

JEE MAIN 2023 · QUESTION PAPER

8 Apr 2023 **Shift 1**

84 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	10 Q20 to Q29
● Chemistry	17 Q30 to Q46	9 Q47 to Q55
● Mathematics	19 Q56 to Q74	10 Q75 to Q84
In this PDF	84 questions · answer key at the end	

- 1 Set a 3 hour timer and attempt the paper in one sitting, like the real exam.
- 2 In the 2021 to 2024 papers, Section B asked you to answer any 5 numerical questions per subject. Try each one here.
- 3 Check yourself against the answer key at the end. Every question names its chapter, so you can see where marks went.
- 4 Got one wrong? Tap "Step-by-step solution" at the top right of it for the full working, where available.

Attempt this paper online

The same questions in the same order, with instant answer checking and step-by-step solutions where available.

prepwisser.in/pyqs/paper/2023-04-08-morning · Free, no signup needed to start

Answers follow NTA's final answer keys. Typing errors are possible, so check doubtful answers against the official key. Spotted a mistake? prepwisser.in/feedback · Terms: prepwisser.in/terms

Q1 Nuclear Physics

[Step-by-step solution](#) › prepwiser.in/questions/kUiM5Zij_v

For a nucleus ${}^A_Z\text{X}$ having mass number A and atomic number Z

- A. The surface energy per nucleon $(b_s) = -a_1 A^{2/3}$.
- B. The Coulomb contribution to the binding energy $b_c = -a_2 \frac{Z(Z-1)}{A^{4/3}}$
- C. The volume energy $b_v = a_3 A$
- D. Decrease in the binding energy is proportional to surface area.
- E. While estimating the surface energy, it is assumed that each nucleon interacts with 12 nucleons. (a_1, a_2 and a_3 are constants)

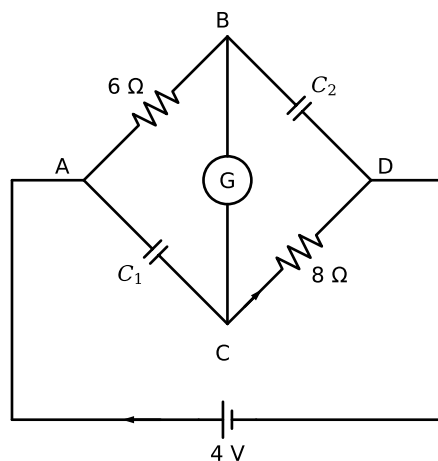
Choose the most appropriate answer from the options given below:

- (A) C, D only (B) B, C, E only (C) B, C only (D) A, B, C, D only

Q2 Electrostatics II: Potential & Capacitance

[Step-by-step solution](#) › prepwiser.in/questions/WNkB2aIHkh

In this figure the resistance of the coil of galvanometer G is 2Ω . The emf of the cell is $4V$. The ratio of potential difference across C_1 and C_2 is:



- (A) $\frac{5}{4}$ (B) $\frac{3}{4}$ (C) 1 (D) $\frac{4}{5}$

Q3 Dual Nature of Radiation & Matter

[Step-by-step solution](#) › prepwiser.in/questions/pRJYFV4bQ

Proton (P) and electron (e) will have same de-Broglie wavelength when the ratio of their momentum is (assume, $m_p = 1849m_e$):

- (A) 1 : 1 (B) 1 : 43 (C) 1 : 1849 (D) 43 : 1

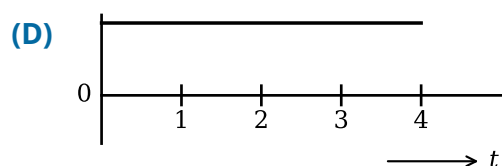
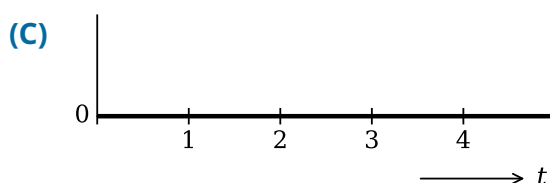
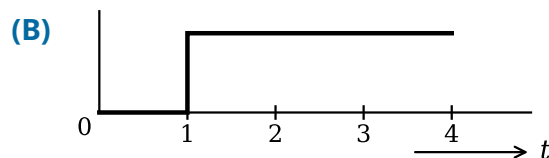
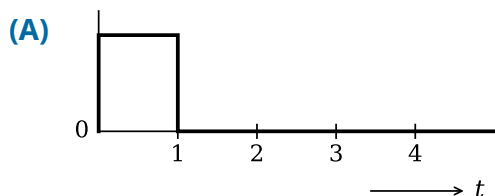
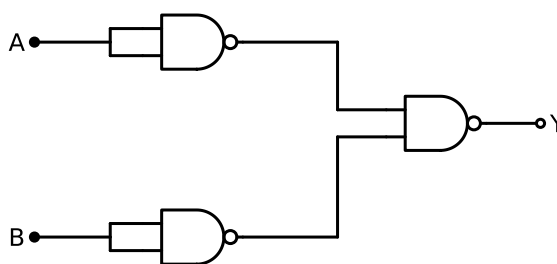
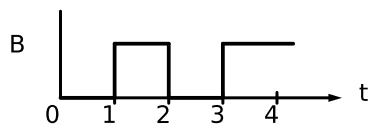
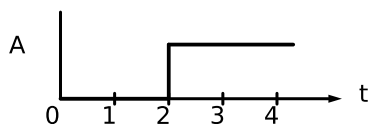
Q4 Moving Charges & Magnetism

[Step-by-step solution](#) › prepwiser.in/questions/NGTxN2Qv4B

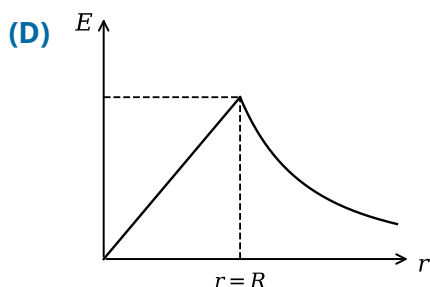
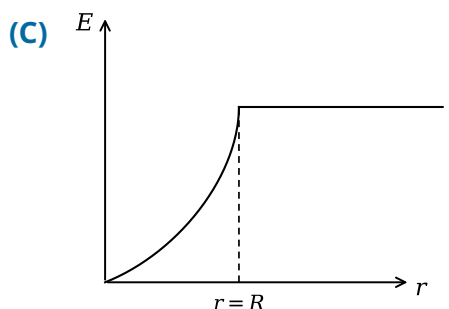
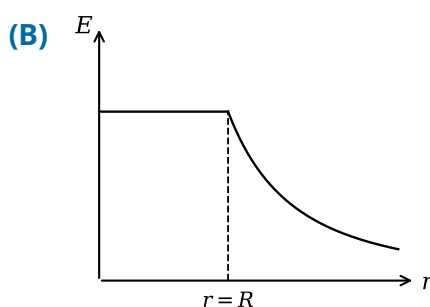
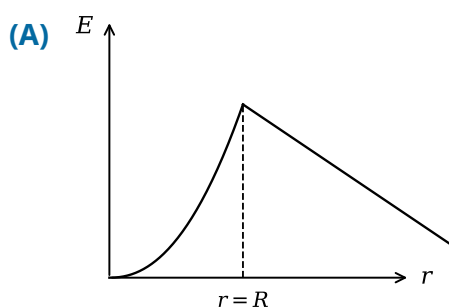
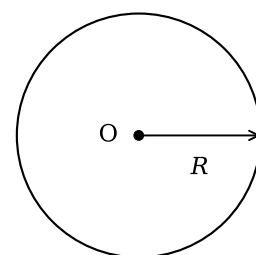
Certain galvanometers have a fixed core made of non magnetic metallic material. The function of this metallic material is

- (A) to bring the coil to rest quickly
- (B) to produce large deflecting torque on the coil
- (C) to oscillate the coil in magnetic field for longer period of time
- (D) to make the magnetic field radial

For the logic circuit shown, the output waveform at Y is:



Graphical variation of electric field due to a uniformly charged insulating solid sphere of radius R , with distance r from the centre O is represented by:



In a reflecting telescope, a secondary mirror is used to:

- (A) make chromatic aberration zero
- (B) remove spherical aberration
- (C) reduce the problem of mechanical support
- (D) move the eyepiece outside the telescopic tube

Given below are two statements:

Statement I: If E be the total energy of a satellite moving around the earth, then its potential energy will be $\frac{E}{2}$.

Statement II: The kinetic energy of a satellite revolving in an orbit is equal to the half the magnitude of total energy E .

In the light of the above statements, choose the most appropriate answer from the options given below

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

The weight of a body on the earth is 400N. Then weight of the body when taken to a depth half of the radius of the earth will be:

- (A) 300 N
- (B) 200 N
- (C) 100 N
- (D) Zero

Given below are two statements:

Statement I: If heat is added to a system, its temperature must increase.

Statement II: If positive work is done by a system in a thermodynamic process, its volume must increase.

In the light of the above statements, choose the correct answer from the options given below

- (A) Both Statement I and Statement II are true
- (B) Statement I is false but Statement II is true
- (C) Statement I is true but Statement II is false
- (D) Both Statement I and Statement II are false

At any instant the velocity of a particle of mass 500g is $(2t\hat{i} + 3t^2\hat{j}) \text{ ms}^{-1}$. If the force acting on the particle at $t = 1\text{s}$ is $(\hat{i} + x\hat{j})\text{N}$. Then the value of x will be:

- (A) 2
- (B) 4
- (C) 6
- (D) 3

A charge particle moving in magnetic field B , has the components of velocity along B as well as perpendicular to B . The path of the charge particle will be

- (A) helical path with the axis along magnetic field B
- (B) straight along the direction of magnetic field B
- (C) circular path
- (D) helical path with the axis perpendicular to the direction of magnetic field B

Attempt this paper online with instant answer checking › [prepwise.in/pyqs/paper/2023-04-08-morning](https://www.prepwise.in/pyqs/paper/2023-04-08-morning)

Q13 Projectile Motion & Relative Motion[Step-by-step solution](https://www.prepwiser.in/questions/tT2YW5kQCD) > prepwiser.in/questions/tT2YW5kQCD

Two projectiles A and B are thrown with initial velocities of 40m/s and 60m/s at angles 30° and 60° with the horizontal respectively. The ratio of their ranges respectively is ($g = 10\text{m/s}^2$)

- (A) 4 : 9 (B) $2 : \sqrt{3}$ (C) $\sqrt{3} : 2$ (D) 1 : 1

Q14 Fluid Mechanics[Step-by-step solution](https://www.prepwiser.in/questions/w0rMq1TLDe) > prepwiser.in/questions/w0rMq1TLDe

An air bubble of volume 1cm^3 rises from the bottom of a lake 40m deep to the surface at a temperature of 12°C . The atmospheric pressure is $1 \times 10^5\text{Pa}$ the density of water is 1000kg/m^3 and $g = 10\text{m/s}^2$. There is no difference of the temperature of water at the depth of 40m and on the surface. The volume of air bubble when it reaches the surface will be:

- (A) 4cm^3 (B) 3cm^3 (C) 2cm^3 (D) 5cm^3

Q15 Elasticity[Step-by-step solution](https://www.prepwiser.in/questions/tYjpjkh4) > prepwiser.in/questions/tYjpjkh4

An aluminium rod with Young's modulus $Y = 7.0 \times 10^{10}\text{N/m}^2$ undergoes elastic strain of 0.04% . The energy per unit volume stored in the rod in SI unit is:

- (A) 5600 (B) 2800 (C) 11200 (D) 8400

Q16 Sound Waves[Step-by-step solution](https://www.prepwiser.in/questions/u7TO6KS-aP) > prepwiser.in/questions/u7TO6KS-aP

The engine of a train moving with speed 10ms^{-1} towards a platform sounds a whistle at frequency 400Hz . The frequency heard by a passenger inside the train is: (neglect air speed. Speed of sound in air = 330ms^{-1})

- (A) 200 Hz (B) 412 Hz (C) 400 Hz (D) 388 Hz

Q17 Units, Dimensions & Errors[Step-by-step solution](https://www.prepwiser.in/questions/5K2rI2gL7W) > prepwiser.in/questions/5K2rI2gL7W

Dimension of $\frac{1}{\mu_0 \epsilon_0}$ should be equal to

- (A) T^2/L^2 (B) T/L (C) L^2/T^2 (D) L/T

Q18 Units, Dimensions & Errors[Step-by-step solution](https://www.prepwiser.in/questions/NpXHq3YUuQ) > prepwiser.in/questions/NpXHq3YUuQ

A cylindrical wire of mass $(0.4 \pm 0.01)\text{g}$ has length $(8 \pm 0.04)\text{cm}$ and radius $(6 \pm 0.03)\text{mm}$. The maximum error in its density will be:

- (A) 1% (B) 5% (C) 4% (D) 3.5%

Q19 Vectors[Step-by-step solution](https://www.prepwiser.in/questions/rUNN9idtw) > prepwiser.in/questions/rUNN9idtw

Two forces having magnitude A and $\frac{A}{2}$ are perpendicular to each other. The magnitude of their resultant is:

- (A) $\frac{5A}{2}$ (B) $\frac{\sqrt{5}A}{4}$ (C) $\frac{\sqrt{5}A}{2}$ (D) $\frac{\sqrt{5}A^2}{2}$

Q20 Alternating Current **NUMERICAL**

[Step-by-step solution](#) > [prepwiser.in/questions/FnrzNz9ITE](https://www.prepwiser.in/questions/FnrzNz9ITE)

An oscillating LC circuit consists of a 75mH inductor and a $1.2\mu\text{F}$ capacitor. If the maximum charge to the capacitor is $2.7\mu\text{C}$. The maximum current in the circuit will be _____ mA

Q21 Nuclear Physics **NUMERICAL**

[Step-by-step solution](#) > [prepwiser.in/questions/0RFR5AS7BH](https://www.prepwiser.in/questions/0RFR5AS7BH)

A nucleus with mass number 242 and binding energy per nucleon as 7.6MeV breaks into two fragment each with mass number 121. If each fragment nucleus has binding energy per nucleon as 8.1MeV , the total gain in binding energy is _____ MeV.

Q22 Work, Energy & Power **NUMERICAL**

[Step-by-step solution](#) > [prepwiser.in/questions/wYs7t01kHp](https://www.prepwiser.in/questions/wYs7t01kHp)

The momentum of a body is increased by 50%. The percentage increase in the kinetic energy of the body is _____ %.

Q23 Current Electricity **NUMERICAL**

[Step-by-step solution](#) > [prepwiser.in/questions/9lmJk-7OGK](https://www.prepwiser.in/questions/9lmJk-7OGK)

A current of 2A flows through a wire of cross-sectional area 25.0mm^2 . The number of free electrons in a cubic meter are 2.0×10^{28} . The drift velocity of the electrons is _____ $\times 10^{-6}\text{ms}^{-1}$ (given, charge on electron = $1.6 \times 10^{-19}\text{C}$).

Q24 Electrostatics II: Potential & Capacitance **NUMERICAL**

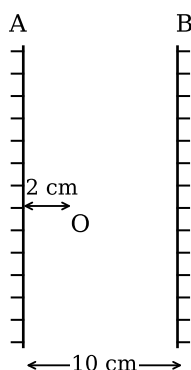
[Step-by-step solution](#) > [prepwiser.in/questions/NC-xepe_NG](https://www.prepwiser.in/questions/NC-xepe_NG)

An electric dipole of dipole moment is $6.0 \times 10^{-6}\text{Cm}$ placed in a uniform electric field of $1.5 \times 10^3\text{NC}^{-1}$ in such a way that dipole moment is along electric field. The work done in rotating dipole by 180° in this field will be _____ mJ.

Q25 Ray Optics **NUMERICAL**

[Step-by-step solution](#) > [prepwiser.in/questions/h93eTTQHqI](https://www.prepwiser.in/questions/h93eTTQHqI)

Two vertical parallel mirrors A and B are separated by 10cm . A point object O is placed at a distance of 2cm from mirror A. The distance of the second nearest image behind mirror A from the mirror A is _____ cm.



Q26 Moving Charges & Magnetism **NUMERICAL**

[Step-by-step solution](#) > [prepwiser.in/questions/6GLA97wIEP](https://www.prepwiser.in/questions/6GLA97wIEP)

The magnetic intensity at the center of a long current carrying solenoid is found to be $1.6 \times 10^3\text{Am}^{-1}$. If the number of turns is 8 per cm, then the current flowing through the solenoid is _____ A.

Q27 Fluid Mechanics **NUMERICAL**

[Step-by-step solution](#) > [prepwiser.in/questions/TtiDPW8uhT](https://www.prepwiser.in/questions/TtiDPW8uhT)

An air bubble of diameter 6mm rises steadily through a solution of density 1750kg/m^3 at the rate of 0.35cm/s . The co-efficient of viscosity of the solution (neglect density of air) is _____ Pas (given, $g = 10\text{ms}^{-2}$).

The moment of inertia of a semicircular ring about an axis, passing through the center and perpendicular to the plane of ring, is $\frac{1}{x}MR^2$, where R is the radius and M is the mass of the semicircular ring. The value of x will be _____.

An organ pipe 40cm long is open at both ends. The speed of sound in air is 360ms^{-1} . The frequency of the second harmonic is _____ Hz.

Chemistry Section A · Multiple choice

Q30 to Q46

Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Butan -1- ol has higher boiling point than ethoxyethane.

Reason R: Extensive hydrogen bonding leads to stronger association of molecules.

In the light of the above statements, choose the correct answer from the options given below:

- (A) A is false but R is true
 (B) Both A and R are true but R is not the correct explanation of A
 (C) Both A and R are true and R is the correct explanation of A
 (D) A is true but R is false

The water gas on reacting with cobalt as a catalyst forms

- (A) Methanoic acid (B) Methanol (C) Methanal (D) Ethanol

Sulphur (S) containing amino acids from the following are:

(a) isoleucine (b) cysteine (c) lysine (d) methionine (e) glutamic acid

- (A) b, d (B) a, d (C) b, c, e (D) a, b, c

Match List I with List II:

	LIST I		LIST II
A.	Saccharin	I.	High potency sweetener
B.	Aspartame	II.	First artificial sweetening agent
C.	Alitame	III.	Stable at cooking temperature
D.	Sucralose	IV.	Unstable at cooking temperature

Choose the correct answer from the options given below:

- (A) A-II, B-III, C-IV, D-I (B) A-II, B-IV, C-I, D-III (C) A-II, B-IV, C-III, D-I (D) A-IV, B-III, C-I, D-II

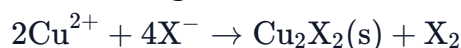
Which of the following complex is octahedral, diamagnetic and the most stable?

- (A) $\text{Na}_3[\text{CoCl}_6]$ (B) $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_2$ (C) $\text{K}_3[\text{Co}(\text{CN})_6]$ (D) $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$

The correct order of spin only magnetic moments for the following complex ions is

- (A) $[\text{Fe}(\text{CN})_6]^{3-} < [\text{CoF}_6]^{3-} < [\text{MnBr}_4]^{2-} < [\text{Mn}(\text{CN})_6]^{3-}$
 (B) $[\text{MnBr}_4]^{2-} < [\text{CoF}_6]^{3-} < [\text{Fe}(\text{CN})_6]^{3-} < [\text{Mn}(\text{CN})_6]^{3-}$
 (C) $[\text{Fe}(\text{CN})_6]^{3-} < [\text{Mn}(\text{CN})_6]^{3-} < [\text{CoF}_6]^{3-} < [\text{MnBr}_4]^{2-}$
 (D) $[\text{CoF}_6]^{3-} < [\text{MnBr}_4]^{2-} < [\text{Fe}(\text{CN})_6]^{3-} < [\text{Mn}(\text{CN})_6]^{3-}$

Which halogen is known to cause the reaction given below:



- (A) All halogens (B) Only Iodine (C) Only Bromine (D) Only Chlorine

In chromyl chloride, the number of d-electrons present on chromium is same as in

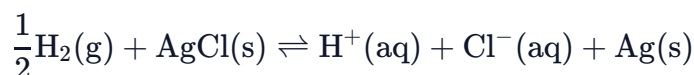
(Given at no. of

Ti : 22, V : 23, Cr : 24, Mn : 25, Fe : 26

)

- (A) Mn (VII) (B) Ti (III) (C) Fe (III) (D) V (IV)

The reaction

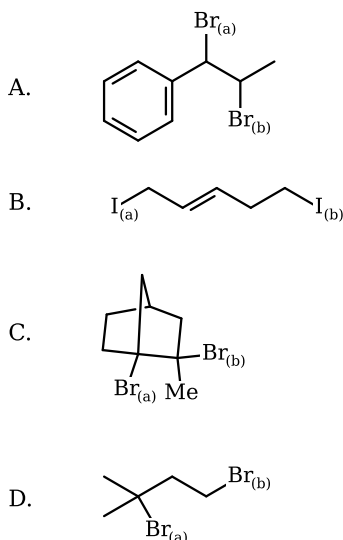


occurs in which of the given galvanic cell.

- (A) $\text{Ag}|\text{AgCl}(\text{s})|\text{KCl}(\text{sol}^n)|\text{AgNO}_3|\text{Ag}$ (B) $\text{Pt}|\text{H}_2(\text{g})|\text{HCl}(\text{sol}^n)|\text{AgCl}(\text{s})|\text{Ag}$
 (C) $\text{Pt}|\text{H}_2(\text{g})|\text{HCl}(\text{sol}^n)|\text{AgNO}_3(\text{sol}^n)|\text{Ag}$ (D) $\text{Pt}|\text{H}_2(\text{g})|\text{KCl}(\text{sol}^n)|\text{AgCl}(\text{s})|\text{Ag}$

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Choose the halogen which is most reactive towards S_N1 reaction in the given compounds (A, B, C & D)



(A) A – Br_(b); B – I_(a); C – Br_(a); D – Br_(a)

(B) A – Br_(a); B – I_(a); C – Br_(a); D – Br_(a)

(C) A – Br_(b); B – I_(b); C – Br_(b); D – Br_(b)

(D) A – Br_(a); B – I_(a); C – Br_(b); D – Br_(a)

Which of the following metals can be extracted through alkali leaching technique?

(A) Sn

(B) Cu

(C) Au

(D) Pb

The correct order of electronegativity for given elements is:

(A) C > P > At > Br

(B) Br > C > At > P

(C) Br > P > At > C

(D) P > Br > C > At



What is the value of x ?

(A) 10

(B) 2

(C) 12

(D) 6

Given below are two statements:

Statement I : Lithium and Magnesium do not form superoxide

Statement II : The ionic radius of Li^+ is larger than ionic radius of Mg^{2+}

In the light of the above statements, choose the most appropriate answer from the options given below:

(A) Statement I is incorrect but Statement II is correct

(B) Both Statement I and Statement II are incorrect

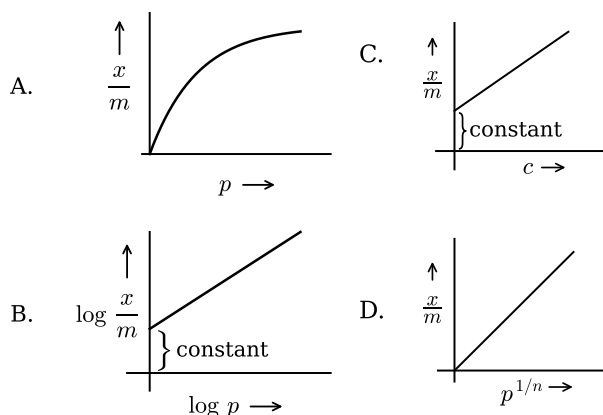
(C) Both Statement I and Statement II are correct

(D) Statement I is correct but Statement II is incorrect

What is the purpose of adding gypsum to cement?

- (A) To facilitate the hydration of cement
 (B) To speed up the process of setting
 (C) To give a hard mass
 (D) To slow down the process of setting

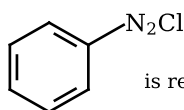
Which of the following represent the Freundlich adsorption isotherms?



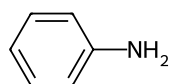
Choose the correct answer from the options given below:

- (A) B, C, D only
 (B) A, B only
 (C) A, B, D only
 (D) A, C, D only

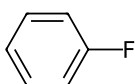
Match List I with List II:



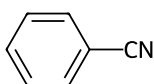
is reacted with reagents in List I to form products in List II.



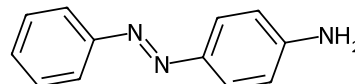
I.



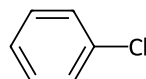
B. HBF_4, Δ II.



C. Cu, HCl III.



D. CuCN/KCN IV.



	LIST I (Reagent)		LIST II (Product)
A.			

Choose the correct answer from the options given below:

- (A) A-III, B-I, C-IV, D-II
 (B) A-III, B-I, C-II, D-IV
 (C) A-IV, B-III, C-II, D-I
 (D) A-I, B-III, C-IV, D-II

Chemistry Section B · Numerical value

Q47 to Q55

The number of following factors which affect the percent covalent character of the ionic bond is _____

- (A) Polarising power of cation
 (B) Extent of distortion of anion
 (C) Polarisability of the anion
 (D) Polarising power of anion

The number of given statement/s which is/are correct is _____.

- (A) The stronger the temperature dependence of the rate constant, the higher is the activation energy.
(B) If a reaction has zero activation energy, its rate is independent of temperature.
(C) The stronger the temperature dependence of the rate constant, the smaller is the activation energy.
(D) If there is no correlation between the temperature and the rate constant then it means that the reaction has negative activation energy.

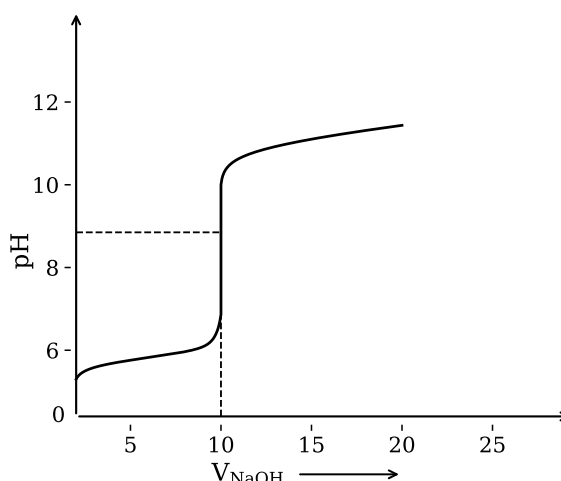
Molar mass of the hydrocarbon (X) which on ozonolysis consumes one mole of O_3 per mole of (X) and gives one mole each of ethanal and propanone is _____ $gmol^{-1}$
(Molar mass of

$$C : 12gmol^{-1}, H : 1gmol^{-1}$$

)

The titration curve of weak acid vs. strong base with phenolphthalein as indicator) is shown below. The $K_{\text{phenolphthalein}} = 4 \times 10^{-10}$.

Given: $\log 2 = 0.3$



The number of following statement/s which is/are correct about phenolphthalein is _____

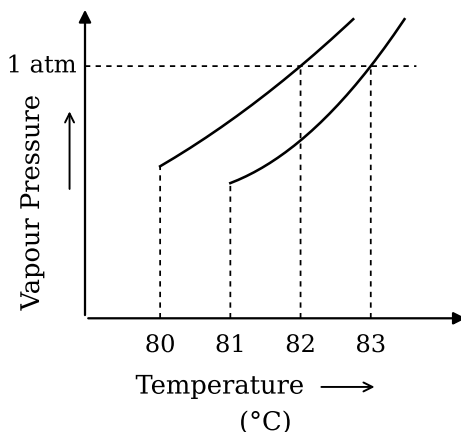
- A. It can be used as an indicator for the titration of weak acid with weak base.
B. It begins to change colour at $pH = 8.4$
C. It is a weak organic base
D. It is colourless in acidic medium

XeF_4 reacts with SbF_5 to form



$$m + n + y + z = \underline{\hspace{2cm}}$$

The vapour pressure vs. temperature curve for a solution solvent system is shown below.



The boiling point of the solvent is _____ °C.

0.5g of an organic compound (X) with 60% carbon will produce _____ $\times 10^{-1}$ g of CO_2 on complete combustion.

The number of following statement/s which is/are incorrect is _____

- (A) Line emission spectra are used to study the electronic structure
- (B) The emission spectra of atoms in the gas phase show a continuous spread of wavelength from red to violet
- (C) An absorption spectrum is like the photographic negative of an emission spectrum
- (D) The element helium was discovered in the sun by spectroscopic method

When a 60W electric heater is immersed in a gas for 100 s in a constant volume container with adiabatic walls, the temperature of the gas rises by 5°C . The heat capacity of the given gas is _____ JK^{-1} (Nearest integer)

Mathematics Section A · Multiple choice

Q56 to Q74

The shortest distance between the lines $\frac{x-4}{4} = \frac{y+2}{5} = \frac{z+3}{3}$ and $\frac{x-1}{3} = \frac{y-3}{4} = \frac{z-4}{2}$ is:

- (A) $3\sqrt{6}$ (B) $6\sqrt{2}$ (C) $6\sqrt{3}$ (D) $2\sqrt{6}$

If the equation of the plane containing the line

$x + 2y + 3z - 4 = 0 = 2x + y - z + 5$ and perpendicular to the plane

$\vec{r} = (\hat{i} - \hat{j}) + \lambda(\hat{i} + \hat{j} + \hat{k}) + \mu(\hat{i} - 2\hat{j} + 3\hat{k})$

is $ax + by + cz = 4$, then $(a - b + c)$ is equal to:

- (A) 18 (B) 22 (C) 20 (D) 24

Q58 Binomial Theorem[Step-by-step solution](#) › [prepwiser.in/questions/cs5mN_vXex](#)

If the coefficients of three consecutive terms in the expansion of $(1+x)^n$ are in the ratio 1 : 5 : 20, then the coefficient of the fourth term is

- (A) 3654 (B) 1827 (C) 5481 (D) 2436

Q59 Complex Numbers[Step-by-step solution](#) › [prepwiser.in/questions/OpduaBzVwv](#)

If for $z = \alpha + i\beta$, $|z + 2| = z + 4(1 + i)$, then $\alpha + \beta$ and $\alpha\beta$ are the roots of the equation:

- (A) $x^2 + 2x - 3 = 0$ (B) $x^2 + 3x - 4 = 0$ (C) $x^2 + x - 12 = 0$ (D) $x^2 + 7x + 12 = 0$

Q60 Differentiation[Step-by-step solution](#) › [prepwiser.in/questions/waB7Ql4GmT](#)

Let

$$f(x) = \frac{\sin x + \cos x - \sqrt{2}}{\sin x - \cos x}, x \in [0, \pi] - \left\{ \frac{\pi}{4} \right\}$$

. Then $f\left(\frac{7\pi}{12}\right) f''\left(\frac{7\pi}{12}\right)$ is equal to

- (A) $\frac{2}{3\sqrt{3}}$ (B) $\frac{2}{9}$ (C) $\frac{-1}{3\sqrt{3}}$ (D) $\frac{-2}{3}$

Q61 Limits[Step-by-step solution](#) › [prepwiser.in/questions/0TfRnOrQWN](#)

$$\lim_{x \rightarrow 0} \left(\left(\frac{(1 - \cos^2(3x))}{\cos^3(4x)} \right) \left(\frac{\sin^3(4x)}{(\log_e(2x + 1))^5} \right) \right)$$

is equal to _____.

- (A) 15 (B) 18 (C) 9 (D) 24

Q62 Determinants[Step-by-step solution](#) › [prepwiser.in/questions/Nl6cmSdQtm](#)

Let

$$A = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

. If $|\text{adj}(\text{adj}(\text{adj } 2A))| = (16)^n$, then n is equal to:

- (A) 9 (B) 8 (C) 10 (D) 12

Q63 Matrices[Step-by-step solution](#) › [prepwiser.in/questions/1QOtEruPFJ](#)

Let

$$P = \begin{bmatrix} \frac{\sqrt{3}}{2} & \frac{1}{2} \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} \end{bmatrix}, A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$$

and $Q = PAP^T$. If

$$P^T Q^{2007} P = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

, then $2a + b - 3c - 4d$ equal to:

- (A) 2004 (B) 2006 (C) 2007 (D) 2005

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Q64 Parabola[Step-by-step solution](https://www.prepwiser.in/questions/6yOOH8JAeu)

Let R be the focus of the parabola $y^2 = 20x$ and the line $y = mx + c$ intersect the parabola at two points P and Q .

Let the point $G(10, 10)$ be the centroid of the triangle PQR . If $c - m = 6$, then $(PQ)^2$ is:

- (A) 317 (B) 325 (C) 346 (D) 296

Q65 Permutations & Combinations[Step-by-step solution](https://www.prepwiser.in/questions/Vi_mntc7Nb)

The number of arrangements of the letters of the word "INDEPENDENCE" in which all the vowels always occur together is:

- (A) 16800 (B) 14800 (C) 18000 (D) 33600

Q66 Permutations & Combinations[Step-by-step solution](https://www.prepwiser.in/questions/2Dqig5mq2R)

The number of ways, in which 5 girls and 7 boys can be seated at a round table so that no two girls sit together, is:

- (A) 720 (B) $7(360)^2$ (C) $7(720)^2$ (D) $126(5!)^2$

Q67 Sets[Step-by-step solution](https://www.prepwiser.in/questions/xdILqiFivE)

Let the number of elements in sets A and B be five and two respectively. Then the number of subsets of $A \times B$ each having at least 3 and at most 6 elements is:

- (A) 782 (B) 772 (C) 752 (D) 792

Q68 Probability: Advanced[Step-by-step solution](https://www.prepwiser.in/questions/igmVKyW1IR)

In a bolt factory, machines A , B and C manufacture respectively 20%, 30% and 50% of the total bolts. Of their output 3, 4 and 2 percent are respectively defective bolts. A bolt is drawn at random from the product. If the bolt drawn is found the defective, then the probability that it is manufactured by the machine C is:

- (A) $\frac{2}{7}$ (B) $\frac{9}{28}$ (C) $\frac{5}{14}$ (D) $\frac{3}{7}$

Q69 Quadratic Equations & Polynomial Inequalities[Step-by-step solution](https://www.prepwiser.in/questions/5m_vB930fg)

Let α, β, γ be the three roots of the equation $x^3 + bx + c = 0$. If $\beta\gamma = 1 = -\alpha$, then $b^3 + 2c^3 - 3\alpha^3 - 6\beta^3 - 8\gamma^3$ is equal to:

- (A) 21 (B) 19 (C) $\frac{169}{8}$ (D) $\frac{155}{8}$

Q70 Sequences & Series[Step-by-step solution](https://www.prepwiser.in/questions/d80SHM4G6f)

Let $S_K = \frac{1+2+\dots+K}{K}$ and $\sum_{j=1}^n S_j^2 = \frac{n}{A} (Bn^2 + Cn + D)$, where $A, B, C, D \in \mathbb{N}$ and A has least value.

Then

- (A) $A + B + C + D$ is divisible by 5 (B) $A + C + D$ is not divisible by B
(C) $A + B = 5(D - C)$ (D) $A + B$ is divisible by D

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Q71 Vectors[Step-by-step solution](https://www.prepwisar.in/questions/ntzaqvXG8b) > prepwisar.in/questions/ntzaqvXG8b

If the points with position vectors

$$\alpha \hat{i} + 10\hat{j} + 13\hat{k}, 6\hat{i} + 11\hat{j} + 11\hat{k}, \frac{9}{2}\hat{i} + \beta\hat{j} - 8\hat{k}$$

are collinear, then $(19\alpha - 6\beta)^2$ is equal to:

- (A) 16 (B) 49 (C) 36 (D) 25

Q72 Area Under Curves[Step-by-step solution](https://www.prepwisar.in/questions/l1EgznGhim) > prepwisar.in/questions/l1EgznGhim

The area of the region $\{(x, y) : x^2 \leq y \leq 8 - x^2, y \leq 7\}$ is:

- (A) 18 (B) 24 (C) 20 (D) 21

Q73 Straight Lines[Step-by-step solution](https://www.prepwisar.in/questions/CSKVL_9hrM) > prepwisar.in/questions/CSKVL_9hrM

Let $C(\alpha, \beta)$ be the circumcenter of the triangle formed by the lines

$$4x + 3y = 69$$

$$4y - 3x = 17, \text{ and}$$

$$x + 7y = 61.$$

Then $(\alpha - \beta)^2 + \alpha + \beta$ is equal to:

- (A) 15 (B) 17 (C) 16 (D) 18

Q74 Indefinite Integration[Step-by-step solution](https://www.prepwisar.in/questions/Y-zUM2mW8n) > prepwisar.in/questions/Y-zUM2mW8n

Let $I(x) = \int \frac{(x+1)}{x(1+xe^x)^2} dx, x > 0$. If $\lim_{x \rightarrow \infty} I(x) = 0$, then $I(1)$ is equal to:

- (A) $\frac{e+1}{e+2} - \log_e(e+1)$ (B) $\frac{e+1}{e+2} + \log_e(e+1)$
(C) $\frac{e+2}{e+1} - \log_e(e+1)$ (D) $\frac{e+2}{e+1} + \log_e(e+1)$

Mathematics Section B · Numerical value

Q75 to Q84

Q75 Three Dimensional Geometry **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/6fmd3eaG2e) > prepwisar.in/questions/6fmd3eaG2e

Let λ_1, λ_2 be the values of λ for which the points $(\frac{5}{2}, 1, \lambda)$ and $(-2, 0, 1)$ are at equal distance from the plane $2x + 3y - 6z + 7 = 0$. If $\lambda_1 > \lambda_2$, then the distance of the point $(\lambda_1 - \lambda_2, \lambda_2, \lambda_1)$ from the line $\frac{x-5}{1} = \frac{y-1}{2} = \frac{z+7}{2}$ is _____.

Q76 Binomial Theorem **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/HAWdmfT4yx) > prepwisar.in/questions/HAWdmfT4yx

If α_n is the greatest term in the sequence $\alpha_n = \frac{n^3}{n^4 + 147}, n = 1, 2, 3, \dots$, then α is equal to _____.

Q77 Binomial Theorem **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/L-VFoPzkOq) > prepwisar.in/questions/L-VFoPzkOq

Let $[t]$ denote the greatest integer $\leq t$. If the constant term in the expansion of $(3x^2 - \frac{1}{2x^5})^7$ is α , then $[\alpha]$ is equal to _____.

Q78 Binomial Theorem **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/rYDwyOb9VM) > prepwisar.in/questions/rYDwyOb9VM

The largest natural number n such that 3^n divides $66!$ is _____.

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Q79 Circles **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/Egq-E4-ua5) › prepwiser.in/questions/Egq-E4-ua5

Consider a circle $C_1 : x^2 + y^2 - 4x - 2y = \alpha - 5$. Let its mirror image in the line $y = 2x + 1$ be another circle $C_2 : 5x^2 + 5y^2 - 10fx - 10gy + 36 = 0$. Let r be the radius of C_2 . Then $\alpha + r$ is equal to _____.

Q80 Definite Integration **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/9KII7NopQY) › prepwiser.in/questions/9KII7NopQY

Let $[t]$ denote the greatest integer $\leq t$. Then

$$\frac{2}{\pi} \int_{\pi/6}^{5\pi/6} (8[\operatorname{cosec} x] - 5[\cot x]) dx$$

is equal to _____.

Q81 Differential Equations **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/DOn_h-aAOL) › prepwiser.in/questions/DOn_h-aAOL

If the solution curve of the differential equation $(y - 2 \log_e x) dx + (x \log_e x^2) dy = 0, x > 1$ passes through the points $(e, \frac{4}{3})$ and (e^4, α) , then α is equal to _____.

Q82 Relations & Functions (Basic) **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/b8I9yf5Hkz) › prepwiser.in/questions/b8I9yf5Hkz

Let $A = \{0, 3, 4, 6, 7, 8, 9, 10\}$ and R be the relation defined on A such that $R = \{(x, y) \in A \times A : x - y \text{ is odd positive integer or } x - y = 2\}$. The minimum number of elements that must be added to the relation R , so that it is a symmetric relation, is equal to _____.

Q83 Statistics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/_2WjTnvSPH) › prepwiser.in/questions/_2WjTnvSPH

Let the mean and variance of 8 numbers $x, y, 10, 12, 6, 12, 4, 8$ be 9 and 9.25 respectively. If $x > y$, then $3x - 2y$ is equal to _____.

Q84 Vectors **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/n-N9_5tbeT) › prepwiser.in/questions/n-N9_5tbeT

Let

$$\vec{a} = 6\hat{i} + 9\hat{j} + 12\hat{k}, \vec{b} = \alpha\hat{i} + 11\hat{j} - 2\hat{k}$$

and $\vec{c}$ be vectors such that $\vec{a} \times \vec{c} = \vec{a} \times \vec{b}$. If

$\vec{a} \cdot \vec{c} = -12, \vec{c} \cdot (\hat{i} - 2\hat{j} + \hat{k}) = 5$, then $\vec{c} \cdot (\hat{i} + \hat{j} + \hat{k})$ is equal to _____.

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Physics

1.	A	2.	D	3.	A	4.	A	5.	B	6.	D	7.	D	8.	A
9.	B	10.	B	11.	D	12.	A	13.	A	14.	D	15.	A	16.	C
17.	C	18.	C	19.	C	20.	9	21.	121	22.	125	23.	25	24.	18
25.	18	26.	2	27.	10	28.	1	29.	900						

Chemistry

30.	C	31.	B	32.	A	33.	B	34.	C	35.	C	36.	B	37.	A
38.	B	39.	D	40.	C	41.	B	42.	A	43.	C	44.	D	45.	C
46.	A	47.	3	48.	2	49.	70	50.	2	51.	11	52.	82	53.	11
54.	1	55.	1200												

Mathematics

56.	A	57.	B	58.	A	59.	D	60.	B	61.	B	62.	C	63.	D
64.	B	65.	A	66.	D	67.	D	68.	C	69.	B	70.	D	71.	C
72.	C	73.	B	74.	C	75.	9	76.	5	77.	1275	78.	31	79.	2
80.	14	81.	3	82.	19	83.	25	84.	11						

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