

JEE MAIN 2023 · QUESTION PAPER

1 Feb 2023 **Shift 2**

81 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	15 Q29 to Q43	9 Q44 to Q52
● Mathematics	19 Q53 to Q71	10 Q72 to Q81
In this PDF	81 questions · answer key at the end	

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

Attempt this paper online

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

prepwis.in/pyqs/paper/2023-02-01-evening · Free, no signup needed to start

Answers follow NTA's final answer keys. Typing errors are possible, so check doubtful answers against the official key. Spotted a mistake? prepwis.in/feedback · Terms: prepwis.in/terms

Q1 Atomic Physics

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

An electron of a hydrogen like atom, having $Z = 4$, jumps from 4th energy state to 2nd energy state. The energy released in this process, will be:

(Given $R_h = 13.6\text{eV}$)

Where R = Rydberg constant

c = Speed of light in vacuum

h = Planck's constant

- (A) 10.5eV (B) 40.8eV (C) 13.6eV (D) 3.4eV

Q2 Electrostatics II: Potential & Capacitance

[Step-by-step solution](#) › [prepwise.in/questions/D1ZIWJUqXI](https://www.prepwise.in/questions/D1ZIWJUqXI)

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

Assertion A: Two metallic spheres are charged to the same potential. One of them is hollow and another is solid, and both have the same radii. Solid sphere will have lower charge than the hollow one.

Reason R: Capacitance of metallic spheres depend on the radii of spheres

In light of the above 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) Both A and R are true and R is the correct explanation of A
 (C) A is false but R is true
 (D) A is true but R is false

Q3 Current Electricity

[Step-by-step solution](#) › [prepwise.in/questions/2gaVkJ7RqeU](https://www.prepwise.in/questions/2gaVkJ7RqeU)

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

Assertion A : For measuring the potential difference across a resistance of 600Ω , the voltmeter with resistance 1000Ω will be preferred over voltmeter with resistance 4000Ω .

Reason R : Voltmeter with higher resistance will draw smaller current than voltmeter with lower resistance.

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

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

Q4 Current Electricity

[Step-by-step solution](#) › [prepwise.in/questions/J1pL6kWdSg](https://www.prepwise.in/questions/J1pL6kWdSg)

Equivalent resistance between the adjacent corners of a regular n -sided polygon of uniform wire of resistance R would be:

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

Q5 Dual Nature of Radiation & Matter[Step-by-step solution](https://www.prepwise.in/questions/UnAVe1PnFP) > prepwise.in/questions/UnAVe1PnFP

The threshold frequency of a metal is f_0 . When the light of frequency $2f_0$ is incident on the metal plate, the maximum velocity of photoelectrons is v_1 . When the frequency of incident radiation is increased to $5f_0$, the maximum velocity of photoelectrons emitted is v_2 . The ratio of v_1 to v_2 is:

- (A) $\frac{v_1}{v_2} = \frac{1}{2}$ (B) $\frac{v_1}{v_2} = \frac{1}{16}$ (C) $\frac{v_1}{v_2} = \frac{1}{4}$ (D) $\frac{v_1}{v_2} = \frac{1}{8}$

Q6 Electromagnetic Induction[Step-by-step solution](https://www.prepwise.in/questions/Wsyd_EAzIk) > prepwise.in/questions/Wsyd_EAzIk

A coil is placed in magnetic field such that plane of coil is perpendicular to the direction of magnetic field. The magnetic flux through a coil can be changed:

- A. By changing the magnitude of the magnetic field within the coil.
B. By changing the area of coil within the magnetic field.
C. By changing the angle between the direction of magnetic field and the plane of the coil.
D. By reversing the magnetic field direction abruptly without changing its magnitude.

Choose the most appropriate answer from the options given below:

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

Q7 Electromagnetic Waves[Step-by-step solution](https://www.prepwise.in/questions/O4GVd7YzSe) > prepwise.in/questions/O4GVd7YzSe

The ratio of average electric energy density and total average energy density of electromagnetic wave is:

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

Q8 Semiconductors & Electronic Devices[Step-by-step solution](https://www.prepwise.in/questions/vxJYaZDvZz) > prepwise.in/questions/vxJYaZDvZz

Choose the correct statement about Zener diode:

- (A) It works as a voltage regulator in reverse bias and behaves like simple pn junction diode in forward bias.
(B) It works as a voltage regulator in both forward and reverse bias.
(C) It works as a voltage regulator only in forward bias.
(D) It works as a voltage regulator in forward bias and behaves like simple pn junction diode in reverse bias.

Q9 Ray Optics[Step-by-step solution](https://www.prepwise.in/questions/7icDgdFiDy) > prepwise.in/questions/7icDgdFiDy

Two objects A and B are placed at 15 cm and 25 cm from the pole in front of a concave mirror having radius of curvature 40 cm. The distance between images formed by the mirror is _____.

- (A) 60 cm (B) 40 cm (C) 160 cm (D) 100 cm

Q10 Gravitation[Step-by-step solution](https://www.prepwise.in/questions/ggO3Xipumj) > prepwise.in/questions/ggO3Xipumj

The escape velocities of two planets A and B are in the ratio 1 : 2. If the ratio of their radii respectively is 1 : 3, then the ratio of acceleration due to gravity of planet A to the acceleration of gravity of planet B will be:

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

For a body projected at an angle with the horizontal from the ground, choose the correct statement.

- (A) Gravitational potential energy is maximum at the highest point.
- (B) The vertical component of momentum is maximum at the highest point.
- (C) The horizontal component of velocity is zero at the highest point.
- (D) The Kinetic Energy (K.E.) is zero at the highest point of projectile motion.

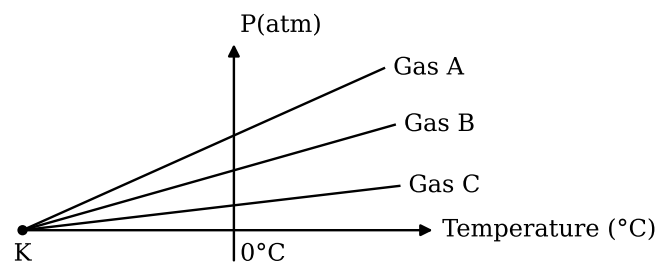
A Carnot engine operating between two reservoirs has efficiency $\frac{1}{3}$. When the temperature of cold reservoir raised by x , its efficiency decreases to $\frac{1}{6}$. The value of x , if the temperature of hot reservoir is 99°C , will be:

- (A) 66 K
- (B) 62 K
- (C) 16.5 K
- (D) 33 K

For three low density gases A, B, C pressure versus temperature graphs are plotted while keeping them at constant volume, as shown in the figure.

The temperature corresponding to the point 'K' is:

- (A) -273°C
- (B) -373°C
- (C) -100°C
- (D) -40°C

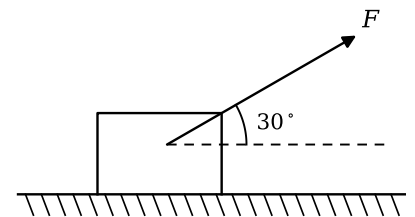


As shown in the figure a block of mass 10 kg lying on a horizontal surface is pulled by a force F acting at an angle 30° , with horizontal.

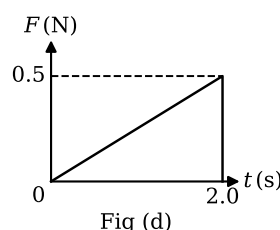
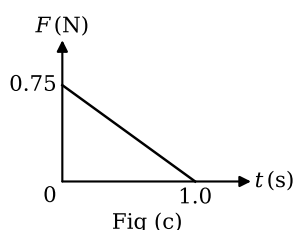
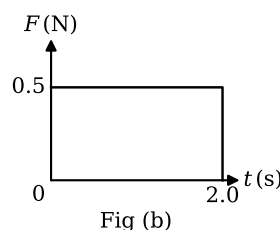
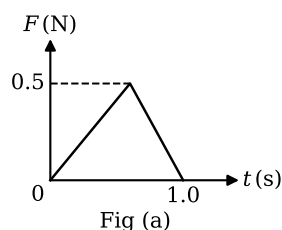
For $\mu_s = 0.25$, the block will just start to move for the value of F :

[Given $g = 10\text{ms}^{-2}$]

- (A) 25.2 N
- (B) 35.7 N
- (C) 20 N
- (D) 33.3 N



Figures (a), (b), (c) and (d) show variation of force with time.

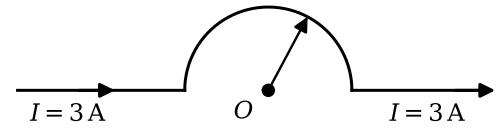


The impulse is highest in figure.

- (A) Fig (c)
- (B) Fig (d)
- (C) Fig (a)
- (D) Fig (b)

Q16 Moving Charges & Magnetism[Step-by-step solution](#) > [prepwisar.in/questions/c2arkxP-Tq](https://www.prepwisar.in/questions/c2arkxP-Tq)

As shown in the figure, a long straight conductor with semicircular arc of radius $\frac{\pi}{10}$ m is carrying current $I = 3$ A. The magnitude of the magnetic field, at the center O of the arc is: (The permeability of the vacuum $= 4\pi \times 10^{-7} \text{NA}^{-2}$)



- (A) $4\mu\text{T}$ (B) $3\mu\text{T}$ (C) $6\mu\text{T}$ (D) $1\mu\text{T}$

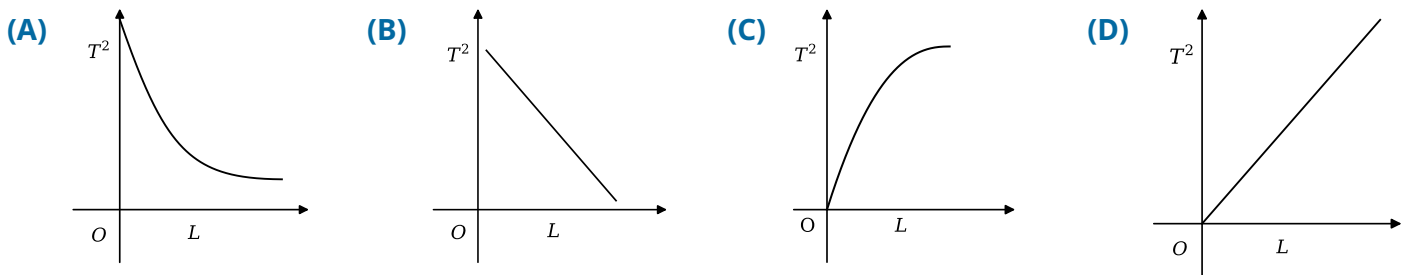
Q17 Elasticity[Step-by-step solution](#) > [prepwisar.in/questions/8WxsB73qQH](https://www.prepwisar.in/questions/8WxsB73qQH)

The Young's modulus of a steel wire of length 6 m and cross-sectional area 3mm^2 , is $2 \times 10^{11} \text{N/m}^2$. The wire is suspended from its support on a given planet. A block of mass 4 kg is attached to the free end of the wire. The acceleration due to gravity on the planet is $\frac{1}{4}$ of its value on the earth. The elongation of wire is (Take g on the earth $= 10 \text{m/s}^2$):

- (A) 0.1 cm (B) 1 cm (C) 0.1 mm (D) 1 mm

Q18 Simple Harmonic Motion[Step-by-step solution](#) > [prepwisar.in/questions/FZCavhNdHH](https://www.prepwisar.in/questions/FZCavhNdHH)

Choose the correct length (L) versus square of the time period (T^2) graph for a simple pendulum executing simple harmonic motion.

**Q19** Units, Dimensions & Errors[Step-by-step solution](#) > [prepwisar.in/questions/ttX_w6M-1Z](https://www.prepwisar.in/questions/ttX_w6M-1Z)

If the velocity of light c , universal gravitational constant G and Planck's constant h are chosen as fundamental quantities. The dimensions of mass in the new system is:

- (A) $[h^1 c^1 G^{-1}]$ (B) $[h^{-1/2} c^{1/2} G^{1/2}]$ (C) $[h^{1/2} c^{1/2} G^{-1/2}]$ (D) $[h^{1/2} c^{-1/2} G^1]$

Physics Section B · Numerical value

Q20 to Q28

Q20 Electromagnetic Induction **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/CICCF9bq4n](https://www.prepwisar.in/questions/CICCF9bq4n)

A square shaped coil of area 70cm^2 having 600 turns rotates in a magnetic field of 0.4wbm^{-2} , about an axis which is parallel to one of the side of the coil and perpendicular to the direction of field. If the coil completes 500 revolution in a minute, the instantaneous emf when the plane of the coil is inclined at 60° with the field, will be _____ V. (Take $\pi = \frac{22}{7}$)

Q21 Nuclear Physics **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/TOJrYqD-86](https://www.prepwisar.in/questions/TOJrYqD-86)

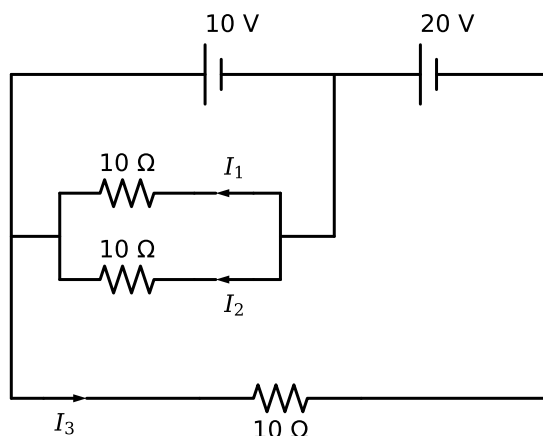
Nucleus A having $Z = 17$ and equal number of protons and neutrons has 1.2MeV binding energy per nucleon.

Another nucleus B of $Z = 12$ has total 26 nucleons and 1.8MeV binding energy per nucleons.

The difference of binding energy of B and A will be _____ MeV.

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In the given circuit, the value of $\left| \frac{I_1 + I_3}{I_2} \right|$ is _____



Q23 Electrostatics I: Charges, Field & Gauss's Law NUMERICAL

Step-by-step solution > prepwiser.in/questions/2z4SHBxoyq

A cubical volume is bounded by the surfaces $x = 0, x = a, y = 0, y = a, z = 0, z = a$. The electric field in the region is given by $\vec{E} = E_0 x \hat{i}$. Where $E_0 = 4 \times 10^4 \text{ NC}^{-1} \text{ m}^{-1}$. If $a = 2 \text{ cm}$, the charge contained in the cubical volume is $Q \times 10^{-14} \text{ C}$. The value of Q is _____.

(Take $\epsilon_0 = 9 \times 10^{-12} \text{ C}^2/\text{Nm}^2$)

Q24 Rectilinear Motion NUMERICAL

Step-by-step solution > prepwiser.in/questions/_IrYIMQJRU

For a train engine moving with speed of 20 ms^{-1} , the driver must apply brakes at a distance of 500 m before the station for the train to come to rest at the station. If the brakes were applied at half of this distance, the train engine would cross the station with speed $\sqrt{x} \text{ ms}^{-1}$. The value of x is _____.

(Assuming same retardation is produced by brakes)

Q25 Fluid Mechanics NUMERICAL

Step-by-step solution > prepwiser.in/questions/K6XU2Nvybm

The surface of water in a water tank of cross section area 750 cm^2 on the top of a house is $h \text{ m}$ above the tap level. The speed of water coming out through the tap of cross section area 500 mm^2 is 30 cm/s . At that instant, $\frac{dh}{dt}$ is $x \times 10^{-3} \text{ m/s}$. The value of x will be _____.

Q26 Rotational Motion NUMERICAL

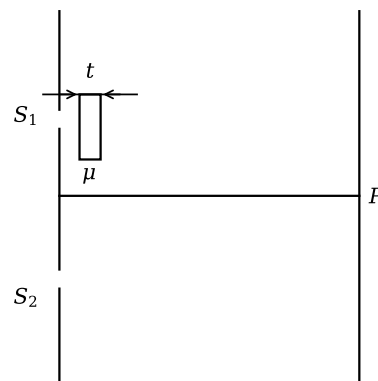
Step-by-step solution > prepwiser.in/questions/kNRSOf_vRp

Moment of inertia of a disc of mass ' M ' and radius ' R ' about any of its diameter is $\frac{MR^2}{4}$. The moment of inertia of this disc about an axis normal to the disc and passing through a point on its edge will be, $\frac{x}{2} MR^2$. The value of x is _____.

Q27 Wave Optics NUMERICAL

Step-by-step solution > prepwiser.in/questions/V_wZWcxrO

As shown in the figure, in Young's double slit experiment, a thin plate of thickness $t = 10 \mu\text{m}$ and refractive index $\mu = 1.2$ is inserted in front of slit S_1 . The experiment is conducted in air ($\mu = 1$) and uses a monochromatic light of wavelength $\lambda = 500 \text{ nm}$. Due to the insertion of the plate, central maxima is shifted by a distance of $x\beta_0$. β_0 is the fringe-width before the insertion of the plate. The value of the x is _____.



A force $F = (5 + 3y^2)$ acts on a particle in the y -direction, where F is in newton and y is in meter. The work done by the force during a displacement from $y = 2\text{m}$ to $y = 5\text{m}$ is _____ J.

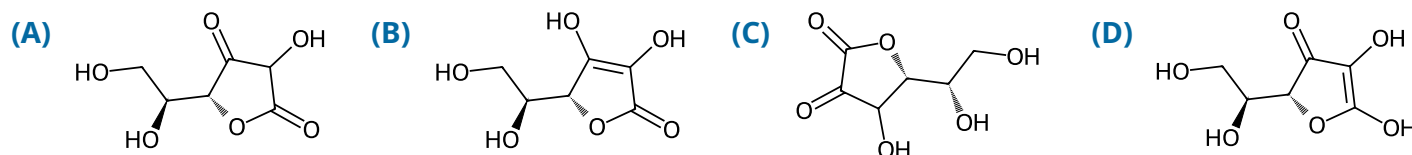
Chemistry Section A · Multiple choice

Q29 to Q43

Q29 Carbohydrates & Biomolecules

[Step-by-step solution > prepwisar.in/questions/CWfbRKqR6c](https://www.prepwisar.in/questions/CWfbRKqR6c)

All structures given below are of vitamin C. Most stable of them is:



Q30 Amines & Diazonium Salts

[Step-by-step solution > prepwisar.in/questions/WPhOIsPXU4](https://www.prepwisar.in/questions/WPhOIsPXU4)

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

Assertion (A): α -halocarboxylic acid on reaction with dil. NH_3 gives good yield of α -amino carboxylic acid whereas the yield of amines is very low when prepared from alkyl halides.

Reason (R) : Amino acids exist in zwitter ion form in aqueous medium.

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

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

Q31 Hydrogen & s-Block Elements

[Step-by-step solution > prepwisar.in/questions/oMcLVqfH0B](https://www.prepwisar.in/questions/oMcLVqfH0B)

O – O bond length in H_2O_2 is X than the O – O bond length in F_2O_2 . The O – H bond length in H_2O_2 is Y than that of the O – F bond in F_2O_2 .

Choose the correct option for X and Y from those given below:

- (A) X - shorter, Y - longer
(B) X - longer, Y - shorter
(C) X - shorter, Y - shorter
(D) X - longer, Y - longer

Q32 Coordination Compounds

[Step-by-step solution > prepwisar.in/questions/NgjUIcCw6e](https://www.prepwisar.in/questions/NgjUIcCw6e)

The complex cation which has two isomers is:

- (A) $[\text{Co}(\text{NH}_3)_5\text{Cl}]^+$ (B) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$ (C) $[\text{Co}(\text{NH}_3)_5\text{NO}_2]^{2+}$ (D) $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{2+}$

Q33 Qualitative Analysis: Salt Analysis

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

Which element is not present in Nessler's reagent?

- (A) Mercury (B) Iodine (C) Potassium (D) Oxygen

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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): Cu^{2+} in water is more stable than Cu^+ .

Reason (R) : Enthalpy of hydration for Cu^{2+} is much less than that of Cu^+ .

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

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

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

Assertion (A) : An aqueous solution of KOH when used for volumetric analysis, its concentration should be checked before the use.

Reason (R) : On aging, KOH solution absorbs atmospheric CO_2 .

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

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

The starting material for convenient preparation of deuterated hydrogen peroxide (D_2O_2) in:

- (A) BaO_2
- (B) 2-ethylantraquinol
- (C) BaO
- (D) $\text{K}_2\text{S}_2\text{O}_8$

The correct order of bond enthalpy (kJmol^{-1}) is:

- (A) $\text{C} - \text{C} > \text{Si} - \text{Si} > \text{Sn} - \text{Sn} > \text{Ge} - \text{Ge}$
- (B) $\text{Si} - \text{Si} > \text{C} - \text{C} > \text{Ge} - \text{Ge} > \text{Sn} - \text{Sn}$
- (C) $\text{C} - \text{C} > \text{Si} - \text{Si} > \text{Ge} - \text{Ge} > \text{Sn} - \text{Sn}$
- (D) $\text{Si} - \text{Si} > \text{C} - \text{C} > \text{Sn} - \text{Sn} > \text{Ge} - \text{Ge}$

For electron gain enthalpies of the elements denoted as $\Delta_{\text{eg}}\text{H}$, the incorrect option is:

- (A) $\Delta_{\text{eg}}\text{H}(\text{I}) < \Delta_{\text{eg}}\text{H}(\text{At})$
- (B) $\Delta_{\text{eg}}\text{H}(\text{Te}) < \Delta_{\text{eg}}\text{H}(\text{Po})$
- (C) $\Delta_{\text{eg}}\text{H}(\text{Cl}) < \Delta_{\text{eg}}\text{H}(\text{F})$
- (D) $\Delta_{\text{eg}}\text{H}(\text{Se}) < \Delta_{\text{eg}}\text{H}(\text{S})$

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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) : Gypsum is used for making fireproof wall boards.

Reason (R) : Gypsum is unstable at high temperatures.

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

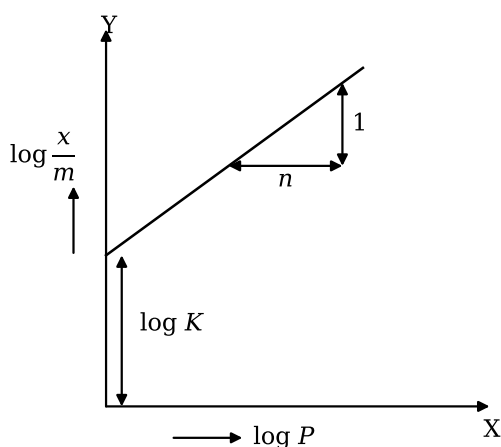
- (A) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
 (B) Both (A) and (R) are correct and (R) is the correct explanation of (A)
 (C) (A) is correct but (R) is not correct
 (D) (A) is not correct but (R) is correct

Which one of the following sets of ions represents a collection of isoelectronic species?

(Given : Atomic Number: F : 9, Cl : 17, Na = 11, Mg = 12, Al = 13, K = 19, Ca = 20, Sc = 21)

- (A) N^{3-} , O^{2-} , F^- , S^{2-} (B) Ba^{2+} , Sr^{2+} , K^+ , Ca^{2+}
 (C) Li^+ , Na^+ , Mg^{2+} , Ca^{2+} (D) K^+ , Cl^- , Ca^{2+} , Sc^{3+}

In figure, a straight line is given for Freundlich Adsorption ($y = 3x + 2.505$). The value of $\frac{1}{n}$ and $\log K$ are respectively.



- (A) 0.3 and $\log 2.505$ (B) 3 and 2.505 (C) 3 and 0.7033 (D) 0.3 and 0.7033

The effect of addition of helium gas to the following reaction in equilibrium state, is:



- (A) the equilibrium will shift in the forward direction and more of Cl_2 and PCl_3 gases will be produced.
 (B) addition of helium will not affect the equilibrium.
 (C) helium will deactivate PCl_5 and reaction will stop.
 (D) the equilibrium will go backward due to suppression of dissociation of PCl_5 .

Given below are two statements:

Statement I : Sulphanilic acid gives esterification test for carboxyl group.

Statement II : Sulphanilic acid gives red colour in Lassaigne's test for extra element detection.

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

Chemistry Section B · Numerical value

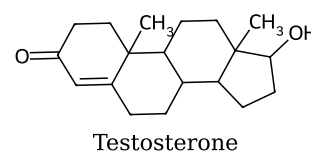
Q44 to Q52

Q44 General Organic Chemistry (GOC) NUMERICAL

[Step-by-step solution](https://www.prepwiser.in/questions/DF2DUBjfWs) > prepwiser.in/questions/DF2DUBjfWs

Testosterone, which is a steroidal hormone, has the following structure.

The total number of asymmetric carbon atom/s in testosterone is _____.



Q45 Chemical Kinetics NUMERICAL

[Step-by-step solution](https://www.prepwiser.in/questions/uD8azw2uBj) > prepwiser.in/questions/uD8azw2uBj

$A \rightarrow B$

The above reaction is of zero order. Half life of this reaction is 50min. The time taken for the concentration of A to reduce to one-fourth of its initial value is _____ min. (Nearest integer)

Q46 Chemistry in Everyday Life NUMERICAL

[Step-by-step solution](https://www.prepwiser.in/questions/PdDqIfjw4z) > prepwiser.in/questions/PdDqIfjw4z

Among the following, the number of tranquilizer/s is/are _____.

- A. Chloroliazepoxide
- B. Veronal
- C. Valium
- D. Salvarsan

Q47 d & f Block Elements NUMERICAL

[Step-by-step solution](https://www.prepwiser.in/questions/wUFvRqM0CK) > prepwiser.in/questions/wUFvRqM0CK

The spin only magnetic moment of $[Mn(H_2O)_6]^{2+}$ complexes is _____ B.M. (Nearest integer)
(Given : Atomic no. of Mn is 25)

Q48 Metallurgy NUMERICAL

[Step-by-step solution](https://www.prepwiser.in/questions/WXvi268nh0) > prepwiser.in/questions/WXvi268nh0

Among following compounds, the number of those present in copper matte is _____.

- A. $CuCO_3$
- B. Cu_2S
- C. Cu_2O
- D. FeO

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Q49 Solid State **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/F9LN89dgOv

A metal M crystallizes into two lattices :- face centred cubic (fcc) and body centred cubic (bcc) with unit cell edge length of 2.0 and $2.5 \text{ \AA}$ respectively. The ratio of densities of lattices fcc to bcc for the metal M is _____. (Nearest integer)

Q50 Solutions & Colligative Properties **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/bqDr_dFFr-

20% of acetic acid is dissociated when its 5g is added to 500mL of water. The depression in freezing point of such water is _____ $\times 10^{-3}^{\circ}\text{C}$.

Atomic mass of C, H and O are 12, 1 and 16 a.m.u. respectively.

[Given : Molal depression constant and density of water are $1.86 \text{ K kg mol}^{-1}$ and 1 g cm^{-3} respectively.]

Q51 Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/KiKoxKTOLU

The molality of a 10% (v/v) solution of di-bromine solution in CCl_4 (carbon tetrachloride) is 'x'. $x =$ _____ $\times 10^{-2} \text{ M}$. (Nearest integer)

[Given : molar mass of $\text{Br}_2 = 160 \text{ g mol}^{-1}$

atomic mass of C = 12 g mol^{-1}

atomic mass of Cl = 35.5 g mol^{-1}

density of dibromine = 3.2 g cm^{-3}

density of $\text{CCl}_4 = 1.6 \text{ g cm}^{-3}$]

Q52 Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/Kk4YdVtGwp

0.3g of ethane undergoes combustion at 27°C in a bomb calorimeter. The temperature of calorimeter system (including the water) is found to rise by 0.5°C . The heat evolved during combustion of ethane at constant pressure is _____ kJ mol^{-1} . (Nearest integer)

[Given : The heat capacity of the calorimeter system is

$$20 \text{ kJ K}^{-1}, R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$$

Assume ideal gas behaviour.

Atomic mass of C and H are 12 and 1 g mol^{-1} respectively]

Mathematics Section A · Multiple choice

Q53 to Q71

Q53 Three Dimensional Geometry[Step-by-step solution](#) › prepwiser.in/questions/JsU_j_4VGm

Let the plane P pass through the intersection of the planes $2x + 3y - z = 2$ and $x + 2y + 3z = 6$, and be perpendicular to the plane $2x + y - z + 1 = 0$. If d is the distance of P from the point $(-7, 1, 1)$, then d^2 is equal to:

(A) $\frac{250}{83}$

(B) $\frac{250}{82}$

(C) $\frac{15}{53}$

(D) $\frac{25}{83}$

Q54 Applications of Derivatives[Step-by-step solution](#) › prepwiser.in/questions/GsI3Rchz0c

The sum of the absolute maximum and minimum values of the function $f(x) = |x^2 - 5x + 6| - 3x + 2$ in the interval $[-1, 3]$ is equal to:

(A) 13

(B) 24

(C) 10

(D) 12

Q55 Complex Numbers[Step-by-step solution](https://prepwiser.in/questions/uhx1fuD8Jy)

Let a, b be two real numbers such that $ab < 0$. If the complex number $\frac{1+ai}{b+i}$ is of unit modulus and $a + ib$ lies on the circle $|z - 1| = |2z|$, then a possible value of $\frac{1+[a]}{4b}$, where $[t]$ is greatest integer function, is:

- (A) $\left(\frac{1 + \sqrt{7}}{4}\right)$ (B) $\frac{1}{2}$ (C) 0 (D) -1

Q56 Definite Integration[Step-by-step solution](https://prepwiser.in/questions/erZSqNgV4c)

The value of the integral

$$\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{x + \frac{\pi}{4}}{2 - \cos 2x} dx$$

is:

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

Q57 Differential Equations[Step-by-step solution](https://prepwiser.in/questions/wjQOgbs6Bw)

Let $\alpha x = \exp(x^\beta y^\gamma)$ be the solution of the differential equation

$$2x^2 y dy - (1 - xy^2) dx = 0, x > 0, y(2) = \sqrt{\log_e 2}$$

. Then $\alpha + \beta - \gamma$ equals:

- (A) 1 (B) 0 (C) 3 (D) -1

Q58 Differentiation[Step-by-step solution](https://prepwiser.in/questions/JZSmEhC8C6)

If $y(x) = x^x, x > 0$, then $y''(2) - 2y'(2)$ is equal to

- (A) $4(\log_e 2)^2 + 2$ (B) $8 \log_e 2 - 2$ (C) $4 \log_e 2 + 2$ (D) $4(\log_e 2)^2 - 2$

Q59 Functions (Advanced)[Step-by-step solution](https://prepwiser.in/questions/uscjIBW8g-)

Let $f: \mathbb{R} - 0, 1 \rightarrow \mathbb{R}$ be a function such that $f(x) + f\left(\frac{1}{1-x}\right) = 1 + x$. Then $f(2)$ is equal to

- (A) $\frac{9}{4}$ (B) $\frac{7}{4}$ (C) $\frac{7}{3}$ (D) $\frac{9}{2}$

Q60 Hyperbola[Step-by-step solution](https://prepwiser.in/questions/mZILJak4-)

Let $P(x_0, y_0)$ be the point on the hyperbola $3x^2 - 4y^2 = 36$, which is nearest to the line $3x + 2y = 1$. Then $\sqrt{2}(y_0 - x_0)$ is equal to:

- (A) 3 (B) -9 (C) -3 (D) 9

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Let

$$S = \left\{ x \in R : 0 < x < 1 \text{ and } 2\tan^{-1} \left(\frac{1-x}{1+x} \right) = \cos^{-1} \left(\frac{1-x^2}{1+x^2} \right) \right\}$$

If $n(S)$ denotes the number of elements in S then:

- (A) $n(S) = 0$
 (B) $n(S) = 1$ and only one element in S is less than $\frac{1}{2}$.
 (C) $n(S) = 1$ and the elements in S is more than $\frac{1}{2}$.
 (D) $n(S) = 1$ and the element in S is less than $\frac{1}{2}$.

For the system of linear equations $\alpha x + y + z = 1, x + \alpha y + z = 1, x + y + \alpha z = \beta$, which one of the following statements is **NOT** correct?

- (A) It has infinitely many solutions if $\alpha = 1$ and $\beta = 1$
 (B) It has infinitely many solutions if $\alpha = 2$ and $\beta = -1$
 (C) $x + y + z = \frac{3}{4}$ if $\alpha = 2$ and $\beta = 1$
 (D) It has no solution if $\alpha = -2$ and $\beta = 1$

If

$$A = \frac{1}{2} \begin{bmatrix} 1 & \sqrt{3} \\ -\sqrt{3} & 1 \end{bmatrix}$$

, then:

- (A) $A^{30} - A^{25} = 2I$ (B) $A^{30} + A^{25} - A = I$ (C) $A^{30} = A^{25}$ (D) $A^{30} + A^{25} + A = I$

Two dice are thrown independently. Let A be the event that the number appeared on the 1st die is less than the number appeared on the 2nd die, B be the event that the number appeared on the 1st die is even and that on the second die is odd, and C be the event that the number appeared on the 1st die is odd and that on the 2nd is even. Then:

- (A) A and B are mutually exclusive
 (B) the number of favourable cases of the events A , B and C are 15, 6 and 6 respectively
 (C) B and C are independent
 (D) the number of favourable cases of the event $(A \cup B) \cap C$ is 6

The number of integral values of k , for which one root of the equation $2x^2 - 8x + k = 0$ lies in the interval $(1, 2)$ and its other root lies in the interval $(2, 3)$, is:

- (A) 2 (B) 0 (C) 1 (D) 3

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Q66 Sequences & Series[Step-by-step solution](https://www.prepwisar.in/questions/qxtKGQmfOt) > prepwisar.in/questions/qxtKGQmfOt

The sum $\sum_{n=1}^{\infty} \frac{2n^2+3n+4}{(2n)!}$ is equal to:

- (A) $\frac{11e}{2} + \frac{7}{2e}$ (B) $\frac{13e}{4} + \frac{5}{4e} - 4$ (C) $\frac{11e}{2} + \frac{7}{2e} - 4$ (D) $\frac{13e}{4} + \frac{5}{4e}$

Q67 Relations & Functions (Basic)[Step-by-step solution](https://www.prepwisar.in/questions/p8HnxMU9XX) > prepwisar.in/questions/p8HnxMU9XX

Let $P(S)$ denote the power set of $S = \{1, 2, 3, \dots, 10\}$. Define the relations R_1 and R_2 on $P(S)$ as AR_1B if

$$(A \cap B^c) \cup (B \cap A^c) = \emptyset$$

and AR_2B if

$$A \cup B^c = B \cup A^c, \forall A, B \in P(S)$$

. Then:

- (A) only R_2 is an equivalence relation (B) both R_1 and R_2 are not equivalence relations
(C) both R_1 and R_2 are equivalence relations (D) only R_1 is an equivalence relation

Q68 Statistics[Step-by-step solution](https://www.prepwisar.in/questions/RdOLAOFKua) > prepwisar.in/questions/RdOLAOFKua

Let $9 = x_1 < x_2 < \dots < x_7$ be in an A.P. with common difference d . If the standard deviation of $x_1, x_2, \dots, x_7$ is 4 and the mean is $\bar{x}$, then $\bar{x} + x_6$ is equal to:

- (A) $2\left(9 + \frac{8}{\sqrt{7}}\right)$ (B) 25 (C) $18\left(1 + \frac{1}{\sqrt{3}}\right)$ (D) 34

Q69 Vectors[Step-by-step solution](https://www.prepwisar.in/questions/bwQL9A06YC) > prepwisar.in/questions/bwQL9A06YC

Let $\vec{a} = 5\hat{i} - \hat{j} - 3\hat{k}$ and $\vec{b} = \hat{i} + 3\hat{j} + 5\hat{k}$ be two vectors. Then which one of the following statements is TRUE?

- (A) Projection of $\vec{a}$ on $\vec{b}$ is $\frac{-13}{\sqrt{35}}$ and the direction of the projection vector is opposite to the direction of $\vec{b}$.
(B) Projection of $\vec{a}$ on $\vec{b}$ is $\frac{13}{\sqrt{35}}$ and the direction of the projection vector is opposite to the direction of $\vec{b}$.
(C) Projection of $\vec{a}$ on $\vec{b}$ is $\frac{13}{\sqrt{35}}$ and the direction of the projection vector is same as of $\vec{b}$.
(D) Projection of $\vec{a}$ on $\vec{b}$ is $\frac{-13}{\sqrt{35}}$ and the direction of the projection vector is same as of $\vec{b}$.

Q70 Vectors[Step-by-step solution](https://www.prepwisar.in/questions/Z00rX6VPSB) > prepwisar.in/questions/Z00rX6VPSB

Let $\vec{a} = 2\hat{i} - 7\hat{j} + 5\hat{k}$, $\vec{b} = \hat{i} + \hat{k}$ and $\vec{c} = \hat{i} + 2\hat{j} - 3\hat{k}$ be three given vectors. If $\vec{r}$ is a vector such that $\vec{r} \times \vec{a} = \vec{c} \times \vec{a}$ and $\vec{r} \cdot \vec{b} = 0$, then $|\vec{r}|$ is equal to:

- (A) $\frac{11}{7}$ (B) $\frac{11}{5}\sqrt{2}$ (C) $\frac{\sqrt{914}}{7}$ (D) $\frac{11}{7}\sqrt{2}$

Q71 Area Under Curves[Step-by-step solution](https://www.prepwisar.in/questions/R3mcmrKnrp) > prepwisar.in/questions/R3mcmrKnrp

The area of the region given by $\{(x, y) : xy \leq 8, 1 \leq y \leq x^2\}$ is:

- (A) $16\log_e 2 - \frac{14}{3}$ (B) $8\log_e 2 - \frac{13}{3}$ (C) $16\log_e 2 + \frac{7}{3}$ (D) $8\log_e 2 + \frac{7}{6}$

Q72 Three Dimensional Geometry **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/fEfQ5qTpvt](https://www.prepwisar.in/questions/fEfQ5qTpvt)

The point of intersection C of the plane $8x + y + 2z = 0$ and the line joining the points A(-3, -6, 1) and B(2, 4, -3) divides the line segment AB internally in the ratio $k : 1$. If a, b, c ($|a|, |b|, |c|$ are coprime) are the direction ratios of the perpendicular from the point C on the line $\frac{1-x}{1} = \frac{y+4}{2} = \frac{z+2}{3}$, then $|a + b + c|$ is equal to _____.

Q73 Three Dimensional Geometry **NUMERICAL**

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

Let $\alpha x + \beta y + \gamma z = 1$ be the equation of a plane passing through the point (3, -2, 5) and perpendicular to the line joining the points (1, 2, 3) and (-2, 3, 5). Then the value of $\alpha\beta\gamma$ is equal to _____.

Q74 Binomial Theorem **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/p5ETooKR35](https://www.prepwisar.in/questions/p5ETooKR35)

Let the sixth term in the binomial expansion of

$$\left(\sqrt{2^{\log_2(10-3^x)}} + \sqrt[5]{2^{(x-2)\log_2 3}} \right)^m$$

in the increasing powers of $2^{(x-2)\log_2 3}$, be 21. If the binomial coefficients of the second, third and fourth terms in the expansion are respectively the first, third and fifth terms of an A.P., then the sum of the squares of all possible values of x is _____.

Q75 Binomial Theorem **NUMERICAL**

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

If the term without x in the expansion of $\left(x^{\frac{2}{3}} + \frac{\alpha}{x^3} \right)^{22}$ is 7315, then $|\alpha|$ is equal to _____.

Q76 Definite Integration **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/a783hpJSmj](https://www.prepwisar.in/questions/a783hpJSmj)

If

$$\int_0^{\pi} \frac{5^{\cos x} (1 + \cos x \cos 3x + \cos^2 x + \cos^3 x \cos 3x) dx}{1 + 5^{\cos x}} = \frac{k\pi}{16}$$

, then k is equal to _____.

Q77 Ellipse **NUMERICAL**

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

The line $x = 8$ is the directrix of the ellipse $E : \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ with the corresponding focus (2, 0). If the tangent to E at the point P in the first quadrant passes through the point $(0, 4\sqrt{3})$ and intersects the x -axis at Q, then $(3PQ)^2$ is equal to _____.

Q78 Parabola **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/THsXyD1ipy](https://www.prepwisar.in/questions/THsXyD1ipy)

If the x -intercept of a focal chord of the parabola $y^2 = 8x + 4y + 4$ is 3, then the length of this chord is equal to _____.

Q79 Permutations & Combinations **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/lkTx-JJs5O](https://www.prepwisar.in/questions/lkTx-JJs5O)

Number of integral solutions to the equation $x + y + z = 21$, where $x \geq 1, y \geq 3, z \geq 4$, is equal to _____.

Q80 Permutations & Combinations **NUMERICAL**

[Step-by-step solution](#) › [prepwisar.in/questions/0reaFnyXJn](https://www.prepwisar.in/questions/0reaFnyXJn)

The total number of six digit numbers, formed using the digits 4, 5, 9 only and divisible by 6, is _____.

The sum of the common terms of the following three arithmetic progressions.

3, 7, 11, 15, ..., 399,

2, 5, 8, 11, ..., 359 and

2, 7, 12, 17, ..., 197,

is equal to _____.

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Physics

1. B	2. C	3. A	4. A	5. A	6. B	7. D	8. A
9. C	10. C	11. A	12. B	13. A	14. A	15. D	16. B
17. C	18. D	19. C	20. 44	21. 6	22. 2	23. 288	24. 200
25. 2	26. 3	27. 4	28. 132				

Chemistry

29. B	30. D	31. B	32. C	33. D	34. A	35. D	36. D
37. C	38. D	39. A	40. D	41. B	42. A, B	43. D	44. 6
45. 75	46. 3	47. 6	48. 1	49. 4	50. 372	51. 139	52. 1006

Mathematics

53. A	54. C	55. C	56. A	57. A	58. D	59. A	60. B
61. D	62. B	63. B	64. D	65. C	66. B	67. C	68. D
69. A	70. D	71. A	72. 10	73. 6	74. 4	75. 1	76. 13
77. 39	78. 16	79. 105	80. 81	81. 321			

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