

JEE MAIN 2022 · QUESTION PAPER

26 Jul 2022 **Shift 2**

83 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	9 Q47 to Q55
● Mathematics	18 Q56 to Q73	10 Q74 to Q83
In this PDF		
83 questions · answer key at the end		

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

Attempt this paper online

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

prepwis.in/pyqs/paper/2022-07-26-evening · Free, no signup needed to start

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

[Step-by-step solution](#) › [prepwisar.in/questions/8qFw5HbORA](https://www.prepwisar.in/questions/8qFw5HbORA)

A nucleus of mass M at rest splits into two parts having masses $\frac{M'}{3}$ and $\frac{2M'}{3}$ ($M' < M$). The ratio of de Broglie wavelength of two parts will be:

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

Q2 Nuclear Physics

[Step-by-step solution](#) › [prepwisar.in/questions/-b3chPBOeg](https://www.prepwisar.in/questions/-b3chPBOeg)

Mass numbers of two nuclei are in the ratio of 4 : 3. Their nuclear densities will be in the ratio of

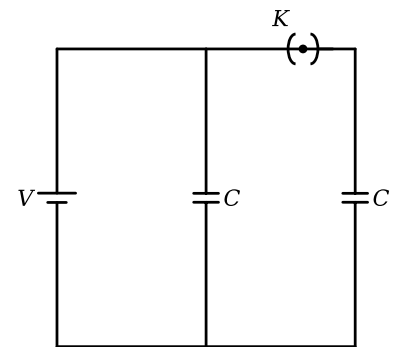
- (A) 4 : 3 (B) $\left(\frac{3}{4}\right)^{\frac{1}{3}}$ (C) 1 : 1 (D) $\left(\frac{4}{3}\right)^{\frac{1}{3}}$

Q3 Electrostatics II: Potential & Capacitance

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

A source of potential difference V is connected to the combination of two identical capacitors as shown in the figure. When key ' K ' is closed, the total energy stored across the combination is E_1 . Now key ' K ' is opened and dielectric of dielectric constant 5 is introduced between the plates of the capacitors. The total energy stored across the combination is now E_2 . The ratio E_1/E_2 will be:

- (A) $\frac{1}{10}$ (B) $\frac{2}{5}$ (C) $\frac{5}{13}$ (D) $\frac{5}{26}$



Q4 Centre of Mass & Linear Momentum

[Step-by-step solution](#) › [prepwisar.in/questions/R3IIar2951](https://www.prepwisar.in/questions/R3IIar2951)

A ball of mass 0.15kg hits the wall with its initial speed of 12ms^{-1} and bounces back without changing its initial speed. If the force applied by the wall on the ball during the contact is 100N , calculate the time duration of the contact of ball with the wall.

- (A) 0.018 s (B) 0.036 s (C) 0.009 s (D) 0.072 s

Q5 Work, Energy & Power

[Step-by-step solution](#) › [prepwisar.in/questions/_NFgKKd_8I](https://www.prepwisar.in/questions/_NFgKKd_8I)

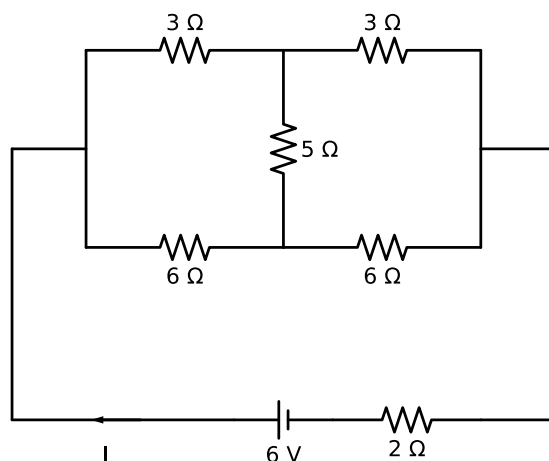
A body of mass 8kg and another of mass 2kg are moving with equal kinetic energy. The ratio of their respective momentum will be:

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

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Q6 Current Electricity[Step-by-step solution](https://www.prepwiser.in/questions/vwA8usf45p) > prepwiser.in/questions/vwA8usf45p

A battery of $6V$ is connected to the circuit as shown below. The current I drawn from the battery is:



- (A) 1A (B) 2A (C) $\frac{6}{11}$ A (D) $\frac{4}{3}$ A

Q7 Electromagnetic Waves[Step-by-step solution](https://www.prepwiser.in/questions/KDkV8628IO) > prepwiser.in/questions/KDkV8628IO

The oscillating magnetic field in a plane electromagnetic wave is given by

$B_y = 5 \times 10^{-6} \sin 1000\pi (5x - 4 \times 10^8 t)$ T. The amplitude of electric field will be:

- (A) $15 \times 10^2 \text{ Vm}^{-1}$ (B) $5 \times 10^{-6} \text{ Vm}^{-1}$ (C) $16 \times 10^{12} \text{ Vm}^{-1}$ (D) $4 \times 10^2 \text{ Vm}^{-1}$

Q8 Moving Charges & Magnetism[Step-by-step solution](https://www.prepwiser.in/questions/rGs-FmashB) > prepwiser.in/questions/rGs-FmashB

A velocity selector consists of electric field $\vec{E} = E \hat{k}$ and magnetic field $\vec{B} = B \hat{j}$ with $B = 12 \text{ mT}$. The value of E required for an electron of energy 728 eV moving along the positive x -axis to pass undeflected is:

(Given, mass of electron = $9.1 \times 10^{-31} \text{ kg}$)

- (A) 192 kVm^{-1} (B) 192 mVm^{-1} (C) 9600 kVm^{-1} (D) 16 kVm^{-1}

Q9 Electrostatics I: Charges, Field & Gauss's Law[Step-by-step solution](https://www.prepwiser.in/questions/DcnHfsNPiY) > prepwiser.in/questions/DcnHfsNPiY

Two uniformly charged spherical conductors A and B of radii 5 mm and 10 mm are separated by a distance of 2 cm . If the spheres are connected by a conducting wire, then in equilibrium condition, the ratio of the magnitudes of the electric fields at the surface of the sphere A and B will be:

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

Q10 Ray Optics[Step-by-step solution](https://www.prepwiser.in/questions/2W7xvlcoRD) > prepwiser.in/questions/2W7xvlcoRD

Light travels in two media M_1 and M_2 with speeds $1.5 \times 10^8 \text{ ms}^{-1}$ and $2.0 \times 10^8 \text{ ms}^{-1}$ respectively. The critical angle between them is:

- (A) $\tan^{-1} \left(\frac{3}{\sqrt{7}} \right)$ (B) $\tan^{-1} \left(\frac{2}{3} \right)$ (C) $\cos^{-1} \left(\frac{3}{4} \right)$ (D) $\sin^{-1} \left(\frac{2}{3} \right)$

Q11 Gravitation[Step-by-step solution](https://www.prepwiser.in/questions/QO1N8yYT2a) > prepwiser.in/questions/QO1N8yYT2a

A body is projected vertically upwards from the surface of earth with a velocity equal to one third of escape velocity. The maximum height attained by the body will be:

(Take radius of earth = 6400 km and $g = 10 \text{ ms}^{-2}$)

- (A) 800 km (B) 1600 km (C) 2133 km (D) 4800 km

Q12 Heat Transfer[Step-by-step solution](#) > [prepwisar.in/questions/immgt5njSk](https://www.prepwisar.in/questions/immgt5njSk)

An ice cube of dimensions $60\text{cm} \times 50\text{cm} \times 20\text{cm}$ is placed in an insulation box of wall thickness 1cm . The box keeping the ice cube at 0°C of temperature is brought to a room of temperature 40°C . The rate of melting of ice is approximately:

(Latent heat of fusion of ice is $3.4 \times 10^5 \text{Jkg}^{-1}$ and thermal conducting of insulation wall is $0.05 \text{Wm}^{-1}\text{C}^{-1}$)

- (A) $61 \times 10^{-3} \text{kgs}^{-1}$ (B) $61 \times 10^{-5} \text{kgs}^{-1}$ (C) 208kgs^{-1} (D) $30 \times 10^{-5} \text{kgs}^{-1}$

Q13 Kinetic Theory of Gases[Step-by-step solution](#) > [prepwisar.in/questions/4XFBhtBR63](https://www.prepwisar.in/questions/4XFBhtBR63)

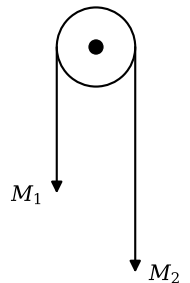
A gas has n degrees of freedom. The ratio of specific heat of gas at constant volume to the specific heat of gas at constant pressure will be:

- (A) $\frac{n}{n+2}$ (B) $\frac{n+2}{n}$ (C) $\frac{n}{2n+2}$ (D) $\frac{n}{n-2}$

Q14 Newton's Laws of Motion[Step-by-step solution](#) > [prepwisar.in/questions/PVz-fw7Hzf](https://www.prepwisar.in/questions/PVz-fw7Hzf)

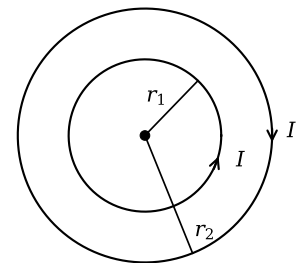
Two masses M_1 and M_2 are tied together at the two ends of a light inextensible string that passes over a frictionless pulley. When the mass M_2 is twice that of M_1 , the acceleration of the system is a_1 . When the mass M_2 is thrice that of M_1 , the acceleration of the system is a_2 . The ratio $\frac{a_1}{a_2}$ will be:

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

**Q15** Moving Charges & Magnetism[Step-by-step solution](#) > [prepwisar.in/questions/V030vzofcl](https://www.prepwisar.in/questions/V030vzofcl)

Two concentric circular loops of radii $r_1 = 30\text{cm}$ and $r_2 = 50\text{cm}$ are placed in X – Y plane as shown in the figure. A current $I = 7\text{A}$ is flowing through them in the direction as shown in figure. The net magnetic moment of this system of two circular loops is approximately:

- (A) $\frac{7}{2} \hat{k} \text{Am}^2$ (B) $-\frac{7}{2} \hat{k} \text{Am}^2$ (C) $7 \hat{k} \text{Am}^2$ (D) $-7 \hat{k} \text{Am}^2$

**Q16** Projectile Motion & Relative Motion[Step-by-step solution](#) > [prepwisar.in/questions/QMTC6R0ShM](https://www.prepwisar.in/questions/QMTC6R0ShM)

Two projectiles are thrown with same initial velocity making an angle of 45° and 30° with the horizontal respectively. The ratio of their respective ranges will be:

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

Q17 Elasticity[Step-by-step solution](#) > [prepwisar.in/questions/-TePpTp98O](https://www.prepwisar.in/questions/-TePpTp98O)

The area of cross section of the rope used to lift a load by a crane is $2.5 \times 10^{-4} \text{m}^2$. The maximum lifting capacity of the crane is 10 metric tons. To increase the lifting capacity of the crane to 25 metric tons, the required area of cross section of the rope should be:

(take $g = 10 \text{ms}^{-2}$)

- (A) $6.25 \times 10^{-4} \text{m}^2$ (B) $10 \times 10^{-4} \text{m}^2$ (C) $1 \times 10^{-4} \text{m}^2$ (D) $1.67 \times 10^{-4} \text{m}^2$

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Q18 Mechanical Waves[Step-by-step solution](https://www.prepwiser.in/questions/muFzmEt6yo) > prepwiser.in/questions/muFzmEt6yo

A transverse wave is represented by $y = 2 \sin(\omega t - kx)$ cm. The value of wavelength (in cm) for which the wave velocity becomes equal to the maximum particle velocity, will be:

- (A) 4π (B) 2π (C) π (D) 2

Q19 Experimental Skills[Step-by-step solution](https://www.prepwiser.in/questions/gDjHEAptJx) > prepwiser.in/questions/gDjHEAptJx

In a Vernier Calipers, 10 divisions of Vernier scale is equal to the 9 divisions of main scale. When both jaws of Vernier calipers touch each other, the zero of the Vernier scale is shifted to the left of zero of the main scale and 4th Vernier scale division exactly coincides with the main scale reading. One main scale division is equal to 1mm. While measuring diameter of a spherical body, the body is held between two jaws. It is now observed that zero of the Vernier scale lies between 30 and 31 divisions of main scale reading and 6th Vernier scale division exactly coincides with the main scale reading. The diameter of the spherical body will be:

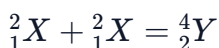
- (A) 3.02 cm (B) 3.06 cm (C) 3.10 cm (D) 3.20 cm

Physics Section B · Numerical value

Q20 to Q29

Q20 Nuclear Physics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/TudFujk_BN) > prepwiser.in/questions/TudFujk_BN

Two lighter nuclei combine to form a comparatively heavier nucleus by the relation given below:



The binding energies per nucleon for ${}^2_1X$ and ${}^4_2Y$ are 1.1 MeV and 7.6 MeV respectively. The energy released in this process is _____ MeV.

Q21 Current Electricity **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/S4AJ8_ScSW) > prepwiser.in/questions/S4AJ8_ScSW

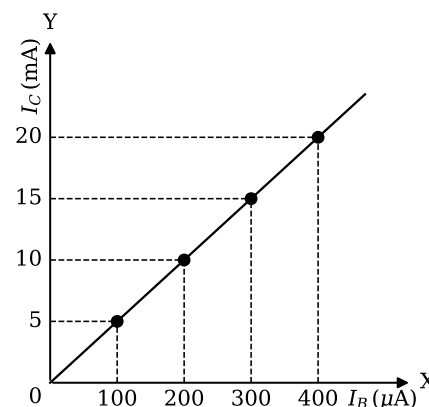
A potentiometer wire of length 300cm is connected in series with a resistance $780\ \Omega$ and a standard cell of emf 4V. A constant current flows through potentiometer wire. The length of the null point for cell of emf 20 mV is found to be 60cm. The resistance of the potentiometer wire is _____ Ω .

Q22 Electromagnetic Induction **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/OSW14OP8YQ) > prepwiser.in/questions/OSW14OP8YQ

In a coil of resistance $8\ \Omega$, the magnetic flux due to an external magnetic field varies with time as $\phi = \frac{2}{3}(9 - t^2)$. The value of total heat produced in the coil, till the flux becomes zero, will be _____ J.

Q23 Semiconductors & Electronic Devices **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/3fsyZPjQz2) > prepwiser.in/questions/3fsyZPjQz2

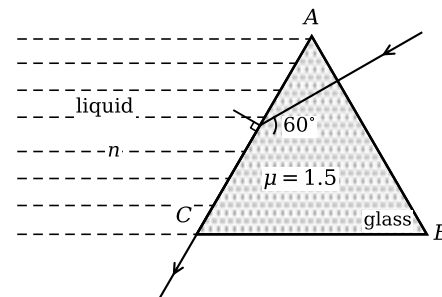
The typical transfer characteristics of a transistor in CE configuration is shown in figure. A load resistor of $2\ k\Omega$ is connected in the collector branch of the circuit used. The input resistance of the transistor is $0.50\ k\Omega$. The voltage gain of the transistor is _____.



Three point charges of magnitude $5\mu\text{C}$, $0.16\mu\text{C}$ and $0.3\mu\text{C}$ are located at the vertices A , B , C of a right angled triangle whose sides are $AB = 3\text{cm}$, $BC = 3\sqrt{2}\text{cm}$ and $CA = 3\text{cm}$ and point A is the right angle corner. Charge at point A experiences _____ N of electrostatic force due to the other two charges.

In the given figure, the face AC of the equilateral prism is immersed in a liquid of refractive index ' n '. For incident angle 60° at the side AC , the refractive light beam just grazes along face AC . The refractive index of the liquid $n = \frac{\sqrt{x}}{4}$. The value of x is _____.

(Given refractive index of glass = 1.5)



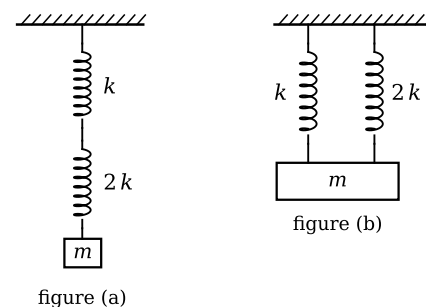
A uniform heavy rod of mass 20kg , cross sectional area 0.4m^2 and length 20m is hanging from a fixed support. Neglecting the lateral contraction, the elongation in the rod due to its own weight is $x \times 10^{-9}\text{m}$. The value of x is _____.

(Given, young modulus $Y = 2 \times 10^{11} \text{Nm}^{-2}$ and $g = 10 \text{ms}^{-2}$)

The radius of gyration of a cylindrical rod about an axis of rotation perpendicular to its length and passing through the center will be _____ m.

Given, the length of the rod is $10\sqrt{3}\text{m}$.

As per given figures, two springs of spring constants k and $2k$ are connected to mass m . If the period of oscillation in figure (a) is 3s , then the period of oscillation in figure (b) will be $\sqrt{x}\text{s}$. The value of x is _____.



If $\vec{A} = (2\hat{i} + 3\hat{j} - \hat{k}) \text{ m}$ and $\vec{B} = (\hat{i} + 2\hat{j} + 2\hat{k}) \text{ m}$. The magnitude of component of vector $\vec{A}$ along vector $\vec{B}$ will be _____ m.

Q30 Alcohols, Phenols & Ethers[Step-by-step solution](https://www.prepwisar.in/questions/hSssfrq8hi) › prepwisar.in/questions/hSssfrq8hi

Hydrolysis of which compound will give carboic acid?

- (A) Cumene (B) Benzenediazonium chloride
(C) Benzal chloride (D) Ethylene glycol ketal

Q31 Carbohydrates & Biomolecules[Step-by-step solution](https://www.prepwisar.in/questions/Pa88W9f9-2) › prepwisar.in/questions/Pa88W9f9-2

Animal starch is the other name of

- (A) amylose. (B) maltose. (C) glycogen. (D) amylopectin.

Q32 Chemical Bonding & Molecular Structure[Step-by-step solution](https://www.prepwisar.in/questions/Lbzu0J0W25) › prepwisar.in/questions/Lbzu0J0W25

Arrange the following in increasing order of their covalent character.

- A. CaF_2
B. CaCl_2
C. CaBr_2
D. CaI_2

Choose the correct answer from the options given below.

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

Q33 Chemical Kinetics[Step-by-step solution](https://www.prepwisar.in/questions/fgSnYWwUie) › prepwisar.in/questions/fgSnYWwUie

At 30°C , the half life for the decomposition of AB_2 is 200s and is independent of the initial concentration of AB_2 . The time required for 80% of the AB_2 to decompose is

Given: $\log 2 = 0.30$ $\log 3 = 0.48$

- (A) 200 s (B) 323 s (C) 467 s (D) 532 s

Q34 Coordination Compounds[Step-by-step solution](https://www.prepwisar.in/questions/Zey4g_PjPm) › prepwisar.in/questions/Zey4g_PjPm

The metal complex that is diamagnetic is (Atomic number: Fe, 26; Cu, 29)

- (A) $\text{K}_3[\text{Cu}(\text{CN})_4]$ (B) $\text{K}_2[\text{Cu}(\text{CN})_4]$ (C) $\text{K}_3[\text{Fe}(\text{CN})_4]$ (D) $\text{K}_4[\text{FeCl}_6]$

Q35 Redox Reactions[Step-by-step solution](https://www.prepwisar.in/questions/QI0ilBrEyt) › prepwisar.in/questions/QI0ilBrEyt

The products obtained from a reaction of hydrogen peroxide and acidified potassium permanganate are:

- (A) Mn^{4+} , H_2O only (B) Mn^{2+} , H_2O only
(C) Mn^{4+} , H_2O , O_2 only (D) Mn^{2+} , H_2O , O_2 only

Q36 Ionic Equilibrium[Step-by-step solution](https://www.prepwisar.in/questions/mA-g3EOV2k) › prepwisar.in/questions/mA-g3EOV2k

Class XII students were asked to prepare one litre of buffer solution of pH 8.26 by their Chemistry teacher: The amount of ammonium chloride to be dissolved by the student in 0.2 M ammonia solution to make one litre of the buffer is:

(Given: $\text{pK}_b(\text{NH}_3) = 4.74$

Molar mass of $\text{NH}_3 = 17\text{gmol}^{-1}$

Molar mass of $\text{NH}_4\text{Cl} = 53.5\text{gmol}^{-1}$)

- (A) 53.5 g (B) 72.3 g (C) 107.0 g (D) 126.0 g

The metal that is not extracted from its sulfide ore is:

- (A) Aluminium (B) Iron (C) Lead (D) Zinc

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

Assertion : Boric acid is a weak acid.

Reason R : Boric acid is not able to release H^+ ion on its own. It receives OH^- ion from water and releases H^+ ion.

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

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

Vulcanization of rubber is carried out by heating a mixture of

- (A) isoprene and styrene (B) neoprene and sulphur
(C) isoprene and sulphur (D) neoprene and styrene

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

Assertion A: Phenolphthalein is a pH dependent indicator, remains colourless in acidic solution and gives pink colour in basic medium.

Reason R: Phenolphthalein is a weak acid. It doesn't dissociate in basic medium.

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

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

The metal that has very low melting point and its periodic position is closer to a metalloid is:

- (A) Al (B) Ga (C) Se (D) In

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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: LiF is sparingly soluble in water.

Reason R: The ionic radius of Li^+ ion is smallest among its group members, hence has least hydration enthalpy.

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

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

Hemoglobin contains 0.34% of iron by mass. The number of Fe atoms in 3.3g of hemoglobin is

(Given: Atomic mass of Fe is 56 u, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$.)

- (A) 1.21×10^5 (B) 12.0×10^{16} (C) 1.21×10^{20} (D) 3.4×10^{22}

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

Assertion A : Finest gold is red in colour, as the size of the particles increases, it appears purple then blue and finally gold.

Reason R : The colour of the colloidal solution depends on the wavelength of light scattered by the dispersed particles.

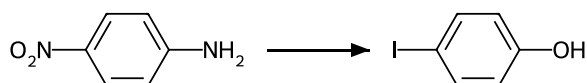
In the light of the above statements, choose the most appropriate answer from the options given below.

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

The correct decreasing order of priority of functional groups in naming an organic compound as per IUPAC system of nomenclature is

- (A) $-\text{COOH} > -\text{CONH}_2 > -\text{COCl} > -\text{CHO}$ (B) $\text{SO}_3\text{H} > -\text{COCl} > -\text{CONH}_2 > -\text{CN}$
(C) $-\text{COOR} > -\text{COCl} > -\text{NH}_2 > \text{>C=O}$ (D) $-\text{COOH} > -\text{COOR} > -\text{CONH}_2 > -\text{COCl}$

The correct sequential order of the reagents for the given reaction is



- (A) $\text{HNO}_2, \text{Fe}/\text{H}^+, \text{HNO}_2, \text{KI}, \text{H}_2\text{O}/\text{H}^+$ (B) $\text{HNO}_2, \text{KI}, \text{Fe}/\text{H}^+, \text{HNO}_2, \text{H}_2\text{O}/\text{warm}$
(C) $\text{HNO}_2, \text{KI}, \text{HNO}_2, \text{Fe}/\text{H}^+, \text{H}_2\text{O}/\text{H}^+$ (D) $\text{HNO}_2, \text{Fe}/\text{H}^+, \text{KI}, \text{HNO}_2, \text{H}_2\text{O}/\text{warm}$

Q47 Chemistry in Everyday Life **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/pRCWDKQGTGI

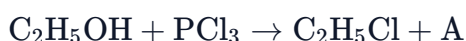
How many of the following drugs is/are example(s) of broad spectrum antibiotics?
Ofloxacin, Penicillin G, Terpeneol, Salvarsan.

Q48 d & f Block Elements **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/25A5uMUtq

The spin-only magnetic moment value of the compound with strongest oxidizing ability among MnF_4 , MnF_3 and MnF_2 is _____ B.M. [nearest integer]

Q49 p-Block Elements: Part II (Group 15-18) **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/bw52AJiB-q

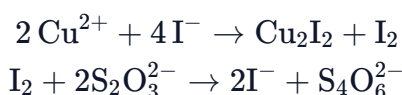
The number of non-ionisable protons present in the product B obtained from the following reactions is _____.



Q50 Redox Reactions **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/8zpr3o3n46

20mL of 0.02 M hypo solution is used for the titration of 10mL of copper sulphate solution, in the presence of excess of KI using starch as an indicator. The molarity of Cu^{2+} is found to be _____ $\times 10^{-2}$ M. [nearest integer]

Given:



Q51 Solutions & Colligative Properties **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/db7SixYJUI

The elevation in boiling point for 1 molal solution of non-volatile solute A is 3K. The depression in freezing point for 2 molal solution of A in the same solvent is 6 K. The ratio of K_b and K_f i.e., K_b/K_f is 1 : X. The value of X is [nearest integer]

Q52 Mole Concept & Stoichiometry **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/VLdQhVrAIL

A 100mL solution of $\text{CH}_3\text{CH}_2\text{MgBr}$ on treatment with methanol produces 2.24mL of a gas at STP. The weight of gas produced is _____ mg. [nearest integer]

Q53 Atomic Structure **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/IQOgGvcf11

Consider an imaginary ion ${}_{22}^{48}\text{X}^{3-}$. The nucleus contains 'a'% more neutrons than the number of electrons in the ion. The value of 'a' is _____. [nearest integer]

Q54 Chemical Thermodynamics **NUMERICAL** [Step-by-step solution](#) › prepwiser.in/questions/d5ZdFu76Xh

For the reaction



$$\Delta U = -59.6\text{kJmol}^{-1} \text{ at } 27^\circ\text{C}.$$

The enthalpy change for the above reaction is (–) _____ kJ mol^{-1} [nearest integer]

Given: $R = 8.314\text{JK}^{-1}\text{mol}^{-1}$.

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Total number of isomers (including stereoisomers) obtained on monochlorination of methylcyclohexane is _____.

Mathematics Section A · Multiple choice

Q56 to Q73

Q56 Vectors

Step-by-step solution › prepwiser.in/questions/QV5xXjGXis

A vector $\vec{a}$ is parallel to the line of intersection of the plane determined by the vectors $\hat{i}, \hat{i} + \hat{j}$ and the plane determined by the vectors $\hat{i} - \hat{j}, \hat{i} + \hat{k}$. The obtuse angle between $\vec{a}$ and the vector $\vec{b} = \hat{i} - 2\hat{j} + 2\hat{k}$ is:

- (A) $\frac{3\pi}{4}$ (B) $\frac{2\pi}{3}$ (C) $\frac{4\pi}{5}$ (D) $\frac{5\pi}{6}$

Q57 Binomial Theorem

Step-by-step solution › prepwiser.in/questions/TMxyewk88z

$$\sum_{\substack{i, j = 0 \\ i \neq j}}^n {}^nC_i {}^nC_j$$

is equal to

- (A) $2^{2n} - {}^{2n}C_n$ (B) $2^{2n-1} - {}^{2n-1}C_{n-1}$ (C) $2^{2n} - \frac{1}{2} {}^{2n}C_n$ (D) $2^{2n-1} + {}^{2n-1}C_n$

Q58 Circles

Step-by-step solution › prepwiser.in/questions/bUQKIC8dUR

Let the abscissae of the two points P and Q on a circle be the roots of $x^2 - 4x - 6 = 0$ and the ordinates of P and Q be the roots of $y^2 + 2y - 7 = 0$. If PQ is a diameter of the circle $x^2 + y^2 + 2ax + 2by + c = 0$, then the value of $(a + b - c)$ is _____.

- (A) 12 (B) 13 (C) 14 (D) 16

Q59 Complex Numbers

Step-by-step solution › prepwiser.in/questions/-6cvNVrLM7

If $z = x + iy$ satisfies $|z| - 2 = 0$ and $|z - i| - |z + 5i| = 0$, then:

- (A) $x + 2y - 4 = 0$ (B) $x^2 + y - 4 = 0$ (C) $x + 2y + 4 = 0$ (D) $x^2 - y + 3 = 0$

Q60 Definite Integration

Step-by-step solution › prepwiser.in/questions/FkSW_PjecB

$\int_0^{20\pi} (|\sin x| + |\cos x|)^2 dx$ is equal to

- (A) $10(\pi + 4)$ (B) $10(\pi + 2)$ (C) $20(\pi - 2)$ (D) $20(\pi + 2)$

Q61 Differential Equations

Step-by-step solution › prepwiser.in/questions/PiKShiHOQI

Let the solution curve $y = f(x)$ of the differential equation $\frac{dy}{dx} + \frac{xy}{x^2-1} = \frac{x^4+2x}{\sqrt{1-x^2}}$, $x \in (-1, 1)$ pass

through the origin. Then $\int_{-\frac{\sqrt{3}}{2}}^{\frac{\sqrt{3}}{2}} f(x) dx$ is equal to

- (A) $\frac{\pi}{3} - \frac{1}{4}$ (B) $\frac{\pi}{3} - \frac{\sqrt{3}}{4}$ (C) $\frac{\pi}{6} - \frac{\sqrt{3}}{4}$ (D) $\frac{\pi}{6} - \frac{\sqrt{3}}{2}$

Q62 Differentiation[Step-by-step solution](https://www.prepwiser.in/questions/F25NI50RoG) › prepwiser.in/questions/F25NI50RoG

The value of $\log_e 2 \frac{d}{dx} (\log_{\cos x} \operatorname{cosec} x)$ at $x = \frac{\pi}{4}$ is

- (A) $-2\sqrt{2}$ (B) $2\sqrt{2}$ (C) -4 (D) 4

Q63 Ellipse[Step-by-step solution](https://www.prepwiser.in/questions/GpL1I5osrp) › prepwiser.in/questions/GpL1I5osrp

The acute angle between the pair of tangents drawn to the ellipse $2x^2 + 3y^2 = 5$ from the point $(1, 3)$ is:

- (A) $\tan^{-1} \left(\frac{16}{7\sqrt{5}} \right)$ (B) $\tan^{-1} \left(\frac{24}{7\sqrt{5}} \right)$ (C) $\tan^{-1} \left(\frac{32}{7\sqrt{5}} \right)$ (D) $\tan^{-1} \left(\frac{3 + 8\sqrt{5}}{35} \right)$

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

If the line $x - 1 = 0$ is a directrix of the hyperbola $kx^2 - y^2 = 6$, then the hyperbola passes through the point:

- (A) $(-2\sqrt{5}, 6)$ (B) $(-\sqrt{5}, 3)$ (C) $(\sqrt{5}, -2)$ (D) $(2\sqrt{5}, 3\sqrt{6})$

Q65 Inverse Trigonometric Functions[Step-by-step solution](https://www.prepwiser.in/questions/SLAnJRXpEq) › prepwiser.in/questions/SLAnJRXpEq

If $0 < x < \frac{1}{\sqrt{2}}$ and $\frac{\sin^{-1} x}{\alpha} = \frac{\cos^{-1} x}{\beta}$, then the value of $\sin \left(\frac{2\pi\alpha}{\alpha+\beta} \right)$ is:

- (A) $4\sqrt{(1-x^2)}(1-2x^2)$ (B) $4x\sqrt{(1-x^2)}(1-2x^2)$
(C) $2x\sqrt{(1-x^2)}(1-4x^2)$ (D) $4\sqrt{(1-x^2)}(1-4x^2)$

Q66 Limits[Step-by-step solution](https://www.prepwiser.in/questions/5b8rgnk4Sv) › prepwiser.in/questions/5b8rgnk4Sv

Let

$$\beta = \lim_{x \rightarrow 0} \frac{\alpha x - (e^{3x} - 1)}{\alpha x (e^{3x} - 1)}$$

for some $\alpha \in \mathbb{R}$. Then the value of $\alpha + \beta$ is:

- (A) $\frac{14}{5}$ (B) $\frac{3}{2}$ (C) $\frac{5}{2}$ (D) $\frac{7}{2}$

Q67 Matrices[Step-by-step solution](https://www.prepwiser.in/questions/cCT8fciAIG) › prepwiser.in/questions/cCT8fciAIG

Let $A = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$ and $B = \begin{bmatrix} 9^2 & -10^2 & 11^2 \\ 12^2 & 13^2 & -14^2 \\ -15^2 & 16^2 & 17^2 \end{bmatrix}$, then the value of $A'BA$ is:

- (A) 1224 (B) 1042 (C) 540 (D) 539

Q68 Applications of Derivatives[Step-by-step solution](https://www.prepwiser.in/questions/Fpju-ccBDd) › prepwiser.in/questions/Fpju-ccBDd

Let P and Q be any points on the curves $(x-1)^2 + (y+1)^2 = 1$ and $y = x^2$, respectively. The distance between P and Q is minimum for some value of the abscissa of P in the interval:

- (A) $(0, \frac{1}{4})$ (B) $(\frac{1}{2}, \frac{3}{4})$ (C) $(\frac{1}{4}, \frac{1}{2})$ (D) $(\frac{3}{4}, 1)$

Q69 Parabola[Step-by-step solution](https://www.prepwiser.in/questions/12EEGHqPkP) › prepwiser.in/questions/12EEGHqPkP

The equation of a common tangent to the parabolas $y = x^2$ and $y = -(x-2)^2$ is

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

Let X be a binomially distributed random variable with mean 4 and variance $\frac{4}{3}$. Then, $54 P(X \leq 2)$ is equal to:

- (A) $\frac{73}{27}$ (B) $\frac{146}{27}$ (C) $\frac{146}{81}$ (D) $\frac{126}{81}$

The minimum value of the sum of the squares of the roots of $x^2 + (3 - a)x + 1 = 2a$ is:

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

The area bounded by the curves $y = |x^2 - 1|$ and $y = 1$ is

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

The integral $\int \frac{(1 - \frac{1}{\sqrt{3}})(\cos x - \sin x)}{(1 + \frac{2}{\sqrt{3}} \sin 2x)} dx$ is equal to

- (A) $\frac{1}{2} \log_e \left| \frac{\tan(\frac{x}{2} + \frac{\pi}{12})}{\tan(\frac{x}{2} + \frac{\pi}{6})} \right| + C$ (B) $\frac{1}{2} \log_e \left| \frac{\tan(\frac{x}{2} + \frac{\pi}{6})}{\tan(\frac{x}{2} + \frac{\pi}{3})} \right| + C$
 (C) $\log_e \left| \frac{\tan(\frac{x}{2} + \frac{\pi}{6})}{\tan(\frac{x}{2} + \frac{\pi}{12})} \right| + C$ (D) $\frac{1}{2} \log_e \left| \frac{\tan(\frac{x}{2} - \frac{\pi}{12})}{\tan(\frac{x}{2} - \frac{\pi}{6})} \right| + C$

Mathematics Section B · Numerical value

Q74 to Q83

The largest value of a , for which the perpendicular distance of the plane containing the lines $\vec{r} = (\hat{i} + \hat{j}) + \lambda(\hat{i} + a\hat{j} - \hat{k})$ and $\vec{r} = (\hat{i} + \hat{j}) + \mu(-\hat{i} + \hat{j} - a\hat{k})$ from the point $(2, 1, 4)$ is $\sqrt{3}$, is _____.

The plane passing through the line $L : lx - y + 3(1 - l)z = 1, x + 2y - z = 2$ and perpendicular to the plane $3x + 2y + z = 6$ is $3x - 8y + 7z = 4$. If θ is the acute angle between the line L and the y -axis, then $415 \cos^2 \theta$ is equal to _____.

Suppose $y = y(x)$ be the solution curve to the differential equation $\frac{dy}{dx} - y = 2 - e^{-x}$ such that $\lim_{x \rightarrow \infty} y(x)$ is finite. If a and b are respectively the x - and y -intercepts of the tangent to the curve at $x = 0$, then the value of $a - 4b$ is equal to _____.

The number of matrices

$$A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

, where $a, b, c, d \in \{-1, 0, 1, 2, 3, \dots, 10\}$, such that $A = A^{-1}$, is _____.

Q78 Permutations & Combinations **NUMERICAL**

[Step-by-step solution](https://www.prepwiser.in/questions/3ZKn6SjLFw) › prepwiser.in/questions/3ZKn6SjLFw

Numbers are to be formed between 1000 and 3000, which are divisible by 4, using the digits 1, 2, 3, 4, 5 and 6 without repetition of digits. Then the total number of such numbers is _____.

Q79 Sequences & Series **NUMERICAL**

[Step-by-step solution](https://www.prepwiser.in/questions/md7sKrZG7_) › prepwiser.in/questions/md7sKrZG7_

If $\sum_{k=1}^{10} \frac{k}{k^4+k^2+1} = \frac{m}{n}$, where m and n are co-prime, then $m + n$ is equal to _____.

Q80 Sequences & Series **NUMERICAL**

[Step-by-step solution](https://www.prepwiser.in/questions/nKzjd8ydPb) › prepwiser.in/questions/nKzjd8ydPb

Different A.P.'s are constructed with the first term 100, the last term 199, and integral common differences. The sum of the common differences of all such A.P.'s having at least 3 terms and at most 33 terms is _____.

Q81 Sets **NUMERICAL**

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

Let $A = \{1, 2, 3, 4, 5, 6, 7\}$ and $B = \{3, 6, 7, 9\}$. Then the number of elements in the set $\{C \subseteq A : C \cap B \neq \phi\}$ is _____.

Q82 Statistics **NUMERICAL**

[Step-by-step solution](https://www.prepwiser.in/questions/EwXXImI8p4) › prepwiser.in/questions/EwXXImI8p4

The mean and standard deviation of 40 observations are 30 and 5 respectively. It was noticed that two of these observations 12 and 10 were wrongly recorded. If σ is the standard deviation of the data after omitting the two wrong observations from the data, then $38\sigma^2$ is equal to _____.

Q83 Trigonometric Equations **NUMERICAL**

[Step-by-step solution](https://www.prepwiser.in/questions/kX8yliE3-7) › prepwiser.in/questions/kX8yliE3-7

If the sum of solutions of the system of equations $2 \sin^2 \theta - \cos 2\theta = 0$ and $2 \cos^2 \theta + 3 \sin \theta = 0$ in the interval $[0, 2\pi]$ is $k\pi$, then k is equal to _____.

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Physics

1.	C	2.	C	3.	C	4.	B	5.	B	6.	A	7.	D	8.	A	9.	B	10.	A
11.	A	12.	B	13.	A	14.	B	15.	B	16.	C	17.	A	18.	A	19.	C	20.	26
21.	20	22.	2	23.	200	24.	17	25.	27	26.	25	27.	5	28.	2	29.	2		

Chemistry

30.	B	31.	C	32.	B	33.	C	34.	A	35.	D	36.	C	37.	A	38.	A	39.	C
40.	C	41.	B	42.	C	43.	C	44.	A	45.	B	46.	B	47.	1	48.	5	49.	2
50.	4	51.	1	52.	3	53.	4	54.	57	55.	12								

Mathematics

56.	A	57.	A	58.	A	59.	C	60.	D	61.	B	62.	D	63.	B	64.	C	65.	B
66.	C	67.	D	68.	C	69.	B	70.	B	71.	C	72.	D	73.	A	74.	2	75.	125
76.	3	77.	50	78.	30	79.	166	80.	53	81.	112	82.	238	83.	3				

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