FIITJEE
ALL INDIA TEST SERIES
JEE (Advanced)-2025
FULL TEST – IV
PAPER –2
TEST DATE: 18-02-2025

Time Allotted: 3 Hours **Maximum Marks: 180**

General Instructions:

- The test consists of total 51 questions.
- Each subject (PCM) has 17 questions.
- This question paper contains **Three Parts.**
- **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
- Each **Part** is further divided into **Three Sections**: **Section-A, Section-B & Section-C**.
  Section – A *(01 – 04, 18 – 21, 35 – 38):* This section contains **TWELVE (12)** questions. Each question has **FOUR** options. **ONLY ONE** of these four options is the correct answer.
  Section – A *(05 –07, 22 – 24, 39 – 41):* This section contains **NINE (09)** questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
  Section – B *(08 – 13, 25 – 30, 42 – 47):* This section contains **EIGHTEEN (18)** numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.
  Section – C *(14 –17, 31 – 34, 48 – 51):* This section contains **SIX (06) paragraphs.** Based on each paragraph, there are **TWO (02)** questions of numerical answer type. The answer to each question is a **NUMERICAL VALUE (XXXXX.XX).** If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.

MARKING SCHEME

Section – A (Single Correct): Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+3	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.

Section – A (One or More than One Correct): 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 Marks	:	0	If none of the options is chosen (i.e. the question is unanswered);
Negative Marks	:	–2	In all other cases.

Section – B: 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	Question is unanswered;
Negative Marks	:	0	In all other cases.

Section – C: Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+3	If ONLY the correct integer is entered;
Zero Marks	:	0	Question is unanswered;
Negative Marks	:	0	In all other cases.

Physics

PART – I

SECTION – A
(One Options Correct Type)

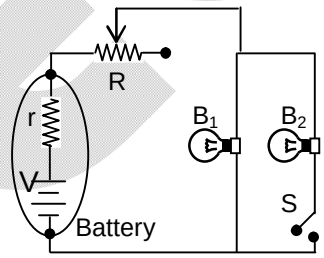
*This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.*

1. Two particles with mass m_1 and m_2 are connected by a mass less rigid rod of length L and placed on a horizontal frictionless table. At time t = 0, the first mass receives an impulse perpendicular to the rod, giving it speed v. At this moment, the second mass is at rest. The minimum time after which the second mass will again come to rest is

(A) $t = \dfrac{2\pi m_1 L}{(m_1+m_2)v}$ (B) $t = \dfrac{2\pi m_1 m_2 L}{(m_1+m_2)^2 v}$

(C) $t = \dfrac{\pi(m_1+m_2)L}{m_2 v}$ (D) $t = \dfrac{2\pi L}{v}$

2. For the circuit shown, all wires have negligible resistance, the battery has a constant internal resistance of r = 8.0 Ω and the two light bulbs (B_1 and B_2) are identical, each with resistance $R_{bulb.}$ The variable resistor is initially set R = 26.0 Ω. The switch S in the circuit now is closed. To what resistance must the variable resistor be set if bulb B_1 is to have the same brightness after the switch is closed as it did with the switch open?



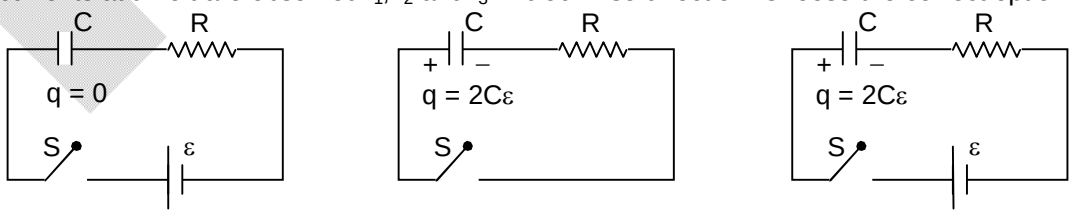
(A) 9.0 Ω
(B) 13.0 Ω
(C) 16.0 Ω
(D) The answer can be computed only if the bulbs' resistance R_{bulb} is known.

3. A point charge q is kept at a point $\left(a, 2a, \dfrac{a}{2}\right)$ in the space. Consider a triangular plane surface whose co-ordinates of vertices are (a, 2a, 0), $\left(\dfrac{3a}{2}, 2a, 0\right)$ and $\left(\dfrac{3a}{2}, \dfrac{5a}{2}, 0\right)$. The electric flux passing through the considered triangular surface is

(A) $\dfrac{q}{12\varepsilon_0}$ (B) $\dfrac{q}{24\varepsilon_0}$

(C) $\dfrac{q}{48\varepsilon_0}$ (D) $\dfrac{q}{96\varepsilon_0}$

4. Three circuits are shown in their initial conditions. In every circuit switch is closed at t = 0. Then currents at time t are observed i_1, i_2 and i_3 in clockwise direction. Choose the correct option.



(A) $i_1 + i_2 = i_3$ (B) $i_1 + i_2 > i_3$

(C) $i_1 + i_2 < i_3$ (D) $i_1 + i_3 = i_2$

SECTION – A
(One or More than one correct type)

*This section contains **THREE (03)** 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).*

5. An artificial satellite of mass m revolves in a circular orbit of radius 4R around the centre of the moon (where R is the radius of the moon). Suddenly it starts experiencing a slight resistance due to cosmic dust. The resistance force depends on the speed of satellite as F = kv where k is a constant. If the radius of the moon is R and acceleration due to gravity on the moon's surface is g, then (assume that at every moment the satellite follows a circular path)

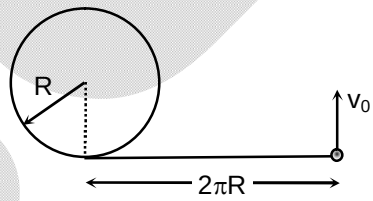
(A) The satellite will hit the moon's surface after time $t = \frac{m}{k}\ln 2$

(B) The satellite will hit the moon's surface after time $t = \frac{2m}{k}\ln 2$

(C) The work done by the resistance force on the satellite till it hits the moon surface $= -\frac{3}{8}mgR$.

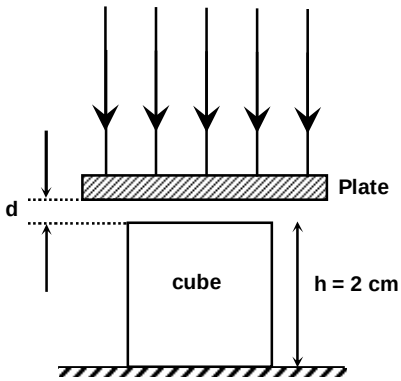
(D) Work done by gravitational force till the satellite hits the moon's surface = $\frac{3}{4}mgR$.

6. A particle of mass m is connected with the fixed vertical cylinder with the help of a string of length $\ell_0 = 2\pi R$ as shown in the figure. The particle is given a horizontal velocity v_0 perpendicular to the string and it moves on a smooth horizontal surface. Then choose the correct option(s).



(A) Speed of the particle increases continuously
(B) Speed of the particle remains constant
(C) Tension in the string increases continuously
(D) Time after which the particle will collide with the cylinder is $\frac{2\pi^2 R}{v_0}$

7. An electromagnetic radiation of wavelength ranging between 400 nm and 1150 nm (for which the plate is penetrable) incident perpendicularly on the plate from above is reflected from both the air surfaces and interferes. In this range only two wavelength give maximum reinforcements, one of them is λ = 400 nm. (refractive index of air = 1 and the coefficient of linear thermal expansion of cube = 8×10^{-6} °C^{-1}). The distance of bottom of cube from plate does not change during warming up. Choose the correct option(s)



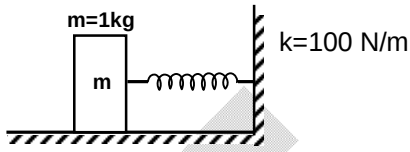
(A) The change in temperature of cube so that it would touch the plate is 6.2°C
(B) The change in temperature of cube so that it would touch the plate is 3.1°C
(C) The second wavelength, which gives maximum reinforcement is $\lambda = \frac{2000}{3}$nm
(D) The second wavelength, which gives maximum reinforcement is $\lambda = \frac{4000}{3}$nm

SECTION – B

(Numerical Answer Type)

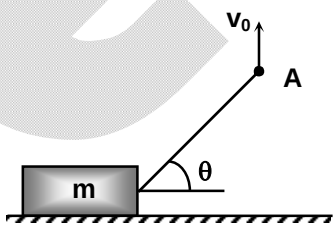
*This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.*

8. A spring mass system is kept on a rough horizontal surface having co-efficient of friction $\mu = 0.4$. One end of the spring is fixed to the vertical wall as shown in the figure. Initially the spring is stretched by 27 cm and then it is released. The total distance covered by the block before it comes to permanent rest is x cm. Find x. (Take $g = 10\ m/s^2$)

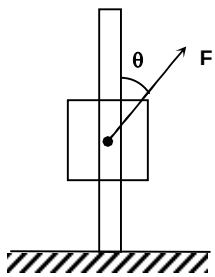


9. Two vernier calipers A and B both have M.S.D. of 1 mm. 8 vernier scale division have same length as 2 main scale division of vernier A and 5 vernier scale division have same length as 3 main scale division for vernier B. The magnitude of difference in least count of vernier A and vernier B is $\frac{k}{100}$ mm. Find the value of k.

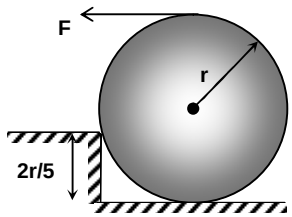
10. A block of mass m = 1kg is placed on a frictionless horizontal surface. One end of a massless string of length 0.8 m is connected to the block. The string is straight and the other end of the string is moved vertically up with constant velocity v_0. When the string makes an angle $\theta = 30°$ with the horizontal surface the block leaves the surface. Find the speed v_0 (in m/s) (given $g = 10\ m/s^2$)



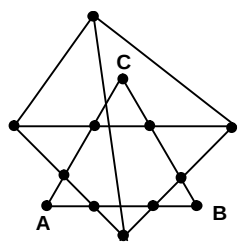
11. The collar of mass m slides up a vertical shaft under the action of a force F of constant magnitude but variable direction. If the angle made by the force F with the vertical at any time t is $\theta = kt$ where k is a positive constant and collar starts from $\theta = 0°$. The collar comes to rest as θ reaches the value $\pi/2$. The coefficient of kinetic friction between the collar and shaft is $\mu_k = 1/3$. If the value of $F = n\pi mg$, then find the value of 100n.



12. A solid cylinder of mass m and radius r is placed at the bottom of a fixed step of height $\frac{2r}{5}$ as shown in the figure. A horizontal force F is applied on the topmost point of cylinder so that it just starts climbing the step without slipping. The minimum coefficient of static friction between the cylinder and step is μ so that the cylinder does not slip just after the application of force F. Find the value of 2μ.



13. Resistance of each wire connecting any two adjacent dots is R. The equivalent resistance between A and B is $\frac{8}{k}R$. Find the value of k. [wires are connected only at the dot points]

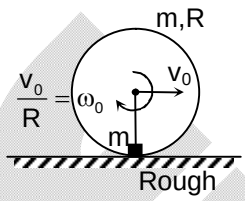


SECTION – C
(Numerical Answer Type)

*This section contains **TWO (02) paragraphs.** Based on each paragraph, there are **TWO (02)** questions of numerical answer type. The answer to each question is a **NUMERICAL VALUE (XXXXX.XX).** If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.*

Paragraph for Question Nos. 14 and 15

A small body of mass m is rigidly fixed to the inside of a thin rigid hoop of same mass m and radius R placed on a rough horizontal surface. When the body is getting in the lowest position, the velocity of the centre of the hoop is $v_0 = \sqrt{5gR}$ as shown in the figure. The hoop rolls without slipping on the rough horizontal surface. (Take mass m = 1 kg and g = 10 m/s^2)



14. When the body will get to the left end of the horizontal diameter of the hoop, the frictional force acting on the hoop due to the horizontal surface is …….

15. When the body will get to the left end of the horizontal diameter of the hoop, the normal force acting on the hoop due to the horizontal surface is …….

Paragraph for Question Nos. 16 and 17

A screw gauge has 100 divisions on the circular scale and linear distance travelled by the head scale is 5 mm in 10 complete rotation of circular scale. When nothing is placed between its studs, the zero of circular scale is 26 divisions above the reference line, it means zero error is –26 divisions on the circular scale. Now if the diameter of a wire is measured by keeping the wire between its studs, the main scale reading is 6 divisions and 48th division of circular scale coincides with the reference line. If the negative zero error of screw gauge is x mm and the measured diameter of the wire is y mm.

16. The value of x is ……..

17. The value of y is ……..

Chemistry

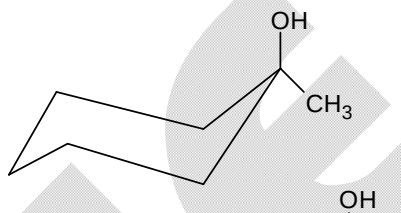
PART – II

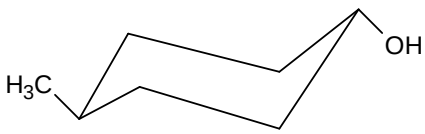
SECTION – A
(One Options Correct Type)

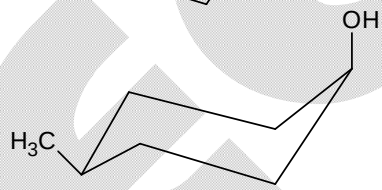
*This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.*

18. Which of the following react with HBr at faster rate?

(A) 

(B) 

(C) 

(D) 

19. The value of universal gas constant R depends on
(A) Temperature of gas
(B) Volume of gas
(C) Number of moles of gas
(D) Units volume and pressure

20. When iodine is dissolved in aqueous potassium iodide, the shape of the species formed is:
(A) Linear
(B) Angular
(C) Triangular
(D) See-saw

21. Among the following complexes
(i) $[Ru(bipyridyl)_3]^+$
(ii) $[Cr(EDTA)]^+$
(iii) trans-$[CrCl_2(Oxalate)_2]^{3-}$
(iv) cis-$[CrCl_2(ox)_2]^{3-}$
The ones that shows chirality are
(A) (i),(ii), (iv)
(B) (i), (ii), (iii)
(C) (ii), (iii), (iv)
(D) (i), (iii), (iv)

SECTION – A
(One or More than one correct type)

*This section contains **THREE (03)** 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).*

22. A binary solution of liquid A and B will show positive deviation from Roult's law if it fulfils the following condition:
(A) $P_A > X_A P_A^o$ and $P_B > X_B P_B^o$
(B) The intermolecular forces of A–B < A–A, B–B
(C) ΔH mixing is positive
(D) Δ V mixing is negative

23. For the reaction: $Cl_2(g) + 3F_2(g) \rightleftharpoons 2ClF_3(g)$; $\Delta H = -329KJ$ dissociation of $ClF_3(g)$ will be favoured by:
(A) Increasing the temperature
(B) Increasing the volume of the container
(C) Adding of F_2 gas
(C) Adding of inert gas at constant pressure

24. Select the correct statement(s):
(A) When $T \to \infty$ or $E_a \to o$ then K = A
(B) A positive catalyst can change ΔH of the reaction
(C) A mixture of reactants may be thermodynamically unstable but kinetically stable
(D) A negative catalyst increase the activation energy of the reaction

SECTION – B

(Numerical Answer Type)

*This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.*

25. An α-particle moving with velocity $\frac{1}{30}$ th times of velocity of light. If uncertainty in position is $\frac{3.31}{\pi}$ pm, then minimum Uncertainty in kinetic energy is y × 10^{-16}J. Calculate value of 'y'.

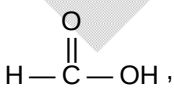
26. The vander Waal's constants for a gas are a = 3.6 atm L^2 mol^{-2}, b = 0.6L mol^{-1}, If R = 0.08 L $atmk^{-1}$ mol^{-1}. If the Boyle's temperature (K) is T_b of this gas, then what is the value of $\frac{T_b}{15}$?

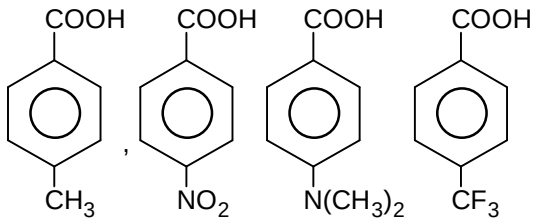
27. Amongst the following, the total number of compounds whose aqueous solution turns red litmus paper blue is NaCN, KCl, CH_3COONH_4, NaH_2PO_4, $ZnCl_2$, Na_3PO_4, $Fe(NO_3)_3$, Na_2CO_3, NH_4Cl, $NaHCO_3$, $Na_2C_2O_4$, Na_2HPO_4 .
Given :

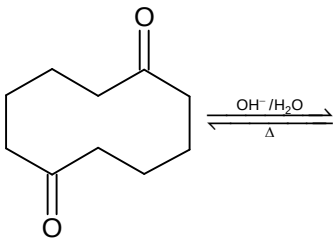
Acid	Ka_1	Ka_2	Ka_3
H_3PO_4	10^{-3}	10^{-8}	10^{-12}
H_2CO_3	10^{-6}	10^{-1}	-
$H_2C_2O_4$	10^{-2}	10^{-5}	-

28. $\Delta G°$ for the hypothetical reaction x + y $\rightleftharpoons$ z is – 4.606 kcal. The equilibrium constant of the reaction at 227° is (x × 10^2). Find the value of x.

29. Find out number of compounds which are more acidic than benzoic acid from the following



, $H_2C_2O_4$,


30. 

Double bond equivalent of final product is .....

SECTION – C
(Numerical Answer Type)

*This section contains **TWO (02) paragraphs.** Based on each paragraph, there are **TWO (02)** questions of numerical answer type. The answer to each question is a **NUMERICAL VALUE (XXXXX.XX).** If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.*

Paragraph for Question Nos. 31 and 32

A proper control by pH is very essential for many industrial as well as biological processes. Solutions with a definite pH can be prepared from single salts or mixtures of acids/bases and their salts. We also require solutions which resist change in pH and hence have a reserve value. Such solutions are called buffer solutions. Henderson gave a theoretical equal for preparing acidic buffers of definite pH. The equation is:

$$pH = pK_a + \log\frac{[Salt]}{[Acid]}$$

A similar equation is used for basic buffers. The pH of aqueous solution of single salts is calculated by using an expression whose exact form depends on the nature of the salt. Considering all that in mind, answer the following questions:

31. Calculate pH of a mixture containing 100 ml of 0.10 M NaOH mixed with 100 ml of 0.05 M CH_3COOH solution

32. Calculate pH if 100 ml of 0.1 M NaOH is mixed with 100 ml of 0.1 M CH_3COOH solution [K_a (CH_3COOH) = 1.8×10^{-5}) log 1.8 = 0.255]

Paragraph for Question Nos. 33 and 34

Molar conductivity ($\wedge_m$) is defined as conducting power of the ions produced by 1 mole of an electrolyte in a solution. $\wedge_m$ = k/c where κ is conductivity (in S cm^2 mol^{-1}) and c is molar concentration (in mole/cm^3) the molar conductivity of 0.04 M solution of $CaCl_2$ is 200 S cm^2 mol^{-1} at 298 K. A cell with electrode that are 2.0 cm^2 in surface area and 0.50 cm apart is filled with $CaCl_2$ solution.

33. Conductance of $CaCl_2$ solution is x, value of 10x is:

34. How much current will flow when the potential difference between the two electrode is 5.0 V?

Mathematics

PART – III

SECTION – A
(One Options Correct Type)

*This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.*

35. $\int \frac{1-\cos x - x\sin x}{x^2+1-2x\sin x}dx = \tan^{-1}(f(x)) + c$, then f(n) is
(A) continuous at x = 0
(B) an odd function
(C) an even function
(D) $f\left(\frac{\pi}{2}\right)=1$

36. If f(x) = ||sin(|x| – 2)| – 3|, then
(A) f(x) is continuous but not differentiable at x = 4
(B) f(x) is discontinuous at x = 4
(C) f(x) is differentiable at x = 4 and f′(4) = cos 2
(D) f(x) is differentiable at x = 4 and f′(4) = –cos 2

37. Consider a equation $x^3 - 3x = \sqrt{x+2}$ such that x is a real number then sum of its positive roots is λ where $\left[\frac{\lambda}{2}\right]$ is
(A) 30
(B) 12
(C) 1
(D) 20

38. Consider A and B as 2 × 2 matrices with determinant equal to 1, then tr(AB) – tr(A)·tr(B) + tr(AB^{-1}) + 2 is
(A) 30
(B) 2
(C) 1
(D) 20

SECTION – A
(One or More than one correct type)

*This section contains **THREE (03)** 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. A and B are two n × n matrices such that det(A) ≠ 0, A + B = $(AB)^2$ and BAB = A + I. Choose the **correct** option(s).
(A) $A^{-1} = (A^4 - I)$
(B) $B^5 - A^5 = A + B$
(C) $A^9 = A^4 + A + I$
(D) $A^2B^2 = BA^2B$

40. Let f(x) be a differentiable function such that f′(x) > 0, $\int_0^1 f(x)dx = 2$, $\int_0^1 |f(x)|dx = 4$. Choose the **correct** option(s).
(A) f(x) = 0 has exactly one root in (0, 1)
(B) f(x) = 0 has no root in (0, 1).
(C) $\int_0^1 f(x).\left(\int_0^x |f(t)|dt\right)dx = 1$
(D) $\int_0^1 f(x).\left(\int_0^x |f(t)|dt\right)dx = 7$

41. Points A and B lie on the auxiliary circle of ellipse $\frac{x^2}{4}+y^2=1$. P and Q are the corresponding points on the ellipse for the points A and B respectively (O is the origin). Choose the **correct** option(s).

(A) The maximum value of angle AOP is $\tan^{-1}2\sqrt{2}$.

(B) The maximum value of angle AOP is $\tan^{-1}\frac{1}{2\sqrt{2}}$.

(C) If OA $\perp$ OB and Q′ is reflection of Q in origin, then minimum value of angle POQ′ is $\tan^{-1}\frac{4}{3}$.

(D) If OA $\perp$ OB and Q′ is reflection of Q in origin, then minimum value of angle POQ′ is $\tan^{-1}\left(\frac{3}{4}\right)$

SECTION – B

(Numerical Answer Type)

*This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.*

42. Let $a_{n+1}\cdot a_n = a_n + 2a_{n+1}$, $n \in \mathbf{N}$. For $a_1 = a$ ($a \neq 0$), sequence is periodic and when $a_1 = b$, a_n is undefined for every n such that $n \geq m$, $m \in \mathbf{N}$. Let maximum value of b is c and minimum value of b is d and $e = \lim\limits_{n\to\infty} a_n$ (for the case when sequence is non-periodic and defined for all values of $n \in N$). Find the value of (a + c + d + e).

43. $f(x) = x^6 - 2x^3 - 8$ and $g(x) = x^2 + 2x + 4$. Let $\alpha_1, \alpha_2, \ldots, \alpha_6$ are the roots of equation f(x) = 0, find $g(\alpha_1)\cdot g(\alpha_2) \ldots g(\alpha_6)$.

44. Find the remainder when $\sum\limits_{r=0}^{2014}\sum\limits_{k=0}^{r}(-1)^k(k+1)(k+2)\,{}^{2019}C_{r-k}$ is divided by 64.

45. P is a point on parabola $y^2 = 4x$ such that PS = 4 (S is the focus). Tangent is drawn at P to parabola which intersects tangent at vertex at T. A point R is taken on axis of parabola such that SR = 4 and R lies inside the parabola. The area of quadrilateral PRST is q. Find the value of $\sqrt{3}\,q$.

46. Find the maximum value of $\int_0^y \sqrt{x^4+\left(y(3-y)\right)^2}\,dx$, where $0 \leq y \leq 3$.

47. Given $a^2 + b^2 + c^2 \leq 16$ and $S = 3a + 4b + 10c$ where $a, b, c \in R$. If the maximum value of S is $\sqrt{N}$, then the value of N is equal to

SECTION – C
(Numerical Answer Type)

*This section contains **TWO (02) paragraphs.** Based on each paragraph, there are **TWO (02)** questions of numerical answer type. The answer to each question is a **NUMERICAL VALUE (XXXXX.XX).** If the numerical value has more than two decimal places, truncate/round-off the value to **TWO** decimal places.*

Paragraph for Question Nos. 48 and 49

Given p, q $\in$ {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15}. Consider the system of equations

$$x + y + z = 4 \; ; \; 2x + y + 3z = 6 \; ; \; x + 2y + pz = q$$

Let A : denote number of ordered pairs (p, q) so that the system of equation has unique solution
B : denote number of ordered pairs (p, q) so that system of equations has no solution
C : denote number of ordered pairs (p, q) so that system of equations has infinite solution

48. The value of A is

49. The value of A + B + C is

Paragraph for Question Nos. 50 and 51

Let f(x) be defined as $f(x) = \begin{vmatrix} \sin(x+a) & \sin(x+b) & \sin(x+c) \\ \cos(x+a) & \cos(x+b) & \cos(x+c) \\ \cos(b-a) & \cos(c-b) & \cos(a-c) \end{vmatrix}$ and let matrix $P = \begin{bmatrix} \cos\left(\frac{\pi}{9}\right) & \sin\left(\frac{\pi}{9}\right) \\ -\sin\left(\frac{\pi}{9}\right) & \cos\left(\frac{\pi}{9}\right) \end{bmatrix}$

where a, b, c be non-zero real numbers such that $\left(aP^6 + bP^3 + cI\right)$ is a zero matrix and where I is identity matrix of order 2. If $f(3) = \lambda \neq 0$

50. The value of $\dfrac{\sum_{k=1}^{3} f(k)}{f(3)}$ is

51. The absolute value of $\dfrac{2b}{c}$ is