



Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

SEC: **Sr.Super60_NUCLEUS&STERLING_BT**

JEE-MAIN

Date: 13-01-2023

Time: **09.00Am to 12.00Pm**

GTM-06

Max. Marks: 300

IMPORTANT INSTRUCTION:

1. Immediately fill in the Admission number on this page of the Test Booklet with **Blue/Black Ball Point Pen** only.
2. The candidates should not write their Admission Number anywhere (except in the specified space) on the Test Booklet/ Answer Sheet.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of 90 questions. The maximum marks are **300**.
5. There are **three** parts in the question paper 1,2,3 consisting of **Physics, Chemistry and Mathematics** having **30 questions** in each subject and subject having **two sections**.

(I) **Section –I** contains 20 **multiple choice** questions with only one correct option.

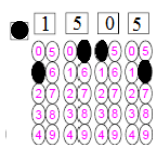
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

(II) **Section-II** contains 10 **Numerical Value Type** questions. Attempt any 5 questions only, if more than 5 questions attempted, First 5 attempted questions will be considered.

- The Answer should be within **0 to 9999**. If the Answer is in **Decimal** then round off to the **nearest Integer** value (Example i.e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11**).

To cancel any attempted question bubble on the question number box.

For example: To cancel attempted question 21. Bubble on 21 as shown below



Question Answered for Marking

Question Cancelled for Marking

Marking scheme: +4 for correct answer, 0 if **not attempt** and -1 in all other cases.

6. Use **Blue / Black Point Pen only** for writing particulars / marking responses on the Answer Sheet. **Use of pencil is strictly prohibited.**
7. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electron device etc, except the Identity Card inside the examination hall.
8. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
9. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Hall. **However, the candidate are allowed to take away this Test Booklet with them.**
10. **Do not fold of make any stray marks on the Answer Sheet**

Name of the Candidate (in Capital): _____

Admission Number:

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Candidate's Signature: _____

Invigilator's Signature: _____

13-01-23_Sr.Super60_NUCLEUS & STERLING_BT_Jee-Main_GTM-06_Test Syllabus

PHYSICS : TOTAL SYLLABUS

CHEMISTRY : TOTAL SYLLABUS

MATHEMATICS : TOTAL SYLLABUS

**PHYSICS****Max Marks: 100****(SINGLE CORRECT ANSWER TYPE)**

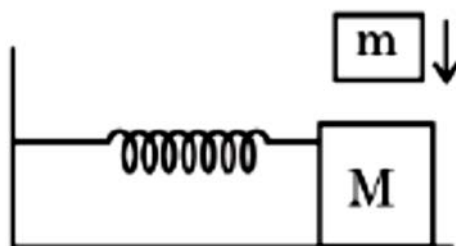
This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -1 in all other cases.

1. Which of the following current must be zero in an unbiased P.N. junction diode?
 - 1) Current due to majority charge carriers (both electrons and holes)
 - 2) Current due to minority charge carriers (both electrons and holes)
 - 3) Current due to minority & minority charge carriers
 - 4) Current due to majority and minority charge carriers (only holes)
2. In a football game, a player wants to throw a ball to his one of teammate, who is running on the field. Taken thrower position as origin and receiver initial position at $2\hat{i} + 3\hat{j}$, where \hat{i} & \hat{j} are in the plane of field. In subsequent run receiver displacement is $5\hat{i}$ then $8\hat{j}$, then $-2\hat{i} + 4\hat{j}$ then $-6\hat{j}$. How far is receiver from thrower?
(all displacements are in meter)
 - 1) $\sqrt{106}$
 - 2) $\sqrt{110}$
 - 3) $\sqrt{103}$
 - 4) $\sqrt{112}$
3. A spherical ball of mass m and radius r is allowed to fall in a medium of viscosity η . The time in which the velocity of the body increases from zero to 0.63 times the terminal velocity is called time constant (τ). Dimensionally τ can be represented by
 - 1) $\frac{mr^2}{6\pi\eta}$
 - 2) $\sqrt{\frac{6\pi mr\eta}{g^2}}$
 - 3) $\frac{m}{6\pi\eta r}$
 - 4) None of these
4. The electric field associated with an electromagnetic wave in vacuum is given by $\vec{E} = 40\cos(kz - 6 \times 10^8 t)\hat{i}$, where E , z & t are in volt/m, meter & second respectively. The value of propagation constant k is :-
 - 1) $6m^{-1}$
 - 2) $3m^{-1}$
 - 3) $2m^{-1}$
 - 4) $0.5m^{-1}$
5. Two polarizing sheets have their transmission axes crossed so that no light is transmitted. A third sheet is inserted so that its transmission axis makes an angle θ with the transmission axis of the first sheet. If the middle polarizing sheet is rotating at an angular speed ω about an axis parallel with the light beam, find an expression for the final intensity transmitted through after all three sheets as a function of time. (Original intensity was I_0) (unpolarized)
 - 1) $I = \frac{I_0}{8} \sin^2 2\omega t$
 - 2) $I = \frac{I_0}{4} \sin^2 2\omega t$
 - 3) $I = \frac{I_0}{4} \cos^2 2\omega t$
 - 4) $I = \frac{I_0}{4} \cos^2 2\omega t$



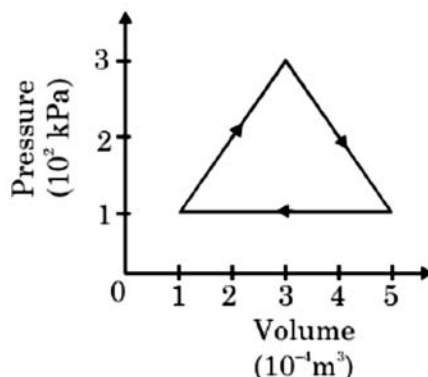
6. A narrow slit of width 1 mm illuminated by monochromatic light of wavelength 600nm. The distance between the first minima on either side of a screen at a distance of 2 m is
1) 1.2 cm 2) 1.2 mm 3) 2.4 cm 4) 2.4 mm
7. The centres of the turns of a toroid form a circle with a radius of 14.0 cm. The cross-sectional area of each turn is 3.00 cm^2 . It is wound with 5278 turns of fine wire, and the wire carries a current of 4.00 A. The core is filled with a paramagnetic material of magnetic susceptibility 2.90×10^{-4} . What would the magnitude of the magnetic field within the substance?
1) 12.6 mT 2) 30.16 mT 3) 10.6 mT 4) 16.6 mT
8. Molten-wax of mass m drops on a block of mass M , which is oscillating on a frictionless table as shown. Select the **CORRECT** statements.



- I) If the collision takes place at extreme position, amplitude does not change
II) If the collision takes place at mean position, amplitude decreases
III) If the collision takes place at mean position, time period increases
IV) If the collision takes place at extreme position, time period increases

Options:-

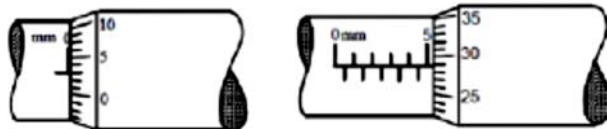
- 1) Only (I), (II) 2) Only (II), (III)
3) Only (I), (IV) 4) All (I), (II), (III), (IV)
9. How much work is done per cycle by a gas following the path shown on the pV - diagram?



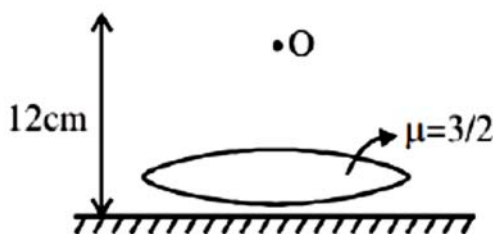
- 1) 10J 2) 20J 3) 30J 4) 40J



10. Diagrams show readings of a screw gauge. Figure (i) shows the zero error reading when the screw gauge is closed, figure (ii) the reading when the screw gauge is being used to measure the diameter of a ball-bearing. What is the diameter of the ball-bearing? There are 50 divisions on circular scale.



- 1) 5.29 mm 2) 5.26 mm 3) 5.32 mm 4) 5.28 mm
11. An equiconvex lens ($\mu = 3/2$) is placed over a plane mirror as indicated in diagram. An object placed 12 cm from system such that image and object coincide. Now a liquid is poured between mirror and lens and for the same object the image now formed at 24 cm from mirror. the refractive index of the liquid poured will be



- 1) $\frac{5}{4}$ 2) $\frac{4}{3}$ 3) $\frac{3}{2}$ 4) $\frac{5}{3}$
12. A rectangular pipe having cross sectional area A. It is closed at one end and at its other end a block having same cross-section and mass 'm' is placed such that system is air tight. In equilibrium position of block the pressure and volume of air enclosed in pipe are P and V respectively. If block is displaced by small distance x inward and released then find the time period of S.H.M.[Assume the walls are frictionless and compression of air is isothermal].

1) $T = 2\pi \left(\frac{mV}{PA^2} \right)^{1/2}$ 2) $T = \frac{\pi}{2} \left(\frac{mV}{PA^2} \right)^{1/2}$ 3) $T = \pi \left(\frac{PA^2}{mV} \right)^{1/2}$ 4) $T = 2\pi \left(\frac{2mV}{PA^2} \right)^{1/2}$

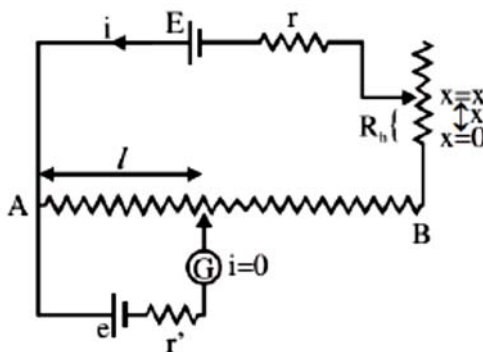
13. A source of frequency 10kHz when vibrated over the mouth of a closed organ pipe is in unison at 300 K. the beats produced when temperature rises by 1 K is
- 1) 30 Hz 2) 13.33 Hz 3) 16.67 Hz 4) 40 Hz



14. Flash light equipped with a new set of batteries produces bright white light. As the batteries wear out

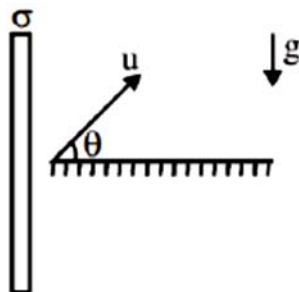
- 1) The light intensity gets reduced with a no change in its colour
- 2) Light colour changes first to yellow and then red with no change in intensity
- 3) It stops working suddenly while giving white light
- 4) Colour changes to red and also intensity gets reduced

15. In given potentiometer, e.m.f of primary cell is 40V and its internal resistance is 2Ω , resistance of wire AB is 4Ω . In primary circuit, there is also a rheostat whose resistance varies as $R_h = (2x + 2)\Omega$. If balance length obtained for $x = 0$ is ℓ_1 and $x = 2$ is ℓ_2 respectively, then find $\frac{\ell_1}{\ell_2}$.



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

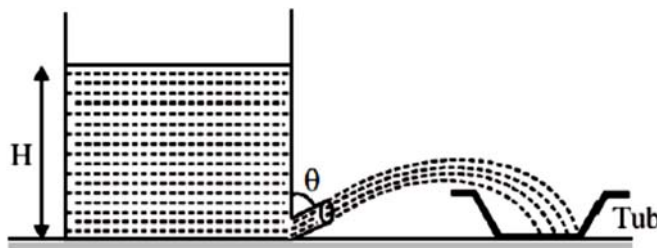
16. In the set-up shown, there is a large thin non-conducting vertical sheet with charge density σ . In the nearby region a charge q of mass m is projected at an angle θ with initial velocity u . When this charge reaches its maximum height, find its velocity.



- 1) $u \cos \theta \left(1 + \frac{\sigma q \tan \theta}{2m\epsilon_0 g} \right)$
- 2) $u \cos \theta \left(1 + \frac{\sigma q \tan \theta}{m\epsilon_0 g} \right)$
- 3) $u \sin \theta \left(1 + \frac{\sigma q \tan \theta}{2m\epsilon_0 g} \right)$
- 4) $u \sin \theta \left(1 + \frac{\sigma q \tan \theta}{m\epsilon_0 g} \right)$



17. There is a tank of cross-section area A_1 with inclined orifice at its bottom with cross-section area A_2 as shown in the figure. If height of water column in tank is 0.3 m and angle of inclination with vertical $\theta = 30^\circ$ and $\frac{A_1}{A_2} = 2$, then at this instant find the position where tub is to be placed to collect the water coming out from orifice. ($g = 10 \text{ m/s}^2$)



- 1) $\frac{\sqrt{3}}{5}m$ 2) $\frac{3\sqrt{3}}{10}m$ 3) $\frac{2\sqrt{3}}{5}m$ 4) $\frac{2}{5}m$
18. If mass density of earth varies with distance 'r' from centre of earth as $\rho = kr$ and 'R' is radius of earth, then find the orbital velocity of an object revolving around earth at a distance '2R' from its centre.

- 1) $\sqrt{\frac{\pi k R^3 G}{4}}$ 2) $\sqrt{\frac{\pi k R^3 G}{2}}$ 3) $\sqrt{\frac{\pi k R^3 G}{8}}$ 4) $\sqrt{\pi k R^3 G}$

19. **STATEMENT-I**

Sky wave communication is not suitable for frequencies greater than 30MHz.

STATEMENT-II

High frequency signals die out before reaching the ionosphere.

- 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.
20. **STATEMENT-I**
 it is possible for a thermal neutron to be absorbed by a nucleus where as a proton or an α - particle would need a much larger amount of energy for being absorbed by the same nucleus.
- STATEMENT-II**
 neutron is electrically neutral but proton and α -particle are positively charged.
- 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.



(NUMERICAL VALUE TYPE)

Section-II contains 10 Numerical Value Type questions. Attempt any 5 questions only. First 5 attempted questions will be considered if more than 5 questions attempted. The Answer should be within 0 to 9999. If the Answer is in Decimal then round off to the nearest Integer value (Example i.e. If answer is above 10 and less than 10.5 round off is 10 and If answer is from 10.5 and less than 11 round off is 11).

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

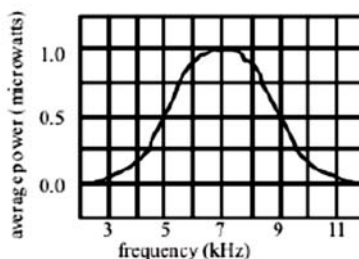
21. Electric potential in volt (in region) is given by

$$V = 6x + 8y + 4z^2$$

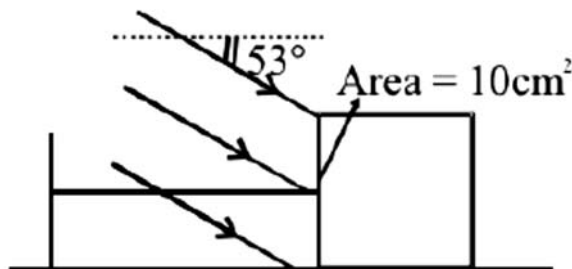
Calculate the electric force (in N) acting on $2C$ point charge placed at origin.

22. A rod is moving with velocity 9 m/s perpendicular to external magnetic field of 1 T and there is a conducting sphere having charge 30 C and radius R . If electric field inside rod is same as electric field on the surface of sphere and radius $R = x \times 10^5 \text{ m}$ then find x . (Round off to nearest integer)

23. A neutron collides with a stationary He^+ atom in its ground state, What should be minimum value of energy of neutron (in eV), so that all type of collisions (Elastic, inelastic and perfectly inelastic) can take place? (Consider mass of He^+ atom is 4 times mass of neutron).
24. The plot given below is of the average power delivered to an LRC circuit versus frequency. Resistance of circuit is 100Ω . Capacitive reactance of circuit at resonance (in Ω) is :

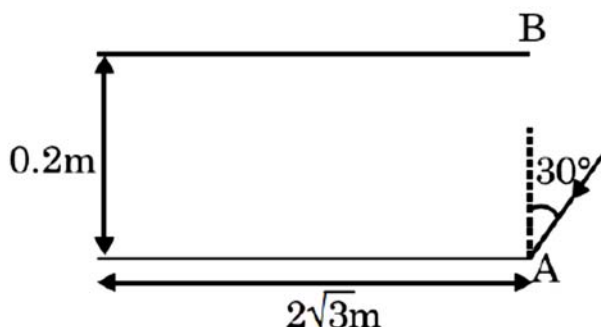


25. A block of mass $1\mu g$ is connected with an elastic string of stiffness constant $K = 10^{-5} \text{ N/m}$. Now a light pulse of intensity $I = 20 \text{ W/m}^2$ strikes the block at its vertical surface of surface area 10 cm^2 at an angle 53° as shown. If surface of block is 100% absorbing the light and the duration of light pulse is 6 ms then the max displacement of block from its mean position is $N \times 10^{-8} \text{ m}$. Find value of N .

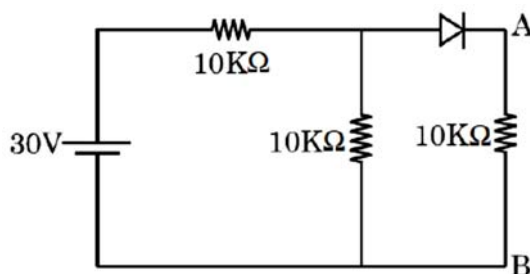




26. A neutron of energy 2 MeV and mass 1.6×10^{-27} kg passes a proton at such a distance that the angular momentum of neutron relative to proton approximately equals 4×10^{-34} Js. The distance of closest approach neglecting the interaction between particles is given by $\alpha \times 10^{-16}$ m. Find the value of α .
27. Two plane A and B are aligned parallel to each other as shown in figure. A light ray is incident at angle of 30° at a point just inside one end of A. The plane of incidence coincides with the plane of the figure. Find the maximum number of reflections (including the first one) the light ray suffers before it emerges out. The length is slightly more than $2\sqrt{3}$ meter.



28. Overall changes in volume and radii of a uniform cylindrical steel wire ($Y = 2.0 \times 10^{11} \text{ Nm}^{-2}$) are 0.2% and 0.002% respectively when subjected to some suitable force. Obtain the longitudinal tensile stress acting on the wire in the multiple of 10^8 N/m^2 .
29. In the given figure, obtain the potential difference between A and B in volt.



30. The diffraction pattern from a single slit is viewed on a screen. Using blue light of wavelength $0.42 \mu\text{m}$, the width of the central maximum is 2.0 cm. What is the width of the central maximum (in $\frac{20}{n} \text{ cm}$) when red light of wavelength $0.70 \mu\text{m}$ is used, find n ?

**CHEMISTRY****Max Marks: 100****(SINGLE CORRECT ANSWER TYPE)**

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -1 in all other cases.

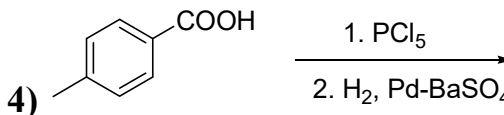
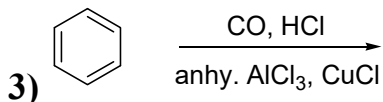
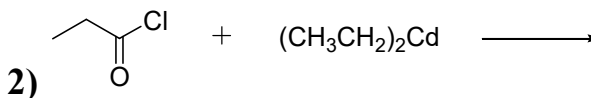
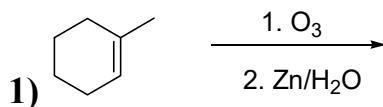
31. The covalent characters of CaCl_2 , BaCl_2 , SrCl_2 and MgCl_2 follow the order:

- 1) $\text{CaCl}_2 < \text{BaCl}_2 < \text{SrCl}_2 < \text{MgCl}_2$ 2) $\text{BaCl}_2 < \text{SrCl}_2 < \text{CaCl}_2 < \text{MgCl}_2$
 3) $\text{CaCl}_2 < \text{BaCl}_2 < \text{MgCl}_2 < \text{SrCl}_2$ 4) $\text{SrCl}_2 < \text{MgCl}_2 < \text{CaCl}_2 < \text{BaCl}_2$

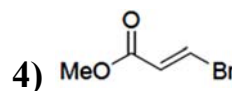
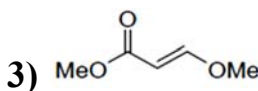
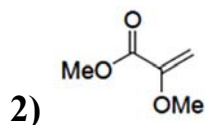
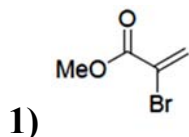
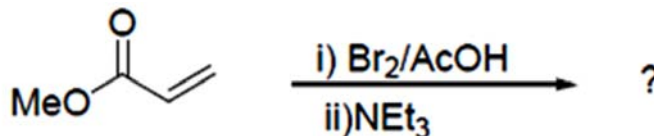
32. The organic compound which can be purified by steam distillation.

- 1) acetone 2) Aniline 3) glucose 4) ethanol

33. The product of which of the following reactions forms a reddish brown precipitate when subjected to Fehling's test?



34. Predict the major product of the following reaction



35. Among the following, the pair of paramagnetic complexes is

- 1) $\text{K}_4[\text{Fe}(\text{CN})_6]$ and $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
 2) $\text{K}_4[\text{Fe}(\text{CN})_6]$ and $\text{K}_3[\text{CoF}_6]$
 3) $\text{K}_3[\text{Fe}(\text{CN})_6]$ and $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
 4) $\text{K}_3[\text{Fe}(\text{CN})_6]$ and $\text{K}_3[\text{CoF}_6]$

36. If an extra electron is added to the hypothetical molecule C_2 , this extra electron will occupy the molecular orbital :

- 1) π_{2p}^* 2) π_{2p} 3) σ_{2p}^* 4) σ_{2p}



37. When a mixture of NaCl , $\text{K}_2\text{Cr}_2\text{O}_7$ and conc. H_2SO_4 is heated in a dry test tube, a red vapor (X) is evolved. This vapor (X) turns an aqueous solution of NaOH yellow due to the formation of Y. X and Y, respectively, are:
- 1) CrCl_3 and $\text{Na}_2\text{Cr}_2\text{O}_7$
 - 2) CrCl_3 and Na_2CrO_4
 - 3) CrO_2Cl_2 and Na_2CrO_4
 - 4) CrO_2Cl_2 and $\text{Na}_2\text{Cr}_2\text{O}_7$
38. Sodium borohydride upon treatment with iodine produces a Lewis acid (X), which on heating with ammonia produces a cyclic compound (Y) and a colorless gas (Z). X, Y and Z are :
- 1) $X = \text{BH}_3$; $Y = \text{BH}_3 \cdot \text{NH}_3$; $Z = \text{N}_2$
 - 2) $X = \text{B}_2\text{H}_6$; $Y = \text{B}_3\text{N}_3\text{H}_6$; $Z = \text{H}_2$
 - 3) $X = \text{B}_2\text{H}_6$; $Y = \text{B}_2\text{H}_6$; $Z = \text{H}_2$
 - 4) $X = \text{B}_2\text{H}_6$; $Y = \text{B}_3\text{N}_3\text{H}_6$; $Z = \text{N}_2$
39. Permanent hardness of water can be removed by
- 1) Heating
 - 2) Treatment with sodium acetate (CH_3COONa)
 - 3) Treating with $\text{Ca}(\text{HCO}_3)_2$
 - 4) Treatment with sodium hexametaphosphate $\text{Na}_6\text{P}_6\text{O}_{18}$
40. Among $\text{Ce}(4f^1 5d^1 6s^2)$, $\text{Nd}(4f^4 6s^2)$, $\text{Eu}(4f^7 6s^2)$ and $\text{Dy}(4f^{10} 6s^2)$, the elements having highest and lowest third ionization energies, respectively, are
- 1) Nd and Ce
 - 2) Eu and Dy
 - 3) Eu and Ce
 - 4) Dy and Nd
41. Among the following metals, the strongest reducing agent is
- 1) Ni
 - 2) Cu
 - 3) Zn
 - 4) Fe
42. Assertion: Classical smog has reducing nature
Reason: Ozone is one of the components of classical smog
- 1) Assertion and reason both are correct and the reason is the correct explanation
 - 2) Assertion and reason both are correct and the reason is not correct explanation
 - 3) Assertion is correct and reason is incorrect
 - 4) Assertion is incorrect and reason is correct
43. Assertion: LiF is less soluble in water
Reason: LiF has high lattice energy than hydration energy
- 1) Assertion and reason both are correct and the reason is the correct explanation
 - 2) Assertion and reason both are correct and the reason is not correct explanation
 - 3) Assertion is correct and reason is incorrect
 - 4) Assertion is incorrect and reason is correct



44. Reaction of ethanol with conc. Sulphuric acid at 170°C produces a gas which is then treated with bromine in CCl_4 . The major product obtained in this reaction is

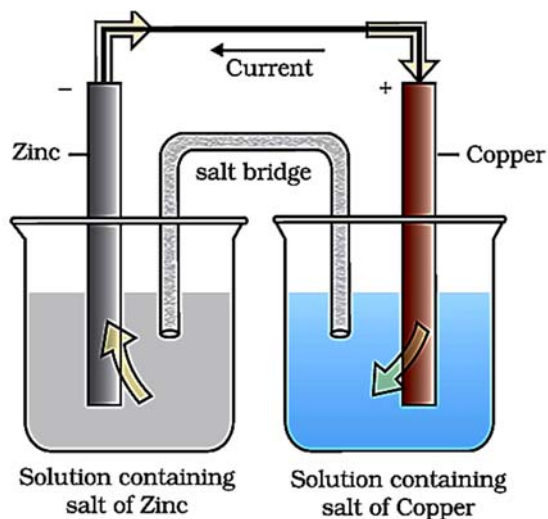
- 1) 1,2-dibromoethane
- 2) Ethylene glycol
- 3) Bromoethane
- 4) Ethyl sulphate

45. Assertion (A) : Adsorbent is gotten concentrated on the surface of adsorbate with higher rate in an adsorption.

Reason (R) : ΔG is negative in an adsorption process, which is spontaneous.

- 1) A is TRUE and R is TRUE, but R is not correct explanation to A
- 2) R is TRUE and A is FALSE
- 3) A is TRUE and R is TRUE as well R is correct explanation to A
- 4) R is FALSE and A is TRUE

46.



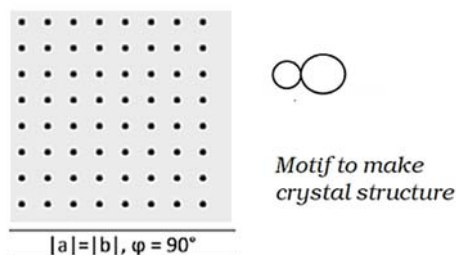
In the above working galvanic cell, a pure copper rod is additionally dipped in the cathodic compartment and connected to zinc rod through separate conducting wire made of same material as earlier used in the circuit, then

Select the option with correct set of changes from the list (labelled I to V) that occur

- I) Cations flow from salt bridge to anodic compartment.
 - II) Anions flow from salt bridge to cathodic compartment.
 - III) Intensity of blue color increases in the cathodic compartment.
 - IV) Concentration of zinc ions continues to increase in anodic compartment.
 - V) Direction of electron flow reverses in external circuit but remains same across salt bridge.
- 1) I, II and III 2) III, IV and V 3) I, II, III and V 4) IV



47. The enthalpy of solution at infinite dilution of hydrogen chloride gas in water is -74.85 kJ/mol . What is the heat with drawn when 15 moles of water are added to the solution that contains 1 mole of hydrogen chloride gas dissolved in 25 moles of water, therefore temperature of the new mixture remains same?
- $\text{HCl(g)} + 25 \text{ aq.} \rightarrow \text{HCl.25 aq.} \quad \Delta H = -72.03 \text{ kJ/mol}$
 $\text{HCl(g)} + 10 \text{ aq.} \rightarrow \text{HCl.10 aq.} \quad \Delta H = -69.01 \text{ kJ/mol}$
 $\text{HCl(g)} + 40 \text{ aq.} \rightarrow \text{HCl.40 aq.} \quad \Delta H = -72.79 \text{ kJ/mol}$
- 1) 760 J/mol 2) 2820 J/mol 3) 3.02 kJ/mol 4) 72.79 kJ/mol
48. Consider the reaction,
- $$\text{CO(g)} + 3\text{H}_2\text{(g)} \rightleftharpoons \text{CH}_4\text{(g)} + \text{H}_2\text{O(g)}$$
- 4 moles of gaseous reactants, taken in a ratio to get maximum yield, are allowed to reach equilibrium (state I) in a cylinder fitted with a piston at constant temperature. It is compressed to reduce the volume to one half of the volume in state-I. Then new equilibrium (state-II) is reached. Then
- 1) State-II can be arrived at different pressures
 2) Partial pressure of methane and water increases whereas partial pressures of carbon monoxide and hydrogen decreases from state-I to state-II
 3) Transformation from State-I to state-II, generates entropy
 4) All are correct
49. In the kinetic study of a reaction between potassium Iodate and sodium sulphite, select option with group of statements from the given list that are correct?
- I) Concentration of potassium iodate solution kept higher than the concentration of sodium sulphite solution.
 II) Nitric acid can be used to provide acidic medium.
 III) Hydrogen chloride can be used to provide acidic medium.
 IV) Concentration of potassium iodate solution kept lower than the concentration of sodium sulphite solution.
 V) Freshly prepared starch solution is used
- 1) I, II, V 2) I, III, V 3) III, IV, V 4) II, IV, V
50. Consider Hypothetical two-dimensional crystal as shown.



If radius of small circle to large circle in motif is 0.414 then maximum packing efficiency of hypothetical two-dimensional crystal is X. Then

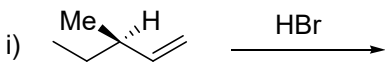
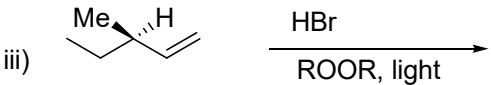
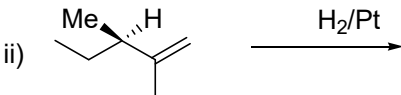
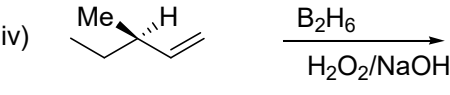
- 1) $X > 90$ 2) $78 < X < 90$ 3) $52 < X < 78$ 4) $X < 52$



(NUMERICAL VALUE TYPE)

Section-II contains 10 Numerical Value Type questions. Attempt any 5 questions only. First 5 attempted questions will be considered if more than 5 questions attempted. The Answer should be within 0 to 9999. If the Answer is in Decimal then round off to the nearest Integer value (Example i.e. If answer is above 10 and less than 10.5 round off is 10 and If answer is from 10.5 and less than 11 round off is 11).

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

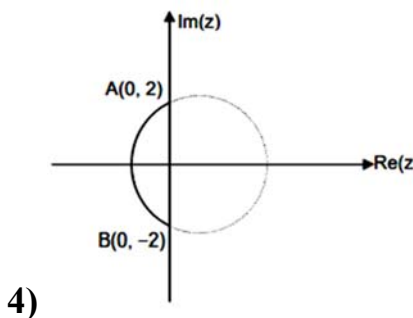
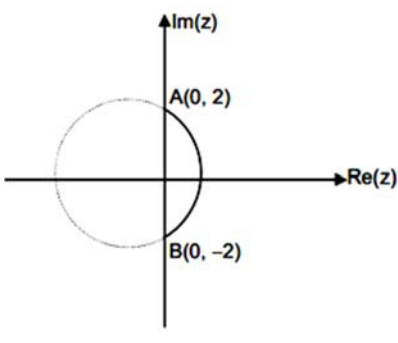
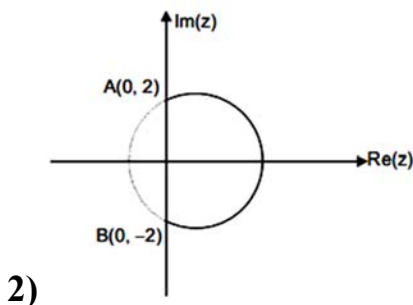
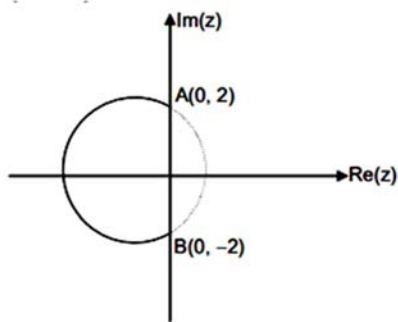
51. Number of non-ionisable hydrogens present in H_3PO_2 , oxoacid of phosphorous, is/are?
52. Among the following reactions, how many reactions yield distereomers as product?
- i)  \xrightarrow{HBr}
- iii)  $\xrightarrow[ROOR, \text{ light}]{HBr}$
- ii)  $\xrightarrow{H_2/Pt}$
- iv)  $\xrightarrow[H_2O_2/NaOH]{B_2H_6}$
53. Maximum number of atoms present linearly in the following molecule is
 $H_2C = C = CH - C \equiv C - C \equiv C - CH_3$
54. Number of peroxy linkages present in the compound, peroxydisulfuric acid, is
55. Number of H-bonds present between adenine and thymine in DNA
56. What is the oxidation state of central atom of a compound obtained by complete hydrolysis of XeF_6
57. The characteristic velocity associated with neutron in a neutron diffraction microscope, if the wavelength used here is 800 pm, is $a \times 10^2$ m/s. What is value of a to nearest integer?
 $h = 6.6 \times 10^{-34}$ J-s and mass of neutron = 1.675×10^{-27} Kg.
58. Equal volumes of Hydrochloric acid of $P^H = 2$ is mixed with Barium hydroxide solution of $P^H = 12$. The concentration of Barium chloride in mixed solution is $p \times 10^{-3} M$ (in scientific notation). What is the value of $2p$?
59. At 300 K, a solution containing 0.2 g of polyisobutylene in 100 ml of benzene developed a rise of 2.463 mm in osmotic equilibrium. The molar mass of polyisobutylene is $p \times 10^4$ g/mol). What is the value of p to nearest integer?
 (Given: The density of final solution is 1.013 g/ml, $g=10, R=0.0821$ L-atm/K-mol)
60. 500 ml of 0.1M $CuSO_4$ solution is electrolysed for 5 min at a current of 0.161A. If Cu is produced at one electrode and oxygen at the other, then what is pH of final solution? Report the value to nearest integer

**MATHEMATICS****Max Marks: 100****(SINGLE CORRECT ANSWER TYPE)**

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -1 in all other cases.

61. If $\arg\left(\frac{z-2i}{z+2i}\right) = \frac{\pi}{6}$, then which of the following options gives the correct locus of z ?



62. If a curve is such that line joining origin to any point $P(x, y)$ on the curve and line parallel to y -axis through P are equally inclined to tangent to curve at P , then the differential equation of the curve is

1) $x\left(\frac{dy}{dx}\right)^2 - 2y\frac{dy}{dx} = x$

2) $\left(\frac{dy}{dx}\right)^2 + 2y\frac{dy}{dx} = x$

3) $y\left(\frac{dy}{dx}\right)^2 + 2y\frac{dy}{dx} = x$

4) $y\left(\frac{dy}{dx}\right)^2 - 2y\frac{dy}{dx} = x$

63. If number of ways of arranging letters aaaabbbbccdd in a line so that there should be at least one b in between two a 's is k , then the value of $|15000 - k|$ is

1) 150

2) 200

3) 250

4) 400

64. Six teams play a match with each other. The probability that neither a team win all the matches nor a team loose all the matches is

1) $\frac{75}{216}$

2) $\frac{57}{216}$

3) $\frac{175}{216}$

4) $\frac{157}{216}$



65. **Statement – 1 :** $\frac{\tan 3x - \tan 2x}{1 + \tan 3x \tan 2x} = 1, x = n\pi + \frac{\pi}{4}, n \in I$

Statement – 2 : $\tan x$ is not defined at $x = n\pi + \frac{\pi}{2}, n \in I$

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

66. All real values of 'u' such that the curves $y = x^2 + u$ and $y = \sqrt{x - u}$ intersect in exactly one point is

1) $(-1, 0) \cup \left\{\frac{1}{4}\right\}$ 2) $(-\infty, -1) \cup (1, 2)$ 3) $(1, \infty)$ 4) $(-\infty, -1)$

67. The equations of the two adjacent sides of a rhombus are $y = x$ and $y = 7x$. The diagonals of the rhombus intersect each other at the point $(1, 2)$ then area of the rhombus is

1) $\frac{10}{3}$ 2) $\frac{20}{3}$ 3) $\frac{50}{3}$ 4) 6

68. Lines $(1 + \lambda)x + (4 - \lambda)y + (2 + \lambda) = 0$ and $(4 - \lambda)x + (1 + \lambda)y + (6 - 3\lambda) = 0$ are concurrent at points A and B respectively and intersect at C, then locus of centroid of ΔABC is

1) $\left(x + \frac{3}{2}\right)^2 + \left(y + \frac{7}{10}\right)^2 = \frac{17}{50}$ 2) $\left(x - \frac{3}{2}\right)^2 + \left(y - \frac{7}{10}\right)^2 = \frac{17}{50}$
 3) $\left(x + \frac{3}{2}\right)^2 + \left(y + \frac{7}{10}\right)^2 = \frac{17}{450}$ 4) $\left(x + \frac{3}{2}\right)^2 + \left(y + \frac{7}{10}\right)^2 = \frac{17}{225}$

69. The range of $\cos \theta \left(\sin \theta + \sqrt{\sin^2 \theta + \sin^2 \alpha} \right)$ is

1) $\left[-\sqrt{1 + \sin^2 \alpha}, \sqrt{1 + \sin^2 \alpha} \right]$ 2) $\left[-\sqrt{1 + \cos^2 \alpha}, \sqrt{1 + \cos^2 \alpha} \right]$
 3) $\left[-\sqrt{1 + \cos^2 \alpha}, \sqrt{1 + \sin^2 \alpha} \right]$ 4) $\left[-\sqrt{1 + \sin^2 \alpha}, \sqrt{1 + \cos^2 \alpha} \right]$



70. Let $f(x) = \begin{cases} 0 & \text{if } x \leq 0 \\ P(x) & \text{if } 0 < x < 1 \\ 1 & \text{if } x \geq 1 \end{cases}$ where $P(x)$ is a polynomial of least degree such that $f(x)$ is

a differentiable function for all $x \in R$. Area bounded by the graph of $y = f(x)$, $x = 0$ and $x = 1$ is

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

71. The value of $\sum_{k=1}^n (n-k) \cos \frac{2k\pi}{n} (n \geq 3)$ is

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

72. The maximum value of $P = \frac{2}{a^2+1} - \frac{2}{b^2+1} + \frac{3}{c^2+1}$ is _____ where $a, b, c > 0$ and $abc + a + c = b$.

- 1) 3 2) $\frac{8}{3}$ 3) 4 4) $\frac{10}{3}$

73. The maximum value of x^2y , subject to constraints $x + y + \sqrt{2x^2 + 2xy + 3y^2} = k$ (constant), $x, y \geq 0$ is

- 1) $\frac{k^2}{(2+\sqrt{15})^2}$ 2) $\frac{4k^3}{(3+\sqrt{15})^3}$ 3) $\frac{4k^2+k^3}{(3+\sqrt{15})^2}$ 4) $\frac{k^3}{(3+\sqrt{15})^2}$

74. A set of consecutive positive integers starting with one is written on blackboard.

One number erased and then the A.M of the remaining numbers is found to be $35\frac{7}{17}$. The erased number is

- 1) 6 2) 7 3) 8 4) 9

75. If the standard deviation of 10 observations x_1, x_2, \dots, x_{10} is 4 and that of another set of 10 observations y_1, y_2, \dots, y_{10} is 3 and also $X_i = (x_i - \bar{x})(y_i - \bar{y})$. \bar{x} is mean of all x_i 's and \bar{y}

is mean all y_i 's and $\sum_{i=1}^{10} X_i = 80$. Then standard deviation of observations

$x_1 - y_1, x_2 - y_2, \dots, x_{10} - y_{10}$ is

- 1) 1 2) 3 3) 5 4) $\sqrt{5}$



76. **Statement 1:** Let x and y are two statements and let $x \oplus y$ be defined as $(x \vee y) \wedge \sim (x \wedge y)$.

Then " $x \Leftrightarrow y$ " is same as $\sim (x \oplus y)$

Statement 2: The statement $\sim (p \Rightarrow q) \Leftrightarrow (\sim p \vee \sim q)$ is a tautology

- 1) Statement -1 is true, Statement - 2 is true
- 2) Statement -1 is false, Statement - 2 is true
- 3) Statement -1 is true, Statement - 2 is false
- 4) Statement -1 is false, Statement - 2 is false

77. If x, y, z are real numbers satisfying

$$\begin{vmatrix} (x^2 + 1)^2 & (xy + 1)^2 & (xz + 1)^2 \\ (xy + 1)^2 & (y^2 + 1)^2 & (yz + 1)^2 \\ (xz + 1)^2 & (yz + 1)^2 & (z^2 + 1)^2 \end{vmatrix} = k(x - y)^2(y - z)^2(z - x)^2 \text{ then } k =$$

- 1) 0
- 2) 1
- 3) 2
- 4) 4

78. If $f(x) = \begin{cases} \frac{x(3e^{1/x} + 4)}{2 - e^{1/x}} & , \quad x \neq 0 \\ 0 & , \quad x = 0 \end{cases}$, then $f(x)$ is

- 1) Continuous as well as differentiable at $x = 0$
- 2) Continuous but not differentiable at $x = 0$
- 3) Differentiable but not continuous at $x = 0$
- 4) Discontinuous every where

79. If the tangent at (x_1, y_1) to the curve $x^3 + y^3 = a^3$ meets the curve again at (x_2, y_2) then

- 1) $\frac{x_2}{x_1} + \frac{y_2}{y_1} = -1$
- 2) $\frac{x_2}{y_1} + \frac{x_1}{y_2} = -1$
- 3) $\frac{x_1}{x_2} + \frac{y_1}{y_2} = -1$
- 4) $\frac{x_2}{x_1} + \frac{y_2}{y_1} = 1$

80. Let f be a continuous function in $[0, 3]$ and differentiable in $(0, 3)$ such that $f(3) = 0$. Then there exist some $\alpha \in (0, 3)$ such that

- 1) $\alpha f^1(\alpha) - f(\alpha) = 0$
- 2) $2\alpha f^1(\alpha) - 3f(\alpha) = 0$
- 3) $3\alpha f^1(\alpha) - f(\alpha) = 0$
- 4) $\alpha f^1(\alpha) + f(\alpha) = 0$



(NUMERICAL VALUE TYPE)

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Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

81. Let the value of $\int_1^{\sqrt{2}} (x^4 - 2x^2 + 1)^{\frac{1}{3}} dx + \int_{-1}^0 \sqrt{(x+1)^{\frac{3}{2}}} + 1 dx$ be I , then $[I]$ is equal to (where $[.]$ denotes the greatest integer function)
82. The abscissa of any two points on the parabola $y^2 = 4ax$ are in the ratio $\mu : 1$. If the locus of the point of intersection of tangents at these points is $y^2 = \left(\mu^{1/\lambda} + \mu^{-1/\lambda}\right)^2 ax$. Then the value of $\lambda =$
83. Given that x, y are real numbers satisfying $x > y > 0$, the minimum value of $\frac{5x^2 - 2xy + y^2}{x^2 - y^2}$ is $a(1 + \sqrt{a})$, then the value of a is _____
84. Let C_1 and C_2 be two circles intersecting at points P and Q . The tangent line closer to Q touches C_1 and C_2 at M and N respectively. If $PQ = 3$, $QN = 2$, and $MN = PN$, The value of QM^2 is
85. Define $\{x\} = x - [x]$, where $[x]$ denotes the largest integer not exceeding x . If $|x| \leq 8$, the number of real solutions to the equation $\{x\} + \{x^2\} = 1$ is _____
86. If \hat{a}, \hat{b} and \hat{c} are unit vectors satisfying $|\hat{a} - \hat{b}|^2 + |\hat{b} - \hat{c}|^2 + |\hat{c} - \hat{a}|^2 = 9$, then the value of $|2\hat{a} + 5\hat{b} + 5\hat{c}|$ is
87. If $\begin{bmatrix} \bar{b} & \bar{c} & \bar{d} \end{bmatrix} = 24$ and $(\bar{a} \times \bar{b}) \times (\bar{c} \times \bar{d}) + (\bar{a} \times \bar{c}) \times (\bar{d} \times \bar{b}) + (\bar{a} \times \bar{d}) \times (\bar{b} \times \bar{c}) + k\bar{a} = \bar{0}$ then $\frac{k}{3} =$ _____
88. The length of perpendicular drawn from $P(1, 2, 3)$ to the line $\frac{x-6}{3} = \frac{y-7}{2} = \frac{z-7}{-2}$ is
89. A college awarded 38 medals in football, 15 in basketball and 20 in cricket. If the medals went to a total of 58 men and only three men got medals in all the three sports, then the number of men received medals in exactly two of the three sports is
90. If $\log_{245} 175 = a, \log_{1715} 875 = b$, then the value of $\frac{1-ab}{a-b}$ is _____