FIITJEE
ALL INDIA TEST SERIES
JEE (Advanced)-2025
PART TEST – III
PAPER –2
TEST DATE: 22-12-2024

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.

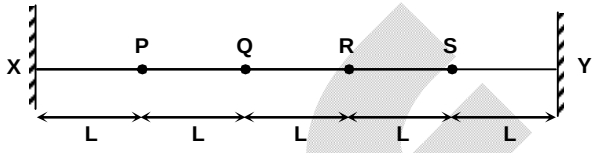
Physics

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. A string of length 5L is clamped between two points X and Y as shown in the figure. T_0 is the uniform tension in the string. A standing wave is formed in the string with the help of a tuning fork of frequency f_0.



The points P, Q, R and S are nodes. Regarding the standing wave formed in the string, pick the INCORRECT statement.

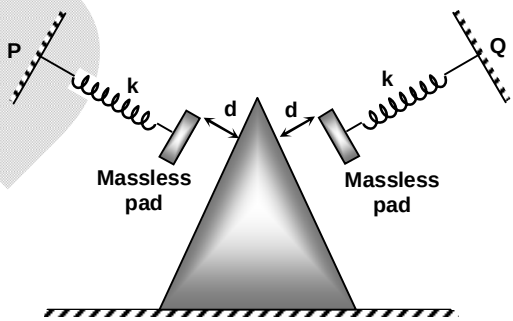
(A) When particles cross their mean positions then kinetic energy of particles located at antinode is maximum.

(B) The position of particle at $\frac{L}{2}, \frac{3L}{2}, \frac{5L}{2}, \frac{7L}{2}$ and $\frac{9L}{2}$ from the end x must be antinode.

(C) The phase difference between any two particles (except node) on the string is either zero ro π at the instant $\frac{T}{3}$, where T is time period of particles.

(D) When particles reach at their extreme positions, then potential energy of the particle is maximum which are near the points P, Q, R, S, X and Y.

2. Two identical massless springs each of force constant k are connected from fixed points P and Q. A massless pad is attached at the other end of each spring. An equilateral prism of mass m is kept on a smooth horizontal surface between both springs as shown in the figure. The face of massless pad is parallel to inclined surface of prism. The lengths of the springs are perpendicular to the inclined face of the prism and are constrained to remain straight. If the prism is imparted an initial velocity v_0 towards right then time period of its oscillation is



(A) $8\pi\sqrt{\frac{m}{3k}}+\frac{16d}{\sqrt{3}v_0}$

(B) $\pi\sqrt{\frac{m}{3k}}+\frac{2d}{\sqrt{3}v_0}$

(C) $2\pi\sqrt{\frac{m}{3k}}+\frac{4d}{\sqrt{3}v_0}$

(D) $4\pi\sqrt{\frac{m}{3k}}+\frac{8d}{\sqrt{3}v_0}$

3. A sinusoidal standing electromagnetic wave in a certain material has frequency 2.20×10^{10} Hz. The nodal plane of magnetic field $\vec{B}$ are 3.55 mm apart. The speed of propagation of electromagnetic wave in the medium is

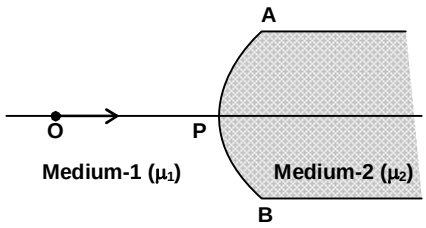
(A) 0.78×10^8 m/s

(B) 1.56×10^8 m/s

(C) 0.39×10^8 m/s

(D) 0.195×10^8 m/s

4. A convex surface AB separates two medium of refractive index $\mu_1 = \frac{3}{2}$ and $\mu_2 = \frac{5}{2}$. An object O is moving along the principal axis of a refracting surface as shown in the figure. The point P is the pole of the refracting surface and R is radius of curvature, then its image

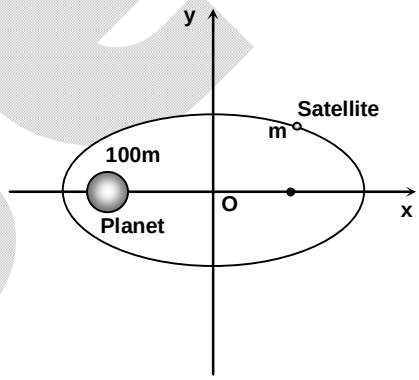


(A) changes from real to virtual when it is getting at a distance R from the surface
(B) changes from virtual to real when it is getting at a distance R from the surface
(C) changes from real to virtual when it is getting at a distance $\frac{3R}{2}$ from the surface
(D) changes from virtual to real when it is getting at a distance $\frac{3R}{2}$ from the surface

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).*

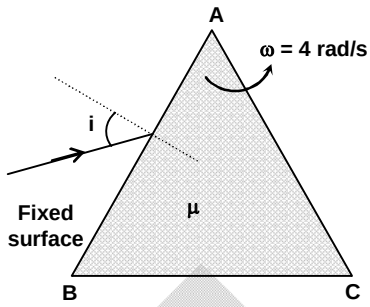
5. A satellite of mass m is moving in an elliptical orbit around a planet of mass 100 m. Satellite moves in (x-y) plane in anticlockwise direction and planet is fixed at one of the foci of the elliptical orbit. The equation of the orbit is given by $\frac{x^2}{25} + \frac{y^2}{16} = d^2$, where d is a positive constant. 'G' is the universal gravitational constant. Choose the correct option(s) regarding the motion of the satellite.



(A) The angular momentum of the satellite during the motion is $40md\sqrt{\frac{Gm}{5d}}$
(B) The velocity of the satellite at perihelion is $\sqrt{\frac{5Gm}{d}}$
(C) The total energy of the satellite during the motion is $\left(\frac{-10Gm^2}{d}\right)$
(D) The velocity of the satellite at aphelion is $20\sqrt{\frac{Gm}{5d}}$

6. A small mirror with area 5.0 cm^2 faces a monochromatic light source that is kept at 3.2 m away from it. At the mirror the electric field amplitude of the light from the source is 0.0280 V/m. It is assumed that source radiates the energy uniformly in all directions and mirror is at large distance. The reflectivity of mirror is assumed to be one and it is fixed at the same place. Choose the correct option(s).
(A) The energy incident on the mirror in 1.00 sec is 2.6×10^{-10} Joule.
(B) The average radiation pressure exerted by light on the mirror is 6.93×10^{-15} Pa
(C) The total radiated power output of the source is 1.34×10^{-4} W
(D) Intensity of light wave reached at the mirror is 2.08×10^{-6} W/m^2

7. Consider a hypothetical prism ABC in which surface AB is fixed and surface AC is rotating with a constant angular velocity ω = 4 rad/s about point A as shown in the figure. Assume that refractive medium bounded by surface AB and AC remains isotropic and its refractive index remains constant during the rotation of surface AC. A ray is incident on the fixed surface AB at an angle i = 45°. The refractive index of the medium is $\mu = \sqrt{2}$. Choose the correct option(s).



(A) Magnitude of the rate of change of angle of emergence from rotating surface AC with respect to time at $\angle A = 60°$ is $2\sqrt{3}$ rad/s

(B) Magnitude of the rate of change of angle of emergence from rotating surface AC with respect to time at $\angle A = 60°$ is $4\sqrt{3}$ rad/s

(C) Magnitude of the rate of change of angle of deviation with respect to time at $\angle$ A = 60° is $(4\sqrt{3} - 4)$ rad/s

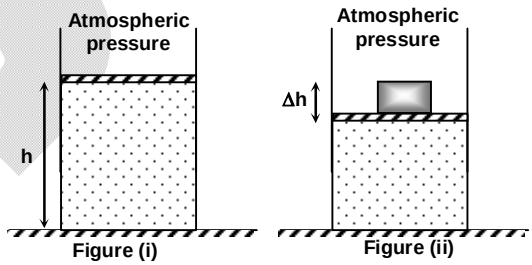
(D) Magnitude of the rate of change of angle of deviation with respect to time at $\angle$ A = 60° is $(2\sqrt{3} - 2)$ rad/s

SECTION – B

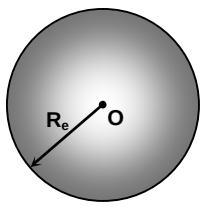
(Numerical Answer Type)

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

8. A liquid of density ρ =1875 kg/m^3 is filled in a cylindrical container of cross-sectional area 0.2 m^2 upto a height h = 10m. There is a massless piston kept over the liquid as shown in the figure-(i). Piston can slide inside the container without friction. Now a block of mass m=3000 kg is placed over the piston, so that piston moves down by Δh = 0.2 mm compressing the liquid as shown in the figure-(ii). Atmospheric pressure and acceleration due to gravity are P_0=10^5 N/m^2 and g=10 m/s^2 respectively. Find the speed(in m/s) of sound in the liquid.

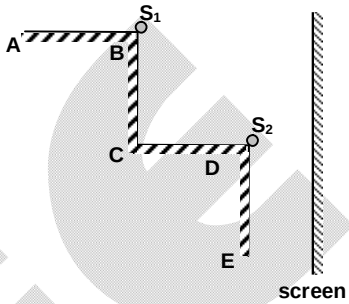


9. Assume mass density of earth is not uniform, it has spherically symmetrically distribution of mass density which is varying as directly proportional to the square of the distance from the centre. At the centre O mass density is assumed to be zero and maximum value ρ_0 at its surface. G is universal gravitational constant and R_e is radius of earth. The value of escape velocity of a particle of mass m at the surface of earth is $\sqrt{\frac{\lambda_1 G\rho_0 R_e^2}{\lambda_2}}$. Find the minimum value of $(\lambda_1 + \lambda_2)$. $\left(\text{Take } \pi = \frac{22}{7}\right)$

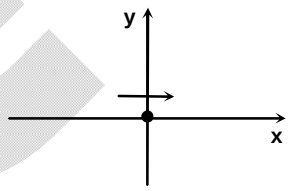


10. A screw gauge is used to measure the diameter of brass wire. In one complete rotation of circular scale, the displacement on main scale is 0.2 mm. Total number of divisions on circular scale is 200. When spindle is brought very close to anvil then 140^{th} division of circular scale is exactly coinciding with the reference line of main scale and zero of main scale is barely visible. Now, brass wire is kept between anvil and spindle then reading of the main scale is 0.6 mm and 60^{th} division of circular scale is exactly coinciding with the reference line of main scale. Find the diameter of the brass wire in μm.

11. ABCDE is a step made by a special type of material from which no reflection or refraction takes place. Two coherent point sources are kept near the points B and D as shown in the figure, they are in same phase. The distance between the points B & C and between the points C & D are 12λ and 5λ respectively, where λ is the wavelength of light emitted by the monochromatic sources S_1 and S_2. Interference pattern is obtained on the screen kept in front of the step. Find the total number of maxima observed on the screen.



12. A particle of mass m = $\frac{1}{2}$kg is projected from origin along x-axis as shown in the figure. The potential energy of particle varies with position x according to the equation U =k|x| in a force field, where k is a positive constant and equal to 4 J/m. At the time of projection of particle its kinetic energy is given by K_0 = 144J. Find the time period (in sec) of the particle during its bound motion.



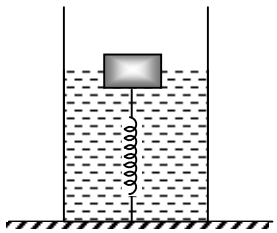
13. A student has two vernier callipers P and Q. The value of one main scale division is 1 mm for both P and Q. Seven vernier scale division is exactly coinciding with the six main scale division for vernier callipers P, and seven vernier scale division of Q is exactly coinciding with the eight main scale division of it. Now, he wanted to calculate the least count of both vernier callipers. If L_P and L_Q are the least counts of vernier callipers P and Q respectively measured by the student. Find the value of $\frac{1}{L_P L_Q}$ in mm^{-2}.

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 cube of side 'ℓ' is attached to one end of a spring whose other end is connected to the bottom of a cylindrical vessel as shown in the figure. Area of cylindrical vessel is 500 cm^2 and mass of the cube is m = 3429.5 gm. The vessel is filled with water so that the cube floats half submerged and spring is relaxed. Now, additional water is slowly poured in the vessel until the cube is fully submerged. In this process, the water level rises by 34.295 cm. The density of water is 1000 kg/m^3 and acceleration due to gravity is g = 10 m/s^2. $\left[(6859)^{1/3} = 19\right]$



14. The displacement (in cm) of the cube in the process is ……..

15. Additional volume (in litre) of the water poured in the process is ……..

Paragraph for Question Nos. 16 and 17

A neon discharge lamp consists of two electrodes in an evacuated glass bulb filled with neon gas. Electrons emitted from cathode are accelerated by voltage between electrodes so that whenever an electron collides with a neon atom, it excites the neon atom. After a very short period, the excited ions returns to the ground state and radiates photons, which results in the bright red fluorescence of the lamp. Consider a neon discharge lamp, the electrodes are separated by a distance d which is much smaller than the linear dimension of the plates. The ionization energy of neon atom is E_0, and average distance travelled by an electron between two consecutive collisions with neon atom is ℓ.

16. The kinetic energy gained by an electron between two successive collisions is $\left(\frac{4eV_0\ell}{\lambda_1 d}\right)$, where e is the charge of electron and V_0 is the applied potential difference between the electrodes. The value of λ_1 is…….

17. For ignition of neon lamp, the applied potential difference between the electrodes is $\left(\frac{9E_0 d}{2\lambda_2 e\ell}\right)$. The value of λ_2 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 order is correct for lattice energy of divalent metal halides
(A) $CaCl_2 > NiCl_2 > VCl_2 > MnCl_2$
(B) $CaCl_2 > VCl_2 > MnCl_2 > NiCl_2$
(C) $NiCl_2 > VCl_2 > MnCl_2 > CaCl_2$
(D) $NiCl_2 > MnCl_2 > VCl_2 > CaCl_2$

19. Which of the following antibiotic has killing effect on microbes
(A) Penicilin (B) Erythromycin
(C) Tetracycline (D) Chloramphenicol

20. Select the correct increasing order of flocculating power in the coagulation of positive sol.
(A) $\left[Fe(CN)_6\right]^{4-} < PO_4^{3-} < SO_4^{2-} < Cl^-$
(B) $PO_4^{3-} < SO_4^{2-} < Cl^- < \left[Fe(CN)_6\right]^{4-}$
(C) $Cl^- < SO_4^{2-} < PO_4^{3-} < \left[Fe(CN)_6\right]^{4-}$
(D) $\left[Fe(CN)_6\right]^{4-} < Cl^- < SO_4^{2-} < PO_4^{3-}$

21. The molar conductivity of acetic acid at infinite dilution is 390 S cm^2 mol^{-1}. At the same temperature 0.001 M solution of acetic acid it is 60 S cm^2 mol^{-1}. What is the degree of dissociation of 0.05 N acetic acid? [Assume $1 - \alpha \approx 1$ for 0.05 N acid.]
(A) 0.24 (B) 0.52
(C) 0.024 (D) 0.052

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. Which of the followings ores are concentrated by froth floatation process?
(A) Copper pyrites (B) Zinc blende
(C) Pyrolusite (D) Cinnabar

23. In which of the following reaction, $N_2(g)$ is produced as one of the product
(A) $N_2H_4 + O_2 \longrightarrow$ (B) $N_2H_4 + I_2 \longrightarrow$
(C) $N_2H_4 + O_2 \xrightarrow[\text{above } 300^oC]{\Delta}$ (D) $(NH_4)_2\,SO_4 \xrightarrow{\Delta}$

24. Molecule(s) with two $p\pi - d\pi$ bonds is/are
(A) SO_2 (B) SO_3
(C) P_4O_8 (D) P_4O_9

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. How many of the following ores contains CO_3^{2-} ion.
Cerrusite, Azurite, Calamine, Zincite, Siderite, Magnetite, Magnesite, Bauxite.

26. Dry air was passed successively through a solution containing 5 g of solute (non-volatile and non-electrolytic) in 90 ml H_2O and then through pure H_2O. The loss in weight of solution was 2 g and that of pure solvent 0.05 g. The mol. wt. of solute (in gm) is:

27. If all the atoms from one of the body diagonals and one of the faces of diamond has been removed then find the percentage change in density (Assume that the volume of unit cell does not change due to removal of atoms)

28. For the galvanic cell
$Ag(s) \mid AgBr(s) \mid Br^-(0.1\,M) \parallel Cl^-(0.01\,M) \mid AgCl(s) \mid Ag(s)$
The value of E_{cell} (in volt) at 298 K is $y \times 10^{-2}$. The value of y is
Given: $K_{SP}(AgBr) = 10^{-13}$
$K_{SP}(AgCl) = 10^{-10}$
$\frac{2.303R \times 298}{F} = 0.06$

29. Cadmium amalgam is prepared by electrolysis of a solution of $CdCl_2$ using Hg-electrode, for how long (in sec) electrolysis should carried out in order to prepare 20% by weight of Cd-amalgam using 20 g of Hg as cathode if the strength of current is 5 A.
[Given: Mol. Wt. of Cd = 112, Hg = 200, 1F = 96488 Coulomb]

30.

$N_2(g)$ 2mol	$H_2(g)$
P = 1 atm	P = 1 atm
T= 300 K	T= 300 K

Given that volume of H_2 compartment is 4 times the volume of N_2 compartment. If the partition between two compartment is removed and the gaseous mixture is heated to 1000 K, $NH_3(g)$ is formed with 100% yield, the final total pressure (in atm) would be

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

The standard reduction potential (in acidic solution) is given by Latimer diagram as shown below:
$ClO_4^- \xrightarrow{1.19\ V} ClO_3^- \xrightarrow{1.21\ V} ClO_2^- \xrightarrow{1.65\ V} ClO^- \xrightarrow{1.61\ V} Cl_2$

31. The $E^o_{ClO_4^-/Cl_2} = x\,V$, the value of x is

32. The pH at which $E_{ClO_3^-/ClO^-} = 1.31$ V, at 298 K. Given $\left[ClO_3^-\right] = 0.5$ M, $\left[ClO^-\right] = 0.5$ M

$\frac{2.303 \times R \times 298}{F} = 0.06$

Paragraph for Question Nos. 33 and 34

All values are in Kcal per mole at $25^\circ C$ given below

$\Delta H^o_{Combustion(ethane)} = -372.0$

$\Delta H^o_{Combustion(propane)} = -530.0$

ΔH^o for $C(graphite) \longrightarrow C(g) = 172.0$

Bond energy of H – H = 104.0

ΔH^o_f of $H_2O(\ell) = -68.0$

ΔH^o_f of $CO_2(g) = -94.0$

33. Find the C – C bond energy in Kcal/mole_____

34. Find the C – H bond energy in Kcal/mole_____

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. If z_1, z_2 and z_3 satisfy $|z| = 1$, $|z - 6 - 8i| = 3$ and $|z + 1 - 7i| = 5$ respectively, then the minimum value of $|z_1 - z_3| + |z_2 - z_3|$ is equal to

(A) 1 (B) 2
(C) 5 (D) 6

36. $\sum_{k=0}^{2n} \frac{1}{(2n-k)!(2n+k)!}$ is equal to

(A) $\frac{2^{4n}}{(4n)!} + \frac{1}{((2n)!)^2}$ (B) $\frac{1}{2}\left(\frac{4^{2n}}{(4n)!} + \frac{1}{((2n)!)^2}\right)$

(C) $\frac{2^{4n+1}}{(4n)!} + \frac{2}{((2n)!)^2}$ (D) $\frac{2^{4n}}{(4n)!} + \frac{1}{2(2n)!}$

37. Let $a_1, a_2, a_3 \ldots\ldots a_n$ be real numbers different from 1 and let n be a natural number such that $a_1^2 + a_2^2 + a_3^2 + \ldots\ldots + a_n^2 = 1000$ and $\frac{a_1^2}{1-a_1} + \frac{a_2^2}{1-a_2} + \frac{a_3^2}{1-a_3} + \ldots\ldots + \frac{a_n^2}{1-a_n} = 100$.

Let $S = \frac{a_1^3}{a_1 - 1} + \frac{a_2^3}{a_2 - 1} + \frac{a_3^3}{a_3 - 1} + \ldots\ldots + \frac{a_n^3}{a_n - 1}$. Then the number of ways in which S can be expressed as a product of two integers is

(A) 15 (B) 18
(C) 28 (D) 36

38. If a_1, a_2, a_3, a_4 and a_5 be the observations with mean $\bar{a}$ and standard deviation s, then the standard deviation of the observations $2a_1 + k, 2a_2 + k, 2a_3 + k, 2a_4 + k$ and $2a_5 + k$ is ($k \in R$)

(A) 2s (B) 2s + k
(C) s + 2k (D) $\frac{2s}{k}$

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. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three unit vectors such that $\left|\vec{a}+\vec{b}+\vec{c}\right|=\sqrt{3}$ and let $\left(\vec{a}\times\vec{b}\right).\left(\vec{b}\times\vec{c}\right)+\left(\vec{b}\times\vec{c}\right).\left(\vec{c}\times\vec{a}\right)+\left(\vec{c}\times\vec{a}\right).\left(\vec{a}\times\vec{b}\right)=\lambda$. Which of the following is/are correct?

(A) The maximum value of λ is 0.

(B) If λ is maximum, then volume of parallelopiped determined by $\vec{a}, \vec{b}$ and $\vec{c}$ is $\sqrt{3}$

(C) If λ is maximum, then the value of $\left|\left(2\vec{a}+3\vec{b}+4\vec{c}\right).\left(\vec{a}\times\vec{b}+5\vec{b}\times\vec{c}+6\vec{c}\times\vec{a}\right)\right|$ is 32

(D) None of these

40. The loci of a point $P(z)$ in the complex plane satisfying the equation $\left|z+\frac{1}{z}\right|=2$ are two circles C_1 and C_2. These circles

(A) have centres on real axis
(B) cut each other orthogonally
(C) do not touch or intersect each other
(D) have exactly two common tangents

41. If P and Q are square matrices of order 2 such that $P+adj\left(Q^T\right)=\begin{bmatrix}2 & 1\\ 1 & 2\end{bmatrix}$ and $P^T-adj(Q)=\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}$, then

(A) Q is a symmetric matrix
(B) $P^n = P \ \forall\ n \in N$
(C) $\left|P+P^2+P^3+P^4+P^5\right|=0$
(D) $\left|Q+Q^2+Q^3+Q^4+Q^5\right|=0$

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 the vertices $A(a), B(b), C(c), D(d), E(e), F(f)$ taken in anticlockwise manner form a regular hexagon in the argand plane. If $a=-2$ and $c=1-\sqrt{3}i$, where $i=\sqrt{-1}$, then the value of $d^2-a^2-b^2-c^2-e^2-f^2$ is equal to

43. Consider all 6-digit numbers of the form $pqrrqp$ where q is an odd digit. Determine the number of all such 6-digit numbers that are divisible by 7.

44. If a, b and c are three non-negative integers such that $2\left(a^3+b^3+c^3\right)=3(a+b+c)^2$, then maximum value of $a+b+c$ is

45. Consider the quadratic equation $x^2 + px + q = 0$ having $(p + q)$ as its root where p and q are integers. Then the maximum possible value of q^2 is

46. Consider a matrix of the form $\begin{bmatrix} a_1 & a_2 & a_3 & a_4 \\ a_5 & a_6 & a_7 & a_8 \end{bmatrix}$, where $a_1, a_2, \ldots\ldots, a_8 \in \{1, -1\}$ such that $\sum_{r=1}^{8} ra_r$ is a multiple of 3. How many such matrices are possible?

47. Let a plane intersect coordinate axes at points A, B and C respectively. Let areas of triangular faces OAB, OBC, OAC and ABC be A_1, A_2, A_3 and A_4 respectively (O is the origin). A_1, A_2, A_3 and A_4 form an increasing A.P. If $A_1 = 1$ sq. units and volume of the tetrahedron formed by the vertices O, A, B and C is equal to $\left(3\sqrt{2} + 2\right)$ cubic units, then the length of perpendicular drawn from origin on plane ABC 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. 48 and 49

Let k and n be two natural numbers and let a and b be any two numbers chosen from the set $P = \{1, 2, ..., k, k+1, k+2, ...2k, 2k+1, 2k+2, ...3k, ..., (n-1)k+1, (n-1)k+2, ..., nk\}$

48. If $k = 5$ and $n = 10$ and a and b are distinct numbers, then what is the probability that $a^4 - b^4$ is divisible by 5.

49. If $k = 3$ and $n = 2$, and a and b may be identical or distinct, then what is the probability that there exist real numbers x, y and z such that $x + y + z = a$ and $xy + yz + zx = b$

Paragraph for Question Nos. 50 and 51

There exists a matrix B such that $ABA^T = D$, where $A = \begin{bmatrix} 1 & 2 & 0 \\ 2 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$. Given D is a diagonal matrix of the form $D = diag(d_1, d_2, d_3)$ where d_1, d_2, d_3 are three values of x satisfying the equation $\det(A - xI) = 0$, where $d_1 < d_2 < d_3$ (I is an identity matrix of order 3×3).

50. The value of $\det(adjD)$ is equal to

51. If $B^T = B + kA$, then the value of real number k is equal to