

JEE MAIN 2023 · QUESTION PAPER

6 Apr 2023 Shift 1

84 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	10 Q20 to Q29
● Chemistry	17 Q30 to Q46	10 Q47 to Q56
● Mathematics	18 Q57 to Q74	10 Q75 to Q84
In this PDF	84 questions · answer key at the end	

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

Attempt this paper online

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

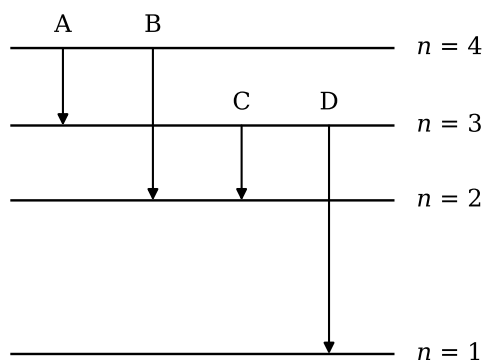
prepwisar.in/pyqs/paper/2023-04-06-morning · Free, no signup needed to start

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

Q1 Atomic Physics

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

The energy levels of an hydrogen atom are shown below. The transition corresponding to emission of shortest wavelength is:



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

Q2 Circular Motion

[Step-by-step solution](#) › [prepwiser.in/questions/F8aQ6_YK_I](https://www.prepwiser.in/questions/F8aQ6_YK_I)

A particle is moving with constant speed in a circular path. When the particle turns by an angle 90° , the ratio of instantaneous velocity to its average velocity is $\pi : x\sqrt{2}$. The value of x will be -

- (A) 1 (B) 7 (C) 5 (D) 2

Q3 Circular Motion

[Step-by-step solution](#) › [prepwiser.in/questions/f4xutS2FEB](https://www.prepwiser.in/questions/f4xutS2FEB)

A small block of mass 100g is tied to a spring of spring constant 7.5N/m and length 20cm. The other end of spring is fixed at a particular point A. If the block moves in a circular path on a smooth horizontal surface with constant angular velocity 5rad/s about point A, then tension in the spring is -

- (A) 0.50 N (B) 1.5 N (C) 0.75 N (D) 0.25 N

Q4 Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwiser.in/questions/DZWZwM3BMK](https://www.prepwiser.in/questions/DZWZwM3BMK)

The kinetic energy of an electron, α -particle and a proton are given as $4K$, $2K$ and K respectively. The de-Broglie wavelength associated with electron (λ_e), α -particle (λ_α) and the proton (λ_p) are as follows:

- (A) $\lambda_\alpha < \lambda_p < \lambda_e$ (B) $\lambda_\alpha > \lambda_p > \lambda_e$ (C) $\lambda_\alpha = \lambda_p < \lambda_e$ (D) $\lambda_\alpha = \lambda_p > \lambda_e$

Q5 Electromagnetic Induction

[Step-by-step solution](#) › [prepwiser.in/questions/o2-lvnqyxt](https://www.prepwiser.in/questions/o2-lvnqyxt)

The induced emf can be produced in a coil by

- A. moving the coil with uniform speed inside uniform magnetic field
- B. moving the coil with non uniform speed inside uniform magnetic field
- C. rotating the coil inside the uniform magnetic field
- D. changing the area of the coil inside the uniform magnetic field

Choose the correct answer from the options given below:

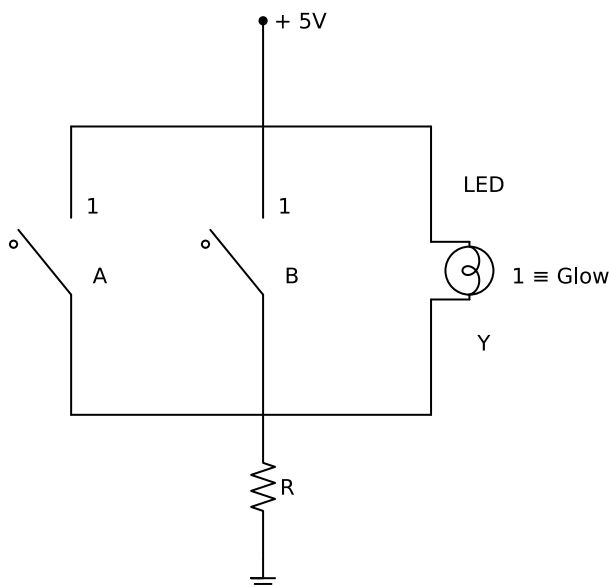
- (A) A and C only (B) C and D only (C) B and D only (D) B and C only

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For the plane electromagnetic wave given by $E = E_0 \sin(\omega t - kx)$ and $B = B_0 \sin(\omega t - kx)$, the ratio of average electric energy density to average magnetic energy density is

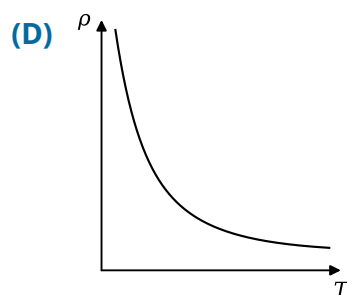
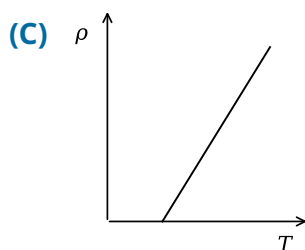
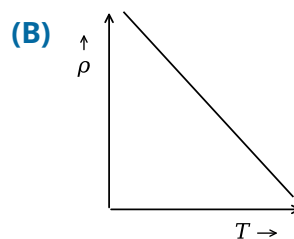
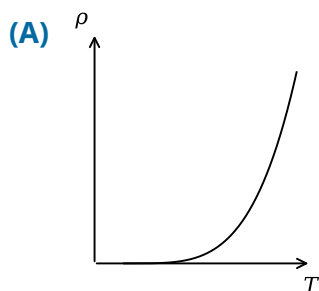
- (A) 1 (B) 4 (C) 2 (D) 1/2

Name the logic gate equivalent to the diagram attached

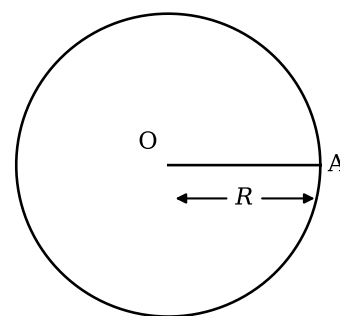
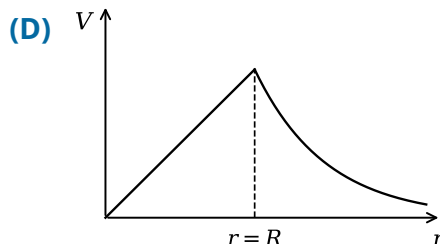
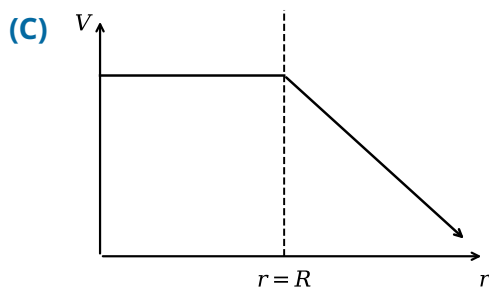
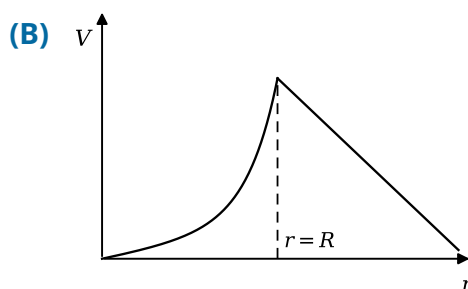
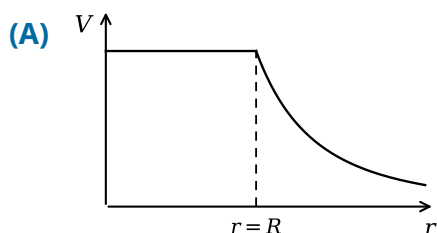


- (A) NOR (B) NAND (C) AND (D) OR

The resistivity (ρ) of semiconductor varies with temperature. Which of the following curve represents the correct behaviour:



For a uniformly charged thin spherical shell, the electric potential (V) radially away from the centre (O) of shell can be graphically represented as



A monochromatic light wave with wavelength λ_1 and frequency ν_1 in air enters another medium. If the angle of incidence and angle of refraction at the interface are 45° and 30° respectively, then the wavelength λ_2 and frequency ν_2 of the refracted wave are:

- (A) $\lambda_2 = \lambda_1, \nu_2 = \frac{1}{\sqrt{2}}\nu_1$ (B) $\lambda_2 = \lambda_1, \nu_2 = \sqrt{2}\nu_1$ (C) $\lambda_2 = \sqrt{2}\lambda_1, \nu_2 = \nu_1$ (D) $\lambda_2 = \frac{1}{\sqrt{2}}\lambda_1, \nu_2 = \nu_1$

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

Assertion **A** : Earth has atmosphere whereas moon doesn't have any atmosphere.

Reason **R** : The escape velocity on moon is very small as compared to that on earth.

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

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

A planet has double the mass of the earth. Its average density is equal to that of the earth. An object weighing W on earth will weigh on that planet:

- (A) $2^{2/3}W$ (B) W (C) $2W$ (D) $2^{1/3}W$

A source supplies heat to a system at the rate of $1000W$. If the system performs work at a rate of $200W$. The rate at which internal energy of the system increases is

- (A) $600W$ (B) $1200W$ (C) $500W$ (D) $800W$

Q14 Kinetic Theory of Gases[Step-by-step solution](#) > [prepwisar.in/questions/zmyIvTyKji](https://www.prepwisar.in/questions/zmyIvTyKji)

The number of air molecules per cm^3 increased from 3×10^{19} to 12×10^{19} . The ratio of collision frequency of air molecules before and after the increase in number respectively is:

- (A) 1.25 (B) 0.25 (C) 0.50 (D) 0.75

Q15 Moving Charges & Magnetism[Step-by-step solution](#) > [prepwisar.in/questions/6WOIj8CNX6](https://www.prepwisar.in/questions/6WOIj8CNX6)

A long straight wire of circular cross-section (radius a) is carrying steady current I . The current I is uniformly distributed across this cross-section. The magnetic field is

- (A) uniform in the region $r < a$ and inversely proportional to distance r from the axis, in the region $r > a$
(B) zero in the region $r < a$ and inversely proportional to r in the region $r > a$
(C) directly proportional to r in the region $r < a$ and inversely proportional to r in the region $r > a$
(D) inversely proportional to r in the region $r < a$ and uniform throughout in the region $r > a$

Q16 Projectile Motion & Relative Motion[Step-by-step solution](#) > [prepwisar.in/questions/C6Opg7MgyP](https://www.prepwisar.in/questions/C6Opg7MgyP)

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

Assertion A : When a body is projected at an angle 45° , its range is maximum.

Reason R : For maximum range, the value of $\sin 2\theta$ should be equal to one.

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

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

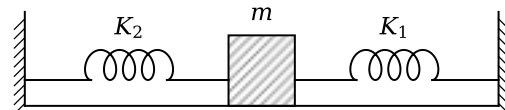
Q17 Fluid Mechanics[Step-by-step solution](#) > [prepwisar.in/questions/56PqKaA5Le](https://www.prepwisar.in/questions/56PqKaA5Le)

A small ball of mass M and density ρ is dropped in a viscous liquid of density ρ_0 . After some time, the ball falls with a constant velocity. What is the viscous force on the ball?

- (A) $F = Mg \left(1 - \frac{\rho_0}{\rho}\right)$ (B) $F = Mg \left(1 + \frac{\rho}{\rho_0}\right)$ (C) $F = Mg \left(1 + \frac{\rho_0}{\rho}\right)$ (D) $F = Mg (1 \pm \rho\rho_0)$

Q18 Simple Harmonic Motion[Step-by-step solution](#) > [prepwisar.in/questions/LIMvEbx1LQ](https://www.prepwisar.in/questions/LIMvEbx1LQ)

A mass m is attached to two strings as shown in figure. The spring constants of two springs are K_1 and K_2 . For the frictionless surface, the time period of oscillation of mass m is:



- (A) $2\pi \sqrt{\frac{m}{K_1 + K_2}}$ (B) $2\pi \sqrt{\frac{m}{K_1 - K_2}}$ (C) $\frac{1}{2\pi} \sqrt{\frac{K_1 + K_2}{m}}$ (D) $\frac{1}{2\pi} \sqrt{\frac{K_1 - K_2}{m}}$

Q19 Units, Dimensions & Errors[Step-by-step solution](#) > [prepwisar.in/questions/TBH3T6sJJa](https://www.prepwisar.in/questions/TBH3T6sJJa)

Two resistances are given as $R_1 = (10 \pm 0.5)\Omega$ and $R_2 = (15 \pm 0.5)\Omega$. The percentage error in the measurement of equivalent resistance when they are connected in parallel is -

- (A) 2.33 (B) 5.33 (C) 4.33 (D) 6.33

Q20 Alternating Current **NUMERICAL**

[Step-by-step solution](#) > [prepwisar.in/questions/r1Ce78ml8j](https://www.prepwisar.in/questions/r1Ce78ml8j)

An ideal transformer with purely resistive load operates at 12kV on the primary side. It supplies electrical energy to a number of nearby houses at 120V. The average rate of energy consumption in the houses served by the transformer is 60 kW. The value of resistive load (R_s) required in the secondary circuit will be _____ $m\Omega$.

Q21 Atomic Physics **NUMERICAL**

[Step-by-step solution](#) > [prepwisar.in/questions/MmDs4BSNOi](https://www.prepwisar.in/questions/MmDs4BSNOi)

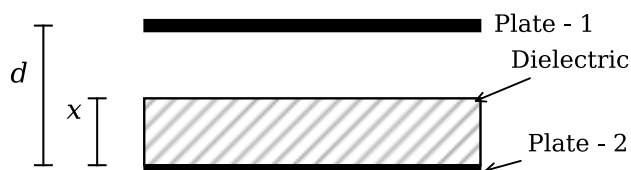
The radius of fifth orbit of the Li^{++} is _____ $\times 10^{-12}m$.

Take: radius of hydrogen atom = $0.51 \text{ \AA}$

Q22 Electrostatics II: Potential & Capacitance **NUMERICAL**

[Step-by-step solution](#) > [prepwisar.in/questions/4h3KjvsU8o](https://www.prepwisar.in/questions/4h3KjvsU8o)

A parallel plate capacitor with plate area A and plate separation d is filled with a dielectric material of dielectric constant $K = 4$. The thickness of the dielectric material is x , where $x < d$.



Let C_1 and C_2 be the capacitance of the system for $x = \frac{1}{3}d$ and $x = \frac{2}{3}d$, respectively. If $C_1 = 2\mu F$ the value of C_2 is _____ μF

Q23 Current Electricity **NUMERICAL**

[Step-by-step solution](#) > [prepwisar.in/questions/Za4ROTi_Qq](https://www.prepwisar.in/questions/Za4ROTi_Qq)

The length of a metallic wire is increased by 20% and its area of cross section is reduced by 4%. The percentage change in resistance of the metallic wire is _____.

Q24 Ray Optics **NUMERICAL**

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

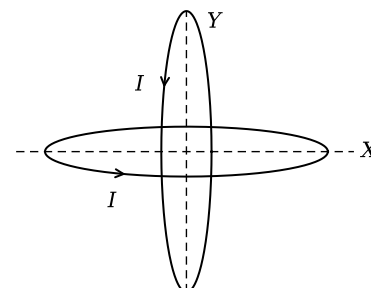
A pole is vertically submerged in swimming pool, such that it gives a length of shadow 2.15m within water when sunlight is incident at angle of 30° with the surface of water. If swimming pool is filled to a height of 1.5m, then the height of the pole above the water surface in centimeters is ($n_w = 4/3$) _____.

Q25 Moving Charges & Magnetism **NUMERICAL**

[Step-by-step solution](#) > [prepwisar.in/questions/maxY7-_kha](https://www.prepwisar.in/questions/maxY7-_kha)

Two identical circular wires of radius 20cm and carrying current $\sqrt{2}A$ are placed in perpendicular planes as shown in figure. The net magnetic field at the centre of the circular wires is _____ $\times 10^{-8}T$.

(Take $\pi = 3.14$)



Q26 Elasticity **NUMERICAL**

[Step-by-step solution](#) > [prepwisar.in/questions/e0ZVjXUJhb](https://www.prepwisar.in/questions/e0ZVjXUJhb)

A steel rod has a radius of 20mm and a length of 2.0m. A force of 62.8kN stretches it along its length. Young's modulus of steel is $2.0 \times 10^{11}N/m^2$. The longitudinal strain produced in the wire is _____ $\times 10^{-5}$

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Two identical solid spheres each of mass 2kg and radii 10cm are fixed at the ends of a light rod. The separation between the centres of the spheres is 40cm. The moment of inertia of the system about an axis perpendicular to the rod passing through its middle point is _____ $\times 10^{-3} \text{kgm}^2$

A person driving car at a constant speed of 15m/s is approaching a vertical wall. The person notices a change of 40Hz in the frequency of his car's horn upon reflection from the wall. The frequency of horn is _____ Hz.

(Given: Speed of sound: 330m/s)

A particle of mass 10g moves in a straight line with retardation $2x$, where x is the displacement in SI units. Its loss of kinetic energy for above displacement is $\left(\frac{10}{x}\right)^{-n} \text{J}$. The value of n will be _____

Chemistry Section A · Multiple choice

Q30 to Q46

Match List I with List II

	LIST I Enzymatic reaction		LIST II Enzyme
A.	Sucrose $\rightarrow$ Glucose and Fructose	I.	Zymase
B.	Glucose $\rightarrow$ ethyl alcohol and CO_2	II.	Pepsin
C.	Starch $\rightarrow$ Maltose	III.	Invertase
D.	Proteins $\rightarrow$ Amino acids	IV.	Diastase

Choose the correct answer from the options given below:

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

Match List I with List II

	LIST I Vitamin		LIST II Deficiency disease
A.	Vitamin A	I.	Beri-Beri
B.	Thiamine	II.	Cheilosis
C.	Ascorbic acid	III.	Xerophthalmia
D.	Riboflavin	IV.	Scurvy

Choose the correct answer from the options given below:

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

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Q32 Coordination Compounds[Step-by-step solution](https://prepwiser.in/questions/e00ctv2fQ5)

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

Assertion **A**: The spin only magnetic moment value for $[\text{Fe}(\text{CN})_6]^{3-}$ is 1.74BM, whereas for $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ is 5.92BM.

Reason **R**: In both complexes, Fe is present in +3 oxidation state.

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

Q33 Redox Reactions[Step-by-step solution](https://prepwiser.in/questions/m50poEY8Vu)

Strong reducing and oxidizing agents among the following, respectively, are:

- (A) Ce^{4+} and Eu^{2+}
- (B) Eu^{2+} and Ce^{4+}
- (C) Ce^{4+} and Tb^{4+}
- (D) Ce^{3+} and Ce^{4+}

Q34 Electrochemistry[Step-by-step solution](https://prepwiser.in/questions/bmFGX11XF9)

The standard electrode potential of M^+/M in aqueous solution does not depend on

- (A) Ionisation of a gaseous metal atom
- (B) Sublimation of a solid metal
- (C) Ionisation of a solid metal atom
- (D) Hydration of a gaseous metal ion

Q35 Atomic Structure[Step-by-step solution](https://prepwiser.in/questions/lrbzIJqwX9)

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

Assertion **A** : Loss of electron from hydrogen atom results in nucleus of $\sim 1.5 \times 10^{-3} \text{pm}$ size.

Reason **R** : Proton (H^+) always exists in combined form.

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

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

Q36 Hydrogen & s-Block Elements[Step-by-step solution](https://prepwiser.in/questions/QE_M7SqIDj)

The setting time of Cement is increased by adding:

- (A) Gypsum
- (B) Limestone
- (C) Clay
- (D) Silica

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Match List I with List II

	LIST I Name of reaction		LIST II Reagent used
A.	Hell-Volhard-Zelinsky reaction	I.	$NaOH + I_2$
B.	Iodoform reaction	II.	(i) CrO_2Cl_2, CS_2 (ii) H_2O
C.	Etard reaction	III.	(i) $Br_2 /$ red phosphorus (ii) H_2O
D.	Gatterman-Koch reaction	IV.	$CO, HCl, \text{ anhyd. } AlCl_3$

Choose the correct answer from the options given below:

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

The difference between electron gain enthalpies will be maximum between:

- (A) Ar and Cl (B) Ne and Cl (C) Ne and F (D) Ar and F

Polymer used in orlon is:

- (A) Polyethylene (B) Polyacrylonitrile (C) Polycarbonate (D) Polyamide

Which of the following options are correct for the reaction



- A. Redox reaction
B. Displacement reaction
C. Decomposition reaction
D. Combination reaction

Choose the correct answer from the options given below:

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

A compound is formed by two elements X and Y. The element Y forms cubic close packed arrangement and those of element X occupy one third of the tetrahedral voids. What is the formula of the compound?

- (A) XY_3 (B) X_3Y_2 (C) X_3Y (D) X_2Y_3

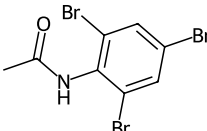
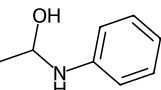
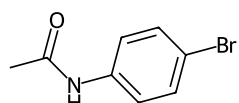
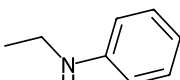
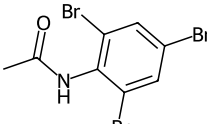
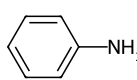
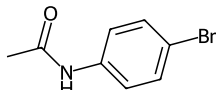
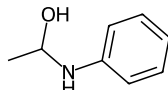
For a concentrated solution of a weak electrolyte (K_{eq} = equilibrium constant) A_2B_3 of concentration 'c', the degree of dissociation ' α ' is:

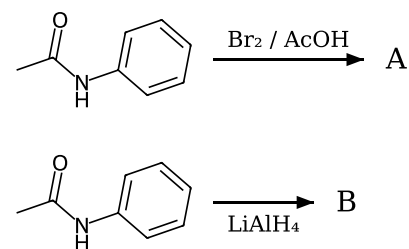
- (A) $\left(\frac{K_{eq}}{25c^2} \right)^{\frac{1}{5}}$ (B) $\left(\frac{K_{eq}}{108c^4} \right)^{\frac{1}{5}}$ (C) $\left(\frac{K_{eq}}{5c^4} \right)^{\frac{1}{5}}$ (D) $\left(\frac{K_{eq}}{6c^5} \right)^{\frac{1}{5}}$

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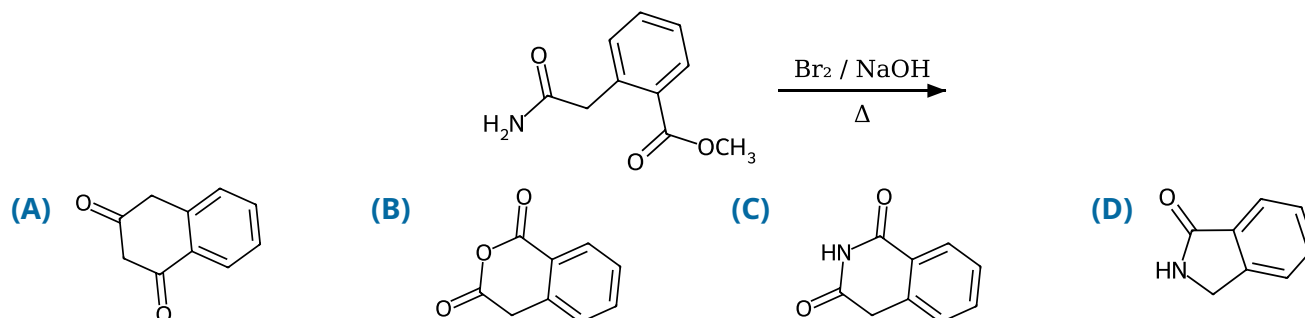
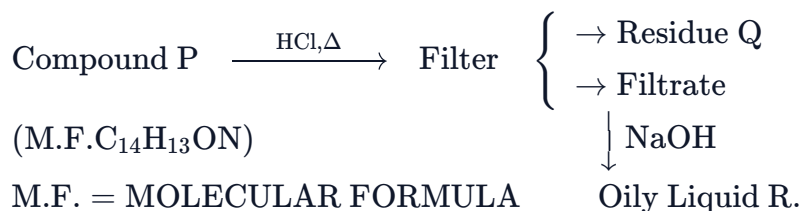
Q43 Amines & Diazonium Salts[Step-by-step solution > prepwiser.in/questions/TyLoWw77hG](https://www.prepwiser.in/questions/TyLoWw77hG)

The major products A and B from the following reactions are:

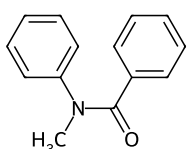
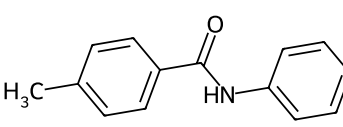
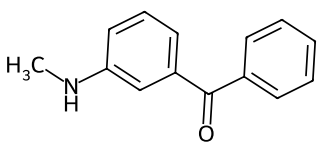
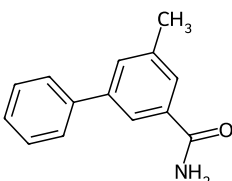
- (A) $A =$  , $B =$ 
- (B) $A =$  , $B =$ 
- (C) $A =$  , $B =$ 
- (D) $A =$  , $B =$ 

**Q44** Amines & Diazonium Salts[Step-by-step solution > prepwiser.in/questions/ZfByXjnzg-](https://www.prepwiser.in/questions/ZfByXjnzg-)

The major product formed in the following reaction is

**Q45** Amines & Diazonium Salts[Step-by-step solution > prepwiser.in/questions/pI8nblBt20](https://www.prepwiser.in/questions/pI8nblBt20)

Compound P is neutral, Q gives effervescence with NaHCO_3 while R reacts with Hinsbergs reagent to give solid soluble in NaOH. Compound P is

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

Match List I with List II

	LIST I Element detected		LIST II Reagent used / Product formed
A.	Nitrogen	I.	$\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$
B.	Sulphur	II.	AgNO_3
C.	Phosphorous	III.	$\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$
D.	Halogen	IV.	$(\text{NH}_4)_2\text{MoO}_4$

Choose the correct answer from the options given below:

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

Chemistry Section B · Numerical value

Q47 to Q56

Q47 Chemical Bonding & Molecular Structure NUMERICAL

[Step-by-step solution](#) › [prepwiser.in/questions/qflbr-gzu9](#)

The number of species from the following which have square pyramidal structure is _____



Q48 Coordination Compounds NUMERICAL

[Step-by-step solution](#) › [prepwiser.in/questions/Lg0J36kX3W](#)Number of ambidentate ligands in a representative metal complex $[\text{M}(\text{en})(\text{SCN})_4]$ is _____.

[en = ethylenediamine]

Q49 Hydrocarbons: Alkanes NUMERICAL

[Step-by-step solution](#) › [prepwiser.in/questions/vIjez53nsb](#)Number of bromo derivatives obtained on treating ethane with excess of Br_2 in diffused sunlight is _____

Q50 Redox Reactions NUMERICAL

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

In ammonium - phosphomolybdate, the oxidation state of Mo is + _____

Q51 Solutions & Colligative Properties NUMERICAL

[Step-by-step solution](#) › [prepwiser.in/questions/KcnXFKS5nm](#)Mass of Urea (NH_2CONH_2) required to be dissolved in 1000g of water in order to reduce the vapour pressure of water by 25% is _____ g. (Nearest integer)Given: Molar mass of N, C, O and H are 14, 12, 16 and 1g mol^{-1} respectively

Q52 Mole Concept & Stoichiometry NUMERICAL

[Step-by-step solution](#) › [prepwiser.in/questions/xXAHKvmUIL](#)If 5 moles of BaCl_2 is mixed with 2 moles of Na_3PO_4 , the maximum number of moles of $\text{Ba}_3(\text{PO}_4)_2$ formed is _____ (Nearest integer)

Q53 Atomic Structure NUMERICAL

[Step-by-step solution](#) › [prepwiser.in/questions/zkmlqTEKLT](#)The wavelength of an electron of kinetic energy $4.50 \times 10^{-29} \text{ J}$ is _____ $\times 10^{-5} \text{ m}$. (Nearest integer)Given : mass of electron is $9 \times 10^{-31} \text{ kg}$, $h = 6.6 \times 10^{-34} \text{ J s}$ Attempt this paper online with instant answer checking › [prepwiser.in/pyqs/paper/2023-04-06-morning](#)

Q54 Surface Chemistry **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/hBMyRqY-yg

For the adsorption of hydrogen on platinum, the activation energy is 30kJmol^{-1} and for the adsorption of hydrogen on nickel, the activation energy is 41.4kJmol^{-1} . The logarithm of the ratio of the rates of chemisorption on equal areas of the metals at 300K is _____ (Nearest integer)

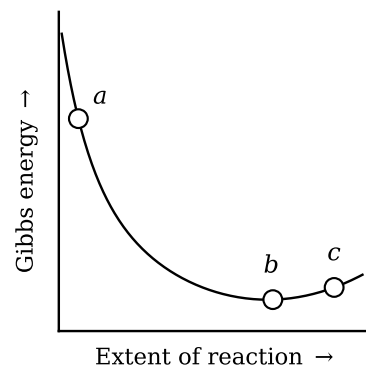
Given: $\ln 10 = 2.3$

$R = 8.3\text{JK}^{-1}\text{mol}^{-1}$

Q55 Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/v148YNh-UT

Consider the graph of Gibbs free energy G vs Extent of reaction. The number of statement/s from the following which are true with respect to points (a), (b) and (c) is _____

- A. Reaction is spontaneous at (a) and (b)
- B. Reaction is at equilibrium at point (b) and non-spontaneous at point (c)
- C. Reaction is spontaneous at (a) and non-spontaneous at (c)
- D. Reaction is non-spontaneous at (a) and (b)

**Q56** Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/Q9uBdD8NdW

The value of $\log K$ for the reaction $A \rightleftharpoons B$ at 298K is _____. (Nearest integer)

Given: $\Delta H^\circ = -54.07\text{kJmol}^{-1}$

$\Delta S^\circ = 10\text{JK}^{-1}\text{mol}^{-1}$

(Take $2.303 \times 8.314 \times 298 = 5705$)

Mathematics Section A · Multiple choice

Q57 to Q74

Q57 Three Dimensional Geometry[Step-by-step solution](#) › prepwiser.in/questions/tH751Cj6xo

If the equation of the plane passing through the line of intersection of the planes $2x - y + z = 3$, $4x - 3y + 5z + 9 = 0$ and parallel to the line $\frac{x+1}{-2} = \frac{y+3}{4} = \frac{z-2}{5}$ is $ax + by + cz + 6 = 0$, then $a + b + c$ is equal to:

- (A) 13 (B) 15 (C) 14 (D) 12

Q58 Three Dimensional Geometry[Step-by-step solution](#) › prepwiser.in/questions/AmuFYrbNw0

One vertex of a rectangular parallelepiped is at the origin O and the lengths of its edges along x , y and z axes are 3, 4 and 5 units respectively. Let P be the vertex $(3, 4, 5)$. Then the shortest distance between the diagonal OP and an edge parallel to z axis, not passing through O or P is:

- (A) $\frac{12}{\sqrt{5}}$ (B) $12\sqrt{5}$ (C) $\frac{12}{5}$ (D) $\frac{12}{5\sqrt{5}}$

Q59 Permutations & Combinations[Step-by-step solution](#) › prepwiser.in/questions/M8uTyMFEH5

If ${}^{2n}C_3 : {}^nC_3 = 10 : 1$, then the ratio $(n^2 + 3n) : (n^2 - 3n + 4)$ is:

- (A) 27 : 11 (B) 2 : 1 (C) 35 : 16 (D) 65 : 37

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Q60 Binomial Theorem[Step-by-step solution](https://www.prepwiser.in/questions/eYrZ5o_Zuq) › prepwiser.in/questions/eYrZ5o_Zuq

If the ratio of the fifth term from the beginning to the fifth term from the end in the expansion of $\left(\sqrt[4]{2} + \frac{1}{\sqrt[4]{3}}\right)^n$ is $\sqrt{6} : 1$, then the third term from the beginning is:

- (A) $30\sqrt{2}$ (B) $60\sqrt{3}$ (C) $60\sqrt{2}$ (D) $30\sqrt{3}$

Q61 Functions (Advanced)[Step-by-step solution](https://www.prepwiser.in/questions/HpKYQULh9W) › prepwiser.in/questions/HpKYQULh9W

Let $5f(x) + 4f\left(\frac{1}{x}\right) = \frac{1}{x} + 3, x > 0$. Then $18 \int_1^2 f(x) dx$ is equal to:

- (A) $10 \log_e 2 + 6$ (B) $5 \log_e 2 - 3$ (C) $10 \log_e 2 - 6$ (D) $5 \log_e 2 + 3$

Q62 Differentiation[Step-by-step solution](https://www.prepwiser.in/questions/9yuoBLwjYd) › prepwiser.in/questions/9yuoBLwjYd

If $2x^y + 3y^x = 20$, then $\frac{dy}{dx}$ at $(2, 2)$ is equal to:

- (A) $-\left(\frac{3 + \log_e 16}{4 + \log_e 8}\right)$ (B) $-\left(\frac{2 + \log_e 8}{3 + \log_e 4}\right)$ (C) $-\left(\frac{3 + \log_e 8}{2 + \log_e 4}\right)$ (D) $-\left(\frac{3 + \log_e 4}{2 + \log_e 8}\right)$

Q63 Limits[Step-by-step solution](https://www.prepwiser.in/questions/E9czA5sT2q) › prepwiser.in/questions/E9czA5sT2q

Let $a_1, a_2, a_3, \dots, a_n$ be n positive consecutive terms of an arithmetic progression. If $d > 0$ is its common difference, then

$$\lim_{n \rightarrow \infty} \sqrt{\frac{d}{n}} \left(\frac{1}{\sqrt{a_1} + \sqrt{a_2}} + \frac{1}{\sqrt{a_2} + \sqrt{a_3}} + \dots + \frac{1}{\sqrt{a_{n-1}} + \sqrt{a_n}} \right)$$

is

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

Q64 Determinants[Step-by-step solution](https://www.prepwiser.in/questions/zSL_B1TGL6) › prepwiser.in/questions/zSL_B1TGL6

If the system of equations

$$x + y + az = b$$

$$2x + 5y + 2z = 6$$

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

has infinitely many solutions, then $2a + 3b$ is equal to:

- (A) 28 (B) 25 (C) 20 (D) 23

Q65 Matrices[Step-by-step solution](https://www.prepwiser.in/questions/q9BHJ2XLWU) › prepwiser.in/questions/q9BHJ2XLWU

Let $A = [a_{ij}]_{2 \times 2}$, where $a_{ij} \neq 0$ for all i, j and $A^2 = I$. Let a be the sum of all diagonal elements of A and $b = |A|$. Then $3a^2 + 4b^2$ is equal to:

- (A) 4 (B) 3 (C) 14 (D) 7

Q66 Probability: Advanced[Step-by-step solution](https://www.prepwiser.in/questions/0WhaknksNI) › prepwiser.in/questions/0WhaknksNI

A pair of dice is thrown 5 times. For each throw, a total of 5 is considered a success. If the probability of at least 4 successes is $\frac{k}{3^{11}}$, then k is equal to:

- (A) 82 (B) 164 (C) 123 (D) 75

Q67 Sets[Step-by-step solution](https://www.prepwisar.in/questions/zlFFX8FRU)

Let $A = \{x \in \mathbb{R} : [x + 3] + [x + 4] \leq 3\}$,

$$B = \left\{ x \in \mathbb{R} : 3^x \left(\sum_{r=1}^{\infty} \frac{3}{10^r} \right)^{x-3} < 3^{-3x} \right\},$$

where $[t]$ denotes greatest integer function. Then,

- (A) $B \subset C, A \neq B$ (B) $A \subset B, A \neq B$ (C) $A = B$ (D) $A \cap B = \phi$

Q68 Quadratic Equations & Polynomial Inequalities[Step-by-step solution](https://www.prepwisar.in/questions/lwYuAbx8XB)

The sum of all the roots of the equation $|x^2 - 8x + 15| - 2x + 7 = 0$ is:

- (A) $11 + \sqrt{3}$ (B) $9 + \sqrt{3}$ (C) $9 - \sqrt{3}$ (D) $11 - \sqrt{3}$

Q69 Sequences & Series[Step-by-step solution](https://www.prepwisar.in/questions/ZF8yr54EHS)

The sum of the first 20 terms of the series $5 + 11 + 19 + 29 + 41 + \dots$ is:

- (A) 3420 (B) 3450 (C) 3250 (D) 3520

Q70 Statistics[Step-by-step solution](https://www.prepwisar.in/questions/a6FAzBCbld)

The mean and variance of a set of 15 numbers are 12 and 14 respectively. The mean and variance of another set of 15 numbers are 14 and σ^2 respectively. If the variance of all the 30 numbers in the two sets is 13, then σ^2 is equal to:

- (A) 12 (B) 11 (C) 10 (D) 9

Q71 Vectors[Step-by-step solution](https://www.prepwisar.in/questions/P0xnEvYgA3)

Let the position vectors of the points A, B, C and D be

$$5\hat{i} + 5\hat{j} + 2\lambda\hat{k}, \hat{i} + 2\hat{j} + 3\hat{k}, -2\hat{i} + \lambda\hat{j} + 4\hat{k}$$

and $-\hat{i} + 5\hat{j} + 6\hat{k}$. Let the set $S = \{\lambda \in \mathbb{R} : \text{the points A, B, C and D are coplanar}\}$.

Then $\sum_{\lambda \in S} (\lambda + 2)^2$ is equal to:

- (A) $\frac{37}{2}$ (B) 25 (C) 13 (D) 41

Q72 Vectors[Step-by-step solution](https://www.prepwisar.in/questions/oqra2jU3kW)

Let $\vec{a} = 2\hat{i} + 3\hat{j} + 4\hat{k}$, $\vec{b} = \hat{i} - 2\hat{j} - 2\hat{k}$ and $\vec{c} = -\hat{i} + 4\hat{j} + 3\hat{k}$. If $\vec{d}$ is a vector perpendicular to both $\vec{b}$ and $\vec{c}$, and $\vec{a} \cdot \vec{d} = 18$, then $|\vec{a} \times \vec{d}|^2$ is equal to:

- (A) 680 (B) 720 (C) 760 (D) 640

Q73 Straight Lines[Step-by-step solution](https://www.prepwisar.in/questions/78LLF5Hmhs)

The straight lines l_1 and l_2 pass through the origin and trisect the line segment of the line $L: 9x + 5y = 45$ between the axes. If m_1 and m_2 are the slopes of the lines l_1 and l_2 , then the point of intersection of the line $y = (m_1 + m_2)x$ with L lies on:

- (A) $6x - y = 15$ (B) $6x + y = 10$ (C) $y - x = 5$ (D) $y - 2x = 5$

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Q74 Indefinite Integration[Step-by-step solution](#) › prepwiser.in/questions/ia1RtBmUt3

Let $I(x) = \int \frac{x^2(x \sec^2 x + \tan x)}{(x \tan x + 1)^2} dx$. If $I(0) = 0$, then $I\left(\frac{\pi}{4}\right)$ is equal to:

(A) $\log_e \frac{(\pi + 4)^2}{32} - \frac{\pi^2}{4(\pi + 4)}$

(B) $\log_e \frac{(\pi + 4)^2}{16} - \frac{\pi^2}{4(\pi + 4)}$

(C) $\log_e \frac{(\pi + 4)^2}{16} + \frac{\pi^2}{4(\pi + 4)}$

(D) $\log_e \frac{(\pi + 4)^2}{32} + \frac{\pi^2}{4(\pi + 4)}$

Mathematics Section B · Numerical value

Q75 to Q84

Q75 Three Dimensional Geometry

NUMERICAL

[Step-by-step solution](#) › prepwiser.in/questions/duCiCnqt56

Let the image of the point $P(1, 2, 3)$ in the plane $2x - y + z = 9$ be Q . If the coordinates of the point R are $(6, 10, 7)$, then the square of the area of the triangle PQR is _____.

Q76 Binomial Theorem

NUMERICAL

[Step-by-step solution](#) › prepwiser.in/questions/ZJ6OV07ScM

The coefficient of x^{18} in the expansion of $\left(x^4 - \frac{1}{x^3}\right)^{15}$ is _____.

Q77 Circles

NUMERICAL

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

Let the point $(p, p + 1)$ lie inside the region $E = \{(x, y) : 3 - x \leq y \leq \sqrt{9 - x^2}, 0 \leq x \leq 3\}$. If the set of all values of p is the interval (a, b) , then $b^2 + b - a^2$ is equal to _____.

Q78 Circles

NUMERICAL

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

A circle passing through the point $P(\alpha, \beta)$ in the first quadrant touches the two coordinate axes at the points A and B . The point P is above the line AB . The point Q on the line segment AB is the foot of perpendicular from P on AB . If PQ is equal to 11 units, then the value of $\alpha\beta$ is _____.

Q79 Differential Equations

NUMERICAL

[Step-by-step solution](#) › prepwiser.in/questions/G01iC7lqoj

Let $y = y(x)$ be a solution of the differential equation

$$(x \cos x)dy + (xy \sin x + y \cos x - 1)dx = 0, 0 < x < \frac{\pi}{2}. \text{ If } \frac{\pi}{3}y\left(\frac{\pi}{3}\right) = \sqrt{3}, \text{ then}$$

$$\left| \frac{\pi}{6}y''\left(\frac{\pi}{6}\right) + 2y'\left(\frac{\pi}{6}\right) \right|$$

is equal to _____.

Q80 Continuity & Differentiability

NUMERICAL

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

Let $a \in \mathbb{Z}$ and $[t]$ be the greatest integer $\leq t$. Then the number of points, where the function $f(x) = [a + 13 \sin x]$, $x \in (0, \pi)$ is not differentiable, is _____.

Q81 Parabola

NUMERICAL

[Step-by-step solution](#) › prepwiser.in/questions/teInf2CqOG

Let the tangent to the curve $x^2 + 2x - 4y + 9 = 0$ at the point $P(1, 3)$ on it meet the y -axis at A . Let the line passing through P and parallel to the line $x - 3y = 6$ meet the parabola $y^2 = 4x$ at B . If B lies on the line $2x - 3y = 8$, then $(AB)^2$ is equal to _____.

Q82 Permutations & Combinations

NUMERICAL

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

The number of ways of giving 20 distinct oranges to 3 children such that each child gets at least one orange is _____.

Let $A = \{1, 2, 3, 4, \dots, 10\}$ and $B = \{0, 1, 2, 3, 4\}$. The number of elements in the relation $R = \{(a, b) \in A \times A : 2(a - b)^2 + 3(a - b) \in B\}$ is _____.

If the area of the region $S = \{(x, y) : 2y - y^2 \leq x^2 \leq 2y, x \geq y\}$ is equal to $\frac{n+2}{n+1} - \frac{\pi}{n-1}$, then the natural number n is equal to _____.

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Physics

1. D	2. D	3. C	4. A	5. B	6. A	7. A	8. D
9. A	10. D	11. C	12. D	13. D	14. B	15. C	16. A
17. A	18. A	19. C	20. 240	21. 425	22. 3	23. 25	24. 50
25. 628	26. 25	27. 176	28. 420	29. 2			

Chemistry

30. B	31. A	32. D	33. B	34. C	35. D	36. A	37. B
38. B	39. B	40. A	41. D	42. B	43. B	44. D	45. B
46. A	47. 3	48. 4	49. 9	50. 6	51. 1111	52. 1	53. 7
54. 2	55. 2	56. 10					

Mathematics

57. C	58. C	59. B	60. B	61. C	62. B	63. B	64. D
65. A	66. C	67. C	68. B	69. D	70. C	71. D	72. B
73. C	74. A	75. 594	76. 5005	77. 3	78. 121	79. 2	80. 25
81. 292	82. 3483638676	83. 18	84. 5				

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