FIITJEE

ALL INDIA TEST SERIES

PART TEST – III

JEE (Advanced)-2019

PAPER –1

TEST DATE: 16-12-2018

Time Allotted: 3 Hours **Maximum Marks: 264**

General Instructions:

- The test consists of total 60 questions.
- Each subject (PCM) has 20 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 – 10, 21 – 30, 41 – 50) *contains 30 multiple choice questions which have one or more than one correct answer. Each question carries* ***+4 marks*** *for correct answer and* ***–2 marks*** *for wrong answer.*

  Section–B (11 – 12, 31 – 32, 51 – 52) *contains 6 Match the following Type questions. Each question having 4 statements in Column I & 5 statements in Column II with any given statement in Column I having correct matching with 1 or more statement (s) given in Column II. Each statement carries* ***+2 marks*** *for correct answer and* ***–1 mark*** *for wrong answer.*

  Section–C (13 – 20, 33 – 40, 53 – 60) *contains 24 Numerical based questions with answers as numerical value from* ***0 to 9*** *and each question carries* ***+4 marks*** *for correct answer. There is no negative marking.*

Physics

PART – I

SECTION – A
(One OR More Than One Choice Type)

This section contains **10 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which only **one or more than one** is/are correct

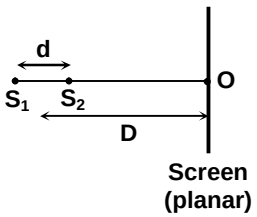
1. Two spherical planets P and Q have the same uniform density ρ, masses M_P and M_Q and surface areas A and 4A respectively. A spherical planet R also has uniform density ρ and its mass is $(M_P + M_Q)$. The escape velocities from the planets P, Q and R are v_P, v_Q and v_R respectively. Then
   (A) $v_Q > v_R > v_P$
   (B) $v_R > v_Q > v_P$
   (C) $\frac{v_R}{v_P} = 3$
   (D) $\frac{v_P}{v_Q} = \frac{1}{2}$

2. Two identical blocks are floating once in water (case-I) and once in mercury container (case –II). They are floating very near to each other. Choose the correct option(s).
   (A) In case –I, both blocks get attracted to each other.
   (B) In case –I, both blocks get repelled from each other.
   (C) In case –II, both blocks get attracted to each other.
   (D) In case –II, both blocks get repelled from each other.

3. The pitch of a screw gauge is 0.5 mm and there are 100 divisions on it's circular scale. The instrument reads 2 circular divisions when nothing is put in between its jaws. In measuring the diameter of a wire, there are 8 divisions on the main scale and 83rd division coincides with the reference line. Then choose the correct option(s).
   (A) Screw gauge is having zero error of -0.01 mm.
   (B) Screw gauge is having zero error of -0.49 mm.
   (C) Diameter of the wire is 4.405 mm.
   (D) Diameter of the wire is 4.425 mm.

4. Heavy stable nucleus have more neutrons than protons. This is because of the fact that
   (A) neutrons are heavier than protons.
   (B) electrostatic force between protons are repulsive.
   (C) neutrons decay into protons through beta decay.
   (D) nuclear forces between neutrons are weaker than that between protons.

5. Two point monochromatic and coherent sources of light of wavelength λ are each placed as shown in the figure. The initial phase difference between the sources is zero. If D >>d, select the correct option(s). (during the counting exclude fringes at infinity)



   (A) If $d = \frac{7\lambda}{2}$, O will be minima.
   (B) If $d = \lambda$, only one maxima can be observed on screen.
   (C) If $d = 4.8\,\lambda$, then a total 8 minima would be there on screen.
   (D) If $d = \frac{5\lambda}{2}$, then intensity at O would be minimum.

6. Sound of wavelength λ passes through a Quincke's tube, which is adjusted to give a maximum intensity I_0. Through what distance should the sliding tube be moved to give an intensity $\frac{I_0}{2}$.

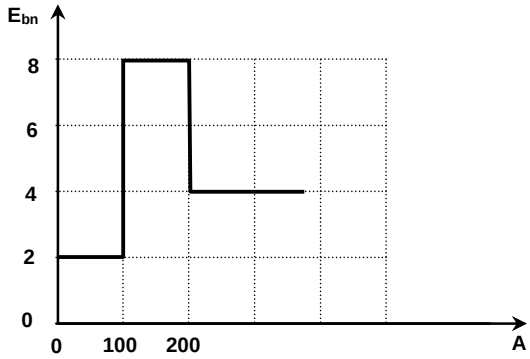
(A) $\frac{7\lambda}{8}$

(B) $\frac{3\lambda}{4}$

(C) $\lambda/4$

(D) $\lambda/8$

7. Assume that the nuclear binding energy per nucleon (E_{bn}) versus mass number (A) is as shown in the figure. Use this plot to choose the correct choice(s) given below:



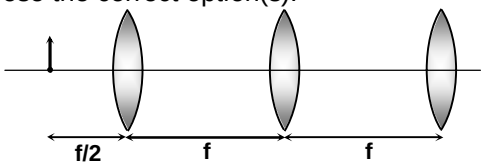
(A) Fusion of two nuclei with mass number lying in the range of $1 < A < 50$ will release energy.

(B) Fusion of two nuclei with mass numbers lying in the range of $51 < A < 100$ will release energy.

(C) Fission of a nucleus lying in the mass range of $100 < A < 200$ will release energy when breaks into two equal fragments.

(D) Fission of a nucleus lying in the mass range of $200 < A < 260$ will release energy when broken into two equal fragment.

8. Three identical biconvex lenses of focal length f are aligned with two neighbouring lenses separated by a distance f as shown in the figure. A small object is located at a distance f/2 in front of the leftmost lens. Choose the correct option(s).



(A) The final image formed is real and inverted.

(B) The final image formed is virtual and erect.

(C) The final image is of same size as that of object.

(D) The final image formed is virtual and inverted.

9. Kepler's law states that

I. the orbit of planets are elliptical with one focus at the sun.

II. A line connecting the sun and a planet sweeps out equal areas in equal times and

III. the square the period of a planet's orbit is proportional to the cube of its semi-major axis.

Which of these laws would remain true if the force of gravity were proportional to $\frac{1}{r^{2.5}}$, rather than $\frac{1}{r^2}$?

(A) only I

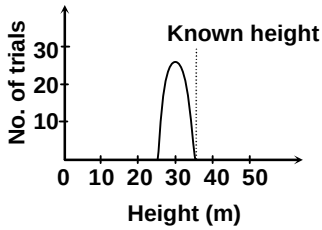
(B) only II

(C) only I and II

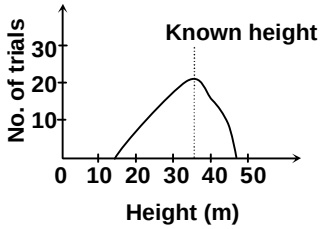
(D) none of these

10. Four classes of students measures the height of a building. Each class uses a different method and each measures the height many different times. The data for each class are plotted below. Which class made the most PRECISE measurement?

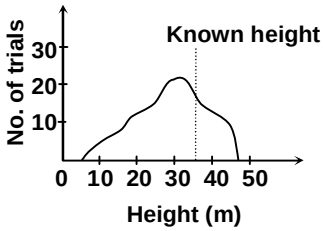
(A)



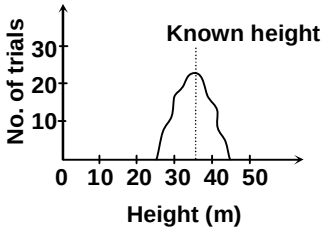
(B)



(C)



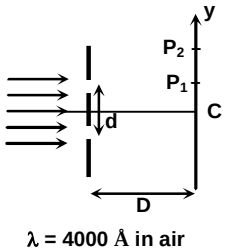
(D)

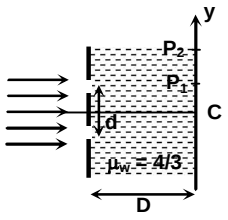
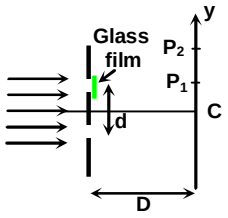
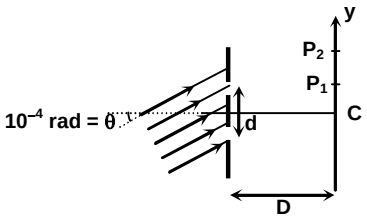


SECTION - B
Matrix – Match Type

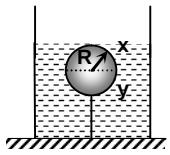
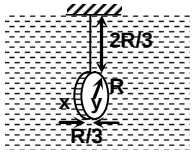
This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **ONE OR MORE** statement(s) in **Column II.**

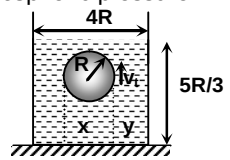
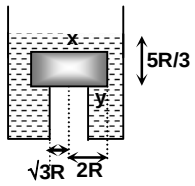
11. Column –I contains four different YDSE systems and Column –II contains intensity measured at some points on the screen. Do the correct match(es) in Column-I and Column –II. (CP_1 = 0.3 mm and CP_2 = 1.2 mm)

Column I			Column II	
(A)	 λ = 4000 Å in air	d = 1 mm D = 1 m Intensity at each slit = I_0	(p)	$I_C = 4I_0$

(B)	 λ = 4000 Å in air	d = 1 mm D = 1 m Intensity at each slit = I_0 and no absorption of light by water (μ_w = 4/3)	(q)	$I_{P_1} = 2I_0$
(C)	 λ = 4000 Å in air	d = 1 mm D = 1 m Film thickness t = 0.8 μm refractive index of film = 3/2 Intensity at each slit = I_0 and no absorption of light by glass	(r)	$I_{P_1} = 4I_0$
(D)	 λ = 4000 Å in air	d = 1 mm D = 1 m Intensity at each slit = I_0	(s)	$I_{P_1} = 0$
			(t)	$I_{P_2} = 2I_0$

12. Column-I contains some systems having a solid body and fluid. Column-II contains some physical quantities for the systems in column-I. Match column- II with column-I.

Column I			Column II	
(A)	Atmospheric pressure = P_0  Density of liquid = ρ Density of solid = σ(σ≠ρ)	A solid sphere of radius R is tied inside a non-viscous liquid and the system is in equilibrium (sphere just touching the top surface of the liquid). x-upper half spherical surface y-lower half spherical surface.	(p)	F_x (force on surface x applied by liquid) $= P_0\pi R^2 + \frac{1}{3}\pi R^3\rho g$
(B)	Atmospheric pressure = P_0  Density of liquid = ρ Density of solid = σ(σ≠ρ)	A solid disc of radius R, thickness R/3 is tied inside a non-viscous liquid and the system is in equilibrium x-rim of the disc y-one of the flat faces of disc.	(q)	F_y (Force on surface y applied by liquid) $= P_0\pi R^2 + \frac{5}{3}\pi R^3\rho g$

(C)	Atmospheric pressure = P_0  Density of liquid = ρ Density of solid = $\sigma(\sigma \neq \rho)$	A solid sphere of radius R is moving upward with a terminal velocity v_t inside a viscous liquid and the beaker is at rest. x-surface of the beaker base just below the sphere y-remaining surface of the beaker base	(r)	Force of buoyancy on sphere or disc (F_B) – weight of sphere or disc (W) is certainly positive
(D)	Atmospheric pressure = P_0  Density of liquid = ρ Density of solid = $\sigma(\sigma \neq \rho)$	A solid disc of radius 2R and height 4R/3 is placed inside a liquid, whose lower part is partially open to atmosphere and the disc is in equilibrium. x-top surface of the disc y-bottom surface of the disc which is in contact with liquid.	(s)	$\sigma < \rho$ (necessarily)
			(t)	$\sigma > \rho$ (necessarily)

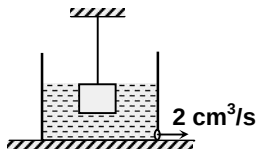
SECTION – C
(One Integer Value Correct Type)

This section contains **8 questions**. Each question, when worked out will result in **one integer** from 0 to 9 (both inclusive).

13. At a depth $h_1 = \frac{R}{2}$ from the surface of a planet (radius R = 3000 km), acceleration due to gravity is g_1. It's value changes by Δg_1, when one moves down further by 1 km. At a height h_2 above the surface of the earth acceleration due to gravity is g_2. It's value changes by Δg_2 when moves up further by 1 km. If $\Delta g_1 = \Delta g_2$ and $h_2 = d \times 10^2$ km. Find d. (Assume the planet to be a uniform sphere of radius R) (Take $2^{1/3} = 1.3$)

14. A massless metal plate is placed on a horizontal tabletop lubricated with oil. The sheet is a square of side length ℓ = 1.0 m and the oil layer has thickness h = 1.0 mm. Initially one edge of the sheet coincides with one edge of the table. The sheet is pulled outwards without rotation with a constant force F = 15 N. If coefficient of viscosity of the oil is η = 0.2 N-s/m^2, how long (in second) will it take to pull half of the sheet out of the table?

15. Figure shows a cubical block of side 10 cm and relative density 1.5 suspended by a wire of cross sectional area 10^{-6} m^2. The breaking stress of the wire is 7×10^6 N/m^2. The block is placed in a beaker of base area 200 cm^2 and initially at t = 0, the top surface of water and block coincide. There is a pump at the bottom corner which ejects 2 cm^3 of water per second. If the wire breaks at t = 10^k seconds, find k. (Take g = 10 m/s^2)

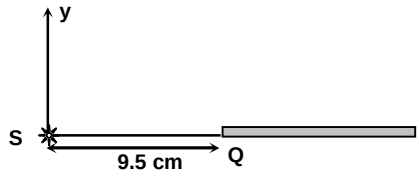


16. If is found that the spectral line of a certain star periodically becomes a doublet indicating that the radiation comes actually from two stars revolving about their centre of mass. Assuming the masses of the stars to be equal, find the distance between them if the maximum splitting of the spectral lines is equal to $\frac{\Delta\lambda}{\lambda} = 1.2\times10^{-4}$ and it occurs every τ = 30 days. Give your answer in terms of d $\times 10^7$ km (approximately) and write d.

17. Find the second longest resonance wavelength (in m) in a string of length ℓ = 6 m for which a point at x = $\frac{9}{4}$ m is an anti-node, where x is distance measured along the length of the string from a fixed end. (string is fixed at both ends)

18. An ideal fluid flows through a pipe of circular cross section of radius r at speed v_0 = 4m/s. Now a viscous liquid is made to flow through the same pipe at the same volume flow rate (measured in m^3/s). Find the maximum speed of the viscous liquid particle in the pipe in m/s.

19. A string SQ is connected to a long heavier string at Q. Linear mass density of the heavier string is 4 times of the string SQ. Length of SQ is 9.5 cm. Both the strings are subjected to same tension. A 50 Hz source connected at S produces transverse disturbance in the string. Wavelength of the wave in string SQ is observed to be 1 cm. If the source is switched on at time t = 0 and the smallest time (in sec) at which a point in the heavier string would oscillate in phase with the source at S is $\frac{T}{10}$. Find T.



20. A particle of mass m = 9 gm is trapped between two perfectly rigid parallel walls. The particle bounces back and forth between the walls without losing any energy. From a wave point of view, the particle trapped between the walls is like a standing wave in stretched string between the walls. Distance between the two walls is L = 1 m. Calculate the energy difference between third energy state and the ground state (lowest energy state) of the particle. Answer the energy difference in C $\times 10^{-65}$ Joule. (Take Planck's constant h = 6 $\times 10^{-34}$ J-sec)

Chemistry

PART – II

SECTION – A
(One OR More Than One Choice Type)

This section contains **10 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which only **one or more than one** is/are correct

21. Which of the following gives precipitate with $(NH_4)_2S$ in aqueous medium?
(A) Fe^{3+}
(B) Al^{3+}
(C) Cr^{3+}
(D) Co^{2+}

22. Which of the following statement is correct? (Neglect vibrational degree of freedom)
(A) Molar internal energy due to motion is $\frac{5}{2}RT$ of diatomic gas molecules.
(B) Molar internal energy due to motion is 3RT of bent triatomic gas molecule.
(C) Molar internal energy due to motion is $\frac{5}{2}RT$ of triatomic linear gas molecules.
(D) Molar internal energy due to motion is $\frac{3}{2}RT$ of monoatomic gas molecules.

23. Select the incorrect statement (s)
(A) above Kraft's temperature and critical micelle concentration, micelle formation take place.
(B) tetra ethyl lead acts as positive catalyst when mixed with petrol for combustion.
(C) higher the gold number more will be the protecting power towards coagulation.
(D) alum purify the water by forming silicate complex with mud particles.

24. 1.350 gm sample of $Co(NH_3)_5SO_4^{2-}Br^-$ (molar mass = 320) is dissolved to prepare 200 ml solution. Osmotic pressure of this solution is found to be 1.039 atm at 27^oC. Which statement/s is/are correct for this solution? [The above complex does not form yellow ppt. with $AgNO_3$]
(A) Each molecule gives two ions in solution.
(B) The complex $Co(NH_3)_5SO_4Br$ is completely soluble under given condition.
(C) Molarity of complex ion $[Co(NH_3)_5Br]^{2+}$ is 0.021 M in the solution.
(D) The van't Hoff factor of the complex is = 2.

25. Which of the following is/are correct for spontaneous isothermal chemical reaction?
(A) $\Delta H = 0$, because $\Delta T = 0$
(B) $\Delta S = 0$
(C) $\Delta U = 0$, because $\Delta T = 0$
(D) $\Delta G < 0$

26. The order of hybridization of the central atom in the following species:
$[PtCl_4]^{2-}, [AuCl_4]^-, [Ni(CO)_4], [Au(CN)_2]^-$
Along with increasing order of oxidation state are
(A) sp^3, sp, sp^3, dsp^2
(B) sp^3, sp, sp^3, sp^3
(C) sp^3, sp, dsp^2, dsp^2
(D) sp^3, sp, dsp^2, sp^3

27. There are three bottles having halides in a lab. One of them containing a yellow compound another has red compound and the last one has touch sensitive explosive. Which of the following combination is possible?
(A) AgI, HgI_2, $SnCl_4$
(B) $PbBr_2$, HgI_2, NI_3
(C) AgBr, $SbCl_3$, $SnCl_2$
(D) $FeCl_3$, $CrCl_3$, NF_3

28. By which of the following method(s) Cl_2 can be prepared?
(A) $2KMnO_4 + 16HCl \longrightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$
(B) At anode, by the electrolysis of aqueous NaCl
(C) $4HCl + MnO_2 \longrightarrow MnCl_2 + Cl_2 + 2H_2O$
(D) $HOCl + HCl \longrightarrow Cl_2 + H_2O$

29. Which of the following statement(s) is/are correct?
(A) Trapping of an electron in the anion vacancy leads to the formation of F-centre defects.
(B) In a fcc unit cell, the body centre is an octahedral voids.
(C) The edge length of the unit cell in NaCl is 552 pm $\left(r_{Na^+} = 95 \text{ pm}, r_{Cl^-} = 181 \text{ pm}\right)$
(D) The coordination number of ions in cesium halide crystal is 8.

30. Which of the following statements is/are correct?
(A) Temperature of an ideal gas does not change when it expands adiabatically in vacuum.
(B) $\Delta H, \Delta U, \Delta T, Q$ are zero for expansion in vaccum under adiabatic.conditions.
(C) On increasing the temperature compressibility of real gas decreases.
(D) Dalton's law of partial pressure is applicable at equilibrium for a reacting gaseous mixture.

SECTION - B
Matrix – Match Type

This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **ONE OR MORE** statement(s) in **Column II.**

31. Match the characteristics of Column – I with the characteristics in Column – II
$\left[\lambda_m = \text{molar conductance at molarity M}, \ \lambda_m^o = \text{molar conductance at infinite dilution}\right]$

Column-I		Column-II	
(A)	Conductivity of an electrolytic solution decreases	(p)	$C\lambda_m^2 / \lambda_m^o\left(\lambda_m^o - \lambda_m\right)$ where C is conc.
(B)	$\lambda^o_{CH_3COOH}$ at 25^oC	(q)	With increase of concentration
(C)	K_a of weak electrolyte	(r)	$> \lambda^o_{KCl}$ at 25^oC
(D)	Conductivity of an electrolytic solution increases	(s)	$< \lambda^o_{KCl}$ at 25^oC
		(t)	On decreasing the concentration

32. Match the characteristics of Column – I with the characteristics in Column – II

Column-I		Column-II	
(A)	$Co^{2+} + KNO_2 + CH_3COOH \longrightarrow$	(p)	Brown ppt.
(B)	$Ni^{2+} + DMG \longrightarrow$	(q)	Blue ppt.
(C)	$Cu^{2+} + K_4\left[Fe(CN)_6\right] \longrightarrow$	(r)	White ppt.
(D)	$Al^{3+} + (NH_4)_2 S \xrightarrow{H_2O}$	(s)	Red ppt.
		(t)	Yellow ppt.

SECTION – C
(One Integer Value Correct Type)

This section contains **8 questions**. Each question, when worked out will result in **one integer** from 0 to 9 (both inclusive).

33. λ_m of 10^{-3} M of a weak acid is $0.0142 \times 10^{+x}$ ohm^{-1}cm^2 / mol. $\lambda_m^o = 450$ ohm^{-1}cm^2 / mol at 25^{o}C, K_a of acid is 10^{-6}. The value of 'x' is

34. The rate of diffusion of hydrogen gas is $5\sqrt{5}$ times of that of a hydrocarbon at identical temperature and pressure if the molecular formula of hydrocarbon is C_nH_{2n-2}. The value of (n/2) is

35. In Fluorite type structure of X^{2+} & Y^- compound if we remove anions from one body diagonal and cations from all the corners then unit cell formula becomes $X_nY_m : n + m = z$, z is:

36. EMF of the following half-cell Pt | H_2(g) | H^+ (aq) is 0.177 if the $p_{H_2} = 1$ atm then calculate the pH of solution?

37. ΔG for the reaction at 500^{o}C is

$$\frac{2}{3}Al_2O_3 \longrightarrow \frac{4}{3}Al + O_2 \qquad \Delta G = +1930 \text{ kJ / mole}$$

The potential difference for this electrolytic reduction of Al_2O_3 at 500^{o}C is 'V' volt.
'V' is

38. Calculate the volume (in ml) of 0.1 M $AgNO_3$ required for complete precipitation of chloride ions present in 20 ml of 0.03 M solution of $[Cr(H_2O)_5Cl_2]Cl$, as AgCl is:

39. How many of the following reaction are correct?

(i) $XeF_6 + NaF \longrightarrow Na^+\left[XeF_7\right]^-$

(ii) $XeF_4 + SbF_5 \longrightarrow \left[XeF_3\right]^+\left[SbF_6\right]^-$

(iii) $6XeF_4 + 12H_2O \longrightarrow 4Xe + 2XeO_3 + 24HF + 3O_2$

(iv) $XeF_6 + H_2O \longrightarrow XeOF_4 + 2HF$

(v) $XeF_6 + 2H_2O \longrightarrow XeO_2F_2 + 4HF$

(vi) $NaNO_3 + Zn(\text{powder}) + NaOH \xrightarrow{\Delta} NH_3 + Na_2ZnO_2$

40. How many of these gives metal by self reduction method?
HgS, PbS, Cu_2S, FeS, ZnS, Na_2S

Mathematics

PART – III

SECTION – A
(One OR More Than One Choice Type)

This section contains **10 multiple choice questions.** Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which only **one or more than one** is/are correct

41. A matrix of order 3×3 is given as $A = [a_{ij}]$, where $a_{ij} \in \{-1, 1\}\ \forall$ i, j then possible values of |A| is (where |A| is determinant of matrix A)
(A) 2
(B) –2
(C) 0
(D) –4

42. If value of $3P = {}^{30}C_5 - {}^{30}C_6 + {}^{30}C_7 - ..... - {}^{30}C_{28} + 29$, and value of ${}^{Q}C_R = {}^{100}C_6 + 4\ {}^{100}C_7 + 6\ {}^{100}C_8 + 4\ {}^{100}C_9 + {}^{100}C_{10}$, then
(A) number of positive divisors of P are 16
(B) Q + R can be divisible either by 9 or 19
(C) if abcd = P, a, b, c, $d \in I^+$, then possible number of order pairs of (a, b, c, d) are 4^4
(D) P is an even integer

43. The number of integral solution of the equation $\alpha + \beta + \gamma + \delta = 18$, with the condition that $1 \le \alpha \le 5$, $-2 \le \beta \le 4$, $0 \le \gamma \le 5$, $3 \le \delta \le 9$, is k, then
(A) Total number of prime factors of k are 7
(B) Exponent of 5 in k! is 13
(C) Number of non negative integer solutions of the equation $x + y + z = \left[\frac{k}{12}\right]$ is 15
(where [.] denotes the greatest integer function)
(D) Number of ordered pair of (a, b, c) such that $abc = k^4$ is 225 (a, b, $c \in I$)

44. If A(1, 2, 3), B(1, 1, 1), C(1, 1, 2) and D(3, –1, 2) are vertices of a tetrahedron, then
(A) if $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$ is a variable plane which is equidistant from all the four vertices A, B, C, D, then maximum number of possible triplet of (a, b, c) are 7
(B) the volume of tetrahedron is 2 $unit^3$
(C) length of altitude from point D to the plane ABC is 2 unit
(D) if the acute angle between edges AB and CD is θ, then $\cos\theta = \frac{1}{\sqrt{10}}$

45. Let A(0, 6, 8) and B(6, 12, 0) be two given points and P(α, 0, 0) be a point on x-axis such that PA + PB is minimum, then
(A) if point Q is on the y-axis such that QA + QB is minimum then area of ΔPOQ is $\frac{90}{7}$ $unit^2$, where O is origin
(B) the volume of tetrahedron OPAB (where O is origin) is $\frac{240}{11}$ $unit^3$
(C) perpendicular distance from the point A to the plane containing the points P, Q, B is 8 unit
(D) the volume of tetrahedron OPAB (where O is origin) is $\frac{480}{11}$ $unit^3$

46. If $z_1 = 4 + 3i$, $z_2 = 1 - i$ and $z_3 = 7 + ki$, $k \in R$ such that z_1, z_2, z_3 are vertices of an isosceles triangle for different values of k, then
    (A) if $k_1, k_2, ... k_n$ are distinct possible values of k, then value of $[|k_1|] + [|k_2|] + ... + [|k_n|]$ is 11 (where [.] denotes the greatest integer function)
    (B) one of the possible values of area of ΔABC is 12 unit^2
    (C) if $k_1, k_2, ..., k_n$ are distinct possible values of k, then value of $[|k_1|] + [|k_2|] + ... + [|k_n|]$ is 3 (where [.] denotes the greatest integer function)
    (D) if $k_1, k_2, ... k_n$ are distinct possible value of k, then value $[|k_1 + k_2 + k_3 + ... + k_n|]$ is 3 (where [.] denotes the greatest integer function)

47. If P is a non null matrix of order 3×3 with real number as entries, such $P^3 = O$, where O is null matrix of order 3×3, then (where I is the identity matrix of order 3×3)
    (A) det of $(4P^2 - 2P + I)$ is a non-zero number
    (B) $I - 2P$ is an invertible matrix
    (C) if matrix P has all integer entries, then $\det(I - 4P^2) = 0$
    (D) if matrix P has all integer entries, then absolute value of $\det (I - 4P^2) = 1$

48. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ are three unit vectors such that $\left|\vec{a}-\vec{b}\right|^2 + \left|\vec{b}-\vec{c}\right|^2 + \left|\vec{c}+\vec{a}\right|^2 = 3$, then
    (A) $\frac{3}{2} < \left|\vec{a}+\vec{b}+\vec{c}\right| < \frac{5}{2}$
    (B) $\left|\vec{a}+\vec{b}\right| > \left|\vec{b}+\vec{c}\right|$
    (C) $\left|\vec{a}+2\vec{b}+3\vec{c}\right| < 20$
    (D) $\vec{a}$, $\vec{b}$, $\vec{c}$ form a system of orthogonal vectors

49. Let z_1, z_2, z_3 be complex numbers representing vertices A, B, C of a triangle. It is known that $|z_1| = |z_2| = |z_3| = 1$, and there exists $\alpha \in \left(0, \frac{\pi}{2}\right)$ such that $z_1 + z_2 \cos\alpha + z_3 \sin\alpha = 0$, then
    (A) ΔABC can be an isosceles triangle, with greatest side length of 2 unit
    (B) the maximum value of area of ΔABC is $\frac{1}{2\left(\sqrt{2}-1\right)}$ unit^2
    (C) triangle ABC can be a right angled triangle
    (D) triangle ABC can not be an equilateral triangle

50. On the side AB and AD of a scalene triangle ABD draw externally squares ABEF and ADGH with centres O and Q respectively if M is mid-point of side BD, then
    (A) OM : QM is equal to 1 : 2
    (B) OM : QM is equal to 1 : 1
    (C) $(OM)^2 + (QM)^2 > (OQ)^2$
    (D) $(OM)^2 + (QM)^2 = (OQ)^2$

SECTION - B
Matrix – Match Type

This section contains 2 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **ONE OR MORE** statement(s) in **Column II.**

51. Match the following Column-I with Column-II

	Column – I	Column – II
(A)	If the coefficient of x^{2r} is greater than half of the coefficient of x^{2r-1} in the expansion of $(1 + x)^{15}$, then possible value(s) of $\|r - 4\|$ is/are	(p) 2
(B)	The number of 3-digit number pqr such that we can construct an isosceles triangle with side length p, q and r is λ, then λ is divisible by	(q) 3
(C)	Let a, b, c be complex numbers such that $\|a\| = \|b\| = \|c\| > 0$ and $az^2 + bz + c = 0$, then possible value(s) of $\|z\| + 2$ is/are	(r) 4
(D)	If the number of ordered triplets of (x, y, z) such that x, y, z $\in$ {1, 2, 3, 4, 5, 6, 7, 8} with the condition that z > max{x, y} is k, then factors of k is/are	(s) 5
		(t) 6

52. Match the following Column-I with Column-II

	Column – I	Column – II
(A)	The probability that a randomly selected positive divisor of 10^{99} is an integer multiple of 10^{88}, is $\frac{p}{q}$, (p and q are coprime), then possible divisors of (q – p) is/are	(p) 2
(B)	Three distinct vertices are randomly selected among the vertices of a cube. The probability that these vertices form an isosceles triangle is $\frac{a}{b}$, (where a, b are coprime), then (b + a) is divisible by	(q) 3
(C)	A man can take either 1 step or 3 steps at a time. If he covers a distance of 10 steps in N number of different ways (without retracing his path at any point), then possible factors of $(N)^2$ is/are	(r) 4
(D)	If N be the number of equilateral triangles formed by joining vertices of a 2018 sided regular polygon, then N is divisible by	(s) 5
		(t) 6

SECTION – C
(One Integer Value Correct Type)

This section contains **8 questions**. Each question, when worked out will result in **one integer** from 0 to 9 (both inclusive).

53. Let a^b be (where 'a' is a prime number) the number of function f: A $\rightarrow$ B, where A = {1, 2, 3, ..., 2019} and B = {2019, 2020, 2021, 2022}, such that f(1) + f(2) + ... + f(2019) is odd number, then last digit of number b is _____

54. Let A and B be points (2, 0, 0) and (0, 4, 0) respectively. If E is mid-point of AB and F is mirror image of origin with respect to edge AB and let D the point on the line $\frac{x-1}{0} = \frac{y-2}{0} = \frac{z}{1}$ at 6 unit distance from the edge AB, then volume of tetrahedron DFAB is _____

55. If $A(z_1)$, $B(z_2)$, $C(z_3)$ and $D(z_4)$ are four points in the Argand plane such that z_1, z_2, z_3, z_4 are roots of equation $z^4 - 5z^3 + 18z^2 - 17z + 13 = 0$, and $|z_1| \neq |z_3|$. Let P is a point of intersection of line $z\left(i+\sqrt{3}\right)+\bar{z}\left(\sqrt{3}-i\right)-2\sqrt{3}=0$ with the real axis, then value of [(PA)(PC)] is equal to _____ (where [.] denotes the greatest integer function)

56. Let ω be a complex cube root of unity and $A=\begin{bmatrix}1 & p & q\\ \omega^{2017} & 1 & r\\ \omega^{2018} & \omega^{2020} & \omega^{2019}\end{bmatrix}$ where p, q, r are either ω or ω^2, then number of such distinct non singular matrix/matrices A is _____

57. Let $\vec{p}=\hat{i}+\hat{j}+\hat{k}$, $\vec{q}=a\hat{i}+b\hat{j}+c\hat{k}$, where a, b, c $\in$ {–3, –2, –1, 0, 1, 2} if the number of possible vectors $\vec{q}$ such that $\vec{p}\cdot\vec{q}=0$ is R, then $\frac{R}{5}$ is _____

58. If $\vec{a},\vec{b},\vec{c}$ are mutually perpendicular unit vectors and $\vec{d}$ is a unit vector which makes equal angle with $\vec{a},\vec{b}$ and $\vec{c}$, then the sum of squares of the possible values of $\left|\vec{a}+\vec{b}+\vec{c}+\vec{d}\right|$ is _____

59. Number of isosceles triangles formed by joining the vertices of a 2019 sided regular polygon is M, then the digit at tens place of M is _____

60. Let x, y, z be positive real numbers such that $xyz \geq \left(\frac{x}{3}+\frac{y}{3}+\frac{z}{3}\right)^3$ and 3x + 4y + 5z = 12, then the value of $x^3 + y^4 + z^5$ is equal to _____