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29-January-2023 (Morning Batch) : JEE Main Paper

PHYSICS **Section - A (Single Correct Answer)**

1. Match List-I with List-II :

List-I (Physical Quantity)		List-II (Dimensional Formula)	
A.	Pressure gradient	**I.**	$\left[M^0L^2T^{-2}\right]$
B.	Energy density	**II.**	$\left[M^1L^{-1}T^{-2}\right]$
C.	Electric Field	**III.**	$\left[M^1L^{-2}T^{-2}\right]$
D.	Latent heat	**IV.**	$\left[M^1L^1T^{-3}A^{-1}\right]$

Choose the correct answer from the options given below:

(A) A → III, B → II, C → I, D → IV (B) A → II, B → III, C → IV, D → I

(C) A → III, B → II, C → IV, D → I (D) A → II, B → III, C → I, D → IV

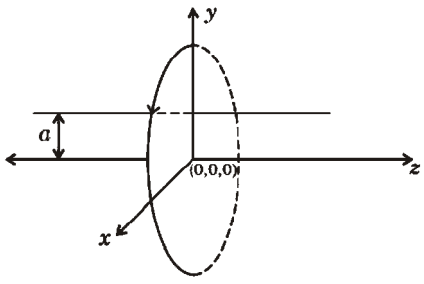
2. In a cuboid of dimension 2L × 2L × L , a charge q is placed at the centre of the surface 'S' having area of 4 L^2. The flux through the opposite surface to 'S' is given by

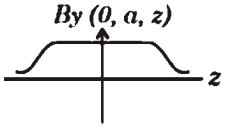
(A) $\frac{q}{12\varepsilon_0}$ (B) $\frac{q}{3\varepsilon_0}$ (C) $\frac{q}{2\varepsilon_0}$ (D) $\frac{q}{6\varepsilon_0}$

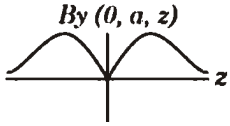
3. Ratio of thermal energy released in two resistor R and 3R connected in parallel in an electric circuit is :

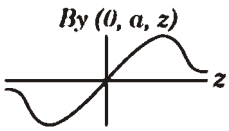
(A) 3 : 1 (B) 1 : 1 (C) 1 : 3 (D) 1 : 27

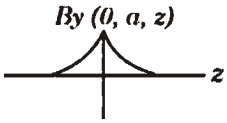
4. A single current carrying loop of wire carrying current I flowing in anticlockwise direction seen from +ve z-direction and lying in xy plane in shown in figure. The plot of $\hat{j}$ component of magnetic field (By) at a distance 'a' (less than radius of the coil) and on yz plane vs z coordinate look like



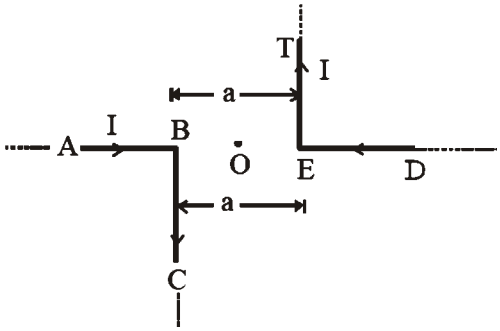
(A) 

(B) 

(C) 

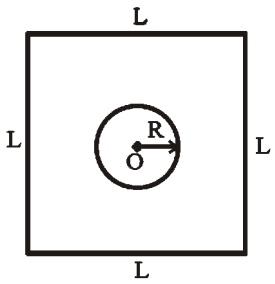
(D) 

5. The magnitude of magnetic induction at mid-point O due to current arrangement as shown in Fig will be :



(A) $\frac{\mu_0 I}{2\pi a}$ (B) 0 (C) $\frac{\mu_0 I}{4\pi a}$ (D) $\frac{\mu_0 I}{\pi a}$

6. Find the mutual inductance in the arrangement, when a small circular loop of wire of radius 'R' is placed inside a large square loop of wire of side L (L >> R). The loops are coplanar and their centres coincide :



(A) $M = \frac{\sqrt{2}\mu_0 R^2}{L}$ (B) $M = \frac{2\sqrt{2}\mu_0 R}{L^2}$ (C) $M = \frac{2\sqrt{2}\mu_0 R^2}{L}$ (D) $M = \frac{\sqrt{2}\mu_0 R}{L^2}$

7. Which of the following are true?

A. Speed of light in vacuum is dependent on the direction of propagation.

B. Speed of light in a medium in independent of the wavelength of light.

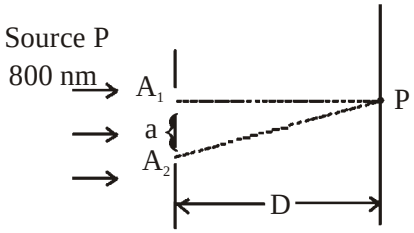
C. The speed of light is independent of the motion of the source.

D. The speed of light in a medium is independent of intensity.

Choose the correct answer from the option given below :

(A) A and C only (B) B and D only (C) B and C only (D) C and D only

8. In a Young's double slit experiment, two slits are illuminated with a light of wavelength 800 nm. The line joining A_1P is perpendicular to A_1A_2 as shown in the figure. If the first minimum is detected at P, the value of slits separation 'a' will be :



The distance of screen from slits D = 5 cm

(A) 0.4 mm (B) 0.5 mm (C) 0.2 mm (D) 0.1 mm

9. A stone is projected at angle 30° to the horizontal. The ratio of kinetic energy of the stone at point of projection to its kinetic energy at the highest point of flight will be :

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

10. A block of mass m slides down the plane inclined at angle 30° with an acceleration g/4. The value of coefficient of kinetic friction will be :

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

11. A car is moving on a horizontal curved road with radius 50 m. The approximate maximum speed of car will be, if friction between tyres and road is 0.34. [Take g = 10 ms^{-2}]

(A) 3.4 ms^{-1} (B) 22.4 ms^{-1} (C) 13 ms^{-1} (D) 17 ms^{-1}

12. Two particles of equal mass 'm' move in a circle of radius 'r' under the action of their mutual gravitational attraction. The speed of each particle will be :

(A) $\sqrt{\frac{GM}{2r}}$ (B) $\sqrt{\frac{4GM}{r}}$ (C) $\sqrt{\frac{GM}{r}}$ (D) $\sqrt{\frac{GM}{4r}}$

13. Surface tension of a soap bubble is 2.0×10^{-2} Nm^{-1}. Work done to increase the radius of soap bubble from 3.5 cm to 7 cm will be : [Take $\pi = \frac{22}{7}$]

(A) 0.72×10^{-4} J (B) 5.76×10^{-4} J (C) 18.48×10^{-4} J (D) 9.24×10^{-4} J

14. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A : If dQ and dW represent the heat supplied to the system and the work done on the system respectively. Then according to the first law of thermodynamics dQ = dU – dW.

Reason R : First law of thermodynamics is based on law of conservation of energy.

In the light of the above statements, choose the correct answer from the option given below :

(A) A is correct but R is not correct

(B) A is not correct but R is correct

(C) Both A and R are correct and R is the correct explanation of A

(D) Both A and R are correct but R is not the correct explanation of A

15. A bicycle tyre is filled with air having pressure of 270 kPa at 27°C. The approximate pressure of the air in the tyre when the temperature increases to 36°C is

(A) 270 kPa (B) 262 KPa (C) 278 kPa (D) 360 kPa

16. A person observes two moving trains, 'A' reaching the station and 'B' leaving the station with equal speed of 30 m/s. If both trains emit sounds with frequency 300 Hz, (Speed of sound : 330 m/s) approximate difference of frequencies heard by the person will be :

(A) 33 Hz (B) 55 Hz (C) 80 Hz (D) 10 Hz

17. If the height of transmitting and receiving antennas are 80 m each, the maximum line of sight distance will be : Given : Earth's radius = 6.4×10^6 m.

(A) 32 km (B) 28 km (C) 36 km (D) 64 km

18. The threshold wavelength for photoelectric emission from a material is 5500 Å. Photoelectrons will be emitted, when this material is illuminated with monochromatic radiation from a

A. 75 W infra-red lamp B. 10 W infra-red lamp

C. 75 W ultra-violet lamp D. 10 W ultra-violet lamp

Choose the correct answer from the options given below :

(A) B and C only (B) A and D only (C) C only (D) C and D only

19. If a radioactive element having half-life of 30 min is undergoing beta decay, the fraction of radioactive element remains undecayed after 90 min. will be :

(A) 1/8 (B) 1/16 (C) 1/4 (D) 1/2

20. Which of the following statement is not correct in the case of light emitting diodes?

A. It is a heavily doped p-n junction.

B. It emits light only when it is forward biased.

C. It emits light only when it is reverse biased.

D. The energy of the light emitted is equal to or slightly less than the energy gap of the semiconductor used.

Choose the correct answer from the options given below :

(A) C and D (B) A (C) C (D) B

SECTION - B

21. A radioactive element $^{242}_{92}X$ emits two α-particles, one electron and two positrons. The product nucleus is represented by $^{234}_{P}Y$. The value of P is ____

22. Two simple harmonic waves having equal amplitudes of 8 cm and equal frequency of 10 Hz are moving along the same direction. The resultant amplitude is also 8 cm. The phase difference between the individual waves is _____ degree.

23. A body cools from 60°C to 40°C in 6 minutes. If, temperature of surroundings is 10°C. Then, after the next 6 minutes, its temperature will be ____ °C.

24. A solid sphere of mass 2kg is making pure rolling on a horizontal surface with kinetic energy 2240 J. The velocity of centre of mass of the sphere will be ____ ms^{-1}.

25. A 0.4 kg mass takes 8s to reach ground when dropped from a certain height 'P' above surface of earth. The loss of potential energy in the last second of fall is ____ J. [Take g = 10 m/s^2]

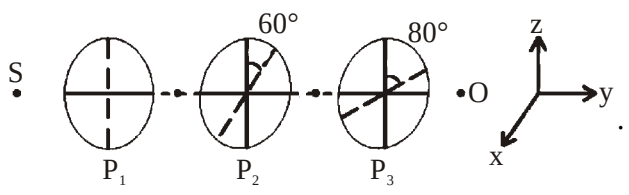
26. A tennis ball is dropped on to the floor from a height of 9.8 m. It rebounds to a height 5.0 m. Ball comes in contact with the floor for 0.2s. The average acceleration during contact is ____ 2 ms^{-2}.
[Given g = 10 ms^{-2}]

27. A point charge $q_1 = 4q_0$ is placed at origin. Another point charge $q_2 = -q_0$ is placed at x = 12 cm. Charge of proton is q_0. The proton is placed on x-axis so that the electrostatic force on the proton in zero. In this situation, the position of the proton from the origin is _____ cm.

28. In a metre bridge experiment the balance point in obtained if the gaps are closed by 2Ω and 3Ω. A shunt of XΩ is added to 3Ω resistor to shift the balancing point by 22.5 cm. The value of X is ____

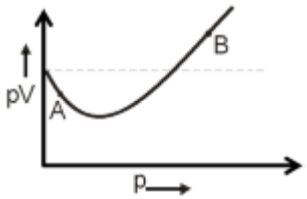
29. A certain elastic conducting material is stretched into a circular loop. It is placed with its plane perpendicular to a uniform magnetic field B = 0.8 T. When released the radius of the loop starts shrinking at a constant rate of 2 cm^{-1}. The induced emf in the loop at an instant when the radius of the loop is 10 cm will be __ mV.

30. As shown in figures, three identical polaroids P_1, P_2 and P_3 are placed one after another. The pass axis of P_2 and P_3 are inclined at angle of 60° and 90° with respect to axis of P_1. The source S has an intensity of $256\frac{W}{m^2}$. The intensity of light at point O is _____ $\frac{W}{m^2}$.



CHEMISTRY **Section - A (Single Correct Answer)**

31. For 1 mol of gas, the plot of pV *vs* p is shown below. 'p' is the pressure and V is the volume of the gas.



What is the value of compressibility factor at point A ?

(A) $1-\frac{a}{RTV}$ (B) $1+\frac{b}{V}$ (C) $1-\frac{b}{V}$ (D) $1+\frac{a}{RTV}$

32. The shortest wavelength of hydrogen atom in Lyman series is λ. The longest wavelength in Balmer series of He^+ is

(A) $\frac{5}{9\lambda}$ (B) $\frac{9\lambda}{5}$ (C) $\frac{36\lambda}{5}$ (D) $\frac{5\lambda}{9}$

33. Which of the following salt solutions would coagulate the colloid soloution formed when $FeCl_3$ is added to NaOH solution, at the fastest rate ?

(A) 10 mL of 0.2 mol dm^{-3} $AlCl_3$ (B) 10 mL of 0.1 mol dm^{-3} Na_2SO_4

(C) 10 mL of 0.1 mol dm^{-3} $Ca_3(PO_4)_2$ (D) 10 mL of 0.15 mol dm^{-3} $CaCl_2$

34. The bond dissociation energy is highest for

(A) Cl_2 (B) I_2 (C) Br_2 (D) F_2

35. The reaction representing the Mond process for metal refining is _____.

(A) $Ni + 4CO \xrightarrow{\Delta} Ni(CO)_4$ (B) $2K[Au(CN)_2] + Zn \xrightarrow{\Delta} K_2[Zn(CN)_4] + 2Au$

(C) $Zr + 2I_2 \xrightarrow{\Delta} Zr\ I_4$ (D) $ZnO + C \xrightarrow{\Delta} Zn + CO$

36. Which of the given compounds can enhance the efficiency of hydrogen storage tank ?

(A) Li/P_4 (B) SiH_4

(C) $NaNi_5$ (D) Di-isobutylaluminium hydride

37. The **correct** order of hydration enthalpies is

A. K^+ B. Rb^+ C. Mg^{2+} D. Cs^+

E. Ca^{2+}

Choose the correct answer from the options given below.

(A) C > A > E > B > D (B) E > C > A > B > D

(C) C > E > A > D > B (D) C > E > A > B > D

38. The magnetic behaviour of Li_2O, Na_2O_2 & KO_2, respectively, are

(A) diamagnetic, paramagnetic and diamagnetic

(B) paramagnetic, paramagnetic and diamagnetic

(C) paramagnetic, diamagnetic and paramagnetic

(D) diamagnetic, diamagnetic and paramagnetic

39. "A" obtained by Ostwald.s method involving air oxidation of NH_3, upon further air oxidation produces "B". "B" on hydration forms an oxoacid of Nitrogen along with evolution of "A". The oxoacid also produces "A" and gives positive brown ring test.

(A) NO_2, N_2O_5 (B) NO_2, N_2O_4 (C) NO, NO_2 (D) N_2O_3, NO_2

40. The standard electrode potential (M^{3+}/M^{2+}) for V, Cr, Mn & Co are –0.26 V, –0.41 V, +1.57 V and +1.97 V, respectively. The metal ions which can liberate H_2 from a dilute acid are

(A) V^{2+} and Mn^{2+} (B) Cr^{2+} and CO^{2+} (C) V^{2+} and Cr^{2+} (D) Mn^{2+} and Co^{2+}

41. **Correct** statement about smog is

(A) NO_2 is present in classical smog

(B) Both NO_2 and SO_2 are present in classical smog

(C) Photochemical smog has high concentration of oxidizing agents

(D) Classical smog also has high concentration of oxidizing agents

42. Chiral complex from the following is :

Here, en = ethylene diamine

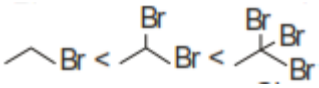
(A) *cis* – $[PtCl_2(en)_2]^{2+}$ (B) *trans* – $[PtCl_2(en)_2]^{2+}$

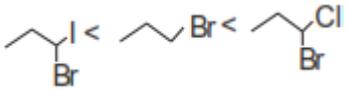
(C) *cis* – $[PtCl_2(NH_3)_2]$ (D) *trans* – $[Co(NH_3)_4Cl_2]^+$

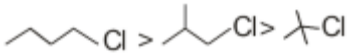
43. Identify the **correct** order for the given property for following compounds.

(A) Boiling Point : 

(B) Density : 

(C) Boiling Point : 

(D) Density : 

(E) Boiling Point : 

Choose the correct answer from the option given below.

(A) (B), (C) and (D) only (B) (A), (C) and (E) only

(C) (A), (C) and (D) only (D) (A), (B) and (E) only

44. The increasing order of pK_a for the following phenols is

(A) 2, 4-Dinitrophenol (B) 4-Nitrophenol

(C) 2, 4, 5-Trimethylphenol (D) Phenol

(5) 3-Chlorophenol

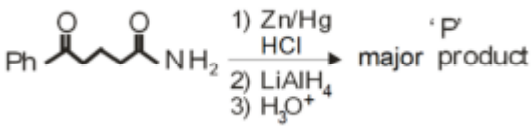
45. Match List I with List II.

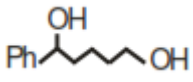
	List-I *Reaction*		**List-II** *Reagents*
A.	Hoffmann Degradation	I.	conc. KOH, Δ
B.	Clemenson reduction	II.	$CHCl_3$, $NaOH/H_3O^+$
C.	Cannizaro reaction	III.	Br_2, NaOH
D.	Reimer-Tiemannreaction	IV.	Zn-Hg/HCl

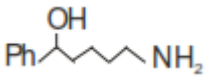
(A) (A)–III, (B)–IV, (C)–II, (D)–I (B) (A)–II, (B)–IV, (C)–I, (D)–III

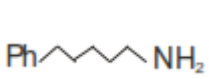
(C) (A)–III, (B)–IV, (C)–I, (D)–II (D) (A)–II, (B)–I, (C)–III, (D)–IV

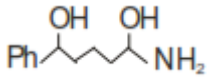
46. The major product 'P' for the following sequence of reactions is :



(A) 

(B) 

(C) 

(D) 

47. During the borax bead test with $CuSO_4$, a blue green colour of the bead was observed in oxidising flame due to the formation of

(A) Cu_3B_2 (B) Cu (C) $Cu(BO_2)_2$ (D) CuO

48. Match List I with List II

	List I *Antimicrobials*		**List II** *Names*
A.	Narrow Spectrum Antibiotic	I.	Furacin
B.	Antiseptic	II.	Sulphur dioxide
C.	Disinfectants	III.	Penicillin-G
D.	Broad spectrum antibiotic	IV.	Chloramphenicol

(A) (A)–III, (B)–I, (C)–II, (D)–IV (B) (A)–I, (B)–II, (C)–IV, (D)–III

(C) (A)–II, (B)–I, (C)–IV, (D)–III (D) (A)–III, (B)–I, (C)–IV, (D)–II

49. Number of cyclic tripeptides formed with 2 amino acids A and B is:

(A) 2 (B) 3 (C) 5 (D) 4

50. Compound that will give positive Lassaigne's test for both nitrogen and halogen is

(A) $N_2H_4 \cdot HCl$ (B) $CH_3NH_2 \cdot HCl$ (C) NH_4Cl (D) $NH_2OH \cdot HCl$

SECTION - B

51. Millimoles of calcium hydroxyide required to produce 100 mL of the aqueous solution of pH 12 is $x \times 10^{-1}$. The value of x is _____.

(Nearest integer).

Assume complete dissociation.

52. The number of molecules or ions from the following, which do not have odd number of electrons are _____.

(A) NO_2 (B) ICl_4^- (C) BrF_3 (D) ClO_2

(E) NO_2^+ (F) NO

53. Consider the following reaction approaching equilibrium at 27°C and 1 atm pressure.

$$A + B \underset{K_r=10^2}{\overset{K_f=10^3}{\rightleftharpoons}} C + D$$

The standard Gibb.s energy change $(\Delta_r G^\circ)$ at 27°C is (–) _____ kJ mol^{-1}. [Nearest integer]

[**Given :** R = 8.3 J K^{-1} mol^{-1} and ln 10 = 2.3]

54. Solid Lead nitrate is dissolved in 1 litre of water. The solution was found to boil at 100.15°C. When 0.2 mol of NaCl is added to the resulting solution, it was observed that the solution froze at –0.8° C. The solutbility product of $PbCl_2$ formed is _____ $\times 10^{-6}$ at 298 K. (Nearest integer)

Given :

K_b = 0.5 K kg mol^{-1} & K_f = 1.8 kg mol^{-1}

Assume molality to be equal to molarity in all cases.

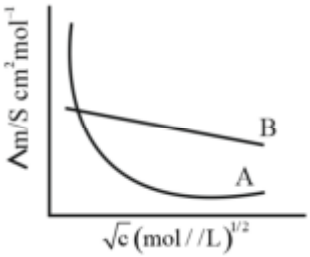
55. Water decomposes at 2300 K

$$H_2O(g) \rightarrow H_2(g) + \frac{1}{2}O_2(g)$$

The percent of water decomposing at 2300 K and 1 bar is _____. [Nearest integer]

Equilibrium constant for the reaction is 2×10^{-3} at 2300 K.

56. Following figure shows dependence of molar conductance of two electrolytes on concentration. Λ_m^o is the limiting molar conductivity.



The number of **incorrect** statement(s) from the following is _____.

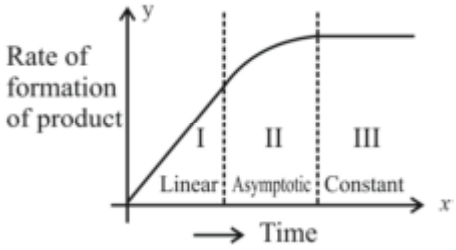
(A) Λ_m^o for electrolyte A is obtained by extra-polation.

(B) For electrolyte B, vx Λm vs $\sqrt{c}$ graph is a straight line with intercept equal to Λ_m^o.

(C) At infinite dilution, the value of degree of dissociation approach zero for electrolyte B.

(D) Λ_m^o for any electrolyte A or B can be calculated using λ^o for individual ions.

57. For certain chemical reaction X → Y, the rate of formation of product is plotted against the time as shown in the figure. The number of **correct** statement/s from the following is _____.



(A) Over all order of this reaction is one.

(B) Order of this reaction can't be determined.

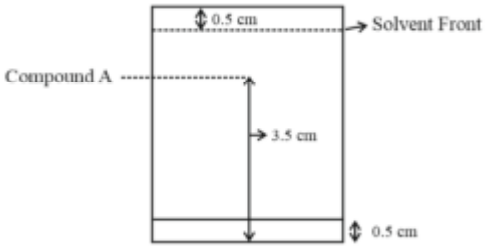
(C) In region-I and III, the reaction is of first and zero order respectively.

(D) In region-II, the reaction is of first order.

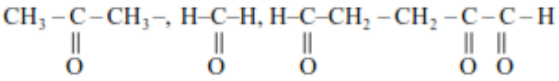
(E) In region-II, the order of reaction is in the range of 0.1 to 0.9.

58. The sum of bridging carbonyls in $W(CO)_6$ and $Mn_2(CO)_{10}$ is _____.

59. Following chromatogram was developed by adsorption of compound 'A' on a 6 cm TLC glass plate. Retardation factor of the compound 'A' is _____ $\times 10^{-1}$.



60. 17 mg of a hydrocarbon (M.F. $C_{10}H_{16}$) takes up 8.40 mL of the H_2 gas measured at 0°C and 760 mm of Hg. Ozonolysis of the same hydrocarbon yields.



The number of double bond/s present in the hydrocarbon is _____.

MATHEMATICS Section - A (Single Correct Answer)

61. The domain of $f(x)=\frac{\log_{(x+1)}(x-2)}{e^{2\log_e x}-(2x+3)}$, $x \in R$ is

(A) $\mathbb{R}-\{1-3\}$ (B) $(2, \infty)-\{3\}$ (C) $(-1, \infty)-\{3\}$ (D) $\mathbb{R}-\{3\}$

62. Let $f : R \to R$ be a function such that $f(x)=\frac{x^2+2x+1}{x^2+1}$. Then

(A) f(x) is many-one in $(\infty, -1)$ (B) f(x) is many-one in $(1, \infty)$

(C) f(x) is one-one in $[1, \infty)$ but not in $(-\infty, \infty)$ (D) f(x) is one-one in $(-\infty, \infty)$

63. For two non-zero complex number z_1 and z_2, if $Re(z_1z_2) = 0$ and $Re(z_1 + z_2) = 0$, then which of the following are possible ?

(1) $Im(z_1) > 0$ and $Im(z_2) > 0$ (2) $Im(z_1) < 0$ and $Im(z_2) > 0$

(3) $Im(z_1) > 0$ and $Im(z_2) < 0$ (4) $Im(z_1) < 0$ and $Im(z_2) < 0$

Choose the correct answer from the options given below :

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

64. Let $\lambda \neq 0$ be a real number. Let α, β be the roots of the equation $14x^2 - 31x + 3\lambda = 0$ and α, γ be the roots of the equation $35x^2 - 53x + 4\lambda = 0$. Then $\frac{3\alpha}{\beta}$ and $\frac{4\alpha}{\gamma}$ are the roots of the equation :

(A) $7x^2 + 245x - 250 = 0$

(B) $7x^2 - 245x + 250 = 0$

(C) $49x^2 - 245x + 250 = 0$

(D) $49x^2 + 245x + 250 = 0$

65. Consider the following system of questions

$\alpha x + 2y + z = 1$

$2\alpha x + 3y + z = 1$

$3x + \alpha y + 2z = \beta$

For some $\alpha, \beta \in \mathbb{R}$. Then which of the following is NOT correct.

(A) It has no solution if $\alpha = -1$ and $\beta \neq 2$

(B) It has no solution for $\alpha = -1$ and for all $\beta \in \mathbb{R}$

(C) It has no solution for $\alpha = 3$ and for all $\beta \neq 2$

(D) It has a solution for all $\alpha \neq -1$ and $\beta = 2$

66. Let α and β be real numbers. Consider a 3×3 matrix A such that $A^2 = 3A + \alpha I$. If $A^4 = 21A + \beta I$, then

(A) $\alpha = 1$ (B) $\alpha = 4$ (C) $\beta = 8$ (D) $\beta = -8$

67. Let x = 2 be a root of the equation $x^2 + px + q = 0$ and $f(x) = \begin{cases} \frac{1-\cos(x^2-4px+q^2+8q+16)}{(x-2p)^4}, & x \neq 2p \\ 0, & x = 2p \end{cases}$

Then $\lim\limits_{x \to 2p^+} [f(x)]$

where [.] denotes greatest integer function, is

(A) 2 (B) 1 (C) 0 (D) –1

68. Let $f(x) = x + \frac{a}{\pi^2-4}\sin x + \frac{b}{\pi^2-4}\cos x,\ x \in \mathbb{R}$ be a function which satisfies $f(x) = x + \int_0^{\pi/2} \sin(x+y) f(y)dy$. Then (a + b) is equal to

(A) $-\pi(\pi + 2)$ (B) $-2\pi(\pi + 2)$ (C) $-2\pi(\pi - 2)$ (D) $-\pi(\pi - 2)$

69. Let $A = \{(x, y) \in R \times R : y \geq 0,\ 2x \leq y \leq \sqrt{4-(x-1)^2}\}$ and

$B = \{(x, y) \in R \times R : 0 \leq y \leq \min\{2x, \sqrt{4-(x-1)^2}\}\}$

Then the ratio of the area of A to the area of B is

(A) $\frac{\pi-1}{\pi+1}$ (B) $\frac{\pi}{\pi-1}$ (C) $\frac{\pi}{\pi+1}$ (D) $\frac{\pi+1}{\pi-1}$

70. Let Δ be the area of the region $\{(x, y) \in \mathbb{R}^2 : x^2 + y^2 \leq 21,\ y^2 \leq 4x,\ x \geq 1\}$. Then $\frac{1}{2}\left(\Delta - 21\sin^{-1}\frac{2}{\sqrt{7}}\right)$ is equal to

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

71. A light ray emits from the origin making an angle 30º with the positive x-axis. After getting reflected by the line x + y = 1, if this ray intersects x-axis at Q, then the abscissa of Q is

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

72. Let B and C be the two points on the line y + x = 0 such that B and C are symmetric with respect to the origin. Suppose A is a point on y – 2x = 2 such that ΔABC is an equilateral triangle. Then, the area of the ΔABC is

(A) $3\sqrt{3}$ (B) $2\sqrt{3}$ (C) $\frac{8}{\sqrt{3}}$ (D) $\frac{10}{\sqrt{3}}$

73. Let the tangents at the points A (4, –11) and B(8, –5) on the circle $x^2 + y^2 – 3x + 10y – 15 = 0$, intersect at the point C. Then the radius of the circle, whose centre is C and the line joining A and B is its tangent, is equal to

(A) $\frac{3\sqrt{3}}{4}$ (B) $2\sqrt{13}$ (C) $\sqrt{13}$ (D) $\frac{2\sqrt{13}}{3}$

74. Let [x] denote the greatest integer $\le x$. Consider the function $f(x) = \max\{x^2, 1 + [x]\}$. Then the value of the integral $\int_0^2 f(x)dx$ is :

(A) $\frac{5+4\sqrt{2}}{3}$ (B) $\frac{8+4\sqrt{2}}{3}$ (C) $\frac{1+5\sqrt{2}}{3}$ (D) $\frac{4+5\sqrt{2}}{3}$

75. If the vectors $\vec{a} = \lambda\hat{i} + \mu\hat{j} + 4\hat{k}$, $\vec{b} = 2\hat{i} + 4\hat{j} - 2\hat{k}$ and $\vec{c} = 2\hat{i} + 3\hat{j} + \hat{k}$ are coplanar and the projection of $\vec{a}$ on the vector $\vec{b}$ is $\sqrt{54}$ units, then the sum of all possible values of $\lambda + \mu$ is equal to

(A) 0 (B) 6 (C) 24 (D) 18

76. Fifteen football players of a club-team are given 15 T-shirts with their names written on the backside. If the players pick up the T-shirts randomly, then the probability that at least 3 players pick the correct T-shirt is

(A) $\frac{5}{24}$ (B) $\frac{2}{15}$ (C) $\frac{1}{6}$ (D) $\frac{5}{36}$

77. Let $f(\theta) = 3\left(\sin^4\left(\frac{3\pi}{2} - \theta\right) + \sin^4(3\pi + \theta)\right) - 2(1 - \sin^2 2\theta)$ and $S = \left\{\theta \in [0, \pi] : f'(\theta) = -\frac{\sqrt{3}}{2}\right\}$. If $4\beta = \sum_{\theta \in S} \theta$, then $f(\beta)$ is equal to

(A) $\frac{11}{8}$ (B) $\frac{5}{4}$ (C) $\frac{9}{8}$ (D) $\frac{3}{2}$

78. If p, q and r are three propositions, then which of the following combination of truth values of p, q and r makes the logical expression $\{(p \vee q) \wedge ((\sim p) \vee r)\} \rightarrow ((\sim q) \vee r)$ false ?

(A) p = T, q = F, r = T (B) p = T, q = T, r = F
(C) p = F, q = T, r = F (D) p = T, q = F, r = F

79. Three rotten apples are mixed accidently with seven good apples and four apples are drawn one by one without replacement. Let the random variable X denote the number of rotten apples. If μ and σ^2 represent mean and variance of X, respectively, then $10(\mu^2 + \sigma^2)$ is equal to

(A) 20 (B) 250 (C) 25 (D) 30

80. Let y = f(x) be the solution of the differential equation $y(x + 1)\,dx - x^2dy = 0$, $y(1) = e$. Then $\lim_{x \to 0^+} f(x)$ is equal to

(A) 0 (B) $\frac{1}{e}$ (C) e^2 (D) $\frac{1}{e^2}$

SECTION - B

81. Let the co-ordinates of one vertex of ΔABC be $A(0, 2, \alpha)$ and the other two vertices lie on the line $\frac{x+\alpha}{5} = \frac{y-1}{2} = \frac{z+4}{3}$. For $\alpha \in \mathbb{Z}$, if the area of ΔABC is 21 sq. units and the line segment BC has length $2\sqrt{21}$ units, then α^2 is equal to _____

82. Let the equation of the plane P containing the line $x+10=\frac{8-y}{2}=z$ be ax + by + 3z = 2(a + b) and the distance of the plane P from the point (1, 27, 7) be c. Then $a^2 + b^2 + c^2$ is equal to____.

83. Suppose f is a function satisfying f(x + y) = f(x) + f(y) for all $x, y \in \mathbb{N}$ and $f(1)=\frac{1}{5}$. If $\sum_{n=1}^{m}\frac{f(n)}{n(n+1)(n+2)}=\frac{1}{12}$, then m is equal to ____.

84. Let a_1, a_2, a_3,..... be a GP of increasing positive numbers. If the product of fourth and sixth terms is 9 and the sum of fifth and seventh terms is 24, then $a_1a_9 + a_2a_4a_9 + a_5 + a_7$ is equal to____.

85. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three non-zero non-coplanar vectors. Let the position vectors of four points A, B, C and D be $\vec{a}-\vec{b}+\vec{c}$, $\lambda\vec{a}-3\vec{b}+4\vec{c}$, $-\vec{a}+2\vec{b}-3\vec{c}$ and $2\vec{a}-4\vec{b}+6\vec{c}$ respectively. If $\overrightarrow{AB}$, $\overrightarrow{AC}$ and $\overrightarrow{AD}$ are coplanar, then λ is :

86. If all the six digit numbers $x_1 x_2 x_3 x_4 x_5 x_6$ with $0 < x_1 < x_2 < x_3 < x_4 < x_5 < x_6$ are arranged in the increasing order, then the sum of the digits in the 72^{th} number is_____.

87. Let $f:\mathbb{R}\to\mathbb{R}$ be a differentiable function that satisfies the relation f(x + y) = f(x) + f(y) –1, $\forall x, y \in \mathbb{R}$. If f '(0) = 2, then |f(–2)| is equal to _____.

88. If the co-efficient of x^9 in $\left(\alpha x^3+\frac{1}{\beta x}\right)^{11}$ and the co-efficient of x^{-9} in $\left(\alpha x-\frac{1}{\beta x^3}\right)^{11}$ are equal, then $(\alpha\beta)^2$ is equal to _____.

89. Let the coefficients of three consecutive terms in the binomial expansion of $(1 + 2x)^n$ be in the ratio 2 : 5 : 8. Then the coefficient of the term, which is in the middle of these three terms, is_____.

90. Five digit numbers are formed using the digits 1, 2, 3, 5, 7 with repetitions and are written in descending order with serial numbers. For example, the number 77777 has serial number 1. Then the serial number of 35337 is_____.

❐ ❐ ❐

29-January-2023 (Morning Batch) : JEE Main Paper

ANSWER KEY

Physics

Single Choice Correct

1.	C	2.	D	3.	A	4.	C	5.	D
6.	C	7.	D	8.	C	9.	D	10.	B
11.	C	12.	D	13.	C	14.	C	15.	C
16.	B	17.	D	18.	D	19.	A	20.	C

Numerical Value

21.	87	22.	120	23.	28	24.	40	25.	300
26.	120	27.	24	28.	2	29.	10	30.	24

Chemistry

Single Choice Correct

31.	A	32.	B	33.	A	34.	A	35.	A
36.	C	37.	D	38.	D	39.	C	40.	C
41.	C	42.	A	43.	B	44.	B	45.	C
46.	C	47.	C	48.	A	49.	D	50.	B

Numerical Value

51.	5	52.	3	53.	6	54.	13	55.	2
56.	2	57.	2	58.	0	59.	6	60.	3

Mathematics

Single Choice Correct

61.	B	62.	C	63.	B	64.	C	65.	B
66.	D	67.	C	68.	B	69.	A	70.	D
71.	B	72.	C	73.	D	74.	A	75.	C
76.	C	77.	B	78.	C	79.	A	80.	A

Numerical Value

81.	9	82.	355	83.	10	84.	60	85.	2
86.	32	87.	3	88.	1	89.	1120	90.	1436