VMC Vidyamandir Classes SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

CODE A

JEE Advanced Home Practice Test -4 | Paper -2 | JEE 2024

Date: 30/04/2024 **Maximum Marks: 180**

Duration : 3.0 Hours

General Instructions

1. The question paper consists of 3 Subject (Subject I: **Physics**, Subject II: **Chemistry**, Subject III: **Mathematics**).
   Each Part has **Four** sections (Section 1, Section 2, Section 3 and Section 4).

2. **Section 1** contains **6 Multiple Correct Answers Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONE OR MORE THAN ONE CHOICE** is correct.

3. **Section 2** contains **3 Question stems**. There are **TWO (02)** questions corresponding to each question stem. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

4. **Section 3** contains **2 Paragraph Type Questions**. Based on each paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.

5. **Section 4** contains **3 Non-Negative Integer Type Questions.** The answer to each question is a **NON-NEGATIVE INTEGER.**

6. For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** properly in the space given in the ANSWER SHEET.

Name of the Candidate (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

Candidate's Signature : _____ **Invigilator's Signature** _____

MARKING SCHEME

SECTION – 1 | (Maximum Marks: 24)

- This section consists of **Six (06)** Questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- 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 and both of which are correct
Partial Marks:	+1 If two or more options are correct but ONLY one option is chosen, and it is a correct option
Zero Mark:	0 if none of the options is chosen (i.e. the question is unanswered)
Negative Marks:	–2 In all other cases.

SECTION – 2 | (Maximum Marks: 12)

- This **Section** contains **3 Question stems**. There are **TWO (02)** questions corresponding to each question stem. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks:	+2 If ONLY the correct numerical value is entered at the designated place.
Zero Mark:	0 In all other cases.

SECTION – 3 | (Maximum Marks: 12)

- This **Section** contains **2 Paragraph Type Questions**. Based on each paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks:	+3 If ONLY the correct option is chosen.
Zero Mark:	0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks:	–1 In all other cases.

SECTION – 4 | (Maximum Marks: 12)

- This **Section** contains **3 Non-Negative Integer Type Questions.** The answer to each question is a **NON-NEGATIVE INTEGER**
- For each question, choose the option corresponding to the correct answer.

  Answer to each question will be evaluated according to the following marking scheme.

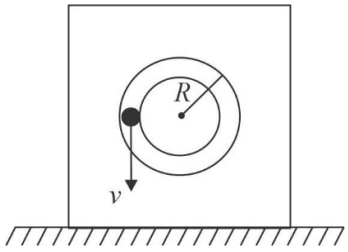
Full Marks	: +4 If ONLY the correct integer is entered.
Zero Marks	: 0 In all other cases.

SUBJECT I : PHYSICS 60 MARKS

Section – 1 | Multiple Correct Type

This Section contains **6 Multiple Correct Answer Type Questions.** Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

1. A cube of mass m and side length $4R$ has a groove made inside it in a vertical plane. The groove is a circle having radius R. A particle of mass m is moving down with a velocity $v=\sqrt{2gR}$ at the instant shown. Assume all surfaces are smooth. The correct statement(s) at this instant is(are):



(A) Normal reaction on particle is mg

(B) Normal reaction on cube by the ground is mg

(C) Acceleration of cube is g

(D) Acceleration of particle with respect to ground is $g\sqrt{2}$

2. A source of sound emits waves of frequency $f_0=1200\ Hz$. The source is travelling at a speed of $v_1=30\ m/s$ towards east. There is a large reflecting surface in front of the source which is travelling at a velocity of $v_2=60$ m/s towards west. Speed of sound in air is $v=330\ m/s$. Which of the following statement(s) is(are) correct?

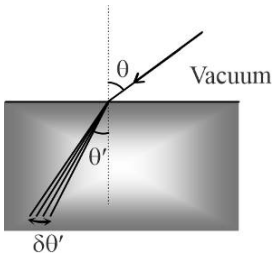
(A) 1560 number of wave pulses are arriving per second at the reflecting surface.

(B) 1360 number of wave pulses are arriving per second at the reflecting surface.

(C) The ratio of wavelength (λ_1) of sound in front of the source travelling towards the reflecting surface to the wavelength (λ_2) of sound in front of the source approaching it after getting reflected is $\frac{11}{9}$.

(D) The ratio of wavelength (λ_1) of sound in front of the source travelling towards the reflecting surface to the wavelength (λ_2) of sound in front of the source approaching it after getting reflected is $\frac{13}{9}$.

3. A beam of light has a small wavelength spread $\delta\lambda$ above a central wavelength λ. The beam travels in vacuum until it enters a glass plate at an angle θ relative to the normal to the plate as shown in the figure. The index of refraction of the glass is given by $n(\lambda)$. The angular spread $\delta\theta'$ of the refracted beam is given by:



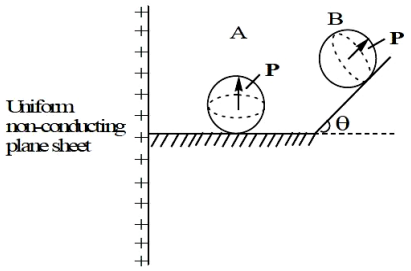
(A) $\delta\theta'=\left|\frac{d\mu(\lambda)}{d\lambda}\delta\lambda\right|$

(B) $\delta\theta'=\left|\frac{\tan\theta'}{n(\lambda)}\frac{dn(\lambda)}{d\lambda}\delta\lambda\right|$

(C) $\delta\theta'=\left|\frac{\sin\theta}{\sin\theta'}\frac{\delta\lambda}{\lambda}\right|$

(D) $\delta\theta'$ remains constant for different values of θ in the range $\frac{\pi}{6}\le\theta\le\frac{\theta}{3}$

4. Two identical solid spheres A and B of mass m and radius r each have short light identical dipoles embedded at their respective centers. B is in equilibrium on an incline of inclination θ as shown such that its dipole moment is parallel to the incline. Sphere A is released, in the position shown, on a rough horizontal surface. Both A and B are located in electric field of a uniform infinite sheet of surface charge density σ. If friction between A and horizontal surface is sufficient to prevent slipping, choose the correct statement(s) regarding the motion of A. (neglect mutual interaction between A and B)



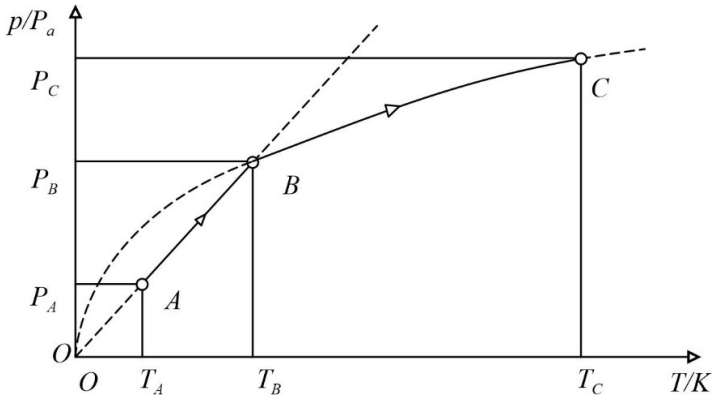
(A) Its acceleration is $\frac{5g}{7}$, just after its release.

(B) Friction acting on it is $\frac{2mg}{7}$, just after its release.

(C) Its angular speed at the instant, when it has rotated by $\frac{\pi}{2}$ is $\sqrt{\frac{10P\sigma}{7mr^2 \in_0}}$.

(D) Friction acting on it, when the dipole becomes parallel to horizontal surface is zero.

5. One mole of an ideal mono-atomic gas undergoes two quasi-static processes $A \to B$ and $B \to C$ in sequence. If in the first process, the pressure p is proportional to temperature T and in the second process, the pressure p is proportional to $\sqrt{T}$. Which of the following statement(s) is(are) correct?



(A) Heat supplied in AB is $\frac{R(T_B - T_A)}{2}$.

(B) Total heat supplied to the gas is $\frac{R(4T_c - T_B - 3T_A)}{2}$

(C) Work done by gas in BC is $\frac{R}{2}(T_C - T_B)$

(D) Temperature at $C, T_C = \frac{T_A^2}{T_B}\frac{P_C^2}{P_A^2}$

6. A current i flows along a thin wire shaped as a regular polygon with n sides which can be inscribed into a circle of radius R. Which of the following statement(s) is(are) correct?

(A) Magnetic induction at center is $\frac{\mu_0 ni}{2\pi R}\tan\left(\frac{\pi}{n}\right)$

(B) Magnetic induction at center is $\frac{\mu_0 ni}{2R}\tan\left(\frac{\pi}{n}\right)$

(C) If $n \to \infty$, magnetic induction at center is $\frac{\mu_0 i}{2R}$

(D) If $n \to \infty$, magnetic induction at center is $\frac{\mu_0 i}{2\pi R}$

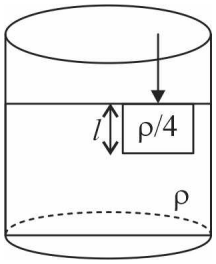
Section – 2 | Numerical Value Type

This **Section** contains **3 Question stems**. There are **TWO (02)** questions corresponding to each question stem. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

Question Stem: For Question Number 7 to 8

Question Stem

A large tank of cross-section area A contains liquid of density ρ. A cylinder of density $\rho/4$ and length l, and cross-section area $a\left(a << A\right)$ is kept in equilibrium by applying an external vertically downward force as shown. The cylinder is just submerged in liquid. At $t = 0$ the external force is removed instantaneously. Assume that water level in the tank remains constant.



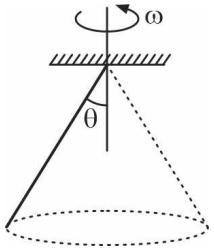
7. The acceleration of cylinder immediately after the external force is removed is ng. Find n

8. The speed of the cylinder when it reaches its equilibrium position is $k\sqrt{gl}$. Find k.

Question Stem: For Question Number 9 to 10

Question Stem

A rod of mass m and length L is rotating about a fixed point in the ceiling with an angular velocity ω as shown in figure. The rod maintains a constant angle θ with the vertical.



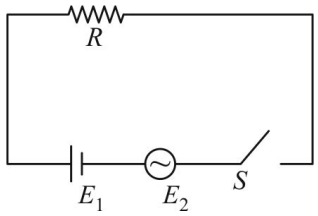
9. The horizontal component of angular momentum of the rod about the point of suspension $(m\omega L^2 \sin 2\theta)/n$, value of n is _____.

10. Rate of change of angular momentum of the rod is $\frac{m\omega^k L^2}{6}\sin 2\theta$, where k is _____.

Question Stem: For Question number 11 to 12

Question Stem

In the circuit shown in the figure $R = 50\Omega$, $E_1 = 25\sqrt{3}$ volt and $E_2 = 25\sqrt{6}\sin(\omega t)$ volt where $\omega = 100\ \pi s^{-1}$. The switch is closed at $t = 0$ and remains closed for 14 minutes, then it is opened:



11. The amount of heat produced in the resistor is_____ *kJ*.

12. If total amount of heat produced is used to heat 3 kg of water at 20°C, the final temperature will be _____°*C*. {specific heat of water = 4200 J/kg °C}

Section – 3 | Single Correct Type

This Section contains **2 Paragraph Type Questions**. Based on each paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer

Paragraph: For Question number. 13 to 14

An infinitesimally small bar magnet of dipole moment M is pointing and moving with the speed v in the X-direction. A small closed circular conducting loop of radius a is placed in the $Y-Z$ plane with its centre at $x = 0$, and its axis coinciding with the X-axis. If the resistance of the loop is R. Assume that the distance x of the magnet from the centre of the loop is much greater than a.

13. Induced e.m.f. in circular loop when magnet is at distance x is:

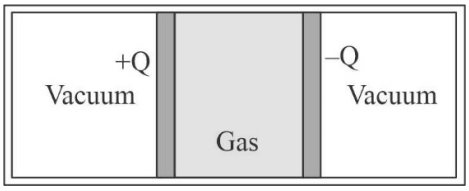
(A) $\frac{\mu_0 M a^2 v}{2x^4}$ **(B)** $\frac{7\mu_0 M a^2 v}{2x^4}$ **(C)** $\frac{5\mu_0 M a^2 v}{2x^4}$ **(D)** $\frac{3\mu_0 M a^2 v}{2x^4}$

14. Opposing force on bar magnet is proportional to:

(A) $\frac{1}{x^4}$ **(B)** $\frac{1}{x^8}$ **(C)** $\frac{1}{x^3}$ **(D)** $\frac{1}{x^2}$

Paragraph: For Question number. 15 to 16

An ideal gas having f degrees of freedom is kept inside a thermally insulated vessel, the vessel has two large pistons each with charge of $+Q$ and $-Q$. Assume charges are uniformly distributed. Pistons can move without friction inside the vessel. At an instant the charge of pistons is increased k times with the help of an external agent.



15. What is the ratio of final to initial temperature of gas in equilibrium?

(A) $\frac{K^2+f}{2+f}$ **(B)** $\frac{K+f}{2+f}$ **(C)** $\frac{K^2+f}{f}$ **(D)** $\frac{Kf}{2+f}$

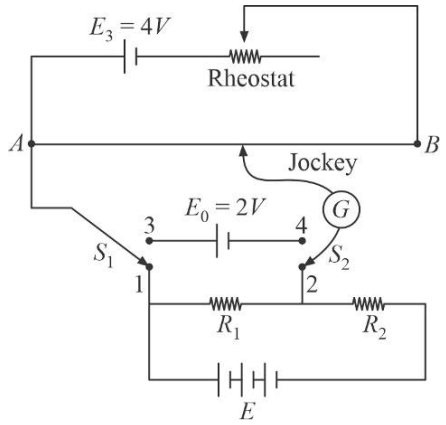
16. What is the final pressure of the gas at equilibrium?

(A) $\frac{KQ^2}{2A\varepsilon_0}$ **(B)** $\frac{K^2Q^2}{2A^2\varepsilon_0}$ **(C)** $\frac{Q^2}{2A^2\varepsilon_0}$ **(D)** $\frac{Q^2}{2A\varepsilon_0}$

Section – 4 | Non-Negative Integer Type

This **Section** contains **3 Non-Negative Integer Type Questions.** The answer to each question is a **NON-NEGATIVE INTEGER.**

17. In the laboratory, the high e.m.f. of a battery is measured by using potentiometer and two resistances R_1 and R_2 where $R_1 << R_2$ as shown in figure. $R_1 = (100 \pm 0.1)\,\Omega$ and $R_2 = (9900 \pm 9.90)\,\Omega$, $AB = 1\ m$. The voltage across R_1 when switches S_1 and S_2 are connected to point 1 and point 2 is balanced against $l_1 = (60 \pm 0.06)\ cm$. When switches S_1 and S_2 are shifted to point 3 and point 4 as shown in the figure, potential difference of standard $E_0 = 2\ \text{Volt}$ is balanced against length $l_2 = (75 \pm 0.075)\ cm$. Maximum error in e.m.f. of battery (E) is $n \times 10^{-2}$ volts, where n is _____.



18. Spirit in a hemispherical bowl of radius R evaporates at a rate that is proportional to the surface area of the liquid. Initially, the bowl is completely filled so that height of liquid in the bowl is $H_0 = R$. It becomes $\frac{H_0}{2}$ in time 2 minutes. How much more time (in minutes) will be needed for the height of liquid to become $\frac{H_0}{4}$?

19. In a photo electric effect set-up, a point source of light of power $9.6 \times 10^{-3} W$ emits monoenergetic photons of energy 5.0 eV. The source is located at a distance of 0.8 m from the centre of a stationary metallic sphere of work function 3.0 eV and of radius $8.0 \times 10^{-3} m$. The efficiency of photo-electron emission is one for every 10^6 incident photons. Assume that the sphere is isolated and initially neutral, and that photo-electrons are instantly swept away after emission.

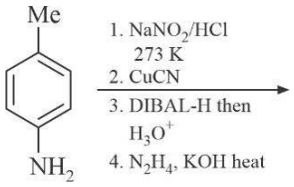
It is observed that the photoelectrons emission stops at a certain time t after the light source is switched on. Time t is _____ seconds.

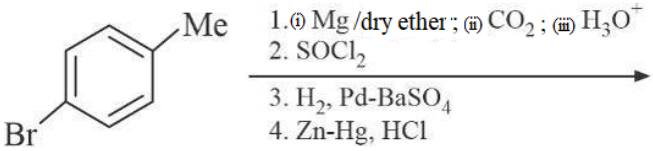
SUBJECT II : CHEMISTRY 60 MARKS

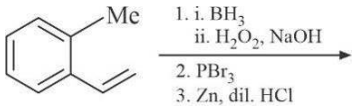
Section – 1 | Multiple Correct Type

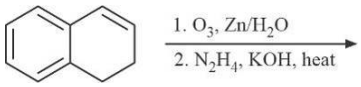
This Section contains **6 Multiple Correct Answer Type Questions.** Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

20. The reaction sequence(s) that would lead to p-xylene as the major product is:

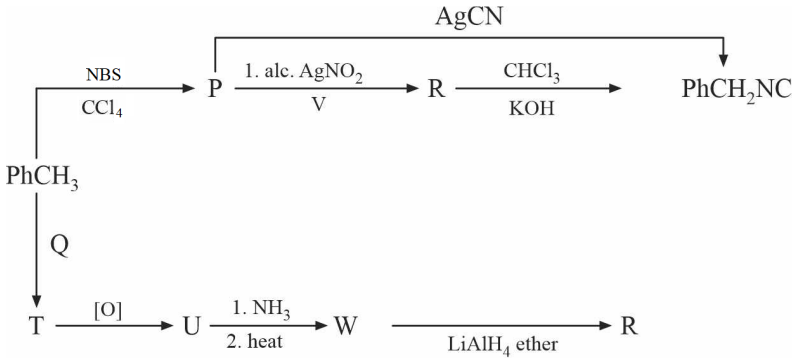
(A) 

(B) 

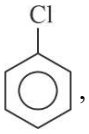
(C) 

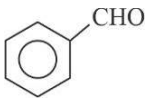
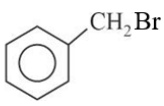
(D) 

21. Correct option(s) for the following sequence of reactions is(are):



(A) $Q = CrO_2Cl_2$, R = phenylmethanamine

(B) P =  , V = Sn/HCl

(C) T =  , P = 

(D) $V = H_2, Pd/C$, R = phenylmethanamine

22. The decomposition reaction: $3A(g) \rightarrow 2B(g) + 2C(s)$ follows first-order kinetics. Starting with pure 'A' (at 6 atm), the pressures of system after 20 min and after a very long time are 5 atm and 4 atm, respectively. Identify the correct statement(s) related with the reaction.

(A) Time for 75% completion of reaction is slightly more than 40 min

(B) Time for 87.5% completion of reaction is slightly less than 60 min

(C) Time for 93.75% completion of reaction is exactly 80 min

(D) The pressure of system after 40 min will be 4.5 atm

23. Some standard electrode potentials at 298 K are given below:

Half Reaction	E° (V)
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$	– 0.763
$Cr^{3+}(aq) + e^- \rightarrow Cr^{2+}(aq)$	– 0.408
$Tl^{+}(aq) + e^- \rightarrow Tl(s)$	– 0.336
$Cu^{2+}(aq) + e^- \rightarrow Cu^{+}(aq)$	+ 0.161
$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$	+ 0.769

Which reaction(s) is(are) spontaneous?

(P) $Cr^{2+}(aq) + Fe^{3+}(aq) \rightarrow Cr^{3+}(aq) + Fe^{2+}(aq)$

(Q) $Cu^{2+}(aq) + Fe^{2+}(aq) \rightarrow Cu^{+}(aq) + Fe^{3+}(aq)$

(A) P only **(B)** Q only

(C) Both P and Q **(D)** Neither P nor Q

24. The pair(s) of complexes where in both exhibit tetrahedral geometry is(are):
(Note: py = pyridine, Given: Atomic numbers of Fe, Co, Ni and Cu are 26, 27, 28 and 29, respectively).

(A) $[Cu(Cl)_4]^{2-}$ and $[Cu(NH_3)_4]^{2+}$ **(B)** $[Co(CO)_4]^{-}$ and $[CoCl_4]^{2-}$

(C) $[NiCl_4]^{2-}$ and $[Ni(PPh_3)_4]$ **(D)** $[Cu(py)_4]^{+}$ and $[Cu(CN)_4]^{3-}$

25. The correct statement(s) related to oxoacids of phosphorous is(are):

(A) Sodium hypophosphite is formed by alkaline hydrolysis of white phosphorous

(B) While H_3PO_3 can act as reducing agent, H_3PO_2 cannot

(C) H_3PO_2 is a monobasic acid

(D) The H atom of P – H bond in H_3PO_2 is not ionizable in water

Section – 2 | Numerical Value Type

This **Section** contains **3 Question stems**. There are **TWO (02)** questions corresponding to each question stem. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

Question Stem: For Question number 26 to 27

Question Stem

Molar conductance of 0.1 M acetic acid is $7\ \text{ohm}^{-1}\ \text{cm}^2\ \text{mol}^{-1}$. If the molar conductance of acetic acid at infinite dilution is $280\ \text{ohm}^{-1}\ \text{cm}^2\ \text{mol}^{-1}$. The value of dissociation constant is $x \times 10^{-5}\ \text{mol dm}^{-3}$ and degree of dissociation is $y \times 10^{-2}$.

26. The value x is _____.

27. The value of y is_____.

Question Stem: For Question number 28 to 29

Question Stem

Reaction of x g of Sn with HCl quantitatively produced a salt. Entire amount of the salt reacted with y g of nitrobenzene in the presence of required amount of HCl to produce 2.58 g of an organic salt (quantitatively).

(Use molar mass (in g mol^{-1}) of H, C, N, O, Cl and Sn as 1, 12, 14, 16, 35 and 119 respectively).

28. The value of x is _____.

29. The value of y is _____.

Question Stem: For Question number 30 to 31

Question Stem

1.6 g of pyrolusite ore was treated with $50\ \text{cm}^3$ of 1.0 N, oxalic acid and some sulphuric acid. The oxalic acid left undecomposed was raised to $250\ \text{cm}^3$ in a flask. $25\ \text{cm}^3$ of this solution when titrated with 0.1 N $KMnO_4$ required $32\ \text{cm}^3$ of the solution. The percentage of pure MnO_2 in the sample is x % by weight. The percentage of available oxygen is y % by weight. (Molar mass of $MnO_2 = 86.9\ \text{gm/mole}$)

30. The value of x is_____.

31. The value of y is _____.

Section – 3 | Single Correct Type

This Section contains **2 Paragraph Type Questions**. Based on each paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer

Paragraph For Question number. 32 to 33

The amount of energy required to break a bond is same as the amount of energy released when the same bond is formed. In gaseous state, the energy required for homolytic cleavage of a bond is called Bond Dissociation Energy (BDE) or Bond Strength. BDE is affected by s-character of the bond and the stability of the radicals formed. Shorter bonds are typically stronger bonds. BDEs for some bonds are given below:

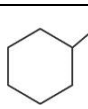
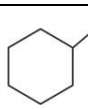
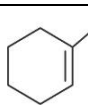
$H_3C-H(g) \rightarrow H_3\dot{C} + \dot{H}(g)$ $\quad \Delta H^\circ = 414$ kJ/mol

$Br-Br \rightarrow Br^\bullet(g) + Br^\bullet(g)$ $\quad \Delta H^\circ = 193$ kJ / mol

$CH_3-Br \rightarrow H_3C^\bullet(g) + Br^\bullet(g)$ $\quad \Delta H^\circ = 276$ kJ / mol

$H-Br(g) \rightarrow H^\bullet(g) + Br^\bullet(g)$ $\quad \Delta H^\circ = 368$ kJ / mol

32. Correct match of the C – H bonds (shown in bold) in column **J** with the BDE in column **K**.

	Column J Molecule	**Column K (BDE kJ/ mol)**	
(p)		**(i)**	611 kJ/mol
(q)		**(ii)**	730 kJ/mol
(r)		**(iii)**	347 kJ/mol
(s)		**(iv)**	836 kJ/mol

(A) (p) – (iv), (q) – (ii), (r) – (i), (s) – (iii) **(B)** (p) – (i), (q) – (ii), (r) – (iii), (s) – (iv)

(C) (p) – (iii), (q) – (iv), (r) – (i), (s) – (ii) **(D)** (p) – (ii), (q) – (iii), (r) – (iv), (s) – (i)

33. For the following reaction:

$$CH_4(g) + Br_2(g) \xrightarrow{\text{light}} CH_3Br(g) + HBr(g)$$

The correct statement is:

(A) Initiation step is exothermic with $\Delta H^\circ = -193$ kJ / mol

(B) Propagation step involving $^\bullet CH_3$ formation is exothermic with $\Delta H^\circ = -20$ kJ / mol

(C) Propagation step involving CH_3Br formation is endothermic with $\Delta H^\circ = 83$ kJ / mol

(D) The reaction is exothermic with $\Delta H^\circ = -37$ kJ / mol

Paragraph For Question number. 34 to 35

A bluish green coloured compound 'A' on heating gives two products 'B' and 'C'. A metal 'D' is deposited on passing H_2 through heated 'B'. The compounds 'A' and 'B' are insoluble in water. 'B' is black in colour, and dissolves in H_2SO_4 acid to give E.E on treatment with $K_4[Fe(CN)_6]$ gives a chocolate brown ppt of compound 'F'. 'C' is colourless, odourless gas and turns lime water milky.

34. The compounds 'B' and 'C' are respectively.

(A) CuS, SO_2 **(B)** CuO, CO_2 **(C)** FeO, H_2S **(D)** Cr_2O_3, CO

35. The metal 'D' and compounds 'F' are respectively.

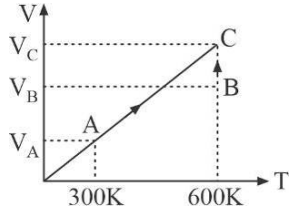
(A) Cu, $Cu_2[Fe(CN)_6]$ **(B)** Fe, $Cu_2[Fe(CN)_6]$

(C) Cu, $CuCO_3$ **(D)** Zn, CuO

Section – 4 | Non-Negative Integer Type

This **Section** contains **3 Non-Negative Integer Type Questions.** The answer to each question is a **NON-NEGATIVE INTEGER.**

36. Below graph is plotted for 1 mole of ideal monoatomic gas.



Find net heat exchange for the process BC (in kJ), if $\frac{V_C}{V_B}=\frac{4}{1}$. [R = 8.314 J/K-mol]

37. When a molecule absorbs a photon, both the energy and momentum are conserved. If a H_2 molecule at 300 K absorbs an ultraviolet photon of wavelength 100 nm, what is the change in its velocity? (in **cm/sec**).

Use Plank constant $=6.6\times10^{-34}$ J s, Avogadro number $=6\times10^{23}\,mol^{-1}$, Molar mass of $H = 1\,gm\ mol^{-1}$.

38. If the oxidation state of platinum in xenon hexafluoroplatinate complex is 'a' and that of xenon in barium perxenate is 'b', find out b – a.

SPACE FOR ROUGH WORK

SUBJECT III : MATHEMATICS 60 MARKS

Section – 1 | Multiple Correct Type

This Section contains **6 Multiple Correct Answer Type Questions.** Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

39. Let $S = \{1,2,3,4,\ldots,2070\}$ and A be the number of subsets of S whose sum of elements is divisible by 9. If $A = \dfrac{2^a(2^b + 2^c + 3)}{9}$, ($a$, b, c are natural numbers and $b > c$) then:

(A) $a = 231$ **(B)** $b = 1840$ **(C)** $c = 460$ **(D)** $b = 1839$

40. A circle of radius 4 *cm* is inscribed in ΔABC, which touches the side BC at D, if $BD = 6$ *cm* : $DC = 8$ *cm* then:

(A) The triangle is necessarily acute angled Δ

(B) $\tan\dfrac{A}{2} = \dfrac{4}{7}$

(C) Perimeter of the triangle ABC is 42 *cm*

(D) Area of ΔABC is 84 cm^2

41. If $g(x) = \lim\limits_{n\to\infty} n\left[x^{\frac{2018}{n}} - x^{\frac{2019}{n}}\right]; x > 0$ then choose the correct option(s).

(A) The number of solution(s) of the equation $g(x) = e^{2018}$ is 2

(B) The number of solution(s) of the equation $g(x) = e^{-2018}$ is 2

(C) The number of solution(s) of the equation $g(x) = e^{2018}$ is 1

(D) The number of solution(s) of the equation $g(x) = e^{-2018}$ is 1

42. If differential equation corresponding to family of curve $y = A\cos 2x + B\sin^2 x + C$ is given by $\lambda\dfrac{d^3y}{dx^3} + f(x)\dfrac{d^2y}{dx^2} = 2\dfrac{dy}{dx}\cos 2x$ where λ is a real constant and $f(x)$ is some function in x, then:

(A) $\lambda = 0$

(B) $\lambda = 1$

(C) Number of solutions of the equation $f(x) = \lambda$ in (0, 4) are 2

(D) Number of solution of the equation $f(x) = \lambda$ in (0, 4) are 3

43. If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a} + \vec{b}| = 5\sqrt{2}$ and $\vec{a} \times (4\hat{i} + \lambda\hat{j} + 2\hat{k}) = (4\hat{i} + \lambda\hat{j} + 2\hat{k}) \times \vec{b}$ and $(\vec{a} + \vec{b}) \cdot (-3\hat{i} + 2\hat{j} + \lambda\hat{k}) = 10$ then:

(A) Sum of values of $\lambda = \dfrac{48}{7}$ **(B)** Product of values of $\lambda = \dfrac{84}{7}$

(C) No possible value of λ **(D)** Two possible values of λ

44. Locus of a point P which divides all chords of slope 1/2 of parabola $x^2 = 4y$ in the ratio 1 : 2 internally is another parabola with vertex $\left(\frac{a}{9}, \frac{b}{9}\right)$ and length of latus rectum $c/9$, then:

(A) $a + b = 10$ **(B)** $abc = 64$ **(C)** $b + 2c = 8$ **(D)** $ab^2c^2 = 512$

Section – 2 | Numerical Value Type

This **Section** contains **3 Question stems**. There are **TWO (02)** questions corresponding to each question stem. For each question, enter the correct numerical value of the answer using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer. If the numerical value has more than two decimal places, **truncate/roundoff** the value to **TWO** decimal places.

Question Stem: For Question number 45 to 46
Question Stem

A_1 and A_2 are the vertices of the conic $C_1 : 4(x-3)^2 + 9(y-2)^2 - 36 = 0$ and point P is moving in the plane such that $|PA_1 - PA_2| = 3\sqrt{2},$ then the locus of P is another conic C_2. If D_1 denotes the distance between foci of conic C_2. D_2 denotes the product of perpendicular distances from the points A_1, A_2 upon any tangent drawn to the conic C_2 and D_3 denotes length of tangent drawn from any point on auxiliary circle of conic C_1 to the auxiliary circle of the conic C_2.

45. If centre of conic C_2 is (a, b) then the value of $a^2 + b^2$ is _____.

46. The value of $\left(\frac{D_1 D_2}{D_3^2}\right)^2$ is _____.

Question Stem: For Question number 47 to 48
Question Stem

Consider the function $f(x)$, a fourth degree polynomial such that $\lim_{x\to 1} \frac{f(x)}{(x-1)^2} = 1,$ and $f'(0) = -6,$ $f'(2) = 6.$

47. The minimum value of $f(x)$ is _____.

48. The length of subtangent of the curve $y = f(x)$ where it cuts the y-axis is l then value of $81l$ is _____.

Question Stem: For Question number 49 to 50
Question Stem

Let $I_1 = \int_1^{10^4} \frac{\{\sqrt{x}\}}{\sqrt{x}}\,dx$ and $I_2 = \int_1^{10} x\{x^2\}dx$ where $\{\cdot\}$ denotes fractional part of x.

49. The value of $\frac{I_1}{I_2}$ is equal to _____.

50. The value of $\frac{I_1 + 4I_2}{11}$ is equal to _____.

Section – 3 | Single Correct Type

This Section contains **2 Paragraph Type Questions**. Based on each paragraph, there are **TWO (02)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer

Paragraph For Question number 51 to 52

A circle C_1 with radius 5 touches *x*-axis and another circle C_2 with radius 4 touches *y*-axis. The two circles touches each other externally so that their point of contact lies in the first quadrant, let the locus of their point of contact be the curve *S*. Two tangents are drawn to the curve *S* from point *P*(9, 5) to meet the curve at *Q* and *R*.

51. Eccentricity of curve *S* is:

(A) $\frac{\sqrt{41}}{5}$ **(B)** $\frac{\sqrt{41}}{4}$ **(C)** $\frac{4}{5}$ **(D)** $\frac{3}{5}$

52. The area of ΔPQR is:

(A) $\frac{29}{4}$ **(B)** $\frac{27}{5}$ **(C)** $\frac{13}{2}$ **(D)** $\frac{25}{3}$

Paragraph For Question number. 53 to 54

$f(x)=1+x\ln(x+\sqrt{x^2+1})-\sqrt{1+x^2}$, $h(x)=f(x)-f^2(x)+f^3(x)$ and $g(x)=\ln(1-\ln x)$.

53. Which of the following statements is true?

(A) $h(x)$ is increasing in $(0,\infty)$ **(B)** $h(x)$ is decreasing in $(0,\infty)$

(C) $h(x)$ is increasing on R **(D)** $h(x)$ is decreasing on R

54. Which of the following statements is true?

(A) $g(x)$ is increasing in (0, 1) and decreasing in (1, e)

(B) $g(x)$ is decreasing in (0, 1) and increasing in (1, e)

(C) $x = 1$ is the critical number for $g(x)$

(D) g has two asymptotes

Section – 4 | Non-Negative Integer Type

This **Section** contains **3 Non-Negative Integer Type Questions.** The answer to each question is a **NON-NEGATIVE INTEGER.**

55. Die *A* has 4 red and 2 white faces whereas die *B* has 2 red and 4 white faces. A coin is flipped once. If it shows a head, the game continues by throwing die *A*, if it shows tail, then die *B* is to be used. When it is given that red throws up every time in first *n* throws, if the probability that die *A* is used is 32/33, then value of *n* is _____.

56. The equation of the curve obtained by reflecting the ellipse $\frac{(x-4)^2}{16}+\frac{(y-3)^2}{9}=1$ about the line $x-y-2=0$ is $16x^2+9y^2+k_1x-36y+k_2=0$ then number of prime factors of (k_1+k_2) is:

57. Let $y = f(x)$ be a differential function satisfying $\int_2^x f(t)\,dt + 2 = \frac{x^2}{2} + \int_x^2 t^2 f(t)\,dt$, then the value of $\int_{-\pi/4}^{\pi/4} \frac{f(x) + x^9 - x^3 + x + 1}{\cos^2 x}\,dx$ is equal to:

SPACE FOR ROUGH WORK