



JEE (Main + Advanced) LEADER & ENTHUSIAST COURSE SCORE(ADVANCED)

Test Type : FULL SYLLABUS

Test Pattern : JEE-Advanced

TEST DATE : 27 - 07 - 2020

Time : 3 Hours

PAPER – 1

Maximum Marks : 264

READ THE INSTRUCTIONS CAREFULLY



GENERAL :

1. This sealed booklet is your Question Paper. Do not break the seal till you are told to do so.
2. Use the Optical Response sheet (ORS) provided separately for answering the questions.
3. Blank spaces are provided within this booklet for rough work.
4. Write your name, form number and sign in the space provided on the back cover of this booklet.
5. After breaking the seal of the booklet, verify that the booklet contains **32** pages and that all the **20** questions in each subject and along with the options are legible. If not, contact the invigilator for replacement of the booklet.
6. You are allowed to take away the Question Paper at the end of the examination.

OPTICAL RESPONSE SHEET :

7. The ORS will be collected by the invigilator at the end of the examination.
8. Do not tamper with or mutilate the ORS. **Do not use the ORS for rough work.**
9. Write your name, form number and sign with pen in the space provided for this purpose on the ORS. **Do not write any of these details anywhere else on the ORS.** Darken the appropriate bubble under each digit of your form number.

DARKENING THE BUBBLES ON THE ORS :

10. Use a **BLACK BALL POINT PEN** to darken the bubbles on the ORS.
11. Darken the bubble  **COMPLETELY.**
12. The correct way of darkening a bubble is as : 
13. The ORS is machine-gradable. Ensure that the bubbles are darkened in the correct way.
14. Darken the bubbles **ONLY IF** you are sure of the answer. There is **NO WAY** to erase or "un-darken" a darkened bubble.
15. Take **$g = 10 \text{ m/s}^2$** unless otherwise stated.

Please see the last page of this booklet for rest of the instructions

DO NOT BREAK THE SEALS WITHOUT BEING INSTRUCTED TO DO SO BY THE INVIGILATOR

SOME USEFUL CONSTANTS

Atomic No. : H = 1, B = 5, C = 6, N = 7, O = 8, F = 9, Al = 13, P = 15, S = 16, Cl = 17, Br = 35, Xe = 54, Ce = 58

Atomic masses : H = 1, Li = 7, B = 11, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24, Al = 27, P = 31, S = 32, Cl = 35.5, Ca = 40, Fe = 56, Br = 80, I = 127, Xe = 131, Ba = 137, Ce = 140,

- | | |
|------------------------------------|--|
| • Boltzmann constant | $k = 1.38 \times 10^{-23} \text{ JK}^{-1}$ |
| • Coulomb's law constant | $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ |
| • Universal gravitational constant | $G = 6.67259 \times 10^{-11} \text{ N-m}^2 \text{ kg}^{-2}$ |
| • Speed of light in vacuum | $c = 3 \times 10^8 \text{ ms}^{-1}$ |
| • Stefan-Boltzmann constant | $\sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2}\text{-K}^{-4}$ |
| • Wien's displacement law constant | $b = 2.89 \times 10^{-3} \text{ m-K}$ |
| • Permeability of vacuum | $\mu_0 = 4\pi \times 10^{-7} \text{ NA}^{-2}$ |
| • Permittivity of vacuum | $\epsilon_0 = \frac{1}{\mu_0 c^2}$ |
| • Planck constant | $h = 6.63 \times 10^{-34} \text{ J-s}$ |

Space for Rough Work

HAVE CONTROL → HAVE PATIENCE → HAVE CONFIDENCE ⇒ 100% SUCCESS**BEWARE OF NEGATIVE MARKING****PART-1 : PHYSICS****SECTION-I : (Maximum Marks: 40)**

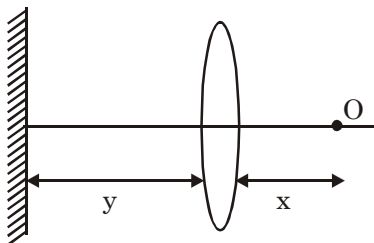
- This section contains **TEN** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 If only (all) the correct option(s) is (are) chosen.
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks : -2 In all other cases.

-
1. The length of a strip measured with a meter rod is 10.0 cm. Its width measured with a vernier callipers is 1.00 cm. The least count of the meter rod is 0.1 cm and that of vernier callipers is 0.01 cm. What can be the error in its area ?

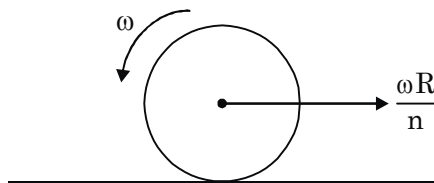
(A) +0.01 cm² (B) -0.1 cm² (C) +0.2 cm² (D) -0.2 cm²

Space for Rough Work

2. A convex lens of focal length f and a plane mirror are y distance apart. A point object O is kept on the principal axis of the lens at a distance x from the lens. For the final image of O to fall exactly on the object 'O', the values of x and y is given in options. Choose **INCORRECT** options.



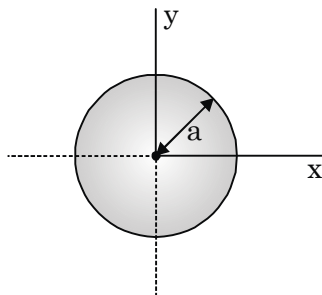
- (A) $x = f, y = f$ (B) $x = f, y = 2f$ (C) $x = 2f, y = f$ (D) $x = 2f, y = 2f$
3. A disc of radius R is given a forward velocity $\frac{\omega R}{n}$ and an angular velocity ω as shown and is left over a rough surface.



- (A) For $n = 1.5$, in the subsequent motion, the disc will cross the initial point again.
 (B) For $n = 3$, in the subsequent motion, the disc will cross the initial point again.
 (C) For $n = 1.5$, kinetic friction on disc is backwards for some time in the subsequent motion.
 (D) For $n = 3$ kinetic friction on disc is backwards for some time in the subsequent motion

Space for Rough Work

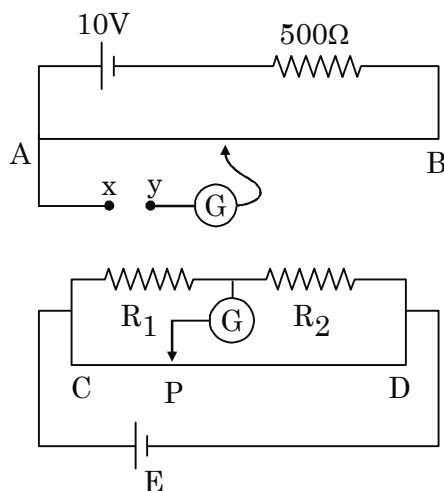
4. A circular ring of radius a and resistance R is placed (fixed) in x - y plane with its centre at origin as shown in the figure. A magnetic field $\vec{B} = (\alpha x)\hat{i} + (\beta y)\hat{j} + (\gamma t)\hat{k}$ is switched on at $t = 0$.



- (A) current induced in ring is $\frac{\pi a^2 \gamma}{R}$
- (B) current induced in ring is $\frac{\pi a^2 \gamma}{2R}$
- (C) the magnetic force acting on the ring is $\frac{\pi^2 a^4 (\alpha + \beta) \gamma}{2R}$
- (D) the magnetic force acting on the ring is $\frac{\pi^2 a^4 (\alpha + \beta) \gamma}{R}$

Space for Rough Work

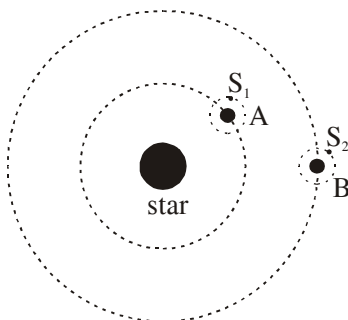
5. In the circuit shown AB is potentiometer wire of length 10 m and resistance 500Ω . CD is a 1m wire of meter bridge which is balanced at CP = 20 cm. Given that when the potential difference across R_1 is applied across XY the balancing length on potentiometer is 2m and for potential difference across R_2 , the corresponding length is 8m. Then :-



- (A) $\frac{R_1}{R_2} = \frac{1}{4}$ (B) Potential difference across R_1 is 1V
(C) Potential difference across R_2 is 4V (D) EMF of the battery $E = 5V$
6. n drops of a liquid each having surface energy E join to form a single drop. Then
(A) Some energy will be released in the process
(B) Some energy will be absorbed in the process
(C) The energy released or absorbed will be $E(n - n^{2/3})$
(D) The energy released or absorbed will be $nE(2^{2/3} - 1)$

Space for Rough Work

7. Consider a star and two planet system. The star has mass M . The planet A and B are identical and they revolve around the star in circular orbits according to Bohr model in first and second orbit (s_1 and s_2 are small geostationary satellites of A and B respectively). Planet A and B have no natural satellite and if a planet does not have natural satellite then time to revolve around star is same the time taken to revolve around its own axis. The potential is taken as zero at infinity.

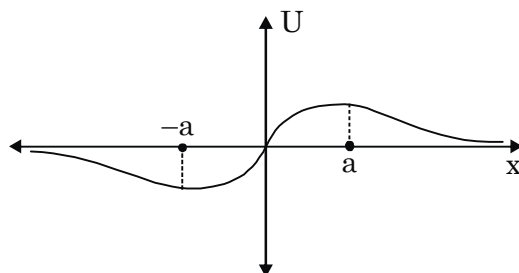


- (A) If the time period of the satellite s_1 is T , then time period of s_2 is $8T$.
 (B) If the radius of s_1 is R , then the radius of s_2 is $4R$.
 (C) If the radius of s_1 is R , then the radius of s_2 is $2R$.
 (D) If the time period of the satellite s_1 is T , then time period of s_2 is $2T$.

Space for Rough Work

8. A particle of mass 'm' moves under a conservative force with potential energy $U(x) = \frac{cx}{x^2 + a^2}$

where c & a are positive constants. Assume that initially particle is on mean position (where equilibrium is stable). For the given function potential energy v/s position graph is shown below.



- (A) position of unstable equilibrium is $x = +a$
 (B) for the particle to be confined in the region the velocity of particle must be less than

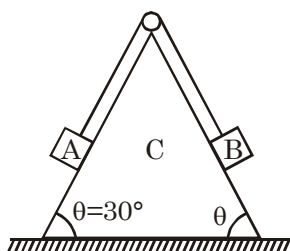
$$\sqrt{\frac{c}{ma}}$$

- (C) for particle to reach $x = +\infty$, velocity of particle must be more than $\sqrt{\frac{2c}{ma}}$

- (D) for the particle to reach $x = -\infty$, velocity of particle must be more than $\sqrt{\frac{c}{ma}}$

Space for Rough Work

9. In a hypothetical atom, a negatively charged particle having a charge of magnitude $3e$ and mass $3m$ revolves around a proton. Here, e is the electronic charge and m is the electronic mass. Mass of proton may be assumed to be much larger than that of the negatively charged particle, thus the proton is at rest. This “atom” obeys Bohr’s postulate of quantization of angular momentum, that is $mvr = n\left(\frac{h}{2\pi}\right)$. It is given that for the first Bohr orbit of hydrogen atom: radius of orbit is r_0 speed of electron is v_0 , and total energy is $-E_0$.
- (A) Speed of the revolving particle in the hypothetical atom is $9v_0$ in the first Bohr orbit.
 (B) Radius of hypothetical atom is $r_0/9$.
 (C) Speed of the revolving particle in the hypothetical atom is $3v_0$ in the first Bohr orbit.
 (D) Radius of hypothetical atom is $r_0/27$.
10. In the figure shown, C is a fixed wedge on horizontal surface. Blocks A and B are of masses m and $2m$ respectively are kept as shown in figure. They can slide along the incline plane smoothly. The pulley and string are massless. The inclined planes are very long. A and B are released from rest. 2 seconds after the release, B is caught for a moment and released again. Then (Take $\theta = 30^\circ$ and $g = 10\text{m/s}^2$) : Choose the **CORRECT** option(s) :



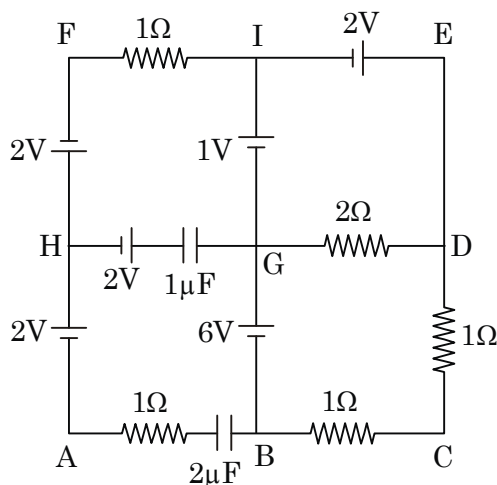
- (A) the speed of ‘A’ just before the instant when the string becomes tight again will be $10/3$ m/s
 (B) the speed of ‘A’ just before the instant when the string becomes tight again will be zero.
 (C) the speed of ‘A’ just after the instant when the string becomes tight again will be $20/9$ m/s.
 (D) the speed of ‘A’ just after the instant when the string becomes tight again will be $10/3$ m/s

Space for Rough Work

SECTION-III : (Maximum Marks : 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +4 If only the bubble corresponding to the correct answer is darkened.
Zero Marks : 0 In all other cases.

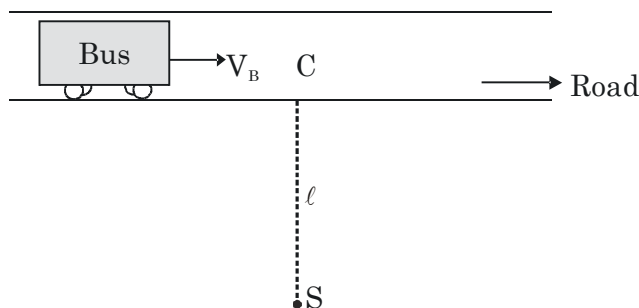
1. Ideal batteries, two capacitors and five resistors are connected in a circuit as shown. Find the ratio of current in the branch BC and GD at time $t = 1$ sec.



Space for Rough Work

2. A bus is moving with a velocity v_B along positive x-axis along a road as shown in the figure. A shooter S is at a distance ℓ from the road. He has a detector which can detect signals only of frequency 1500 Hz. The bus blows horn of frequency 1000 Hz. When detector detects a signal, shooter immediately shoots towards the road along SC and bullet hits the bus. If velocity of

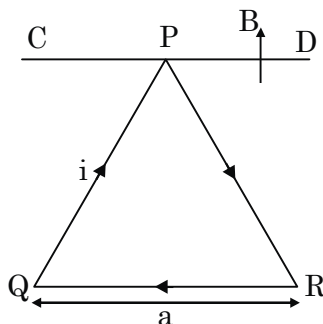
sound in medium is 360 m/s and $\frac{v_{\text{bus}}}{v_{\text{sound}}} = \frac{2}{3\sqrt{3}}$, then velocity of bullet is $(12)^n$ m/s. Find n.



3. A circuit draws a power of 550 watt from a source of 220 volt, 50 hertz. The power factor of the circuit is 0.8 and the current lags in phase behind the potential difference. To make the power factor of the circuit as unity, the capacitance connected with the circuit in series is $15 \times n \mu\text{F}$. Find the value of n.

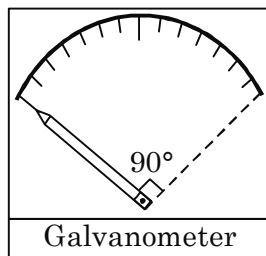
Space for Rough Work

4. A solid copper sphere ($e = 1$, density ρ and specific heat capacity c) of radius r at an initial temperature 200 K is suspended inside a chamber whose walls are at almost 0 K . The time required (in μs) for the temperature of the sphere to drop to 100 K is $\frac{n}{72} \frac{\rho pc}{\sigma}$. Find the value of n . (All symbols have their usual meaning)
5. Assume that the largest stone of mass ' m ' that can be moved by a flowing river depends upon the velocity of flow v , the density d & the acceleration due to gravity g . If ' m ' varies as the K^{th} power of acceleration due to gravity, then find the value of $|2K|$.
6. A loop formed by three identical uniform conducting rods each of length $a = 20\text{ cm}$ is suspended from one of its vertices (P) so that it can rotate about horizontal fixed smooth axis CD . Initially plane of loop is in vertical plane. A constant current $i = 10\text{ A}$ is flowing in the loop. Total mass of the loop is $m = 60\text{ gm}$. At $t = 0$, a uniform magnetic field of strength B directed vertically upwards is switched on. If the minimum value of B (in mT) is n , so that the plane of the loop becomes horizontal (even for an instant) during its subsequent motion. Then value of $n/100$ is (Assume current in the loop is maintained constant).



Space for Rough Work

7. In a moving coil galvanometer, a coil of area $\pi \text{ cm}^2$ and 10 windings is used. Magnetic field strength applied on the coil is 1 tesla and torsional stiffness of the torsional spring is $6 \times 10^{-6} \text{ N.m/rad}$. A needle is welded with the coil. Due to limited space, the coil (or needle) can rotate only by 90° . For marking, the 90° space is equally divided into 10 parts as shown. If the least count of this galvanometer in mA is k, then find 10k.



8. A glass surface is coated by an oil film of uniform thickness $1.00 \times 10^{-4} \text{ cm}$. The index of refraction of the oil is 1.25 and that of the glass is 1.50. Some of the wavelengths in visible region (400 nm – 490 nm) are completely transmitted by the oil film under normal incidence.
- One of the wavelength transmitted completely in visible region is $\frac{n \times 10^{-6}}{11} \text{ m}$. Find the value of n.

Space for Rough Work

SECTION-IV : (Maximum Marks : 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column-I** and **Column-II**.
- **Column-I** has **four** entries (A), (B), (C) and (D)
- **Column-II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column-I** with the entries in **column-II**.
- One or more entries in **Column-I** may match with one or more entries in **Column-II**.
- The ORS contains a 4×5 matrix whose layout will be similar to the one shown below :

 (A) ☐ (P) ☐ (Q) ☐ (R) ☐ (S) ☐ (T)

 (B) ☐ (P) ☐ (Q) ☐ (R) ☐ (S) ☐ (T)

 (C) ☐ (P) ☐ (Q) ☐ (R) ☐ (S) ☐ (T)

 (D) ☐ (P) ☐ (Q) ☐ (R) ☐ (S) ☐ (T)

- For each entry in **column-I**, darken the bubbles of all the matching entries. For example, if entry (A) in **Column-I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (B), (C) and (D).
- For each question, marks will be awarded in one of the following categories :

 For each entry in **Column-I**

Full Marks : +2 If only the bubble(s) corresponding to all the correct match(es) is (are) darkened

Zero Marks : 0 If none of the bubbles is darkened

Negative Marks : -1 In all other cases

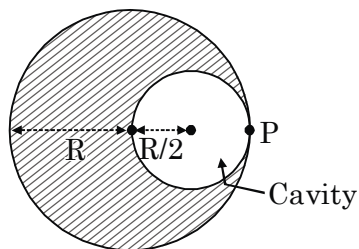
Space for Rough Work

1. Column-I contains four charged systems of uniform charge density. Column-II contains potential at point P due to system in Column-I. Match Column-I with Column-II and select the correct answer using the code given below the column.

Column-I

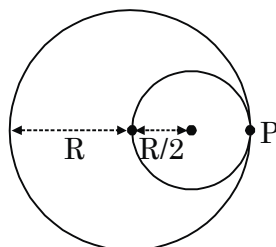
Column-II

- (A) Sphere of radius R having a cavity of radius $R/2$ with charge density ρ .



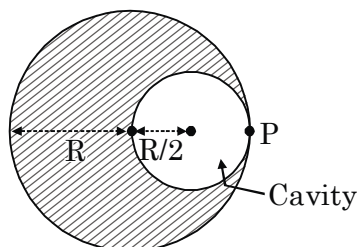
(P) $\frac{3\sigma R}{2\epsilon_0}$

- (B) Spherical shell of radius R having another spherical shell for radius $R/2$, both having charge density σ on their surface



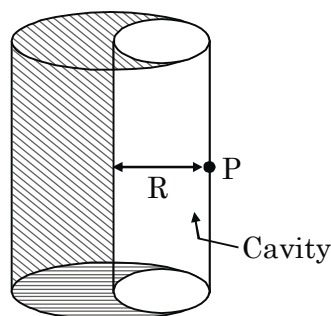
(Q) $\frac{\sigma R}{2\pi\epsilon_0}$

- (C) Disc of radius R having a cut disc of radius $R/2$ with surface charge density σ



(R) $\frac{\rho R^2}{4\epsilon_0}$

- (D) Solid large cylinder of radius R having volume charge density ρ . Consider the potential at the axis of given cylinder as $\frac{\rho R^2}{2\epsilon_0}$

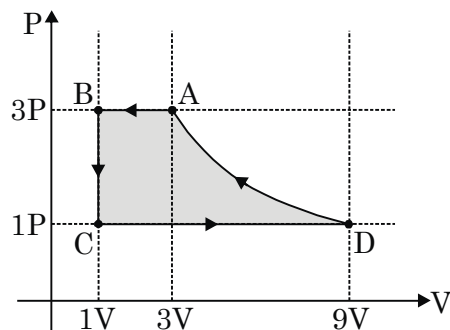


(S) $\frac{3\rho R^2}{4\epsilon_0}$

(T) $\frac{\sigma R}{4\epsilon_0}$

Space for Rough Work

2. One mole of a monoatomic ideal gas is taken through a cycle ABCDA as shown in the P-V diagram. COLUMN-II gives the characteristics involved in the cycle. Match them with each of the processes given in COLUMN-I.



Column - I

- (A) Process $A \rightarrow B$
- (B) Process $B \rightarrow C$
- (C) Process $C \rightarrow D$
- (D) Process $D \rightarrow A$

Column-II

- (P) Internal energy decreases
- (Q) Internal energy increases
- (R) Heat is lost by the gas
- (S) Heat is gained by the gas
- (T) Work is done on the gas

Space for Rough Work

PART-2 : CHEMISTRY

SECTION-I : (Maximum Marks: 40)

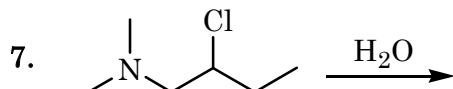
- This section contains **TEN** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 If only (all) the correct option(s) is (are) chosen.
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks : -2 In all other cases.

1. For a galvanic cell :
 $\text{Al(s)} | \text{Al}^{3+} (0.1 \text{ M}) || \text{Ag}^{+}(\text{aq}) (0.1 \text{ M}) | \text{Ag(s)}$
 Which of the following is/are correct ? (Q is reaction quotient.)
 (A) $Q = 1.0 \times 10^{-2}$, (B) $\log_{10} Q = 2$ (C) $Q = 1.0 \times 10^3$ (D) $Q = 1.0 \times 10^2$
2. Which of the following statements is/are correct about hexagonal close packing ?
 (A) In hcp, atoms occupy 74% of the available space.
 (B) It is AB AB type packing in which third layer is aligned with the first layer.
 (C) ABAB..... and ABCABC... type packing have same density
 (D) The coordination number is 6.
3. Identify true statements.
 (A) Aquatic species are more comfortable in cold water because O_2 has more solubility at low temperature.
 (B) Henry's constant ' K_H ' (atm) increases with increase in temperature for gas like O_2 , N_2 .
 (C) Solubility of gas increases with increase in partial pressure of gas.
 (D) Solubility of gas increases with increase in temperature.
4. Which of the following cations form ppt. with $\text{K}_4[\text{Fe}(\text{CN})_6]$
 (A) Zn^{2+} (B) Cu^{2+} (C) Cd^{2+} (D) Sr^{2+}
5. In which of the following pair(s), the minerals are converted into metals by self-reduction process ?
 (A) Cu_2S , PbS (B) PbS , HgS (C) PbS , ZnS (D) Ag_2S , ZnS

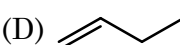
Space for Rough Work

6. Which of the following statements are correct ?

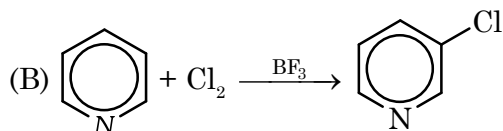
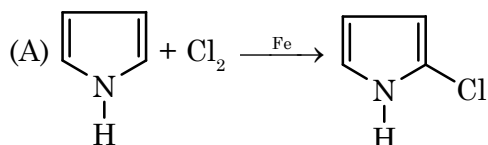
- (A) Sulphur exists as S_8 , S_6 and S_2 in various condition
- (B) In diamond, 'C' is sp^3 hybridised whereas in graphite it is sp^2 hybridised.
- (C) Black phosphorus is also known as metallic phosphorus
- (D) Sulphur on reaction with NaOH shows disproportionation.



The products formed in the above reaction can be

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

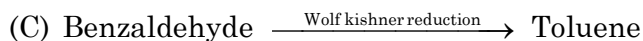
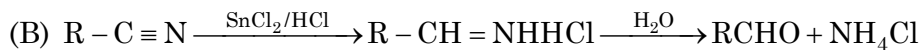
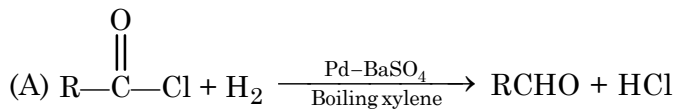
8. Which of the following is/are correct ?



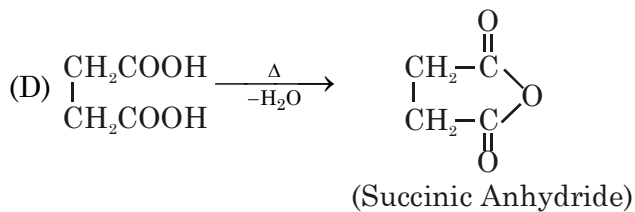
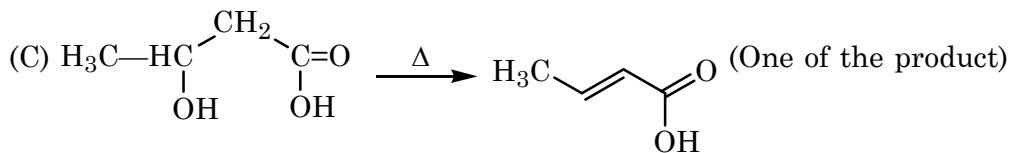
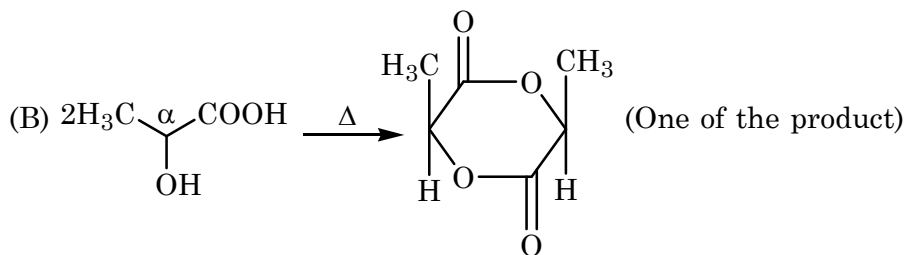
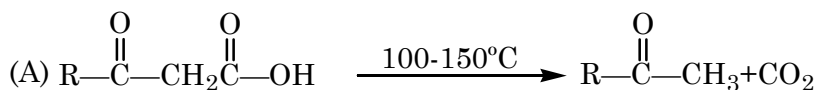
- (C) $C_6H_6 > C_6D_6 > C_6T_6$ (reactivity towards nitration)
- (D) $C_6H_6 > C_6D_6 > C_6T_6$ (reactivity towards sulphonation)

Space for Rough Work

9. Which of the following reactions is/are correct ?



10. Which of the following reactions is/are correct w.r.t heating of carboxylic acid ?

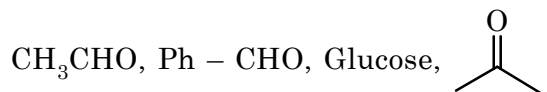


Space for Rough Work

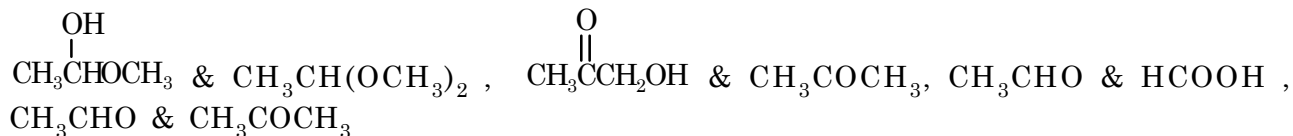
SECTION-III : (Maximum Marks : 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +4 If only the bubble corresponding to the correct answer is darkened.
Zero Marks : 0 In all other cases.

1. Critical temperature and critical pressure of a real gas is 27°C & 75 atm respectively. Then what is critical volume of 1 mole of real gas (in mL) - ($R = 0.08\text{ atm-L/mol-K}$)
Fill your answer as sum of digits (excluding decimal places) till you get the single digit answer.
2. A H-like species emitted a photon corresponding to the first line of Lyman series. The photon liberated a photoelectron from He^+ in ground state. The de-Broglie wavelength of the photoelectron is 2\AA . Calculate the atomic number of H-like species.
3. Find the number of molecules / ions which are having unpaired electron in its antibonding molecular orbital.
 O_2 ; N_2 ; NO ; N_2^+ ; O_2^+ ; O_2^- ; O_2^{2+}
4. The total number of carbonate ores among the following is—
 (i) Argentite (ii) Calamine (iii) Malachite (iv) Siderite
 (v) Galena (vi) Magnetite (vii) Dolomite (viii) Cassiterite
 (ix) Bauxite
5. (i) Number of compounds which do not react with Fehling solution are **x** ?



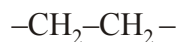
- (ii) Tollen's reagent can be used to distinguish between **y** number of pairs:



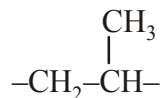
[Give your answer as **x + y**]

Space for Rough Work

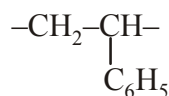
6. The compounds D-glucose, D-mannose & 'X' forms same osazone on reaction with phenyl hydrazine. 'X' exists predominantly in furanose form 'Y'. In the molecule Y the anomeric carbon is atposition.
7. Find correct number of matchings.

Repeating unit
Polymer


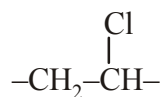
Polyethylene



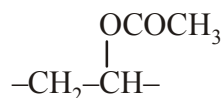
Polypropene



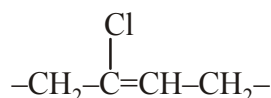
Polystyrene



Polyvinyl Chloride(PVC)



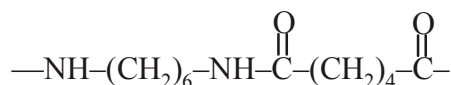
Polyvinyl Acetate



Neoprene



Nylon-6



Nylon - 66

8. Amino acids are monomer of protein and these aminoacids are connected by peptide bond. A decapeptide (Mole wt. 796) on complete hydrolysis gives glycine (Mole wt. 75), alanine and phenylalanine. Glycine contributes 39.14% to the total weight of the hydrolysed products. The number of glycine units present in the decapeptide is :

 Space for Rough Work

SECTION-IV : (Maximum Marks : 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column-I** and **Column-II**.
- **Column-I** has **four** entries (A), (B), (C) and (D)
- **Column-II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column-I** with the entries in **column-II**.
- One or more entries in **Column-I** may match with one or more entries in **Column-II**.
- The ORS contains a 4×5 matrix whose layout will be similar to the one shown below :

(A)	<input type="checkbox"/>	(P)	<input type="checkbox"/>	(Q)	<input type="checkbox"/>	(R)	<input type="checkbox"/>	(S)	<input type="checkbox"/>	(T)	<input type="checkbox"/>
(B)	<input type="checkbox"/>	(P)	<input type="checkbox"/>	(Q)	<input type="checkbox"/>	(R)	<input type="checkbox"/>	(S)	<input type="checkbox"/>	(T)	<input type="checkbox"/>
(C)	<input type="checkbox"/>	(P)	<input type="checkbox"/>	(Q)	<input type="checkbox"/>	(R)	<input type="checkbox"/>	(S)	<input type="checkbox"/>	(T)	<input type="checkbox"/>
(D)	<input type="checkbox"/>	(P)	<input type="checkbox"/>	(Q)	<input type="checkbox"/>	(R)	<input type="checkbox"/>	(S)	<input type="checkbox"/>	(T)	<input type="checkbox"/>

- For each entry in **column-I**, darken the bubbles of all the matching entries. For example, if entry (A) in **Column-I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (B), (C) and (D).
- For each question, marks will be awarded in one of the following categories :

For each entry in **Column-I**

Full Marks : +2 If only the bubble(s) corresponding to all the correct match(es) is (are) darkened

Zero Marks : 0 If none of the bubbles is darkened

Negative Marks : -1 In all other cases

1. Match the Matrix.

[Where M is central metal atom and a,b,c & d are monodentate ligand]

Column - I (Type of complex)	Column - II (Correct Characteristics)
(A) $[\text{Ma}_3\text{b}_2\text{c}]$	(P) All stereoisomers are optically inactive.
(B) $[\text{Ma}_3\text{b}_3]$	(Q) No. of geometrical isomers = 2.
(C) $[\text{Ma}_3\text{bcd}]$	(R) No. of geometrical isomers = 4.
(D) $[\text{Ma}_4\text{bc}]$	(S) Total 3 stereoisomers.
	(T) Only one enantiomeric pair is possible.

Space for Rough Work

2. The match Column I with Column II assuming single reactant to be involved..

Column I	Column II
(A) 1 st order reaction	(P) Rate of reaction will decrease with time as the reaction proceeds.
(B) Zero order reaction	(Q) Reaction can get 100% completed in finite time interval.
(C) Order greater than 1	(R) Graph of rate of reaction v/s concentraion of reactant will be a straight line.
(D) Negative order	(S) Half life depends on initial concentration
	(T) Rate of reaction will increase with time as the reaction proceeds.

Space for Rough Work

PART-3 : MATHEMATICS

SECTION-I : (Maximum Marks: 40)

- This section contains **TEN** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 If only (all) the correct option(s) is (are) chosen.
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks : -2 In all other cases.

1. Let $A = [a_{ij}]$ be 3×3 order matrix and $B = [b_{ij}]$ be 3×3 order matrix such that b_{ij} is the sum of the elements of i^{th} row of A except a_{ij} . If $\det. (A) = 4$, then the value of $\det. (B)$ is divisible by
 (A) 2 (B) 4 (C) 6 (D) 8

2. ABCD is a tetrahedron where $A(2, 0, 0)$, $B(0, 4, 0)$ and $CD = \sqrt{14}$. The edge CD lies on the line $\frac{x-1}{1} = \frac{y-2}{2} = \frac{z-3}{3}$. If locus of centroid of tetrahedron is $\frac{x-\frac{3}{2}}{1} = \frac{y-y_1}{a} = \frac{z-z_1}{b}$ then
 (A) $a + b = 5$ (B) $y_1 + z_1 = 6$ (C) $y_1 - z_1 = 1$ (D) $a + b + y_1 = 8$

3. Let $P(x_1, y_1)$ be a point on the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$. The tangent at point P passes through the point $(0, -b)$ and the normal at point P passes through the point $(2\sqrt{2}a, 0)$. If e denotes the eccentricity of the hyperbola then which of the following is/are correct?
 (A) $x_1 = \sqrt{2}a$ (B) $x_1 = 2a$ (C) $y_1 = b$ (D) $e^2 = 2$

Space for Rough Work

4. A curve $y = f(x)$ satisfies the differential equation $(1 + x^2) \frac{dy}{dx} + 2yx = 4x^2$ and passes through the origin. For the function $y = f(x)$ which of the following does not hold good?
- (A) $f(x)$ has same domain and range.
 (B) $f(x)$ is strictly increasing $\forall x \in \mathbb{R}$.
 (C) $f(x)$ has no inflection point.
 (D) The area enclosed by $y = f^{-1}(x)$, the x -axis and the ordinate at $x = 2/3$ is $\frac{4}{3} \ln 2$
5. Identify which of the following statement(s) is(are) correct. ($[k]$ denotes greatest integer function of k)
- (A) $f(x) = 3 \cos(|x^2 - x|) + 4(x + 2)|x| \sin(|x^2 + 2x|)$ is not differentiable exactly at 1 point
 (B) $f(x) = 3 \cos(|x^7 - x|) + 4|x| \sin(|x^7 + x|)$ is differentiable $\forall x \in \mathbb{R}$
 (C) $f(x) = [x^2 - 2](|x| + |2x - 1| + |2x - 3| + |3x - 5|)$ is not differentiable exactly at 5 points in $(-1, 2)$
 (D) $f(x) = [x^2 - 2](|x| + |2x - 1| + |2x - 3|)$ is not differentiable exactly at 5 points in $(-1, 2)$
6. If $\lim_{x \rightarrow \infty} \left(\frac{x^3 + 1}{x + 1} - ax^2 - bx - c \right) = 4$ then
- (A) $a + b < c$ (B) $a + b > c$ (C) $a - b + c = 5$ (D) $a - b - c = 5$
7. If $\vec{a} \times (\vec{b} \times \vec{c}) + (\vec{a} \cdot \vec{b})\vec{b} = (4 - 2\beta - \sin \alpha)\vec{b} + (\beta^2 - 1)\vec{c}$ and $(\vec{c} \cdot \vec{c})\vec{a} = \vec{c}$, where \vec{b} and \vec{c} are non-collinear vectors, then
- (A) $\alpha = \frac{\pi}{2}$ (B) $\alpha = \frac{\pi}{3}$ (C) $\beta = 1$ (D) $\beta = -1$

Space for Rough Work

8. If $A = \begin{bmatrix} 3 & 1 \\ 4 & 2 \end{bmatrix}$ and B_p is another matrix defined as $B_p = \underbrace{(A^p)(\text{adj}(\text{adj}(\dots(\text{adj} A))))}_{p\text{-times}}$

where $p \in \mathbb{N}$, then identify the correct statement(s)

- (A) $\text{Tr}(B_1) = 4$ (B) $\det(B_2) = 8$ (C) $\sum_{p=1}^{\infty} \det(B_p^{-1}) = 1$ (D) $\text{adj}(\text{adj} B_2) = A^3$
9. The tangent at any point P on a curve $f(x, y) = 0$ cuts the y -axis at T . If the distance of the point T from P equals the distance of T from the origin then which of the following is/are correct ?
- (A) $f(x, y) = 0$ represents a family of circles having common radical axis
 (B) $f(x, y) = 0$ is orthogonal to the circle $x^2 + y^2 - 4y = 0$
 (C) If $f(x, y) = 0$ passes through $(2, 2)$ then the portion intercepted by its director circle on the y -axis is equal to 8.
 (D) If $f(x, y) = 0$ passes through $(-1, 1)$ then image of its centre in the line $y = x$, is $(0, 1)$
10. The direction cosines of the lines bisecting the angle between the lines whose direction cosines are ℓ_1, m_1, n_1 and ℓ_2, m_2, n_2 and the angle between these lines is θ , are

- (A) $\frac{\ell_1 + \ell_2}{\cos \frac{\theta}{2}}, \frac{m_1 + m_2}{\cos \frac{\theta}{2}}, \frac{n_1 + n_2}{\cos \frac{\theta}{2}}$ (B) $\frac{\ell_1 + \ell_2}{2\cos \frac{\theta}{2}}, \frac{m_1 + m_2}{2\cos \frac{\theta}{2}}, \frac{n_1 + n_2}{2\cos \frac{\theta}{2}}$
- (C) $\frac{\ell_1 + \ell_2}{\sin \frac{\theta}{2}}, \frac{m_1 + m_2}{\sin \frac{\theta}{2}}, \frac{n_1 + n_2}{\sin \frac{\theta}{2}}$ (D) $\frac{\ell_1 - \ell_2}{2\sin \frac{\theta}{2}}, \frac{m_1 - m_2}{2\sin \frac{\theta}{2}}, \frac{n_1 - n_2}{2\sin \frac{\theta}{2}}$

Space for Rough Work

SECTION-III : (Maximum Marks : 32)

- This section contains **EIGHT** questions.
- The answer to each question is a **SINGLE DIGIT INTEGER** ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +4 If only the bubble corresponding to the correct answer is darkened.
Zero Marks : 0 In all other cases.

1. If the line $y = mx + c$ is tangent to the circle $x^2 + y^2 = 5r^2$ and the parabola $y^2 - 4x - 2y + 4\lambda + 1 = 0$ and point of contact of the tangent with the parabola is $(8, 5)$, then find the value of $(25r^2 + \lambda + 2m - c)$.
2. If $\int_{-\pi/4}^{\pi/4} \frac{(\pi - 4\theta)\tan\theta}{1 - \tan\theta} d\theta = \pi \ln k - \frac{\pi^2}{w}$, find (kw) , where $k, w \in \mathbb{N}$
3. $f(x)$ be a polynomial of degree at most 7 which leaves remainders -1 and 1 upon division by $(x-1)^4$ and $(x+1)^4$ respectively. If the sum of pairwise product of all roots of $f(x) = 0$ is n then the value of $(5n + 24)$ is
4. The area bounded by the curves $y = 6x - x^2$ and $y = x^2 - 2x$ is A , then value of $\frac{3A}{8}$ is
5. If $\cos^5 x + \cos^5\left(x + \frac{2\pi}{3}\right) + \cos^5\left(x + \frac{4\pi}{3}\right) = 0$, then find the number of solution(s) in $[0, 2\pi]$.

Space for Rough Work

6. A circle has same centre as an ellipse and passes through the Foci F_1 and F_2 of the ellipse, such that the 2 curves intersect in 4 points. Let P be any of their point of intersection. If the major axis of the ellipse is 15 and the area of the triangle PF_1F_2 is $\frac{81}{4}$, then the distance between the foci is k then $\left(\frac{k}{3}\right)$ is
7. Let a fair coin be tossed 6 times. A, B and C three events are defined as
A : exactly 4 heads are obtained.
B : 4th head obtained on 5th toss.
C : tail is obtained, on 2nd or 4th toss
- If conditional probability, $P\left(\frac{B}{A \cap C}\right) = \frac{m}{n}$ where $m, n \in \mathbb{N}$ then find the least value of $(n - m)$.
8. In a certain test there are n questions. In this test $(n - r)^2$ students gave wrong answers to at least r questions ($1 \leq r \leq n$). If total number of wrong answers given is 204 then the value of n is

Space for Rough Work

SECTION-IV : (Maximum Marks : 16)

- This section contains **TWO** questions.
- Each question contains two columns, **Column-I** and **Column-II**.
- **Column-I** has **four** entries (A), (B), (C) and (D)
- **Column-II** has **five** entries (P), (Q), (R), (S) and (T)
- Match the entries in **Column-I** with the entries in **column-II**.
- One or more entries in **Column-I** may match with one or more entries in **Column-II**.
- The ORS contains a 4×5 matrix whose layout will be similar to the one shown below :

 (A) ☐ (P) ☐ (Q) ☐ (R) ☐ (S) ☐ (T)

 (B) ☐ (P) ☐ (Q) ☐ (R) ☐ (S) ☐ (T)

 (C) ☐ (P) ☐ (Q) ☐ (R) ☐ (S) ☐ (T)

 (D) ☐ (P) ☐ (Q) ☐ (R) ☐ (S) ☐ (T)

- For each entry in **column-I**, darken the bubbles of all the matching entries. For example, if entry (A) in **Column-I** matches with entries (Q), (R) and (T), then darken these three bubbles in the ORS. Similarly, for entries (B), (C) and (D).
- For each question, marks will be awarded in one of the following categories :

 For each entry in **Column-I**

Full Marks : +2 If only the bubble(s) corresponding to all the correct match(es) is (are) darkened

Zero Marks : 0 If none of the bubbles is darkened

Negative Marks : -1 In all other cases

1. Match the following

Column-I	Column-II
(A) Let $f : (-1, \infty) \rightarrow \mathbb{R}$ be a differentiable function for all $x \in (-1, \infty)$ defined by $f(x) = \begin{cases} k, & \text{if } x = 0 \\ \frac{\ln(1+x^3)}{(x - \sin x)}, & \text{if } x \neq 0 \end{cases}$, then the value of $f'(0)$ is less than	(P) 1 (Q) 3
(B) Let $z = x + iy$ (where $i = \sqrt{-1}$, $x, y \in \mathbb{R}$) be a complex number such that $ z - 2 = \min\{ z , z - 4 \}$. $\text{Re}(z)$ can have value	(R) 5
(C) If area of a triangular face BCD of a regular tetrahedron ABCD is $4\sqrt{3}$ sq. units, then area of a triangle whose two sides are represented by vectors \overline{AB} and \overline{CD} is greater than	(S) 6
(D) The sum of n terms of an arithmetic progression is 153, and the common difference is 2. If the first term is an integer and $n > 1$, then n can have value	(T) 9

Space for Rough Work

2. Match the following :

Column-I
Column-II

- (A) If the point $A(2, -9, \lambda)$ and $B(\lambda, -1, -3)$ lie on the same side of a plane which contain the lines

(P) -5

$$\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1} \text{ and } \frac{x}{1} = \frac{7-y}{3} = \frac{z+7}{2},$$

(Q) 1

then λ can have value

- (B) Let ABC and ABC' be two non-congruent triangles such that

$$AB = \sqrt{2}, AC = AC' = 1, BC > BC' \text{ and } \angle B = 30^\circ, \text{ then}$$

twice the area of $\Delta ACC'$ can have value

(R) 2

- (C) Let S be the area bounded by the curve $y = \sin x$ ($0 \leq x \leq \pi$) and the x-axis and T be the area bounded by the curves

$$y = \sin x \left(0 \leq x \leq \frac{\pi}{2} \right), y = a \cos x \left(0 \leq x \leq \frac{\pi}{2} \right) \text{ and the x-axis}$$

(where $a \in \mathbb{R}^+$). If $S : T = 1 : \frac{1}{3}$ then $(a + T)$ is greater than

(S) 5

- (D) If $\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_8$ are the roots of the equation

$$z^8 + z^4 + 1 = 0 \text{ then the value of } \sum_{i=1}^8 \alpha_i^{16} \text{ is less than}$$

(T) 6

Space for Rough Work

QUESTION PAPER FORMAT AND MARKING SCHEME :

16. The question paper has three parts : Physics, Chemistry and Mathematics.

17. Each part has three sections as detailed in the following table.

Section	Que. Type	No. of Que.	Category-wise Marks for Each Question				Maximum Marks of the section
			Full Marks	Partial Marks	Zero Marks	Negative Marks	
I	One or more correct option(s)	10	+4 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened	—	0 If none of the bubbles is darkened	–2 In all other cases	40
III	Single digit Integer (0-9)	8	+4 If only the bubble corresponding to correct answer is darkened	—	0 In all other cases	—	32
IV	Matrix Match Type	2	+8 If only the bubble(s) corresponding to all the correct match(es) is(are) darkened	+2 For darkening a bubble corresponding to each correct match is darkened	0 If none of the bubbles is darkened	–1 In all other cases	16

NAME OF THE CANDIDATE

FORM NO.

I have read all the instructions and shall abide by them.

 Signature of the Candidate

I have verified the identity, name and Form number of the candidate, and that question paper and ORS codes are the same.

 Signature of the Invigilator

FINAL TEST SERIES

ICAD
Creating & Nurturing Talent

Subject: PCM

Topic: JEE-20-FTSA-14-Paper I (Full Course)

Time Allowed: 3 Hrs.

Date of Test: 25/07/2020

Batch : JEE-20

Test No: 14-PI

Maximum Marks:198

PHYSICS

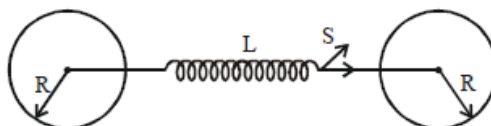
NOTE: There are 20 questions in this part.

- | | | |
|-----------------------------------|---|-----------------------|
| (A) Single Correct Option | : | 08 × 3 = 24 (3R - 1W) |
| (B) Passage | : | 06 × 3 = 18 (3R - 1W) |
| (C) Single Integer Type Questions | : | 06 × 4 = 24 (4R - 0W) |

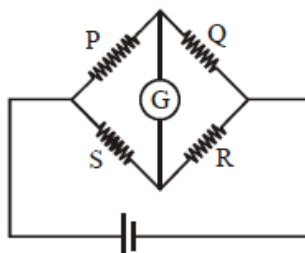
PART : A (8 × 3 = 24 Marks) (3R - 1W)

CHOOSE THE SINGLE CORRECT OPTION :

1. A uniform circular disc has a moment of inertia I and radius of gyration K about an axis perpendicular to the disc and passing through its centre. A smaller concentric disc is taken out from this bigger disc. As a result of which moment of inertia and radius of gyration of the resulting body about the same axis :-
(A) Increases and decreases respectively (B) Increases and increases respectively
(C) Decreases and increases respectively (D) Decreases and decreases respectively
2. Two conducting spheres of equal radii R are placed far apart and are connected by an ideal inductor as shown. Initially one of the spheres has charge Q while other is uncharged. Switch is closed at time $t = 0$. Then :-

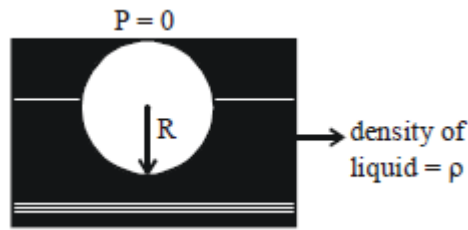


- (A) Minimum time after which all charge can be transferred to other sphere is $\sqrt{2\pi^3 \epsilon_0 LR}$
(B) Minimum time after which all charge can be transferred to other sphere is $\sqrt{8\pi^3 \epsilon_0 LR}$
(C) First sphere will acquire a negative charge at some instant of time
(D) At some instant of time both spheres will have zero charge
3. Resistances are arranged in a cyclic order to form a balanced wheatstone bridge as shown in figure. Ratio of power consumed in the branches $P + Q$ and $R + S$ is :

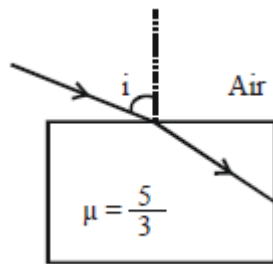


- (A) $R : Q$ (B) $R : P$ (C) $P^2 : Q^2$ (D) $P^2 : R^2$

4. A sphere floats in water just submerged as shown in the diagram. If atmospheric pressure is neglected then :-



- (A) Force exerted by liquid on lower half of sphere is $\frac{4\rho\pi R^3}{3}g$
- (B) Force exerted by liquid on lower half of sphere and upper half of sphere is same in magnitude
- (C) Ratio of magnitude of forces exerted by liquid on lower and upper half of sphere is 5 : 1
- (D) Ratio of magnitude of forces exerted by liquid on lower and upper half of sphere is 4 : 1
5. A progressive wave propagating in a medium is given by $y = \sin(4t - 3x)$, where y is in mm, x is in m and t is in second. This wave gets reflected from a boundary at $x = 2\text{m}$:-
- (A) If boundary is a free end, then equation of reflected wave is given by $y_r = 2\sin(4t + 3x)$
- (B) If boundary is a free end, then equation of reflected wave is given by $y_r = 2\sin(4t + 3x - 12)$
- (C) If boundary is a fixed end, then equation of reflected wave is given by $y_r = 2\sin(3x - 4t)$
- (D) If boundary is a fixed end, then equation of reflected wave is given by $y_r = 2\sin(12 - 3x + 4t)$
6. A glass cube has refractive index of $1.66 = \left(\frac{5}{3}\right)$. A light beam enters the top face obliquely and then strikes the vertical side of cube. Mark the **INCORRECT** option :-



- (A) No light can emerge from vertical side surface
- (B) Light can emerge from vertical side surface for a suitable value of angle of incidence i .
- (C) If light emerges from a surface then its angle of emergence will be equal to angle of incidence on top surface
- (D) If angle of incidence is 30° , then deviation suffered by emergent ray is 60° .
7. A particle of charge q is moved from infinity to the centre of a hollow conducting spherical shell of radius R , thickness $t \ll R$ through a very tiny hole in the shell. How much work is done by an external agent in the process.

- (A) $\frac{q^2 t}{8\pi \epsilon_0 R^2}$ (B) $\frac{q^2 t}{4\pi \epsilon_0 R^2}$ (C) $-\frac{q^2 t}{8\pi \epsilon_0 R^2}$ (D) $-\frac{q^2 t}{4\pi \epsilon_0 R^2}$

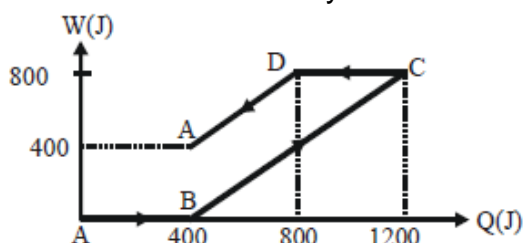
8. A small ball of mass 1 gm carrying a charge of 1mC is dropped in a uniform magnetic field of 1T in horizontal direction in the presence of uniform gravity in vertically downward direction. Maximum speed of the ball in subsequent motion is :
 (A) 2 m/s (B) 8 m/s (C) 10 m/s (D) 20 m/s

PART : B (6 × 3 = 18 Marks) (3R – 1W)

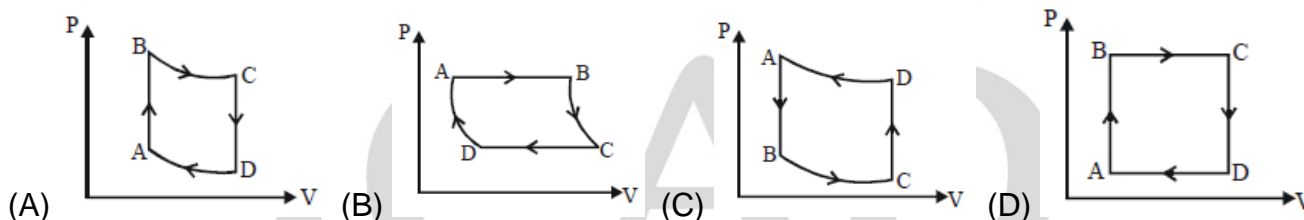
READ THE FOLLOWING PASSAGE AND CHOOSE THE CORRECT OPTION:

PASSAGE – I :

A sample of mono-atomic ideal gas is taken through a cyclic process ABCDA. The cyclic process is such that each of the subprocesses have constant molar specific heat capacity. A graph is plotted in which heat exchanged by the gas upto an instant is shown on x-axis and work done by the gas upto that instant is shown on y-axis.



9. The given cyclic process can be represented on a pressure-volume graph as :-



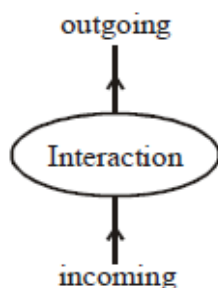
10. Choose **INCORRECT** statement :

- (A) Magnitude of temperature change in the process AB and CD are same
 (B) Process AB and CD are isochoric
 (C) Process BC and DA are isothermal
 (D) Process BC is adiabatic but CD is isothermal

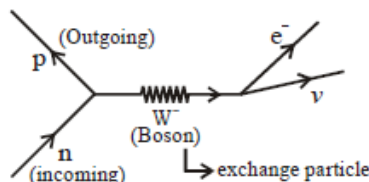
PASSAGE – II :

It is a matter of common knowledge that two electrons kept at a distance repel each other. Have you ever thought how does one electron get to know the presence of other ? Obviously there must be some information exchange between the particles. This information exchange takes place with the help of exchange of some elementary particles, which are called force carriers.

Scientists have found these exchange particles for all types of interaction except gravitational forces. These particles are called gauge bosons. For strong nuclear forces these gauge bosons are called gluons, for electromagnetic forces these gauge bosons are photon and for weak interaction the gauge bosons are called W^\pm gauge bosons. The great Scientist Richard Feynman explained the interaction between particles by now legendary Feynman diagram. The rules of these diagram is that time always goes up, So we start with incoming particle at bottom and outgoing particle at top while interaction takes place at the middle, as shown below.

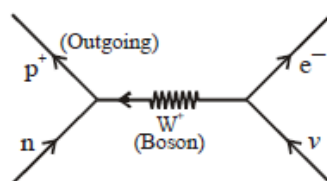
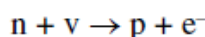


In an actual situation, let's consider a case when a neutron gets converted into proton, an electron and an antineutrino, Feynman diagram will look like as shown below.

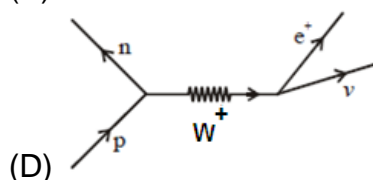
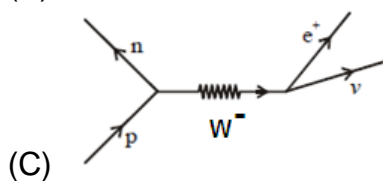
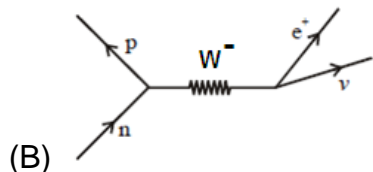
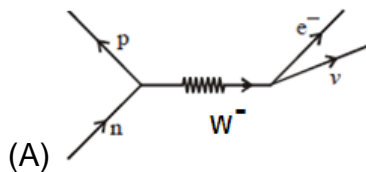


So conversion of neutron into proton involves emission of W^- boson which quickly decays into electron and antineutrino.

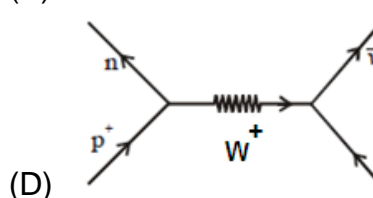
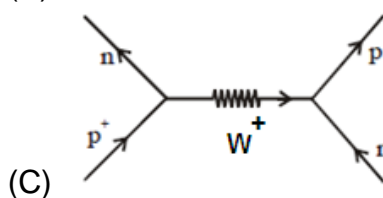
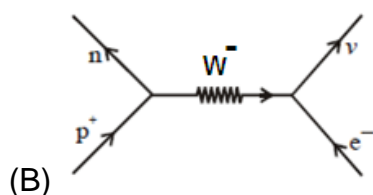
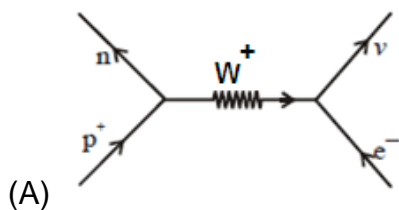
Let us consider a reaction in which a neutron and a neutrino combine to give a proton and an electron.



11. For a nucleus having $\frac{N}{Z}$ ratio considerably less than 1, which of the Feynman diagram is most suitable, when it regains its stability.



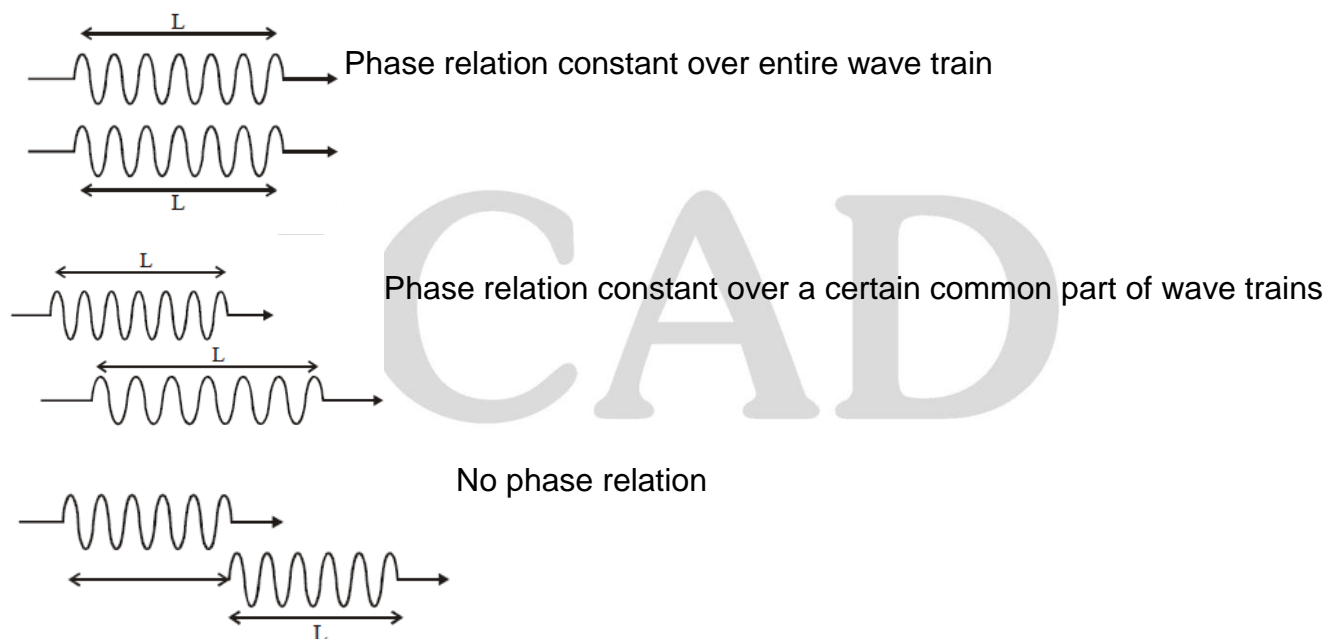
12. The Feynman diagram representing K-capture is given by :



PASSAGE – III : (13 & 14)

A crucial requirement for sustainable interference is coherence, which simply means, waves arriving at a given point from two sources must have a definite phase relationship. Obtaining coherent waves is extremely difficult as light emitted by ordinary sources are not infinitely long but consists of wave trains of finite length. Basic mechanism of emission of light involves atoms radiating em waves. A typical atom radiates for 10^{-9} s, This time is called coherence time (τ_c) and length of wave train $L = (C)(\tau_c)$ is called coherence length.

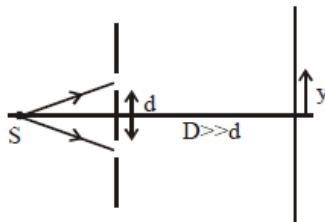
So waves emitted by two ordinary sources, reaching at a point can have a constant phase difference for a maximum of 10^{-9} s, after which two new waves will reach the point. Situation gets worse if we consider interference of waves emitted at different times, in such cases, actual time for which phase difference between waves remains constant is much less than 10^{-9} s. The above mentioned facts can be explained easily with the help of diagram as shown below.



13. Choose the **CORRECT** statement :

- (A) Interference between two waves of same frequencies, is more profound when their path difference is much greater than coherence length
- (B) Interference between two waves of same frequencies, is more profound when their path difference is much smaller than coherence length
- (C) Profoundness of interference between two waves of same frequencies is independent of their coherence length.
- (D) All are correct.

14. In a YDSE set up ($D \gg d$), if coherence lengths of interfering waves are L each, the maximum distance y from central line beyond which there will be practically no sustainable interference is given by :

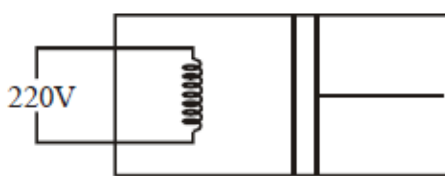


- (A) $\frac{DL}{d}$ (B) $\frac{dL}{D}$ (C) $\frac{dD}{L}$ (D) $\frac{2(d)(L)}{D}$

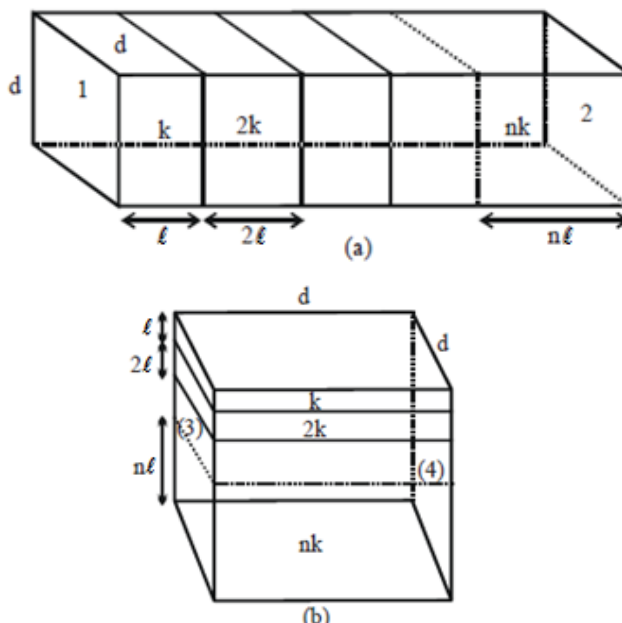
PART : C ($6 \times 4 = 24$ Marks) (4R – 0W)

NUMERICAL VALUE TYPE QUESTIONS :

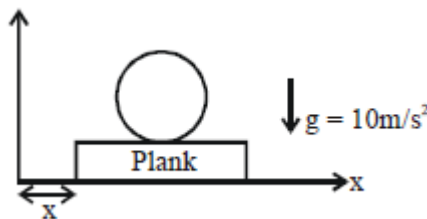
15. There is a certain mass of hydrogen gas in a container closed with a frictionless piston as shown in figure. The gas is heated for 25 s by an electric heater of resistance 50Ω built in the container using a power supply of 220 volt. While the gas expands at constant pressure its temperature increases by 250°C . If efficiency of electric heater is 75%, then find the mass of gas approximately (in gm) in container.



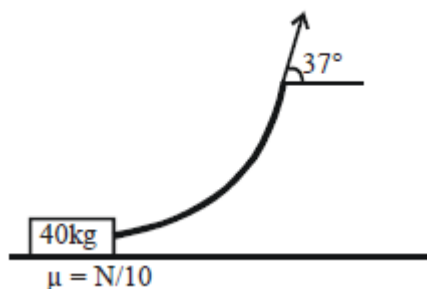
16. An arrangement consisting of slabs is shown in the figure. When system is placed in situation (a) with temperature difference is maintained between (1) & (2), equivalent thermal conductivity of system is K and when system is changed to situation (b) and temperature difference is maintained between (3) & (4) then equivalent thermal conductivity increases by 20%. Find number of slabs in the arrangement.



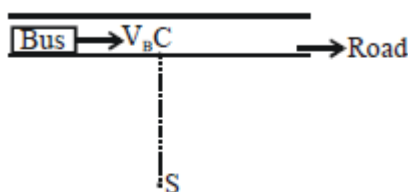
17. A solid cylinder is kept over a rough plank which is oscillating along x-axis according to equation $x = A \cos(10)t$, where x is in m and t is in s. If coefficient friction between cylinder and plank is 0.3, then find maximum amplitude of plank (in cm) possible, so that cylinder never slips on plank.



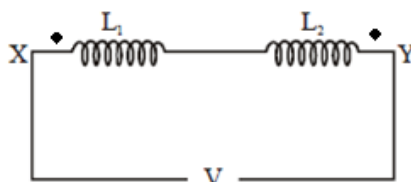
18. A mass 40 kg is kept on a rough surface as shown. A person tries to pull this mass by attaching a uniform string of mass 6 kg. The mass 40 kg is about to move when the person pulls the top end of string at an angle 37° with horizontal while tangent at lower end of string is horizontal. If coefficient of friction between mass and ground is $\frac{N}{10}$, find N.



19. A bus is moving with a velocity v_B along positive x-axis along a road as shown in the figure. A shooter S is at a distance ℓ from the road. He has a detector which can detect signals only of frequency 1500 Hz. The bus blows horn of frequency 1000 Hz. When detector detects a signal, shooter immediately shoots towards the road along SC and bullet hits the bus. If velocity of sound in medium is 360 m/s and $\frac{v_{\text{bus}}}{v_{\text{sound}}} = \frac{2}{3\sqrt{3}}$, then velocity of bullet (in m/s) is $(12)^n$ m/s. Find n.



20. In the circuit shown current is changing at the rate of $\frac{di}{dt} = 2 \text{ A/s}$. If $L_1 = L_2 = 1 \text{ H}$ and $M_{12} = \frac{1}{2} \text{ H}$, find emf V (in volt) between terminals X and Y.



□□□

CHEMISTRY

NOTE: There are 20 questions in this part.

- | | |
|-----------------------------------|-------------------------|
| (A) Single Correct Option | : 08 × 3 = 24 (3R - 1W) |
| (B) Passage | : 06 × 3 = 18 (3R - 1W) |
| (C) Single Integer Type Questions | : 06 × 4 = 24 (4R - 0W) |

PART : A (8 × 3 = 24 Marks) (3R – 1W)

CHOOSE THE SINGLE CORRECT OPTION :

21. The angular velocity (ω) of an electron occupying second orbit of Li^{2+} ion is, where ω is defined as the ratio of velocity of electron in an orbit to the radius of an orbit -

- (A) $\left(\frac{8\pi^3 m e^4 k^2}{h^3}\right)$ (B) $\left(\frac{8\pi m e^4 k^2}{9h^2}\right)$ (C) $\left(\frac{9\pi^3 m^2 e^4 k^2}{h^3}\right)$ (D) $\left(\frac{9\pi^3 m e^4 k^2}{h^3}\right)$

22. The molar solubility of $\text{Mn}(\text{OH})_2$ ($K_{sp} = 4.5 \times 10^{-14}$) in a buffer solution containing equal amount of NH_4^+ and NH_3 ($K_b = 2 \times 10^{-5}$)

- (A) 3×10^{-4} (B) 1.38×10^{-4} (C) 7.3×10^{-4} (D) 1.125×10^{-4}

23. Select the correct diagram for non-bonding molecular orbital :

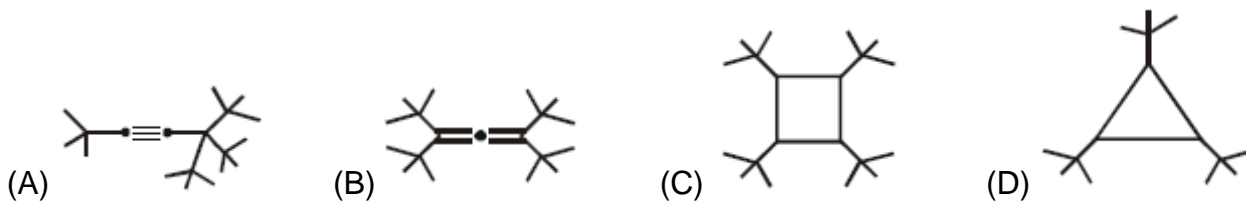
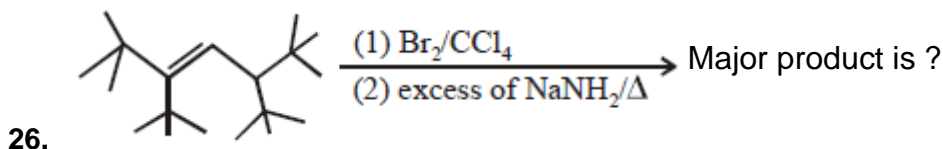


24. $[\text{Fe}(\text{H}_2\text{O})_6]^{+2}$ have pairing energy (P) 17600 cm^{-1} and crystal field splitting energy value 10400 cm^{-1} then it is :

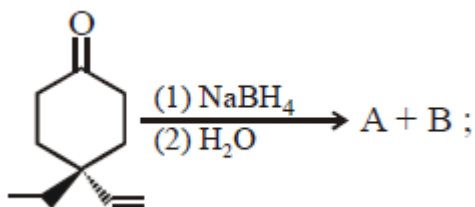
- (A) high spin complex (B) Low spin complex (C) Both (A) and (B) (D) None of these

25. Among the following, the paramagnetic compound is :

- (A) BaO_2 (B) Na_2O_2 (C) O_3 (D) RbO_2

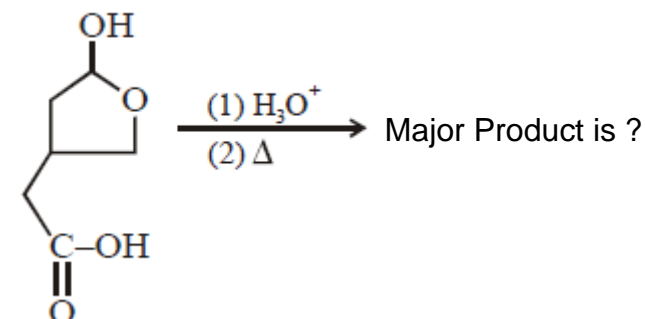


27. Identify relationship between A & B products ?



- (A) Diastereoisomers (B) Enantiomers (C) Geometrical isomers (D) Identical

28. In the reaction,



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

PART : B (6 × 3 = 18 Marks) (3R – 1W)

READ THE FOLLOWING PASSAGE AND CHOOSE THE CORRECT OPTION:

PASSAGE – I :

The rate of nuclear decay is determined from measurement of the activity (A) of a sample.

Activity , $A = \lambda.N$

$$\text{Or } -\frac{dN}{dt} = \lambda.N$$

Number of nuclei of radioactive element can be determined after time by

$$N = N_0.e^{-\lambda t}$$

Average life of radioactive element can be determined with the help of decay constant (λ).

$$T_{\text{average}} = \frac{1}{\lambda}$$

In a certain conditions, the age of a material can be determined based on the rate of decay of a radioactive isotope.

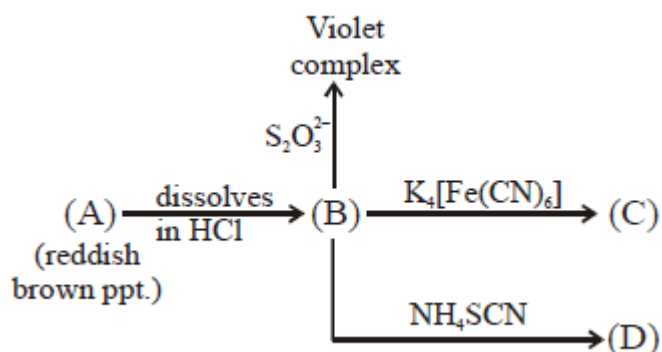
29. In a sample of wood, the reading of a counter is 32 dpm and in a fresh sample of tree it is 122 dpm. Due to error, counter gives the reading 2 dpm even in the absence of ^{14}C . The age (in years) of wood sample is :

Given : $t_{1/2}$ of $^{14}\text{C} = 5770$ years

- (A) 7997.2 (B) 5770 (C) 11,540 (D) 15140

30. A radioactive element is spread over a laboratory when its activity is 4 times the permissible value of safe working. After 230 hrs the room will be available for safe working. What is the mean life of radioactive element (Take $\ln 2 = 0.7$)
- (A) 62.5 hrs (B) 115 hrs (C) 164.28 hrs (D) 328.5 hrs

PASSAGE – II :

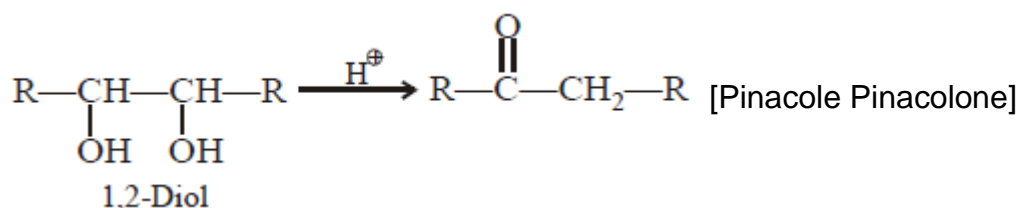


31. Colour of compound D is
 (A) Blue (B) Blood red (C) Chocolate brown (D) None of these
32. When (B) react with $\text{K}_3[\text{Fe}(\text{CN})_6]$ in presence of SnCl_2 then :
 (A) Blue ppt is formed (B) white ppt is formed
 (C) Blood red colouration is formed (D) Green colour solution is formed

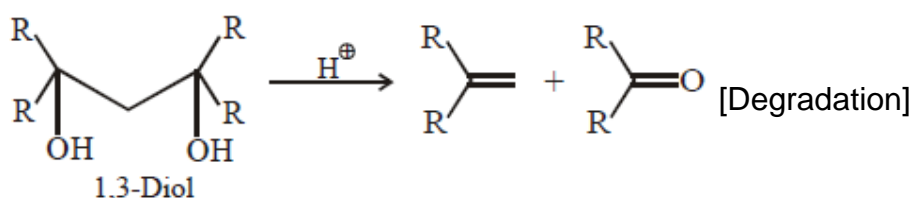
PASSAGE – III :

Acid catalysed reactions of diol are

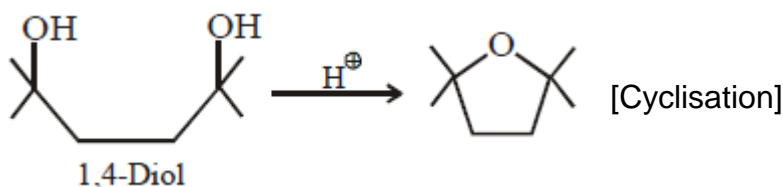
(1)



(2)

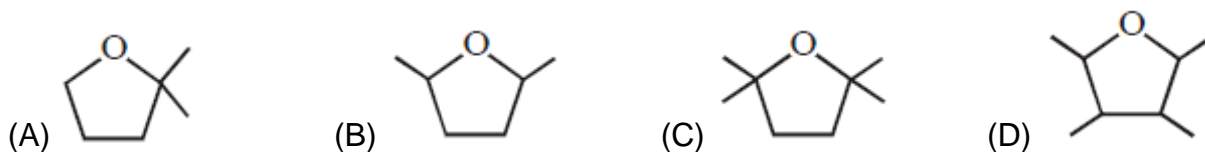
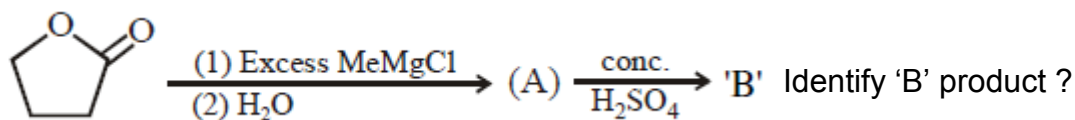


(3)

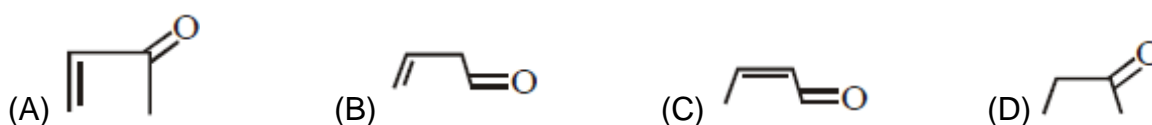
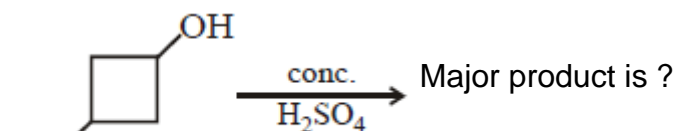


On the basis of above reactions give answer to following questions :

33. In the reaction,



34.



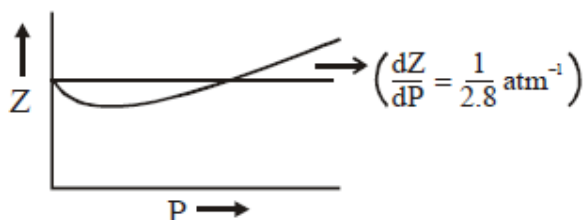
PART : C (6 × 4 = 24 Marks) (4R – 0W)

NUMERICAL VALUE TYPE QUESTIONS :

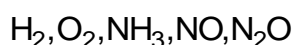
35. ΔH_f° of hypothetical Mg^+Cl^- is -125 kJ/mole and for MgCl_2 is -642 kJ/mole . The enthalpy of disproportionation of MgCl in $\text{MgCl}_2(\text{s})$ and $\text{Mg}(\text{s})$ is $-49x$. The value of x will be.

36. The graph between compressibility factor (z) and pressure (P) is plotted for one mole of a real gas at constant temperature of 273K as shown in figure. If the slope of graph at very high pressure is $\left(\frac{1}{2.8}\right) \text{ atm}^{-1}$, then excluded volume of one mole of real gas molecules ($“b”$ in litres/mole) is.

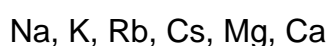
Given : $R = \frac{22.4}{273} \text{ LatmK}^{-1} \text{ mole}^{-1}$



37. Find the number of gaseous products which are formed when dilute nitric acid react with Ag metal in absence of air

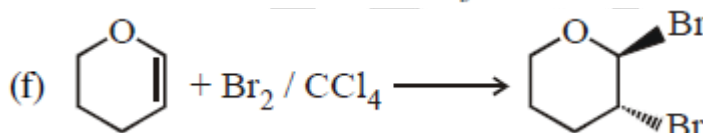
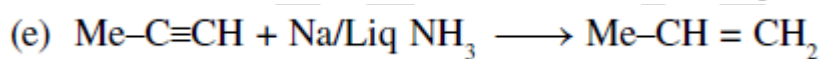
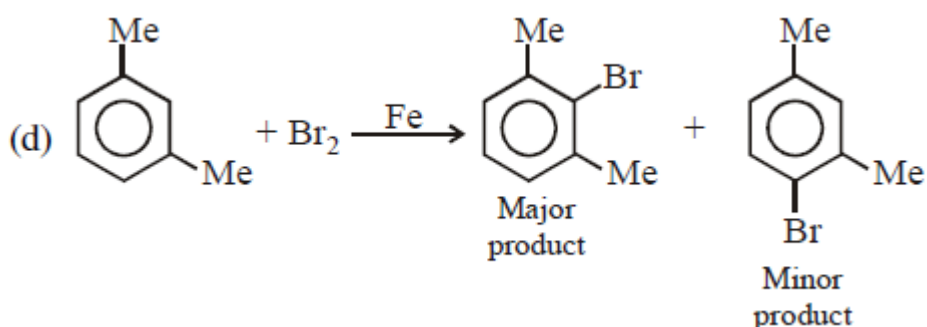
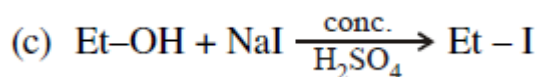
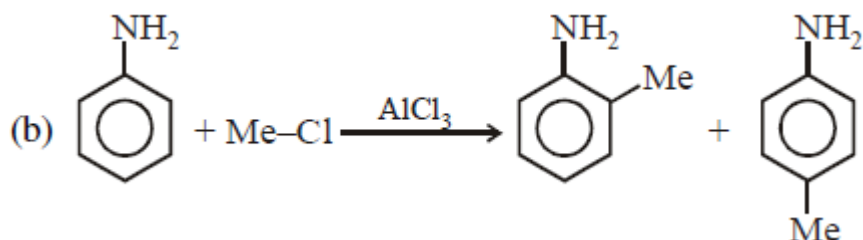
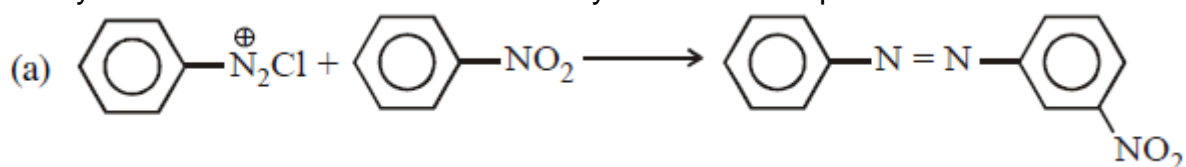


38. Which of the following metal will be better reducing agent in comparison to Li in aqueous medium

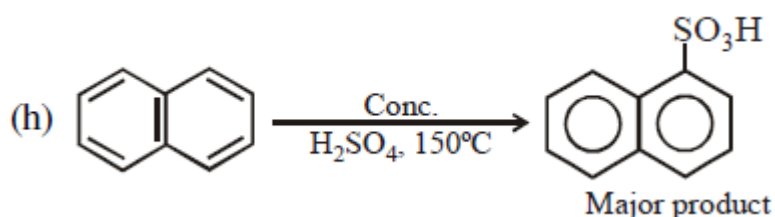
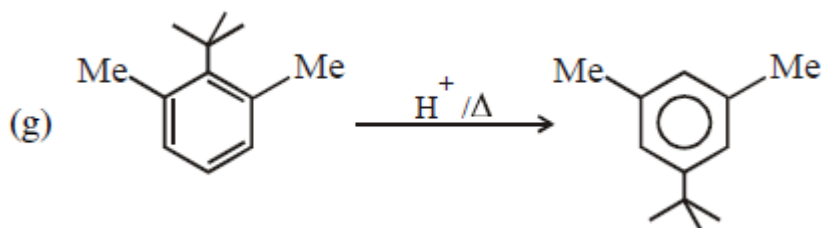


39. Identify total number of ester with $C_5H_{10}O_2$ molecular formula which give 3° alcohol as product on reaction with excess of $MeMgCl$ followed by H_2O ?

40. Identify total number of reactions incorrectly match with its product ?



100% product [Stereo specific reactions]



□□□

MATHEMATICS

NOTE: There are 20 questions in this part.

- (A) Single Correct Option : 08 × 3 = 24 (3R - 1W)
(B) Passage : 06 × 3 = 18 (3R - 1W)
(C) Single Integer Type Questions : 06 × 4 = 24 (4R - 0W)

PART : A (8 × 3 = 24 Marks) (3R - 1W)

CHOOSE THE SINGLE CORRECT OPTION :

41. In a triangle ABC (with usual notations), if ex-radii r_1, r_2, r_3 are in H.P., then $\frac{a+c}{b}$ is -
(A) 1 (B) 2 (C) 3 (D) 4
42. If A is an invertible square matrix of order n such that $|adj(adjA)| = |A|^{(2n^2-7n+7)}$, then sum of possible values of n is -
(A) 3 (B) 4 (C) 5 (D) 6
43. In $\triangle ABC$ (with usual notations); $a=2b$ and $|A-B| = \frac{\pi}{3}$, then which of the following does not hold good ?
(A) $B + \frac{C}{2} = \pi$ (B) $2B = C$ (C) $A + \frac{3C}{2} = \pi$ (D) $A > C > B$
44. Let $f(x)$ is an even function such that $f(x) + f(x-3) = x(x-3) + 1$, then $\int_0^3 \frac{f(x)dx}{(x^2-3x+1)}$ is -
(A) $-\frac{2}{3}$ (B) $-\frac{3}{2}$ (C) $\frac{2}{3}$ (D) $\frac{3}{2}$
45. The range of function $f(x) = e^{\left(\sin^{-1}x + \frac{\cos^{-1}x}{4}\right)}$ is -
(A) $\left[e^{-\frac{\pi}{4}}, e^{\frac{\pi}{2}}\right]$ (B) $[0, 1]$ (C) $\left[e^{-\frac{\pi}{2}}, e^{\frac{\pi}{2}}\right]$ (D) $[e^{-\pi}, e^{\pi}]$
46. If $2^{35} \cdot 3^{16}$ is divided by 11, then the remainder is -
(A) 1 (B) 3 (C) 5 (D) 8
47. If $(1+x+x^2)^n = a_0 + a_1x + a_2x^2 + \dots + a_{(2n-1)}x^{(2n-1)} + a_{2n}x^{2n}$,
Then $(a_0 + a_1 + \dots + a_n)^3 - (a_n + a_{(n+1)} + \dots + a_{2n})^3$ is (where $n \in N$)-
(A) 0 (B) $\frac{3^n-1}{2}$ (C) $\frac{9^n+1}{2}$ (D) $\frac{9^n-1}{2}$
48. If the range of $f(x) = -\sin^{-1}\left(\frac{x}{3}\right) + x^2 - 6x + 10$ is $[a, b]$, then $a+b$ is -
(A) 22 (B) 27 (C) 38 (D) 34

PART : B (6 × 3 = 18 Marks) (3R – 1W)

READ THE FOLLOWING PASSAGE AND CHOOSE THE CORRECT OPTION:

PASSAGE – I :

Let $f : R \rightarrow R$ and $f(x) = \sqrt{x^8 + x^6 + x^2 + 1}$.

49. $\lim_{x \rightarrow 1} \frac{f(x) - f(1)}{(x - 1)}$ is -

- (A) 1 (B) 4 (C) 8 (D) 9

50. Which of the following statement is false ?

- (A) $f(x)$ is an even function (B) Range of $f(x)$ is $[1, \infty)$
(C) $f(f(x)) = 0$ is possible for two values of x (D) $f(x)$ is many one function

PASSAGE – II :

Let α, β, γ are the roots of the equation $x^3 - 3x^2 + 8x - 2 = 0$.

51. The value of $(9 + \alpha^2)(9 + \beta^2)(9 + \gamma^2)$ is

- (A) 616 (B) 634 (C) 125 (D) 521

52. The given equation has -

- (A) Three real roots in which two are positive and one is negative
(B) Two imaginary and one real root which is positive
(C) Two imaginary and one real root which is negative
(D) Three real roots in which one is positive and two are negative

PASSAGE – III :

Let $f(x) = \begin{cases} x^3 & ; x \geq 0 \\ x^2 & ; x < 0 \end{cases}$ and $g(x) = \begin{cases} x^2 & ; x > 0 \\ x^3 & ; x \leq 0 \end{cases}$.

53. Area bounded by $y = f(x)$ and $y = g(x)$ is -

- (A) $\frac{1}{5}$ (B) $\frac{1}{6}$ (C) $\frac{1}{11}$ (D) $\frac{1}{12}$

54. Area bounded by $f(x)$ and line $y = 1$ is -

- (A) $\frac{17}{12}$ (B) $\frac{15}{6}$ (C) $\frac{3}{5}$ (D) $\frac{12}{11}$

PART : C (6 × 4 = 24 Marks) (4R – 0W)

NUMERICAL VALUE TYPE QUESTIONS :

55. Let the intercept made by the line $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ between the plane $x + y + z = 3$ and the line

$\frac{x-1}{2} = \frac{y-2}{-1} = \frac{z-3}{-1}$ is λ , then $\frac{4\lambda}{\sqrt{14}}$ is

56. Let $x^2 + 2ax + b = 0$ and $x^2 + 2bx + a = 0$ have real roots ($a, b > 0$), then minimum possible integral value of ab is
57. Let $\Delta = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}$, where D_1, D_2 and D_3 are co-factors of c_1, c_2 and c_3 respectively such that $D_1^2 + D_2^2 + D_3^2 = 16$ and $c_1^2 + c_2^2 + c_3^2 = 4$, then maximum value of Δ is
58. If the length of subnormal to the curve $y^2 = a(x+7)$ is $\frac{5}{2}$, then $|a|$ is
59. $\left(\sum_{r=1}^{160} \frac{(\log_{(r+1)} 3)(\log_{(r+2)} 3)}{\log_{\frac{(r+2)}{(r+1)} 3} 3} \right) (\log_3 162)(\log_3 2)$ is
60. If $1 - \cos^2(\alpha + \beta) \geq \frac{1}{1 + \cos^2(\alpha + \beta)}$, then $\cos \alpha + \sin \beta$ is (where $\sin(\alpha + \beta) \neq 1$)

□□□

ICAD