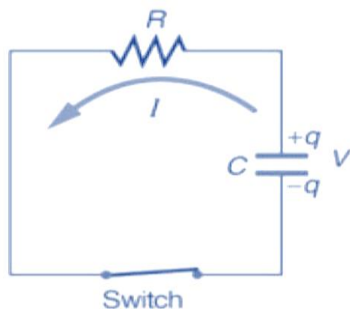


PART-I PHYSICS

1. Energy of an oscillating system is E . At a particular instant kinetic energy of system is $3E/4$. Find displacement of the oscillating particle from its mean position. Its amplitude of oscillation is A .

- (a) $\frac{A}{2}$ (b) $\frac{A}{3}$
(c) $\frac{A}{4}$ (d) $\frac{A}{6}$

2. A capacitor of capacitance $100\mu\text{F}$ discharges through a resistor R . At the same time a radioactive substance decays with mean life 30 ms. If ratio of charge on capacitor to activity of substance does not change with time, then find R .



- (a) 300Ω (b) 100Ω
(c) 200Ω (d) 400Ω

3. Three balls A, B and C of masses m , $2m$ and $2m$ respectively are placed on a smooth horizontal surface. A is initially moving with velocity 9 m/s , collides elastically with B (initially at rest), which in turn collides inelastically with C (initially at rest). Assuming all collisions to be head on, final velocity of C is

- (a) $\frac{9}{2}\text{ (m/s)}$ (b) 9 (m/s)
(c) 6 (m/s) (d) 3 (m/s)

4. A particle of mass $9.1 \times 10^{-31}\text{ kg}$ moving with a velocity 10^6 m/s has de Broglie wavelength λ_1 . A photon of momentum 10^{-27} kgm/s has wavelength λ_2 . Find $\frac{\lambda_2}{\lambda_1}$

- (a) 910 (b) 667
(c) $\frac{1}{310}$ (d) 1

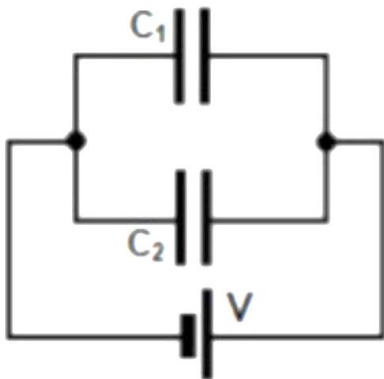
5. Two disks having same surface mass density have radii r and R .

$I_1 \rightarrow$ Moment of inertia of 1st disk about an axis perpendicular to the plane and passing through centre.

$I_2 \rightarrow$ Moment of inertia of 2nd disk about one of its diameters. Find $\frac{I_1}{I_2}$ Memory based questions

- (a) $\frac{r^4}{R^4}$ (b) $\frac{2r^4}{R^4}$
(c) $\frac{r^4}{2R^4}$ (d) $\frac{2r^2}{R^4}$

6. Two capacitor C_1 with capacitor $2C$, and C_2 with capacitance C are connected in parallel. They are charged and then the battery is removed. If a material of dielectric constant K is inserted in C_2 , find final potential across them

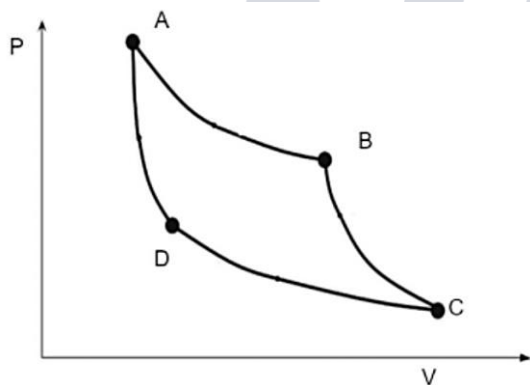


- (a) KV (b) $\frac{3V}{K+2}$
(c) $\frac{V}{K}$ (d) $\frac{3}{KV}$

7. Pressure of a monatomic gas in a container is 2 atm. Average kinetic energy per molecule is 2×10^{-9} J. Volume of gas is 1 litre. Find number of molecules of gas present in the container.

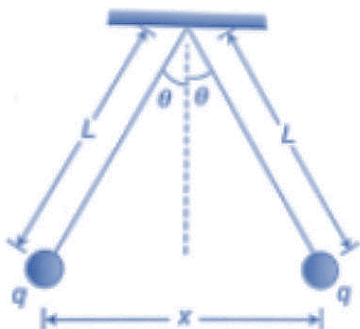
- (a) $\frac{3}{2} \times 10^{11}$ (b) $\frac{3}{2} \times 10^{10}$
(c) $\frac{5}{2} \times 10^{12}$ (d) $\frac{5}{2} \times 10^{11}$

8. If $V_A = V_0$; $V_B = 3.5 V$, $V_C = 5.5 V_0$, $V_0 = 1.5 V_0$, $P_A = 9P_0$, $P_D = P_0$ in the given indicator diagram, choose correct option



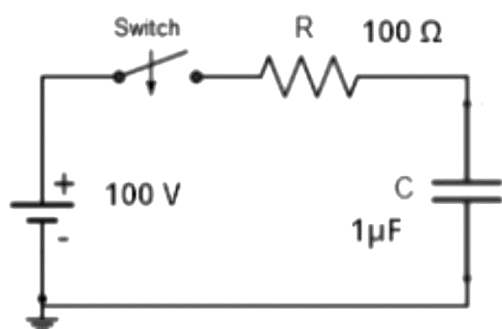
- (a) $W_{AB} < W_{CD}$ (b) $W_{AB} = W_{CD}$
(c) $W_{BC} + W_{DA} > 0$ (d) $W_{BC} = W_{AD}$

9. Two-point charges are suspended from a given point as shown in the figure. Find the equilibrium separation between them



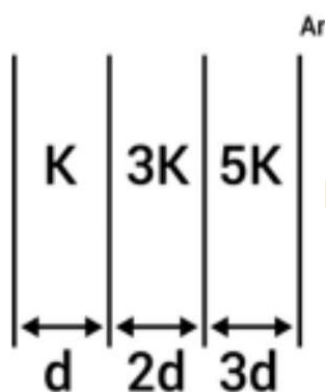
- (a) $q \sqrt{\frac{4\pi\epsilon_0}{mg \tan \theta}}$ (b) $q \sqrt{\frac{\cot \theta}{4\pi\epsilon_0 mg}}$
 (c) $q \sqrt{\frac{\sin \theta}{mg 4\pi\epsilon_0}}$ (d) $q \sqrt{\frac{\cos \theta}{4\pi\epsilon_0 mg}}$

10. The switch is closed at $t = 0$. Find time after which voltage across capacitor becomes 50 volt. [take $\ln 2 = 0.6$]



- (a) $100\mu s$ (b) $60\mu s$
 (c) $80\mu s$ (d) $70\mu s$

11. Equivalent capacitance of following arrangement of identical parallel plates is



- (a) $\frac{25k\epsilon_0 A}{6d}$ (b) $\frac{6k\epsilon_0 A}{25d}$
 (c) $\frac{15k\epsilon_0 A}{34d}$ (d) $\frac{2k\epsilon_0 A}{15d}$

12. Young's modulus of a string is 0.5×10^9 Pa, length of the wire without any force applied in 0.1 m and area is 0.04×10^{-4} m². If this wire is stretched by a length of 0.001 m. The energy stored in this string is transferred to a particle of mass 20 grams. Find speed of the particle

- (a) 1 m/s (b) 0.5 m/s
(c) 2 m/s (d) 0.25 m/s

13. In a YDSE setup, orange light is replaced by blue light. Then,

- (a) Fringe width will increase
(b) Fringe width will decrease
(c) At center, instead of maxima, there would be a minima
(d) The intensity of central maxima will decrease

14. Match the moment of inertia of the rods with given mass and length in column A about the given axis.

A	M, 2L 	i	$\frac{8}{3}ML^2$
B	2M, 2L 	ii	$\frac{ML^2}{3}$
C	2M, L 	iii	$\frac{2ML^2}{3}$
D	M, L 	iv	$\frac{ML^2}{12}$

- (a) A(iv), B(iii), C(ii), D(i) (b) A(ii), B(iii), C(iv), D(i)
(c) A(iii), B(ii), C(iv), D(i) (d) A(ii), B(iv), C(i), D(iii)

15. A cylindrical massless container of cross-sectional area 'A' have a fluid filled upto height 'h' and have a small orifice of area 'a' in wall near its bottom. Find minimum coefficient between container and ground, so that container does not move.

- (a) $\frac{2a}{A}$ (b) $\frac{a}{2A}$
(c) $\frac{A}{a}$ (d) None

16. Two prisms P_1 and P_2 whose refractive index as a function of wavelength λ are μ_1 and μ_2 respectively where $\mu_1 = 1.2 + \frac{10.8 \times 10^{-14}}{\lambda^2}$ and $\mu_2 = 1.45 + \frac{1.8 \times 10^{-14}}{\lambda^2}$.

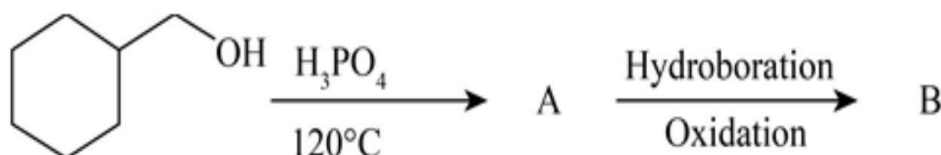
Find λ for which when P_1 and P_2 are put together, no deviation of light happened in the contact surface. Assume both the prism are thin, and both having refracting angle $A = 4^\circ$

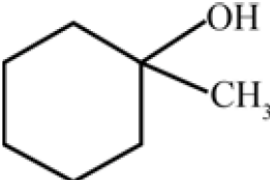
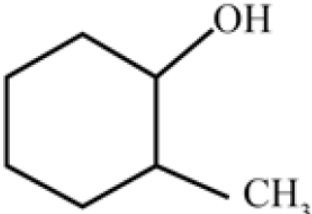
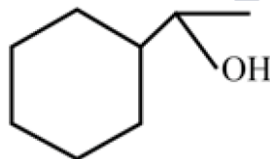
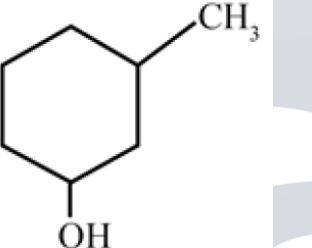
- (a) 900 nm (b) 600 nm
(c) 800 nm (d) 700 nm

17. Two planets A and B of masses M and $9M$ with radii R and $2R$ respectively are present $8R$ distance away from each other. Minimum velocity with which a particle is projected from surface of A such that it reaches plane B is given by $\sqrt{\frac{aGM}{7R}}$. Value of 'a' is

PART-II CHEMISTRY

18. In the following reaction find 'B'



- (a)  (b) 
- (c)  (d) 

19. If density of aqueous NaOH solution is 1.2 g/cm^3 , then find its molality.

[Given that: density of water = 1 gm/cm^3 and molar mass of NaOH = 40 gm]

- (a) 5M (b) 10M
(c) 15M (d) 20M

20. Difference between bond order of CO and NO^+ is $x/2$. Find x.

- (a) 1 (b) 0
(c) 2 (d) 0.5

21. $\text{CH}_3 - \text{I} + \text{I}_2 \rightleftharpoons \text{CH}_4 + \text{HI}$ Which reagent can stop backward reaction?

- (a) Dilute HNO_2 (b) Conc. HIO_3
(c) HClO (d) NH_3 (aq)

22. Which of the following is incorrect about Ellingham diagram?

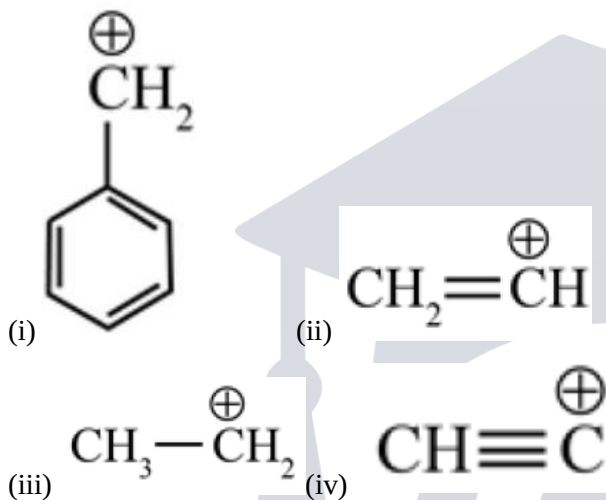
- (a) Graph gives idea about rate of reaction

- (b) Graph gives idea about reduction of metal oxide
- (c) Graph gives idea about free energy change
- (d) Graph gives idea about phase change

23. Oxidation state of Phosphorus in $\text{H}_4\text{P}_2\text{O}_7$; $\text{H}_4\text{P}_2\text{O}_6$ and $\text{H}_4\text{P}_2\text{O}_5$ is respectively:

- (a) +5, +4 and +3 respectively
- (b) +5, +5 and +3 respectively
- (c) +3, +4 and +5 respectively
- (d) +7, +4 and +4 respectively

24. Arrange the increasing order of stability order of the following:



- (a) i > iii > ii > iv
- (b) ii > iii > i > iv
- (c) iii > ii > i > iv
- (d) iv > ii > iii > i

25. A: Aniline is less basic than acetamide.

R : Lone pair of N in aniline is involved in resonance.

- (a) Both Assertion and Reason are correct.
- (b) Assertion is correct and Reason is incorrect
- (c) Assertion is incorrect but Reason is correct.
- (d) Both Assertion and Reason are incorrect.

26. S1: Halides of Lithium are generally covalent.

S2: Lithium has high polarisability.

- (a) Both S1 and S2 are correct.
- (b) S1 is correct but S2 is incorrect.
- (c) S1 is incorrect but S2 is correct.

(d) Both S1 and S2 are incorrect.

27. S1: Rutherford's gold foil experiment didn't explain hydrogen spectrum.

S2: Bohr's model contradicted Heisenberg's uncertainty principle.

(a) Both S1 and S2 are correct.

(b) S1 is correct but S2 is incorrect.

(c) S1 is incorrect but S2 is correct.

(d) Both S1 and S2 are incorrect.

28. Staggered and eclipsed form of ethane are:

(a) Rotamers

(b) Enantiomers

(c) Mirror images

(d) Polymers

29. $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$, $K_c = 1.844$ If 3 moles of PCl_5 are taken in 1 L vessel. Find equilibrium concentration of PCl_5 .

(a) 3.4M

(b) 2.4M

(c) 1.4M

(d) 4.4M

30. Decomposition of N_2O_5 is a order reaction

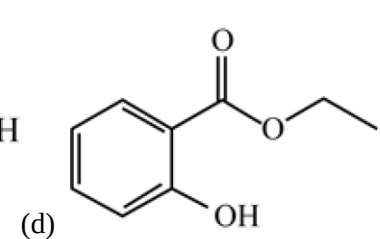
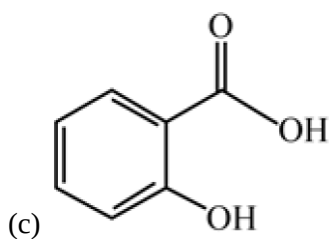
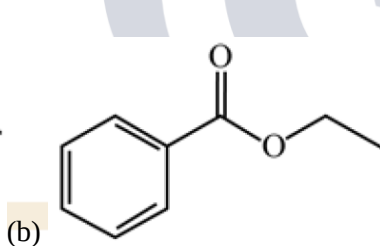
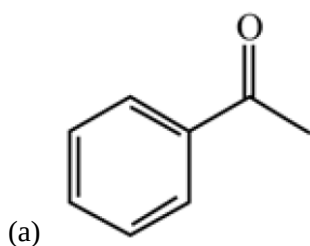
(a) Zero

(b) First

(c) Second

(d) Pseudo-first

31. Which gives orange colour with 2,4 DNP?



32. Electrolysis of sulphate compound solution will give:

(a) $\text{HO}_3\text{SOOSO}_3\text{H}$

(b) $\text{HO}_2\text{SOOSO}_2\text{H}$

(c) $\text{HO}_2\text{SOSO}_2\text{H}$

(d) $\text{HO}_3\text{SOSO}_3\text{H}$

33. Match the column.

Column I	Column II
1. Arsphenamine	(A) Antibiotic
2. Valium	(B) Tranquilizer
3. Furacine	(C) Antiseptic
	(D) Synthetic antihistamine

(a) 1 → A; 2 → B; 3 → C

(b) 1 → B; 2 → D; 3 → C

(c) 1 → D; 2 → B; 3 → A

(d) 1 → C; 2 → B; 3 → A

34. Identify the incorrect statement?

(a) Eutrophication pollutes water

(b) Eutrophication increases oxygen level in water

(c) Oxygen conc. is below 6ppm, it is harmful for fish

(d) None of these

35. In crystal system, $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$ and $a = 1.5$, $b = 2.5$ and $c = 3$. Find the crystal?

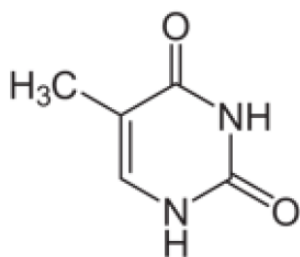
(a) Monoclinic

(b) Orthorhombic

(c) Triclinic

(d) Hexagonal

36. Which of the following is complementary base of the given structure in RNA?



(a) Uracil

(b) Cytosine

(c) Adenine

(d) Guanine

37. Match the column.

(1) $\text{Be}(\text{OH})_2$	(A) Acidic
------------------------------	------------

(2) $B(OH)_3$	(B) Basic
(3) $NaOH$	(C) Amphoteric
(4) $Ca(OH)_2$	
(5) $Al(OH)_3$	

(a) $1 \rightarrow C; 2 \rightarrow A; 3 \rightarrow B; 4 \rightarrow B; 5 \rightarrow C$

(b) $1 \rightarrow A; 2 \rightarrow C; 3 \rightarrow B; 4 \rightarrow A; 5 \rightarrow C$

(c) $1 \rightarrow B; 2 \rightarrow A; 3 \rightarrow C; 4 \rightarrow A; 5 \rightarrow C$

(d) $1 \rightarrow A; 2 \rightarrow C; 3 \rightarrow B; 4 \rightarrow B; 5 \rightarrow C$

38. How to differentiate between monosaccharides and disaccharides

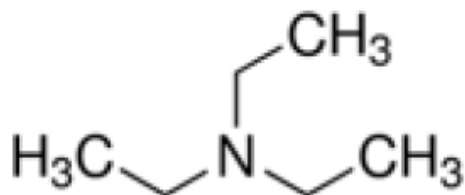
(a) Iodine test (b) Seliwanoff's test

(c) Barfoed test (d) Tollen's test

39. If number of geometrical isomers of $[Co(NH_3)_3(NO_2)_3]$ is a and that of $(Cr(C_2O_4)_3)$ is b , then find $a + b$?

40. According to $x/m = kp^{1/n}$, when pressure is increased 2 times, the concentration becomes 64 times. Find the value of n [in terms of 10^{-2}] (Round off to nearest integer)

41. The bond angle of $C - N - C$ in $N(Et)_3$ is (Round of the answer to the nearest integer.)



PART-III MATHEMATICS

42. $\lim_{x \rightarrow 2} \frac{x^2 f(2) - 4f(x)}{(x-2)} =$ Where, $f(2) = 4f'(2) = 1$

(a) 12 (b) 16

(c) 8 (d) 10

43. If Coefficient of x^7 in $\left(x^2 + \frac{1}{bx}\right)^{11}$ and x^{-7} in $\left[x - \frac{1}{bx^2}\right]^{11}$, $b = 0$, are equal then find b .

(a) 1 (b) -1

(c) 2 (d) -2

44. $\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{dx}{(1+e^{x\cos x})(\sin^4 x + \cos^4 x)}$

- (a) $\frac{\pi}{2(\sqrt{2})}$ (b) $\frac{\pi}{4(\sqrt{2})}$
(c) $\frac{\pi}{8(\sqrt{2})}$ (d) $\frac{\pi}{\sqrt{2}}$

45. If α and β are the roots of equation $x^2 + 20^{\frac{1}{4}}x + 5^{\frac{1}{2}} = 0$ the find $(\alpha^8 + \beta^8)$

- (a) 100 (b) 50
(c) 200 (d) 300

46. If $f(x) = \begin{cases} (1 + |\sin x|)^{\frac{3a}{|\sin x|}}, & x = 0 \\ b, & x = 0 \\ e^{\cot \frac{4x}{\cot 2x}}, & x > 0 \end{cases}$. Find $6a + b^2$.

- (a) $1 + e$ (b) $1 - e$
(c) e (d) $e - 1$

47. If $\sin \theta + \cos \theta = \frac{1}{2}$, then find $16[\sin 2\theta + \cos 4\theta + \sin 6\theta]$ Options:

- (a) -27 (b) -23
(c) 27 (d) 23

48. The probability that a randomly selected 2-digit number belongs to the set $\{n \in N: (2^n - 2) \text{ is a multiple of } 3\}$ is equal to

- (a) $\frac{2}{3}$ (b) $\frac{1}{3}$
(c) $\frac{1}{2}$ (d) $\frac{1}{6}$

49. From point $(-1, 1)$ two tangents drawn to $x^2 + y^2 - 2x - 6y + 6 = 0$ that meet the circle A and B. A point D on the circle such that $AD = AB$. Find are of $\triangle ABD$.

- (a) 2 (b) 4
(c) $2 + \sqrt{2}$ (d) 1

50. Circle with centre $(2, 3)$ passing through origin. P, Q are two points on the circle such that OC is perpendicular to both CP&CQ. Find points P&Q.

51. For the data 6, 10, 7, 13, a , 12, b , 12. If mean is 9, variance is $\frac{37}{4}$ find $(a - b)^2$.

52. $\lim_{n \rightarrow \infty} \frac{1}{n} \sum_{j=1}^n \frac{2j-1+8n}{2j-1+4n}$

53. If $\log_3 2, \log_3(2^x - 5), \log_3(2x - \frac{7}{3})$ are in an arithmetic progression then the value of x is equal to

54. Let $f(x) = \begin{vmatrix} \sin^2 x & -2 + \cos^2 x & \cos 2x \\ 2 + \sin^2 x & \cos^2 x & \cos 2x \\ \sin^2 x & \cos^2 x & 1 + \cos 2x \end{vmatrix}; x \in (0, \pi]$. Then the maximum value of $f(x)$ is?

55. $f(x) = \text{minimum} \{x - [x], 1 + [x] - x\} [0, 3] \rightarrow R$, p is the number of points where it is discontinuous, q is the number of points where it is not differentiable. Find $p + q$.

56. If $A = \begin{bmatrix} 1 & 2 \\ -1 & 4 \end{bmatrix} A^{-1} = \alpha I + \beta A$, find $5(\alpha - \beta) = ?$

57. Area enclosed by the figure: maximum $\{0, \log_e(x)\} \leq y \leq 2^x$ and $\frac{1}{2} \leq x \leq 2$.

58. $\vec{a} = \hat{i} + \hat{j} + 2\hat{k}, \vec{b} = -\hat{i} + 2\hat{j} + 3\hat{k}$

$(\vec{a} + \vec{b}) \times ((\vec{a} \times (\vec{a} - \vec{b})) \times \vec{b})$

59. $\ln\left(\frac{dy}{dx}\right) = 3x + 4y$ and $y(0) = 0$. Find $y\left(\frac{-2}{3} \ln 2\right)$

60. Let a plane p pass through the point $(3, 7, -9)$ and contain the line, $\frac{x-2}{-3} = \frac{y-3}{2} = \frac{z-2}{1}$ or distance of the plane p from the origin d_1 then d_2 is equal to

61. If $\sec x \left(\frac{dy}{dx}\right) - \sin(x+y) - \sin(x-y) = 0$ and $y(0) = 0$. Find $5\left[y'\left(\frac{\pi}{2}\right)\right]$.

