AITS
ALL INDIA TEST SERIES
SELECTION HOGA YAHIN SE

12th JEE Main

AJLM4/03

Test- 03

DURATION : 180 Minutes

DATE : 15/12/2024

M.MARKS : 300

Topics Covered

Physics:	Electric Charges and Fields, Electrostatic Potential and Capacitance, Current Electricity, Moving Charges and Magnetism, Magnetism and Matter, Electromagnetic Induction, Alternating Current, Wave Optics, Dual Nature of Radiation and Matter
Chemistry:	Solutions, Electrochemistry, Chemical Kinetics, Haloalkanes and Haloarenes, Alcohols, Phenols and Ethers, Aldehydes, Ketones and Carboxylic Acids, Amines, Biomolecules, Coordination Compounds, The p-Block Elements, The d and f-Block Elements
Mathematics:	Determinants, Matrices, Basic Mathematics, Relations and Functions, Inverse Trigonometric Functions, Limit Continuity and Differentiability, Method of Differentiation, Application of Derivatives, Indefinite Integration, Definite Integration, Application of Integrals, Differential Equation, Vector Algebra, Three Dimensional Geometry

General Instructions:

1. Immediately fill in the particulars on this page of the test booklet.
2. The test is of **3 hours** duration.
3. The test booklet consists of 75 questions. The maximum marks are **300**.
4. There are three Sections in the question paper, Section I, II & III consisting of Section-I **(Physics)**, Section-II **(Chemistry)**, Section-III **(Mathematics)** and having **25 questions** in each part in which first **20** questions are of Objective Type and Last **5 questions** are integers type and all **25 questions are compulsory**.
5. There is only one correct response among 4 alternate choices provided for each objective type question.
6. Each correct answer will give **4** marks while **1** Mark will be deducted for a wrong response.
7. No student is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
8. 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.
9. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

OMR Instructions:

1. Use blue/black dark ballpoint pens.
2. Darken the bubbles completely. Don't put a tick mark or a cross mark where it is specified that you fill the bubbles completely. Half-filled or over-filled bubbles will not be read by the software.
3. Never use pencils to mark your answers.
4. Never use whiteners to rectify filling errors as they may disrupt the scanning and evaluation process.
5. Writing on the OMR Sheet is permitted on the specified area only and even small marks other than the specified area may create problems during the evaluation.
6. Multiple markings will be treated as invalid responses.
7. **Do not fold or make any stray mark on the Answer Sheet (OMR).**

Name of the Student (In CAPITALS) : _____

Roll Number : _____

OMR Bar Code Number : _____

Candidate's Signature : _____ **Invigilator's Signature** _____

IMPORTANT CONSTANTS

Speed of light in free space,	:	$3.00 \times 10^{8}\ ms^{-1}$
Permeability of free space,	:	$4\pi \times 10^{-7}\ Hm^{-1}$
Permittivity of free space,	:	$8.85 \times 10^{-12}\ Fm^{-1}$
The Planck constant,	:	$6.63 \times 10^{-34}\ Js$
Rest mass of electron,	:	$9.1 \times 10^{-31}\ kg$
Rest mass of proton,	:	$1.67 \times 10^{-27}\ kg$
Molar gas constant,	:	$8.31\ JK^{-1}\ mol^{-1}$
The Avogadro constant,	:	$6.02 \times 10^{23}\ mol^{-1}$
The Boltzmann constant,	:	$1.38 \times 10^{-23}\ JK^{-1}$
Gravitational constant,	:	$6.67 \times 10^{-11}\ N\ m^2kg^{-2}$
Acceleration of free fall	:	$9.8\ ms^{-2}$
Rydberg Constant	:	$1.097 \times 10^{7}\ m^{-1}$
Atomic mass unit	:	$1.67 \times 10^{-27}\ kg$
Charge on proton	:	$1.6 \times 10^{-19}\ C$

IMPORTANT VALUES

$\sqrt{2}$ = 1.414

$\sqrt{3}$ = 1.732

$\sqrt{5}$ = 2.236

π = 3.142

e (Euler's constant) = 2.718

ln 10 = 2.303

$\log_{10}2$ = 0.3010

$\log_{10}3$= 0.4770

$\log_{10}7$ = 0.845

**** Use above values unless otherwise specified in a question.***

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SECTION-I (PHYSICS)

Single Correct Type Questions

1. A deuteron and a helium nucleus are traversing through a homogeneous magnetic field. The ratio of kinetic energy of deuteron nucleus with the helium nucleus is 1 : 2. The ratio of the Lorentz forces exerted on deuteron and helium nucleus respectively by the magnetic field is

(1) 1 : 1 (2) 1 : 2
(3) 2 : 1 (4) 1 : 4

2. Given below are two statements:

Statement-I : The peak power dissipation in a series RLC circuit (comprising an inductance, capacitance, and resistance) driven by an alternating current (AC) source is achieved at the resonant frequency of the system, where the inductive reactance equals the capacitive reactance, minimizing the impedance.

Statement-II : The peak power dissipation in a purely resistive AC circuit is attributed to the fact that the phase angle between the current and voltage is zero, ensuring maximum power transfer due to perfect alignment of these waveforms.

(1) Statement-I is false but Statement-II is true
(2) Statement-I is true but Statement-II is false
(3) Both Statement-I and Statement-II are true
(4) Both Statement-I and Statement-II are false

3. In a homogeneous electric field with an intensity of 2×10^3 N/C, an HCl molecule dipole is oriented along the direction of the electric field vector. If the work done to rotate it by 90° is 10 mJ, then the dipole moment of HCl molecule is

(1) 10^{-6} C-m
(2) 2.5×10^{-6} C-m
(3) 10^{-5} C-m
(4) 5×10^{-6} C-m

4. The maximum electric field intensity on the axis of a uniformly charged ring of charge q and radius R will be:

(1) $\frac{1}{4\pi\varepsilon_0}\frac{q}{3\sqrt{3}R^2}$ (2) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{3R^2}$

(3) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{3\sqrt{3}R^2}$ (4) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{2\sqrt{3}R^2}$

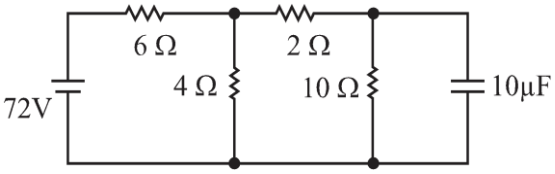
5. In a YDSE experiment, when a mica plate of refractive index 1.6 is placed in front of one of the slits, the light intensity at the central maxima point remain unchanged. If a monochromatic light source of wavelength λ is used, then the minimum thickness of mica sheet is

(1) 0.6 λ (2) 1.67 λ
(3) 1.5 λ (4) 0.73 λ

6. If the visible rays of wavelength 400 nm fall directly on a caesium plate whose work function is 2.1 eV to perform the photoelectric effect experiment, then find the change in the stopping potential on changing the initial incident wavelength to 200 nm. [Take hc = 1240 eV–nm]

(1) 2.1 V (2) 3.1 V
(3) 4.2 V (4) 6.2 V

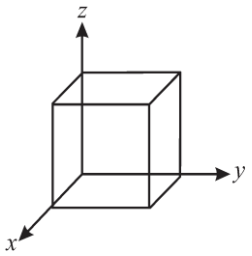
7. At steady state, the charge on the capacitor in the following circuit is



(1) 100 μC (2) 50 μC
(3) 450 μC (4) 200 μC

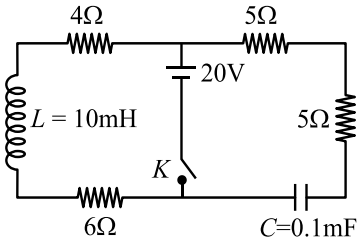
8. Electric field in a region is given $\vec{E} = -4x\hat{i} + 6y\hat{j}$ V/m. Find charge (in SI unit) enclosed in the cube of side 1 m as shown in the diagram.

(ε_0 = Electrical permittivity of free space in SI unit)



(1) $2\varepsilon_0$ (2) ε_0
(3) $-2\varepsilon_0$ (4) $-\varepsilon_0$

9. In the circuit shown, the key K is closed at t = 0, the current through the key at the instant $t = 10^{-3} \ln 2$ s, is:



(1) 2 A (2) 8 A
(3) 4 A (4) Zero

10. If an uncharged capacitor is connected to an identical charged capacitor of capacitance 30 pF which is already charged by a battery of 120 V, then the total energy loss during this process is

(1) 54 nJ (2) 128 nJ
(3) 64 nJ (4) 108 nJ

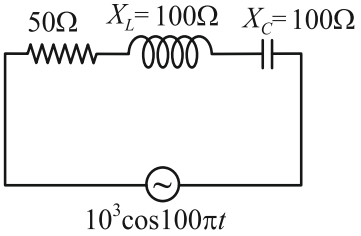
11. An aluminium conductor of cross sectional area 1 mm^2 and length 2 m with a resistivity of $2 \times 10^{-8}\ \Omega$ m carries a current of 2 A. The electric force experienced by an electron moving within the conductor is

(1) 6.4×10^{-21} N (2) 38×10^{-19} N
(3) 5.2×10^{-21} N (4) None of these

12. A plastic roller with a cross-sectional area of 12 cm^2 is wrapped with a thin aluminium cable with single turn. A resistor is connected across the terminals of the wire, resulting in a total resistance in the circuit of 10 Ω. Find the total number of electrons that traverse a point in the circuit due to the variation of a uniform magnetic field from 2 tesla in one direction to 2 tesla in opposite direction, which is aligned along its axis.

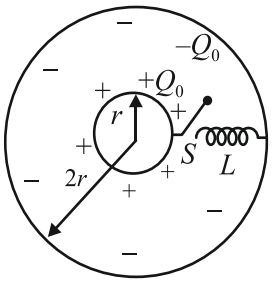
(1) 15×10^{15} (2) 4.8×10^{15}
(3) 3×10^{15} (4) 48×10^{15}

13. Find the peak value of the current for the given circuit



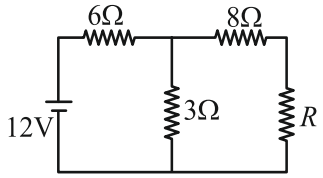
(1) 4 A (2) 20 A
(3) 15 A (4) 40 A

14. Two concentric conducting spherical shells of radius r and $2r$ are having initial charges $+Q_0$ and $-Q_0$ respectively as shown in the figure. Switch S is closed at time $t = 0$. The current through the inductor L at time $t = \frac{\pi}{4}\sqrt{8\pi L\varepsilon_0 r}$ is



(1) $\frac{3Q_0}{2\sqrt{\pi\varepsilon_0 Lr}}$ (2) $\frac{Q_0}{\sqrt{2\pi\varepsilon_0 Lr}}$
(3) $\frac{Q_0}{2\sqrt{\pi\varepsilon_0 Lr}}$ (4) $\frac{Q_0}{4\sqrt{\pi\varepsilon_0 Lr}}$

15. The maximum power that can be delivered to resistance R in circuit below is

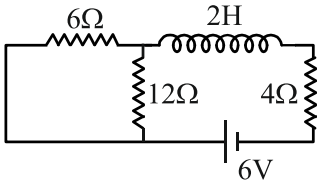


(1) 0.2 W (2) 0.4 W
(3) 0.8 W (4) 0.16 W

16. A PW student performs an experiment of YDSE to produce an interference pattern on the screen by using a monochromatic light of 300 nm wavelength. Find the fringe angular width on the screen if the distance between the slits is 0.03 mm.

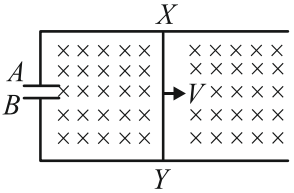
(1) 0.10 radian (2) 0.01 radian
(3) 0.5 radian (4) 0.05 radian

17. For the circuit shown in the figure, the steady state current through the battery will be



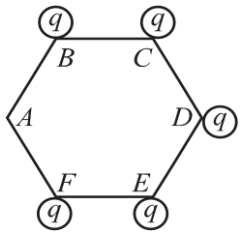
(1) 0.75 A (2) 1 A
(3) 1.25 A (4) 0.5 A

18. A conducting rod XY of length ℓ = 10 m is moving with a uniform speed of V = 4 m/s in a uniform magnetic field B = 2 T directed vertically down wards, as shown. An initially uncharged capacitor of capacity, C = 10 μF (With its two plates marked A and B) is connected as shown in the figure. If the rod is moving in a horizontal plane, then



(1) q_A = + 800 μC & q_B = – 800 μC
(2) q_A = – 800 μC & q_B = + 800 μC
(3) $q_A = q_B = 0$
(4) Charge on the capacitor increases with time.

19. Five identical charges are kept at five vertices of a regular hexagon. Match the following two columns at centre of the hexagon. If in the given situation electric field at centre is E. Then,



Column-I		Column-II	
A	If charge at B is removed, then electric field will become	P	$2E$
B	If charge at C is removed, then electric field will become	Q	E
C	If charge at D is removed then electric field will become	R	Zero
D	If charges at B and C both are removed, then electric field will become	S	$\sqrt{3}E$

	A	B	C	D
(1)	P	Q	R	S
(2)	S	Q	R	P
(3)	S	P	Q	R
(4)	P	S	R	Q

20. If the magnetic moment of an electron moving with a speed of 5 m/s in a circular path under a 2 T magnetic field is

(1) 4.27×10^{-30} A-m^2

(2) 3.16×10^{-30} A-m^2

(3) 5.69×10^{-30} A-m^2

(4) 6.24×10^{-30} A-m^2

Integer Type Questions

21. The potential difference of two concentric spherical shells of radii R and $2R$ which hold charges Q and $2Q$ respectively is $\frac{xKQ}{R}$. Find the value of $10x$.

22. If the ratio of current to average drift velocity of free electrons in a copper wire with a cross-sectional area of 10 mm^2 and an electron density of 250×10^{25} m^{-3} is x A·s/m then find $\frac{x}{100}$.

23. If the magnitude of electromotive force induced across the ends of a moving conducting rod of length 2 m, which is moving perpendicular to a magnetic field of 5 T with a speed of 6 m/s perpendicular to length of rod, is x volts then find x.

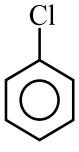
24. If the ratio of the intercepts on frequency axis on a radiation frequency Vs stopping potential graph for photoelectric experiment of two metals X and Y, whose work functions are 6 eV and 3 eV respectively, is p, then find p.

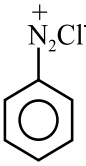
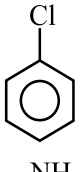
25. Ram performs an experiment by rotating a circular wire loop with a radius of 1 m in the presence of a uniform magnetic field of 10 T, with an angular velocity of 10 rad/s about an axis within its plane passing through its center. The axis of rotation is perpendicular to the field. If the maximum induced emf is $x\pi$ volts then find x.

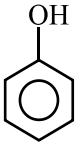
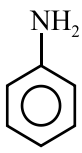
SECTION-II (CHEMISTRY)

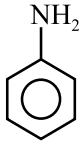
Single Correct Type Questions

26. (X) and (Y) in the following reaction sequence are:

(1) (X)  (Y) 

(2) (X)  (Y) 

(3) (X)  (Y) 

(4) (X)  (Y) 

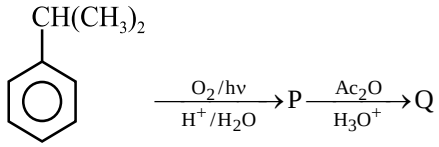
27. The incorrect statement among the following is:

(1) Sc shows +3 oxidation state which is oxidizing in nature.

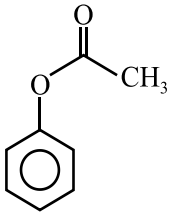
(2) Manganese exhibits lowest oxidation state in 3d series.

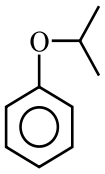
(3) $K_2Cr_2O_7$ shows oxidising nature

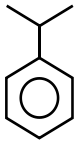
(4) Osmium can exhibit +8 oxidation in its oxide.

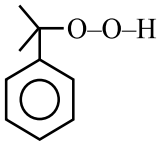
28. 

The product Q in this reaction is

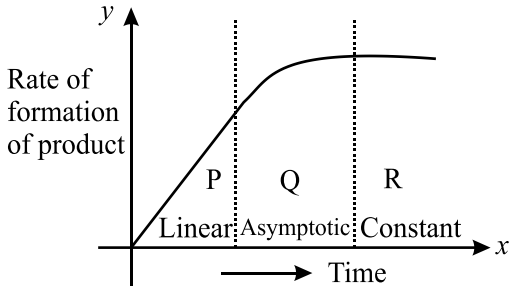
(1) 

(2) 

(3) 

(4) 

29. During the kinetic study of a chemical reaction, A $\rightarrow$ B, a graph is plotted between rate of formation of product vs time.

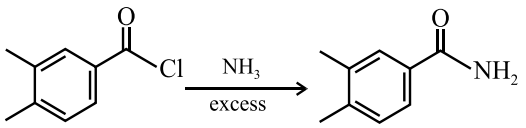


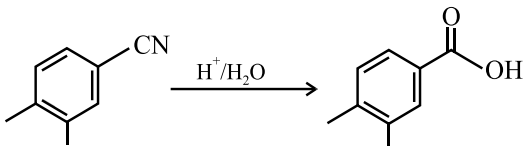
The order of reaction in region P, Q, R is respectively.

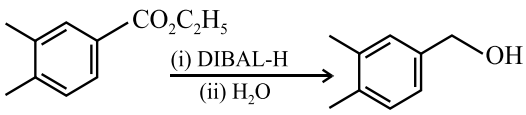
(1) 0, 1, 0 (2) 1, 0 to 1, 0

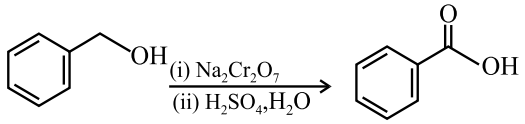
(3) 1, 1, 0 (4) 0, 0 to 1, 1

30. Which of the following reaction fails to pair the reactant with its product?

(1) 

(2) 

(3) 

(4) 

31. IUPAC name for the complex $[Pt(H_2O)_2Br(NH_2CH_2CH_3)]$ Br is

(1) Diaquabromido(aminoethane) platinum(II)

(2) Diaquabromido(ethanamine) platinum(II) bromide

(3) Diaqua(ethanamine)bromido platinum(II) bromide

(4) Bisaqua(ethanamine)bromide platinum(II) bromide

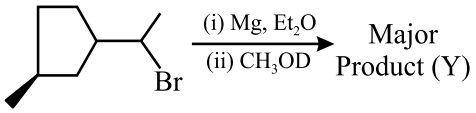
32. The vapour pressure of ethanol and water is 100 and 47 mm of Hg respectively at 37°C. A solution of ethanol and water in equimolar ratio has a total vapour pressure of 92.8 mm of Hg. Choose the incorrect statement.

(1) Mixture is a non-ideal solution

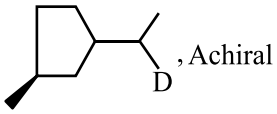
(2) $\Delta_{mix}H$ = +ve

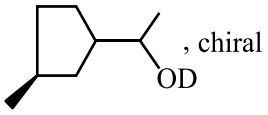
(3) Ethanol and water are more attracted to each other than to themselves

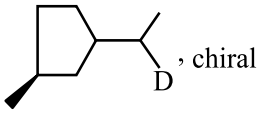
(4) $\Delta_{mix}G$ = –ve

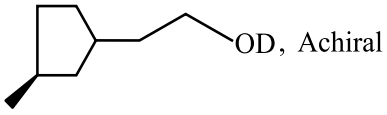
33. 

Y is:

(1) 

(2) 

(3) 

(4) 

34. 5.05 g of an unknown non-electrolyte and non-volatile solute is dissolved in 108g of water (assume very dilute solution is formed). At 100°C, the vapour pressure of solution is lowered by 5mm of Hg. Find the molar mass of solute (in g/mol)

(1) 180 (2) 128

(3) 60 (4) 342

35. Given below are two statements:

Statement-I: The enthalpy of dissociation of F_2 is smaller compared to that of Cl_2

Statement-II: The lone pair-lone pair repulsion in F_2 molecule is relatively high where they are much closer to each other than in case of Cl_2

In the light of the above statements, choose the correct answer from the options given below.

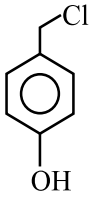
(1) Both the statements-I and Statement-II are true

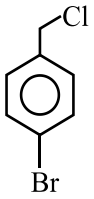
(2) Statement-I is true but Statement-II is false

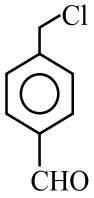
(3) Statement-I is false but Statement-II is true

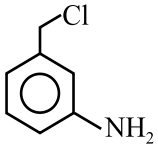
(4) Both the Statements-I and II are false

36. Which of the following gives fastest S_N1 reaction?

(1) 

(2) 

(3) 

(4) 

37. In a reaction sequence,

$X \xrightarrow{k_1} Y$

$Y \xrightarrow{k_2} Z$

If the rate of appearance of Y is set to be zero then the concentration of X is given by:

(1) $(k_1 + k_2)[Y]$ (2) $k_1k_2\,[X]$

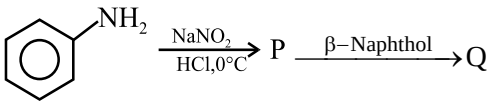
(3) $\left(\frac{k_1}{k_2}\right)[X]$ (4) $\left(\frac{k_2}{k_1}\right)[Y]$

38. Out of the following complexes, the one which is octahedral, paramagnetic and the least stable is

(1) $Na_3[Cr(CN)_6]$ (2) $[Ni(H_2O)_6]Cl_2$

(3) $K_4[Fe(CN)_6]$ (4) $[Co(NH_3)_6]Cl_2$

39. Choose the correct colour of the product Q for the following reaction.



(1) Blue (2) Red

(3) Yellow (4) Pink

40. For a given reaction,

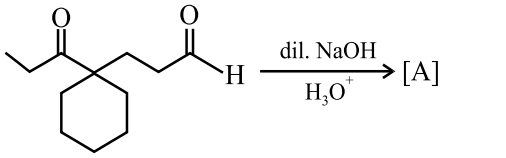
$Cu^{2+}(aq) + Pb(s) \rightarrow Pb^{2+}(aq) + Cu(s)$

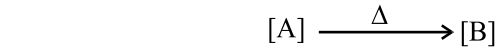
Find the standard gibbs free energy if $E^{o}_{Cu^{2+}/Cu}$ and $E^{o}_{Pb^{2+}/Pb}$ is 0.34 V and –0.126 V respectively at 298K. (1F = 96,500 C) (Calculate for 2 moles of electrons transferred in the cell reaction)

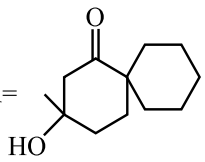
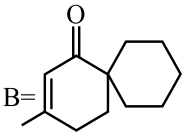
(1) +44.9 kJ (2) –44.9 kJ

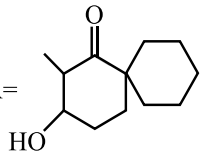
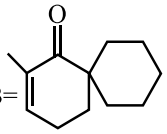
(3) +89.9 kJ (4) –89.9 kJ

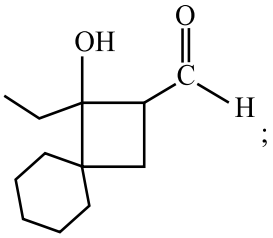
41. In the following reactions, products A and B are

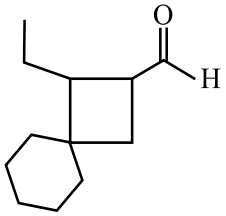


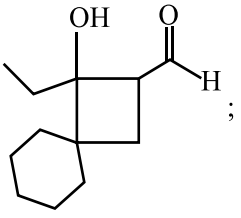


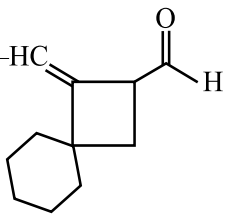
(1) A=  ; B= 

(2) A=  ; B= 

(3) A =  ;

B = 

(4) A =  ;

B = 

42. Given below are two statements one is labelled as **Assertion (A)** and other is labelled as **Reason (R)**:

Assertion (A): P_2O_5, is more acidic than P_2O_3.

Reason (R): The acidic character of pentavalent oxide of group 15 elements, E_2O_5 increases down the group.

In light of the above statements, choose most appropriate answer from the options given below:

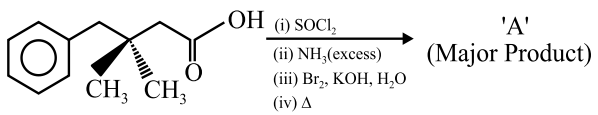
(1) Both **A** and **R** are true and **R** is the correct explanation of **A**.

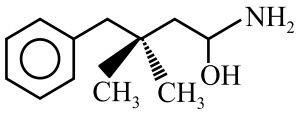
(2) Both **A** are **R** are true but **R** is NOT the correct explanation of **A**

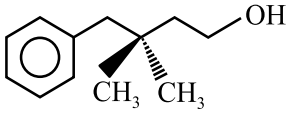
(3) **A** is true but **R** is false

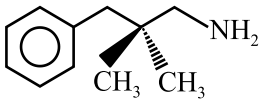
(4) **A** is false but **R** is true

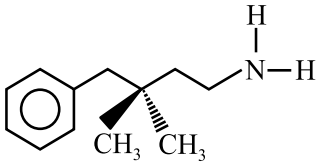
43. The major product 'A' formed in the following sequence of reactions is



(1) 

(2) 

(3) 

(4) 

44. 5 moles of 30 mL KCl solution are filled in a conductivity cell which results in a molar conductance (A). In another identical conductivity cell, 25 moles of 90 mL KCl solution are filled having molar conductance (B). The conductivity exhibited by first cell is 5 times of second cell. The relationship between B and A is

(1) 3A = 2B (2) 2A = 25B

(3) 2A = 3B (4) 3A = 25B

45. The addition of dilute NaOH to $FeCl_3$ salt solution will give

(1) A solution of $[Fe(OH)_4]^-$

(2) Precipitate of $Fe_2O_3(H_2O)_n$

(3) Brown precipitate of $[Fe(OH)_3]$

(4) Green precipitate of $Fe(OH)_3$

Integer Type Questions

46. The number of chiral centres present in isoleucine is_____.

47. How many of the following compounds will produce red precipitate with Fehling solution?
Fructose, maltose, formic acid, galactose, amylose, lactose.

48. The total number of isomers for a complex $[Pt(NH_3)(Br)(CN)(H_2O)]$ is_____.

49. During the kinetic study of the given reaction,

$$K_2Cr_2O_7 + 4NaCl + 6H_2SO_4 \rightarrow 2KHSO_4 + 4NaHSO_4 + 2CrO_2Cl_2$$

The initial conc. of $K_2Cr_2O_7$ was 15 M and after 45 min, became 12.6 M. The rate of appearance of CrO_2Cl_2 is. _____$\times 10^{-4}$ mol L^{-1} s^{-1} (Nearest integer)

50. The magnitude of crystal field stabilization energy for M^{3+} ion (in aqueous state) from the pairs Cr^{3+} / Cr^{2+}, Mn^{3+} / Mn^{2+}, Fe^{3+} / Fe^{2+} and Co^{3+} / Co^{2+} that has negative standard electrode potential, is _____ $\times 10^{-2}$ Δ_0 (Where $\Delta°$ is splitting energy in octahedral field)

SECTION-III (MATHEMATICS)

Single Correct Type Questions

51. Let for $x \in \mathbb{R}$, $P_0(x) = x^2$,

$$P_k(x) = C_k x^2 + k\int_0^x P_{k-1}(t)\,dt \text{ where}$$

$$C_0 = 1, C_k = 1 - 3\int_0^1 P_{k-1}(x)\,dx,\ k = 1, 2, 3 \text{ then}$$

$3P_2(4) + 20 \cdot C_3$ is

(1) 167 (2) 176

(3) 184 (4) 188

52. The domain of the function $\sin^{-1}\left(\frac{24\left(5^x\right)}{25-5^{2x}}\right)$ is:

(1) $(-\infty, -25) \cup (-1, \infty)$

(2) $(-\infty, 0] \cup [2, \infty)$

(3) $[0, 2]$

(4) $(-\infty, 0) \cup (2, \infty)$

53. The acute angle 'θ' between line $\frac{x-1}{\alpha}=\frac{y+1}{\beta}=\frac{z}{\gamma}$ and $\frac{x-2}{\gamma}=\frac{y-3}{\alpha}=\frac{z+1}{\beta}$, where $\alpha > \beta > \gamma$ and α, β, γ are roots of cubic equation $x^3 + x^2 - 2x - 4 = 0$, then,
match correct option

Column I		Column II	
A	cos θ is	P	$\frac{2}{5}$
B	$\alpha^2 + \beta^2 + \gamma^2$ is	Q	$\frac{3}{5}$
C	$\int_0^{\alpha^2+\beta^2+\gamma^2} [x]dx$, (where [·] is G.I.F) is	R	5
D	$\int_0^{\alpha^3+\beta^3+\gamma^3} [x]dx$ (where [·] is G.I.F) is	S	10

	A	B	C	D
(1)	P	R	S	S
(2)	P	Q	R	S
(3)	Q	R	S	P
(4)	S	S	R	P

54. Let $p, q \in R, q \neq 0$. Define a function

$$f(x)=\begin{cases} p\sin\frac{3\pi(x-1)}{2}, & \text{for } x \le 0 \\ \frac{e^{\tan 3x}-e^{\sin 3x}}{qx^3}, & \text{for } x > 0 \end{cases}$$

If $f(x)$ is continuous at $x = 0$, then $30 - 2pq$ is
(1) 3 (2) 4
(3) 6 (4) 5

55. Let λ be the area of the region $\left\{(x,y)\in\mathbb{R}^2 : (x-1)^2+(y-1)^2 \le 21, (y-1)^2 \le 4(x-1)\right\}$ and $x \ge 2$. Then value $\left(\lambda - 21\cos^{-1}\sqrt{\frac{3}{7}}\right)$ is

(1) $\sqrt{7}-\frac{4}{3}$ (2) $\sqrt{3}-\frac{8}{3}$
(3) $2\sqrt{3}-\frac{8}{3}$ (4) $2\sqrt{3}-\frac{4}{3}$

56. Let X & Y be two 3 × 3 skew symmetric and symmetric matrix respectively, then which is **NOT** true
(1) $XY + YX$ is skew symmetric
(2) $Y^6 - X^6$ is symmetric
(3) $X^5 + Y^5$ is symmetric
(4) $X^3Y^3 + Y^3X^3$ is skew symmetric

57. If $\frac{dy}{dx}+\frac{3^{x-y}\left(3^{y+2}-2\right)}{\left(3^{x+2}-2\right)}=0$, where $x > -2$ and $y > -2$ and $y(-1) = 1$, then $y(2)$ is
(1) $\log_3\left(\frac{79}{183}\right)-2$
(2) $\log_3\left(\frac{79}{183}\right)+2$
(3) $\log_3\left(\frac{183}{79}\right)-2$
(4) $\log_3\left(\frac{183}{79}\right)+2$

58. Let g and f be twice differentiable even function on (–3, 3) such that $g(2) = g(1) = g\left(\frac{1}{4}\right) = g\left(\frac{1}{2}\right) = 0$, g (2.5) = 3 and $f\left(\frac{5}{3}\right) = f\left(\frac{4}{3}\right) = 0$, $f(2.2) = 2$. Then minimum number of solutions of equation $g(x) f''(x) + g'(x) f'(x) = 0$ in (–3, 3) is equal to
(1) 8 (2) 9
(3) 10 (4) 5

59. Let $p(x)$ be polynomial function such that $p(x) + p'(x) + p''(x) = x^6 + 25$, then the value of $\lim_{x\to 1}\frac{p(x)}{(x-1)^2}$ $\left(\text{Where } p'(x)=\frac{dp(x)}{dx}, p''(x)=\frac{d^2p(x)}{dx^2}\right)$
(1) 237 (2) –240
(3) –237 (4) 245

60. Let $\vec{x} = 3\hat{i} + \hat{j} + 2\hat{k}$, $\vec{y} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{z} = 3\hat{i} - 3\hat{j} + 5\hat{k}$ be three vectors. If $\vec{r}$ is a vector such that $\vec{r} \times \vec{y} = \vec{y} \times \vec{z}$ and $\vec{r} \cdot \vec{x} = 0$, the $49|\vec{r}|^2$ is
(1) 507 (2) 611
(3) 525 (4) 508

61. If B is a 3 × 3 matrix and $|B| = 3$, $|4\text{adj}(|4B|B^2)|$ is equal to
(1) $2^{21} \cdot 3^8$ (2) $2^{42} \cdot 3^{10}$
(3) $3^{21} \cdot 4^{16}$ (4) $3^6 \cdot 2^{40}$

62. The integral $\int\frac{(3x-2)\sin\left(\sqrt{(3x-2)^2+3}\right)}{\sqrt{9x^2-12x+7}}dx$ is equal to: (where c is a constant of integration)
(1) $-\frac{1}{2}\cos\sqrt{(3x-2)^2+3}+c$
(2) $\frac{1}{2}\cos\sqrt{(3x-2)^2+3}+c$
(3) $-\frac{1}{3}\cos\sqrt{(3x-2)^2+3}+c$
(4) $-\frac{1}{3}\sin\sqrt{(3x-2)^2+3}+c$

63. Consider function $f(x)=(x-1)\ e^{(x-1)(2-x)}$, $x\in\mathbb{R}$. Which of the following is **NOT** true

(1) $f(x)$ is increasing in $x\in\left(\frac{1}{2},2\right)$

(2) $f(x)$ is decreasing in $x\in\left(-\infty,\frac{1}{2}\right)\cup(2,\infty)$

(3) Maxima at $x = 2$

(4) Maxima at $x=\frac{1}{2}$

64. Let T and C respectively be transverse and conjugate axes of the hyperbola $16x^2 - y^2 + 8y - 32 = 0$. Then area of the region above the parabola $(x - 2)^2 = y + 2$ below the transverse axis (T) and on the right of the conjugate axis C is

(1) $4\sqrt{6}-\frac{28}{3}$ (2) $4\sqrt{6}+\frac{28}{3}$

(3) $2\sqrt{6}+\frac{28}{3}$ (4) $\frac{28}{3}-2\sqrt{6}$

65. Let $P(x)=\int\frac{x^2(\cot x - x\operatorname{cosec}^2 x)}{(x\cot x-1)^2}dx$, if $P\left(\frac{\pi}{2}\right)=\frac{\pi^2}{4}$ then $P\left(\frac{\pi}{4}\right)$ is

(1) $\frac{\pi^2}{4-\pi}-\ln\left|\frac{\left(\frac{\pi}{4}+1\right)^2}{2}\right|$

(2) $\frac{\pi^2}{16-4\pi}-\ln\left|\frac{\left(\frac{\pi}{4}-1\right)^2}{2}\right|$

(3) $\frac{\pi^2}{16+4\pi}-\ln\left|\frac{\left(\frac{\pi}{4}-1\right)^2}{2}\right|$

(4) $\frac{\pi^2\sqrt{2}}{4+\pi}+\ln\left|\frac{\left(\frac{\pi}{4}+1\right)^2}{2}\right|$

66. The value of $\sum_{r=1}^{82}\left[\frac{25r}{83}\right]$ is (where $[\cdot]$ is G.I.F)

(1) 984 (2) 884

(3) 894 (4) 982

67. Let P be matrix of order 3×3 and $\det(P) = 3$, There $\det(\det(P)\text{Adj}(6\text{Adj}(P^3)))$ is equal to $2^k \cdot 3^l$ then $k + l$ is

(1) 27 (2) 29

(3) 37 (4) 25

68. Let the function

$$f(x)=\begin{cases}\frac{x^2\left(\ln(1+6x)-\ln(1+\beta x)\right)}{(\tan x-\sin x)} & ;\ \text{if } x\neq 0.\\ -6 & ;\ \text{if } x=0\end{cases}$$

be continuous at $x = 0$, Then β is equal to

(1) 9 (2) 7

(3) 5 (4) 3

69. $\lim\limits_{n\to\infty}\cot\left(\sum\limits_{r=2}^{n}\tan^{-1}\left(\frac{2r}{1+r^4-r^2}\right)\right)$ is equal to

(1) 4 (2) 3

(3) 2 (4) 1

70. The minimum value of the function $f(x)=\int_0^3 e^{|x-t|}dt$ is $2\cdot e^{\frac{m}{n}}-2$, then $m + n$ is (where G.C.D $(m, n) = 1$)

(1) 4 (2) 3

(3) 5 (4) 7

Integer Type Questions

71. Let $y = y(x)$ be solution curve of the differential equation

$$\sin 2x^3\ln(\cot x^3)dy-6x^2ydx+6\sqrt{2}x^2\cos\left(x^3-\frac{\pi}{4}\right)dx=0.$$

If the equation comes as

$$y\cdot\ln\left(\cot x^3\right)+\ln\left|\frac{\sin x^3-\cos x^3+\alpha}{\sin x^3-\cos x^3-\alpha}\right|=C$$ (where C is arbitrary constant) then the value of α will be

72. Let $x = 3$ be a root of the equation $x^2 + ax + b = 0$ and

$$f(x)=\begin{cases}\frac{1-\cos^2(x^2-6ax+b^2+81+18b)}{(x-3a)^4}, & x\neq 3a\\ M & x=3a\end{cases}$$

be continuous at $x = 3a$, then M is

73. An arc AB of a circle subtends a right angle at its centre O, C divide arc AB in 2 : 1 ratio. If $\overrightarrow{OA}=\vec{P}$, $\overrightarrow{OC}=\vec{q}$ and $\overrightarrow{OB}=\alpha\vec{p}+\beta\vec{q}$, then value of $3(\alpha^2+\beta^2)$ is

74. Let $P=\begin{bmatrix}3 & 4\\ b & 0\end{bmatrix}, b\in R$ be written as $A + B$, where A is a symmetric matrix and B is skew symmetric matrix. If det(B) = 25, then the absolute value of the sum of all possible values of determinant of A, is equal to

75. Let $\frac{x+2}{2}=\frac{y-3}{1}=\frac{z-1}{3}$ intersect the line $\frac{x-6}{4}=\frac{y-8}{3}=\frac{z-9}{2}$ and $\frac{x-1}{3}=\frac{y-5}{1}=\frac{1-z}{-9}$ at P and Q respectively. Then distance of mid-point of segment PQ and (3, 5, 8) is k, then $4k^2$ is

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