

**CONCEPT RECAPITULATION TEST  
(Set – II)**

**Paper 2**

**Time Allotted: 3 Hours**

**Maximum Marks: 243**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

**INSTRUCTIONS**

**A. General Instructions**

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part is further divided into two sections: **Section-A & Section-B**
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

**B. Filling of OMR Sheet**

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with black pen for each character of your Enrolment No. and write your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

**C. Marking Scheme For All Three Parts.**

- (i) **Section-A (01 to 09)** contains 09 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **- 1 mark** for wrong answer.  
**Section-A (10 – 13)** contains 4 Assertion-Reasoning (multiple choice questions) which have only one correct answer. Each question carries **+3 marks** for correct answer and **- 1 mark** for wrong answer.  
**Section-A (14 – 19)** contains 2 paragraphs. Based upon paragraph, 3 multiple choice questions have to be answered. Each question has only one correct answer and carries **+4 marks** for correct answer and **- 1 mark** for wrong answer.
- (ii) **Section-B (1 – 03)** contains 3 Matrix Match Type (4 × 4 Matrix) questions containing statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. Each question carries **+6 marks** for all correct answer. There is no negative marking.

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**Useful Data**
**PHYSICS**

Acceleration due to gravity	$g = 10 \text{ m/s}^2$
Planck constant	$h = 6.6 \times 10^{-34} \text{ J-s}$
Charge of electron	$e = 1.6 \times 10^{-19} \text{ C}$
Mass of electron	$m_e = 9.1 \times 10^{-31} \text{ kg}$
Permittivity of free space	$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N-m}^2$
Density of water	$\rho_{\text{water}} = 10^3 \text{ kg/m}^3$
Atmospheric pressure	$P_a = 10^5 \text{ N/m}^2$
Gas constant	$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

**CHEMISTRY**

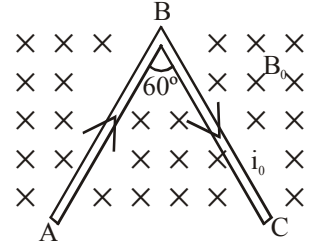
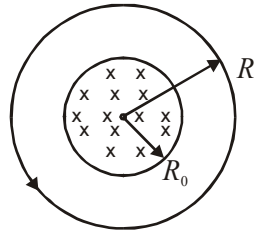
Gas Constant	R	=	$8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
		=	$0.0821 \text{ Lit atm K}^{-1} \text{ mol}^{-1}$
		=	$1.987 \approx 2 \text{ Cal K}^{-1} \text{ mol}^{-1}$
Avogadro's Number	$N_a$	=	$6.023 \times 10^{23}$
Planck's constant	h	=	$6.625 \times 10^{-34} \text{ J-s}$
		=	$6.625 \times 10^{-27} \text{ erg-s}$
1 Faraday		=	96500 coulomb
1 calorie		=	4.2 joule
1 amu		=	$1.66 \times 10^{-27} \text{ kg}$
1 eV		=	$1.6 \times 10^{-19} \text{ J}$

Atomic No: H=1, He = 2, Li=3, Be=4, B=5, C=6, N=7, O=8, N=9, Na=11, Mg=12, Si=14, Al=13, P=15, S=16, Cl=17, Ar=18, K =19, Ca=20, Cr=24, Mn=25, Fe=26, Co=27, Ni=28, Cu = 29, Zn=30, As=33, Br=35, Ag=47, Sn=50, I=53, Xe=54, Ba=56, Pb=82, U=92.

Atomic masses: H=1, He=4, Li=7, Be=9, B=11, C=12, N=14, O=16, F=19, Na=23, Mg=24, Al = 27, Si=28, P=31, S=32, Cl=35.5, K=39, Ca=40, Cr=52, Mn=55, Fe=56, Co=59, Ni=58.7, Cu=63.5, Zn=65.4, As=75, Br=80, Ag=108, Sn=118.7, I=127, Xe=131, Ba=137, Pb=207, U=238.

**Physics****PART – I****SECTION – A****Single Correct Choice Type**

This section contains **9 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

- A block of mass 1 kg is released from rest at  $t = 0$  to fall freely under gravity. Power of gravitational force acting on it at  $t = 2$  s is ( $g = 10 \text{ m/s}^2$ )  
 (A) 200 watts (B) 10 watts  
 (C) 100 watts (D) zero
  - When light enters from air to water, then its  
 (A) frequency increases and speed decreases  
 (B) frequency is same but the wavelength is smaller in water than in air  
 (C) frequency is same but the wavelength in water is greater than in air  
 (D) frequency decreases and wavelength is smaller in water than in air
  - The radius of the shortest orbit in a hydrogen like atom is 18 pm. It may be  
 (A) hydrogen (B) deuterium  
 (C)  $\text{He}^+$  (D)  $\text{Li}^{++}$
  - A V shaped rod kept inside a magnetic field of strength  $B_0$  is carrying a current  $i_0$ . If  $AB = BC = l$ , then the net magnetic force on the rod is  
 (A)  $B_0 i_0 2l$  (B)  $B_0 i_0 l$   
 (C) zero (D)  $B_0 i_0 l \sqrt{3}$
- 
- The magnetic field ( $B$ ) within a cylindrical region of radius  $R_0$  increases linearly with time. A concentric circle with radius  $R > R_0$  is drawn as shown in the figure. The induced electric field ( $E$ ) acting tangential to the circle satisfies  
 (A)  $E \propto R$ . (B)  $E \propto \frac{1}{R}$ .  
 (C)  $E \propto \frac{1}{R^2}$ . (D)  $E = \text{constant}$ .
- 

**Rough work**

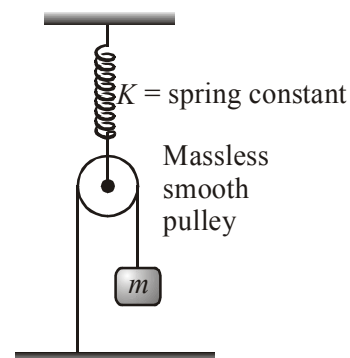
6. A railway track is banked for a speed  $v$ , by making the height of the outer rail 'h' higher than that of the inner rail. The horizontal separation between the rails is  $d$ . The radius of curvature of the track is 'r' : then which of the following relation is true?

(A)  $\frac{h}{d} = \frac{v^2}{rg}$  (B)  $\tan\left(\sin^{-1}\frac{h}{d}\right) = \frac{v^2}{rg}$   
 (C)  $\tan^{-1}\left(\frac{h}{d}\right) = \frac{v^2}{rg}$  (D)  $\frac{h}{r} = \frac{v^2}{dg}$

7. A charged particle enters into a uniform magnetic field with velocity  $v_0$  perpendicular to it, the length of magnetic field is  $x = \frac{\sqrt{3}}{2}R$ , where  $R$  is the radius of the circular path of the particle in the field. The magnitude of change in velocity of the particle when it comes out of the field is  
 (A)  $2v_0$  (B)  $v_0/2$   
 (C)  $\sqrt{3} v_0/2$  (D)  $v_0$

8. The angular frequency of small oscillations of the system shown in the figure is

(A)  $\sqrt{\frac{K}{2m}}$  (B)  $\sqrt{\frac{2K}{m}}$   
 (C)  $\sqrt{\frac{K}{4m}}$  (D)  $\sqrt{\frac{4K}{m}}$



9. Two resistances are measured in Ohm.  
 $R_1 = 3\Omega \pm 1\%$   
 $R_2 = 6\Omega \pm 2\%$   
 When they are connected in parallel, the percentage error in equivalent resistance is  
 (A) 3% (B) 4.5%  
 (C) 0.67% (D) 4.67%.

**Rough work**

**Assertion - Reasoning Type**

This section contains 4 questions numbered 10 to 13. Each question contains **STATEMENT-1 (Assertion)** and **STATEMENT-2 (Reason)**. Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

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10. STATEMENT-1:  
Newton's law of gravitation can be used to calculate the force of attractions between two planets in two different galaxies.

**and**

STATEMENT-2:

Newton's law of gravitation is universal.

- (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
(C) Statement-1 is True, Statement -2 is False.  
(D) Statement-1 is False, Statement-2 is True.
11. STATEMENT-1:  
In a simple battery circuit, the point at the lowest potential is positive terminal of the battery.

**and**

STATEMENT-2:

The current flows towards the point of the lowest potential, as it does in such a circuit from negative to the positive terminal inside the battery.

- (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
(C) Statement-1 is True, Statement -2 is False.  
(D) Statement-1 is False, Statement-2 is True.
- 

***Rough work***

12. STATEMENT-1:  
The presence of large magnetic flux through a coil maintains a current in the coil if the circuit is continuous.

**and**

STATEMENT-2:

Only a change in magnetic flux will maintain an induced current the coil.

- (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
 (C) Statement-1 is True, Statement -2 is False.  
 (D) Statement-1 is False, Statement-2 is True.

13. STATEMENT-1:  
If a convex lens is kept in water, its convergent power decreases.

**and**

STATEMENT-2:

Focal length of lens is independent of the refractive index used medium.

- (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
 (C) Statement-1 is True, Statement -2 is False.  
 (D) Statement-1 is False, Statement-2 is True.

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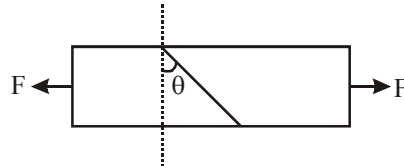
***Rough work***

### Comprehension Type

This section contains 2 groups of questions. Each group has 3 multiple choice question based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

#### Paragraph for Question Nos. 14 to 16

A bar of cross-section  $A$  is subjected to equal and opposite tensile forces  $F$  at its ends. Consider a plane through the bar making an angle  $\theta$  with a plane at right angles to the bar as shown in figure

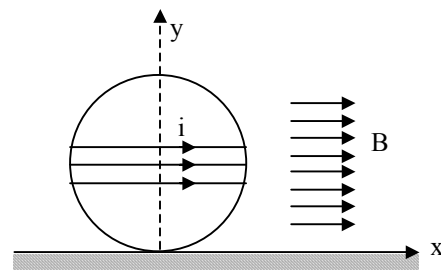


14. The tensile stress at this plane in terms of  $F$ ,  $A$  and  $\theta$  is
- (A)  $\frac{F \cos^2 \theta}{A}$  (B)  $\frac{F}{A \cos^2 \theta}$
- (C)  $\frac{F \sin^2 \theta}{A}$  (D)  $\frac{F}{A \sin^2 \theta}$
15. In the above problem, for what value of  $\theta$  is the tensile stress a maximum?
- (A) Zero (B)  $90^\circ$
- (C)  $45^\circ$  (D)  $30^\circ$
16. The shearing stress at the plane, in terms of  $F$ ,  $A$  and  $\theta$  is
- (A)  $\frac{F \cos 2\theta}{2A}$  (B)  $\frac{F \sin 2\theta}{2A}$
- (C)  $\frac{F \sin \theta}{A}$  (D)  $\frac{F \cos \theta}{A}$

**Rough work**

**Paragraph for Question Nos. 17 to 19**

A person wants to roll a solid non-conducting spherical ball of mass  $m$  and radius  $r$  on a surface whose coefficient of static friction is  $\mu$ . He placed the ball on the surface wrapped with  $n$  turns of closely packed conducting coils of negligible mass at the diameter. By some arrangement he is able to pass a current  $i$  through the coils either in the clockwise direction or in the anti-clockwise direction. A constant horizontal magnetic field  $\vec{B}$  is present throughout the space as shown in the fig. (Assume  $\mu$  is large enough to help rolling motion)



17. If current  $i$  is passed through the coils the maximum torque in the coil is  
 (A)  $-\pi n i r^2 B \hat{k}$  (B)  $\pi n i r^2 B \hat{j}$   
 (C)  $-\pi n i r^2 B \hat{j}$  (D)  $\pi n i r^2 B \hat{k}$
18. The angular velocity of the ball when it has rotated through an angle  $\theta$  is ( $\theta < 180^\circ$ ), is  
 (A)  $\sqrt{\frac{10}{7} \frac{\pi n i B}{m}} \sin \theta$  (B)  $\sqrt{\frac{5}{14} \frac{\pi n i B}{m}} \sin \theta$   
 (C)  $\sqrt{\frac{5}{14} \frac{\pi n i B}{m}} \cos \theta$  (D)  $\sqrt{\frac{5}{7} \frac{\pi n i B}{m}} \sin \theta$
19. If the surface is frictionless, then the sphere will  
 (A) only slide (B) only rotate  
 (C) undergo pure rolling (D) undergo rolling with sliding

**Rough work**



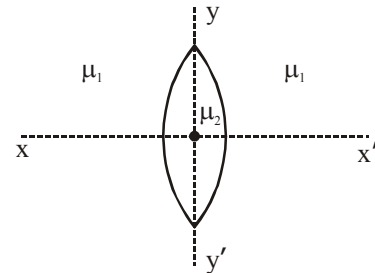
**SECTION - B****Matrix – Match Type**

This section contains 3 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **ONE OR MORE** statement(s) in **Column II**. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example:

If the correct matches are A – p, s and t; B – q and r; C – p and q; and D – s and t; then the correct darkening of bubbles will look like the following:

	p	q	r	s	t
A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

1. A equi convex lens of refractive index  $\mu_2$  and focal length  $f$  (in air) is kept in medium of refractive index  $\mu_1$ .

**Column A**

- (A) If lens is cut in two equal parts by a plane  $yy'$ . ( $\mu_1 = 1$ )  
 (B) If lens is cut in two equal parts by a plane  $xx'$ . ( $\mu_1 = 1$ )  
 (C) If  $\mu_1 = \mu_2$ .  
 (D) If  $\mu_1 > \mu_2$ .

**Column B**

- (p) Lens will act as a glass slab.  
 (q) Lens will be converging and focal length will change.  
 (r) Lens will be converging and focal length will remain same.  
 (s) Lens will be diverging and focal length will not change.  
 (t) Lens will be diverging and focal length will change.

**Rough work**

2. Column A lists different processes or physical quantities while column B lists energy associated with these processes or physical quantities.

<b>Column A</b>		<b>Column B</b>	
(A)	Binding energy of heavy nuclei per nucleon.	(p)	28 MeV.
(B)	X-ray photon energy may be	(q)	200 MeV.
(C)	The energy releases by fission of a high mass nuclide to two middle mass nuclides.	(r)	7 MeV.
(D)	Binding energy of $\alpha$ -particle.	(s)	10 keV.
		(t)	20 keV.

3. Match the following:

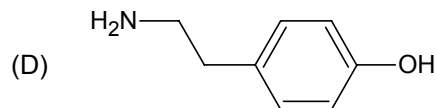
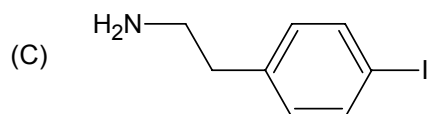
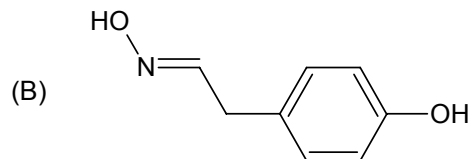
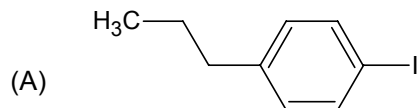
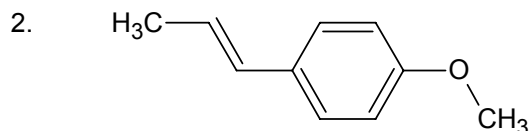
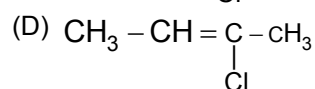
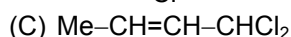
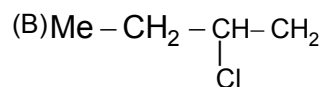
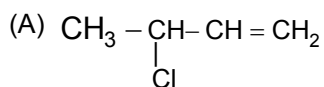
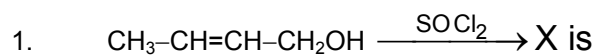
<b>Column A</b>		<b>Column B</b>	
(A)	Phase difference between any two particles can have any value between 0 to $2\pi$ .	(p)	Stationary waves.
(B)	Energy is transferred from one place to an other place.	(q)	Plane simple harmonic transverse waves.
(C)	Phase difference between any two particles is either zero or $\pi$ .	(r)	Sound waves.
(D)	Amplitude of vibration of all particles are equal.	(s)	Standing waves in an open organ pipe.
		(t)	Plane simple harmonic longitudinal waves.

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**Rough work**

**Chemistry****PART – II****SECTION – A****Straight Objective Type**

This section contains 9 multiple choice questions numbered 1 to 9. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.



3. How many are the ores of iron- siderite, Fool's gold, Limonite, Malachite, Calamine, Magnetite, Argentite, Pyrolusite, Haematite

(A) 7

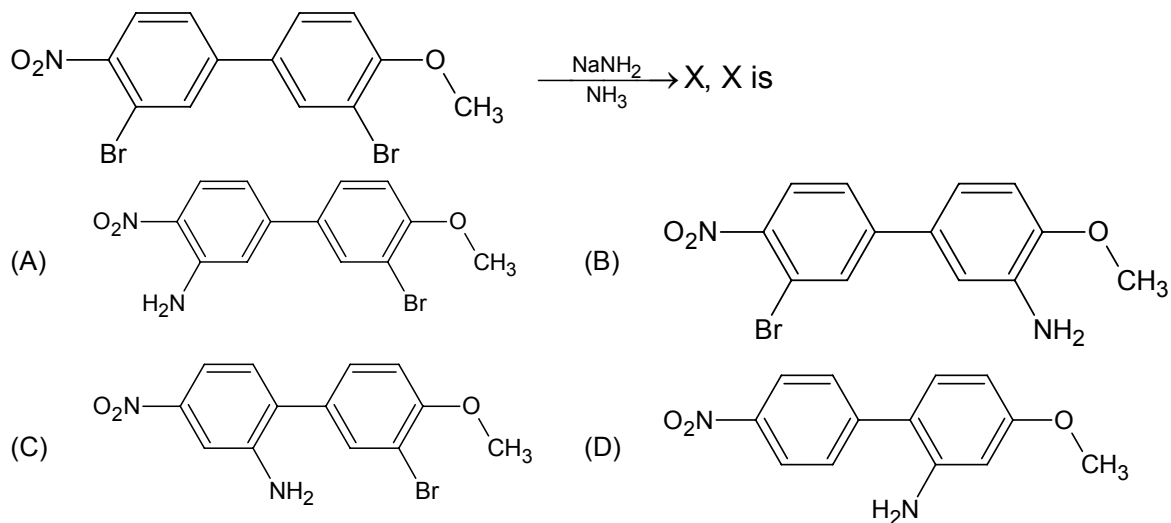
(B) 3

(C) 4

(D) 5

*Rough Work*

4.



5. For the reaction  $A + B \rightleftharpoons C + D$ ,  $\Delta G^\circ = 690.9$  cal. If 4 moles each of A & B is allowed to come to equilibrium at 300 K then the ratio of concentration of D to B at equilibrium will be  
 (A) 1.85 (B) 1.77  
 (C) 8.74 (D) 4.82

6. A cell  $\text{Zn/Zn}^{+2} \parallel \text{Cu}^{+2} \mid \text{Cu}$  Initially contains 1 M each of  $\text{Zn}^{+2}$  &  $\text{Cu}^{+2}$ . Now  $\text{NH}_3$  is passed in cathode compartment to make its concentration 0.2 M in the compartment then the emf of the cell will be [ $\log 62.5 = 1.795$ ]

$$K_f[\text{Cu}(\text{NH}_3)_4]^{+2} = 10^{12}$$

$$E^\circ_{\text{Cell}} = 1.1 \text{ V}$$

- (A) 0.828 (B) 2.41  
 (C) 0.125 (D) 11.45

**Rough Work**

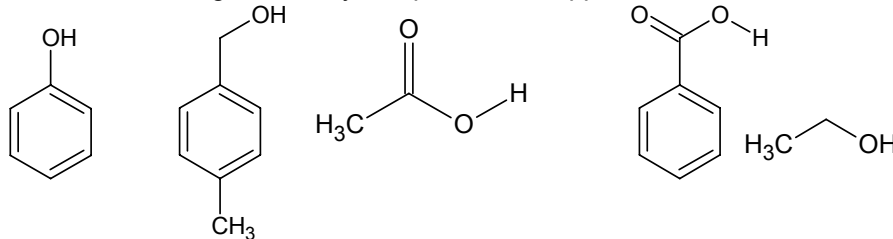
7. How many moles of water vapour will be contained in a cylindrical vessel having diameter 2 m and height 10 m, if the relative humidity is 80% and the temperature is 300 K. If we assume the V.P of water at 300 K is 26 mm Hg.

(A) 40.56 (B) 38.32  
(C) 57.82 (D) 34.89

8. Which of the following is colored?

(A)  $\text{ICl}_3$  (B)  $\text{IF}_5$   
(C)  $\text{ClF}_3$  (D)  $\text{IF}_7$

9. Out of the following how many compounds are appreciable soluble in water



(A) 2 (B) 3  
(C) 4 (D) 5

*Rough Work*

**Reasoning Type**

This section contains 4 questions numbered 10 to 13. Each question contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

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10. STATEMENT-1: Acetaldehyde reacts with HCN to give a pair of enantiomers.  
**and**  
 STATEMENT-2: The cyanohydrin of acetaldehyde has chiral carbon.  
 (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
 (C) Statement-1 is True, Statement -2 is False.  
 (D) Statement-1 is False, Statement-2 is True.
11. STATEMENT-1: Greater the value of van der Waal's constant 'a' easier is the liquefaction of gas.  
**and**  
 STATEMENT-2: 'a' indirectly measures the magnitude of attractive forces between the molecules.  
 (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
 (C) Statement-1 is True, Statement -2 is False.  
 (D) Statement-1 is False, Statement-2 is True.
- 

**Rough Work**

12. STATEMENT-1: To a solution of potassium chromate if a strong acid is added it changes its colour from yellow to orange.  
**and**  
STATEMENT-2: The colour change is due to the oxidation of potassium chromate.  
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
(C) Statement-1 is True, Statement -2 is False.  
(D) Statement-1 is False, Statement-2 is True.
13. STATEMENT-1: Rate of electrophilic aromatic nitration of  $C_6H_6$ ,  $C_6D_6$  and  $C_6T_6$  follows the order  $C_6H_6 > C_6D_6 > C_6T_6$ .  
**and**  
STATEMENT-2: The cleavage of C – H, C – D and C – T is not involved in the rate limiting step.  
(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.  
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.  
(C) Statement-1 is True, Statement -2 is False.  
(D) Statement-1 is False, Statement-2 is True.
- 

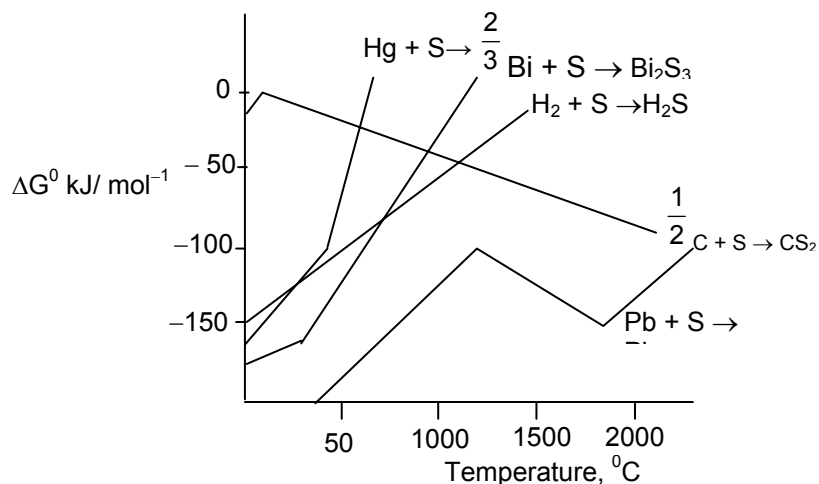
**Rough Work**

## Comprehension Type

This section contains 2 groups of questions. Each group has 3 multiple choice question based on a paragraph. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct.

## Paragraph for Question Nos. 14 to 16

The Ellingham diagram for a number of metallic sulphides is shown below.



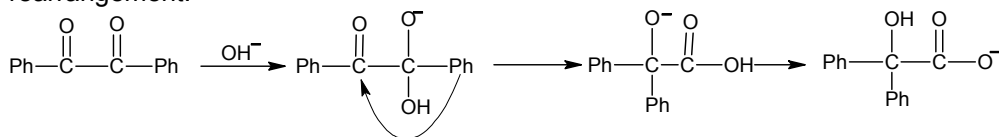
14. Formation of which of the sulphides is most spontaneous?  
 (A) HgS (B) Bi<sub>2</sub>S<sub>3</sub>  
 (C) PbS (D) CS<sub>2</sub>
15. Which sulphide occurs to minimum extent in nature at room temperature?  
 (A) HgS (B) H<sub>2</sub>S  
 (C) Bi<sub>2</sub>S<sub>3</sub> (D) CS<sub>2</sub>
16. Which of the sulphide is most stable?  
 (A) HgS (B) H<sub>2</sub>S  
 (C) Bi<sub>2</sub>S<sub>3</sub> (D) PbS

*Rough Work*

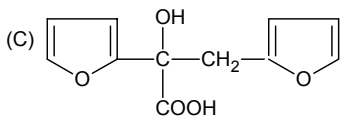
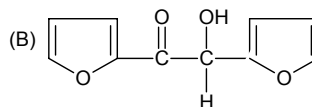
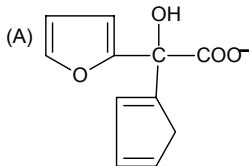
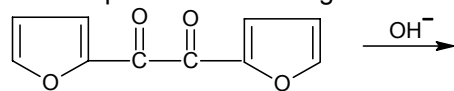


## Paragraph for Question Nos. 17 to 19

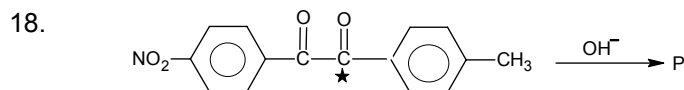
The base catalysed reaction of 1, 2 diketone to a salt of 2-hydroxy carboxylic acid is known as benzilic acid rearrangement.



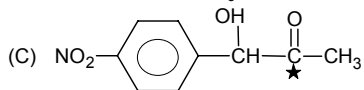
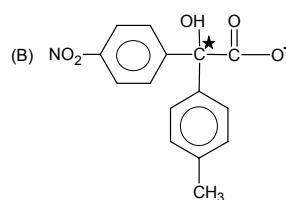
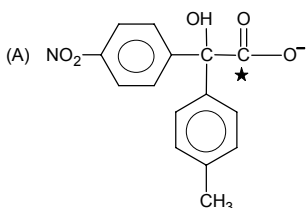
17. Find out product of following reaction



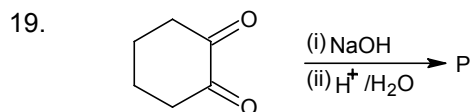
(B) All of the above



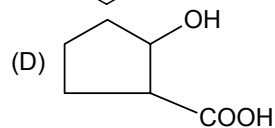
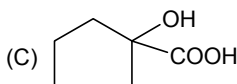
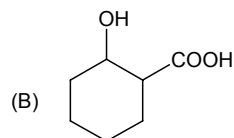
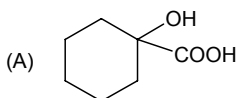
Find P



(D) All of the above



Find P



Rough Work

**SECTION-B**  
**(Matrix Type)**

This section contains 3 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **ONE OR MORE** statement(s) in **Column II**. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example:

If the correct matches are A – p, s and t; B – q and r; C – p and q; and D – s and t; then the correct darkening of bubbles will look like the following:

	p	q	r	s	t
A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

1. Match the following:

**Column – I (No. of H<sub>2</sub>O molecules required)**

- (A) 6  
 (B) 5  
 (C) 4  
 (D) 3

**Column – II (Hydrolysis of following mixture)**

- (p) Lactose + hexapeptide  
 (q) Trisaccharide + dipeptide  
 (r) Maltose + pentapeptide  
 (s) Trisaccharide + tripeptide  
 (t) Sucrose + pentapeptide

2. Match the following:

**Column – I (highest stoichiometric coefficient for any reactant or product in balanced chemical reaction)**

- (A) 2  
 (B) 4  
 (C) 6  
 (D) 16

**Column – II (Reactants of chemical reaction)**

- (p) NaOH (hot) + Cl<sub>2</sub>  
 (q) NaOH (cold) + Cl<sub>2</sub>  
 (r) H<sub>2</sub>SO<sub>4</sub> + HI  
 (s) MnO<sub>4</sub><sup>-</sup> + H<sup>+</sup> + Cl<sup>-</sup>  
 (t) CuSO<sub>4</sub> + KI

3. Match the following:

**Column – I**

- (A) H<sub>2</sub>O (l) → H<sub>2</sub>O (g)  
 (B) 2KClO<sub>3</sub> (s) → 2KCl (s) + 3O<sub>2</sub> (g)  
 (C) 2H(g) → H<sub>2</sub> (g)  
 (D) P<sub>(white, solid)</sub> → P<sub>(red, solid)</sub>

**Column – II**

- (p) ΔH is positive  
 (q) ΔS is positive  
 (r) ΔS is negative  
 (s) Phase transition  
 (t) Allotropic change

*Rough Work*

**Mathematics****PART – III****SECTION – A****Single Correct Choice Type**

This section contains **9 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

- Which of the following is incorrect?
  - if A and B are two square matrices of order 3 and A is a non-singular matrix such that  $AB = O$  then B must be a null matrix
  - if A, B, C are three square matrices of order 2 and  $\det. (A) = 2$ ,  $\det. (B) = 3$ ,  $\det. (C) = 4$ , then the value of  $\det. (3ABC)$  is 216
  - if A is a square matrix of order 3 and  $\det. (A) = \frac{1}{2}$ , then  $\det. (\text{adj. } A^{-1})$  is 4
  - every skew symmetric matrix is singular
- Let  $f(x)$  be a periodic function with fundamental period 12. If  $\int_{-6}^{12} f(x)dx = 9$  and  $\int_0^{12} f(x)dx = 12$  then  $\left| \int_0^6 f(x)dx \right|$  is equal to
 

(A) 3	(B) 9
(C) 12	(D) 15
- $\vec{a}_i, i \in \{1, 2, 3\}$  are three vectors such that  $|\vec{a}_i| = \sqrt{15}$  and  $|\vec{a}_i - \vec{a}_j| = 6 \quad \forall i, j$ . Then value of  $[\vec{a}_1 \vec{a}_2 \vec{a}_3]$  is
 

(A) 24	(B) 36
(C) 54	(D) none of these

---

**Rough work**

4.  $\lim_{x \rightarrow 0^+} \{\ln(x^7 + 2x^6e + x^5e^2) - \ln(x^2 \sin^3 x)\}$  is equal to  
 (A) 0 (B) 1  
 (C) 2 (D) none of these
5. A variable point P(-x, -y, -z) defined such that  $2x = -a - b - 1$ ,  $y = -a - 4b - 2$  and  $4z = 3a - 6b$  where a and b are fixed. If the minimum distance of P from Q(1, 1, 1) is s the |s| is  
 (A) 1 (B) 2  
 (C) 3 (D) 4
6.  $\sum_{r=0}^{10} (-1)^r \binom{110}{r} C_r$  is equal to  
 (A)  $^{109}C_{10}$  (B)  $^{-109}C_{10}$   
 (C)  $^{110}C_{11}$  (D) none of these
7. If  $\alpha$  and  $\beta$  ( $\alpha > \beta$ ) are roots of the equation  $x^2 - \sqrt{2}x + \sqrt{3 - 2\sqrt{2}} = 0$  then  $(\cos^{-1} \alpha + \tan^{-1} \alpha + \tan^{-1} \beta)$  is equals to  
 (A)  $\frac{5\pi}{8}$  (B)  $\frac{7\pi}{8}$   
 (C)  $\frac{\pi}{8}$  (D)  $\frac{3\pi}{8}$
8. Let  $g(x) = e^{f(x)}$ ;  $g(x+1) = xg(x)$ , then  $\frac{g'(\frac{2n+1}{2})g(\frac{1}{2}) - g'(\frac{1}{2})g(\frac{2n+1}{2})}{g(\frac{2n+1}{2})g(\frac{1}{2})}$ , where  $n \in \mathbb{N}$ , is  
 (A)  $2\left(1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n}\right)$  (B)  $2\left(1 + \frac{1}{3} + \frac{1}{5} + \dots + \frac{1}{2n-1}\right)$   
 (C) 0 (D) none of these
9. The smallest possible value of  $\left[\frac{a+b}{c}\right] + \left[\frac{b+c}{a}\right] + \left[\frac{c+a}{b}\right]$ , (where  $a, b, c \in \mathbb{R}^+$  and  $[\cdot]$  denotes the greatest integer function)  
 (A) 6 (B) 4  
 (C) 8 (D) 3

**Rough work**

### Reasoning Type

This section contains 4 questions numbered 10 to 13. Each question contains STATEMENT-1 (Assertion) and STATEMENT-2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

10. STATEMENT 1: If  $a, b, c$  are non zero real numbers such that  $3(a^2 + b^2 + c^2 + 1) = 2(a + b + c + ab + bc + ca)$ , then  $a, b, c$  are in A.P. and G.P. both.  
STATEMENT 2: A series is in A.P. and G.P. both if all the terms in the series are equal and non-zero.  
(A) Both the statements are true and Statement 2 is correct explanation of Statement 1  
(B) Both the Statements are true and Statement 2 is not the correct explanation of Statement 1  
(C) Statement 1 is true and Statement 2 is false  
(D) Statement 1 is false and Statement 2 is true
11. STATEMENT 1:  $2222^{5555} + 5555^{2222}$  is divisible by 7.  
STATEMENT 2:  $x^n - a^n$  is divisible by  $x - a$ , if  $n$  is even or odd,  $n \in \mathbb{N}$  and  $x^n + a^n$  is divisible by  $x + a$ , if  $n$  is odd,  $n \in \mathbb{N}$ . If two positive integers  $b$  and  $c$  leave the same remainder on division by a positive integer  $d$ , then  $b - c$  is divisible by  $d$ .  
(A) Both the statements are true and Statement 2 is correct explanation of Statement 1  
(B) Both the Statements are true and Statement 2 is not the correct explanation of Statement 1  
(C) Statement 1 is true and Statement 2 is false  
(D) Statement 1 is false and Statement 2 is true
12. STATEMENT 1: If  $x \in \mathbb{R} - \{(2n + 1)\pi : n \in \mathbb{I}\}$ , then  $\sqrt{\frac{1 - \cos x}{1 + \cos x}} = \frac{1 - \cos x}{|\sin x|}$  is an identity.  
STATEMENT 2: If  $x \in \mathbb{R} - \{(2n + 1)\pi : n \in \mathbb{I}\}$  then  $\sqrt{\frac{1 - \cos x}{1 + \cos x}} = \frac{|\sin x|}{1 - \cos x}$  is an identity.  
(A) Both the statements are true and Statement 2 is correct explanation of Statement 1  
(B) Both the Statements are true and Statement 2 is not the correct explanation of Statement 1  
(C) Statement 1 is true and Statement 2 is false  
(D) Statement 1 is false and Statement 2 is true

### Rough work

13. STATEMENT 1: The equation  $4x^2 - 24y^2 + 20z^2 - 28yz + 18zx + 10xy = 0$  represents a pair of perpendicular planes.  
 STATEMENT 2: Let  $ax^2 + by^2 + cz^2 + 2fyz + 2gzx + 2hxy = 0$  represents a pair of planes. The planes are perpendicular if  $a + b + c = 0$ .  
 (A) Both the statements are true and Statement 2 is correct explanation of Statement 1  
 (B) Both the Statements are true and Statement 2 is not the correct explanation of Statement 1  
 (C) Statement 1 is true and Statement 2 is false  
 (D) Statement 1 is false and Statement 2 is true

**Comprehension Type**

This section contains **2 paragraphs**. Based upon paragraphs **3 multiple choice questions** have to be answered. Each of these questions has four choices (A), (B), (C) and (D) out of **which ONLY ONE** is correct.

**Paragraph for Question Nos. 14 to 16**

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

If  $\vec{x} \cdot \vec{y} = xy \cos \theta$  and  $\vec{x} \times \vec{y} = xy \sin \theta \hat{n}$ . Now define a new operation between two non anti-parallel vectors

$\vec{x}$  and  $\vec{y}$  as  $\vec{x} \otimes \vec{y} = xy \tan \frac{\theta}{2}$ , where  $\theta$  is angle between  $\vec{x}$  and  $\vec{y}$ .

14. Projection of  $\vec{x}$  and  $\vec{y}$  will be

(A)  $\frac{\vec{x} \otimes \vec{y}}{|\vec{y}|}$

(B)  $\frac{\vec{x} \otimes \vec{y}}{|\vec{x}|}$

(C)  $|\vec{x}| \left( \frac{|\vec{x}|^2 |\vec{y}|^2 - (\vec{x} \otimes \vec{y})^2}{|\vec{x}|^2 |\vec{y}|^2 + (\vec{x} \otimes \vec{y})^2} \right)$

(D)  $\frac{|\vec{x}|^2 |\vec{y}|^2 - (\vec{x} \otimes \vec{y})^2}{|\vec{x}|^2 |\vec{y}|^2 + (\vec{x} \otimes \vec{y})^2}$

15. If  $\vec{x}$  and  $\vec{y}$  represent the adjacent sides of a parallelogram, then its area is given by

(A)  $|\vec{x} \otimes \vec{y}|$

(B)  $\frac{2(\vec{x} \otimes \vec{y})|\vec{x}|^2 |\vec{y}|^2}{|\vec{x} \otimes \vec{y}|^2 + |\vec{x}|^2 |\vec{y}|^2}$

(C)  $\frac{\vec{x} \otimes \vec{y}}{1 + (\vec{x} \otimes \vec{y})^2}$

(D) none of these

**Rough work**

16. If  $\vec{x}$  and  $\vec{y}$  two non zero linearly independent vectors such that  $|\vec{x} \times \vec{y}| = |\vec{x} \otimes \vec{y}|$  then  
 (A)  $\vec{x}$  and  $\vec{y}$  are parallel (B)  $\vec{x}$  and  $\vec{y}$  are perpendicular  
 (C) angle between  $\vec{x}$  and  $\vec{y}$  is  $\frac{\pi}{4}$  (D) none of these

**Paragraph for Question Nos. 17 to 19**

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

Let ABC be a triangle and  $\Delta I_1 I_2 I_3$  be the excentral triangle of  $\Delta ABC$ . Then answer the following questions.

17.  $\angle I_2 I_1 I_3$  is equal to  
 (A)  $\frac{\pi - A}{2}$  (B)  $\pi - 2A$   
 (C)  $\pi - \frac{A}{2}$  (D)  $\frac{\pi}{2} - A$
18.  $I_1 I_2$  is equal to  
 (A)  $4R \cos \frac{C}{2}$  (B)  $2R \sin C$   
 (C)  $4R \sin \frac{C}{2}$  (D) none of these
19. Circum radius of  $\Delta I_1 I_2$  is equal to  
 (A) R (B)  $\frac{R}{2}$   
 (C) 2R (D)  $\frac{R}{4}$

**Rough work**

**SECTION – B**  
**Matrix – Match Type**

This section contains 3 questions. Each question contains statements given in two columns, which have to be matched. The statements in **Column I** are labelled A, B, C and D, while the statements in **Column II** are labelled p, q, r, s and t. Any given statement in **Column I** can have correct matching with **ONE OR MORE** statement(s) in **Column II**. The appropriate bubbles corresponding to the answers to these questions have to be darkened as illustrated in the following example:

If the correct matches are A – p, s and t; B – q and r; C – p and q; and D – s and t; then the correct darkening of bubbles will look like the following:

	p	q	r	s	t
A	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
B	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
C	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

1. Let  $f(x) = \frac{x^3 - 10x^2 + 29x - 20}{x^3 - 9x^2 + 26x - 24}$ . Match the following column-I with column-II.

Column – I	Column – II
(A) $-1 < x < 1$	(p) $0 < f(x) < 1$
(B) $1 < x < 2$	(q) $f(x) < 0$
(C) $4 < x < 5$	(r) $f(x) > 0$
(D) $x > 5$	(s) $f(x) < 1$

2. If an equilateral  $\Delta ABC$  with vertices  $z_1, z_2$  and  $z_3$  respectively be inscribed in the circle  $|z| = 2$  and again a circle is inscribed in the  $\Delta ABC$  touching sides AB, BC and CA at D( $z_4$ ), E( $z_5$ ) and F( $z_6$ ) respectively. Match the following column-I with column-II.

Column – I	Column – II
(A) $\text{Re}(z_1\bar{z}_2 + z_2\bar{z}_3 + z_3\bar{z}_1)$ is equal to	(p) 2
(B) If $\frac{4z_1}{z_3} = k(-1 + i\sqrt{3})$ , k is equal to	(q) -6
(C) $ z_1 + z_2 ^2 +  z_2 + z_3 ^2 +  z_3 + z_1 ^2$ is equal to	(r) 12
(D) If R is any point on incircle then $DR^2 + ER^2 + FR^2$ is equal to	(s) 6

3. Match the following column-I with column-II.

Column – I	Column – II
(A) Foot of the perpendicular drawn from the point (2, 3) to the line joining the points (8, 10) and (6, 2) is the point	(p) (14, 16)
(B) Image of the point (2, 4) in the line $x + y = 12$ is the point	(q) (-2, 0)
(C) Harmonic conjugate of the point (6, 8) with respect to the points (2, 4) and (8, 10) is the point	(r) (6, 2)
(D) The points A and B are (2, 4) and (6, 0) respectively. If AB is rotated through an angle of $90^\circ$ in the clockwise direction about the point A, then the new position of B becomes the point	(s) (8, 10)

*Rough work*