JEE(Advanced) PAPER - II

Time : 3 Hrs **Max. Marks : 240**

PART I : CHEMISTRY

SECTION – I (Total Marks:12)

(Single answer type)

This section contains 4 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct. Each correct answer carries 3 Marks. Each wrong answer carries -1 mark.

1. When a certain photoelectric substance was exposed to light with $\nu = 4.0\times10^{15}\,/\,s$ photoelectrons had kinetic energy twice when a substance was exposed to $\nu = 3.0\times10^{15}\,/\,s$. The threshold ν of photoelectric substance is

   A) $2\times10^{15}\,/\,s$ B) $4\times10^{15}\,/\,s$ C) $3\times10^{15}\,/\,s$ D) $6\times10^{15}\,/\,s$

2. Which of the following is incorrect statement?

   A) Ketones are more polar than aldehydes B) Ethers are more volatile than alcohols

   C) Boiling point of alcohols is more than water

   D) Alkynes are more reactive than alkenes in nucleophilic addition reaction

3. Peroxide linkage does not exist in

   A) H_2SO_5 B) CrO_5 C) BaO_2 D) MnO_2

4. A metal X on heating in nitrogen gas gives compound Y. Y on treatment with H_2O gives a colourless gas which when passed through $CuSO_4$ solution gives a blue colour. The metal X is

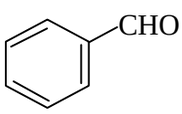
   A) Na B) K C) Mg D) Zn

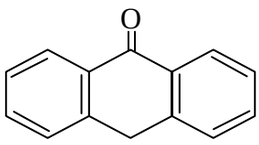
SECTION – II (Total Marks:20)

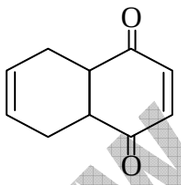
(Multiple correct answer(s) type)

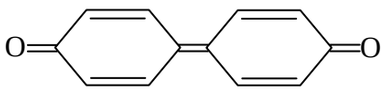
This section contains 5 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE may be correct. Each correct answer carries 4 Marks. Each wrong answer carries -1 mark.

5. Which of the following will not show tautomerism?

   A) 

   B) 

   C) 

   D) 

6. Which of the following statements is/are correct?

   A) $(C_2H_5)_4Pb$ is not an organometallic compound

   B) $K_2\left[Pt(en)_2Cl_2\right]$ gives white ppt. with $AgNO_3$

   C) $[NiCl_4]^{2-}, VO_4^{3-}, MnO_4^-$ have tetrahedral geometry

   D) $\left[Co(NH_3)_3(NO_3)_3\right]$ has 2 geometrical isomers.

7. Which of the following has spin multiplicity equal to 6?

   A) Fe^{2+} B) Co^{2+} D) Fe^{3+} D) Mn^{2+}

8. Which of the following is/are correct?

   A) Dipole moment of CO_2 is equal to CS_2 B) Hybridization of central nitrogen in N_3^- is sp

   C) Dipole moment of CO_2 is more than CS_2 D) Dipole moment of BF_3 is less than NF_3

9. Carnallite on electrolysis gives
   A) K B) Mg C) Cl_2 D) H_2

SECTION – III (Total Marks:16)
(Matrix-Match type)

This section contains 2 questions. Each question has four statements (A, B, C and D) given in Column I and five statements (P, Q, R, S and T) in Column II. Any given statement in Column I can have correct matching with ONE or MORE statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS. Each correct matching carries 2 Marks. There is no negative marking.

10. Match the following:

Column-I	Column-II
A) K, specific conductance	P) Increases with dilution
B) Λ_m, molar conductance	Q) Increases with increasing the distance between parallel plates
C) α, degree of dissociation	R) Decreases with dilution
D) Resistance	S) Decreases with increase in concentration of electrolyte
	T) $\frac{\Lambda_m}{\Lambda_m^{\alpha}}$

11. Match the following:

Column-I	Column-II
A) Nitrobenzene $\rightarrow$ azobenzene	P) $LiAlH_4$
B) Aniline $\rightarrow$ phenyl isocyanide	Q) $NaNO_2 + HCl + Cu_2Cl_2$
C) Aniline $\rightarrow$ chlorobenzne	R) $CHCl_3 + KOH$
D) Ethylamine $\rightarrow$ ethanol	S) $NaNO_2 + HCl_{(aq)}$
	T) $Zn + NaOH + CH_3OH$

SECTION – IV (Total Marks:32)
(Integer Answer type)

This section contains 8 questions. The answer to each of the question is a single digit integer, ranging from 0 to 9. The bubble corresponding to the correct answer is to be darkened in the ORS. Each correct answer carries 4 Marks. Each wrong answer carries -1 mark.

12. When 1.823 gm of the hydrate $CaCrO_4.xH_2O$ was heated at 200°C, 1.479 gm of anhydrous $CaCrO_4$ was obtained. The value of x is _____

13. Consider a reaction $aX + bY \rightarrow$ Products. When concentration of both the reactants X and Y is doubled, the rate increases by 8 times. However, when concentration of X is doubled keeping the concentration of Y fixed, the rate is doubled. The overall order of the reaction is

14. The total number of α and β particles emitted in the nuclear reaction $_{92}A^{238} \rightarrow {}_{82}B^{214}$ is _____

15. The coordination number of each cation in alums is _____

16. When pure $AgCl_{(s)}$ is added to 0.01M $AgNO_3$ and 0.025 M KCl then the ratio of Cl^- ion conc. to the Ag^+ ion conc. in the second solution will be_____

17. For the reaction $2NOCl_{(g)} \rightleftharpoons 2NO_{(g)} + Cl_{2(g)}$, $K_C = 3\times10^{-6} L/mole$ at 427°C. K_P is nearly $a\times10^{-4}$. Then the value 'a' is

18. Liquid ammonia ionizes to a slight extent. At $-75°C$ its self ionization constant is 10^{-34}. The number of amide ions present per cm^3 of pure liquid ammonia is ____$\times 10^3$

19. The ratio of coordination number of cation to anion in ZnS is _____

PART II : MATHEMATICS

SECTION – I (Total Marks:12)

(Single answer type)

This section contains 4 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct. Each correct answer carries 3 Marks. Each wrong answer carries -1 mark.

ASSERTION – REASONING

20. Let $f(x) = x^2 - 2ax + (a^2 + a - 3)$. The roots of the equation $f(x) = 0$ are distinct and both are less than 3. Then
St-1 : $2 < a < 3$.
St-2 : $f(3) > 0$ and discriminant of $f(x) = 0$ is positive
A) Both the statements are true and St-2 is the correct explanation of St-1
B) Both the statements are true and St-2 is not the correct explanation of St-I
C) St -1 is true and St-2 is false D) St-1 is false and St-2 is true

21. Given $S = \left[\frac{1}{3}\right] + \left[\frac{1}{3}+\frac{1}{100}\right] + \left[\frac{1}{3}+\frac{2}{100}\right] + \left[\frac{1}{3}+\frac{3}{100}\right] + ... + \left[\frac{1}{3}+\frac{99}{100}\right]$, where [x] denotes greatest integer less than or equal to x. Then
St-1: The value of S is 33.
St-2: If k is an integer, $\left[\frac{1}{3}+\frac{k}{100}\right]$ takes only two possible values for $0 \le k \le 99$.
A) Both the statements are true and St-2 is the correct explanation of St-1
B) Both the statements are true and St-2 is not the correct explanation of St-I
C) St -1 is true and St-2 is false D) St-1 is false and St-2 is true

22. Given the point P(6, 10) and the ellipse $x^2 + 4y^2 = 25$.
St-1 : The point P is nearest to the ellipse at (3, 2).
St-2 : Normal to the ellipse at (3, 2) is $8x - 3y = 18$.
A) Both the statements are true and St-2 is the correct explanation of St-1
B) Both the statements are true and St-2 is not the correct explanation of St-I
C) St -1 is true and St-2 is false D) St-1 is false and St-2 is true

23. The point P is one extremity of the latus rectum of a parabola and PT, PN are the tangent and normal to the parabola drawn at P. If S is the focus of the parabola. Then
St-1 : $\angle SPT = \angle SPN$.
St-2 : In a parabola focal distance of any point bisects the angle between the tangent and normal at the point.
A) Both the statements are true and St-2 is the correct explanation of St-1
B) Both the statements are true and St-2 is not the correct explanation of St-I
C) St -1 is true and St-2 is false D) St-1 is false and St-2 is true

SECTION – II (Total Marks:20)

(Multiple correct answer(s) type)

This section contains 5 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE may be correct. Each correct answer carries 4 Marks. Each wrong answer carries -1 mark.

24. The centre of the largest circle passing through (1, 1), (2, 2) and lying in the first quadrant is
A) (3, 0) B) (2, 1) C) $\left(\frac{5}{2},\frac{1}{2}\right)$ D) (1, 2)

25. The solution of the differential equation $\frac{dy}{dx} + 2y\tan x = \sin x$ passing through $(\pi/3, 0)$ has
A) a local minimum -1 B) a local maximum 1/8
C) a global minimum -3 D) fundamental period 2π

26. If $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$, abc = 1 and A^T is the inverse of A, then $a^3 + b^3 + c^3$ is

A) 0 B) 2 C) 3 D) 4

27.

$$\text{Let } f(x) = x[x] \quad \text{for } 0 \le x < 2$$
$$= (x-1)[x] \quad \text{for } 2 \le x < 3$$

and let g(x) = f o f(x) then

A) Domain of g(x) is $\left[0, \frac{5}{2}\right)$ B) g(x) is continuous at x = 2

C) g(x) is differentiable at x = 2 D) g(x) has a local minimum at x = 2.

28. If ω is a complex cube root of unity such that $(a\omega^2 + b + c\omega)^3 + (a\omega + b + c\omega^2)^3 = 0$ where a, b, c are real, then it is possible that

A) a, c, b are in A.P

B) The line ax + by + c = 0 passes through (1, –2)

C) The equation $6ax^2 - 2bx - c = 0$ has a root in (0, 1).

D) none of these.

SECTION – III (Total Marks:16)
(Matrix-Match type)

This section contains 2 questions. Each question has four statements (A, B, C and D) given in Column I and five statements (P, Q, R, S and T) in Column II. Any given statement in Column I can have correct matching with ONE or MORE statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS. Each correct matching carries 2 Marks. There is no negative marking.

29.

	Column-I		Column-II
A)	In triangle ABC, if $C = \sin^{-1}(4/5) + \sin^{-1}(5/13) + \sin^{-1}(16/65)$ and $\cot\frac{A}{2}$, $\cot\frac{B}{2}$ are the roots of the equation $px^2 + qx + r = 0$ then the line $px + qy + r = 0$ passes through	P)	(8, 9)
B)	The image of the point A(3, 4) with respect to the line $x - 2y + 10 = 0$ is B and the image of B with respect to $x - y + 1 = 0$ is C. Then the circumcentre of triangle ABC is	Q)	(–1, 1)
C)	Normals are drawn from the point (32, 36) to the hyperbola $xy = 1$ and (x_i, y_i), i = 1, 2, 3, 4 be the feet of the co-normal points. If the algebric sum of perpendicular lengths drawn from (x_i, y_i), on to a variable line vanishes, then the line passes through	R)	(2, 2)
D)	If the function $f(x) = \frac{4 + \sin 2x + a\sin x + b\cos x}{x^2}$ when x # 0, is continuous at x = 0, then the order pair (b/a, f(0)) is equal to	S)	vertex of the conic $\lvert z + 1 - 2i\rvert = \text{Im } z$

30.

	Column-I		Column-II
A)	$\int_{-1/\sqrt{3}}^{1/\sqrt{3}} \frac{Cos^{-1}\left(\frac{2x}{1+x^2}\right) + Tan^{-1}\left(\frac{2x}{1-x^2}\right)}{1+e^x} dx$ is equal to	P)	$\sqrt{3}\left(\frac{\pi}{3} - \frac{\sqrt{3}}{4}\right)$
B)	If A ≡ ($^1/_2$, 0), B ≡ ($^3/_2$, 0) and C ≡ ($^5/_2$, 0), the area of the region(in square units) of the point P satisfying maximum {PA + PB, PB + PC} < 2, is	Q)	π/3
C)	If $\int f(x)\sec^2 x\, dx = f(x)\sec x + c$ then f(6x) is a periodic function with fundamental period	R)	π/12
D)	If the latus rectum of the hyperbola $x^2\tan^2\theta - y^2\sec^2\theta = 1$ is 1/2 and $0 < \theta < \pi$ then θ can be	S)	$\pi/2\sqrt{3}$
		T)	5π/12

SECTION – IV (Total Marks:32)
(Integer Answer type)

This section contains 8 questions. The answer to each of the question is a single digit integer, ranging from 0 to 9. The bubble corresponding to the correct answer is to be darkened in the ORS. Each correct answer carries 4 Marks. Each wrong answer carries -1 mark.

31. For the series 21, 22, 23, …….. K – 1, K, the A.M. and G.M. of the first and the last number exists in the given series. If K is a three digit number, then find the number of values of K.

32. If $\int \frac{d\left(\sec^2 x\right)}{\sqrt{2+\tan^2 x}}$ is equal to $2\left(\sqrt{\frac{k+\cos 2x}{1+\cos 2x}}\right)+c$, then find k

33. Find the value of cosec $\frac{2\pi}{7}$ + cosec $\frac{4\pi}{7}$ + cosec $\frac{8\pi}{7}$.

34. If $\left({}^{100}C_0\right)\left({}^{200}C_{150}\right) + \left({}^{100}C_1\right)\left({}^{200}C_{151}\right) + \ldots\ldots\ldots + \left({}^{100}C_{50}\right)\left({}^{200}C_{200}\right) = {}^{n}C_r$ then find the value of the integer $\frac{n}{r}$.

35. Find the shortest distance between any two edges of the tetrahedron formed by the planes x + y = 0; y + z = 0; z + x = 0 and x + y + z = $2\sqrt{6}$.

36. Let A = {1, 2, 3, 4, 5, 6}. Let the number of bijective functions from A $\rightarrow$ A in which at least three elements have self image be P and let Q be the number of non increasing functions from A $\rightarrow$ A. Then find the integral part of Q/P

37. A plane is parallel to the two vectors $\hat{i}+\hat{j}+\hat{k}$ and $2\hat{i}$ and another plane is parallel to two other vectors $\hat{i}+\hat{j}$ and $\hat{i}-\hat{k}$. If the acute angle between $2\hat{i}-\hat{j}$ and the line of inter section of the planes is θ, find [tanθ], where [ ] denotes greatest integer function.

38. In an examination an examinee either guesses or copies or knows the answer to a "numerical answer" question, whose answer is a digit from 1 to 9. The chance that he makes a guess or copies is, each equal to the probability of getting the same number when two identical dies are rolled. The probability that he answers correctly given that he copied it is 1/8. If P is the probability that he knew the answer to the question, given that he answered it correctly, then find $\frac{250P}{27}$.

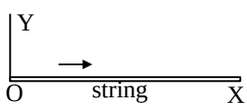
PART III : PHYSICS
SECTION – I (Total Marks:12)
(Single answer type)

This section contains 4 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct. Each correct answer carries 3 Marks. Each wrong answer carries -1 mark.

39. The dimensional formula of the quantity $\frac{m^2 g}{Q^2 B^2 R}$ where m is mass, g gravitational field, B magnetic field, R Radius, Q charge, is

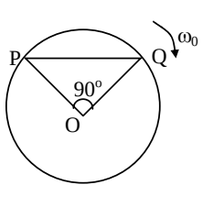
A) $M^0L^0T^0$ B) $M^2L^{-1}T^{-2}$ C) $M^{-1}LT^{-2}$ D) M^0L^0T

40. Two transverse waves traveling along a string are describedd by $y = y_0 \cos(kx - \omega t)$ and $y = -y_0 \sin(\omega t - kx + \pi/3)$. The phase difference between the two waves at any point x on the string is



A) π/2 B) 2π/3 C) π/3 D) 5π/6

41. The figure shows a disc of radius R rotating about centre O with a uniform angular velocity ω_0 rad/s. P and Q are two points on the circumference of the disc. The acceleration of P with respect to Q is



A) zero B) $R\omega_0^2$

C) $2R\omega_0^2$ D) $\sqrt{2}\,R\omega_0^2$

42. Half life of a radioactive substance is 4 days. The probability that a nucleus will decay in two half lies is

A) 1 B) 3/4 C) 1/2 D) 1/4

SECTION – II (Total Marks:20)
(Multiple correct answer(s) type)

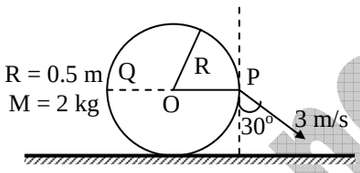
This section contains 5 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE may be correct. Each correct answer carries 4 Marks. Each wrong answer carries -1 mark.

43. Two bodies A and B have thermal emissivities 0.01 and 0.81 respectively. The outer surface areas of the two bodies are equal. The bodies emit total radiant power at the same rate. The wavelength λ_B for maximum spectral radiancy in B is shifted from the wavelength for maximum spectral radiancy in A by 1.00 μm. The temperature of A is 5802 K.

A) The temperature of B is 1934 K B) λ_B = 1.5 μm

C) The temperature of B is 1160 K D) λ_B = 2.0 μm

44. A disc of mass M and radius R rolls on a horizontal surface. At the instant shown, the velocity of point P is 3 m/s.



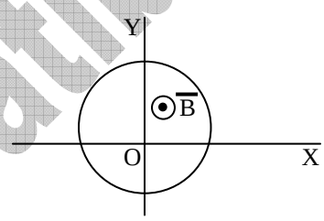
A) Angular velocity of the body is $3\sqrt{3}$ rad/s clockwise

B) The instantaneous centre is at a distance $\frac{1}{2\sqrt{3}}$ m vertically below O.

C) The velocity of the centre of the disc is 1.5 m/s.

D) The velocity of point Q is 3 m/s.

45. A flat coil of n turns, area A and resistance R is placed in a uniform magnetic field $B_0\ \hat{k}$. The coil is rotated about its diameter by an angle θ and charge Q flows through it.



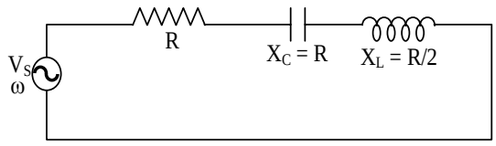
A) θ = π, Q = 0

B) θ = 2π, Q = 0

C) θ = π/2, Q = B_0An/R

D) θ = π, Q = B_0An/R

46. In the LCR ac circuit shown, the voltage across the inductance L is V.



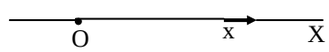
A) The supply voltage is $\sqrt{5}$ V

B) The voltage across the resistor is 2V

C) The supply frequency ω = $\sqrt{\frac{2}{LC}}$

D) The power supplied to the circuit is $4V^2/R$

47. A particle moves along X-axis according to equation x = 4 $-9t + \frac{t^3}{3}$ where t is time



A) Direction of motion remains constant

B) In the time interval 0 < t < 3, the speed of the particle decreases

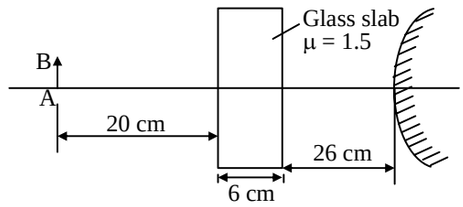
C) In the time interval t > 3, the speed of the particle increases

D) The initial acceleration of the particle is zero

SECTION – III (Total Marks:16)
(Matrix-Match type)

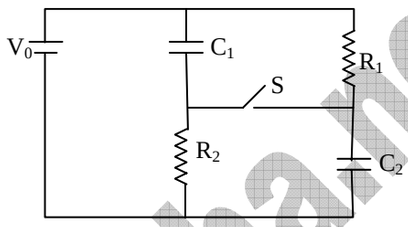
This section contains 2 questions. Each question has four statements (A, B, C and D) given in Column I and five statements (P, Q, R, S and T) in Column II. Any given statement in Column I can have correct matching with ONE or MORE statement(s) given in Column II. For example, if for a given question, statement B matches with the statements given in q and r, then for the particular question, against statement B, darken the bubbles corresponding to q and r in the ORS. Each correct matching carries 2 Marks. There is no negative marking.

48. An object AB is placed on the principal axis in front of a convex mirror of radius of curvature 50 cm. Assume paraxial rays for image formation.



Column-I		Column-II	
A)	First image by refraction through the glass slab	P)	Erect with respect to AB
B)	Image by mirror	Q)	Inverted with respect to AB
C)	Final image of the object	R)	$+ {}^{2}/_{3}$
D)	Magnification of the final image	S)	$+ {}^{1}/_{3}$
		T)	+ 1

49. The switch S is closed for a long time and the RC circuit carries a steady current. Let C_1 = 3.0 μF, C_2 = 6.0 μF, R_1 = 4.0 kΩ, R_2 = 7.0 kΩ. The power dissipated in R_2 is 2.8 W

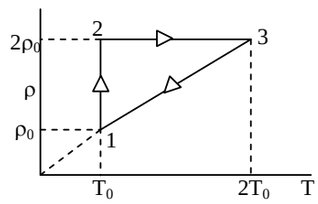


Column-I		Column-II	
A)	The power dissipated R_1 is watt	P)	1.6
B)	The charge on capacitor C_1 in μC	Q)	1.8
C)	The charge on capacitor C_2 in μC	R)	240
D)	Long time after switch S is opened, the charge on C_1 in μC	S)	660
		T)	840

SECTION – IV (Total Marks:32)
(Integer Answer type)

This section contains 8 questions. The answer to each of the question is a single digit integer, ranging from 0 to 9. The bubble corresponding to the correct answer is to be darkened in the ORS. Each correct answer carries 4 Marks. Each wrong answer carries -1 mark.

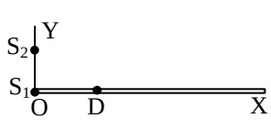
50. A diatomic ideal gas undergoes a cyclic process 1231 shown on pressure P, temperature T diagram. The efficiency of the cycle is $\frac{2-\ln 4}{n}$. Find the value of n.



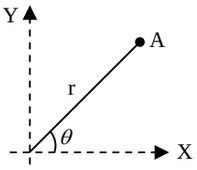
51. K_α X-ray emitted by an atom (Z = 11) is λ. Find the atomic number of the atom that emits K_α X-ray of wavelength 4λ.

52. Light from a discharge tube containing hydrogen atoms falls on sodium surface. The kinetic energy of the fastest photoelectrons emitted from sodium is 0.73eV. The work function for sodium is 1.82eV. The photons emitted from hydrogen involves transition from n to 2. Find the value of n.

53. The coherent sources of light S_1 and S_2 are placed at (0, 0) and (0, 3λ). Interference is observed by a detector D placed on X-axis. Find the number of minima observed as D is moved from x = 0 to x = ∞. (λ = wavelength of light).



54. A short dipole is oriented along *x*-axis such that direction of dipole moment is along positive *x*-axis. It is observed that the magnitude of electric field and electric potential are equal at a point A, r = $\sqrt{x}$ *m* from the centre of the dipole as shown. The value of $\theta = 45°$. Find the value of *x*.



55. A voltmeter of resistance R_1 and an ammeter of resistance R_2 are connected in series across a battery of negligible internal resistance (fig 1) when a resistance R is connected in parallel to voltmeter,

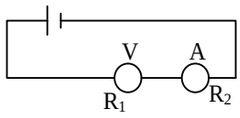


Fig. 1

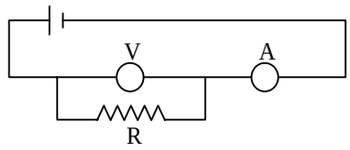
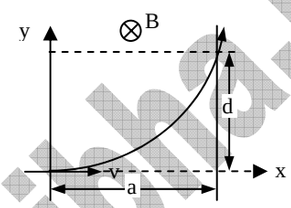


Fig. 2

the ammeter reading becomes thrice and voltmeter reading becomes one third. (fig 2). Then R_2 = nR/3. Find the value of n.

56. The lateral magnification of an object placed in front of a convex lens is +2. The focal length of the lens is 2m. Find the distance (in m) by which the object should be moved to obtain a magnification of –2.

57. A charged particle *q* enters a region of uniform magnetic field B. (into the page) as shown in figure and is deflected a distance *d* along *y* axis after traveling a distance a along x-axis. Find the magnitude of momentum of the particle in kg-*m*/*s*(*a* = 3*m*, *d* = 4*m*, *q*B = 0.32 SI units)



KEY

CHEMISTRY

1. A	2. C	3. D	4. C	5. AD	6. CD
7. CD	8. ABD	9. BC	10. A-R; B-P,S; C-P,S,T; D-Q,R		
11. A-P,T; B-R, C-Q, D-S			12. 2	13. 3	14. 8
15. 6	16. 3	17. 2	18. 6	19. 1	

MATHEMATICS

20. D	21. A	22. A	23. C	24. BD	25. ABCD
26. BD	27. AB	28. ABC	29. A–QS,B–P,C–P,D–R;		
30. A–S;B–P;C–Q;D–RT;			31. 2	32. 3	33. 0
34. 6	35. 4	36. 8	37. 3	38. 8	

PHYSICS

39. B	40. D	41. D	42. B	43. A, B	44. A,B,C,D
45. B,C	46. A,B,D	47. B,C,D	48. A-P; B-P; C-P; D-S		
49. A-P; B-R; C-T; D-S			50. 7	51. 6	52. 4
53. 3	54. 5	55. 8	56. 2	57. 1	

Paper-2
HINTS & SOLUTIONS

CHEMISTRY

1. A

Sol: $h\nu = h\nu_0 + KE$

2. C

3. D

4. C

Sol: $Mg + N_2 \rightarrow Mg_3N_2 \xrightarrow{H_2O} Mg(OH)_2 + NH_3 \xrightarrow{CuSO_4} \underset{\text{Blue}}{\left[Cu(NH_3)_4\right]^{2+}}$

5. AD

Sol: α – hydrogen absent

6. CD

7. CD

Sol: Spin multiplicity = n + 1, n = number of unpaired electrons.

8. ABD

9. BC

Sol: $MgCl_2 \rightarrow \underset{\text{cathode}}{Mg^{2+}} + \underset{\text{anode}}{2Cl^-}$

10. A-R; B-PS; C-PST; D-QR;

Sol: Specific conductance decreases with dilution, increase with increase in conc. molar conductance increases with dilution, decreases with increase in concentration α increases with dilution, decreases with increase in concentration. $\alpha = \frac{\Lambda_m}{\Lambda_m^{\alpha}}$. Resistance increases with increasing the distance between parallel plates

11. A-PT; B-R; C-Q; D-S

Sol: $C_6H_5NO_2 \xrightarrow{LiAlH_4 \text{ or } Zn+NaOH+CH_3OH} C_6H_5N = N - C_6H_5$

$C_6H_5NH_2 \xrightarrow{NaNO_2, HCl} C_6H_5 - \overset{\oplus}{N} \equiv C_6H_5 - Cl$

Aniline $\rightarrow$ carbyl amine

$CH_3CH_2NH_2 \xrightarrow{NaNO_2, HCl} CH_3CH_2 - \overset{\oplus}{N}_2 \xrightarrow{-N_2} CH_3 - CH_2 \xrightarrow{H_2O, -H} C_2H_5OH$

12. 2

Sol: $1.823 - 1.479 = \text{wt. of } H_2O. \frac{\text{wt.}}{\text{Mol.wt.}} = x$

13. 3

Sol: $\frac{[2X]^a[2Y]^b}{[X]^a[Y]^b} = 2^3$

14. 8

Sol: No. of $\alpha = \frac{238-214}{4}$

15. 6

Sol: $X_2SO_4.Y_2(SO_4)_3.24H_2O$

16. 3

Sol: $K_{sp} = [Ag^+][Cl^-]$ solubility of AgCl in 0.01M $AgNO_3$

$\frac{Ksp}{0.01} = S_1 ; \frac{Ksp}{0.025} = S_2$

$\frac{S_1}{S_2} = \frac{[Cl^-]}{[Ag^+]} = \sim 3$

17. 2

Sol: $K_p = K_c(RT)^{\Delta n}$

18. 6

Sol: $2NH_3 \rightleftharpoons NH_4^{\oplus} + NH_2^-$

$NH_2^- = \sqrt{K} = \sqrt{10^{-34}} = 10^{-17}$

No. of amide ions in $1cm^3 = \frac{10^{-17} \times 6 \times 10^{23}}{10^{23}}$

19. 1

Sol: $\frac{Zn^{+2}}{S^{-2}} = \frac{4}{4} = 1$

MATHEMATICS

20. Ans. : D

Sol. Since the roots are real and distinct, dis > 0,

since $\alpha < 3, \beta < 3, (\alpha - 3)(\beta - 3) > 0$

$\alpha\beta - 3(\alpha + \beta) + 9 = 0 \quad \rightarrow \underline{\lfloor C} \frac{c}{K} - 3\left(\frac{-b}{K}\right) + 9 > 0$

if $g(x)\ kx^2 + bx + c$

$\rightarrow \frac{9a^2 + 3b + c}{K} > 0 \quad \rightarrow f(3) > 0$ on solving we get $a < 2$ as the range of a.

∴ St01 is wrong and St-2 is true.

21. Ans. : A

Sol. Observe that $\left[\frac{1}{3} + \frac{K}{100}\right] = 0 \quad$ if $0 < \frac{1}{3} + \frac{K}{100} < 1$

or $K < \frac{200}{3} = 66.66$

$\therefore$ K = 0, 1, 2, 3, …….. 66.

if $67 \le K \le 99$ observe that

$1 < \frac{1}{3} + \frac{67}{100} \le \frac{1}{3} + \frac{K}{100} \le \frac{1}{3} + \frac{99}{100} < 2 \quad \rightarrow \left[\frac{1}{3} + \frac{K}{100}\right] = 1$

$\therefore \left[\frac{1}{3} + \frac{K}{100}\right] = 0$ for K = 1, 2, 3, …….. 66 and

= 1 for K = 67, 68, …….. 99.

$\therefore$ S = (0 + 0 + …… 67 terms) + (1 + 1 + …… 33 terms) = 33.

22. Ans. : A

Sol. The ellipse is $\frac{x^2}{25} + \frac{y^2}{\frac{25}{4}} = 1$ Here $a^2 = 25$, $b^2 = 25/4$

Equation to normal at (x_1, y_1) is $\frac{a^2 x}{x_1} - \frac{b^2 y}{y_1} = a^2 - b^2$

$\rightarrow 8x - 3y - 18 = 0$. (6, 10) lies on it. $\therefore$ (6, 10) is nearest to (3, 2).

23. Ans. : C

24. Ans. : BD

Sol. Equation of circle with A(1, 1), B(2, 2) as ends of diameter is
(x – 1) (x – 2) + (y – 1) (y – 2) = 0 and equation to line AB is x – y = 0.
Hence any circle through A and B is
(x – 1) (x – 2) + (y – 1) (y – 2) + λ(x – y) = 0 ……. (1)
If this C lies in 1st quadrant, it will not cut x or y axis in real point.
$\therefore x^2 - 3x + 2 + 2 + \lambda x = 0$ and $2 + y^2 - 3y + 2 - \lambda y = 0$ will not have real roots on solving we get –1

$\le \lambda \le 1$ radius of (1) is $\sqrt{\frac{\lambda^2 + 1}{2}}$ will be greatest when $\lambda = \pm 1$.

Its centre is (2, 1) or (1, 2)

25. Ans. : ABCD

Sol. Given equation is $\frac{dy}{dx} + 2y \tan x = \sin x$

I . F is $e^{\int 2 \tan x \, dx} = \sec^2 x$

$\therefore$ Solutions y . $\sec^2 x = \int \sin x . \sec^2 x \, dx + C$

$\rightarrow$ y . $\sec^2 x$ = sec x + c. If it is passes through $\left(\frac{\pi}{3}, 0\right)$

C = – 2. $\therefore$ y $\sec^2 x$ = sec x – 2 or
y = cos x – 2 $\cos^2 x$ = cos x – 1 – cos 2x.

$\left.\begin{aligned}\frac{dy}{dx} &= -\sin x + 2\sin 2x \\ \frac{d^2y}{dx^2} &= -\cos x + 4\cos 2x\end{aligned}\right\}$ $\frac{dy}{dx} = 0 \rightarrow -\sin x(1 - 4\cos x) = 0$

$\rightarrow$ sin x= 0 or cos x = 1/4 or π

$\frac{d^2y}{dx^2} > 0$ when x = 0, or x = π, $\frac{d^2y}{dx^2} < 0$ when cos x = ¼

$\therefore$ local min = –1, –3, local maximum $\frac{1}{4} - \frac{2}{16} = \frac{1}{8}$

Period of the function is 2π.

26. Ans. : BD

Sol. Given $A = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$ Since $A^T = A^{-1}$.

$(A^T)(A) = I \rightarrow \det(A^T) \cdot dt(A) = \det I.$

$\rightarrow (\det A)^2 = 1 \rightarrow (a^3 + b^3 + c^3 - 3abc)^2 = 1$

$\therefore a^3 + b^3 + c^3 - 3abc = \pm 1 \rightarrow a^3 + b^3 + c^3 = 3abc \pm 1.$

But abc = 1 $\therefore a^3 + b^3 + c^3 = 3 \pm 1 = 4$ or 2

27. Ans. : AB

Sol. f(x) = 0 for $0 \le x < 1$

= x for $1 \le x < 2$

= 2(x – 1) for $2 \le x < 3$

$\therefore$ For $0 \le x < 1$, f o f(x) = f[f(x)] = f(0) = 0.

Now let $1 \le x < 2$ then f o f(x) = f[f(x)] = f(x) = x

Now let $2 \le x < \frac{5}{2}$ then $2 \le 2x - 2 < 3$

f o f(x) = f[f(x)] = f(2x – 2)

= 2(2x – 2) – 2 = 4x – 6.

and if $x \ge \frac{5}{2}$, $2x - 2 \ge 3$, so f(x) is undefined.

Hence

g(x) = f o f(x) = 0 for $0 \le x < 1$

= x for $1 \le x < 2$

= 4x – 6 for $2 \le x < \frac{5}{2}$.

Domain of f o f(x) is [0, 5/2). Observe that g(x) is continuous but not differentiable at x = 2.

Now g′(x) = 1 > 0 for $1 \le x < 2$

= 4 > 0 for $2 \le x < 5/2$

g(2) = 2

$\therefore$ g(x) has no max or min at 2

28. Ans. : ABC

Sol. Given $(a\omega^2 + b + c\omega)^3 + (a\omega + b + c\omega^2)^2 = 0$ and a, b, c $\in$ R.

Let $x = a\omega^2 + b + c\omega$ and $y = a\omega + b + c\omega^2$ then

LHS = $x^3 + y^3 = (x + y)(x + \omega y)(x + \omega^2 y) = 0$

$\rightarrow x + y = 0$ or $x + \omega y = 0$ or $x + \omega^2 y = 0$

$x + y = 0 \rightarrow a(\omega^2 + \omega) + 2b + c(\omega + \omega^2) = 0$