

JEE MAIN 2023 · QUESTION PAPER

12 Apr 2023 **Shift 1**

78 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	15 Q30 to Q44	8 Q45 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.

prepwis.in/pyqs/paper/2023-04-12-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? prepwis.in/feedback · Terms: prepwis.in/terms

Q1 Alternating Current

[Step-by-step solution](#) › [prepwisar.in/questions/KZjMxY61In](https://www.prepwisar.in/questions/KZjMxY61In)

Given below are two statements:

Statement I : When the frequency of an a.c source in a series LCR circuit increases, the current in the circuit first increases, attains a maximum value and then decreases.

Statement II : In a series LCR circuit, the value of power factor at resonance is one.

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

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

Q2 Atomic Physics

[Step-by-step solution](#) › [prepwisar.in/questions/p6ZGWOrxo9](https://www.prepwisar.in/questions/p6ZGWOrxo9)

A 12.5eV electron beam is used to bombard gaseous hydrogen at room temperature. The number of spectral lines emitted will be:

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

Q3 Current Electricity

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

A wire of resistance 160Ω is melted and drawn in a wire of one-fourth of its length. The new resistance of the wire will be

- (A) 640Ω
- (B) 40Ω
- (C) 16Ω
- (D) 10Ω

Q4 Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwisar.in/questions/xHZdaUYsq6](https://www.prepwisar.in/questions/xHZdaUYsq6)

A proton and an α -particle are accelerated from rest by 2V and 4V potentials, respectively. The ratio of their de-Broglie wavelength is:

- (A) 4 : 1
- (B) 2 : 1
- (C) 8 : 1
- (D) 16 : 1

Q5 Electromagnetic Waves

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

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

Assertion A : EM waves used for optical communication have longer wavelengths than that of microwave, employed in Radar technology.

Reason R : Infrared EM waves are more energetic than microwaves, (used in Radar)

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

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

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In an n-p-n common emitter (CE) transistor the collector current changes from 5 mA to 16mA for the change in base current from $100\mu\text{A}$ and $200\mu\text{A}$, respectively. The current gain of transistor is _____.

- (A) 210 (B) 0.9 (C) 9 (D) 110

Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R
Assertion A : If an electric dipole of dipole moment $30 \times 10^{-5} \text{Cm}$ is enclosed by a closed surface, the net flux coming out of the surface will be zero.

Reason R : Electric dipole consists of two equal and opposite charges.

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

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

An ice cube has a bubble inside. When viewed from one side the apparent distance of the bubble is 12cm. When viewed from the opposite side, the apparent distance of the bubble is observed as 4cm. If the side of the ice cube is 24cm, the refractive index of the ice cube is

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

The ratio of escape velocity of a planet to the escape velocity of earth will be:-

Given: Mass of the planet is 16 times mass of earth and radius of the planet is 4 times the radius of earth.

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

Two satellites A and B move round the earth in the same orbit. The mass of A is twice the mass of B. The quantity which is same for the two satellites will be

- (A) Potential energy (B) Kinetic energy (C) Total energy (D) Speed

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An engine operating between the boiling and freezing points of water will have

- A. efficiency more than 27%.
- B. efficiency less than the efficiency of a Carnot engine operating between the same two temperatures.
- C. efficiency equal to 27%
- D. efficiency less than 27%

Choose the correct answer from the options given below:

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

If the r. m.s speed of chlorine molecule is 490m/s at 27°C , the r. m. s speed of argon molecules at the same temperature will be (Atomic mass of argon = 39.9u , molecular mass of chlorine = 70.9u)

- (A) 451.7m/s (B) 751.7m/s (C) 551.7m/s (D) 651.7m/s

Three forces $F_1 = 10\text{N}$, $F_2 = 8\text{N}$, $F_3 = 6\text{N}$ are acting on a particle of mass 5kg . The forces F_2 and F_3 are applied perpendicularly so that particle remains at rest. If the force F_1 is removed, then the acceleration of the particle is:

- (A) 4.8ms^{-2} (B) 7ms^{-2} (C) 2ms^{-2} (D) 0.5ms^{-2}

Given below are two statements:

Statement I : The diamagnetic property depends on temperature.

Statement II : The induced magnetic dipole moment in a diamagnetic sample is always opposite to the magnetizing field.

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

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

A ball is thrown vertically upward with an initial velocity of 150m/s . The ratio of velocity after 3s and 5s is $\frac{x+1}{x}$. The value of x is _____.

{ take, $g = 10\text{m/s}^2$ }

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

A body cools from 80°C to 60°C in 5 minutes. The temperature of the surrounding is 20°C . The time it takes to cool from 60°C to 40°C is:

- (A) 500 s (B) $\frac{25}{3}\text{S}$ (C) 450 s (D) 420 s

A particle is executing simple harmonic motion (SHM). The ratio of potential energy and kinetic energy of the particle when its displacement is half of its amplitude will be

- (A) 1 : 1 (B) 1 : 4 (C) 2 : 1 (D) 1 : 3

Given below are two statements:

Statement I : A truck and a car moving with same kinetic energy are brought to rest by applying breaks which provide equal retarding forces. Both come to rest in equal distance.

Statement II : A car moving towards east takes a turn and moves towards north, the speed remains unchanged. The acceleration of the car is zero.

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

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

Match List I with List II

	LIST I		LIST II
A.	Spring constant	I.	$[T^{-1}]$
B.	Angular speed	II.	$[MT^{-2}]$
C.	Angular momentum	III.	$[ML^2]$
D.	Moment of inertia	IV.	$[ML^2T^{-1}]$

Choose the correct answer from the options given below:

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

Physics Section B · Numerical value

Q20 to Q29

A common example of alpha decay is



Given:

$${}_{92}^{238}\text{U} = 238.05060\text{u},$$

$${}_{90}^{234}\text{Th} = 234.04360\text{u},$$

$${}_2^4\text{He} = 4.00260\text{u} \text{ and}$$

$$1\text{u} = 931.5 \frac{\text{MeV}}{c^2}$$

The energy released (Q) during the alpha decay of ${}_{92}^{238}\text{U}$ is _____ MeV

The current flowing through a conductor connected across a source is 2A and 1.2 A at 0°C and 100°C respectively. The current flowing through the conductor at 50°C will be _____ $\times 10^2\text{mA}$.

Q22 Electromagnetic Induction **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/oeBhI0dGQg) › prepwiser.in/questions/oeBhI0dGQg

A conducting circular loop is placed in a uniform magnetic field of 0.4T with its plane perpendicular to the field. Somehow, the radius of the loop starts expanding at a constant rate of 1mm/s . The magnitude of induced emf in the loop at an instant when the radius of the loop is 2cm will be _____ μV .

Q23 Electrostatics II: Potential & Capacitance **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/gwBBDq_90h) › prepwiser.in/questions/gwBBDq_90h

64 identical drops each charged upto potential of 10mV are combined to form a bigger drop. The potential of the bigger drop will be _____ mV .

Q24 Ray Optics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/14ja0ZNIJwc) › prepwiser.in/questions/14ja0ZNIJwc

Two convex lenses of focal length 20cm each are placed coaxially with a separation of 60cm between them. The image of the distant object formed by the combination is at _____ cm from the first lens.

Q25 Magnetism & Matter **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/aOqY87uk7Y) › prepwiser.in/questions/aOqY87uk7Y

A compass needle oscillates 20 times per minute at a place where the dip is 30° and 30 times per minute where the dip is 60° . The ratio of total magnetic field due to the earth at two places respectively is $\frac{4}{\sqrt{x}}$. The value of x is _____.

Q26 Fluid Mechanics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/hhjseks25w) › prepwiser.in/questions/hhjseks25w

Glycerin of density $1.25 \times 10^3\text{kgm}^{-3}$ is flowing through the conical section of pipe. The area of cross-section of the pipe at its ends are 10cm^2 and 5cm^2 and pressure drop across its length is 3Nm^{-2} . The rate of flow of glycerin through the pipe is $x \times 10^{-5}\text{m}^3\text{s}^{-1}$. The value of x is _____.

Q27 Rotational Motion **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/_1aj4vv__c) › prepwiser.in/questions/_1aj4vv__c

For a rolling spherical shell, the ratio of rotational kinetic energy and total kinetic energy is $\frac{x}{5}$. The value of x is _____.

Q28 Mechanical Waves **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/KW3J8UI0kC) › prepwiser.in/questions/KW3J8UI0kC

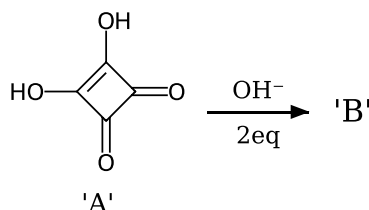
For a certain organ pipe, the first three resonance frequencies are in the ratio of $1 : 3 : 5$ respectively. If the frequency of fifth harmonic is 405Hz and the speed of sound in air is 324ms^{-1} the length of the organ pipe is _____ m .

Q29 Work, Energy & Power **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/lvT9h977qB) › prepwiser.in/questions/lvT9h977qB

To maintain a speed of 80 km/h by a bus of mass 500 kg on a plane rough road for 4 km distance, the work done by the engine of the bus will be _____ KJ . [The coefficient of friction between tyre of bus and road is 0.04 .]

Q30 Hydrocarbons: Aromatic (Arenes)[Step-by-step solution](#) › [prepwisar.in/questions/3bwPmE40KM](https://www.prepwisar.in/questions/3bwPmE40KM)

Correct statements for the given reaction are:



- A. Compound 'B' is aromatic
 B. The completion of above reaction is very slow
 C. 'A' shows tautomerism
 D. The bond lengths of C-C in compound B are found to be same

Choose the correct answer from the options given below:

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

Q31 Chemical Bonding & Molecular Structure[Step-by-step solution](#) › [prepwisar.in/questions/2_C155LbaM](https://www.prepwisar.in/questions/2_C155LbaM)

The bond order and magnetic property of acetylide ion are same as that of

- (A) O_2^+ (B) O_2^- (C) N_2^+ (D) NO^+

Q32 Coordination Compounds[Step-by-step solution](#) › [prepwisar.in/questions/PNK7EPlI47](https://www.prepwisar.in/questions/PNK7EPlI47)

Match List I with List II

	LIST I Complex		LIST II CFSE (Δ_0)
A.	$[\text{Cu}(\text{NH}_3)_6]^{2+}$	I.	-0.6
B.	$[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$	II.	-2.0
C.	$[\text{Fe}(\text{CN})_6]^{3-}$	III.	-1.2
D.	$[\text{NiF}_6]^{4-}$	IV.	-0.4

Choose the correct answer from the options given below:

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

Q33 d & f Block Elements[Step-by-step solution](#) › [prepwisar.in/questions/xKXrktNdMi](https://www.prepwisar.in/questions/xKXrktNdMi)Given below are two statement: one is labelled as Assertion **A** and the other is labelled as Reason **R**.

Assertion A: 5f electrons can participate in bonding to a far greater extent than 4f electrons

Reason R: 5f orbitals are not as buried as 4f orbitals

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) 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

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For lead storage battery pick the correct statements

- A. During charging of battery, PbSO_4 on anode is converted into PbO_2
- B. During charging of battery, PbSO_4 on cathode is converted into PbO_2
- C. Lead storage battery consists of grid of lead packed with PbO_2 as anode
- D. Lead storage battery has $\sim 38\%$ solution of sulphuric acid as an electrolyte

Choose the correct answer from the options given below:

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

Match List I with List II

	LIST I Type of Hydride		LIST II Example
A.	Electron deficient hydride	I.	MgH_2
B.	Electron rich hydride	II.	HF
C.	Electron precise hydride	III.	B_2H_6
D.	Saline hydride	IV.	CH_4

Choose the correct answer from the options given below:

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

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

Assertion A : In the Ellingham diagram, a sharp change in slope of the line is observed for $\text{Mg} \rightarrow \text{MgO}$ at $\sim 1120^\circ\text{C}$

Reason R: There is a large change of entropy associated with the change of state

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

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

Given below are two statements:

Statement I : Boron is extremely hard indicating its high lattice energy.

Statement II : Boron has highest melting and boiling point compared to its other group members.

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

- (A) Both Statement I and Statement II are incorrect
- (B) Statement I is incorrect but Statement II is correct
- (C) Statement I is correct but Statement II is incorrect
- (D) Both statement I and Statement II are correct

Given below are two statements:

Statement I: SbCl_5 is more covalent than SbCl_3

Statement II: The higher oxides of halogens also tend to be more stable than the lower ones.

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

- (A) Both statement I and Statement II are correct
 (B) Both Statement I and Statement II are incorrect
 (C) Statement I is correct but Statement II is incorrect
 (D) Statement I is incorrect but Statement II is correct

Q39 Polymers

[Step-by-step solution](https://www.prepwisar.in/questions/P8oeA-c1Md) > prepwisar.in/questions/P8oeA-c1Md

Match List I with List II

	LIST I (Examples)		LIST II (Type)
A.	2-chloro-1,3- butadiene	I.	Biodegradable polymer
B.	Nylon 2-nylon 6	II.	Synthetic Rubber
C.	Polyacrylonitrile	III.	Polyester
D.	Dacron	IV.	Addition Polymer

Choose the correct answer from the options given below:

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

Q40 Hydrogen & s-Block Elements

[Step-by-step solution](https://www.prepwisar.in/questions/FSkTHnd1yY) > prepwisar.in/questions/FSkTHnd1yY

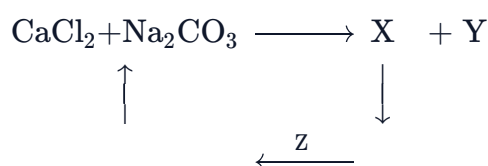
The density of alkali metals is in the order:

- (A) $\text{Na} < \text{K} < \text{Cs} < \text{Rb}$ (B) $\text{K} < \text{Na} < \text{Rb} < \text{Cs}$
 (C) $\text{K} < \text{Cs} < \text{Na} < \text{Rb}$ (D) $\text{Na} < \text{Rb} < \text{K} < \text{Cs}$

Q41 Chemical Thermodynamics

[Step-by-step solution](https://www.prepwisar.in/questions/aiug1voo81) > prepwisar.in/questions/aiug1voo81

In the given reaction cycle



X, Y and Z respectively are:

- (A) X: CaCO_3 , Y: NaCl , Z: KCl (B) X: CaO , Y: $\text{NaCl} + \text{CO}_2$, Z: NaCl
 (C) X: CaCO_3 , Y: NaCl , Z: HCl (D) X: CaO , Y: $\text{NaCl} + \text{CO}_2$, Z: KCl

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Q42 Mole Concept & Stoichiometry[Step-by-step solution](https://www.prepwiser.in/questions/SixD2mp4Lg) › prepwiser.in/questions/SixD2mp4Lg

A metal chloride contains 55.0% of chlorine by weight. 100mL vapours of the metal chloride at STP weigh 0.57g. The molecular formula of the metal chloride is
(Given: Atomic mass of chlorine is 35.5u)

- (A) MCl_2 (B) MCl_4 (C) MCl_3 (D) MCl

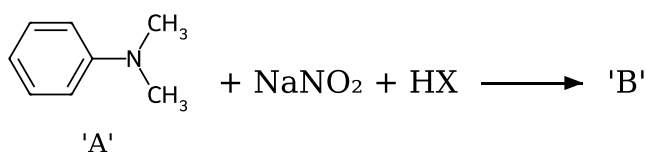
Q43 Surface Chemistry[Step-by-step solution](https://www.prepwiser.in/questions/z4jFbL8PZm) › prepwiser.in/questions/z4jFbL8PZm

Four gases A, B, C and D have critical temperatures 5.3, 33.2, 126.0 and 154.3K respectively. For their adsorption on a fixed amount of charcoal, the correct order is:

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

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

The incorrect statement regarding the reaction given below is



- (A) 'B' is N-nitroso ammonium compound
(B) The product 'B' formed in the above reaction is p-nitroso compound at low temperature
(C) The electrophile involved in the reaction is NO^+
(D) The reaction occurs at low temperature

Chemistry Section B · Numerical value

Q45 to Q52

Q45 Mole Concept & Stoichiometry**NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/Hz1iKwzeAJ) › prepwiser.in/questions/Hz1iKwzeAJ

The mass of NH_3 produced when 131.8 kg of cyclohexanecarbaldehyde undergoes Tollen's test is _____ kg. (Nearest Integer)

Molar Mass of

C = 12g/mol

N = 14g/mol

O = 16g/mol

Q46 Carbohydrates & Biomolecules**NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/5WB8AEWkxm) › prepwiser.in/questions/5WB8AEWkxm

In an oligopeptide named Alanylglycylphenyl alanyl isoleucine, the number of sp^2 hybridised carbons is _____.

Q47 Chemical Kinetics**NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/GBEMqkka3y) › prepwiser.in/questions/GBEMqkka3y

The reaction $2\text{NO} + \text{Br}_2 \rightarrow 2\text{NOBr}$

takes places through the mechanism given below:

$\text{NO} + \text{Br}_2 \rightleftharpoons \text{NOBr}_2$ (fast)

$\text{NOBr}_2 + \text{NO} \rightarrow 2\text{NOBr}$ (slow)

The overall order of the reaction is _____.

An analyst wants to convert 1L HCl of pH = 1 to a solution of HCl of pH 2. The volume of water needed to do this dilution is _____ mL. (Nearest integer)

80 mole percent of MgCl_2 is dissociated in aqueous solution. The vapour pressure of 1.0 molal aqueous solution of MgCl_2 at 38°C is _____ mmHg. (Nearest integer)

Given : Vapour pressure of water at 38°C is 50 mmHg

Values of work function (W_0) for a few metals are given below

Metal	Li	Na	K	Mg	Cu	Ag
W_0/eV	2.42	2.3	2.25	3.7	4.8	4.3

The number of metals which will show photoelectric effect when light of wavelength 400 nm falls on it is _____

Given: $h = 6.6 \times 10^{-34} \text{ Js}$

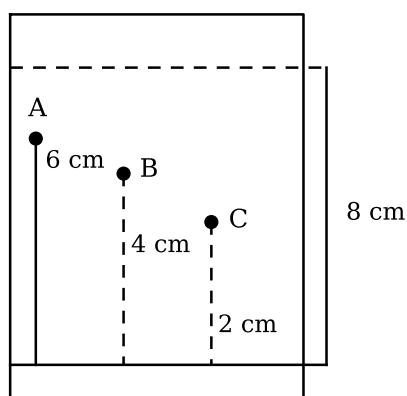
$c = 3 \times 10^8 \text{ ms}^{-1}$

$e = 1.6 \times 10^{-19} \text{ C}$

One mole of an ideal gas at 350 K is in a 2.0 L vessel of thermally conducting walls, which are in contact with the surroundings. It undergoes isothermal reversible expansion from 2.0 L to 3.0 L against a constant pressure of 4 atm. The change in entropy of the surroundings (ΔS) is _____ JK^{-1} (Nearest integer)

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

Three organic compounds A, B and C were allowed to run in thin layer chromatography using hexane and gave the following result (see figure). The R_f value of the most polar compound is _____ $\times 10^{-2}$



Q53 Three Dimensional Geometry

[Step-by-step solution](#) › [prepwisar.in/questions/dIh3aksWdF](https://www.prepwisar.in/questions/dIh3aksWdF)

Let the lines $l_1 : \frac{x+5}{3} = \frac{y+4}{1} = \frac{z-\alpha}{-2}$ and $l_2 : 3x + 2y + z - 2 = 0 = x - 3y + 2z - 13$ be coplanar. If the point $P(a, b, c)$ on l_1 is nearest to the point $Q(-4, -3, 2)$, then $|a| + |b| + |c|$ is equal to

- (A) 12 (B) 14 (C) 10 (D) 8

Q54 Three Dimensional Geometry

[Step-by-step solution](#) › [prepwisar.in/questions/RH6mXUyFv](https://www.prepwisar.in/questions/RH6mXUyFv)

Let the plane $P: 4x - y + z = 10$ be rotated by an angle $\frac{\pi}{2}$ about its line of intersection with the plane $x + y - z = 4$. If α is the distance of the point $(2, 3, -4)$ from the new position of the plane P , then 35α is equal to:

- (A) 126 (B) 105 (C) 85 (D) 90

Q55 Applications of Derivatives

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

If the local maximum value of the function

$$f(x) = \left(\frac{\sqrt{3}e}{2\sin x} \right)^{\sin^2 x}, x \in \left(0, \frac{\pi}{2} \right)$$

, is $\frac{k}{e}$, then $\left(\frac{k}{e} \right)^8 + \frac{k^8}{e^8} + k^8$ is equal to

- (A) $e^3 + e^6 + e^{10}$ (B) $e^3 + e^5 + e^{11}$ (C) $e^3 + e^6 + e^{11}$ (D) $e^5 + e^6 + e^{11}$

Q56 Binomial Theorem

[Step-by-step solution](#) › [prepwisar.in/questions/weBR0cPBkn](https://www.prepwisar.in/questions/weBR0cPBkn)

If

$$\frac{1}{n+1} {}^nC_n + \frac{1}{n} {}^nC_{n-1} + \dots + \frac{1}{2} {}^nC_1 + {}^nC_0 = \frac{1023}{10}$$

then n is equal to:

- (A) 9 (B) 6 (C) 7 (D) 8

Q57 Binomial Theorem

[Step-by-step solution](#) › [prepwisar.in/questions/kip4fMz_61](https://www.prepwisar.in/questions/kip4fMz_61)

The sum, of the coefficients of the first 50 terms in the binomial expansion of $(1 - x)^{100}$, is equal to

- (A) ${}^{99}C_{49}$ (B) ${}^{101}C_{50}$ (C) $-{}^{99}C_{49}$ (D) $-{}^{101}C_{50}$

Q58 Complex Numbers

[Step-by-step solution](#) › [prepwisar.in/questions/UgILuKReE5](https://www.prepwisar.in/questions/UgILuKReE5)

Let C be the circle in the complex plane with centre $z_0 = \frac{1}{2}(1 + 3i)$ and radius $r = 1$. Let $z_1 = 1 + i$ and the complex number z_2 be outside the circle C such that $|z_1 - z_0| |z_2 - z_0| = 1$. If z_0, z_1 and z_2 are collinear, then the smaller value of $|z_2|^2$ is equal to:

- (A) $\frac{3}{2}$ (B) $\frac{5}{2}$ (C) $\frac{13}{2}$ (D) $\frac{7}{2}$

Q59 Differential Equations

[Step-by-step solution](#) › [prepwisar.in/questions/SPrk50jamZ](https://www.prepwisar.in/questions/SPrk50jamZ)

Let $y = y(x)$, $y > 0$, be a solution curve of the differential equation $(1 + x^2) dy = y(x - y)dx$. If $y(0) = 1$ and $y(2\sqrt{2}) = \beta$, then

- (A) $e^{\beta-1} = e^{-2}(3 + 2\sqrt{2})$ (B) $e^{3\beta-1} = e(5 + \sqrt{2})$
(C) $e^{3\beta-1} = e(3 + 2\sqrt{2})$ (D) $e^{\beta-1} = e^{-2}(5 + \sqrt{2})$

Q60 Ellipse[Step-by-step solution](https://www.prepwiser.in/questions/t4JN4vUT-U)

Let

$$P \left(\frac{2\sqrt{3}}{\sqrt{7}}, \frac{6}{\sqrt{7}} \right), Q, R$$

and S be four points on the ellipse $9x^2 + 4y^2 = 36$. Let PQ and RS be mutually perpendicular and pass through the origin. If $\frac{1}{(PQ)^2} + \frac{1}{(RS)^2} = \frac{p}{q}$, where p and q are coprime, then $p + q$ is equal to:

- (A) 143 (B) 147 (C) 137 (D) 157

Q61 Matrices[Step-by-step solution](https://www.prepwiser.in/questions/uPA6_8RkL0)

Let

$$A = \begin{bmatrix} 1 & \frac{1}{51} \\ 0 & 1 \end{bmatrix}$$

. If

$$B = \begin{bmatrix} 1 & 2 \\ -1 & -1 \end{bmatrix} A \begin{bmatrix} -1 & -2 \\ 1 & 1 \end{bmatrix}$$

, then the sum of all the elements of the matrix $\sum_{n=1}^{50} B^n$ is equal to

- (A) 50 (B) 75 (C) 100 (D) 125

Q62 Permutations & Combinations[Step-by-step solution](https://www.prepwiser.in/questions/emrdL559dM)

The number of five digit numbers, greater than 40000 and divisible by 5, which can be formed using the digits 0, 1, 3, 5, 7 and 9 without repetition, is equal to:

- (A) 132 (B) 72 (C) 120 (D) 96

Q63 Probability: Advanced[Step-by-step solution](https://www.prepwiser.in/questions/82Xv-1BCGb)

Two dice A and B are rolled. Let the numbers obtained on A and B be α and β respectively. If the variance of $\alpha - \beta$ is $\frac{p}{q}$, where p and q are co-prime, then the sum of the positive divisors of p is equal to:

- (A) 48 (B) 31 (C) 72 (D) 36

Q64 Quadratic Equations & Polynomial Inequalities[Step-by-step solution](https://www.prepwiser.in/questions/tP-RBNAZzI)

Let α, β be the roots of the quadratic equation $x^2 + \sqrt{6}x + 3 = 0$. Then

$$\frac{\alpha^{23} + \beta^{23} + \alpha^{14} + \beta^{14}}{\alpha^{15} + \beta^{15} + \alpha^{10} + \beta^{10}}$$

is equal to:

- (A) 72 (B) 9 (C) 729 (D) 81

Q65 Sequences & Series[Step-by-step solution](https://www.prepwiser.in/questions/nCF6Rq6hmk)

Let $\langle a_n \rangle$ be a sequence such that $a_1 + a_2 + \dots + a_n = \frac{n^2 + 3n}{(n+1)(n+2)}$. If $28 \sum_{k=1}^{10} \frac{1}{a_k} = p_1 p_2 p_3 \dots p_m$, where $p_1, p_2, \dots, p_m$ are the first m prime numbers, then m is equal to

- (A) 5 (B) 7 (C) 6 (D) 8

Q66 Vectors[Step-by-step solution](#) › [prepwisetutor.com/questions/rMNtWW9S7M](https://www.prepwisetutor.com/questions/rMNtWW9S7M)

Let a, b, c be three distinct real numbers, none equal to one. If the vectors

$$a\hat{i} + \hat{j} + \hat{k}, \hat{i} + b\hat{j} + \hat{k}$$

and $\hat{i} + \hat{j} + c\hat{k}$ are coplanar, then $\frac{1}{1-a} + \frac{1}{1-b} + \frac{1}{1-c}$ is equal to:

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

Q67 Vectors[Step-by-step solution](#) › [prepwisetutor.com/questions/JA5HYxoT5U](https://www.prepwisetutor.com/questions/JA5HYxoT5U)

Let $\lambda \in \mathbb{Z}$, $\vec{a} = \lambda\hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = 3\hat{i} - \hat{j} + 2\hat{k}$. Let $\vec{c}$ be a vector such that

$$(\vec{a} + \vec{b} + \vec{c}) \times \vec{c} = \vec{0}, \vec{a} \cdot \vec{c} = -17$$

and $\vec{b} \cdot \vec{c} = -20$. Then $|\vec{c} \times (\lambda\hat{i} + \hat{j} + \hat{k})|^2$ is equal to:

- (A) 53 (B) 62 (C) 49 (D) 46

Q68 Area Under Curves[Step-by-step solution](#) › [prepwisetutor.com/questions/RdbS0atz2u](https://www.prepwisetutor.com/questions/RdbS0atz2u)

The area of the region enclosed by the curve $y = x^3$ and its tangent at the point $(-1, -1)$ is:

- (A) $\frac{23}{4}$ (B) $\frac{19}{4}$ (C) $\frac{27}{4}$ (D) $\frac{31}{4}$

Q69 Straight Lines[Step-by-step solution](#) › [prepwisetutor.com/questions/Iomh-AS8Ef](https://www.prepwisetutor.com/questions/Iomh-AS8Ef)

If the point $\left(\alpha, \frac{7\sqrt{3}}{3}\right)$ lies on the curve traced by the mid-points of the line segments of the lines $x \cos \theta + y \sin \theta = 7, \theta \in \left(0, \frac{\pi}{2}\right)$ between the co-ordinates axes, then α is equal to:

- (A) -7 (B) 7 (C) $-7\sqrt{3}$ (D) $7\sqrt{3}$

Mathematics Section B · Numerical value

Q70 to Q78

Q70 Three Dimensional Geometry **NUMERICAL**[Step-by-step solution](#) › [prepwisetutor.com/questions/zJ5tj64eAz](https://www.prepwisetutor.com/questions/zJ5tj64eAz)

Let the plane $x + 3y - 2z + 6 = 0$ meet the co-ordinate axes at the points A, B, C. If the orthocenter of the triangle ABC is $\left(\alpha, \beta, \frac{6}{7}\right)$, then $98(\alpha + \beta)^2$ is equal to _____.

Q71 Circles **NUMERICAL**[Step-by-step solution](#) › [prepwisetutor.com/questions/tr53fY2A5j](https://www.prepwisetutor.com/questions/tr53fY2A5j)

Two circles in the first quadrant of radii r_1 and r_2 touch the coordinate axes. Each of them cuts off an intercept of 2 units with the line $x + y = 2$. Then $r_1^2 + r_2^2 - r_1 r_2$ is equal to _____.

Q72 Definite Integration **NUMERICAL**[Step-by-step solution](#) › [prepwisetutor.com/questions/4tcWhZC93_](https://www.prepwisetutor.com/questions/4tcWhZC93_)

If $\int_{-0.15}^{0.15} |100x^2 - 1| dx = \frac{k}{3000}$, then k is equal to _____.

Q73 Continuity & Differentiability **NUMERICAL**[Step-by-step solution](#) › [prepwisetutor.com/questions/S2OpLIFn63](https://www.prepwisetutor.com/questions/S2OpLIFn63)

Let $[x]$ be the greatest integer $\leq x$. Then the number of points in the interval $(-2, 1)$, where the function $f(x) = |[x]| + \sqrt{x - [x]}$ is discontinuous, is _____.

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Let

$$D_k = \begin{vmatrix} 1 & 2k & 2k-1 \\ n & n^2+n+2 & n^2 \\ n & n^2+n & n^2+n+2 \end{vmatrix}$$

. If $\sum_{k=1}^n D_k = 96$, then n is equal to _____.

A fair n ($n > 1$) faces die is rolled repeatedly until a number less than n appears. If the mean of the number of tosses required is $\frac{n}{9}$, then n is equal to _____.

The number of relations, on the set $\{1, 2, 3\}$ containing $(1, 2)$ and $(2, 3)$, which are reflexive and transitive but not symmetric, is _____.

Let the positive numbers a_1, a_2, a_3, a_4 and a_5 be in a G.P. Let their mean and variance be $\frac{31}{10}$ and $\frac{m}{n}$ respectively, where m and n are co-prime. If the mean of their reciprocals is $\frac{31}{40}$ and $a_3 + a_4 + a_5 = 14$, then $m + n$ is equal to _____.

Let $I(x) = \int \sqrt{\frac{x+7}{x}} dx$ and $I(9) = 12 + 7 \log_e 7$. If $I(1) = \alpha + 7 \log_e (1 + 2\sqrt{2})$, then α^4 is equal to _____.

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Physics

1.	C	2.	C	3.	D	4.	A	5.	D	6.	D	7.	D	8.	A
9.	D	10.	D	11.	B	12.	D	13.	C	14.	A	15.	C	16.	A
17.	D	18.	B	19.	C	20.	4	21.	15	22.	50	23.	160	24.	100
25.	243	26.	4	27.	2	28.	1	29.	784						

Chemistry

30.	B	31.	D	32.	A	33.	A	34.	D	35.	C	36.	A	37.	D
38.	A	39.	C	40.	B	41.	C	42.	A	43.	A	44.	A	45.	60
46.	10	47.	3	48.	9000	49.	48	50.	3	51.	3	52.	25		

Mathematics

53.	C	54.	A	55.	C	56.	A	57.	C	58.	B	59.	C	60.	D
61.	C	62.	C	63.	A	64.	D	65.	C	66.	B	67.	D	68.	C
69.	B	70.	288	71.	7	72.	575	73.	2	74.	6	75.	10	76.	3
77.	211	78.	64												

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