

FIITJEE MOCK TEST-8

IIT - JEE, 2019

PAPER-II

Paper Code
100399.1

Time: 3 Hours

Maximum Marks: 198

A. Question Paper Format:

1. The question paper consists of 3 Parts (Chemistry-**Part-I**, Mathematics-**Part-II** and Physics-**Part-III**).
2. **Section A(i)** contains **10** multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **only one is correct**.
3. **Section A(ii)** contains **3** groups of questions. Each group has 2 questions based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **only one is correct**.
4. **Section A(iii)** contains **FOUR (04)** questions. Each question has **TWO (02)** matching lists: **LIST - I** and **LIST - II**. **FOUR** options are given representing matching of elements from **LIST - I** and **LIST - II**. **ONLY ONE** of these four options corresponds to a correct matching.

B. Marking Scheme:

5. For each question in **Section A(i)** you will be **awarded 3 marks** if you darken the bubble corresponding to the correct answer and **zero mark** if no bubble is darkened. In case of bubbling of incorrect answer, **minus one (-1) mark** will be awarded.
6. For each question in **Section A(ii)**, you will be **awarded 4 marks** if you darken the bubble(s) corresponding to the correct answer and **zero mark** if no bubble is darkened. In all other cases, **minus one (-1) mark** will be awarded.
7. For each question in **Section A(iii)**, you will be **awarded 3 marks** if you darken the bubble(s) corresponding to the correct choice(s) for the answer, and **zero mark** if no bubble is darkened. In all other cases, **Minus one (-1) mark** will be awarded.

Enrolment No. :

Name :

Batch : Date:.....

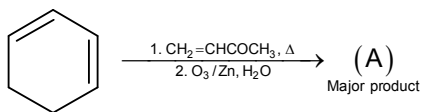
Chemistry

PART – I

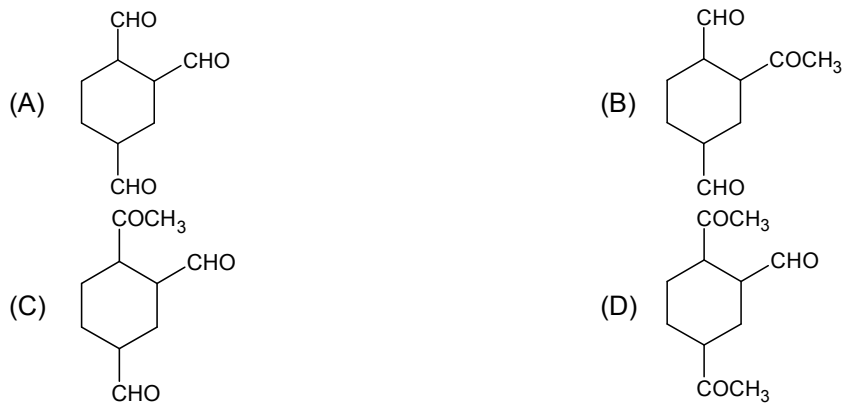
SECTION – A (Only One Option Correct Type)

This section contains **10 multiple choice** questions. Each question has four choices **(A), (B), (C) and (D)** out of which **ONLY ONE** option is correct.

1. The rate of effusion of an unknown gas (X) is $\frac{2}{3}$ rd the rate of effusion of CH_4 under same condition. The density of gas (X) at 1 atm and 400 K is 0.8 kg/m^3 . The compressibility factor of the gas (X) is?
 (A) 1.52 (B) 1.37
 (C) 1.82 (D) 1
2. In the following reaction

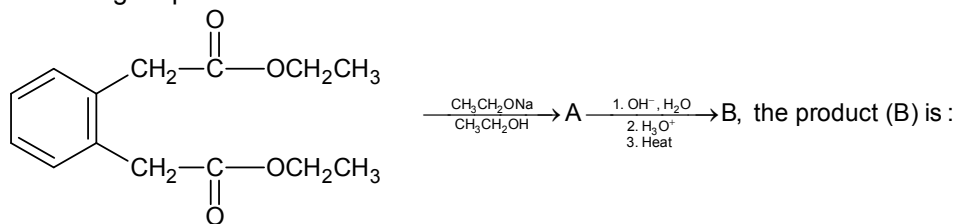


the major product (A) is:



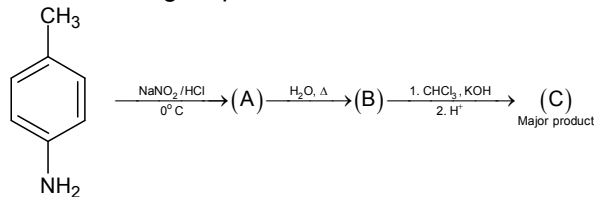
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3. In the following sequence of reaction



- (A)
- (B)
- (C)
- (D)

4. In the following sequence of reaction

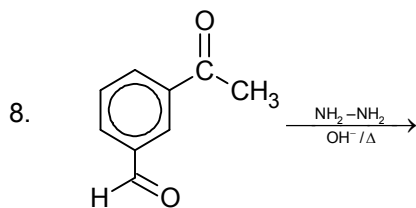


the product (C) is:

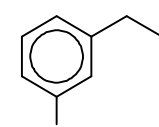
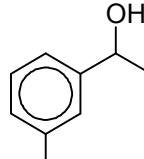
- (A)
- (B)
- (C)
- (D)

Space for Rough work

5. Which of the following is optically inactive?
 (A) $[\text{Co}(\text{en})_3]^{3+}$ (B) $[\text{Cr}(\text{OX})_3]^{3-}$
 (C) $\text{Cis-}[\text{CoCl}_2(\text{en})_2]^+$ (D) $\text{trans-}[\text{CoCl}_2(\text{en})_2]^+$
6. Which of the following order of acidic strength is incorrect?
 (A) $\text{HClO}_4 > \text{HClO}_3 > \text{HClO}_2$ (B) $\text{HIO}_4 > \text{HBrO}_4 > \text{HClO}_4$
 (C) $\text{HI} > \text{HBr} > \text{HCl}$ (D) $\text{HF} > \text{H}_2\text{O} > \text{NH}_3$
7. Which of the following statement is incorrect?
 (A) XeF_6 on hydrolysis produces XeO_3
 (B) XeF_2 on hydrolysis produces XeO_3
 (C) XeO_3 reacts with XeF_6 to form XeOF_4
 (D) XeOF_4 is formed by the partial hydrolysis of XeF_6



The major product is

- (A)  (B) 
- (C)  (D) 

9. A solution of 100 ml of 1 M KOH is added to 100 ml of 1 M HCl and the mixture is shaken well. The rise in temperature T_1 is noted. The experiment is repeated by using 50 ml of 1M KOH and 50 ml of 1M HCl and increase in temperature T_2 is noted. Which of the following is correct?
 (A) $T_1 = 2T_2$ (B) $T_1 = T_2$
 (C) $T_1 = 4T_2$ (D) $2T_1 = T_2$
10. In a closed vessel of 2L capacity, 0.1 mole of $\text{Sb}_2\text{S}_3(\text{s})$ and 0.1 mole of $\text{H}_2(\text{g})$ are mixed at 400 K. At equilibrium

$$\text{Sb}_2\text{S}_3(\text{s}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{Sb}(\text{s}) + 3\text{H}_2\text{S}(\text{g})$$
 the $\text{H}_2\text{S}(\text{g})$ formed was analysed by dissolving it in water and treating with excess Pb^{2+} . Which gives 11.9 g of PbS precipitate. The value of K_c at 400°C is (MW of $\text{PbS} = 238$)
 (A) 1 (B) 2
 (C) 4 (D) 16

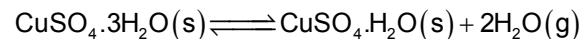
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Comprehension type (Only One Option Correct)

This section contains **3 paragraphs**, each describing theory, experiments, data etc. Six questions relate to the three paragraphs with **two questions on each paragraph**. Each question has **only one** correct answer among the four given options (A), (B), (C) and (D).

Paragraph for Question Nos. 11 to 12

The pressure of $\text{H}_2\text{O}(\text{g})$ at 25°C for the reaction at equilibrium

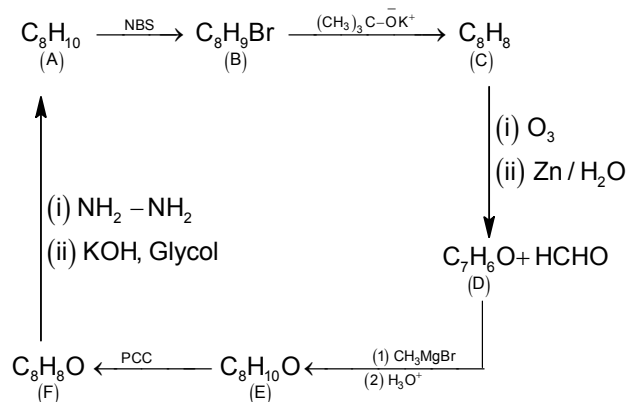


is 10×10^{-3} atm. The standard enthalpy change of the reaction is 100 kJ/mole.

11. The ΔG° of the given reaction is
(A) 22.8 kJ mol^{-1} (B) 19.2 kJ mol^{-1}
(C) 16.4 kJ mol^{-1} (D) 82.6 kJ mol^{-1}
12. The ΔS° of the given reaction is
(A) $518 \text{ J K}^{-1} \text{ mol}^{-1}$ (B) $259 \text{ J K}^{-1} \text{ mol}^{-1}$
(C) $129.5 \text{ J K}^{-1} \text{ mol}^{-1}$ (D) $316 \text{ J K}^{-1} \text{ mol}^{-1}$

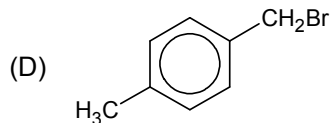
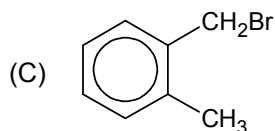
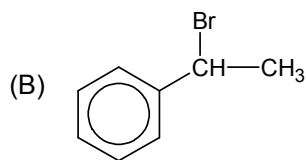
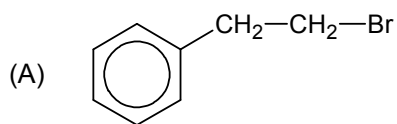
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Paragraph for Question Nos. 13 to 14

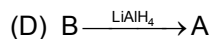
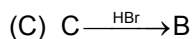
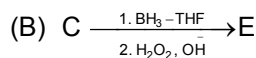
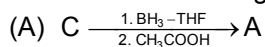


Answer the following question based on the above sequence of reactions.

13. Compound (B) is

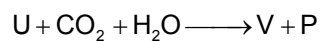
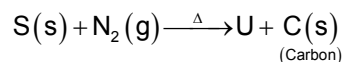
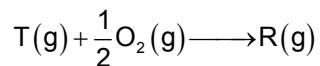
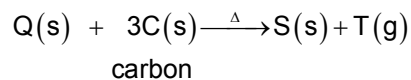
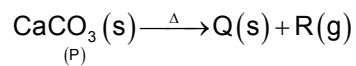


14. Which of the following is incorrect?



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Paragraph for Question Nos. 15 to 16



Answer the following question based on the above passage.

15. Compound 'U' is

- (A) CaC_2
(C) Ca_3N_2

- (B) CaCN_2
(D) Ca(CN)_2

16. The compound 'V' is

- (A) $\text{H}_2\text{N}-\overset{\text{O}}{\parallel}{\text{C}}-\text{NH}_2$
(C) H_2NNH_2

- (B) NH_3
(D) H_2NCN

Space for Rough work

Match List Type (Only One Option Correct)

This section contains four questions, each having two matching lists. Choices for the correct combination of elements from **List-I** and **List-II** are given as option (A), (B), (C) and (D) out of which **one is correct**.

17. Match List - I with List – II.

List – I		List – II	
(P) Excluded molar volume		(1) $Z = 1$	
(Q) Higher the compressibility factor		(2) b	
(R) At Boyle's temperature		(3) All gases behave ideally	
(S) At extremely low pressure		(4) Difficult is the liquification of gas	

Codes:

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

18. Match the pair of complexes with properties that are same in them

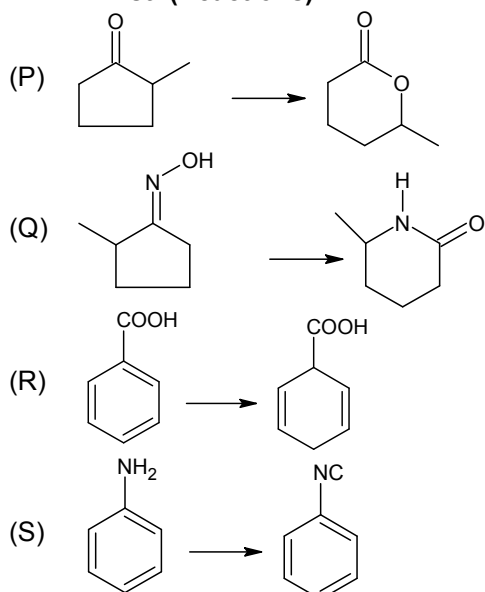
List-I		List-II	
(P) $[\text{NiCl}_4]^{2-}$ and $\text{Ni}(\text{CO})_4$		(1) Diamagnetic	
(Q) $[\text{Ni}(\text{CN})_4]^{2+}$ and $\text{Ni}(\text{CO})_4$		(2) Square planar	
(R) $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{Cu}(\text{NH}_3)_4]^{2+}$		(3) Tetrahedral	
(S) $[\text{NiCl}_4]^{2-}$ and $[\text{Cu}(\text{NH}_3)_4]^{2+}$		(4) Paramagnetic	

Codes:

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

Space for Rough work

19. Match the following

List-I(Reactions)**List-II(Reagent)**(1) PCl_5 (2) $\text{C}_6\text{H}_5\text{CO}_3\text{H}$ (3) CHCl_3/KOH (4) $\text{Na}/\text{NH}_3(\text{liq.})$

Codes:

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

20. Match the following

List-I(Polymer)**List-II(monomer)**

(P) Terylene

(1) Acrylonitrile

(Q) Orlon

(2) Ethylene glycol and phthalic acid

(R) Glyptol

(3) Dimethyl terephthalate and ethylene glycol

(S) Natural rubber

(4) Isoprene

Codes:

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

Space for Rough work

Mathematics**PART – II****SECTION – A**
(Only One Option Correct Type)

This section contains **10 multiple choice** questions. Each question has four choices **(A), (B), (C) and (D)** out of which **ONLY ONE** option is correct.

1. If Z_1, Z_2 are two complex numbers such that $|Z_1|=1, |Z_2|=1$ then the maximum value of $|Z_1 + Z_2| + |Z_1 - Z_2|$ is
- (A) 2 (B) $2\sqrt{2}$
(C) 4 (D) none of these
2. The equation of a straight line meeting the circle $x^2 + y^2 = a^2$ in two points at equal distance 'd' from the point (x_1, y_1) on its circumference is
- (A) $xx_1 + yy_1 + a^2 - \frac{d^2}{2} = 0$ (B) $xx_1 + yy_1 - a^2 - \frac{d^2}{2} = 0$
(C) $xx_1 + yy_1 + a^2 + \frac{d^2}{2} = 0$ (D) $xx_1 + yy_1 - a^2 + \frac{d^2}{2} = 0$
3. $I = \int \frac{\sqrt{1+\sqrt{x}}}{\sqrt{1-\sqrt{x}}} \cdot \frac{dx}{x}$ is equal to
- (A) $2 \left[\cos^{-1} \sqrt{x} + \log \left| \frac{1+\sqrt{1-x}}{x} \right| \right] + c$ (B) $2 \left[\cos^{-1} \sqrt{x} - \log \left| \frac{1-\sqrt{1-x}}{\sqrt{x}} \right| \right] + c$
(C) $-2 \left[\cos^{-1} \sqrt{x} + \log \left| \frac{1+\sqrt{1-x}}{\sqrt{x}} \right| \right] + c$ (D) $-2 \left[-\cos^{-1} \sqrt{x} + \log \left| \frac{1+\sqrt{1-x}}{\sqrt{x}} \right| \right] + c$
4. Let l_1, l_2 and l_3 are the 3 normals to the parabola $y^2 = 4ax$ from point P inclined at the angle θ_1, θ_2 and θ_3 with x-axis respectively then the locus of point P, if $\theta_1 + \theta_2 + \theta_3 = \alpha$ (constant) will be
- (A) parabola (B) ellipse
(C) hyperbola (D) straight line

Space for rough work

5. The value of $\lim_{x \rightarrow \infty} x^2 \sin\left(\ln \sqrt{\cos \frac{\pi}{x}}\right)$ is
- (A) $\frac{\pi^2}{4}$ (B) $-\frac{\pi^2}{4}$
 (C) $\frac{\pi^2}{8}$ (D) $-\frac{\pi^2}{8}$
6. If $\lim_{x \rightarrow \infty} \left(\frac{x^3 + x^2}{x^2 + 2\cos x} - bx \right) = 1$, then $b =$
- (A) 1 (B) 2
 (C) 3 (D) none of these
7. The number of points in $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ for which $x^3 + 2x + \cos x + \tan x = 0$, is
- (A) 1 (B) 3
 (C) 5 (D) none of these
8. The curve $y = ax^3 + bx^2 + cx + 5$, touches the x -axis at $P(-2, 0)$ and cuts the y -axis at point Q , where its gradient is 3. Then $2(a + 2b + c) =$
- (A) 2 (B) 4
 (C) 6 (D) none of these
9. The value of $\int_0^1 \frac{e^x(1+x)\sin^2(xe^x) dx}{\sin^2(xe^x) + \sin^2(e - e^x)}$ is
- (A) $\frac{e}{4}$ (B) $\frac{e}{2}$
 (C) $2e$ (D) $\frac{e}{8}$
10. Let $p(x) = a_1x + a_2x^2 + a_3x^3 \dots a_{100}x^{100}$, where $a_1 = 1$ and $a_i \in \mathbb{R} \forall i = 2, 3, \dots, 100$, then $\lim_{x \rightarrow 0} \left[\frac{1}{x^4} \int_0^x \left\{ x^2 \left(\sqrt[100]{p(t)+1} \right) - x^2 \right\} dt \right]$ is
- (A) $\frac{1}{200}$ (B) $\frac{1}{50}$
 (C) 150 (D) none of these

Space for rough work

Comprehension type (Only One Option Correct)

This section contains **3 paragraphs**, each describing theory, experiments, data etc. Six questions relate to the three paragraphs with **two questions on each paragraph**. Each question has **only one** correct answer among the four given options (A), (B), (C) and (D).

Paragraph for Question Nos. 11 to 12

Read the following write up carefully and answer the following questions:

Let us consider the equation $x^2 - (m - 3)x + m = 0$, ($m \in \mathbb{R}$).

11. The set of values of m such that the given quadratic equation has one root smaller than '2' and the other root greater than 2.
(A) $(-\infty, 10)$ (B) $(10, \infty)$
(C) $(-\infty, -10) \cup (10, \infty)$ (D) $(-\infty, -10)$
12. The set of values of m such that the given quadratic equation has both roots greater than '2'
(A) $[10, \infty)$ (B) $(-9, 10)$
(C) $[9, 10]$ (D) $[9, 10]$

Space for rough work

Paragraph for Question Nos. 13 to 14

Read the following write up carefully and answer the following questions:

If $\lim_{x \rightarrow a} f(x) = 0$, then $\lim_{x \rightarrow a} \frac{1 - \cos f(x)}{(f(x))^2} = \frac{1}{2}$. If α, β, γ are roots of $ax^3 + bx^2 + cx + d = 0$, then

13. $\lim_{x \rightarrow \alpha} \frac{1 - \cos(ax^3 + bx^2 + cx + d)}{(x - \alpha)^2} =$

(A) $a^2 (\alpha - \beta)^2 (\alpha - \gamma)^2$

(B) $a(\alpha - \beta)(\alpha - \gamma)$

(C) $a(\alpha\beta + \beta\gamma + \gamma\alpha)$

(D) $\frac{a^2}{2} (\alpha - \beta)^2 (\alpha - \gamma)^2$

14. $\lim_{x \rightarrow 0} \frac{1 - \cos 1 \cdot \cos \cos x - \sin 1 \cdot \sin \cos x}{x^4} =$

(A) $\frac{1}{8}$

(B) $\frac{1}{16}$

(C) $\frac{1}{4}$

(D) 1

Space for rough work

Paragraph for Question Nos. 15 to 16

Read the following write up carefully and answer the following questions:

- (i) Let $\pi_1: a_1x + b_1y + c_1z + d_1 = 0$;
 $\pi_2: a_2x + b_2y + c_2z + d_2 = 0$
 $\pi_3: a_3x + b_3y + c_3z + d_3 = 0$
 These planes may (i) intersect in a common line

(ii) may form a triangular prism

(iii) may intersect in a point

$$\text{Let } \Delta_1 = \begin{vmatrix} b_1 & c_1 & d_1 \\ b_2 & c_2 & d_2 \\ b_3 & c_3 & d_3 \end{vmatrix}; \Delta_2 = \begin{vmatrix} a_1 & c_1 & d_1 \\ a_2 & c_2 & d_2 \\ a_3 & c_3 & d_3 \end{vmatrix}$$

$$\Delta_3 = \begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}; \Delta_4 = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}. \text{ If } \Delta_4 \neq 0, \text{ then planes intersect in a point. If } \Delta_4 = 0, \text{ then none}$$

of Δ_1, Δ_2 and Δ_3 is zero then the planes form a triangular prism and if $\Delta_4 = 0$ and one of $\Delta_1, \Delta_2, \Delta_3$ is zero, then the planes intersect in a line.

15. Let the equation of planes be $x - y + z + 1 = 0$, $\lambda x + 3y + 2z - 3 = 0$ and $3x + \lambda y + z - 2 = 0$. The above three planes intersect in a point if λ is not equal to
 (A) 3 (B) 2
 (C) 4 (D) -4
16. The above three planes in Q.36 form a triangular prism if λ is
 (A) 2 (B) 4
 (C) 3 (D) -4

Space for rough work

Match List Type (Only One Option Correct)

This section contains four questions, each having two matching lists. Choices for the correct combination of elements from **List-I** and **List-II** are given as option (A), (B), (C) and (D) out of which **one is correct**.

17. Let $S_n = \sum_{r=1}^n r!$, then for $n > 7$ (Given $\sum_{r=1}^7 r! = 4340$). Match the following List-I with List-II

List - I		List - II	
(P)	$\tan^{-1}\left(\tan\left(S_n - 8\left[\frac{S_n}{8}\right] + 1\right)\right)$	1.	$2\pi - 5$
(Q)	$\cos^{-1}\left(\cos\left(S_n - 8\left[\frac{S_n}{8}\right] + 1\right)\right)$	2.	$5 - 2\pi$
(R)	The value of $\left(\lim_{n \rightarrow \infty} \left(\frac{n^2}{n^2 - 1}\right)^{\tan\left(\frac{1}{\sqrt{n}}\right)}\right) + 2\pi$ is	3.	$2\pi + 2$
(S)	If $\lim_{n \rightarrow \infty} \sum_{i=1}^n \frac{(\ln 2i - \ln(n))}{n} = \ln k$, then $ek + 2\pi$ is	4.	$2\pi + 1$

Codes:

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

Space for rough work

18. Let 10 letters and envelope both numbered 1 to 10. Number of ways of placing letters in envelopes such that no letter goes to same numbered envelope is $D(10)$ is equal to 1334961 without contradicting the above mention de-arrangement, match the following List-I with List-II

List – I		List – II	
(P)	The number of ways such that letter numbered 1 goes in envelope number 10 is A, then $\frac{A}{D(10)}$ is	1.	$\frac{5}{9}$
(Q)	The probability that letter number 1 goes to envelope number 2 is P_2 and to envelope number 9 is P_9 , then $P_2 + P_9$ is	2.	$\frac{1}{9}$
(R)	The number of ways such that letter number 1 goes to even numbered envelope is E, then $\frac{E}{D(10)}$ is	3.	$\frac{2}{9}$
(S)	The probability that letter number 1 goes to envelope number 3 and number 2 goes to envelope number 1 is P_0 , then $24P_0$ is	4.	$\frac{1}{3}$

Codes:

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

19. Match the equation in List-I with the number of solutions in List-II

List – I		List – II	
(P)	$\cos ax + \cos bx = 2, (a \neq 0, b \neq 0)$	1.	Exactly one solution
(Q)	$\cos x + \cos(\sqrt{2})x = 2$	2.	At least one solution
(R)	$\cos ax + \cos bx = 1, (a \neq 0, b \neq 0)$	3.	No solution
(S)	$\cos x + \cos \pi x = -2$	4.	Infinite

Codes:

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

Space for rough work

20. Match the following List-I with List-II

List – I		List – II (Locus of complex no. z)	
(P)	$\operatorname{Re}\left(\frac{1}{z}\right) = c$ (a non zero constant)	1.	Ellipse
(Q)	$\log_{\frac{1}{2}} z-2 = \log_{\frac{1}{2}} z-i $	2.	Circle
(R)	$ z+1 + z-3i = 4$	3.	Straight line
(S)	$z^2 + \bar{z}^2 - 2z\bar{z} + 8(z + \bar{z}) = 0$	4.	Parabola

Codes:

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

Space for rough work

Physics**PART – III****SECTION – A**
(Only One Option Correct Type)

This section contains **10 multiple choice** questions. Each question has four choices **(A), (B), (C) and (D)** out of which **ONLY ONE** option is correct.

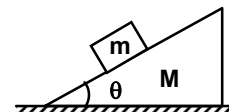
- A charge distribution that is spherically symmetric but not uniform radially produce an electric field of magnitude $E = kr^a$, directed radially outward from the centre of the sphere, here k is positive constant and r is the radial distance from the centre. If ρ be the volume density the charge distribution at a distance r from the centre, then
(A) $\rho \propto r^{a-1}$ (B) $\rho \propto r^{a+1}$
(C) $\rho \propto r^{2a}$ (D) $\rho \propto r^{a-2}$
- Sound waves of frequency f are sent at speed v from a stationary transmitter and are received back at the site of transmitter from a distant object moving towards the transmitter with speed u . The beat frequency due to superposition of transmitted and received wave by transmitter will be
(A) $\frac{u}{v}f$ (B) $\frac{2u}{v-u}f$
(C) $\frac{u}{v+u}f$ (D) $\frac{u+v}{v-u}f$
- An open organ pipe is vibrating in its fifth overtone. The distance between two consecutive points where pressure amplitude is $\frac{1}{\sqrt{2}}$ times pressure amplitude at pressure antinodes, is 40 cm. Then the length of open organ pipe is (Neglect end connection)
(A) 3 m (B) 3.6 m
(C) 4.2 m (D) 4.8 m

Space for Rough work

4. A charge q is placed at some distance along the axis of a uniformly charged disc of surface charge density σ . The flux due to the charge q through the disc is ϕ . The electric force on charge q exerted by the disc is

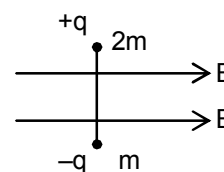
(A) $\sigma\phi$ (B) $\frac{\sigma\phi}{4\pi}$
 (C) $\frac{\sigma\phi}{2\pi}$ (D) $\frac{\sigma\phi}{3\pi}$

5. A block of mass m is placed on a wedge of mass M . There is no friction between the block and the wedge. The minimum coefficient of friction between the wedge and the ground so that wedge does not move, is



(A) $\frac{m\cos^2\theta}{M+m\cos^2\theta}$ (B) $\frac{m\sin^2\theta}{M+m\cos^2\theta}$
 (C) $\frac{m\cos\theta\sin\theta}{M+m\cos^2\theta}$ (D) $\frac{m\cos\theta\sin\theta}{M+m\sin^2\theta}$

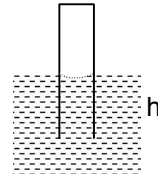
6. A charged particle of charge $-q$ and mass m is connected to another charged particle of charge $+q$ and mass $2m$ by a massless rod of length ℓ . The assembly of charges is placed in a uniform electric field of magnitude E such that the rod is perpendicular to the electric field. Now the rod is released. Find the speed of the negatively charged particle when the rod become parallel to the electric field



(A) $\sqrt{\frac{q\ell E}{3m}}$ (B) $\sqrt{\frac{2q\ell E}{3m}}$
 (C) $\sqrt{\frac{4q\ell E}{3m}}$ (D) $\sqrt{\frac{3q\ell E}{m}}$

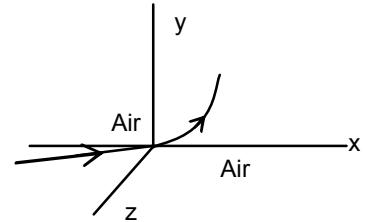
Space for Rough work

7. A glass capillary of length ℓ and inside radius r ($r \ll \ell$) is submerged vertically into water. The upper end of the capillary is sealed. The atmospheric pressure is p_0 . To what length h has the capillary to be submerged to make the water levels inside and outside the capillary coincide. Assume that temperature of air in the capillary remains constant. (given, surface tension of water = T , angle of contact between glass water interface = 0°)



- (A) $\frac{\ell}{1 + \frac{p_0 r}{T}}$ (B) $\frac{\ell}{1 + \frac{p_0 r}{2T}}$
 (C) $\frac{\ell}{1 + \frac{p_0 r}{4T}}$ (D) $\frac{\ell}{1 + \frac{2p_0 r}{T}}$

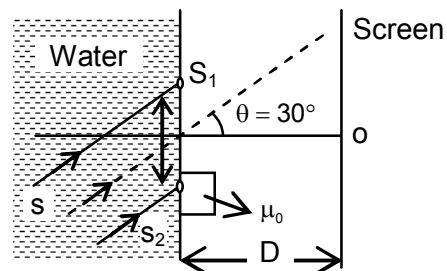
8. The refractive index n of a medium within a certain region $x > 0, y > 0$ changes with y till it acquires a value n_{\max} . After it acquires the value n_{\max} it remains constant. A light ray travelling in air, strikes the medium at a grazing angle and moves through the medium along a circular arc as shown in the figure. If angular deviation of the ray before it starts moving on a straight line is 60° , then n_{\max} is



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

Space for Rough work

9. In a YDSE experiment, the two slits are covered with a transparent membrane of negligible thickness which allows light to pass through it but does not allow water. A glass slab of thickness $t = 0.41$ mm and refractive index $\mu_0 = 1.5$ is placed in front of one of the slits as shown in the figure. The separation between the slits is $d = 0.30$ mm. The entire space to the left of the slits is filled with water of refractive index $\mu_w = 4/3$.



A coherent light of intensity I and absolute wavelength $\lambda = 5000 \text{ \AA}$ is being incident on the slits making an angle 30° with horizontal. If screen is placed at a distance $D = 1\text{m}$ from the slits, the position of central maxima will be (approximately)

- (A) 0.6 cm above the central line of slits
 (B) 0.6 cm below the central line of slits
 (C) 1.6 cm above the central line of slits
 (D) 1.6 cm below the central line of slits
10. An object is projected vertically upwards. It explodes at the topmost point of its trajectory into three identical fragments. One of the fragments comes straight down in time t_1 while the other two lands at a time t_2 after explosion. Height at which the explosion occurred is equal to
- (A) $\frac{gt_1 t_2 (t_2 + 3t_1)}{2(t_1 + t_2)}$ (B) $\frac{gt_1 t_2^2}{2t_3}$
 (C) $\frac{gt_1 t_2 (t_1 + 2t_2)}{2 (2t_1 + t_2)}$ (D) $\frac{gt_1 t_2 (2t_1 + t_2)}{4 (t_1 + 2t_2)}$

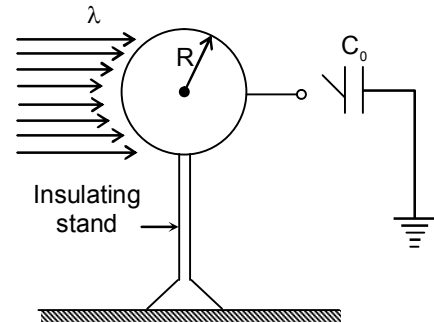
Space for Rough work

Comprehension type (Only One Option Correct)

This section contains **3 paragraphs**, each describing theory, experiments, data etc. Six questions relate to the three paragraphs with **two questions on each paragraph**. Each question has **only one** correct answer among the four given options (A), (B), (C) and (D).

Paragraph for Questions 11 & 12

An insulated conducting spherical shell is exposed to a radiation of wavelength λ . The threshold wavelength of the conducting shell is, $\lambda_0 (> \lambda)$. Since energy of incident photon is greater than threshold energy, the emission of photoelectrons will occur and due to it sphere gets charged and its potential becomes V_0 and at this moment emission of photoelectrons stops. A parallel plate capacitor of capacitance C_0 is connected to shell through a switch.



(Given: $\frac{hc}{e} = 12 \times 10^{-7} \text{ V-m}$, $\lambda = 4000\text{\AA}$, $\lambda_0 = 6000\text{\AA}$, $C_0 = 2\mu\text{F}$, $R = 18\text{cm}$)

11. By closing the switch a capacitor is connected to sphere as shown in figure. The charge on the capacitor after long time is (in μC)

(A) 2	(B) 0.5
(C) 1	(D) 10^{-5}

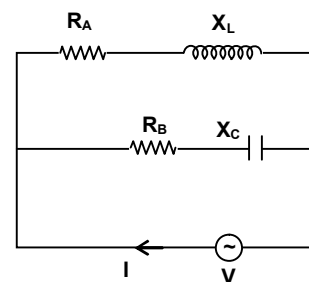
12. When potential of the conducting shell is $\frac{V_0}{2}$, the maximum kinetic energy of the emitted photoelectrons when they are far from the conducting shell, will be (in eV)

(A) 2	(B) 0.5
(C) 1	(D) 10^{-5}

Space for Rough work

Paragraph for Questions 13 & 14

Figure shows a two branched parallel circuit with $R_A = 8 \Omega$, $X_L = 6 \Omega$, $R_B = 6 \Omega$ and $X_C = 8 \Omega$. The current supplied by alternating source V is $I = 14 \text{ A}$. (take $\sin 37^\circ = 3/5$)



13. Current passing through the resistor R_A is
 (A) 5 A (B) 7 A
 (C) $7\sqrt{2}$ A (D) 10 A
14. Power dissipated in the circuit is
 (A) 686 W (B) 1372 W
 (C) 920 W (D) 1500 W

Paragraph for Questions 15 & 16

Two particle P and Q each of mass m are connected by a light inextensible string of length πa . The string lies over a smooth fixed cylinder of radius 'a' whose axis is horizontal so that the string is just taut and each particle is in level with the axis of the cylinder. The system is slightly displaced so that P begins to fall vertically when the radius vector joining to Q has turned through an angle θ from its initial position and Q is still in contact with cylinder the common speed of the particle P and Q is v . At this instant,

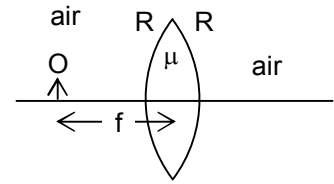
15. The normal force exerted by cylinder to the Q is
 (A) mg (B) $mg(2\sin \theta - \theta)$
 (C) $2mg \sin \theta$ (D) $mg \cos \theta$
16. The magnitude of acceleration of P is
 (A) $g(1 - \cos \theta)$ (B) $\frac{g}{3}(1 - \cos \theta)$
 (C) $\frac{g}{2}(1 - \cos \theta)$ (D) zero

Space for Rough work

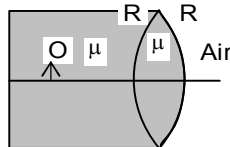
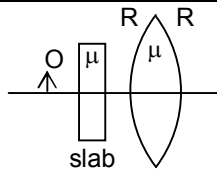
Match List Type (Only One Option Correct)

This section contains four questions, each having two matching lists. Choices for the correct combination of elements from **List-I** and **List-II** are given as option (A), (B), (C) and (D) out of which **one is correct**.

17. An object O (real) is placed at focus of an equi-biconvex lens as shown in figure. The refractive index of lens is $\mu = 1.5$ and the radius of curvature of either surface of lens is R. The lens is surrounded by air. In each statement of List-I some changes are made to situation given above and information regarding final image formed as a result is given in List-II. The distance between lens and object is unchanged in all statements of List-I. Match the statements in List-I with resulting image in List-II.



	List I		List II
P.	If the refractive index of the lens is doubled (that is, made 2μ) then	1.	Final image is real
Q.	If the radius of curvature is doubled (that is made $2R$) then	2.	Final image is virtual
R.	If a glass slab of refractive index $\mu = 1.5$ is introduced between the object and lens as shown, then	3.	Final image becomes bigger in size in comparison to size of image before the change was made
S.	If the left side of lens is filled with a medium of refractive index $\mu = 1.5$ as shown, then	4.	Final image is of same size of object.

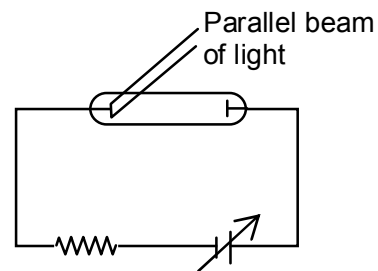


Code:

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

Space for Rough work

18. In the shown experimental setup to study photoelectric effect, two conducting electrodes are enclosed in an evacuated glass-tube as shown. A continuous parallel beam of monochromatic light, falls on photosensitive electrodes. The emf of battery shown is high enough such that all photoelectrons ejected from left electrode will reach the right electrode. Under initial conditions photoelectrons are emitted. As changes are made in each situation of List-I; Match the statements in List-I with results in List-II.



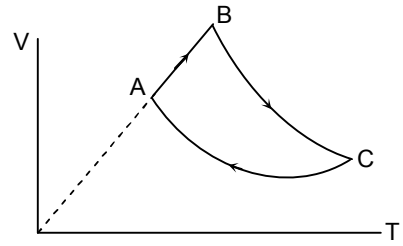
	List I		List II
P.	If frequency of incident light is increased keeping its intensity constant.	1.	magnitude of stopping potential will increase
Q.	If frequency of incident light is increased and its intensity is decreased (but not zero)	2.	Current through circuit may stop
R.	If work function of photo sensitive electrode is increased.	3.	Maximum kinetic energy of ejected photoelectrons will be constant
S.	If intensity of incident light is increased keeping its frequency constant	4.	Saturation current will increase

Code:

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

Space for Rough work

19. One mole of a monatomic ideal gas undergoes a thermodynamic cyclic process ABCA as shown in V-T diagram. During the process B → C $VT^2 = \text{constant}$ and during the process C → A, $VT^{3/2} = \text{constant}$. Match the process given in List-I with the statements given in List-II.



List - I		List - II	
(P)	During the process B → C	(1)	Work done by gas is zero
(Q)	During the process C → A	(2)	Heat is supplied to the gas
(R)	During the process A → B	(3)	Heat is rejected by the gas
(S)	During the entire cyclic process A → B → C → A	(4)	Heat change ΔQ is zero

Codes:

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

20. Match the physical quantities from List I with the dimensions in List II and select the correct answer using the code given below the Lists.

List - I		List - II	
(P)	Magnetic Flux	(1)	$[ML^2T^{-2}A^{-2}]$
(Q)	Inductance	(2)	$[MLT^{-2}A^{-2}]$
(R)	Electric Flux	(3)	$[ML^2T^{-2}A^{-1}]$
(S)	Permeability	(4)	$[ML^3T^{-3}A^{-1}]$

Codes:

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

Space for Rough work