

JEE MAIN 2023 · QUESTION PAPER

1 Feb 2023 Shift 1

81 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	8 Q47 to Q54
● Mathematics	17 Q55 to Q71	10 Q72 to Q81
In this PDF	81 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.

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

Q1 Alternating Current

[Step-by-step solution](#) > [prepwiser.in/questions/_I9-9ha_pn](https://www.prepwiser.in/questions/_I9-9ha_pn)

Match List - I with List - II:

	List I		List II
A.	AC generator	I.	Presence of both L and C
B.	Transformer	II.	Electromagnetic Induction
C.	Resonance phenomenon to occur	III.	Quality factor
D.	Sharpness of resonance	IV.	Mutual Induction

Choose the correct answer from the options given below:

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

Q2 Nuclear Physics

[Step-by-step solution](#) > [prepwiser.in/questions/D5ebtctlg3](https://www.prepwiser.in/questions/D5ebtctlg3)

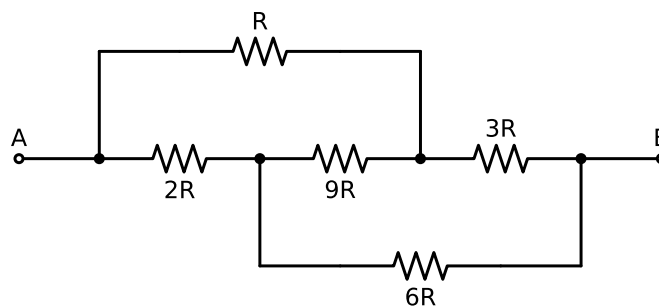
The mass of proton, neutron and helium nucleus are respectively $1.0073u$, $1.0087u$ and $4.0015u$. The binding energy of helium nucleus is:

- (A) 28.4MeV (B) 56.8MeV (C) 7.1MeV (D) 14.2MeV

Q3 Current Electricity

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

The equivalent resistance between A and B of the network shown in figure;



- (A) 21 R (B) $\frac{8}{3}$ R (C) $11\frac{2}{3}$ R (D) 14 R

Q4 Dual Nature of Radiation & Matter

[Step-by-step solution](#) > [prepwiser.in/questions/dA2_kMj-Kr](https://www.prepwiser.in/questions/dA2_kMj-Kr)

A proton moving with one tenth of velocity of light has a certain de Broglie wavelength of λ . An alpha particle having certain kinetic energy has the same de-Broglie wavelength λ . The ratio of kinetic energy of proton and that of alpha particle is:

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

Q5 Electromagnetic Waves

[Step-by-step solution](#) > [prepwiser.in/questions/NVaCNT-3BD](https://www.prepwiser.in/questions/NVaCNT-3BD)

Match List I with List II:

	List I		List II
A.	Microwaves	I.	Radio active decay of the nucleus
B.	Gamma rays	II.	Rapid acceleration and deceleration of electron in aerials
C.	Radio waves	III.	Inner shell electrons
D.	X-rays	IV.	Klystron valve

Choose the correct answer from the options given below:

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

Match List I with List II:

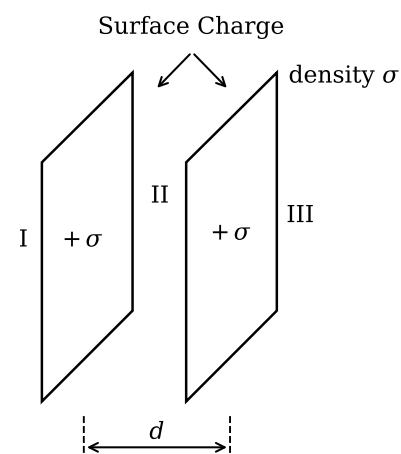
	List I		List II
A.	Intrinsic semiconductor	I.	Fermi-level near the valence band
B.	n-type semiconductor	II.	Fermi-level in the middle of valence and conduction band.
C.	p-type semiconductor	III.	Fermi-level near the conduction band
D.	Metals	IV.	Fermi-level inside the conduction band

Choose the correct answer from the options given below:

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

Let σ be the uniform surface charge density of two infinite thin plane sheets shown in figure. Then the electric fields in three different region E_I , E_{II} and E_{III} are:

- (A) $\vec{E}_I = 0, \vec{E}_{II} = \frac{\sigma}{\epsilon_0} \hat{n}, E_{III} = 0$
 (B) $\vec{E}_I = \frac{\sigma}{2\epsilon_0} \hat{n}, \vec{E}_{II} = 0, \vec{E}_{III} = \frac{\sigma}{2\epsilon_0} \hat{n}$
 (C) $\vec{E}_I = -\frac{\sigma}{\epsilon_0} \hat{n}, \vec{E}_{II} = 0, \vec{E}_{III} = \frac{\sigma}{\epsilon_0} \hat{n}$
 (D) $\vec{E}_I = \frac{2\sigma}{\epsilon_0} \hat{n}, \vec{E}_{II} = 0, \vec{E}_{III} = \frac{2\sigma}{\epsilon_0} \hat{n}$



If earth has a mass nine times and radius twice to that of a planet P. Then $\frac{v_e}{3} \sqrt{x} \text{ms}^{-1}$ will be the minimum velocity required by a rocket to pull out of gravitational force of P, where v_e is escape velocity on earth. The value of x is

- (A) 1 (B) 3 (C) 2 (D) 18

Given below are two statements:

Statement I: Acceleration due to gravity is different at different places on the surface of earth.

Statement II: Acceleration due to gravity increases as we go down below the earth's surface.

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

A sample of gas at temperature T is adiabatically expanded to double its volume. The work done by the gas in the process is (given, $\gamma = \frac{3}{2}$):

- (A) $W = TR[\sqrt{2} - 2]$ (B) $W = \frac{T}{R}[\sqrt{2} - 2]$ (C) $W = \frac{R}{T}[2 - \sqrt{2}]$ (D) $W = RT[2 - \sqrt{2}]$

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Q11 Units, Dimensions & Errors[Step-by-step solution > prepwiser.in/questions/vTvo6Xgcyl](https://www.prepwiser.in/questions/vTvo6Xgcyl)

$(P + \frac{a}{V^2})(V - b) = RT$ represents the equation of state of some gases. Where P is the pressure, V is the volume, T is the temperature and a, b, R are the constants. The physical quantity, which has dimensional formula as that of $\frac{b^2}{a}$, will be:

- (A) Energy density (B) Bulk modulus (C) Modulus of rigidity (D) Compressibility

Q12 Kinetic Theory of Gases[Step-by-step solution > prepwiser.in/questions/QDQgZLLViQ](https://www.prepwiser.in/questions/QDQgZLLViQ)

The average kinetic energy of a molecule of the gas is

- (A) proportional to volume (B) dependent on the nature of the gas
(C) proportional to absolute temperature (D) proportional to pressure

Q13 Friction[Step-by-step solution > prepwiser.in/questions/hCvhDleZDZ](https://www.prepwiser.in/questions/hCvhDleZDZ)

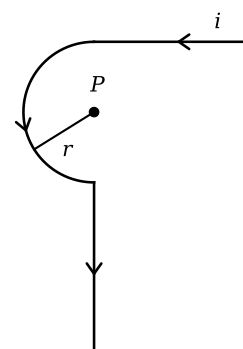
A block of mass 5kg is placed at rest on a table of rough surface. Now, if a force of 30N is applied in the direction parallel to surface of the table, the block slides through a distance of 50m in an interval of time 10s . Coefficient of kinetic friction is (given, $g = 10\text{ms}^{-2}$):

- (A) 0.25 (B) 0.75 (C) 0.60 (D) 0.50

Q14 Moving Charges & Magnetism[Step-by-step solution > prepwiser.in/questions/k5ym8anWGX](https://www.prepwiser.in/questions/k5ym8anWGX)

Find the magnetic field at the point P in figure. The curved portion is a semicircle connected to two long straight wires.

- (A) $\frac{\mu_0 i}{2r} \left(\frac{1}{2} + \frac{1}{2\pi} \right)$ (B) $\frac{\mu_0 i}{2r} \left(1 + \frac{2}{\pi} \right)$
(C) $\frac{\mu_0 i}{2r} \left(\frac{1}{2} + \frac{1}{\pi} \right)$ (D) $\frac{\mu_0 i}{2r} \left(1 + \frac{1}{\pi} \right)$

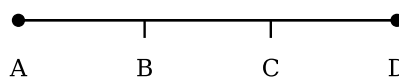
**Q15** Projectile Motion & Relative Motion[Step-by-step solution > prepwiser.in/questions/1ucU8j7w-m](https://www.prepwiser.in/questions/1ucU8j7w-m)

A child stands on the edge of the cliff 10m above the ground and throws a stone horizontally with an initial speed of 5ms^{-1} . Neglecting the air resistance, the speed with which the stone hits the ground will be ms^{-1} (given, $g = 10\text{ms}^{-2}$).

- (A) 20 (B) 25 (C) 30 (D) 15

Q16 Rectilinear Motion[Step-by-step solution > prepwiser.in/questions/rMZCWERY-W](https://www.prepwiser.in/questions/rMZCWERY-W)

An object moves with speed v_1, v_2 and v_3 along a line segment AB, BC and CD respectively as shown in figure. Where $AB = BC$ and $AD = 3AB$, then average speed of the object will be:



- (A) $\frac{v_1 v_2 v_3}{3(v_1 v_2 + v_2 v_3 + v_3 v_1)}$ (B) $\frac{(v_1 + v_2 + v_3)}{3}$
(C) $\frac{(v_1 + v_2 + v_3)}{3v_1 v_2 v_3}$ (D) $\frac{3v_1 v_2 v_3}{(v_1 v_2 + v_2 v_3 + v_3 v_1)}$

Attempt this paper online with instant answer checking > [prepwiser.in/pyqs/paper/2023-02-01-morning](https://www.prepwiser.in/pyqs/paper/2023-02-01-morning)

Q17 Surface Tension[Step-by-step solution](https://www.prepwiser.in/questions/oTxqQjaIWZ) › prepwiser.in/questions/oTxqQjaIWZ

A mercury drop of radius 10^{-3}m is broken into 125 equal size droplets. Surface tension of mercury is 0.45Nm^{-1} . The gain in surface energy is:

- (A) $28 \times 10^{-5}\text{J}$ (B) $17.5 \times 10^{-5}\text{J}$ (C) $5 \times 10^{-5}\text{J}$ (D) $2.26 \times 10^{-5}\text{J}$

Q18 Wave Optics[Step-by-step solution](https://www.prepwiser.in/questions/zY7z_3014P) › prepwiser.in/questions/zY7z_3014P

' n ' polarizing sheets are arranged such that each makes an angle 45° with the preceding sheet. An unpolarized light of intensity I is incident into this arrangement. The output intensity is found to be $I/64$. The value of n will be:

- (A) 4 (B) 5 (C) 3 (D) 6

Q19 Mechanical Waves[Step-by-step solution](https://www.prepwiser.in/questions/a7L9fBP30e) › prepwiser.in/questions/a7L9fBP30e

A steel wire with mass per unit length $7.0 \times 10^{-3}\text{kgm}^{-1}$ is under tension of 70N . The speed of transverse waves in the wire will be:

- (A) 10m/s (B) 50m/s (C) 100m/s (D) $200\pi\text{m/s}$

Physics Section B · Numerical value

Q20 to Q29

Q20 Alternating Current **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/QQEqCNQzB-) › prepwiser.in/questions/QQEqCNQzB-

A series LCR circuit is connected to an ac source of 220V , 50Hz . The circuit contains a resistance $R = 100\Omega$ and an inductor of inductive reactance $X_L = 79.6\Omega$. The capacitance of the capacitor needed to maximize the average rate at which energy is supplied will be _____ μF .

Q21 Atomic Physics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/fDDzGB0T-a) › prepwiser.in/questions/fDDzGB0T-a

A light of energy 12.75eV is incident on a hydrogen atom in its ground state. The atom absorbs the radiation and reaches to one of its excited states. The angular momentum of the atom in the excited state is $\frac{x}{\pi} \times 10^{-17}\text{eVs}$. The value of x is _____ (use $h = 4.14 \times 10^{-15}\text{eVs}$, $c = 3 \times 10^8\text{ms}^{-1}$).

Q22 Current Electricity **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/FS10iylhtg) › prepwiser.in/questions/FS10iylhtg

In an experiment to find emf of a cell using potentiometer, the length of null point for a cell of emf 1.5V is found to be 60cm . If this cell is replaced by another cell of emf E , the length-of null point increases by 40cm . The value of E is $\frac{x}{10}\text{V}$. The value of x is _____.

Q23 Electrostatics I: Charges, Field & Gauss's Law **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/Qrq0tuiHNj) › prepwiser.in/questions/Qrq0tuiHNj

Two equal positive point charges are separated by a distance $2a$. The distance of a point from the centre of the line joining two charges on the equatorial line (perpendicular bisector) at which force experienced by a test charge q_0 becomes maximum is $\frac{a}{\sqrt{x}}$. The value of x is _____.

Q24 Ray Optics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/zxWxla8gM7) › prepwiser.in/questions/zxWxla8gM7

A thin cylindrical rod of length 10cm is placed horizontally on the principle axis of a concave mirror of focal length 20cm . The rod is placed in a such a way that mid point of the rod is at 40cm from the pole of mirror. The length of the image formed by the mirror will be $\frac{x}{3}\text{cm}$. The value of x is _____.

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Q25 Moving Charges & Magnetism **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/0lqY3Fm37a

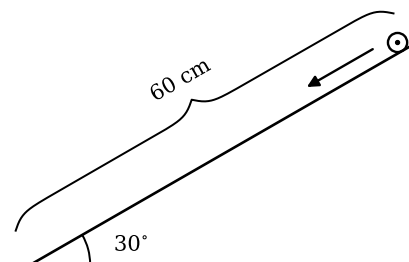
A charge particle of $2\mu\text{C}$ accelerated by a potential difference of 100V enters a region of uniform magnetic field of magnitude 4mT at right angle to the direction of field. The charge particle completes semicircle of radius 3cm inside magnetic field. The mass of the charge particle is $\text{_____} \times 10^{-18}\text{kg}$

Q26 Elasticity **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/lf4Z9f76cn

A certain pressure 'P' is applied to 1 litre of water and 2 litre of a liquid separately. Water gets compressed to 0.01% whereas the liquid gets compressed to 0.03% . The ratio of Bulk modulus of water to that of the liquid is $\frac{3}{x}$. The value of x is _____ .

Q27 Rotational Motion **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/GR24p35vZi

A solid cylinder is released from rest from the top of an inclined plane of inclination 30° and length 60cm . If the cylinder rolls without slipping, its speed upon reaching the bottom of the inclined plane is _____ ms^{-1} . (Given $g = 10\text{ms}^{-2}$)

**Q28** Simple Harmonic Motion **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/3GqV_sCibh

The amplitude of a particle executing SHM is 3cm . The displacement at which its kinetic energy will be 25% more than the potential energy is: _____ cm

Q29 Work, Energy & Power **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/Qfq31Lafag

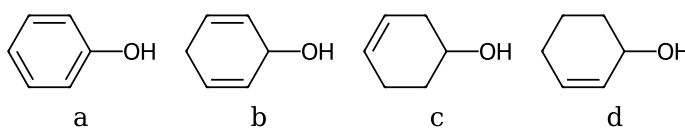
A small particle moves to position $5\hat{i} - 2\hat{j} + \hat{k}$ from its initial position $2\hat{i} + 3\hat{j} - 4\hat{k}$ under the action of force $5\hat{i} + 2\hat{j} + 7\hat{k}\text{N}$. The value of work done will be _____ J .

Chemistry Section A · Multiple choice

Q30 to Q46

Q30 Alcohols, Phenols & Ethers[Step-by-step solution](#) > prepwiser.in/questions/X9HZdljhc1

Decreasing order of dehydration of the following alcohols is



- (A) $d > b > c > a$ (B) $b > d > c > a$ (C) $a > d > b > c$ (D) $b > a > d > c$

Q31 Practical Organic Chemistry[Step-by-step solution](#) > prepwiser.in/questions/Ck_nw6prn

Match List I with List II

List I		List II	
	Test		Functional group / Class of Compound
A.	Molisch's Test	I.	Peptide
B.	Biuret Test	II.	Carbohydrate
C.	Carbylamine Test	III.	Primary amine
D.	Schiff's Test	IV.	Aldehyde

Choose the correct answer from the options given below:

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

Match List I with List II

	List I		List II
A.	Tranquilizers	I.	Anti blood clotting
B.	Aspirin	II.	Salvarsan
C.	Antibiotic	III.	antidepressant drugs
D.	Antiseptic	IV.	soframycin

Choose the correct answer from the options given below:

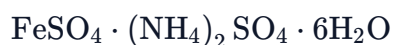
(A) (A) - II, (B) - I, (C) - III, (D) - IV**(B)** (A) - IV, (B) - II, (C) - I, (D) - III**(C)** (A) - III, (B) - I, (C) - II, (D) - IV**(D)** (A) - II, (B) - IV, (C) - I, (D) - III

Which of the following complex will show largest splitting of d-orbitals?

(A) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$ **(B)** $[\text{Fe}(\text{CN})_6]^{3-}$ **(C)** $[\text{Fe}(\text{NH}_3)_6]^{3+}$ **(D)** $[\text{FeF}_6]^{3-}$

Which of the following are the example of double salt?

A.

B. $\text{CuSO}_4 \cdot 4\text{NH}_3 \cdot \text{H}_2\text{O}$

C.

D. $\text{Fe}(\text{CN})_2 \cdot 4\text{KCN}$

Choose the correct answer:

(A) A, B and D only**(B)** B and D only**(C)** A and B only**(D)** A and C onlyA solution of FeCl_3 when treated with $\text{K}_4[\text{Fe}(\text{CN})_6]$ gives a prussian blue precipitate due to the formation of:**(A)** $\text{Fe}[\text{Fe}(\text{CN})_6]$ **(B)** $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$ **(C)** $\text{Fe}_3[\text{Fe}(\text{CN})_6]_2$ **(D)** $\text{K}[\text{Fe}_2(\text{CN})_6]$ Highest oxidation state of Mn is exhibited in Mn_2O_7 . The correct statements about Mn_2O_7 are

(A) Mn is tetrahedrally surrounded by oxygen atoms.

(B) Mn is octahedrally surrounded by oxygen atoms.

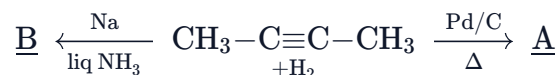
(C) Contains Mn-O-Mn bridge.

(D) Contains Mn-Mn bond.

Choose the correct answer from the options given below:

(A) A and C only**(B)** A and D only**(C)** B and C only**(D)** B and D onlyAttempt this paper online with instant answer checking › [prepwise.in/pyqs/paper/2023-02-01-morning](https://www.prepwise.in/pyqs/paper/2023-02-01-morning)

But-2-yne is reacted separately with one mole of Hydrogen as shown below:



- A. A is more soluble than B.
B. The boiling point & melting point of A are higher and lower than B respectively.
C. A is more polar than B because dipole moment of A is zero.
D. Br₂ adds easily to B than A.

Identify the **incorrect** statements from the options given below:

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

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

Assertion A : Hydrogen is an environment friendly fuel.

Reason R : Atomic number of hydrogen is 1 and it is a very light element.

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

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

Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R
Assertion A: In an Ellingham diagram, the oxidation of carbon to carbon monoxide shows a negative slope with respect to temperature.

Reason R: CO tends to get decomposed at higher temperature.

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

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

Given below are two statements:

Statement I : Chlorine can easily combine with oxygen to form oxides; and the product has a tendency to explode.

Statement II : Chemical reactivity of an element can be determined by its reaction with oxygen and halogens.

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

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

Match List I with List II:

	List I		List II
A.	Slaked lime	I.	NaOH
B.	Dead burnt plaster	II.	Ca(OH) ₂
C.	Caustic soda	III.	Na ₂ CO ₃ · 10H ₂ O
D.	Washing soda	IV.	CaSO ₄

Choose the correct answer from the options given below:

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

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

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

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

Choose the correct statement(s):

A. Beryllium oxide is purely acidic in nature.

B. Beryllium carbonate is kept in the atmosphere of CO₂.

C. Beryllium sulphate is readily soluble in water.

D. Beryllium shows anomalous behaviour.

Choose the correct answer from the options given below:

(A) A only

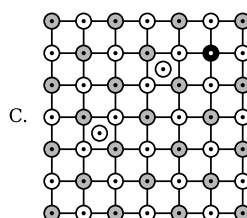
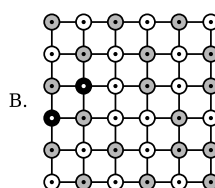
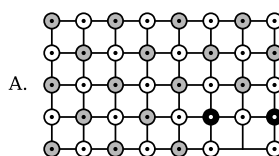
(B) B, C and D only

(C) A, B and C only

(D) A and B only

Which of the following represents the lattice structure of A_{0.95}O containing A²⁺, A³⁺ and O²⁻ ions?

☐ A²⁺
 ☒ A³⁺
 ☐ O²⁻



(A) B only

(B) A and B only

(C) A only

(D) B and C only

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

Assertion A: Amongst He, Ne, Ar and Kr; 1g of activated charcoal adsorbs more of Kr.

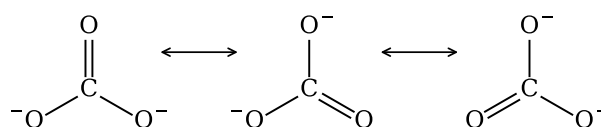
Reason R: The critical volume V_c ($\text{cm}^3\text{mol}^{-1}$) and critical pressure P_c (atm) is highest for Krypton but the compressibility factor at critical point Z_c is lowest for Krypton.

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

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

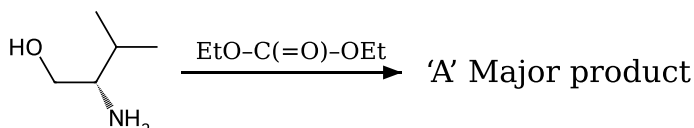
Resonance in carbonate ion (CO_3^{2-}) is

Which of the following is true?



- (A) It is possible to identify each structure individually by some physical or chemical method.
- (B) All these structures are in dynamic equilibrium with each other.
- (C) Each structure exists for equal amount of time.
- (D) CO_3^{2-} has a single structure i.e., resonance hybrid of the above three structures.

In the following reaction, 'A' is



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

Chemistry Section B · Numerical value

Q47 to Q54

A and B are two substances undergoing radioactive decay in a container. The half life of A is 15 min and that of B is 5 min. If the initial concentration of B is 4 times that of A and they both start decaying at the same time, how much time will it take for the concentration of both of them to be same? _____ min.

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At what pH, given half cell $\text{MnO}_4^- (0.1\text{M}) | \text{Mn}^{2+} (0.001\text{M})$ will have electrode potential of 1.282 V? _____ (Nearest Integer)

Given

$$E_{\text{MnO}_4^- | \text{Mn}^{2+}}^{\circ} = 1.54\text{V}, \frac{2.303RT}{F} = 0.059\text{V}$$

Sum of oxidation states of bromine in bromic acid and perbromic acid is _____.

25 mL of an aqueous solution of KCl was found to require 20 mL of 1 M AgNO_3 solution when titrated using K_2CrO_4 as an indicator. What is the depression in freezing point of KCl solution of the given concentration? _____ (Nearest integer).

(Given: $K_f = 2.0\text{Kkgmol}^{-1}$)

Assume 1) 100% ionization and 2) density of the aqueous solution as 1 g mL^{-1}

The density of 3M solution of NaCl is 1.0g mL^{-1} . Molality of the solution is _____ $\times 10^{-2}\text{m}$. (Nearest integer).

Given: Molar mass of Na and Cl is 23 and 35.5g mol^{-1} respectively.

Electrons in a cathode ray tube have been emitted with a velocity of 1000 m s^{-1} . The number of following statements which is/are true about the emitted radiation is _____.

Given: $h = 6 \times 10^{-34}\text{Js}$, $m_e = 9 \times 10^{-31}\text{kg}$.

(A) The de-Broglie wavelength of the electron emitted is 666.67 nm.

(B) The characteristic of electrons emitted depend upon the material of the electrodes of the cathode ray tube.

(C) The cathode rays start from cathode and move towards anode.

(D) The nature of the emitted electrons depends on the nature of the gas present in cathode ray tube.

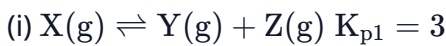
At 25°C , the enthalpy of the following processes are given:

$\text{H}_2(\text{g}) + \text{O}_2(\text{g})$	$\rightarrow$	$2\text{OH}(\text{g})$	$\Delta H^\circ = 78\text{kJmol}^{-1}$
$\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g})$	$\rightarrow$	$\text{H}_2\text{O}(\text{g})$	$\Delta H^\circ = -242\text{kJmol}^{-1}$
$\text{H}_2(\text{g})$	$\rightarrow$	$2\text{H}(\text{g})$	$\Delta H^\circ = 436\text{kJmol}^{-1}$
$\frac{1}{2}\text{O}_2(\text{g})$	$\rightarrow$	$\text{O}(\text{g})$	$\Delta H^\circ = 249\text{kJmol}^{-1}$

What would be the value of X for the following reaction? _____ (Nearest integer)



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If the degree of dissociation and initial concentration of both the reactants $X(g)$ and $A(g)$ are equal, then the ratio of the total pressure at equilibrium $\left(\frac{p_1}{p_2}\right)$ is equal to $x : 1$. The value of x is _____
(Nearest integer)

Mathematics Section A · Multiple choice

Q55 to Q71

The shortest distance between the lines

$$\frac{x-5}{1} = \frac{y-2}{2} = \frac{z-4}{-3} \text{ and } \frac{x+3}{1} = \frac{y+5}{4} = \frac{z-1}{-5} \text{ is:}$$

(A) $7\sqrt{3}$

(B) $5\sqrt{3}$

(C) $4\sqrt{3}$

(D) $6\sqrt{3}$

Let the image of the point $P(2, -1, 3)$ in the plane $x + 2y - z = 0$ be Q .

Then the distance of the plane $3x + 2y + z + 29 = 0$ from the point Q is:

(A) $2\sqrt{14}$

(B) $\frac{22\sqrt{2}}{7}$

(C) $\frac{24\sqrt{2}}{7}$

(D) $3\sqrt{14}$

If the center and radius of the circle $\left|\frac{z-2}{z-3}\right| = 2$ are respectively (α, β) and γ , then $3(\alpha + \beta + \gamma)$ is equal to:

(A) 12

(B) 10

(C) 11

(D) 9

$$\lim_{n \rightarrow \infty} \left[\frac{1}{1+n} + \frac{1}{2+n} + \frac{1}{3+n} + \dots + \frac{1}{2n} \right]$$

is equal to

(A) 0

(B) $\log_e 2$

(C) $\log_e \left(\frac{2}{3}\right)$

(D) $\log_e \left(\frac{3}{2}\right)$

The area enclosed by the closed curve C given by the differential equation

$$\frac{dy}{dx} + \frac{x+a}{y-2} = 0, y(1) = 0 \text{ is } 4\pi.$$

Let P and Q be the points of intersection of the curve C and the y -axis. If normals at P and Q on the curve C intersect x -axis at points R and S respectively, then the length of the line segment RS is:

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

(B) $2\sqrt{3}$

(C) 2

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

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Q60 Differential Equations[Step-by-step solution](https://www.prepwise.in/questions/940di8GJqT)

If $y = y(x)$ is the solution curve of the differential equation

$\frac{dy}{dx} + y \tan x = x \sec x, 0 \leq x \leq \frac{\pi}{3}, y(0) = 1$, then $y\left(\frac{\pi}{6}\right)$ is equal to

- (A) $\frac{\pi}{12} - \frac{\sqrt{3}}{2} \log_e \left(\frac{2\sqrt{3}}{e} \right)$ (B) $\frac{\pi}{12} + \frac{\sqrt{3}}{2} \log_e \left(\frac{2\sqrt{3}}{e} \right)$
 (C) $\frac{\pi}{12} + \frac{\sqrt{3}}{2} \log_e \left(\frac{2}{e\sqrt{3}} \right)$ (D) $\frac{\pi}{12} - \frac{\sqrt{3}}{2} \log_e \left(\frac{2}{e\sqrt{3}} \right)$

Q61 Inverse Trigonometric Functions[Step-by-step solution](https://www.prepwise.in/questions/IblGoQoBBW)

Let $f(x) = 2x + \tan^{-1}x$ and $g(x) = \log_e(\sqrt{1+x^2} + x), x \in [0, 3]$. Then

- (A) there exists $\hat{x} \in [0, 3]$ such that $f'(\hat{x}) < g'(\hat{x})$
 (B) there exist $0 < x_1 < x_2 < 3$ such that $f(x) < g(x), \forall x \in (x_1, x_2)$
 (C) $\min f'(x) = 1 + \max g'(x)$
 (D) $\max f(x) > \max g(x)$

Q62 Determinants[Step-by-step solution](https://www.prepwise.in/questions/TwojcNLFSe)

Let

$$f(x) = \begin{vmatrix} 1 + \sin^2 x & \cos^2 x & \sin 2x \\ \sin^2 x & 1 + \cos^2 x & \sin 2x \\ \sin^2 x & \cos^2 x & 1 + \sin 2x \end{vmatrix}, x \in \left[\frac{\pi}{6}, \frac{\pi}{3} \right]$$

. If α and β respectively are the maximum and the minimum values of f , then

- (A) $\alpha^2 - \beta^2 = 4\sqrt{3}$ (B) $\beta^2 - 2\sqrt{\alpha} = \frac{19}{4}$ (C) $\beta^2 + 2\sqrt{\alpha} = \frac{19}{4}$ (D) $\alpha^2 + \beta^2 = \frac{9}{2}$

Q63 Inverse Trigonometric Functions[Step-by-step solution](https://www.prepwise.in/questions/2PddCTpjdx)

Let S be the set of all solutions of the equation

$$\cos^{-1}(2x) - 2 \cos^{-1}(\sqrt{1-x^2}) = \pi, x \in \left[-\frac{1}{2}, \frac{1}{2} \right]$$

. Then $\sum_{x \in S} 2 \sin^{-1}(x^2 - 1)$ is equal to:

- (A) $\pi - 2 \sin^{-1} \left(\frac{\sqrt{3}}{4} \right)$ (B) $\pi - \sin^{-1} \left(\frac{\sqrt{3}}{4} \right)$ (C) $\frac{-2\pi}{3}$ (D) None

Q64 Determinants[Step-by-step solution](https://www.prepwise.in/questions/LHSyDu1kf7)

Let S denote the set of all real values of λ such that the system of equations

$$\lambda x + y + z = 1$$

$$x + \lambda y + z = 1$$

$$x + y + \lambda z = 1$$

is inconsistent, then $\sum_{\lambda \in S} (|\lambda|^2 + |\lambda|)$ is equal to

- (A) 12 (B) 2 (C) 4 (D) 6

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The value of

$$\frac{1}{1!50!} + \frac{1}{3!48!} + \frac{1}{5!46!} + \dots + \frac{1}{49!2!} + \frac{1}{51!1!}$$

is:

- (A) $\frac{2^{51}}{50!}$ (B) $\frac{2^{51}}{51!}$ (C) $\frac{2^{50}}{50!}$ (D) $\frac{2^{50}}{51!}$

In a binomial distribution $B(n, p)$, the sum and the product of the mean and the variance are 5 and 6 respectively, then $6(n + p - q)$ is equal to:

- (A) 52 (B) 50 (C) 51 (D) 53

Let

$$S = \left\{ x : x \in \mathbb{R} \text{ and } (\sqrt{3} + \sqrt{2})^{x^2-4} + (\sqrt{3} - \sqrt{2})^{x^2-4} = 10 \right\}$$

. Then $n(S)$ is equal to

- (A) 6 (B) 4 (C) 0 (D) 2

The sum of 10 terms of the series

$$\frac{1}{1 + 1^2 + 1^4} + \frac{2}{1 + 2^2 + 2^4} + \frac{3}{1 + 3^2 + 3^4} + \dots$$

is

- (A) $\frac{58}{111}$ (B) $\frac{56}{111}$ (C) $\frac{55}{111}$ (D) $\frac{59}{111}$

Let R be a relation on $\mathbb{R}$, given by $R = \{(a, b) : 3a - 3b + \sqrt{7} \text{ is an irrational number}\}$. Then R is

- (A) an equivalence relation (B) reflexive and symmetric but not transitive
(C) reflexive and transitive but not symmetric (D) reflexive but neither symmetric nor transitive

The mean and variance of 5 observations are 5 and 8 respectively. If 3 observations are 1, 3, 5, then the sum of cubes of the remaining two observations is:

- (A) 1792 (B) 1216 (C) 1456 (D) 1072

If the orthocentre of the triangle, whose vertices are (1, 2), (2, 3) and (3, 1) is (α, β) , then the quadratic equation whose roots are $\alpha + 4\beta$ and $4\alpha + \beta$, is:

- (A) $x^2 - 20x + 99 = 0$ (B) $x^2 - 22x + 120 = 0$
(C) $x^2 - 19x + 90 = 0$ (D) $x^2 - 18x + 80 = 0$

Q72 Binomial Theorem **NUMERICAL**

[Step-by-step solution](#) · [prepwisar.in/questions/E5haFPeaqj](https://www.prepwisar.in/questions/E5haFPeaqj)

The remainder, when $19^{200} + 23^{200}$ is divided by 49, is _____.

Q73 Definite Integration **NUMERICAL**

[Step-by-step solution](#) · [prepwisar.in/questions/UupflZYjvy](https://www.prepwisar.in/questions/UupflZYjvy)

If

$$\int_0^1 (x^{21} + x^{14} + x^7) (2x^{14} + 3x^7 + 6)^{1/7} dx = \frac{1}{l} (11)^{m/n}$$

where $l, m, n \in \mathbb{N}$, m and n are coprime then $l + m + n$ is equal to _____.

Q74 Differential Equations **NUMERICAL**

[Step-by-step solution](#) · [prepwisar.in/questions/BzO5a6fZwu](https://www.prepwisar.in/questions/BzO5a6fZwu)

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a differentiable function such that $f'(x) + f(x) = \int_0^2 f(t) dt$. If $f(0) = e^{-2}$, then $2f(0) - f(2)$ is equal to _____.

Q75 Differentiation **NUMERICAL**

[Step-by-step solution](#) · [prepwisar.in/questions/W7Cg-68qtD](https://www.prepwisar.in/questions/W7Cg-68qtD)

If $f(x) = x^2 + g'(1)x + g''(2)$ and $g(x) = f(1)x^2 + xf'(x) + f''(x)$, then the value of $f(4) - g(4)$ is equal to _____.

Q76 Sets **NUMERICAL**

[Step-by-step solution](#) · [prepwisar.in/questions/kNMiBvGqV5](https://www.prepwisar.in/questions/kNMiBvGqV5)

The number of 3-digit numbers, that are divisible by either 2 or 3 but not divisible by 7, is _____.

Q77 Permutations & Combinations **NUMERICAL**

[Step-by-step solution](#) · [prepwisar.in/questions/xNshZaGS6O](https://www.prepwisar.in/questions/xNshZaGS6O)

The number of words, with or without meaning, that can be formed using all the letters of the word ASSASSINATION so that the vowels occur together, is _____.

Q78 Sequences & Series **NUMERICAL**

[Step-by-step solution](#) · [prepwisar.in/questions/oU_b3JCuuQ](https://www.prepwisar.in/questions/oU_b3JCuuQ)

Let $a_1 = 8, a_2, a_3, \dots, a_n$ be an A.P. If the sum of its first four terms is 50 and the sum of its last four terms is 170, then the product of its middle two terms is _____.

Q79 Vectors **NUMERICAL**

[Step-by-step solution](#) · [prepwisar.in/questions/tGFpaJdzAX](https://www.prepwisar.in/questions/tGFpaJdzAX)

Let

$$\vec{v} = \alpha \hat{i} + 2\hat{j} - 3\hat{k}, \vec{w} = 2\alpha \hat{i} + \hat{j} - \hat{k}$$

and $\vec{u}$ be a vector such that $|\vec{u}| = \alpha > 0$. If the minimum value of the scalar triple product

$$[\vec{u} \quad \vec{v} \quad \vec{w}]$$

is $-\alpha\sqrt{3401}$, and $|\vec{u} \cdot \hat{i}|^2 = \frac{m}{n}$ where m and n are coprime natural numbers, then $m + n$ is equal to _____.

Q80 Vectors **NUMERICAL**

[Step-by-step solution](#) · [prepwisar.in/questions/2yFQFLozCk](https://www.prepwisar.in/questions/2yFQFLozCk)

$A(2, 6, 2), B(-4, 0, \lambda), C(2, 3, -1)$ and $D(4, 5, 0)$, $|\lambda| \leq 5$ are the vertices of a quadrilateral $ABCD$. If its area is 18 square units, then $5 - 6\lambda$ is equal to _____.

Q81 Area Under Curves **NUMERICAL**

[Step-by-step solution](#) · [prepwisar.in/questions/2hofXLkpw](https://www.prepwisar.in/questions/2hofXLkpw)

Let A be the area bounded by the curve $y = x|x - 3|$, the x -axis and the ordinates $x = -1$ and $x = 2$. Then $12A$ is equal to _____.

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Physics

1. C	2. A	3. B	4. C	5. C	6. D	7. C	8. C
9. D	10. D	11. D	12. C	13. D	14. A	15. D	16. D
17. D	18. D	19. C	20. 40	21. 828	22. 25	23. 2	24. 32
25. 144	26. 1	27. 2	28. 2	29. 40			

Chemistry

30. B	31. B	32. C	33. B	34. D	35. B	36. A	37. D
38. A	39. A	40. D	41. C	42. B	43. C	44. D	45. D
46. B	47. 15	48. 3	49. 12	50. 3	51. 364	52. 2	53. 499
54. 12							

Mathematics

55. D	56. D	57. A	58. B	59. A	60. D	61. D	62. B
63. D	64. D	65. D	66. A	67. B	68. C	69. D	70. D
71. A	72. 29	73. 63	74. 1	75. 14	76. 514	77. 50400	78. 754
79. 3501	80. 11	81. 62					

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