# COMBINED ADMISSION ENTRANCE TEST (CAET) 2025
## SESSION - 1
### IIT DELHI ABU DHABI

CAET-1A-001

**Maximum Marks: 240**

**Duration: 3 hours**

## Instructions to Candidates

### A. General

1. This booklet is your Question Paper (QP). Do not break the seals of this booklet before being instructed to do so by the invigilators.
2. Read the instructions printed on the front and back cover pages of this booklet, and fill your name, signature and roll number on the back cover page of the booklet.
3. The QP code is printed on the right hand top corner of this page and on the back cover page of this booklet.
4. Blank papers, clipboards, log tables, slide rules, programmable calculators, cameras, cellular phones, pagers, smart watches / wearables and other electronic gadgets are NOT allowed inside the examination hall.
5. You would be allowed to break the seals of the QP by the Invigilator at the starting time of the examination. Once the seal is opened, the you should check that it has 20 pages, and all the 60 questions and corresponding answer choices are legible. You should also read carefully the instructions printed at the beginning of each section.
6. Blank spaces and blank pages are provided in QP booklet for rough work.
7. There are three subject parts in this QP booklet, on Physics, Chemistry and Mathematics. You need to score minimum marks in each subject part in order to qualify for admission.
8. You would be provided with a machine-gradable Optical Mark Recognition (OMR) sheet with the same paper code as the QP booklet, 10 minutes before the starting time of the examination.
9. You should answer the questions given in the QP booklet by darkening the appropriate bubbles against respective question numbers on the left part of OMR sheet, using a black ink ball point pen. Only the answers bubbled in the OMR sheet will be evaluated.
10. Do not tamper with the QP booklet, OMR sheet or the bar code on the OMR sheet.
11. The Test Admit Card should be presented to the Invigilator for verification. Your will be verified against details on the Test Admit Card/ Roll List and the original ID proof. The invigilator would sign on the QP booklet and OMR sheet after verification. No extra time will be allowed for these formalities to be completed.
12. Any alteration in Name or Roll number on the OMR sheet made after the Invigilator's signature/ endorsement will render the OMR sheet invalid and will lead to cancellation of candidature. If any such correction is necessary, please inform the invigilator.
13. You would not be allowed to leave the examination centre before the end time of the examination. Short bio-breaks, however, would be allowed. No compensatory time would be allowed against such breaks.
14. You should remain seated after the end of the examination. You would be allowed to leave the examination hall only after the Invigilators collect all OMR sheets and verify the total number.
15. After the examination, you are allowed to take the QP booklet and Test Admit Card with you.

### B. Filling the back cover page of QP booklet and Right Part of the OMR sheet

16. As soon as the QP booklet is given to you, please write your name and roll number on the back cover page of the booklet without opening the seal, and sign in the space provided. Note the Paper Code printed on the QP booklet.
17. As soon as the OMR sheet is given to you, please check that the same Paper Code is printed on the OMR sheet as on the QP booklet. If it is not, then ask for a change of the OMR sheet with the same code as the QP booklet. Sign at the place provided on the OMR sheet and darken the paper code with black ink ball point pen in the boxes provided (section R4) affirming that you have verified that all the codes are same.
18. Write your Name (section R1), Roll Number (R2) and the Code of examination centre (R3) (as printed on your Test Admit Card), on the right part of the OMR sheet. Darken the appropriate bubble under each letter/digit of your Roll number. Do not write any of this information anywhere else.

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**Subject Part – 1:  Physics**
**SECTION 1 (32 Marks)**

- This section contains **EIGHT (8)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, darken the bubble on the OMR sheet corresponding to the correct answer.
- Answer to each question will be evaluated <u>according to the following marking scheme</u>:

  *Full Marks*       : $+4$   If **ONLY** the correct option is chosen;
  *Zero Marks*      :   0   If none of the options is chosen (i.e., the question is unanswered).
  *Negative Marks* : $-1$   In all other cases

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Q.1    *Water is heated at* $1$ *atm pressure from* $0°\,C$ *to* $20°\,C$*. The plot which best describes the qualitative variation of density of water with the temperature is*
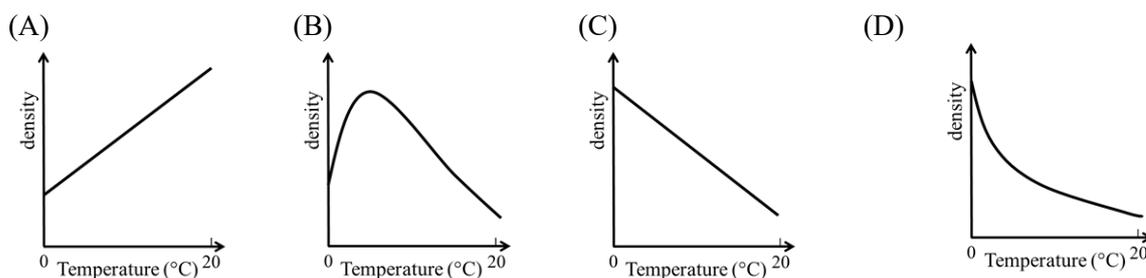


Q.2    *The quantity that has the same SI units as the Boltzmann constant is*

(A) kinetic energy.                           (B) heat capacity.
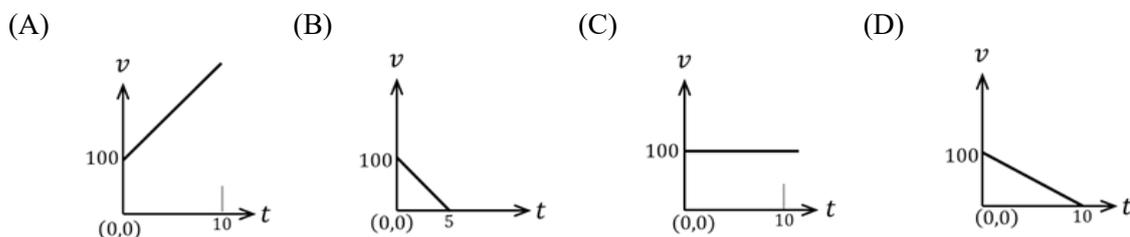(C) universal gas constant.              (D) thermal conductivity.

Q.3    *In a Hydrogen atom,* $T$*,* $U$ *and* $E$ *denote the kinetic energy, the potential energy, and the total energy of the electron, respectively. The correct statement is*

(A) $T < 0, U > 0, E < 0$
(B) $T < 0, U > 0, E > 0$
(C) $T > 0, U < 0, E < 0$
(D) $T > 0, U < 0, E > 0$

Q.4    *A vertical U-tube of uniform narrow cross-section contains a liquid, as shown below. The ends of the U-tube are open to the atmosphere. The separation between the vertical limbs of the U-tube is L. The U-tube is accelerated horizontally with a constant acceleration a, which is not equal to the acceleration due to gravity, g. The height difference h of the liquid in the two limbs is*
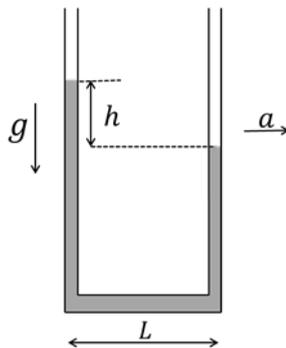


(A) $L$                (B) $\frac{aL}{g}$                (C) $\frac{gL}{a}$                (D) $0$

Q.5    *A pin of length $4\ cm$ is kept upright in front of a thin biconvex lens at a distance $2f$ from the lens, where $f$ is the focal length of the lens. The image is formed behind the lens at a distance*

(A) $2f$ and is inverted with a length of $4\ cm$.

(B) $2f$ and is erect with a length of $4\ cm$.

(C) $\frac{3f}{2}$ and is inverted with a length of $\frac{8}{3}\ cm$.

(D) $\frac{4f}{3}$ and is erect with a length of $3\ cm$.

Q.6    *A nuclear process is given as $^{22}_{11}Na \rightarrow\ ^{22}_{10}Ne\ + e^{+} + X$. The particle X is*

(A) $\nu$                (B) $\gamma$                (C) $\bar{\nu}$                (D) $^{1}_{0}n$

Q.7    *Consider a parallel plate capacitor with charge $\pm Q$ on the plates. Now a dielectric material with dielectric constant $K = 2$ is filled between the plates of the capacitor. The correct statement is*

(A) the electric field between the plates is doubled.
(B) the potential difference between the plates is doubled.
(C) the capacitance is doubled.
(D) the energy stored in the capacitor is doubled.

Q.8    *A point particle of mass m moves with speed $v = 100 - 10\ t$, where t is the time. The correct speed versus time plot is*

**Subject Part – 1:  Physics**
**SECTION 2 (24 Marks)**

- This section contains **SIX (6)** questions.
- The answer to each question is a **SINGLE DIGIT NON-NEGATIVE INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the correct digit on your **OMR sheet**. **Do not** write the answer on the question paper.
- Answer to each question will be evaluated <u>according to the following marking scheme</u>:
  *Full Marks*      :  $+4$   If **ONLY** the correct digit is darkened;
  *Zero Marks*     :    0   In all other cases.

Q.9    *Water flows into a conical tank at a constant flow rate, as shown below. Initially, the tank is empty. The bottom of the tank is at $y = 0$. The water level measured from the bottom of the tank at time $t$ is at $y = h(t)$. The water level varies as $h \propto t^{\frac{1}{\alpha}}$. The value of $\alpha$ is _____.*
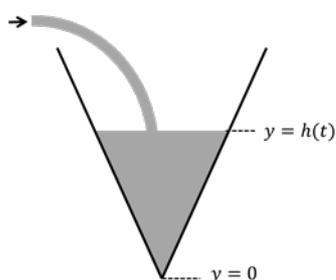


Q.10   *A stretched string is attached to a rigid support at one end.  A wave travelling on the string is reflected back from the rigid support. The reflected wave suffers a phase change of $p\pi$. The value of $p$ is _____.*

Q.11   *A thin metal rod P is placed in an inertial frame S, parallel to +z-axis. The length of this rod is measured to be $5\ m$ by a stationary observer in S. Another inertial frame S′ is moving away from S along the $+x$ axis with a speed of $1.8 \times 10^8\ m\ sec^{-1}$, as shown below. The length of the rod measured by a stationary observer in S′, in $meters$, is _____.*
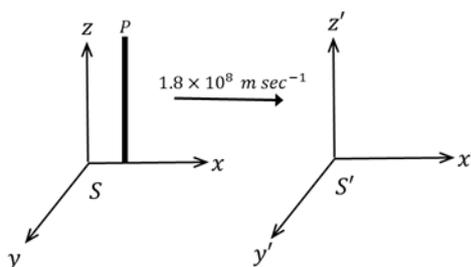
Q.12    *An air-conditioner, based on the Carnot cycle operating in reverse, is used to maintain the room temperature at $300\ K$. The temperature of the ambient surroundings is $320\ K$. If the air-conditioner rejects heat at a rate of $3.2\ kW$ to the surroundings, the rate of heat extracted by the air-conditioner from the room, in $kW$, is _____ .*

Q.13    *A charged particle is moving with a speed of $3.14 \times 10^7\ m\ sec^{-1}$, perpendicular to a uniform magnetic field of $8.8 \times 10^{-3}\ Tesla$. The time taken by the charged particle for one complete revolution is $n \times 10^{-9} sec$. The value of $n$ is _____ (rounded off to the nearest integer).*
    *[Take the mass of the particle as $9 \times 10^{-31}\ kg$, charge of particle as $1.6 \times 10^{-19}\ C$, and $\pi$ as 3.14]*

Q.14    *Two rigid bodies P and Q have heat capacities $C_0$ and $2C_0$, respectively. Initially, bodies P and Q have temperatures $4T_0$ and $T_0$, respectively. These two bodies are now brought in thermal contact without any heat loss to the surroundings. The new equilibrium temperature of the bodies is $nT_0$. The value of $n$ is _____.*

**Subject Part – 1:  Physics**
**SECTION 3 (24 Marks)**

- This section contains **THREE (3)** paragraphs.
- Based on each paragraph, there are **TWO (2)** questions.
- The questions are of multiple-choice type, based on the given paragraph.
- If the answer is numerical, the final answer is obtainable by truncation/round-off of the value to TWO decimal places.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
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  *Full Marks*     : $+4$  If **ONLY** the correct option is chosen;
  *Zero Marks*    :   $0$  If none of the options is chosen (i.e., the question is unanswered).
  *Negative Marks* : $-1$  In all other cases

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*PARAGRAPH I*

*A particle of mass $0.2\ kg$ is taken from point P to Q via three different paths I, II, and III, as shown below. Point P is on the surface of the Earth and point Q is vertically $20\ m$ above point P.*



Q.15   *If $W_1, W_2$ and $W_3$ denote the work done to take the particle from P to Q along the path I, II, and III, respectively, the correct statement is*
[*Neglect air resistance. Take acceleration due to gravity $g$ as $10\ m\ sec^{-2}$*]

(A) $W_1 > W_2 = W_3$                    (B) $W_3 > W_1 = W_2$
(C) $W_2 > W_3 > W_1$                    (D) $W_2 = W_3 = W_1$

Q.16    *Once the particle reaches the point Q, it is allowed to fall freely under gravity. The particle hits point P and comes to a rest. The impulse on the particle, in $kg\ m\ sec^{-1}$, is*
[*Neglect air resistance. Take acceleration due to gravity $g$ as $10\ m\ sec^{-2}$*]

(A) 5                    (B) 7                    (C)  4                    (D)  2

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**PARAGRAPH II**

*In a Young's double slit experiment, as shown below, fringes are observed on the screen at a distance D from the slit. Maximum intensity is observed at the central maximum P and the next maximum R while the first minimum intensity is observed at Q (with PQ=QR). The wavelength used is $\lambda_0$.*



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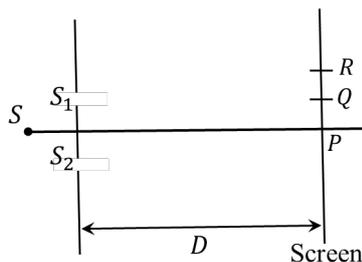
Q.17 *For the first minimum to be observed at R, the wavelength should be*

(A) $\frac{\lambda_0}{2}$        (B) $2\lambda_0$        (C) $\frac{3\lambda_0}{2}$        (D) $\frac{\lambda_0}{4}$

Q.18 *The separation between the slits is changed such that the first minimum is observed at R for wavelength $\lambda_0$. The new separation between slits would be $d = f\, d_0$, where $d_0$ is the original slit separation. The value of $f$ is*

(A) $\frac{1}{2}$        (B) 2        (C) 4        (D) $\frac{1}{4}$

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**PARAGRAPH III**

*Two infinitely long wires $W_1$ and $W_2$ are kept at a distance of $2\ m$ from each other, as shown below. Wires $W_1$ and $W_2$ carry antiparallel currents of $4\ A$ and $8\ A$, respectively. Points P and R are located at a distance of $1\ m$ each from the wires $W_1$ and $W_2$, respectively, as shown in the figure. The middle point Q is equidistant from both the wires.*
*[Take the permeability of the free space as $\mu_0$]*



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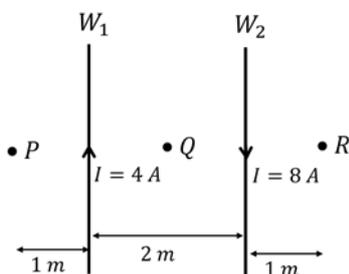
Q.19 *The magnitude of the total magnetic field at point Q is*

(A) $\frac{2\mu_0}{\pi}$        (B) $\frac{\mu_0}{2\pi}$        (C) 0        (D) $\frac{6\mu_0}{\pi}$

Q.20 *The correct relation between the magnitudes of total magnetic field at points P and R is*

(A) $B_P = B_R$        (B) $B_P = \frac{B_R}{3}$        (C) $B_P = \frac{B_R}{5}$        (D) $B_P = \frac{B_R}{7}$

# END OF SUBJECT PART - PHYSICS

**Subject Part – 2:  Chemistry**
**SECTION 1 (32 Marks)**

- This section contains **EIGHT (8)** questions.
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Q.21    *The INCORRECT statement amongst the following is:*

(A) Density is an intensive property and internal energy is an extensive property.
(B) Volume is an extensive property and temperature is an intensive property.
(C) Heat capacity is an intensive property and enthalpy is an extensive property.
(D) Mass is an extensive property and pressure is an intensive property.

Q.22    *The work function of Na is 2.3 eV. Upon shining 124 nm light, the kinetic energy of the ejected electrons is $\left[ Use\ E\ (\text{in eV}) = \frac{1240}{\lambda\ (\text{in nm})} \right]$*

(A) 2.3 eV              (B) 3.2 eV              (C) 7.7 eV              (D) 0.0 eV

Q.23    *Law of definite proportions states*

(A) a given compound always contains  exactly the same proportion of element by weight.
(B) two elements always combine in the same proportion.
(C) there is no net change in mass during a chemical process.
(D) equal volumes of gaseous compounds contain equal number of molecules at a given temperature and pressure.

Q.24    *Chocolate brown precipitate is formed by mixing aqueous solutions containing*

(A) $Cu^{2+}$ and $SO_4^{2-}$
(B) $Ag^+$ and $SO_4^{2-}$
(C) $Ni^{2+}$ and $CN^-$
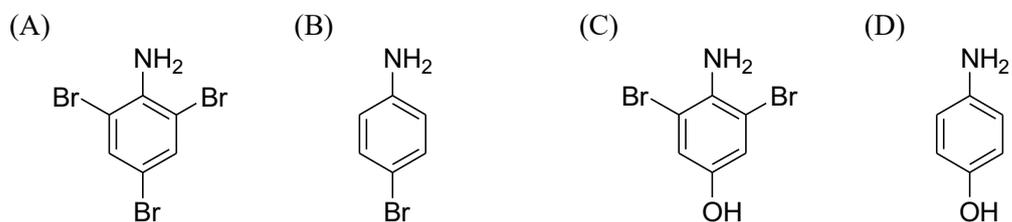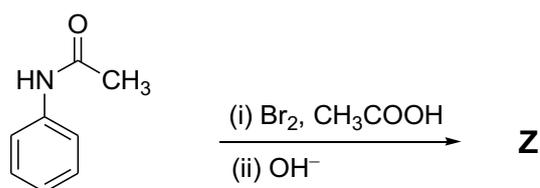(D) $Cu^{2+}$ and $[Fe(CN)_6]^{4-}$

Q.25    *The pair of molecules/ions having the same geometry is*

(A) $SF_4$ and $CCl_4$
(B) $PCl_5$ and $BrF_5$
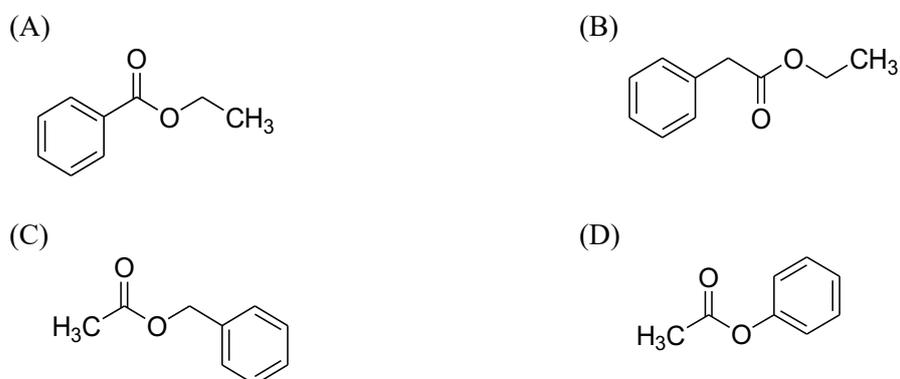(C) $NH_3$ and $BF_3$
(D) $CBr_4$ and $NH_4^+$

Q.26    *The compound which reacts most rapidly by an S$_N$2 mechanism is*

(A)



(B)



(C)



(D)
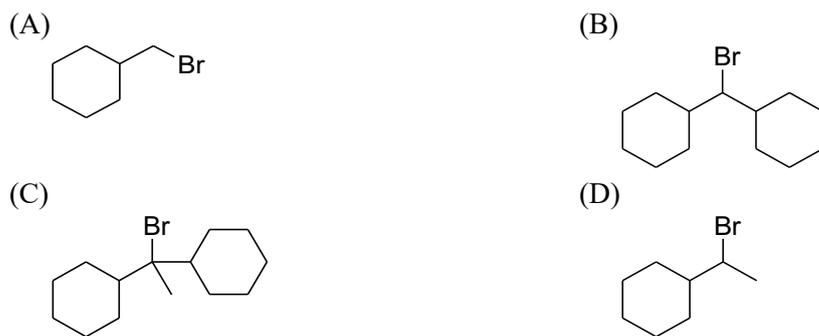


Q.27    *The major product **Z**, formed in the given transformation is*



$$\xrightarrow[\text{(ii) OH}^-]{\text{(i) Br}_2, \text{ CH}_3\text{COOH}} \textbf{Z}$$

(A)



(B)



(C)



(D)



Q.28    *The correct structure of benzylethanoate is*

(A)



(B)



(C)



(D)

**Subject Part – 2: Chemistry**
**SECTION 2 (24 Marks)**

- This section contains **SIX (6)** questions.
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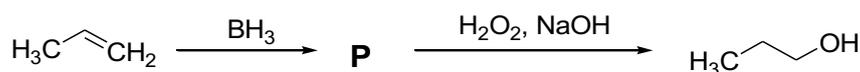  *Full Marks*   : $+4$  If **ONLY** the correct digit is darkened;
  *Zero Marks*   :   0  In all other cases.

Q.29   *In the following reaction, an organic product **M** is formed. The number of C–H bonds in **M** is _____.*



$$\text{C}_6\text{H}_5\text{CH}_3 \xrightarrow[\text{(ii) H}_3\text{O}^+]{\text{(i) CrO}_2\text{Cl}_2,\ \text{CS}_2} \textbf{M}$$
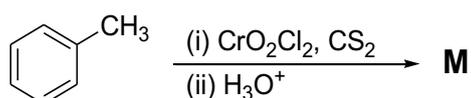
Q.30   *$KMnO_4$ is a secondary standard. To determine its exact concentration, $(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$ can be used as a reagent. Under acidic conditions to reduce 1 mole $KMnO_4$, the number of moles of $(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$ required is _____.*

Q.31   *For the given transformation, where propene is taken in excess, 3 moles of borane yield **n** moles of propan-1-ol. The value of **n** is _____.*



$$\text{H}_3\text{C-CH=CH}_2 \xrightarrow{\text{BH}_3} \textbf{P} \xrightarrow{\text{H}_2\text{O}_2,\ \text{NaOH}} \text{H}_3\text{C-CH}_2\text{CH}_2\text{-OH}$$

Q.32   *Ne is kept at 800 K while $O_2$ is stored at 320 K. Considering the gases to be ideal, the ratio of average speeds of Ne:$O_2$ molecules is _____. [Molar mass (in g mol$^{-1}$): Ne = 20, $O_2$ = 32]*

Q.33   *The sum of the number of neutrons present in $^{8}_{4}Be$ and $^{10}_{5}B$ is _____.*

Q.34   *For a second order reaction where concentration is expressed in $mol\ L^{-1}$ and time in seconds, the value of $'p'$ in the units of the rate constant $mol^{-p} \cdot L \cdot s^{-p}$ is _____.*

## Subject Part – 2:  Chemistry
## SECTION 3 (24 Marks)

- This section contains **THREE (3)** paragraphs.
- Based on each paragraph, there are **TWO (2)** questions.
- The questions are of multiple-choice type, based on the given paragraph.
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### *PARAGRAPH IV*

*Polymers are macromolecules formed by joining repeating structural units on a large scale. Polymers can be classified on the basis of polymerization. The addition polymers are formed by polymerization of single monomer, whereas condensation polymers are formed by repeated condensation reaction between two different bi-functional or tri-functional monomeric units.*

Q.35   *Buna-S is formed by the polymerization of*

(A) $CH_2=CH_2$                                                   (B) $NH_2(CH_2)_6NH_2 + HOOC(CH_2)_6COOH$
(C) $CH_2=CH-CH=CH_2 + C_6H_5CH=CH_2$      (D) $CH_2=C(Cl)-CH=CH_2$

Q.36   *Nylon 6,6 is synthesized by*

(A) Free-radical polymerization                        (B) Ziegler-Natta polymerization
(C) Anionic polymerization                                (D) Condensation polymerization

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### *PARAGRAPH V*

*The rate constants of a reaction carried out at 300 K and 450 K are 0.1 $s^{-1}$ and 0.35 $s^{-1}$, respectively.*

Q.37   *The value for the activation energy is closest to* [*Use $R = 8.314\,JK^{-1}mol^{-1}$*]

(A) 4071 J mol$^{-1}$        (B) 9374 J mol$^{-1}$        (C)  11 J mol$^{-1}$        (D)  1875 J mol$^{-1}$

Q.38   *The order of the reaction is*

(A) 0                    (B) 1                    (C)  2                    (D)  3

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### *PARAGRAPH VI*

*Acidified aqueous permanganate solution reacts with oxalate to give $CO_2$.*

Q.39   *In this reaction, the reductant is*

(A) permanganate        (B) $CO_2$                (C)  oxalate            (D)  $H^+$

Q.40   *In this reaction, the number of moles of $CO_2$ produced by one mole of permanganate is*

(A) 1                    (B) 5                    (C)  6                    (D)  10

## END OF SUBJECT PART - CHEMISTRY

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**Subject Part – 3: Mathematics**
**SECTION 1 (32 Marks)**

- This section contains **EIGHT (8)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, darken the bubble on the OMR sheet corresponding to the correct answer.
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  *Full Marks*       : $+4$  If **ONLY** the correct option is chosen;
  *Zero Marks*      :    $0$   If none of the options is chosen (i.e., the question is unanswered).
  *Negative Marks* : $-1$  In all other cases

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Q.41    *Suppose $a_1, a_2, a_3, \ldots,$ are nonzero real numbers in an arithmetic progression, and $i = \sqrt{-1}$*

$$P = \begin{pmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_7 & a_8 & a_9 \end{pmatrix} \text{ and } Q = \begin{pmatrix} a_2 & ia_1 \\ ia_1 & a_2 \end{pmatrix}.$$

*Which one of the following statements is TRUE?*

(A) *$P$ is singular*
(B) *The homogeneous linear system $PX = 0$ has only trivial solution*
(C) *$Q$ is singular, but $P$ is nonsingular*
(D) *$P$ and $Q$ are nonsingular*

Q.42    *In a coffee shop, café latte costs 2 dollars each and cappuccino costs 1.5 dollars each. The total amount of money earned from these sale equals 150 dollars. How many cappuccino were sold if 30 café latte were sold?*

(A) 40                  (B) 30                  (C)  50                  (D)  60

Q.43    *The value of the integral*

$$\int_1^e x \left(\log_e x\right)^2 dx$$

*is equal to*

(A) $\frac{e^2-2}{2}$              (B) $\frac{e^2-4}{4}$              (C) $\frac{e^2-1}{2}$              (D) $\frac{e^2-1}{4}$

Q.44    *If the line $\frac{x}{3m} + \frac{y}{4n} = 1,$ where $m \neq 1, n \neq 1,$ touches the ellipse $\frac{x^2}{9} + \frac{y^2}{16} = 1,$ then which one of the following statements is TRUE?*

(A) $n^2 = \frac{m^2}{m^2-1}$          (B) $n^2 = \frac{m^2}{m-1}$          (C) $n^2 = \frac{m^2+1}{m-1}$          (D) $n^2 = \frac{m^2+1}{m^2-1}$

Q.45 *Consider the function*
$$f(x) = \tan^{-1}(2x^3 - 15x^2 + 36x)$$

*where* $\tan^{-1} x$ *is the principle value branch of the inverse function of* $\tan x$. *Then* $f$ *is decreasing in the interval*

(A) $(3, 4)$     (B) $(-\infty, 2)$     (C) $(2, 3)$     (D) $(4, \infty)$

Q.46 *If an unbiased coin is tossed five times, then the probability of getting* 1, 3 *or* 5 *heads is*

(A) $\frac{1}{3}$     (B) $\frac{1}{4}$     (C) $\frac{1}{2}$     (D) $\frac{1}{5}$

Q.47 *Suppose* $P$ *is an orthogonal matrix, (that is,* $P^T = P^{-1}$*),* $S^5 = I$, $Q = PSP^T$ *and* $R = P^T Q^{2025} P$, *where* $I$ *denotes the identity matrix. Then* $R^{2025}$ *is equal to*

(A) $2R$     (B) $I$     (C) $2025 R$     (D) $5I$

Q.48 *For the functions*
$$f(x) = x^{\frac{2}{3}} \ and \ g(x) = x^{\frac{4}{3}}$$

*consider the following statements.*
I)     $f$ *is differentiable at* $x = 0$.
II)     $g$ *is differentiable at* $x = 0$.
*Then which one of the following statements is TRUE?*

(A) $I$) only     (B) $II$) only     (C) Both $I$) and $II$)     (D) Neither $I$) nor $II$)

**Subject Part – 3: Mathematics**
**SECTION 2 (24 Marks)**

- This section contains **SIX (6)** questions.
- The answer to each question is a **SINGLE DIGIT NON-NEGATIVE INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the correct digit on your **OMR sheet**. **Do not** write the answer on the question paper.
- Answer to each question will be evaluated <u>according to the following marking scheme</u>:
  *Full Marks* : $+4$ If **ONLY** the correct digit is darkened;
  *Zero Marks* : 0 In all other cases.

Q.49 *The radius of the circle that passes through $(0,0)$, $(8,0)$ and $(0,6)$ is equal to _____*

Q.50 *For real numbers $a, b$, if the limit*
$$\lim_{x \to 0} \frac{2x - \log_e(1 + ax)}{x^2} = b$$
*then the value of $a + b$ is equal to _____*

Q.51 *The value of the integral*
$$\frac{8}{\pi} \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{\sin^2 x}{1 + e^x} \, dx$$
*is equal to _____*

Q.52 *A survey is taken after the candidates have written an admission test to find whether the test was easy (E) or difficult (D). Assume that, there is equal probability for the response from each candidate to be E or D. Then, the minimum number of candidates required to participate in the survey so that the probability of getting at least one E is at least 0.9 is equal to _____*

Q.53 *If $x\hat{\imath} - 6\hat{\jmath} + z\hat{k}$ is perpendicular to both $\hat{\imath} - \hat{\jmath} + \hat{k}$ and $\hat{\imath} - 2\hat{k}$, then $xz$ is equal to _____*

Q.54 *X and Y are car renting agencies. The number of cars in X and Y together is 6 times the difference of the number of cars in X and Y. If you multiply the number of cars of X and the number of cars of Y, the outcome is larger than 40 but less than 300. Then the difference of the number of cars of X and the number of cars of Y is _____*

**Subject Part – 3: Mathematics**
**SECTION 3 (24 Marks)**

- This section contains **THREE (3)** paragraphs.
- Based on each paragraph, there are **TWO (2)** questions.
- The questions are of multiple-choice type, based on the given paragraph.
- If the answer is numerical, the final answer is obtainable by truncation/round-off of the value to TWO decimal places.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, darken the bubble on the OMR sheet corresponding to the correct answer.
- Answer to each question will be evaluated <u>according to the following marking scheme</u>:

  *Full Marks* : $+4$ If **ONLY** the correct option is chosen;
  *Zero Marks* : $0$ If none of the options is chosen (i.e., the question is unanswered).
  *Negative Marks* : $-1$ In all other cases

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*PARAGRAPH VII*

$Let\ f(x) = \begin{cases} 2x + 1, & if\ x \leq 1 \\ 4x - 1, & if\ x > 1. \end{cases}$

$Define\ g(x) = \int_0^x f(t)dt\ for\ x > 0.$

---

Q.55 *The value of the derivative of g at $x = 1$ is equal to*

(A) 1          (B) 2          (C) 3          (D) 4

Q.56 *Which one of the following statements is TRUE?*

(A) $\frac{g(x)}{x}$ is decreasing on $(0, \infty)$
(B) $\frac{g(x)}{x}$ is increasing on $(0, \infty)$
(C) $\frac{g(x)}{x}$ is increasing on $(0, 1)$ but decreasing on $(1, \infty)$
(D) $\frac{g(x)}{x}$ is decreasing on $(0, 1)$ but increasing on $(1, \infty)$

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*PARAGRAPH VIII*

*Let E and F be events such that $P(E) = \frac{1}{4}$, $P(F) = \frac{1}{2}$ and $P(E \cap F) = \frac{1}{8}$*

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Q.57 *The value of the probability of happening of E or F but not both, is*

(A) $\frac{1}{8}$          (B) $\frac{5}{8}$          (C) $\frac{1}{4}$          (D) $\frac{1}{2}$

Q.58 *The value of $P(not\ E\ and\ not\ F)$ is*

(A) $\frac{3}{8}$          (B) $\frac{5}{8}$          (C) $\frac{1}{8}$          (D) $\frac{7}{8}$

*PARAGRAPH IX*

Let

$$P = \begin{pmatrix} 2 & 0 & 0 \\ 4 & 2 & 0 \\ 6 & 4 & 2 \end{pmatrix}$$

*If* $Q_1, Q_2, Q_3$ *are column matrices such that*

$$PQ_1 = \begin{pmatrix} 2 \\ 0 \\ 0 \end{pmatrix}, \qquad PQ_2 = \begin{pmatrix} 4 \\ 6 \\ 0 \end{pmatrix}, \qquad PQ_3 = \begin{pmatrix} 4 \\ 6 \\ 2 \end{pmatrix}$$

*and* $Q$ *is the* $3 \times 3$ *matrix with* $Q_i$ *as its* $i^{th}$ *column for* $i = 1, 2, 3.$

Q.59    *The trace of* $P^{-1}$ *is*

(A) $\frac{-1}{6}$ 　　　　　 (B) $\frac{-3}{2}$ 　　　　　 (C) $\frac{1}{6}$ 　　　　　 (D) $\frac{3}{2}$

Q.60    *The value of the determinant of Q is*

(A) 1 　　　　　 (B) 2 　　　　　 (C) 3 　　　　　 (D) 4

# END OF THE QUESTION PAPER

Rough work:

Rough Work

Rough Work

Rough Work

Rough Work

Rough Work

# Instructions to Candidates

## C. Question Paper Format and Marking Scheme

19. The question paper consists of 3 subject parts (Physics, Chemistry and Mathematics). It is compulsory to attempt all three subject parts. Each subject part consists of three sections.
    a. Section I contains 8 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct.
    b. Section II contains 6 questions. The answer to each question is a Single Digit Integer, ranging from 0 to 9 (both inclusive).
    c. Section III contains 6 multiple choice questions, based on 3 paragraphs. There are 2 questions based on each paragraph. If the answer is numerical, the final answer is obtainable by truncation/ round-off of the value to TWO decimal places. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct.

    You should answer the questions by darkening the appropriate bubbles against respective question numbers on the left part of OMR sheet, using a black ink ball point pen. Only the answers bubbled in the OMR sheet will be evaluated.

20. Marking Scheme:
    a. Maximum marks for each subject part is 80, and Maximum total marks is 240.
    b. For each question in Section I, you will be awarded 4 marks if you darken the bubble corresponding to the correct answer only; zero marks if no bubbles are darkened. In all other cases, minus one (–1) mark will be awarded in this section.
    c. For each question In Section II, you will be awarded 4 marks if you darken the bubble corresponding to the correct answer only. In all other cases zero (0) marks will be awarded. No negative marks will be awarded for incorrect answers in this section.
    d. For each question in Section III, you will be awarded 4 marks if you darken the bubble corresponding to the correct answer only; zero marks if no bubbles are darkened. In all other cases, minus one (–1) mark will be awarded in this section.