

JEE MAIN 2021 · QUESTION PAPER

31 Aug 2021 Shift 2

81 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	18 Q1 to Q18	9 Q19 to Q27
● Chemistry	15 Q28 to Q42	10 Q43 to Q52
● Mathematics	19 Q53 to Q71	10 Q72 to Q81
In this PDF	81 questions · answer key at the end	

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

Attempt this paper online

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

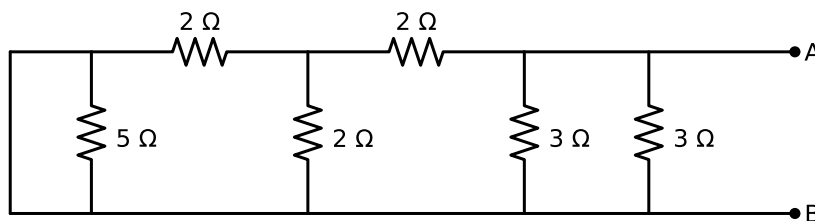
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Answers follow NTA's final answer keys. Typing errors are possible, so check doubtful answers against the official key. Spotted a mistake?
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Q1 Current Electricity

[Step-by-step solution](#) › [prepwiser.in/questions/jVi4NfUXlJ](https://www.prepwiser.in/questions/jVi4NfUXlJ)

The equivalent resistance of the given circuit between the terminals A and B is:



- (A) $0\ \Omega$ (B) $3\ \Omega$ (C) $\frac{9}{2}\ \Omega$ (D) $1\ \Omega$

Q2 Atomic Physics

[Step-by-step solution](#) › [prepwiser.in/questions/XTD9-FDf6e](https://www.prepwiser.in/questions/XTD9-FDf6e)

A free electron of 2.6 eV energy collides with a H^+ ion. This results in the formation of a hydrogen atom in the first excited state and a photon is released. Find the frequency of the emitted photon. ($h = 6.6 \times 10^{-34}\text{ Js}$)

- (A) $1.45 \times 10^{16}\text{ MHz}$ (B) $0.19 \times 10^{15}\text{ MHz}$ (C) $1.45 \times 10^9\text{ MHz}$ (D) $9.0 \times 10^{27}\text{ MHz}$

Q3 Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwiser.in/questions/MWpqL3s6NK](https://www.prepwiser.in/questions/MWpqL3s6NK)

Consider two separate ideal gases of electrons and protons having same number of particles. The temperature of both the gases are same. The ratio of the uncertainty in determining the position of an electron to that of a proton is proportional to :-

- (A) $\left(\frac{m_p}{m_e}\right)^{3/2}$ (B) $\sqrt{\frac{m_e}{m_p}}$ (C) $\sqrt{\frac{m_p}{m_e}}$ (D) $\frac{m_p}{m_e}$

Q4 Electromagnetic Waves

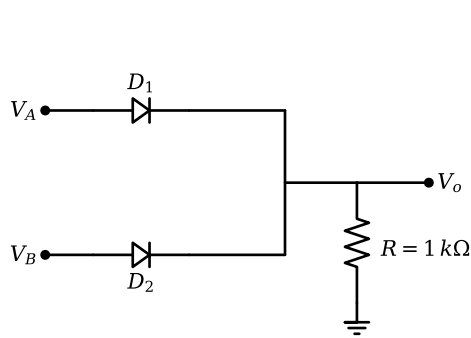
[Step-by-step solution](#) › [prepwiser.in/questions/rAFZETLkPf](https://www.prepwiser.in/questions/rAFZETLkPf)

The magnetic field vector of an electromagnetic wave is given by $B = B_0 \frac{\hat{i} + \hat{j}}{\sqrt{2}} \cos(kz - \omega t)$; where $\hat{i}, \hat{j}$ represents unit vector along x and y-axis respectively. At $t = 0$ s, two electric charges q_1 of 4π coulomb and q_2 of 2π coulomb located at $(0, 0, \frac{\pi}{k})$ and $(0, 0, \frac{3\pi}{k})$, respectively, have the same velocity of $0.5\ c\ \hat{i}$, (where c is the velocity of light). The ratio of the force acting on charge q_1 to q_2 is :-

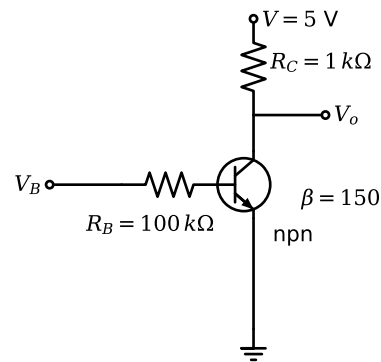
- (A) $2\sqrt{2} : 1$ (B) $1 : \sqrt{2}$ (C) $2 : 1$ (D) $\sqrt{2} : 1$

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If V_A and V_B are the input voltages (either 5V or 0V) and V_O is the output voltage then the two gates represented in the following circuit (A) and (B) are :-



(A)



(B)

(A) AND and OR Gate

(B) OR and NOT Gate

(C) NAND and NOR Gate

(D) AND and NOT Gate

Statement - I:

To get a steady dc output from the pulsating voltage received from a full wave rectifier we can connect a capacitor across the output parallel to the load R_L .

Statement - II:

To get a steady dc output from the pulsating voltage received from a full wave rectifier we can connect an inductor in series with R_L .

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

(A) Statement I is true but Statement II is false

(B) Statement I is false but Statement II is true

(C) Both Statement I and Statement II are false

(D) Both Statement I and Statement II are true

Choose the incorrect statement:

(1) The electric lines of force entering into a Gaussian surface provide negative flux.

(2) A charge 'q' is placed at the centre of a cube. The flux through all the faces will be the same.

(3) In a uniform electric field net flux through a closed Gaussian surface containing no net charge, is zero.

(4) When electric field is parallel to a Gaussian surface, it provides a finite non-zero flux.

Choose the most appropriate answer from the options given below

(A) (3) and (4) only

(B) (2) and (4) only

(C) (4) only

(D) (1) and (3) only

If R_E be the radius of Earth, then the ratio between the acceleration due to gravity at a depth 'r' below and a height 'r' above the earth surface is : (Given : $r < R_E$)

(A) $1 - \frac{r}{R_E} - \frac{r^2}{R_E^2} - \frac{r^3}{R_E^3}$

(B) $1 + \frac{r}{R_E} + \frac{r^2}{R_E^2} + \frac{r^3}{R_E^3}$

(C) $1 + \frac{r}{R_E} - \frac{r^2}{R_E^2} + \frac{r^3}{R_E^3}$

(D) $1 + \frac{r}{R_E} - \frac{r^2}{R_E^2} - \frac{r^3}{R_E^3}$

Q9 Heat Transfer[Step-by-step solution > prepwisar.in/questions/EhWwUZeI4B](https://www.prepwisar.in/questions/EhWwUZeI4B)

Two thin metallic spherical shells of radii r_1 and r_2 ($r_1 < r_2$) are placed with their centres coinciding. A material of thermal conductivity K is filled in the space between the shells. The inner shell is maintained at temperature θ_1 and the outer shell at temperature θ_2 ($\theta_1 < \theta_2$). The rate at which heat flows radially through the material is :-

(A) $\frac{4\pi K r_1 r_2 (\theta_2 - \theta_1)}{r_2 - r_1}$

(B) $\frac{\pi r_1 r_2 (\theta_2 - \theta_1)}{r_2 - r_1}$

(C) $\frac{K(\theta_2 - \theta_1)}{r_2 - r_1}$

(D) $\frac{K(\theta_2 - \theta_1)(r_2 - r_1)}{4\pi r_1 r_2}$

Q10 Kinetic Theory of Gases[Step-by-step solution > prepwisar.in/questions/nqXkUFb4bl](https://www.prepwisar.in/questions/nqXkUFb4bl)

A mixture of hydrogen and oxygen has volume 500 cm^3 , temperature 300 K , pressure 400 kPa and mass 0.76 g . The ratio of masses of oxygen to hydrogen will be :-

(A) 3 : 8

(B) 3 : 16

(C) 16 : 3

(D) 8 : 3

Q11 Moving Charges & Magnetism[Step-by-step solution > prepwisar.in/questions/H3xyqrbU1Q](https://www.prepwisar.in/questions/H3xyqrbU1Q)

A current of 1.5 A is flowing through a triangle, of side 9 cm each. The magnetic field at the centroid of the triangle is:

(Assume that the current is flowing in the clockwise direction.)

(A) $3 \times 10^{-7} \text{ T}$, outside the plane of triangle

(B) $2\sqrt{3} \times 10^{-7} \text{ T}$, outside the plane of triangle

(C) $2\sqrt{3} \times 10^{-5} \text{ T}$, inside the plane of triangle

(D) $3 \times 10^{-5} \text{ T}$, inside the plane of triangle

Q12 Elasticity[Step-by-step solution > prepwisar.in/questions/MpGwqAjoB6](https://www.prepwisar.in/questions/MpGwqAjoB6)

Four identical hollow cylindrical columns of mild steel support a big structure of mass $50 \times 10^3 \text{ kg}$. The inner and outer radii of each column are 50 cm and 100 cm respectively. Assuming uniform local distribution, calculate the compression strain of each column. [Use $Y = 2.0 \times 10^{11} \text{ Pa}$, $g = 9.8 \text{ m/s}^2$]

(A) 3.60×10^{-8}

(B) 2.60×10^{-7}

(C) 1.87×10^{-3}

(D) 7.07×10^{-4}

Q13 Rotational Motion[Step-by-step solution > prepwisar.in/questions/-83kU60SDC](https://www.prepwisar.in/questions/-83kU60SDC)

A system consists of two identical spheres each of mass 1.5 kg and radius 50 cm at the end of light rod. The distance between the centres of the two spheres is 5 m . What will be the moment of inertia of the system about an axis perpendicular to the rod passing through its midpoint?

(A) 18.75 kgm^2

(B) $1.905 \times 10^5 \text{ kgm}^2$

(C) 19.05 kgm^2

(D) $1.875 \times 10^5 \text{ kgm}^2$

Q14 Simple Harmonic Motion[Step-by-step solution > prepwisar.in/questions/SEffuVhW0Y](https://www.prepwisar.in/questions/SEffuVhW0Y)

A bob of mass ' m ' suspended by a thread of length l undergoes simple harmonic oscillations with time period T . If the bob is immersed in a liquid that has density $\frac{1}{4}$ times that of the bob and the length of the thread is increased by $\frac{1}{3}$ rd of the original length, then the time period of the simple harmonic oscillations will be :-

(A) T

(B) $\frac{3}{2}T$

(C) $\frac{3}{4}T$

(D) $\frac{4}{3}T$

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For a body executing S.H.M.:

- (1) Potential energy is always equal to its K.E.
- (2) Average potential and kinetic energy over any given time interval are always equal.
- (3) Sum of the kinetic and potential energy at any point of time is constant.
- (4) Average K.E. in one time period is equal to average potential energy in one time period.

Choose the most appropriate option from the options given below:

- (A) (3) and (4) (B) only (3) (C) (2) and (3) (D) only (2)

A block moving horizontally on a smooth surface with a speed of 40 m/s splits into two parts with masses in the ratio of 1 : 2. If the smaller part moves at 60 m/s in the same direction, then the fractional change in kinetic energy is :-

- (A) $\frac{1}{3}$ (B) $\frac{2}{3}$ (C) $\frac{1}{8}$ (D) $\frac{1}{4}$

If velocity [V], time [T] and force [F] are chosen as the base quantities, the dimensions of the mass will be:

- (A) $[FT^{-1} V^{-1}]$ (B) $[FTV^{-1}]$ (C) $[FT^2 V]$ (D) $[FVT^{-1}]$

Statement I:

Two forces $(\vec{P} + \vec{Q})$ and $(\vec{P} - \vec{Q})$ where $\vec{P} \perp \vec{Q}$, when act at an angle θ_1 to each other, the magnitude of their resultant is $\sqrt{3(P^2 + Q^2)}$, when they act at an angle θ_2 , the magnitude of their resultant becomes $\sqrt{2(P^2 + Q^2)}$. This is possible only when $\theta_1 < \theta_2$.

Statement II:

In the situation given above.

$$\theta_1 = 60^\circ \text{ and } \theta_2 = 90^\circ$$

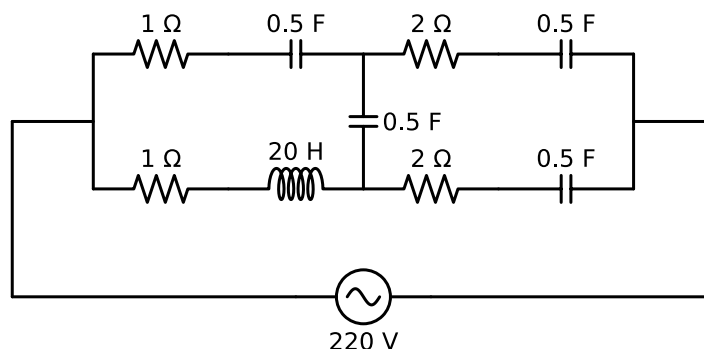
In the light of the above statements, choose the most appropriate answer from the options given below :-

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

Q19 Alternating Current **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/Qhtq6gKDjF](https://www.prepwisar.in/questions/Qhtq6gKDjF)

At very high frequencies, the effective impedance of the given circuit will be _____ Ω .



Q20 Electrostatics II: Potential & Capacitance **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/HKRX-M4pag](https://www.prepwisar.in/questions/HKRX-M4pag)

A parallel plate capacitor of capacitance $200 \mu\text{F}$ is connected to a battery of 200 V . A dielectric slab of dielectric constant 2 is now inserted into the space between plates of capacitor while the battery remain connected. The change in the electrostatic energy in the capacitor will be _____ J.

Q21 Current Electricity **NUMERICAL**

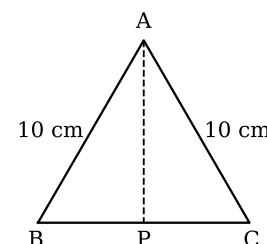
[Step-by-step solution](#) › [prepwisar.in/questions/HQolcMg2ha](https://www.prepwisar.in/questions/HQolcMg2ha)

A resistor dissipates 192 J of energy in 1 s when a current of 4 A is passed through it. Now, when the current is doubled, the amount of thermal energy dissipated in 5 s in _____ J.

Q22 Ray Optics **NUMERICAL**

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

Cross-section view of a prism is the equilateral triangle ABC in the figure. The minimum deviation is observed using this prism when the angle of incidence is equal to the prism angle. The time taken by light to travel from P (midpoint of BC) to A is _____ $\times 10^{-10} \text{ s}$. (Given, speed of light in vacuum = $3 \times 10^8 \text{ m/s}$ and $\cos 30^\circ = \frac{\sqrt{3}}{2}$)



Q23 Thermodynamics **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/RcNPrs4iXS](https://www.prepwisar.in/questions/RcNPrs4iXS)

A sample of gas with $\gamma = 1.5$ is taken through an adiabatic process in which the volume is compressed from 1200 cm^3 to 300 cm^3 . If the initial pressure is 200 kPa . The absolute value of the workdone by the gas in the process = _____ J.

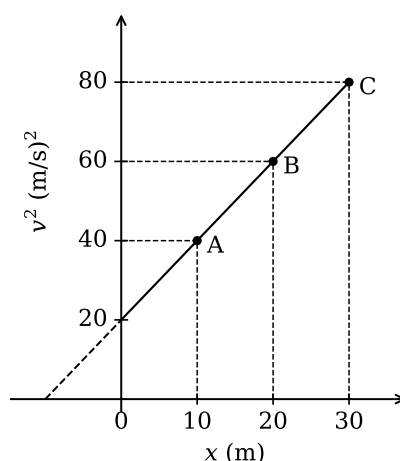
Q24 Magnetism & Matter **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/_rePYTdM4P](https://www.prepwisar.in/questions/_rePYTdM4P)

A long solenoid with 1000 turns/m has a core material with relative permeability 500 and volume 10^3 cm^3 . If the core material is replaced by another material having relative permeability of 750 with same volume maintaining same current of 0.75 A in the solenoid, the fractional change in the magnetic moment of the core would be approximately $\left(\frac{x}{499}\right)$. Find the value of x .

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A particle is moving with constant acceleration 'a'. Following graph shows v^2 versus x (displacement) plot. The acceleration of the particle is _____ m/s^2 .

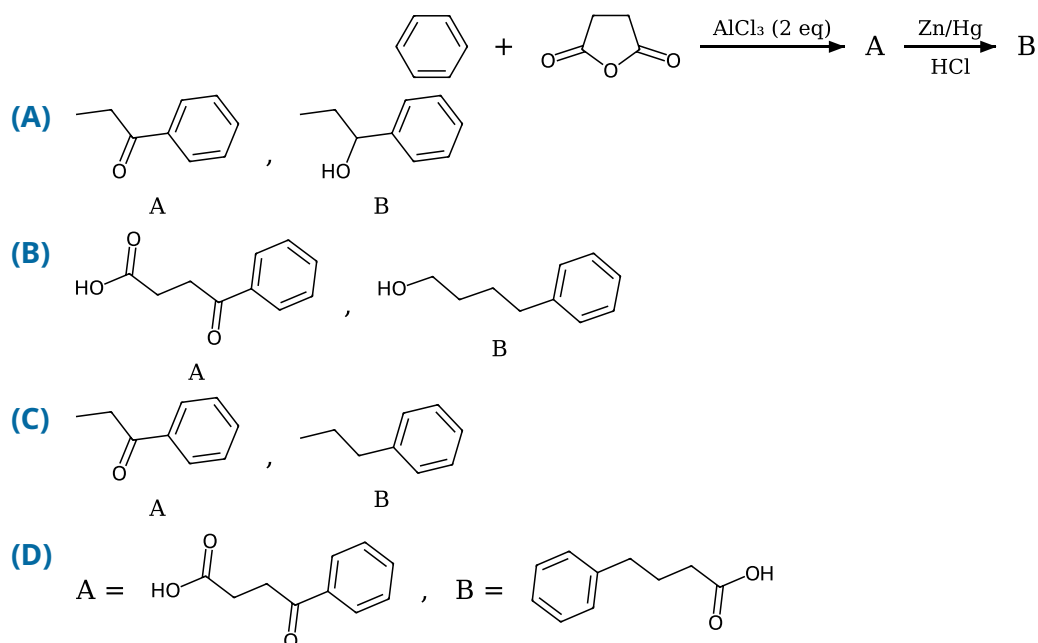


In a Young's double slit experiment, the slits are separated by 0.3 mm and the screen is 1.5 m away from the plane of slits. Distance between fourth bright fringes on both sides of central bright is 2.4 cm. The frequency of light used is _____ $\times 10^{14}$ Hz.

The diameter of a spherical bob is measured using a vernier callipers. 9 divisions of the main scale, in the vernier callipers, are equal to 10 divisions of vernier scale. One main scale division is 1 mm. The main scale reading is 10 mm and 8th division of vernier scale was found to coincide exactly with one of the main scale division. If the given vernier callipers has positive zero error of 0.04 cm, then the radius of the bob is _____ $\times 10^{-2}$ cm.

Chemistry Section A · Multiple choice

The structures A and B formed in the following reaction are : [Ph = $\text{—C}_6\text{H}_5$]



Which of the following is not an example of fibrous protein?

- (A) Keratin (B) Albumin (C) Collagen (D) Myosin

Spin only magnetic moment in BM of $[\text{Fe}(\text{CO})_4(\text{C}_2\text{O}_4)]^+$ is:

- (A) 5.92 (B) 0 (C) 1 (D) 1.73

The Eu^{2+} ion is a strong reducing agent in spite of its ground state electronic configuration (outermost) : [Atomic number of Eu = 63]

- (A) $4f^7 6s^2$ (B) $4f^6$ (C) $4f^7$ (D) $4f^6 6s^2$

Match List - I with List - II

	List - I (Parameter)		List - II (Unit)
(a)	Cell constant	(i)	$\text{Scm}^2\text{mol}^{-1}$
(b)	Molar conductivity	(ii)	Dimensionless
(c)	Conductivity	(iii)	m^{-1}
(d)	Degree of dissociation of electrolyte	(iv)	$\Omega^{-1}\text{m}^{-1}$

Choose the most appropriate 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)-(iv), (c)-(iii), (d)-(ii) (D) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

Which one of the following statements is incorrect?

- (A) Atomic hydrogen is produced when H_2 molecules at a high temperature are irradiated with UV radiation.
(B) At around 2000 K, the dissociation of dihydrogen into its atoms is nearly 8.1%
(C) Bond dissociation enthalpy of H_2 is highest among diatomic gaseous molecules which contain a single bond.
(D) Dihydrogen is produced on reacting zinc with HCl as well as $\text{NaOH}_{(\text{aq})}$.

Which one of the following correctly represents the order of stability of oxides, X_2O ; (X = halogen)?

- (A) $\text{Br} > \text{Cl} > \text{I}$ (B) $\text{Br} > \text{I} > \text{Cl}$ (C) $\text{Cl} > \text{I} > \text{Br}$ (D) $\text{I} > \text{Cl} > \text{Br}$

The number of S = O bonds present in sulphurous acid, peroxodisulphuric acid and pyrosulphuric acid, respectively are:

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

Which among the following is not a polyester?

- (A) Novolac (B) PHBV (C) Dacron (D) Glyptal

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

Assertion (A) : Lithium salts are hydrated.

Reason (R) : Lithium has higher polarising power than other alkali metal group members.

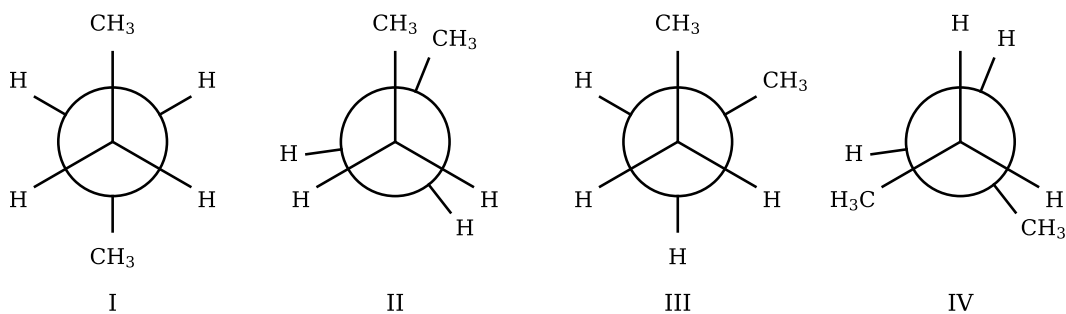
In the light of the above statements, choose the most appropriate answer from the options given below:

- (A) Both (A) and (R) are correct but (R) is not 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 and (R) is the correct explanation of (A)

The incorrect expression among the following is:

- (A) $\frac{\Delta G_{System}}{\Delta S_{Total}} = -T$ (at constant P)
 (B) $K = \frac{\Delta H^\circ - T\Delta S^\circ}{RT}$
 (C) $K = e^{-\Delta G^\circ/RT}$
 (D) For isothermal process $w_{reversible} = -nRT \ln \frac{V_f}{V_i}$

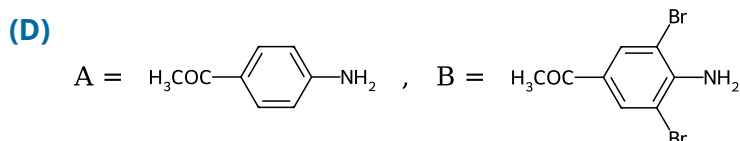
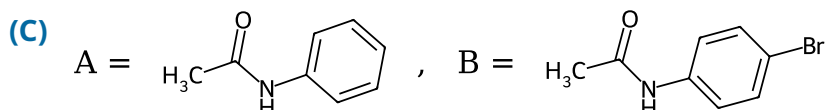
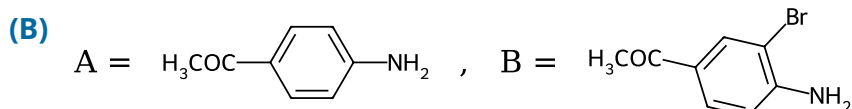
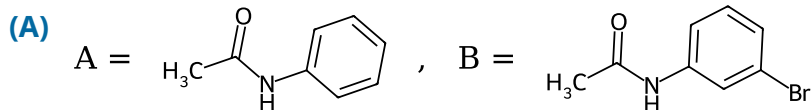
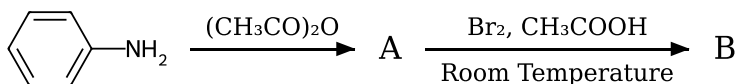
Arrange the following conformational isomers of n-butane in order of their increasing potential energy:



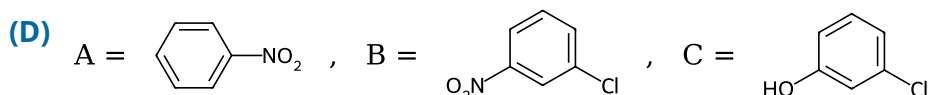
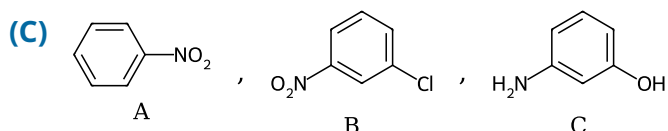
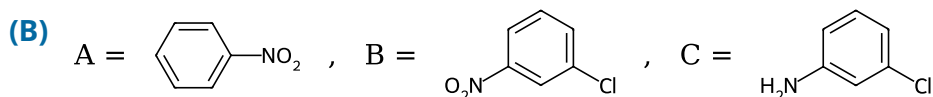
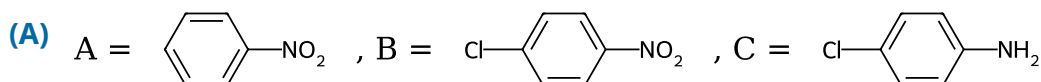
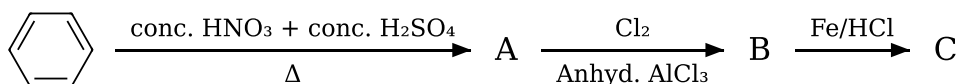
- (A) II < III < IV < I (B) I < IV < III < II (C) II < IV < III < I (D) I < III < IV < II

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The major products A and B formed in the following reaction sequence are:



Identify correct A, B and C in the reaction sequence given below:



Match List - I with List - II:

	List - I (Metal Ion)		List - II (Group of Qualitative analysis)
(a)	Mn^{2+}	(i)	Group - III
(b)	As^{3+}	(ii)	Group - IIA
(c)	Cu^{2+}	(iii)	Group - IV
(d)	Al^{3+}	(iv)	Group - IIB

Choose the most appropriate answer from the options given below:

(A) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

(B) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

(C) (a)-(i), (b)-(iv), (c)-(ii), (d)-(iii)

(D) (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)

Q43 Chemical Bonding & Molecular Structure **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/oxbhpgA9mX

According to molecular orbital theory, the number of unpaired electron(s) in O_2^{2-} is:

Q44 Chemical Kinetics **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/a4EfBU4y9I

For the reaction $A \rightarrow B$, the rate constant k (in s^{-1}) is given by

$$\log_{10} k = 20.35 - \frac{(2.47 \times 10^3)}{T}$$

The energy of activation in kJ mol^{-1} is _____. (Nearest integer) [Given : $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$]

Q45 Atomic Structure **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/4DC7ykfGQc

The value of magnetic quantum number of the outermost electron of Zn^+ ion is _____.

Q46 Ionic Equilibrium **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/SYL0Pf6UNc

The pH of a solution obtained by mixing 50 mL of 1 M HCl and 30 mL of 1 M NaOH is $x \times 10^{-4}$. The value of x is _____. (Nearest integer) [$\log 2.5 = 0.3979$]

Q47 Metallurgy **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/ObvncBBSLx

In the electrolytic refining of blister copper, the total number of main impurities, from the following, removed as anode mud is _____

Pb, Sb, Se, Te, Ru, Ag, Au and Pt

Q48 Solid State **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/WdPrkHue1c

The empirical formula for a compound with a cubic close packed arrangement of anions and with cations occupying all the octahedral sites in A_xB . The value of x is _____. (Integer answer)

Q49 Solutions & Colligative Properties **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/YBjrUOoctU

1.22 g of an organic acid is separately dissolved in 100 g of benzene ($K_b = 2.6 \text{ K kg mol}^{-1}$) and 100 g of acetone ($K_b = 1.7 \text{ K kg mol}^{-1}$). The acid is known to dimerize in benzene but remain as a monomer in acetone. The boiling point of the solution in acetone increases by 0.17°C . The increase in boiling point of solution in benzene in $^\circ\text{C}$ is $x \times 10^{-2}$. The value of x is _____. (Nearest integer) [Atomic mass : C = 12.0, H = 1.0, O = 16.0]

Q50 Mole Concept & Stoichiometry **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/GluBMQKEbu

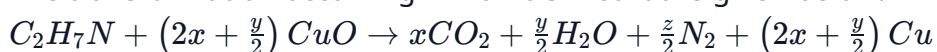
Sodium oxide reacts with water to produce sodium hydroxide. 20.0 g of sodium oxide is dissolved in 500 mL of water. Neglecting the change in volume, the concentration of the resulting NaOH solution is _____ $\times 10^{-1} \text{ M}$. (Nearest integer) [Atomic mass : Na = 23.0, O = 16.0, H = 1.0]

Q51 Surface Chemistry **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/AWEJp6J5iA

CH_4 is absorbed on 1 g charcoal at 0°C following the Freundlich adsorption isotherm 10.0 mL of CH_4 is adsorbed at 100 mm of Hg, whereas 15.0 mL is adsorbed at 200 mm of Hg. The volume of CH_4 adsorbed at 300 mm of Hg is 10^x mL . The value of x is _____ $\times 10^{-2}$. (Nearest integer) [Use $\log_{10} 2 = 0.3010$, $\log_{10} 3 = 0.4771$]

Q52 Purification & Characterisation of Organic Compounds **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/CCrZ89rqqu

The transformation occurring in Duma's method is given below:



The value of y is _____. (Integer answer)

Q53 Three Dimensional Geometry

[Step-by-step solution](#) › [prepwisar.in/questions/her5N5bu9z](https://www.prepwisar.in/questions/her5N5bu9z)

The distance of the point $(-1, 2, -2)$ from the line of intersection of the planes $2x + 3y + 2z = 0$ and $x - 2y + z = 0$ is:

- (A) $\frac{1}{\sqrt{2}}$ (B) $\frac{5}{2}$ (C) $\frac{\sqrt{42}}{2}$ (D) $\frac{\sqrt{34}}{2}$

Q54 Complex Numbers

[Step-by-step solution](#) › [prepwisar.in/questions/yKFVlggU02](https://www.prepwisar.in/questions/yKFVlggU02)

If z is a complex number such that $\frac{z-i}{z-1}$ is purely imaginary, then the minimum value of $|z - (3 + 3i)|$ is:

- (A) $2\sqrt{2} - 1$ (B) $3\sqrt{2}$ (C) $6\sqrt{2}$ (D) $2\sqrt{2}$

Q55 Definite Integration

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

If $[x]$ is the greatest integer $\leq x$, then

$$\pi^2 \int_0^2 \left(\sin \frac{\pi x}{2} \right) (x - [x])^{[x]} dx$$

is equal to:

- (A) $2(\pi - 1)$ (B) $4(\pi - 1)$ (C) $4(\pi + 1)$ (D) $2(\pi + 1)$

Q56 Differential Equations

[Step-by-step solution](#) › [prepwisar.in/questions/zytXV0f1AB](https://www.prepwisar.in/questions/zytXV0f1AB)

If

$$\frac{dy}{dx} = \frac{2^x y + 2^y \cdot 2^x}{2^x + 2^{x+y} \log_e 2}$$

, $y(0) = 0$, then for $y = 1$, the value of x lies in the interval:

- (A) $(1, 2)$ (B) $\left(\frac{1}{2}, 1\right]$ (C) $(2, 3)$ (D) $\left(0, \frac{1}{2}\right]$

Q57 Differential Equations

[Step-by-step solution](#) › [prepwisar.in/questions/E8JyZaSrNG](https://www.prepwisar.in/questions/E8JyZaSrNG)

If

$$y \frac{dy}{dx} = x \left[\frac{y^2}{x^2} + \frac{\phi\left(\frac{y^2}{x^2}\right)}{\phi'\left(\frac{y^2}{x^2}\right)} \right]$$

, $x > 0$, $\phi > 0$, and $y(1) = -1$, then $\phi\left(\frac{y^2}{4}\right)$ is equal to:

- (A) $4\phi(2)$ (B) $4\phi(1)$ (C) $2\phi(1)$ (D) $\phi(1)$

Q58 Ellipse

[Step-by-step solution](#) › [prepwisar.in/questions/e9D_4_IHyK](https://www.prepwisar.in/questions/e9D_4_IHyK)

The locus of mid-points of the line segments joining $(-3, -5)$ and the points on the ellipse $\frac{x^2}{4} + \frac{y^2}{9} = 1$ is:

- (A) $9x^2 + 4y^2 + 18x + 8y + 145 = 0$ (B) $36x^2 + 16y^2 + 90x + 56y + 145 = 0$
(C) $36x^2 + 16y^2 + 108x + 80y + 145 = 0$ (D) $36x^2 + 16y^2 + 72x + 32y + 145 = 0$

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Q59 Ellipse[Step-by-step solution](https://www.prepwisar.in/questions/7-H1yfVWVR)

An angle of intersection of the curves, $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ and $x^2 + y^2 = ab$, $a > b$, is:

- (A) $\tan^{-1} \left(\frac{a+b}{\sqrt{ab}} \right)$ (B) $\tan^{-1} \left(\frac{a-b}{2\sqrt{ab}} \right)$ (C) $\tan^{-1} \left(\frac{a-b}{\sqrt{ab}} \right)$ (D) $\tan^{-1} (2\sqrt{ab})$

Q60 Functions (Advanced)[Step-by-step solution](https://www.prepwisar.in/questions/JyCj2oOQuj)

Let $f: \mathbb{N} \rightarrow \mathbb{N}$ be a function such that $f(m+n) = f(m) + f(n)$ for every $m, n \in \mathbb{N}$. If $f(6) = 18$, then $f(2) \cdot f(3)$ is equal to:

- (A) 6 (B) 54 (C) 18 (D) 36

Q61 Inverse Trigonometric Functions[Step-by-step solution](https://www.prepwisar.in/questions/KtXI0BeGnZ)

The domain of the function

$$f(x) = \sin^{-1} \left(\frac{3x^2 + x - 1}{(x-1)^2} \right) + \cos^{-1} \left(\frac{x-1}{x+1} \right)$$

is:

- (A) $\left[0, \frac{1}{4} \right]$ (B) $[-2, 0] \cup \left[\frac{1}{4}, \frac{1}{2} \right]$ (C) $\left[\frac{1}{4}, \frac{1}{2} \right] \cup \{0\}$ (D) $\left[0, \frac{1}{2} \right]$

Q62 Limits[Step-by-step solution](https://www.prepwisar.in/questions/2mrBjoynDW)

If

$$\alpha = \lim_{x \rightarrow \frac{\pi}{4}} \frac{\tan^3 x - \tan x}{\cos \left(x + \frac{\pi}{4} \right)}$$

and $\beta = \lim_{x \rightarrow 0} (\cos x)^{\cot x}$ are the roots of the equation, $ax^2 + bx - 4 = 0$, then the ordered pair (a, b) is:

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

Q63 Applications of Derivatives[Step-by-step solution](https://www.prepwisar.in/questions/1D0aiA_D4-)

Let f be any continuous function on $[0, 2]$ and twice differentiable on $(0, 2)$. If $f(0) = 0$, $f(1) = 1$ and $f(2) = 2$, then

- (A) $f''(x) = 0$ for all $x \in (0, 2)$ (B) $f''(x) = 0$ for some $x \in (0, 2)$
(C) $f'(x) = 0$ for some $x \in [0, 2]$ (D) $f''(x) > 0$ for all $x \in (0, 2)$

Q64 Determinants[Step-by-step solution](https://www.prepwisar.in/questions/dXKQg2BRPu)

If $\alpha + \beta + \gamma = 2\pi$, then the system of equations

$$x + (\cos \gamma)y + (\cos \beta)z = 0$$

$$(\cos \gamma)x + y + (\cos \alpha)z = 0$$

$$(\cos \beta)x + (\cos \alpha)y + z = 0$$

has:

- (A) no solution (B) infinitely many solution
(C) exactly two solutions (D) a unique solution

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Let $S = \{1, 2, 3, 4, 5, 6\}$. Then the probability that a randomly chosen onto function g from S to S satisfies $g(3) = 2g(1)$ is:

(A) $\frac{1}{10}$

(B) $\frac{1}{15}$

(C) $\frac{1}{5}$

(D) $\frac{1}{30}$

The sum of the roots of the equation

$$x + 1 - 2\log_2(3 + 2^x) + 2\log_4(10 - 2^{-x}) = 0, \text{ is:}$$

(A) $\log_2 14$

(B) $\log_2 11$

(C) $\log_2 12$

(D) $\log_2 13$

Let $a_1, a_2, a_3, \dots$ be an A.P. If

$$\frac{a_1 + a_2 + \dots + a_{10}}{a_1 + a_2 + \dots + a_p} = \frac{100}{p^2}$$

, $p \neq 10$, then $\frac{a_{11}}{a_{10}}$ is equal to:

(A) $\frac{19}{21}$

(B) $\frac{100}{121}$

(C) $\frac{21}{19}$

(D) $\frac{121}{100}$

The mean and variance of 7 observations are 8 and 16 respectively. If two observations are 6 and 8, then the variance of the remaining 5 observations is:

(A) $\frac{92}{5}$

(B) $\frac{134}{5}$

(C) $\frac{536}{25}$

(D) $\frac{112}{5}$

The number of solutions of the equation $32^{\tan^2 x} + 32^{\sec^2 x} = 81$, $0 \leq x \leq \frac{\pi}{4}$ is:

(A) 3

(B) 1

(C) 0

(D) 2

Let $\vec{a}, \vec{b}, \vec{c}$ three vectors mutually perpendicular to each other and have same magnitude. If a vector $\vec{r}$ satisfies.

$$\vec{a} \times \{(\vec{r} - \vec{b}) \times \vec{a}\} + \vec{b} \times \{(\vec{r} - \vec{c}) \times \vec{b}\} + \vec{c} \times \{(\vec{r} - \vec{a}) \times \vec{c}\} = \vec{0}$$

, then $\vec{r}$ is equal to:

(A) $\frac{1}{3}(\vec{a} + \vec{b} + \vec{c})$

(B) $\frac{1}{3}(2\vec{a} + \vec{b} - \vec{c})$

(C) $\frac{1}{2}(\vec{a} + \vec{b} + \vec{c})$

(D) $\frac{1}{2}(\vec{a} + \vec{b} + 2\vec{c})$

Let A be the set of all points (α, β) such that the area of triangle formed by the points (5, 6), (3, 2) and (α, β) is 12 square units. Then the least possible length of a line segment joining the origin to a point in A, is:

(A) $\frac{4}{\sqrt{5}}$

(B) $\frac{16}{\sqrt{5}}$

(C) $\frac{8}{\sqrt{5}}$

(D) $\frac{12}{\sqrt{5}}$

Q72 Three Dimensional Geometry **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/d-tOc8d7Cj

Suppose, the line $\frac{x-2}{\alpha} = \frac{y-2}{-5} = \frac{z+2}{2}$ lies on the plane $x + 3y - 2z + \beta = 0$. Then $(\alpha + \beta)$ is equal to _____.

Q73 Applications of Derivatives **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/NcIs9izpMJ

Let $f(x)$ be a cubic polynomial with $f(1) = -10$, $f(-1) = 6$, and has a local minima at $x = 1$, and $f'(x)$ has a local minima at $x = -1$. Then $f(3)$ is equal to _____.

Q74 Binomial Theorem **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/qUq40ufELB

If the coefficient of a^7b^8 in the expansion of $(a + 2b + 4ab)^{10}$ is $K \cdot 2^{16}$, then K is equal to _____.

Q75 Circles **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/IXNb0Use6D

Let B be the centre of the circle $x^2 + y^2 - 2x + 4y + 1 = 0$. Let the tangents at two points P and Q on the circle intersect at the point $A(3, 1)$. Then $8 \cdot \left(\frac{\text{area } \triangle APQ}{\text{area } \triangle BPQ} \right)$ is equal to _____.

Q76 Matrices **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/SqNdpks2eN

The number of elements in the set

$$\left\{ A = \begin{pmatrix} a & b \\ 0 & d \end{pmatrix} : a, b, d \in \{-1, 0, 1\} \text{ and } (I - A)^3 = I - A^3 \right\}$$

, where I is 2×2 identity matrix, is:

Q77 Parabola **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/20kFIkR31F

A tangent line L is drawn at the point $(2, -4)$ on the parabola $y^2 = 8x$. If the line L is also tangent to the circle $x^2 + y^2 = a$, then 'a' is equal to _____.

Q78 Permutations & Combinations **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/9yg73nBcS3

The number of 4-digit numbers which are neither multiple of 7 nor multiple of 3 is _____.

Q79 Sequences & Series **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/ADQr91BVHj

If

$$S = \frac{7}{5} + \frac{9}{5^2} + \frac{13}{5^3} + \frac{19}{5^4} + \dots$$

, then $160S$ is equal to _____.

Q80 Area Under Curves **NUMERICAL**

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

If the line $y = mx$ bisects the area enclosed by the lines $x = 0$, $y = 0$, $x = \frac{3}{2}$ and the curve $y = 1 + 4x - x^2$, then $12m$ is equal to _____.

Q81 Indefinite Integration **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/CCS3Uf_kbW

If $\int \frac{\sin x}{\sin^3 x + \cos^3 x} dx =$

$\alpha \log_e |1 + \tan x| + \beta \log_e |1 - \tan x + \tan^2 x| + \gamma \tan^{-1} \left(\frac{2 \tan x - 1}{\sqrt{3}} \right) + C$, when C is constant of integration, then the value of $18(\alpha + \beta + \gamma^2)$ is _____.

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Physics

1. D	2. C	3. C	4. C	5. B	6. D	7. C	8. D
9. A	10. C	11. D	12. B	13. C	14. D	15. A	16. C
17. B	18. B	19. 2	20. 4	21. 3840	22. 5	23. 480	24. 250
25. 1	26. 5	27. 52					

Chemistry

28. D	29. B	30. D	31. C	32. A	33. B	34. D	35. D
36. A	37. A	38. B	39. D	40. C	41. B	42. B	43. 0
44. 47	45. 0	46. 6021	47. 6	48. 1	49. 13	50. 13	51. 128
52. 7							

Mathematics

53. D	54. D	55. B	56. A	57. B	58. C	59. C	60. B
61. C	62. D	63. B	64. B	65. A	66. B	67. C	68. C
69. B	70. C	71. C	72. 7	73. 22	74. 315	75. 18	76. 8
77. 2	78. 5143	79. 305	80. 26	81. 3			

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