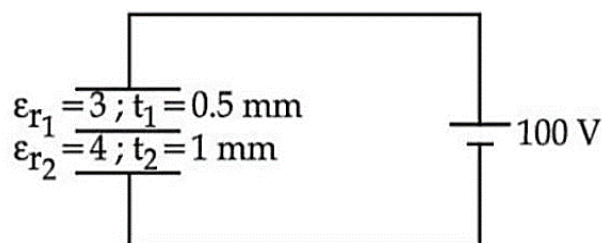
21. If the initial velocity in horizontal direction of a projectile is unit vector $\hat{i}$ and the equation of trajectory is $y = 5x(1 - x)$. The y component vector of the initial velocity is (Take $g = 10\text{ m/s}^2$)

22. A disc of mass 1 kg and radius R is free of rotate about a horizontal axis passing through its centre and perpendicular to the plane of disc. A body of same mass as that of disc is fixed at the highest point of the disc. Now the system is released, when the body comes to the lowest position, its angular speed will be

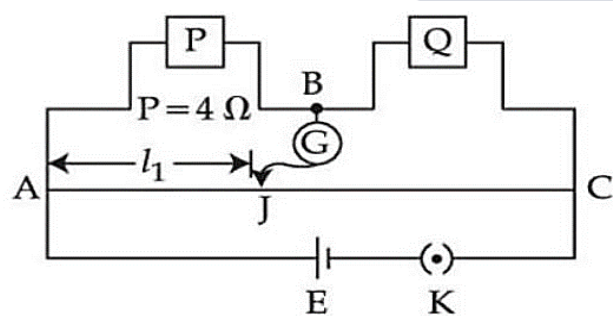
$$4\sqrt{\frac{x}{3R}}\text{ rad s}^{-1} \text{ where } x = (g = 10\text{ ms}^{-2})$$

23. In an experiment of determine the Young's modulus of wire of a length exactly 1 m, the extension in the length of the wire is measured as 0.4 mm with an uncertainty of $\pm 0.02\text{ mm}$ when a load of 1 kg is applied. The diameter of the wire is measured as 0.4 mm with an uncertainty of $\pm 0.01\text{ mm}$. The error in the measurement of Young's modulus (ΔY) is found to be $x \times 10^{10}\text{ Nm}^{-2}$. The value of x is [Take $g = 10\text{ m/s}^2$]

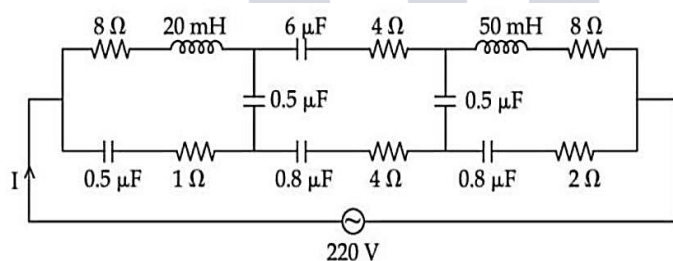
24. When a car is approaching the observer, the frequency of horn is 100 Hz. After passing the observer, it is 50 Hz. If the observer moves with the car, the frequency will be $\frac{x}{3}$ Hz where $x =$
25. A composite parallel plate capacitor is made up of two different dielectric materials with different thickness (t_1 and t_2) as shown in figure. The two different dielectric material are separated by a conducting foil F. The voltage of the conducting foil is V.



26. Resistance are connected in a meter bridge circuit as shown in the figure. The balancing length l_1 is 40 cm. Now an unknown resistance X is connected in series with P and new balancing length is found to be 80 cm measured from the same end. Then the value of x will be Ω

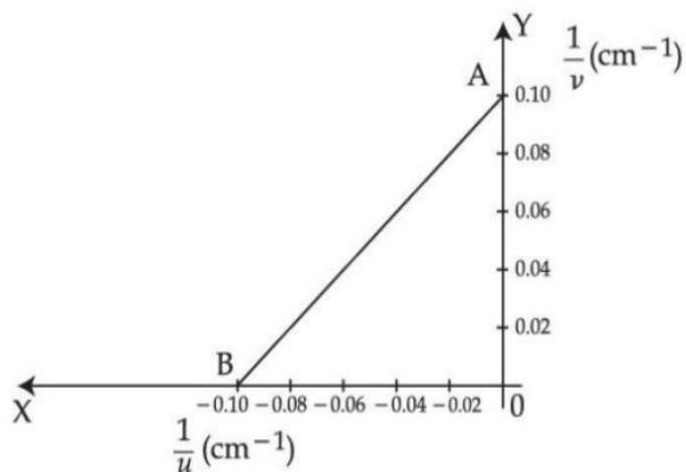


27. The effective current I in the given circuit at very high frequencies will be A



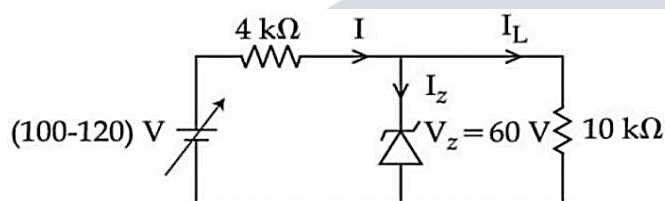
28. The graph between $\frac{1}{u}$ and $\frac{1}{v}$ for a thin convex lens in order to determine its focal length is plotted as shown in the figure. The refractive index of length is 1.5 and its both the surfaces have same radius of curvatures R. The value of R will be cm.

(Where u = object distance, v = image distance)



29. In a hydrogen spectrum, λ be the wavelength of first transition line of Lyman series. The wavelength difference will be " $a\lambda$ " between the wavelength of 3rd transition line of Paschen series and that of 2nd transition line of Balmer Series where $a =$

30. In the circuit shown below, maximum zener diode current will be mA



PART-II CHEMISTRY

SECTION-A

31. Match List - I with List - II.

List - I

(Compound)

(A) BrF_5

(B) $[\text{CrF}_6]^{3-}$

(C) O_3

(D) PCl_5

List - II

(Shape)

(I) bent

(II) square pyramidal

(III) trigonal bipyramidal

(IV) octahedral

Choose the correct answer from the options given below :

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

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

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

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

32. Match List - I with List - II.

LIST-I

(Processes/Reactions)

(A) $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$

LIST-II

(Catalyst)

(I) $\text{Fe}(\text{s})$

- (B) $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$ (II) $\text{Pt}(\text{s}) - \text{Rh}(\text{s})$
 (C) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$ (III) V_2O_5
 (D) $\text{Vegetable oil}(\text{l}) + \text{H}_2 \rightarrow \text{Vegetable ghee}(\text{s})$ (IV) $\text{Ni}(\text{s})$

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

33. Given two statements below :

Statement I : In Cl_2 molecule the covalent radius is double of the atomic radius of chlorine.

Statement II : Radius of anionic species is always greater than their parent atomic radius.

Choose the most appropriate answer from options given below:

- (a) Both Statement I and Statement II are correct.
 (b) Both Statement I and Statement II are incorrect.
 (c) Statement I is correct but Statement II is incorrect.
 (d) Statement I is incorrect but Statement II is correct.

34. Refining using liquation method is the most suitable for metals with:

- (a) Low melting point
 (b) High boiling point
 (c) High electrical conductivity
 (d) Less tendency to be soluble in melts than impurities

35. Which of the following can be used to prevent the decomposition of H_2O_2 ?

- (a) Urea (b) Formaldehyde
 (c) Formic acid (d) Ethanol

36. Reaction of BeCl_2 with LiAlH_4 gives:

- (A) AlCl_3 (B) BeH_2
 (C) LiH (D) LiCl
 (E) BeAlH_4

Choose the correct answer from options given below:

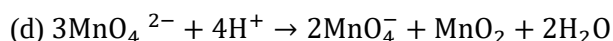
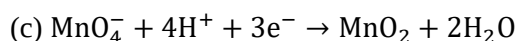
- (a) (A), (D) and (E) (b) (A), (B) and (D)
 (c) (D) and (E) (d) (B), (C) and (D)

37. Borazine, also known as inorganic benzene, can be prepared by the reaction of 3-equivalents of "X" with 6-equivalents of "Y". "X" and "Y", respectively are:

- (a) $\text{B}(\text{OH})_3$ and NH_3 (b) B_2H_6 and NH_3
 (c) B_2H_6 and HN_3 (d) NH_3 and B_2O_3

38. Which of the given reactions is not an example of disproportionation reaction?

- (a) $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$
 (b) $2\text{NO}_2 + \text{H}_2\text{O} \rightarrow \text{HNO}_3 + \text{HNO}_2$



39. The dark purple colour of KMnO_4 disappears in the titration with oxalic acid in acidic medium. The overall change in the oxidation number of manganese in the reaction is:

- (a) 5 (b) 1
(c) 7 (d) 2



A and B in the above atmospheric reaction step are

- (a) C_2H_6 and Cl_2 (b) $\dot{\text{C}}\text{HCl}_2$ and H_2
(c) $\dot{\text{C}}\text{H}_3$ and HCl (d) C_2H_6 and HCl

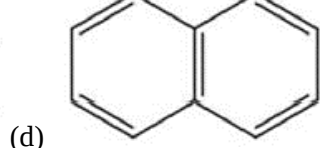
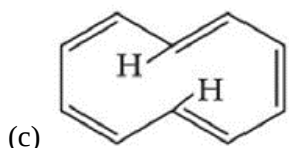
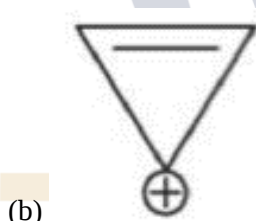
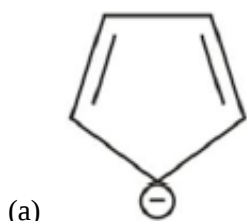
41. Which technique among the following, is most appropriate in separation of a mixture of 100mg of p-nitrophenol and picric acid?

- (a) Steam distillation
(b) 2-5 ft long column of silica gel
(c) Sublimation
(d) Preparative TLC (Thin Layer Chromatography)

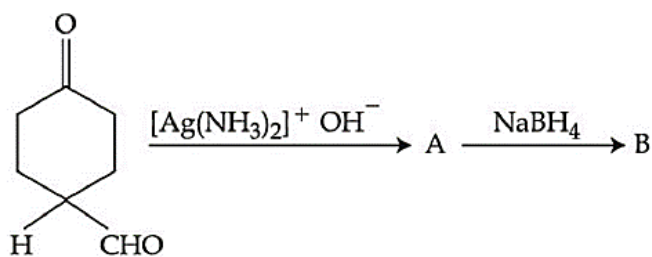
42. The difference in the reaction of phenol with bromine in chloroform and bromine in water medium is due to:

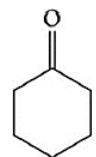
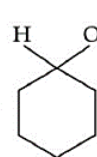
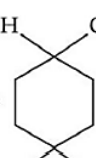
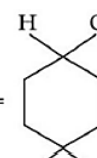
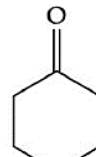
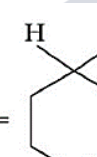
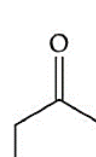
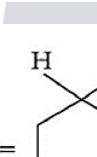
- (a) Hyperconjugation in substrate
(b) Polarity of solvent
(c) Free radical formation
(d) Electromeric effect of the substrate

43. Which of the following compounds is not aromatic?

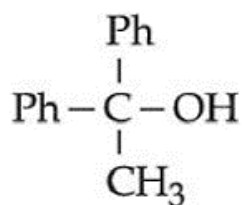


44. The products formed in the following reaction, A and B are



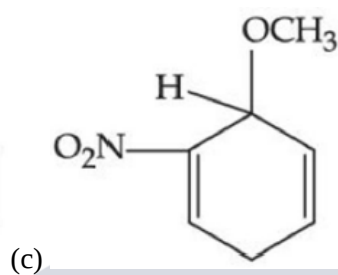
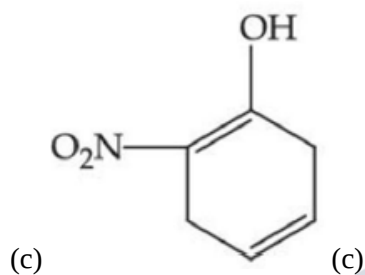
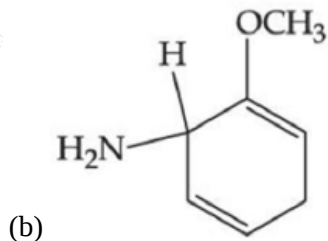
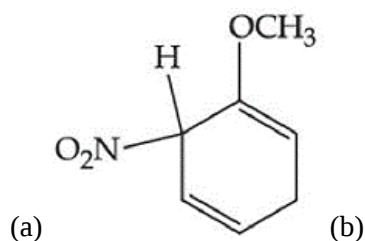
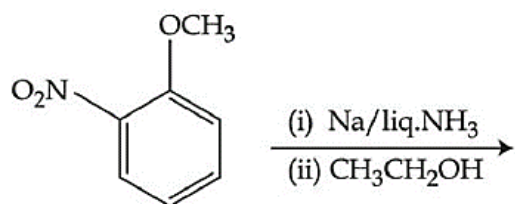
- (a) $A =$  , $B =$ 
- (b) $A =$  , $B =$ 
- (c) $A =$  , $B =$ 
- (d) $A =$  , $B =$ 

45. Which reactant will give the following alcohol on reaction with one mole of phenyl magnesium bromide (PhMgBr) followed by acidic hydrolysis?

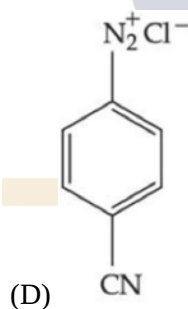
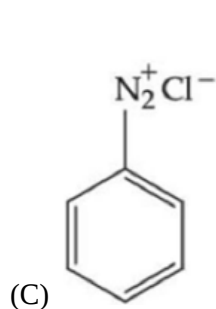
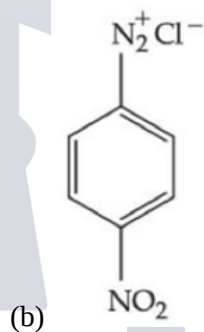
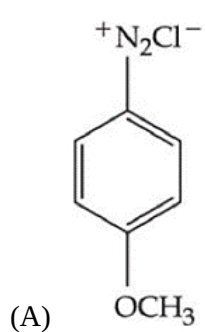


- (a) $\text{CH}_3 - \text{C} \equiv \text{N}$ (b) $\text{Ph} - \text{C} \equiv \text{N}$
- (c) $\text{CH}_3 - \text{C}(=\text{O}) - \text{O} - \text{Ph}$ (d) $\text{Ph} - \text{C}(=\text{O}) - \text{CH}_3$

46. The major product of the following reaction is



47. The correct stability order of the following diazonium salt is



(a) (A) > (B) > (C) > (D)

(b) (A) > (B) > (D) > (C)

(c) (C) > (A) > (D) > (B)

(d) (C) > (D) > (B) > (A)

48. Stearic acid and polyethylene glycol react to form which one of the following soap/s detergents?

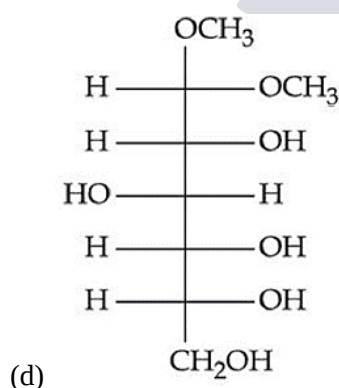
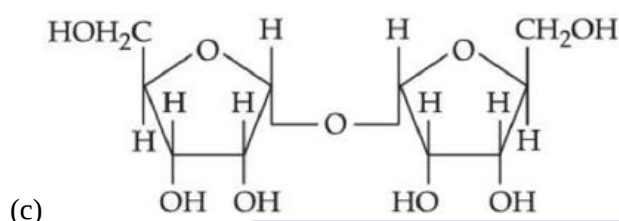
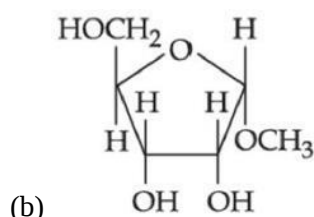
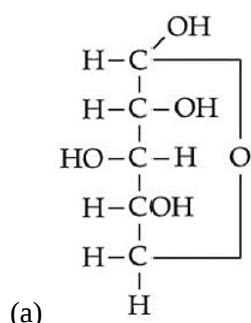
(a) Cationic detergent

(b) Soap

(c) Anionic detergent

(d) Non-ionic detergent

49. Which of the following is reducing sugar?



50. Given below are two statements: one is labelled as Assertion (a) and the other is labelled as Reason (R).

Assertion (a): Experimental reaction of CH_3Cl with aniline and anhydrous AlCl_3 does not give o and p-methylaniline.

Reason (R): The $-\text{NH}_2$ group of aniline becomes deactivating because of salt formation with anhydrous AlCl_3 and hence yields m-methyl aniline as the product.

In the light of the above statements, choose the most appropriate answer from the options given below:

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
- (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
- (c) (A) is true, but (R) is false.
- (d) (A) is false, but (R) is true.

SECTION-B

51. Chlorophyll extracted from the crushed green leaves was dissolved in water to make 2 L solution of Mg of concentration 48ppm. The number of atoms of Mg in this solution is $x \times 10^{20}$ atoms. The value of x is . (Nearest Integer) (Given: Atomic mass of Mg is 24 g mol^{-1} , $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$)
52. A mixture of hydrogen and oxygen contains 40% hydrogen by mass when the pressure is 2.2 bar. The partial pressure of hydrogen is bar. (Nearest Integer)
53. The wavelength of an electron and a neutron will become equal when the velocity of the electron is x times the velocity of neutron. The value of x is. (Nearest Integer) (Mass of electron is $9.1 \times 10^{-31} \text{ kg}$ and mass of neutron is $1.6 \times 10^{-27} \text{ kg}$)
54. 2.4 g coal is burnt in a bomb calorimeter in excess of oxygen at 298 K and 1 atm pressure. The temperature of the calorimeter rises from 298 K to 300 K. The enthalpy change during the combustion of coal is $-x \text{ kJ mol}^{-1}$. The value of x is . (Nearest Integer)
- (Given: Heat capacity of bomb calorimeter 20.0 kJ K^{-1} . Assume coal to be pure carbon)
55. When 800 mL of 0.5M nitric acid is heated in a beaker, its volume is reduced to half and 11.5 g of nitric acid is evaporated. The molarity of the remaining nitric acid solution is $x \times 10^{-2} \text{ M}$. (Nearest Integer) (Molar mass of nitric acid is 63 g mol^{-1})
56. At 298 K, the equilibrium constant is 2×10^{15} for the reaction:
- $$\text{Cu(s)} + 2\text{Ag}^+(\text{aq}) \rightleftharpoons \text{Cu}^{2+}(\text{aq}) + 2\text{Ag(s)}$$
- The equilibrium constant for the reaction
- $$\frac{1}{2}\text{Cu}^{2+}(\text{aq}) + \text{Ag(s)} \rightleftharpoons \frac{1}{2}\text{Cu(s)} + \text{Ag}^+(\text{aq})$$
- is $x \times 10^{-8}$. The value of x is (Nearest Integer)
57. The amount of charge in F (Faraday) required to obtain one mole of iron from Fe_3O_4 is (Nearest Integer)
58. For a reaction $\text{A} \rightarrow 2\text{B} + \text{C}$ the half-lives are 100 s and 50 s when the concentration of reactant A is 0.5 and 1.0 mol L^{-1} respectively. The order of the reaction is . (Nearest Integer)
59. The difference between spin only magnetic moment values of $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_2$ and $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ is
60. In the presence of sunlight, benzene reacts with Cl_2 to give product, X. The number of hydrogens in X is

PART-III MATHEMATICS

SECTION-A

61. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be a continuous function such that $f(3x) - f(x) = x$. If $f(8) = 7$, then $f(14)$ is equal to:
- (a) 4 (b) 10
(c) 11 (d) 16

62. Let O be the origin and A be the point $z_1 = 1 + 2i$. If B is the point z_2 , $\text{Re}(z_2) < 0$, such that OAB is a right-angled isosceles triangle with OB as hypotenuse, then which of the following is NOT true?

(a) $\arg z_2 = \pi - \tan^{-1} 3$

(b) $\arg(z_1 - 2z_2) = -\tan^{-1} \frac{4}{3}$

(c) $|z_2| = \sqrt{10}$

(d) $|2z_1 - z_2| = 5$

63. If the system of linear equations.

$$8x + y + 4z = -2$$

$$x + y + z = 0$$

$$\lambda x - 3y = \mu$$

has infinitely many solutions, then the distance of the point $(\lambda, \mu, -\frac{1}{2})$ from the plane $8x + y + 4z + 2 = 0$ is :

(a) $3\sqrt{5}$

(b) 4

(c) $\frac{26}{9}$

(d) $\frac{10}{3}$

64. Let A be a 2×2 matrix with $\det(A) = -1$ and $\det((A + I)(\text{Adj}(A) + I)) = 4$. Then the sum of the diagonal elements of A can be:

(a) -1

(b) 2

(c) 1

(d) $-\sqrt{2}$

65. The odd natural number a , such that the area of the region bounded by $y = 1, y = 3, x = 0, x = y^a$ is $\frac{364}{3}$, equal to:

(a) 3

(b) 5

(c) 7

(d) 9

66. Consider two G.Ps. $2, 2^2, 2^3, \dots$ and $4, 4^2, 4^3, \dots$ of 60 and n terms respectively. If the geometric mean of all the $60 + n$ terms is $(2)^{\frac{225}{8}}$, then $\sum_{k=1}^n k(n-k)$ is equal to:

(a) 560

(b) 1540

(c) 1330

(d) 2600

67. If the function

$$f(x) = \begin{cases} \frac{\log_e(1-x+x^2) + \log_e(1+x+x^2)}{\sec x - \cos x}, & x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right) - \{0\} \\ k, & x = 0 \end{cases}$$

(a) 1

(b) -1

(c) e

(d) 0

68. If $f(x) = \begin{cases} x + a, & x \leq 0 \\ |x - 4|, & x > 0 \end{cases}$ and

$$g(x) = \begin{cases} x + 1, & x < 0 \\ (x - 4)^2 + b, & x \geq 0 \end{cases}$$

are continuous on $\mathbb{R}$, then $(g \circ f)(2) + (f \circ g)(-2)$ is equal to:

(a) -10

(b) 10

(c) 8

(d) -8

69. Let $f(x) = \begin{cases} x^3 - x^2 + 10x - 7, & x \leq 1 \\ -2x + \log_2(b^2 - 4), & x > 1 \end{cases}$

Then the set of all values of b , for which $f(x)$ has maximum value at $x = 1$, is:

- (a) $(-6, -2)$ (b) $(2, 6)$
(c) $[-6, -2) \cup (2, 6]$ (d) $[-\sqrt{6}, -2) \cup (2, \sqrt{6}]$

70. If $a = \lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{2n}{n^2+k^2}$ and $f(x) = \sqrt{\frac{1-\cos x}{1+\cos x}}$, $x \in (0, 1)$, then:

- (a) $2\sqrt{2}f\left(\frac{a}{2}\right) = f'\left(\frac{a}{2}\right)$ (b) $f\left(\frac{a}{2}\right)f'\left(\frac{a}{2}\right) = \sqrt{2}$
(c) $\sqrt{2}f\left(\frac{a}{2}\right) = f'\left(\frac{a}{2}\right)$ (d) $f\left(\frac{a}{2}\right) = \sqrt{2}f'\left(\frac{a}{2}\right)$

71. If $\frac{dy}{dx} + 2y \tan x = \sin x$, $0 < x < \frac{\pi}{2}$ and $y\left(\frac{\pi}{3}\right) = 0$, then the maximum value of $y(x)$ is

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

72. A point P moves so that the sum of squares of its distances from the points $(1, 2)$ and $(-2, 1)$ is 14. Let $f(x, y) = 0$ be the locus of P , which intersects the x -axis at the points A, B and the y -axis at the point C, D . Then the area of the quadrilateral $ACBD$ is equal to

- (a) $\frac{9}{2}$ (b) $\frac{3\sqrt{17}}{2}$
(c) $\frac{3\sqrt{17}}{4}$ (d) 9

73. Let the tangent drawn to the parabola $y^2 = 24x$ at the point (α, β) is perpendicular to the line $2x + 2y = 5$. Then the normal to the hyperbola $\frac{x^2}{\alpha^2} - \frac{y^2}{\beta^2} = 1$ at the point $(\alpha + 4, \beta + 4)$ does NOT pass through the point:

- (a) $(25, 10)$ (b) $(20, 12)$
(c) $(30, 8)$ (d) $(15, 13)$

74. The length of the perpendicular from the point $(1, -2, 5)$ on the line passing through $(1, 2, 4)$ and parallel to the line $x + y - z = 0 = x - 2y + 3z - 5$ is:

- (a) $\sqrt{\frac{21}{2}}$ (b) $\sqrt{\frac{9}{2}}$
(c) $\sqrt{\frac{73}{2}}$ (d) 1

75. Let $\vec{a} = \alpha\hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = 2\hat{i} + \hat{j} - \alpha\hat{k}$, $\alpha > 0$. If the projection of $\vec{a} \times \vec{b}$ on the vector $-\hat{i} + 2\hat{j} - 2\hat{k}$ is 30, then α is equal to

- (a) $\frac{15}{2}$ (b) 8
(c) $\frac{13}{2}$ (d) 7

76. The mean and variance of a binomial distribution are α and $\frac{\alpha}{3}$ respectively. If $P(X = 1) = \frac{4}{243}$, then $P(X = 4 \text{ or } 5)$ is equal to:

- (a) $\frac{5}{9}$ (b) $\frac{64}{81}$
(c) $\frac{16}{27}$ (d) $\frac{145}{243}$

77. Let E_1, E_2, E_3 be three mutually exclusive events such that $P(E_1) = \frac{2+3p}{6}$, $P(E_2) = \frac{2-p}{8}$ and $P(E_3) = \frac{1-p}{2}$. If the maximum and minimum values of p are p_1 and p_2 , then $(p_1 + p_2)$ is equal to:

- (a) $\frac{2}{3}$ (b) $\frac{5}{3}$
(c) $\frac{5}{4}$ (d) 1

78. Let

$S = \{\theta \in [0, 2\pi]: 8^{2\sin^2 \theta} + 8^{2\cos^2 \theta} = 16\}$. Then

$n(S) + \sum_{\theta \in S} \left(\sec\left(\frac{\pi}{4} + 2\theta\right) \operatorname{cosec}\left(\frac{\pi}{4} + 2\theta\right) \right)$ is

equal to:

- (a) 0 (b) -2
(c) -4 (d) 12

79. $\tan\left(2\tan^{-1}\frac{1}{5} + \sec^{-1}\frac{\sqrt{5}}{2} + 2\tan^{-1}\frac{1}{8}\right)$ is equal to:

- (a) 1 (b) 2
(c) $\frac{1}{4}$ (d) $\frac{5}{4}$

80. The statement $(\sim (p \Leftrightarrow \sim q)) \wedge q$ is:

- (a) a tautology
(b) a contradiction
(c) equivalent to $(p \Rightarrow q) \wedge q$
(d) equivalent to $(p \Rightarrow q) \wedge p$

SECTION-B

81. If for some $p, q, r \in \mathbb{R}$, not all have same sign, one of the roots of the equation $(p^2 + q^2)x^2 - 2q(p + r)x + q^2 + r^2 = 0$ is also a root of the equation $x^2 + 2x - 8 = 0$, then $\frac{q^2 + r^2}{p^2}$ is equal to-

82. The number of 5-digit natural numbers, such that the product of their digits is 36, is

83. The series of positive multiples of 3 is divided into sets: $\{3\}, \{6, 9, 12\}, \{15, 18, 21, 24, 27\}, \dots$. Then the sum of the elements in the 11th set is equal to

84. The number of distinct real roots of the equation $x^5(x^3 - x^2 - x + 1) + x(3x^3 - 4x^2 - 2x + 4) - 1 = 0$ is

85. If the coefficients of x and x^2 in the expansion of $(1 + x)^p(1 - x)^q$, $p, q \leq 15$, are -3 and -5 respectively, then the coefficient of x^3 is equal to

86. If $n(2n + 1) \int_0^1 (1 - x^n)^{2n} dx = 1177 \int_0^1 (1 - x^n)^{2n+1} dx$, then $n \in \mathbb{N}$ is equal to

87. Let a curve $y = y(x)$ pass through the point $(3, 3)$ and the area of the region under this curve, above the x -axis and between the abscissae 3 and $x(> 3)$ be $\left(\frac{y}{x}\right)^3$. If this curve also passes through the point $(\alpha, 6\sqrt{10})$ in the first quadrant, then α is equal to

88. The equations of the sides AB, BC and CA of a triangle ABC are $2x + y = 0$, $x + py = 15a$ and $x - y = 3$ respectively. If its ortho centre is $(2, a)$, $-\frac{1}{2} < a < 2$, then p is equal to

89. Let the function $f(x) = 2x^2 - \log_e x$, $x > 0$, be decreasing in $(0, a)$ and increasing in $(a, 4)$. A tangent to the parabola $y^2 = 4ax$ at a point P on it passes through the point $(8a, 8a - 1)$ but does not pass through the point $\left(-\frac{1}{a}, 0\right)$. If the equation of the normal at P is $\frac{x}{\alpha} + \frac{y}{\beta} = 1$, then $\alpha + \beta$ is equal to-

90. Let Q and R be two points on the line $\frac{x+1}{2} = \frac{y+2}{3} = \frac{z-1}{2}$ at a distance $\sqrt{26}$ from the point $P(4, 2, 7)$. Then the square of the area of the triangle PQR is

