

Solutions to JEE(Main)-2019

Test Date: 8th April 2019 (First Shift)

PHYSICS, CHEMISTRY & MATHEMATICS

Paper - 1

Time Allotted: 3 Hours

Maximum Marks: 360

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

Important Instructions:

1. The test is of **3 hours** duration.
2. This **Test Paper** consists of **90** questions. The maximum marks are **360**.
3. There are **three** parts in the question paper A, B, C consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each question is allotted **4 (four)** marks for correct response.
4. Out of the four options given for each question, only one option is the correct answer.
5. For each incorrect response 1 mark i.e. $\frac{1}{4}$ (**one-fourth**) marks of the total marks allotted to the question will be deducted from the total score. No deduction from the total score, however, will be made if no response is indicated for an item in the Answer Box.
6. *Candidates will be awarded marks as stated above in **instruction No.3** for correct response of each question. One mark will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer box.*
7. There is only one correct response for each question. Marked up more than one response in any question will be treated as wrong response and marked up for wrong response will be deducted accordingly as per **instruction 6** above.

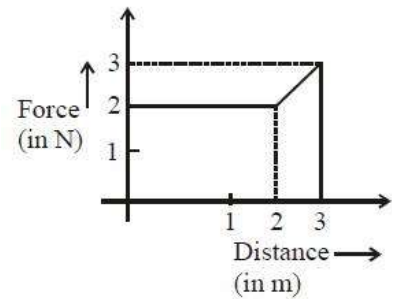
PART –A (PHYSICS)

1. If 10^{22} gas molecules each of mass 10^{-26} kg collide with a surface (perpendicular to it) elastically per second over an area 1 m^2 with a speed 10^4 m/s, the pressure exerted by the gas molecules will be of the order of:

- (A) $10^8 \frac{\text{N}}{\text{m}^2}$ (B) $10^3 \frac{\text{N}}{\text{m}^2}$
 (C) $10^4 \frac{\text{N}}{\text{m}^2}$ (D) $10^{16} \frac{\text{N}}{\text{m}^2}$

2. A particle moves in one dimension from rest under the influence of a force that varies with the distance traveled by that varies with the distance traveled by the particle as shown in the figure. The kinetic energy of the particle after it has traveled 3 m is:

- (A) 2.5 J
 (B) 4 J
 (C) 5 J
 (D) 6.5 J

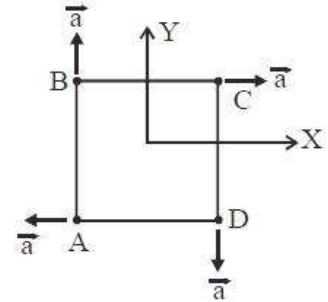


3. An upright object is placed at a distance of 40 cm in front of a convergent lens of focal length 20 cm. A convergent mirror of focal length 10 cm is placed at a distance of 60 cm on the other side of the lens. The position and size of the final image will be:

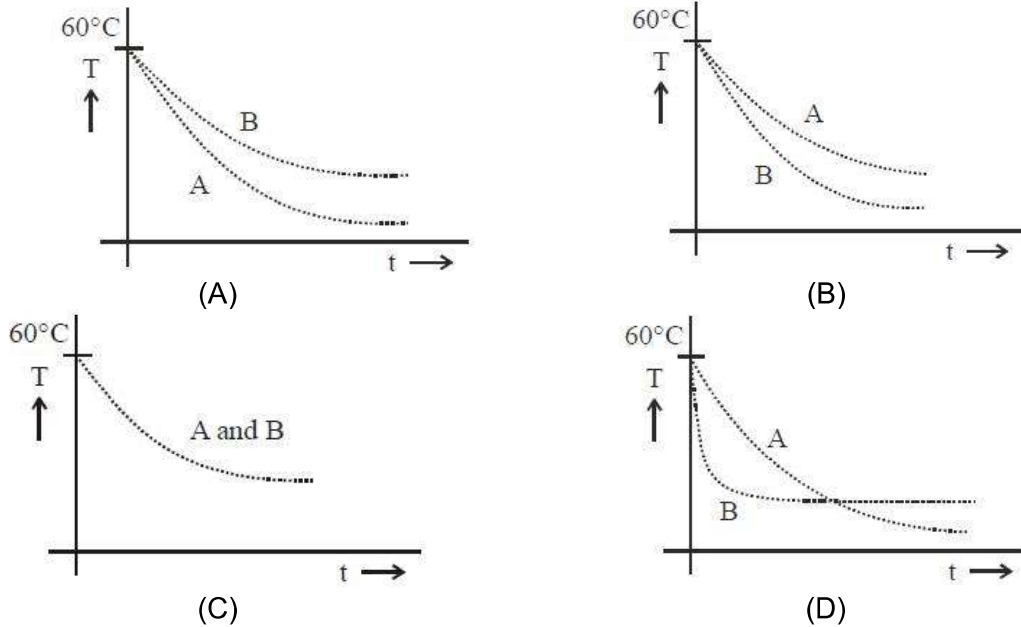
- (A) 40 cm from the convergent mirror, same size as the object
 (B) 20 cm from the convergent mirror, same size as the object
 (C) 40 cm from the convergent lens, twice the size of the object
 (D) 20 cm from the convergent mirror, twice the size of the object

4. Four particles A, B, C and D with masses $m_A = m$, $m_B = 2m$, $m_C = 3m$ and $m_D = 4m$ are at the corners of a square. They have accelerations of equal magnitude with directions as shown. The acceleration of the centre of mass of the particles is:

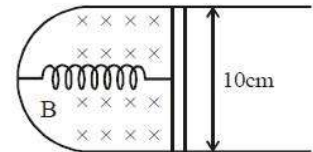
- (A) $\frac{a}{5}(\hat{i} - \hat{j})$ (B) Zero
 (C) $\frac{a}{5}(\hat{i} + \hat{j})$ (D) $a(\hat{i} + \hat{j})$



5. Two identical beakers A and B contain equal volumes of two different liquids at 60°C each and left to cool down. Liquid in A has density of $8 \times 10^2 \text{ kg/m}^3$ and specific heat of $2000 \text{ Jkg}^{-1}\text{K}^{-1}$ while liquid in B has density of 10^3 kgm^{-3} and specific heat of $4000 \text{ JKg}^{-1}\text{K}^{-1}$. Which of the following best describes their temperature versus time graph schematically? (assume the emissivity of both the beakers to be the same)

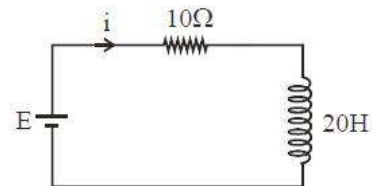


6. A thin strip 10 cm long is on a U shaped wire of negligible resistance and it is connected to a spring of spring constant 0.5 Nm^{-1} (see figure). The assembly is kept in a uniform magnetic field of 0.1 T. If the strip is pulled from its equilibrium position and released, the number of oscillations it performs before its amplitude decreases by a factor of e is N . If the mass of the strip is 50 grams, its resistance 10Ω and air drag negligible, N will be close to:



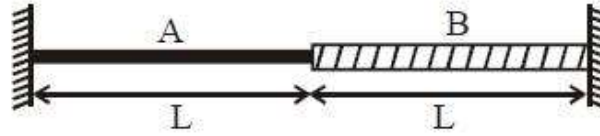
- (A) 50000 (B) 10000
(C) 1000 (D) 5000

7. A 20 Henry inductor coil is connected to a 10 ohm resistance in series as shown in figure. The time at which rate of dissipation of energy (Joule's heat) across resistance is equal to the rate at which magnetic energy is stored in the inductor, is



- (A) $\frac{2}{\ln 2}$ (B) $\ln 2$
(C) $\frac{1}{2} \ln 2$ (D) $2 \ln 2$

8. A wire of length $2L$ is made by joining two wires A and B of same lengths but different radii r and $2r$ and made of the same material. It is vibrating at a frequency such that the joint of the two wires forms a node. If the number of antinodes in wire A is p and that in B is q then the ratio $p : q$ is:



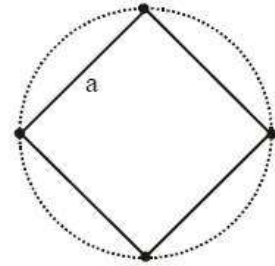
- (A) 1 : 4
(B) 1 : 2
(C) 3 : 5
(D) 4 : 9
9. A steel wire having a radius of 2.0 mm, carrying a load of 4 kg, is hanging from a ceiling. Given that $g = 3.1\pi\text{ms}^{-2}$, what will be the tensile stress that would be developed in the wire?
(A) $6.2 \times 10^6 \text{Nm}^{-2}$
(B) $4.8 \times 10^6 \text{Nm}^{-2}$
(C) $5.2 \times 10^6 \text{Nm}^{-2}$
(D) $3.1 \times 10^6 \text{Nm}^{-2}$
10. Voltage rating of a parallel plate capacitor is 500V. Its dielectric can withstand a maximum electric field of $10^6 \frac{\text{V}}{\text{m}}$. The plate area is 10^{-4}m^2 . What is the dielectric constant if the capacitance is 15 pF? (given $\epsilon_0 = 8.86 \times 10^{-12} \text{C}^2 / \text{Nm}^2$)
(A) 3.8
(B) 6.2
(C) 4.5
(D) 8.5
11. An alternating voltage $v(t) = 220\sin 100\pi t$ volt is applied to a purely resistive load of 50Ω . The time taken for the current to rise from half of the peak value of the peak value is:
(A) 2.2 ms
(B) 3.3 ms
(C) 5 ms
(D) 7.2 ms
12. The wavelength of the carrier waves in a modern optical fiber communication network is close to:
(A) 1500 nm
(B) 600 nm
(C) 2400 nm
(D) 900 nm
13. Water from a pipe is coming at a rate of 100 litres per minute. If the radius of the pipe is 5 cm, the Reynolds number for the flow is of the order of : (density of water = 1000kg/m^3 , coefficient of viscosity of water = 1mPa s)
(A) 10^3
(B) 10^6
(C) 10^2
(D) 10^4
14. A boy's catapult is made of rubber cord which is 42 cm long, with 6 mm diameter of cross – section and of negligible mass. The boy keeps a stone weighing 0.02 kg on it and stretches the cord by 20 cm by applying a constant force. When released, the stone flies off with a velocity of 20ms^{-1} . Neglect the change in the area of cross section of the cord while stretched. The Young's modulus of rubber is closest to:
(A) 10^3Nm^{-2}
(B) 10^6Nm^{-2}
(C) 10^8Nm^{-2}
(D) 10^4Nm^{-2}

15. Two particles move at right angle to each other. Their de Broglie wavelengths are λ_1 and λ_2 respectively. The particles suffer perfectly inelastic collision. The de Broglie wavelength λ , of the final particle, is given by:

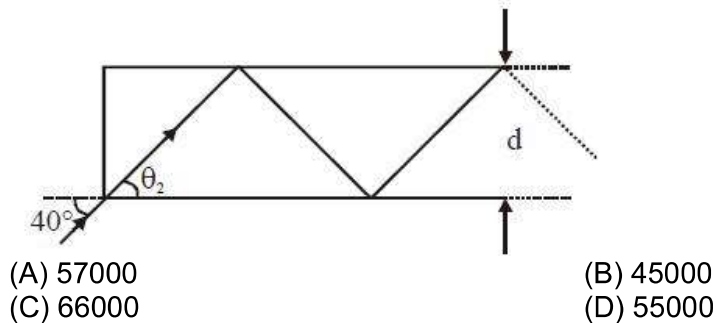
(A) $\lambda = \sqrt{\lambda_1 \lambda_2}$ (B) $\lambda = \frac{\lambda_1 + \lambda_2}{2}$
 (C) $\frac{2}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$ (D) $\frac{1}{\lambda^2} = \frac{1}{\lambda_1^2} + \frac{1}{\lambda_2^2}$

16. Four identical particles of mass M are located at the corners of a square of side 'a'. What should be their speed if each of them revolves under the influence of other's gravitational field in a circular orbit circumscribing the square?

(A) $1.35\sqrt{\frac{GM}{a}}$ (B) $1.16\sqrt{\frac{GM}{a}}$
 (C) $1.41\sqrt{\frac{GM}{a}}$ (D) $1.21\sqrt{\frac{GM}{a}}$



17. In figure, the optical fiber is $l = 2\text{m}$ long and has a diameter of $d = 20\ \mu\text{m}$. If a ray of light is incident on one end of the fiber at angle $\theta_1 = 40^\circ$, the number of reflection it makes before emerging from the other end is close to:



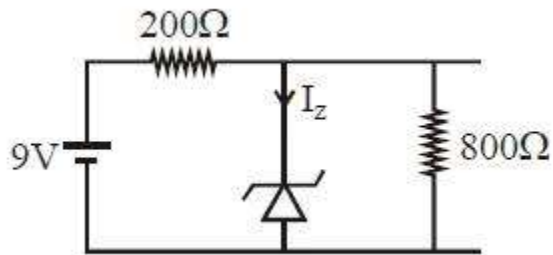
18. A circular coil having N turns and radius r carries a current. It is held in the XZ plane in a magnetic field $B\hat{i}$. The torque on the coil due to the magnetic field is:

(A) $\frac{Br^2I}{\pi N}$ (B) zero
 (C) $\frac{B\pi r^2I}{N}$ (D) $B\pi r^2IN$

19. Ship A is sailing towards north – east with velocity $\vec{v} = 30\hat{i} + 50\hat{j}$ km/hr where \hat{i} points east and \hat{j} , north. Ship B is at a distance of 80 km east and 150 km north of Ship A and is sailing towards west at 10 km/hr. A will be at minimum distance from B ins:

(A) 2.2 hrs. (B) 4.2 hrs.
 (C) 2.6 hrs. (D) 3.2 hrs.

20. A plane electromagnetic wave travels in free space along the x – direction. The electric field component of the wave at a particular point of space and time is $E = Vm^{-1}$ along y – direction. Its corresponding magnetic field component, B would be:
 (A) $2 \times 10^{-8} T$ along z – direction (B) $6 \times 10^{-8} T$ along x – direction
 (C) $6 \times 10^{-8} T$ along z - direction (D) $2 \times 10^{-8} T$ along y – direction
21. A thermally insulated vessel contains 150 g of water at $0^\circ C$. Then the air from the vessel is pumped out a adiabatically. A fraction of water turns into ice and the rest evaporates at $0^\circ C$ itself. The mass of evaporated water will be closes to:
 (Latent heat of vaporization of water = $2.10 \times 10^6 Jkg^{-1}$ and Laten heat of Fusion of water = $3.36 \times 10^5 Jkg^{-1}$)
 (A) 35 g (B) 150 g
 (C) 130 g (D) 20 g
22. Radiation coming from transition $n = 2$ to $n = 1$ of hydrogen atoms fall of He^+ ions in $n = 1$ and $n = 2$ states. The possible. Transition of helium ions as they absorb energy from the radiation is:
 (A) $n = 2 \rightarrow n = 4$ (B) $n = 2 \rightarrow n = 5$
 (C) $n = 2 \rightarrow n = 3$ (D) $n = 1 \rightarrow n = 4$
23. A 200Ω resistor has a certain color code. If one replaces the red color by green in the code, the new resistance will be:
 (A) 500Ω (B) 400Ω
 (C) 300Ω (D) 100Ω
24. The reverse breakdown voltage of a Zener diode is $5.6 V$ in the given circuit .



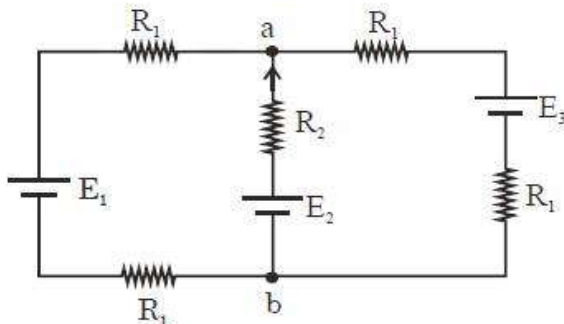
The current I_z through the Zener is:

- (A) 10 mA (B) 15 mA
 (C) 7 mA (D) 17 mA
25. A thin circular plate of mass M and radius R has its density varying as $p(r) = p_0 r$ with P_0 as constant and r is the distance from its center. The moment of Inertia of the circular plate about an axis perpendicular to the plate and passing through its edge is $I = aMR^2$. The value of the coefficient a is:
 (A) $\frac{8}{5}$ (B) $\frac{1}{2}$
 (C) $\frac{3}{5}$ (D) $\frac{3}{2}$

26. In SI units, the dimensions of $\sqrt{\frac{\epsilon_0}{\mu_0}}$ is:

- (A) $AT^{-3}ML^{3/2}$ (B) $A^{-1}TML^3$
 (C) $A^2T^3M^{-1}L^{-2}$ (D) $AT^2M^{-1}L^{-1}$

27. For the circuit shown, with $R_1 = 1.0\Omega$, $R_2 = 2.0\Omega$, $E_1 = 2V$ and $E_2 = E_3 = 4V$, the potential difference between the points 'a' and 'b' is approximately (in V):



- (A) 3.3 (B) 2.3
 (C) 3.7 (D) 2.7

28. A solid conducting sphere, having a charge Q , is surrounded by an uncharged conducting hollow spherical shell. Let the potential difference between the surface of the solid sphere and that of the outer surface of the hollow shell be V . If the shell is now given a charge of $-4Q$, the new potential difference between the same two surface is:

- (A) $2V$ (B) $-2V$
 (C) $4V$ (D) V

29. In an interference experiment the ratio of amplitudes of coherent waves is $\frac{a_1}{a_2} = \frac{1}{3}$. The ratio of maximum and minimum intensities of fringes will be:

- (A) 9 (B) 4
 (C) 18 (D) 2

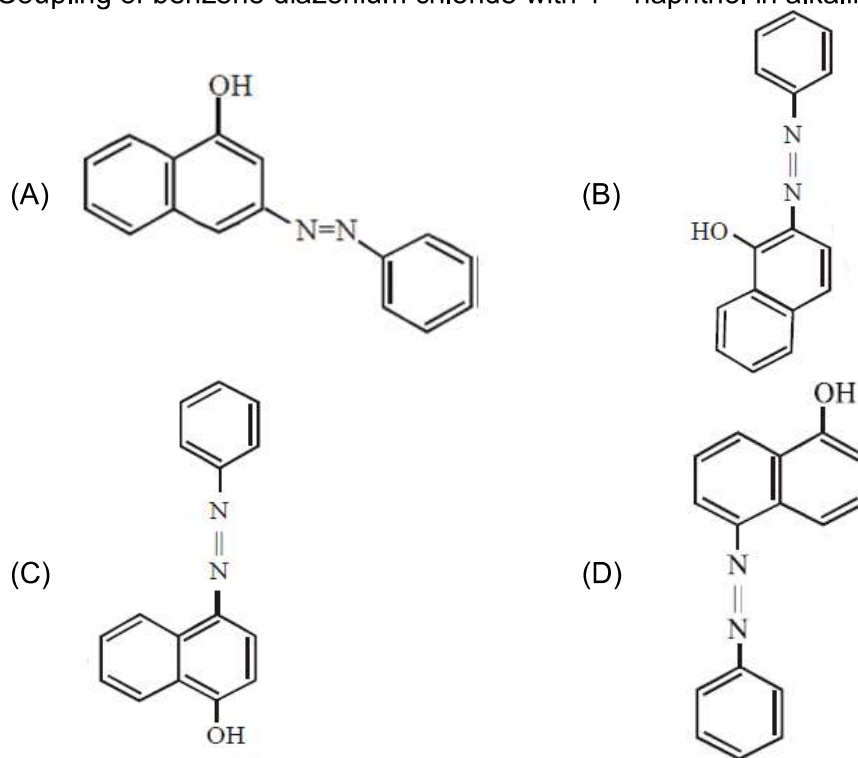
30. The bob of a simple pendulum has mass $2g$ and a charge of $5.0\mu C$. It is at rest in a uniform horizontal electric field of intensity $2000\frac{V}{m}$. At equilibrium, the angle that the pendulum makes with the vertical is: (take $g = 10\frac{m}{s^2}$)

- (A) $\tan^{-1}(2.0)$ (B) $\tan^{-1}(0.2)$
 (C) $\tan^{-1}(5.0)$ (D) $\tan^{-1}(0.5)$

PART –B (CHEMISTRY)

31. Element 'B' forms ccp structure and 'A' occupies half of the octahedral voids, while oxygen atoms occupy all the tetrahedral voids. The structure of bimetallic oxide is
 (A) A_2B_2O (B) AB_2O_4
 (C) A_4B_2O (D) A_2BO_4

32. Coupling of benzene diazonium chloride with 1 – naphthol in alkaline medium will give:



33. The size of the iso-electronic species Cl^- , Ar and Ca^{2+} is affected by

- (A) Principal quantum number of valence shell
 (B) Azimuthal quantum number of valence shell
 (C) electron – electron interaction in the outer orbitals
 (D) nuclear charge

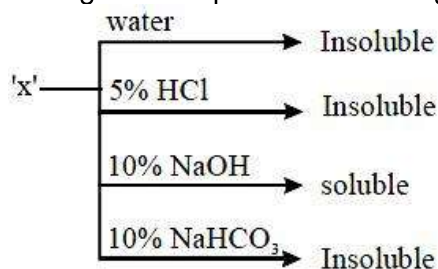
34. In the following compounds, the decreasing order of basic strength will be:

- (A) $C_2H_5NH_2 > NH_3 > (C_2H_5)_2NH$ (B) $NH_3 > C_2H_5NH_2 > (C_2H_5)_2NH$
 (C) $(C_2H_5)_2NH > C_2H_5NH_2 > NH_3$ (D) $(C_2H_5)_2NH > NH_3 > C_2H_5NH_2$

35. The correct order of the spin only magnetic moment of metal ions in the following low spin complexes, $[V(CN)_6]^{4-}$, $[Fe(CN)_6]^{4-}$, $[Ru(NH_3)_6]^{3+}$, and $[Cr(NH_3)_6]^{2+}$, is:

- (A) $Cr^{2+} > Ru^{3+} > Fe^{2+} > V^{2+}$ (B) $V^{2+} > Cr^{2+} > Ru^{3+} > Fe^{2+}$
 (C) $Cr^{2+} > V^{2+} > Ru^{3+} > Fe^{2+}$ (D) $V^{2+} > Ru^{3+} > Cr^{2+} > Fe^{2+}$

36. An organic compound 'X' showing the following solubility profile is:



(A) Oleic acid
(C) Benzamide

(B) o – Toluidine
(D) m – Cresol

37. Diborane (B₂H₆) reacts independently with O₂ and H₂O to produce, respectively:

(A) H₃BO₃ and B₂O₃

(B) B₂O₃ and H₃BO₃

(C) HBO₂ and H₃BO₃

(D) B₂O₃ and [BH₄]⁻

38. The lanthanoid that would show colour is:

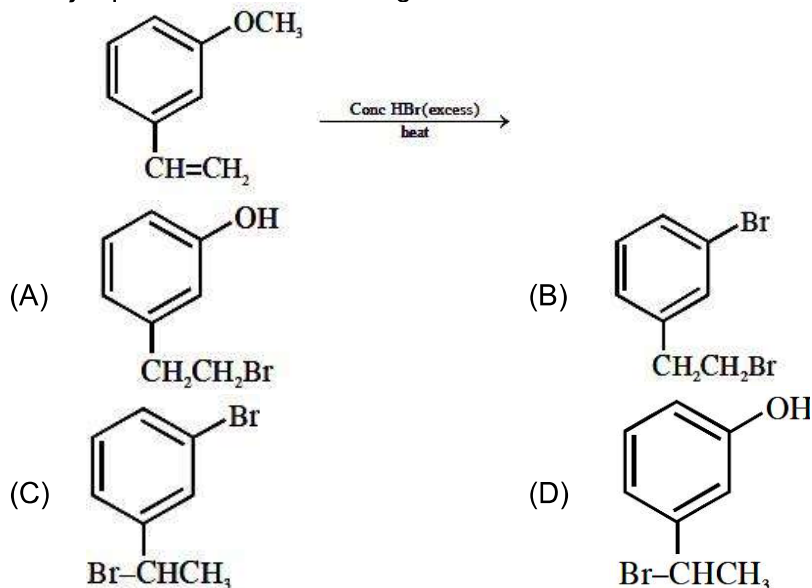
(A) Gd³⁺

(B) La³⁺

(C) Lu³⁺

(D) Sm³⁺

39. The major product of the following reaction



40. 100 mL of a water sample contains 0.81 g of calcium bicarbonate and 0.73 g of magnesium bicarbonate. The hardness of this water sample expressed in terms of equivalents of CaCO₃ is:

(molar mass of calcium bicarbonate is 162 gmol⁻¹ and magnesium bicarbonate is 146 g mol⁻¹)

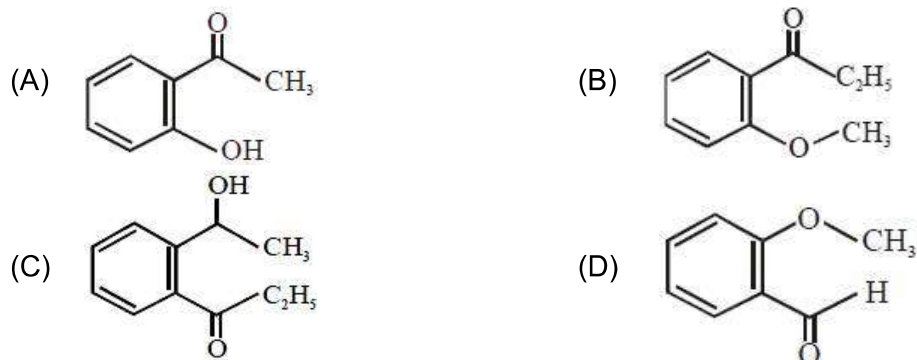
(A) 10, 000 ppm

(B) 1, 000 ppm

(C) 5,000 ppm

(D) 100 ppm

41. An organic compound neither reacts with neutral ferric chloride solution nor with Fehling solution. It however, reacts with Grignard reagent and gives positive iodoform test. The compound is:

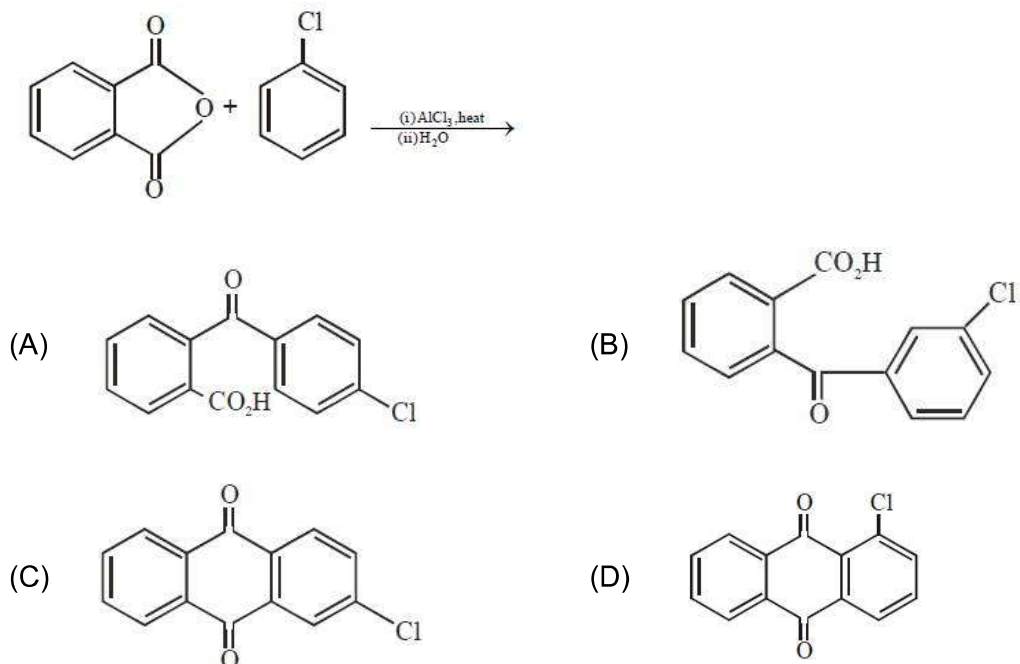


42. For the reaction $2A + B \rightarrow C$, the values of initial rate at different reactant concentrations are given in the table below: The rate law for the reaction is:

[A] (mol L ⁻¹)	[B] (mol L ⁻¹)	Initial Rate (mol L ⁻¹ s ⁻¹)
0.05	0.05	0.045
0.10	0.05	0.090
0.20	0.10	0.72

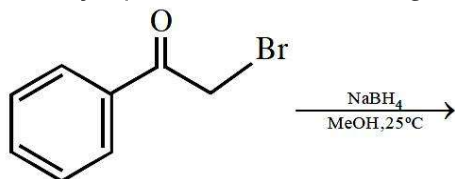
- (A) Rate = $k[A]^2[B]^2$ (B) Rate = $k[A][B]^2$
 (C) Rate = $k[A][B]$ (D) Rate = $k[A]^2[B]$

43. The major product of the following reaction is:



44. Which is wrong with respect to our responsibility as a human being to protect our environment?
 (A) Restricting the use of vehicles
 (B) Using plastic bags
 (C) Setting up compost tin in gardens
 (D) Avoiding the use of floodlighted facilities.

45. The major product of the following reaction



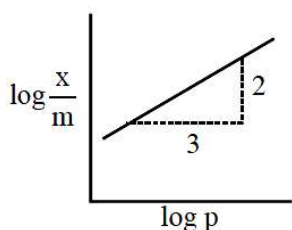
- (A)
- (B)
- (C)
- (D)

46. For silver $C_p(\text{JK}^{-1}\text{mol}^{-1}) = 23 + 0.01T$. If the temperature (T) of 3 moles of silver is raised from 300 K to 1000 K at 1 atm pressure, the value of ΔH will be close to:
 (A) 13 kJ
 (B) 62 kJ
 (C) 16 kJ
 (D) 21 kJ

47. The correct order of hydration enthalpies of alkali metal ions is:
 (A) $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Cs}^+ > \text{Rb}^+$
 (B) $\text{Na}^+ > \text{Li}^+ > \text{K}^+ > \text{Rb}^+ > \text{Cs}^+$
 (C) $\text{Na}^+ > \text{Li}^+ > \text{K}^+ > \text{Cs}^+ > \text{Rb}^+$
 (D) $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+ > \text{Cs}^+$

48. Adsorption of a gas follows Freundlich adsorption isotherm. x is the mass of the gas adsorbed on mass m of the adsorbent. The plot of $\log \frac{x}{m}$ versus $\log p$ is shown in the

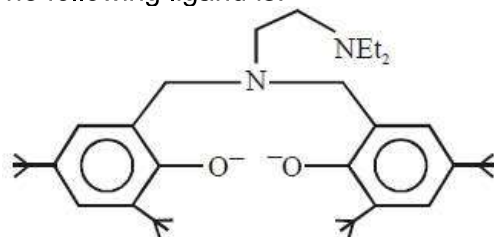
given graph, $\frac{x}{m}$ is proportional to:



- (A) $p^{2/3}$
 (B) p^2
 (C) p^3
 (D) $p^{3/2}$

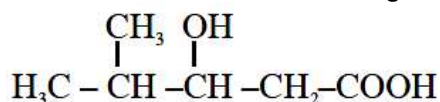
49. The vapour pressures of pure liquids A and B are 400 and 600 mm Hg, respectively at 298 K. On mixing the two liquids, the sum of their initial volumes is equal to the volume of the final mixture. The mole fraction of liquid B is 0.5 in the mixture. The vapour pressure of the final solution, the mole fractions of components A and B in vapour phase, respectively are:
 (A) 500 mmHg, 0.4, 0.6 (B) 500 mmHg, 0.5, 0.5
 (C) 450 mmHg, 0.5, 0.5 (D) 450 mmHg, 0.4, 0.6
50. Given that $E_{\text{O}_2/\text{H}_2\text{O}}^0 = +1.23\text{V}$; $E_{\text{S}_2\text{O}_8^{2-}/\text{SO}_4^{2-}}^0 = 2.05\text{V}$; $E_{\text{Br}_2/\text{Br}^-}^0 = +1.09\text{V}$; $E_{\text{Au}^{3+}/\text{Au}}^0 = 1.4\text{V}$. The strongest oxidizing agent is:
 (A) O_2 (B) $\text{S}_2\text{O}_8^{2-}$
 (C) Au^{3+} (D) Br_2
51. The quantum number of four electrons are given below:
 I. $n = 4, l = 2, m_l = -2, m_s = -1/2$
 II. $n = 3, l = 2, m_l = 1, m_s = +1/2$
 III. $n = 4, l = 1, m_l = 0, m_s = +1/2$
 IV. $n = 3, l = 1, m_l = 1, m_s = -1/2$
 The correct order of their increasing energies will be:
 (A) $\text{I} < \text{III} < \text{II} < \text{IV}$ (B) $\text{I} < \text{II} < \text{III} < \text{IV}$
 (C) $\text{IV} < \text{II} < \text{III} < \text{I}$ (D) $\text{IV} < \text{III} < \text{II} < \text{I}$
52. If solubility product of $\text{Zr}_3(\text{PO}_4)_4$ is denoted by K_{SP} and its molar solubility is denoted by S, then which of the following relation between S and K_{SP} is correct?
 (A) $S = \left(\frac{K_{\text{SP}}}{6912}\right)^{1/7}$ (B) $S = \left(\frac{K_{\text{SP}}}{144}\right)^{1/6}$
 (C) $S = \left(\frac{K_{\text{SP}}}{929}\right)^{1/9}$ (D) $S = \left(\frac{K_{\text{SP}}}{216}\right)^{1/7}$
53. Which of the following amines can be prepared by Gabriel phthalimide reaction?
 (A) t – butylamine (B) n – butylamine
 (C) neo – pentylamine (D) triethylamine
54. Which one of the following equations does not correctly represent the first law of thermodynamics for the given processes involving an ideal gas? (Assume non – expansion work is zero)
 (A) Adiabatic process: $\Delta U = -w$ (B) Isochoric process: $\Delta U = q$
 (C) Cyclic process: $q = -w$ (D) Isothermal process: $q = -w$

55. The following ligand is:



- (A) tridentate (B) bidentate
(C) tetradentate (D) hexadentate

56. The IUPAC name of the following compound is



- (A) 3-Hydroxy – 4 – methylpentaonic acid
(B) 4 – Methyl – 3 – hydroxypentanoic acid
(C) 2 – Methyl – 3 – hydroxypentan-5-oic acid
(D) 4, 4 – Dimethyl – 3 – hydroxybutanoic acid
57. In order to oxidize a mixture of one mole of each of FeC_2O_4 , $\text{Fe}_2(\text{C}_2\text{O}_4)_3$, FeSO_4 and $\text{Fe}_2(\text{SO}_4)_3$ in acidic medium, the number of moles of KMnO_4 required is:
- (A) 1 (B) 1.5
(C) 2 (D) 3
58. Assertion : Ozone is destroyed by CFCs in the upper stratosphere.
Reason : Ozone holes increase the amount of UV radiation reaching the earth.
- (A) Assertion and reason are incorrect
(B) Assertion is false, but the reason is correct
(C) Assertion and reasons are both correct, and the reason is the correct explanation for the assertion.
(D) Assertion and reason are correct, but the reason is not the explanation for the assertion.
59. Maltose on treatment with dilute HCl gives:
- (A) D – Fructose (B) D – Galactose
(C) D – Glucose and D – Fructose (D) D – Glucose
60. With respect to an ore, Ellingham diagram helps to predict the feasibility of its
- (A) Electrolysis (B) Thermal reduction
(C) Vapour phase refining (D) Zone refining

PART-C (MATHEMATICS)

61. The magnitude of the projection of the vector $2\hat{i} + 3\hat{j} + \hat{k}$ on the vector perpendicular to the plane containing the vectors $\hat{i} + \hat{j} + \hat{k}$ and $\hat{i} + 2\hat{j} + 3\hat{k}$, is:
- (A) $3\sqrt{6}$ (B) $\frac{\sqrt{3}}{2}$
(C) $\sqrt{6}$ (D) $\sqrt{\frac{3}{2}}$
62. The shortest distance between the line $y = x$ and the curve $y^2 = x - 2$ is:
- (A) $\frac{11}{4\sqrt{2}}$ (B) 2
(C) $\frac{7}{4\sqrt{2}}$ (D) $\frac{7}{8}$
63. If α and β be the roots of the equation $x^2 - 2x + 2 = 0$, then the least value of n for which $\left(\frac{\alpha}{\beta}\right)^n = 1$ is:
- (A) 4 (B) 2
(C) 5 (D) 3
64. All possible numbers are formed using the digits 1, 1, 2, 2, 2, 2, 3, 4, 4 taken all at a time. The number of such numbers in which the odd digits occupy even places is:
- (A) 180 (B) 175
(C) 162 (D) 160
65. $\int \frac{\sin \frac{5x}{2}}{\sin \frac{x}{2}} dx$ is equal to:
- (where c is a constant of integration).
- (A) $x + 2 \sin x + 2 \sin 2x + c$ (B) $2x + \sin x + 2 \sin 2x + c$
(C) $x + 2 \sin x + \sin 2x + c$ (D) $2x + \sin x + \sin 2x + c$
66. Let $O(0, 0)$ and $A(0, 1)$ be two fixed points. Then the locus of a point P such that the perimeter of $\triangle AOP$, is 4, is:
- (A) $9x^2 - 8y^2 + 8y = 16$ (B) $8x^2 + 9y^2 - 9y = 18$
(C) $9x^2 + 8y^2 - 8y = 16$ (D) $8x^2 - 9y^2 + 9y = 18$

67. If $\cos(\alpha + \beta) = \frac{3}{5}$, $\sin(\alpha - \beta) = \frac{5}{13}$ and $0 < \alpha, \beta < \frac{\pi}{4}$, then $\tan(2\alpha)$ is equal to:
- (A) $\frac{63}{52}$ (B) $\frac{33}{52}$
(C) $\frac{63}{16}$ (D) $\frac{21}{16}$
68. Let $A = \begin{pmatrix} \cos \alpha & -\sin \alpha \\ \sin \alpha & \cos \alpha \end{pmatrix}$, ($\alpha \in \mathbb{R}$) such that $A^{32} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$. Then a value of α is:
- (A) 0 (B) $\frac{\pi}{16}$
(C) $\frac{\pi}{32}$ (D) $\frac{\pi}{64}$
69. If $f(x) = \log_e \left(\frac{1-x}{1+x} \right)$, $|x| < 1$, then $f\left(\frac{2x}{1+x^2}\right)$ is equal to:
- (A) $2f(x)$ (B) $(f(x))^2$
(C) $2f(x^2)$ (D) $-2f(x)$
70. If $2y = \left(\cot^{-1} \left(\frac{\sqrt{3} \cos x + \sin x}{\cos x - \sqrt{3} \sin x} \right) \right)^2$, $x \in \left(0, \frac{\pi}{2} \right)$ then $\frac{dy}{dx}$ is equal to
- (A) $\frac{\pi}{6} - x$ (B) $\frac{\pi}{3} - x$
(C) $x - \frac{\pi}{6}$ (D) $2x - \frac{\pi}{3}$
71. The sum of the solutions of the equation $|\sqrt{x} - 2| + \sqrt{x}(\sqrt{x} - 4) + 2 = 0$, ($x > 0$) is equal to:
- (A) 9 (B) 4
(C) 10 (D) 12
72. $\lim_{x \rightarrow 0} \frac{\sin^2 x}{\sqrt{2} - \sqrt{1 + \cos x}}$ equals
- (A) $\sqrt{2}$ (B) $4\sqrt{2}$
(C) 4 (D) $2\sqrt{2}$
73. $2 \cdot {}^{20}C_0 + 5 \cdot {}^{20}C_1 + 8 \cdot {}^{20}C_2 + 11 \cdot {}^{20}C_3 + \dots + 62 \cdot {}^{20}C_{20}$ is equal to
- (A) 2^{23} (B) 2^{26}
(C) 2^{24} (D) 2^{25}

74. Let $y = y(x)$ be the solutions of the differential equation, $(x^2 + 1)^2 \frac{dy}{dx} + 2x(x^2 + 1)y = 1$ such that $y(0) = 0$. If $\sqrt{a}y(1) = \frac{\pi}{32}$, then the value of 'a' is
- (A) $\frac{1}{2}$ (B) 1
(C) $\frac{1}{16}$ (D) $\frac{1}{4}$
75. If $f(x) = \frac{2 - x \cos x}{2 + x \cos x}$ and $g(x) = \log_e x, (x > 0)$ then the value of the integral $\int_{-\pi/4}^{\pi/4} g(f(x)) dx$ is:
- (A) $\log_e 1$ (B) $\log_e 2$
(C) $\log_e e$ (D) $\log_e 3$
76. The area (in sq. units) of the region $A = \{(x, y) \in \mathbb{R} \times \mathbb{R} \mid 0 \leq x \leq 3, 0 \leq y \leq 4, y \leq x^2 + 3x\}$ is:
- (A) $\frac{26}{3}$ (B) $\frac{59}{6}$
(C) $\frac{53}{6}$ (D) 8
77. The mean and variance of seven observations are 8 and 16, respectively. If 5 of the observations are 2, 4, 10, 12, 14, then the product of the remaining two observations is:
- (A) 40 (B) 45
(C) 49 (D) 48
78. The length of the perpendicular from the point $(2, -1, 4)$ on the straight line, $\frac{x+3}{10} = \frac{y-2}{-7} = \frac{z}{1}$ is:
- (A) greater than 2 but less than 3 (B) less than 2
(C) greater than 4 (D) greater than 3 but less than 4
79. The contrapositive of the statement "If you are born in India, then you are a citizen of India", is:
- (A) If you are a citizen of India, then you are born in India
(B) If you are not a citizen of India, then you are not born in India
(C) If you are not born in India, then you are not a citizen of India
(D) If you are born in India, then you are not a citizen of India
80. The sum of all natural numbers 'n' such that $100 < n < 200$ and H.C.F. $(91, n) > 1$ is:
- (A) 3221 (B) 3303
(C) 3203 (D) 3121

81. If S_1 and S_2 are respectively the sets of local minimum and local maximum points of the function. $f(x) = 9x^4 + 12x^3 - 36x^2 + 25, x \in \mathbb{R}$, then
- (A) $S_1 = \{-2, 1\}; S_2 = \{0\}$
 (B) $S_1 = \{-2, 0\}; S_2 = \{1\}$
 (C) $S_1 = \{-2\}; S_2 = \{0, 1\}$
 (D) $S_1 = \{-1\}; S_2 = \{0, 2\}$
82. The sum of the coefficient of all even degree terms in x in the expansion of $(x + \sqrt{x^3 - 1})^6 + (x - \sqrt{x^3 - 1})^6, (x > 1)$ is equal to:
- (A) 26 (B) 24
 (C) 32 (D) 29
83. A point on the straight line, $3x + 5y = 15$ which is equidistant from the coordinate, axes will lie only in:
- (A) 4th quadrant (B) 1st, 2nd and 4th quadrants
 (C) 1st quadrant (D) 1st and 2nd quadrants
84. If the tangents on the ellipse $4x^2 + y^2 = 8$ at the points $(1, 2)$ and (a, b) are perpendicular to each other, then a^2 is equal to:
- (A) $\frac{2}{17}$ (B) $\frac{4}{17}$
 (C) $\frac{64}{17}$ (D) $\frac{128}{17}$
85. If $\alpha = \cos^{-1}\left(\frac{3}{5}\right), \beta = \tan^{-1}\left(\frac{1}{3}\right)$, where $0 < \alpha, \beta < \frac{\pi}{2}$, then $\alpha - \beta$ is equal to:
- (A) $\sin^{-1}\left(\frac{9}{5\sqrt{10}}\right)$ (B) $\cos^{-1}\left(\frac{9}{5\sqrt{10}}\right)$
 (C) $\tan^{-1}\left(\frac{9}{5\sqrt{10}}\right)$ (D) $\tan^{-1}\left(\frac{9}{14}\right)$
86. The equation of a plane containing the line of intersection of the planes $2x - y - 4 = 0$ and $y + 2z - 4 = 0$ and passing through the point $(1, 1, 0)$ is:
- (A) $x + 3y + z = 4$ (B) $2x - z = 2$
 (C) $x - 3y - 2z = -2$ (D) $x - y - z = 0$
87. The sum of the squares of the lengths of the chords intercepted on the circle, $x^2 + y^2 = 16$, by the lines, $x + y = n, n \in \mathbb{N}$, where \mathbb{N} is the set of all natural numbers is:
- (A) 320 (B) 160
 (C) 105 (D) 210

88. The greatest value of $c \in \mathbb{R}$ for which the system of linear equations
- $$\begin{aligned}x - cy - cz &= 0 \\cx - y + cz &= 0 \\cx + cy - z &= 0\end{aligned}$$
- has a non-trivial solution, is:

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

89. Let $f : [0, 2] \rightarrow \mathbb{R}$ be a twice differentiable function such that $f''(x) > 0$, for all $x \in (0, 2)$. If

$\phi(x) = f(x) + f(2 - x)$, then ϕ is:

- (A) increasing on $(0, 2)$
(B) decreasing on $(0, 2)$
(C) decreasing on $(0, 1)$ and increasing on $(1, 2)$
(D) increasing on $(0, 1)$ and decreasing on $(1, 2)$
90. Let A and b be two non-null events such that $A \subset B$. Then, which of the following statements is always correct?
- (A) $P(A|B) = 1$ (B) $P(A|B) \leq P(A)$
(C) $P(A|B) = P(B) - P(A)$ (D) $P(A|B) \geq P(A)$

JEE (Main) – 2019

ANSWERS

PART A – PHYSICS

1.	Bonus	2.	D	3.	Bonus	4.	A
5.	A	6.	D	7.	D	8.	B
9.	D	10.	D	11.	B	12.	A
13.	D	14.	B	15.	D	16.	B
17.	Bonus	18.	D	19.	C	20.	A
21.	D	22.	B	23.	A	24.	A
25.	A	26.	C	27.	A	28.	D
29.	B	30.	D				

PART B – CHEMISTRY

31.	B	32.	C	33.	D	34.	C
35.	B	36.	D	37.	B	38.	D
39.	D	40.	A	41.	C	42.	B
43.	A	44.	B	45.	D	46.	B
47.	D	48.	A	49.	A	50.	B
51.	C	52.	A	53.	B	54.	B
55.	C	56.	A	57.	C	58.	D
59.	D	60.	B				

PART C – MATHEMATICS

61.	D	62.	C	63.	A	64.	A
65.	C	66.	C	67.	C	68.	D
69.	A	70.	D	71.	C	72.	B
73.	D	74.	C	75.	A	76.	B
77.	D	78.	D	79.	B	80.	D
81.	A	82.	B	83.	D	84.	A
85.	A	86.	D	87.	D	88.	B
89.	C	90.	D				