



Sri Chaitanya IIT Academy.,India.

☆ A.P ☆ T.S ☆ KARNATAKA ☆ TAMILNADU ☆ MAHARASTRA ☆ DELHI ☆ RANCHI

A right Choice for the Real Aspirant
ICON Central Office - Madhapur - Hyderabad

SEC: **Sr.Super60_NUCLEUS & STERLING_BT** JEE-MAIN

Date: 09-01-2023

Time: 09.00Am to 12.00Pm

GTM-04

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.

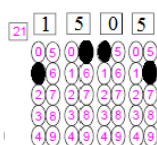
Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.

(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: _____

09-01-23_Sr.Super60_NUCLEUS & STERLING_BATCH_Jee-Main_GTM-04_Test Syllabus

PHYSICS : TOTAL SYLLABUS

CHEMISTRY : TOTAL SYLLABUS

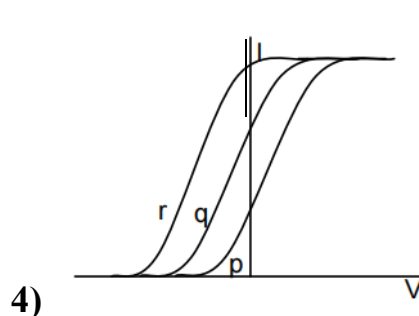
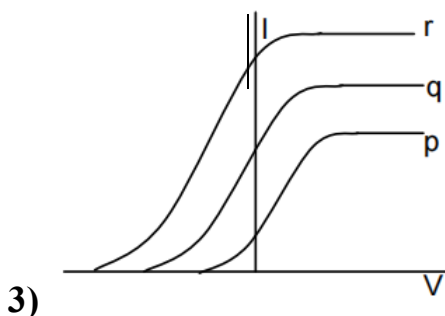
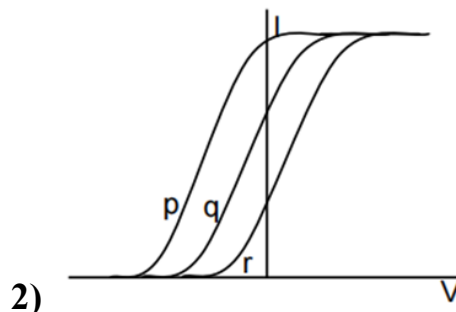
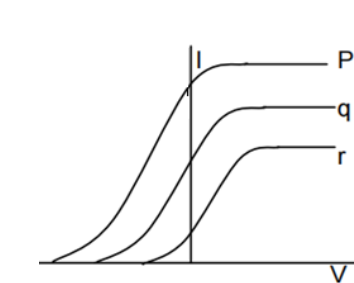
MATHEMATICS : TOTAL SYLLABUS

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

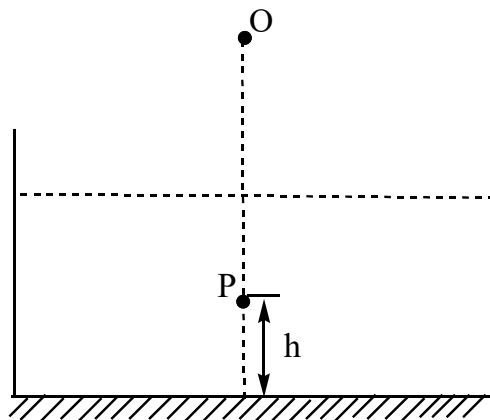
This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

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

1. Photoelectric effect experiments are performed using three different metal plates p, q and r having work functions, $\phi_p = 2.0 \text{ eV}$, $\phi_q = 2.5 \text{ eV}$, and $\phi_r = 3.0 \text{ eV}$, respectively. A light beam containing wavelengths of 550 nm, 450 nm and 350 nm with equal intensities illuminates each of the plates. The correct I-V graph for the experiment is



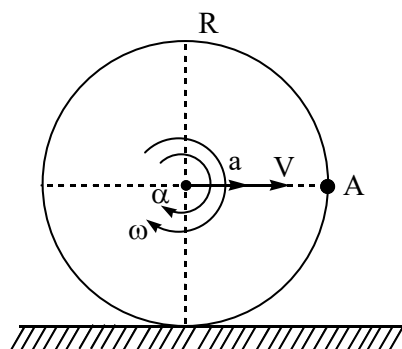
2. A plane mirror is placed at bottom of a tank containing a liquid of refractive index μ . P is a small object at a height 'h' above the mirror. An observer "O" vertically above P outside the liquid observes P & its image in the mirror. The apparent distance between these two will be



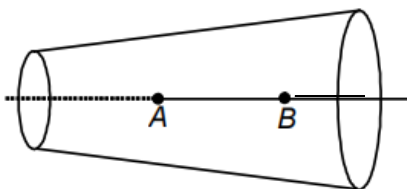
- 1) $2\mu h$ 2) $\frac{2h}{\mu}$ 3) $\frac{2h}{\mu - 1}$ 4) $h \left(1 + \frac{1}{\mu} \right)$



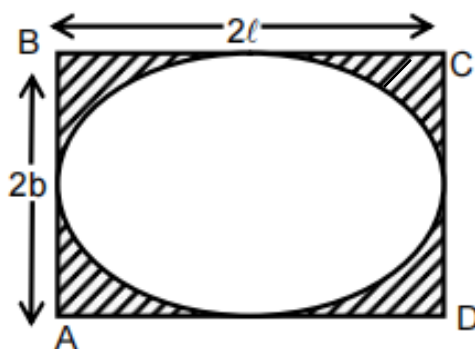
3. A uniform circular disc of radius 'R' is rolling without slipping on a rough horizontal surface with a constant acceleration 'a'. Then the radius of curvature of trajectory of point 'A' of the disc relative to the ground at the given instant as shown in the figure is



- 1) $4R$ 2) $2\sqrt{2}R$ 3) $2R$ 4) $\sqrt{2}R$
4. A resistance of frustum shape is shown in figure. If a current i passes through the resistance, the electric field at A and B are related as



- 1) $E_A > E_B$ 2) $E_B > E_A$ 3) $E_A = E_B$ 4) There is no relation
5. There is a thin plate ABCD with an elliptical hole as shown in the figure. The coefficient of linear expansion of the sheet is α . When the temperature of the plate is increased by T K, the area of the hole increases by an amount:-



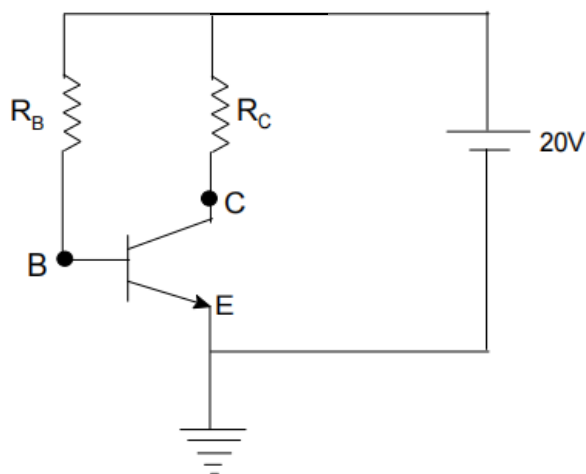
- 1) $\pi lb\alpha T$ 2) $2\pi lb\alpha T$ 3) $3\pi lb\alpha T$ 4) Data insufficient
6. When an ultrasonic waves travels from air into water,
- 1) Waves bends towards the normal
- 2) Frequency of waves changes from air to water
- 3) Speed of ultrasonic wave is greater in water than that in air
- 4) Speed of ultrasonic wave is less in water than that in air.



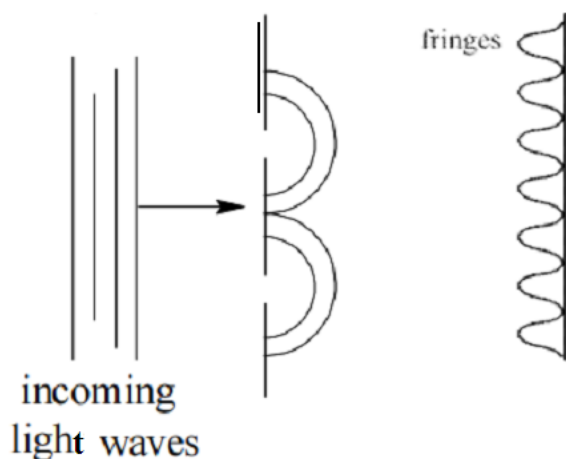
7. **ASSERTION:** Two sound waves of same intensity in a particular medium will have displacement amplitude in ratio of 2:1 if they have frequency in the ratio 1:2
REASON: Two wave of same velocity amplitude in a particular medium have equal intensity
- 1) ASSERTION is true ,REASON is a correct explanation
 - 2) ASSERTION is true ,REASON is not a correct explanation
 - 3) ASSERTION is true ,REASON is false
 - 4) ASSERTION is false ,REASON is true
8. A particle is vibrating in S.H.M. Its velocities are v_1 and v_2 when the displacements from the mean position are y_1 and y_2 , respectively, then its time period is
- 1) $2\pi \sqrt{\frac{y_1^2 + y_2^2}{v_1^2 + v_2^2}}$
 - 2) $2\pi \sqrt{\frac{v_1^2 - v_2^2}{y_1^2 - y_2^2}}$
 - 3) $2\pi \sqrt{\frac{v_1^2 + v_2^2}{y_1^2 + y_2^2}}$
 - 4) $2\pi \sqrt{\frac{y_1^2 - y_2^2}{v_2^2 - v_1^2}}$
9. Regarding transistor what is not correct
- 1) For transistor to act an amplifier EB junction should be forward biased and CB junction should be reverse biased
 - 2) $I_E = I_B + I_C$ in any configuration and for any transistor.
 - 3) $\alpha = \frac{\beta}{1 + \beta}$ where α and β transistor parameter
 - 4) $\beta = \frac{\alpha}{1 + \alpha}$
10. Number of amplitude modulation broadcast stations that can be accommodated in a 100 KHz bandwidth if the highest frequency modulating a carrier is 5KHz
- 1) 10
 - 2) 100
 - 3) 1000
 - 4) 10000
11. **ASSERTION:** Light of red colour travels faster than the light of violet colour in vacuum.
REASON: Refractive index of a medium in general, depends on wavelength and its value reduces with the increase of wavelength
- 1) ASSERTION is true ,REASON is a correct explanation
 - 2) ASSERTION is true ,REASON is not a correct explanation
 - 3) ASSERTION is true ,REASON is false
 - 4) ASSERTION is false ,REASON is true



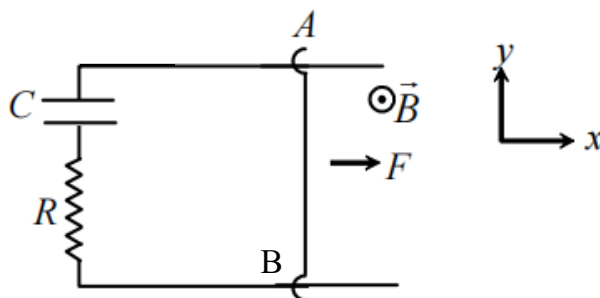
12. The plane of the dip circle is set in the geographical meridian and apparent dip is θ_1 . It is then set in a vertical plane perpendicular to the geographical meridian, the apparent dip becomes θ_2 . The angle of declination α at that place is given by
- 1) $\tan \alpha = \sqrt{\tan \theta_1 \tan \theta_2}$
 - 2) $\tan \alpha = \sqrt{\tan^2 \theta_1 \tan^2 \theta_2}$
 - 3) $\tan \alpha = \frac{\tan \theta_1}{\tan \theta_2}$
 - 4) $\tan \alpha = \frac{\tan \theta_2}{\tan \theta_1}$
13. **ASSERTION:** In an experiment, the reliable digits plus the first uncertain digit are known as significant digits or significant figures.
- REASON:** A choice of change of different units does not change the number of significant digits or figures in a measurement
- 1) ASSERTION is true ,REASON is a correct explanation
 - 2) ASSERTION is true ,REASON is not a correct explanation
 - 3) ASSERTION is true ,REASON is false
 - 4) ASSERTION is false ,REASON is true
14. For given CE biasing circuit, voltage across collector-emitter is 12V, current gain is 100 and base current is 0.04 mA. Then the value of collector resistance ' R_c ' is



- 1) 1200Ω
 - 2) 200Ω
 - 3) 400Ω
 - 4) 2000Ω
15. In a Young's double slit experiment, green light is incident on the two slits. The interference pattern is observed on a screen. Which of the following changes would cause the observed fringes to be more closely spaced?



- 1) Reducing the separation between the slits
 2) Using blue light instead of green light
 3) Used red light instead of green light
 4) Moving the light source further away from the slits.
16. **ASSERTION:** Absolute error may be positive or negative
REASON: Absolute error is the magnitude difference between the real value and measured value of a physical quantity
- 1) ASSERTION is true ,REASON is a correct explanation
 2) ASSERTION is true ,REASON is not a correct explanation
 3) ASSERTION is true ,REASON is false
 4) ASSERTION is false ,REASON is true
17. A solid piece of lead has a mass of 23.94 g and a volume of 2.10cm^3 . From these data, calculate the density of lead in SI units (kilograms per cubic meter).
- 1) $1.14 \times 10^4 \text{ kg / m}^3$ 2) $2.28 \times 10^4 \text{ kg / m}^3$
 3) $2.14 \times 10^3 \text{ kg / m}^3$ 4) $1.28 \times 10^3 \text{ kg / m}^3$
18. A conducting rod AB (length l) moves parallel to x-axis in the x-y plane. A uniform magnetic field B pointing normally out of the plane exists throughout the region. A force F acts perpendicular to the rod, so that the rod moves with uniform velocity v . The force F is given by (neglect resistance of all the connecting wires)





1) $\frac{VB^2l^2}{R}e^{-t/RC}$

2) $\frac{VB^2l^2}{R}$

3) $\frac{VB^2l^2}{R}(1 - e^{-t/RC})$

4) $\frac{VB^2l^2}{R}(1 - e^{-2t/RC})$

19. **ASSERTION:** In photoelectric, the number photoelectrons emitted is always equal to number of photons incident.

REASON: The photons falling on the surface will eject photoelectrons, is not necessary

- 1) ASSERTION is true ,REASON is a correct explanation
 2) ASSERTION is true ,REASON is not a correct explanation
 3) ASSERTION is true ,REASON is false
 4) ASSERTION is false ,REASON is true

20. Consider the following statements

- (i) Young's modulus is numerically equal to the stress which will double the length of a wire
 (ii) The surface tension of a liquid decreases due to the presence of insoluble contamination
 (iii) Viscosity of gases is greater than that of liquids.

The number of above statements that are true is

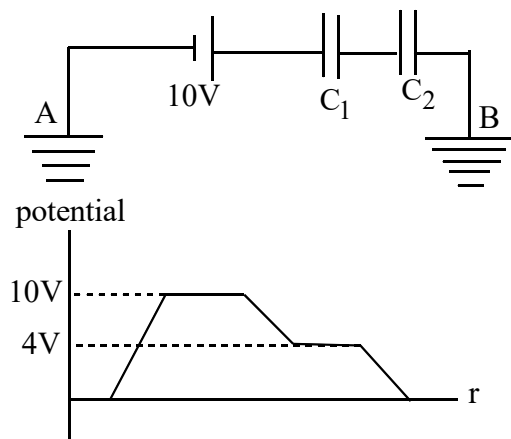
- 1) Zero 2) Three 3) Two 4) One

(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. A particle is projected horizontally from the top of a tower with a velocity v_0 . If v be its velocity at any instant, then the radius of curvature of the path of the particle at the point (where the particle is at that instant) is directly proportional to v^n , then find the value of 'n'.
22. Figures shows two capacitors C_1 and C_2 connected with 10 V battery and terminal A and B are earthed. The graph shows the variation of potential as one moves from left to right. Then the ratio of C_1 / C_2 is $\frac{N}{3}$. Then N is _____.



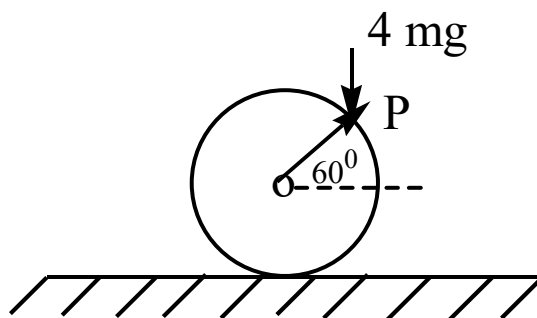


23. Suppose the potential energy between the electron and proton at a distance r is given by

$$-\frac{Ke^2}{3r^3}. \text{ Application of Bohr's theory of hydrogen atom in this case shows that energy in the}$$

n th orbit is proportional to n^x . Then x is _____.

24. A solid sphere of mass m and radius R is lying on a rough horizontal plane. A constant force $4mg$ acts vertically at point P such that OP makes an angle 60° with horizontal. Minimum coefficient of friction is $n \times 10^{-2}$ so that sphere starts pure rolling. Then the value of n is _____



25. Consider the following reaction: ${}_1^1\text{H} + {}_6^{13}\text{C} \rightarrow {}_7^{13}\text{N} + {}_0^1\text{n}$

The atomic masses of the nuclei are

$$M({}_1^1\text{H}) = 1.007825 \text{ amu},$$

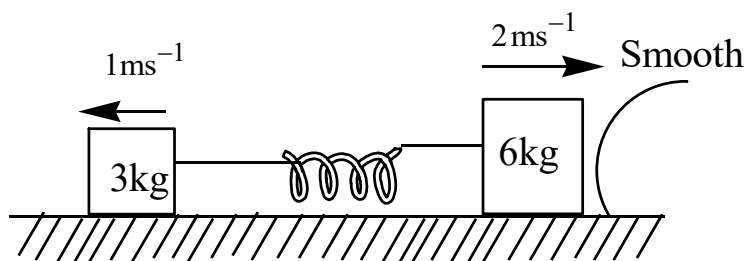
$$M({}_0^1\text{n}) = 1.008665 \text{ amu},$$

$$M({}_6^{13}\text{C}) = 13.00336 \text{ amu},$$

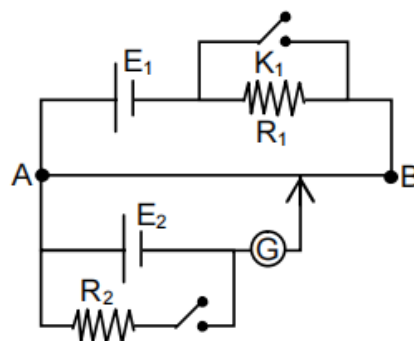
$$M({}_7^{13}\text{N}) = 13.00574 \text{ amu and } 1 \text{ amu} = 931 \text{ MeV}.$$

The minimum kinetic energy of proton $({}_1^1\text{H})$ required to initiate the reaction is _____ in Mev

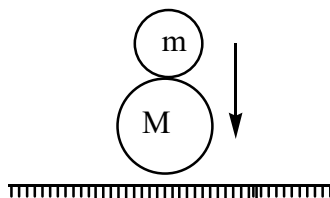
26. Two blocks of masses 3kg and 6kg are placed on a smooth horizontal surface. They are connected by a light spring of force constant, $k = 200 \text{ Nm}^{-1}$. Initially the spring is unstretched. The indicated velocities are imparted to the blocks. The maximum extension of the spring is _____ in cm



27. The critical angle for a prism and its surrounding interface is 36° . The minimum angle of prism for which no emergent ray is possible is _____ degrees.
28. Figure shows the circuit of a potentiometer. The length of the potentiometer wire AB is 50 cm. The e.m.f. of the battery E_1 is 4 volt, having negligible internal resistance. Values of resistances R_1 and R_2 are 15 ohm and 5 ohm respectively. When both the keys are open, the null point is obtained at distance of 31.25 cm from end A but when both the keys are closed. The balance length reduces to 5 cm only. Given $R_{AB} = 10\Omega$. The e.m.f. of the cell E_2 is _____ V.



29. A small ball of mass m is placed on top of the “super ball” of mass M and the two ball are dropped to the floor from height h . Height rise of small ball after the collision is Nh , then ‘ N ’ is: (Assume that the collision with the super ball are elastic, and the $m \ll M$)



30. The sound from a trumpet is emitted uniformly in all directions at 20°C . At point ‘P’ in space the sound intensity level is 30 dB. The density of air in the medium is 1.5 kg/m^3 , the velocity of sound at 20°C is 300 m/sec. Find the displacement amplitude (in \AA) at point ‘P’. The frequency of sound wave in the medium is 600 Hz. (Take $\pi^2 = 10$)

**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. Which of the following statements regarding HNO_3 is correct
- A) Concentrated nitric acid is a strong oxidizing agent and attacks most metals such as gold and platinum.
 B) It is used in pickling of stainless steel and etching of metals.
 C) 68% HNO_3 , 32% water by mass is an example of minimum boiling azeotrope.
 D) Zinc reacts with dil. HNO_3 to give NO_2 and with con. HNO_3 to give N_2O
- 1) A,B,C,D 2) B,C,D only 3) B only 4) B,C only
32. Which of the following electronic configuration of the corresponding element is wrongly matched?
- 1) Thulium - $[\text{Xe}]4f^{13}6s^2$ 2) Americium - $[\text{Rn}]5f^77s^2$
 3) Uranium - $[\text{Rn}]5f^47s^2$ 4) Terbium - $[\text{Xe}]4f^96s^2$
33. **Assertion:** In co-ordination entity of type $[\text{PtCl}_2(\text{en})_2]^{2+}$, only cis-isomer shows optical activity ;Trans isomer shows optical inactive
- Reason:** Trans isomer has plane of symmetry, hence optically inactive.
- 1) Both A and R are correct but R is not the correct explanation of A
 2) Both A and R are correct and R is the correct explanation of A.
 3) A is true but R is false.
 4) A is false but R is true.
34. Match List -I with List – II (Method of preparation /method of purification)
- | List -I | List - II |
|---------------------|------------------------|
| A) Sodium carbonate | (I) Deacon |
| B) Titanium | (II) Castner – Kellner |
| C) Chlorine | (III) van – Arkel |
| D) Sodium Hydroxide | (IV) Solvay |
- 1) $A \rightarrow \text{IV}, B \rightarrow \text{III}, C \rightarrow \text{I}, D \rightarrow \text{II}$ 2) $A \rightarrow \text{I}, B \rightarrow \text{IV}, C \rightarrow \text{III}, D \rightarrow \text{II}$
 3) $A \rightarrow \text{IV}, B \rightarrow \text{III}, C \rightarrow \text{II}, D \rightarrow \text{I}$ 4) $A \rightarrow \text{I}, B \rightarrow \text{IV}, C \rightarrow \text{II}, D \rightarrow \text{III}$



35. **Assertion:-** Atomic hydrogen is produced at a high temperature in an electric arc or under ultraviolet radiations (from Hydrogen molecule).

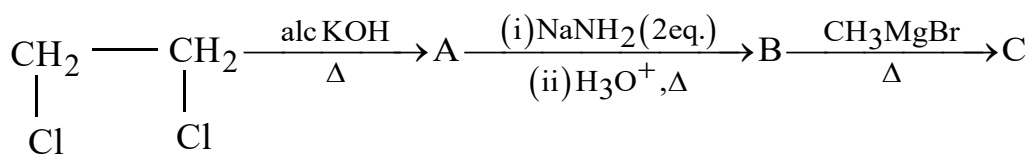
Reason:- The H-H bond dissociation enthalpy is the highest for a single bond between two atoms of any element.

- 1) Both A and R are true and R is the correct explanation of A
- 2) Both A and R are true and R is not the correct explanation of A
- 3) A is true but R is false
- 4) A is false but R is true

36. The number of acyclic isomers (including stereo isomers) for C_5H_{10} is/are ?

- 1) 4
- 2) 5
- 3) 6
- 4) 7

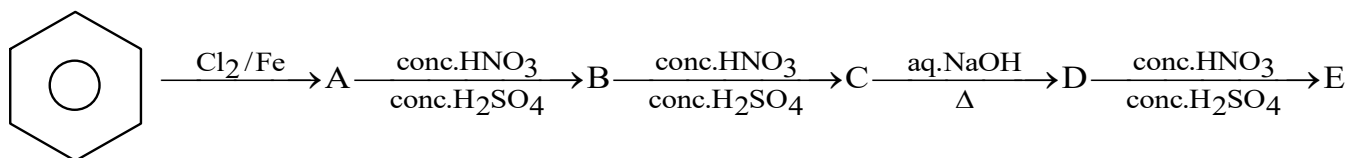
37.



Then C is _____.

- 1) $\text{HC} \equiv \text{C} - \text{CH}_3$
- 2) $\text{CH}_3 - \text{C} \equiv \text{C} - \text{CH}_3$
- 3) $\text{CH}_2 = \text{CH} - \text{CH}_3$
- 4) CH_4

38.

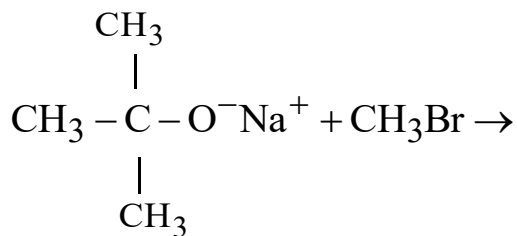
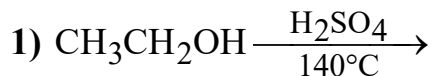


The compound E is

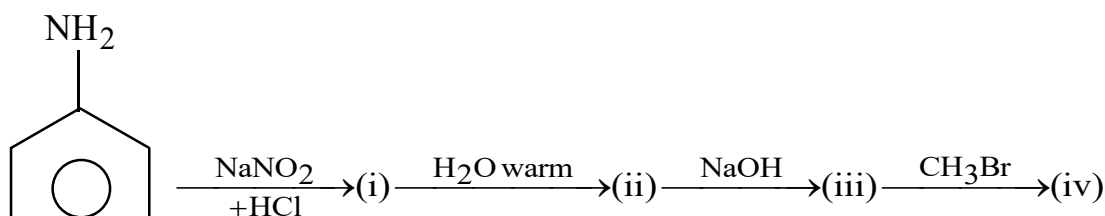
- 1)
- 2)
- 3)
- 4)



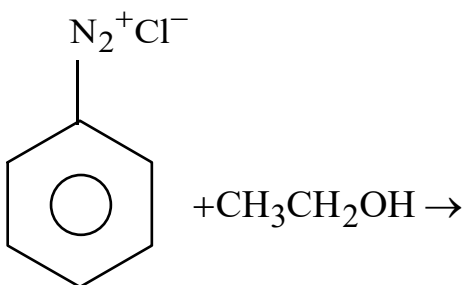
39. Which of the following doesn't produce an ether compound as a major product



3)



4)



40. **Assertion:-** Phenoxide ion is more stable than carboxylate ion hence phenol is more acidic than carboxylic acids

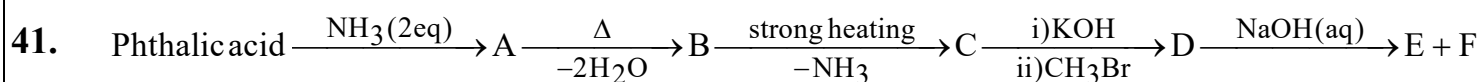
Reason:- The negative charge is delocalised over two electronegative oxygen atoms in carboxylate ion

1) Both A and R are true and R is the correct explanation of A

2) Both A and R are true and R is not the correct explanation of A

3) A is true but R is false

4) A is false but R is true



(Nitrogen containing compound) F cannot be prepared by



- 1) $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{NH}_2 + \text{Br}_2 + \text{aq. NaOH} \rightarrow$
- 2) $\text{CH}_3\text{Cl} \xrightarrow{\text{Ethanolic NaCN}} \text{(i)} \xrightarrow{\text{H}_2/\text{Ni}} \text{(ii)}$
- 3) $\text{CH}_3\text{NO}_2 \xrightarrow{\text{Sn} + \text{HCl}} \rightarrow$
- 4) $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{CrO}_3 - \text{H}_2\text{SO}_4} \text{(i)} \xrightarrow{\text{NH}_3} \text{(ii)} \xrightarrow[\text{-H}_2\text{O}]{\Delta} \text{(iii)} \xrightarrow{\text{Br}_2 \cdot \text{aq. NaOH}} \text{(iv)}$

42. Which of the following statement is incorrect
- 1) Glucose give schiff's test and forms the hydrogen sulphite addition product with NaHSO_3
 - 2) The pentacetate of glucose does not react with hydroxyl amine indicating the absence of free $-\text{CHO}$ group
 - 3) On oxidation with conc. HNO_3 , both glucose and gluconic acid yield saccharic acid
 - 4) Glucose reacts with hydroxylamine to form an oxime
43. A chemical which stimulate the secretion of pepsin is :-
- 1) Antihistamine
 - 2) Cimetidine
 - 3) Zantac
 - 4) Histamine
44. Consider the ions/molecule $\text{O}_2^+, \text{O}_2, \text{O}_2^-, \text{O}_2^{2-}$ For increasing bond order the correct option.
- 1) $\text{O}_2^{2-} < \text{O}_2^- < \text{O}_2 < \text{O}_2^+$
 - 2) $\text{O}_2^- < \text{O}_2^{2-} < \text{O}_2 < \text{O}_2^+$
 - 3) $\text{O}_2 < \text{O}_2^{2-} < \text{O}_2^- < \text{O}_2^+$
 - 4) $\text{O}_2^- < \text{O}_2^+ < \text{O}_2^{2-} < \text{O}_2$
45. Which of the following statement(s) is/are correct:
- 1) Nylon 6,6 is prepared under high pressure and at very low temperature
 - 2) Bakelite is a thermoplastic used for Electrical switches manufacturing
 - 3) Buna- N is a copolymer
 - 4) Both A and C
46. From each pair given below, identify the ion which is larger in size
- Pair-1: $\text{Li}^+, \text{Mg}^{2+}$
- Pair-2: $\text{Cu}^{+2}, \text{Zn}^{+2}$
- Pair-3: Na^+, F^-
- Pair-4: $\text{Ce}^{3+}, \text{Pr}^{3+}$
- 1) $\text{Li}^+, \text{Zn}^{+2}, \text{F}^-, \text{Ce}^{3+}$
 - 2) $\text{Mg}^{2+}, \text{Zn}^{+2}, \text{F}^-, \text{Ce}^{3+}$
 - 3) $\text{Mg}^{2+}, \text{Zn}^{+2}, \text{F}^-, \text{Pr}^{3+}$
 - 4) $\text{Mg}^{2+}, \text{Cu}^{+2}, \text{F}^-, \text{Pr}^{3+}$



47. Identify correct statements:

(a) Hybridisation of Al in $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ is sp^3d

(b) Boron is able to form BF_6^{3-}

(c) $4\text{BF}_3 + 3\text{LiAlH}_4 \rightarrow 2\text{B}_2\text{H}_6 + 3\text{LiF} + 3\text{AlF}_3$

(d) $[\text{SiCl}_6]^{2-}$ is known whereas $[\text{SiF}_6]^{2-}$ not

1) a,b,c,d

2) a,b

3) a, c

4) c only

48. Which of the following statement is incorrect

1) Liquid dinitrogen is used in cryosurgery

2) $\text{Cu} + 4\text{HNO}_3(\text{conc}) \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{NO} + 2\text{H}_2\text{O} + \text{O}_2$

3) $\text{H}_2\text{S}_2\text{O}_8$ contain peroxy bond

4) Acidic strength : $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$

49. Assertion : Helium is used in diving apparatus

Reason : Helium is sparingly less soluble in blood.

1) Both "A" and "R" are correct, "R" is correct explanation of "A"

2) Both "A" and "R" are correct, "R" is not correct explanation of "A"

3) "A" is correct, "R" is incorrect

4) Both "A" and "R" are incorrect

50. In carius method 0.3905 g of an organic compound gave 0.7175 g of silver chloride calculate the percentage of Chlorine in the compound

1) 48.45

2) 54.56

3) 45.45

4) 40

(NUMERICAL VALUE TYPE)

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

51. For 3s orbital of hydrogen atom normalised wave function is

$$\psi_{3s} = \frac{1}{81\sqrt{3\pi}} \left(\frac{1}{a_0} \right)^{3/2} \left(1 - \frac{13r}{36a_0} + \frac{r^2}{36a_0^2} \right) e^{-r/3a_0}$$

if the distance between the radial nodes is xa_0 then the value of x is _____



52. value of K_p for equilibrium reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ at 288 K is 47.9. The K_c for reaction at same temperature is _____. ($R = 0.083 \text{ L bar K}^{-1} \text{ mol}^{-1}$)
53. On dissolving 0.25 g of a non-volatile non-ionic solute to 39 g of benzene, its vapour decreases from 650 mm of Hg to 640 mm Hg. The depression of freezing point of benzene (in K) upon addition of solute is _____
(Molal freezing point depression constant of benzene is $5.12 \text{ K kg mol}^{-1}$)
54. For the reaction $In^{+2} + Cu^{2+} \longrightarrow In^{+3} + Cu^{+}$ of 298 K, the equilibrium constant is 10^x then $x =$ _____

$$\left[E^0_{Cu^{+2}/Cu^{+1}} = 0.15V, E^0_{In^{+3}/In^{+1}} = -0.42V, E^0_{In^{+2}/In^{+1}} = -0.4V \right]$$
55. The decomposition reaction

$$2N_2O_5(g) \xrightarrow{\Delta} 2N_2O_4(g) + O_2(g)$$
 is started in a closed cylinder under isothermal isochoric condition at an initial pressure of 1 atm. After $Y \times 10^2$ sec the pressure inside the cylinder is found to be 1.45 atm. If the rate constant of reaction is $5 \times 10^{-4} \text{ s}^{-1}$, assuming ideal behavior of gases, the value of Y is _____.
56. 3.12 g of O_2 is adsorbed on 1.2 g of platinum metal. The volume of O_2 adsorbed per gram of adsorbent at 1 atm and 300 K in L is _____ ($R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$)
57. $2MnO_4^- + bC_2O_4^{2-} + cH^+ \rightarrow xMn^{2+} + yCO_2 + zH_2O$
 If the above equation is balanced with integer coefficients the value of $(b + c) - (x + y + z) =$ _____
58. Standard entropy of X_2, Y_2 and XY_3 are 40, 20 and $30 \text{ JK}^{-1} \text{ mol}^{-1}$ respectively for reaction

$$\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightarrow XY_3, \Delta H = -10 \text{ KJ}$$
 to be at equilibrium the temperature would be _____ (in K)
59. An ionic solid crystallises in FCC with unit cell of edge length a . The distance between the centres of two nearest octahedral voids in the crystal lattice is $\frac{a}{\sqrt{K}}$ then $K =$ _____
60. A solution is prepared by mixing 0.01 mol of each of $H_2CO_3, NaHCO_3, Na_2CO_3$ and NaOH in 100 ml of water P^H of resulting solution is nearly _____
 $[Pka_1 \text{ and } Pka_2 \text{ of } H_2CO_3 \text{ are } 6.37 \text{ and } 10.31 \text{ respectively. } \log 2 = 0.3010]$

**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. In a certain town 25% families own a cell phone, 15% families own a scooter and 65% families own neither a cell phone nor a scooter. If 1500 families own both a cell phone and a scooter, then the total number of families in the town is
1) 10000 2) 20000 3) 30000 4) 40000
62. If the ordered triple (α, β, γ) is a solution of the system of linear equations $3x - 2y + z + 6 = 0$, $2x + 5y - 3z = 2$, $4x - 9y + 5z + 14 = 0$ then the straight line in the xy -plane which contains the point (α, β) is
1) $31x + 15y = 76$ 2) $209x - 19y + 304 = 0$
3) $79x - 53y + 14 = 0$ 4) $11x - 99y + 56 = 0$
63. If $\vec{a} = 2\vec{i} - x\vec{j} + \vec{k}$ and $\vec{b} = \vec{i} - \vec{j} + 2\vec{k}$, $\forall x \in \mathbb{R}$ and $|\vec{a} \times \vec{b}| = r$ then the value of r cannot be
1) 4 2) $3\sqrt{3}$ 3) $3\sqrt{80}$ 4) 3
64. Two vertical poles of heights 'a'm and 'b'm stand apart on a horizontal plane. The height (in meters) of the point of intersection of the lines joining the top of each pole to the foot of the other from this horizontal plane is
1) $\frac{a+b}{2}$ 2) \sqrt{ab} 3) $\frac{ab}{a+b}$ 4) $\frac{2ab}{a+b}$
65. A right circular cone is inscribed in a sphere of radius $3\sqrt{2}$ units. The radius of the base of the cone so that the volume of the cone is maximum is
1) 3 2) $2\sqrt{3}$ 3) 4 4) $2\sqrt{2}$
66. The point $P(\alpha, \beta)$, $\beta > 0$ is a point of intersection of the curves C_1, C_2 whose equations are $y^2 = 24x$ and $\frac{x^2}{100} + \frac{y^2}{225} = 1$ respectively. The normal to the curve C_1 at the point P passes through the point
1) $(-11, 4)$ 2) $\left(-\frac{7}{3}, \frac{61}{3}\right)$ 3) $\left(-\frac{15}{2}, \frac{1}{2}\right)$ 4) $(2, -3)$



Statement-2 $\sim (p \leftrightarrow \sim q)$ is a tautology.

1)Statement-1 is true, Statement-2 is true;

Statement-2 is not a correct explanation for Statement-1

2) Statement-1 is true, Statement-2 is true;

Statement-2 is correct explanation for Statement-1

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

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

68. The equation of the tangent at the point on the curve $9y^2 = x^3$, where the normal to the curve makes equal intercepts with positive coordinate axes, is

1) $3x + 3y - 4 = 0$

2) $3x + 3y + 5 = 0$

3) $3x - 3y - 4 = 0$

4) $3x - 3y + 10 = 0$

69. The value of the $\int_0^1 \frac{\sqrt{x}}{(1+x)(3+x)} dx$ is

$$1) \frac{\pi}{4} \left[\frac{2}{\sqrt{3}} - 1 \right]$$

$$2) \frac{\pi}{8} \left[1 - \frac{\sqrt{3}}{2} \right]$$

$$\mathbf{3) \frac{\pi}{8} \left[1 - \frac{\sqrt{3}}{8} \right]}$$

$$4) \frac{\pi}{4} \left[1 - \frac{\sqrt{3}}{4} \right]$$

70. The solution of the D.E $\left\{ \frac{1}{x} - \frac{y^2}{(x-y)^2} \right\} dx + \left\{ \frac{x^2}{(x-y)^2} - \frac{1}{y} \right\} dy = 0$ (Where C is the parameter)

$$\mathbf{1) \ln \left| \frac{x}{y} \right| + \frac{xy}{x-y} = c}$$

$$2) \ln|xy| = c + \frac{xy}{x-y}$$

$$\mathbf{3) \ln|xy| = c + \frac{2xy}{x - y}}$$

4) $\frac{xy}{x-y} = ce^{x/y}$

71. The area of the region bounded by the curves $4y = |4 - x^2|$ and $y = 7 - |x|$ in sq.units is

1) 30

2) 31

3) 32

4) 33

72. If $\sum_{i=1}^{20} \sin^{-1} x_i = 10\pi$ then $\frac{\sum_{i=1}^{20} x_i}{10}$ is equal to ($\sin x$ is invertible in principle interval)

1) 3

2) 4

3) 1

4) 2



73. Let $S_1 = x^2 + y^2 - 4x - 8y + 4 = 0$ and its image in the line $y = x$ is S_2 . The radius of the circle touching $y = x$ at $(1, 1)$ and orthogonal to S_2 is $\frac{3}{\sqrt{\lambda}}$ then $\lambda^2 + 2 =$
- 1) 3 2) 5 3) 6 4) 10
74. Define $F(x)$ as the product of two real functions
- $$f_1(x) = x, x \in \mathbb{R}, \text{ and } f_2(x) = \begin{cases} \sin \frac{1}{x}, & \text{if } x \neq 0 \\ 0, & \text{if } x = 0 \end{cases} \quad \text{as follows:}$$
- $$F(x) = \begin{cases} f_1(x) \cdot f_2(x) & \text{if } x \neq 0 \\ 0, & \text{if } x = 0 \end{cases}$$
- Statement -1: $F(x)$ is continuous on \mathbb{R} .
- Statement -2: $f_1(x)$ and $f_2(x)$ are continuous on \mathbb{R} .
- 1) Statement -1 is true, Statement-2 is false
- 2) Statement -1 is false, Statement-2 is true
- 3) Statement-1 is true, Statement-2 is true;
- Statement-2 is correct explanation for Statement-1
- 4) Statement-1 is true, Statement-2 is true;
- Statement-2 is not a correct explanation for Statement-1
75. The absolute value of difference of the solutions of the equation
- $$\sum_{m=1}^6 \operatorname{Cosec} \left[\theta + \frac{(m-1)\pi}{4} \right] \operatorname{Cosec} \left[\theta + \frac{m\pi}{4} \right] = 4\sqrt{2} \text{ where } \theta \in \left[0, \frac{\pi}{2} \right] \text{ is } \underline{\hspace{2cm}}$$
- 1) $\frac{\pi}{2}$ 2) $\frac{\pi}{3}$ 3) $\frac{\pi}{4}$ 4) $\frac{\pi}{6}$
76. The number of times the digit 3 will be written when listing the integers from 1 To 1000 is
- 1) 269 2) 300 3) 271 4) 302
77. If b_1, b_2, b_3 ($b_1 > 0$) are three successive terms of G.P with common ratio r , the value of r for which the inequality $b_3 > 4b_2 - 3b_1$, holds is
- 1) 1.5 2) 2 3) 2.5 4) 3.5



78. The farthest point on the circle $x^2 + y^2 - 2x - 4y - 11 = 0$ from the origin is

- 1) $\left(\frac{4}{\sqrt{5}}, \frac{8}{\sqrt{5}}\right)$ 2) $\left(1 + \frac{4}{\sqrt{5}}, 2 + \frac{8}{\sqrt{5}}\right)$
3) $\left(1 + \frac{4}{\sqrt{5}}, 2 - \frac{8}{\sqrt{5}}\right)$ 4) $\left(1 + \frac{3}{\sqrt{5}}, 2 - \frac{8}{\sqrt{5}}\right)$

79. The value of $\lim_{x \rightarrow 0} \frac{\cos(\sin^2 x) - \cos(x^2)}{x^6}$ is

- 1) 0 2) $1/2$ 3) $1/3$ 4) $3/4$

80. If $f(x) = (2x - 3\pi)^{25} + \frac{4}{3}x + \cos x$ and $g(x)$ is inverse of $f(x)$ Then find $\frac{d}{dx}(g(x))$ at $x = 2\pi$

- 1) $\frac{7}{3}$ 2) $\frac{3}{7}$ 3) $\frac{30^{25} + 4}{3}$ 4) $\frac{-3}{7}$

(NUMERICAL VALUE TYPE)

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

81. A target is to be destroyed in a bombing exercise. There is 75% chance that any one bomb will strike the target. Assume that two direct hits are required to destroy the target completely. The minimum number of bombs that must be dropped in order that the chance of destroying the target is greater than or equal to 99% is

82. The minimum length of intercept on any tangent to the ellipse $\frac{x^2}{4} + \frac{y^2}{9} = 1$ cut by the circle

$$x^2 + y^2 = 25 \text{ is}$$

83. Mean and variance of numbers 12 and 14 is same as the mean and variance of the four numbers 12, 14, α and β ($\alpha > \beta$) then $|\alpha - \beta| = \underline{\hspace{2cm}}$

84. The value of x such that the four points $A(3, 2, 1)$, $B(4, x, 5)$, $C(4, 2, -2)$ and $D(6, 5, -1)$ are coplanar is

85. Two finite sets have m and n elements. If the Total number of subsets of the first set is 56 more than the Total number of subsets of second set, then $m+n$ is $\underline{\hspace{2cm}}$



86. . If $2f\left(x^2\right)+3f\left(\frac{1}{x^2}\right)=x^2-1$ for $x \in \mathbb{R}-\{0\}$. Then $5f\left(\frac{1}{2}\right)$ is equal to _____

87. If $z \in \mathbb{C}-\mathbb{R}$, and $\frac{1+z+z^2}{1-z+z^2} \in \mathbb{R}$ then $|z|$ is _____

88. The number of irrational solutions of the equation $\sqrt{x^2+\sqrt{x^2+11}}+\sqrt{x^2-\sqrt{x^2+11}}=4$ is

89. What is the value of x for which the sixth term of the expansion of

$$\left(3^{\log_3 \sqrt{9^{|x-2|}}} + 7^{\frac{1}{5} \log_3 [4 \times 3^{|x-2|-9}]}\right)^7 \text{ is } 567 \text{ where } (x \neq 1)$$

90. Let $f: [-1, 3] \rightarrow \mathbb{R}$ is designed by $f(x) = \begin{cases} |x| + [x], & -1 \leq x < 1 \\ x + \{x\}, & 1 \leq x < 2 \\ |x-1| + \{x\} & 2 \leq x \leq 3 \end{cases}$

Where $[x]$, $\{x\}$ denotes the integral part and the fractional part of x respectively. If 'a' denotes the number of points of discontinuity and 'b' denotes the number of points of non-differentiability of $f(x)$ then $a+b$ is equal to