



VIDYAPEETH

An IIT Alumni Body

IIT Academy

Premier Institute For IIT JEE (Main & Advanced)/KVPY/OLYMPIAD/NTSE

SAMPLE PAPER

Time : 3 :00 hours.

(Class 12th)

Maximum Marks : 360

INSTRUCTIONS

DO NOT BREAK THE SEAL WITHOUT BEING INSTRUCTED TO DO SO BY THE INVALIDATOR

1. Immediately fill in the particulars on this page of the Test Booklet with **Black Ball Point Pen**. Use of pencil is strictly prohibited.
2. The Answer Sheet is kept inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particular carefully.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of **90** questions. The maximum marks are **360**.
5. There are three parts in the question paper A, B, C consisting of **Physics, Chemistry** and **Mathematics** having total 30 questions in each part of equal weightage. Each question is allotted **4 (four) marks** for correct response.
6. *Candidates will be awarded marks as stated above in Instructions No. 5 for correct response of each question. $\frac{1}{4}$ (one fourth) marks 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 sheet.*
7. **There is only one correct response for each question.** Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 6 above.
8. No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc., except the Admit Card inside the examination room/hall.
9. Rough work is to be done on the space provided for this purpose in the Test Booklet only. This space is given at the bottom of each page and in one page at the end of the booklet.
10. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. **However, the candidates are allowed to take away this Test Booklet with them.**
11. The CODE for this Booklet **0**. Make sure that the CODE printed on the Answer Sheet is the same as that on this booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer Sheet.
12. **Do not fold or make any stray marks on the Answer Sheet.**

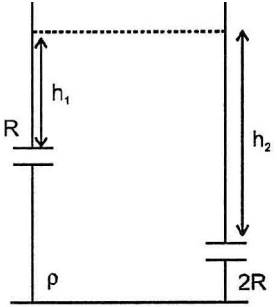
Name of the Candidate (in Capital letters) : _____

Roll Number : in figures : in words : _____

Name of Examination Centre (in Capital letters) : _____

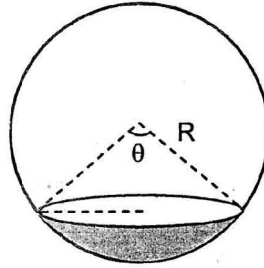
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PART - I PHYSICS

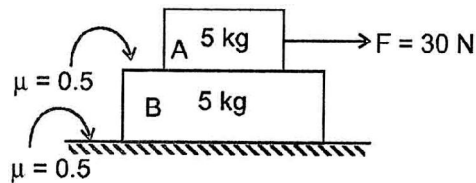
- Q.1 An explosion breaks a rock into three parts. Two parts of masses 1 kg and 2 kg go off at right angles to each other with velocity of 12 m/s and velocity of 8 m/s respectively. If the third part flies off with a velocity of 4 m/s, its mass would be :
- (A) 7 kg (B) 17 kg (C) 3 kg (D) 5 kg
- Q.2 In a cylindrical water tank there are two small holes of radius R and $2R$ respectively at a depth h_1 and h_2 from the upper level of water. If tank is at rest on smooth horizontal surface than the ratio of h_1 and h_2 : (Assume that height of liquid level is kept constant)
- (A) 1
(B) 2
(C) 3
(D) 4
- 
- Q.3 Assume that magnetic field of earth is similar to magnetic field of a magnetic bar. If angle of dip at Delhi and Chennai are θ_1 and θ_2 respectively then :
- (A) $\theta_1 > \theta_2$ (B) $\theta_1 = \theta_2$ (C) $\theta_1 < \theta_2$ (D) $2\theta_1 = \theta_2$
- Q.4 A particle is projected with initial speed 10 m/s at an angle of 53° with horizontal. Then the time after which its speed becomes half of the initial speed.
- (A) 1 sec (B) $\frac{4}{5}$ sec (C) $\frac{8}{5}$ sec (D) Never

Space for rough works

- Q.5 Consider a spherical drop of radius R . Surface tension of the liquid is S . Force of surface tension on shaded sub hemisphere due to remaining drop is $\frac{S\pi R}{2}$. The value of angle θ (angle subtended by the sub hemisphere at centre of drop) is :



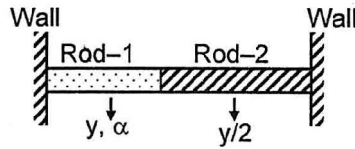
- (A) 60° (B) 120° (C) 30° (D) 90°
- Q.6 Consider a system of two blocks as shown in the figure. The accelerations of both the blocks (A and B) respectively are



- (A) 0 ; 0 (B) 0 ; 1 m/s^2
- (C) 1 m/s^2 ; 0 (D) 1 ; 1

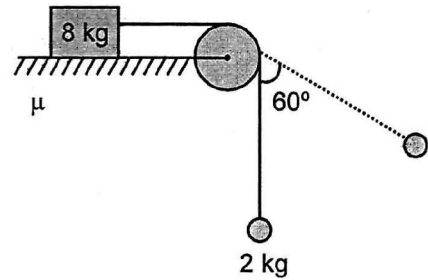
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Q.7 If on increasing temperature of the system shown, interface does not displace, thermal coefficient of linear expansion of rod-2 is



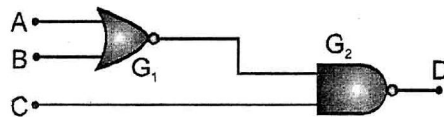
- (A) α (B) 2α (C) $\frac{\alpha}{2}$ (D) $\frac{\alpha}{3}$

Q.8 In the system shown, the mass $m = 2\text{ kg}$ oscillates in a circular arc of amplitude 60° , the minimum value of coefficient of friction between mass = 8 kg and surface of table to avoid slipping is :



- (A) 0.25 (B) 0.50
(C) 0.40 (D) 0.30

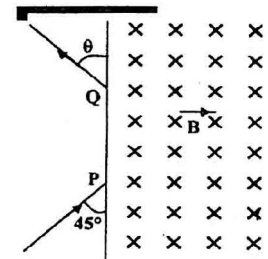
Q.9 For the given combination of gates, if the logic states of inputs A, B, C are as follows $A = B = C = 0$ and $A = B = 1, C = 0$ then the logic states of output D are



- (A) 0, 0 (B) 0, 1 (C) 1, 0 (D) 1, 1

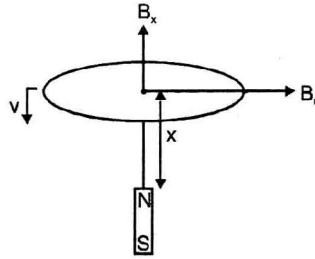
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- Q.10 If the mass of proton = 1.008 a.m.u. and mass of neutron = 1.009 a.m.u. then binding energy per nucleon for ${}^9_4\text{Be}$ (mass = 9.012 amu) would be
 (A) 0.065 MeV (B) 60.44 MeV (C) 67.2 MeV (D) 6.72 MeV
- Q.11 When light of intensity 1 W/m^2 and wavelength $5 \times 10^{-7} \text{ m}$ is incident on a surface, it is completely absorbed by the surface. If 100 photons emit one electron and area of the surface is 1 cm^2 , then the photoelectric current will be
 (A) 2 mA (B) $0.4 \mu\text{A}$ (C) 4.0 mA (D) $4 \mu\text{A}$
- Q.12 If the frequency of K_{α} line of the element having $Z = 65$ is ν_{α} , and the frequency of K_{α} line of the element having $Z = 81$ is $\nu_{\alpha'}$, then the ratio of their frequencies will be about
 (A) $\sqrt{2/5}$ (B) $2/\sqrt{5}$ (C) 16/25 (D) 2/5
- Q.13 When 100 volt d.c. is applied across solenoid a current of 1.0 amp flows in it. When 100 volts a.c. is applied across the same coil, the current drops to 0.5 amp. If the frequency of the a.c. source is 50 Hz the impedance and inductance of the solenoid are
 (A) 200 ohm and 0.55 Henry (B) 100 ohm and 0.86 Henry
 (C) 200 ohm and 1.0 Henry (D) 100 ohm and 0.93 Henry
- Q.14 A particle of mass $1.6 \times 10^{-27} \text{ kg}$ and charge $1.6 \times 10^{-19} \text{ coulomb}$ enters a uniform magnetic field of 1 Tesla as shown in the figure. The speed of the particle is 10^7 m/s . the distance PQ will be
 (A) 0.14 m (B) 0.28 m
 (C) 0.4 m (D) 0.5 m



Space for rough works

- Q.15 A conducting ring of radius r and resistance R is moving downward with a constant velocity v . Let due to a fixed magnet axial magnetic field varies only with the axial distance (x) from north pole as $B_x = \frac{1}{\pi x}$ Tesla and the radial magnetic field varies as $B_r = \frac{2}{\pi x}$ Tesla. When the ring is at a height x from the north pole of the magnet, the magnetic force experienced by the ring is :



- (A) $\frac{2r^3v}{Rx^3}$ upwards (B) $\frac{2r^3v}{Rx^3}$ downwards
- (C) $\frac{4r^3v}{Rx^3}$ upwards (D) $\frac{4r^3v}{Rx^3}$ downwards
- Q.16 The radius of the earth is R_e and the acceleration due to gravity at its surface is g . The work required in raising a body of mass m to a height h from the surface of the earth will be

- (A) $\frac{mgh}{\left(1 - \frac{h}{R_e}\right)}$ (B) $\frac{mgh}{\left(1 + \frac{h}{R_e}\right)^2}$ (C) $\frac{mgh}{\left(1 + \frac{h}{R_e}\right)}$ (D) $\frac{mg}{\left(1 + \frac{h}{R_e}\right)}$

Space for rough works

- Q.17 540 g of ice at 0°C is mixed with 540 g of water at 80°C . The final temperature of the mixture is
(A) 0°C (B) 40°C (C) 80°C (D) 100°C
- Q.18 An unknown frequency source X produces 8 beats with another source of frequency 250 Hz and 12 beats with source of frequency 270 Hz. The frequency of source X will be
(A) 282 Hz (B) 262 Hz (C) 242 Hz (D) 258 Hz
- Q.19 An unknown quantity x is measured using an experiment by measuring a length ℓ (in cm) from scale having least count of 1 cm. Formula used is $x = R \frac{\ell}{100 - \ell}$. R is known accurately. Find the percentage error in measurement of 'x' for $\ell = 50\text{cm}$.
(A) 4 % (B) 2 % (C) 3 % (D) 1 %
- Q.20 Light traveling in air falls at an incidence angle of 2° on one refracting surface of a prism of refractive index 1.5 and angle of refraction 4° . The medium on the other side is water ($n = 4/3$). Find the deviation produced by the prism.
(A) 1 (B) 2 (C) 3 (D) 4
- Q.21 A mono atomic ideal gas is filled in a non conducting container. The gas can be compressed by a movable non conducting piston. The gas is compressed slowly to 12.5% of its initial volume. the ratio of initial adiabatic bulk modulus of the gas to the final value of adiabatic bulk modulus of the gas is :
(A) $\frac{1}{4}$ (B) $\frac{1}{8}$ (C) $\frac{1}{32}$ (D) $\frac{1}{16}$

Space for rough works

- Q.22 In a single slit diffraction experiment, the width of the slit is made half the original width :
- (A) the width of the central maxima becomes double
 (B) the width of the central maxima becomes half
 (C) the width of the central maxima becomes one fourth
 (D) the width of the central maxima becomes four times.
- Q.23 Current I is flowing along the path ABCD, along the four edges of the cube (figure-a), produces a magnetic field B_0 at the centre of the cube. Find the magnetic field B produced at the center of the cube by a current I flowing along the path of the six edges ABCGHEA (figure-b)

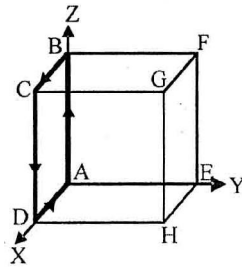


Figure-(a)

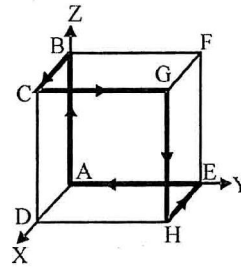
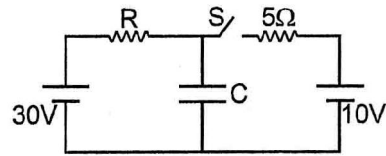


Figure-(b)

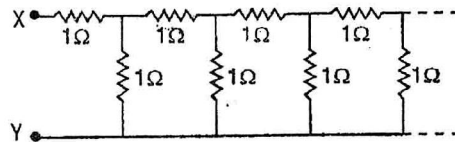
- (A) $\sqrt{\frac{3}{2}} B_0$ directed towards corner G
 (B) $\sqrt{3} B_0$ directed towards corner E
 (C) $\sqrt{\frac{3}{2}} B_0$ directed towards corner H
 (D) $\sqrt{3} B_0$ directed towards corner F

Space for rough works

- Q.24 In the circuit shown the capacitor is in steady state. The current through the 5Ω resistance just after the switch S is closed is :



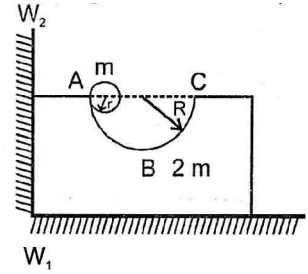
- (A) 2 A (B) 4 A
 (C) depends on value of R only (D) depends on the value of R and C
- Q.25 An electric field given by $\vec{E} = 4\hat{i} - 3(y^2 + 2)\hat{j}$ passes Gaussian cube of side 1 m placed with one corner at origin such that its sides represents x, y and z axes. The magnitude of net charge enclosed within the cube is
- (A) $4\epsilon_0$ (B) $3\epsilon_0$ (C) $5\epsilon_0$ (D) $-2\epsilon_0$
- Q.26 Figure shows an infinite ladder network of resistances. The equivalent resistance between points X and Y is



- (A) Infinite (B) 3 ohm
 (C) 8.62 ohm (D) 1.62 ohm

Space for rough works

- Q.27 A sphere of mass m and radius r is released from a wedge of mass $2m$ as shown. ABC is hemispherical position of radius R . The impulse imparted to the system consisting wedge and sphere by the vertical wall $w_1 w_2$ till the time sphere reaches at the bottom most position of spherical portion for the first time is : (Friction between wedge and horizontal surface is absent and between sphere and wedge friction is sufficient to avoid slipping between them.)

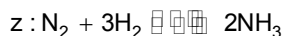
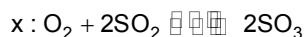


- (A) $m\sqrt{\frac{2g(R-r)}{7}}$ (B) $m\sqrt{\frac{10g(R-r)}{7}}$ (C) $2m\sqrt{\frac{5g(R-r)}{7}}$ (D) $3m\sqrt{\frac{2g(R-r)}{7}}$
- Q.28 Angular magnification produced by astronomical telescope for normal adjustment is 10 and length of telescope is 1.1 m. The angular magnification when the image is formed at least distance of distinct vision ($D = 25$ cm) is
- (A) 12 (B) 6 (C) 16 (D) 14
- Q.29 Two S.H.Ms. $s_1 = a \sin \omega t$ & $s_2 = b \sin \omega t$ are superimposed on a particle. The s_1 and s_2 are along the directions which make angle 37° with each other.
- (A) the particle will perform S.H.M. (B) the particle will not perform S.H.M.
 (C) the particle will perform motion but not S.H.M. (D) the motion will not be oscillatory.
- Q.30 A T.V tower has a height of 100 m. The population which is covered by T.V. broadcast, if the average population density around the tower is $1000/\text{km}^2$ will be
- (A) 39.5×10^5 (B) 40.2×10^5 (C) 29.5×10^7 (D) 9×10^4

Space for rough works

PART - II CHEMISTRY

- Q.31 A sample of 3 gram (92% pure) of silver carbonate on being strongly heated yields a residue and gaseous products Find the volume of evolved gases at STP.
- (A) 112 mL (B) 22 mL (C) 336 mL (D) 33.6 mL
- Q.32 The enthalpy of combustion of cyclohexane, 1,4-cyclohexadiene and H_2 are respectively -3920 , -3680 and -241 KJ mol^{-1} . The heat of hydrogenation of 1, 4-cyclohexadiene is :
- (A) -121 KJ/mol (B) -242 KJ/mol (C) 42 KJ/mol (D) 242 KJ/mol
- Q.33 Find the freezing point of a solution when 5 mol of KI is mixed with 1 mol of $HgCl_2$ in 3500 gram of H_2O . K_f of $H_2O = 1.86 \frac{K}{m}$. ($KI + HgCl_2 \longrightarrow K_2HgI_4 + KCl$)
- (A) $-28.7^\circ C$ (B) $-41.45^\circ C$ (C) $-35.07^\circ C$ (D) $-4.78^\circ C$
- Q.34 For the following gaseous equilibrium w, x, y and z at 300 K, the increasing order of $\left(\frac{K_p}{K_c}\right)$ is :



- (A) $w = x = y = z$ (B) $z < x < w < y$ (C) $y < w < x < z$ (D) $z < x < w = y$

Space for rough works

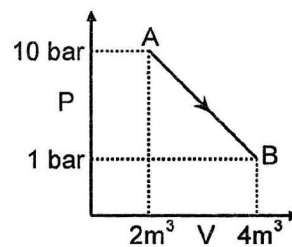
- Q.35 The slag produced during formation of wrought iron from its ore is/are :
- (A) CaSiO_3 & MnAsO_3 (B) CaSiO_3
 (C) MnSiO_3 (D) CaSiO_3 & MnSiO_3
- Q.36 Bleaching powder is a mixture of :
- (A) $\text{Ca}(\text{OCl})_2$ (B) $\text{Ca}(\text{OCl})_2 + \text{Ca}(\text{OH})_2$
 (C) $\text{CaCl}_2 + 2\text{H}_2\text{O}$ (D) $\text{Ca}(\text{OCl})_2 + \text{CaCl}_2 + \text{Ca}(\text{OH})_2 + 2\text{H}_2\text{O}$
- Q.37 Given $E^\circ_{\text{Cu}^+/\text{Cu}} = 0.52\text{V}$, $E^\circ_{\text{Cu}^{2+}/\text{Cu}^+} = 0.16\text{V}$. The equilibrium constant for disproportionation reaction
- $$2\text{Cu}^+(\text{aq}) \longrightarrow \text{Cu}(\text{s}) + \text{Cu}^{2+}(\text{aq}) \text{ at } 298\text{K is : (Take } \frac{2.303RT}{F} = 0.06\text{V)}$$
- (A) 6×10^4 (B) 6×10^6 (C) 10^6 (D) 1.2×10^{-6}
- Q.38 Correct statement about helmoholtz electrical double layer is :
- (I) It is a combination of two layer of similar charges around colloidal sol.
 (II) It is a combination of two layers of opposite charges around the colloidal sol.
 (III) In it 1st layer of ions is diffused while 2nd layer of ions is fixed.
 (IV) The potential difference between the fixed layer and the diffused layer is called zeta potential.
- (A) II & IV (B) I & III (C) III & IV (D) I & IV

Space for rough works

- Q.39 Which of the following statement is/are correct ?
- (A) Metal carbonyls possess both σ and π character.
 (B) Synergic bonding is present in metal carbonyls.
 (C) M–C π bond in metal carbonyls is formed by the donation of pair of e^- from a filled d-orbital of metal to vacant antibonding orbital (π^*) in CO.
 (D) All of these
- Q.40 In FCC structure what is the total number of voids in 0.6 mol of compound ? $\{N_A = 6 \times 10^{23} / \text{mol}\}$
- (A) 6.00×10^{23} (B) 1.08×10^{24} (C) 1.08×10^{23} (D) 7.2×10^{24}
- Q.41 If the e^- is transferred from A to B forming A^+ & B^- . The above process is possible when :
- [I = Ionisation enthalpy, E = Magnitude of electron gain enthalpy]
- (A) $(E_B + I_B) = (I_A - E_A)$ (B) $(I_A - E_B) > (I_B - E_A)$
 (C) $(I_B + E_B) > (I_A + E_A)$ (D) None of these
- Q.42 (I) In a cyclotimetaphosphoric acid molecule 3 double bonds; 12 single bonds are present.
 (II) PH_3 is highly poisonous and has smell like rotten fish.
 (III) Strong reducing behaviour of H_3PO_2 is due to presence of two P–H bonds.
 (IV) SO_2 acts as bleaching agent in moist conditions.
 (V) SO_2 can be prepared by the reaction of dilute H_2SO_4 with metal sulphide.
- Correct statements are :
- (A) I, II & III (B) I, II, III & IV (C) I, II, III, IV & V (D) II, III & V

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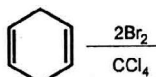
- Q.43 In the decomposition of Ammonia it was found that at 50 torr pressure $t_{1/2}$ was 3.64 hour while at 100 torr $t_{1/2}$ was 1.82 hours. Then order of reaction would be :
- (A) 0 (B) 1 (C) 2 (D) 3
- Q.44 Which of the following statement is INCORRECT ?
- (A) C_{60} contains twenty-six membered rings and twelve-five membered rings.
 (B) Fullerenes are cage-like molecules.
 (C) Graphite is thermodynamically most stable allotrope of carbon.
 (D) None of these
- Q.45 A buffer solution cannot be prepared by mixing solutions of :
- (A) Sodium chloride and Sodium hydroxide
 (B) Ammonium hydroxide and Ammonium chloride.
 (C) Formic acid and Sodium formate.
 (D) Boric acid and borax.
- Q.46 What is the value of ΔH_{AB} (in KJ) for an ideal gas in the given process represented in the figure ? Heat supplied during the process = 2740 KJ
- (A) 40 KJ (B) 400 KJ
 (C) 1640 KJ (D) 80 KJ

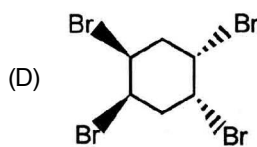
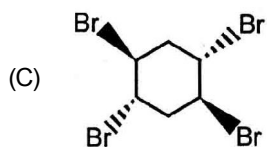
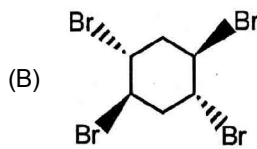
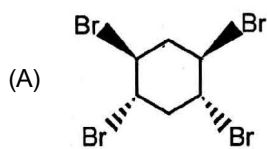


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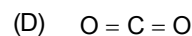
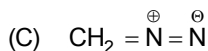
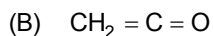
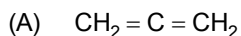
- Q.47 Gadolinium (Gd) belongs to 4f series. It's atomic number is 64. Which of the following is the correct electronic configuration of gadolinium ?
- (A) [Xe] 4f⁷, 5d¹, 6s² (B) [Xe] 4f⁶, 5d², 6s²
 (C) [Xe] 4f⁸, 6d² (D) [Xe] 4f⁹, 5s¹
- Q.48 In which of the following molecule/ion no unpaired electron is present ?
- (A) N₂⁺ (B) O₂ (C) O₂²⁻ (D) B₂
- Q.49 Toluene is nitrated and the resulting product is reduced with tin and hydrochloric acid. The product so obtained is diazotised and then heated with cuprous bromide. The reaction mixture so formed contains :
- (A) mixture of o- and p-dibromobenzenes (B) mixture of o- and p-bromoanilines
 (C) mixture of o- and m-bromotoluenes (D) mixture of o- and p-bromotoluenes
- Q.50 The pyrimidine bases present in DNA are
- (A) cytosine and guanine (B) cytosine and thymine
 (C) cytosine and uracil (D) cytosine and adenine
- Q.51 Choose the correct option :
- (A) Teflon, Polystyrene and neoprene are Copolymers
- (B) Monomer of $\left[\begin{array}{c} \text{CH}_3 \\ | \\ \text{---CH}_2\text{---C---} \\ | \\ \text{CH}_3 \end{array} \right]_n$ is butane
- (C) Bakelite is a cross linked polymer
- (D) Olefinic monomers undergo condensation polymerisation

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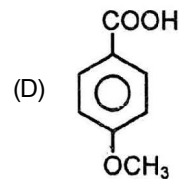
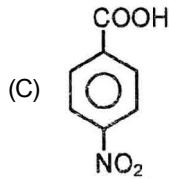
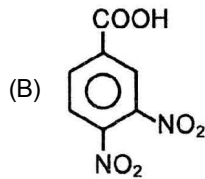
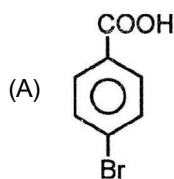
Q.52  Which product is not possible in above reaction ?



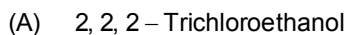
Q.53 Identify the molecule not showing resonance.



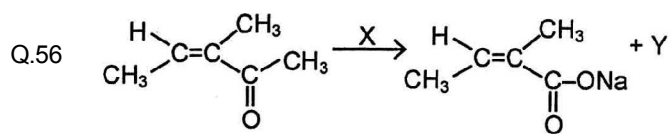
Q.54 Which one is the strongest acid.



Q.55 Trichloroacetaldehyde was subjected to reaction by using NaOH. The mixture of the products contains sodium trichloroacetate ion and another compound. The other compound is :



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Reagent X is :

- (A) $O_3 / Zn, H_2O$ (B) $NaOX$ (C) CrO_3 / CH_2Cl_2 (D) Cu / Δ

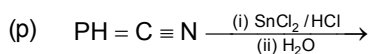
Q.57 What is the end product if alcohol consist primary alkyl group and react with H_2SO_4 at low temperature (413 K) :

- (A) Alkene (B) Protonated alcohol
(C) Ether (D) Alkyl hydrogen sulphate

Q.58 When $Me_3C - O - CH_3$ react with excess of HI gives CH_3I and Me_3Cl . It follows the type of mechanism respectively

- (A) only S_N1 (B) only S_N2 (C) S_N2 & S_N1 (D) S_N1 & S_N2

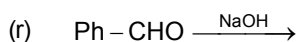
Q.59 Which is the correct code for the given name reactions ?



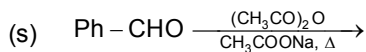
(i) Perkin reaction



(ii) Benzoin condensation



(iii) Stephen reduction



(iv) Canizzarro reaction

(A) p - iii, q - ii, r - iv, s - i

(B) p - iii, q - i, r - iv, s - ii

(C) p - ii, q - iii, r - iv, s - i

(D) p - iii, q - ii, r - i, s - iv

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- Q.60 Which one of the following undergoes reaction with 50% sodium hydroxide solution to give the corresponding alcohol and acid ?
- (A) Phenol (B) Benzoic acid
(C) Butanal (D) Benzaldehyde

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PART - III MATHEMATICS

- Q.61 If the mid-point of a chord of the ellipse $\frac{x^2}{16} + \frac{y^2}{25} = 1$ is $(0, 3)$, then length of the chord is
- (A) $\frac{32}{5}$ (B) 16 (C) $\frac{4}{5}$ (D) 12
- Q.62 The number of tangents drawn from point $(-5, 3)$ to the hyperbola $\frac{x^2}{25} - \frac{y^2}{9} = 1$ are
- (A) 0 (B) 1 (C) 2 (D) 3
- Q.63 If $x^2 + ax + 10 = 0$ and $x^2 + bx - 10 = 0$ have a common root, then $a^2 - b^2$ is equal to
- (A) 10 (B) 20 (C) 30 (D) 40
- Q.64 A relation R on the set of complex numbers is defined by $z_1 R z_2 \Leftrightarrow \frac{z_1 - z_2}{z_1 + z_2}$ is real, then R is an
- (A) equivalence relation (B) only reflexive
(C) only transitive (D) only symmetric
- Q.65 The roots of the equation $\cot x - \cos x = 1 - \cot x \cos x$ are
- (A) $n\pi + \frac{\pi}{4}, n \in I$ (B) $2n\pi + \frac{\pi}{4}, n \in I$
(C) $2n\pi \pm \pi$ or $n\pi + \frac{\pi}{4}, n \in I$ (D) $n\pi, n \in I$

Space for rough works

- Q.66 The degree of the differential equation $x = 1 + \left(\frac{dy}{dx}\right) + \frac{1}{2!}\left(\frac{dy}{dx}\right)^2 + \frac{1}{3!}\left(\frac{dy}{dx}\right)^3 + \dots$
- (A) 3 (B) 2 (C) 1 (D) 0
- Q.67 The equation of one of the curves whose slope of tangent at any point is equal to $y + 2x$ is
- (A) $y = 2(e^x + x - 1)$ (B) $y = 2(e^x - x - 1)$
 (C) $y = 2(e^x - x + 1)$ (D) $y = 2(e^x + x + 1)$
- Q.68 If $I_1 = \int_0^{3\pi} f(\cos^2 x) dx$ and $I_2 = \int_0^{\pi} f(\cos^2 x) dx$ then
- (A) $I_1 = I_2$ (B) $3I_1 = I_2$ (C) $I_1 = 3I_2$ (D) $I_1 = 5I_2$
- Q.69 If $(3\sqrt{3} + 5)^7 = P + F$ where P is an integer and F is a proper fraction, then F. (P + F)
- (A) 3^7 (B) 2^6 (C) 3^6 (D) 2^7
- Q.70 Let $A = \left\{ \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} : a_{ij} \in \{0, 1, 2\} \text{ and } a_{11} = a_{22} \right\}$, Then the number of singular matrices in set A is
- (A) 10 (B) 7 (C) 5 (D) 3
- Q.71 If $\vec{A} = \hat{i} - 3\hat{j} + 4\hat{k}$, $\vec{B} = 6\hat{i} + 4\hat{j} - 8\hat{k}$, $\vec{C} = 5\hat{i} + 2\hat{j} + 5\hat{k}$ and a vector \vec{R} satisfies $\vec{R} \times \vec{B} = \vec{C} \times \vec{B}$, $\vec{R} \cdot \vec{A} = 0$ then $\frac{|\vec{B}|}{|\vec{R} - \vec{C}|}$ is equal to
- (A) 1 (B) $\frac{1}{2}$ (C) 2 (D) 3

Space for rough works

Q.72 Solution set of $|x^2 - 4| \leq 5 - |x^2 - 9|$ is

(A) $[-3, 3]$

(B) $[-3, -2] \cup [2, 3]$

(C) $[-2, 2] \cup [3, 4]$

(D) $[-2, 4]$

Q.73 Let p : 7 is not greater than 4 and q : Paris is in France be two statements. Then $\sim(p \vee q)$ is the statement

(A) 7 greater than 4 or Paris is not in France

(B) 7 is not greater than 4 and Paris is not in France

(C) 7 is greater than 4 and Paris is in France

(D) 7 is greater than 4 and Paris is not in France

Q.74 If the vectors $\vec{a} = 2\hat{i} + \hat{j} + 4\hat{k}$, $\vec{b} = 4\hat{i} - 2\hat{j} + 3\hat{k}$ and $\vec{c} = 2\hat{i} - 3\hat{j} - \lambda\hat{k}$ are coplanar, then the value of λ is equal to

(A) 2

(B) 1

(C) 3

(D) -1

Q.75 A is a square matrix such that $A^2 = A$, then $(I - A)^3 + A$ is equal to

(A) A

(B) $I - A$

(C) I

(D) 3A

Q.76 For the equations

$$x + 2y + 3z = 1,$$

$$2x + y + 3z = 2,$$

$$5x + 5y + 9z = 4,$$

(A) there is only one solution

(B) there exists infinitely many solutions

(C) there is no solution

(D) more than one solutions

Space for rough works

- Q.77 Let $A = \{-1, 0, 1, 2\}$, $B = \{4, 2, 0, -2\}$ and $f, g : A \rightarrow B$ be functions defined by $f(x) = x^2 - x$ and $g(x) = 2 \left| x - \frac{1}{2} \right| - 1$.
Then
(A) $f = g$ (B) $f = 2g$ (C) $g = 2f$ (D) $f = 3g$
- Q.78. The number of solutions of the system of equations $\operatorname{Re}(z^2) = 0, |z| = 2$ is
(A) 4 (B) 3 (C) 2 (D) 1
- Q.79. $\left(1 - \frac{\cos 61^\circ}{\cos 1^\circ}\right) \left(1 - \frac{\cos 62^\circ}{\cos 2^\circ}\right) \left(1 - \frac{\cos 63^\circ}{\cos 3^\circ}\right) \dots \left(1 - \frac{\cos 119^\circ}{\cos 59^\circ}\right)$ is
(A) -1 (B) 1 (C) 2 (D) -2
- Q.80 If $2 \tan^{-1}(\cos x) = \tan^{-1}(2 \operatorname{cosec} x)$, then x is equal to
(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{3}$ (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{6}$
- Q.81 If a, b, c, d and p are different real number such that $(a^2 + b^2 + c^2)p^2 - 2(ab + bc + cd)p + (b^2 + c^2 + d^2) \leq 0$, then a, b, c and d are in
(A) A.P. (B) G.P. (C) H.P. (D) A.G.P.
- Q.82 The area of the parallelogram contained by the lines $4y - 3x + 1 = 0, 4y - 3x - 1 = 0, 3y - 4x + 1 = 0$ and $3y - 4x + 2 = 0$ is $\frac{p}{q}$, where p and q are prime, then the value of $p + q$ is
(A) $\frac{24}{7}$ (B) $\frac{48}{7}$ (C) 9 (D) 3

Space for rough works

- Q.83 For the function $f(x) = \frac{4}{3}x^3 - 8x^2 + 16x + 5$, $x = 2$ is a point of
- (A) local maxima (B) local minima
(C) point of inflexion (D) decreasing
- Q.84 Equation of the circle touching the line $x + y = 4$ at $(1, 3)$ and intersecting the circle $x^2 + y^2 = 4$ orthoconally is
- (A) $x^2 + y^2 - x + 2y - 15 = 0$ (B) $2x^2 + 2y^2 - x - 9y + 8 = 0$
(C) $2x^2 + 2y^2 - x + y - 22 = 0$ (D) $x^2 + y^2 - x - y - 6 = 0$
- Q.85 Bag I contains 3 red and 4 black balls while another bag II contains 5 red and 6 black balls. One ball is drawn at random from one of the bags and it is found to be black. The probability that it was drawn from bag II is
- (A) $\frac{7}{43}$ (B) $\frac{13}{43}$ (C) $\frac{21}{43}$ (D) $\frac{1}{2}$
- Q.86 For the binomial distribution $(p + q)^n$ whose mean is 20 and variance is 16, pair (n, p) is
- (A) $\left(100, \frac{1}{5}\right)$ (B) $\left(100, \frac{2}{5}\right)$ (C) $\left(50, \frac{1}{5}\right)$ (D) $\left(50, \frac{2}{5}\right)$
- Q.87 If $N = \frac{1 - \cos 4\beta}{\sec^2 2\beta - 1} + \frac{1 + \cos 4\beta}{\operatorname{cosec}^2 2\beta - 1}$ then $\log_{0.25} N$ is equal to
- (A) -2 (B) -1 (C) $-\frac{1}{2}$ (D) $\frac{1}{2}$

Space for rough works

- Q.88 If the coefficient of x in the expansion of $(1 - 2x^3 + 3x^5) \left(1 + \frac{1}{x}\right)^n$ is 154, then n can be equal to
- (A) 6 (B) 7 (C) 8 (D) 9
- Q.89 If the function $f(x)$ satisfies $\lim_{x \rightarrow 1} \frac{f(x) - 3}{x^2 - 1} = \pi$, then $\lim_{x \rightarrow 1} f(x)$ is
- (A) 1 (B) 2 (C) 3 (D) π
- Q.90 $\int e^x \left(\frac{1 + \sin x}{1 + \cos x} \right) dx =$ (where C is integration constant)
- (A) $e^x \tan \frac{x}{2} + C$ (B) $e^x \cot \frac{x}{2} + C$
- (C) $e^x \sin x + C$ (D) $e^x \cos x + C$

Space for rough works
