

JEE MAIN 2021 · QUESTION PAPER

27 Aug 2021 Shift 1

79 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	9 Q20 to Q28
● Chemistry	13 Q29 to Q41	10 Q42 to Q51
● Mathematics	18 Q52 to Q69	10 Q70 to Q79
In this PDF	79 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/2021-08-27-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 Nuclear Physics

[Step-by-step solution](https://www.prepwise.in/questions/I9qMlk4pUI) · prepwise.in/questions/I9qMlk4pUI

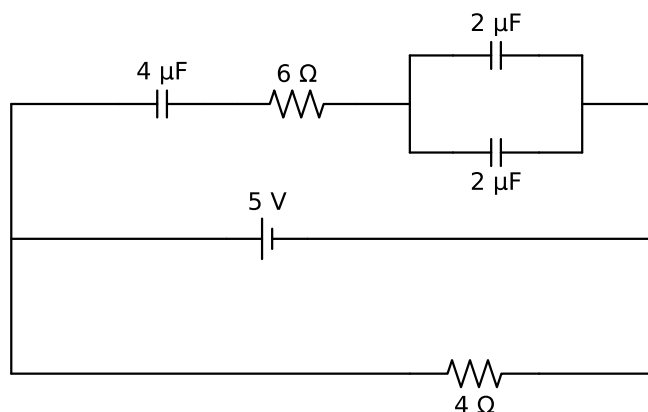
There are 10^{10} radioactive nuclei in a given radioactive element, its half-life time is 1 minute. How many nuclei will remain after 30 seconds? ($\sqrt{2} = 1.414$)

- (A) 2×10^{10} (B) 7×10^9 (C) 10^5 (D) 4×10^{10}

Q2 Electrostatics II: Potential & Capacitance

[Step-by-step solution](https://www.prepwise.in/questions/UnhoRRtn30) · prepwise.in/questions/UnhoRRtn30

Calculate the amount of charge on capacitor of $4\mu\text{F}$. The internal resistance of battery is 1Ω :



- (A) $8\mu\text{C}$ (B) zero (C) $16\mu\text{C}$ (D) $4\mu\text{C}$

Q3 Circular Motion

[Step-by-step solution](https://www.prepwise.in/questions/5ugf42N8gw) · prepwise.in/questions/5ugf42N8gw

A huge circular arc of length 4.4 ly subtends an angle '4s' at the centre of the circle. How long it would take for a body to complete 4 revolution if its speed is 8 AU per second?

Given : $1\text{ ly} = 9.46 \times 10^{15}\text{ m}$

$1\text{ AU} = 1.5 \times 10^{11}\text{ m}$

- (A) $4.1 \times 10^8\text{ s}$ (B) $4.5 \times 10^{10}\text{ s}$ (C) $3.5 \times 10^6\text{ s}$ (D) $7.2 \times 10^8\text{ s}$

Q4 Current Electricity

[Step-by-step solution](https://www.prepwise.in/questions/yWLj8nI8p0) · prepwise.in/questions/yWLj8nI8p0

Five identical cells each of internal resistance 1Ω and emf 5V are connected in series and in parallel with an external resistance 'R'. For what value of 'R', current in series and parallel combination will remain the same?

- (A) 1Ω (B) 25Ω (C) 5Ω (D) 10Ω

Q5 Dual Nature of Radiation & Matter

[Step-by-step solution](https://www.prepwise.in/questions/pJUzTmuXti) · prepwise.in/questions/pJUzTmuXti

In a photoelectric experiment, increasing the intensity of incident light:

- (A) increases the number of photons incident and also increases the K.E. of the ejected electrons
 (B) increases the frequency of photons incident and increases the K.E. of the ejected electrons
 (C) increases the frequency of photons incident and the K.E. of the ejected electrons remains unchanged
 (D) increases the number of photons incident and the K.E. of the ejected electrons remains unchanged

Attempt this paper online with instant answer checking · [prepwise.in/pyqs/paper/2021-08-27-morning](https://www.prepwise.in/pyqs/paper/2021-08-27-morning)

Q6 Electromagnetic Waves[Step-by-step solution](https://www.prepwisar.in/questions/8waz8wCsUP)

Electric field in a plane electromagnetic wave is given by $E = 50 \sin(500x - 10 \times 10^{10} t)$ V/m The velocity of electromagnetic wave in this medium is:
(Given C = speed of light in vacuum)

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

Q7 Semiconductors & Electronic Devices[Step-by-step solution](https://www.prepwisar.in/questions/7DK-ekF1TS)

For a transistor in CE mode to be used as an amplifier, it must be operated in:

- (A) Both cut-off and Saturation (B) Saturation region only
(C) Cut-off region only (D) The active region only

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

A uniformly charged disc of radius R having surface charge density σ is placed in the xy plane with its center at the origin. Find the electric field intensity along the z -axis at a distance Z from origin :-

- (A) $E = \frac{\sigma}{2\epsilon_0} \left(1 - \frac{Z}{(Z^2 + R^2)^{1/2}} \right)$ (B) $E = \frac{\sigma}{2\epsilon_0} \left(1 + \frac{Z}{(Z^2 + R^2)^{1/2}} \right)$
(C) $E = \frac{2\epsilon_0}{\sigma} \left(\frac{1}{(Z^2 + R^2)^{1/2}} + Z \right)$ (D) $E = \frac{\sigma}{2\epsilon_0} \left(\frac{1}{(Z^2 + R^2)} + \frac{1}{Z^2} \right)$

Q9 Ray Optics[Step-by-step solution](https://www.prepwisar.in/questions/MnaSxfB_nU)

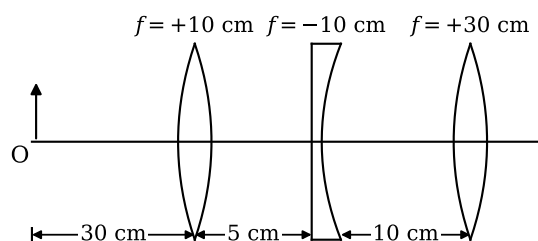
An object is placed beyond the centre of curvature C of the given concave mirror. If the distance of the object is d_1 from C and the distance of the image formed is d_2 from C , the radius of curvature of this mirror is:

- (A) $\frac{2d_1d_2}{d_1 - d_2}$ (B) $\frac{2d_1d_2}{d_1 + d_2}$ (C) $\frac{d_1d_2}{d_1 + d_2}$ (D) $\frac{d_1d_2}{d_1 - d_2}$

Q10 Ray Optics[Step-by-step solution](https://www.prepwisar.in/questions/T9B9pgzam6)

Find the distance of the image from object O , formed by the combination of lenses in the figure:

- (A) 75 cm (B) 10 cm (C) 20 cm (D) infinity

**Q11** Fluid Mechanics[Step-by-step solution](https://www.prepwisar.in/questions/DSPegmiidT)

A balloon carries a total load of 185 kg at normal pressure and temperature of 27°C . What load will the balloon carry on rising to a height at which the barometric pressure is 45 cm of Hg and the temperature is -7°C . Assuming the volume constant?

- (A) 181.46 kg (B) 214.15 kg (C) 219.07 kg (D) 123.54 kg

Q12 Thermodynamics[Step-by-step solution](https://www.prepwisar.in/questions/7itVW_g_zj)

An ideal gas is expanding such that $PT^3 = \text{constant}$. The coefficient of volume expansion of the gas is:

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

Q13 Moving Charges & Magnetism[Step-by-step solution](#) > [prepwiser.in/questions/CHXQ8tB4Kg](https://www.prepwiser.in/questions/CHXQ8tB4Kg)

Two ions of masses 4 amu and 16 amu have charges $+2e$ and $+3e$ respectively. These ions pass through the region of constant perpendicular magnetic field. The kinetic energy of both ions is same. Then:

- (A) lighter ion will be deflected less than heavier ion
- (B) lighter ion will be deflected more than heavier ion
- (C) both ions will be deflected equally
- (D) no ion will be deflected

Q14 Fluid Mechanics[Step-by-step solution](#) > [prepwiser.in/questions/MX3jvNgo1w](https://www.prepwiser.in/questions/MX3jvNgo1w)

In Millikan's oil drop experiment, what is viscous force acting on an uncharged drop of radius 2.0×10^{-5} m and density $1.2 \times 10^3 \text{ kg m}^{-3}$? Take viscosity of liquid = $1.8 \times 10^{-5} \text{ N s m}^{-2}$. (Neglect buoyancy due to air).

- (A) $3.8 \times 10^{-11} \text{ N}$
- (B) $3.9 \times 10^{-10} \text{ N}$
- (C) $1.8 \times 10^{-10} \text{ N}$
- (D) $5.8 \times 10^{-10} \text{ N}$

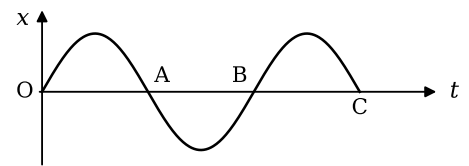
Q15 Rotational Motion[Step-by-step solution](#) > [prepwiser.in/questions/hCmYE-ONUO](https://www.prepwiser.in/questions/hCmYE-ONUO)

Moment of inertia of a square plate of side l about the axis passing through one of the corner and perpendicular to the plane of square plate is given by:

- (A) $\frac{Ml^2}{6}$
- (B) Ml^2
- (C) $\frac{Ml^2}{12}$
- (D) $\frac{2}{3}Ml^2$

Q16 Simple Harmonic Motion[Step-by-step solution](#) > [prepwiser.in/questions/72If_OGNwZ](https://www.prepwiser.in/questions/72If_OGNwZ)

The variation of displacement with time of a particle executing free simple harmonic motion is shown in the figure. The potential energy $U(x)$ versus time (t) plot of the particle is correctly shown in figure:



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

Q17 Units, Dimensions & Errors[Step-by-step solution](#) > [prepwiser.in/questions/imsCespGfq](https://www.prepwiser.in/questions/imsCespGfq)

Which of the following is not a dimensionless quantity?

- (A) Relative magnetic permeability (μ_r)
- (B) Power factor
- (C) Permeability of free space (μ_0)
- (D) Quality factor

Q18 Units, Dimensions & Errors[Step-by-step solution](#) > [prepwiser.in/questions/uTbiGOSXr9](https://www.prepwiser.in/questions/uTbiGOSXr9)

If E and H represents the intensity of electric field and magnetising field respectively, then the unit of E/H will be:

- (A) ohm
- (B) mho
- (C) joule
- (D) newton

Q19 Vectors[Step-by-step solution > prepwiser.in/questions/Rd-3gKd6CK](https://www.prepwiser.in/questions/Rd-3gKd6CK)

The resultant of these forces $\vec{OP}$, $\vec{OQ}$, $\vec{OR}$, $\vec{OS}$ and $\vec{OT}$ is approximately N.

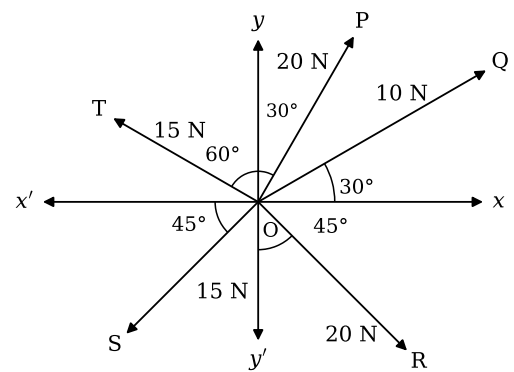
[Take $\sqrt{3} = 1.7$, $\sqrt{2} = 1.4$ Given $\hat{i}$ and $\hat{j}$ unit vectors along x, y axis]

(A) $9.25\hat{i} + 5\hat{j}$

(B) $3\hat{i} + 15\hat{j}$

(C) $2.5\hat{i} - 14.5\hat{j}$

(D) $-1.5\hat{i} - 15.5\hat{j}$

**Physics** Section B · Numerical value

Q20 to Q28

Q20 Alternating Current **NUMERICAL**[Step-by-step solution > prepwiser.in/questions/j5DMKLjkGY](https://www.prepwiser.in/questions/j5DMKLjkGY)

The alternating current is given by $i = \left\{ \sqrt{42} \sin \left(\frac{2\pi}{T} t \right) + 10 \right\} A$

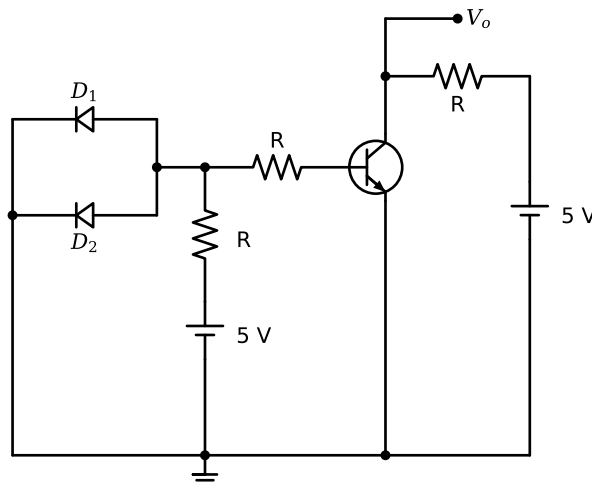
The r.m.s. value of of this current is A.

Q21 Current Electricity **NUMERICAL**[Step-by-step solution > prepwiser.in/questions/L3Z0QAXe6F](https://www.prepwiser.in/questions/L3Z0QAXe6F)

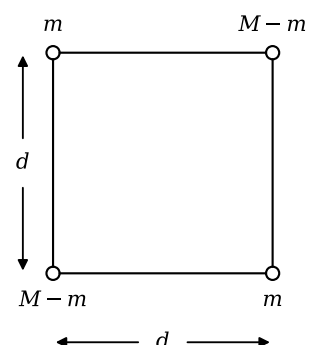
First, a set of n equal resistors of 10Ω each are connected in series to a battery of emf 20V and internal resistance 10Ω . A current I is observed to flow. Then, the n resistors are connected in parallel to the same battery. It is observed that the current is increased 20 times, then the value of n is

Q22 Semiconductors & Electronic Devices **NUMERICAL**[Step-by-step solution > prepwiser.in/questions/4IjETVymMd](https://www.prepwiser.in/questions/4IjETVymMd)

A circuit is arranged as shown in figure. The output voltage V_0 is equal to V.

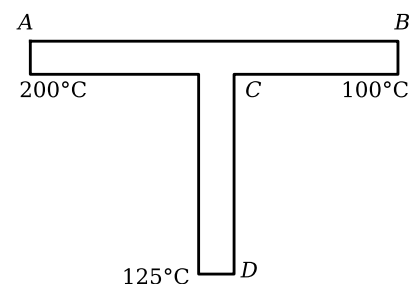
**Q23** Gravitation **NUMERICAL**[Step-by-step solution > prepwiser.in/questions/npdeAF4DN9](https://www.prepwiser.in/questions/npdeAF4DN9)

A body of mass (2M) splits into four masses (m, M – m, m, M – m), which are rearranged to form a square as shown in the figure. The ratio of $\frac{M}{m}$ for which, the gravitational potential energy of the system becomes maximum is x : 1. The value of x is



Q24 Heat Transfer **NUMERICAL**[Step-by-step solution > prepwisar.in/questions/ADiGK1kRD](https://www.prepwisar.in/questions/ADiGK1kRD)

A rod CD of thermal resistance 10.0 KW^{-1} is joined at the middle of an identical rod AB as shown in figure. The end A, B and D are maintained at 200°C , 100°C and 125°C respectively. The heat current in CD is P watt. The value of P is

**Q25** Moving Charges & Magnetism **NUMERICAL**[Step-by-step solution > prepwisar.in/questions/1XW7M2Umhs](https://www.prepwisar.in/questions/1XW7M2Umhs)

A uniform conducting wire of length is $24a$, and resistance R is wound up as a current carrying coil in the shape of an equilateral triangle of side 'a' and then in the form of a square of side 'a'. The coil is connected to a voltage source V_0 . The ratio of magnetic moment of the coils in case of equilateral triangle to that for square is $1:\sqrt{y}$ where y is

Q26 Rectilinear Motion **NUMERICAL**[Step-by-step solution > prepwisar.in/questions/0Sq54dg_PL](https://www.prepwisar.in/questions/0Sq54dg_PL)

If the velocity of a body related to displacement x is given by $v = \sqrt{5000 + 24x}$ m/s, then the acceleration of the body is m/s^2 .

Q27 Sound Waves **NUMERICAL**[Step-by-step solution > prepwisar.in/questions/_DXWvQM5i2](https://www.prepwisar.in/questions/_DXWvQM5i2)

Two cars X and Y are approaching each other with velocities 36 km/h and 72 km/h respectively. The frequency of a whistle sound as emitted by a passenger in car X, heard by the passenger in car Y is 1320 Hz . If the velocity of sound in air is 340 m/s , the actual frequency of the whistle sound produced is Hz .

Q28 Work, Energy & Power **NUMERICAL**[Step-by-step solution > prepwisar.in/questions/rBddijecPN](https://www.prepwisar.in/questions/rBddijecPN)

Two persons A and B perform same amount of work in moving a body through a certain distance d with application of forces acting at angle 45° and 60° with the direction of displacement respectively. The ratio of force applied by person A to the force applied by person B is $\frac{1}{\sqrt{x}}$. The value of x is

Chemistry Section A · Multiple choice

Q29 to Q41

Q29 Alcohols, Phenols & Ethers[Step-by-step solution > prepwisar.in/questions/umlFoGPMvd](https://www.prepwisar.in/questions/umlFoGPMvd)

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

Assertion (A) : Synthesis of ethyl phenyl ether may be achieved by Williamson synthesis.

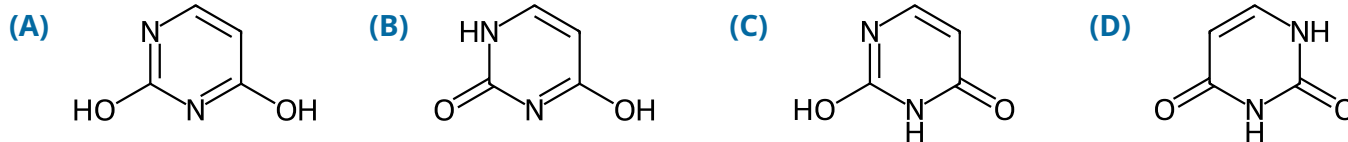
Reason (R) : Reaction of bromobenzene with sodium ethoxide yields ethyl phenyl ether.

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).

Q30 Carbohydrates & Biomolecules[Step-by-step solution](https://www.prepwiser.in/questions/uGKrtxqC-y)

Out of following isomeric forms of uracil, which one is present in RNA?

**Q31** d & f Block Elements[Step-by-step solution](https://www.prepwiser.in/questions/-LjH6_5iIo)

Match items of List-I with those of List-II:

	List - I (Property)		List - II (Example)
(a)	Diamagnetism	(i)	MnO
(b)	Ferrimagnetism	(ii)	O ₂
(c)	Paramagnetism	(iii)	NaCl
(d)	Antiferromagnetism	(iv)	Fe ₃ O ₄

Choose the most appropriate answer from the options given below:

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

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

The nature of oxides V₂O₃ and CrO is indexed as 'X' and 'Y' type respectively. The correct set of X and Y is:

- (A) X = basic Y = amphoteric (B) X = amphoteric Y = basic
 (C) X = acidic Y = acidic (D) X = basic Y = basic

Q33 Hydrogen & s-Block Elements[Step-by-step solution](https://www.prepwiser.in/questions/xwRuQ1DG-i)

Deuterium resembles hydrogen in properties but:

- (A) reacts slower than hydrogen (B) reacts vigorously than hydrogen
 (C) reacts just as hydrogen (D) emits β^+ particles

Q34 Metallurgy[Step-by-step solution](https://www.prepwiser.in/questions/1aGQymWyB_)

Which refining process is generally used in the purification of low melting metals?

- (A) Chromatographic method (B) Liquation
 (C) Electrolysis (D) Zone refining

Q35 p-Block Elements: Part I (Group 13 & 14)[Step-by-step solution](https://www.prepwiser.in/questions/IDhW2J7SiY)

In which one of the following molecules strongest back donation of an electron pair from halide to boron is expected?

- (A) BCl₃ (B) BF₃ (C) BBr₃ (D) BI₃

Q36 Redox Reactions[Step-by-step solution](https://www.prepwiser.in/questions/bzThAZxrgy)

In polythionic acid, H₂S_xO₆ (x = 3 to 5) the oxidation state(s) of sulphur is/are:

- (A) + 5 only (B) + 6 only (C) + 3 and + 5 only (D) 0 and + 5 only

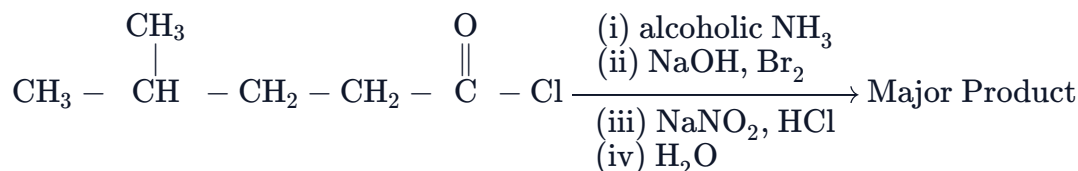
The number of water molecules in gypsum, dead burnt plaster and plaster of Paris, respectively are:

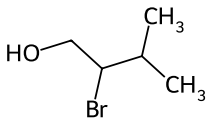
- (A) 2, 0 and 1 (B) 0.5, 0 and 2 (C) 5, 0 and 0.5 (D) 2, 0 and 0.5

Tyndall effect is more effectively shown by:

- (A) true solution (B) lyophilic colloid (C) lyophobic colloid (D) suspension

The major product of the following reaction is:



- (A)  (B) $\text{CH}_3 - \overset{\text{CH}_3}{\underset{|}{\text{CH}}} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2\text{OH}$
- (C) $\text{CH}_3 - \overset{\text{CH}_3}{\underset{|}{\text{CH}}} - \text{CH}_2 - \text{CH}_2\text{OH}$ (D) $\text{CH}_3 - \overset{\text{H}}{\underset{\text{CH}_3}{\underset{|}{\text{C}}}} - \text{CH}_2 - \text{CH}_2 - \text{Cl}$

Which of the following is not a correct statement for primary aliphatic amines?

- (A) The intermolecular association in primary amines is less than the intermolecular association in secondary amines.
- (B) Primary amines on treating with nitrous acid solution form corresponding alcohols except methylamine.
- (C) Primary amines are less basic than the secondary amines.
- (D) Primary amines can be prepared by the Gabriel phthalimide synthesis.

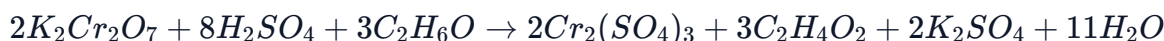
Acidic ferric chloride solution on treatment with excess of potassium ferrocyanide gives a Prussian blue coloured colloidal species. It is:

- (A) $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$ (B) $\text{K}_5\text{Fe}[\text{Fe}(\text{CN})_6]_2$ (C) $\text{HFe}[\text{Fe}(\text{CN})_6]$ (D) $\text{KFe}[\text{Fe}(\text{CN})_6]$

Chemistry Section B · Numerical value

Q42 to Q51

The reaction that occurs in a breath analyser, a device used to determine the alcohol level in a person's blood stream is



If the rate of appearance of $\text{Cr}_2(\text{SO}_4)_3$ is $2.67 \text{ mol min}^{-1}$ at a particular time, the rate of disappearance of $\text{C}_2\text{H}_6\text{O}$ at the same time is _____ mol min^{-1} . (Nearest integer)

Q43 Coordination Compounds **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/DbSHCLcKWY

1 mol of an octahedral metal complex with formula $MCl_3 \cdot 2L$ on reaction with excess of $AgNO_3$ gives 1 mol of $AgCl$. The denticity of Ligand L is _____. (Integer answer)

Q44 d & f Block Elements **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/PfjS1vMMzx

The number of f electrons in the ground state electronic configuration of Np ($Z = 93$) is _____. (Nearest integer)

Q45 Solutions & Colligative Properties **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/KWMP7KBa76

1 kg of 0.75 molal aqueous solution of sucrose can be cooled up to $-4^\circ C$ before freezing. The amount of ice (in g) that will be separated out is _____. (Nearest integer)
[Given : $K_f(H_2O) = 1.86 \text{ K kg mol}^{-1}$]

Q46 Purification & Characterisation of Organic Compounds **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/pLwn12MWcE

In Carius method for estimation of halogens, 0.2 g of an organic compound gave 0.188 g of $AgBr$. The percentage of bromine in the compound is _____. (Nearest integer)
[Atomic mass : $Ag = 108$, $Br = 80$]

Q47 Atomic Structure **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/jn0iMWSFN1

The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is equal to $\frac{h^2}{xma_0^2}$. The value of $10x$ is _____. (a_0 is radius of Bohr's orbit) (Nearest integer) [Given: $\pi = 3.14$]

Q48 Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/N-wLIwDfS

200 mL of 0.2 M HCl is mixed with 300 mL of 0.1 M $NaOH$. The molar heat of neutralization of this reaction is -57.1 kJ . The increase in temperature in $^\circ C$ of the system on mixing is $x \times 10^{-2}$. The value of x is _____. (Nearest integer)
[Given : Specific heat of water = $4.18 \text{ J g}^{-1} \text{ K}^{-1}$, Density of water = 1.00 g cm^{-3}]
[Assume no volume change on mixing]

Q49 Coordination Compounds **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/PEjVJXwATI

The number of moles of NH_3 , that must be added to 2L of 0.80 M $AgNO_3$ in order to reduce the concentration of Ag^+ ions to $5.0 \times 10^{-8} \text{ M}$ ($K_{\text{formation}}$ for $[Ag(NH_3)_2]^+ = 1.0 \times 10^8$) is _____. (Nearest integer)
[Assume no volume change on adding NH_3]

Q50 Purification & Characterisation of Organic Compounds **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/Cx0Q_xW4Yb

The number of moles of CuO , that will be utilized in Dumas method for estimation nitrogen in a sample of 57.5 g of N, N-dimethylaminopentane is _____ $\times 10^{-2}$. (Nearest integer)

Q51 Redox Reactions **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/NjU6-gMirH

When 10 mL of an aqueous solution of $KMnO_4$ was titrated in acidic medium, equal volume of 0.1 M of an aqueous solution of ferrous sulphate was required for complete discharge of colour. The strength of $KMnO_4$ in grams per litre is _____ $\times 10^{-2}$. (Nearest integer)
[Atomic mass of $K = 39$, $Mn = 55$, $O = 16$]

Q52 Three Dimensional Geometry

[Step-by-step solution](#) › [prepwisar.in/questions/X1t1ZDbhMV](https://www.prepwisar.in/questions/X1t1ZDbhMV)

The distance of the point $(1, -2, 3)$ from the plane $x - y + z = 5$ measured parallel to a line, whose direction ratios are $2, 3, -6$ is:

- (A) 3 (B) 5 (C) 2 (D) 1

Q53 Three Dimensional Geometry

[Step-by-step solution](#) › [prepwisar.in/questions/JPB98MaZhE](https://www.prepwisar.in/questions/JPB98MaZhE)

Equation of a plane at a distance $\sqrt{\frac{2}{21}}$ from the origin, which contains the line of intersection of the planes $x - y - z - 1 = 0$ and $2x + y - 3z + 4 = 0$, is:

- (A) $3x - y - 5z + 2 = 0$ (B) $3x - 4z + 3 = 0$
(C) $-x + 2y + 2z - 3 = 0$ (D) $4x - y - 5z + 2 = 0$

Q54 Applications of Derivatives

[Step-by-step solution](#) › [prepwisar.in/questions/EI1vmC7AaN](https://www.prepwisar.in/questions/EI1vmC7AaN)

A wire of length 20 m is to be cut into two pieces. One of the pieces is to be made into a square and the other into a regular hexagon. Then the length of the side (in meters) of the hexagon, so that the combined area of the square and the hexagon is minimum, is:

- (A) $\frac{5}{2 + \sqrt{3}}$ (B) $\frac{10}{2 + 3\sqrt{3}}$ (C) $\frac{5}{3 + \sqrt{3}}$ (D) $\frac{10}{3 + 2\sqrt{3}}$

Q55 Binomial Theorem

[Step-by-step solution](#) › [prepwisar.in/questions/Q7_FsUTk4-](https://www.prepwisar.in/questions/Q7_FsUTk4-)

$\sum_{k=0}^{20} \binom{20}{k}^2$ is equal to:

- (A) ${}^{40}C_{21}$ (B) ${}^{40}C_{19}$ (C) ${}^{40}C_{20}$ (D) ${}^{41}C_{20}$

Q56 Complex Numbers

[Step-by-step solution](#) › [prepwisar.in/questions/7hwFPJu724](https://www.prepwisar.in/questions/7hwFPJu724)

If $S = \{z \in \mathbb{C} : \frac{z-i}{z+2i} \in \mathbb{R}\}$, then:

- (A) S contains exactly two elements (B) S contains only one element
(C) S is a circle in the complex plane (D) S is a straight line in the complex plane

Q57 Limits

[Step-by-step solution](#) › [prepwisar.in/questions/_AgfYFEe7a](https://www.prepwisar.in/questions/_AgfYFEe7a)

If

$$U_n = \left(1 + \frac{1}{n^2}\right) \left(1 + \frac{2^2}{n^2}\right)^2 \dots \left(1 + \frac{n^2}{n^2}\right)^n$$

, then $\lim_{n \rightarrow \infty} (U_n)^{\frac{-4}{n^2}}$ is equal to:

- (A) $\frac{e^2}{16}$ (B) $\frac{4}{e}$ (C) $\frac{16}{e^2}$ (D) $\frac{4}{e^2}$

Q58 Definite Integration

[Step-by-step solution](#) › [prepwisar.in/questions/5cGullh02d](https://www.prepwisar.in/questions/5cGullh02d)

$$\int_6^{16} \frac{\log_e x^2}{\log_e x^2 + \log_e (x^2 - 44x + 484)} dx$$

is equal to:

- (A) 6 (B) 8 (C) 5 (D) 10

Q59 Differential Equations[Step-by-step solution > prepwiser.in/questions/ERkkJ8a8rL](https://www.prepwiser.in/questions/ERkkJ8a8rL)

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

$\frac{dy}{dx} = 2(y + 2 \sin x - 5)x - 2 \cos x$ such that $y(0) = 7$. Then $y(\pi)$ is equal to:

- (A) $2e^{\pi^2} + 5$ (B) $e^{\pi^2} + 5$ (C) $3e^{\pi^2} + 5$ (D) $7e^{\pi^2} + 5$

Q60 Differential Equations[Step-by-step solution > prepwiser.in/questions/G32qH-Qcak](https://www.prepwiser.in/questions/G32qH-Qcak)

Let us consider a curve, $y = f(x)$ passing through the point $(-2, 2)$ and the slope of the tangent to the curve at any point $(x, f(x))$ is given by $f(x) + xf'(x) = x^2$. Then:

- (A) $x^2 + 2xf(x) - 12 = 0$ (B) $x^3 + xf(x) + 12 = 0$
(C) $x^3 - 3xf(x) - 4 = 0$ (D) $x^2 + 2xf(x) + 4 = 0$

Q61 Ellipse[Step-by-step solution > prepwiser.in/questions/11n2aZjBhz](https://www.prepwiser.in/questions/11n2aZjBhz)

If $x^2 + 9y^2 - 4x + 3 = 0$, $x, y \in \mathbb{R}$, then x and y respectively lie in the intervals:

- (A) $[-\frac{1}{3}, \frac{1}{3}]$ and $[-\frac{1}{3}, \frac{1}{3}]$ (B) $[-\frac{1}{3}, \frac{1}{3}]$ and $[1, 3]$
(C) $[1, 3]$ and $[1, 3]$ (D) $[1, 3]$ and $[-\frac{1}{3}, \frac{1}{3}]$

Q62 Inverse Trigonometric Functions[Step-by-step solution > prepwiser.in/questions/hofkRm3GE6](https://www.prepwiser.in/questions/hofkRm3GE6)

If $(\sin^{-1}x)^2 - (\cos^{-1}x)^2 = a$; $0 < x < 1$, $a \neq 0$, then the value of $2x^2 - 1$ is:

- (A) $\cos\left(\frac{4a}{\pi}\right)$ (B) $\sin\left(\frac{2a}{\pi}\right)$ (C) $\cos\left(\frac{2a}{\pi}\right)$ (D) $\sin\left(\frac{4a}{\pi}\right)$

Q63 Limits[Step-by-step solution > prepwiser.in/questions/6n-RoLat2R](https://www.prepwiser.in/questions/6n-RoLat2R)

If α, β are the distinct roots of $x^2 + bx + c = 0$, then

$$\lim_{x \rightarrow \beta} \frac{e^{2(x^2+bx+c)} - 1 - 2(x^2 + bx + c)}{(x - \beta)^2}$$

is equal to:

- (A) $b^2 + 4c$ (B) $2(b^2 + 4c)$ (C) $2(b^2 - 4c)$ (D) $b^2 - 4c$

Q64 Matrices[Step-by-step solution > prepwiser.in/questions/DzHkxrHZAK](https://www.prepwiser.in/questions/DzHkxrHZAK)

If the matrix $A = \begin{pmatrix} 0 & 2 \\ K & -1 \end{pmatrix}$ satisfies $A(A^3 + 3I) = 2I$, then the value of K is:

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

Q65 Parabola[Step-by-step solution > prepwiser.in/questions/L1w4a483KS](https://www.prepwiser.in/questions/L1w4a483KS)

A tangent and a normal are drawn at the point $P(2, -4)$ on the parabola $y^2 = 8x$, which meet the directrix of the parabola at the points A and B respectively. If $Q(a, b)$ is a point such that $AQBP$ is a square, then $2a + b$ is equal to:

- (A) -16 (B) -18 (C) -12 (D) -20

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Q66 Probability: Basic[Step-by-step solution](https://www.prepwisar.in/questions/hFnYwA3_Fo)

When a certain biased die is rolled, a particular face occurs with probability $\frac{1}{6} - x$ and its opposite face occurs with probability $\frac{1}{6} + x$. All other faces occur with probability $\frac{1}{6}$. Note that opposite faces sum to 7 in any die. If $0 < x < \frac{1}{6}$, and the probability of obtaining total sum = 7, when such a die is rolled twice, is $\frac{13}{96}$, then the value of x is:

- (A) $\frac{1}{16}$ (B) $\frac{1}{8}$ (C) $\frac{1}{9}$ (D) $\frac{1}{12}$

Q67 Sequences & Series[Step-by-step solution](https://www.prepwisar.in/questions/RaDtfD8qbH)

If $0 < x < 1$, then $\frac{3}{2}x^2 + \frac{5}{3}x^3 + \frac{7}{4}x^4 + \dots$, is equal to:

- (A) $x \left(\frac{1+x}{1-x} \right) + \log_e(1-x)$ (B) $x \left(\frac{1-x}{1+x} \right) + \log_e(1-x)$
 (C) $\frac{1-x}{1+x} + \log_e(1-x)$ (D) $\frac{1+x}{1-x} + \log_e(1-x)$

Q68 Sequences & Series[Step-by-step solution](https://www.prepwisar.in/questions/cY4eEmIzKc)

If for $x, y \in \mathbb{R}$, $x > 0$, $y = \log_{10}x + \log_{10}x^{1/3} + \log_{10}x^{1/9} + \dots$ upto ∞ terms and

$$\frac{2 + 4 + 6 + \dots + 2y}{3 + 6 + 9 + \dots + 3y} = \frac{4}{\log_{10}x}$$

, then the ordered pair (x, y) is equal to:

- (A) $(10^6, 6)$ (B) $(10^4, 6)$ (C) $(10^2, 3)$ (D) $(10^6, 9)$

Q69 Straight Lines[Step-by-step solution](https://www.prepwisar.in/questions/eYIKZnDTzC)

Let A be a fixed point $(0, 6)$ and B be a moving point $(2t, 0)$. Let M be the mid-point of AB and the perpendicular bisector of AB meets the y-axis at C. The locus of the mid-point P of MC is:

- (A) $3x^2 - 2y - 6 = 0$ (B) $3x^2 + 2y - 6 = 0$ (C) $2x^2 + 3y - 9 = 0$ (D) $2x^2 - 3y + 9 = 0$

Mathematics Section B · Numerical value

Q70 to Q79

Q70 Quadratic Equations & Polynomial Inequalities **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/oeGRcsB6-r)

The number of distinct real roots of the equation $3x^4 + 4x^3 - 12x^2 + 4 = 0$ is _____.

Q71 Circles **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/dKKAm5xf1W)

Let the equation $x^2 + y^2 + px + (1 - p)y + 5 = 0$ represent circles of varying radius $r \in (0, 5]$. Then the number of elements in the set $S = \{q : q = p^2 \text{ and } q \text{ is an integer}\}$ is _____.

Q72 Differentiation **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/bvLRj-ygVH)

If $y^{1/4} + y^{-1/4} = 2x$, and

$(x^2 - 1)\frac{d^2y}{dx^2} + \alpha x \frac{dy}{dx} + \beta y = 0$, then $|\alpha - \beta|$ is equal to _____.

Q73 Ellipse **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/oEJjnyI9L)

If the minimum area of the triangle formed by a tangent to the ellipse $\frac{x^2}{b^2} + \frac{y^2}{4a^2} = 1$ and the co-ordinate axis is kab , then k is equal to _____.

Q74 Determinants **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/r457v0y6xA)

If the system of linear equations

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

$$x - y - z = \alpha$$

$$3x + 3y + \beta z = 3$$

has infinitely many solution, then $\alpha + \beta - \alpha\beta$ is equal to _____.

Q75 Permutations & Combinations **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/HU8r5IdNfP)

A number is called a palindrome if it reads the same backward as well as forward. For example 285582 is a six digit palindrome. The number of six digit palindromes, which are divisible by 55, is _____.

Q76 Sets **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/1i7dm2H7ek)

$$A = \{x \in \mathbb{R} : |x - 2| > 1\},$$

$$B = \{x \in \mathbb{R} : \sqrt{x^2 - 3} > 1\},$$

$C = \{x \in \mathbb{R} : |x - 4| \geq 2\}$ and Z is the set of all integers, then the number of subsets of the set $(A \cap B \cap C)^c \cap Z$ is _____.

Q77 Statistics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/pSIhRISniC)

Let n be an odd natural number such that the variance of 1, 2, 3, 4, ..., n is 14. Then n is equal to _____.

Q78 Vectors **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/G-MfR99bXs)

Let $\vec{a} = \hat{i} + 5\hat{j} + \alpha\hat{k}$, $\vec{b} = \hat{i} + 3\hat{j} + \beta\hat{k}$ and $\vec{c} = -\hat{i} + 2\hat{j} - 3\hat{k}$ be three vectors such that, $|\vec{b} \times \vec{c}| = 5\sqrt{3}$ and $\vec{a}$ is perpendicular to $\vec{b}$. Then the greatest amongst the values of $|\vec{a}|^2$ is _____.

Q79 Indefinite Integration **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/0j8eZiVkyA)

If $\int \frac{dx}{(x^2+x+1)^2} = a \tan^{-1} \left(\frac{2x+1}{\sqrt{3}} \right) + b \left(\frac{2x+1}{x^2+x+1} \right) + C$, $x > 0$ where C is the constant of integration, then the value of $9(\sqrt{3}a + b)$ is equal to _____.

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1. B	2. A	3. B	4. A	5. D	6. C	7. D	8. A
9. A	10. A	11. D	12. C	13. B	14. B	15. D	16. D
17. C	18. A	19. A	20. 11	21. 20	22. 5	23. 2	24. 2
25. 3	26. 12	27. 1210	28. 2				

Chemistry

29. B	30. D	31. C	32. D	33. A	34. B	35. B	36. D
37. D	38. C	39. C	40. A	41. A	42. 4	43. 2	44. 18
45. 518	46. 40	47. 3155	48. 82	49. 4	50. 1125	51. 316	

Mathematics

52. D	53. D	54. D	55. C	56. D	57. A	58. C	59. A
60. C	61. D	62. B	63. C	64. A	65. A	66. B	67. A
68. D	69. C	70. 4	71. 61	72. 17	73. 2	74. 5	75. 100
76. 256	77. 13	78. 90	79. 15				

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