

JEE MAIN 2021 · QUESTION PAPER

26 Feb 2021 **Shift 2**

80 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	8 Q20 to Q27
● Chemistry	15 Q28 to Q42	10 Q43 to Q52
● Mathematics	18 Q53 to Q70	10 Q71 to Q80
In this PDF	80 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.

prepwis.in/pyqs/paper/2021-02-26-evening · Free, no signup needed to start

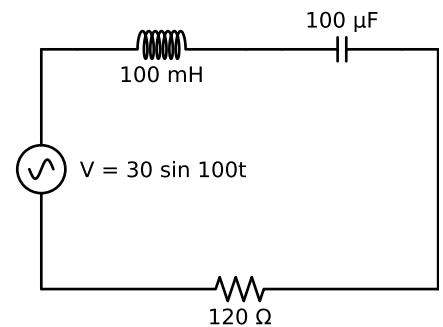
Answers follow NTA's final answer keys. Typing errors are possible, so check doubtful answers against the official key. Spotted a mistake? prepwis.in/feedback · Terms: prepwis.in/terms

Q1 Alternating Current

[Step-by-step solution](#) › [prepwisar.in/questions/OQ2rhhucHs](https://www.prepwisar.in/questions/OQ2rhhucHs)

Find the peak current and resonant frequency of the following circuit (as shown in figure).

- (A) 2 A and 100 Hz (B) 2 A and 50 Hz
(C) 0.2 A and 100 Hz (D) 0.2 A and 50 Hz



Q2 Nuclear Physics

[Step-by-step solution](#) › [prepwisar.in/questions/5aHIMmOBwe](https://www.prepwisar.in/questions/5aHIMmOBwe)

A radioactive sample is undergoing α decay. At any time t_1 , its activity is A and another time t_2 , the activity is $\frac{A}{5}$. What is the average life time for the sample?

- (A) $\frac{\ln 5}{t_2 - t_1}$ (B) $\frac{\ln(t_2 + t_1)}{2}$ (C) $\frac{t_1 - t_2}{\ln 5}$ (D) $\frac{t_2 - t_1}{\ln 5}$

Q3 Current Electricity

[Step-by-step solution](#) › [prepwisar.in/questions/oJP-XsWgWr](https://www.prepwisar.in/questions/oJP-XsWgWr)

A wire of 1Ω has a length of 1 m. It is stretched till its length increases by 25%. The percentage change in resistance to the nearest integer is:

- (A) 76% (B) 12.5% (C) 25% (D) 56%

Q4 Atomic Physics

[Step-by-step solution](#) › [prepwisar.in/questions/B6MTyp7xxQ](https://www.prepwisar.in/questions/B6MTyp7xxQ)

The recoil speed of a hydrogen atom after it emits a photon in going from $n = 5$ state to $n = 1$ state will be:

- (A) 4.34 m/s (B) 2.19 m/s (C) 3.25 m/s (D) 4.17 m/s

Q5 Electromagnetic Induction

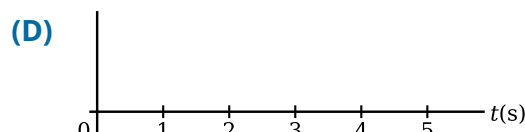
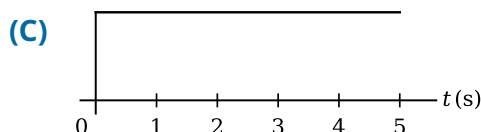
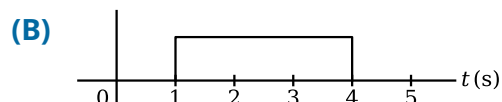
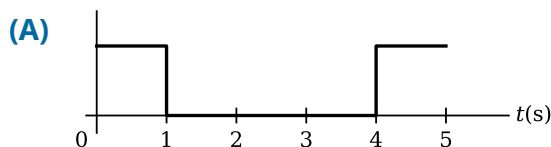
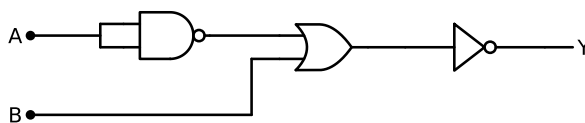
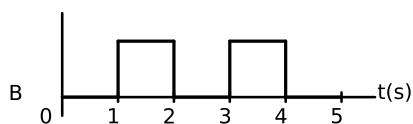
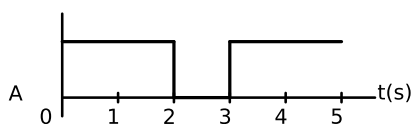
[Step-by-step solution](#) › [prepwisar.in/questions/12gXEEExOhK](https://www.prepwisar.in/questions/12gXEEExOhK)

An aeroplane, with its wings spread 10 m, is flying at a speed of 180 km/h in a horizontal direction. The total intensity of earth's field at that part is $2.5 \times 10^{-4} \text{ Wb/m}^2$ and the angle of dip is 60° . The emf induced between the tips of the plane wings will be _____.

- (A) 88.37 mV (B) 62.50 mV (C) 54.125 mV (D) 108.25 mV

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Draw the output signal Y in the given combination of gates.



Given below are two statements:

Statement I : An electric dipole is placed at the center of a hollow sphere. The flux of the electric field through the sphere is zero but the electric field is not zero anywhere in the sphere.

Statement II : If R is the radius of a solid metallic sphere and Q be the total charge on it. The electric field at any point on the spherical surface of radius r ($< R$) is zero but the electric flux passing through this closed spherical surface of radius r is not zero..

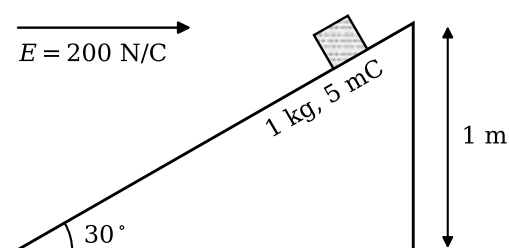
In the light of the above statements, choose the correct answer from the options given below:

- (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

An inclined plane making an angle of 30° with the horizontal is placed in a uniform horizontal electric field $200 \frac{N}{C}$ as shown in the figure. A body of mass 1 kg and charge 5 mC is allowed to slide down from rest at a height of 1 m. If the coefficient of friction is 0.2, find the time taken by the body to reach the bottom.

$$[g = 9.8 \text{ m/s}^2; \sin 30^\circ = \frac{1}{2}; \cos 30^\circ = \frac{\sqrt{3}}{2}]$$

- (A) 0.46 s (B) 0.92 s (C) 1.3 s (D) 2.3 s



The incident ray, reflected ray and the outward drawn normal are denoted by the unit vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ respectively. Then choose the correct relation for these vectors.

- (A) $\vec{b} = \vec{a} + 2\vec{c}$ (B) $\vec{b} = \vec{a} - 2(\vec{a} \cdot \vec{c})\vec{c}$
(C) $\vec{b} = 2\vec{a} + \vec{c}$ (D) $\vec{b} = \vec{a} - \vec{c}$

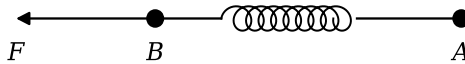
Q10 Kinetic Theory of Gases[Step-by-step solution](https://www.prepwiser.in/questions/8rvFjs8dXL) > prepwiser.in/questions/8rvFjs8dXL

The internal energy (U), pressure (P) and volume (V) of an ideal gas are related as $U = 3PV + 4$. The gas is:

- (A) either monoatomic or diatomic. (B) monoatomic only.
(C) polyatomic only. (D) diatomic only.

Q11 Newton's Laws of Motion[Step-by-step solution](https://www.prepwiser.in/questions/Bmrs9ECj8M) > prepwiser.in/questions/Bmrs9ECj8M

Two masses A and B, each of mass M are fixed together by a massless spring. A force acts on the mass B as shown in the figure. If the mass A starts moving away from mass B with acceleration 'a', then the acceleration of mass B will be:



- (A) $\frac{MF}{F + Ma}$ (B) $\frac{F + Ma}{M}$ (C) $\frac{Ma - F}{M}$ (D) $\frac{F - Ma}{M}$

Q12 Projectile Motion & Relative Motion[Step-by-step solution](https://www.prepwiser.in/questions/5VI6x3ZZfe) > prepwiser.in/questions/5VI6x3ZZfe

The trajectory of a projectile in a vertical plane is $y = \alpha x - \beta x^2$, where α and β are constants and x & y are respectively the horizontal and vertical distances of the projectile from the point of projection. The angle of projection θ and the maximum height attained H are respectively given by:

- (A) $\tan^{-1}\alpha, \frac{\alpha^2}{4\beta}$ (B) $\tan^{-1}\alpha, \frac{4\alpha^2}{\beta}$ (C) $\tan^{-1}\left(\frac{\beta}{\alpha}\right), \frac{\alpha^2}{\beta}$ (D) $\tan^{-1}\beta, \frac{\alpha^2}{2\beta}$

Q13 Rectilinear Motion[Step-by-step solution](https://www.prepwiser.in/questions/OE7uwc-BYn) > prepwiser.in/questions/OE7uwc-BYn

A scooter accelerates from rest for time t_1 at constant rate a_1 and then retards at constant rate a_2 for time t_2 and comes to rest. The correct value of $\frac{t_1}{t_2}$ will be:

- (A) $\frac{a_1 + a_2}{a_2}$ (B) $\frac{a_1 + a_2}{a_1}$ (C) $\frac{a_2}{a_1}$ (D) $\frac{a_1}{a_2}$

Q14 Elasticity[Step-by-step solution](https://www.prepwiser.in/questions/jF9Qtng9iQ) > prepwiser.in/questions/jF9Qtng9iQ

The length of metallic wire is l_1 when tension in it is T_1 . It is l_2 when the tension is T_2 . The original length of the wire will be:

- (A) $\frac{T_1 l_1 - T_2 l_2}{T_2 - T_1}$ (B) $\frac{l_1 + l_2}{2}$ (C) $\frac{T_2 l_1 + T_1 l_2}{T_1 + T_2}$ (D) $\frac{T_2 l_1 - T_1 l_2}{T_2 - T_1}$

Q15 Rotational Motion[Step-by-step solution](https://www.prepwiser.in/questions/wHRSLJEhUR) > prepwiser.in/questions/wHRSLJEhUR

A cord is wound round the circumference of wheel of radius r. The axis of the wheel is horizontal and the moment of inertia about it is I. A weight mg is attached to the cord at the end. The weight falls from rest. After falling through a distance 'h', the square of angular velocity of wheel will be:

- (A) $\frac{2mgh}{I + 2mr^2}$ (B) $\frac{2mgh}{I + mr^2}$ (C) 2gh (D) $\frac{2gh}{I + mr^2}$

Q16 Simple Harmonic Motion[Step-by-step solution](https://www.prepwiser.in/questions/34oBh-MZBZ) > prepwiser.in/questions/34oBh-MZBZ

A particle executes S.H.M., the graph of velocity as a function of displacement is:

- (A) a parabola (B) a helix (C) an ellipse (D) a circle

Q17 Simple Harmonic Motion[Step-by-step solution](https://www.prepwiser.in/questions/CExEUzJLRK) > prepwiser.in/questions/CExEUzJLRK

Given below are two statements:

Statement I : A second's pendulum has a time period of 1 second.

Statement II : It takes precisely one second to move between the two extreme positions.

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

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

Q18 Sound Waves[Step-by-step solution](https://www.prepwiser.in/questions/oLSpSN2yAb) > prepwiser.in/questions/oLSpSN2yAb

A tuning fork A of unknown frequency produces 5 beats/s with a fork of known frequency 340 Hz. When fork A is filed, the beat frequency decreases to 2 beats/s. What is the frequency of fork A?

- (A) 335 Hz (B) 345 Hz (C) 338 Hz (D) 342 Hz

Q19 Units, Dimensions & Errors[Step-by-step solution](https://www.prepwiser.in/questions/iKtASy6lt-) > prepwiser.in/questions/iKtASy6lt-

If 'C' and 'V' represent capacity and voltage respectively then what are the dimensions of λ where $C/V = \lambda$?

- (A) $[M^{-3}L^{-4}I^3T^7]$ (B) $[M^{-2}L^{-3}I^2T^6]$ (C) $[M^{-2}L^{-4}I^3T^7]$ (D) $[M^{-1}L^{-3}I^{-2}T^{-7}]$

Physics Section B · Numerical value

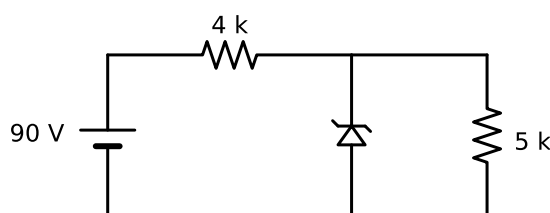
Q20 to Q27

Q20 Dual Nature of Radiation & Matter**NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/QebWJAV_sr) > prepwiser.in/questions/QebWJAV_sr

Two stream of photons, possessing energies equal to twice and ten times the work function of metal are incident on the metal surface successively. The value of ratio of maximum velocities of the photoelectrons emitted in the two respective cases is $x : y$. The value of x is _____.

Q21 Semiconductors & Electronic Devices**NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/Ioj1mmNXRM) > prepwiser.in/questions/Ioj1mmNXRM

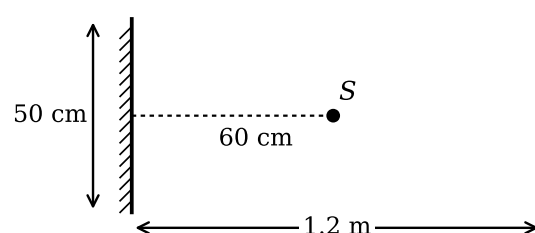
The zener diode has a $V_z = 30V$. The current passing through the diode for the following circuit is _____ mA.

**Q22** Electrostatics II: Potential & Capacitance**NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/7M5dZmjZSR) > prepwiser.in/questions/7M5dZmjZSR

27 similar drops of mercury are maintained at 10V each. All these spherical drops combine into a single big drop. The potential energy of the bigger drop is _____ times that of a smaller drop.

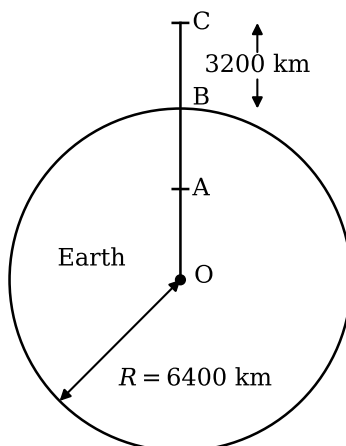
Q23 Ray Optics**NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/OUYgNSpqIR) > prepwiser.in/questions/OUYgNSpqIR

A point source of light S, placed at a distance 60cm in front of the centre of a plane mirror of width 50 cm, hangs vertically on a wall. A man walks in front of the mirror along a line parallel to the mirror at a distance 1.2 m from it (see in the figure). The distance between the extreme points where he can see the image of the light source in the mirror is _____ cm.



Q24 Gravitation **NUMERICAL**[Step-by-step solution](https://www.prepwise.in/questions/TX5zVe5Q9L)

In the reported figure of earth, the value of acceleration due to gravity is same at point A and C but it is smaller than that of its value at point B (surface of the earth). The value of OA : AB will be x : y. The value of x is _____.

**Q25** Thermodynamics **NUMERICAL**[Step-by-step solution](https://www.prepwise.in/questions/q-o1WzVCxK)

1 mole of rigid diatomic gas performs a work of $\frac{Q}{5}$ when heat Q is supplied to it. The molar heat capacity of the gas during this transformation is $\frac{xR}{8}$. The value of x is _____. [R = universal gas constant]

Q26 Thermodynamics **NUMERICAL**[Step-by-step solution](https://www.prepwise.in/questions/Hsmt0cHpXV)

The volume V of a given mass of monoatomic gas changes with temperature T according to the relation $V = KT^{\frac{2}{3}}$. The workdone when temperature changes by 90K will be xR. The value of x is _____. [R = universal gas constant]

Q27 Simple Harmonic Motion **NUMERICAL**[Step-by-step solution](https://www.prepwise.in/questions/mFbVcPoiIA)

A particle executes S.H.M. with amplitude 'a', and time period 'T'. The displacement of the particle when its speed is half of maximum speed is $\frac{\sqrt{x}a}{2}$. The value of x is _____.

Chemistry Section A · Multiple choice

Q28 to Q42

Q28 Practical Organic Chemistry[Step-by-step solution](https://www.prepwise.in/questions/rTILVe6_si)

Ceric ammonium nitrate and $\text{CHCl}_3/\text{alc. KOH}$ are used for the identification of functional groups present in _____ and _____ respectively.

- (A) amine, alcohol (B) alcohol, phenol (C) alcohol, amine (D) amine, phenol

Q29 Practical Organic Chemistry[Step-by-step solution](https://www.prepwise.in/questions/tjcSmX1W0S)

2, 4-DNP test can be used to identify:

- (A) ether (B) amine (C) aldehyde (D) halogens

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Match List - I with List - II.

	List - I		List - II
(a)	Sucrose	(i)	β -D-Galactose and β -D-Glucose
(b)	Lactose	(ii)	α -D-Glucose and β -D-Fructose
(c)	Maltose	(iii)	α -D-Glucose and α -D-Glucose

Choose the correct answer from the options given below:

(A) (a) $\rightarrow$ (iii), (b) $\rightarrow$ (ii), (c) $\rightarrow$ (i)**(B)** (a) $\rightarrow$ (i), (b) $\rightarrow$ (iii), (c) $\rightarrow$ (ii)**(C)** (a) $\rightarrow$ (ii), (b) $\rightarrow$ (i), (c) $\rightarrow$ (iii)**(D)** (a) $\rightarrow$ (iii), (b) $\rightarrow$ (i), (c) $\rightarrow$ (ii)

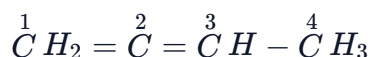
Match List - I with List - II.

	List - I (Molecule)		List - II (Bond order)
(a)	Ne_2	(i)	1
(b)	N_2	(ii)	2
(c)	F_2	(iii)	0
(d)	O_2	(iv)	3

Choose the correct answer from the options given below:

(A) (a) $\rightarrow$ (i), (b) $\rightarrow$ (ii), (c) $\rightarrow$ (iii), (d) $\rightarrow$ (iv)**(B)** (a) $\rightarrow$ (iv), (b) $\rightarrow$ (iii), (c) $\rightarrow$ (ii), (d) $\rightarrow$ (i)**(C)** (a) $\rightarrow$ (iii), (b) $\rightarrow$ (iv), (c) $\rightarrow$ (i), (d) $\rightarrow$ (ii)**(D)** (a) $\rightarrow$ (ii), (b) $\rightarrow$ (i), (c) $\rightarrow$ (iv), (d) $\rightarrow$ (iii)

In



molecule, the hybridization of carbon 1, 2, 3 and 4 respectively, are:

(A) sp^2, sp, sp^2, sp^3 **(B)** sp^2, sp^2, sp^2, sp^3 **(C)** sp^3, sp, sp^3, sp^3 **(D)** sp^2, sp^3, sp^2, sp^3

Match List - I with List - II.

	List - I		List - II
(a)	Sodium Carbonate	(i)	Deacon
(b)	Titanium	(ii)	Castner-Kellner
(c)	Chlorine	(iii)	van-Arkel
(d)	Sodium hydroxide	(iv)	Solvay

Choose the correct answer from the options given below:

(A) (a) $\rightarrow$ (iv), (b) $\rightarrow$ (iii), (c) $\rightarrow$ (i), (d) $\rightarrow$ (ii)**(B)** (a) $\rightarrow$ (iv), (b) $\rightarrow$ (i), (c) $\rightarrow$ (ii), (d) $\rightarrow$ (iii)**(C)** (a) $\rightarrow$ (iii), (b) $\rightarrow$ (ii), (c) $\rightarrow$ (i), (d) $\rightarrow$ (iv)**(D)** (a) $\rightarrow$ (i), (b) $\rightarrow$ (iii), (c) $\rightarrow$ (iv), (d) $\rightarrow$ (ii)Attempt this paper online with instant answer checking › [prepwiser.in/pyqs/paper/2021-02-26-evening](https://www.prepwiser.in/pyqs/paper/2021-02-26-evening)

Match List - I with List - II.

	List - I		List - II
(a)	Siderite	(i)	Cu
(b)	Calamine	(ii)	Ca
(c)	Malachite	(iii)	Fe
(d)	Cryolite	(iv)	Al
		(v)	Zn

Choose the correct answer from the options given below:

(A) (a) → (i), (b) → (ii), (c) → (iii), (d) → (iv)**(B)** (a) → (iii), (b) → (i), (c) → (v), (d) → (ii)**(C)** (a) → (i), (b) → (ii), (c) → (v), (d) → (iii)**(D)** (a) → (iii), (b) → (v), (c) → (i), (d) → (iv)

Calgon is used for water treatment. Which of the following statement is NOT true about Calgon?

(A) It is also known as Graham's salt.**(B)** It is polymeric compound and is water soluble.**(C)** It does not remove Ca^{2+} ion by precipitation.**(D)** Calgon contains the 2nd most abundant element by weight in the Earth's crust.

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

Assertion A : In TlI_3 , isomorphous to CsI_3 , the metal is present in +1 oxidation state.

Reason R : Tl metal has fourteen f electrons in its electronic configuration.

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

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

Which pair of oxides is acidic in nature?

(A) CaO , SiO_2 **(B)** B_2O_3 , CaO **(C)** B_2O_3 , SiO_2 **(D)** N_2O , BaO

The correct order of electron gain enthalpy is:

(A) $\text{Te} > \text{Se} > \text{S} > \text{O}$ **(B)** $\text{S} > \text{Se} > \text{Te} > \text{O}$ **(C)** $\text{S} > \text{O} > \text{Se} > \text{Te}$ **(D)** $\text{O} > \text{S} > \text{Se} > \text{Te}$ Which of the following forms of hydrogen emits low energy β^- particles?**(A)** Tritium ${}^3_1\text{H}$ **(B)** Proton H^+ **(C)** Protium ${}^1_1\text{H}$ **(D)** Deuterium ${}^2_1\text{H}$ Attempt this paper online with instant answer checking › [prepwise.in/pyqs/paper/2021-02-26-evening](https://www.prepwise.in/pyqs/paper/2021-02-26-evening)

Q40 Surface Chemistry[Step-by-step solution](https://www.prepwisar.in/questions/G8YMqZcFY_) › prepwisar.in/questions/G8YMqZcFY_

The nature of charge on resulting colloidal particles when FeCl_3 is added to excess of hot water is:

- (A) neutral (B) sometimes positive and sometimes negative
(C) positive (D) negative

Q41 Amines & Diazonium Salts[Step-by-step solution](https://www.prepwisar.in/questions/dMCJaFQmOw) › prepwisar.in/questions/dMCJaFQmOw

- A. Phenyl methanamine
B. N,N-Dimethylaniline
C. N-Methyl aniline
D. Benzenamine

Choose the correct order of basic nature of the above amines.

- (A) $D > C > B > A$ (B) $A > C > B > D$ (C) $D > B > C > A$ (D) $A > B > C > D$

Q42 Carbohydrates & Biomolecules[Step-by-step solution](https://www.prepwisar.in/questions/NknEF5K65C) › prepwisar.in/questions/NknEF5K65C

Seliwanoff test and Xanthoproteic test are used for the identification of _____ and _____ respectively.

- (A) ketoses, proteins (B) proteins, ketoses (C) aldoses, ketoses (D) ketoses, aldoses

Chemistry Section B · Numerical value

Q43 to Q52

Q43 Chemical Kinetics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/CP9Rp2g2h_) › prepwisar.in/questions/CP9Rp2g2h_

If the activation energy of a reaction is 80.9 kJ mol^{-1} , the fraction of molecules at 700 K , having enough energy to react to form products is e^{-x} . The value of x is _____. (Rounded off to the nearest integer) [Use $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$]

Q44 Coordination Compounds **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/IsP9l6SP-z) › prepwisar.in/questions/IsP9l6SP-z

The number of stereoisomers possible for $[\text{Co}(\text{ox})_2(\text{Br})(\text{NH}_3)]^{2-}$ is _____. [ox = oxalate]

Q45 Redox Reactions **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/5ey4agt7qn) › prepwisar.in/questions/5ey4agt7qn

In mildly alkaline medium, thiosulphate ion is oxidized by MnO_4^- to "A". The oxidation state of sulphur in "A" is _____.

Q46 Electrochemistry **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/qePSDxgpz4) › prepwisar.in/questions/qePSDxgpz4

Emf of the following cell at 298 K in V is $x \times 10^{-2}$.



The value of x is _____. (Rounded off to the nearest integer)

[Given:

$$E_{\text{Zn}^{2+}/\text{Zn}}^{\theta} = -0.76 \text{ V}; E_{\text{Ag}^{2+}/\text{Ag}}^{\theta} = +0.80 \text{ V}; \frac{2.303RT}{F} = 0.059$$

]

Q47 Ionic Equilibrium **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/pDZqjPWC9-) › prepwisar.in/questions/pDZqjPWC9-

The pH of ammonium phosphate solution, if pK_a of phosphoric acid and pK_b of ammonium hydroxide are 5.23 and 4.75 respectively, is _____.

Q48 Solid State **NUMERICAL**[Step-by-step solution](#) > [prepwise.in/questions/_egtfo5Yo1](#)

The number of octahedral voids per lattice site in a lattice is _____. (Rounded off to the nearest integer)

Q49 Solutions & Colligative Properties **NUMERICAL**[Step-by-step solution](#) > [prepwise.in/questions/596FponxWu](#)

When 12.2 g of benzoic acid is dissolved in 100 g of water, the freezing point of solution was found to be -0.93°C ($K_f(\text{H}_2\text{O}) = 1.86 \text{ K kg mol}^{-1}$). The number (n) of benzoic acid molecules associated (assuming 100% association) is _____.

Q50 Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](#) > [prepwise.in/questions/nn-IGFuEwt](#)

The NaNO_3 weighed out to make 50 mL of an aqueous solution containing 70.0 mg Na^+ per mL is _____ g. (Rounded off to the nearest integer)
[Given : Atomic weight in g mol^{-1} - Na : 23; N : 14; O : 16]

Q51 Atomic Structure **NUMERICAL**[Step-by-step solution](#) > [prepwise.in/questions/kXyv9y4uRM](#)

A ball weighing 10 g is moving with a velocity of 90 ms^{-1} . If the uncertainty in its velocity is 5%, then the uncertainty in its position is _____ $\times 10^{-33} \text{ m}$. (Rounded off to the nearest integer)
[Given : $h = 6.63 \times 10^{-34} \text{ Js}$]

Q52 Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](#) > [prepwise.in/questions/X54bSHXqmH](#)

The average S-F bond energy in kJ mol^{-1} of SF_6 is _____. (Rounded off to the nearest integer)
[Given : The values of standard enthalpy of formation of $\text{SF}_6(\text{g})$, $\text{S}(\text{g})$ and $\text{F}(\text{g})$ are - 1100, 275 and 80 kJ mol^{-1} respectively.]

Mathematics Section A · Multiple choice

Q53 to Q70

Q53 Three Dimensional Geometry[Step-by-step solution](#) > [prepwise.in/questions/057o_uKING](#)

If the mirror image of the point (1, 3, 5) with respect to the plane $4x - 5y + 2z = 8$ is (α, β, γ) , then $5(\alpha + \beta + \gamma)$ equals:

- (A) 39 (B) 41 (C) 47 (D) 43

Q54 Three Dimensional Geometry[Step-by-step solution](#) > [prepwise.in/questions/FZmPFWw-Ci](#)

Let L be a line obtained from the intersection of two planes $x + 2y + z = 6$ and $y + 2z = 4$. If point $P(\alpha, \beta, \gamma)$ is the foot of perpendicular from (3, 2, 1) on L, then the value of $21(\alpha + \beta + \gamma)$ equals:

- (A) 102 (B) 142 (C) 136 (D) 68

Q55 Differential Equations[Step-by-step solution](#) > [prepwise.in/questions/WE4M7ApEar](#)

Let slope of the tangent line to a curve at any point $P(x, y)$ be given by $\frac{xy^2 + y}{x}$. If the curve intersects the line $x + 2y = 4$ at $x = -2$, then the value of y, for which the point (3, y) lies on the curve, is:

- (A) $-\frac{18}{19}$ (B) $-\frac{4}{3}$ (C) $\frac{18}{35}$ (D) $-\frac{18}{11}$

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Q56 Circles[Step-by-step solution > prepwiser.in/questions/MbMNtIa7DU](https://www.prepwiser.in/questions/MbMNtIa7DU)

Let $A(1, 4)$ and $B(1, -5)$ be two points. Let P be a point on the circle $(x - 1)^2 + (y - 1)^2 = 1$ such that $(PA)^2 + (PB)^2$ have maximum value, then the points, P , A and B lie on:

- (A) a straight line (B) an ellipse (C) a parabola (D) a hyperbola

Q57 Circles[Step-by-step solution > prepwiser.in/questions/09Wv2BWVzh](https://www.prepwiser.in/questions/09Wv2BWVzh)

If the locus of the mid-point of the line segment from the point $(3, 2)$ to a point on the circle, $x^2 + y^2 = 1$ is a circle of radius r , then r is equal to:

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

Q58 Definite Integration[Step-by-step solution > prepwiser.in/questions/x_oh3z7UEY](https://www.prepwiser.in/questions/x_oh3z7UEY)

Let $f(x) = \int_0^x e^t f(t) dt + e^x$ be a differentiable function for all $x \in \mathbb{R}$. Then $f(x)$ equals:

- (A) $e^{(e^x-1)}$ (B) $2e^{e^x} - 1$ (C) $2e^{e^x-1} - 1$ (D) $e^{e^x} - 1$

Q59 Definite Integration[Step-by-step solution > prepwiser.in/questions/TIsnJe_Uef](https://www.prepwiser.in/questions/TIsnJe_Uef)

For $x > 0$, if $f(x) = \int_1^x \frac{\log_e t}{(1+t)} dt$, then $f(e) + f\left(\frac{1}{e}\right)$ is equal to:

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

Q60 Relations & Functions (Basic)[Step-by-step solution > prepwiser.in/questions/iacAcfBf_V](https://www.prepwiser.in/questions/iacAcfBf_V)

Let $A = \{1, 2, 3, \dots, 10\}$ and $f : A \rightarrow A$ be defined as

$$f(k) = \begin{cases} k+1 & \text{if } k \text{ is odd} \\ k & \text{if } k \text{ is even} \end{cases}$$

Then the number of possible functions $g : A \rightarrow A$ such that $g \circ f = f$ is:

- (A) 5^5 (B) 10^5 (C) $5!$ (D) $^{10}C_5$

Q61 Sequences & Series[Step-by-step solution > prepwiser.in/questions/sNh2p3QpQJ](https://www.prepwiser.in/questions/sNh2p3QpQJ)

If $0 < a, b < 1$, and $\tan^{-1}a + \tan^{-1}b = \frac{\pi}{4}$, then the value of

$$(a+b) - \left(\frac{a^2+b^2}{2}\right) + \left(\frac{a^3+b^3}{3}\right) - \left(\frac{a^4+b^4}{4}\right) + \dots$$

is:

- (A) $\log_e 2$ (B) e (C) $\log_e \left(\frac{e}{2}\right)$ (D) $e^2 = 1$

Q62 Limits[Step-by-step solution > prepwiser.in/questions/qe3W0V89em](https://www.prepwiser.in/questions/qe3W0V89em)

Let $f(x)$ be a differentiable function at $x = a$ with $f'(a) = 2$ and $f(a) = 4$.

Then $\lim_{x \rightarrow a} \frac{xf(a) - af(x)}{x-a}$ equals:

- (A) $4 - 2a$ (B) $2a + 4$ (C) $a + 4$ (D) $2a - 4$

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Q63 Relations & Functions (Basic)[Step-by-step solution](https://www.prepwise.in/questions/48bq5lnHxt) › prepwise.in/questions/48bq5lnHxt

Let $f(x) = \sin^{-1}x$ and $g(x) = \frac{x^2-x-2}{2x^2-x-6}$. If $g(2) = \lim_{x \rightarrow 2} g(x)$, then the domain of the function fog is:

- (A) $(-\infty, -2] \cup [-\frac{4}{3}, \infty)$ (B) $(-\infty, -2] \cup [-1, \infty)$
 (C) $(-\infty, -2] \cup [-\frac{3}{2}, \infty)$ (D) $(-\infty, -1] \cup [2, \infty)$

Q64 Continuity & Differentiability[Step-by-step solution](https://www.prepwise.in/questions/PQINsjN0f3) › prepwise.in/questions/PQINsjN0f3

Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be defined as

$$f(x) = \begin{cases} 2 \sin\left(-\frac{\pi x}{2}\right), & \text{if } x < -1 \\ |ax^2 + x + b|, & \text{if } -1 \leq x \leq 1 \\ \sin(\pi x), & \text{if } x > 1 \end{cases}$$

If $f(x)$ is continuous on $\mathbb{R}$, then $a + b$ equals:

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

Q65 Determinants[Step-by-step solution](https://www.prepwise.in/questions/FH5mhg8O0Z) › prepwise.in/questions/FH5mhg8O0Z

Consider the following system of equations:

$$x + 2y - 3z = a$$

$$2x + 6y - 11z = b$$

$$x - 2y + 7z = c,$$

where a, b and c are real constants. Then the system of equations:

- (A) has no solution for all a, b and c
 (B) has a unique solution when $5a = 2b + c$
 (C) has infinite number of solutions when $5a = 2b + c$
 (D) has a unique solution for all a, b and c

Q66 Permutations & Combinations[Step-by-step solution](https://www.prepwise.in/questions/RIFUEwr0tu) › prepwise.in/questions/RIFUEwr0tu

A natural number has prime factorization given by $n = 2^x 3^y 5^z$, where y and z are such that $y + z = 5$ and $y^{-1} + z^{-1} = \frac{5}{6}$, $y > z$. Then the number of odd divisions of n , including 1, is:

- (A) 11 (B) 6 (C) 12 (D) $6x$

Q67 Probability: Basic[Step-by-step solution](https://www.prepwise.in/questions/zQzTvcMLmf) › prepwise.in/questions/zQzTvcMLmf

A seven digit number is formed using digits 3, 3, 4, 4, 4, 5, 5. The probability, that number so formed is divisible by 2, is:

- (A) $\frac{1}{7}$ (B) $\frac{4}{7}$ (C) $\frac{6}{7}$ (D) $\frac{3}{7}$

Q68 Sequences & Series[Step-by-step solution](https://www.prepwise.in/questions/P-fK4PvcXe) › prepwise.in/questions/P-fK4PvcXe

The sum of the series

$$\sum_{n=1}^{\infty} \frac{n^2 + 6n + 10}{(2n+1)!}$$
 is equal to:

- (A) $\frac{41}{8}e + \frac{19}{8}e^{-1} - 10$ (B) $\frac{41}{8}e - \frac{19}{8}e^{-1} - 10$
 (C) $\frac{41}{8}e + \frac{19}{8}e^{-1} + 10$ (D) $-\frac{41}{8}e + \frac{19}{8}e^{-1} - 10$

Q69 Vectors[Step-by-step solution](https://www.prepwisar.in/questions/t7dM8k9eo3)

If vectors $\vec{a_1} = x\hat{i} - \hat{j} + \hat{k}$ and $\vec{a_2} = \hat{i} + y\hat{j} + z\hat{k}$ are collinear, then a possible unit vector parallel to the vector $x\hat{i} + y\hat{j} + z\hat{k}$ is:

- (A) $\frac{1}{\sqrt{3}} (\hat{i} - \hat{j} + \hat{k})$ (B) $\frac{1}{\sqrt{2}} (-\hat{j} + \hat{k})$ (C) $\frac{1}{\sqrt{2}} (\hat{i} - \hat{j})$ (D) $\frac{1}{\sqrt{3}} (\hat{i} + \hat{j} - \hat{k})$

Q70 Area Under Curves[Step-by-step solution](https://www.prepwisar.in/questions/pf1-C3MkgH)

Let A_1 be the area of the region bounded by the curves $y = \sin x$, $y = \cos x$ and y -axis in the first quadrant. Also, let A_2 be the area of the region bounded by the curves $y = \sin x$, $y = \cos x$, x -axis and $x = \frac{\pi}{2}$ in the first quadrant. Then,

- (A) $A_1 : A_2 = 1 : \sqrt{2}$ and $A_1 + A_2 = 1$ (B) $A_1 = A_2$ and $A_1 + A_2 = \sqrt{2}$
(C) $2A_1 = A_2$ and $A_1 + A_2 = 1 + \sqrt{2}$ (D) $A_1 : A_2 = 1 : 2$ and $A_1 + A_2 = 1$

Mathematics Section B · Numerical value

Q71 to Q80

Q71 Circles **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/bd8MQO3V9u)

Let the normals at all the points on a given curve pass through a fixed point (a, b) . If the curve passes through $(3, -3)$ and $(4, -2\sqrt{2})$, and given that $a - 2\sqrt{2}b = 3$, then $(a^2 + b^2 + ab)$ is equal to _____.

Q72 Quadratic Equations & Polynomial Inequalities **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/Rk2ylWmnLj)

Let a be an integer such that all the real roots of the polynomial $2x^5 + 5x^4 + 10x^3 + 10x^2 + 10x + 10$ lie in the interval $(a, a + 1)$. Then, $|a|$ is equal to _____.

Q73 Complex Numbers **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/T3kLbOF5tz)

Let z be those complex numbers which satisfy

$$|z + 5| \leq 4 \text{ and } z(1 + i) + \bar{z}(1 - i) \geq -10, i = \sqrt{-1}.$$

If the maximum value of $|z + 1|^2$ is $\alpha + \beta\sqrt{2}$, then the value of $(\alpha + \beta)$ is _____.

Q74 Definite Integration **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/n4IbdIXwbX)

If $I_{m,n} = \int_0^1 x^{m-1}(1-x)^{n-1} dx$, for $m, n \geq 1$, and

$$\int_0^1 \frac{x^{m-1} + x^{n-1}}{(1+x)^{m+n}} dx = \alpha I_{m,n}, \alpha \in R$$

, then α equals _____.

Q75 Ellipse **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/X5ujgpEci7)

Let L be a common tangent line to the curves $4x^2 + 9y^2 = 36$ and $(2x)^2 + (2y)^2 = 31$. Then the square of the slope of the line L is _____.

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If the matrix

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 3 & 0 & -1 \end{bmatrix}$$

satisfies the equation

$$A^{20} + \alpha A^{19} + \beta A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

for some real numbers α and β , then $\beta - \alpha$ is equal to _____.

Let α and β be two real numbers such that $\alpha + \beta = 1$ and $\alpha\beta = -1$. Let $p_n = (\alpha)^n + (\beta)^n$, $p_{n-1} = 11$ and $p_{n+1} = 29$ for some integer $n \geq 1$. Then, the value of p_n^2 is _____.

The total number of 4-digit numbers whose greatest common divisor with 18 is 3, is _____.

If the arithmetic mean and geometric mean of the p^{th} and q^{th} terms of the sequence $-16, 8, -4, 2, \dots$ satisfy the equation $4x^2 - 9x + 5 = 0$, then $p + q$ is equal to _____.

Let $X_1, X_2, \dots, X_{18}$ be eighteen observations such

that $\sum_{i=1}^{18} (X_i - \alpha) = 36$ and $\sum_{i=1}^{18} (X_i - \beta)^2 = 90$, where α and β are distinct real numbers. If the standard deviation of these observations is 1, then the value of $|\alpha - \beta|$ is _____.

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Physics

1.	D	2.	D	3.	D	4.	D	5.	D	6.	A	7.	C	8.	C
9.	B	10.	C	11.	D	12.	A	13.	C	14.	D	15.	B	16.	C
17.	B	18.	A	19.	C	20.	1	21.	9	22.	243	23.	150	24.	4
25.	25	26.	60	27.	3										

Chemistry

28.	C	29.	C	30.	C	31.	C	32.	A	33.	A	34.	D	35.	D
36.	C	37.	C	38.	B	39.	A	40.	C	41.	D	42.	A	43.	14
44.	3	45.	6	46.	147	47.	7	48.	1	49.	2	50.	13	51.	1
52.	309														

Mathematics

53.	C	54.	A	55.	A	56.	A	57.	B	58.	C	59.	A	60.	B
61.	A	62.	A	63.	A	64.	C	65.	C	66.	C	67.	D	68.	B
69.	A	70.	A	71.	9	72.	2	73.	48	74.	1	75.	3	76.	4
77.	324	78.	1000	79.	10	80.	4								

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