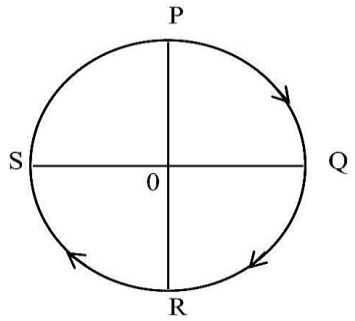
PART- I PHYSICS

SECTION- A

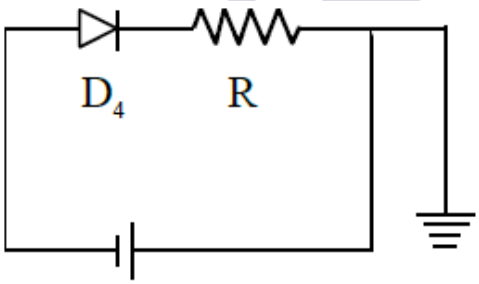
1. **The translational degrees of freedom (f) and rotational degrees of freedom (f_r) of CH_4 molecule are :**
   (a) $f_t = 2$ and $f_r = 2$ (b) $f_t = 3$ and $f_r = 3$
   (c) $f_t = 3$ and $f_r = 2$ (d) $f_t = 2$ and $f_r = 3$
2. **A cyclist starts from the point P of a circular ground of radius 2 km and travels along its circumference to the point S. The displacement of a cyclist is:**



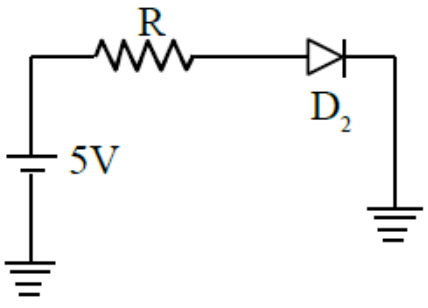
(a) 6 km (b) $\sqrt{8}$ km
(c) 4 km (d) 8 km

3. **The magnetic moment of a bar magnet is $0.5Am^2$. It is suspended in a uniform magnetic field of 8×10^{-2} T. The work done in rotating it from its most stable to most unstable position is:**
   (a) 16×10^{-2} J (b) 8×10^{-2} J
   (c) 4×10^{-2} J (d) Zero
4. **Which of the diode circuit shows correct biasing used for the measurement of dynamic resistance of p-n junction diode:**

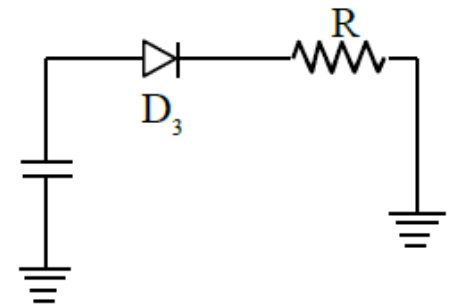
(a)



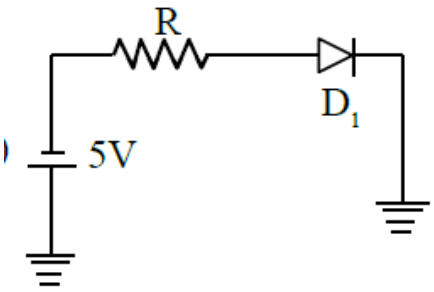
(b)



(c)



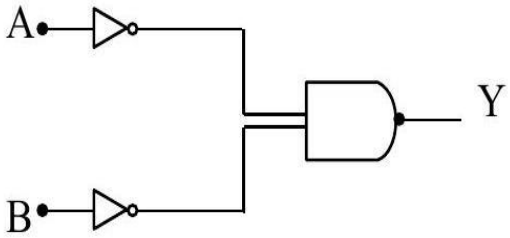
(d)



5. Arrange the following in the ascending order of wavelength:
(A) Gamma rays (λ_1)
(B) x-ray (λ_2)
(C) Infrared waves (λ_3)
(D) Microwaves (λ_4)

Choose the most appropriate answer from the options given below :
(a) $\lambda_4 < \lambda_3 < \lambda_1 < \lambda_2$ (b) $\lambda_4 < \lambda_3 < \lambda_2 < \lambda_1$
(c) $\lambda_1 < \lambda_2 < \lambda_3 < \lambda_4$ (d) $\lambda_2 < \lambda_1 < \lambda_4 < \lambda_3$

6. Identify the logic gate given in the circuit:

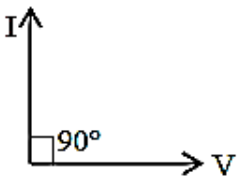
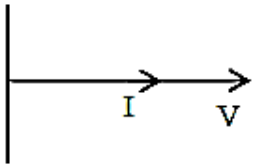
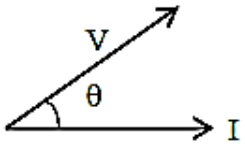
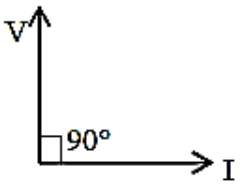


(a) NAND – gate (b) OR - gate
(c) AND gate (d) NOR gate

7. The width of one of the two slits in a Young's double slit experiment is 4 times that of the other slit. The ratio of the maximum of the minimum intensity in the interference pattern is:
(a) 9: 1 (b) 16: 1
(c) 1: 1 (d) 4: 1

8. Correct formula for height of a satellite from earths surface is :
(a) $\left(\frac{T^2R^2g}{4\pi}\right)^{1/2} - R$ (b) $\left(\frac{T^2R^2g}{4\pi^2}\right)^{1/3} - R$
(c) $\left(\frac{T^2R^2}{4\pi^2g}\right)^{1/3} - R$ (d) $\left(\frac{T^2R^2}{4\pi^2}\right)^{-1/3} + R$

9. Match List I with List II

	List–I		List–II
A.	Purely capacitive circuit	I.	
B.	Purely inductive circuit	II.	
C.	LCR series at resonance	III.	
D.	LCR series circuit	IV.	

Choose the correct answer from the options given below:

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

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

10. Given below are two statements:

Statement I: The contact angle between a solid and a liquid is a property of the material of the solid and liquid as well.

Statement II: The rise of a liquid in a capillary tube does not depend on the inner radius of the tube.

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

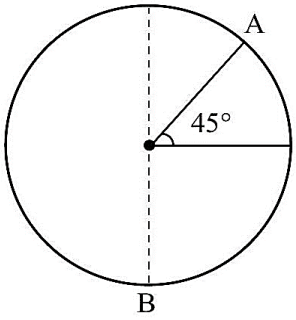
(a) Both Statement I and Statement II are false

(b) Statement I is false but Statement II is true.

(c) Statement I is true but Statement II is false.

(d) Both Statement I and Statement II are true.

11. A body of mkg slides from rest along the curve of vertical circle from point A to B in friction less path. The velocity of the body at B is :



(Vertical Circle)

(given, R = 14 m, g = 10 m/s² and $\sqrt{2} = 1.4$)

(a) 19.8 m/s (b) 21.9 m/s

(c) 16.7 m/s (d) 10.6 m/s

12. An electric bulb rated 50 W − 200 V is connected across a 100 V supply. The power dissipation of the bulb is :

(a) 12.5 W (b) 25 W

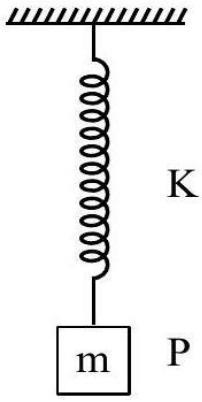
(c) 50 W (d) 100 W

13. A 2 kg brick begins to slide over a surface which is inclined at an angle of 45° with respect to horizontal axis. The co-efficient of static friction between their surfaces is:

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

(c) 0.5 (d) 1.7

14. In simple harmonic motion, the total mechanical energy of given system is E. If mass of oscillating particle P is doubled then the new energy of the system for same amplitude is:



(a) $\frac{E}{\sqrt{2}}$ (b) E

(c) $E\sqrt{2}$ (d) 2E

15. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A : Number of photons increases with increase in frequency of light.

Reason R : Maximum kinetic energy of emitted electrons increases with the frequency of incident radiation.

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

(a) Both A and R are correct and R is NOT the correct explanation of A.

(b) A is correct but R is not correct.

(c) Both A and R are correct and R is the correct explanation of A.

(d) A is not correct but R is correct.

16. According to Bohr's theory, the moment of momentum of an electron revolving in 4^{th} orbit of hydrogen atom is:
(a) $8\frac{h}{\pi}$ (b) $\frac{h}{\pi}$
(c) $2\frac{h}{\pi}$ (d) $\frac{h}{2\pi}$

17. A sample of gas at temperature T is adiabatically expanded to double its volume. Adiabatic constant for the gas is $\gamma = 3/2$. The work done by the gas in the process is : ($\mu = 1$ mole)
(a) $RT[\sqrt{2} - 2]$ (b) $RT[1 - 2\sqrt{2}]$
(c) $RT[2\sqrt{2} - 1]$ (d) $RT[2 - \sqrt{2}]$

18. A charge q is placed at the center of one of the surface of a cube. The flux linked with the cube is:-
(a) $\frac{q}{4\epsilon_0}$ (b) $\frac{q}{2\epsilon_0}$
(c) $\frac{q}{8\epsilon_0}$ (d) Zero

19. Applying the principle of homogeneity of dimensions, determine which one is correct. where T is time period, G is gravitational constant, M is mass, r is radius of orbit.
(a) $T^2 = \frac{4\pi^2 r}{GM^2}$ (b) $T^2 = 4\pi^2 r^3$
(c) $T^2 = \frac{4\pi^2 r^3}{GM}$ (d) $T^2 = \frac{4\pi^2 r^2}{GM}$

20. A 90 kg body placed at 2R distance from surface of earth experiences gravitational pull of:

(R = Radius of earth, $g = 10\ ms^{-2}$)
(a) 300 N (b) 225 N
(c) 120 N (d) 100 N

SECTION- B

21. The displacement of a particle executing SHM is given by $x = 10\sin\left(\omega t + \frac{\pi}{3}\right)$ m. The time period of motion is 3.14 s. The velocity of the particle at $t = 0$ is _____ m/s.

22. A bus moving along a straight highway with speed of 72 km/h is brought to halt within 4 s after applying the brakes. The distance travelled by the bus during this time (Assume the retardation is uniform) is ____ m.

23. A parallel plate capacitor of capacitance 12.5pF is charged by a battery connected between its plates to potential difference of 12.0 V. The battery is now disconnected and a dielectric slab ($\epsilon_r = 6$) is inserted between the plates. The change in its potential energy after inserting the dielectric slab is _____ $\times 10^{-12}$ J

24. In a system two particles of masses $m_1 = 3$ kg and $m_2 = 2$ kg are placed at certain distance from each other. The particle of mass m_1 is moved towards the center of mass of the system through a distance 2 cm. In order to keep the center of mass of the system at the original position, the particle of mass m_2 should move towards the center of mass by the distance ____ cm.

25. The disintegration energy Q for the nuclear fission of $^{235}U \rightarrow {}^{140}Ce + {}^{94}Zr + n$ is MeV.

Given atomic masses of

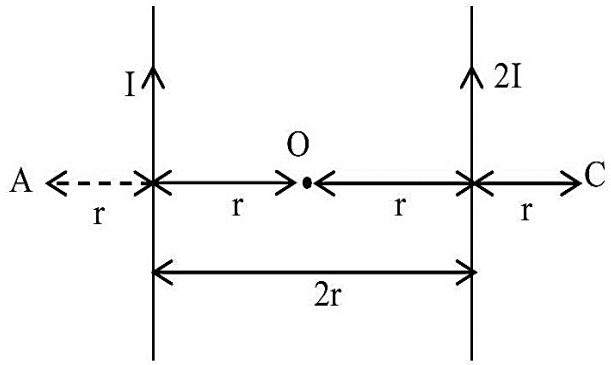
$^{235}U: 235.0439u$; $^{140}Ce; 139.9054u$
$^{94}Zr: 93.9063u$; $n: 1.0086u$

Value of $c^2 = 931 MeV/u$.

26. A light ray is incident on a glass slab of thickness $4\sqrt{3}$ cm and refractive index $\sqrt{2}$. The angle of incidence is equal to the critical angle for the glass slab with air. The lateral displacement of ray after passing through glass slab is _____ cm.

(Given $\sin 15^\circ = 0.25$)

27. A rod of length 60 cm rotates with a uniform angular velocity $20 rads^{-1}$ about its perpendicular bisector, in a uniform magnetic field 0.5 T. The direction of magnetic field is parallel to the axis of rotation. The potential difference between the two ends of the rod is _____ V.
28. Two wires A and B are made up of the same material and have the same mass. Wire A has radius of 2.0 mm and wire B has radius of 4.0 mm. The resistance of wire B is 2Ω. The resistance of wire A is ___ Ω.
29. Two parallel long current carrying wire separated by a distance 2r are shown in the figure. The ratio of magnetic field at A to the magnetic field produced at C is $\frac{x}{7}$. The value of x is _____ .



30. Mercury is filled in a tube of radius 2 cm up to a height of 30 cm. The force exerted by mercury on the bottom of the tube is _____ N.

(Given, atmospheric pressure = $10^5 Nm^{-2}$, density of mercury = 1.36×10^4 kg m^{-3}, g = 10 ms^{-2}, $\pi = \frac{22}{7}$)

PART- II CHEMISTRY

SECTION- A

31. The equilibrium constant for the reaction

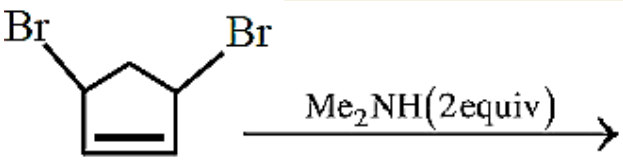
$$SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)$$

is $K_C = 4.9 \times 10^{-2}$. The value of K_C for the reaction given below is

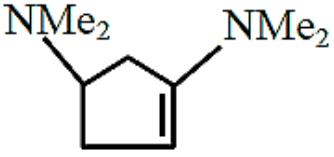
$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ is

(a) 4.9 (b) 41.6
(c) 49 (d) 416

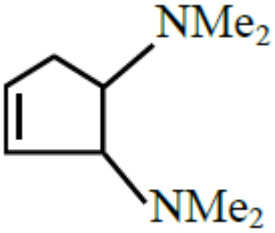
32. Find out the major product formed from the following reaction. [Me: $-CH_3$]

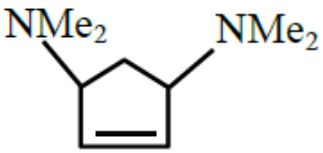


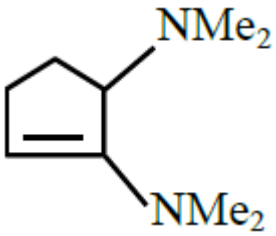
(a)



(b)



(c) 

(d) 

33. When MnO_2 and H_2SO_4 is added to a salt (A), the greenish yellow gas liberated as salt (A) is :

(a) NaBr (b) CaI_2
(c) KNO_3 (d) NH_4Cl

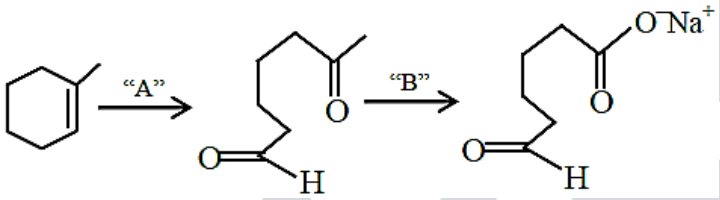
34. The correct statement/s about Hydrogen bonding is/are:

(A) Hydrogen bonding exists when H is covalently bonded to the highly electro negative atom.
(B) Intermolecular H bonding is present in o-nitro phenol
(C) Intramolecular H bonding is present in HF.
(D) The magnitude of H bonding depends on the physical state of the compound.
(E) H-bonding has powerful effect on the structure and properties of compounds.

Choose the correct answer from the options given below:

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

35.



In the above chemical reaction sequence "A" and "B" respectively are:

(a) $O_3, Zn/H_2O$ and $NaOH_{(alc.)}/I_2$

(b) H_2O, H^+ and $NaOH_{(alc.)}/I_2$

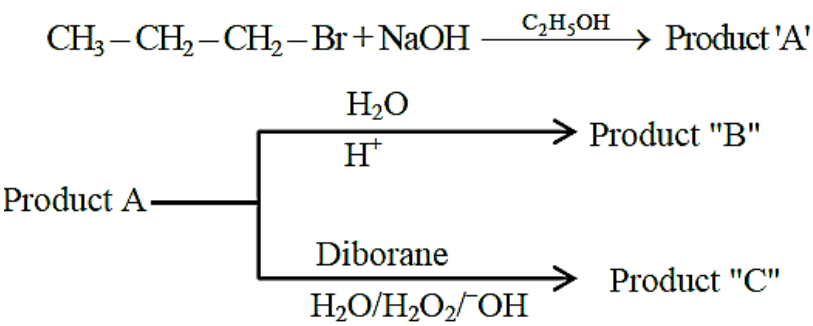
(c) H_2O, H^+ and $KMnO_4$

(d) $O_3, Zn/H_2O$ and $KMnO_4$

36. Common name of Benzene-1, 2-diol is

(a) quinol (b) resorcinol
(c) catechol (d) o-cresol

37.



Consider the above reactions, identify product B and product C.

(a) B = C = 2-Propanol

(b) B = 2-Propanol C = 1-Propanol

(c) B = 1-Propanol C = 2-Propanol

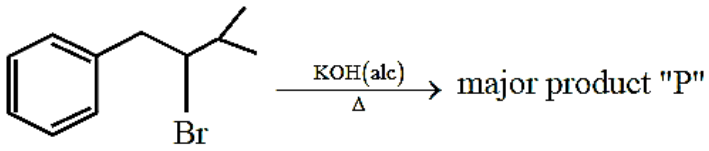
(d) B = C = 1-Propanol

38. The adsorbent used in adsorption chromatography is/are

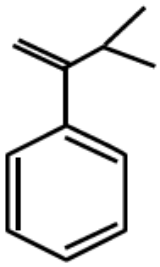
(A) silica gel **(B) alumina**
(C) quick lime **(D) magnesia**

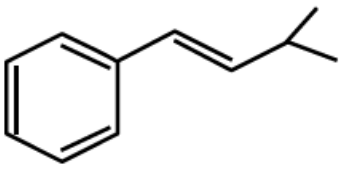
Choose the most appropriate answer from the options given below:
(a) B only (b) C and D only
(c) A and B only (d) A only

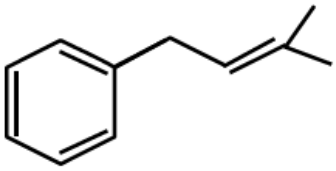
39.

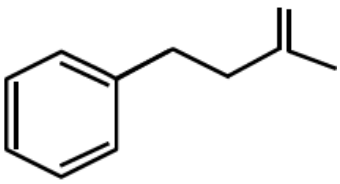


Product P is

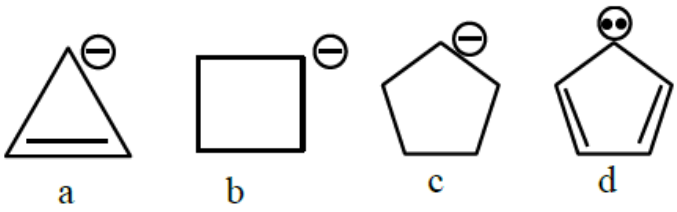
(a)


(b)


(c)


(d)


40. Correct order of stability of carbanion is



(a) c > b > d > a (b) a > b > c > d
(c) d > a > c > b (d) d > c > b > a

41. The correct order of the first ionization enthalpy is
(a) Al > Ga > Tl (b) Ga > Al > B
(c) B > Al > Ga (d) Tl > Ga > Al

42. If an iron (III) complex with the formula $[Fe(NH_3)_x(CN)_y]^-$ has no electron in its e_g orbital, then the value of x + y is
(a) 5 (b) 6
(c) 3 (d) 4

43. Fuel cell, using hydrogen and oxygen as fuels,

(A) has been used in spaceship

(B) has as efficiency of 40% to produce electricity

(C) uses aluminium as catalysts

(D) is eco-friendly

(E) is actually a type of Galvanic cell only
(a) A,B,C only (b) A,B,D only
(c) A,B,D,E only (d) A,D,E only

44. Choose the Incorrect Statement about Dalton's Atomic Theory

(a) Compounds are formed when atoms of different elements combine in any ratio

(b) All the atoms of a given element have identical properties including identical mass

(c) Matter consists of indivisible atoms

(d) Chemical reactions involve reorganization of atoms

45. Match List I with List II

	LIST I		LIST II
A.	**α-Glucose and α-Galactose**	**I.**	**Functional isomers**
B.	**α-Glucose and β-Glucose**	**II.**	**Homologous**
C.	**α-Glucose and α-Fructose**	**III.**	**Anomers**
D.	**α-Glucose and α-Ribose**	**IV.**	**Epimers**

Choose the correct answer from the options given below:

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

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

46. Given below are two statements:

Statement I: The correct order of first ionization enthalpy values of Li, Na, F and Cl is Na < Li < Cl < F.

Statement II: The correct order of negative electron gain enthalpy values of Li, Na, F and Cl is Na < Li < F < Cl

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

(a) Both Statement I and Statement II are true

(b) Both Statement I and Statement II are false

(c) Statement I is false but Statement II is true

(d) Statement I is true but Statement II is false

47. For a strong electrolyte, a plot of molar conductivity against (concentration) $^{1/2}$ is a straight line, with a negative slope, the correct unit for the slope is

(a) $Scm^2\ mol^{-3/2}\ L^{1/2}$
(b) $Scm^2\ mol^{-1}\ L^{1/2}$
(c) $Scm^2\ mol^{-3/2}\ L$
(d) $Scm^2\ mol^{-3/2}\ L^{-1/2}$

48. A first-row transition metal in its +2 oxidation state has a spin-only magnetic moment value of 3.86 BM. The atomic number of the metal is

(a) 25 (b) 26
(c) 22 (d) 23

49. The number of unpaired d-electrons in

$[Co(H_2O)_6]^{3+}$ is _____

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

50. The number of species from the following that have pyramidal geometry around the central atom is _____
$S_2O_3^{2-}, SO_4^{2-}, SO_3^{2-}, S_2O_7^{2-}$

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

SECTION- B

51. The maximum number of orbitals which can be identified with $n = 4$ and $m_l = 0$ is _____

52. Number of compounds/species from the following with non-zero dipole moment is _____
$BeCl_2, BCl_3, NF_3, XeF_4, CCl_4, H_2OH_2\ S, HBr, CO_2, H_2, HCl$

53. Three moles of an ideal gas are compressed isothermally from 60 L to 20 L using constant pressure of 5 atm. Heat exchange Q for the compression is - _____ Lit. atm.

54. From 6.55 g of aniline, the maximum amount of acetanilide that can be prepared will be _____ $\times 10^{-1}$ g.

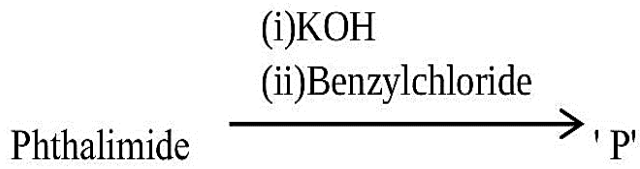
55. Consider the following reaction, the rate expression of which is given below

$A + B \rightarrow C$

$rate = k[A]^{1/2}[B]^{1/2}$

The reaction is initiated by taking 1M concentration A and B each. If the rate constant (k) is $4.6 \times 10^{-2}\ s^{-1}$, then the time taken for A to become 0.1M is _____ sec. (nearest integer)

56. Phthalimide is made to undergo following sequence of reactions.



Total number of π bonds present in product ' P ' is/are

57. The total number of 'sigma' and 'Pi' bonds in 2-oxohex-4-ynoic acid is ___ .

58. A first-row transition metal with highest enthalpy of atomisation, upon reaction with oxygen at high temperature forms oxides of formula M_2O_n (where $n = 3, 4, 5$). The 'spin-only' magnetic moment value of the amphoteric oxide from the above oxides is ___ BM (near integer)

(Given atomic number: Sc : 21, Ti: 22, V: 23,

Cr: 24, Mn: 25, Fe: 26, Co: 27, Ni: 28, Cu: 29, Zn: 30)

59. 2.7Kg of each of water and acetic acid are mixed, the freezing point of the solution will be $-x\,^{\circ}C$. Consider the acetic acid does not dimerise in water, nor dissociates in water x = _____ (nearest integer)

[Given: Molar mass of water $= 18\ g\ mol^{-1}$, acetic acid $= 60\ g\ mol^{-1}$]

$K_f H_2O$: 1.86 K kg mol^{-1}

K_f acetic acid : 3.90 K kg mol^{-1}

freezing point: $H_2O = 273$ K, acetic acid $= 290$ K]

60. Vanillin compound obtained from vanilla beans, has total sum of oxygen atoms and π electrons is_____

PART- III MATHEMATICS

SECTION- A

61. If the function $f(x) = \begin{cases} \frac{72^x - 9^x - 8^x + 1}{\sqrt{2} - \sqrt{1+\cos x}} & , x \neq 0 \\ a\log_e 2 \log_e 3 & , x = 0 \end{cases}$ is continuous at $x = 0$, then the value of a^2 is equal to

(a) 968 (b) 1152
(c) 746 (d) 1250

62. If $\lambda > 0$, let θ be the angle between the vectors $\vec{a} = \hat{i} + \lambda\hat{j} - 3\hat{k}$ and $\vec{b} = 3\hat{i} - \hat{j} + 2\hat{k}$. If the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are mutually perpendicular, then the value of $(14\cos\theta)^2$ is equal to

(a) 25 (b) 20
(c) 50 (d) 40

63. Let C be a circle with radius $\sqrt{10}$ units and centre at the origin. Let the line $x + y = 2$ intersects the circle C at the points P and Q. Let MN be a chord of C of length 2 unit and slope -1 . Then, a distance (in units) between the chord PQ and the chord MN is

(a) $2 - \sqrt{3}$ (b) $3 - \sqrt{2}$
(c) $\sqrt{2} - 1$ (d) $\sqrt{2} + 1$

64. Let a relation R on $\mathbb{N} \times \mathbb{N}$ be defined as:

$(x_1, y_1)R(x_2, y_2)$ if and only if $x_1 \leq x_2$ or $y_1 \leq y_2$

Consider the two statements:

(I) R is reflexive but not symmetric.

(II) R is transitive

Then which one of the following is true?

(a) Only (II) is correct.

(b) Only (I) is correct.

(c) Both (I) and (II) are correct.

(d) Neither (I) nor (II) is correct.

65. Let three real numbers a, b, c be in arithmetic progression and $a+1, b, c+3$ be in geometric progression. If $a > 10$ and the arithmetic mean of a, b and c is 8 , then the cube of the geometric mean of a, b and c is

(a) 120 (b) 312
(c) 316 (d) 128

66. Let $A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$ and $B = I + \text{adj}(A) + (\text{adj } A)^2 + \cdots + (\text{adj } A)^{10}$. Then, the sum of all the elements of the matrix B is:

(a) -110 (b) 22
(c) -88 (d) -124

67. The value of $\frac{1\times2^2+2\times3^2+\cdots+100\times(101)^2}{1^2\times2+2^2\times3+\cdots+100^2\times101}$ is

(a) $\frac{306}{305}$ (b) $\frac{305}{301}$
(c) $\frac{32}{31}$ (d) $\frac{31}{30}$

68. Let $f(x) = \int_0^x \left(t + \sin\left(1 - e^t\right)\right)dt, x \in \mathbb{R}$.

Then $\lim_{x\to0} \frac{f(x)}{x^3}$ is equal to

(a) $\frac{1}{6}$ (b) $-\frac{1}{6}$
(c) $-\frac{2}{3}$ (d) $\frac{2}{3}$

69. The area (in sq. units) of the region described by $\{(x, y): y^2 \le 2x, \text{ and } y \ge 4x - 1\}$ is

(a) $\frac{11}{32}$ (b) $\frac{8}{9}$
(c) $\frac{11}{12}$ (d) $\frac{9}{32}$

70. The area (in sq. units) of the region $S = \{z \in \mathbb{C}; |z-1| \le 2; (z+\bar{z}) + i(z-\bar{z}) \le 2, \text{Im}(z) \ge 0\}$ is

(a) $\frac{7\pi}{3}$ (b) $\frac{3\pi}{2}$
(c) $\frac{17\pi}{8}$ (d) $\frac{7\pi}{4}$

71. If the value of the integral $\int_{-1}^{1} \frac{\cos\alpha x}{1+3^x}dx$ is $\frac{2}{\pi}$. Then, a value of α is

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{2}$
(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{4}$

72. Let $f(x) = 3\sqrt{x-2} + \sqrt{4-x}$ be a real valued function. If α and β are respectively the minimum and the maximum values of f, then $\alpha^2 + 2\beta^2$ is equal to

(a) 44 (b) 42
(c) 24 (d) 38

73. If the coefficients of x^4, x^5 and x^6 in the expansion of $(1+x)^n$ are in the arithmetic progression, then the maximum value of n is:

(a) 14 (b) 21
(c) 28 (d) 7

74. Consider a hyperbola H having centre at the origin and foci and the x-axis. Let C_1 be the circle touching the hyperbola H and having the centre at the origin. Let C_2 be the circle touching the hyperbola H at its vertex and having the centre at one of its foci. If areas (in sq. units) of C_1 and C_2 are 36π and 4π, respectively, then the length (in units) of latus rectum of H is

(a) $\frac{28}{3}$ (b) $\frac{14}{3}$
(c) $\frac{10}{3}$ (d) $\frac{11}{3}$

75. If the mean of the following probability distribution of a random variable X;

X	0	2	4	6	8
P(X)	a	2a	a + b	2 b	3 b

is $\frac{46}{9}$, then the variance of the distribution is

(a) $\frac{581}{81}$ (b) $\frac{566}{81}$
(c) $\frac{173}{27}$ (d) $\frac{151}{27}$

76. Let PQ be a chord of the parabola $y^2 = 12x$ and the midpoint of PQ be at $(4, 1)$. Then, which of the following point lies on the line passing through the points P and Q ?

(a) $(3, -3)$ (b) $\left(\frac{3}{2}, -16\right)$
(c) $(2, -9)$ (d) $\left(\frac{1}{2}, -20\right)$

77. Given the inverse trigonometric function assumes principal values only. Let x, y be any two real numbers in $[-1, 1]$ such that

$\cos^{-1} x - \sin^{-1} y = \alpha, \frac{-\pi}{2} \leq \alpha \leq \pi.$

Then, the minimum value of $x^2 + y^2 + 2xy\sin\alpha$ is

(a) -1 (b) 0
(c) $\frac{-1}{2}$ (d) $\frac{1}{2}$

78. Let $y = y(x)$ be the solution of the differential equation

$(x^2 + 4)^2 dy + (2x^3 y + 8xy - 2)dx = 0$. **If $y(0) = 0$ then $y(2)$ is equal to**

(a) $\frac{\pi}{8}$ (b) $\frac{\pi}{16}$
(c) 2π (d) $\frac{\pi}{32}$

79. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}, \vec{b} = 2\hat{i} + 4\hat{j} - 5\hat{k}$ and $\vec{c} = x\hat{i} + 2\hat{j} + 3\hat{k}, x \in \mathbb{R}$. If $\vec{d}$ is the unit vector in the direction of $\vec{b} + \vec{c}$ such that $\vec{a} \cdot \vec{d} = 1$, then $(\vec{a} \times \vec{b}) \cdot \vec{c}$ is equal to

(a) 9 (b) 6
(c) 3 (d) 11

80. Let P the point of intersection of the lines $\frac{x-2}{1} = \frac{y-4}{5} = \frac{z-2}{1}$ and $\frac{x-3}{2} = \frac{y-2}{3} = \frac{z-3}{2}$.

Then, the shortest distance of P from the line $4x = 2y = z$ is

(a) $\frac{5\sqrt{14}}{7}$ (b) $\frac{\sqrt{14}}{7}$
(c) $\frac{3\sqrt{14}}{7}$ (d) $\frac{6\sqrt{14}}{7}$

SECTION- B

81. Let $S = \{\sin^2 2\theta : (\sin^4\theta + \cos^4\theta)x^2 + (\sin 2\theta)x + (\sin^6\theta + \cos^6\theta) = 0$ has real roots $\}$. If α and β be the smallest and largest elements of the set S, respectively, then $3((\alpha - 2)^2 + (\beta - 1)^2)$ equals .....

82. If $\int \text{cosec}^5 x dx = \alpha\cot x\,\text{cosec}\,x\left(\text{cosec}^2 x + \frac{3}{2}\right) + \beta\log_e\left|\tan\frac{x}{2}\right| + C$ where $\alpha, \beta \in \mathbb{R}$ and C is constant of integration, then the value of $8(\alpha + \beta)$ equals .....

83. Let $f: \mathbb{R} \to \mathbb{R}$ be a thrice differentiable function

such that $f(0)=0, f(a)=1, f(b)=-1, f(c)=2$ and $f(d)=-2$. Then, the minimum number of zeros of $(3f'f'+fff'')(x)$ is ....

84. Consider the function $f:\mathbb{R}\to\mathbb{R}$ defined by

$f(x)=\frac{2x}{\sqrt{1+9x^2}}$. If the composition of

$f,\underbrace{(f\,o\,f\,o\,f\,o...o\,f)}_{10\text{ times}}(x)=\frac{2^{10}x}{\sqrt{1+9\alpha x^2}}$, then the

value of $\sqrt{3\alpha+1}$ is equal to .....

85. Let A be a 2×2 symmetric matrix such that $A\begin{bmatrix}1\\1\end{bmatrix}=\begin{bmatrix}3\\7\end{bmatrix}$ and the determinant of A be 1.

If $A^{-1}=\alpha A+\beta I$, where I is an identity matrix of order 2×2, then $\alpha+\beta$ equals….

86. There are 4 men and 5 women in Group A, and 5 men and 4 women in Group B. If 4 persons are selected from each group, then the number of ways of selecting 4 men and 4 women is……
87. In a tournament, a team plays 10 matches with probabilities of winning and losing each match as $\frac{1}{3}$ and $\frac{2}{3}$ respectively. Let x be the number of matches that the team wins, and y be the number of matches that team loses. If the probability $P(|x-y|\le 2)$ is p, then 3^9p equals ____
88. Consider a triangle ABC having the vertices $A(1,2), B(\alpha,\beta)$ and $C(\gamma,\delta)$ and angles $\angle ABC=\frac{\pi}{6}$ and $\angle BAC=\frac{2\pi}{3}$. If the points B and C lie on the line $y=x+4$, then $\alpha^2+\gamma^2$ is equal to .....
89. Consider a line L passing through the points $P(1,2,1)$ and $Q(2,1,-1)$. If the mirror image of the point $A(2,2,2)$ in the line L is (α,β,γ), then $\alpha+\beta+6\gamma$ is equal to ....
90. Let $y=y(x)$ be the solution of the differential equation $(x+y+2)^2dx=dy, y(0)=-2$. Let the maximum and minimum values of the function $y=y(x)$ in $\left[0,\frac{\pi}{3}\right]$ be α and β, respectively. If $(3\alpha+\pi)^2+\beta^2=\gamma+\delta\sqrt{3}, \gamma,\delta\in\mathbb{Z}$, then $\gamma+\delta$ equals……..