

JEE MAIN 2021 · QUESTION PAPER

31 Aug 2021 Shift 1

82 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	9 Q20 to Q28
● Chemistry	16 Q29 to Q44	10 Q45 to Q54
● Mathematics	18 Q55 to Q72	10 Q73 to Q82
In this PDF	82 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.

prepwise.in/pyqs/paper/2021-08-31-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? prepwise.in/feedback · Terms: prepwise.in/terms

Q1 Alternating Current

[Step-by-step solution](#) › [prepwisar.in/questions/0oX2x6nG3F](https://www.prepwisar.in/questions/0oX2x6nG3F)

In an ac circuit, an inductor, a capacitor and a resistor are connected in series with $X_L = R = X_C$. Impedance of this circuit is:

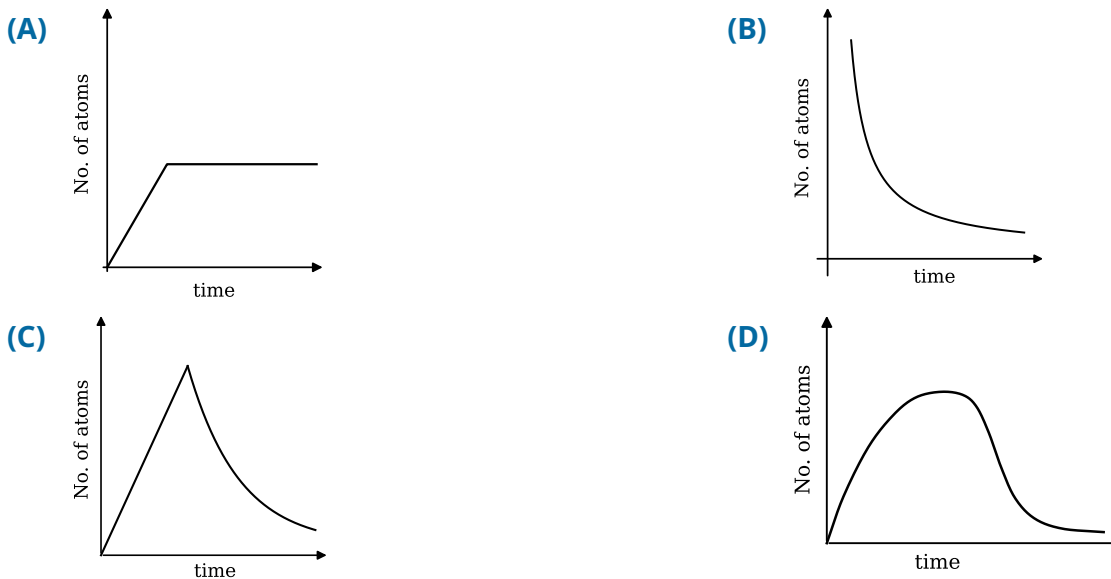
- (A) $2R^2$ (B) Zero (C) R (D) $R\sqrt{2}$

Q2 Nuclear Physics

[Step-by-step solution](#) › [prepwisar.in/questions/bVzIq8rGJN](https://www.prepwisar.in/questions/bVzIq8rGJN)

A sample of a radioactive nucleus A disintegrates to another radioactive nucleus B, which in turn disintegrates to some other stable nucleus C. Plot of a graph showing the variation of number of atoms of nucleus B versus time is:

(Assume that at $t = 0$, there are no B atoms in the sample)



Q3 Collision

[Step-by-step solution](#) › [prepwisar.in/questions/aIW3jkVZj_](https://www.prepwisar.in/questions/aIW3jkVZj_)

A body of mass M moving at speed V_0 collides elastically with a mass ' m ' at rest. After the collision, the two masses move at angles θ_1 and θ_2 with respect to the initial direction of motion of the body of mass M . The largest possible value of the ratio M/m , for which the angles θ_1 and θ_2 will be equal, is:

- (A) 4 (B) 1 (C) 3 (D) 2

Q4 Moving Charges & Magnetism

[Step-by-step solution](#) › [prepwisar.in/questions/2pZWW6gV6j](https://www.prepwisar.in/questions/2pZWW6gV6j)

Consider a galvanometer shunted with 5Ω resistance and 2% of current passes through it. What is the resistance of the given galvanometer?

- (A) 300Ω (B) 344Ω (C) 245Ω (D) 226Ω

Q5 Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwisar.in/questions/6XqXJ_AVtx](https://www.prepwisar.in/questions/6XqXJ_AVtx)

A moving proton and electron have the same de-Broglie wavelength. If K and P denote the K.E. and momentum respectively. Then choose the correct option:

- (A) $K_p < K_e$ and $P_p = P_e$ (B) $K_p = K_e$ and $P_p = P_e$ (C) $K_p < K_e$ and $P_p < P_e$ (D) $K_p > K_e$ and $P_p = P_e$

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Q6 Electromagnetic Induction[Step-by-step solution](https://www.prepwiser.in/questions/n6U_xgt9Zo)

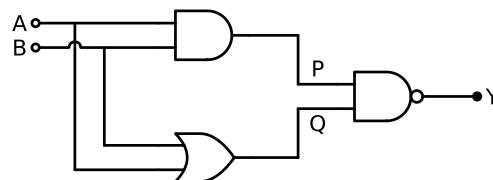
A small square loop of side 'a' and one turn is placed inside a larger square loop of side b and one turn ($b \gg a$). The two loops are coplanar with their centres coinciding. If a current I is passed in the square loop of side 'b', then the coefficient of mutual inductance between the two loops is:

- (A) $\frac{\mu_0}{4\pi} 8\sqrt{2} \frac{a^2}{b}$ (B) $\frac{\mu_0}{4\pi} \frac{8\sqrt{2}}{a}$ (C) $\frac{\mu_0}{4\pi} 8\sqrt{2} \frac{b^2}{a}$ (D) $\frac{\mu_0}{4\pi} \frac{8\sqrt{2}}{b}$

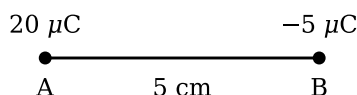
Q7 Semiconductors & Electronic Devices[Step-by-step solution](https://www.prepwiser.in/questions/y_It8isT4i)

In the following logic circuit the sequence of the inputs A, B are (0, 0), (0, 1), (1, 0) and (1, 1). The output Y for this sequence will be:

- (A) 1, 0, 1, 0 (B) 0, 1, 0, 1 (C) 1, 1, 1, 0 (D) 0, 0, 1, 1

**Q8** Electrostatics I: Charges, Field & Gauss's Law[Step-by-step solution](https://www.prepwiser.in/questions/CIDAU7BvHL)

Two particles A and B having charges $20\mu\text{C}$ and $-5\mu\text{C}$ respectively are held fixed with a separation of 5 cm. At what position a third charged particle should be placed so that it does not experience a net electric force?



- (A) At 5 cm from $20\mu\text{C}$ on the left side of system (B) At 5 cm from $-5\mu\text{C}$ on the right side
(C) At 1.25 cm from $-5\mu\text{C}$ between two charges (D) At midpoint between two charges

Q9 Ray Optics[Step-by-step solution](https://www.prepwiser.in/questions/oqOWrDUX-4)

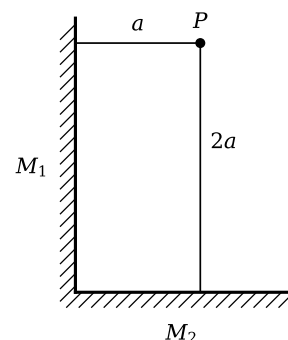
An object is placed at the focus of concave lens having focal length f. What is the magnification and distance of the image from the optical centre of the lens?

- (A) 1, ∞ (B) Very high, ∞ (C) $\frac{1}{2}$, $\frac{f}{2}$ (D) $\frac{1}{4}$, $\frac{f}{4}$

Q10 Ray Optics[Step-by-step solution](https://www.prepwiser.in/questions/4Ff_tFtBe-)

Two plane mirrors M_1 and M_2 are at right angle to each other shown. A point source 'P' is placed at 'a' and '2a' meter away from M_1 and M_2 respectively. The shortest distance between the images thus formed is : (Take $\sqrt{5} = 2.3$)

- (A) 3a (B) 4.6a (C) 2.3a (D) $2\sqrt{10}a$

**Q11** Gravitation[Step-by-step solution](https://www.prepwiser.in/questions/ASpYvAu2ij)

The masses and radii of the earth and moon are (M_1, R_1) and (M_2, R_2) respectively. Their centres are at a distance 'r' apart. Find the minimum escape velocity for a particle of mass 'm' to be projected from the middle of these two masses:

- (A) $V = \frac{1}{2} \sqrt{\frac{4G(M_1+M_2)}{r}}$ (B) $V = \sqrt{\frac{4G(M_1+M_2)}{r}}$ (C) $V = \frac{1}{2} \sqrt{\frac{2G(M_1+M_2)}{r}}$ (D) $V = \frac{\sqrt{2G(M_1+M_2)}}{r}$

Q12 Thermodynamics[Step-by-step solution](https://www.prepwisar.in/questions/vwSz4eChrZ) › prepwisar.in/questions/vwSz4eChrZ

A reversible engine has an efficiency of $\frac{1}{4}$. If the temperature of the sink is reduced by 58°C , its efficiency becomes double. Calculate the temperature of the sink:

- (A) 174 K (B) 280°C (C) 180.4°C (D) 382°C

Q13 Thermodynamics[Step-by-step solution](https://www.prepwisar.in/questions/4-5zP6_ejb) › prepwisar.in/questions/4-5zP6_ejb

For an ideal gas the instantaneous change in pressure 'p' with volume 'v' is given by the equation $\frac{dp}{dv} = -ap$. If $p = p_0$ at $v = 0$ is the given boundary condition, then the maximum temperature one mole of gas can attain is : (Here R is the gas constant)

- (A) $\frac{p_0}{aeR}$ (B) $\frac{ap_0}{eR}$ (C) infinity (D) 0°C

Q14 Moving Charges & Magnetism[Step-by-step solution](https://www.prepwisar.in/questions/h3tRve-IXi) › prepwisar.in/questions/h3tRve-IXi

A coil having N turns is wound tightly in the form of a spiral with inner and outer radii 'a' and 'b' respectively. Find the magnetic field at centre, when a current I passes through coil:

- (A) $\frac{\mu_0 IN}{2(b-a)} \log_e \left(\frac{b}{a} \right)$ (B) $\frac{\mu_0 I}{8} \left[\frac{a+b}{a-b} \right]$ (C) $\frac{\mu_0 I}{4(a-b)} \left[\frac{1}{a} - \frac{1}{b} \right]$ (D) $\frac{\mu_0 I}{8} \left(\frac{a-b}{a+b} \right)$

Q15 Projectile Motion & Relative Motion[Step-by-step solution](https://www.prepwisar.in/questions/IC6Yo-G3jm) › prepwisar.in/questions/IC6Yo-G3jm

A helicopter is flying horizontally with a speed 'v' at an altitude 'h' has to drop a food packet for a man on the ground. What is the distance of helicopter from the man when the food packet is dropped?

- (A) $\sqrt{\frac{2ghv^2 + 1}{h^2}}$ (B) $\sqrt{2ghv^2 + h^2}$ (C) $\sqrt{\frac{2v^2h}{g} + h^2}$ (D) $\sqrt{\frac{2gh}{v^2} + h^2}$

Q16 Elasticity[Step-by-step solution](https://www.prepwisar.in/questions/-APDqSxVcp) › prepwisar.in/questions/-APDqSxVcp

A uniform heavy rod of weight 10 kg ms^{-2} , cross-sectional area 100 cm^2 and length 20 cm is hanging from a fixed support. Young modulus of the material of the rod is $2 \times 10^{11} \text{ Nm}^{-2}$. Neglecting the lateral contraction, find the elongation of rod due to its own weight.

- (A) $2 \times 10^{-9} \text{ m}$ (B) $5 \times 10^{-8} \text{ m}$ (C) $4 \times 10^{-8} \text{ m}$ (D) $5 \times 10^{-10} \text{ m}$

Q17 Rotational Motion[Step-by-step solution](https://www.prepwisar.in/questions/Sef8-VjmId) › prepwisar.in/questions/Sef8-VjmId

Angular momentum of a single particle moving with constant speed along circular path:

- (A) changes in magnitude but remains same in the direction
(B) remains same in magnitude and direction
(C) remains same in magnitude but changes in the direction
(D) is zero

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Match List - I with List - II.

	List - I		List - II
(a)	Torque	(i)	MLT^{-1}
(b)	Impulse	(ii)	MT^{-2}
(c)	Tension	(iii)	ML^2T^{-2}
(d)	Surface Tension	(iv)	MLT^{-2}

Choose the most appropriate answer from the option given below:

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

Which of the following equations is dimensionally incorrect?

Where t = time, h = height, s = surface tension, θ = angle, ρ = density, a, r = radius, g = acceleration due to gravity, v = volume, p = pressure, W = work done, T = torque, ϵ = permittivity, E = electric field, J = current density, L = length.

(A) $v = \frac{\pi p a^4}{8 \eta L}$

(B) $h = \frac{2s \cos \theta}{\rho r g}$

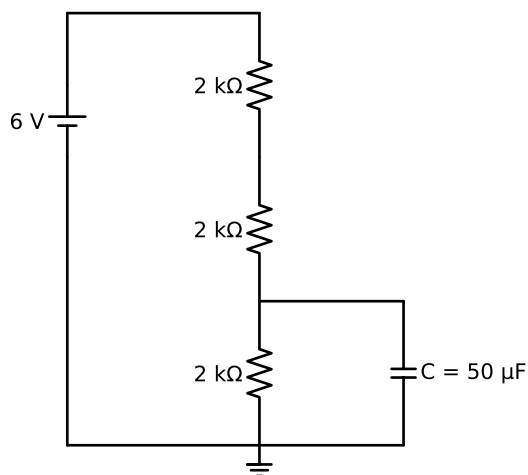
(C) $J = \epsilon \frac{\partial E}{\partial t}$

(D) $W = \Gamma \theta$

Physics Section B · Numerical value

Q20 to Q28

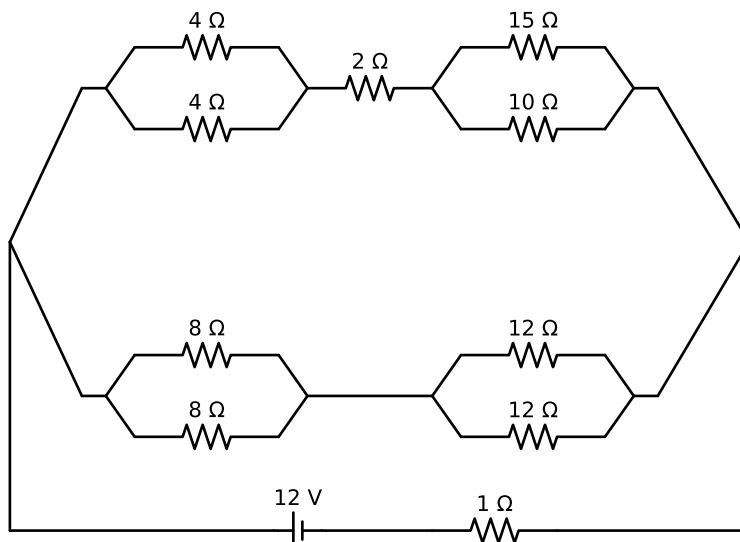
A capacitor of $50 \mu\text{F}$ is connected in a circuit as shown in figure. The charge on the upper plate of the capacitor is _____ μC .



A square shaped wire with resistance of each side 3Ω is bent to form a complete circle. The resistance between two diametrically opposite points of the circle in unit of Ω will be _____.

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The voltage drop across 15Ω resistance in the given figure will be _____ V.



The electric field in an electromagnetic wave is given by $E = (50 \text{ NC}^{-1}) \sin \omega (t - x/c)$

The energy contained in a cylinder of volume V is $5.5 \times 10^{-12} \text{ J}$. The value of V is _____ cm^3 .
(given $\epsilon_0 = 8.8 \times 10^{-12} \text{ C}^2 \text{N}^{-1} \text{m}^{-2}$)

A car is moving on a plane inclined at 30° to the horizontal with an acceleration of 10 ms^{-2} parallel to the plane upward. A bob is suspended by a string from the roof of the car. The angle in degrees which the string makes with the vertical is _____. (Take $g = 10 \text{ ms}^{-2}$)

When a rubber ball is taken to a depth of _____ m in deep sea, its volume decreases by 0.5%.
(The bulk modulus of rubber = $9.8 \times 10^8 \text{ Nm}^{-2}$, Density of sea water = 10^3 kgm^{-3} , $g = 9.8 \text{ m/s}^2$)

A particle of mass 1 kg is hanging from a spring of force constant 100 Nm^{-1} . The mass is pulled slightly downward and released so that it executes free simple harmonic motion with time period T . The time when the kinetic energy and potential energy of the system will become equal, is $\frac{T}{x}$. The value of x is _____.

A wire having a linear mass density $9.0 \times 10^{-4} \text{ kg/m}$ is stretched between two rigid supports with a tension of 900 N. The wire resonates at a frequency of 500 Hz. The next higher frequency at which the same wire resonates is 550 Hz. The length of the wire is _____ m.

A block moving horizontally on a smooth surface with a speed of 40 ms^{-1} splits into two equal parts. If one of the parts moves at 60 ms^{-1} in the same direction, then the fractional change in the kinetic energy will be $x : 4$ where $x =$ _____.

Q29 Hydrocarbons: Alkenes & Alkynes[Step-by-step solution](https://www.prepwisar.in/questions/vX26z4RGr7) > prepwisar.in/questions/vX26z4RGr7

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

Assertion (A) : Treatment of bromine water with propene yields 1-bromopropan-2-ol.

Reason (R) : Attack of water on bromonium ion follows Markovnikov rule and results in 1-bromopropan-2-ol.

In the light of the above statements, choose the most appropriate 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) Both (A) and (R) are true and (R) is the correct explanation of (A)
(D) (A) is true but (R) is false

Q30 Carbohydrates & Biomolecules[Step-by-step solution](https://www.prepwisar.in/questions/yQNM2ZFtZt) > prepwisar.in/questions/yQNM2ZFtZt

Which one of the following compounds contains β -C₁-C₄ glycosidic linkage?

- (A) Lactose (B) Sucrose (C) Maltose (D) Amylose

Q31 Coordination Compounds[Step-by-step solution](https://www.prepwisar.in/questions/g8bmR0SEw8) > prepwisar.in/questions/g8bmR0SEw8

The denticity of an organic ligand, biuret is:

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

Q32 d & f Block Elements[Step-by-step solution](https://www.prepwisar.in/questions/GucdRUZRpI) > prepwisar.in/questions/GucdRUZRpI

In the structure of the dichromate ion, there is a:

- (A) linear symmetrical Cr-O-Cr bond. (B) non-linear symmetrical Cr-O-Cr bond.
(C) linear unsymmetrical Cr-O-Cr bond. (D) non-linear unsymmetrical Cr-O-Cr bond.

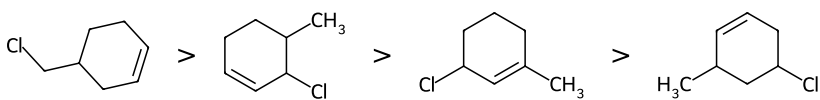
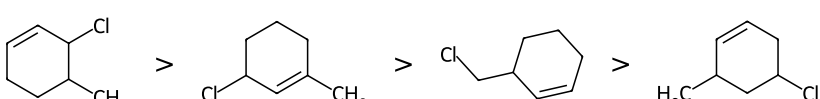
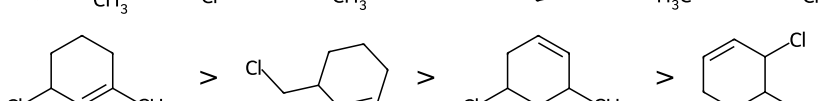
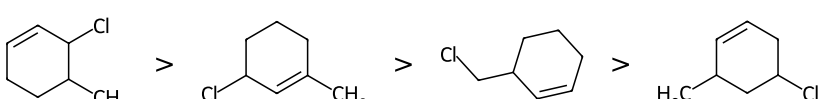
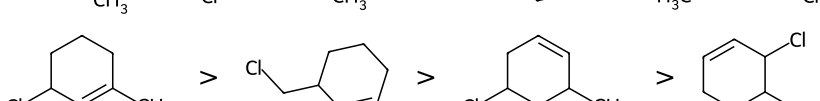
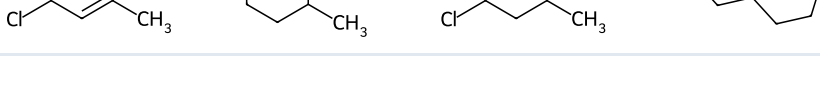
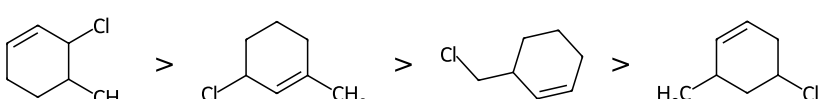
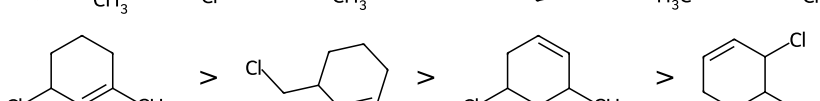
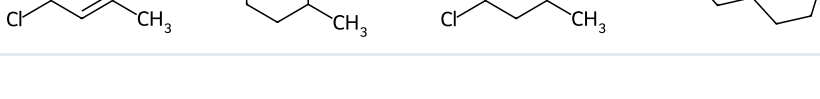
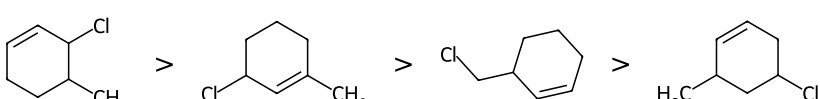
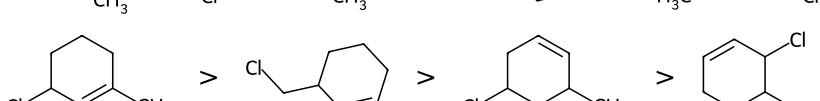
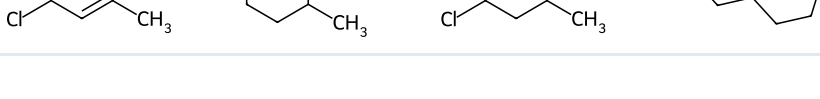
Q33 d & f Block Elements[Step-by-step solution](https://www.prepwisar.in/questions/EFdhIj29x-) > prepwisar.in/questions/EFdhIj29x-

Which one of the following lanthanides exhibits +2 oxidation state with diamagnetic nature? (Given Z for Nd = 60, Yb = 70, La = 57, Ce = 58)

- (A) Nd (B) Yb (C) La (D) Ce

Q34 Halogen Derivatives: Haloalkanes & Haloarenes[Step-by-step solution](https://www.prepwisar.in/questions/q2O5VryYgK) > prepwisar.in/questions/q2O5VryYgK

The correct order of reactivity of the given chlorides with acetate in acetic acid is:

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

Given below are two statements:

Statement I : The process of producing syn-gas is called gasification of coal.

Statement II : The composition of syn-gas is $\text{CO} + \text{CO}_2 + \text{H}_2$ (1 : 1 : 1)

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

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

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

Assertion (A) : Aluminium is extracted from bauxite by the electrolysis of molten mixture of Al_2O_3 with cryolite.

Reason (R) : The oxidation state of Al in cryolite is +3.

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

- (A) (A) is true but (R) is false.
(B) (A) is false but (R) is true.
(C) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(D) Both (A) and (R) are correct but (R) is not 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) : Metallic character decreases and non-metallic character increases on moving from left to right in a period.

Reason (R) : It is due to increase in ionisation enthalpy and decrease in electron gain enthalpy, when one moves from left to right in a period.

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

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

Monomer of Novolac is:

- (A) 3-Hydroxybutanoic acid (B) phenol and melamine
(C) o-Hydroxymethylphenol (D) 1, 3-Butadiene and styrene

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The major component/ingredient of Portland Cement is:

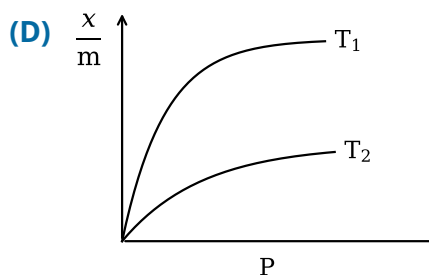
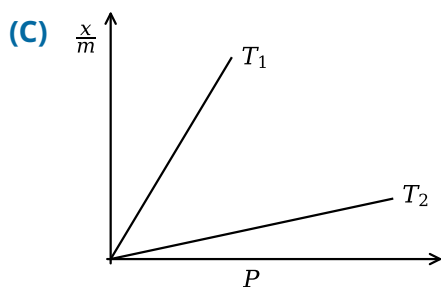
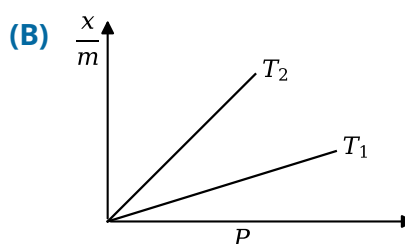
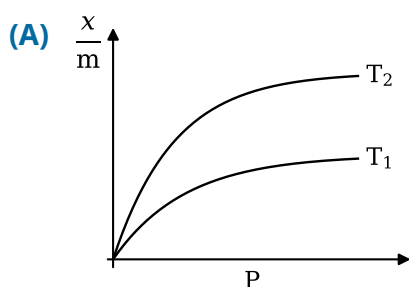
- (A) tricalcium aluminate (B) tricalcium silicate
(C) dicalcium aluminate (D) dicalcium silicate

Which one of the following 0.10 M aqueous solutions will exhibit the largest freezing point depression?

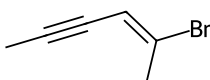
- (A) hydrazine (B) glucose (C) glycine (D) KHSO_4

Select the graph that correctly describes the adsorption isotherms at two temperatures T_1 , and T_2 ($T_1 > T_2$) for a gas:

(x - mass of the gas absorbed; m - mass of adsorbent; P - pressure)



Choose the correct name for compound given below:



- (A) (4E)-5-Bromo-hex-4-en-2-yne (B) (2E)-2-Bromo-hex-4-yn-2-ene
(C) (2E)-2-Bromo-hex-2-en-4-yne (D) (4E)-5-Bromo-hex-2-en-4-yne

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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) : A simple distillation can be used to separate a mixture of propanol and propanone.

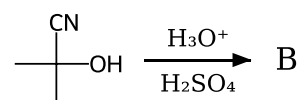
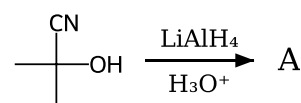
Reason (R) : Two liquids with a difference of more than 20° in their boiling points can be separated by simple distillations.

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

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

The major products A and B in the following set of reactions are:

- (A) $A = \begin{array}{c} \text{OH} \\ | \\ \text{---} \text{C} \text{---} \\ | \\ \text{CHO} \end{array}$, $B = \begin{array}{c} \text{OH} \\ | \\ \text{---} \text{C} \text{---} \\ | \\ \text{COOH} \end{array}$
 (B) $A = \text{H}_2\text{N}-\text{CH}_2-\text{C}(\text{OH})(\text{CH}_3)_2$, $B = \begin{array}{c} \text{COOH} \\ | \\ \text{---} \text{C} \text{---} \\ | \\ \text{CH}_2 \end{array}$
 (C) $A = \text{HO}-\text{CH}_2-\text{C}(\text{OH})(\text{CH}_3)_2$, $B = \begin{array}{c} \text{CHO} \\ | \\ \text{---} \text{C} \text{---} \\ | \\ \text{OH} \end{array}$
 (D) $A = \text{H}_2\text{N}-\text{CH}_2-\text{C}(\text{OH})(\text{CH}_3)_2$, $B = \begin{array}{c} \text{OH} \\ | \\ \text{---} \text{C} \text{---} \\ | \\ \text{CHO} \end{array}$



Chemistry Section B · Numerical value

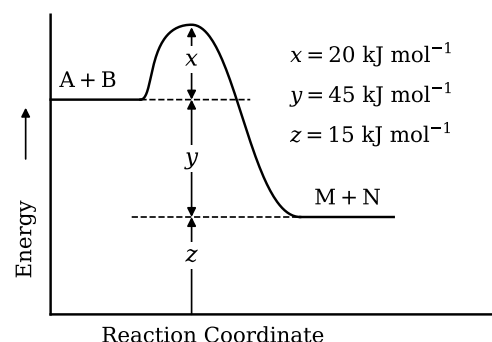
Q45 to Q54

The number of hydrogen bonded water molecule(s) associated with stoichiometry $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is _____.

For a first order reaction, the ratio of the time for 75% completion of a reaction to the time for 50% completion is _____. (Integer answer)

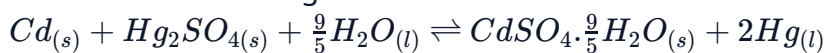
According to the following figure, the magnitude of the enthalpy change of the reaction

$A + B \rightarrow M + N$ in kJ mol^{-1} is equal to _____. (Integer answer)



Q48 Electrochemistry **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/zreZsxWxEf) > prepwiser.in/questions/zreZsxWxEf

Consider the following cell reaction:



The value of E_{cell}^0 is 4.315 V at 25°C. If $\Delta H^\circ = -825.2 \text{ kJ mol}^{-1}$, the standard entropy change ΔS° in J K^{-1} is _____. (Nearest integer) [Given : Faraday constant = 96487 C mol^{-1}]

Q49 Ionic Equilibrium **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/KJEIDeeqCi) > prepwiser.in/questions/KJEIDeeqCi

A_3B_2 is a sparingly soluble salt of molar mass $M \text{ (g mol}^{-1}\text{)}$ and solubility $x \text{ g L}^{-1}$. The solubility product satisfies $K_{sp} = a\left(\frac{x}{M}\right)^5$. The value of a is _____. (Integer answer)

Q50 Qualitative Analysis: Salt Analysis **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/iLxtjC9J-c) > prepwiser.in/questions/iLxtjC9J-c

Consider the sulphides HgS , PbS , CuS , Sb_2S_3 , As_2S_3 and CdS . Number of these sulphides soluble in 50% HNO_3 is _____.

Q51 p-Block Elements: Part II (Group 15-18) **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/hsDW4hhPP4) > prepwiser.in/questions/hsDW4hhPP4

The number of halogen/(s) forming halic (V) acid is _____.

Q52 Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/kHI1ZKjNIV) > prepwiser.in/questions/kHI1ZKjNIV

The molarity of the solution prepared by dissolving 6.3 g of oxalic acid ($H_2C_2O_4 \cdot 2H_2O$) in 250 mL of water in mol L^{-1} is $x \times 10^{-2}$. The value of x is _____. (Nearest integer) [Atomic mass : H : 1.0, C : 12.0, O : 16.0]

Q53 Atomic Structure **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/dCDUvf9fva) > prepwiser.in/questions/dCDUvf9fva

$Ge(Z = 32)$ in its ground state electronic configuration has x completely filled orbitals with $m_l = 0$. The value of x is _____.

Q54 Amines & Diazonium Salts **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/LHHwcYHN96) > prepwiser.in/questions/LHHwcYHN96

The total number of reagents from those given below, that can convert nitrobenzene into aniline is _____. (Integer answer)

I. $Sn - HCl$

II. $Sn - NH_4OH$

III. $Fe - HCl$

IV. $Zn - HCl$

V. $H_2 - Pd$

VI. $H_2 - \text{Raney Nickel}$

Mathematics Section A · Multiple choice

Q55 to Q72

Q55 Three Dimensional Geometry[Step-by-step solution](https://www.prepwiser.in/questions/WrT9qRY-Z2) > prepwiser.in/questions/WrT9qRY-Z2

Let the equation of the plane, that passes through the point $(1, 4, -3)$ and contains the line of intersection of the

planes $3x - 2y + 4z - 7 = 0$

and $x + 5y - 2z + 9 = 0$, be

$\alpha x + \beta y + \gamma z + 3 = 0$, then $\alpha + \beta + \gamma$ is equal to:

(A) -23

(B) -15

(C) 23

(D) 15

The number of real roots of the equation

$$e^{4x} + 2e^{3x} - e^x - 6 = 0 \text{ is:}$$

- (A) 2 (B) 4 (C) 1 (D) 0

Let f be a non-negative function in $[0, 1]$ and twice differentiable in $(0, 1)$. If

$$\int_0^x \sqrt{1 - (f'(t))^2} dt = \int_0^x f(t) dt, 0 \leq x \leq 1 \text{ and } f(0) = 0, \text{ then } \lim_{x \rightarrow 0} \frac{1}{x^2} \int_0^x f(t) dt:$$

- (A) equals 0 (B) equals 1 (C) does not exist (D) equals $\frac{1}{2}$

If $\frac{dy}{dx} = \frac{2^{x+y} - 2^x}{2^y}$, $y(0) = 1$, then $y(1)$ is equal to:

- (A) $\log_2(2 + e)$ (B) $\log_2(1 + e)$ (C) $\log_2(2e)$ (D) $\log_2(1 + e^2)$

The line $12x \cos \theta + 5y \sin \theta = 60$ is tangent to which of the following curves?

- (A) $x^2 + y^2 = 169$ (B) $144x^2 + 25y^2 = 3600$ (C) $25x^2 + 12y^2 = 3600$ (D) $x^2 + y^2 = 60$

The function

$$f(x) = |x^2 - 2x - 3| \cdot e^{|9x^2 - 12x + 4|}$$

is not differentiable at exactly:

- (A) four points (B) three points (C) two points (D) one point

If the function

$$f(x) = \begin{cases} \frac{1}{x} \log_e \left(\frac{1+\frac{x}{a}}{1-\frac{x}{b}} \right) & , \quad x < 0 \\ k & , \quad x = 0 \\ \frac{\cos^2 x - \sin^2 x - 1}{\sqrt{x^2 + 1} - 1} & , \quad x > 0 \end{cases}$$

is continuous

at $x = 0$, then $\frac{1}{a} + \frac{1}{b} + \frac{4}{k}$ is equal to:

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

$$\lim_{x \rightarrow 0} \frac{\sin^2(\pi \cos^4 x)}{x^4}$$

is equal to:

- (A) π^2 (B) $2\pi^2$ (C) $4\pi^2$ (D) 4π

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Q63 Determinants[Step-by-step solution](#) › [prepwisar.in/questions/EYMerWGakK](https://www.prepwisar.in/questions/EYMerWGakK)

If the following system of linear equations

$$2x + y + z = 5$$

$$x - y + z = 3$$

$$x + y + az = b$$

has no solution, then:

- (A) $a = -\frac{1}{3}, b \neq \frac{7}{3}$ (B) $a \neq \frac{1}{3}, b = \frac{7}{3}$ (C) $a \neq -\frac{1}{3}, b = \frac{7}{3}$ (D) $a = \frac{1}{3}, b \neq \frac{7}{3}$

Q64 Determinants[Step-by-step solution](#) › [prepwisar.in/questions/sG85C0fR7G](https://www.prepwisar.in/questions/sG85C0fR7G)

If $a_r = \cos \frac{2r\pi}{9} + i \sin \frac{2r\pi}{9}$, $r = 1, 2, 3, \dots, i = \sqrt{-1}$, then the determinant

$$\begin{vmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_7 & a_8 & a_9 \end{vmatrix}$$

is equal to:

- (A) $a_2a_6 - a_4a_8$ (B) a_9 (C) $a_1a_9 - a_3a_7$ (D) a_5

Q65 Parabola[Step-by-step solution](#) › [prepwisar.in/questions/Mh7Is3Nk0t](https://www.prepwisar.in/questions/Mh7Is3Nk0t)

The length of the latus rectum of a parabola, whose vertex and focus are on the positive x-axis at a distance R and S ($S > R$) respectively from the origin, is:

- (A) $4(S + R)$ (B) $2(S - R)$ (C) $4(S - R)$ (D) $2(S + R)$

Q66 Trigonometric Ratios & Identities[Step-by-step solution](#) › [prepwisar.in/questions/T7fIJ8h3kL](https://www.prepwisar.in/questions/T7fIJ8h3kL)

$\operatorname{cosec} 18^\circ$ is a root of the equation:

- (A) $x^2 + 2x - 4 = 0$ (B) $4x^2 + 2x - 1 = 0$ (C) $x^2 - 2x + 4 = 0$ (D) $x^2 - 2x - 4 = 0$

Q67 Sequences & Series[Step-by-step solution](#) › [prepwisar.in/questions/i5ynfhpY12](https://www.prepwisar.in/questions/i5ynfhpY12)

The sum of 10 terms of the series

$$\frac{3}{1^2 \times 2^2} + \frac{5}{2^2 \times 3^2} + \frac{7}{3^2 \times 4^2} + \dots$$

is:

- (A) 1 (B) $\frac{120}{121}$ (C) $\frac{99}{100}$ (D) $\frac{143}{144}$

Q68 Sequences & Series[Step-by-step solution](#) › [prepwisar.in/questions/jBLhzVFROr](https://www.prepwisar.in/questions/jBLhzVFROr)

Three numbers are in an increasing geometric progression with common ratio r . If the middle number is doubled, then the new numbers are in an arithmetic progression with common difference d . If the fourth term of GP is $3r^2$, then $r^2 - d$ is equal to:

- (A) $7 - 7\sqrt{3}$ (B) $7 + \sqrt{3}$ (C) $7 - \sqrt{3}$ (D) $7 + 3\sqrt{3}$

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Which of the following is not correct for relation R on the set of real numbers?

- (A) $(x, y) \in R \Leftrightarrow 0 < |x| - |y| \leq 1$ is neither transitive nor symmetric.
 (B) $(x, y) \in R \Leftrightarrow 0 < |x - y| \leq 1$ is symmetric and transitive.
 (C) $(x, y) \in R \Leftrightarrow |x| - |y| \leq 1$ is reflexive but not symmetric.
 (D) $(x, y) \in R \Leftrightarrow |x - y| \leq 1$ is reflexive and symmetric.

Let $\vec{a}$ and $\vec{b}$ be two vectors such that

$$|2\vec{a} + 3\vec{b}| = |3\vec{a} + \vec{b}|$$

and the angle between $\vec{a}$ and $\vec{b}$ is 60° . If $\frac{1}{8}\vec{a}$ is a unit vector, then $|\vec{b}|$ is equal to:

- (A) 4 (B) 6 (C) 5 (D) 8

If p and q are the lengths of the perpendiculars from the origin on the lines,
 $x \operatorname{cosec} \alpha - y \sec \alpha = k \cot 2\alpha$ and
 $x \sin \alpha + y \cos \alpha = k \sin 2\alpha$
 respectively, then k^2 is equal to:

- (A) $4p^2 + q^2$ (B) $2p^2 + q^2$ (C) $p^2 + 2q^2$ (D) $p^2 + 4q^2$

The integral $\int \frac{1}{\sqrt[4]{(x-1)^3(x+2)^5}} dx$ is equal to : (where C is a constant of integration)

- (A) $\frac{3}{4} \left(\frac{x+2}{x-1} \right)^{\frac{1}{4}} + C$ (B) $\frac{3}{4} \left(\frac{x+2}{x-1} \right)^{\frac{5}{4}} + C$ (C) $\frac{4}{3} \left(\frac{x-1}{x+2} \right)^{\frac{1}{4}} + C$ (D) $\frac{4}{3} \left(\frac{x-1}{x+2} \right)^{\frac{5}{4}} + C$

Mathematics Section B · Numerical value

Q73 to Q82

The square of the distance of the point of intersection

of the line $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z+1}{6}$ and the plane $2x - y + z = 6$ from the point $(-1, -1, 2)$ is _____.

If 'R' is the least value of 'a' such that the function $f(x) = x^2 + ax + 1$ is increasing on $[1, 2]$ and 'S' is the greatest value of 'a' such that the function $f(x) = x^2 + ax + 1$ is decreasing on $[1, 2]$, then the value of $|R - S|$ is _____.

If $\left(\frac{3^6}{4^4}\right)k$ is the term, independent of x, in the binomial expansion of $\left(\frac{x}{4} - \frac{12}{x^2}\right)^{12}$, then k is equal to _____.

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Q76 Circles **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/P6t9zkRdNK) › prepwisar.in/questions/P6t9zkRdNK

If the variable line $3x + 4y = \alpha$ lies between the two circles $(x - 1)^2 + (y - 1)^2 = 1$ and $(x - 9)^2 + (y - 1)^2 = 4$, without intercepting a chord on either circle, then the sum of all the integral values of α is _____.

Q77 Complex Numbers **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/XYN4p1VK4F) › prepwisar.in/questions/XYN4p1VK4F

A point z moves in the complex plane such that $\arg\left(\frac{z-2}{z+2}\right) = \frac{\pi}{4}$, then the minimum value of $|z - 9\sqrt{2} - 2i|^2$ is equal to _____.

Q78 Definite Integration **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/dC-eSk2zIc) › prepwisar.in/questions/dC-eSk2zIc

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

8. $\int_{-\frac{1}{2}}^1 ([2x] + |x|) dx$ is _____.

Q79 Differential Equations **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/6h6BVOrcK5) › prepwisar.in/questions/6h6BVOrcK5

If $x\phi(x) = \int_5^x (3t^2 - 2\phi'(t)) dt$, $x > -2$, and $\phi(0) = 4$, then $\phi(2)$ is _____.

Q80 Permutations & Combinations **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/V37JZbXOmQ) › prepwisar.in/questions/V37JZbXOmQ

The number of six letter words (with or without meaning), formed using all the letters of the word 'VOWELS', so that all the consonants never come together, is _____.

Q81 Probability: Advanced **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/i65IHSXgRd) › prepwisar.in/questions/i65IHSXgRd

An electric instrument consists of two units. Each unit must function independently for the instrument to operate. The probability that the first unit functions is 0.9 and that of the second unit is 0.8. The instrument is switched on and it fails to operate. If the probability that only the first unit failed and second unit is functioning is p , then $98p$ is equal to _____.

Q82 Statistics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/puZLAB5Kwv) › prepwisar.in/questions/puZLAB5Kwv

The mean of 10 numbers $7 \times 8, 10 \times 10, 13 \times 12, 16 \times 14, \dots$ is _____.

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Physics

1.	C	2.	D	3.	C	4.	C	5.	A	6.	A	7.	C	8.	B	9.	C	10.	B
11.	B	12.	A	13.	A	14.	A	15.	C	16.	D	17.	B	18.	A	19.	A	20.	100
21.	3	22.	6	23.	500	24.	30	25.	500	26.	8	27.	10	28.	1				

Chemistry

29.	C	30.	A	31.	A	32.	B	33.	B	34.	D	35.	B	36.	D	37.	B	38.	C
39.	B	40.	D	41.	A	42.	C	43.	D	44.	B	45.	1	46.	2	47.	45	48.	25
49.	108	50.	4	51.	3	52.	20	53.	7	54.	5								

Mathematics

55.	A	56.	C	57.	D	58.	B	59.	B	60.	C	61.	A	62.	C	63.	D	64.	C
65.	C	66.	D	67.	B	68.	B	69.	B	70.	C	71.	A	72.	C	73.	61	74.	2
75.	55	76.	165	77.	98	78.	5	79.	4	80.	576	81.	28	82.	398				

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