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TEST ID : 511448

IIT JEE 2013 – Full Length Test 8

PHYSICS , CHEMISTRY & MATHEMATICS

[Syllabus : Unit & dimension, Errors, Significant Digits, Vectors, Calculus, Kinematics, Constraints, NLM & Friction, Circular Motion, W.E.P., Collision & Momentum, Statics, Rotational Mechanics, Thermal physics – I & II, Electrostatics, Capacitors, Gravitation, SHM, Elasticity, Electric Current, **Magnetism and Sound & Waves.** Redox Reaction, Stoichiometry, Gas Laws, Atomic structure, Chemical Equilibrium, Ionic Equilibrium, Energetics and Thermodynamics, Thermochemistry, Solutions & Colligative Properties, Volumetric Titration, Electrochemistry, Periodic properties, Chemical Bonding, Nomenclature, Isomerism, Reaction mechanism, Hydrocarbon, Aromatic Compounds, Halogen Derivatives, Alcohols, Ethers & Phenols, Chemical Kinetics, Nuclear Chemistry, Solid State, Hydrogen, s – block elements, **p-block elements and Surface Chemistry.** Logarithms, Trigonometric Identities, Functions, Trigonometric Equations and Inverse Trigonometry, Straight Line, Basic Co-ordinate Geometry, Properties of Triangles, Quadratic Equations & Expressions, Complex Number – I & II, Sequences & Series, Determinants & Matrices, Permutation & Combinations, Binomial theorem, Probability, Limits, Continuity & Differentiability, Derivatives & Pair of Lines, **Circles and Application of Derivatives.]**

PAPER - II

Time : 3 hours ***Maximum Marks : 198***

Instructions to Test Takers :

1) The question paper consists of 3 parts (Physics, Chemistry and Mathematics). Each part has 3 sections.

2) This Question Paper has **60** questions comprising of **Physics (Q. 1 to 20), Chemistry (Q. 21 to 40) and Mathematics (Q. 41 to 60).**

3) **Section I** contains **8** multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **only one is correct.** For each question you will be awarded **3 marks** if you have darkened only the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In all other cases, **minus one (–1) mark** will be awarded.

4) **Section II** contains **6 multiple choice questions** relating to three paragraphs with **two questions on each paragraph.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct. For each question you will be awarded **3 marks** if you have darkened only the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In all other cases, **minus one (–1) mark** will be awarded.

5) **Section III** contains **6** multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which **one or more than one answer is correct.** For each question you will be awarded **4 marks** if you have darkened only the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In all other cases, **minus one (–1) mark** will be awarded.

6) Use of calculators, log tables, cellular phones & electronic instruments in any form are **not permitted**.

7) Questions are to be answered by darkening with a soft HB pencil the appropriate bubble(s) (A, B, C or D) against the question number on the ORS.

Name : …… Reg. No.: ……

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PART I : PHYSICS

SECTION I

Single Correct Answer Type

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. Particle 'A' makes a perfectly elastic collision with another stationary particle 'B'. They fly apart in opposite directions with equal velocities. The mass ratio will be

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

2. A progressive wave and a stationary wave have same frequency 200 Hz; same wavelength moving with 50 ms^{-1}. The amplitude of progressive wave is 5 cm, the equation of the stationary wave can be written as

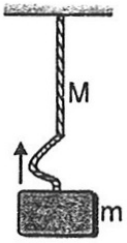
(A) $y = 10 \sin \pi (200\, t - 4x)$ (B) $y = 10 \cos 8\pi x (\sin 400\, \pi t)$

(C) $y = 10 \cos 8\pi x \sin 4\pi\, t$ (D) $y = 10 \sin 2\pi (200\, t - x)$

3. The orbital period of a satellite in a circular orbit of radius r about a spherical planet of mass M and density ρ for a low altitude orbit ($r \approx r_p$) will be

(A) $\sqrt{\frac{3\pi}{G\rho}}$ (B) $\sqrt{3\pi G\rho}$ (C) $\sqrt{\frac{\pi}{G\rho}}$ (D) $\sqrt{2G\rho}$

4. A uniform rope of length ℓ and mass M hangs vertically from a rigid support. A block of mass m is attached to the free end of the rope. A transverse pulse of wavelength λ is produced at the lower end of the rope. The wavelength of the pulse, when it reaches the top of the rope, is



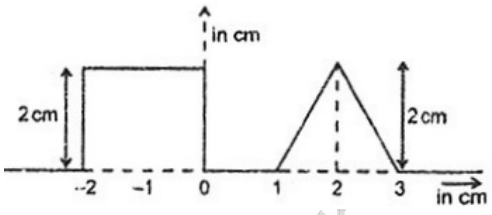
(A) $\lambda\sqrt{\frac{M-m}{m}}$ (B) $\lambda\frac{M+m}{m}$

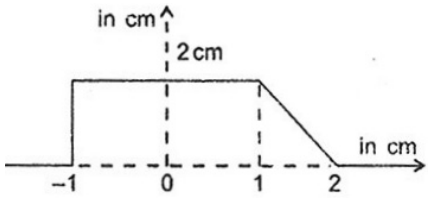
(C) $\lambda\sqrt{\frac{m}{M+m}}$ (D) $\lambda\sqrt{\frac{M+m}{m}}$

SPACE FOR ROUGH WORK

PHYSICS

5. The figure shows at time t = 0 second, a rectangular and triangular pulse on a uniform wire are approaching each other. The pulse speed is 0.5 cm/s. The resultant pulse at t = 2 second is



(A)


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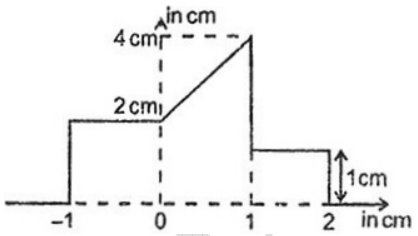

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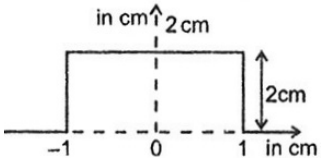
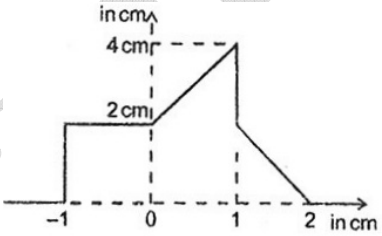
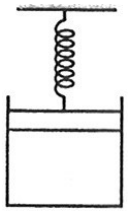


(D)


6. One mole of an ideal gas is kept enclosed under a light piston (area = 10^{-2} m^2) connected by a compressed spring (spring constant 100 N/m). The volume of gas is 0.83 m^3 and its temperature is 100 K. The gas is heated so that it compresses the spring further by 0.1 m. The work done by the gas in the process is : (Take R = 8.3 J/K–mole and suppose there is no atmosphere).



(A) 3 J (B) 6 J (C) 9 J (D) 1.5 J

7. Moment of inertia of a uniform quarter disc of radius R and mass M about an axis through its centre of mass and perpendicular to its plane is :

(A) $\frac{MR^2}{2}-M\left(\frac{4R}{3\pi}\right)^2$ (B) $\frac{MR^2}{2}-M\left(\sqrt{2}\frac{4R}{3\pi}\right)^2$

(C) $\frac{MR^2}{2}+M\left(\frac{4R}{3\pi}\right)^2$ (D) $\frac{MR^2}{2}+M\left(\sqrt{2}\frac{4R}{3\pi}\right)^2$

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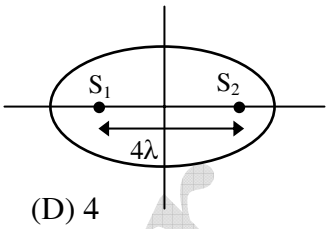
8. S_1, S_2 are two coherent sources (having initial phase difference zero) of sound located along x–axis separated by 4λ where λ is wavelength of sound emitted by them. Number of maxima located on the elliptical boundary around it will be : [S_1 & S_2 are assumed to be at focus of ellipse]



(A) 16 (B) 12 (C) 8 (D) 4

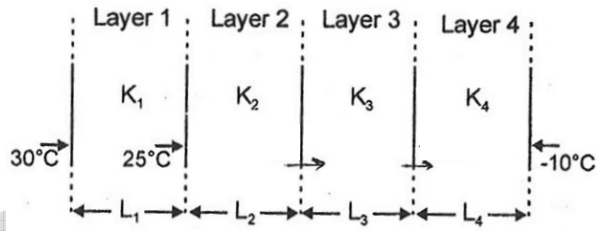
SECTION II

Paragraph Type

This section contains **6 multiple choice questions** relating to three paragraphs with **two questions on each paragraph.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Q. No. 9 & 10

Figure shows in cross section a wall consisting of four layers with thermal conductivities K_1 = 0.06 W/K; K_3 = 0.04 W/K and K_4 = 0.10 W/K. The layer thicknesses are L_1 = 1.5 cm; L_3 = 2.8 cm and L_4 = 3.5 cm. The temperature of interfaces is as shown in figure. Energy transfer through the wall is steady.



9. The temperature of the interface between layers 2 and 3 is :

(A) 11°C (B) 8°C (C) 7.2°C (D) 5.4°C

10. If layer thickness L_2 is 1.4 cm, then its thermal conductivity K_2 will have value (in W/K) :

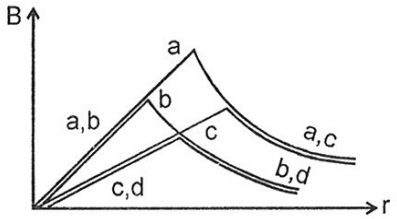
(A) 2×10^{-2} (B) 2×10^{-3} (C) 4×10^{-2} (D) 4×10^{-3}

SPACE FOR ROUGH WORK

PHYSICS

Paragraph for Q. No. 11 & 12

Curves in the graph shown give, as function of radial distance r (from the axis), the magnitude B of the magnetic field (due to individual wire) inside and outside four long wires a, b, c and d, carrying currents that are uniformly distributed across the cross section of the wires. Overlapping portions of the plots are indicated by double labels. All curves start from the origin.



11. Which wire has the greatest radius?

(A) a (B) b (C) c (D) d

12. The current density in wire a is

(A) greater than in wire c

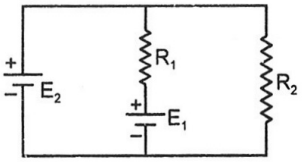
(B) less than in wire c

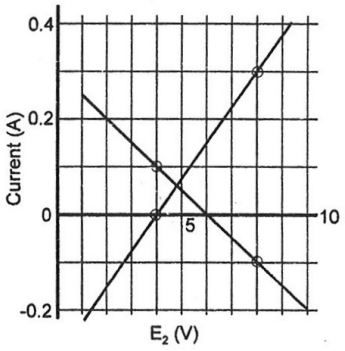
(C) equal to that in wire c

(D) not comparable to that of in wire c due to lack of information

Paragraph for Q. No. 13 & 14

In the circuit given below, both batteries are ideal. EMF E_1 of battery 1 has a fixed value, but emf E_2 of battery 2 can be varied between 1.0 V and 10.0 V. The graph gives the currents through the two batteries as a function of E_2, but are not marked as which plot corresponds to which battery. But for both plots, current is assumed to be negative when the direction of the current through the battery is opposite the direction of the battery's emf. (direction of emf is from negative to positive)





13. The value of emf E_1 is

(A) 8 V (B) 6 V (C) 4 V (D) 2 V

14. The resistance R_2 is equal to :

(A) 10 Ω (B) 20 Ω (C) 30 Ω (D) 40 Ω

SPACE FOR ROUGH WORK

SECTION III
Multiple Correct Answer(s) Type

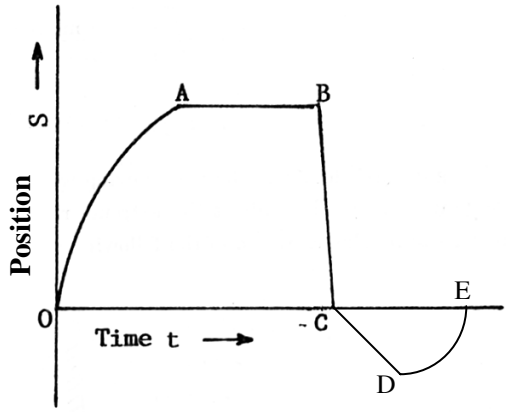
This section contains **6 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

15. A particle executes S.H.M. in a straight line such that in two of its positions the speeds are u and v and the corresponding accelerations are α and β ($0 < \alpha < \beta$). If the distance between the positions is d and the period of motion is T, then:

(A) $d = \left|\frac{u^2 - v^2}{\alpha + \beta}\right|$ (B) $d = \left|\frac{u^2 - v^2}{\alpha - \beta}\right|$

(C) $T = 2\pi\sqrt{\left|\frac{u^2 - v^2}{\alpha^2 - \beta^2}\right|}$ (D) $T = 2\pi\sqrt{\frac{u^2 + v^2}{\alpha^2 + \beta^2}}$

16. A particle has a rectilinear motion and the figure gives its displacement as a function of time. Which of the following statements are true with respect to the motion?

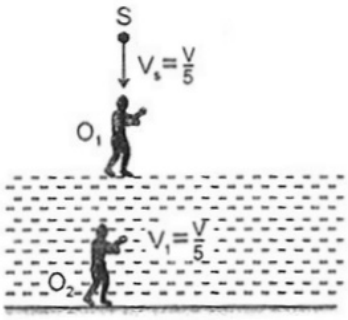


(A) In the motion between O and A the velocity is positive and acceleration is negative
(B) Between A and B the velocity and acceleration are positive
(C) Between C and D the velocity is negative and acceleration is zero
(D) Between D and E the acceleration is positive.

17. If the tension in a string is changed by 21 per cent, the fundamental frequency of the string changes by 15 Hz. Which of the following statements be correct?
(A) The original fundamental frequency is nearly 143 Hz
(B) The velocity of propagation changes nearly by 4.5%
(C) The velocity of propagation changes by 10.5%
(D) The fundamental wavelength changes nearly by 10%

SPACE FOR ROUGH WORK

18. In the figure shown an observer O_1 floats on (static) water surface with ears in air while another observer O_2 is moving upwards with constant velocity $V_1 = \frac{V}{5}$ in water. The source moves down with constant velocity $V_s = \frac{V}{5}$ and emits sound of frequency 'f'. The velocity of sound in air is V and that in water is 4V. For the situation shown in figure.



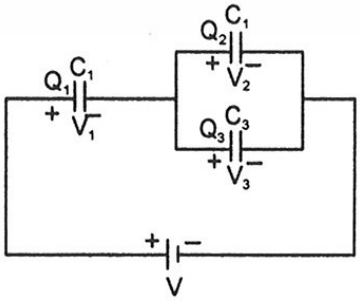
(A) The wavelength of the sound received by O_1 is $\frac{4V}{5f}$

(B) The wavelength of the sound received by O_1 is $\frac{V}{f}$

(C) The frequency of the sound received by O_2 is $\frac{21f}{16}$

(D) The wavelength of the sound received O_2 is $\frac{16V}{5f}$

19. In the adjoining diagram all the capacitors are initially uncharged, they are connected with a battery as a shown in figure. Then



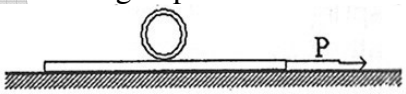
(A) $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_2$

(B) $Q_1 = Q_2 + Q_3$ and $V = V_1 + \frac{V_2 + V_3}{2}$

(C) $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_3$

(D) $Q_2 = Q_3$ and $V = V_2 + V_3$

20. A 160 mm diameter ring of mass 6 kg rests on a 1.5 kg plate. The ring and plate are initially at rest when a force P of magnitude 25 N is applied for 0.75 s. on the plate. and if $\mu_k = 0.20$ between the plate and the floor and there is sufficient friction to prevent slipping between ring & plank. If the resulting speed of plate is v_P and of ring is v_R; then



(A) $v_R = \frac{5}{3} ms^{-1}$ (B) $v_R = \frac{5}{6} ms^{-1}$ (C) $v_P = \frac{5}{3} ms^{-1}$ (D) $v_P = \frac{5}{6} ms^{-1}$

SPACE FOR ROUGH WORK

PART II : CHEMISTRY

SECTION I

Single Correct Answer Type

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

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21. A square planar complex is formed by hybridisation of which atomic orbitals?

(A) s, p_x, p_y, d_{yz} (B) s, p_x, p_y, $d_{x^2-y^2}$

(C) s, p_x, p_y, d_{z^2} (D) s, p_y, p_z, d_{xy}

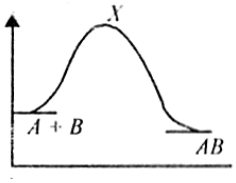
22. At a temperature TK, the pressure of 4.0 g argon in a bulb is P. The bulb is now put in a bath having temperature 50 K higher by T. 0.8 g of argon had to be removed to maintain original pressure. The temperature T is equal to

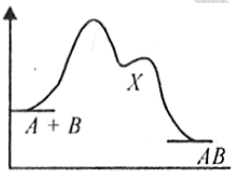
(A) 510 K (B) 200 K (C) 100 K (D) 73 K

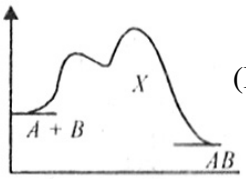
23. For an exothermic chemical reaction occurring in two steps as :

(i) $A + B \rightarrow X$ (slow) (ii) $X \rightarrow AB$ (fast)

The progress of the reaction can be best described by

(A) 

(B) 

(C) 

(D) All of these

24. The solubility of AgI in NaI solution is less than that in pure water because

(A) solubility product of AgI is less than that of NaI

(B) of common ion effect

(C) AgI forms complex with NaI

(D) solubility product of NaI is less than that of AgI

25. $^{235}_{92}U + n \rightarrow ^{236}_{92}U \rightarrow$ fission product + neutron + 3.20×10^{-11} J. The energy released when 1 g of $^{235}_{92}U$ undergoes fission is

(A) 12.75×10^8 kJ (B) 18.60×10^9 kJ (C) 8.20×10^7 kJ (D) 6.55×10^6 kJ

26. The enthalpy change involved in the oxidation of glucose is − 2880 kJ mol^{-1}. Twenty five percent of this energy is available for muscular work. If 100 kJ of muscular work is needed to walk one kilometer, what is the maximum distance that a person will be able to walk eating 120 g of glucose?

(A) 7.9 cm (B) 9.7 km (C) 4.8 km (D) 8.4 km

SPACE FOR ROUGH WORK

27. Consider the following statements.

S_1 : The percentage of s–character in the orbital forming S–S bonds and P–P bonds in S_8 and P_4 molecules respectively are same.

S_2 : In SF_4 the bond angles, instead of being 90° and 180° are 89° and 177° respectively due to the repulsions between lone pair and bond pairs of electrons.

S_3 : Aqueous H_3PO_4 is syrupy (i.e. more viscous than water)

S_4 : SiO_2 crystal may be considered as giant molecule in which eight–membered rings are formed with alternate silicon and oxygen atoms.

Of these :

(A) S_1 & S_4 are correct only (B) S_2, S_3 & S_4 are correct only

(C) S_1, S_2, S_3 & S_4 are correct (D) S_1, S_2 & S_3 are correct only

28. In the structure of H_2CSF_4, to decide the plane in which C = S is present the following bond angle values are given :

Axial FSF angle (idealized = 180°) $\Rightarrow$ 170°

Equatorial FSF angle (idealized = 120°) $\Rightarrow$ 97°

After deciding the plane of double bond, which of the following statement is/are correct?

(A) two C–H bonds are in the same plane of axial S–F bonds

(B) two C–H bonds are in the same plane of equatorial S–F bonds

(C) total five atoms are in the same plane

(D) equatorial S–F bonds are perpendicular to plane of π–bond

SECTION II

Paragraph Type

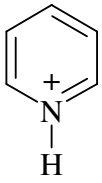
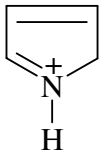
This section contains **6 multiple choice questions** relating to three paragraphs with **two questions on each paragraph.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Q. No. 29 & 30

The acidic nature of carboxylic acids, phenol and basic nature of amines can be decided by considering the magnitudes of inductive and mesomeric effects caused by atoms or group attached to these species. Electron withdrawing groups (–I, –M) increase acidic nature but reduces basic nature while electron releasing groups (+I, +M) have just opposite trends.

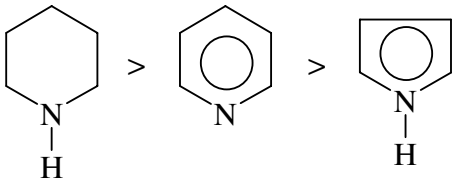
SPACE FOR ROUGH WORK

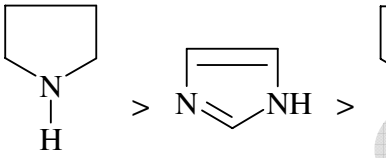
29. Which of the following is the correct order of acidic nature?

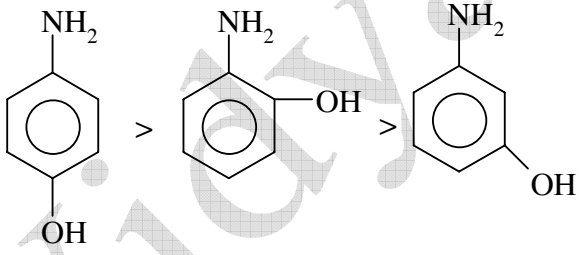
(I) H_2O (II) $H2O^+$ (III)  (IV) 

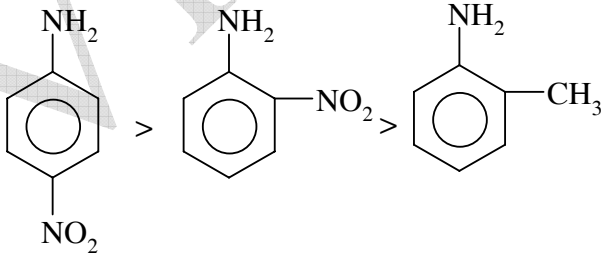
(A) II > IV > III > I
(B) IV > III > II > I
(C) IV > II > III > I
(D) II > III > IV > I

30. Which of the following order is not correct for basic nature?

(A) 

(B) 

(C) 

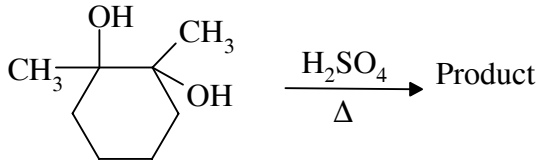
(D) 

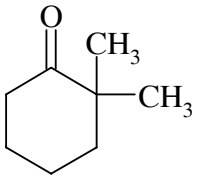
SPACE FOR ROUGH WORK

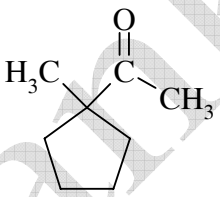
Paragraph for Q. No. 31 & 32

Pinacole pinocolone rearrangement involves the acid catalyzed elimination conversion of di–ols (1, 2 or vic) into carbonyl compounds. This pehomenon starts with the protonation of –OH group followed by H_2O elimination to give a carbocation alder rearrangement of stable carbocation formation finally H^+ is elimination to give carbonyl compound.

31. Proposes a mechanism for each of the following reactions :

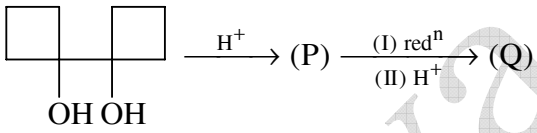


(A) 

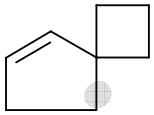
(B) 

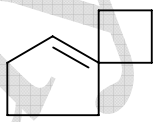
(C) None of these

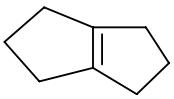
(D) Both (A) and (B)

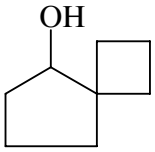
32. 

In this sequence of reaction the final product (R) is?

(A) 

(B) 

(C) 

(D) 

Paragraph for Q. No. 33 & 34

The amount of energy required to remove the most loosely bound electron from an isolated gaseous atom is called as first ionization energy (IE_1). Similarly the amount of energies required to knock out second, third etc. electrons from the isolated gaseous cations are called successive ionization energies and $IE_3 > IE_2 > IE_1$.

(i) Nuclear charge (ii) Atomic size (iii) penetration effect of the electrons (iv) shielding effect of the inner electrons and (v) electronic configurations (exactly half filled & completely filled configurations are extra stable) are the important factors which affect the ionization energies.

SPACE FOR ROUGH WORK

Similarly the amount of energy released when a neutral isolated gaseous atom accepts an extra electron to form gaseous anion is called electron affinity.

$$X(g) + e^{-}(g) + \text{energy}$$

A positive electron affinity indicates that the ion X^{-} has a lower more negative energy than the neutral atom X. The second electron affinity for the addition of a second electron to an initially neutral atom is negative because the electron repulsion out weighs the nuclear attraction, e.g.,

$$O(g) + e^{-} \xrightarrow{\text{Exothermic}} O^{-}(g); E_a = +141 \text{ kJ mol}^{-1} \quad \text{..... (i)}$$

$$O^{-}(g) + e^{-} \xrightarrow{\text{Endothermic}} O^{2-}(g); E_a = -780 \text{ kJ mol}^{-1} \quad \text{.....(ii)}$$

The electron affinity of an element depends upon (i) atomic size (ii) Nuclear charge & (iii) electronic configuration. In general, ionization energy and electron affinity increases as the atomic radii decrease and nuclear charge increases across a period. In general, in a group, ionization energy and electron affinity decrease as the atomic size increases.

The members of third period have some higher (e.g. S and Cl) electron affinity values than the members of second period (e.g. O and F) because second period elements have very small atomic size. Hence there is a tendency of electron–electron repulsion, which results in less evolution of energy in the formation of corresponding anion.

33. Identify the least stable ion amongst the following :

(A) Li^{-} (B) Be^{-} (C) B^{-} (D) C^{-}

34. Which one of the following statements is correct?

(A) The elements like F, Cl, Br, O etc. having high values of electron affinity act as strong oxidizing agent.

(B) The elements having low values of ionization energies act as strong reducing agent

(C) The formation of $S^{2-}(g)$ is an endothermic process

(D) All of these

SECTION III

Multiple Correct Answer(s) Type

This section contains **6 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

35. What products can be isolated when 2–hexyne reacts with aqueous sulfuric acid and Hg^{2+}?

(A) 2–hexen–2–ol (B) 2–hexanone (C) 3–hexanone (D) 2–hexen–3–ol

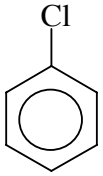
SPACE FOR ROUGH WORK

36. Difference between crystalloid and colloid is/are of

(A) particle size (B) Tyndall effect

(C) diffusion through a membrane (D) None of these

37. In the Dow process for the manufacture of phenol as follows



$\xrightarrow[\text{High pressure}]{\text{NaOH, 360°C}}$ [Intermediate] Aromatic $\xrightarrow{H_2O}$ Phenol + (A) + (B)

Side products

Which of these statement is/are correct :

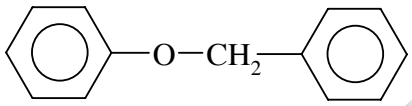
(A) p–phenylphenol is also formed as by–product

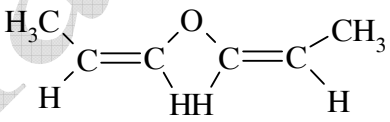
(B) Phenol is formed via an intermediate that is aromatic

(C) Biphenylene is also formed as by–product

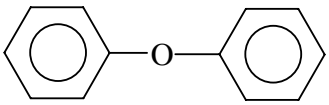
(D) diphyenylether is also formed as by–product

38. Which of the following ethers can be synthesized directly by Williamson's synthesis?

(A) 

(B) 

(C) $CH_3CH_2-O-CH_3$

(D) 

39. Which of the following is correct?

(A) In an exothermic reaction, the enthalpy of products is less than that of the reactants

(B) $\Delta H_{combustion}$ is always positive

(C) A reaction for which $\Delta H < 0$ and $\Delta S > 0$ is possible at all temperature

(D) ΔH is more that ΔE for the reaction $C_{(s)} + \frac{1}{2}O_{2(g)} \rightarrow CO_{(g)}$

40. An aerosol is a colloidal system of

(A) solid dispersed in gas (B) liquid dispersed in gas

(C) gas dispersed in solid (D) gas dispersed in liquid

SPACE FOR ROUGH WORK

PART III : MATHEMATICS

SECTION – I
Single Correct Answer Type

This section contains **8 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

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41. If X denotes the set of real numbers p for which the equation $x^2 = p\,(x + p)$ has its roots greater than p then X is equal to

(A) $\left(-2, -\frac{1}{2}\right)$ (B) $\left(-\frac{1}{2}, \frac{1}{4}\right)$ (C) null set ϕ (D) $(-\infty, 0)$

42. If $a\sin\left(x^2\right) = b\cos\left(x^2\right) = \frac{2c\tan\left(x^2\right)}{1-\tan^2\left(x^2\right)}, \left(x^2 \neq n\pi \pm \frac{\pi}{4}\right)$ then the value of $(a^2 - b^2)^2$ is

(A) $2c^2(a^2 + b^2)$ (B) $4c^2(a^2 - b^2)$ (C) $2c^2(a^2 - b^2)$ (D) $4c^2(a^2 + b^2)$

43. In ΔABC, if $a \tan A + b \tan B = (a + b)\tan\frac{A+B}{2}$, then ΔABC must be

(A) isoceles triangle (B) equilateral triangle
(C) right angled triangle (D) both (A) and (C)

44. If $\sin(\alpha + \beta) = 1$, $\sin(\alpha - \beta) = \frac{1}{2}$, $\alpha, \beta \in \left[0, \frac{\pi}{2}\right]$, then $\tan(\alpha + 2\beta)\tan(2\alpha + \beta)$ is equal to

(A) 1 (B) –1 (C) 0 (D) None of these

45. The value of $\cos\left[\frac{1}{2}\cos^{-1}\left(\cos\left(-\frac{14\pi}{5}\right)\right)\right]$ is

(A) $\cos\left(-\frac{7\pi}{5}\right)$ (B) $-\sin\frac{\pi}{10}$ (C) $\cos\frac{2\pi}{5}$ (D) None of these

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SPACE FOR ROUGH WORK

46. From a fixed point A on the circumference of a circle of radius r, the perpendicular AY is let fall on the tangent at P. The maximum area of the triangle APY is

(A) r^2 (B) $\frac{3\sqrt{3}}{4} r^2$ (C) $\frac{3\sqrt{3}}{8} r^2$ (D) $\sqrt{3} r^2$

47. If $e^{-\pi/2} < \theta < \pi/2$, then

(A) $\cos(\ell n\ \theta) < \ell n(\cos\theta)$

(B) $\cos(\ell n\ \theta) > \ell n\ (\cos\theta)$

(C) $\cos(\ell n\ \theta) = \ell n\ (\cos\theta)$ for exactly 2 values of θ

(D) none of these

48. The equation of the pair of straight lines parallel to x–axis and touching the circle $x^2 + y^2 - 6x - 4y - 12 = 0$ is

(A) $y^2 + 11y + 28 = 0$ (B) $y^2 - 4y - 21 = 0$ (C) $y^2 + 4y - 1 = 0$ (D) $y^2 - 4y + 3 = 0$

SECTION – II

Paragraph Type

This section contains **6 multiple choice questions** relating to three paragraphs with **two questions on each paragraph.** Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

Paragraph for Q. No. 49 & 50

Let a function named 'anti–modulus' function be defined as $]x[= \begin{cases} -x & \text{if } x \geq 0 \\ x & \text{if } x < 0 \end{cases}$

49. The number of integral solutions of the equation $\frac{]x[^2 + 6]x[+ 8}{]x[+ 6} > 0$ is

(A) 1 (B) 3 (C) 2 (D) 5

50. The number of real solutions of the equation, $\left]x + \frac{1}{x}\right[= \left|x + \frac{1}{x}\right|$ is

(A) 1 (B) 0 (C) 2 (D) 4

SPACE FOR ROUGH WORK

Paragraph for Question No. 51 & 52

If f is a continuous and differentiable function from R $\rightarrow$ R and $f^2(x)$ stands for f(f(x)), $f^3(x)$ for f (f(f(x))) and so on.

51. If f is a polynomial function and f(1) = 0, f(2) = 7, f(4) = 63, then

(A) $f'(x) = 3x^2 \ \forall\, x \in R$

(B) $f'(x) = 3x^2$ for at least one $x \in (1, 3)$

(C) $f'(x) = 3x^2$ for exactly two $x \in (1, 4)$

(D) $f'(x) = 3x^2$ for maximum two $x \in (1, 4)$

52. If $f(x) - x = 0$ has no real root, then $f^n(x) - x = 0$ has

(A) at least (n – 1) real roots
(B) at least (n – 2) real roots
(C) no real root
(D) at least two non-real roots

Paragraph for Question No. 53 & 54

If $P_k = 1 + x + \ldots\ldots + x^k$, $k \in N$
and terms of the product $P_1P_2P_3\ldots\ldots P_n$ obtained are arranged in increasing power of x as

$$P_1.P_2.P_3.....P_n = a_0 + a_1x + a_2x^2 + ...$$

53. The number of terms in the product $P_1.P_2\ldots.P_n$ is :

(A) $\frac{n(n+1)}{2}$
(B) $\frac{n^2-n}{2}$
(C) $\frac{n^2+n-2}{2}$
(D) $\frac{n^2+n+2}{2}$

54. The value of $a_0 + a_2 + a_4 + ...$ is

(A) $\frac{2^n-1}{2}$
(B) $\frac{2^n+1}{2}$
(C) $\frac{(n-1)!}{2}$
(D) $\frac{(n+1)!}{2}$

SPACE FOR ROUGH WORK

SECTION – III

Multiple Correct Answer(s) Type

This section contains **6 multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

55. Which of the following function(s) not defined at x = 0 has/have removable discontinuity at the origin ?

(A) $f(x) = \dfrac{1}{1+2^{\cot x}}$ (B) $f(x) = \cos\left(\dfrac{|\sin x|}{x}\right)$

(C) $f(x) = x \sin\dfrac{\pi}{x}$ (D) $f(x) = \dfrac{1}{ln|x|}$

56. If all the roots of $z^3 + az^2 + bz + c = 0$ are of unit modulus then

(A) $|a| \le 3$ (B) $|b| \le 3$ (C) $|c| = 1$ (D) $|c| \ge 3$

57. $f(x) = |[x]\, x|$ in $-1 < x \le 2$ is

(A) continuous at x = 0 (B) discontinuous at x = 1

(C) not differentiable at x = 2 (D) not differentiable at x = 0

58. If P, Q, R are the p^{th}, q^{th} & r^{th} $(p < q < r)$ terms of an A.P. then

(A) pQ + qR + rP = pR + rQ + qP (B) $\begin{vmatrix} P & Q & R \\ p & q & r \\ 1 & 1 & 1 \end{vmatrix} = 0$

(C) $\sum P(q - r) = 0$ (D) $\Sigma\, p(Q - R) = 0$

59. Let L_1 be a straight line passing through the origin and L_2 be the straight line x + y = 1. If the intercepts made by the circle $x^2 + y^2 - x + 3y = 0$ on L_1 and L_2 are equal, then which of the following equation can represent L_1 ?

(A) x + 7y = 0 (B) x − y = 0 (C) x − 7y = 0 (D) x + 2y = 0

60. Let $f'(x) > 0$ and $g'(x) < 0$ for all $x \in R$. Then,

(A) $f\{g(x)\} > f\{g(x+1)\}$ (B) $f\{g(x)\} > f\{g(x-1)\}$

(C) $g\{f(x)\} > g\{f(x+1)\}$ (D) $g\{f(x)\} > g\{f(x-1)\}$

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SPACE FOR ROUGH WORK