

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

**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		=	$1.6 \times 10^{-19} \text{ J}$

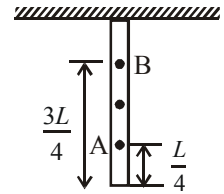
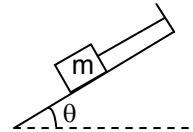
Atomic No: H=1, He = 2, Li=3, Be=4, B=5, C=6, N=7, O=8, N=9, Na=11, Mg=12, Si=14, Al=13, P=15, S=16, Cl=17, Ar=18, K =19, Ca=20, Cr=24, Mn=25, Fe=26, Co=27, Ni=28, Cu = 29, Zn=30, As=33, Br=35, Ag=47, Sn=50, I=53, Xe=54, Ba=56, Pb=82, U=92.

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**.

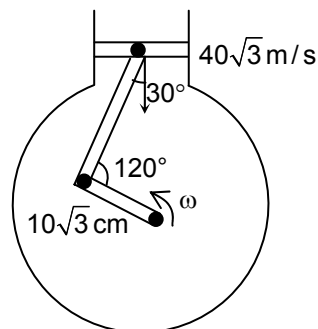
- An electron is released from rest at one point in a uniform electric field and travels a distance of 10 cm in  $10^{-7}$  seconds. Potential difference across the points is  
 (A) 11.375 volts (B) 10 volts  
 (C) 5 volts (D) 5.7 volts
- A metal block of mass  $m$  is placed on a smooth metallic plane in support with string as shown in diagram. If, after long time due to corrosion, the contact surface becomes rough with coefficient of friction  $\mu$ , then friction force acting on the block will be  
 (A)  $\mu mg \cos \theta$  (B)  $mg \sin \theta$   
 (C)  $mg$  (D) None
- A string of mass  $m$  and length  $l$  is hanging from ceiling as shown in the figure. Wave in string move upward.  $v_A$  and  $v_B$  are the speed of wave at A and B respectively. Then  $v_B$  is  
 (A)  $\sqrt{3}v_A$  (B)  $v_A$   
 (C)  $< v_A$  (D)  $\sqrt{2}v_A$

**Rough work**

4. Which of the following is correct about principle of conservation of momentum?  
 (A) Conservation of momentum can be applied only in absence of external forces  
 (B) Conservation of momentum can be applied only during collisions of bodies  
 (C) Conservation of momentum can be applied in a process even in the presence of external forces  
 (D) Conservation of momentum is not applicable in rocket propulsion

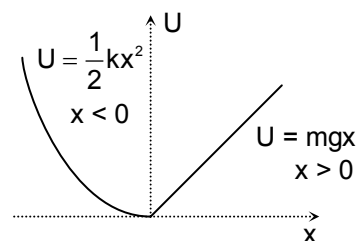
5. A snapshot of a petrol engine is given in which piston is moving downwards with velocity  $40\sqrt{3}$  m/s. Find the angular velocity of the shaft.

- (A) 400 rad/s  
 (B) 300 rad/s  
 (C) 200 rad/s  
 (D) 500 rad/s



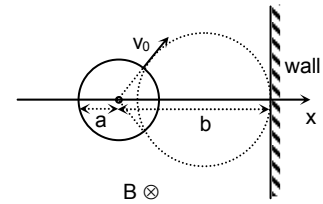
6. A particle of mass  $m$  moves in the potential shown in the figure. The particle has energy  $E$ . The period of the motion the particle is

- (A)  $2\pi\sqrt{\frac{m}{k}} + 2\sqrt{\frac{2E}{mg^2}}$   
 (B)  $2\pi\sqrt{\frac{m}{k}} + \sqrt{\frac{2E}{mg^2}}$   
 (C)  $\pi\sqrt{\frac{m}{k}} + 2\sqrt{\frac{2E}{mg^2}}$   
 (D)  $\pi\sqrt{\frac{m}{k}} + \sqrt{\frac{2E}{mg^2}}$



**Rough work**

7. A electron is projected normally from the surface of a sphere with speed  $v_0$  in a uniform magnetic field perpendicular to the plane of the paper such that it strikes symmetrically opposite on the sphere with respect to the x-axis. Radius of the sphere is 'a' and the distance of its centre from the wall is 'b'. What should be magnetic field such that the charge particle just escapes the wall

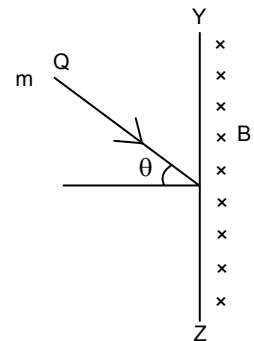


- (A)  $B = \frac{2bmv_0}{(b^2 - a^2)e}$  (B)  $B = \frac{2bmv_0}{(a^2 - b^2)e}$   
 (C)  $B = \frac{(a^2 - b^2)}{2bmv_0}$  (D)  $B = \frac{me(b^2 - a^2)}{2bmv_0}$

8. A particle with positive charge Q and mass m enters a magnetic field of magnitude B, existing only to the right of boundary YZ. The direction of the motion of the particle is perpendicular to the direction of B. Let

$T = 2\pi\left(\frac{m}{QB}\right)$ . The time spent by the particle in the field will be

- (A)  $T\theta$  (B)  $2T\theta$   
 (C)  $T\left(\frac{\pi + 2\theta}{2\pi}\right)$  (D)  $T\left(\frac{\pi - 2\theta}{2\pi}\right)$



9. If net external torque, about a point, acting on the system is zero, then we can surely say  
 (A) Kinetic energy of the system remains constant  
 (B) Mechanical energy of the system remains constant  
 (C) Torque of Internal forces is zero  
 (D) Momentum of system will remain constant.

**Rough work**

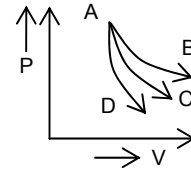
**Assertion - Reasoning Type**

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**.

10. STATEMENT-1:  
Statement -1: Bulk modulus in an adiabatic process is greater than bulk modulus in an isothermal process.  
**and**
- STATEMENT-2:  
Heat is exchanged freely in an isothermal change, but not in an adiabatic change.
- (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:  
On going away from a point charge or a small electric dipole, electric field decreases at the same rate in both cases.  
**and**
- STATEMENT-2:  
Electric field due to charge is inversely proportional to square of distance from the charge
- (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: In given PV diagram, the process AC is isothermal, then process AD is adiabatic.



**and**

STATEMENT -2: The slope of adiabatic process is more than that of isothermal process.

- (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:  
 A beam of white light passing through a hollow prism gives no spectrum.

**and**

The refracting faces of hollow prism then act as plates so rays of all colours of white light deflect by the same amount.

- (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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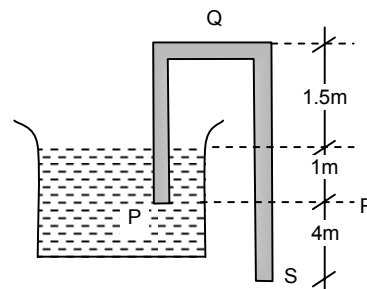
**Rough work**

**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**

Consider the siphon tube discharging a liquid of specific gravity 1 from a reservoir as shown in diagram.



14. Velocity of liquid through the siphon equals  
 (A) 10 m/s (B) 15 m/s  
 (C) 5 m/s (D) zero
15. Pressure at Q equals  
 (A) 28 k Pa (B) 35 k Pa  
 (C) 42 k Pa (D) None
16. Pressure at R equals  
 (A) 30 k Pa (B) 50 k Pa  
 (C) 40 k Pa (D) None

**Rough work**



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

A long thin vertical wire has positive charge  $\lambda$  per unit length and a current  $I$  in the wire. A charged particle moves with speed  $u$  in a straight-line trajectory, parallel to the wire and at a distance  $r$  from the wire. Assume that the only forces on the particle are those resulting from the charge on the wire and the current in the wire.

17. Suppose that the current in the wire is reduced to  $I/2$ . Which of the following changes are necessary if the particle is to remain in the same trajectory
- (A) doubling the charge per unit length in the wire  
(B) doubling the charge on the particle  
(C) doubling the speed of the particle  
(D) introducing an additional magnetic field parallel to the wire.
18. The particle is later observed to move in a straight-line trajectory parallel to the wire but a distance  $2r$  from the wire. If the wire carries a current  $I$  and charge per unit length is still  $\lambda$ , the speed of the particle is
- (A)  $4u$  (B)  $2u$   
(C)  $u$  (D)  $u/2$
19. If the charge particle has mass  $m$ , and suddenly charge on the wire is disappeared. The initial radius of curvature of the path followed by particle is
- (A)  $R = \frac{2\pi r u m}{\mu_0 q I}$  (B)  $R = \frac{\mu_0 q I}{2\pi r u m}$   
(C)  $R = \frac{q m I}{2\pi \mu_0}$  (D) None

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**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
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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. In Column I, some statements or expressions related to first law of thermodynamics are given and corresponding processes are given in Column II. Match the entries of Column I with that of Column II:

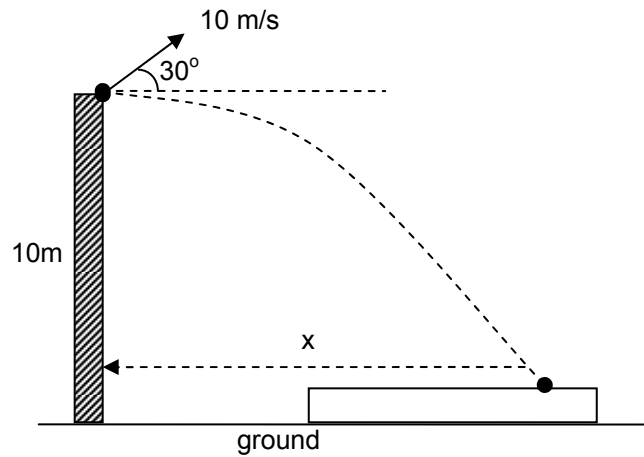
Column I	Column II
(A) Work done by the system on surroundings can be non-zero in	(p) Adiabatic process
(B) $dU = nC_v dT$ is valid for	(q) Isothermal process
(C) $dU$ is zero for	(r) Isothermal expansion process
(D) $dQ = nCdT$ is non-zero for	(s) Polytropic process
	(t) Isochoric process

2. A closed vessel contains a mixture of two diatomic gases A and B. Molar mass of A is 16 times that of B and the mass of A contained in the vessel is 2 times that of B. Match the following.

Column –I	Column –II
(A) Ratio of Average KE per molecules of A to that of B.	(p) 4
(B) Ratio of root mean square value of translational velocity of B to that of A.	(q) 8
(C) Ratio of pressure exerted by B over the walls of container to that by A.	(r) 1
(D) Ratio of No. of molecules of B in the container to that of A.	(s) 2
	(t) Zero

**Rough work**

3. From the top of a tower of height 10 m a ball is thrown at  $t = 0$  at  $30^\circ$  with horizontal as shown so that it falls (at  $t = t_1$ ) on a plank of same mass but negligible thickness. The co-efficient of friction between the plank and the ground is  $\frac{\sqrt{3}}{6}$  and the co-efficient of friction between the ball and the plank is  $\frac{1}{\sqrt{3}}$ . Ratio of velocity of approach to velocity of separation along the normal of plank is 3. At  $t = t_2$  the ball collides with the plank second time. Then match the correct. [Take  $g = 10\text{m/s}^2$  and neglect the duration of collision]



Column – I	Column – II
(A) Distance travelled (in meter) by the plank between time interval ' $t_1$ ' to ' $t_2$ '	(p) zero
(B) The magnitude of the horizontal displacement of the ball (in meter) between time interval ' $t_1$ ' to ' $t_2$ '.	(q) $\frac{5}{8\sqrt{3}}$
(C) Speed (in m/sec) of plank just after the instant $t = t_1$ .	(r) $\frac{5}{2\sqrt{3}}$
(D) Horizontal component of velocity (in m/sec) of the ball just after the instant $t = t_1$ .	(s) $\frac{5}{\sqrt{3}}$
	(t) $\frac{10}{\sqrt{3}}$

**Rough work**

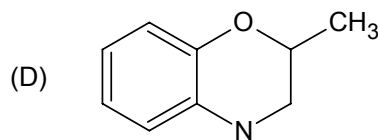
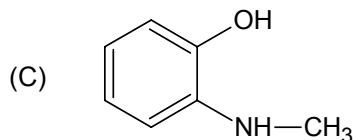
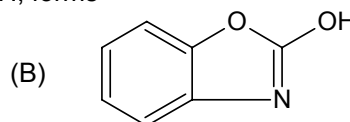
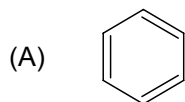
# Chemistry

## PART – II

### 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**.

1. Ortho-aminophenol, on treatment with  $\text{CH}_3\text{COOH}$ , forms

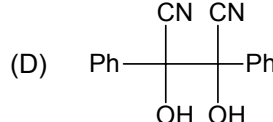
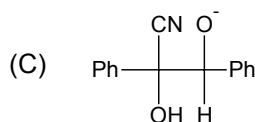
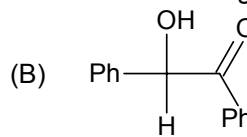
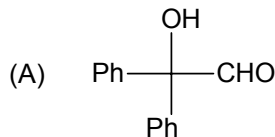


2. Acetic anhydride, on heating forms

(A) Ketone  
(C) Acid

(B) Aldehyde  
(D) ester

3. In Benzoin condensation, which of the following intermediate can be generated?

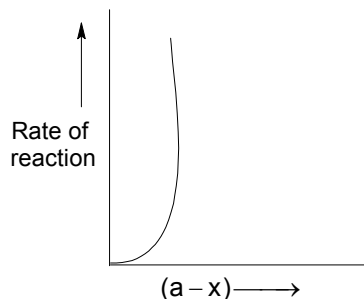


*Rough work*

4. Benzaldehyde, on treatment with  $\text{NH}_3$ , forms hydrobenzamide. The number of optical isomers of hydrobenzamide is

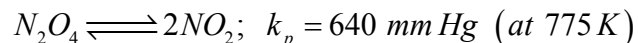
(A) 0 (B) 1  
(C) 4 (D) 6

5.



$a$  is initial concentration of reaction  $x$  is concentration of product after time  $t$ . This graph represents

- (A) Zero order reaction (B) First order reaction  
(C) Second order reaction (D) Third order reaction
6. Softening of hard water is done by using sodium aluminium silicate (Zeolite). This causes
- (A) Adsorption of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions of hard water replacing  $\text{Na}^+$  ions  
(B) Adsorption of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions of hard water replacing  $\text{Al}^{3+}$  ions  
(C) Both true  
(D) None is true
7. On heating in a closed vessel,  $\text{N}_2\text{O}_4$  shows following equilibria.



Calculate % dissociation. If equilibrium pressure is 160 mm Hg. Also calculate the pressure required for 50% dissociation.

(A) 750 mm Hg (B) 760 mm Hg  
(C) 770 mm Hg (D) 780 mm Hg

**Rough work**

8. Which of the following statement is wrong with respect to calcium ammonium nitrate (CAN)?  
 (A) It is hygroscopic in nature (B) It is explosive  
 (C) It is used as fertilizer (D) It is soluble in water
9. Which of the following express the spontaneity of chemical reaction?  
 (A)  $\Delta S_{\text{total}} \geq 0$  (B)  $\Delta S_{\text{total}} > 0$   
 (C)  $\Delta S_{\text{total}} = \Delta G$  (D)  $T\Delta S_{\text{total}} > \Delta G$

### 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: Decrease in free energy during the process under constant temperature and pressure provides a measure of its spontaneity.  
**and**  
 STATEMENT-2: A spontaneous change must have +ve sign of  $\Delta S_{\text{system}}$ .  
 (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: Nucleus does not contain free electron, yet it emits  $\beta$ -particle.  
**and**  
 STATEMENT-2: At high n/p ratio, one neutron suppose to give 1 proton and 1  $e^-$  ( $\beta$ ).  
 (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 rate of chlorination of benzene and hexadutero benzene are different in presence of  $\text{AlCl}_3$ .  
**and**  
STATEMENT-2: The C-deuterium bond is stronger than that of C-H bond but in the above reaction no bond between C – H or C – D is broken in rate determination 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.
13. STATEMENT-1: Zeise's salt is a  $\pi$ -bonded organometallic compound.  
**and**  
STATEMENT-2: Zeise's salt contain  $\text{C}_2\text{H}_4$  molecules as one of the ligand.  
(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 electrochemical series is the arrangement of various electrode systems in the increasing order of their standard reduction potentials. It has several important features. On moving from the top to the bottom in the series, tendency to gain electrons, i.e., to get reduced increases. The electrode systems having negative values of standard reduction potentials act as anode when connected to a standard hydrogen electrode, while those having positive values act as cathode.

14. HCl can not be stored in an aluminium vessel because  
 (A)  $E^\circ_{\text{Al}^{3+}/\text{Al}}$  is much smaller than  $E^\circ_{\text{H}^+/\text{H}_2}$ . (B) Al is a highly reactive metal.  
 (C) HCl is an oxidizing acid. (D) All of these
15. If  $E^\circ_{\text{Cu}^{3+}/\text{Cu}} = 0.34 \text{ V}$  and  $E^\circ_{\text{Ag}^{3+}/\text{Ag}} = 0.8 \text{ V}$ , predict whether the reaction given below is feasible or not?  
 $\text{Cu}^{2+}(\text{aq}) + 2\text{Ag}(\text{s}) \rightarrow \text{Cu}(\text{s}) + 2\text{Ag}^+(\text{aq})$   
 (A) Feasible. (B) Not feasible.  
 (C) Feasible at high temp. (D) Feasible on increasing the conc. of  $\text{Ag}^+(\text{aq})$ .
16. If  $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44 \text{ V}$  and  $E^\circ_{\text{Mg}^{+2}/\text{Mg}} = -2.37 \text{ V}$ ,  $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34 \text{ V}$  and  $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80 \text{ V}$ , the correct order in which the metals displace each other is  
 (A)  $\text{Ag} > \text{Cu} > \text{Fe} > \text{Mg}$  (B)  $\text{Fe} > \text{Cu} > \text{Ag} > \text{Mg}$   
 (C)  $\text{Fe} > \text{Ag} > \text{Cu} > \text{Mg}$  (D)  $\text{Mg} > \text{Fe} > \text{Cu} > \text{Ag}$

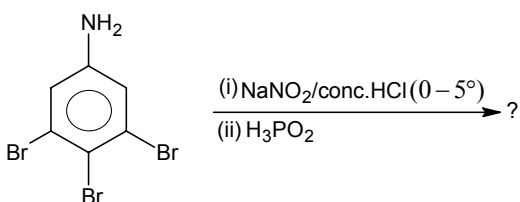
**Rough work**



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

Amines can be produced by selective reduction of nitro compounds. A mixture of (Sn + HCl) acts as a good reducing agent which converts nitro benzene to aniline. Diazotisation takes place when aniline is treated with a mixture of  $\text{NaNO}_2$  and conc. HCl. A large number of aromatic compounds can be prepared from diazonium salt e.g. on hydrolysis it produces a hydroxyl group.

17. Nitration of aniline in strongly acidic medium, results in the formation of m-nitroaniline also. This is because  
 (A) Amino group is meta orienting during electrophilic substitution reaction.  
 (B) Nitro group goes away to the meta position irrespective of the substituents.  
 (C) Nitration of aniline is a nucleophilic substitution reaction in strongly acidic medium.  
 (D) In strongly acidic solution aniline is present as anilinium ion.
18. Identify the product in the following sequence



- (A) 3, 4, 5-tribromobenzene  
 (B) 1, 2, 3-tribromobenzene  
 (C) 2, 4, 6-tribromobenzene  
 (D) 3, 4, 5-tribromophenol
19. Electrolytic reduction of nitrobenzene in weakly acidic medium gives:  
 (A) N-phenyl hydroxyl amine  
 (B) Nitrosobenzene  
 (C) Aniline  
 (D) p-hydroxyaniline

**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:

	p	q	r	s	t
A	<input 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"/>

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:

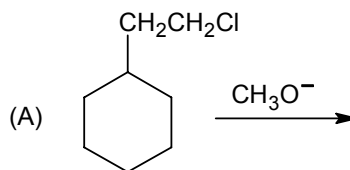
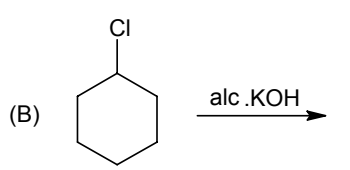
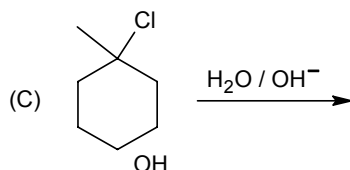
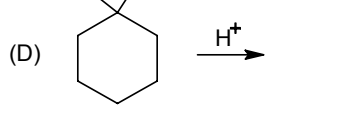
1. Match the following

- Column I**
- (A) Poling
  - (B) Cupellation
  - (C) Electro-refining
  - (D) Van Arkel method

- Column II**
- (p) Titanium
  - (q) Copper
  - (r) Silver
  - (s) Zirconium
  - (t) Zn

*Rough work*

2. Match the following

Column I	Column II
(A)  <chem>ClCC1CCCCC1.[O-]C&gt;&gt;</chem>	(p) S <sub>N</sub> 1
(B)  <chem>ClC1CCCCC1.O[K]&gt;&gt;</chem>	(q) S <sub>N</sub> 2
(C)  <chem>ClC1(C)CCCCC1.O/[OH-]&gt;&gt;</chem>	(r) E <sub>1</sub>
(D)  <chem>OC1(C)CCCCC1.O=[H+]&gt;&gt;</chem>	(s) E <sub>2</sub>
	(t) E1cb

3. Match the Column-I with Column-II:

**Column-I**

- (A) Fehling's solution  
 (B) Fenton's reagent  
 (C) Etard's reagent  
 (D) Lucas reagent

**Column-II**

- (p) FeSO<sub>4</sub> + H<sub>2</sub>O<sub>2</sub>  
 (q) Conc. HCl + anhydrous ZnCl<sub>2</sub>  
 (r) CuSO<sub>4</sub> solution + sodium potassium tartrate  
 (s) CrO<sub>2</sub>Cl<sub>2</sub>  
 (t) Used for test the nature of alcohols

**Rough work**

# Mathematics

## PART – III

### 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.

- If the equation  $(a - 2)(x - [x])^2 + 2(x - [x]) + a^2 = 0$  has no integral solution and has exactly one solution in  $(2, 3)$ , then (where  $[.]$  denotes the greatest integer function)

(A)  $a \in (0, 1)$  (B)  $a \in (2, 3)$   
 (C)  $a \in (-2, -1)$  (D) none of these
- $\int \frac{(2 + \sqrt{x})dx}{(x + \sqrt{x} + 1)^2}$  is equal to

(A)  $\frac{x}{x + \sqrt{x} + 1} + c$  (B)  $\frac{2x}{x + \sqrt{x} + 1} + c$   
 (C)  $\frac{1}{x + \sqrt{x} + 1} + c$  (D) none of these
- If  $g(x)$  is a differentiable real valued function satisfying  $g''(x) - 3g'(x) > 3 \forall x \geq 0$  and  $g'(0) = -1$  then  $g(x) + x$  for  $x > 0$  is

(A) increasing function of  $x$  (B) decreasing function of  $x$   
 (C) data insufficient (D) none of these
- If a variable straight line  $x \cos \alpha + y \sin \alpha = p$ , which is a chord of the hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$  ( $b > a$ ), subtend a right angle at the centre of the hyperbola, then it always touches a fixed circle whose radius is

(A)  $\frac{ab}{\sqrt{b - 2a}}$  (B)  $\frac{a}{\sqrt{a - b}}$   
 (C)  $\frac{ab}{\sqrt{b^2 - a^2}}$  (D)  $\frac{ab}{b\sqrt{(b + a)}}$

**Rough work**

5. If  $\left| \frac{z-6}{z-8} \right| = 1$ , then the value of  $x \in \mathbb{R}$ , where  $z = x + i \begin{vmatrix} -3 & 2i & 2+i \\ -2i & 2 & 4-3i \\ 2-i & 4+3i & 7 \end{vmatrix}$  is
- (A) 5 (B) 7  
(C) 9 (D) can't be determined
6. The area bounded by the curve  $f(x) = \cos^{-1}(\cos x)$ ,  $0 \leq x \leq 2\pi$  with the tangent to the curve  $f(x) = |\cos x|$  at  $x = \pi$  is
- (A)  $(\pi + 1)^2$  (B)  $(\pi - 1)^2$   
(C)  $\frac{(2\pi - 1)(\pi - 1)}{2}$  (D)  $\frac{(2\pi - 1)(\pi + 1)}{2}$
7. If  $(\sqrt{2} \cos x + \sqrt{2} \sin x + \sqrt{7})^m = 1$  holds then
- (A) greatest negative integral value of  $m$  is  $-1$  (B) least positive integral value of  $m$  is  $5$   
(C) no such  $m$  exists (D)  $m \in [-7, -1) \cup (1, \infty)$
8. The solution of differential equation  $(x \cot y + \ln \cos x) dy + (\ln \sin y - y \tan x) dx = 0$
- (A)  $(\sin x)^y (\cos y)^x = c$  (B)  $(\sin y)^x (\cos x)^y = c$   
(C)  $(\sin x)^y (\sin y)^x = c$  (D)  $(\cot x)^y (\cot y)^x = c$
9. If  $m$  is selected at random from set  $\{1, 2, \dots, 10\}$  and the probability that the quadratic equation  $2x^2 + 2mx + m + 1 = 0$  has real roots is
- (A)  $\frac{1}{8}$  (B)  $\frac{1}{9}$   
(C)  $\frac{4}{5}$  (D)  $\frac{1}{2}$

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**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. Consider the circle having a diameter AB and a point P lying in the exterior region of the circle, on the line AB. From point P a tangent is drawn to the circle at point T, if M be the foot of perpendicular from T upon AB, G be the centre of the circle and N be a point on the line AB which divides the segment AB in the ratio PA : PB internally then  
 STATEMENT 1:  $PG > PM > PN$   
 STATEMENT 2:  $A.M. > G.M. > H.M.$   
 (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:  $a + b + c + d + e = 8$  and  $a^2 + b^2 + c^2 + d^2 + e^2 = 16$ , where a, b, c, d, e are positive non-negative real numbers, then  $e \in \left[0, \frac{16}{5}\right]$ .  
 STATEMENT 2:  $\left(\frac{a+b+c+d}{4}\right)^2 \leq \frac{a^2+b^2+c^2+d^2}{4}$ .  
 (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: The equation  $\log_3(5 + 4\log_3(x - 1)) = 2$  has only one solution.  
 STATEMENT 2:  $2^{\log_3 x} = x^{\log_3 2}$ ;  $x \neq 0$ .  
 (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
13. STATEMENT 1: The order of differential equation of family of circles touching both the axes is 1.  
 STATEMENT 2: The order of differential equation is equal to the number of arbitrary constants.  
 (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**

### 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

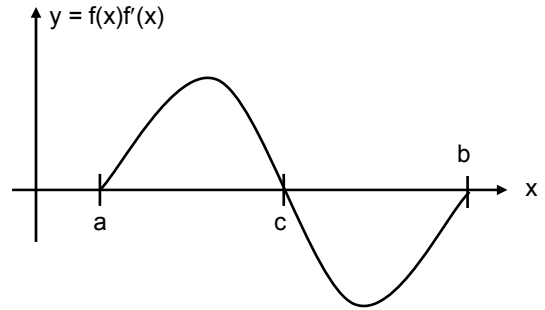
Read the following write up carefully and answer the following questions:

$f(x)$  is continuous and differentiable function.

Given  $f(x)$  takes values of the form  $\pm \sqrt{l}$  where  $l$  denotes set of whole numbers whenever  $x = a$  or  $b$ ;

otherwise  $f(x)$  takes real values. Also  $f(c) = -\frac{3}{2}$  and

$|f(a)| \leq |f(b)|$ .



14. The number of rational values that  $f(a) + f(b) + f(c)$  can take is / are  
 (A) 4 (B) 2  
 (C) 3 (D) 5
15. The number of values that  $(f(a))^2 + (f(b))^2 + (f(c))^2$  can take is  
 (A) 5 (B) 2  
 (C) 3 (D) 7
16. The possible number of triplets  $(f(a), f(b), f(c))$  is / are  
 (A) 4 (B) 5  
 (C) 7 (D) 6

*Rough work*

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

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

Let P be a point in the plane of  $\Delta ABC$  such that the triangles PAB, PBC, PCA all have the same perimeter and the same area.

- 17. If P lies inside the  $\Delta ABC$ , then  $\Delta ABC$ 
  - (A) must be equilateral
  - (B) may not be equilateral
  - (C) must be right angled
  - (D) none of these
  
- 18. If P lies outside the  $\Delta ABC$ , then  $\Delta ABC$ 
  - (A) must be equilateral
  - (B) may not be equilateral
  - (C) must be right angled
  - (D) none of these
  
- 19. If P lies outside the  $\Delta ABC$ , then the quadrilateral formed by A, B, C and P is necessarily
  - (A) rectangle
  - (B) square
  - (C) rhombus
  - (D) none of these

**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  $f: R \rightarrow R$  and  $g: R \rightarrow R$  be functions such that  $f(g(x))$  is a one-one function. Match the following:

Column – I		Column – II	
(A)	Then $g(x)$	(p)	Must be one-one
(B)	Then $f(x)$	(q)	May not be one-one
(C)	If $g(x)$ is onto then $f(x)$	(r)	May be many one
(D)	If $g(x)$ is into then $f(x)$	(s)	Must be many-one

**Rough work**



2. Match the following:

Column – I	Column – II
(A) The number of solution of $\frac{x}{2} + \frac{\sin x}{\cos x} = \frac{\pi}{4}$ in $[-\pi, \pi]$	(p) 1
(B) The number of solution of equation $\sin^{-1}( x^2 - 1 ) + \cos^{-1}( 2x^2 - 5 ) = \frac{\pi}{2}$	(q) 0
(C) The number of solution of $x^4 - 2x^2 \sin^2 \frac{\pi}{2} x + 1 = 0$	(r) 3
(D) The number of solution of $x^2 + 2x + 2 \sec^2 \pi x + \tan^2 \pi x = 0$	(s) 2

3. Match the following:

Column – I	Column – II
(A) Number of distinct terms in the expansion of $(y - z)^{16}$	(p) 17
(B) Number of terms in the expansion of $(x + \sqrt{x^2 - 1})^6 + (x - \sqrt{x^2 - 1})^6$	(q) 97
(C) The number of irrational terms in $(\sqrt[8]{5} + \sqrt[6]{2})^{100}$	(r) 4
(D) The value of $\left[ (\sqrt{2} + 1)^6 \right]$ , (where $[.]$ represents greatest integer function) is	(s) 197

**Rough work**