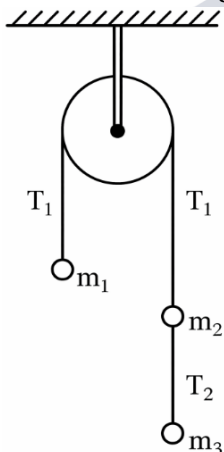


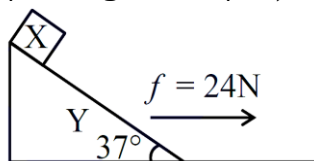
PHYSICS

SECTION-A

- In a Vernier calipers, when both jaws touch each other, zero of the Vernier scale is shifted to the right of zero of the main scale and 7th Vernier division coincides with a main scale reading. If the value of 1 main scale division is 1 mm and there are 10 Vernier scale divisions, then the Vernier caliper has
 - 0.07 cm negative zero error
 - 0.7 cm negative zero error
 - 0.07 cm positive zero error
 - 0.7 cm positive zero error
- L, C and R represents physical quantities inductance, capacitance and resistance respectively. The dimensional formula $ML^2 T^{-4} A^{-2}$ corresponds to
 - $\frac{R}{\sqrt{LC}}$
 - $\frac{R}{LC}$
 - $\frac{C}{\sqrt{LR}}$
 - $\frac{1}{R} \sqrt{\frac{L}{C}}$
- When one moves from a point 16 km below the earth's surface to a point 16 km above the earth's surface. The change in g is approximately $\alpha\%$. The value of α is ____ . (Take radius of the earth = 6400 km.)
 - 0.12
 - 0.25
 - 0.50
 - 0.75
- Three masses $m_1 = 4$ kg, $m_2 = 4$ kg and $m_3 = 6$ kg are suspended from a fixed smooth frictionless pulley as shown in the figure below. The value of T_1/T_2 is ____ . (take $g = 10$ m/s²)



- $\frac{5}{3}$
 - $\frac{2}{3}$
 - $\frac{3}{5}$
 - $\frac{2}{5}$
- A wedge Y with mass of 10 kg and all frictionless surfaces and the inclined surface making 37° with horizontal. A block X with mass 2 kg is placed at the highest point of the wedge as shown in figure is at rest. At $t = 0$ wedge (Y) is pulled toward right with constant force (f) of 24 N . Taking the block X at rest at $t = 0$, the time taken by it to slide down 8.8 m on the slope, while Y is on the move, is ____ s. (take $\tan(37^\circ) = 3/4$ and $g = 10$ m/s²)



- 2
 - 4
 - $\sqrt{2}$
 - $2\sqrt{2}$
- The Young's modulus of steel wire of radius r and length L is Y . If the radius r and length L of the wire are doubled then the value of Y

- (a) increases by two times
- (b) reduces by half
- (c) remains unchanged
- (d) becomes one fourth

7. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R
Statement I: Change in internal energy of a system containing n mole of ideal gas can be written as $\Delta U =$

$$nC_v(T_f - T_i) = \frac{nR}{\gamma - 1} (T_f - T_i), \text{ where } \gamma = \frac{C_p}{C_v}, T_i = \text{initial temperature, } T_f = \text{final temperature.}$$

Statement II : Relation between degree of freedom f and $\gamma (= C_p/C_v)$ is $(\gamma = 1 + \frac{2}{f})$

Choose the correct 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

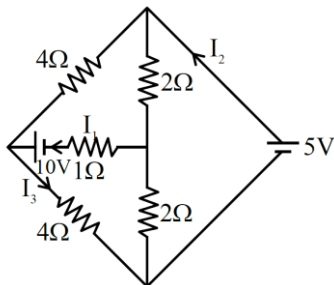
8. Consider the following statements:

- (A) Zeroth law of thermodynamics gives concept of temperature
- (B) First law of thermodynamics gives concept of internal energy
- (C) In isothermal expansion of ideal gas, $\Delta Q \neq \Delta W$
- (D) Product of intensive and extensive variables is extensive
- (E) The ratio of any extensive variable to mass will be an extensive variable

Choose the correct combination of statements from the options given below:

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

9. Refer to the figure given below. The values of I_1, I_2 and I_3 are ____.



- (a) $I_1 = 2.5 \text{ A}, I_2 = 1.875 \text{ A}, I_3 = 1.875 \text{ A}$
- (b) $I_1 = 1.875 \text{ A}, I_2 = 2.5 \text{ A}, I_3 = 1.875 \text{ A}$
- (c) $I_1 = 1.875 \text{ A}, I_2 = 1.875 \text{ A}, I_3 = 2.5 \text{ A}$
- (d) $I_1 = 2.5 \text{ A}, I_2 = 2.5 \text{ A}, I_3 = 1.875 \text{ A}$

10. An electron of mass m is moving in an electric field $\vec{E} = -2E_0\hat{i}$ ($E_0 = \text{constant} > 0$), with an initial velocity $\vec{V} = v_0\hat{i}$ ($v_0 = \text{constant} > 0$). If $\lambda_0 = \frac{h}{4mv_0}$, its de Broglie wavelength at time t is ____ . ($e = \text{charge of electron}$)

- (a) $\frac{4\lambda_0}{\left[1 - \frac{E_0 e t}{2m v_0}\right]}$
- (b) $\frac{4\lambda_0}{\left[1 + \frac{E_0 e t}{2m v_0}\right]}$
- (c) $\frac{4\lambda_0}{\left[1 + \frac{2E_0 e t}{m v_0}\right]}$
- (d) $\frac{4\lambda_0}{\left[1 - \frac{2E_0 e t}{m v_0}\right]}$

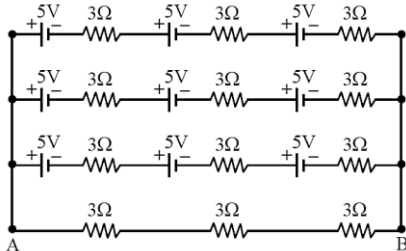
11. In the hydrogen atom, the electron makes a transition from the higher orbit (i) to a lower orbit (f). The ratio of the radius of the orbits is given by $r_i : r_f = 16 : 4$. The wavelength of photon emitted due to this transition is ____ nm. (Given Rydberg constant = $1.0973 \times 10^7/\text{m}$)

- (a) 121
- (b) 242
- (c) 486
- (d) 974

12. A displacement current of 4.0 A can be set up in the space between two parallel plates of $6\mu\text{F}$ capacitor. The rate of change of potential difference across the plates of the capacitor is nearly $\alpha \times 10^6\text{ V/s}$. The value of α is ____ .

(a) 0.58 (b) 0.67
(c) 0.82 (d) 0.75

13. Refer to the figure given below, current between terminals A and B is ____ A.



(a) 12.5 (b) 1.25
(c) 7.5 (d) 5

14. In Young's double slit experiment, the fringes width of the interferences pattern produced on the screen is $2.4\mu\text{m}$. If the experiment is carried out in another medium having refractive index 1.2, the fringe width will be ____ μm .

(a) 1.2 (b) 2
(c) 2.4 (d) 2.88

15. A ray of light passing through an equilateral prism is having velocity $2.12 \times 10^8\text{ m/s}$ in the prism material, then the minimum angle of deviation is ____ degrees.

(a) 45 (b) 30
(c) 28 (d) 58

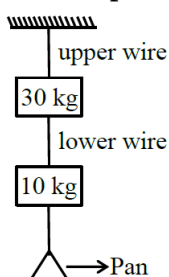
16. Light source having wavelength 331 nm is used to generate photoelectrons whose stopping potential is 0.2 V . The work function of the used metal in the experiment is $\alpha \times 10^{-19}\text{ J}$. The value of α is ____ . ($h = 6.62 \times 10^{-34}\text{ J s}$, $e = 1.6 \times 10^{-19}\text{ C}$ and $c = 3 \times 10^8\text{ m/s}$)

(a) 3.68 (b) 4.68
(c) 5.68 (d) 2.68

17. A compound microscope is designed with two symmetric biconvex lenses. The objective lens is cut vertically, creating two identical plano-convex lenses. One of them is used in place of original objective lens. To retain same magnification keeping the object distance unchanged, the tube length has to be :-

(a) increased two times
(b) increased $\frac{3}{2}$ times
(c) decreased two times
(d) decreased $\frac{3}{2}$ times

18. Two wires as shown in the figure below, made of steel and have breaking stress of $12 \times 10^8\text{ N/m}^2$. Area of cross-section of upper wire is 0.008 cm^2 and of lower wire is 0.004 cm^2 . The maximum mass that can be added to pan without breaking any wire is ____ kg. (take $g = 10\text{ m/s}^2$)

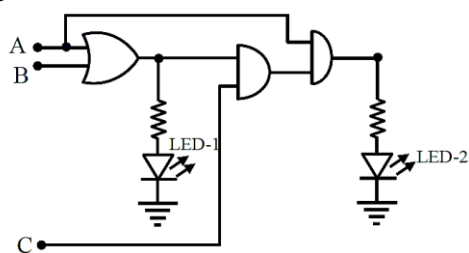


- (a) 56 (b) 38
(c) 96 (d) 5.6

19. An a.c. source of angular frequency ω is connected across a resistor R and a capacitor C in series. The current is observed as I . Now the frequency of the source is changed to $\omega/4$, (keeping the voltage unchanged) the current is found to be $I/3$. The ratio of resistance to reactance at frequency ω is

- (a) $\sqrt{\frac{6}{7}}$ (b) $\sqrt{\frac{3}{5}}$
(c) $\sqrt{\frac{7}{8}}$ (d) $\sqrt{\frac{3}{4}}$

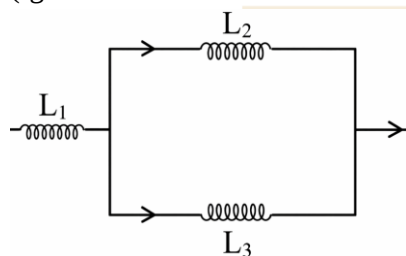
20. For the given logic circuit, which of the following inputs combination will make both LED-1 and LED-2 to glow?



- (a) $A = 0, B = 1, C = 1$
(b) $A = 1, B = 0, C = 0$
(c) $A = 1, B = 0, C = 1$
(d) $A = 1, B = 1, C = 0$

SECTION-B

21. A cube has side length 5 cm and modulus of rigidity 10^5 N/m^2 . The displacement produced by a force of 10 N in the upper face of cube is ____ mm .
22. From 18 m height above the ground a ball is dropped from rest. The height above the ground at which the magnitude of velocity equal to the magnitude of acceleration (in the same set of units) due to gravity is ____ m. (Take $g = 10 \text{ m/s}^2$ and neglect the air resistance)
23. A transverse wave on a string is described by $y = 3\sin(36t + 0.018x + \pi/4)$. Where x, y are in cm and t in seconds. The least distance between the two successive crests in the wave is ____ cm. (Nearest integer) ($\pi = 3.14$)
24. The charged particle moving in a uniform magnetic field of $(3\hat{i} + 2\hat{j})T$ has an acceleration $(4\hat{i} - \frac{x}{2}\hat{j}) \text{ m/s}^2$. The value of x is
25. In the given circuit below inductance values of L_1, L_2 and L_3 are same. The magnetic energy stored in the entire circuit is (U_t) and that stored in the L_2 inductor is (U_l) . (U_t/U_l) is ____ . (Ignore the mutual inductance if any)



CHEMISTRY

SECTION-A

26. How many grams of residue is obtained by heating 2.76 g of silver carbonate?
(Given : Molar mass of C, O and Ag are 12, 16 and 108 g mol^{-1} respectively)
- (a) 1.08 g (b) 2.16 g
(c) 3.24 g (d) 4.32 g

27. Arrange the following atomic orbitals of multi electron atoms in order of increasing energy.

- (A) $n = 3, \ell = 2, m = +1$
 (B) $n = 4, \ell = 0, m = 0$
 (C) $n = 6, \ell = 1, m = 0$
 (D) $n = 5, \ell = 1, m = +1$
 (E) $n = 2, \ell = 1, m = +1$

Choose the correct answer from the options given below :

- (a) $(C) < (D) < (B) < (A) < (E)$
 (b) $(B) < (A) < (E) < (C) < (D)$
 (c) $(E) < (C) < (D) < (B) < (A)$
 (d) $(E) < (B) < (A) < (D) < (C)$

28. Identify the correct statements from the following :

- (A) Heisenberg uncertainty principle is applicable to electron.
 (B) The size of $2p_x$ orbital is less than the size of $3p_x$ orbital.
 (C) The energy of 2s orbital of H atom is equal to the energy of 2s orbital of Li.
 (D) The electronic configuration of Cr is $[Ar]3d^5 4s^1$

Choose the correct answer from the options given below:

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

29. What is the mole fraction of water in 10% by weight (w/w) of aqueous urea solution ?

[Given : Molar mass of H, O, C and N are 1, 16, 12 and 14 g mol^{-1} respectively]

- (a) 0.825 (b) 0.032
 (c) 0.867 (d) 0.967

30. $M_3 A_2$ is a sparingly soluble salt of molar mass $y \text{ g mol}^{-1}$ and solubility $\times \text{g L}^{-1}$. The ratio of the molar concentration of the anion (A^{3-}) to the solubility product of the salt is

- (a) $\frac{1}{54} \cdot \frac{y^4}{x^4}$ (b) $\frac{y^5}{108x^4}$
 (c) $108 \cdot \frac{x^5}{y^5}$ (d) $\frac{1}{108} \cdot \frac{y^4}{x^4}$

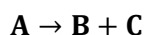
31. Arrange the following resultant mixtures in increasing order of their pH values

- (A) 10 mL 0.2M Ca(OH)_2 + 25 mL 0.1M HCl
 (B) 10 mL 0.01M H_2SO_4 + 10 mL 0.01M Ca(OH)_2
 (C) 10 mL 0.1M H_2SO_4 + 10 mL 0.1M KOH

Choose the correct answer from the options given below :

- (a) $(B) < (C) < (A)$
 (b) $(C) < (A) < (B)$
 (c) $(C) < (B) < (A)$
 (d) $(A) < (C) < (B)$

32. First order gas phase reaction



p_i = initial pressure of gas A, p_t = total pressure of the reaction mixture at time t

Expression of rate constant (k) is

- (a) $\frac{1}{t} \ln \frac{p_i}{2p_i - p_t}$ (b) $\frac{1}{t} \ln \frac{2p_i}{p_i - p_t}$
 (c) $\frac{1}{t} \ln \frac{p_i}{3p_i - 2p_t}$ (d) $\frac{1}{t} \ln \frac{3p_i}{4p_i - p_t}$

33. Statement I : The correct order of electronegativity of fluorine, oxygen nitrogen is $F > O > N$.

Statement II : The oxidation state of oxygen in OF_2 is +2 and in Na_2O is -2 .

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

34. Correct statements from the following are :

- (A) Nitrogen in oxidation states from +1 to +4 disproportionate in acid medium.
(B) Nitrogen has the ability of form $d\pi - p\pi$ multiple bonds with itself and other elements with small size and high electronegativity.
(C) N-N single bond is stronger than P-P single bond.
(D) Nitrogen has highest density in its group due to small size.
(E) The maximum covalency of nitrogen is four since it has only four valence orbitals for bonding.

Choose the correct answer from the options given below :

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

35. Which of the following is NOT a physical or chemical characteristics of interstitial compounds?

- (a) They have high melting points, higher than those of pure metals
(b) They are very soft ionic in nature
(c) They retain metallic conductivity
(d) They are chemically inert and usually nonstoichiometric

36. The correct statements about metal carbonyls are

- (A) The metal-carbon bonds in metals carbonyls possess both σ and π -character.
(B) Due to synergic bonding interactions between metals and CO ligand the metal-carbon bond becomes weak.
(C) The metal-carbon σ bond is formed by the donation of lone pair of electrons on the carbonyl carbon into a vacant orbital of metal.
(D) The metal-carbon π bond is formed by the donation of electrons from filled d-orbital of metal into vacant π^* orbital of CO.

Choose the correct answer from the options given below:

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

37. Given below are two statements :

Statement I : Each electron in e_g orbitals destabilizes the orbitals by $+0.6\Delta_0$ and each electron in the t_{2g} orbitals stabilizes the orbitals by $-0.4\Delta_0$ in an octahedral field on the basis of crystal field theory.

Statement II : All the d-orbitals of the transition metals have the same energy in their free atomic state but when a complex is formed the ligands destroy the degeneracy of these orbitals on the basis of crystal field theory.

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 incorrect
(c) Statement (I) is correct but Statement (II) is incorrect
(d) Statement (I) is incorrect but Statement (II) is correct

38. Given below are two statements :

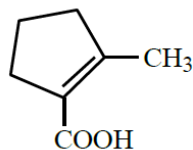
Statement I: On the basis of inductive effect, the order of stability of alkyl carbanions is $\text{CH}_3^- > \text{CH}_3 - \text{CH}_2^- > (\text{CH}_3)_2\text{CH}^- > (\text{CH}_3)_3\text{C}^-$.

Statement II : Allyl and benzyl carbanions are more stabilised by inductive effect and not by resonance effect.

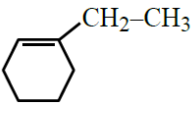
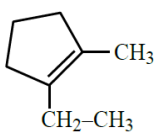
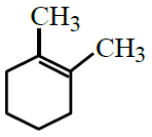
In the light of the above statements choose the correct answer from the options given below

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

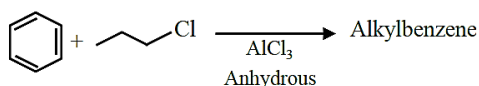
39. "P" is hydrocarbon of molecular formula : C_8H_{14} . On ozonolysis, "P" forms "Q". "Q" on treatment with alkali under reflux condition produces. "R", which on treatment with $I_2/NaOH$ gives a yellow precipitate. Acidification of the solution gives "S". The structure of "S" given below :



The correct structure of "P" is

- (a)  (b) 
- (c)  (d) 

40. For the following Friedel Craft's alkylation reaction, which of the statements are correct?

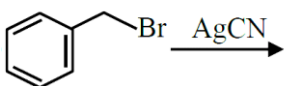
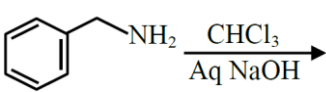
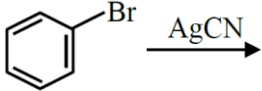
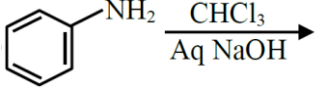
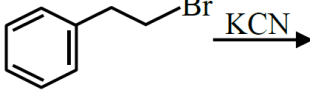


- (A) Major product is n-propyl benzene.
 (B) iso-propyl carbocation intermediate is also generated
 (C) Multiple substitution is inevitable.
 (D) Introducing electron-donating substituent on benzene will not produce any alkylbenzene.

Choose the correct answer from the options given below :

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

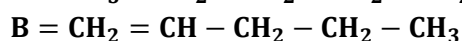
41. Benzyl isocyanide can be obtained from

- (A) 
 (B) 
 (C) 
 (D) 
 (E) 

Choose the correct answer from the options given below :

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

42. Consider compounds A, B and C with following structural formulae

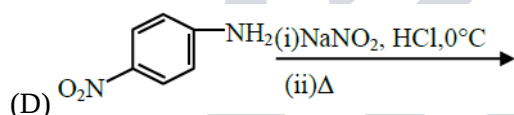
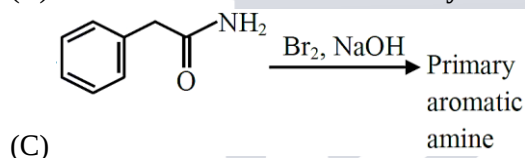
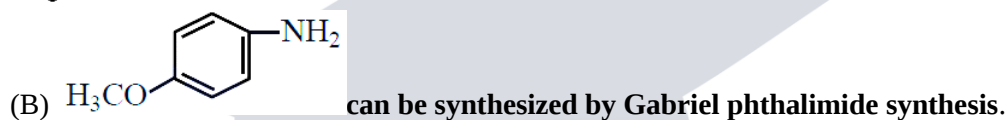
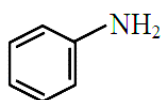
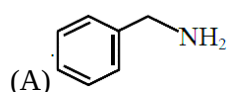




For the conversion of B from A, reagent (D) required is ____ and structural formula of product (E) obtained when C undergoes same reaction using excess reagent (D) is ____

	D	E
(a)	Conc. H_2SO_4	$CH_2 = CH - CH(OH) / CH_3$
(b)	PCC	$HO - CH_2 - CH_2 - CH = CH_2$
(c)	PCC	$CH_2 = CH - CH = CH_2$
(d)	Conc. H_2SO_4 or H_3PO_4	$CH_2 = CH - CH = CH_2$

43. Identify the incorrect statements :



Product will dissolve in NaOH

Choose the correct answer from the options given below :

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

44. Identify the correct statements

- (A) Glucose exist in two anomeric forms.
(B) Anomers of glucose differ in configuration at C -1 in cyclic hemiacetal structure.
(C) Melting point of α -anomer of glucose is greater than β -anomer.
(D) Specific rotation of α -anomer is $+19^\circ$ while for β -anomer is $+112^\circ$
(E) α and β -anomers of glucose are prepared by crystallization of saturated glucose solution at 303 K and 371 K respectively.

Choose the correct answer from the options given below :

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

45. **Statement I** : Sodium dichromate and potassium dichromate are classified as primary standard in titrimetric analysis .

Statement II : Phenolphthalein is a weak base; therefore it dissociates in acidic medium.

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

SECTION-B

46. Consider the following species BrF_5 , XeF_5^- , BF_4^- , ICl_4^- , XeF_4 , SF_4 , NH_4^+ , ClF_3 , XeF_2 , ICl_2^-
 Number of species having $\text{sp}^3 \text{d}$ hybridized central atom is ____
47. In an estimation of sulphur by Carius method 0.2 g of the substance gave 0.6 g of BaSO_4 . The percentage of sulphur in the substance is ____ %. (Given molar mass in gmol^{-1} S: 32, BaSO_4 : 231)
48. One mole of phenol is treated with dilute HNO_3 at 298 K to give a mixture of products. The mixture is separated by steam distillation. The seam volatile compound (X) is separated. The increase in percentage of oxygen in (X) with respect to phenol is ____ $10^{-1}\%$ (Given molar mass in gmol^{-1} H: 1, C: 12, N: 14, O:16)
49. The values of pressure equilibrium constant recorded at different temperatures for the following equilibrium reaction have been given below: $\text{A(g)} \rightleftharpoons \text{B(g)} + \text{C(g)}$

$\frac{1}{T} (\text{K}^{-1})$	$\log_{10} K_p$
0.05	3.5
0.06	2.5
0.07	1.5

The magnitude of $\frac{\Delta H^\circ}{R}$ calculated from the above data is ____ . (Nearest integer)

50. If the half-life of a first order reaction is 6.93 minutes then the time required for completion of 99% of the reaction will be ____ minutes.
 (Given : $\log 2 = 0.3010$)

MATHEMATICS

SECTION-A

51. Let $a, b \in \mathbb{C}$. Let α, β be the roots of the equation $x^2 + ax + b = 0$. If $\beta - \alpha = \sqrt{11}$ and $\beta^2 - \alpha^2 = 3i\sqrt{11}$, then $(\beta^3 - \alpha^3)^2$ is equal to:
 (a) 160 (b) 176
 (c) 194 (d) 187
52. Let the sum of the first n terms of an A.P. be $3n^2 + 5n$. Then the sum of squares of the first 10 terms of the A.P. is :
 (a) 10220 (b) 12860
 (c) 15220 (d) 19780
53. Let A be a 3×3 matrix such that $A^T \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 5 \\ 2 \\ 2 \end{bmatrix}$, $A^T \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 3 \\ 1 \\ 1 \end{bmatrix}$, $A \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 3 \\ 4 \\ 4 \end{bmatrix}$ and $A \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ 3 \\ 1 \end{bmatrix}$
 If $\det(A) = 1$, then $\det(\text{adj}(A^2 + A))$ is equal to :
 (a) 16 (b) 25
 (c) 49 (d) 64
54. Consider the system of linear equations in x, y, z :
 $x + 2y + tz = 0$,
 $6x + y + 5tz = 0$,
 $3x + t^2y + f(t)z = 0$,
 Where $f: \mathbb{R} \rightarrow \mathbb{R}$ is a differentiable function. If this system has infinitely many solutions for all $t \in \mathbb{R}$, then f
 (a) is a constant function

- (b) is strictly increasing on R
 (c) is strictly decreasing on R
 (d) has two critical points

55. $\sum_{n=1}^{10} \left(\frac{528}{n(n+1)(n+2)} \right)$ is equal to :

- (a) 65 (b) 130
 (c) 220 (d) 440

56. Let $\tan A, \tan B$, where $A, B \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$, be the roots of the quadratic equation $x^2 - 2x - 5 = 0$. Then

$20\sin^2\left(\frac{A+B}{2}\right)$ is equal to :

- (a) $10 + \sqrt{10}$ (b) $10 - 2\sqrt{10}$
 (c) $10 - 3\sqrt{10}$ (d) $10 - \sqrt{10}$

57. A letter is known to have arrived by post either from KANPUR or from ANANTPUR. On the envelope just two consecutive letters AN are visible. The probability, that the letter came from ANANTPUR, is :

- (a) $\frac{7}{10}$ (b) $\frac{10}{17}$
 (c) $\frac{12}{19}$ (d) $\frac{7}{19}$

58. The mean deviation about the mean for the data is equal to :

x_i	5	7	9	10	12	15
f_i	8	6	2	2	2	6

- (a) $\frac{40}{13}$ (b) $\frac{42}{13}$
 (c) $\frac{44}{13}$ (d) $\frac{46}{13}$

59. Let a focus of the ellipse $E: \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ be $S(4, 0)$ and its eccentricity be $\frac{4}{5}$. If the point $P(3, \alpha)$ lies on E and

O is the origin, then the area of $\triangle POS$ is equal to :

- (a) $12/5$ (b) $14/5$
 (c) $24/5$ (d) $48/5$

60. Let P be a moving point on the circle $x^2 + y^2 - 6x - 8y + 21 = 0$, Then, the maximum distance of P from the vertex of the parabola $x^2 + 6x + y + 13 = 0$ is equal to :

- (a) 8 (b) 10
 (c) 12 (d) 9

61. In an equilateral triangle PQR , let the vertex P be at $(3, 5)$ and the side QR be along the line $x + y = 4$. If the orthocenter of the triangle PQR is (α, β) , then $9(\alpha + \beta)$ is equal to :

- (a) 16 (b) 27
 (c) 36 (d) 48

62. The sum of all the integral values of p such that the equation $3\sin^2 x + 12\cos x - 3 = p, x \in R$, has at least one solution, is :

- (a) -54 (b) -60
 (c) -75 (d) -84

63. The square of the distance of the point $P(5, 6, 7)$ from the line $\frac{x-2}{2} = \frac{y-5}{3} = \frac{z-2}{4}$ is equal to :

- (a) 3 (b) 5
 (c) 6 (d) 8

64. Let $\vec{a} = \sqrt{7}\hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = \hat{j} + 2\hat{k}$. If $\vec{r}$ is a vector such that $\vec{r} \times \vec{a} + \vec{a} \times \vec{b} = \vec{0}$ and $\vec{r} \cdot \vec{a} = 0$, then $|3\vec{r}|^2$ is equal to :

- (a) 44 (b) 54
 (c) 86 (d) 132

65. The square of the distance of the point of intersection of the line $\vec{r} = (\hat{i} + \hat{j} - \hat{k}) + \lambda(\hat{a} - \hat{j})$, $\hat{a} \neq \mathbf{0}$ and $\vec{r} = (4\hat{i} - \hat{k}) + \mu(2\hat{i} + \hat{a}\hat{k})$ from the origin is :
- (a) 5 (b) 10
(c) 17 (d) 26
66. The area of the region $R = \{(x, y) : xy \leq 27, 1 \leq y \leq x^2\}$ is equal to :
- (a) $78\log_e 3 - \frac{52}{3}$ (b) $54\log_e 3 - \frac{52}{3}$
(c) $54\log_e 3 - \frac{26}{3}$ (d) $54\log_e 3 + \frac{26}{3}$
67. The product of all possible values of α , for which $\lim_{x \rightarrow 0} \left(\frac{1 - \cos(\alpha x) \cos((\alpha+1)x) \cos((\alpha+2)x)}{\sin^2((\alpha+1)x)} \right) = 2$, is :
- (a) -2 (b) 1
(c) -1 (d) $\frac{5}{4}$
68. The value of the integral $\int_0^\infty \frac{\log_e(x)}{x^2+4} dx$ is:
- (a) $\frac{\pi \log_e(2)}{2}$ (b) $\frac{\pi \log_e(2)}{4}$
(c) $1 + \pi \log_e(2)$ (d) $2 + \pi \log_e(2)$
69. Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be a differentiable function such that $f\left(\frac{x+y}{3}\right) = \frac{f(x)+f(y)}{3}$ for all $x, y \in \mathbb{R}$ and $f'(0) = 3$. Then the minimum value of the function $g(x) = 3 + e^x f(x)$, is
- (a) $3\left(\frac{e+1}{e}\right)$ (b) $3\left(\frac{e-1}{e}\right)$
(c) $\frac{3-e}{e}$ (d) $3e$
70. The value of the integral $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \left(\frac{4 - \operatorname{cosec}^2 x}{\cos^4 x} \right) dx$ is :
- (a) $\frac{11}{\sqrt{3}}$ (b) $\frac{16}{\sqrt{3}}$
(c) $\frac{32}{3\sqrt{3}}$ (d) $\frac{64}{3\sqrt{3}}$

SECTION-B

71. Let $A = \{1, 2, 3, 4, 5, 6\}$. The number of one-one functions $f: A \rightarrow A$ such that $f(1) \geq 3$, $f(3) \leq 4$ and $f(2) + f(3) = 5$, is ____.
72. Two players A and B play a series of games of badminton. The player, who wins 5 games first, wins the series. Assuming that no game ends in a draw, the number of ways, in which player A wins the series is ____.
73. If the sum of the coefficients of x^7 and x^{14} in the expansion of $\left(\frac{1}{x^3} - x^4\right)^n$, $x \neq 0$, is zero, then the value of n is ____.
74. If $\frac{\pi}{4} + \sum_{p=1}^{11} \tan^{-1}\left(\frac{2^{p-1}}{1+2^{2p-1}}\right) = \alpha$, then $\tan \alpha$ is equal to ____.
75. Let $y = y(x)$ be the solution of the differential equation $x \sin\left(\frac{y}{x}\right) dy = \left(y \sin\left(\frac{y}{x}\right) - x\right) dx$, $y(1) = \frac{\pi}{2}$ and let $\alpha = \cos\left(\frac{y(e^{12})}{e^{12}}\right)$. Then the number of integral value of p , for which the equation $x^2 + y^2 - 2px + 2py + \alpha + 2 = 0$ represents a circle of radius $r \leq 6$, is ____.