

08/04/2025

Evening



# Aakash

Medical | IIT-JEE | Foundations

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Join our Youtube  
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Memory Based Paper  
Live Discussion

## Memory Based Answers & Solutions

Time : 3 hrs.

for

M.M. : 300

## JEE (Main)-2025 (Online) Phase-2

(Physics, Chemistry and Mathematics)

### IMPORTANT INSTRUCTIONS:

- (1) The test is of **3 hours** duration.
- (2) This test paper consists of 75 questions. Each subject (PCM) has 25 questions. The maximum marks are 300.
- (3) This question paper contains **Three Parts**. **Part-A** is Physics, **Part-B** is Chemistry and **Part-C** is **Mathematics**. Each part has only two sections: **Section-A** and **Section-B**.
- (4) **Section - A** : Attempt all questions.
- (5) **Section - B** : Attempt all questions.
- (6) **Section - A (01 – 20)** contains 20 multiple choice questions which have **only one correct answer**. Each question carries **+4 marks** for correct answer and **-1 mark** for wrong answer.
- (7) **Section - B (21 – 25)** contains 5 **Numerical value** based questions. The answer to each question should be rounded off to the **nearest integer**. Each question carries **+4 marks** for correct answer and **-1 mark** for wrong answer.

## THE LEGACY OF SUCCESS CONTINUES

JEE Main (Session-1) 2025

4 STATE  
TOPPERS

70+ 100  
PERCENTILERS  
IN PHYSICS, CHEMISTRY & MATHEMATICS

1000+ 99 PERCENTILERS  
& ABOVE

4000+ 95 PERCENTILERS  
& ABOVE

100  
Percentile  
in  
Physics  
&  
Maths



**Shreyas Lohiya**  
PSID: 00003389699

100  
Percentile  
in  
Physics



**Harsh Jha**  
PSID: 00014863322

100  
Percentile  
in  
Physics  
&  
Chemistry



**Devya Rustagi**  
PSID: 00014768785

99.99  
Percentile



**Amogh Bansal**  
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4 Year Classroom  
**1** AIR  
JEE (Adv.)  
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**Tanishka Kabra**  
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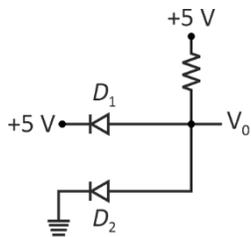
**PHYSICS**

**SECTION - A**

**Multiple Choice Questions:** This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

**Choose the correct answer:**

1. Find output voltage in the given circuit.



- (1) +5 Volt
- (2) 0
- (3) 10 Volt
- (4) -5 Volt

**Answer (2)**

**Sol.**  $D_2$  is in forward biased.

So,  $V_0 = 0$

2. A fractional errors in  $x$ ,  $y$  and  $z$  are 0.1, 0.2 and 0.5 respectively. Find maximum fractional error in  $x^{-2}y^{3/2}z^{-2/5}$ .

- (1) 0.2
- (2) 0.7
- (3) 0.6
- (4) 0.3

**Answer (2)**

**Sol.** Max. fractional error =  $2 \times 0.1 + \frac{3}{2} \times 0.2 + \frac{2}{5} \times 0.5$   
 $= 0.2 + 0.3 + 0.2$   
 $= 0.7$

3. A convex lens ( $f = 30$  cm) is in contact with concave lens ( $f = 20$  cm). Object is placed on the left side at a distance of 20 cm. Find the image distance.

- (1) 10 cm
- (2) 20 cm
- (3) 15 cm
- (4) 25 cm

**Answer (3)**

**Sol.**  $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{30} + \frac{1}{-20} = \frac{2-3}{60} = \frac{-1}{60}$   
 $v = \frac{Fu}{F+u} = \frac{(-60)(-20)}{-60-20} = \frac{60 \times 20}{-80} = -15$  cm

4. For a nucleus of mass number  $A$  and radius  $R$ , mass density is  $\rho$ . Then choose the correct option.

- (1)  $\rho \propto A^3$
- (2)  $\rho$  is independent of  $A$
- (3)  $\rho \propto A$
- (4)  $\rho \propto A^3$

**Answer (2)**

**Sol.** Conceptual

5. There are two charged sphere of radius  $R$  and  $3R$ . When the sphere are made to touch each other and then separate, the surface charge density becomes  $r_1$  and  $r_2$  respectively. Find  $\frac{r_1}{r_2}$

- (1)  $\frac{1}{9}$
- (2)  $\frac{1}{3}$
- (3) 3
- (4) 9

**Answer (3)**

**Sol.** We know finally the potential will be same.

So,  $\delta_1 r_1 = \delta_2 r_2$   
 $\Rightarrow \delta_1 R = \delta_2 \cdot 3R$   
 $\Rightarrow \frac{\delta_1}{\delta_2} = 3$

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100 Percentile in Physics & Maths



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99.99 Percentile



**Amogh Bansal**  
PSID: 00014769016

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6. Given  $\lambda = \frac{2nC}{m}$  (linear charge density) is for  $Q$  wire which is passing through body diagonal of a closed cube of side length  $\sqrt{3}$  cm. Find flux through the cube.
- (1)  $1.44 \pi$
  - (2)  $0.72 \pi$
  - (3)  $2.16 \pi$
  - (4)  $6.84 \pi$

**Answer (3)**

**Sol.** Total length of the wire inside cube is 3 cm

$$q_{(in)} = 2 \times 10^{-9} \times 3 \times 10^{-2}$$

$$\phi = 2 \times 10^{-9} \times 3 \times 10^{-2} \times 4\pi \times 9 \times 10^9$$

$$\Rightarrow \phi = 2.16\pi$$

7. A monoatomic gas is stored in a thermally insulated container. The gas is suddenly compressed to  $\left(\frac{1}{8}\right)^{\text{th}}$  of its initial volume. Find ratio of final pressure to initial pressure.
- (1) 8
  - (2) 16
  - (3) 4
  - (4) 32

**Answer (4)**

**Sol.** Process will be adiabatic

$$P_i V_i^{5/3} = P_f \left(\frac{V_i}{8}\right)^{5/3}$$

$$\frac{P_f}{P_i} = 32$$

8. Two balls are projected with same speed at different angles. If maximum height of 1<sup>st</sup> is 8 times maximum height of 2<sup>nd</sup> ball. Find the ratio of their time of flight
- (1)  $1 : 2\sqrt{2}$
  - (2)  $2\sqrt{2} : 1$
  - (3)  $2 : 1$
  - (4)  $4 : 1$

**Answer (2)**

$$\text{Sol. } \frac{H_1}{H_2} = 8 = \frac{u^2 \sin^2 \theta / 2g}{u^2 \sin^2 \theta_2 / 2g} = \left(\frac{\sin \theta_1}{\sin \theta_2}\right)^2 \Rightarrow \frac{\sin \theta_1}{\sin \theta_2} = 2\sqrt{2}$$

$$\frac{T_1}{T_2} = \frac{2u \sin \theta_1 / g}{2u \sin \theta_2 / g} = \frac{\sin \theta_1}{\sin \theta_2} = 2\sqrt{2}$$

9. A uniform disc of radius  $r$  is rotating about a axis passing through diameter with angular speed 800 rpm. A torque of magnitude  $25\pi$  Nm is applied on the disc for 40 sec. If final angular speed of disc is 2100 rpm. Find diameter of the disc if mass is 1 kg.

- (1)  $\frac{40}{3}$
- (2)  $40\sqrt{\frac{3}{13}}$
- (3)  $20\sqrt{\frac{2}{13}}$
- (4)  $10\sqrt{\frac{3}{2}}$

**Answer (2)**

$$\text{Sol. } \omega_f = \omega_i + \alpha t$$

$$\frac{2100 \times 2\pi}{60} = \frac{800 \times 2\pi}{60} + \alpha \times 40$$

$$\alpha = \frac{13}{12} \pi$$

$$\frac{25\pi}{13\pi} = \frac{mR^2}{4 \times 12}$$

$$\sqrt{\frac{1200}{13}} = 4$$

$$R = 20\sqrt{\frac{3}{13}}, D = 40\sqrt{\frac{3}{13}}$$

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ALL INDIA FEMALE TOPPER



Sol.  $A^2 = A_1^2 + A_2^2 + 2A_1 A_2 \cos \phi$

$$= 4^2 + 2^2 + 2 \times 4 \times 2 \times -\frac{1}{2}$$

$$A = \sqrt{12} = 2\sqrt{3}$$

$$\phi = \frac{2\pi}{3}$$

14. A force  $6\hat{k}$  is applied for  $\frac{5}{3}$  seconds on a body of mass

2 kg. If initial velocity of body was  $3\hat{i} + 4\hat{j}$ . Then find final velocity of the body.

(1)  $3\hat{i} + \hat{j} + 5\hat{k}$                       (2)  $3\hat{i} + 4\hat{j} + 5\hat{k}$

(3)  $3\hat{i} + 2\hat{j} - 3\hat{k}$                       (4)  $3\hat{i} + 4\hat{j} - 5\hat{k}$

Answer (2)

Sol. Impulse =  $6 \times \frac{5}{3} \hat{k} = 10\hat{k}$

$$\vec{P}_f - \vec{P}_i = 10\hat{k}$$

$$2\vec{v}_f - 2(3\hat{i} + 4\hat{j}) = 10\hat{k} \quad \vec{v}_f = 3\hat{i} + 4\hat{j} + 5\hat{k}$$

15. A rod of linear mass density ' $\lambda$ ' and length ' $L$ ' is bent into the form of a ring of radius  $R$ . Moment of inertia of ring about any of its diameter is

(1)  $\frac{\lambda L^3}{12}$                                       (2)  $\frac{\lambda L^3}{4\pi^2}$

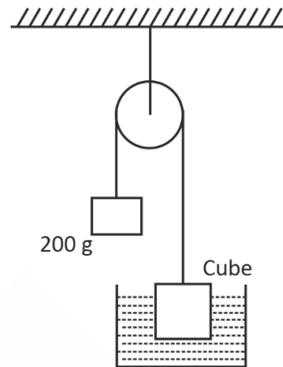
(3)  $\frac{\lambda L^2}{12}$                                       (4)  $\frac{\lambda L^3}{8\pi^2}$

Answer (4)

Sol.  $I = \frac{MR^2}{2} = \frac{\lambda L}{2} R^2 \Rightarrow \frac{\lambda L L^2}{2 \times 4\pi^2} \quad \left[ \because R = \frac{L}{2\pi} \right]$

$$= \frac{\lambda L^3}{8\pi^2}$$

16. A cube of side 10 cm is suspended from one end of a fine string of length 27 cm, and a mass of 200 gram is connected to the other end of the string. When the cube is half immersed in water, then the system remains in balance. Find density of cube.



(1) 800 kg/m<sup>3</sup>

(2) 500 kg/m<sup>3</sup>

(3) 700 kg/m<sup>3</sup>

(4) 600 kg/m<sup>3</sup>

Answer (3)

Sol.  $\left(\frac{1}{10}\right)^3 \sigma g - \left(\frac{1}{10}\right)^3 \frac{\rho_0 g}{2} = 0.2 g$

$$\Rightarrow \left(\frac{1}{10}\right)^3 \left(\sigma - \frac{\rho_0}{2}\right) g = 0.2 g$$

$$\Rightarrow \sigma - \frac{\rho_0}{2} = 200$$

$$\Rightarrow \sigma = 200 + 500$$

$$\Rightarrow \sigma = 700 \text{ kg/m}^3$$

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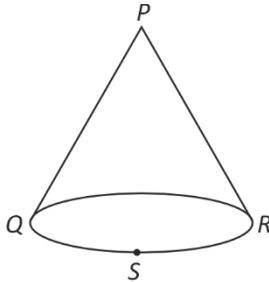


**Amogh Bansal**  
PSID: 00014769016

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17. A cone made of conducting material is given a charge  $Q$ .  $\sigma_1, \sigma_2, \sigma_3$  and  $\sigma_4$  are charge densities at four points  $P, Q, R$  and  $S$ .  $P$  is at vertex of cone and  $Q, R$  and  $S$  are at periphery of the base. Choose correct option.



- (1)  $\sigma_1 > \sigma_2 > \sigma_3 > \sigma_4$
- (2)  $\sigma_1 > \sigma_2 = \sigma_3 = \sigma_4$
- (3)  $\sigma_1 < \sigma_2 = \sigma_3 < \sigma_4$
- (4)  $\sigma_1 = \sigma_2 > \sigma_3 > \sigma_4$

**Answer (2)**

**Sol.** Charge density  $\propto \frac{1}{\text{Radius of curvature}}$

18. **Assertion (A)** : Work done to move a charge between two points is zero inside a uniformly charged shell.

**Reason (R)** : Potential inside a uniformly charged shell is constant and equal to the potential at its surface.

- (1) Both (A) & (R) are correct, and Reason is the correct explanation of (A).
- (2) Both (A) & (R) are correct but R is not correct explanation of A.
- (3) A is correct and R is incorrect
- (4) A is correct and R is correct

**Answer (1)**

**Sol.**  $W = 0 = q \Delta V$

as  $\Delta V = 0$

19.

20.

**SECTION - B**

**Numerical Value Type Questions:** This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. Two ropes of same material of radius  $R$  and  $\frac{R}{2}$ . What will be the ratio of wave speed in second rope to first? (They both are with same tension)

**Answer (2)**

**Sol.**  $\mu = \frac{(\pi R^2 l \rho)}{l} = \pi R^2 \rho$

So,  $v_2 = \sqrt{\frac{5\tau}{\pi \rho R^2}}$

$v_1 = \sqrt{\frac{\tau}{\pi \rho R^2}}$

$\therefore \frac{v_2}{v_1} = 2$

22.

23.

24.

25.

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Sanvi Jain  
4 Year Classroom  
**1** AIR-34 CRL JEE (Main) 2024

**CHEMISTRY**

**SECTION - A**

**Multiple Choice Questions:** This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

**Choose the correct answer :**

1. Consider the last electron of element having atomic number 9 and choose correct option.

- (1) Sum total nodes = 1
- (2)  $n = 2; l = 0$
- (3) Last electron enters in 2s subshell
- (4) There are  $5e^-$  with  $l = 0$

**Answer (1)**

**Sol.** Electronic configuration of fluorine  $\Rightarrow 1s^2 2s^2 2p^5$

Last electron enters in 2p-subshell.

Number of angular nodes =  $l = 1$

Number of radial nodes =  $n - l - 1 = 0$

Total nodes = 1

Number of electrons with  $l = 0$  is 4

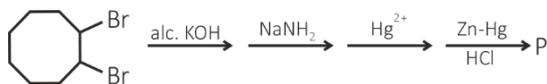
2. Which of the following has  $sp^3d^2$  hybridisation?

- (1)  $[\text{NiCl}_4]^{2-}$
- (2)  $[\text{Ni}(\text{CO})_4]$
- (3)  $\text{SF}_6$
- (4)  $[\text{Ni}(\text{CN})_4]^{2-}$

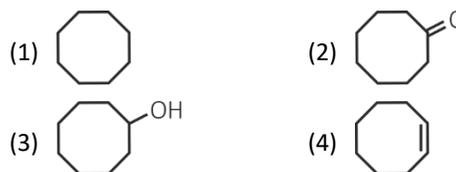
**Answer (3)**

**Sol.**  $\text{SF}_6$  has 6 bond pairs, 6 hybridised  $sp^3d^2$  orbitals.

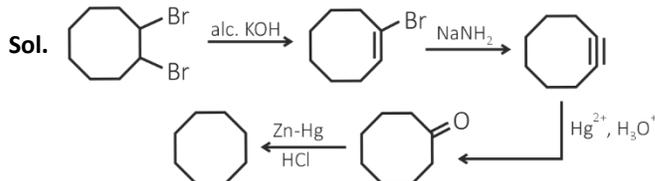
3. Consider the following sequence of reactions given below



The product P is



**Answer (1)**



4. Atomic number of element with lowest first ionisation enthalpy is

- (1) 32
- (2) 19
- (3) 35
- (4) 87

**Answer (4)**

**Sol.** Atomic Number

32  $\Rightarrow$  Ge

19  $\Rightarrow$  K

35  $\Rightarrow$  Cl

87  $\Rightarrow$  Fr

87 Fr has lowest 1<sup>st</sup> ionisation enthalpy.

5. Consider the following statement

**Statement-I:**  $\text{H}_2\text{Se}$  is more acidic than  $\text{H}_2\text{Te}$ .

**Statement-II:**  $\text{H}_2\text{Se}$  has higher bond dissociation enthalpy, then  $\text{H}_2\text{Te}$

In light of above statement, choose correct option.

- (1) Statement-I is true and statement-II is false
- (2) Statement-I is false and statement-II is true
- (3) Both statement-I and statement-II are true
- (4) Both statement-I and statement-II are false

**Answer (4)**

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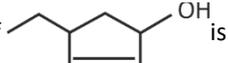


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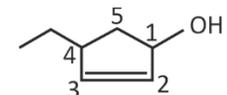


**Sol.**  $H_2Se$  is less acidic than  $H_2Te$  as bond dissociation enthalpy of  $H_2Te$  is lower than  $H_2Se$  and hence  $H^+$  is dissociated with more ease.

6. The correct IUPAC name of  is

- (1) 4-ethylcyclopent-2-en-1-ol
- (2) 3-ethylcyclopent-4-en-1-ol
- (3) 5-ethylcyclopent-1-en-3-ol
- (4) 3-ethylcyclopent-1-en-5-ol

**Answer (1)**

**Sol.**  4-ethylcyclopent-2-en-1-ol

7. Correct decreasing order of spin only magnetic moment values is

- (1)  $Cr^{3+} > Cr^{2+} > Cu^{2+} > Cu^+$
- (2)  $Cr^{3+} > Cr^{2+} > Cu^+ > Cu^{2+}$
- (3)  $Cr^{2+} > Cr^{3+} > Cu^{2+} > Cu^+$
- (4)  $Cr^{2+} > Cr^{3+} > Cu^+ > Cu^{2+}$

**Answer (3)**

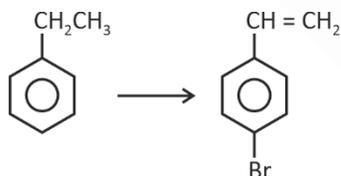
**Sol.**  $Cu^+ [Ar] 3d^{10} \Rightarrow n = 0, \mu = 0$

$Cu^{2+} [Ar] 3d^9 \Rightarrow n = 1, \mu = \sqrt{3} \text{ BM}$

$Cr^{2+} [Ar] 3d^4 \Rightarrow n = 4, \mu = \sqrt{24} \text{ BM}$

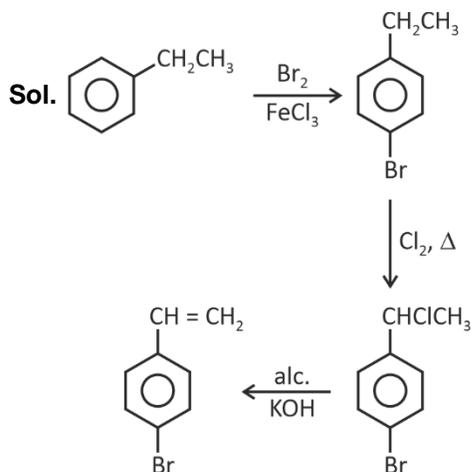
$Cr^{3+} [Ar] 3d^3 \Rightarrow n = 3, \mu = \sqrt{15} \text{ BM}$

8. The correct sequence of reagents to be added for the following conversion



- (1)  $Br_2/Fe$ ; alc.  $KOH$ ;  $Cl_2/FeCl_3$
- (2)  $Br_2/FeCl_3$ ;  $Cl_2/\Delta$ ; alc.  $KOH$
- (3)  $FeCl_3/Br_2$ ; alc.  $KOH$ ;  $H^+/\Delta$
- (4)  $Cl_2/FeCl_3$ ;  $Br_2/FeCl_3$ ; alc.  $KOH$

**Answer (2)**



9. For a first order reaction, the ratio of time required is  $\frac{t_1}{t_2}$ , if  $t_1$  is time consumed when reactant reaches

$\frac{1}{4}$ th of initial concentration and  $t_2$  is the time when

it reaches  $\frac{1}{8}$ th of initial concentration

(1)  $\frac{2}{3}$

(2)  $\frac{3}{4}$

(3)  $\frac{3}{2}$

(4)  $\frac{4}{3}$

**Answer (1)**

**Sol.**  $t_1 = \frac{2.303}{K} \log \frac{A_0}{A_0/4} = \frac{2.303}{K} \log 4$

$t_2 = \frac{2.303}{K} \log \frac{A_0}{A_0/8} = \frac{2.303}{K} \log 8$

$\frac{t_1}{t_2} = \frac{2 \log 2}{3 \log 2} = \frac{2}{3}$

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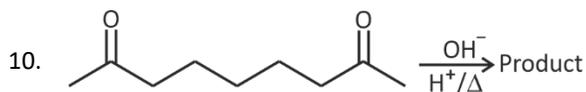
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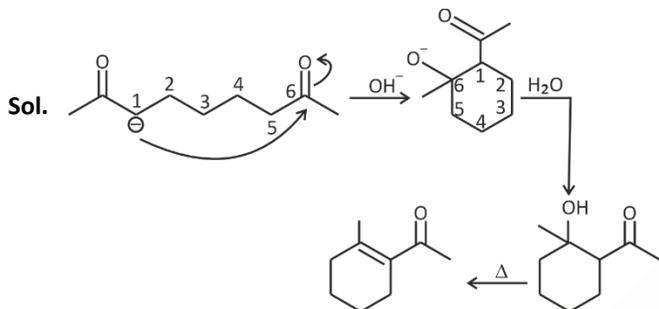




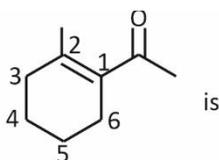
The correct IUPAC name of the product is

- (1) 1-acetyl-2-methyl cyclohexene
- (2) (2-methylcyclohex-1-enyl)ethanone
- (3) cyclo-oct-2-en-1-one
- (4) 2-cycloocten-1-one

**Answer (2)**



The IUPAC Name of



1-(2methylcyclohex-1-enyl)ethanone

11. Match list-I with list-II and choose the correct option.

	List-I		List-II
(a)	Nucleophile	(i)	Tetrahedral shape
(b)	Electrophile	(ii)	Planar and $sp^2$ hybridized
(c)	Carbocation	(iii)	Species that accepts electron
(d)	Carbanion	(iv)	Species that donate electron

- (1) a(i), b(ii), c(iv), d(iii)
- (2) a(iv), b(iii), c(ii), d(i)
- (3) a(iv), b(iii), c(i), d(ii)
- (4) a(iii), b(iv), c(ii), d(i)

**Answer (2)**

Sol. Electrophile → Electron loving species

Nucleophile → +ve charge/vacant orbital loving species

$CH_3^+$  ⇒ planer ( $sp^2$ ) ;  $CH_3^-$  ⇒ tetrahedral

12. Match List-I with List-II and select the correct option.

	List-I		List-II
A	dil $KMnO_4$	I	Unsaturation test
B	$FeCl_3$ test	II	Alcoholic -OH
C	Liberate $CO_2$ with $NaHCO_3$	III	Phenolic -OH
D	Ceric Ammonium nitrate test	IV	Carboxylic Acid

- (1) A-I, B-IV, C-III, D-II
- (2) A-IV, B-I, C-III, D-II
- (3) A-I, B-III, C-IV, D-II
- (4) A-III, B-II, C-IV, D-I

**Answer (3)**

Sol. A-I, B-III, C-IV, D-II

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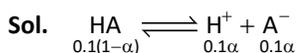
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13. An aqueous solution of 0.1 M HA shows depression in freezing point of 0.2°C. If  $K_f$  ( $H_2O$ ) = 1.86 K kg mol<sup>-1</sup> and assuming molarity = molality, find the dissociation constant of HA.

- (1)  $4.50 \times 10^{-5}$   
 (2)  $6.25 \times 10^{-3}$   
 (3)  $5.625 \times 10^{-4}$   
 (4)  $2.65 \times 10^{-4}$

**Answer (3)**



$$i = 1 + \alpha$$

$$\Delta T_f = iK_f m$$

$$0.2 = i \times 1.86 \times 0.1$$

$$i = \frac{0.2}{0.186} = 1.075$$

$$\alpha = 0.075$$

$$K_a = \frac{0.1(\alpha)^2}{1-\alpha} \approx 0.1(0.075)^2$$

$$= 5.625 \times 10^{-4}$$

14. Which of the following solution can form minimum boiling azeotrope?

- (1)  $C_2H_5OH + H_2O$   
 (2) n-heptane + n-hexane  
 (3)  $CH_3COOH + C_5H_5N$   
 (4)  $C_2H_5Br + C_2H_5I$

**Answer (1)**

**Sol.** The solution showing positive deviation forms minimum boiling azeotrope.

15. On combustion of 0.21 g of an organic compound containing C, H and O gave 0.127 g  $H_2O$  and 0.307 g  $CO_2$ . The percentage of H and O in the given organic compound respectively are

- (1) 7.55 and 43.85  
 (2) 6.72 and 53.41  
 (3) 6.72 and 39.87  
 (4) 53.41 and 39.60

**Answer (2)**

**Sol.** Mass of organic compound = 0.21 g

Mass of  $H_2O$  formed = 0.127 g

Mass of  $CO_2$  formed = 0.307 g

$$\text{Mass of H in organic compound} = \frac{0.127 \times 2}{18} \text{ g}$$

$$\% \text{ of H in organic compound} = \frac{0.127 \times 2 \times 100}{18 \times 0.21} = 6.72 \%$$

$$\text{Mass of C in organic compound} = \frac{0.307 \times 12}{44} \text{ g}$$

$$\% \text{ of C in organic compound} = \frac{0.307 \times 12 \times 100}{44 \times 0.21} = 39.87 \%$$

$$\therefore \% \text{ of O in organic compound} = 100 - 6.72 - 39.87$$

$$= 53.41 \%$$

16. Match List-I with List-II and select the correct option.

	List-I (Complex)		List-II (Characteristics)
A.	$[NiCl_4]^{2-}$	I.	$sp^3$ , tetrahedral, 3.87 BM
B.	$[Ni(CN_4)]^{2-}$	II.	$dsp^2$ , square planar, 0 BM

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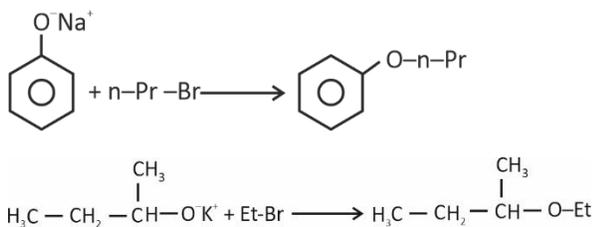


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19.

20.

**SECTION - B**

**Numerical Value Type Questions:** This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. The energy of an electron in first Bohr orbit of H-atom is  $-13.6$  eV. Find the magnitude of energy of an electron in first excited state of  $\text{Be}^{3+}$  ion in eV.

**Answer (54)**

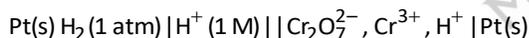
**Sol.**  $E_{2, \text{Be}^{3+}} = -13.6 \times \frac{Z^2}{n^2}$

$$= -13.6 \times \frac{4^2}{2^2}$$

$$= -13.6 \times 4$$

$$= -54.4 \text{ eV}$$

22. Consider the following cell

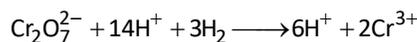
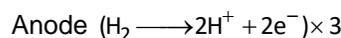
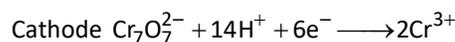


$$E^\circ_{\text{Cr}_2\text{O}_7^{2-}/\text{Cr}^{3+}} = 1.33 \text{ V, At equilibrium } \frac{[\text{Cr}^{3+}]^2}{[\text{Cr}_2\text{O}_7^{2-}]} = 10^{-7}$$

At what pH at cathode,  $E_{\text{cell}}$  of reaction is zero.

**Answer (10)**

**Sol.** Cell reaction



$$K = \frac{[\text{H}^+]^6_{\text{anode}} [\text{Cr}^{3+}]^2}{[\text{H}^+]^{14}_{\text{anode}} [\text{Cr}_2\text{O}_7^{2-}] \times (\text{pH}_2)^3} = \frac{[\text{Cr}^{3+}]^2}{[\text{Cr}_2\text{O}_7^{2-}] [\text{H}^+]^{14}_{\text{anode}}}$$

$$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{0.06}{n} \log K$$

At equilibrium,  $E_{\text{cell}} = 0$

$$0 = 1.33 - \frac{0.06}{6} \log \frac{10^{-7}}{[\text{H}^+]^{14}}$$

$$133 = \log \frac{10^{-7}}{[\text{H}^+]^{14}}$$

$$[\text{H}^+]^{14} = \frac{10^{-7}}{10^{133}} = 10^{-140}$$

$$[\text{H}^+] = 10^{-10}$$

$$\boxed{\text{pH} = 10}$$

23.

24.

25.

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4. Probability of event  $A$  is 0.7 and event  $B$  is 0.4,  $P(A \cap B^c) = 0.5$ , then the value of  $P(B|A \cup B^c)$  is equal to

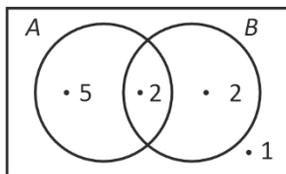
- (1)  $\frac{1}{2}$  (2)  $\frac{1}{3}$   
(3)  $\frac{1}{4}$  (4)  $\frac{3}{4}$

**Answer (3)**

**Sol.**  $P(A \cap B^c) = \frac{1}{2}$

$$P\left(\frac{B}{A \cup B^c}\right) = \frac{P(B \cap (A \cup B^c))}{P(A \cup B^c)}$$

$$= \frac{P((A \cap B) \cup B \cap B^c)}{P(A \cup B^c)}$$



$$= \frac{P(A \cap B)}{P(A \cup B^c)} = \frac{0.2}{0.5 + 0.2 + 0.1}$$

$$\frac{0.2}{0.8} = \frac{1}{4}$$

5.  $\int_{-1}^{3/2} |\pi^2 x \sin(\pi x)| dx.$

- (1)  $4\pi + 1$  (2)  $3\pi + 1$   
(3)  $5\pi + 1$  (4)  $6\pi + 1$

**Answer (2)**

**Sol.**  $I = \int_{-1}^{3/2} |\pi^2 x \sin(\pi x)| dx$

$$= \int_{-1}^1 |\pi^2 x \sin(\pi x)| dx + \int_1^{3/2} |\pi^2 x \sin(\pi x)| dx$$

$$= 2 \int_0^1 |\pi^2 x \sin(\pi x)| dx - \pi^2 \int_1^{3/2} |x \sin(\pi x)| dx$$

$$= 2\pi^2 \int_0^1 |x \sin(\pi x)| dx - \pi^2 \int_1^{3/2} |x \sin(\pi x)| dx$$

$$\therefore \int x \sin(\pi x) dx = x \left( \frac{-\cos \pi x}{\pi} \right) - \int \frac{-\cos \pi x}{\pi} dx$$

$$= -\frac{x}{\pi} \cos \pi x + \frac{1}{\pi^2} \sin \pi x + C$$

$$\therefore I = 2\pi^2 \left( \frac{1}{\pi} \right) - \pi^2 \left( -\frac{1}{\pi^2} - \frac{1}{\pi} \right)$$

$$= 2\pi + 1 + \pi$$

$$= 3\pi + 1$$

6. The product of last 2 digits of  $(1919)^{1919}$  is

- (1) 56  
(2) 63  
(3) 45  
(4) 54

**Answer (2)**

**Sol.**  $(1920 - 1)^{1919} = {}^{1919}C_0(1920)^{1919} - {}^{1919}C_1(1920)^{1918} + \dots$   
 $\dots - {}^{1919}C_{1918}(1920)^1 - {}^{1919}C_{1919}1$

Last two digits  ${}^{1919}C_{1918}(1920) - 1$

$$= 3684479$$

$$\therefore \text{Last 2 digits} = 79$$

The product is  $7 \times 9 = 63$

7. If  $A = \begin{bmatrix} 2 & 2+p & 2+p+q \\ 4 & 6+2p & 8+3p+2q \\ 6 & 12+3p & 20+6p+3q \end{bmatrix}$ , then the value of

$\det(\text{adj}(\text{adj}(3A))) = 2^m \cdot 3^n$ , then  $m + n$  is equal to

- (1) 20 (2) 24  
(3) 36 (4) 18

**Answer (2)**

**Sol.**  $\begin{vmatrix} 2 & 2+p & 2+p+q \\ 4 & 6+2p & 8+3p+2q \\ 6 & 12+3p & 20+6p+3q \end{vmatrix}$

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$$= \begin{vmatrix} 2 & 2 & 2+p+q \\ 4 & 6 & 8+3p+2q \\ 6 & 12 & 20+6p+3q \end{vmatrix} + \underbrace{\begin{vmatrix} 2 & p & 2+p+q \\ 4 & 2p & 8+3p+2q \\ 6 & 3p & 20+6p+3q \end{vmatrix}}_{=0}$$

$$= 2 \times 2 \begin{vmatrix} 1 & 1 & 2+p+q \\ 2 & 3 & 8+3p+2q \\ 3 & 6 & 20+6p+3q \end{vmatrix}$$

$$C_3 \rightarrow C_3 \rightarrow pC_2$$

$$= 4 \begin{vmatrix} 1 & 1 & 2+q \\ 2 & 3 & 8+2q \\ 3 & 6 & 20+3q \end{vmatrix} = 4 \begin{vmatrix} 1 & 1 & 2 \\ 2 & 3 & 8 \\ 3 & 6 & 20 \end{vmatrix} + 0$$

$$= 4 \begin{vmatrix} 1 & 1 & 1 \\ 2 & 3 & 4 \\ 3 & 6 & 10 \end{vmatrix}$$

$$= 8(1(6) - 1(8) + 1(3))$$

$$= 8$$

$$|\text{adj}(\text{adj}(3A))| = (|3A|)^2 = |3A|^4$$

$$= (3^3|A|)^4 = 3^{12} \cdot |A|^4$$

$$= 3^{12} \cdot (2^3)^4$$

$$= 3^{12} \cdot 2^{12}$$

8. If  $f(x) = x - 1$  and  $g(x) = e^x$  and

$$\frac{dy}{dx} = \left( e^{-2\sqrt{x}} g(f(f(x))) - \frac{y}{\sqrt{x}} \right), \text{ where } y(0) = 0.$$

Then  $y(1)$  equals to

(1)  $\frac{2e-1}{e^4}$

(2)  $\frac{e-1}{e^4}$

(3)  $\frac{e^3-1}{e^4}$

(4)  $\frac{e^2-1}{e^4}$

Answer (2)

Sol.  $\frac{dy}{dx} = e^{-2\sqrt{x}} e^{x-2} - \frac{y}{\sqrt{x}}$

$$\frac{dy}{dx} = e^{x-2\sqrt{x}-2} \frac{-y}{\sqrt{x}}$$

$$\frac{dy}{dx} + \frac{y}{\sqrt{x}} = e^{x-2\sqrt{x}-2}$$

$$I.F = e^{\int \frac{1}{\sqrt{x}} dx}$$

$$= e^{2\sqrt{x}}$$

$$y \cdot e^{2\sqrt{x}} = \int e^{2\sqrt{x}} \cdot e^{-2\sqrt{x}} e^{x-2} dx$$

$$y \cdot e^{2\sqrt{x}} = \int e^{x-2} dx$$

$$y e^{2\sqrt{x}} = e^{x-2} + c$$

$$Y(0) = 0$$

$$0 = \frac{1}{e^2} + c$$

$$c = -\frac{1}{e^2}$$

$$\therefore y e^{2\sqrt{x}} = e^{x-2} - \frac{1}{e^2}$$

$$\therefore \text{Put } x = 1$$

$$y e^2 = e^{-1} - \frac{1}{e^2}$$

$$y = \frac{1}{e^3} - \frac{1}{e^4}$$

$$y = \frac{e-1}{e^4}$$

9. Consider two statements

Statement 1:  $\lim_{x \rightarrow 0} \frac{\tan^{-1} x + \ln \sqrt{\frac{1+x}{1-x}} - 2x}{x^5} = \frac{2}{5}$

Statement 2: The  $\lim_{x \rightarrow 1} x^{\left(\frac{2}{1-x}\right)}$  is equal to  $e^2$  and can be

solved by the method  $e^{\lim_{x \rightarrow 1} f(x)} (g(x) - 1)$

(1) Only Statement 1 is true

(2) Only Statement 2 is true

(3) Both Statement 1 and Statement 2 true

(4) Both Statement 1 and Statement 2 False

Answer (1)

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Sol.  $\lim_{x \rightarrow 0} \left( \frac{\tan^{-1} x + \ln \sqrt{\frac{1+x}{1-x}} - 2x}{x^5} \right)$

$$\Rightarrow \lim_{x \rightarrow 0} \frac{\left( x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \dots \right) + \frac{1}{2} \left( x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5} + \dots \right) - \frac{1}{2} \left( -x - \frac{x^2}{2} - \frac{x^3}{3} - \frac{x^4}{4} - \frac{x^5}{5} + \dots \right) - 2x}{x^5}$$

$$\Rightarrow \lim_{x \rightarrow 0} \frac{\left( x + \frac{1}{2}(x+x) - 2x \right) + x^3 \left( \frac{-1}{3} + \frac{1}{2} \times \frac{1}{3} + \frac{1}{2} \times \frac{1}{3} \right) + x^5 \left( \frac{1}{5} + \frac{1}{2} \times \frac{1}{5} + \frac{1}{2} \times \frac{1}{5} \right) + \dots}{x^5}$$

$$\Rightarrow \lim_{x \rightarrow 0} \frac{\left( \frac{1}{5} + \frac{1}{10} + \frac{1}{10} \right) x^5}{x^5} = \frac{2}{5}$$

$$\Rightarrow \lim_{x \rightarrow 1} x^{\left( \frac{2}{1-x} \right)} = \lim_{x \rightarrow 1} \left( [1 + (x-1)]^{\frac{1}{x-1}} \right)^{(x-1)2}$$

$$= e^{-2} = \frac{1}{e^2}$$

10. Value of  $\cot^{-1} \left( \frac{\sqrt{1+\tan^2 2} + 1}{\tan 2} \right) - \cot^{-1} \left( \frac{\sqrt{1+\tan^2 2} - 1}{\tan 2} \right)$  is

(1)  $\frac{\pi}{2} + \frac{\pi}{2}$                       (2)  $\frac{\pi}{2} - \frac{3}{2}$

(3)  $2 - \frac{\pi}{2}$                          (4)  $3 + \frac{\pi}{2}$

**Answer (3)**

Sol.  $\cot^{-1} \left( \frac{\sqrt{1+\tan^2 2} + 1}{\tan 2} \right) - \cot^{-1} \left( \frac{\sqrt{1+\tan^2 2} - 1}{\tan 2} \right)$

$$= \cot^{-1} \left( \frac{|\sec 2| + 1}{\tan 2} \right) - \cot^{-1} \left( \frac{|\sec 2| - 1}{\tan 2} \right)$$

$$= \cot^{-1} \left( \frac{1 - \sec 2}{\tan 2} \right) - \cot^{-1} \left( \frac{\sec 2 - 1}{\tan 2} \right)$$

$$= \cot^{-1} \left( \frac{\cos 2 - 1}{\sin 2} \right) - \left( \pi - \cot^{-1} \left( \frac{\sec 2 - 1}{\tan 2} \right) \right)$$

$$= \left( \pi - \cot^{-1} \left( \frac{1 - \cos 2}{\sin 2} \right) \right) - \left( \pi - \cot^{-1} \left( \frac{1 + \cos 2}{\sin 2} \right) \right)$$

$$= \cot^{-1} \left( \frac{1 + \cos 2}{\sin 2} \right) - \cot^{-1} \left( \frac{1 - \cos 2}{\sin 2} \right)$$

$$= \tan^{-1} \left( \frac{\sin 2}{1 + \cos 2} \right) - \tan^{-1} \left( \frac{\sin 2}{1 - \cos 2} \right)$$

$$= \tan^{-1} \left( \frac{\frac{\sin 2}{1 + \cos 2} - \frac{\sin 2}{1 - \cos 2}}{1 + \frac{\sin 2}{1 + \cos 2} \cdot \frac{\sin 2}{1 - \cos 2}} \right)$$

$$= \tan^{-1} \left( \frac{-2 \cos 2 \cdot \sin 2}{1 - \cos^2 2 + \sin^2 2} \right)$$

$$= \tan^{-1} \left( \frac{-2 \sin 2 \cdot \cos 2}{2 \sin^2 2} \right)$$

$$= \tan^{-1}(-\cot 2)$$

$$= -\tan^{-1}(\cot 2)$$

$$= -\tan^{-1} \left( \tan \left( \frac{\pi}{2} - 2 \right) \right) = 2 - \frac{\pi}{2}$$

11. Let  $\vec{a} = \hat{i} + 4\hat{j} + 3\hat{k}$  and  $\vec{b} = 2\hat{i} + 3\hat{j} + 4\hat{k}$  and  $\vec{c}$  is a vector perpendicular to  $\vec{a}$  and lies in the plane of  $\vec{a}, \vec{b}$  is equal to

- (1)  $\hat{i} + \hat{j} + \hat{k}$                       (2)  $-\hat{i} + \hat{j} - \hat{k}$
- (3)  $\hat{i} - \hat{j} + \hat{k}$                       (4)  $-\hat{i} - \hat{j} - \hat{k}$

**Answer (2)**

Sol.  $\vec{c} = \vec{a} + \lambda \vec{b}$

$$\vec{c} \cdot \vec{a} = 0$$

$$\Rightarrow 0 = 26 + \lambda \cdot (2 + 12 + 12)$$

$$\Rightarrow \lambda = -1$$

$$\therefore \vec{c} = \vec{a} - \vec{b}$$

$$= -\hat{i} + \hat{j} - \hat{k}$$

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12. Area of the region

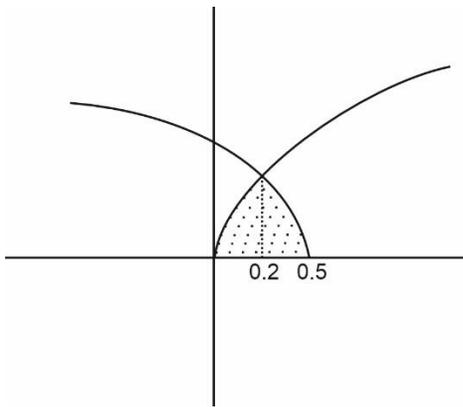
$$\{(x, y) : 0 \leq y \leq \sqrt{9x}, y^2 \geq 3 - 6x\} \text{ (in square units)}$$

(1)  $\frac{1}{3} \left(\frac{9}{5}\right)^{1/2}$                       (2)  $\frac{3}{5} \left(\frac{8}{5}\right)^{1/2}$

(3)  $\frac{1}{3} \left(\frac{7}{5}\right)^{1/2}$                       (4)  $\frac{1}{9} \left(\frac{7}{5}\right)^{1/2}$

Answer (1)

Sol.  $0 \leq y \leq \sqrt{9x}$   
 $y^2 \leq 3 - 6x$



$$\text{Area} = \int_0^{1/5} \sqrt{9x} dx + \int_{1/5}^{1/2} \sqrt{3-6x} dx$$

$$\frac{2(9x)^{3/2}}{3 \times 9} \Big|_0^{1/5} + \frac{2(3-6x)^{3/2}}{3(-6)} \Big|_{1/5}^{1/2}$$

$$\frac{2}{27} \times \left(\frac{9}{5}\right)^{3/2} + \frac{1}{9} \left(3 - \frac{6}{5}\right)^{3/2}$$

$$= \frac{2}{27} \times \left(\frac{9}{5}\right)^{3/2} + \frac{1}{9} \left(\frac{9}{5}\right)^{3/2}$$

$$= \left(\frac{9}{5}\right)^{3/2} \left[\frac{2}{27} + \frac{1}{9}\right] = \frac{5}{27} \times \left(\frac{9}{5}\right)^{3/2}$$

$$= \frac{1}{3} \times \left(\frac{9}{5}\right)^{1/2}$$

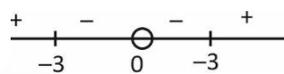
13. Let  $f$  be defined as  $R - \{0\} \rightarrow R$  such that  $f(x) = \frac{x}{3} + \frac{3}{x} + 3$ .  
 If  $f(x)$  is strictly increasing in  $(-\infty, \alpha_1) \cup (\alpha_2, \infty)$  and strictly decreasing in  $(\alpha_3, \alpha_4) \cup (\alpha_4, \alpha_5)$  then  $\sum_{i=1}^5 (\alpha_i)^2$  is

- equal to  
 (1) 28                                      (2) 36  
 (3) 48                                      (4) 40

Answer (2)

Sol.  $f(x) = \frac{x}{3} + \frac{3}{x} + 3, x \neq 0$

$$f'(x) = \frac{1}{3} - \frac{3}{x^2} = \frac{x^2 - 9}{3x^2}$$



$(-\infty, -3) \cup (0, \infty)$   $f(x)$  increasing

$f(x)$  is decreasing  $(-3, 0) \cup (0, 3)$

$$(-\infty, \alpha_1) \cup (\alpha_2, \infty) \Rightarrow \alpha_1 = -3, \alpha_2 = 3$$

$$(-3, 0) \cup (0, 3) \Rightarrow \alpha_3 = -3, \alpha_4 = 0, \alpha_5 = 3$$

$$\sum_{i=1}^5 \alpha_i^2 = (-3)^2 + 3^2 + (-3)^2 + 0^2 + 3^2 = 4.3^2 = 4 \times 9 = 36$$

14. Let  $A = \{0, 1, 2, 3, 4, 5, 6\}$ . Let  $R_1$  be a relation defined on  $A \times A$  such that  $R_1 = \{(x, y) : \max(x, y) \in \{3, 4\}\}$ .

Consider two statements

Statement 1 : Total number of elements in  $R_1$  is 18

Statement 2:  $R$  is symmetric but not reflexive and transitive

- (1) Statement 1 is true but Statement 2 is false  
 (2) Statement 2 is true but Statement 1 is false  
 (3) Statement 1 and Statement 2 are true  
 (4) Neither Statement 1 nor Statement 2 are true

Answer (2)

Sol. Let  $\max(x, y) = 3$

$$\Rightarrow \{(0, 3), (1, 3), (2, 3), (3, 3), (3, 0), (3, 1), (3, 2)\}$$

similarly  
 Let  $\max(x, y) = 4$

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(in 1000+ students)

**1000+ 99 PERCENTILERS**  
9 ABOVE

**4000+ 95 PERCENTILERS**  
9 ABOVE

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$\Rightarrow \{(0, 4), (1, 4), (2, 4), (3, 4), (4, 4), (4, 0), (4, 1), (4, 2), (4, 3)\}$  Total 16 elements

$R_1$  is not reflexive :  $\max(x, y) \in \{3, 4\} \Rightarrow R_1$  is symmetric

$\Rightarrow \max(y, x) \in \{3, 4\}$

$\max(x, y) \in \{3, 4\}$  and  $\max(y, z) \in \{3, 4\} \Rightarrow \max = \{x, z\} \Rightarrow$  not transitive  $(0, 4) \in R_1$  and  $(4, 0) \in R_1 \Rightarrow (0, 0) \notin R_1$

15. Let  $I_1 = \int_{-\frac{1}{2}}^1 2xf(2x(1-2x))dx$  and

$I_2 = \int_{-1}^1 f(x(1-x))dx$  then  $\frac{I_2}{I_1}$  equals to

- (1) 4 (2) 2  
(3) 3 (4) 1

**Answer (1)**

**Sol.**  $I_1 = \int_{-\frac{1}{2}}^1 2xf(2x(1-2x))dx$

$$I_1 = \int_{-\frac{1}{2}}^1 2\left(\frac{1}{2}-x\right)f\left(2\left(\frac{1}{2}-x\right)\left(1-2\left(\frac{1}{2}-x\right)\right)\right)dx$$

$$I_1 = \int_{-\frac{1}{2}}^1 (1-2x)f((1-2x)(2x))dx$$

$$I_1 = \int_{-\frac{1}{2}}^1 f((1-2x)(2x))dx - \int_{-\frac{1}{2}}^1 2xf((1-2x)(2x))dx$$

$$2I_1 = \int_{-\frac{1}{2}}^1 f((1-2x)(2x))dx$$

Put  $2x = t$

$2dx = dt$

$$dx = \frac{dt}{2}$$

$$2I_1 = \frac{1}{2} \int_{-1}^2 f((1-t)(t))dt$$

$$I_1 = \frac{1}{4} \int_{-1}^2 f((1-x)(x))dx$$

$$I_1 = \frac{1}{4} I_2$$

$$4 \Rightarrow \frac{I_2}{I_1}$$

16. A circle touches the parabola  $y^2 = 9x$  at  $(4, 6)$  and positive x-axis. Find the radius of the circle.

- (1)  $\frac{20}{3}$  (2)  $\frac{10}{3}$   
(3)  $\frac{1}{3}$  (4)  $\frac{5}{3}$

**Answer (2)**

**Sol.** Equation of tangent at  $(4, 6)$  using  $T = 0$

$$y \cdot 6 = \frac{9}{2}(x+4)$$

$$\Rightarrow 3x - 4y + 12 = 0$$

Equation of circle

$$(x-4)^2 + (y-6)^2 + \lambda(3x-4y+12) = 0$$

It touches x-axis.

$\therefore$  put  $y = 0$  and make  $D = 0$

$$(x-4)^2 + 36 + \lambda(3x+12) = 0$$

$$\Rightarrow x^2 + (3\lambda-8)x + 52 + 12\lambda = 0$$

$D = 0$

$$(3\lambda-8)^2 - 4(12\lambda+52) = 0$$

$$\Rightarrow \lambda = 12, \frac{-4}{3}$$

For  $\lambda = \frac{-4}{3}$ , circle touches positive x-axis.

$$(x-4)^2 + (y-6)^2 - \frac{4}{3}(3x-4y+12) = 0$$

$$r = \frac{10}{3}$$

17.  
18.  
19.  
20.

**SECTION - B**

**Numerical Value Type Questions:** This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

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100 Percentile in Physics & Chemistry



**Devya Rustagi**  
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99.99 Percentile



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**JEE (Main)-2025 : Phase-2 (08-04-2025)-Evening**

21. The sum of squares of roots of  $|x-2|^2 - |x-2| - 2 = 0$  and  $x^2 - 2|x-3| - 5 = 0$  equals to

**Answer (42)**

**Sol.**  $|x-2|^2 - |x-2| - 2 = 0$

Let  $|x-2| = t$

$$t^2 - t - 2 = 0$$

$$t^2 - 2t + t - 2 = 0$$

$$t(t-2) + 1(t-2) = 0$$

$$(t+1)(t-2) = 0$$

$$t = -1, t = 2$$

$$\therefore |x-2| = -1, |x-2| = 2$$

Number + possible  $\Rightarrow x-2 = \pm 2$

$$\Rightarrow x = 0, 4$$

$$x^2 - 2|x-3| - 5 = 0$$

when  $x < 3$

$$x^2 + 2(x-3) - 5 = 0$$

$$x^2 + 2x - 11 = 0$$

$$x = \frac{-2 \pm \sqrt{4+44}}{2}$$

$$x = \frac{-2 \pm 4\sqrt{3}}{2}$$

$$x = -1 \pm 2\sqrt{3}$$

When  $x \geq 3$

$$\Rightarrow x^2 - 2x + 6 - 5 = 0$$

$$\Rightarrow x^2 - 2x + 1 = 0$$

$$\Rightarrow (x-1)^2 = 0$$

$$\Rightarrow x = 1 \text{ (rejected)}$$

$\therefore$  Sum of square of roots

$$= 4^2 + (-1+2\sqrt{3})^2 + (-1-2\sqrt{3})^2$$

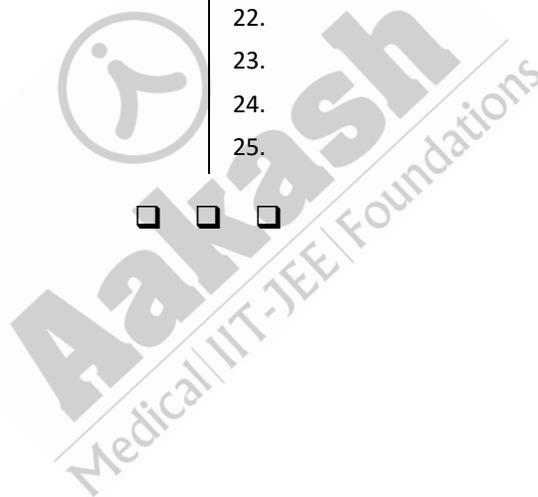
$$= 16 + 1 + 12 + 1 + 12 = 42$$

22.

23.

24.

25.



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