

Advanced Practice Test-13

TIME : 3 hrs	M.M. : 390
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Read the following Instructions very carefully before you proceed.

- The question paper consists of 3 subjects :
(Subject I : Chemistry, Subject II : Physics, Subject III : Mathematics).
Each Part has 3 sections (Section I, Section II & Section III).
- Section-I** contains **4 Single Correct Answer Type Questions**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE CHOICE** is correct.
➤ *Marking scheme [3 Marks for Correct answer & **-1 NEGATIVE MARKING** for wrong answer]*
- Section II** contains **10 Single Integer Value Type Questions**. The answer to each of the questions is a single-digit integer, ranging from 0 to 9 (both inclusive).
➤ *Marking scheme [4 Marks for Correct answer & **-1 NEGATIVE MARKING** for wrong answer]*
- Section III** contains **10 Match the columns type questions**. Each question contains statements given in 2 columns. Statements in the first column have to be matched with statements in the second column. The answers to these questions have to be appropriately bubbled in the answer sheet.
➤ *Marking scheme [6 Marks if you darken ALL the bubbles corresponding ONLY to the correct answer or given 1.5 Marks each for correct bubbling of answer in any row. **No Negative mark will be given for an incorrectly bubbled answer]***
- No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc., except the Admit Card inside the examination hall/room.
- Rough work is to be done on the space provided for this purpose in the Test Booklet only.
- For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** properly in the space given in the ANSWER SHEET.
- On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.
- Do not fold or make any stray marks on the Answer Sheet.
- No one will be permitted to leave the test room before the end of the test, i.e. 01:00 PM**

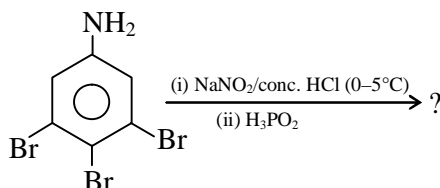
SECTION-I
SINGLE CORRECT ANSWER

This section contains 10 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct:

Paragraph for Questions 1 - 3

Amines can be produced by selective reduction of nitro compounds. A mixture of (Sn and HCl) acts as a good reducing agent which converts nitro benzene to aniline. Diazotisation takes place when aniline is treated with a mixture of NaNO₂ and conc. HCl. A large number of aromatic compounds can be prepared from diazonium salt e.g. on hydrolysis it produces phenol.

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



- 3, 4, 5-tribromobenzene
 - 1, 2, 3-tribromobenzene
 - 2, 6-dibromophenol
 - 3, 4, 5-tribromophenol
- Electrolytic reduction of nitrobenzene in weakly acidic medium gives:
 - N-phenyl hydroxyl amine
 - Nitrosobenzene
 - Aniline
 - p-hydroxyaniline

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Paragraph for Questions 4 - 6

Any nucleophilic substitution reaction proceeds via two processes:

- I.** S_N1 i.e. substitution nucleophilic unimolecular
II. S_N2 i.e. substitution nucleophilic bimolecular

The examples which serve for these are the solvolysis of alkyl halides. Let solvolysis of tert-butyl bromide takes place via two conditions given below.

Reaction 1 : Tert-butyl bromide was reacted with ethanol containing small amount of sodium ethoxide. The reaction was proceeding with a half life of only a few minutes and this resulted in products **(A)**, an ether and **(B)**, an alkene with MF C_4H_8 . The rate for the reaction is given by the rate expression,

$$\text{Rate} = k_1 [\text{tert-butyl bromide}] + k_2 [\text{tert-butyl bromide}] [C_2H_5O^-]$$

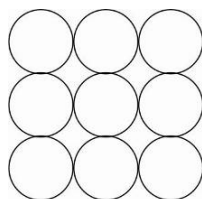
Reaction 2 : Tert-butyl bromide was reacted with a mixture of solvents containing 70% ethanol and 30% water.

4. The number of products (including minor) possible for the second reaction is :
(A) 1 **(B)** 2 **(C)** 3 **(D)** reaction will not occur
5. The two constants k_1 and k_2 for the reaction I are for the reactions :
(A) S_N1 and S_N2 respectively **(B)** S_N1 and E2 respectively
(C) E1 and S_N2 respectively **(D)** E1 and S_N1 respectively
6. During substitution reactions with weak base via carbocation mechanism :
(A) S_N1 predominates **(B)** S_N2 predominates
(C) E1 predominates **(D)** E2 predominates

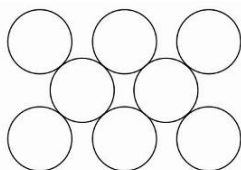
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Paragraph for Questions 7 - 9

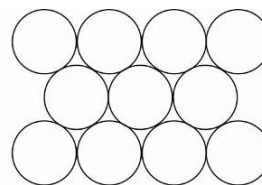
In metals, the atoms can be packed in one of following pattern:



Pattern 1



Pattern 2



Pattern 3

The pattern shown above are two dimensional and it can be extended in three dimension to form a metal lattice.

The packing fraction of a 3D arrangement depends on (A) the layout of each layer (B) the manner in which the layers are stacked over one another.

The density of a metal is same as the density of a unit cell, as density is an intensive property.

$$\text{Density of a unit cell} = \frac{\text{No. of effective atoms in a unit cell} \times \text{atomic mass of metal}}{\text{Avogadro's No.} \times \text{Volume of unit cell}}$$

$$d = \frac{n \times M}{N_A \times a^3} \text{ where } a \text{ is the edge length of a cubic unit cell.}$$

7. The area fraction of pattern 3 will be :

- (A) $\frac{3\pi}{8\sqrt{2}}$ (B) $\frac{3\pi}{4\sqrt{2}}$ (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{2\sqrt{3}}$

8. Placing another similar layer over pattern 2 into the interstitial spaces of first layer, lead to the formation of :

- (A) Body centered cubic unit cell (B) End entered monoclinic unit cell
(C) Face centered cubic unit cell (D) Body centered tetragonal unit cell

9. A metal M (atomic mass = 50) crystallizes in FCC and BCC structure depending upon temperature. The ratio of the density of two forms is : ($r_M = 120 \text{ pm}$)

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

10. A compound which gives a yellow solid on adding to an alcoholic solution of 2, 4-dinitrophenyl-hydrazine but does not reduce Fehling's solution and ammoniacal silver nitrate solution, is :

- (A) $\text{CH}_3\text{CHOHCH}_3$ (B) CH_3COCH_3
(C) CH_3CHO (D) CH_3COOH

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SPACE FOR ROUGH WORK

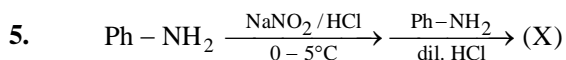
SECTION - II

SINGLE INTEGER VALUE CORRECT TYPE

This section contains 10 Single Integer Value Correct type Questions. Each question has an integer answer between 0 and 9. Fill the answer bubbles in the OMR Sheet APPROPRIATELY and CAREFULLY.

1. Ferrous oxide has a cubic structure and edge length of the unit cell is 5\AA . Assuming the density of ferrous oxide to be 3.84 g/cm^3 the number of Fe^{2+} and O^{2-} present in each unit cell will be _____.
2. 100 mL of tap water containing $\text{Ca}(\text{HCO}_3)_2$ was titrated with N/50 HCl in presence of methyl orange as an indicator. If 30 mL of HCl was required, the temporary hardness as parts of CaCO_3 per 10^6 parts of water is $x \times 10^2$ ppm. What is numerical value of x?
3. The poly β -hydroxybutyrate-co- β -hydroxy valerate (*PHBV*) is a biodegradable polymer. How many carbon atoms are present in repeating unit of this polymer?
4. At equimolar concentrations of Fe^{2+} and Fe^{3+} , voltage of the galvanic cell made from Ag^+ / Ag and $\text{Fe}^{3+} / \text{Fe}^{2+}$ electrodes equals zero. The reaction is : $\text{Fe}^{2+} + \text{Ag}^+ \rightleftharpoons \text{Fe}^{3+} + \text{Ag}$.
The equilibrium constant at 25°C for the reaction is _____. (Given: $E^\circ_{\text{Ag}^+/\text{Ag}} = 0.799$ volt and $E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = 0.771$ volt)

SPACE FOR ROUGH WORK



What is the sum of the number of nitrogen atoms present in (X) and the total number of stereoisomers of (X) formed ?

6. How many gaseous products are formed in the reaction representing complete hydrolysis of XeF_4 ?

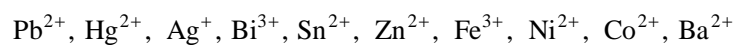
7. K_a for butyric acid is 2×10^{-5} . The pH of 0.2 M aqueous solution of sodium butyrate is_____.

8. How many of the following compounds are more acidic than benzoic acid ?

o-nitrobenzoic acid	p-methoxybenzoic acid	2, 4, 6-trinitrophenol
o-toluic acid	Salicylic acid	Formic acid
p-toluic acid	m-hydroxy benzoic acid	p-hydroxy benzoic acid

9. Glucose reacts with x number of molecules of phenyl hydrazine to yield osazone. The value of x is.....

10. How many of the following metal ions are precipitated as sulphides in systematic qualitative analysis?



SPACE FOR ROUGH WORK



SECTION - III
MATRIX MATCH TYPE

This section contains 10 questions. Each question contains statements given in two columns which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. The answers to these questions have to be appropriately bubbled. More than one choice from Column 2 can be matched with Column 1.

1. **MATCH THE FOLLOWING :**

Column 1 (Organic compound)		Column 2 (Chemical test/reactions shown)	
(A)	C_6H_5CHO	(p)	Positive fehling's test
(B)	HCHO	(q)	Cannizaro's reaction
(C)	CH_3CHO	(r)	Haloform reaction
(D)	CH_3COCH_3	(s)	Reacts with NH_3 to give urotropine

2. Match the elements of Column-1 to elements of Column-2.

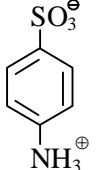
Column 1		Column 2	
(A)	$CH_3 - \overset{\oplus}{C}H - CH_3$	(p)	Aromatic
(B)		(q)	Hyperconjugation
(C)		(r)	Delocalisation of π electrons
(D)	$CH_2 = CH - \overset{\oplus}{C}H - Ph$	(s)	Anti Aromatic
		(t)	+I effect

SPACE FOR ROUGH WORK

3. MATCH THE FOLLOWING :

	Column 1		Column 1
(A)	$[\text{Co}(\text{NO}_2)_2(\text{H}_2\text{O})_2(\text{NH}_3)_2]\text{NO}_3$	(p)	Number of stereoisomers = 6
(B)	$[\text{Ni}(\text{en})_3]\text{Br}_3$	(q)	Linkage isomerism
(C)	$[\text{Co}(\text{NH}_3)_3(\text{py})_3]\text{Br}_2$	(r)	Ionization isomerism
(D)	$[\text{Pt}(\text{en})(\text{SCN})_2](\text{NO}_3)_2$	(s)	Optical isomerism
		(t)	Geometrical isomerism

4. MATCH THE FOLLOWING :

	Column 1		Column 1
(A)	$\begin{array}{c} \text{NH} \\ \diagdown \\ \text{C} \\ \diagup \\ \text{H}_2\text{N} \end{array} \text{---} \text{NH} \text{---} \text{CH}_2 \text{---} \underset{\text{NH}_3^{\oplus}}{\text{CH}} \text{---} \text{CO}_2^{\ominus}$	(p)	Show acidic behaviour towards water.
(B)	$\begin{array}{c} \text{CH}_2 \text{---} \text{CH} \text{---} \text{NH} \text{---} \text{CH}_3 \\ \\ \text{O}^{\oplus} \\ \\ \text{H} \end{array}$	(q)	Show basic behaviour towards water.
(C)		(r)	Show resonance
(D)	$\begin{array}{c} \text{H}_3\text{C} \text{---} \text{C} \text{---} \text{OH} \\ \quad \quad \\ \text{H}_3\text{C} \quad \quad \text{SO}_3^{\ominus} \text{Na}^{\oplus} \end{array}$	(s)	Zwitter ion
		(t)	Crystalline salt

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5. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	Cu^{2+}	(p)	Gives chocolate brown ppt with $\text{K}_4[\text{Fe}(\text{CN})_6]$
(B)	Fe^{3+}	(q)	Gives Prussian blue solution with $\text{K}_4[\text{Fe}(\text{CN})_6]$
(C)	Ni^{2+}	(r)	Gives black ppt. with H_2S (excess)
(D)	Pb^{2+}	(s)	Gives rose red ppt. with DMG in NH_4OH
		(t)	Gives blood red ppt. with KCNS

6. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	$[\text{Co}(\text{NH}_3)_6]^{3+}$	(p)	Geometrical isomerism
(B)	$[\text{CoF}_6]^{3-}$	(q)	Optical isomerism
(C)	$[\text{Fe}(\text{ox})_3]^{3-}$	(r)	High spin complex
(D)	$[\text{Cr}(\text{H}_2\text{O})_2(\text{en})(\text{NH}_3)_2]^{3+}$	(s)	Inner orbital complex
		(t)	Paramagnetic

7. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	Ethanol - Acetone	(p)	Enthalpy change positive
(B)	Chloroethane - Bromoethane	(q)	Enthalpy change negative
(C)	Carbon disulphide - Acetone	(r)	Entropy change positive
(D)	Chloroform - Acetone	(s)	Change in volume, ΔV positive

SPACE FOR ROUGH WORK

8. MATCH THE FOLLOWING :

Column 1 [Unit Cell]		Column 2 [Second nearest neighbors]	
(A)	Simple cubic crystal	(p)	2
(B)	Body centre cubic crystal	(q)	4
(C)	Face centre cubic crystal	(r)	6
(D)	Simple tetragonal crystal ($a = b \neq c$) ; ($\sqrt{2}a > c$)	(s)	8
		(t)	12

9. MATCH THE FOLLOWING :

Column 1 [Chemical reactions]		Column 2 [Favourable conditions for formation of products]	
(A)	$N_2(g) + O_2(g) \rightleftharpoons 2NO(g), \Delta H = (+)ve$	(p)	High temperature
(B)	$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g), \Delta H = (-)ve$	(q)	Addition of reactants
(C)	$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g), \Delta H = (+)ve$	(r)	Addition of inert gas at constant pressure
(D)	$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g), \Delta H = (+)ve$	(s)	Increasing pressure of system

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10. MATCH THE FOLLOWING :

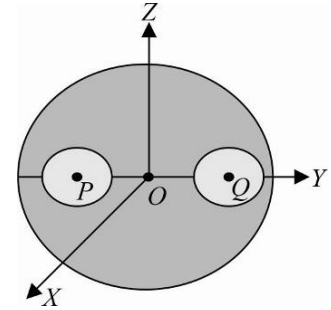
Column 1		Column 2	
(A)	$\Delta G < 0$	(p)	Spontaneous process
(B)	$\Delta S_{\text{total}} < 0$	(q)	Process at equilibrium
(C)	$\Delta S_{\text{total}} = 0$	(r)	$\Delta H > T\Delta S$
(D)	$\Delta G = 0$	(s)	$\Delta H < T\Delta S$

SPACE FOR ROUGH WORK

SECTION-I
SINGLE CORRECT ANSWER

This section contains 10 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct:

1. A solid sphere of uniform density and mass M has radius $4m$. Its centre is at the origin of the coordination system. Two spheres of radii 1 m are taken out so that their centres are at $P(0, -2, 0)$ and $Q(0, 2, 0)$, respectively. This leaves two spherical cavities. What is the gravitational field at the origin of the coordination axes?



- (A) $\frac{31GM}{1024}$ (B) $\frac{Gm}{1024}$
(C) $31GM$ (D) Zero

2. A frame of reference F_2 moves with velocity \vec{v} with respect to another frame F_1 . When an object is observed from both frames, its velocity is found to be \vec{v}_1 in F_1 and \vec{v}_2 in F_2 . Then \vec{v}_2 is equal to :

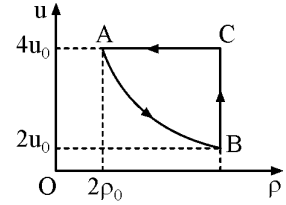
- (A) $\vec{v}_1 + \vec{v}$ (B) $\vec{v}_1 - \vec{v}$ (C) $\vec{v} - \vec{v}_1$ (D) $|\vec{v} - \vec{v}_1| \frac{\vec{v}_1}{|\vec{v}_1|}$

3. A metal rod of uniform resistance 20Ω is fixed at centre along a diameter of a conducting ring of radius 0.1 m and lies on x - y plane. There is a magnetic field $\vec{B} = (50T)\hat{k}$. The rod rotates with an angular velocity. $\omega = 20\text{ rad/sec}$ about its axis passing through centre. An external resistance of 10Ω is connected across the centre of the ring and rim. The current through external resistance is

- (A) $\frac{1}{4}\text{ A}$ (B) $\frac{1}{2}\text{ A}$ (C) $\frac{1}{3}\text{ A}$ (D) 0

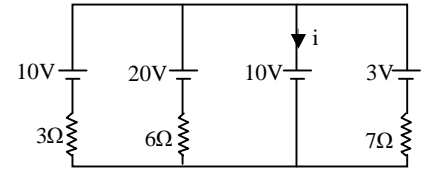
SPACE FOR ROUGH WORK

4. Figure shown the variation of internal energy ' u ' with the density of one mole of monoatomic gas for a thermodynamic cycle $ABCA$. AB process is a rectangular hyperbola. The amount of work done in the process $A \rightarrow B$ is :



- (A) $\frac{2u_0}{3}$ (B) $-\frac{2u_0}{3}$
 (C) $\frac{4u_0}{3}$ (D) $-\frac{4u_0}{3}$

5. In the given figure, all the batteries are ideal. The value of i is :



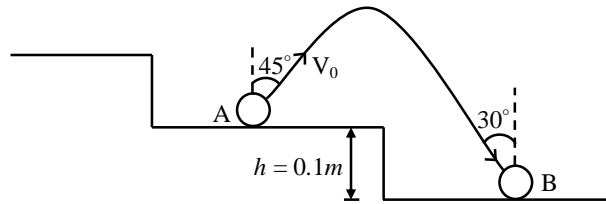
- (A) $2A$ (B) $6A$
 (C) $\frac{2}{3}A$ (D) $\frac{4}{9}A$

6. A particle is projected at an angle 53° to the horizontal at speed of 10 m/s . Find its tangential acceleration at $t = 1.4 \text{ sec}$. (Take $g = 10 \text{ m/s}^2$)

- (A) 5 m/s^2 (B) $5\sqrt{2} \text{ m/s}^2$ (C) $10\sqrt{2} \text{ m/s}^2$ (D) 10 m/s^2

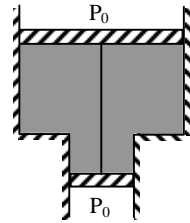
7. A ball is dropped onto a step at a point A and rebounds with a velocity V_0 at an angle of 45° with the vertical. The value of V_0 knowing that just before the ball hits the point B its velocity forms an angle 30° with the vertical is ($g = 10 \text{ m/s}^2$)

- (A) $\sqrt{3} \text{ m/s}$
 (B) $\sqrt{2} \text{ m/s}$
 (C) 1.0 m/s
 (D) 2.0 m/s



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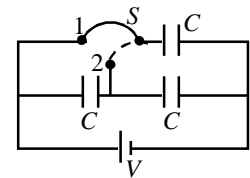
8. A smooth vertical tube having two different cross sections is open at both ends and equipped with two pistons having cross-sectional areas $2A$ and A respectively. Each piston slides within a respective tube section. One mole of ideal gas is enclosed between the pistons tied with a non-stretchable thread. The outside pressure is P_0 atm. If the combined mass of the two pistons is m and system is in equilibrium then pressure of the ideal gas will be :



- (A) $P = P_0 - \frac{mg}{A}$ (B) $P = P_0 + \frac{mg}{2A}$ (C) $P = P_0 + \frac{mg}{A}$ (D)

$$P = P_0 + \frac{2mg}{A}$$

9. Figure shows three similar capacitors connected to a battery for a long time when switch(s) is at 1. Now switch is thrown from point 1 to 2 for a long time then work done by the battery for this process is:



- (A) $-\frac{2}{3}CV^2$ (B) $\frac{2}{3}CV^2$
 (C) $-\frac{5}{6}CV^2$ (D) $\frac{5}{6}CV^2$

10. A particle experiences a net force that is always parallel to y -axis. If it moves along the curve $xy = a^2$, where a is a constant, then magnitude of this force is proportional to :

- (A) y (B) y^2 (C) y^3 (D) $y\sqrt{y}$

SPACE FOR ROUGH WORK

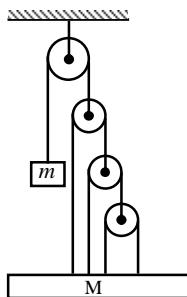
SECTION - II

SINGLE INTEGER VALUE CORRECT TYPE

This section contains 10 Single Integer Value Correct type Questions. Each question has an integer answer between 0 and 9. Fill the answer bubbles in the OMR Sheet APPROPRIATELY and CAREFULLY.

1. An organ pipe filled with oxygen gas at 47°C resonates in its fundamental mode at a frequency 300 Hz . If it is now filled with nitrogen gas, at what temperature in $^{\circ}\text{C}$ will it resonate at the same frequency, in the fundamental mode ?

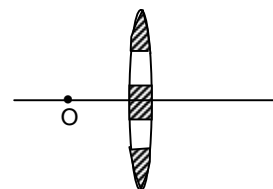
2. Consider the system shown in the figure. the system is so arranged that both m and M are in pure translation. If at a certain instant M is moving down with a speed of 1 m/s then speed of m will be _____ m/s .



3. The centers of two identical small conducting sphere are 1 m apart. They carry charges of opposite kind and attract each other with a force F . When they are connected by conducting thin wire, they repel each other with a force $\frac{F}{3}$. The ratio of magnitude of charges carried by spheres initially is $n : 1$. Find value of n .
4. A wooden cube of side 10 cm and density 0.8 gm/cm^3 is floating in water (1 gm/cm^3). A mass of $(100x)\text{ gm}$ is placed over the cube so that cube is completely immersed without wetting the mass. Find value of x .

SPACE FOR ROUGH WORK

5. Consider a buffer solution made of 0.500 M CH_3COOH and 0.500 M CH_3COONa solution, having pH equal to x . It's pH becomes y after 10 fold dilution. The value of $(x - y)$ is _____
6. How many oxygen atoms are co-ordinated to central metal ion in complex $[\text{Ca}(\text{EDTA})]^{2-}$?
7. When a surface 1 cm thick is illuminated with light of wavelength λ the stopping potential is V_0 but when the same surface is illuminated by light of wavelength 3λ the stopping potential is $\frac{V_0}{6}$. Then the threshold wavelength for metallic surface will be $n\lambda$, find n .
8. A proton and an alpha particle have kinetic energies in the ratio of 16:1. The ratio of their de-Broglie wavelengths associated with them is 1 : K then K is _____.
9. If lens is made such that (in the figure) the shaded part is made of crown glass and unshaded part is flint glass, for an object O how many images will be formed?
10. The path of photoelectrons emitted due to electromagnetic radiation incident on a sample of material A , is found to have a maximum bending radius of 0.1m in a magnetic field of $(\sqrt{2}/3) \times 10^{-4} T$. When the radiation is incident normally on a double slit having a slit separation of 0.1 mm, it is observed that there are 10 fringes in a width of 3.1 cm on a screen placed at a distance of 1m from the double slit. Find the work function (eV) of metal [Given: $hC = 12400 \text{ eV} - \text{\AA}$]

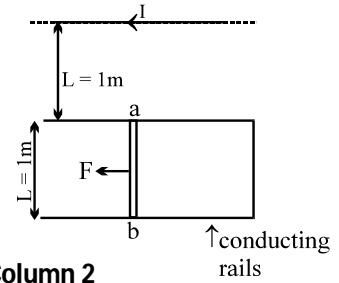


SPACE FOR ROUGH WORK

SECTION - III
MATRIX MATCH TYPE

This section contains 10 questions. Each question contains statements given in two columns which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. The answers to these questions have to be appropriately bubbled. More than one choice from Column 2 can be matched with Column 1.

1. A rod 'ab' of length $L = 1\text{m}$ and resistance $R = 1\Omega$ is moving with constant velocity $V = 1\text{ m/s}$ by applying external force along the long conducting rails. The conducting rails are placed in the same plane of long current carrying wire having current $I = 1\text{A}$. Neglect the resistance of rails :



Column 1

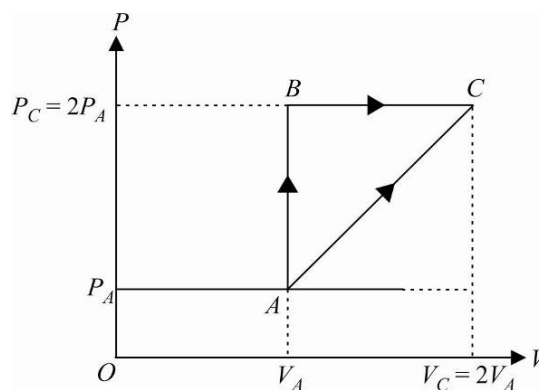
- (A) Emf induced in rod is
 (B) Induced current in rod is
 (C) External horizontal force (F) applied on the rod is
 (D) Rate of work done by external agent is

Column 2

- (p) $\left(\frac{\mu_0}{2\pi}\right)^2 (\ln 2)^2$
 (q) $\frac{\mu_0}{2\pi} \ln 2$
 (r) $\frac{\mu_0}{4\pi} \ln 4$
 (s) $\left(\frac{\mu_0}{4\pi} \ln 2\right)^2$

SPACE FOR ROUGH WORK

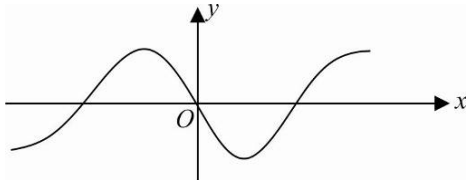
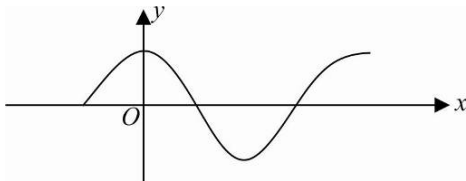
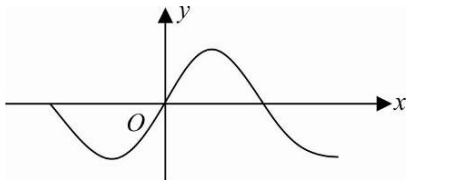
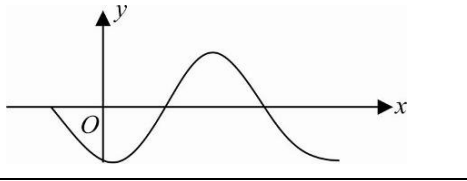
2. n kmol of a monochromatic ideal gas is taken quasi-statically from state A to state C along the straight line shown in figure. Alternatively, the same gas is taken quasi-statically from A to C along the path ABC. Express all answers in terms of P_A and V_A .



	Column 1		Column 2
(A)	The heat ΔH added to the gas along the straight line path AC	(p)	$2P_A V_A$
(B)	Change in internal energy of the gas along the straight line path AC	(q)	$13/2 P_A V_A$
(C)	The work done by the gas along the path ABC	(r)	$6P_A V_A$
(D)	The heat ΔH added to the gas along the straight line path ABC	(s)	$9/2 P_A V_A$

SPACE FOR ROUGH WORK

3. For four sine waves, moving on a string along positive x -direction, displacement distance curves (y - x curves) as shown at time $t = 0$. In the right column, expressions for y as function of distance x and time t for sinusoidal waves are given. All terms in the equations have their usual meanings. Correctly match y - x curves with corresponding equations.

	Column 1		Column 2
(A)		(p)	$y = A \cos (\omega t - kx)$
(B)		(q)	$y = -A \cos (kx - \omega t)$
(C)		(r)	$y = A \sin (\omega t - kx)$
(D)		(s)	$y = A \sin (kx - \omega t)$

SPACE FOR ROUGH WORK

4. Match the following: [\vec{V} is velocity, \vec{r} is position vector and S is distance traveled]

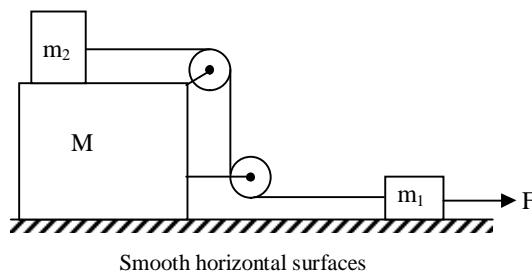
	Column 1		Column 2
(A)	$\frac{d\vec{v}}{dt}$	(p)	Velocity
(B)	$\frac{d \vec{v} }{dt}$	(q)	Acceleration
(C)	$\frac{d\vec{r}}{dt}$	(r)	Magnitude of velocity
(D)	$\frac{dS}{dt}$	(s)	Tangential acceleration

5. In the $s-t$ equation ($s = 10 + 20t - 5t^2$). Match the following :

	Column 1		Column 2
(A)	Distance travelled in 3s	(p)	-20 unit
(B)	Displacement in 1s	(q)	15 unit
(C)	Initial acceleration	(r)	25 unit
(D)	Velocity at 4s	(s)	-10unit

SPACE FOR ROUGH WORK

6. Three blocks of masses m_1 , m_2 and M are arranged as shown in figure. All the surfaces are frictionless and string is inextensible. A constant horizontal force of magnitude F is applied on block of mass m_1 as shown. Pulleys and string are light. Part of the string connecting both the pulleys is vertical and part of the string connecting pulleys with masses m_1 and m_2 are horizontal. Match the following:

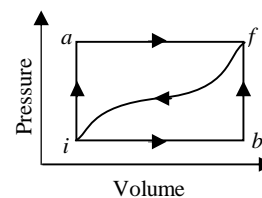


[Take $m_1 = 2\text{ kg}$, $m_2 = 4\text{ kg}$, $M = 10\text{ kg}$ and $F = 20\text{ N}$]

	Column 1		Column 2
(A)	Acceleration of mass m_1 in m/s^2	(p)	5
(B)	Acceleration of mass m_2 in m/s^2	(q)	$\frac{10}{3}$
(C)	Acceleration of mass M in m/s^2	(r)	Zero
(D)	Tension in the string in Newton	(s)	$\frac{40}{3}$

SPACE FOR ROUGH WORK

7. When a sample of a gas is taken from state i to state f along path iaf , heat supplied to the gas is 50 cal and work done by the gas is 20 cal. If it is taken by path ibf , then heat supplied is 36 cal.



	Column 1		Column 2
(A)	Work done by the gas along path ibf is	(p)	6 cal
(B)	If work done upon the gas is 13 cal for the return path fi , then heat rejected by the gas along path fi is	(q)	18 cal
(C)	If internal energy of the gas at state i is 10 cal, then internal energy at state f is	(r)	40 cal.
(D)	If internal energy at state b is 22 cal and at i is 10 cal then heat supplied to the gas along path ib is	(s)	43 cal

8. A block of mass 2kg is kept on a smooth horizontal surface. If a variable horizontal force $F = 2t$ starts acting on the block at $t = 0$ then match the following :

	Column 1		Column 2
(A)	Power delivered by the forces at $t = 5$ sec. is (in watt) :	(p)	$625/4$
(B)	Work done by force between $t = 0$ to $t = 5$ sec. (in J) is :	(q)	$125/6$
(C)	Average power delivered by force between $t = 0$ to $t = 5$ sec (in watt) is :	(r)	125
(D)	Displacement of block between $t = 0$ to $t = 5$ (in m) is :	(s)	$125/4$

SPACE FOR ROUGH WORK

9. MATCH THE FOLLOWING LISTS :

	Column 1		Column 2
(A)	Stress \times Strain	(p)	N
(B)	$\frac{YA}{\ell}$	(q)	N/m
(C)	$Y\ell^2$	(r)	J/m^3
(D)	$\frac{F\ell}{AY}$	(s)	m

10. For a spherical mirror position of object and mirror type is given on L.H.S. and properties of image is given on R.H.S.

	Column 1 [Object position/Mirror type]		Column 2 [Image properties]
(A)	In front of mirror/Convex	(p)	Real erect
(B)	Between pole and focus/Convex	(q)	Virtual magnified
(C)	Between focus and centre of curvature/Concave	(r)	Real magnified
(D)	Between pole and focus/Concave	(s)	Virtual erect

SPACE FOR ROUGH WORK

SECTION-I
SINGLE CORRECT ANSWER

This section contains 10 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct:

Paragraph for Questions 1 - 3

A JEE aspirant estimates that she will be successful with an 80% chance if she studies 10 hours per day, with a 60% chance if she studies 7 hours per day and with a 40% chance if she studies 4 hours per day. She further believes that she will study 10 hours, 7 hours and 4 hours per day with probabilities 0.1, 0.2 and 0.7, respectively :

1. The chance she will be successful is :
 (A) 0.28 (B) 0.38 (C) 0.48 (D) 0.58
2. Given that she does not achieve success, the chance she studied for 4 hours is :
 (A) $\frac{11}{16}$ (B) $\frac{21}{33}$ (C) $\frac{21}{26}$ (D) $\frac{11}{26}$
3. Given that she achieves success, the chance she studied for 10 hours is :
 (A) $\frac{1}{6}$ (B) $\frac{1}{3}$ (C) $\frac{2}{3}$ (D) $\frac{4}{9}$

Paragraph for Questions 4 - 5

Two lines whose equations are $\frac{x-3}{2} = \frac{y-2}{3} = \frac{z-1}{\lambda}$ and $\frac{x-2}{3} = \frac{y-3}{2} = \frac{z-2}{3}$ lie in same plane, then :

4. The value of $\sin^{-1} \sin \lambda$ is equal to :
 (A) 3 (B) $\pi - 3$ (C) 4 (D) $\pi - 4$
5. Angle between the planes containing both lines and the plane $4x + y + 2z = 0$ is :
 (A) $\frac{\pi}{3}$ (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{6}$ (D) $\cos^{-1} \left(\frac{1}{\sqrt{186}} \right)$

SPACE FOR ROUGH WORK

Paragraph for Questions 6 - 7

Tangents PA and PB are drawn to the circle $(x-4)^2 + (y-5)^2 = 4$ from the point P on the curve $y = \sin x$, where A and B lie on the circle. Consider the function $y = f(x)$ represented by the locus of the centre of the circumcircle of triangle PAB , then answer the following questions.

6. Range of $y = f(x)$ is :
 (A) $[-2, 1]$ (B) $[-1, 4]$ (C) $[0, 2]$ (D) $[2, 3]$
7. Which of the following is true?
 (A) $f(x) = 4$ has real roots (B) $f(x) = 1$ has real roots
 (C) Range of $y = f^{-1}(x)$ is $\left[-\frac{\pi}{4} + 2, \frac{\pi}{4} + 2\right]$
 (D) Range of $y = f^{-1}(x)$ is $\left[-\frac{\pi}{4} - 2, \frac{\pi}{4} + 2\right]$
8. Two circles of radii ' a ' and ' b ' touching each other externally, are inscribed in the area bounded by $y = \sqrt{1-x^2}$ and the X-axis such that both circles touch the boundary of the region. If $b = \frac{1}{2}$, then a is equal to :
 (A) $\frac{1}{4}$ (B) $\frac{1}{8}$ (C) $\frac{1}{2}$ (D) $\frac{1}{\sqrt{2}}$
9. If $z + \frac{1}{z} = 2 \cos \theta$, then $\left| \frac{z^{2n} - 1}{z^{2n} + 1} \right|$ is equal to :
 (A) $|\tan n\theta|$ (B) $|\cot n\theta|$ (C) $|\cot^n \theta|$ (D) $|\tan^n \theta|$
10. If $f(x) = \begin{cases} \sqrt{\{x\}}, & x \notin I \\ 1, & x \in I \end{cases}$ and $g(x) = \{x\}^2$ (where $\{\cdot\}$ denotes fractional part of x), then area bounded by $y_1 = f(x)$ and $y_2 = g(x)$ for $x \in [0, 10]$ is :
 (A) $5/3$ (B) 5 (C) $10/3$ (D) None of these

SPACE FOR ROUGH WORK

SECTION - II

SINGLE INTEGER VALUE CORRECT TYPE

This section contains 10 Single Integer Value Correct type Questions. Each question has an integer answer between 0 and 9. Fill the answer bubbles in the OMR Sheet APPROPRIATELY and CAREFULLY.

1. Consider a chess board of 8×8 square units. If the number of rectangles that can be formed such that each side of the rectangle is greater than or equal to 6 are k^2 , then find the value of $|k|$.
2. If $d = \lambda(\vec{a} \times \vec{b}) + \mu(\vec{b} \times \vec{c}) + \nu(\vec{c} \times \vec{a})$ and $[\vec{a}\vec{b}\vec{c}] = 1/8$ and $\vec{d} \cdot (\vec{a} + \vec{b} + \vec{c}) = 8$ then $\lambda + \mu + \nu$ is equal to xy (a two digit number). Then x is _____.
3. If CF is perpendicular from the centre C of the ellipse $\frac{x^2}{49} + \frac{y^2}{25} = 1$ on the tangent at any point P, and G is the point where the normal at P meets the minor axis, then (CF.PG) is equal to ab (a two digit number). Then b is _____.
4. If $x \in \left(0, \frac{\pi}{2}\right)$ and $\cos x = \frac{1}{3}$, then the value of $\sum_{n=0}^{\infty} \frac{\cos nx}{3^n}$ is equal to _____.
5. An even polynomial function $f(x)$ satisfies a relation :

$$f(2x) \left(1 - f\left(\frac{1}{2x}\right)\right) + f(16x^2y) = f(-2) - f(4xy) \forall x, y \in R - \{0\}$$
and $f(4) = -255, f(0) = 1$,
then the value of $\left| \frac{f(2) + 1}{2} \right|$ is _____.

SPACE FOR ROUGH WORK

6. Consider a triangle ABC where median AD meets the side at D . A point E on AD is chosen such that $AE : DE = 1 : 3$. The straight line BE extended meets the side AC at point F , then $\frac{CF}{AF}$ equals _____.
7. If the coordinates of the point where the line $x - 2y + z - 1 = 0 = x + 2y - 2z - 5$ intersects the plane $x + y - 2z = 7$ is (α, β, γ) , then the value of $(|\alpha| + |\beta| + |\gamma|)$ is equal to _____.
8. If G is the greatest and L is the least value of $|z + 2i|$, where $i = \sqrt{-1}$, and $1 \leq |z - 1| \leq 3$ then $(G + L - \sqrt{5})^2$ is equal to _____.
9. The area between the curve $2\{y\} = [x] + 1, 0 \leq y < 1$ (where $\{.\}$ and $[.]$ are the fractional part and greatest integer functions respectively), and the x -axis, is $\frac{1}{a}$ then 'a' is _____.
10. If $f(x) = \sin x - x$, then $\int_{-2\pi}^{2\pi} |f^{-1}(x)| dx$ is $a\pi^2$ then the value of a is _____.

SPACE FOR ROUGH WORK

SECTION - III
MATRIX MATCH TYPE

This section contains 10 questions. Each question contains statements given in two columns which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. The answers to these questions have to be appropriately bubbled. More than one choice from Column 2 can be matched with Column 1.

1. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	$\left \frac{2z-i}{z+1} \right = 1$, locus of point z is	(p)	4
(B)	$ z-i = \frac{ (1+i)z + (1-i)\bar{z} + 1 }{4}$ then locus of z is	(q)	1
(C)	If the points (1, 2, 3) and (2, 1, 0) lie on the opposite sides of the plane $2x + 3y - 2z = k$, then the number of integral values of k is	(r)	A circle
(D)	If (x_1, y_1, z_1) is the image of the point (1, 2, 3) about the plane $x + y + z = 0$ then $-z_1$ is	(s)	An ellipse

2. 5 balls are placed in 3 boxes. Each box can hold all 5 balls. Number of ways in which the balls can be placed if :

	Column 1		Column 2
(A)	Balls are identical but boxes are different and no box remains empty	(p)	2
(B)	Balls are different but boxes are identical and no box remains empty	(q)	25
(C)	Balls as well as boxes are identical and no box remains empty	(r)	243
(D)	Balls are different and boxes are different and boxes can remain empty	(s)	6

SPACE FOR ROUGH WORK

3. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	The distance between the lines $(x + 7y)^2 + 4\sqrt{2}(x + 7y) - 42 = 0$ is	(p)	2
(B)	If the sum of the distances of a point from two perpendicular lines in a plane is 1, then its locus is $ x + y = k$, where k is	(q)	7
(C)	If $6x + 6y + m = 0$ is acute angle bisector of line $x + 2y + 4 = 0$ and $4x + 2y - 1 = 0$, then m is equal to	(r)	3
(D)	Area of the triangle formed by the lines $y^2 - 9xy + 18x^2 = 0$ and $y = 6$ is	(s)	1

4. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	If A, B, C and D are four points in space, then $ \overline{AB} \times \overline{CD} + \overline{BC} \times \overline{AD} + \overline{CA} \times \overline{BD} = k$ (area of ΔABC), then the value of k is	(p)	$3\sqrt{3}$
(B)	If $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar, then the value of $\frac{[\vec{a} + 2\vec{b}, \vec{b} + 2\vec{c}, \vec{c} + 2\vec{a}]}{[\vec{a}, \vec{b}, \vec{c}]}$ is equal to	(q)	$\sqrt{3}$
(C)	If \vec{a}, \vec{b} and \vec{c} are mutually perpendicular vectors each of magnitude 3, then $ \vec{a} + \vec{b} + \vec{c} $ is equal to	(r)	4
(D)	If the sum of the two unit vectors is a unit vector, then the magnitude of their difference is	(s)	9

SPACE FOR ROUGH WORK

5. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	If the function $y = e^{4x} + 2e^{-x}$ is a solution of the differential equation $\frac{d^3 y}{dx^3} - 13 \frac{dy}{dx} = k$, then the value of $k/4$ is	(p)	3
(B)	Number of straight lines which satisfy the differential equation $x \frac{dy}{dx} + \left(\frac{dy}{dx}\right)^2 - y = 0$ and passes through $P(0, 1)$ is	(q)	9
(C)	If a real value of m exists for which the substitution, $y = u^m$ will transform the differential equation, $2x^4 y \frac{dy}{dx} + y^4 = 4x^6$ into a homogeneous equation, then the value of $6m$ is	(r)	2
(D)	If the solution of differential equation $x^2 \frac{d^2 y}{dx^2} + 2x \frac{dy}{dx} = 12y$ is $y = Ax^m + Bx^{-n}$, then $ m - n $ can be	(s)	1

6. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	The value of $\left\{ \sin^{-1}\left(\frac{1}{3}\right) + \sin^{-1}\left(\frac{1}{3\sqrt{11}}\right) + \sin^{-1}\left(\frac{3}{\sqrt{11}}\right) \right\}$	(p)	$\frac{9}{2}$
(B)	If $2 \sec 2\alpha = \tan \beta + \cot \beta$ then $(\alpha + \beta)$ is equal to	(q)	$\frac{\pi}{2}$
(C)	The last digit of $(1! + 2! + \dots + (2010)!)^{102}$ is	(r)	$\frac{\pi}{4}$
(D)	Minimum value of $\left((x^2 + 4) + \frac{2}{(x^2 + 4)} \right)$ is	(s)	9

SPACE FOR ROUGH WORK

7. MATCH THE FOLLOWING :

	Column 1		Column 2
(A)	Number of five digit numbers of the form $d_1d_2d_3d_4d_5$ where d_i are digits $\forall, i = 1, 2, 3, 4, 5$ and satisfying $d_1 < d_2 \leq d_3 < d_4 \leq d_5$	(p)	5
(B)	$256(\cos 12^\circ \cos 24^\circ \cos 36^\circ \cos 48^\circ \cos 60^\circ \cos 72^\circ \cos 84^\circ)$ is divisible by	(q)	2
(C)	A badminton team has to be selected comprising of 5 students out of 10 students for inter school tournament. Number of ways this can be done if a particular player is to be always included or always excluded from the team, is a multiple of	(r)	7
(D)	Let $y = \sin^2 x + \cos x$ for $0 \leq x \leq \frac{2\pi}{3}$. The ratio of the maximum and minimum value of y is	(s)	3

8. MATCH THE FOLLOWING LISTS :

	Column 1		Column 2
(A)	The units place in $S = \lfloor 1 \rfloor + \lfloor 4 \rfloor + \lfloor 7 \rfloor + \lfloor 10 \rfloor + \dots + \lfloor 400 \rfloor$ is :	(p)	1
(B)	The number of solutions of the system of equations $Re(z^2) = 0, z = 2$ is :	(q)	4
(C)	If the number of triangles that can be formed with 10 points as vertices, n of them being collinear, is 110, then n is	(r)	5
(D)	Let $f(x) = x^2 - x + 1, x \geq \frac{1}{2}$, then the solution of the equation $f^{-1}(x) = f(x)$ is $x =$	(s)	6

SPACE FOR ROUGH WORK

9. MATCH THE FOLLOWING LISTS :

Column 1		Column 2	
(A)	The length of the intercept on the straight line $4x - 3y - 10 = 0$ by the circle $x^2 + y^2 - 2x + 4y - 20 = 0$ is :	(p)	1
(B)	If lines $3x + y - 4 = 0$, $x - 2y - 6 = 0$ and $\lambda x + 4y + \lambda^2 = 0$ are concurrent, then $\lambda =$	(q)	2
(C)	If line $x + y - 1 - \left \frac{\lambda}{2} \right = 0$, passing through the intersection of $x - y + 1 = 0$ and $3x + y - 5 = 0$, is perpendicular to one of them, then the value of λ is:	(r)	4
(D)	If $y - x - 1 + \lambda = 0$ is equidistant from the points $(1, -2)$ and $(3, 4)$, then $\lambda =$	(s)	10

10. Match the following :

Column 1		Column 2	
(A)	The length of the common chord of two circles of radii 3 and 4 units which intersect orthogonally is $\frac{k}{5}$, then k equals to	(p)	1
(B)	The circumference of the circle $x^2 + y^2 + 4x + 12y + p = 0$ is bisected by the circle $x^2 + y^2 - 2x + 8y - q = 0$, then $p + q$ is equal to	(q)	24
(C)	Number of distinct chords of the circle $2x(x - \sqrt{2}) + y(2y - 1) = 0$ passing through the point $\left(\sqrt{2}, \frac{1}{2}\right)$ and are bisected by X-axis, is equal to	(r)	2
(D)	Number of common tangents to circles $x^2 + y^2 + 6x + 2y - 6 = 0$ and $x^2 + y^2 - 2x - 6y + 1 = 0$ are equal to	(s)	36

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

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