FIITJEE

JEE(Advanced), 2014

FULL TEST – I

Paper 1

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.

Name of the Candidate	
Enrolment No.	

Useful Data

PHYSICS

Acceleration due to gravity	$g = 10\ m/s^2$
Planck constant	$h = 6.6 \times 10^{-34}$ J-s
Charge of electron	$e = 1.6 \times 10^{-19}$ C
Mass of electron	$m_e = 9.1 \times 10^{-31}$ kg
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N\text{-}m^2$
Density of water	$\rho_{water} = 10^3\ kg/m^3$
Atmospheric pressure	$P_a = 10^5\ N/m^2$
Gas constant	$R = 8.314\ J\ K^{-1}\ mol^{-1}$

CHEMISTRY

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

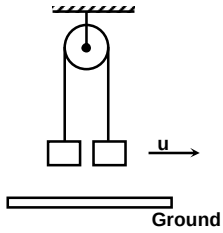
PART – I

SECTION – A

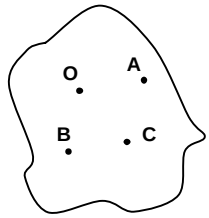
Single Correct Choice Type

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

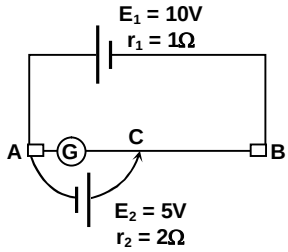
1. Two equal masses hang on either side of a pulley at the same height from the ground. The mass on the right is given a horizontal speed, after some time.
(A) The mass on the left will be nearer to ground.
(B) The mass on the right will be nearer to ground.
(C) Both the masses will be at equal distance from the ground.
(D) Nothing can be said regarding their positions.



2. O is the centre of mass of a body of mass M as shown in the figure. A, B, C are three different point on the body. OB = 8 cm, OC = 10 cm, BC = 6 cm and OA = 10 cm. Which of the following can be written by using parallel axis theorem? I_0 is the moment of inertia about the axis passing through point O and perpendicular to plane of object.
(A) $I_B = I_C + M(BC)^2$ (B) $I_C = I_B + M(BC)^2$
(C) $I_A = I_0 + M(OB)^2$ (D) None of these

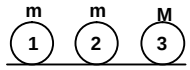


3. For the potentiometer arrangement shown in the figure, length of wire AB is 100 cm and its resistance is 9Ω. Find the length AC for which the galvanometer G will show zero deflection.
(A) 66.7 cm (B) 60 cm
(C) 50 cm (D) 33.3 cm



Space for rough work

4. Two balls marked 1 and 2 of the same mass m and a third ball marked 3 of mass M are arranged over a smooth horizontal surface as shown in the figure. Ball 1 moves with a velocity v_1 towards balls 2. All collisions are assumed to be elastic. If M < m the number of collisions between the balls will be



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

5. An electron and a proton are separated by a large distance and the electron approaches the proton with K.E. of 2 eV. If the electron is captured by the proton to form a hydrogen atom in the ground state, wavelength of photon emitted will be
(A) 793 Å (B) 1096 Å
(C) 704.5 Å (D) 1291.6 Å

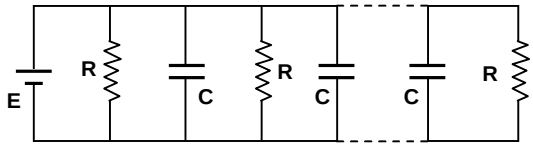
6. A metallic surface is irradiated with monochromatic light of variable wavelength. Above a wavelength of 5000 Å, no photoelectrons are emitted from the surface. With an unknown wavelength, a stopping potential of 3 V is necessary to eliminate the photo current. The unknown wavelength is
(A) 2258Å (B) 4133 Å
(C) 3126 Å (D) 2679 Å

7. An electric bulb of 100 W – 300 V is connected with an A.C. supply of 500 V and $150/\pi$ Hz. The required inductance to save the electric bulb is

(A) 2H (B) $\frac{1}{2}$H

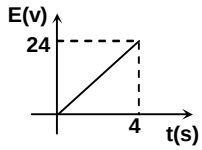
(C) 4 H (D) $\frac{1}{4}$H

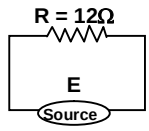
8. n resistances each of resistance R are joined with capacitors of capacity C (each) and a battery of emf E as shown in the figure. In steady state condition ratio of charge stored in the first and last capacitor is



(A) n : 1 (B) (n – 1) : R
(C) $(n^2 + 1) : (n^2 - 1)$ (D) 1 : 1

9. A resistance R = 12 Ω is connected across a source of emf as shown in the figure. Its emf changes with time as shown in the graph. What is the heat developed in the resistance in the first four seconds?





(A) 72 J (B) 64 J
(C) 108 J (D) 100 J

Space for 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: In a certain frame if the work done by all the real force is zero then the change in kinetic energy may not be zero.
and

STATEMENT-2: To apply work energy theorem in non inertial frames one must also consider the work done by the pseudo force.
(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: If a block of mass M is made to slide along a circular path on a rough horizontal surface then frictional force must be acting in a centripetal direction.
and

STATEMENT-2: Kinetic friction acts always opposite to the direction of relative velocity.
(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.

Space for rough work

12. STATEMENT-1: For expansion of one mole of a gas isobarically from one temperature to another, the ratio of ΔQ and ΔW is depends on γ
and

STATEMENT-2: Difference between C_P and C_V for all ideal gases is R.
(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: Current in a phototube is independent of applied voltage.
and

STATEMENT-2: Saturation current in a phototube depends on intensity of incident light.
(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.

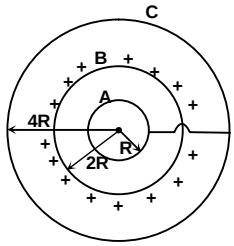
Space for rough work

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

Three concentric spherical conductors A, B and C of radii R, 2R and 4R respectively. A and C is shorted and B is uniformly charged (charge +Q)



14. Charge on conductor A is
(A) Q/3 (B) $-Q/3$
(C) 2Q/3 (D) None of these

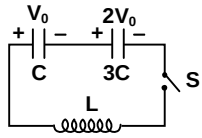
15. Potential at A is
(A) $\frac{Q}{4\pi\varepsilon_0 R}$ (B) $\frac{Q}{16\pi\varepsilon_0 R}$
(C) $\frac{Q}{20\pi\varepsilon_0 R}$ (D) None of these

16. Potential at B is
(A) $\frac{Q}{4\pi\varepsilon_0 R}$ (B) $\frac{Q}{16\pi\varepsilon_0 R}$
(C) $\frac{5Q}{48\pi\varepsilon_0 R}$ (D) None of these

Space for rough work

Paragraph for Question Nos. 17 to 19

Two capacitors of capacitance C and 3C are charged to potential difference V_0 and $2V_0$ respectively and connected to an inductor of inductance L as shown in the figure. Initially the current in the inductor is zero. Now the switch S is closed.



17. The maximum current in the inductor is

(A) $\frac{3V_0}{2}\sqrt{\frac{3C}{L}}$ (B) $V_0\sqrt{\frac{3C}{L}}$

(C) $2V_0\sqrt{\frac{3C}{L}}$ (D) $V_0\sqrt{\frac{C}{L}}$

18. Potential difference across capacitor of capacitance C when the current in the circuit is maximum

(A) $\frac{CV_0}{4}$ (B) $\frac{3CV_0}{4}$

(C) $\frac{5CV_0}{4}$ (D) None of these

19. Potential difference across capacitor of capacitance 3C when the current in the circuit is maximum

(A) $\frac{CV_0}{4}$ (B) $\frac{3CV_0}{4}$

(C) $\frac{5CV_0}{4}$ (D) None of these

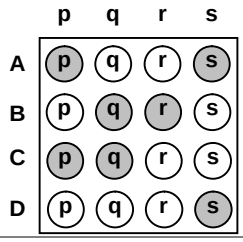
Space for rough work

SECTION - B

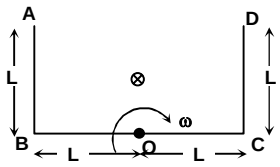
Matrix – Match Type

This section contains 3 questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in column I have to be matched with statements (p, q, r, s) in column II. The answers to these questions have to be appropriately bubbled as illustrated in the following example.

If the correct match are A-p, A-s, B-q, B-r, C-p, C-q and D-s, then the correctly bubbled 4×4 matrix should be as follows:

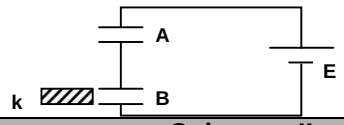


1. A frame ABCD is rotating with angular velocity ω about an axis which passes through the point O perpendicular to the plane of paper as shown in the figure. A uniform magnetic field $\vec{B}$ is applied into the plane of the paper in the region as shown. Match the following.



Column – I	Column – II
(A) Potential difference between A and O	(p) zero
(B) Potential difference between O and D	(q) $B\omega L^2/2$
(C) Potential difference between C and D	(r) $B\omega L^2$
(D) Potential difference between A and D	(s) constant

2. When a dielectric slab is inserted between the plates of one of the two identical capacitors shown in the figure, then match the following.



Column – I	Column – II
(A) Charge on A	(p) increases
(B) Potential difference across A	(q) decreases
(C) Potential difference across B	(r) remains constant
(D) Charge on B	(s) will change

3. Match the following.

Column – I	Column – II
(A) Concave mirror, real object	(p) real image
(B) Convex mirror, real object	(q) virtual image
(C) Concave lens, real object	(r) magnified image
(D) Convex lens, real object	(s) diminished image

Space for rough work

Chemistry

PART – II

SECTION – A

Straight Objective Type

This section contains **09 multiple choice questions** numbered 1 to 9. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. Given the data at 25°C

$Ag + I^- \longrightarrow AgI + e^-$ $\quad E^o = 0.152$ V

$Ag \longrightarrow Ag^+ + e$ $\quad E^o = -0.800$ V

What is the value of $\log K_{SP}$ for AgI?
(2.303 RT/F = 0.059 V)
(A) - 37.83 (B) - 16.13
(C) - 8.12 (D) + 8.612

2. The oxidation of certain metal is found to obey the equation $A^2 = \alpha t + \beta$. Where A is the thickness of the metal oxide film at time t, α and β are constants. The order of this reaction is:
(A) 0 (B) 1
(C) -1 (D) 12

3. In an ionic compound AB the radii of A^+ and B^- ions are 1.0 pm and 2.0 pm respectively. The volume of the unit cell of the crystal AB will be
(A) 27 pm^3 (B) 64 pm^3
(C) 125 pm^3 (D) 216 pm^3

4. In the equilibrium : $BaF_2(s) \rightleftharpoons Ba^{2+}(aq) + 2F^-(aq)$, if $[Ba^{2+}]$ is increased two times, then $[F^-]$ in solution will:
(A) increase two times (B) increase four times
(C) decrease two times (D) decrease $\frac{1}{\sqrt{2}}$ times

5. Which of the following does not involve innershell hybridisation:
(A) $\left[Co(F)_6\right]^{3-}$ (B) $\left[Co(CN)_6\right]^{3-}$
(C) $\left[Fe(CN)_6\right]^{4-}$ (D) $\left[Ni(NH_3)_6\right]^{2+}$

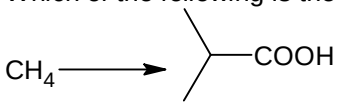
Rough Work

6. Pick up the incorrect statement

(A) Bond length N_2^+ > bond length N_2 (B) Bond length of NO^+ < bond length of NO

(C) Bond length of CN^- < bond length of CN (D) Bond length of CO < bond length of CO^+

7. Which of the following is the correct option of reagent for the given conversion?



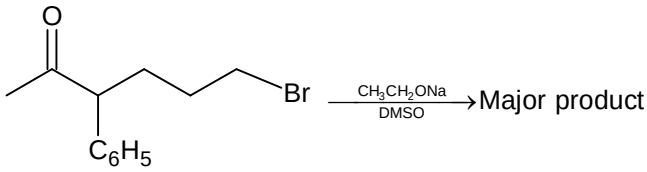
(A) $Br_2 / h\nu$,  , $Br_2 / h\nu$, HCOOH

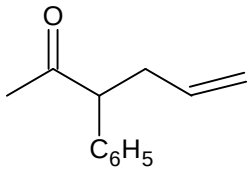
(B) $Cl_2 / h\nu$,  , $Br_2 / h\nu$, KCN / H_3O^+

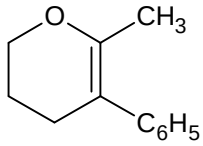
(C) $Br_2 / h\nu$,  , $Br_2 / h\nu$, $NaNH_2$,HCN,H_3O^+

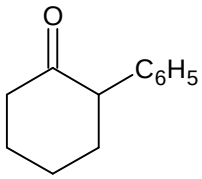
(D) $Cl_2 / h\nu$, CH_3MgBr, $Br_2 / h\nu$, CH_3COOH

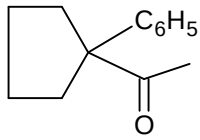
Rough Work

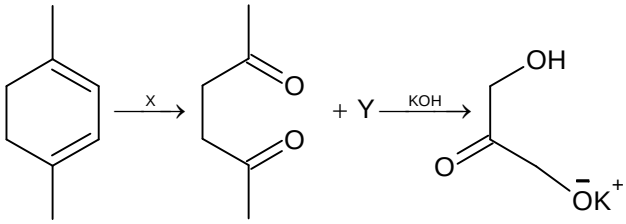
8. 

(A) 

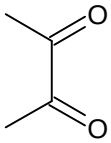
(B) 

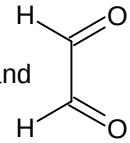
(C) 

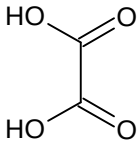
(D) 

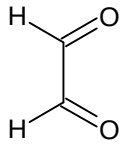
9. 

Identify 'X' and 'Y' of the above reaction:

(A) O_3 / Ag_2O and 

(B) O_3 / $Zn - H_2O$ and 

(C) $KMnO_4$ and 

(D) $KMnO_4$ and 

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: $[Fe(CN)_6]^{3-}$ is weakly paramagnetic while $[Fe(CN)_6]^{4-}$ is diamagnetic
and
STATEMENT-2: Both $[Fe(CN)_6]^{3-}$ and $[Fe(CN)_6]^{4-}$ involve d^2sp^3 hybridisation. In rearranging electrons in d-orbitals one d-orbital is singly occupied in $[Fe(CN)_6]^{3-}$ and all d-orbitals are doubly occupied in $[Fe(CN)_6]^{4-}$.
(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: $AlCl_3$ forms dimer Al_2Cl_6 but it dissolves in water forming $[Al(H_2O)_6]^{3+}$ and Cl^- ions.
and
STATEMENT-2: Aqueous solution of $AlCl_3$ is acidic due to hydrolysis.
(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 acidic medium Zn^{2+} is not precipitated by S^{2-} ions.
and
STATEMENT-2: Common ion effect reduces the concentration of S^{2-} ions to the minimum level.
(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: In acidic medium, an amino acid migrates to cathode.
and
STATEMENT-2: Zwitter ion of the amino acid changes to cation in acidic medium thus migrates to cathode.
(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

Concrete is produced from a mixture of cement, water, sand and small stones. It consists primarily of calcium silicates and calcium aluminates formed by heating and grinding of clay and limestone. In later steps of cement production a small amount of gypsum, $CaSO_4.2H_2O$ is added to improve subsequent hardening of concrete. The use of elevated temperatures during the final production may lead to formation of unwanted hemihydrate, $CaSO_4.1/2H_2O$. Consider the following reaction:

$$CaSO_4.2H_2O(s) \longrightarrow CaSO_4.\frac{1}{2}H_2O(s) + \frac{3}{2}H_2O(g)$$

The following thermodynamic data apply at 25°C, standard pressure: 1 bar

Compound	$\Delta H^o_{f(kJ/mol)}$	$S^o(JK^{-1}\ mol^{-1})$
$CaSO_4.2H_2O(s)$	- 2021.0	194.0
$CaSO_4.\frac{1}{2}H_2O(s)$	- 1575.0	130.5
$H_2O(g)$	- 241.8	188.6

$R = 8.314\ JK^{-1}\ mol^{-1}$

14. ΔH^o for the formation of 1.00 kg of $CaSO_4.\frac{1}{2}H_2O(s)$ from $CaSO_4.2H_2O(s)$ is
(A) + 446 kJ (B) + 484 kJ
(C) - 446 kJ (D) - 484 kJ

15. Equilibrium pressure (in bar) of water vapour in closed vessel containing $CaSO_4.2H_2O(s)$, $CaSO_4.\frac{1}{2}H_2O(s)$, $H_2O(g)$ at 25°C
(A) 17.35×10^{-4} bar (B) 2.15×10^{-4} bar
(C) 8.10×10^{-3} bar (D) 7.00×10^{-4} bar

16. Temperature at which the equilibrium water vapour pressure is 1.00 bar
(A) 107°C (B) 380°C
(C) 215°C (D) 240°C

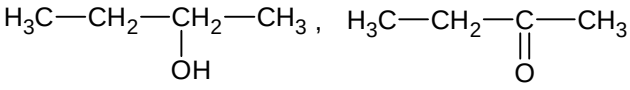
Rough Work

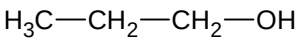
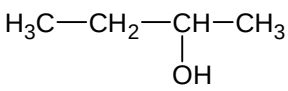
Paragraph for Question Nos. 17 to 19

A research scholar synthesised alcohol by hydration of 1-butene. He was unaware of the fact that the vessel he used had some coating of a metal and in addition to alcohol (b.p. 100^oC) he also got compound (X). X (b.p. 80^oC) formsbisulphate compound as well as 2,4-dinitrophenylhydrazo. He honour, was successful in the separation, based on physical and chemical properties. Read the above technical report and answer the following questions.

17. Which alcohol does research scholar want to sysnthesise and what is the other product?

(A) $CH_3-CH_2CH_2CH_2OH,\ CH_3CH_2-CH_2-CHO$

(B)  ,

(C)  ,


(D) $CH_3-CH_2-CH_2-CH_2-OH, CH_3-CH_2-CH=CH_2$

18. He also got yellow precipitate on heating with $NaOH/I_2$. This yellow ppt. is due to

(A) alcohol and side product both (B) side product only
(C) alcohol only (D) none of the above

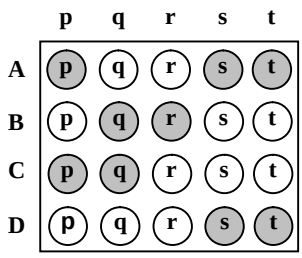
19. Carbonyl compound can be converted into required alcohol by

(A) Clemmensen reduction (B) Wolf-Kishner reduction
(C) $LiAlH_4$ (D) All of the above

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:

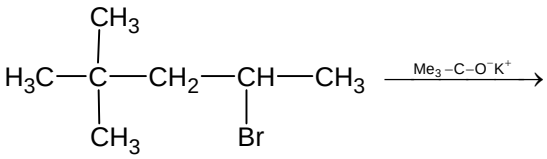
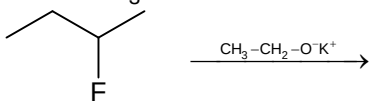
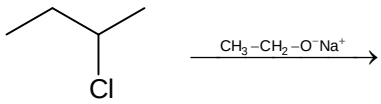
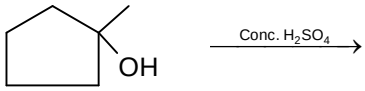


If the correct matches are A – p, s and t; B – q and r; C – p and q; and D – s and t; then the correct darkening of bubbles will look like the following:

1. Match the Column – I with Column – II:

Column – I		Column – II	
(A)	0.1 M glucose sol.	(p)	Lowest freezing point
(B)	0.1 M sucrose sol.	(q)	Highest freezing point
(C)	0.1 M $BaCl_2$ sol.	(r)	Lowest osmotic pressure
(D)	0.1 M $Ca(NO_3)_2$ sol.	(s)	Highest atmospheric pressure

2. Match the Column – I with Column – II:

Column – I		Column – II	
(A)		(p)	p-Saytzeff's product
(B)		(q)	q-Carbocation
(C)		(r)	r-E_2 elimination
(D)		(s)	s-Hoffmann product

3. Match the reactions of metals with dilute HNO_3 (in Column – I) with the nitrogen compounds obtained by oxidation/reduction (in Column – II):

Column – I		Column – II	
(A)	Mg + dil. HNO_3	(p)	NO
(B)	Zn + dil. HNO_3	(q)	H_2
(C)	Sn + dil. HNO_3	(r)	N_2O
(D)	Pb + dil. HNO_3	(s)	NH_4NO_3

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.

1. Consider two circles $x^2 + y^2 = 1$ and $(x - 1)^2 + (y - 1)^2 = 3$ then the point circle which is orthogonal to the given two circles can be

(A) $\left(x - \frac{1}{2}\right)^2 + \left(y - \frac{1}{2}\right)^2 = 0$ (B) $\left(x - \frac{1}{\sqrt{2}}\right)^2 + \left(y - \frac{1}{\sqrt{2}}\right)^2 = 0$

(C) $(x - 1)^2 + (y - 1)^2 = 0$ (D) none of these

2. Consider a 9 sided regular polygon then the probability that if 3 vertices are selected at random the triangle so formed will contain the centre of the polygon is

(A) $\frac{5}{14}$ (B) $\frac{1}{2}$

(C) $\frac{11}{14}$ (D) none of these

3. The range of m for which the line $z(1 - mi) - \bar{z}(1 + mi) = 0$ divides two chords drawn from point $z_1 = \sqrt{3} + i$ to the curve $|z| = 2$ in the ratio 1 : 2 is

(A) $(0, \sqrt{3})$ (B) (1, 2)

(C) $\left(\frac{1}{\sqrt{3}}, 1\right)$ (D) none of these

4. Consider the equation $x^4 - ax^3 - bx^2 - cx - d = 0$, $a, b, c, d \in I^+$, $a \geq b \geq c \geq d$ then, the number of integral solutions are

(A) 0 (B) 4

(C) 2 (D) none of these

Space for rough work

5. Consider a function f : X $\to$ R such that $f(x) = \log_{|x-1|-|x+1|-\frac{1}{2}}\left[\left(x^2-x+\frac{1}{2}\right)^{x^2-3x+2}-1\right]$ then the exhaustive set X can be

(A) $\left[1, \frac{5}{4}\right]$ (B) $\left(-\infty, -\frac{1}{4}\right)$

(C) $\left(-\infty, -\frac{1}{4}\right)-\left\{-\frac{3}{4}\right\}$ (D) none of these

6. For the given curve, x = a cos t + $\frac{1}{2}$ a ln $\tan^2 \frac{t}{2}$; y = a sin t the area bounded by the curve is

(A) $\frac{\pi}{2}a^2$ (B) πa^2

(C) $2\pi a^2$ (D) none of these

7. Consider a 3–D figure represented as $xyz^2 = 2$ then its minimum distance from origin is

(A) 2 (B) 4

(C) 8 (D) none of these

8. Consider curve, r^2 = a sin 2θ then its orthogonal trajectory is

(A) $r^2 = c$ (B) $r^2 = c \sin \theta$

(C) $r^2 = c \cos 2\theta$ (D) none of these

9. If the equation $x^3 + bx^2 + cx + 1 = 0$, $(b < c)$, has only one real root α. Then the value of $2\tan^{-1}(\operatorname{cosec}\alpha) + \tan^{-1}(2\sin\alpha \sec^2\alpha)$, is

(A) $-\pi$ (B) $-\frac{\pi}{2}$

(C) $\frac{\pi}{2}$ (D) π

Space for 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: Consider a function $f(z)=\frac{1}{1+z^2}$ where z $\in$ complex number then, f(z) is continuous inside a unit circle centred at origin.
STATEMENT 2: $|z| \neq 1$ if f(z) is continuous.
(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: f(z) = Re(z) is a function where z $\in$ complex number then f(z) is continuous but not differentiable
STATEMENT 2: $\lim\limits_{\substack{\Delta x\to 0\\ \Delta y\to 0}} \frac{f(z+\Delta z)-f(z)}{\Delta z} = \lim\limits_{\substack{\Delta y\to 0\\ \Delta x\to 0}} \frac{f(z+\Delta z)-f(z)}{\Delta z}$ for any point z
(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 $y = \sin(m \sin^{-1} x)$ then $(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} + (n^2 - m^2)y_n = 0$ [y_n is nth derivative of y w.r.t. x]
STATEMENT 2: $\frac{d^n}{dx^n}[u(x)v(x)] = u_n v_0 + {}^nC_1 u_{n-1} v_1 + {}^nC_2 u_{n-2} v_2 + ... + {}^nC_n u_0 v_n$ [u_n, v_n denote nth derivative of u(x), v(x) w.r.t. x]
(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: Consider a curve defined as given $x=\frac{3at}{1+t^3}$, $y=\frac{3at^2}{1+t^3}$, $a>0$ then
$\left[a(4)^{1/3}, a(2)^{1/3}\right]$ is point where a vertical tangent exists
STATEMENT 2: A vertical tangent exists if $\frac{dy}{dx} = -1$
(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.

Space for 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

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

Let $\overrightarrow{OP_1}$, $\overrightarrow{OP_2}$, $\overrightarrow{OP_3}$, ..., $\overrightarrow{OP_n}$ be unit vectors in a plane. P_1, P_2, P_3, ... P_n all lie on the same side of a line through O. $|\overrightarrow{OM}|$ denotes length of vector through O

14. $\overrightarrow{OP_v} \cdot \left(\overrightarrow{OP_3} + \overrightarrow{OP_4} + \overrightarrow{OP_5} + ... + \overrightarrow{OP_{k-1}}\right)$ $\left(\text{where } \overrightarrow{P_r} = \overrightarrow{P_2} + \overrightarrow{P_k}\right)$ is

(A) > 0 (B) < 0
(C) = 0 (D) none of these

15. If n is odd then, $\left|\overrightarrow{OP_1} + \overrightarrow{OP_2} + ... + \overrightarrow{OP_n}\right|$ is

(A) < 1 (B) < 0
(C) $\geq$ 1 (D) none of these

16. If $\vec{S} = \overrightarrow{OP_2} + \overrightarrow{OP_3} + \overrightarrow{OP_4} + \overrightarrow{OP_5} + \overrightarrow{OP_6}$ and $\vec{V} = \overrightarrow{OP_1} + \overrightarrow{OP_7}$ then least value of $|\vec{S}| + |\vec{V}|$ is

(A) 0 (B) 2
(C) 1 (D) none of these

Paragraph for Question Nos. 17 to 19

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

Let A be a n $\times$ n matrix. Suppose the linear transformation Y = AX transforms X into a scalar multiple of itself i.e. AX = Y = λX i.e. X is an invariant vector. Then the unknown scalar λ is known as an eigen value of matrix A and corresponding non zero vector X as eigen vector. Thus eigen values satisfy the equation AX = λX

17. $A = \begin{bmatrix} 8 & -4 \\ 2 & 2 \end{bmatrix}$ then possible eigen values is/are

(A) 4 (B) –4
(C) –6 (D) none of these

Space for rough work

18. The possible matrix X acting as eigen vector for $A = \begin{bmatrix} 8 & -4 \\ 2 & 2 \end{bmatrix}$ is

(A) $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$ (B) $\begin{bmatrix} 2 \\ 1 \end{bmatrix}$

(C) $\begin{bmatrix} \frac{1}{2} \\ \frac{3}{2} \end{bmatrix}$ (D) none of these

19. Let, $A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$ then value of λ for which eigen vector so formed is orthogonal is

(A) –1 (B) 2

(C) 3 (D) none of these

SECTION – B

(Matching List Type)

This section contains **3 multiple choice questions.** Each question has matching Column(s). The codes for the Column(s) have choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. Match the following Column–I with Column–II

	Column – I		Column – II
(A)	A variable plane through a fixed point (1, 2, 3) cuts the coordinate axes in the point P, Q, R then locus of centre of sphere OPQR is (0 is origin)	(p)	$x^2 + y^2 + z^2 = \frac{4}{9}$
(B)	A sphere of radius 1 unit passes through O and cuts axis in P, Q, R then locus of centroid of ΔPQR is	(q)	$2xy - \frac{z^2}{2} = 0$
(C)	Consider a point P on OX, Q and OY so that angle OPQ is $\frac{\pi}{12}$, with PQ as a diameter is circle is so described such that its plane is parallel to z–axis. Now if length of PQ is varied then locus generated by circle is	(r)	$x + 2y + 2z = 9$
(D)	The equation of a plane tangent to the sphere $x^2 + y^2 + z^2 = 9$ which passes through the line of intersection of the planes $x + y = 6$, $x - 2z = 3$	(s)	$\frac{1}{x} + \frac{2}{y} + \frac{3}{z} = 2$

Space for rough work

2. Match the following Column–I with Column–II

	Column – I		Column – II
(A)	Consider real numbers x, y, z such that $x \geq y \geq z \geq \frac{\pi}{2}$, $x + y + z = \frac{\pi}{2}$ then the maximum value of cos x sin y cos z is	(p)	$\frac{1}{2}$
(B)	Consider a trigonometric equation as shown [$x \in [0, 2\pi]$] $3\cot^2 x + 8\cot x + 3 = 0$ then the sum of all x is	(q)	$\frac{2+\sqrt{3}}{8}$
(C)	Consider a ΔABC, points D, E, F are on sides BC, CA, AB respectively such that $\|DC\| + \|CE\| = \|EA\| + \|AF\| = \|FB\| + \|BD\|$ then the minimum value of $\frac{\|DE\|+\|EF\|+\|FD\|}{\|AB\|+\|BC\|+\|CA\|}$ is	(r)	3
(D)	Let $x_1, x_2, \ldots. x_{10}$ be real numbers in the interval $\left[0, \frac{\pi}{2}\right]$ such that $\sin^2 x_1 + \sin^2 x_2 + \ldots.. + \sin^2 x_{10} = 1$. If $\frac{\cos x_1 + \cos x_2 + \ldots.. + \cos x_{10}}{\sin x_1 + \sin x_2 + \ldots.. + \sin x_{10}} \geq \alpha$ then maximum value of α is	(s)	5π

3. Match the following Column–I with Column–II

	Column – I		Column – II
(A)	The product of the perpendiculars drawn from the foci upon a tangent made at the locus of points described by P(4 cos θ, 3 sin θ) is	(p)	$\frac{\sqrt{162}}{2}$
(B)	The length of the normal chord subtending an angle of 90º at the vertex of locus of $P(t^2, 2t)$ where (t is a parameter)	(q)	9
(C)	Let P(2, 4) be a point and L : x = y then a circle is made with centre as Q [Image of P in L] and radius as 4. If a circle is so made such that it touches L in (1, 1) and its radical axis with S passes through P then its radius is	(r)	$\sqrt{\frac{5}{2}}$
(D)	The differential equation $\frac{dy}{dx} = \frac{2x}{3y}$ can represent hyperbolas of eccentricity as	(s)	$6\sqrt{3}$

Space for rough work