

JEE MAIN 2023 · QUESTION PAPER

30 Jan 2023 **Shift 2**

86 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	19 Q30 to Q48	10 Q49 to Q58
● Mathematics	18 Q59 to Q76	10 Q77 to Q86
In this PDF		
86 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.

prepwise.in/pyqs/paper/2023-01-30-evening · Free, no signup needed to start

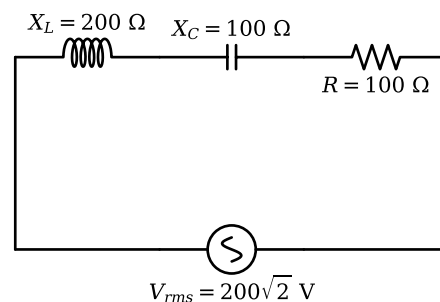
Answers follow NTA's final answer keys. Typing errors are possible, so check doubtful answers against the official key. Spotted a mistake? prepwise.in/feedback · Terms: prepwise.in/terms

Q1 Alternating Current

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

In the given circuit, rms value of current (I_{rms}) through the resistor R is:

- (A) $2\sqrt{2}\text{A}$ (B) 2A (C) $\frac{1}{2}\text{A}$ (D) 20A



Q2 Nuclear Physics

[Step-by-step solution](https://www.prepwiser.in/questions/lzkWj_6PsX) > prepwiser.in/questions/lzkWj_6PsX

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

Assertion A: The nuclear density of nuclides $^{10}_5\text{B}$, ^6_3Li , $^{56}_{26}\text{Fe}$, $^{20}_{10}\text{Ne}$ and $^{209}_{83}\text{Bi}$ can be arranged as $\rho_{\text{Bi}}^{\text{N}} > \rho_{\text{Fe}}^{\text{N}} > \rho_{\text{Ne}}^{\text{N}} > \rho_{\text{B}}^{\text{N}} > \rho_{\text{Li}}^{\text{N}}$

Reason R: The radius R of nucleus is related to its mass number A as $R = R_0 A^{1/3}$, where R_0 is a constant.

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 false but **R** is true
 (D) **A** is true but **R** is false

Q3 Centre of Mass & Linear Momentum

[Step-by-step solution](https://www.prepwiser.in/questions/Z4OfHz8WTG) > prepwiser.in/questions/Z4OfHz8WTG

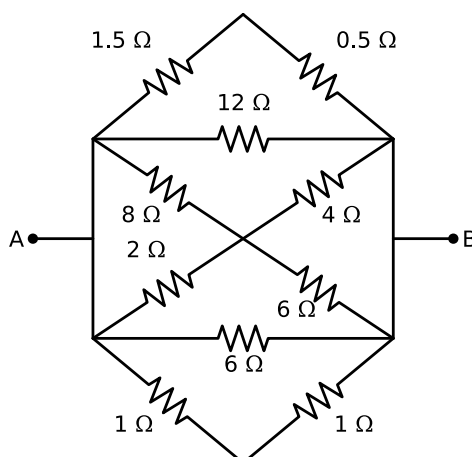
A machine gun of mass 10kg fires 20g bullets at the rate of 180 bullets per minute with a speed of 100ms^{-1} each. The recoil velocity of the gun is

- (A) 0.02m/s (B) 1.5m/s (C) 2.5m/s (D) 0.6m/s

Q4 Current Electricity

[Step-by-step solution](https://www.prepwiser.in/questions/ndeVi4KQtd) > prepwiser.in/questions/ndeVi4KQtd

The equivalent resistance between A and B is _____.



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

Q5 Dual Nature of Radiation & Matter[Step-by-step solution](https://www.prepwisar.in/questions/RmRK55gjdP) > prepwisar.in/questions/RmRK55gjdP

An electron accelerated through a potential difference V_1 has a de-Broglie wavelength of λ . When the potential is changed to V_2 , its de-Broglie wavelength increases by 50%. The value of $\left(\frac{V_1}{V_2}\right)$ is equal to

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

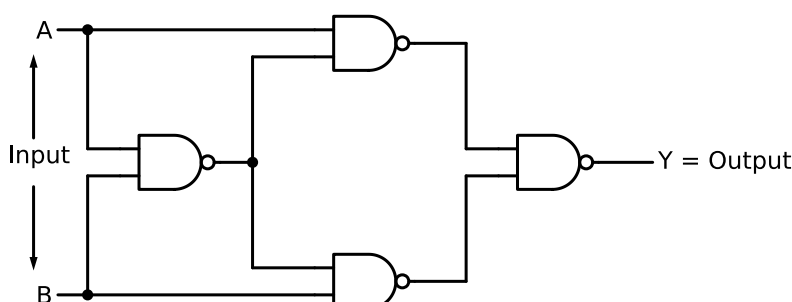
Q6 Electromagnetic Waves[Step-by-step solution](https://www.prepwisar.in/questions/a8GctBCLHj) > prepwisar.in/questions/a8GctBCLHj

A point source of 100W emits light with 5% efficiency. At a distance of 5m from the source, the intensity produced by the electric field component is:

- (A) $\frac{1}{40\pi} \frac{W}{m^2}$ (B) $\frac{1}{10\pi} \frac{W}{m^2}$ (C) $\frac{1}{20\pi} \frac{W}{m^2}$ (D) $\frac{1}{2\pi} \frac{W}{m^2}$

Q7 Semiconductors & Electronic Devices[Step-by-step solution](https://www.prepwisar.in/questions/8JLGiwW1r1) > prepwisar.in/questions/8JLGiwW1r1

The output Y for the inputs A and B of circuit is given by



Truth table of the shown circuit is:

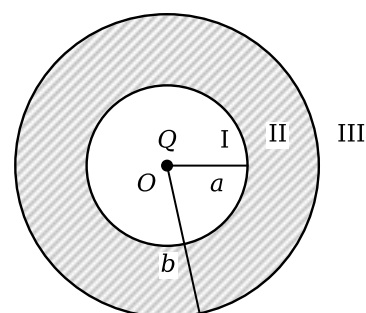
- | A | B | Y |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |
- | A | B | Y |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |
- | A | B | Y |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |
- | A | B | Y |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

Q8 Electrostatics I: Charges, Field & Gauss's Law[Step-by-step solution](https://www.prepwisar.in/questions/IOaafkr8Q3) > prepwisar.in/questions/IOaafkr8Q3

As shown in the figure, a point charge Q is placed at the centre of conducting spherical shell of inner radius a and outer radius b . The electric field due to charge Q in three different regions I, II and III is given by:

(I : $r < a$, II : $a < r < b$, III: $r > b$)

- (A) $E_I = 0, E_{II} = 0, E_{III} \neq 0$ (B) $E_I \neq 0, E_{II} = 0, E_{III} = 0$
 (C) $E_I \neq 0, E_{II} = 0, E_{III} \neq 0$ (D) $E_I = 0, E_{II} = 0, E_{III} = 0$

**Q9** Ray Optics[Step-by-step solution](https://www.prepwisar.in/questions/hoj8ID72ed) > prepwisar.in/questions/hoj8ID72ed

A thin prism P_1 with an angle 6° and made of glass of refractive index 1.54 is combined with another prism P_2 made from glass of refractive index 1.72 to produce dispersion without average deviation. The angle of prism P_2 is

- (A) 4.5° (B) 7.8° (C) 1.3° (D) 6°

Q10 Gravitation[Step-by-step solution](https://www.prepwisar.in/questions/U24hkVL3NS)

An object is allowed to fall from a height R above the earth, where R is the radius of earth. Its velocity when it strikes the earth's surface, ignoring air resistance, will be

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

Q11 Thermodynamics[Step-by-step solution](https://www.prepwisar.in/questions/tbzMDICH1M)

Given below are two statements: one is labelled as Assertion **A** and the other is labelled as Reason **R**.
Assertion A: Efficiency of a reversible heat engine will be highest at -273°C temperature of cold reservoir.

Reason R: The efficiency of Carnot's engine depends not only on the temperature of the cold reservoir but it depends on the temperature of the hot reservoir too and is given as $\eta = \left(1 - \frac{T_2}{T_1}\right)$

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 false but **R** is true
(D) A is true but **R** is false

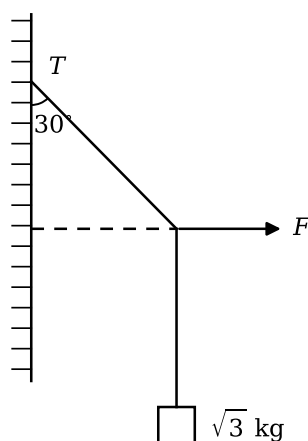
Q12 Kinetic Theory of Gases[Step-by-step solution](https://www.prepwisar.in/questions/s7F1IzjFBk)

A flask contains hydrogen and oxygen in the ratio of 2 : 1 by mass at temperature 27°C . The ratio of average kinetic energy per molecule of hydrogen and oxygen respectively is:

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

Q13 Newton's Laws of Motion[Step-by-step solution](https://www.prepwisar.in/questions/L-G2sLpWWA)

A block of $\sqrt{3}\text{kg}$ is attached to a string whose other end is attached to the wall. An unknown force F is applied so that the string makes an angle of 30° with the wall. The tension T is: (Given $g = 10\text{ms}^{-2}$)

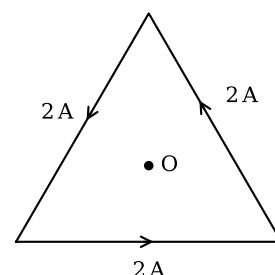


- (A) 15 N (B) 10 N (C) 25 N (D) 20 N

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Q14 Moving Charges & Magnetism[Step-by-step solution](https://www.prepwisar.in/questions/nu0Omyz5xE)

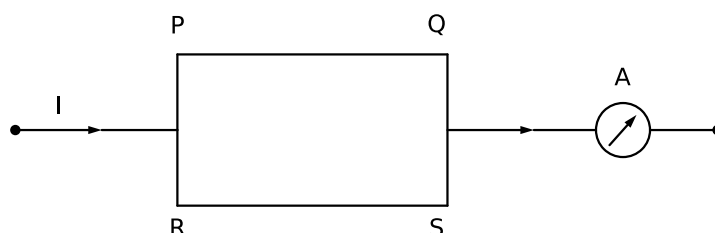
As shown in the figure, a current of 2A flowing in an equilateral triangle of side $4\sqrt{3}\text{cm}$. The magnetic field at the centroid O of the triangle is (Neglect the effect of earth's magnetic field)



- (A) $4\sqrt{3} \times 10^{-4}\text{T}$ (B) $4\sqrt{3} \times 10^{-5}\text{T}$ (C) $3\sqrt{3} \times 10^{-5}\text{T}$ (D) $\sqrt{3} \times 10^{-4}\text{T}$

Q15 Moving Charges & Magnetism[Step-by-step solution](https://www.prepwisar.in/questions/1V_gYlb6Fk)

A current carrying rectangular loop PQRS is made of uniform wire. The length $PR = QS = 5\text{cm}$ and $PQ = RS = 100\text{cm}$. If ammeter current reading changes from I to $2I$, the ratio of magnetic forces per unit length on the wire PQ due to wire RS in the two cases respectively ($f_{PQ}^I : f_{PQ}^{2I}$) is:



- (A) 1 : 4 (B) 1 : 3 (C) 1 : 2 (D) 1 : 5

Q16 Rectilinear Motion[Step-by-step solution](https://www.prepwisar.in/questions/-IHWo9kK8a)

A vehicle travels 4km with speed of 3km/h and another 4km with speed of 5km/h , then its average speed is

- (A) 3.75km/h (B) 4.25km/h (C) 3.50km/h (D) 4.00km/h

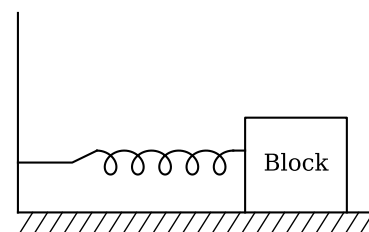
Q17 Elasticity[Step-by-step solution](https://www.prepwisar.in/questions/Y5yDYC96s_)

A force is applied to a steel wire 'A', rigidly clamped at one end. As a result elongation in the wire is 0.2mm . If same force is applied to another steel wire 'B' of double the length and a diameter 2.4 times that of the wire 'A', the elongation in the wire 'B' will be (wires having uniform circular cross sections)

- (A) $6.9 \times 10^{-2}\text{mm}$ (B) $6.06 \times 10^{-2}\text{mm}$ (C) $2.77 \times 10^{-2}\text{mm}$ (D) $3.0 \times 10^{-2}\text{mm}$

Q18 Simple Harmonic Motion[Step-by-step solution](https://www.prepwisar.in/questions/IKB61FbS-6)

For a simple harmonic motion in a mass spring system shown, the surface is frictionless. When the mass of the block is 1kg , the angular frequency is ω_1 . When the mass block is 2kg the angular frequency is ω_2 . The ratio ω_2/ω_1 is



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

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Match List I with List II:

List I		List II	
A.	Torque	I.	$\text{kg m}^{-1} \text{s}^{-2}$
B.	Energy density	II.	kg ms^{-1}
C.	Pressure gradient	III.	$\text{kg m}^{-2} \text{s}^{-2}$
D.	Impulse	IV.	$\text{kg m}^2 \text{s}^{-2}$

Choose the correct answer from the options given below:

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

Physics Section B · Numerical value

Q20 to Q29

Q20 Electromagnetic Induction **NUMERICAL**

[Step-by-step solution](https://www.prepwisar.in/questions/6HNVHzZ10X) > prepwisar.in/questions/6HNVHzZ10X

In an ac generator, a rectangular coil of 100 turns each having area $14 \times 10^{-2} \text{m}^2$ is rotated at 360rev/min about an axis perpendicular to a uniform magnetic field of magnitude 3.0T . The maximum value of the emf produced will be _____ V.

(Take $\pi = \frac{22}{7}$)

Q21 Nuclear Physics **NUMERICAL**

[Step-by-step solution](https://www.prepwisar.in/questions/b5H8uRk0hn) > prepwisar.in/questions/b5H8uRk0hn

A radioactive nucleus decays by two different process. The half life of the first process is 5 minutes and that of the second process is 30s. The effective half-life of the nucleus is calculated to be $\frac{\alpha}{11} \text{s}$. The value of α is _____.

Q22 Circular Motion **NUMERICAL**

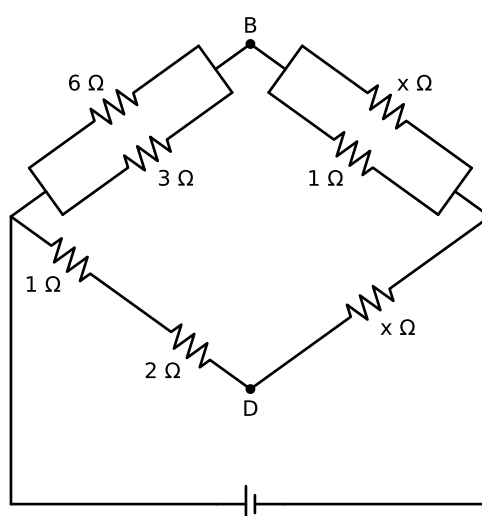
[Step-by-step solution](https://www.prepwisar.in/questions/iRhYl2X1Wl) > prepwisar.in/questions/iRhYl2X1Wl

A stone tied to 180cm long string at its end is making 28 revolutions in horizontal circle in every minute. The magnitude of acceleration of stone is $\frac{1936}{x} \text{ms}^{-2}$. The value of x _____. (Take $\pi = \frac{22}{7}$)

Q23 Current Electricity **NUMERICAL**

[Step-by-step solution](https://www.prepwisar.in/questions/o9iLc3e9i2) > prepwisar.in/questions/o9iLc3e9i2

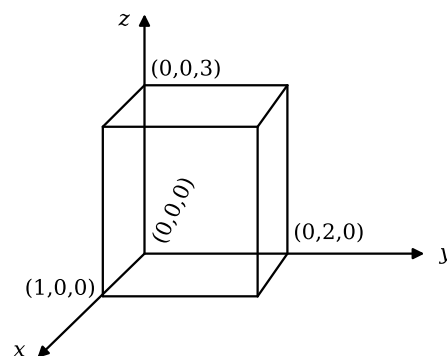
If the potential difference between B and D is zero, the value of x is $\frac{1}{n} \Omega$. The value of n is _____.



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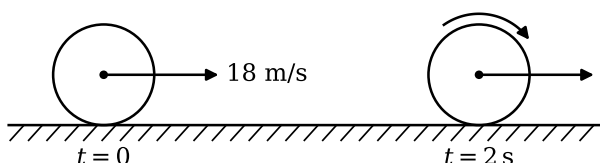
As shown in figure, a cuboid lies in a region with electric field $E = 2x^2\hat{i} - 4y\hat{j} + 6z\hat{k}$ N/C. The magnitude of charge within the cuboid is $n\epsilon_0 C$.

The value of n is _____ (if dimension of cuboid is $1 \times 2 \times 3\text{m}^3$)



A faulty thermometer reads 5°C in melting ice and 95°C in steam. The correct temperature on absolute scale will be _____ K when the faulty thermometer reads 41°C .

A uniform disc of mass 0.5kg and radius r is projected with velocity 18m/s at $t = 0\text{ s}$ on a rough horizontal surface. It starts off with a purely sliding motion at $t = 0\text{ s}$. After 2 s it acquires a purely rolling motion (see figure). The total kinetic energy of the disc after 2 s will be _____ J (given, coefficient of friction is 0.3 and $g = 10\text{m/s}^2$).



The velocity of a particle executing SHM varies with displacement (x) as $4v^2 = 50 - x^2$. The time period of oscillations is $\frac{x}{7}\text{ s}$. The value of x is _____. (Take $\pi = \frac{22}{7}$)

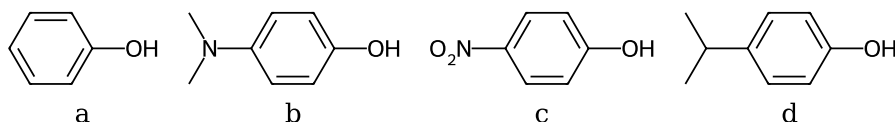
In a Young's double slit experiment, the intensities at two points, for the path differences $\frac{\lambda}{4}$ and $\frac{\lambda}{3}$ (λ being the wavelength of light used) are I_1 and I_2 respectively. If I_0 denotes the intensity produced by each one of the individual slits, then $\frac{I_1 + I_2}{I_0} = \underline{\hspace{2cm}}$.

A body of mass 2kg is initially at rest. It starts moving unidirectionally under the influence of a source of constant power P . Its displacement in 4 s is $\frac{1}{3}\alpha^2\sqrt{P}\text{m}$. The value of α will be _____.

Chemistry Section A · Multiple choice

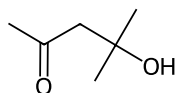
Q30 to Q48

The correct order of pK_a values for the following compounds is:

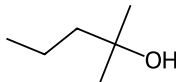
(A) $a > b > c > d$ (B) $c > a > d > b$ (C) $b > d > a > c$ (D) $b > a > d > c$

Q31 Aldehydes & Ketones[Step-by-step solution](https://www.prepwisetutor.com/questions/vMfCiNhwnR) > prepwiser.in/questions/vMfCiNhwnR

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



can be easily reduced using $\text{Zn} - \text{Hg}/\text{HCl}$ to



Reason R : $\text{Zn} - \text{Hg}/\text{HCl}$ is used to reduce carbonyl group to $-\text{CH}_2-$ group.

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

Q32 Chemistry in Everyday Life[Step-by-step solution](https://www.prepwisetutor.com/questions/B5bOWIQaf8) > prepwiser.in/questions/B5bOWIQaf8

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

Assertion A: Antihistamines do not affect the secretion of acid in stomach.

Reason R: Antiallergic and antacid drugs work on different receptors.

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

Q33 Coordination Compounds[Step-by-step solution](https://www.prepwisetutor.com/questions/Rlvk5T-vnq) > prepwiser.in/questions/Rlvk5T-vnq

Match List I with List II:

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

List I (Complexes)		List II (Hybridisation)	
A.	$[\text{Ni}(\text{CO})_4]$	I.	sp^3
B.	$[\text{Cu}(\text{NH}_3)_4]^{2+}$	II.	dsp^2
C.	$[\text{Fe}(\text{NH}_3)_6]^{2+}$	III.	sp^3d^2
D.	$[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$	IV.	d^2sp^3

Q34 Coordination Compounds[Step-by-step solution](https://www.prepwisetutor.com/questions/bLk7sX0Ap-) > prepwiser.in/questions/bLk7sX0Ap-

The $\text{Cl} - \text{Co} - \text{Cl}$ bond angle values in a fac- $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ complex is/are:

- (A) 90° & 120° (B) 90° (C) 180° (D) 90° & 180°

Q35 Qualitative Analysis: Salt Analysis[Step-by-step solution](https://www.prepwisetutor.com/questions/Vh9xvOXNrH) > prepwiser.in/questions/Vh9xvOXNrH

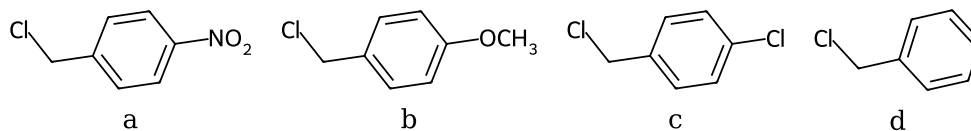
Formulae for Nessler's reagent is:

- (A) KHgI_3 (B) HgI_2 (C) KHg_2I_2 (D) K_2HgI_4

KMnO_4 oxidises I^- in acidic and neutral/faintly alkaline solutions, respectively, to:

- (A) IO_3^- & IO_3^- (B) I_2 & I_2 (C) I_2 & IO_3^- (D) IO_3^- & I_2

Decreasing order towards $\text{S}_\text{N}1$ reaction for the following compounds is:



- (A) $a > c > d > b$ (B) $d > b > c > a$ (C) $a > b > c > d$ (D) $b > d > c > a$

Given below are two statements:

Statement I: During Electrolytic refining, the pure metal is made to act as anode and its impure metallic form is used as cathode.

Statement II: During the Hall-Heroult electrolysis process, purified Al_2O_3 is mixed with Na_3AlF_6 to lower the melting point of the mixture.

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

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

Boric acid is solid, whereas BF_3 is gas at room temperature because of:

- (A) Strong van der Waal's interaction in Boric acid (B) Strong covalent bond in BF_3
 (C) Strong hydrogen bond in Boric acid (D) Strong ionic bond in Boric acid

Bond dissociation energy of "E-H" bond of the " H_2E " hydrides of group 16 elements (given below), follows order.

- A. O
 B. S
 C. Se
 D. Te

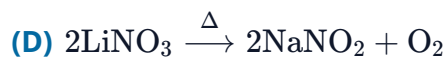
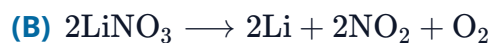
Choose the correct from the options given below:

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

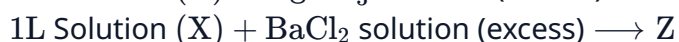
Chlorides of which metal are soluble in organic solvents:

- (A) K (B) Be (C) Ca (D) Mg

Which of the following reaction is correct?



1L, 0.02M solution of $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ is mixed with 1L, 0.02M solution of $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$. The resulting solution is divided into two equal parts (X) and treated with excess of AgNO_3 solution and BaCl_2 solution respectively as shown below:



The number of moles of Y and Z respectively are

(A) 0.01, 0.01

(B) 0.01, 0.02

(C) 0.02, 0.01

(D) 0.02, 0.02

Maximum number of electrons that can be accommodated in shell with $n = 4$ are:

(A) 50

(B) 32

(C) 72

(D) 16

The wave function (Ψ) of 2s is given by

$$\Psi_{2s} = \frac{1}{2\sqrt{2\pi}} \left(\frac{1}{a_0} \right)^{1/2} \left(2 - \frac{r}{a_0} \right) e^{-r/2a_0}$$

At $r = r_0$, radial node is formed. Thus, r_0 in terms of a_0

(A) $r_0 = a_0$

(B) $r_0 = 4a_0$

(C) $r_0 = 2a_0$

(D) $r_0 = \frac{a_0}{2}$

Match List I with List II:

List I (Mixture)		List II (Separation Technique)	
A.	$\text{CHCl}_3 + \text{C}_6\text{H}_5\text{NH}_2$	I.	Steam distillation
B.	$\text{C}_6\text{H}_{14} + \text{C}_5\text{H}_{12}$	II.	Differential extraction
C.	$\text{C}_6\text{H}_5\text{NH}_2 + \text{H}_2\text{O}$	III.	Distillation
D.	Organic compound in H_2O	IV.	Fractional distillation

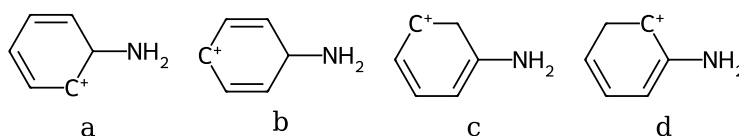
(A) A-III, B-I, C-IV, D-II

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

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

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

The most stable carbocation for the following is:



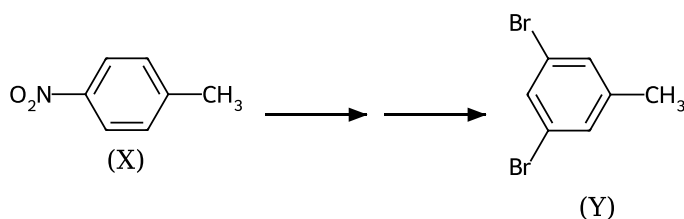
(A) b

(B) d

(C) c

(D) a

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In the above conversion of compound (X) to product (Y), the sequence of reagents to be used will be:

- (A)** (i) Br_2, Fe (ii) Fe, H^+ (iii) LiAlH_4 **(B)** (i) $\text{Br}_2(\text{aq})$ (ii) LiAlH_4 (iii) H_3O^+
(C) (i) Fe, H^+ (ii) $\text{Br}_2(\text{aq})$ (iii) HNO_2 (iv) H_3PO_2 **(D)** (i) Fe, H^+ (ii) $\text{Br}_2(\text{aq})$ (iii) HNO_2 (iv) CuBr

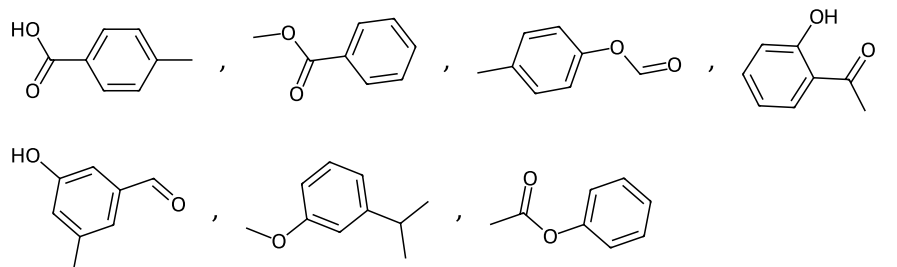
Chemistry Section B · Numerical value

Q49 to Q58

Q49 Alcohols, Phenols & Ethers NUMERICAL

Step-by-step solution > prepwiser.in/questions/e3SjCAdUD3

Number of compounds from the following which will not dissolve in cold NaHCO_3 and NaOH solutions but will dissolve in hot NaOH solution is _____.



Q50 Carbohydrates & Biomolecules NUMERICAL

Step-by-step solution > prepwiser.in/questions/ub-uUiZCPq

A short peptide on complete hydrolysis produces 3 moles of glycine (G), two moles of leucine (L) and two moles of valine (V) per mole of peptide. The number of peptide linkages in it are _____.

Q51 Chemical Kinetics NUMERICAL

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

An organic compound undergoes first-order decomposition. If the time taken for the 60% decomposition is 540s, then the time required for 90% decomposition will be _____ s. (Nearest integer).

Given: $\ln 10 = 2.3$; $\log 2 = 0.3$

Q52 Electrochemistry NUMERICAL

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

The electrode potential of the following half cell at 298K

$\text{X} | \text{X}^{2+} (0.001\text{M}) || \text{Y}^{2+} (0.01\text{M}) | \text{Y}$ is _____ $\times 10^{-2}\text{V}$ (Nearest integer)

Given: $E_{\text{X}^{2+}|\text{X}}^0 = -2.36\text{V}$

$E_{\text{Y}^{2+}|\text{Y}}^0 = +0.36\text{V}$

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

Q53 Solid State NUMERICAL

Step-by-step solution > prepwiser.in/questions/wyD8VWiNqY

Iron oxide FeO , crystallises in a cubic lattice with a unit cell edge length of $5.0 \text{ \AA}$. If density of the FeO in the crystal is 4.0gcm^{-3} , then the number of FeO units present per unit cell is _____. (Nearest integer)

Given: Molar mass of Fe and O is 56 and 16g mol^{-1} respectively. $N_A = 6.0 \times 10^{23}\text{mol}^{-1}$

Lead storage battery contains 38% by weight solution of H_2SO_4 . The van't Hoff factor is 2.67 at this concentration. The temperature in Kelvin at which the solution in the battery will freeze is _____. (Nearest integer).

Given $K_f = 1.8 \text{ K kg mol}^{-1}$

The strength of 50 volume solution of hydrogen peroxide is _____ g/L (Nearest integer).

Given:

Molar mass of H_2O_2 is 34 g mol^{-1}

Molar volume of gas at STP = 22.7 L

The graph of $\log \frac{x}{m}$ vs $\log p$ for an adsorption process is a straight line inclined at an angle of 45° with intercept equal to 0.6020. The mass of gas adsorbed per unit mass of adsorbent at the pressure of 0.4 atm is _____ $\times 10^{-1}$ (Nearest integer).

Given: $\log 2 = 0.3010$

1 mole of ideal gas is allowed to expand reversibly and adiabatically from a temperature of 27°C . The work done is 3 kJ mol^{-1} . The final temperature of the gas is _____ K (Nearest integer).

Given $C_V = 20 \text{ J mol}^{-1} \text{ K}^{-1}$

Consider the following equation:



The number of factors which will increase the yield of SO_3 at equilibrium from the following is _____.

- A. Increasing temperature
- B. Increasing pressure
- C. Adding more SO_2
- D. Adding more O_2
- E. Addition of catalyst

Mathematics Section A · Multiple choice

Q59 to Q76

A vector $\vec{v}$ in the first octant is inclined to the x -axis at 60° , to the y -axis at 45° and to the z -axis at an acute angle. If a plane passing through the points $(\sqrt{2}, -1, 1)$ and (a, b, c) , is normal to $\vec{v}$, then:

- (A) $a + b + \sqrt{2}c = 1$ (B) $\sqrt{2}a + b + c = 1$ (C) $\sqrt{2}a - b + c = 1$ (D) $a + \sqrt{2}b + c = 1$

If a plane passes through the points $(-1, k, 0)$, $(2, k, -1)$, $(1, 1, 2)$ and is parallel to the line

$\frac{x-1}{1} = \frac{2y+1}{2} = \frac{z+1}{-1}$, then the value of $\frac{k^2+1}{(k-1)(k-2)}$ is:

- (A) $\frac{17}{5}$ (B) $\frac{6}{13}$ (C) $\frac{13}{6}$ (D) $\frac{5}{17}$

Q61 Applications of Derivatives[Step-by-step solution](https://www.prepwisar.in/questions/Cvou3Ct4pQ) > prepwisar.in/questions/Cvou3Ct4pQ

If the functions $f(x) = \frac{x^3}{3} + 2bx + \frac{ax^2}{2}$

and $g(x) = \frac{x^3}{3} + ax + bx^2, a \neq 2b$

have a common extreme point, then $a + 2b + 7$ is equal to:

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

Q62 Binomial Theorem[Step-by-step solution](https://www.prepwisar.in/questions/IFZyeWecem) > prepwisar.in/questions/IFZyeWecem

Let $x = (8\sqrt{3} + 13)^{13}$ and $y = (7\sqrt{2} + 9)^9$. If $[t]$ denotes the greatest integer $\leq t$, then:

- (A) $[x]$ is odd but $[y]$ is even (B) $[x]$ and $[y]$ are both odd
(C) $[x] + [y]$ is even (D) $[x]$ is even but $[y]$ is odd

Q63 Definite Integration[Step-by-step solution](https://www.prepwisar.in/questions/Vs4RpDCgyl) > prepwisar.in/questions/Vs4RpDCgyl

$\lim_{n \rightarrow \infty} \frac{3}{n} \left\{ 4 + \left(2 + \frac{1}{n}\right)^2 + \left(2 + \frac{2}{n}\right)^2 + \dots + \left(3 - \frac{1}{n}\right)^2 \right\}$ is equal to:

- (A) 0 (B) $\frac{19}{3}$ (C) 19 (D) 12

Q64 Differential Equations[Step-by-step solution](https://www.prepwisar.in/questions/J_EQ3Z8kp5) > prepwisar.in/questions/J_EQ3Z8kp5

The solution of the differential equation

$$\frac{dy}{dx} = -\left(\frac{x^2 + 3y^2}{3x^2 + y^2}\right), y(1) = 0 \text{ is:}$$

- (A) $\log_e |x + y| + \frac{xy}{(x+y)^2} = 0$ (B) $\log_e |x + y| - \frac{xy}{(x+y)^2} = 0$
(C) $\log_e |x + y| + \frac{2xy}{(x+y)^2} = 0$ (D) $\log_e |x + y| - \frac{2xy}{(x+y)^2} = 0$

Q65 Functions (Advanced)[Step-by-step solution](https://www.prepwisar.in/questions/vxmqcMDIf) > prepwisar.in/questions/vxmqcMDIf

The range of the function $f(x) = \sqrt{3-x} + \sqrt{2+x}$ is:

- (A) $[2\sqrt{2}, \sqrt{11}]$ (B) $[\sqrt{5}, \sqrt{13}]$ (C) $[\sqrt{2}, \sqrt{7}]$ (D) $[\sqrt{5}, \sqrt{10}]$

Q66 Limits[Step-by-step solution](https://www.prepwisar.in/questions/jz4af7wGQ3) > prepwisar.in/questions/jz4af7wGQ3

Let f, g and h be the real valued functions defined on $\mathbb{R}$ as

$$f(x) = \begin{cases} \frac{x}{|x|}, & x \neq 0 \\ 1, & x = 0 \end{cases}$$

$$g(x) = \begin{cases} \frac{\sin(x+1)}{(x+1)}, & x \neq -1 \\ 1, & x = -1 \end{cases}$$

and $h(x) = 2[x] - f(x)$, where $[x]$ is the greatest integer $\leq x$. Then the value of $\lim_{x \rightarrow 1} g(h(x-1))$ is:

- (A) 1 (B) -1 (C) $\sin(1)$ (D) 0

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For $\alpha, \beta \in \mathbb{R}$, suppose the system of linear equations

$$x - y + z = 5$$

$$2x + 2y + \alpha z = 8$$

$$3x - y + 4z = \beta$$

has infinitely many solutions. Then α and β are the roots of:

- (A) $x^2 + 18x + 56 = 0$ (B) $x^2 - 10x + 16 = 0$ (C) $x^2 + 14x + 24 = 0$ (D) $x^2 - 18x + 56 = 0$

If P is a 3×3 real matrix such that $P^T = aP + (a - 1)I$, where $a > 1$, then:

- (A) $|Adj P| = 1$ (B) $|Adj P| > 1$
 (C) $|Adj P| = \frac{1}{2}$ (D) P is a singular matrix

Let A be a point on the x -axis. Common tangents are drawn from A to the curves $x^2 + y^2 = 8$ and $y^2 = 16x$. If one of these tangents touches the two curves at Q and R , then $(QR)^2$ is equal to:

- (A) 76 (B) 81 (C) 64 (D) 72

The parabolas: $ax^2 + 2bx + cy = 0$ and $dx^2 + 2ex + fy = 0$ intersect on the line $y = 1$. If a, b, c, d, e, f are positive real numbers and a, b, c are in G.P., then:

- (A) $\frac{d}{a}, \frac{e}{b}, \frac{f}{c}$ are in A.P. (B) $\frac{d}{a}, \frac{e}{b}, \frac{f}{c}$ are in G.P. (C) d, e, f are in A.P. (D) d, e, f are in G.P.

The number of ways of selecting two numbers a and b , $a \in \{2, 4, 6, \dots, 100\}$ and $b \in \{1, 3, 5, \dots, 99\}$ such that 2 is the remainder when $a + b$ is divided by 23 is:

- (A) 186 (B) 54 (C) 108 (D) 268

Let $a, b, c > 1$, a^3, b^3 and c^3 be in A.P., and $\log_a b, \log_c a$ and $\log_b c$ be in G.P. If the sum of first 20 terms of an A.P., whose first term is $\frac{a+4b+c}{3}$ and the common difference is $\frac{a-8b+c}{10}$ is -444 , then abc is equal to:

- (A) 343 (B) 216 (C) $\frac{343}{8}$ (D) $\frac{125}{8}$

Let S be the set of all values of a_1 for which the mean deviation about the mean of 100 consecutive positive integers $a_1, a_2, a_3, \dots, a_{100}$ is 25. Then S is:

- (A) $\{9\}$ (B) ϕ (C) $\{99\}$ (D) N

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Q74 Vectors[Step-by-step solution](#) > [prepwisar.in/questions/koeG8qCvdu](https://www.prepwisar.in/questions/koeG8qCvdu)

Let $\lambda \in \mathbb{R}$, $\vec{a} = \lambda\hat{i} + 2\hat{j} - 3\hat{k}$, $\vec{b} = \hat{i} - \lambda\hat{j} + 2\hat{k}$.

If $((\vec{a} + \vec{b}) \times (\vec{a} \times \vec{b})) \times (\vec{a} - \vec{b}) = 8\hat{i} - 40\hat{j} - 24\hat{k}$,
then $|\lambda(\vec{a} + \vec{b}) \times (\vec{a} - \vec{b})|^2$ is equal to:

(A) 136**(B)** 140**(C)** 144**(D)** 132**Q75** Vectors[Step-by-step solution](#) > [prepwisar.in/questions/qa9YULieW](https://www.prepwisar.in/questions/qa9YULieW)

Let $\vec{a}$ and $\vec{b}$ be two vectors, Let $|\vec{a}| = 1$, $|\vec{b}| = 4$ and $\vec{a} \cdot \vec{b} = 2$. If $\vec{c} = (2\vec{a} \times \vec{b}) - 3\vec{b}$, then the value of $\vec{b} \cdot \vec{c}$ is:

(A) -48**(B)** -60**(C)** -84**(D)** -24**Q76** Area Under Curves[Step-by-step solution](#) > [prepwisar.in/questions/sbZNtFic3i](https://www.prepwisar.in/questions/sbZNtFic3i)

Let q be the maximum integral value of p in $[0, 10]$ for which the roots of the equation $x^2 - px + \frac{5}{4}p = 0$ are rational. Then the area of the region $\{(x, y) : 0 \leq y \leq (x - q)^2, 0 \leq x \leq q\}$ is:

(A) $\frac{125}{3}$ **(B)** 243**(C)** 164**(D)** 25**Mathematics Section B · Numerical value**

Q77 to Q86

Q77 Three Dimensional Geometry **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/euEEe6RvyB](https://www.prepwisar.in/questions/euEEe6RvyB)

Let a line L pass through the point $P(2, 3, 1)$ and be parallel to the line $x + 3y - 2z - 2 = 0 = x - y + 2z$. If the distance of L from the point $(5, 3, 8)$ is α , then $3\alpha^2$ is equal to:

Q78 Binomial Theorem **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/d_GMWhPqNH](https://www.prepwisar.in/questions/d_GMWhPqNH)

50^{th} root of a number x is 12 and 50^{th} root of another number y is 18. Then the remainder obtained on dividing $(x + y)$ by 25 is _____.

Q79 Circles **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/poUn9Lh636](https://www.prepwisar.in/questions/poUn9Lh636)

Let $P(a_1, b_1)$ and $Q(a_2, b_2)$ be two distinct points on a circle with center $C(\sqrt{2}, \sqrt{3})$. Let O be the origin and OC be perpendicular to both CP and CQ . If the area of the triangle OCP is $\frac{\sqrt{35}}{2}$, then $a_1^2 + a_2^2 + b_1^2 + b_2^2$ is equal to:

Q80 Functions (Advanced) **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/zvpMcf1GwF](https://www.prepwisar.in/questions/zvpMcf1GwF)

Let $A = \{1, 2, 3, 5, 8, 9\}$. Then the number of possible functions $f : A \rightarrow A$ such that $f(m \cdot n) = f(m) \cdot f(n)$ for every $m, n \in A$ with $m \cdot n \in A$ is equal to _____.

Q81 Permutations & Combinations **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/yIv_YnQbOk](https://www.prepwisar.in/questions/yIv_YnQbOk)

The number of seven digits odd numbers, that can be formed using all the seven digits 1, 2, 2, 2, 3, 3, 5 is _____.

Q82 Probability: Basic **NUMERICAL**[Step-by-step solution](#) > [prepwisar.in/questions/7EcVMBalOI](https://www.prepwisar.in/questions/7EcVMBalOI)

A bag contains six balls of different colours. Two balls are drawn in succession with replacement. The probability that both the balls are of the same colour is p . Next four balls are drawn in succession with replacement and the probability that exactly three balls are of the same colour is q . If $p : q = m : n$, where m and n are coprime, then $m + n$ is equal to:

Q83 Quadratic Equations & Polynomial Inequalities **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/TP1J0ER8u-

If the value of real number $a > 0$ for which $x^2 - 5ax + 1 = 0$ and $x^2 - ax - 5 = 0$ have a common real root is $\frac{3}{\sqrt{2}\beta}$ then β is equal to _____.

Q84 Sequences & Series **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/FgJ_3asLvE

The 8th common term of the series

$$S_1 = 3 + 7 + 11 + 15 + 19 + \dots$$

$$S_2 = 1 + 6 + 11 + 16 + 21 + \dots$$

is:

Q85 Area Under Curves **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/n2DoAMWRmc

Let A be the area of the region

$$\{(x, y) : y \geq x^2, y \geq (1 - x)^2, y \leq 2x(1 - x)\}.$$

Then $540A$ is equal to:

Q86 Indefinite Integration **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/4mPYeXt5rh

If $\int \sqrt{\sec 2x - 1} dx = \alpha \log_e \left| \cos 2x + \beta + \sqrt{\cos 2x \left(1 + \cos \frac{1}{\beta} x \right)} \right| + \text{constant}$, then $\beta - \alpha$ is equal to _____.

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Physics

1. B	2. C	3. D	4. B	5. D	6. A	7. A	8. C
9. A	10. B	11. A	12. A	13. D	14. C	15. A	16. A
17. A	18. A	19. A	20. 1584	21. 300	22. 125	23. 2	24. 12
25. 313	26. 54	27. 88	28. 3	29. 4			

Chemistry

30. C	31. B	32. C	33. C	34. B	35. D	36. C	37. D
38. B	39. C	40. A	41. B	42. A	43. A	44. B	45. C
46. D	47. C	48. C	49. 3	50. 6	51. 1350	52. 275	53. 4
54. 243	55. 150	56. 16	57. 150	58. 3			

Mathematics

59. D	60. C	61. A	62. C	63. C	64. C	65. D	66. A
67. D	68. A	69. D	70. A	71. C	72. B	73. D	74. B
75. A	76. B	77. 158	78. 23	79. 24	80. 432	81. 240	82. 14
83. 13	84. 151	85. 25	86. 1				

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