



TELEGRAM

SELECTION HOGA YAHIN SE

DURATION: 180 Minutes

M. MARKS: 300

Topics covered

Physics:	Full Syllabus
Chemistry:	Full Syllabus
Mathematics:	Full Syllabus

General Instructions:

1. Immediately fill in the particulars on this page of the test booklet.
2. The test is of **3 hours** duration.
3. The test booklet consists of 75 questions. The maximum marks are **300**.
4. There are three Sections in the question paper, Section I, II & III consisting of Section-I (**Physics**), Section-II (**Chemistry**), Section-III (**Mathematics**) and having **25** questions in each part in which first **20** questions are of Objective Type and Last **5** questions are integers type and all **25** questions are **compulsory**.
5. There is only one correct response for each question.
6. Each correct answer will give **4** marks while **1** Mark will be deducted for a wrong response.
7. No student is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
8. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.
9. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

OMR Instructions:

1. Use blue/black dark ballpoint pens.
2. Darken the bubbles completely. Don't put a tick mark or a cross mark where it is specified that you fill the bubbles completely. Half-filled or over-filled bubbles will not be read by the software.
3. Never use pencils to mark your answers.
4. Never use whiteners to rectify filling errors as they may disrupt the scanning and evaluation process.
5. Writing on the OMR Sheet is permitted on the specified area only and even small marks other than the specified area may create problems during the evaluation.
6. Multiple markings will be treated as invalid responses.
7. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

OMR Instructions

1. Use blue/black dark ballpoint pens.
2. Darken the bubble completely. Don't put a tick mark or a cross mark where it is specified that you fill the bubbles completely. Half-filled or over-filled bubbles will not be read by the software.
3. Never use pencils to mark your answers.
4. Never use whiteners to rectify filling errors as they may disrupt the scanning and evaluation process.
5. Writing on the OMR Sheet is permitted on the specified area only and even small marks other than the specified area may create problems during the evaluation.
6. Multiple marking will be treated as invalid responses.
7. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

Name of the Student (In CAPITALS) :

Roll Number : _____

OMR Bar Code Number : _____

Candidate's Signature

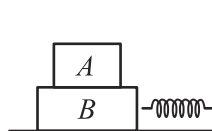
Invigilator's Signature

PART-I (PHYSICS)

Single Correct Type Questions

1. When someone jumps, one always bends one's knees to lower the centre of mass. A person lowers its centre of mass of the body by 40 cm and then jumps up. One can usually reach a height of 50 cm above your normal height. If a man of mass 80 kg jumps as described above, the work done by the man is (Take $g = 10 \text{ m/s}^2$)
- (1) 720 J (2) 400 J
(3) 320 J (4) 0

2. A block A is placed over block B having mass m and $2m$ respectively. Block B is resting on a frictionless surface and there is friction between block A and B. The system of blocks is pushed towards a spring with a velocity V_0 such that A doesn't slip on B by the time the system comes to momentary rest. The correct statement is:



- (1) Work done by friction on A is zero
(2) Work done by friction on B is $-1/2 mv_0^2$
(3) Work done by spring on B is $-3/2 mv_0^2$
(4) Work done by friction on A and B is zero.
3. The mean radius of earth is R , its angular speed on its own axis is ω and the acceleration due to gravity at earth's surface is g . What will be the radius of the orbit of a geostationary satellite?
- (1) $(R^2 g / \omega^2)^{1/3}$ (2) $(R g / \omega^2)^{1/3}$
(3) $(R^2 \omega^2 / g)^{1/3}$ (4) $(R^2 g / \omega)^{1/3}$
4. Two planets A and B have radius in the ratio 1:6. A satellite revolving near the surface of planets have same time period of revolution. The ratio of density of planets A and B is:
- (1) 1:6 (2) 6:1
(3) 1:1 (4) 36:1

5. One mole of a diatomic gas undergoes a process $P = \frac{P_0}{\left(1 + \frac{V}{V_0}\right)^3}$, where P_0 & V_0 are constants. The

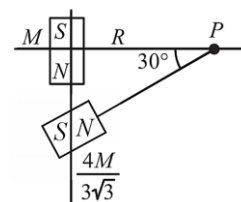
translational kinetic energy of the gas when $V = V_0$ is given by

- (1) $\frac{3P_0 V_0}{2}$ (2) $\frac{3P_0 V_0}{16}$
(3) $\frac{3P_0 V_0}{4}$ (4) $\frac{5P_0 V_0}{2}$

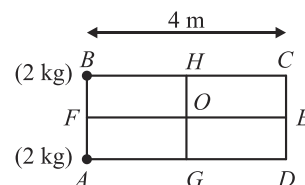
6. An experiment measures quantities a , b , c and x the value of x is calculated from $x = ab/c^3$. If the maximum percentage error in a , b and c are 1%, 1% and 2% respectively, then
- (1) The error in x is zero
(2) For any particular reading, error in x may be 10%
(3) Maximum percentage error in x is -4%
(4) Maximum percentage error in x is 8%

7. What will be magnitude of net magnetic field as shown in figure at point P. (Magnetic moment of small magnets are M and $\frac{4M}{3\sqrt{3}}$ respectively).

Given that $\left(\frac{\mu_0 M}{4\pi R^3} = B_0\right)$



- (1) B_0 (2) $\sqrt{5} B_0$
(3) $\sqrt{3} B_0$ (4) None of these
8. The de-Broglie wavelength of a vehicle moving with velocity v is λ . Its load is changed so that the velocity as well as kinetic energy are doubled. What will be the de-Broglie wavelength now?
- (1) λ (2) $\frac{\lambda}{4}$
(3) 4λ (4) 16λ
9. Charges are distributed over two spheres of radii R and r such that their surface charge densities are equal. What is the ratio of their surface potentials?
- (1) $\frac{R}{r}$ (2) $\frac{R^2}{r^2}$
(3) $\frac{R^3}{r^3}$ (4) $\frac{R^4}{r^4}$
10. Masses of 2 kg each are placed at the corners B and A of a uniform rectangular plate ABCD as shown in the figure. A mass of 8 kg has to be placed on the plate so that the centre of mass of the system should be at the centre O of rectangle. Then the mass should be placed at:



- (1) 1 m from O on OE
(2) 2 m from O on OF
(3) 2 m from O on OG
(4) 2 m from O on OH

11. A ball, moving with a speed of 9 m/s, strikes an identical stationary ball such that after the collision, the direction of each ball makes an angle of 30° with the original line of motion. The speeds of the two balls after the collision are, respectively,

- (1) $3\sqrt{3}$ m/s, 3 m/s (2) 3 m/s, $3\sqrt{3}$ m/s
(3) 3 m/s, 3 m/s (4) $3\sqrt{3}$ m/s, $3\sqrt{3}$ m/s

12. The distance between an object and a screen is 100 cm. A lens produces an image on the screen when placed at either of the two positions 40 cm apart. The power of the lens (in D) is nearly:-

- (1) 4 (2) 5
(3) 3 (4) 6

13. The electric potential at a point (x, y, z) is given by $V = -x^2y - xz^3 + 4$. The electric field at that point is:

- (1) $\vec{E} = \hat{i}2xy + \hat{j}(x^2 + y^2) + \hat{k}(3xz - y^2)$
(2) $\vec{E} = \hat{i}z^3 + \hat{j}xyz + \hat{k}z^2$
(3) $\vec{E} = \hat{i}(2xy - z^3) + \hat{j}xy^2 + \hat{k}3z^2x$
(4) $\vec{E} = \hat{i}(2xy + z^3) + \hat{j}x^2 + \hat{k}3xz^2$

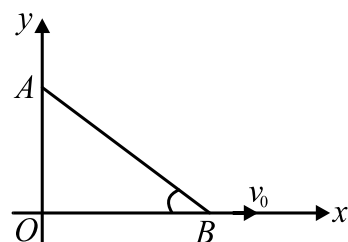
14. Two sources of sound placed close to each other, are emitting progressive waves given by $y_1 = 4 \sin 600 \pi t$ and $y_2 = 5 \sin 608 \pi t$. An observer located near these two sources of sound will hear

- (1) 4 beats per second with intensity ratio 25:16 between waxing and waning.
(2) 8 beats per second with intensity ratio 25:16 between waxing and waning.
(3) 8 beats per second with intensity ratio 81:1 between waxing and waning.
(4) 4 beats per second with intensity ratio 81:1 between waxing and waning.

15. Velocity of a particle moving in a curvilinear path in a horizontal X-Y plane varies with time as $\vec{v} = (2t\hat{i} + t^2\hat{j})$ m/s. Here, t is in second. At $t = 1$ s

- (1) Acceleration of particle is 8 m/s^2
(2) Tangential acceleration of particle is $\frac{4}{\sqrt{5}} \text{ m/s}^2$
(3) Radial acceleration of particle is $\frac{6}{\sqrt{5}} \text{ m/s}^2$
(4) Radius of curvature to the path is $\frac{5\sqrt{5}}{2} \text{ m}$

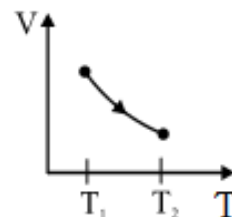
16. The end B of the rod AB which makes angle θ with the floor is being pulled with, a constant velocity v_0 as shown. The length of the rod is l . At the instant when $\theta = 37^\circ$ then



- (1) Velocity of end A is $\frac{5}{3} v_0$ downwards
(2) Angular velocity of rod is $\frac{5 v_0}{3 \ell}$
(3) Angular velocity of rod is constant
(4) Velocity of end A is constant

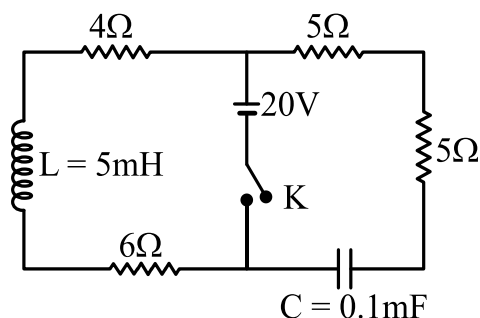
17. The figure shows a process AB undergone by 2 moles of an ideal diatomic gas. The process AB is in such a way that $VT = \text{constant}$.

$T_1 = 300\text{K}$ and $T_2 = 500\text{K}$ ($R =$ gas constant)



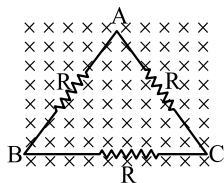
- (1) The molar heat capacity of gas in the process $A \rightarrow B$ is $5\frac{R}{2} \text{ J/mol-K}$
(2) The molar heat capacity of gas in the process $A \rightarrow B$ is $R \text{ J/mol-K}$
(3) The work done by the gas is $-400RJ$
(4) The work done by the gas is $-200RJ$

18. In the circuit shown, the key (K) is closed at $t = 0$, the current through the key at the instant $t = 10^{-3} \ln 2$ sec is



- (1) 1.5 Amp
(2) 2.5 Amp
(3) 4 Amp
(4) $\frac{2}{3}$ Amp

19. Three resistances of magnitude R each are connected in the form of an equilateral triangle of side a . The combination is placed in a magnetic field $B = B_0 e^{-\lambda t}$ perpendicular to its plane. The induced current in the circuit is given by:



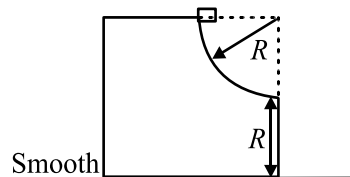
- (1) $\left(\frac{a^2 \lambda}{2\sqrt{3}R} B_0 \right) e^{-\lambda t}$ (2) $\left(\frac{a^2 \lambda}{4\sqrt{3}R} B_0 \right) e^{-\lambda t}$
 (3) $\left(\frac{a^2 B_0}{\lambda 4\sqrt{3}R} \right) e^{-\lambda t}$ (4) $\left(\frac{a^2 B_0 R}{\lambda 4\sqrt{3}} \right) e^{-\lambda t}$
20. A particle is projected with a velocity (10 m/s) along y-axis from point (2, 3). Magnetic field of $(3\hat{i} + 4\hat{j})$ Tesla exist uniformly in the space. Its speed when particle passes through y-axis for the third time is: (neglect gravity)
- (1) $\sqrt{20}$ m/s (2) $\sqrt{60}$ m/s
 (3) $\sqrt{30}$ m/s (4) 10 m/s

Integer Type Questions

21. The reaction ${}^7_3\text{Li} + {}^1_1\text{H} \rightarrow {}^7_4\text{Be} + {}^1_0\text{n}$ is endothermic. Assuming that Li nuclei is free and at rest. What is the minimum kinetic energy (in keV) of incident proton so that this reaction occurs? Take Q value of this reaction as -1645 keV . If your answer is N find value of $\frac{N}{235}$.

22. The end of a glass capillary tube of radius $r = 0.35 \text{ mm}$ lowered into the water to a depth of $h = 2.0 \text{ cm}$. What gauge pressure Δp (in Pa) is needed inside the capillary tube to blow a hemispherical air bubble at its lower end? Take surface tension of water as $7 \times 10^{-3} \text{ N/m}$. (Take $g = 10 \text{ m/s}^2$) Wetting is complete.

23. A block is released from the state of rest from a wedge, as shown. The block and the wedge are both of the same mass. If friction is absent, the total horizontal displacement of the block with respect to earth before it falls on the earth is given by $0.5R + \sqrt{x}R$, then the value of x will be:

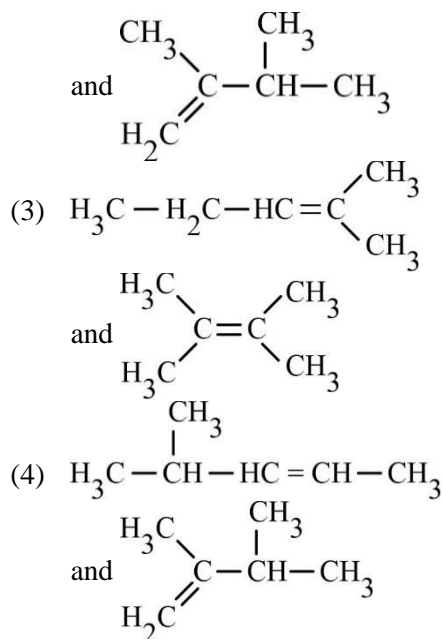
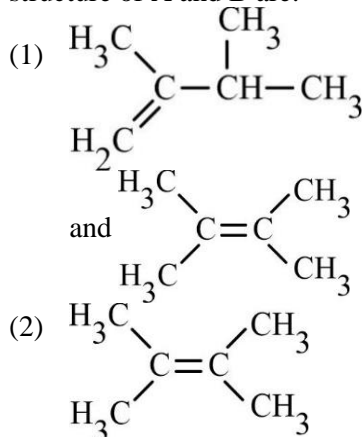


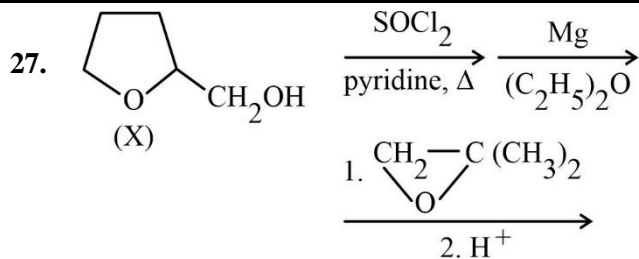
24. A non-conducting thin spherical shell of radius R has uniform surface charge density σ . The shell rotates about a diameter with constant angular velocity ω . The magnetic induction B at the centre of the shell is $\frac{2}{x} \mu_0 \sigma \omega R$. Find the value of x .
25. A gun kept on a straight horizontal road is used to hit a car travelling along the same road away from the gun with a uniform speed of $72\sqrt{2} \text{ km h}^{-1}$. The car is at a distance of 50 m from the gun, when the gun is fired at an angle of 45° with the horizontal. Find the speed of projection of the shell from the gun. (in m/s^{-1}) (Take $g = 10 \text{ m/s}^2$) (Answer to the nearest integer)

PART-II (CHEMISTRY)

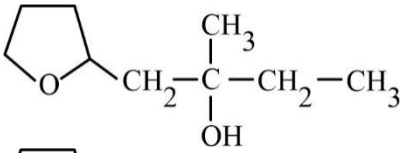
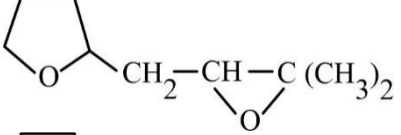
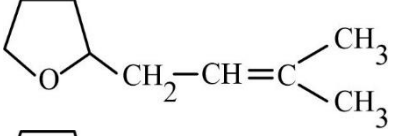
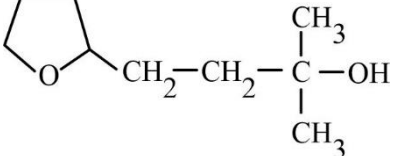
Single Correct Type Questions

26. When 3, 3-Dimethyl-2-butanol is heated with acid H_3PO_4 , it is converted into an 80 : 20 mixture of alkene A and B respectively. The structure of A and B are:

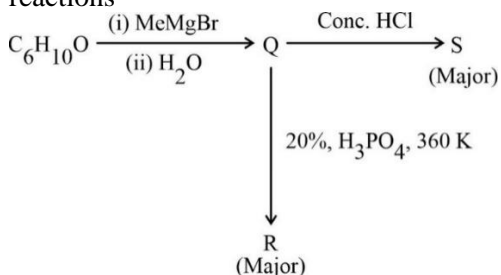


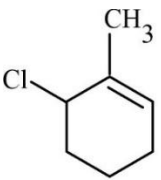
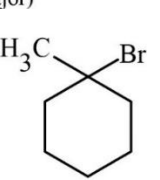
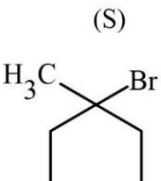
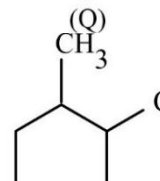
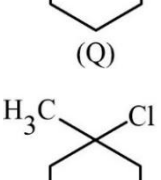
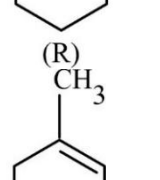
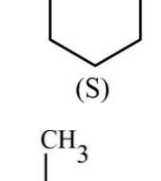
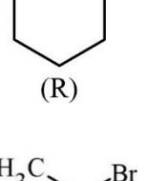


Product of the reaction is:

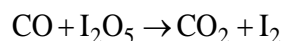
- (1) 
- (2) 
- (3) 
- (4) 

28. Choose the correct option for the following set of reactions



- (1)  
- (2)  
- (3)  
- (4)  

29. During the reaction given below:



What are the equivalent weights of CO and I_2O_5 if their molar masses are M_1 and M_2 respectively?

- (1) $\frac{M_1}{4}, \frac{M_2}{5}$ (2) $\frac{M_1}{2}, \frac{M_2}{5}$
- (3) $\frac{M_1}{4}, \frac{M_2}{10}$ (4) $\frac{M_1}{2}, \frac{M_2}{10}$

30. With respect to periodic properties, the correct statement from the following is

- (1) 1st Electron affinity order is $F > O > Cl$
- (2) First ionisation energy order is $Al > Mg > K$
- (3) Atomic radii order is $N > P > As$
- (4) Ionic radii order is $K^+ > Ca^{2+} > Mg^{2+}$

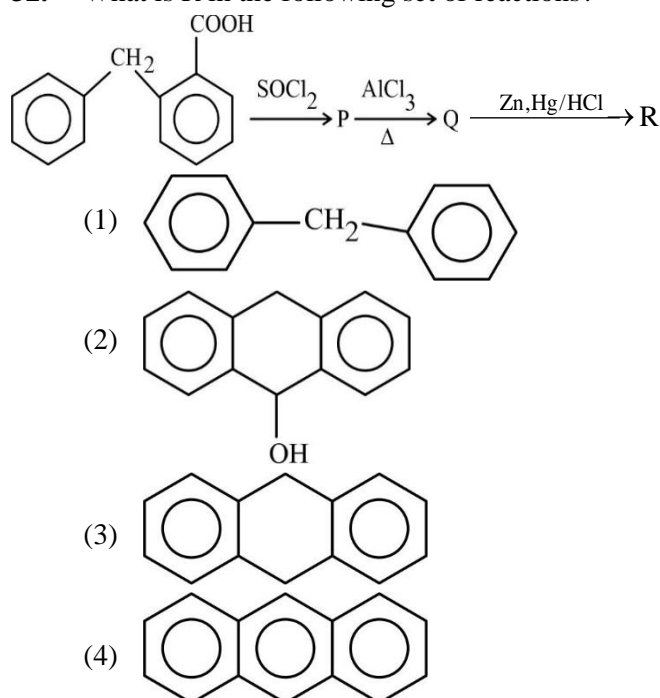
31. Match the Column - I with Column - II:

Column - I (Orbitals)		Column - II (Quantum No.)	
A	2s	P	$n = 2, \ell = 0, m = 0$
B	2p _z	Q	$n = 2, \ell = 1, m = 0$
C	4d _{x²-y²}	R	$n = 4, \ell = 2, m = \mp 2$
D	4d _{z²}	S	$n = 4, \ell = 2, m = 0$

Choose the correct option:

- (1) $A \rightarrow P; B \rightarrow Q; C \rightarrow R; D \rightarrow S$
- (2) $A \rightarrow Q; B \rightarrow R; C \rightarrow P; D \rightarrow Q$
- (3) $A \rightarrow R; B \rightarrow S; C \rightarrow P; D \rightarrow Q$
- (4) $A \rightarrow S; B \rightarrow P; C \rightarrow Q; D \rightarrow R$

32. What is R in the following set of reactions?



33. At same temperature, N_2O_4 is dissociated to an extent of 40% and 50% at total pressure P_1 and P_2 atm respectively in NO_2 . Then the ratio of P_1 and P_2 is

- (1) $\frac{4}{5}$ (2) $\frac{7}{4}$
(3) $\frac{4}{7}$ (4) $\frac{5}{4}$

34. 27 kg of SO_2Cl_2 is reacted with excess of NaOH completely. If the difference between masses of Na_2SO_4 and NaCl produced is x kg, then the value of x is

[Given: $M_{SO_2Cl_2} = 135 \text{ g mol}^{-1}$, $M_{Na_2SO_4} = 142 \text{ g mol}^{-1}$, $M_{NaCl} = 58.5 \text{ g mol}^{-1}$]

(Reaction involved is $SO_2Cl_2 + NaOH \rightarrow Na_2SO_4 + NaCl + H_2O$)

- (1) 5 (2) 3
(3) 2 (4) None of these

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

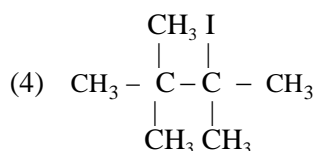
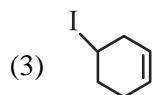
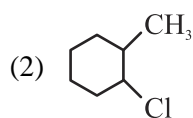
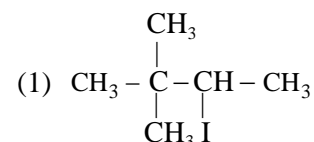
Assertion (A): For π overlap the lobes of the atomic orbitals are perpendicular to the line joining the nuclei.

Reason (R): In π molecular orbitals probability of finding the electron is maximum along the internuclear axis

In the light of above statements choose the correct option

- (1) (A) is True, (R) is True; (R) is a correct explanation for (A).
(2) (A) is True, (R) is True; (R) is NOT a correct explanation for (A).
(3) (A) is True, (R) is False.
(4) (A) is False, (R) is True.

36. Which of the following alkyl halide will not undergo rearrangement in S_N1 reaction?



37. The correct order of melting point of 14th group elements

- (1) $C > Si > Ge > Pb > Sn$
(2) $C < Si < Ge < Sn < Pb$
(3) $Sn > Pb > Ge > Si > C$
(4) $Si > C > Ge > Sn > Pb$

38. **Statement-1:** The carboxylic acid and amino group in amino acid always neutralize each other in aqueous solution.
and

Statement-2: Amino acid forms Zwitter ion at isoelectronic point.

- (1) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
(2) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
(3) Statement-1 is True, Statement -2 is False.
(4) Statement- 1 is False, Statement-2 is True.

39. Consider the thermodynamic data with the solvents listed below.

Solvent	K_b (K molal ⁻¹)	B.Pt (K)
CCl_4	5.03	350
Benzene	2.53	353.3
Ethanol	1.20	351.5

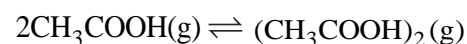
Equimolar solutions of a non-dissociative, non-associative and non-volatile solute are made with the solvents CCl_4 , benzene and ethanol and are labelled as I, II and III respectively. Which of the following is correct?

- (1) Boiling point of II will always be the greatest
(2) Boiling point of III will always be the greatest
(3) Boiling point of I will always be greater than II
(4) Boiling point of II will always be greater than III

40. $KMnO_4$ and $K_2Cr_2O_7$ are intensely colour compound because

- (1) These are diamagnetic in nature
(2) Charge transfer from metal to ligand
(3) Charge transfer from ligand to metal ion
(4) They are paramagnetic

41. Acetic acid can form a dimer through H-bonding as shown below.



At temperature 25°C , the equilibrium constant (K_p) for the dimerisation process is 10^3 . The bond energy per mole of H-bond formed is 32.385 kJ. What is the change in entropy for the above reaction (in kJ/K)?

- (1) -2.3 (2) -0.98
(3) -0.16 (4) -13.2

42. Which one of the following ions gives brown precipitate with $\text{H}_2\text{S}/\text{H}^+$?

- (1) Cu^{2+}
- (2) Bi^{3+}
- (3) Cd^{2+}
- (4) As^{3+}

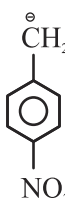
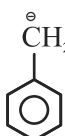
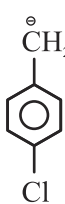
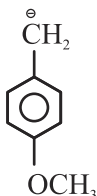
43. An organic compound 'A' having molecular formula $\text{C}_2\text{H}_3\text{N}$ on reduction gives another compound 'B'. On treatment with nitrous acid, 'B' gives ethyl alcohol. On warming with chloroform and alcoholic KOH, B forms an offensive smelling compound 'C'. The compound C is

- (1) $\text{CH}_3\text{CH}_2\text{NH}_2$
- (2) $\text{CH}_3\text{CH}_2\text{NC}$
- (3) CH_3CN
- (4) $\text{CH}_3\text{CH}_2-\text{OH}$

44. AgBr has highest solubility in

- (1) 10^{-3}M NaBr
- (2) Pure water
- (3) 10^{-3}M HBr
- (4) $10^{-3}\text{M NH}_4\text{OH}$

45. Most stable carbanion is

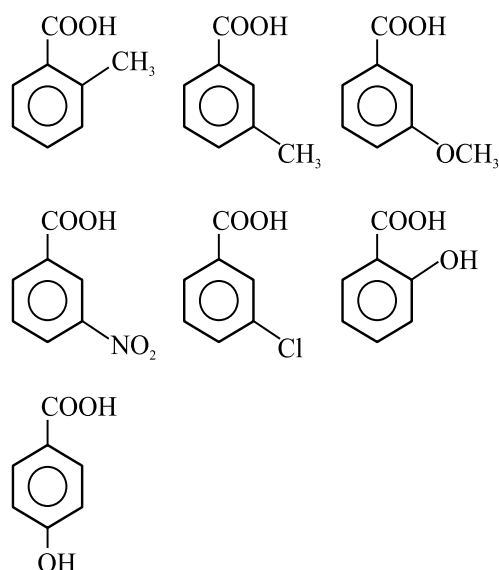
- (1) 
- (2) 
- (3) 
- (4) 

Integer Type Questions

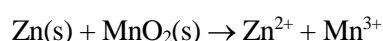
46. The activation energy of the reaction is zero. At 280 K, rate constant is $1.6 \times 10^{-6} \text{ s}^{-1}$. The rate constant at 300 K is $Q \times 10^{-7} \text{ s}^{-1}$. The value of Q is

47. If dimethyl glyoxime is added to the aqueous solution of nickel chloride and made alkaline by adding NH_4OH solution, then a brilliant red precipitate of P is obtained. The number of five membered rings around metal in P is _____.

48. Among the following compounds, how many are more acidic than benzoic acid?

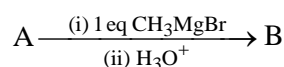


49. Consider the following redox reaction:



If the value of $x = |\Delta G^\circ \text{ (in joules)}| \times 10^{-4}$ of the reaction, and if the electrode potential of cathode ($E^\circ_{\text{Reduction}}$) is 0.49V and electrode potential of anode ($E^\circ_{\text{Oxidation}}$) is 0.71V, then value of x is _____. (1F = 96,500 C mol⁻¹) (Nearest Integer)

50. Consider the following reactions:



The mass percentage of carbon present in A is _____. (Round off upto nearest integer)

PART-III (MATHEMATICS)

Single Correct Type Questions

51. The shortest distance from the line $3x + 4y = 25$ to the circle $x^2 + y^2 = 6x - 8y$ is equal to

- (1) $\frac{7}{3}$ (2) $\frac{9}{5}$
(3) $\frac{11}{5}$ (4) $\frac{7}{5}$

52. Lines $L_1 : y - x = 0$ and $L_2 : 2x + y = 0$ intersect the line $L_3 : y + 2 = 0$ at P and Q .

Statement-1 : Length $PQ = 3$ units

Statement-2 : Area of PQR is 1 units, when R is point of intersection of L_1 and L_2

- (1) Statement-1 is true, statement-2 is true; statement-2 is a correct explanation for statement-1.
(2) Statement-1 is true, statement-2 is true; statement-2 is NOT a correct explanation for statement-1.
(3) Statement-1 is true, statement-2 is false.
(4) Statement-1 is false, statement-2 is true.

53. Let the vectors $\vec{a}, \vec{b}, \vec{c}$ represent three unit vectors such that $\vec{a} + \vec{b} + \vec{c} = 0$ then $\vec{a} \cdot \vec{b}$ equals.

- (1) 0 (2) $\frac{1}{2}$
(3) $-\frac{1}{2}$ (4) $-\frac{3}{2}$

54. In a bolt factory, machines A, B and C manufacture respectively 20%, 30% and 50% of the total bolts. Of their output 3, 4 and 2 percent are respectively defective bolts. A bolt is drawn at random from the product. If the bolt drawn is found the defective, then the probability that it is manufactured by the machine C is.

- (1) $\frac{5}{14}$
(2) $\frac{3}{7}$
(3) $\frac{9}{28}$
(4) $\frac{2}{7}$

55. If α, β and γ are the roots of $x^3 - x^2 - 1 = 0$, then

- $\left\{ \frac{1+\alpha}{1-\alpha} + \frac{1+\beta}{1-\beta} + \frac{1+\gamma}{1-\gamma} \right\}$ is equal to
(1) -5 (2) -6
(3) -7 (4) -2

56. If 1, 2, 3 are first terms; 1, 3, 5 are common difference and $S_1, S_2, S_3 \dots$ are sums of n terms of given AP 's; then $S_1 + S_2 + S_3 + \dots + S_p$ is equal to

- (1) $\frac{np(np+1)}{2}$
(2) $\frac{n(np+1)}{2}$
(3) $\frac{np(p+1)}{2}$
(4) $\frac{np(np-1)}{2}$

57. If $x = -5 + 2\sqrt{-4}$, then the value of $x^4 + 9x^3 + 35x^2 - x + 4$, is equal to

- (1) 56 (2) -160
(3) 160 (4) -56

58. Let $A = \{x : x \in R, |x| < 1\}$; $B = \{x : x \in R, |x - 1| \geq 1\}$ and $A \cup B = R - D$, then the set D is

- (1) $\{x : 1 < x \leq 2\}$
(2) $\{x : 1 \leq x < 2\}$
(3) $\{x : 1 \leq x \leq 2\}$
(4) None of these

59. If $a_r = \cos \frac{2r\pi}{9} + i \sin \frac{2r\pi}{9}$;

$r = 1, 2, 3, \dots$ (where $i = \sqrt{-1}$), then the

determinant $\begin{vmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_7 & a_8 & a_9 \end{vmatrix}$ is equal to

- (1) $a_2a_6 - a_4a_8$ (2) a_9
(3) $a_1a_9 - a_3a_7$ (4) a_5

60. The function $f(x) = |x^2 - 2x - 3| \cdot e^{|9x^2 - 12x + 4|}$ is not differentiable at exactly

- (1) Four points (2) Three points
(3) Two points (4) One point

61. If α, β are the distinct roots of $x^2 + bx + c = 0$, then

- $\lim_{x \rightarrow \beta} \frac{e^{2(x^2+bx+c)} - 1 - 2(x^2+bx+c)}{(x-\beta)^2}$ is equal to
(1) $2(b^2 + 4c)$
(2) $b^2 - 4c$
(3) $2(b^2 - 4c)$
(4) $b^2 + 4c$

62. If $y = y(x), x \in \left(0, \frac{\pi}{2}\right)$ be the solution curve of the differential equation
- $$\left(\sin^2 2x\right) \frac{dy}{dx} + (8\sin^2 2x + 2\sin 4x)y = 2e^{-4x} (2\sin 2x + \cos 2x), \quad \text{with } y\left(\frac{\pi}{4}\right) = e^{-\pi},$$

then $y\left(\frac{\pi}{6}\right)$ is equal to

- (1) $\frac{2}{\sqrt{3}}e^{-2\pi/3}$ (2) $\frac{2}{\sqrt{3}}e^{2\pi/3}$
 (3) $\frac{1}{\sqrt{3}}e^{-2\pi/3}$ (4) $\frac{1}{\sqrt{3}}e^{2\pi/3}$

63. If $\int_0^{100\pi} \sin^2 x \, dx = \alpha\pi, \alpha \in R$, then the value of α is
- (1) 50 (2) 100
 (3) 200 (4) Zero

64. If $f: R \rightarrow R$ be a function such that $f(x) = x^3 + x^2 + 4x + \sin x$, then the function $f(x)$ is
- (1) One-one and onto
 (2) One-one and into
 (3) Many-one and onto
 (4) Many-one and into

65. The value of $\int \frac{e^{\sqrt{x}}}{\sqrt{x}} (x + \sqrt{x}) dx$ is equal to

- (1) $2e^{\sqrt{x}} [\sqrt{x} - x + 1] + c$
 (2) $2e^{\sqrt{x}} [x - 2\sqrt{x} + 1] + c$
 (3) $2e^{\sqrt{x}} [x - \sqrt{x} + 1] + c$
 (4) $2e^{\sqrt{x}} [x + \sqrt{x} + 1] + c$

66. A water tank has a shape of an inverted right circular cone with its axis vertical and vertex lowermost. Its semi-vertical angle is $\tan^{-1}\left(\frac{3}{4}\right)$.

Water is poured into it at a constant rate of 3 cubic meter per hour. The rate at which the level of the water is rising at an instant when the height (from vertex) of water in the tank is 4 m is

- (1) $\frac{1}{\pi}$ m/h (2) $\frac{1}{3\pi}$ m/h
 (3) $\frac{2}{\pi}$ m/h (4) $\frac{3}{\pi}$ m/h

67. Let $f: R \rightarrow \left(0, \frac{2\pi}{3}\right]$ defined as
- $$f(x) = \cot^{-1}(x^2 - 4x + \alpha).$$
- Then the smallest integral value of α such that $f(x)$ is into function is
- (1) 2 (2) 4
 (3) 6 (4) 8

68. If $x = \sqrt{a^{\sin^{-1}t}}$ and $y = \sqrt{a^{\cos^{-1}t}}$, then the value of $\frac{dy}{dx}$ is

- (1) $\frac{y}{x}$ (2) $\frac{x}{y}$
 (3) $-\frac{y}{x}$ (4) $-\frac{x}{y}$

69. The value of $k \in R$, for which the following system of linear equations $3x - y + 4z = 3$, $x + 2y - 3z = -2$, $6x + 5y + kz = -3$ has infinitely many solutions, is

- (1) -5 (2) -3
 (3) 3 (4) 5

70. Let $a, b \in R$. If the mirror image of the point $P(a, 6, 9)$ with respect to the line $\frac{x-3}{7} = \frac{y-2}{5} = \frac{z-1}{-9}$ is $(20, b, -a-9)$, then a is equal to:

- (1) -56 (2) 34
 (3) 56 (4) -34

Integer Type Questions

71. If the mean deviations about the median of the number $a, 2a, \dots, 50a$ is 50, then $|a|$ equals
72. $(\tan \alpha + 2\tan 2\alpha + 2^2 \tan 2^2 \alpha + \dots + 2^{n-1} \tan 2^{n-1} \alpha + 2^n \cot 2^n \alpha)^2$, is equal to $\left(\text{Where } \alpha = \frac{\pi}{6}\right)$
73. If the sum of all the coefficients in the expansion of $(a + 3b)^{10}$, is 2^k , then k is
74. The area of the region $\{(x, y) : |x-1| \leq y \leq \sqrt{5-x^2}\}$ is equal to $\lambda \frac{\pi}{4} + \mu$ then $[\lambda - \mu]$ is ([.] is G.I.F.)
75. Let $A = \{1, 2, 3, 4\}$. If the number of different ordered pairs (B, C) that can be formed such that $B \subseteq A, C \subseteq A$ and $B \cap C = \phi$ is n then \sqrt{n} is

