

**SAMPLE PAPER-1**

**PAPER-1**

Time : 3 Hours

Maximum Marks : 180

**READ THE INSTRUCTIONS CAREFULLY**

**GENERAL :**

1. This sealed booklet is your Question Paper. Do not break the seal till you are told to do so.
2. Use the Optical Response sheet (ORS) provided separately for answering the questions.
3. Blank spaces are provided within this booklet for rough work.
4. Write your name, form number and sign in the space provided on the back cover of this booklet.
5. After breaking the seal of the booklet, verify that the booklet contains **28** pages and that all the **18** questions in each subject and along with the options are legible. If not, contact the invigilator for replacement of the booklet.
6. You are allowed to take away the Question Paper at the end of the examination.

**OPTICAL RESPONSE SHEET :**

7. The ORS will be collected by the invigilator at the end of the examination.
8. Do not tamper with or mutilate the ORS. **Do not use the ORS for rough work.**
9. Write your name, form number and sign with pen in the space provided for this purpose on the ORS. **Do not write any of these details anywhere else on the ORS.** Darken the appropriate bubble under each digit of your form number.

**DARKENING THE BUBBLES ON THE ORS :**

10. Use a **BLACK BALL POINT PEN** to darken the bubbles on the ORS.
11. Darken the bubble  **COMPLETELY.**
12. The correct way of darkening a bubble is as :
13. The ORS is machine-gradable. Ensure that the bubbles are darkened in the correct way.
14. Darken the bubbles **ONLY IF** you are sure of the answer. There is **NO WAY** to erase or "un-darken" a darkened bubble.
15. Take **g = 10 m/s<sup>2</sup>** unless otherwise stated.

**DO NOT BREAK THE SEALS WITHOUT BEING INSTRUCTED TO DO SO BY THE INVIGILATOR**

## SOME USEFUL CONSTANTS

**Atomic No.** : H = 1, B = 5, C = 6, N = 7, O = 8, F = 9, Al = 13, P = 15, S = 16,  
Cl = 17, Br = 35, Xe = 54, Ce = 58

**Atomic masses** : H = 1, Li = 7, B = 11, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24,  
Al = 27, P = 31, S = 32, Cl = 35.5, Ca = 40, Fe = 56, Br = 80, I = 127,  
Xe = 131, Ba = 137, Ce = 140,

- |                                    |  |
|------------------------------------|--|
| • Boltzmann constant               | $k = 1.38 \times 10^{-23} \text{ JK}^{-1}$                   |
| • Coulomb's law constant           | $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$                   |
| • Universal gravitational constant | $G = 6.67259 \times 10^{-11} \text{ N-m}^2 \text{ kg}^{-2}$  |
| • Speed of light in vacuum         | $c = 3 \times 10^8 \text{ ms}^{-1}$                          |
| • Stefan-Boltzmann constant        | $\sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2}\text{-K}^{-4}$ |
| • Wien's displacement law constant | $b = 2.89 \times 10^{-3} \text{ m-K}$                        |
| • Permeability of vacuum           | $\mu_0 = 4\pi \times 10^{-7} \text{ NA}^{-2}$                |
| • Permittivity of vacuum           | $\epsilon_0 = \frac{1}{\mu_0 c^2}$                           |
| • Planck constant                  | $h = 6.63 \times 10^{-34} \text{ J-s}$                       |

Space for Rough Work

HAVE CONTROL → HAVE PATIENCE → HAVE CONFIDENCE ⇒ 100% SUCCESS

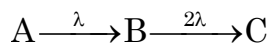
**BEWARE OF NEGATIVE MARKING**

**PART-1 : PHYSICS**

**SECTION-I(i) : (Maximum Marks: 24)**

- This section contains **SIX** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
  - Full Marks* : +4 If only (all) the correct option(s) is (are) chosen.
  - Partial Marks* : +3 If all the four options are correct but **ONLY** three options are chosen.
  - Partial Marks* : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct options.
  - Partial Marks* : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option.
  - Zero Marks* : 0 If none of the options is chosen (i.e. the question is unanswered).
  - Negative Marks* : -2 In all other cases.
- **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.

1. In a radioactive decay reaction :

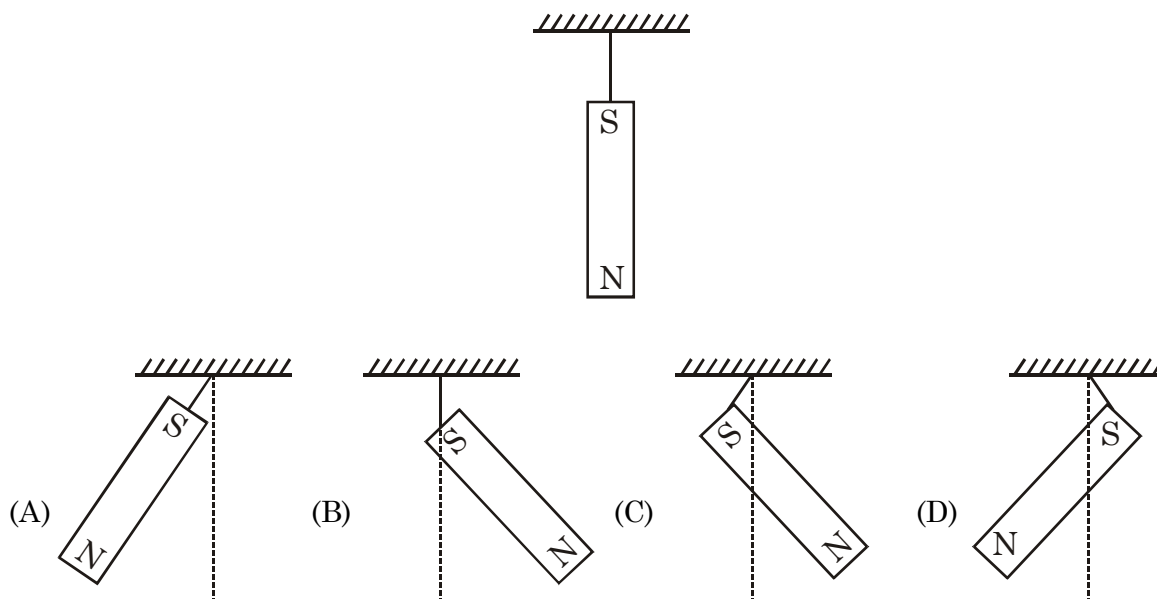


Select correct alternative/s at the instant the number of the particles of B is maximum :

- (A) Activity of A is equal to activity of B.
- (B) No. of atoms of A is 2 times of B.
- (C) Activity of A is more than activity of B.
- (D) Activity of B is maximum.

**Space for Rough Work**

2. The two slits of double slit experiment were moved symmetrically apart with small relative velocity  $v$  and the distance between screen and mid-point of slits is fixed and equal to  $D$ . Consider a point  $P$  on the screen at a distance  $x$  from central maxima then ( $x \ll D$ ):
- (A) Rate of change of number of fringes between central maxima and point  $P$  changes with respect to time is  $\frac{xv}{\lambda D}$ .
- (B) Number of fringes contained between central maxima and point  $P$  increases with time.
- (C) Fringe width decreases as time passes.
- (D) Maximas are moving closer to each other.
3. A simple bar magnet hangs from a string as in figure. A uniform magnetic field  $\vec{B}$  directed horizontally to the right is then established. Which of the pictures in figure does not show the equilibrium orientation of the bar magnet ?



Space for Rough Work

4. A particle constrained to move along x-axis given a velocity  $u$  along the positive x-axis. The acceleration 'a' of the particle varies as  $a = -bx$ , where  $b$  is a positive constant and  $x$  is the x co-ordinate of the position of the particle. Then select the correct alternative(s):
- (A) The maximum displacement of the particle from the starting point is  $\frac{u}{\sqrt{b}}$ .
- (B) The particle will oscillate about the origin.
- (C) Speed is maximum at the origin.
- (D) Angular frequency of oscillation is  $b$ .
5. Lower end of a capillary tube of radius  $10^{-3}\text{m}$  is dipped vertically into a liquid. Surface tension of liquid is  $0.5\text{ N/m}$  and specific gravity of liquid is  $5$ . Contact angle between liquid and material of capillary tube is  $120^\circ$ . Choose the correct options (use  $g = 10\text{ m/s}^2$ )
- (A) Maximum possible depression of liquid column in the capillary tube is  $1\text{ cm}$
- (B) Maximum possible depression of mercury column in the capillary tube is  $2\text{ cm}$
- (C) If the length of the capillary tube dipped inside mercury is half of the maximum possible depression of mercury column in the capillary tube, angle made of the mercury surface at the end of the capillary tube with the vertical, is  $\cos^{-1}\left(-\frac{1}{4}\right)$ .
- (D) If the length of the capillary tube dipped inside mercury is one third of the maximum possible depression of mercury column in the capillary tube, angle made by the mercury surface at the end of the capillary tube with the vertical, is  $\cos^{-1}\left(-\frac{1}{6}\right)$ .

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**Space for Rough Work**

6. A car moves towards a hill with speed  $v_c$ . It blows a horn of frequency  $f$  which is heard by an observer following the car with speed  $v_0$ . The speed of sound in air is  $v$ .

(A) The frequency of sound reaching the hill is  $\left(\frac{v}{v - v_c}\right) f$ .

(B) The wavelength of sound reaching the hill is  $\frac{v - v_c}{f}$ .

(C) The wavelength of sound of horn directly reaching the observer is  $\frac{v + v_c}{f}$ .

(D) The beat frequency observed by the observer is  $\frac{2v_c(v + v_0)f}{v^2 - v_c^2}$ .

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**Space for Rough Work**

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**SECTION-I(ii) : (Maximum Marks : 12)**

- This section contains **TWO** paragraphs.
  - Based on each paragraph, there are **TWO** questions.
  - Each question has **FOUR** options (A), (B), (C) and (D) **ONLY ONE** of these four options is correct.
  - For each question, darken the bubble corresponding to the correct option in the ORS.
  - For each question, marks will be awarded in one of the following categories :  
*Full Marks* : +3 If only the bubble corresponding to the correct answer is darkened.  
*Zero Marks* : 0 If none of the bubbles is darkened.  
*Negative Marks* : -1 In all other cases
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**Paragraph for Questions 7 and 8**

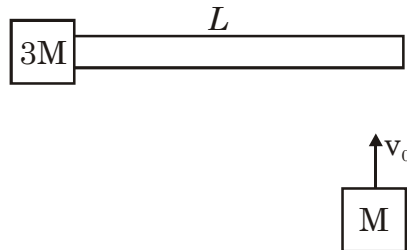
In physics laboratory a student is trying to calculate the focal length of a convex lens. He measures the distance between screen and a light source lined up on the optical bench to be 120 cm. When he shifts the lens along the axis of optical bench, sharp image of source is obtained at two lens positions. He also measures the ratio of these two magnifications to be 1 : 9.

7. The focal length of the convex lens measured by student is  
(A) 22.5 cm                      (B) 30 cm                      (C) 45 cm                      (D) none of these
8. Which image, as seen by student is brighter ?  
(A) smaller    (B) bigger  
(C) both are equally bright                      (D) can not be judged
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**Space for Rough Work**

## Paragraph for Questions 9 and 10

A block of mass  $3M$  connected to a massless rod of length  $L$  lies at rest on a fixed frictionless table. A second block of mass  $M$  impinges on the system with speed  $v_0$  strikes the opposite end of the rod at a right angle and sticks to it.



9. Angular velocity of new system about its COM is

- (A)  $\frac{v_0}{L}$                       (B)  $\frac{v_0}{2L}$                       (C)  $\frac{3v_0}{4L}$                       (D)  $\frac{4v_0}{3L}$

10. Initial velocity of  $3M$  after collision is

- (A)  $\frac{3v_0}{4}$                       (B) zero                      (C)  $\frac{v_0}{2}$                       (D)  $\frac{v_0}{4}$

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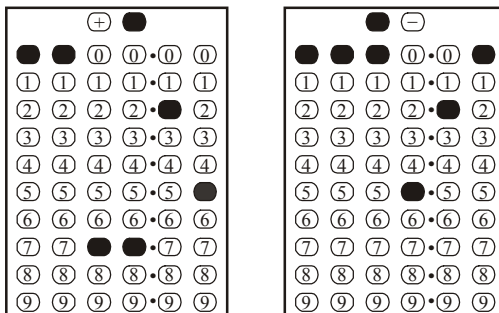
Space for Rough Work



**SECTION-II : (Maximum Marks: 24)**

- This section contains **EIGHT** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darkening the corresponding bubbles in the ORS.

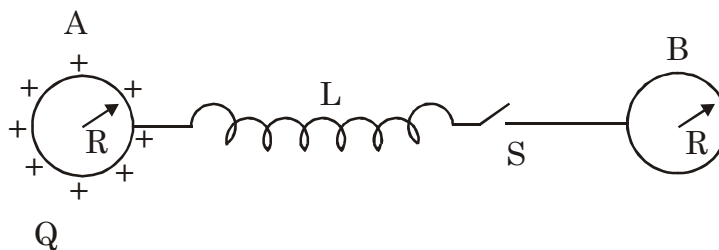
**For Example :** If answer is -77.25, 5.2 then fill the bubbles as follows.



- Answer to each question will be evaluated according to the following marking scheme:  
*Full Marks* : +3 If **ONLY** the correct numerical value is entered as answer.  
*Zero Marks* : 0 In all other cases.

1. A human body excretes certain material by a law similar to radioactivity. The body excretes half the amount injected in 24 h. Find the time in which activity falls to  $3\mu\text{Ci}$  (in hours) if a person is injected technetium ( $t_{1/2} = 6\text{h}$ ) and its activity just after the injection is  $6\mu\text{Ci}$ .
2. Two conducting sphere of radius  $R$  are placed at a large distance from each other. They are connected by a coil of inductance  $L$ , as shown in the figure. Neglect the resistance of the coil. The sphere A is given a charge  $Q$  and the switch 'S' is closed at time  $t = 0$ . Time after charge

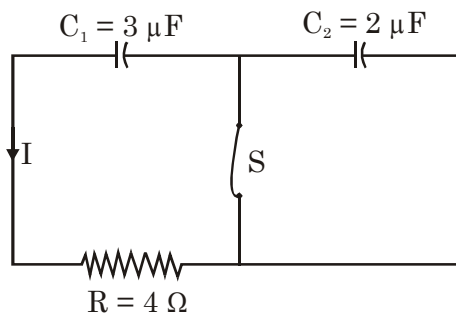
on B is  $\frac{Q}{2}$  is  $\frac{\pi}{a} \sqrt{\frac{LR}{k}}$ . Then value of 'a' is :



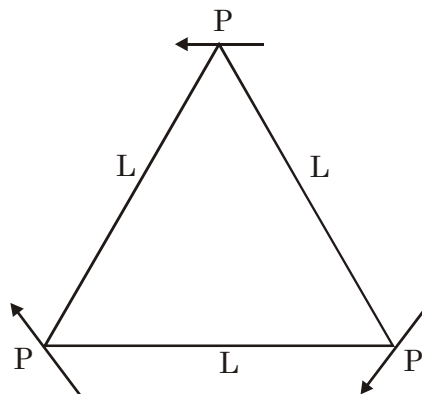
Space for Rough Work

**ALLEN**

3. A charged capacitor ( $C_1 = 3 \mu\text{F}$ ) is getting discharged in the circuit shown. When the current  $I$  was observed to be  $2.5\text{A}$ , switch 'S' was opened. Determine the amount of heat (in  $\mu\text{J}$ ) that will be liberated in the circuit after 'S' is opened.



4. Three short electric dipoles, each of dipole moment  $P$ , are placed at the vertices of an equilateral triangle of side length  $L$ . Each dipole has its moment, oriented parallel to the opposite side of the triangle as shown in the fig. The electric field strength at the centroid of the triangle is  $a \frac{KP}{L^3}$ . Then value of 'a' is :




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Space for Rough Work

5. In a vernier calliper, there are 10 divisions on the vernier scale and 1 cm on main scale is divided in 10 parts. While measuring a length, the zero of the vernier scale lies just ahead of 1.8 cm mark and 4th division of vernier scale coincides with a main scale division. The value of length (in cm) is
6. 1 g ice at  $-40^{\circ}\text{C}$  is placed in a container having 1 g water at  $20^{\circ}\text{C}$ . Find equilibrium temperature (in  $^{\circ}\text{C}$ ).

Water equivalent of container = 3 gm

Latent heat of fusion of ice = 80 cal/gm

Specific heat capacity of water = 1 cal/gm $^{\circ}\text{C}$

Specific heat capacity of ice = 0.5 cal/g $^{\circ}\text{C}$

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**Space for Rough Work**

7. A point-like mass moves horizontally between two walls on a frictionless surfaces with initial kinetic energy  $E$ . With every collision with the walls, the mass loses 50% of its kinetic energy to thermal energy. How many collisions with the walls are necessary before the speed of the mass is reduced by a factor of 8 (means it becomes  $\frac{1}{8}$ th of initial speed)?
8. The velocity of liquid ( $v$ ) in steady flow at a location through cylindrical pipe is given by  $v = v_0 \left(1 - \frac{r^2}{R^2}\right)$ , where  $r$  is the radial distance of that location from the axis of the pipe and  $R$  is the inner radius of pipe. If  $R = 10$  cm, volume rate of flow through the pipe is  $\pi/2 \times 10^{-2} \text{ m}^3 \text{ s}^{-1}$  and the coefficient of viscosity of the liquid is  $0.75 \text{ N sm}^{-2}$ , find the magnitude of the viscous force per unit area, in  $\text{Nm}^{-2}$  at  $r = 4$  cm.

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**Space for Rough Work**

## PART-2 : CHEMISTRY

## SECTION-I(i) : (Maximum Marks: 24)

- This section contains **SIX** questions.
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*Partial Marks* : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct options.  
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- **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.

- 
1. Which of the following statements is/are INCORRECT :
- (A) All spectral lines belonging to Balmer series in hydrogen spectrum lie in visible region.
- (B) If a light of frequency  $\nu$  falls on a metal surface having work function  $h\nu_0$ , photoelectric effect will take place only if  $\nu \leq \nu_0$ .
- (C) The number of photoelectrons ejected from a metal surface in photoelectric effect depends upon the frequency of incident radiations.
- (D) The series limit wavelength of Balmer series of H-atom is  $\frac{4}{R}$ , where R is Rydberg's constant.

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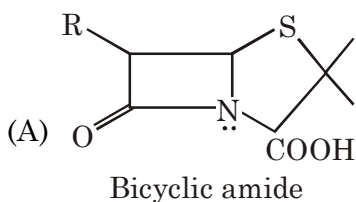
Space for Rough Work

2. Which one of the following statements is/are incorrect ?
- (A) The principal ore of aluminium; bauxite usually contains silica, ironoxide and titanium oxide as impurity
  - (B) Limonite, magnesite and haematite are ores of iron
  - (C) The Anode mud in electrolytic refining of silver contains Cu and Au.
  - (D) During calcinations at high temperatures sulphide ores of some metal like Cu, Pb, Hg are reduced directly into metal.

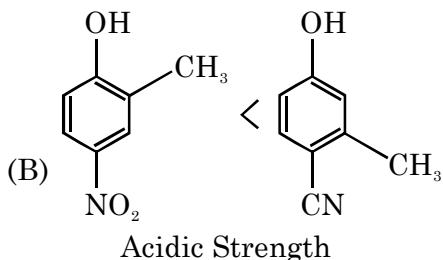
3. Incorrectly matched amongst the following is/are :

**Column-I**

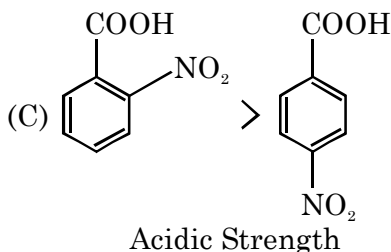
**Column-II**



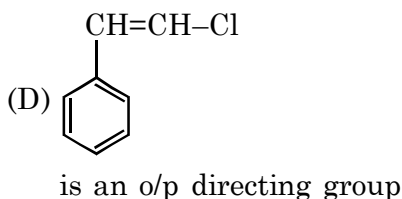
Resonance is restricted due to non-planarity

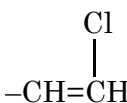


Reason being  $-CN$  is a better  $-M$  group than  $-NO_2$



Reason being  $-M$  effect of  $-NO_2$  group at ortho is more than that at para.

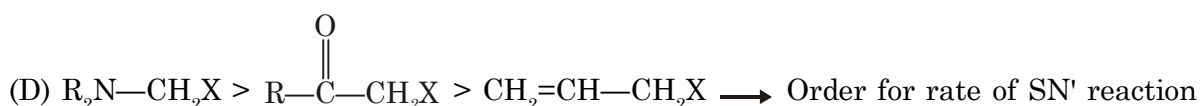
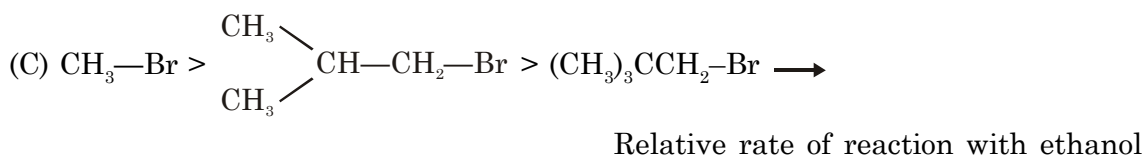
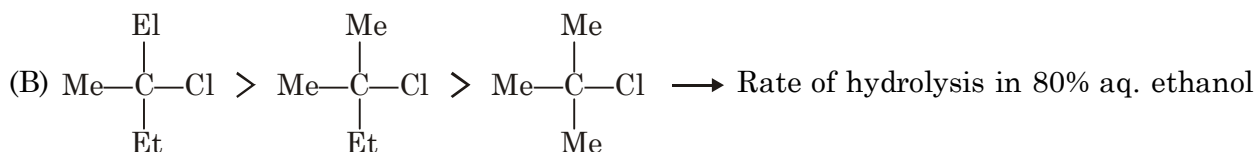
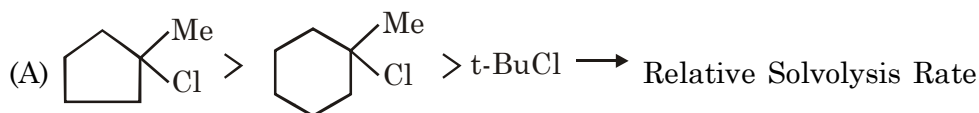


 is an activating group

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Space for Rough Work

4. Which of the following are correct ?
- (A)  $K_{sp}$  of  $\text{Fe}(\text{OH})_3$  in aqueous solution is  $3.8 \times 10^{-38}$  at 298K. The concentration of  $\text{Fe}^{3+}$  will increase when  $[\text{H}^+]$  ion concentration decreases
- (B) In a mixture of  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{OH}$  in water, a further amount of  $\text{NH}_4\text{Cl}$  is added. The pH of the mixture will decrease.
- (C) An aqueous solution of each of the following salts ( $\text{NH}_4\text{I}$ ,  $\text{Cr}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ ,  $\text{KCN}$ ) will be basic, basic, acidic respectively.
- (D) From separate solutions of four sodium salts  $\text{NaW}$ ,  $\text{NaX}$ ,  $\text{NaY}$  and  $\text{NaZ}$  had pH 7.0, 9.0, 10.0 and 11.0 respectively, when each solution was 0.1M, the strongest acid is HW
5. Aqueous solution of boric acid is treated with salicylic acid. Which of the following statements are incorrect for the product formed in above reaction.
- (A) No product will be formed because both are acids.
- (B) Product is 4-coordinated complex and optically resolvable.
- (C) Product is 4-coordinated complex and optically non-resolvable.
- (D) There are two newly formed five membered rings.
6. Correctly matched among the following is/are :



Space for Rough Work

**SECTION-I(ii) : (Maximum Marks : 12)**

- This section contains **TWO** paragraphs.
- Based on each paragraph, there are **TWO** questions.
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- For each question, darken the bubble corresponding to the correct option in the ORS.
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**Paragraph for Questions 7 and 8**

Dependence of rate constant of a reaction is given by Arrhenius equation  $k = A \cdot e^{-\frac{E_a}{RT}}$  but originally it's derived from it's differential equation.

7. Reactions  $A + B \rightarrow C + D$  follows following rate law :  $\text{rate} = k [A]^{+1/2}[B]^{1/2}$ . Starting with initial conc. of one mole of A and B each, what is the time taken for amount of A of become 0.25 mole. Given  $k = 2.31 \times 10^{-3} \text{ sec}^{-1}$ .
- (A) 300 sec.                      (B) 600 sec.                      (C) 900 sec.                      (D) None of these
8. For a reaction, the dependence of rate constant ( $\text{sec}^{-1}$ ) on temperature (K) is given as

$$\ln K = 10 - \frac{2500}{T} + 3 \ln T$$

The activation energy of reaction is

- (A)  $2500 + 3T$                       (B)  $2500 R$                       (C)  $(2500 + 3T)R$                       (D)  $(2500 - 3 \ln T)R$

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**Space for Rough Work**



**Paragraph for Questions 9 and 10**

There are 4 glass bottles containing water solutions. These bottles are not labelled. Bottles 1, 2 and 3 contained colourless solutions, while Bottle 4 contained a coloured solution. Each Bottle is having any solution among the following (Each bottle is having different solution) :

Copper (II) sulphate

Sodium carbonates

Lead nitrate

Hydrochloric acid

By mixing samples of the contents of the bottles in pairs, following observations are made.

- |                         |                        |
|-------------------------|------------------------|
| (1) Bottle 1 + Bottle 2 | White ppt.             |
| (2) Bottle 1 + Bottle 3 | White ppt.             |
| (3) Bottle 1 + Bottle 4 | White ppt.             |
| (4) Bottle 2 + Bottle 3 | Colourless gas evolved |
| (5) Bottle 2 + Bottle 4 | No visible reaction    |
| (6) Bottle 3 + Bottle 4 | Blue ppt.              |
9. Aqueous solution in bottle 4 is reacted with excess of KI and then  $\text{Na}_2\text{S}_2\text{O}_3$  solution is added to it. Which of the following statement is incorrect.
- (A) Evolved  $\text{I}_2$  is reduced  
(B)  $\text{S}_2\text{O}_3^{2-}$  is converted into  $\text{SO}_4^{2-}$  in the above reaction  
(C) aqueous solution in bottle 4 is  $\text{CuSO}_4$   
(D)  $\text{Na}_2\text{S}_2\text{O}_3$  is oxidised
10. Chemical formula of white ppt. formed in observation (3) is :
- (A)  $\text{PbCl}_2$                       (B)  $\text{PbCO}_3$                       (C)  $\text{CuCO}_3$                       (D)  $\text{PbSO}_4$

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**Space for Rough Work**

SECTION-II : (Maximum Marks: 24)

- This section contains **EIGHT** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darkening the corresponding bubbles in the ORS.

**For Example :** If answer is -77.25, 5.2 then fill the bubbles as follows.

+	●				
●	●	0	0	0	0
1	1	1	1	1	1
2	2	2	2	●	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	●
6	6	6	6	6	6
7	7	●	●	7	7
8	8	8	8	8	8
9	9	9	9	9	9

●	-				
●	●	●	0	0	●
1	1	1	1	1	1
2	2	2	2	●	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	●	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9

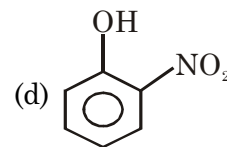
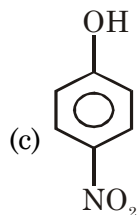
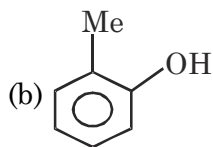
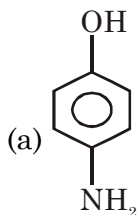
- Answer to each question will be evaluated according to the following marking scheme:  
*Full Marks* : +3 If **ONLY** the correct numerical value is entered as answer.  
*Zero Marks* : 0 In all other cases.

- 'X'  $\xrightarrow{\text{HONO}}$  N<sub>2</sub> + H<sub>2</sub>O + 'Y' (Rubbing alcohol used in Hand Sanitizer). Find out mass % of Nitrogen in compound 'X'.
- How many compounds or ions can be oxidised by H<sub>2</sub>O<sub>2</sub> among the following :  
 (1) AsO<sub>3</sub><sup>-3</sup>                      (2) SO<sub>4</sub><sup>-2</sup>                      (3) Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>                      (4) NH<sub>2</sub>-NH<sub>2</sub>  
 (5) H<sub>2</sub>S                      (6) PbS                      (7) O<sub>3</sub>                      (8) SO<sub>3</sub><sup>2-</sup>  
 (9) Cl<sub>2</sub>
- For the couple at 25°C Ag<sub>(s)</sub> | AgCl<sub>(s)</sub> | Cl<sub>(aq)</sub><sup>-</sup> || Ag<sub>(aq)</sub><sup>+</sup> | Ag<sub>(s)</sub> where k<sub>sp</sub>(AgCl) = 10<sup>-10</sup>,  $\frac{2.303RT}{F} = 0.06$ ,  $\sqrt{0.41} = 0.64$ .

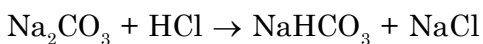
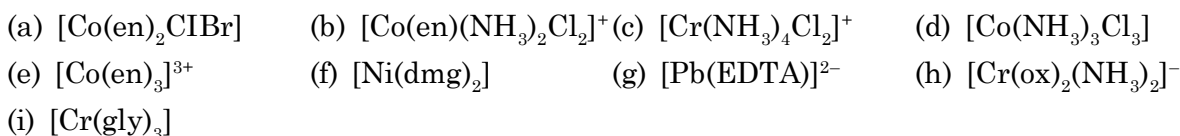
If initially in a 10 litre container, 1 mole KCl and 2 mole AgNO<sub>3</sub> are taken along with sufficient amount of Ag and AgCl in it then find the moles of AgCl changed after long time.

Space for Rough Work

4. Find out the sum of position of electrophile only in the major product obtained on aromatic Electrophilic substitution reaction. (Considering Locant w.r.t. the OH group)



5. How many of the following compound can be optically active ?



10 ml solution of 0.1 M NaOH and 0.1 M  $\text{Na}_2\text{CO}_3$  is taken and 0.1M HCl is added drop by drop.

$\text{pK}_{a[\text{phenolphthalein}]} = 9.6$

For  $\text{H}_2\text{CO}_3$   $\text{p}k_{a_1} = 7$ ,  $\text{p}k_{a_2} = 11$

pH of the solution when 25% of the color remains = x

Volume of HCl used in ml. for 25% color remaining = y

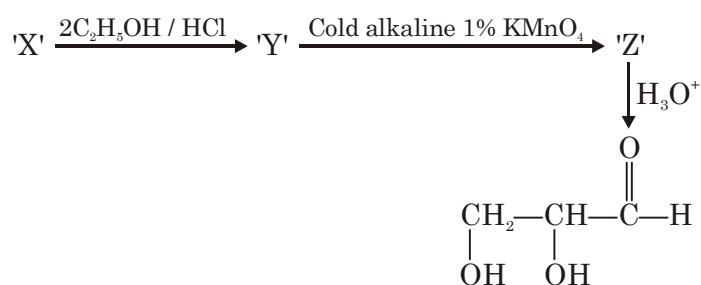
No. of unpaired electrons in colored form = z

of indicator. Find  $x + y + z$ . Given :  $10^{1.88} = 75.85$ ,  $\log 3 = 0.48$

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**Space for Rough Work**

7. How many of the following is/are correct for Penicillin.
- (a) It gives Black ppt with lead Acetate. [Lassainge Test]
  - (b) It gives effervescence of  $\text{CO}_2$  with  $\text{NaHCO}_3$
  - (c) Presence of Lactum in its structure.
  - (d) It gives Red colour in Victor Mayer Test.
  - (e) It forms pungent smelling compound with  $\text{CHCl}_3 + \text{NaOH}$
  - (f) It do not give violet colour with neutral  $\text{FeCl}_3$
  - (g) It give +ve Mustard oil test.
  - (h) It give Prussian blue colour in Lassainge Test
  - (i) 1 mol of Penicillin releases 1 mol of  $\text{H}_2(\text{g})$  on treatment with Na.
8. In the given reaction. Find out the molecular mass of 'X'.



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Space for Rough Work

## PART-3 : MATHEMATICS

## SECTION-I(i) : (Maximum Marks: 24)

- This section contains **SIX** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
  - Full Marks* : +4 If only (all) the correct option(s) is (are) chosen.
  - Partial Marks* : +3 If all the four options are correct but **ONLY** three options are chosen.
  - Partial Marks* : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct options.
  - Partial Marks* : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option.
  - Zero Marks* : 0 If none of the options is chosen (i.e. the question is unanswered).
  - Negative Marks* : -2 In all other cases.
- **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -2 marks.

1. Consider the following system of linear equations in  $x$ ,  $y$  and  $z$  :
- $$\begin{cases} px + qy + rz = 0 \\ qx + ry + pz = 0 \\ rx + py + qz = 0 \end{cases} ; p, q, r \in \mathbb{R}$$

If this system has non-trivial solution, then the system of equations may represent :

- (A) planes meeting only at a single point      (B) the line  $x = y = z$   
 (C) identical planes      (D) whole 3d space
2. If a complex number  $z$  satisfies the condition  $\left| \log_{\frac{1}{\sqrt{3}}} \frac{|z|^2 - |z| + 1}{2 + |z|} \right| < 2$ , then locus of  $z$  may represent
- (A) A circle having centre at origin and radius 1.  
 (B) A ring between circles of radii 1 & 5 with centre at origin.  
 (C) Interior of a circle having radius  $\frac{1}{3}$  with centre as origin.  
 (D) Exterior of a circle having radius 5.

**Space for Rough Work**

3. Let the function  $f : \mathbb{R} \rightarrow \mathbb{R}$  be defined by  $f(x) = x^3 - x^2 + (x - 1) \sin x$  and let  $g : \mathbb{R} \rightarrow \mathbb{R}$  be an arbitrary function. Let  $fg : \mathbb{R} \rightarrow \mathbb{R}$  be the product function defined by  $(fg)(x) = f(x)g(x)$ . Then which of the following statements is/are TRUE ?
- (A) If  $g$  is continuous at  $x = 1$ , then  $fg$  is differentiable at  $x = 1$
- (B) If  $fg$  is differentiable at  $x = 1$ , then  $g$  is continuous at  $x = 1$
- (C) If  $g$  is differentiable at  $x = 1$ , then  $fg$  is differentiable at  $x = 1$
- (D) If  $fg$  is differentiable at  $x = 1$ , then  $g$  is differentiable at  $x = 1$
4. In a triangle ABC, points D and E are taken on side BC such that  $BD = DE = EC$ . If  $\angle ADE = \angle AED = \theta$ , then :
- (A)  $\tan \theta = 3 \tan B$  (B)  $3 \tan \theta = \tan C$
- (C)  $\frac{6 \tan \theta}{\tan^2 \theta - 9} = \tan A$  (D)  $\angle B = \angle C$

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**Space for Rough Work**

5. Let  $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ , then

(A)  $A^3 - 3A^2 - 9A - 5I_3 = 0$

(B)  $A^{-1} = \frac{1}{5}(A^2 - 3A - 9I)$

(C)  $A^2$  is not invertible

(D)  $A^2$  is invertible

6. Which of the following is/are true ?

(A)  $\int_a^{\pi-a} x f(\sin x) dx = \frac{\pi}{2} \int_a^{\pi-a} f(\sin x) dx$

(B)  $\int_{-a}^a f^2(x) dx = 2 \int_0^a f^2(x) dx$

(C)  $\int_0^{n\pi} f(\cos^2 x) dx = n \int_0^{\pi} f(\cos^2 x) dx, n \in \mathbb{N}$

(D)  $\int_0^{b-c} f(x+c) dx = \int_c^b f(x) dx$

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Space for Rough Work

## SECTION-I(ii) : (Maximum Marks : 12)

- This section contains **TWO** paragraphs.
- Based on each paragraph, there are **TWO** questions.
- Each question has **FOUR** options (A), (B), (C) and (D) **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :  
*Full Marks* : +3 If only the bubble corresponding to the correct answer is darkened.  
*Zero Marks* : 0 If none of the bubbles is darkened.  
*Negative Marks* : -1 In all other cases

## Paragraph for Questions 7 and 8

Consider  $f(x) = x^3(x - 2)^2(x - 1)$

On the basis of above information, answer the following questions :

7. If maxima of  $f(x)$  occurs at  $x_i$  then  $\sum x_i^2$  is equal to-
- (A)  $\frac{9}{4}$                       (B)  $\frac{25}{4}$                       (C)  $\frac{40}{9}$                       (D)  $\frac{4}{9}$
8. Least value of  $f(x)$  is-
- (A)  $\frac{1}{9}$                       (B)  $\frac{4}{27}$                       (C)  $-\frac{128}{729}$                       (D) 0

## Paragraph for Questions 9 and 10

Let  $f : \mathbb{R} \rightarrow \mathbb{R}$  be a function defined as,

$$f(x) = \begin{cases} 1 - |x|, & |x| \leq 1 \\ 0, & |x| > 1 \end{cases} \text{ and } g(x) = f(x - 1) + f(x + 1), \forall x \in \mathbb{R}. \text{ Then}$$

9. The function  $g(x)$  is continuous for,  $x \in$
- (A)  $\mathbb{R} - \{0, 1, 2, 3, 4\}$
- (B)  $\mathbb{R} - \{-2, -1, 0, 1, 2\}$
- (C)  $\mathbb{R}$
- (D) None of these

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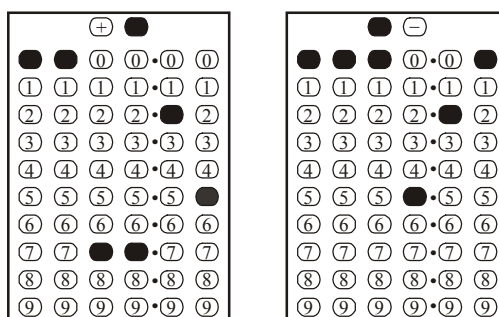
10. The function  $g(x)$  is differentiable for,  $x \in$

- (A)  $\mathbb{R}$
- (B)  $\mathbb{R} - \{-2, -1, 0, 1, 2\}$
- (C)  $\mathbb{R} - \{0, 1, 2, 3, 4\}$
- (D) None of these

**SECTION-II : (Maximum Marks: 24)**

- This section contains **EIGHT** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darken the corresponding bubbles in the ORS.

**For Example :** If answer is -77.25, 5.2 then fill the bubbles as follows.



- Answer to each question will be evaluated according to the following marking scheme:  
*Full Marks* : +3 If **ONLY** the correct numerical value is entered as answer.  
*Zero Marks* : 0 In all other cases.

1. If  $V$  be the volume of a tetrahedron and  $V'$  be the volume of the tetrahedron formed by joining the centroids of faces of given tetrahedron. If  $V = kV'$  then the value of  $k$  is
2. If  $(\alpha, \beta)$  is a point on the circle whose centre is on the  $x$ -axis and which touches the line  $x + y = 0$  at  $(2, -2)$ , then the greatest possible value of ' $\alpha$ ' is
3. Let  $m$  be the minimum possible value of  $\log_3(3^{y_1} + 3^{y_2} + 3^{y_3})$ , where  $y_1, y_2, y_3$  are real numbers for which  $y_1 + y_2 + y_3 = 9$ . Let  $M$  be the maximum possible value of  $(\log_3 x_1 + \log_3 x_2 + \log_3 x_3)$ , where  $x_1, x_2, x_3$  are positive real numbers for which  $x_1 + x_2 + x_3 = 9$ . Then the value of  $\log_2(m^3) + \log_3(M^2)$  is \_\_\_\_\_.

**Space for Rough Work**

4. Let  $W_1$  and  $W_2$  be the sets of words which can be formed using all the letters of the words “SHREYASH” and “SANIDHYA” respectively. A set is chosen and a word is selected from it randomly and found that it contains two alike letters together. If the probability that it was selected from the set  $W_1$  is  $\left(\frac{p}{q}\right)$ ,  $p, q \in \mathbb{N}$ , then the least possible value of  $(q - p)$  is
5. If  $\vec{a}_1 = a\hat{i} + b\hat{j}$ ,  $\vec{a}_2 = \vec{a}_1 - (2\hat{i} + \sqrt{5}\hat{j})$  and  $\vec{a}_3 = \vec{a}_1 + (2\hat{i} - \sqrt{5}\hat{j})$ , then
- $$\begin{vmatrix} 1 + \vec{a}_1 \cdot \vec{a}_1 & 1 + \vec{a}_1 \cdot \vec{a}_2 & 1 + \vec{a}_1 \cdot \vec{a}_3 \\ 1 + \vec{a}_2 \cdot \vec{a}_1 & 1 + \vec{a}_2 \cdot \vec{a}_2 & 1 + \vec{a}_2 \cdot \vec{a}_3 \\ 1 + \vec{a}_3 \cdot \vec{a}_1 & 1 + \vec{a}_3 \cdot \vec{a}_2 & 1 + \vec{a}_3 \cdot \vec{a}_3 \end{vmatrix}$$
- is equal to
6. Let A, B and P be three non-singular matrices of order 2 satisfying  $AB - BP = 2I$  (where I is identity matrix) and  $\det(P) = 3$ ,  $\text{Tr}(P) = 4$  and  $B = \text{adj}(B)$ , where  $\det(P)$  represents determinant value of matrix P and  $\text{Tr}(P) = \text{Trace of matrix P}$ . If  $\det(A) = 15$  and  $\text{Tr}(B) < 0$ , then the value of  $3|\text{Tr}(B)|$  is
7. Let  $a_1, a_2, a_3, \dots, a_n$  be real numbers in A.P. such that  $a_1 = 15$  and  $a_2$  is an integer. Given  $\sum_{r=1}^{10} (a_r)^2 = 1185$ . If  $S_n = \sum_{r=1}^n a_r$ , then the maximum value of ‘n’ for which  $S(n) \geq S(n - 1)$  is
8. The ten's digit of coefficient of  $x^{18}$  in  $S^2$ , where  $S = (1 + 3x + 5x^2 + \dots + 21x^{10})$ , will be

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Space for Rough Work

**QUESTION PAPER FORMAT AND MARKING SCHEME :**

- 16. The question paper has three parts : Physics, Chemistry and Mathematics.
- 17. Each part has two sections as detailed in the following table.

Section	Que. Type	No. of Que.	Category-wise Marks for Each Question				Maximum Marks of the section
			Full Marks	Partial Marks	Zero Marks	Negative Marks	
I(i)	One or more correct option(s)	6	+4 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened	+1 For darkening a bubble corresponding to each correct option, provided NO incorrect option darkened	0 If none of the bubbles is darkened	-2 In all other cases	24
I(ii)	Paragraph Based (Single correct option)	4	+3 If only the bubble corresponding to the correct option is darkened	—	0 If none of the bubbles is darkened	-1 In all other cases	12
II	Numerical Value Type (Up to second decimal place)	8	+3 If only the bubble corresponding to correct answer is darkened	—	0 In all other cases	—	24

NAME OF THE CANDIDATE .....	
FORM NO. ....	
I have read all the instructions and shall abide by them.   <hr style="width: 80%; margin: 0 auto;"/> Signature of the Candidate	I have verified the identity, name and Form number of the candidate, and that question paper and ORS codes are the same.   <hr style="width: 80%; margin: 0 auto;"/> Signature of the Invigilator