

JEE MAIN 2023 · QUESTION PAPER

30 Jan 2023 **Shift 1**

78 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	16 Q28 to Q43	9 Q44 to Q52
● Mathematics	17 Q53 to Q69	9 Q70 to Q78
In this PDF	78 questions · answer key at the end	

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

Attempt this paper online

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

prepwisar.in/pyqs/paper/2023-01-30-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 Alternating Current

[Step-by-step solution](#) › [prepwisar.in/questions/6HVuMij2vY](https://www.prepwisar.in/questions/6HVuMij2vY)

In a series LR circuit with $X_L = R$, power factor P_1 . If a capacitor of capacitance C with $X_C = X_L$ is added to the circuit the power factor becomes P_2 . The ratio of P_1 to P_2 will be:

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

Q2 Atomic Physics

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

Speed of an electron in Bohr's 7th orbit for Hydrogen atom is $3.6 \times 10^6 \text{ m/s}$. The corresponding speed of the electron in 3rd orbit, in m/s is:

- (A) (1.8×10^6) (B) (7.5×10^6) (C) (8.4×10^6) (D) (3.6×10^6)

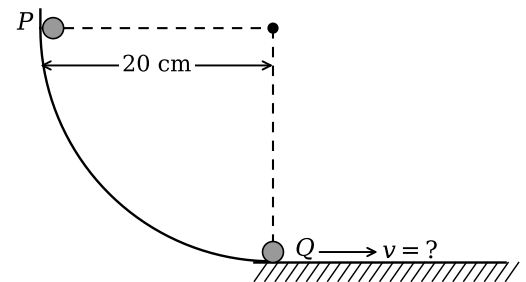
Q3 Collision

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

As per the given figure, a small ball P slides down the quadrant of a circle and hits the other ball Q of equal mass which is initially at rest. Neglecting the effect of friction and assume the collision to be elastic, the velocity of ball Q after collision will be:

($g = 10 \text{ m/s}^2$)

- (A) 0.25 m/s (B) 4 m/s (C) 0 (D) 2 m/s



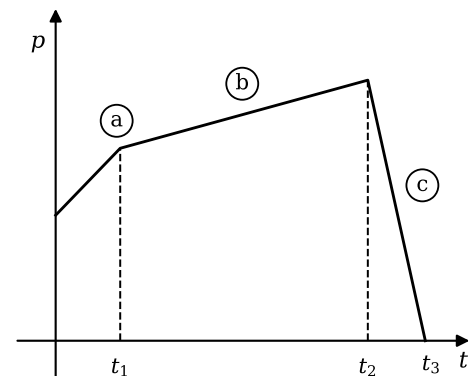
Q4 Centre of Mass & Linear Momentum

[Step-by-step solution](#) › [prepwisar.in/questions/2mbx1vHcih](https://www.prepwisar.in/questions/2mbx1vHcih)

The figure represents the momentum time ($p - t$) curve for a particle moving along an axis under the influence of the force. Identify the regions on the graph where the magnitude of the force is maximum and minimum respectively?

If $(t_3 - t_2) < t_1$

- (A) b and c (B) c and a (C) a and b (D) c and b



Q5 Collision

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

A ball of mass 200g rests on a vertical post of height 20m. A bullet of mass 10g, travelling in horizontal direction, hits the centre of the ball. After collision both travel independently. The ball hits the ground at a distance 30m and the bullet at a distance of 120m from the foot of the post. The value of initial velocity of the bullet will be (if $g = 10 \text{ m/s}^2$):

- (A) 120 m/s (B) 360 m/s (C) 400 m/s (D) 60 m/s

Q6 Basic Mathematics for Physics

[Step-by-step solution](#) › [prepwisar.in/questions/GKy5hhok6I](https://www.prepwisar.in/questions/GKy5hhok6I)

The charge flowing in a conductor changes with time as

$$Q(t) = \alpha t - \beta t^2 + \gamma t^3$$

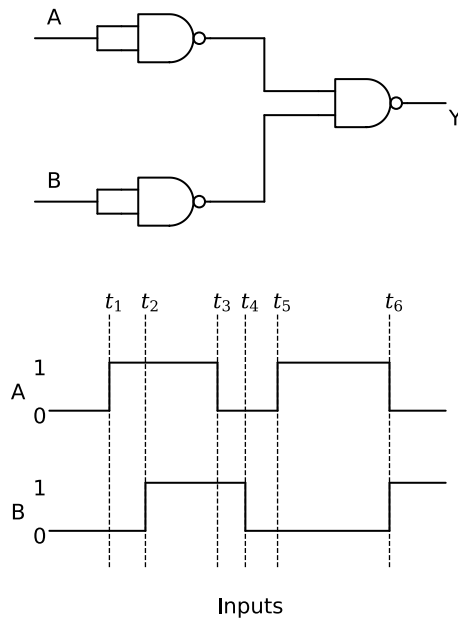
. Where α, β and γ are constants. Minimum value of current is:

- (A) $\beta - \frac{\alpha^2}{3\gamma}$ (B) $\alpha - \frac{3\beta^2}{\gamma}$ (C) $\alpha - \frac{\beta^2}{3\gamma}$ (D) $\alpha - \frac{\gamma^2}{3\beta}$

A small object at rest, absorbs a light pulse of power 20mW and duration 300ns . Assuming speed of light as $3 \times 10^8\text{m/s}$, the momentum of the object becomes equal to:

- (A) $1 \times 10^{-17}\text{kgm/s}$ (B) $0.5 \times 10^{-17}\text{kgm/s}$ (C) $3 \times 10^{-17}\text{kgm/s}$ (D) $2 \times 10^{-17}\text{kgm/s}$

The output waveform of the given logical circuit for the following inputs A and B as shown below, is:



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

Electric field in a certain region is given by

$$\vec{E} = \left(\frac{A}{x^2} \hat{i} + \frac{B}{y^3} \hat{j} \right). \text{ The SI unit of A and B}$$

are:

- (A) $\text{Nm}^2\text{C}; \text{Nm}^3\text{C}$ (B) $\text{Nm}^3\text{C}^{-1}; \text{Nm}^2\text{C}^{-1}$ (C) $\text{Nm}^3\text{C}; \text{Nm}^2\text{C}$ (D) $\text{Nm}^2\text{C}^{-1}; \text{Nm}^3\text{C}^{-1}$

Two isolated metallic solid spheres of radii R and $2R$ are charged such that both have same charge density σ . The spheres are then connected by a thin conducting wire. If the new charge density of the bigger sphere is σ' . The ratio $\frac{\sigma'}{\sigma}$ is:

- (A) $\frac{5}{3}$ (B) $\frac{5}{6}$ (C) $\frac{9}{4}$ (D) $\frac{4}{3}$

Q11 Ray Optics[Step-by-step solution > prepwiser.in/questions/XnEjBa7j67](https://www.prepwiser.in/questions/XnEjBa7j67)

A person has been using spectacles of power -1.0 dioptre for distant vision and a separate reading glass of power 2.0 dioptres. What is the least distance of distinct vision for this person:

- (A) 50 cm (B) 40 cm (C) 30 cm (D) 10 cm

Q12 Gravitation[Step-by-step solution > prepwiser.in/questions/CghP9Stona](https://www.prepwiser.in/questions/CghP9Stona)

If the gravitational field in the space is given as $(-\frac{K}{r^2})$. Taking the reference point to be at $r = 2\text{cm}$ with gravitational potential $V = 10\text{J/kg}$. Find the gravitational potential at $r = 3\text{cm}$ in SI unit (Given, that $K = 6\text{Jcm/kg}$)

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

Q13 Kinetic Theory of Gases[Step-by-step solution > prepwiser.in/questions/tvIJC_K5K9](https://www.prepwiser.in/questions/tvIJC_K5K9)

The pressure (P) and temperature (T) relationship of an ideal gas obeys the equation $PT^2 = \text{constant}$. The volume expansion coefficient of the gas will be:

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

Q14 Thermodynamics[Step-by-step solution > prepwiser.in/questions/cq8wtcAFSS](https://www.prepwiser.in/questions/cq8wtcAFSS)

Heat is given to an ideal gas in an isothermal process.

- A. Internal energy of the gas will decrease.
B. Internal energy of the gas will increase.
C. Internal energy of the gas will not change.
D. The gas will do positive work.
E. The gas will do negative work.

Choose the correct answer from the options given below:

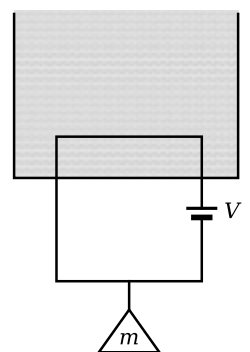
- (A) B and D only (B) C and E only (C) A and E only (D) C and D only

Q15 Moving Charges & Magnetism[Step-by-step solution > prepwiser.in/questions/fHVPIhquij](https://www.prepwiser.in/questions/fHVPIhquij)

A massless square loop, of wire of resistance 10Ω , supporting a mass of 1g , hangs vertically with one of its sides in a uniform magnetic field of 10^3G , directed outwards in the shaded region. A dc voltage V is applied to the loop. For what value of V , the magnetic force will exactly balance the weight of the supporting mass of 1g ?

(If sides of the loop = 10cm , $g = 10\text{ms}^{-2}$)

- (A) 1 V (B) $\frac{1}{10}$ V (C) 10 V (D) 100 V

**Q16** Magnetism & Matter[Step-by-step solution > prepwiser.in/questions/yqfkUVLwzK](https://www.prepwiser.in/questions/yqfkUVLwzK)

The magnetic moments associated with two closely wound circular coils A and B of radius $r_A = 10\text{cm}$ and $r_B = 20\text{cm}$ respectively are equal if : (Where N_A, I_A and N_B, I_B are number of turn and current of A and B respectively)

- (A) $4N_AI_A = N_BI_B$ (B) $2N_AI_A = N_BI_B$ (C) $N_A = 2N_B$ (D) $N_AI_A = 4N_BI_B$

Q17 Surface Tension[Step-by-step solution](#) > [prepwisar.in/questions/-hIulUD5ys](https://www.prepwisar.in/questions/-hIulUD5ys)

The height of liquid column raised in a capillary tube of certain radius when dipped in liquid A vertically is, 5cm. If the tube is dipped in a similar manner in another liquid B of surface tension and density double the values of liquid A, the height of liquid column raised in liquid B would be _____ m.

- (A) 0.05 (B) 0.20 (C) 0.5 (D) 0.10

Q18 Elasticity[Step-by-step solution](#) > [prepwisar.in/questions/6JaS502qIz](https://www.prepwisar.in/questions/6JaS502qIz)

Choose the correct relationship between Poisson ratio (σ), bulk modulus (K) and modulus of rigidity (η) of a given solid object:

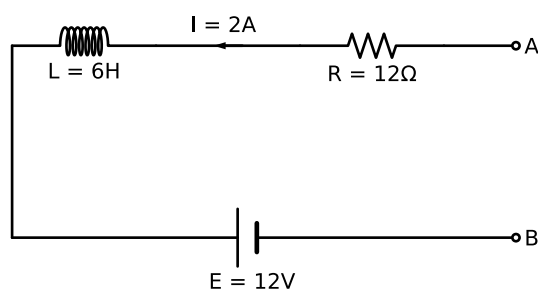
- (A) $\sigma = \frac{3K+2\eta}{6K+2\eta}$ (B) $\sigma = \frac{3K-2\eta}{6K+2\eta}$ (C) $\sigma = \frac{6K+2\eta}{3K-2\eta}$ (D) $\sigma = \frac{6K-2\eta}{3K-2\eta}$

Physics Section B · Numerical value

Q19 to Q27

Q19 Electrostatics II: Potential & Capacitance **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/4jy3JpYhgN](https://www.prepwisar.in/questions/4jy3JpYhgN)

A capacitor of capacitance $900\mu\text{F}$ is charged by a 100V battery. The capacitor is disconnected from the battery and connected to another uncharged identical capacitor such that one plate of uncharged capacitor connected to positive plate and another plate of uncharged capacitor connected to negative plate of the charged capacitor. The loss of energy in this process is measured as $x \times 10^{-2}\text{J}$. The value of x is _____.

Q20 Electromagnetic Induction **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/FICPUEKoHT](https://www.prepwisar.in/questions/FICPUEKoHT)

As per the given figure, if $\frac{dI}{dt} = -1\text{A/s}$ then the value of V_{AB} at this instant will be _____ V.

Q21 Electromagnetic Waves **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/fRcfvgKE1j](https://www.prepwisar.in/questions/fRcfvgKE1j)

A point source of light is placed at the centre of curvature of a hemispherical surface. The source emits a power of 24W . The radius of curvature of hemisphere is 10cm and the inner surface is completely reflecting. The force on the hemisphere due to the light falling on it is _____ $\times 10^{-8}\text{N}$.

Q22 Experimental Skills **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/Qf2mgWnBVU](https://www.prepwisar.in/questions/Qf2mgWnBVU)

In an experiment for estimating the value of focal length of converging mirror, image of an object placed at 40cm from the pole of the mirror is formed at distance 120cm from the pole of the mirror. These distances are measured with a modified scale in which there are 20 small divisions in 1cm . The value of error in measurement of focal length of the mirror is $\frac{1}{K}\text{cm}$. The value of K is _____.

Q23 Rectilinear Motion **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/A9N6Ra24rw](https://www.prepwisar.in/questions/A9N6Ra24rw)

A horse rider covers half the distance with 5m/s speed. The remaining part of the distance was travelled with speed 10m/s for half the time and with speed 15m/s for other half of the time. The mean speed of the rider averaged over the whole time of motion is $\frac{x}{7}\text{m/s}$. The value of x is _____.

Q24 Rotational Motion **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/mIR-vrrE-O](https://www.prepwiser.in/questions/mIR-vrrE-O)

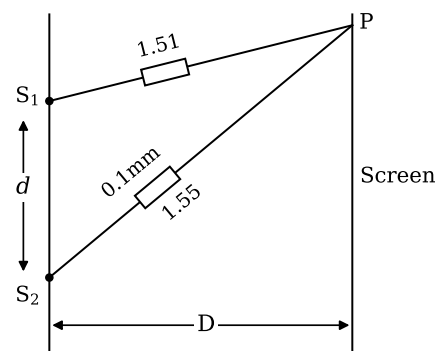
A thin uniform rod of length $2m$, cross sectional area ' A ' and density ' d ' is rotated about an axis passing through the centre and perpendicular to its length with angular velocity ω . If value of ω in terms of its rotational kinetic energy E is $\sqrt{\frac{\alpha E}{Ad}}$ then value of α is _____.

Q25 Simple Harmonic Motion **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/LwKugD6j6a](https://www.prepwiser.in/questions/LwKugD6j6a)

The general displacement of a simple harmonic oscillator is $x = A \sin \omega t$. Let T be its time period. The slope of its potential energy (U) - time (t) curve will be maximum when $t = \frac{T}{\beta}$. The value of β is _____.

Q26 Wave Optics **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/5FINRsgXG0](https://www.prepwiser.in/questions/5FINRsgXG0)

In Young's double slit experiment, two slits S_1 and S_2 are ' d ' distance apart and the separation from slits to screen is D (as shown in figure). Now if two transparent slabs of equal thickness 0.1mm but refractive index 1.51 and 1.55 are introduced in the path of beam ($\lambda = 4000 \text{ \AA}$) from S_1 and S_2 respectively. The central bright fringe spot will shift by _____ number of fringes.

**Q27** Experimental Skills **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/l7KKBNtjc-](https://www.prepwiser.in/questions/l7KKBNtjc-)

In a screw gauge, there are 100 divisions on the circular scale and the main scale moves by 0.5mm on a complete rotation of the circular scale. The zero of circular scale lies 6 divisions below the line of graduation when two studs are brought in contact with each other. When a wire is placed between the studs, 4 linear scale divisions are clearly visible while 46^{th} division of the circular scale coincide with the reference line. The diameter of the wire is _____ $\times 10^{-2}\text{mm}$.

Chemistry Section A · Multiple choice

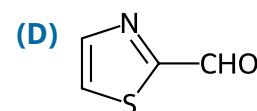
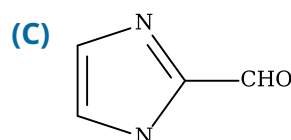
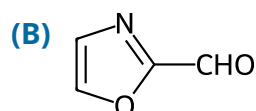
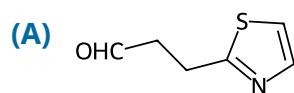
Q28 to Q43

Q28 Practical Organic Chemistry[Step-by-step solution](#) > [prepwiser.in/questions/UucpeqxeqD](https://www.prepwiser.in/questions/UucpeqxeqD)

Which of the following compounds would give the following set of qualitative analysis?

(i) Fehling's Test : Positive

(ii) Na fusion extract upon treatment with sodium nitroprusside gives a blood red colour but not prussian blue.



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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) : Ketoses give Seliwanoff's test faster than Aldoses.

Reason (R) : Ketoses undergo β -elimination followed by formation of furfural.

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

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

For OF_2 molecule consider the following:

- A. Number of lone pairs on oxygen is 2.
 B. FOF angle is less than 104.5° .
 C. Oxidation state of O is -2 .
 D. Molecule is bent 'V' shaped.
 E. Molecular geometry is linear.

correct options are:

- (A) A, C, D only (B) A, B, D only (C) C, D, E only (D) B, E, A only

Match List I with List II

	List I (molecules/ions)		List II (No. of lone pairs of e^- on central atom)
A.	IF_7	I.	Three
B.	ICl_4^-	II.	One
C.	XeF_6	III.	Two
D.	XeF_2	IV.	Zero

Choose the correct answer from the options given below:

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

Amongst the following compounds, which one is an antacid?

- (A) Ranitidine (B) Brompheniramine (C) Terfenadine (D) Meprobamate

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To inhibit the growth of tumours, identify the compounds used from the following:

- A. EDTA
- B. Coordination Compounds of Pt
- C. D - Penicillamine
- D. Cis - Platin

Choose the correct answer from the option given below:

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

Which of the following is correct order of ligand field strength?

- (A) $S^{2-} < C_2O_4^{2-} < NH_3 < en < CO$ (B) $CO < en < NH_3 < C_2O_4^{2-} < S^{2-}$
 (C) $S^{2-} < NH_3 < en < CO < C_2O_4^{2-}$ (D) $NH_3 < en < CO < S^{2-} < C_2O_4^{2-}$

During the qualitative analysis of SO_3^{2-} using dilute H_2SO_4 , SO_2 gas is evolved which turns $K_2Cr_2O_7$ solution (acidified with dilute H_2SO_4):

- (A) blue (B) black (C) red (D) green

In the extraction of copper, its sulphide ore is heated in a reverberatory furnace after mixing with silica to:

- (A) remove FeO as $FeSiO_3$
 (B) remove calcium as $CaSiO_3$
 (C) decrease the temperature needed for roasting of Cu_2S
 (D) separate CuO as $CuSiO_3$

Match List I with List II

	List I (Atomic number)		List II (Block of periodic table)
A.	37	I.	p-block
B.	78	II.	d-block
C.	52	III.	f-block
D.	65	IV.	s-block

Choose the correct answer from the options given below:

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

Caprolactam when heated at high temperature in presence of water, gives

- (A) Dacron (B) Nylon 6 (C) Teflon (D) Nylon 6,6

Lithium aluminium hydride can be prepared from the reaction of:

- (A) LiCl and Al_2H_6 (B) LiH and $\text{Al}(\text{OH})_3$ (C) LiH and Al_2Cl_6 (D) LiCl, Al and H_2

The alkaline earth metal sulphate(s) which are readily soluble in water is/are:

- A. BeSO_4
 B. MgSO_4
 C. CaSO_4
 D. SrSO_4
 E. BaSO_4

Choose the correct answer from the options given below:

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

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

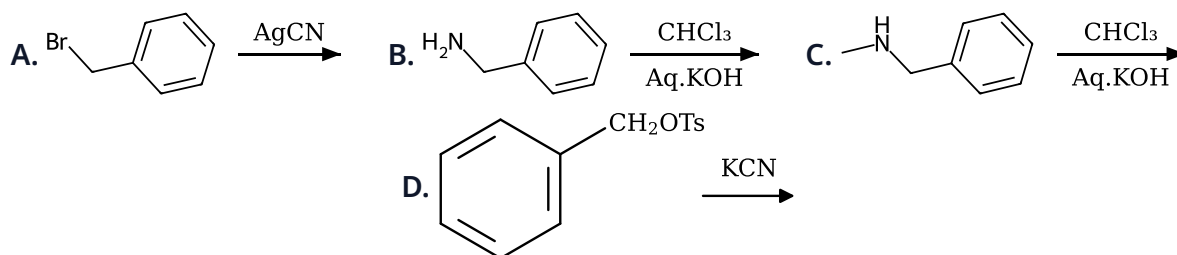
Assertion (A) : In expensive scientific instruments, silica gel is kept in watch-glasses or in semipermeable membrane bags.

Reason (R) : Silica gel adsorbs moisture from air via adsorption, thus protects the instrument from water corrosion (rusting) and / or prevents malfunctioning.

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

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

Benzyl isocyanide can be obtained by:



Choose the correct answer from the options given below:

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

In the wet tests for identification of various cations by precipitation, which transition element cation doesn't belong to group IV in qualitative inorganic analysis?

- (A) Co^{2+} (B) Ni^{2+} (C) Zn^{2+} (D) Fe^{3+}

Q44 Alcohols, Phenols & Ethers **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/4yFTegB8EC) > prepwiser.in/questions/4yFTegB8EC

A trisubstituted compound 'A', $C_{10}H_{12}O_2$ gives neutral $FeCl_3$ test positive. Treatment of compound 'A' with $NaOH$ and CH_3Br gives $C_{11}H_{14}O_2$, with hydroiodic acid gives methyl iodide and with hot conc. $NaOH$ gives a compound B, $C_{10}H_{12}O_2$. Compound 'A' also decolorises alkaline $KMnO_4$. The number of π bond/s present in the compound 'A' is _____.

Q45 Chemical Kinetics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/wN_4nUC8ns) > prepwiser.in/questions/wN_4nUC8ns

If compound A reacts with B following first order kinetics with rate constant $2.011 \times 10^{-3} s^{-1}$. The time taken by A (in seconds) to reduce from 7g to 2g will be _____. (Nearest Integer)

$$[\log 5 = 0.698, \log 7 = 0.845, \log 2 = 0.301]$$

Q46 Redox Reactions **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/FMEmsDAW_7) > prepwiser.in/questions/FMEmsDAW_7

The number of electrons involved in the reduction of permanganate to manganese dioxide in acidic medium is _____.

Q47 Electrochemistry **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/l6buQSU39w) > prepwiser.in/questions/l6buQSU39w

Consider the cell



When the potential of the cell is 0.712V at 298K, the ratio $[Fe^{2+}] / [Fe^{3+}]$ is _____. (Nearest integer)

Given:



$$\frac{2.303RT}{F} = 0.06V$$

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

600mL of 0.01M HCl is mixed with 400mL of 0.01M H_2SO_4 . The pH of the mixture is _____ $\times 10^{-2}$. (Nearest integer)

[Given $\log 2 = 0.30$

$$\log 3 = 0.48$$

$$\log 5 = 0.69$$

$$\log 7 = 0.84$$

$$\log 11 = 1.04]$$

Q49 Solutions & Colligative Properties **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/-nIAqofUwA) > prepwiser.in/questions/-nIAqofUwA

A solution containing 2g of a non-volatile solute in 20g of water boils at 373.52K. The molecular mass of the solute is _____ $gmol^{-1}$. (Nearest integer)

Given, water boils at 373K, K_b for water = $0.52Kkgmol^{-1}$

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Some amount of dichloromethane (CH_2Cl_2) is added to 671.141 mL of chloroform (CHCl_3) to prepare $2.6 \times 10^{-3}\text{M}$ solution of CH_2Cl_2 (DCM). The concentration of DCM is _____ ppm (by mass).

Given:

atomic mass : C = 12

H = 1

Cl = 35.5

density of $\text{CHCl}_3 = 1.49\text{gcm}^{-3}$

The energy of one mole of photons of radiation of frequency $2 \times 10^{12}\text{Hz}$ in Jmol^{-1} is _____. (Nearest integer)

[Given: $h = 6.626 \times 10^{-34}\text{Js}$

$N_A = 6.022 \times 10^{23}\text{mol}^{-1}$]

When 2 litre of ideal gas expands isothermally into vacuum to a total volume of 6 litre, the change in internal energy is _____ J. (Nearest integer)

Mathematics Section A · Multiple choice

Q53 to Q69

The line l_1 passes through the point (2, 6, 2) and is perpendicular to the plane $2x + y - 2z = 10$. Then the shortest distance between the line l_1 and the line $\frac{x+1}{2} = \frac{y+4}{-3} = \frac{z}{2}$ is:

- (A) 9 (B) 7 (C) $\frac{19}{3}$ (D) $\frac{13}{3}$

The number of points on the curve $y = 54x^5 - 135x^4 - 70x^3 + 180x^2 + 210x$ at which the normal lines are parallel to $x + 90y + 2 = 0$ is:

- (A) 2 (B) 3 (C) 4 (D) 0

If the coefficient of x^{15} in the expansion of $(ax^3 + \frac{1}{bx^{1/3}})^{15}$ is equal to the coefficient of x^{-15} in the expansion of $(ax^{1/3} - \frac{1}{bx^3})^{15}$, where a and b are positive real numbers, then for each such ordered pair (a, b):

- (A) $a = 3b$ (B) $ab = 1$ (C) $ab = 3$ (D) $a = b$

The coefficient of x^{301} in

$$(1+x)^{500} + x(1+x)^{499} + x^2(1+x)^{498} + \dots + x^{500}$$

is:

- (A) $^{500}C_{300}$ (B) $^{501}C_{200}$ (C) $^{500}C_{301}$ (D) $^{501}C_{302}$

Q57 Circles[Step-by-step solution > prepwiser.in/questions/8INoQJWAVX](https://www.prepwiser.in/questions/8INoQJWAVX)

Let $y = x + 2$, $4y = 3x + 6$ and $3y = 4x + 1$ be three tangent lines to the circle $(x - h)^2 + (y - k)^2 = r^2$. Then $h + k$ is equal to:

- (A) 6 (B) $5(1 + \sqrt{2})$ (C) 5 (D) $5\sqrt{2}$

Q58 Definite Integration[Step-by-step solution > prepwiser.in/questions/sATQtEFy11](https://www.prepwiser.in/questions/sATQtEFy11)

If $[t]$ denotes the greatest integer $\leq t$, then the value of $\frac{3(e-1)}{e} \int_1^2 x^2 e^{[x]+[x^3]} dx$ is:

- (A) $e^8 - e$ (B) $e^7 - 1$ (C) $e^9 - e$ (D) $e^8 - 1$

Q59 Differential Equations[Step-by-step solution > prepwiser.in/questions/1VXRVPeW0K](https://www.prepwiser.in/questions/1VXRVPeW0K)

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

$$\frac{dy}{dx} - \frac{3x^5 \tan^{-1}(x^3)}{(1+x^6)^{3/2}} y = 2x \exp \left\{ \frac{x^3 - \tan^{-1} x^3}{\sqrt{1+x^6}} \right\}$$

pass through the origin. Then $y(1)$ is equal to :

- (A) $\exp \left(\frac{1-\pi}{4\sqrt{2}} \right)$ (B) $\exp \left(\frac{4-\pi}{4\sqrt{2}} \right)$ (C) $\exp \left(\frac{4+\pi}{4\sqrt{2}} \right)$ (D) $\exp \left(\frac{\pi-4}{4\sqrt{2}} \right)$

Q60 Functions (Advanced)[Step-by-step solution > prepwiser.in/questions/1iZEv2L1J](https://www.prepwiser.in/questions/1iZEv2L1J)

Suppose $f : \mathbb{R} \rightarrow (0, \infty)$ be a differentiable function such that $5f(x+y) = f(x) \cdot f(y)$, $\forall x, y \in \mathbb{R}$. If $f(3) = 320$, then $\sum_{n=0}^5 f(n)$ is equal to:

- (A) 6875 (B) 6525 (C) 6575 (D) 6825

Q61 Determinants[Step-by-step solution > prepwiser.in/questions/7jo1qe8UKT](https://www.prepwiser.in/questions/7jo1qe8UKT)

Let the system of linear equations

$$x + y + kz = 2$$

$$2x + 3y - z = 1$$

$$3x + 4y + 2z = k$$

have infinitely many solutions. Then the system

$$(k+1)x + (2k-1)y = 7$$

$$(2k+1)x + (k+5)y = 10$$

has:

- (A) unique solution satisfying $x - y = 1$ (B) infinitely many solutions
(C) no solution (D) unique solution satisfying $x + y = 1$

Q62 Matrices[Step-by-step solution > prepwiser.in/questions/Ot8SAElrsg](https://www.prepwiser.in/questions/Ot8SAElrsg)

Let

$$A = \begin{pmatrix} m & n \\ p & q \end{pmatrix}, d = |A| \neq 0$$

and $|A - d(\text{Adj}A)| = 0$. Then

- (A) $1 + d^2 = m^2 + q^2$ (B) $1 + d^2 = (m+q)^2$
(C) $(1+d)^2 = m^2 + q^2$ (D) $(1+d)^2 = (m+q)^2$

Q63 Parabola[Step-by-step solution](#) > [prepwiser.in/questions/RIPCegKvVx](https://www.prepwiser.in/questions/RIPCegKvVx)

If $P(h, k)$ be a point on the parabola $x = 4y^2$, which is nearest to the point $Q(0, 33)$, then the distance of P from the directrix of the parabola $y^2 = 4(x + y)$ is equal to:

- (A) 8 (B) 2 (C) 6 (D) 4

Q64 Probability: Basic[Step-by-step solution](#) > [prepwiser.in/questions/wMwzsJumzW](https://www.prepwiser.in/questions/wMwzsJumzW)

If an unbiased die, marked with $-2, -1, 0, 1, 2, 3$ on its faces, is thrown five times, then the probability that the product of the outcomes is positive, is:

- (A) $\frac{27}{288}$ (B) $\frac{521}{2592}$ (C) $\frac{440}{2592}$ (D) $\frac{881}{2592}$

Q65 Sequences & Series[Step-by-step solution](#) > [prepwiser.in/questions/6d7Zw3jx0k](https://www.prepwiser.in/questions/6d7Zw3jx0k)

If $a_n = \frac{-2}{4n^2 - 16n + 15}$, then $a_1 + a_2 + \dots + a_{25}$ is equal to:

- (A) $\frac{51}{144}$ (B) $\frac{49}{138}$ (C) $\frac{50}{141}$ (D) $\frac{52}{147}$

Q66 Relations & Functions (Basic)[Step-by-step solution](#) > [prepwiser.in/questions/Fa5aj93DK5](https://www.prepwiser.in/questions/Fa5aj93DK5)

The minimum number of elements that must be added to the relation $R = \{(a, b), (b, c)\}$ on the set $\{a, b, c\}$ so that it becomes symmetric and transitive is:

- (A) 7 (B) 3 (C) 4 (D) 5

Q67 Vectors[Step-by-step solution](#) > [prepwiser.in/questions/5A7xYERABu](https://www.prepwiser.in/questions/5A7xYERABu)

If $\vec{a}, \vec{b}, \vec{c}$ are three non-zero vectors and $\hat{n}$ is a unit vector perpendicular to $\vec{c}$ such that $\vec{a} = \alpha \vec{b} - \hat{n}$, ($\alpha \neq 0$) and $\vec{b} \cdot \vec{c} = 12$, then

$$|\vec{c} \times (\vec{a} \times \vec{b})|$$

is equal to:

- (A) 15 (B) 9 (C) 6 (D) 12

Q68 Three Dimensional Geometry[Step-by-step solution](#) > [prepwiser.in/questions/IDTrHc7GWE](https://www.prepwiser.in/questions/IDTrHc7GWE)

Let a unit vector $\widehat{OP}$ make angles α, β, γ with the positive directions of the co-ordinate axes OX, OY, OZ respectively, where $\beta \in (0, \frac{\pi}{2})$. If $\widehat{OP}$ is perpendicular to the plane through points $(1, 2, 3), (2, 3, 4)$ and $(1, 5, 7)$, then which one of the following is true?

- (A) $\alpha \in (\frac{\pi}{2}, \pi)$ and $\gamma \in (\frac{\pi}{2}, \pi)$ (B) $\alpha \in (0, \frac{\pi}{2})$ and $\gamma \in (\frac{\pi}{2}, \pi)$
 (C) $\alpha \in (\frac{\pi}{2}, \pi)$ and $\gamma \in (0, \frac{\pi}{2})$ (D) $\alpha \in (0, \frac{\pi}{2})$ and $\gamma \in (0, \frac{\pi}{2})$

Q69 Trigonometric Ratios & Identities[Step-by-step solution](#) > [prepwiser.in/questions/u0FtZHdzhh](https://www.prepwiser.in/questions/u0FtZHdzhh)

If $\tan 15^\circ + \frac{1}{\tan 75^\circ} + \frac{1}{\tan 105^\circ} + \tan 195^\circ = 2a$, then the value of $(a + \frac{1}{a})$ is:

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

Q70 Three Dimensional Geometry **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/55SGB4ozgI1](https://www.prepwisar.in/questions/55SGB4ozgI1)

If the equation of the plane passing through the point $(1, 1, 2)$ and perpendicular to the line $x - 3y + 2z - 1 = 0 = 4x - y + z$ is $Ax + By + Cz = 1$, then $140(C - B + A)$ is equal to _____.

Q71 Three Dimensional Geometry **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/PWqyjSOMr0](https://www.prepwisar.in/questions/PWqyjSOMr0)

If $\lambda_1 < \lambda_2$ are two values of λ such that the angle between the planes $P_1 : \vec{r}(3\hat{i} - 5\hat{j} + \hat{k}) = 7$ and $P_2 : \vec{r} \cdot (\lambda\hat{i} + \hat{j} - 3\hat{k}) = 9$ is $\sin^{-1}\left(\frac{2\sqrt{6}}{5}\right)$, then the square of the length of perpendicular from the point $(38\lambda_1, 10\lambda_2, 2)$ to the plane P_1 is _____.

Q72 Complex Numbers **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/i2nM_IuPSU](https://www.prepwisar.in/questions/i2nM_IuPSU)

Let $z = 1 + i$ and $z_1 = \frac{1+i\bar{z}}{\bar{z}(1-z)+\frac{1}{z}}$. Then $\frac{12}{\pi} \arg(z_1)$ is equal to _____.

Q73 Limits **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/4QOaiSSO8f](https://www.prepwisar.in/questions/4QOaiSSO8f)

$$\lim_{x \rightarrow 0} \frac{48}{x^4} \int_0^x \frac{t^3}{t^6 + 1} dt$$

is equal to _____.

Q74 Relations & Functions (Basic) **NUMERICAL**

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

Let $f^1(x) = \frac{3x+2}{2x+3}$, $x \in \mathbf{R} - \left\{-\frac{3}{2}\right\}$ For $n \geq 2$, define $f^n(x) = f^1 \circ f^{n-1}(x)$. If

$$f^5(x) = \frac{ax+b}{bx+a}, \gcd(a, b) = 1$$

, then $a + b$ is equal to _____.

Q75 Permutations & Combinations **NUMERICAL**

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

Number of 4-digit numbers (the repetition of digits is allowed) which are made using the digits 1, 2, 3 and 5, and are divisible by 15, is equal to _____.

Q76 Sequences & Series **NUMERICAL**

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

Let

$$\sum_{n=0}^{\infty} \frac{n^3((2n)!) + (2n-1)(n!)}{(n!)((2n)!)} = ae + \frac{b}{e} + c$$

, where $a, b, c \in \mathbb{Z}$ and $e = \sum_{n=0}^{\infty} \frac{1}{n!}$ Then $a^2 - b + c$ is equal to _____.

Q77 Statistics **NUMERICAL**

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

The mean and variance of 7 observations are 8 and 16 respectively. If one observation 14 is omitted and a and b are respectively mean and variance of remaining 6 observation, then $a + 3b - 5$ is equal to _____.

Q78 Area Under Curves **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/atJAHuu8et](https://www.prepwisar.in/questions/atJAHuu8et)

Let α be the area of the larger region bounded by the curve $y^2 = 8x$ and the lines $y = x$ and $x = 2$, which lies in the first quadrant. Then the value of 3α is equal to _____.

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Physics

1. A	2. C	3. D	4. D	5. B	6. C	7. D	8. D
9. D	10. B	11. A	12. B	13. D	14. D	15. C	16. D
17. A	18. B	19. 225	20. 30	21. 4	22. 32	23. 50	24. 3
25. 8	26. 10	27. 220					

Chemistry

28. A	29. C	30. B	31. C	32. A	33. C	34. A	35. D
36. A	37. C	38. B	39. C	40. A	41. A	42. C	43. D
44. 4	45. 623	46. 3	47. 10	48. 186	49. 100	50. 148	51. 798
52. 0							

Mathematics

53. A	54. C	55. B	56. B	57. C	58. A	59. B	60. D
61. D	62. D	63. C	64. B	65. C	66. A	67. D	68. A
69. D	70. 15	71. 315	72. 9	73. 12	74. 3125	75. 21	76. 26
77. 37	78. 22						

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