

Rankers Academy JEE

(1001CJA101021240026)



Test Pattern



CLASSROOM CONTACT PROGRAMME
(Academic Session : 2024 - 2025)

JEE(Main)
PART TEST
08-12-2024

JEE(Main+Advanced) : ENTHUSIAST COURSE (SCORE-I)

Time : 3 Hours

PAPER-1 (OPTIONAL)

Maximum Marks : 300

IMPORTANT NOTE : Students having 8 digits **Form No.** must fill two zero before their Form No. in OMR. For example, if your **Form No.** is 12345678, then you have to fill **0012345678**.

READ THE INSTRUCTIONS CAREFULLY

Important Instructions :

1. Immediately fill in the form number on this page of the Test Booklet with Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.
2. The candidates should not write their Form Number anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
3. The Test Booklet consists of **75** questions.
4. There are **three** parts in the question paper 1,2,3 consisting of **Physics, Chemistry and Mathematics** having **25 questions** in each subject and each subject having **Two sections**.
 - (i) Section-I contains 20 multiple choice questions with **only one correct** option.
Marking scheme : +4 for correct answer, 0 if not attempted and -1 in all other cases.
 - (ii) Section-II contains 05 **Numerical Value Type** questions.
Marking scheme : +4 for correct answer, 0 if not attempted and -1 in all other cases.
5. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electronic device etc, except the Identity Card inside the examination hall/room.
6. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
7. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Room/Hall. **However, the candidate are allowed to take away this Test Booklet with them.**
8. **Do not fold or make any stray marks on the Answer Sheet.**
9. **Take $g = 10 \text{ m/s}^2$ unless otherwise stated.**

Name of the Candidate (in Capitals) _____

Form Number : in figures _____

: in words _____

Centre of Examination (in Capitals) : _____

Candidate's Signature : _____ Invigilator's Signature : _____

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Ph. : +91-744-3556677, +91-744-2757575 | E-mail : info@allen.in | Website : www.allen.ac.in

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SECTION-I : (Maximum Marks: 80)

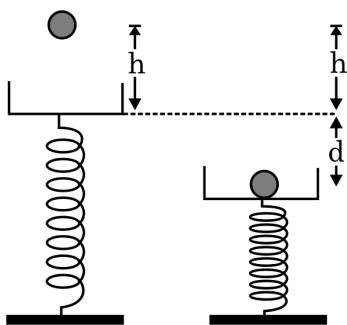
This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

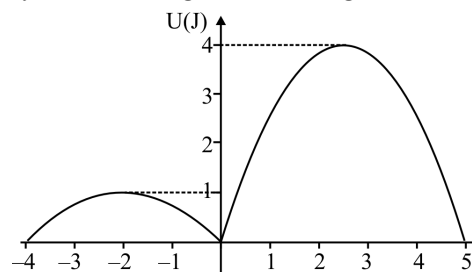
Negative Marks : -1 If wrong option is selected.

1. A vertical spring with force constant k is fixed on a table. A ball of mass m at a height h above the free upper end of the spring falls vertically on the spring so that the spring is compressed by a distance d . The net work done on the ball, in the process is :-



- (A) $mg(h + d) + \frac{1}{2}kd^2$
- (B) $mg(h + d) - \frac{1}{2}kd^2$
- (C) $mg(h - d) - \frac{1}{2}kd^2$
- (D) $mg(h - d) + \frac{1}{2}kd^2$

2. A point particle of mass 0.5 kg is moving along the x -axis under a force described by the potential energy U shown below. It is projected towards the right from the origin with a speed v . What is the minimum value of v for which the particle will escape infinitely far away from the origin towards right ?

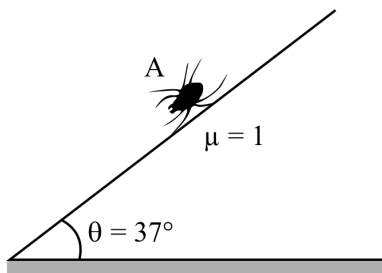


- (A) $2\sqrt{2}$ m/s
- (B) 2 m/s
- (C) 4 m/s
- (D) the particle will never escape
3. **STATEMENT-1** : Two concentric conducting spherical shells are charged. The charge on the outer shell is varied keeping the charge on inner shell constant. As a result the electric potential difference between the two shells does not change.
- STATEMENT-2** : If charge is changed on a thin conducting spherical shell, the potential at all points inside the shell changes by same amount.
- (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
- (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.
- (C) Statement-1 is True, Statement-2 is False.
- (D) Statement-1 is False, Statement-2 is True.

4. Two charges Q_1 and Q_2 have their respective placements at the inside and the outside of a closed surface S . If E be the field at any point on S and ϕ be the flux of E over the surface S , then choose the incorrect option.

- (A) Q_1 changes, both E and ϕ will change.
 (B) Q_2 changes, E will change but ϕ will not change.
 (C) $Q_1 = 0$ and $Q_2 \neq 0$ then $E \neq 0$ but $\phi = 0$
 (D) $Q_1 \neq 0$ and $Q_2 = 0$ then $E = 0$ but $\phi \neq 0$

5. An insect of mass m , moves on a rough inclined surface from point A. As the surface is very sticky, the coefficient of friction between the insect and the incline is $\mu = 1$. Assume that it can move in any direction; up the incline or down the incline then ($g = 10 \text{ m/s}^2$). Choose the correct option:

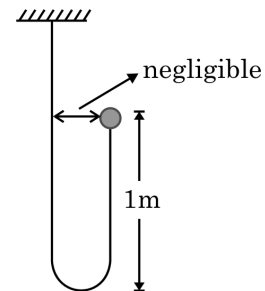


- (A) The maximum possible acceleration of the insect is 14 m/sec^2 .
 (B) The maximum possible acceleration of the insect is 2 m/sec^2 .
 (C) The insect cannot move with a constant velocity.
 (D) No friction force will act on insect when it moves with constant velocity.

6. A wagon filled with sand has a hole so that sand leaks through the bottom at a constant rate λ . An external force \vec{F} acts on the wagon in the direction of motion. Assuming instantaneous velocity of the wagon to be \vec{v} and initial mass of system to be m_0 , the force equation governing the motion of the wagon is :-

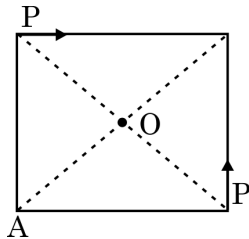
- (A) $\vec{F} = m_0 \frac{d\vec{v}}{dt} + \lambda \vec{v}$
 (B) $\vec{F} = m_0 \frac{d\vec{v}}{dt} - \lambda \vec{v}$
 (C) $\vec{F} = (m_0 - \lambda t) \frac{d\vec{v}}{dt}$
 (D) $\vec{F} = (m_0 - \lambda t) \frac{d\vec{v}}{dt} + \lambda \vec{v}$

7. A ball of mass 1 kg is attached to an inextensible string. The ball is released from the position shown in figure. The impulse imparted by the string to the ball just after string becomes taut is :- ($g = 10 \text{ m/s}^2$)



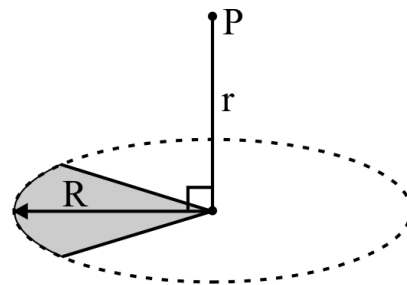
- (A) $\sqrt{20} \text{ N-s}$ (B) $\sqrt{40} \text{ N-s}$
 (C) $\sqrt{10} \text{ N-s}$ (D) $2\sqrt{20} \text{ N-s}$

8. Two short dipoles of dipole moment p are placed at two corners of a square as shown in the figure. What is the ratio of magnitudes of electric field at two points O & A?



- (A) 2
(B) $2\sqrt{2}$
(C) 1
(D) $\sqrt{2}$
9. A and B are two spherical conductors of same size. A is solid and B is hollow. Both are charged to the same potential. If the charges on A and B are Q_A and Q_B respectively, then :-
- (A) Q_A is less than Q_B
(B) Q_A is greater than Q_B but not double
(C) $Q_A = Q_B$
(D) $Q_A = 2Q_B$

10. A plastic disk is charged on one side with a uniform surface charge density σ and then three quadrant of the disk are removed. The remaining quadrant is shown in figure, with $V = 0$ at infinity, the potential due to the remaining quadrant at point P is :-

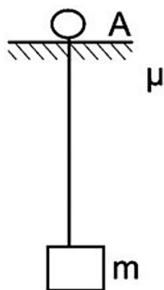


- (A) $\frac{\sigma}{2\epsilon_0}[(r^2 + R^2)^{1/2} - r]$
(B) $\frac{\sigma}{2\epsilon_0}[R - r]$
(C) $\frac{\sigma}{8\epsilon_0}[(r^2 + R^2)^{1/2} - r]$
(D) None of these
11. A bullet is fired from a gun. The force on the bullet in the barrel is given by $F = 600 - 2 \times 10^5 t$, where, F is in newton and t in second. The force on the bullet becomes zero as soon as it leaves the barrel. What is the average impulse imparted to the bullet?
- (A) 1.8 N-s
(B) zero
(C) 9 N-s
(D) 0.9 N-s

12. An oil drop of radius r and density ρ is held stationary in a uniform vertically upwards electric field 'E'. If ρ_0 ($<\rho$) is the density of air and e is quanta of charge, then the drop has :-

- (A) $\frac{4\pi r^3(\rho - \rho_0)g}{3eE}$ excess electrons
 (B) $\frac{4\pi r^2(\rho - \rho_0)g}{eE}$ excess electrons
 (C) deficiency of $\frac{4\pi r^3(\rho - \rho_0)g}{3eE}$ electrons
 (D) deficiency of $\frac{4\pi r^2(\rho - \rho_0)g}{eE}$ electrons

13. A mass m is hung from a massless pivot A which rests on a support of co-efficient of friction μ . The mass is now given a horizontal velocity such that A just slips. The tension in the string when this happens is :-



- (A) μmg
 (B) $\frac{\mu}{\sqrt{1 + \mu^2}} mg$
 (C) mg
 (D) $\frac{mg}{\sqrt{1 + \mu^2}}$

14. A block C of mass m is moving with velocity v_0 and collides elastically with block A of mass m . A is connected to another block B of mass $2m$ through an ideal spring of spring constant k . What is k , if x_0 is compression of spring when velocity of A and B is same.



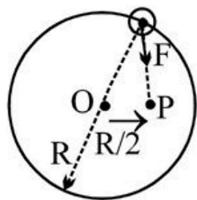
- (A) $\frac{mv_0^2}{x_0^2}$
 (B) $\frac{mv_0^2}{2x_0^2}$
 (C) $\frac{3}{2} \frac{mv_0^2}{x_0^2}$
 (D) $\frac{2}{3} \frac{mv_0^2}{x_0^2}$

15. **Statement-1** : A body is projected upward along a rough inclined plane from its bottom with a speed v , when another identical body is projected down along on the same inclined plane with same speed v . When they travel the same distance on the inclined plane, the loss in KE is same for both.

Statement-2 : Same magnitude of frictional force in the opposite direction of motion develop in each case and does same negative work.

- (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.

16. A small bead of mass m can move on a smooth circular wire (radius R) under the action of a force $F = \frac{Km}{r^2}$ directed (r = position of bead from P & K = constant) towards a point P within the circle at a distance $\frac{R}{2}$ from the centre. What should be the minimum velocity of bead at the point of the wire nearest the centre of force (P) so that bead will complete the circle?



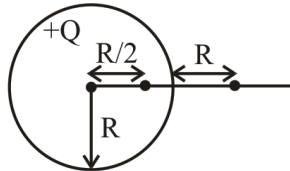
- (A) $\sqrt{\frac{3K}{R}}$ (B) $\sqrt{\frac{8K}{3R}}$
 (C) $\sqrt{\frac{6K}{R}}$ (D) None of these
17. Which of the following statements is TRUE for a system comprising of two bodies in contact exerting frictional force on each other?
- (A) Total work done by static friction on whole system is always zero.
 (B) Work done by static friction on one body is always zero.
 (C) Work done by kinetic friction on one body is always negative.
 (D) Total work done by internal kinetic friction on whole system is always zero.

18. When identical point charges are placed at the vertices of a cube of edge length a , each of them experiences a net force of magnitude F . Now these charges are placed on the vertices of another cube of edge length b . What will magnitude of the net force on any of the charges be? These cubes are simply geometrical constructs and not made of any matter.

- (A) $\frac{aF}{b}$
 (B) $\frac{bF}{a}$
 (C) $\frac{a^2F}{b^2}$
 (D) $\frac{b^2F}{a^2}$

19. Two masses, 800 kg and 450 kg are at a distance 25 m apart. The magnitude of gravitational field intensity at a point 20 m distant from the 800 kg mass and 15 m distant from the 450 kg mass will be (in N/kg) -
 (G is universal gravitational constant) :-
- (A) $2G$
 (B) $2\sqrt{2}G$
 (C) $4G$
 (D) zero

20. A point charge (+q) of mass m is released from a distance $\left(\frac{R}{2}\right)$ from the centre of a solid sphere of radius R and charge Q (uniformly charged in volume). The speed of the point charge when it reaches a distance R from the surface of the sphere, is: (there is no interaction between sphere and point charge other than electrostatic).



fixed solid sphere

- (A) $\sqrt{\frac{7kQq}{16mR}}$
- (B) $\sqrt{\frac{7kQq}{4mR}}$
- (C) $\sqrt{\frac{5kQq}{16mR}}$
- (D) $\sqrt{\frac{3kQq}{4mR}}$

SECTION-II : (Maximum Marks: 20)

This section contains 05 questions.

The answer to each question is a **Numerical Value**.

For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If correct answer is entered.

Zero Marks : 0 If the question is unanswered.

Negative Marks : -1 If wrong answer is entered.

- The radius in kilometre to which the present radius of earth ($R = 6400$ km) be compressed keeping mass same, so that the escape velocity is increased to ten times is $16n$ km. Find n.
- A person is standing on a weighing machine placed on the floor of an elevator. The elevator starts going up with some acceleration, then moves with uniform velocity for a while and finally decelerates to stop. The maximum and the minimum weights recorded are 80.5 kg and 59.5 kg. Assuming that magnitudes of the acceleration and the deceleration are the same, find the sum of magnitudes of acceleration and deceleration. Take $g = 10 \text{ m/s}^2$.

3. A planet of radius R equal to one-tenth the radius of earth has the same mass density as earth. Scientists dig a well of depth $\frac{R}{5}$ on it and lower a wire of the same length and of linear mass density 10^{-3} kgm^{-1} into it. If the wire is not touching anywhere the force applied at the top of the wire by a person holding it in place is 12m . Find m . Take the radius of earth to be $6 \times 10^6 \text{ m}$ and the acceleration due to gravity of earth to be 10 ms^{-2} .
4. Particle A makes a perfectly elastic collision with another stationary particle B. They fly apart in opposite directions with equal speeds. The ratio $\frac{m_B}{m_A}$ is :-
5. A very small sphere of mass 80 g having a charge q is held at a height 9 m vertically above the centre of a fixed non conducting sphere of radius 1 m , carrying an equal charge q . When released it falls until it is repelled just before it comes in contact with the sphere. The charge q is $7 \times K$. Find the value of K (in μC) [$g = 9.8 \text{ m/s}^2$]

PART-2 : CHEMISTRY

SECTION-I : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

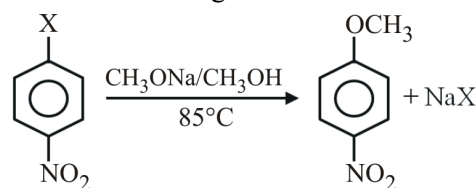
Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

Negative Marks : -1 If wrong option is selected.

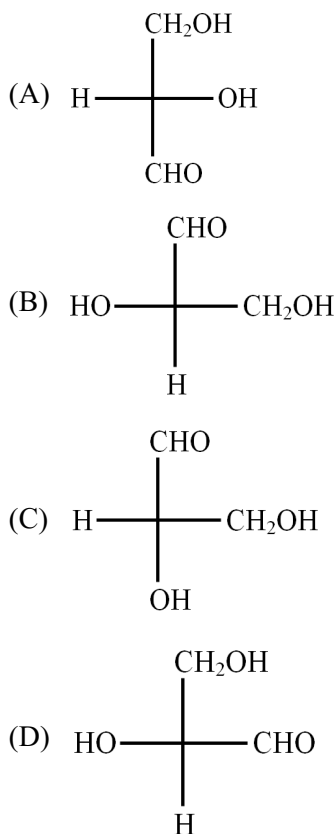
- Two square pyramidal $M(CO)_x$ units joined by a metal-metal bond result into formation of homoleptic complex species :
 (A) Octacarbonyldicobalt (0)
 (B) Decarbonyldimanganese (0)
 (C) Hexacarbonylchromium (0)
 (D) Pentacarbonyliron (0)
- In Friedel Crafts reaction, what is the function of anhydrous $AlCl_3$?
 (A) In generation of benzene
 (B) In generation of electrophile
 (C) Absorption of formed HCl
 (D) In generation of nucleophile
- Which of the following electronic transition explains the colour in hexaaqua complex of Ti^{3+} ?
 (A) $t_{2g}^0 e_g^1 \rightarrow t_{2g}^1 e_g^0$
 (B) $3d^1 \rightarrow 5d^1$
 (C) $5d^1 \rightarrow 3d^1$
 (D) $t_{2g}^1 e_g^0 \rightarrow t_{2g}^0 e_g^1$

4. Consider following reaction



for highest rate of this reaction, 'X' should be

- (A) F (B) Cl (C) Br (D) I
5. Carbohydrates are
- (A) Polycarbonyl alcohols
 (B) Polycarboxylic aldehydes
 (C) Polyhydroxy carboxylic acids
 (D) Polyhydroxy aldehyde or ketone
6. Which of the following represents D-Glyceraldehyde?



7. Which of the following statements is incorrect regarding valence bond theory (VBT) of co-ordination compounds :-

- (A) It explains the colour exhibited by coordination compounds.
- (B) It does not give a quantitative interpretation of the thermodynamics or kinetic stabilities of coordination compounds.
- (C) It does not distinguish between weak and strong field ligands.
- (D) It does not make exact predictions regarding the tetrahedral and square planar structures of 4-coordinate complexes.

8. Maximum how many moles of white ppt are obtained on reaction of 1 mole of complex $\text{CoCl}_3 \cdot 6\text{NH}_3(\text{aq.})$ with excess AgNO_3 ?

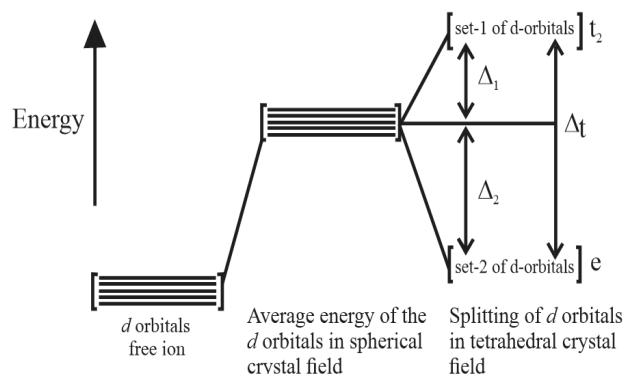
- (A) 1
- (B) 2
- (C) 3
- (D) 0

9.

List-I (Complex ion)		List-II (Total valence electrons of central atom of complex ion)	
(I)	$[\text{Fe}(\text{CN})_6]^{4-}$	(P)	14
(II)	$[\text{Cr}(\text{CN})_6]^{3-}$	(Q)	15
(III)	$[\text{NiCl}_4]^{2-}$	(R)	16
(IV)	$[\text{FeCl}_4]^{2-}$	(S)	18

- (A) $\text{I} \rightarrow \text{P}$; $\text{II} \rightarrow \text{S}$; $\text{III} \rightarrow \text{R}$; $\text{IV} \rightarrow \text{Q}$
- (B) $\text{I} \rightarrow \text{S}$; $\text{II} \rightarrow \text{Q}$; $\text{III} \rightarrow \text{R}$; $\text{IV} \rightarrow \text{P}$
- (C) $\text{I} \rightarrow \text{S}$; $\text{II} \rightarrow \text{P}$; $\text{III} \rightarrow \text{Q}$; $\text{IV} \rightarrow \text{R}$
- (D) $\text{I} \rightarrow \text{P}$; $\text{II} \rightarrow \text{R}$; $\text{III} \rightarrow \text{S}$; $\text{IV} \rightarrow \text{Q}$

10. Consider the following splitting diagram of tetrahedral complex species :



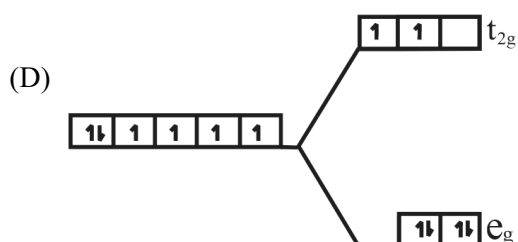
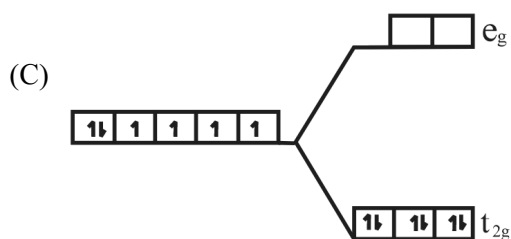
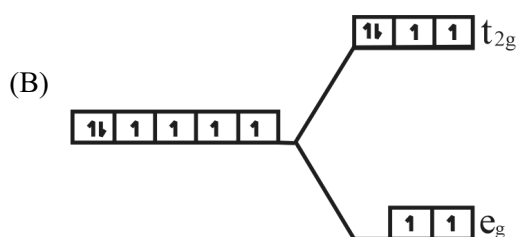
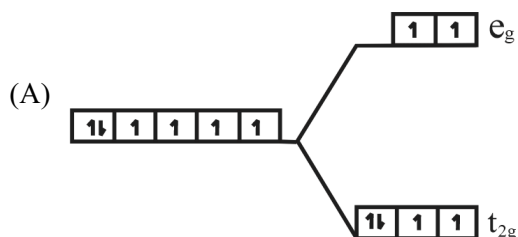
Select the correct statement :

- (A) set-1 of d-orbitals contains axial d-orbitals.
- (B) set-2 of d-orbitals are directly facing the ligands.
- (C) set-1 of d-orbitals are facing more repulsion from ligands as compared to that from set-2 of d-orbitals.
- (D) set-2 of d-orbitals are not facing any repulsion from ligands.

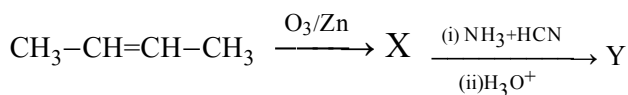
11. In transition metal carbonyls, the metal-carbon π bond is formed by electron pair donation from :

- (A) Filled d-orbital of metal into vacant σ of CO.
- (B) Filled p-orbital of metal into vacant π^* of CO.
- (C) Filled p-orbital of metal into vacant σ^* of CO.
- (D) Filled d-orbital of metal into vacant π^* of CO.

12. Select the correct crystal field splitting diagram for complex species $K_3[Co(C_2O_4)_3]$



13. Consider following reactions



(Amino acid)

What is the name of formed amino acid 'Y'?

- (A) Leucine (B) Valine
(C) Glycine (D) Alanine

14. Which of the following Amine can be prepared by Hofmann bromamide reaction but not by Gabriel Phthalimide reaction and also gives positive isocyanide test?

- (A) CH_3NH_2
(B) $Me-NH-Me$
(C) Me_3N
(D) $Ph-NH_2$

15. Given below are two statements

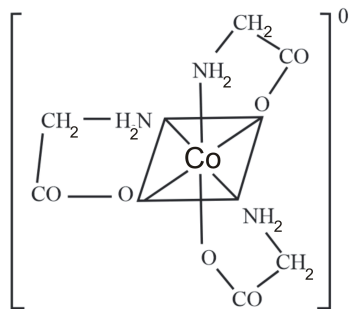
Statement-I : Acetaldehyde and Benzaldehyde can be differentiated using Tollens test.

Statement-II: Lassaigne's test for the detection of nitrogen will fail in case of NH_2-NH_2 .

In the light of above statements, choose the correct answer from the following.

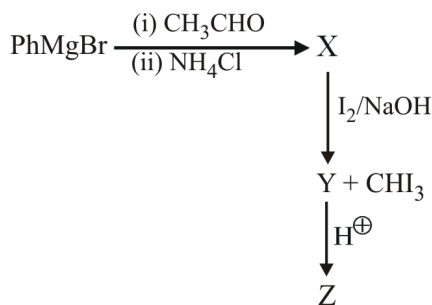
- (A) Both Statement-I and Statement-II are correct
(B) Both Statement-I and Statement-II are incorrect
(C) Statement-I is correct but Statement-II is incorrect
(D) Statement-I is incorrect but Statement-II is correct

16. What is correct IUPAC name of mentioned complex



- (A) fac-triglycinatocobalt (III)
 (B) mer-triglycinatocobalt (III)
 (C) cis-triglycinatocobalt (III)
 (D) fac-triglycinatocobalt (0)
17. Which of the following is incorrect?
- (A) CH_3OH and PhOH can be differentiated using neutral FeCl_3
 (B) $\text{CH}_3 - \text{CH}(\text{OCH}_3)_2$ and $\text{CH}_3\text{CH}(\text{OH})\text{OCH}_3$ can be differentiated using Tollens reagent
 (C) $\text{CH}_3 - \text{CH}(\text{OCH}_3)_2$ and $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$ can be differentiated using $(\text{NaOH} + \text{I}_2)$
 (D) Cyclohexane and Cyclohexene can not be differentiated using $\text{Br}_2/\text{H}_2\text{O}$
18. Which of the following species is **not** expected to be a ligand?
- (A) NO^+ (B) C_2H_6
 (C) C_2H_4 (D) C_6H_6

19. Consider the following reactions



Which of the following is incorrect?

- (A) Compound X can give turbidity immediately in lucas test
 (B) Conversion of X into Y is through haloform reaction
 (C) Compound Z can give positive sodium bicarbonate test
 (D) CHCl_3 upon treatment with Ag/Δ can not give acetylene gas
20. $\text{K}_2[\text{PtCl}_4] + 2\text{Kgly} \rightarrow \text{X} + 4\text{KCl}$
 $[\text{Pt}(\text{NH}_3)_4](\text{NO}_3)_2 + 2\text{Kgly} \rightarrow \text{Y} + 2\text{KNO}_3 + 4\text{NH}_3 \uparrow$
 (Kgly is potassium glycinate.)
- 'X' is soluble in polar solvent while 'Y' is soluble in non-polar solvent.
- Choose the correct statement regarding 'X' and 'Y' :
- (A) (X) and (Y) are linkage isomers.
 (B) (X) is low spin and (Y) is high spin complex.
 (C) (X) and (Y) are stereoisomers.
 (D) All atoms in (X) and (Y) lie in same plane.

SECTION-II : (Maximum Marks: 20)

This section contains 05 questions.

The answer to each question is a **Numerical Value**.

For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If correct answer is entered.

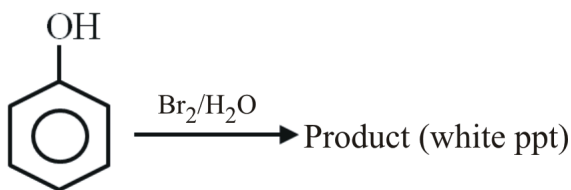
Zero Marks : 0 If the question is unanswered.

Negative Marks : -1 If wrong answer is entered.

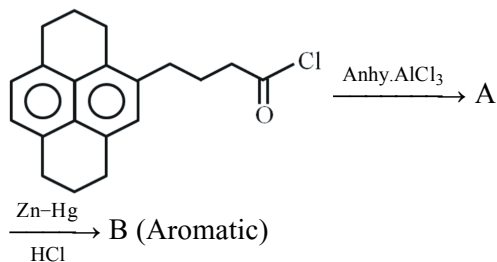
1. For Mn^{3+} ion, the electron pairing energy (P) is 28000 cm^{-1} . The splitting energy for complex $[\text{Mn}(\text{H}_2\text{O})_6]^{3+}$ ion is 15800 cm^{-1} . What is magnitude of crystal field stabilisation energy of $[\text{Mn}(\text{H}_2\text{O})_6]^{3+}$ in cm^{-1} ?

2. 0.0012 mole of $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ is passed through a cation exchange resin and acid obtained from it requires 28.5 ml of xM NaOH for complete neutralisation. What is value of 1000x?

3. Total number of bromine atoms in one molecule of aromatic product formed in following reaction is

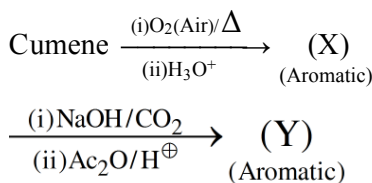


4. Consider following reactions



Degree of unsaturation of product B is

5. Consider following reactions



Number of oxygen atoms in one molecule of product 'Y' is

SECTION-I : (Maximum Marks: 80)

This section contains **20 questions**. Each question has 4 options for correct answer. Multiple-Choice Questions (MCQs) **Only one option is correct**. For each question, marks will be awarded as follows:

Full Marks : +4 If correct answer is selected.

Zero Marks : 0 If none of the option is selected.

Negative Marks : -1 If wrong option is selected.

1. If the normals at the points $P(x_i, y_i)$, $i = 1, 2, 3, 4$ on the hyperbola $xy = 4$ are concurrent at the point $Q(3, 2)$ then $\frac{(x_1 + x_2 + x_3 + x_4)}{x_1 x_2 x_3 x_4}$ is equal to

(A) $\frac{\sqrt{6}}{16}$

(B) $-\frac{9}{16}$

(C) $-\frac{3}{16}$

(D) $\frac{3}{8}$

2. Consider the conic $xy + y - 2x - 3 = 0$. Length of its transverse axis is -

(A) 1

(B) $\sqrt{2}$

(C) 2

(D) $2\sqrt{2}$

3. **Assertion (A)** : If a circle $S \equiv 0$ intersect a hyperbola $xy = 4$ at four points, three of them being $(2, 2)$, $(4, 1)$ and $(6, 2/3)$, then the coordinates of the fourth point are $\left(\frac{1}{4}, 16\right)$

Reason (R) : If a circle $S \equiv 0$ intersects a hyperbola $xy = c^2$ at t_1, t_2, t_3 and t_4 , then $t_1 t_2 t_3 t_4 = 1$.

(A) Both **A** and **R** are correct and **R** is the correct explanation of **A**

(B) Both **A** and **R** are correct but **R** is **NOT** the correct explanation of **A**

(C) **A** is correct but **R** is not correct

(D) **A** is not correct but **R** is correct

4. The foci of a hyperbola coincide with the foci of the ellipse $\frac{x^2}{49} + \frac{y^2}{24} = 1$, then the equation of hyperbola with eccentricity $\frac{5}{\sqrt{2}}$ is :

(A) $\frac{x^2}{2} - \frac{y^2}{23} = 1$

(B) $\frac{x^2}{23} - \frac{y^2}{2} = 1$

(C) $2x^2 - 23y^2 = 1$

(D) None of these

5. Let S be the set of lines belonging to family of lines $(1 + \lambda)y + (\lambda - 1)x + 2(1 - \lambda) = 0$, then the length of the line segment which belongs to S and makes shortest intercept on $y^2 = 4x - 4$ is

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

6. If $E = \left[(\alpha - \beta)^2 + \left(14 - \sqrt{9 - (\alpha + 1)^2} - \sqrt{4\beta} \right)^2 \right]^{\frac{1}{2}}$, then $\forall \alpha, \beta \in \mathbb{R}$, minimum value of E is

(A) $3\sqrt{3} - 3$
(B) $12 - 5\sqrt{2}$
(C) $5\sqrt{5} - 3$
(D) $4\sqrt{7} - 2$

7. Let $x^2 + y^2 + Ax + By + C = 0$ be a circle passing through $(0, 0)$ and touching the parabola $y = x^2$ at $(2, 4)$. Then $A + B + C$ is equal to _____.

(A) 3 (B) -3
(C) 29 (D) -29

8. If the parabola $y = (p - q)x^2 + (q - r)x + (r - p)$, touches the x-axis in the interval $(0, 3)$ then $px + qy + r = 0$

(A) always passes through a fixed point $(-2, 1)$
(B) always perpendicular to $y = 2x$
(C) is always parallel to $y = 2x$
(D) none of these

9. Match List-I with List-II and select the correct answer using the code given below the list.

List-I		List-II	
(A)	If number of values of $x \left(0 \leq x \leq \frac{\pi}{2} \right)$ which satisfy the equation $81^{\sin^2 x} + 81^{\cos^2 x} = 30$ is	(I)	$2\sqrt{6}$
(B)	$(\ln(x + 1) - \ln 3)^2 + (e^{y+2} - e^3)^2 = 0$, then $x + y$ is	(II)	6
(C)	Minimum value of $2\tan^2 \theta + 3\cot^2 \theta$ is	(III)	2
(D)	Let $x^2 + (\sin \theta)x + \cos \theta = 0$ is having the roots $x = \alpha, \beta$ and maximum value of $(1 - \alpha)(1 - \beta)$ is λ , then $\lambda - \sqrt{2} + 5$ is	(IV)	3

- (A) (A)→(III); (B)→(I); (C)→(IV); (D)→(II)
(B) (A)→(III); (B)→(I); (C)→(II); (D)→(IV)
(C) (A)→(IV); (B)→(III); (C)→(I); (D)→(II)
(D) (A)→(III); (B)→(IV); (C)→(I); (D)→(II)

10. Let $S_1 : x^2 + y^2 = 9$ and $S_2 : (x - 2)^2 + y^2 = 1$. Then the locus of center of a variable circle S which touches S_1 internally and S_2 externally always passes through the points :

(A) $(0, \pm\sqrt{3})$
(B) $\left(\frac{1}{2}, \pm\frac{\sqrt{5}}{2} \right)$
(C) $\left(2, \pm\frac{3}{2} \right)$
(D) $(1, \pm 2)$

11. Let an ellipse $E : \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $a^2 > b^2$, passes through $\left(\sqrt{\frac{3}{2}}, 1\right)$ and has eccentricity $\frac{1}{\sqrt{3}}$. If a circle, centered at focus $F(\alpha, 0)$, $\alpha > 0$, of E and radius $\frac{2}{\sqrt{3}}$, intersects E at two points P and Q , then $\frac{PQ^2}{OF^2}$ is equal to (O is origin)
- (A) $\frac{8}{3}$ (B) $\frac{4}{3}$
(C) $\frac{16}{3}$ (D) 3
12. Two perpendicular tangents drawn to the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$ intersect on the curve $ax^2 + by^2 + c = 0$ then $a + b - c$ is (a and c are co-prime)
- (A) 42 (B) 43
(C) 44 (D) 45
13. The range value of ' h ' for which the point $\left(7 - \frac{5h}{4}, -h\right)$ lies inside the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$ equals
- (A) $\left[-\frac{12}{5}, -\frac{16}{5}\right]$
(B) $\left(\frac{12}{5}, \frac{16}{5}\right)$
(C) $\left[0, \frac{16}{5}\right]$
(D) $(0, \infty)$
14. If $\frac{\cos 5^\circ \cos 55^\circ \cos 65^\circ}{\sin 5^\circ \sin 55^\circ \sin 65^\circ} = a\sqrt{3} + b$ then value of $a + b$ is
- (A) -1 (B) 2
(C) 3 (D) $\frac{1}{3}$
15. Let a, b, c, p, q be real numbers. Suppose α, β are the roots of the equation $x^2 + 2px + q = 0$, α and $1/\beta$ are the roots of the equation $ax^2 + 2bx + c = 0$ where $\beta^2 \notin \{-1, 0, 1\}$.
- Statement-I :** $(p^2 - q)(b^2 - ac) \geq 0$
- Statement-II :** $b \neq pa$ or $c \neq qa$
- (A) Both Statement-I and Statement-II are false.
(B) Both Statement-I and Statement-II are true.
(C) Statement-I is true but Statement-II is false.
(D) Statement-I is false but Statement-II is true.
16. If $\tan A$ and $\tan B$ are roots of $qx^2 - px + 1 = 0$ then value of $\cos^2(A + B)$ is
- (A) $\frac{(q-1)^2}{p^2 + (q-1)^2}$
(B) $\frac{(q+1)^2}{p^2 + (q+1)^2}$
(C) $\frac{q^2}{p^2 + q^2}$
(D) $\frac{(p+1)^2}{p^2 - (q+1)^2}$

17. Let S_k be sum of the first k terms of the arithmetic sequence with first term 1 and common difference 1

then $\sum_{k=2}^{100} \frac{1}{S_k}$ equals

- (A) $\frac{1}{100}$ (B) $\frac{101}{100}$
(C) $\frac{200}{101}$ (D) $\frac{99}{101}$

18. If $\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots \infty = \omega$ then the value of $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots \infty$ is

- (A) $\frac{\omega}{2}$ (B) $\frac{\omega}{3}$
(C) $\frac{3\omega}{4}$ (D) $\frac{\omega}{9}$

19. The sum of the product of the $2n$ numbers $\pm 1, \pm 2, \pm 3, \dots, \pm n$ taken two at a time is -

- (A) $\sum_{r=1}^n r$
(B) $2 \sum_{r=1}^n r^2$
(C) $-\sum_{r=1}^n (r^2)$
(D) $\sum_{r=1}^n r^2$

20. If non-zero real numbers a and b are such that $\min. f(x) > \max. g(x)$ where $f(x) = x^2 + 2ax + 2b^2$ and $g(x) = -x^2 - 2bx + a^2$ ($x \in \mathbb{R}$) then least integral value of $\left\lfloor \frac{b}{a} \right\rfloor$ is

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

SECTION-II : (Maximum Marks: 20)

This section contains 05 questions.

The answer to each question is a **Numerical Value**.

For each question, enter the correct integer value (In case of non-integer value, the answer should be rounded off to the nearest Integer).

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If correct answer is entered.

Zero Marks : 0 If the question is unanswered.

Negative Marks : -1 If wrong answer is entered.

1. If $y + x = 0$ and $y - x = 0$ are tangent at the vertex and axis of a parabola respectively and $y = 2x + 3$ is a tangent to the same parabola and if the distance of focus from directrix is L , find $[L^2]$ ($[.]$ is greatest integer function)
2. In triangle ABC , $A \equiv (0, 2)$, $B \equiv (-2, 0)$ & $C \equiv (2, 0)$, a point 'P' moves within triangle such that the square of its distance from 'BC' is half the area of rectangle contained by its distances from the other two sides. If e is the eccentricity of the locus of P, then $24e^2$ is
3. Tangents are drawn from any point on the hyperbola $\frac{x^2}{4} - \frac{y^2}{9} = 1$ to the circle $x^2 + y^2 = 4$. If the locus of the mid-point of the chord of contact is $(x^2 + y^2)^2 = bx^2 - cy^2$, then value of $\left\lfloor \frac{b}{c} \right\rfloor$ is (where $[.]$ is G.I.F.)

4. If $2\sec^2 A - \sec^4 A - 2\operatorname{cosec}^2 A + \operatorname{cosec}^4 A = \frac{15}{4}$
then $100 \left(\frac{1 - \cos 2A}{1 + \cos 2A} \right)$ is equal to
5. A parabola $x = y^2 - 12y + 64$ cross the y-axis at $(0, \alpha), (0, \beta)$ both to the above of the origin, many circles also passes through these two points. The lengths of the tangent from origin to these circles is.....

Rankers Academy JEE

Space for Rough Work