

## JEE MAIN 2023 · QUESTION PAPER

# 25 Jan 2023 **Shift 1**

83 questions in exam order, with answer key

| Subject              | Section A multiple choice                   | Section B numerical value |
|----------------------|---------------------------------------------|---------------------------|
| ● <b>Physics</b>     | <b>18</b> Q1 to Q18                         | <b>10</b> Q19 to Q28      |
| ● <b>Chemistry</b>   | <b>17</b> Q29 to Q45                        | <b>10</b> Q46 to Q55      |
| ● <b>Mathematics</b> | <b>19</b> Q56 to Q74                        | <b>9</b> Q75 to Q83       |
| <b>In this PDF</b>   | <b>83</b> 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/2023-01-25-morning](https://prepwis.in/pyqs/paper/2023-01-25-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](https://prepwis.in/feedback) · Terms: [prepwis.in/terms](https://prepwis.in/terms)

**Q1** Alternating Current

[Step-by-step solution](#) › [prepwiser.in/questions/BkM4bQMDBx](https://www.prepwiser.in/questions/BkM4bQMDBx)

In an LC oscillator, if values of inductance and capacitance become twice and eight times, respectively, then the resonant frequency of oscillator becomes  $x$  times its initial resonant frequency  $\omega_0$ . The value of  $x$  is:

- (A)  $1/4$  (B)  $1/16$  (C)  $4$  (D)  $16$

**Q2** Nuclear Physics

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

The ratio of the density of oxygen nucleus ( $^{16}_8\text{O}$ ) and helium nucleus ( $^4_2\text{He}$ ) is

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

**Q3** Electrostatics II: Potential & Capacitance

[Step-by-step solution](#) › [prepwiser.in/questions/Wbzdv99Ryc](https://www.prepwiser.in/questions/Wbzdv99Ryc)

A parallel plate capacitor has plate area  $40 \text{ cm}^2$  and plates separation  $2 \text{ mm}$ . The space between the plates is filled with a dielectric medium of a thickness  $1 \text{ mm}$  and dielectric constant  $5$ . The capacitance of the system is:

- (A)  $10\epsilon_0 F$  (B)  $24\epsilon_0 F$  (C)  $\frac{3}{10}\epsilon_0 F$  (D)  $\frac{10}{3}\epsilon_0 F$

**Q4** Circular Motion

[Step-by-step solution](#) › [prepwiser.in/questions/11mj77I-xz](https://www.prepwiser.in/questions/11mj77I-xz)

A car is moving with a constant speed of  $20 \text{ m/s}$  in a circular horizontal track of radius  $40 \text{ m}$ . A bob is suspended from the roof of the car by a massless string. The angle made by the string with the vertical will be : (Take  $g = 10 \text{ m/s}^2$ )

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

**Q5** Current Electricity

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

A uniform metallic wire carries a current  $2 \text{ A}$ , when  $3.4 \text{ V}$  battery is connected across it. The mass of uniform metallic wire is  $8.92 \times 10^{-3} \text{ kg}$ , density is  $8.92 \times 10^3 \text{ kg/m}^3$  and resistivity is  $1.7 \times 10^{-8} \Omega\text{-m}$ . The length of wire is:

- (A)  $l = 100 \text{ m}$  (B)  $l = 6.8 \text{ m}$  (C)  $l = 5 \text{ m}$  (D)  $l = 10 \text{ m}$

**Q6** Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwiser.in/questions/MdBeV\\_bEps](https://www.prepwiser.in/questions/MdBeV_bEps)

Electron beam used in an electron microscope, when accelerated by a voltage of  $20 \text{ kV}$ , has a de-Broglie wavelength of  $\lambda_0$ . If the voltage is increased to  $40 \text{ kV}$ , then the de-Broglie wavelength associated with the electron beam would be:

- (A)  $3 \lambda_0$  (B)  $9 \lambda_0$  (C)  $\frac{\lambda_0}{\sqrt{2}}$  (D)  $\frac{\lambda_0}{2}$

**Q7** Electromagnetic Waves

[Step-by-step solution](#) › [prepwiser.in/questions/ZzDFAYB6kt](https://www.prepwiser.in/questions/ZzDFAYB6kt)

An electromagnetic wave is transporting energy in the negative  $z$  direction. At a certain point and certain time the direction of electric field of the wave is along positive  $y$  direction. What will be the direction of the magnetic field of the wave at that point and instant?

- (A) Negative direction of  $y$  (B) Positive direction of  $z$   
(C) Positive direction of  $x$  (D) Negative direction of  $x$

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

Assertion A : Photodiodes are used in forward bias usually for measuring the light intensity.

Reason R : For a p-n junction diode, at applied voltage  $V$  the current in the forward bias is more than the current in the reverse bias for  $|V_z| > \pm v \geq |v_0|$  where  $v_0$  is the threshold voltage and  $V_z$  is the breakdown voltage.

In the 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) 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

## Q9 Gravitation

[Step-by-step solution](https://www.prepwisar.in/questions/i1M6sPHtYi) > prepwisar.in/questions/i1M6sPHtYi

Assume that the earth is a solid sphere of uniform density and a tunnel is dug along its diameter throughout the earth. It is found that when a particle is released in this tunnel, it executes a simple harmonic motion. The mass of the particle is 100 g. The time period of the motion of the particle will be (approximately)

(Take  $g = 10 \text{ m s}^{-2}$ , radius of earth = 6400 km)

- (A) 12 hours
- (B) 1 hour 24 minutes
- (C) 24 hours
- (D) 1 hour 40 minutes

## Q10 Kinetic Theory of Gases

[Step-by-step solution](https://www.prepwisar.in/questions/GYHGdvby4U) > prepwisar.in/questions/GYHGdvby4U

The root mean square velocity of molecules of gas is

- (A) Proportional to temperature ( $T$ )
- (B) Inversely proportional to square root of temperature ( $\sqrt{\frac{1}{T}}$ )
- (C) Proportional to square of temperature ( $T^2$ )
- (D) Proportional to square root of temperature ( $\sqrt{T}$ )

## Q11 Thermodynamics

[Step-by-step solution](https://www.prepwisar.in/questions/IAvmOQep84) > prepwisar.in/questions/IAvmOQep84

A Carnot engine with efficiency 50% takes heat from a source at 600 K. In order to increase the efficiency to 70%, keeping the temperature of sink same, the new temperature of the source will be:

- (A) 300 K
- (B) 1000 K
- (C) 900 K
- (D) 360 K

## Q12 Moving Charges &amp; Magnetism

[Step-by-step solution](https://www.prepwisar.in/questions/d8niRToGrW) > prepwisar.in/questions/d8niRToGrW

A solenoid of 1200 turns is wound uniformly in a single layer on a glass tube 2 m long and 0.2 m in diameter. The magnetic intensity at the center of the solenoid when a current of 2 A flows through it is:

- (A)  $1 \text{ Am}^{-1}$
- (B)  $2.4 \times 10^{-3} \text{ Am}^{-1}$
- (C)  $1.2 \times 10^3 \text{ Am}^{-1}$
- (D)  $2.4 \times 10^3 \text{ Am}^{-1}$

## Q13 Rectilinear Motion

[Step-by-step solution](https://www.prepwisar.in/questions/hnyEXP8N2_) > prepwisar.in/questions/hnyEXP8N2\_

A car travels a distance of ' $x$ ' with speed  $v_1$  and then same distance ' $x$ ' with speed  $v_2$  in the same direction. The average speed of the car is:

- (A)  $\frac{v_1 v_2}{2(v_1 + v_2)}$
- (B)  $\frac{2v_1 v_2}{v_1 + v_2}$
- (C)  $\frac{2x}{v_1 + v_2}$
- (D)  $\frac{v_1 + v_2}{2}$

Match List I with List II

|    | List I          |      | List II                        |
|----|-----------------|------|--------------------------------|
| A. | Surface tension | I.   | $\text{kgm}^{-1}\text{s}^{-1}$ |
| B. | Pressure        | II.  | $\text{kgms}^{-1}$             |
| C. | Viscosity       | III. | $\text{kgm}^{-1}\text{s}^{-2}$ |
| D. | Impulse         | IV.  | $\text{kgs}^{-2}$              |

Choose the correct answer from the options given below:

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

## Q15 Heat Transfer

[Step-by-step solution](https://www.prepwise.in/questions/VUCB5K0HZs) > prepwise.in/questions/VUCB5K0HZs

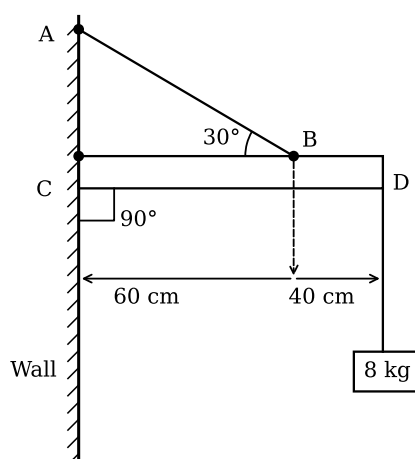
A bowl filled with very hot soup cools from  $98^\circ\text{C}$  to  $86^\circ\text{C}$  in 2 minutes when the room temperature is  $22^\circ\text{C}$ . How long it will take to cool from  $75^\circ\text{C}$  to  $69^\circ\text{C}$ ?

- (A) 2 minutes      (B) 0.5 minute      (C) 1.4 minutes      (D) 1 minute

## Q16 Rotational Motion

[Step-by-step solution](https://www.prepwise.in/questions/5ANRg0unIV) > prepwise.in/questions/5ANRg0unIV

An object of mass 8 kg is hanging from one end of a uniform rod CD of mass 2 kg and length 1 m pivoted at its end C on a vertical wall as shown in figure. It is supported by a cable AB such that the system is in equilibrium. The tension in the cable is (Take  $g = 10 \text{ m/s}^2$ )



- (A) 90 N      (B) 240 N      (C) 30 N      (D) 300 N

## Q17 Gravitation

[Step-by-step solution](https://www.prepwise.in/questions/G6Yg3c0i1u) > prepwise.in/questions/G6Yg3c0i1u

T is the time period of simple pendulum on the earth's surface. Its time period becomes  $xT$  when taken to a height R (equal to earth's radius) above the earth's surface. Then, the value of  $x$  will be:

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

## Q18 Wave Optics

[Step-by-step solution](https://www.prepwise.in/questions/RyRtwagz_B) > prepwise.in/questions/RyRtwagz\_B

In Young's double slits experiment, the position of 5<sup>th</sup> bright fringe from the central maximum is 5 cm. The distance between slits and screen is 1 m and wavelength of used monochromatic light is 600 nm. The separation between the slits is:

- (A)  $60 \mu\text{m}$       (B)  $48 \mu\text{m}$       (C)  $36 \mu\text{m}$       (D)  $12 \mu\text{m}$

**Q19** Alternating Current **NUMERICAL**

[Step-by-step solution](#) > [prepwisar.in/questions/Kc91p98Fso](http://prepwisar.in/questions/Kc91p98Fso)

An LCR series circuit of capacitance  $62.5 \text{ nF}$  and resistance of  $50 \Omega$ , is connected to an A.C. source of frequency  $2.0 \text{ kHz}$ . For maximum value of amplitude of current in circuit, the value of inductance is \_\_\_\_\_  $\text{mH}$ .

(Take  $\pi^2 = 10$ )

**Q20** Atomic Physics **NUMERICAL**

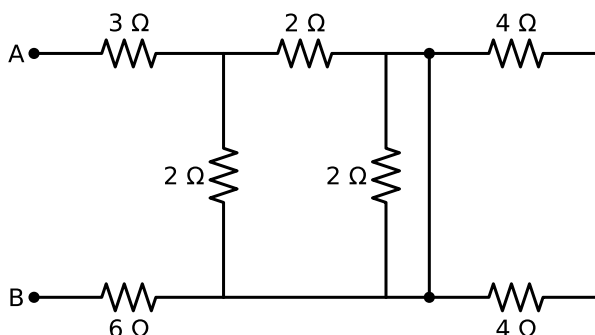
[Step-by-step solution](#) > [prepwisar.in/questions/LJkI-kfH5U](http://prepwisar.in/questions/LJkI-kfH5U)

The wavelength of the radiation emitted is  $\lambda_0$  when an electron jumps from the second excited state to the first excited state of hydrogen atom. If the electron jumps from the third excited state to the second orbit of the hydrogen atom, the wavelength of the radiation emitted will  $\frac{20}{x} \lambda_0$ . The value of  $x$  is \_\_\_\_\_.

**Q21** Current Electricity **NUMERICAL**

[Step-by-step solution](#) > [prepwisar.in/questions/2U-AOI-sFP](http://prepwisar.in/questions/2U-AOI-sFP)

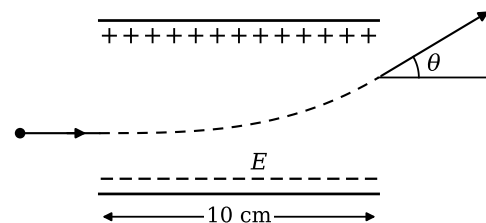
In the given circuit, the equivalent resistance between the terminal A and B is \_\_\_\_\_  $\Omega$ .



**Q22** Electrostatics I: Charges, Field & Gauss's Law **NUMERICAL**

[Step-by-step solution](#) > [prepwisar.in/questions/fmVa\\_ectO1](http://prepwisar.in/questions/fmVa_ectO1)

A uniform electric field of  $10 \text{ N/C}$  is created between two parallel charged plates (as shown in figure). An electron enters the field symmetrically between the plates with a kinetic energy  $0.5 \text{ eV}$ . The length of each plate is  $10 \text{ cm}$ . The angle ( $\theta$ ) of deviation of the path of electron as it comes out of the field is \_\_\_\_\_ (in degree).



**Q23** Ray Optics **NUMERICAL**

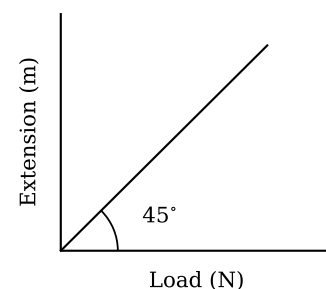
[Step-by-step solution](#) > [prepwisar.in/questions/-F2IaF9geR](http://prepwisar.in/questions/-F2IaF9geR)

A ray of light is incident from air on a glass plate having thickness  $\sqrt{3} \text{ cm}$  and refractive index  $\sqrt{2}$ . The angle of incidence of a ray is equal to the critical angle for glass-air interface. The lateral displacement of the ray when it passes through the plate is \_\_\_\_\_  $\times 10^{-2} \text{ cm}$ . (given  $\sin 15^\circ = 0.26$ )

**Q24** Elasticity **NUMERICAL**

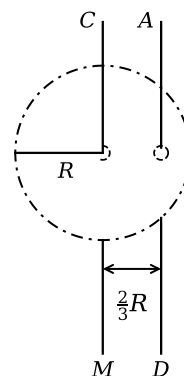
[Step-by-step solution](#) > [prepwisar.in/questions/rBCDWG1GW8](http://prepwisar.in/questions/rBCDWG1GW8)

As shown in the figure, in an experiment to determine Young's modulus of a wire, the extension-load curve is plotted. The curve is a straight line passing through the origin and makes an angle of  $45^\circ$  with the load axis. The length of wire is  $62.8 \text{ cm}$  and its diameter is  $4 \text{ mm}$ . The Young's modulus is found to be  $x \times 10^4 \text{ Nm}^{-2}$ . The value of  $x$  is \_\_\_\_\_.



**Q25** Rotational Motion **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/DCk52ou09S) > prepwiser.in/questions/DCk52ou09S

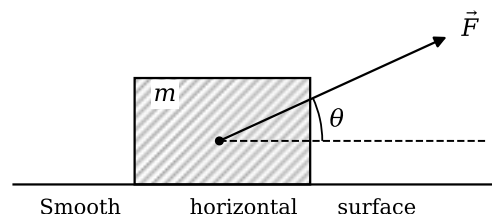
$I_{CM}$  is the moment of inertia of a circular disc about an axis (CM) passing through its center and perpendicular to the plane of disc.  $I_{AB}$  is its moment of inertia about an axis AB perpendicular to plane and parallel to axis CM at a distance  $\frac{2}{3}R$  from center. Where  $R$  is the radius of the disc. The ratio of  $I_{AB}$  and  $I_{CM}$  is  $x : 9$ . The value of  $x$  is \_\_\_\_\_.

**Q26** Mechanical Waves **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/uDa7PLOhhF) > prepwiser.in/questions/uDa7PLOhhF

The distance between two consecutive points with phase difference of  $60^\circ$  in a wave of frequency 500 Hz is 6.0 m. The velocity with which wave is travelling is \_\_\_\_\_ km/s

**Q27** Work, Energy & Power **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/BaBvlllewT) > prepwiser.in/questions/BaBvlllewT

An object of mass 'm' initially at rest on a smooth horizontal plane starts moving under the action of force  $F = 2N$ . In the process of its linear motion, the angle  $\theta$  (as shown in figure) between the direction of force and horizontal varies as  $\theta = kx$ , where  $k$  is a constant and  $x$  is the distance covered by the object from its initial position. The expression of kinetic energy of the object will be  $E = \frac{n}{k} \sin \theta$ . The value of  $n$  is \_\_\_\_\_.

**Q28** Vectors **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/2NZdexBgHP) > prepwiser.in/questions/2NZdexBgHP

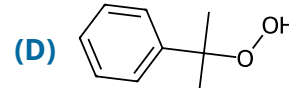
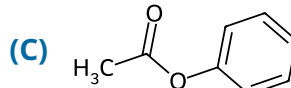
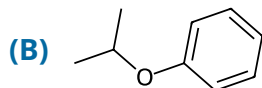
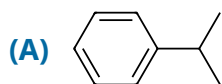
If  $\vec{P} = 3\hat{i} + \sqrt{3}\hat{j} + 2\hat{k}$  and  $\vec{Q} = 4\hat{i} + \sqrt{3}\hat{j} + 2.5\hat{k}$  then, the unit vector in the direction of  $\vec{P} \times \vec{Q}$  is  $\frac{1}{x} (\sqrt{3}\hat{i} + \hat{j} - 2\sqrt{3}\hat{k})$ . The value of  $x$  is \_\_\_\_\_.

**Chemistry** Section A · Multiple choice

Q29 to Q45

**Q29** Alcohols, Phenols & Ethers[Step-by-step solution](https://www.prepwiser.in/questions/uOrXU_lyp) > prepwiser.in/questions/uOrXU\_lyp

In the cumene to phenol preparation in presence of air, the intermediate is



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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 : Acetal / Ketal is stable in basic medium.

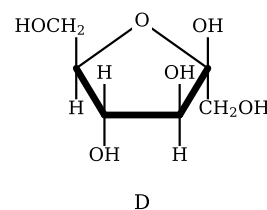
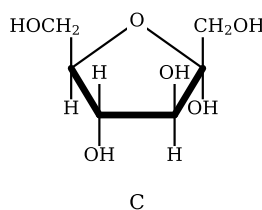
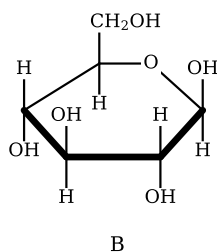
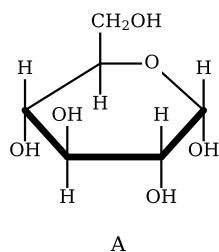
Reason R : The high leaving tendency of alkoxide ion gives the stability to acetal/ketal in basic medium.

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.

Match items of Row I with those of Row II.

Row I:



Row II:

- (i)  $\alpha$ -D-(–)-Fructofuranose  
 (ii)  $\beta$ -D-(–)-Fructofuranose  
 (iii)  $\alpha$ -D-(–) Glucopyranose  
 (iv)  $\beta$ -D-(–)-Glucopyranose

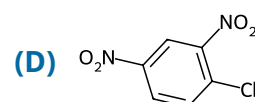
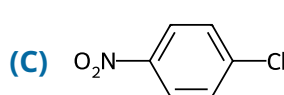
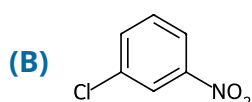
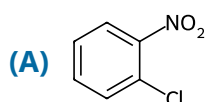
Correct match is

- (A) A  $\rightarrow$  iii, B  $\rightarrow$  iv, C  $\rightarrow$  i, D  $\rightarrow$  ii  
 (B) A  $\rightarrow$  iv, B  $\rightarrow$  iii, C  $\rightarrow$  i, D  $\rightarrow$  ii  
 (C) A  $\rightarrow$  i, B  $\rightarrow$  ii, C  $\rightarrow$  iii, D  $\rightarrow$  iv  
 (D) A  $\rightarrow$  iii, B  $\rightarrow$  iv, C  $\rightarrow$  ii, D  $\rightarrow$  i

Which of the following statements is incorrect for antibiotics?

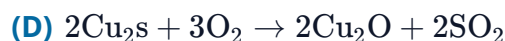
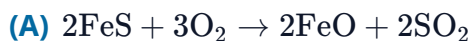
- (A) An antibiotic should promote the growth or survival of microorganisms.  
 (B) An antibiotic must be a product of metabolism.  
 (C) An antibiotic should be effective in low concentrations.  
 (D) An antibiotic is a synthetic substance produced as a structural analogue of naturally occurring antibiotic.

The compound which will have the lowest rate towards nucleophilic aromatic substitution on treatment with  $\text{OH}^-$  is



**Q34** Metallurgy[Step-by-step solution](https://www.prepwiser.in/questions/p8U4DnBUxB)

Which one of the following reactions does not occur during extraction of copper?

**Q35** p-Block Elements: Part II (Group 15-18)[Step-by-step solution](https://www.prepwiser.in/questions/d7J_cLOgbV)

Reaction of thionyl chloride with white phosphorus forms a compound [A], which on hydrolysis gives [B], a dibasic acid. [A] and [B] are respectively:

**Q36** Hydrogen & s-Block Elements[Step-by-step solution](https://www.prepwiser.in/questions/ee4sHuuJlI)

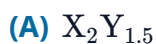
Compound A reacts with  $\text{NH}_4\text{Cl}$  and forms a compound B. Compound B reacts with  $\text{H}_2\text{O}$  and excess of  $\text{CO}_2$  to form compound C which on passing through or reaction with saturated  $\text{NaCl}$  solution forms sodium hydrogen carbonate. Compound A, B and C, are respectively:

**Q37** p-Block Elements: Part II (Group 15-18)[Step-by-step solution](https://www.prepwiser.in/questions/NfHpEiW7hB)

Inert gases have positive electron gain enthalpy. Its correct order is:

**Q38** Solid State[Step-by-step solution](https://www.prepwiser.in/questions/Fhf1Za2749)

A cubic solid is made up of two elements X and Y. Atoms of X are present on every alternate corner and one at the center of cube. Y is at  $\frac{1}{3}$  of the total faces. The empirical formula of the compound is:

**Q39** Hydrogen & s-Block Elements[Step-by-step solution](https://www.prepwiser.in/questions/GFHCSe5y6V)

'25 volume' hydrogen peroxide means

**Q40** Atomic Structure[Step-by-step solution](https://www.prepwiser.in/questions/4AU-JNft0B)

The radius of the 2<sup>nd</sup> orbit of  $\text{Li}^{2+}$  is  $x$ . The expected radius of the 3<sup>rd</sup> orbit of  $\text{Be}^{3+}$  is

**(A)**  $\frac{16}{27}x$

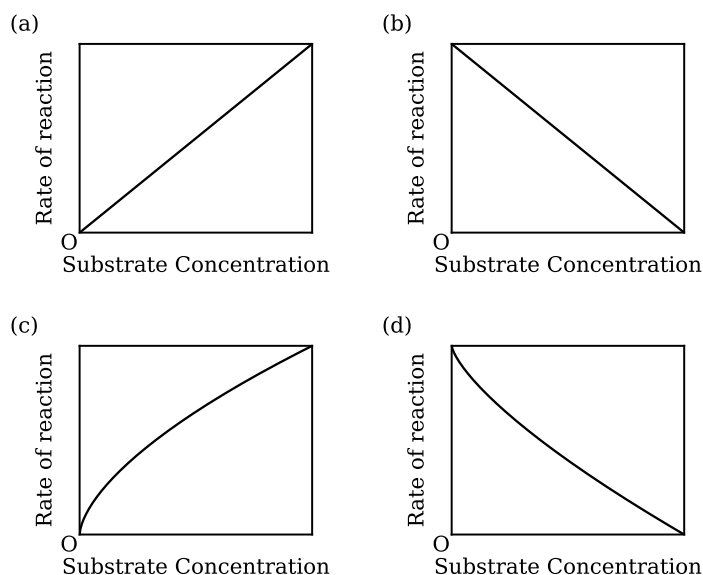
**(B)**  $\frac{4}{9}x$

**(C)**  $\frac{9}{4}x$

**(D)**  $\frac{27}{16}x$

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The variation of the rate of an enzyme catalyzed reaction with substrate concentration is correctly represented by graph:



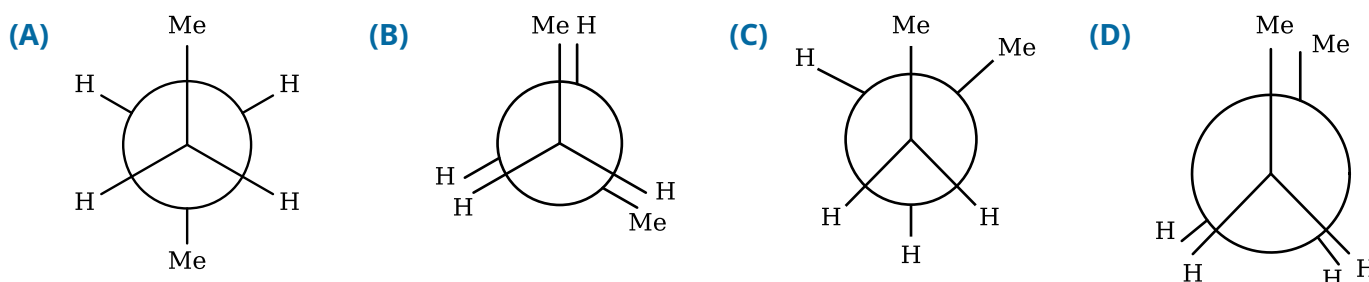
(A) (a)

(B) (b)

(C) (d)

(D) (c)

Which of the following conformations will be the most stable?



The correct order in aqueous medium of basic strength in case of methyl substituted amines is:

(A)  $\text{NH}_3 > \text{Me}_3\text{N} > \text{MeNH}_2 > \text{Me}_2\text{NH}$ (B)  $\text{Me}_3\text{N} > \text{Me}_2\text{NH} > \text{MeNH}_2 > \text{NH}_3$ (C)  $\text{Me}_2\text{NH} > \text{MeNH}_2 > \text{Me}_3\text{N} > \text{NH}_3$ (D)  $\text{Me}_2\text{NH} > \text{Me}_3\text{N} > \text{MeNH}_2 > \text{NH}_3$ 

Match List I with List II

| List I<br>Elements |    | List II<br>Colour imparted to the flame |             |
|--------------------|----|-----------------------------------------|-------------|
| A.                 | K  | I.                                      | Brick Red   |
| B.                 | Ca | II.                                     | Violet      |
| C.                 | Sr | III.                                    | Apple Green |
| D.                 | Ba | IV.                                     | Crimson Red |

Choose the correct answer from the options given below:

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

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

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

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

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Match the List-I with List-II:

|    | List-I<br>Cations                |      | List-II<br>Group reagents                                          |
|----|----------------------------------|------|--------------------------------------------------------------------|
| A. | $\text{Pb}^{2+}, \text{Cu}^{2+}$ | i)   | $\text{H}_2\text{S}$ gas in presence of dilute HCl                 |
| B. | $\text{Al}^{3+}, \text{Fe}^{3+}$ | ii)  | $(\text{NH}_4)_2\text{CO}_3$ in presence of $\text{NH}_4\text{OH}$ |
| C. | $\text{Co}^{2+}, \text{Ni}^{2+}$ | iii) | $\text{NH}_4\text{OH}$ in presence of $\text{NH}_4\text{Cl}$       |
| D. | $\text{Ba}^{2+}, \text{Ca}^{2+}$ | iv)  | $\text{H}_2\text{S}$ in presence of $\text{NH}_4\text{OH}$         |

Correct match is -

(A)  $A \rightarrow i, B \rightarrow \text{iii}, C \rightarrow \text{iv}, D \rightarrow \text{ii}$ (B)  $A \rightarrow i, B \rightarrow \text{iii}, C \rightarrow \text{ii}, D \rightarrow \text{iv}$ (C)  $A \rightarrow \text{iii}, B \rightarrow i, C \rightarrow \text{iv}, D \rightarrow \text{ii}$ (D)  $A \rightarrow \text{iv}, B \rightarrow \text{ii}, C \rightarrow \text{iii}, D \rightarrow i$ **Chemistry** Section B · Numerical value

Q46 to Q55

**Q46** Chemical Bonding & Molecular Structure **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/StHJ_MbW_e) > prepwisar.in/questions/StHJ\_MbW\_e

The total number of lone pairs of electrons on oxygen atoms of ozone is \_\_\_\_\_.

**Q47** Chemical Kinetics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/Wijo8-QRU2) > prepwisar.in/questions/Wijo8-QRU2For the first order reaction  $A \rightarrow B$ , the half life is 30 min. The time taken for 75% completion of the reaction is \_\_\_\_\_ min. (Nearest integer)Given :  $\log 2 = 0.3010$  $\log 3 = 0.4771$  $\log 5 = 0.6989$ **Q48** Coordination Compounds **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/HDAaJ_zYKL) > prepwisar.in/questions/HDAaJ\_zYKL

The number of paramagnetic species from the following is \_\_\_\_\_.

 $[\text{Ni}(\text{CN})_4]^{2-}, [\text{Ni}(\text{CO})_4], [\text{NiCl}_4]^{2-}$  $[\text{Fe}(\text{CN})_6]^{4-}, [\text{Cu}(\text{NH}_3)_4]^{2+}$  $[\text{Fe}(\text{CN})_6]^{3-}$  and  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ **Q49** d & f Block Elements **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/8eKWvKq9g) > prepwisar.in/questions/8eKWvKq9g

How many of the following metal ions have similar value of spin only magnetic moment in gaseous state? \_\_\_\_\_

(Given : Atomic number V, 23; Cr, 24; Fe, 26; Ni, 28)

 $\text{V}^{3+}, \text{Cr}^{3+}, \text{Fe}^{2+}, \text{Ni}^{3+}$ **Q50** Electrochemistry **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/mprBZ7G0Tt) > prepwisar.in/questions/mprBZ7G0Tt

Consider the cell

Given  $E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^{\circ} = 0.771 \text{ V}$  and  $E_{\text{H}^+/1/2\text{H}_2}^{\circ} = 0 \text{ V}$ ,  $T = 298 \text{ K}$ If the potential of the cell is 0.712 V, the ratio of concentration of  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$  is \_\_\_\_\_ (Nearest integer)Attempt this paper online with instant answer checking > [prepwisar.in/pyqs/paper/2023-01-25-morning](https://www.prepwisar.in/pyqs/paper/2023-01-25-morning)

**Q51** Ionic Equilibrium **NUMERICAL**[Step-by-step solution](#) > [prepwise.in/questions/w52WWo2LNK](https://www.prepwise.in/questions/w52WWo2LNK)

A litre of buffer solution contains 0.1 mole of each of  $\text{NH}_3$  and  $\text{NH}_4\text{Cl}$ . On the addition of 0.02 mole of  $\text{HCl}$  by dissolving gaseous  $\text{HCl}$ , the pH of the solution is found to be \_\_\_\_\_  $\times 10^{-3}$  (Nearest integer)

[Given:  $\text{pK}_b(\text{NH}_3) = 4.745$

$\log 2 = 0.301$

$\log 3 = 0.477$

$T = 298\text{K}$ ]

**Q52** Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](#) > [prepwise.in/questions/2FXhorDCBq](https://www.prepwise.in/questions/2FXhorDCBq)

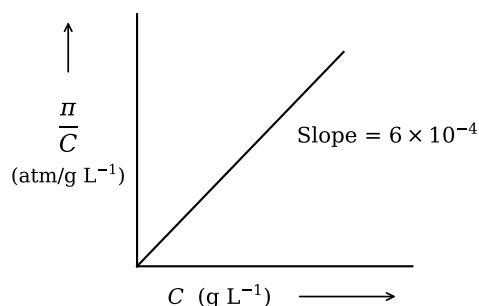
The density of a monobasic strong acid (Molar mass  $24.2\text{ g/mol}$ ) is  $1.21\text{ kg/L}$ . The volume of its solution required for the complete neutralization of  $25\text{ mL}$  of  $0.24\text{ M NaOH}$  is \_\_\_\_\_  $\times 10^{-2}\text{ mL}$  (Nearest integer)

**Q53** Solutions & Colligative Properties **NUMERICAL**[Step-by-step solution](#) > [prepwise.in/questions/Qo6K46vJb4](https://www.prepwise.in/questions/Qo6K46vJb4)

The osmotic pressure of solutions of PVC in cyclohexanone at  $300\text{ K}$  are plotted on the graph.

The molar mass of PVC is \_\_\_\_\_  $\text{g mol}^{-1}$  (Nearest integer)

(Given :  $R = 0.083\text{ L atm K}^{-1}\text{ mol}^{-1}$ )

**Q54** Purification & Characterisation of Organic Compounds **NUMERICAL**[Step-by-step solution](#) > [prepwise.in/questions/xh68L5sWQn](https://www.prepwise.in/questions/xh68L5sWQn)

In sulphur estimation,  $0.471\text{ g}$  of an organic compound gave  $1.4439\text{ g}$  of barium sulphate. The percentage of sulphur in the compound is \_\_\_\_\_ (Nearest Integer)

(Given : Atomic mass Ba:  $137\text{ u}$ , S:  $32\text{ u}$ , O:  $16\text{ u}$ )

**Q55** Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](#) > [prepwise.in/questions/tfEmFXANDM](https://www.prepwise.in/questions/tfEmFXANDM)

An athlete is given  $100\text{ g}$  of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) for energy. This is equivalent to  $1800\text{ kJ}$  of energy. The 50% of this energy gained is utilized by the athlete for sports activities at the event. In order to avoid storage of energy, the weight of extra water he would need to perspire is \_\_\_\_\_  $\text{g}$  (Nearest integer)

Assume that there is no other way of consuming stored energy.

Given : The enthalpy of evaporation of water is  $45\text{ kJ mol}^{-1}$

Molar mass of C, H & O are  $12$ ,  $1$  and  $16\text{ g mol}^{-1}$ .

**Mathematics Section A · Multiple choice**

Q56 to Q74

**Q56** Three Dimensional Geometry[Step-by-step solution](#) > [prepwise.in/questions/mz5GaZ0pvC](https://www.prepwise.in/questions/mz5GaZ0pvC)

The distance of the point  $P(4, 6, -2)$  from the line passing through the point  $(-3, 2, 3)$  and parallel to a line with direction ratios  $3, 3, -1$  is equal to:

**(A)** 3**(B)**  $\sqrt{14}$ **(C)**  $\sqrt{6}$ **(D)**  $2\sqrt{3}$

Consider the lines  $L_1$  and  $L_2$  given by

$$L_1 : \frac{x-1}{2} = \frac{y-3}{1} = \frac{z-2}{2}$$

$$L_2 : \frac{x-2}{1} = \frac{y-2}{2} = \frac{z-3}{3}.$$

A line  $L_3$  having direction ratios  $1, -1, -2$ , intersects  $L_1$  and  $L_2$  at the points  $P$  and  $Q$  respectively. Then the length of line segment  $PQ$  is

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

Let  $x = 2$  be a local minima of the function  $f(x) = 2x^4 - 18x^2 + 8x + 12$ ,  $x \in (-4, 4)$ . If  $M$  is local maximum value of the function  $f$  in  $(-4, 4)$ , then  $M =$

- (A)  $18\sqrt{6} - \frac{33}{2}$  (B)  $18\sqrt{6} - \frac{31}{2}$  (C)  $12\sqrt{6} - \frac{33}{2}$  (D)  $12\sqrt{6} - \frac{31}{2}$

Let  $f : (0, 1) \rightarrow \mathbb{R}$  be a function defined  $f(x) = \frac{1}{1-e^{-x}}$ , and  $g(x) = (f(-x) - f(x))$ . Consider two statements

(I)  $g$  is an increasing function in  $(0, 1)$

(II)  $g$  is one-one in  $(0, 1)$

Then,

- (A) Both (I) and (II) are true (B) Neither (I) nor (II) is true  
(C) Only (II) is true (D) Only (I) is true

If  $a_r$  is the coefficient of  $x^{10-r}$  in the Binomial expansion of  $(1+x)^{10}$ , then

$$\sum_{r=1}^{10} r^3 \left( \frac{a_r}{a_{r-1}} \right)^2$$

is equal to

- (A) 3025 (B) 4895 (C) 5445 (D) 1210

The points of intersection of the line  $ax + by = 0$ , ( $a \neq b$ ) and the circle  $x^2 + y^2 - 2x = 0$  are  $A(\alpha, 0)$  and  $B(1, \beta)$ . The image of the circle with  $AB$  as a diameter in the line  $x + y + 2 = 0$  is:

- (A)  $x^2 + y^2 + 5x + 5y + 12 = 0$  (B)  $x^2 + y^2 + 3x + 5y + 8 = 0$   
(C)  $x^2 + y^2 - 5x - 5y + 12 = 0$  (D)  $x^2 + y^2 + 3x + 3y + 4 = 0$

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**Q62** Complex Numbers[Step-by-step solution](https://www.prepwiser.in/questions/8mpku_jYSn) > prepwiser.in/questions/8mpku\_jYSn

Let  $z_1 = 2 + 3i$  and  $z_2 = 3 + 4i$ . The set

$$S = \left\{ z \in \mathbb{C} : |z - z_1|^2 - |z - z_2|^2 = |z_1 - z_2|^2 \right\}$$

represents a

- (A) hyperbola with the length of the transverse axis 7  
 (B) hyperbola with eccentricity 2  
 (C) straight line with the sum of its intercepts on the coordinate axes equals  $-18$   
 (D) straight line with the sum of its intercepts on the coordinate axes equals 14

**Q63** Definite Integration[Step-by-step solution](https://www.prepwiser.in/questions/GgNPcLa8z7) > prepwiser.in/questions/GgNPcLa8z7

The minimum value of the function  $f(x) = \int_0^2 e^{|x-t|} dt$  is:

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

**Q64** Differential Equations[Step-by-step solution](https://www.prepwiser.in/questions/B15izBBMbx) > prepwiser.in/questions/B15izBBMbx

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

$$\frac{dy}{dx} = \frac{y}{x} (1 + xy^2(1 + \log_e x)), x > 0, y(1) = 3$$

. Then  $\frac{y^2(x)}{9}$  is equal to:

- (A)  $\frac{x^2}{5 - 2x^3(2 + \log_e x^3)}$  (B)  $\frac{x^2}{3x^3(1 + \log_e x^2) - 2}$   
 (C)  $\frac{x^2}{7 - 3x^3(2 + \log_e x^2)}$  (D)  $\frac{x^2}{2x^3(2 + \log_e x^3) - 3}$

**Q65** Differentiation[Step-by-step solution](https://www.prepwiser.in/questions/7Posb3vQ7B) > prepwiser.in/questions/7Posb3vQ7B

Let  $y(x) = (1 + x)(1 + x^2)(1 + x^4)(1 + x^8)(1 + x^{16})$ . Then  $y' - y''$  at  $x = -1$  is equal to

- (A) 496 (B) 976 (C) 464 (D) 944

**Q66** Limits[Step-by-step solution](https://www.prepwiser.in/questions/Sq8wLRV6T8) > prepwiser.in/questions/Sq8wLRV6T8

The value of

$$\lim_{n \rightarrow \infty} \frac{1 + 2 - 3 + 4 + 5 - 6 + \dots + (3n - 2) + (3n - 1) - 3n}{\sqrt{2n^4 + 4n + 3} - \sqrt{n^4 + 5n + 4}}$$

is:

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

**Q67** Determinants[Step-by-step solution](https://www.prepwiser.in/questions/ecINZnfpSd) > prepwiser.in/questions/ecINZnfpSd

Let  $x, y, z > 1$  and

$$A = \begin{bmatrix} 1 & \log_x y & \log_x z \\ \log_y x & 2 & \log_y z \\ \log_z x & \log_z y & 3 \end{bmatrix}$$

. Then  $|\text{adj}(\text{adj} A^2)|$  is equal to

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

**Q68** Determinants[Step-by-step solution](https://www.prepwiser.in/questions/ZV3V44GRd7) › prepwiser.in/questions/ZV3V44GRd7

Let  $S_1$  and  $S_2$  be respectively the sets of all  $a \in \mathbb{R} - \{0\}$  for which the system of linear equations

$$ax + 2ay - 3az = 1$$

$$(2a + 1)x + (2a + 3)y + (a + 1)z = 2$$

$$(3a + 5)x + (a + 5)y + (a + 2)z = 3$$

has unique solution and infinitely many solutions. Then

(A)  $n(S_1) = 2$  and  $S_2$  is an infinite set

(B)  $S_1 = \Phi$  and  $S_2 = \mathbb{R} - \{0\}$

(C)  $S_1 = \mathbb{R} - \{0\}$  and  $S_2 = \Phi$

(D)  $S_1$  is an infinite set and  $n(S_2) = 2$

**Q69** Parabola[Step-by-step solution](https://www.prepwiser.in/questions/K6Sw0dfYhx) › prepwiser.in/questions/K6Sw0dfYhx

The distance of the point  $(6, -2\sqrt{2})$  from the common tangent  $y = mx + c$ ,  $m > 0$ , of the curves  $x = 2y^2$  and  $x = 1 + y^2$  is:

(A)  $\frac{1}{3}$

(B) 5

(C)  $\frac{14}{3}$

(D)  $5\sqrt{3}$

**Q70** Probability: Basic[Step-by-step solution](https://www.prepwiser.in/questions/OMsDEW8WxV) › prepwiser.in/questions/OMsDEW8WxV

Let  $M$  be the maximum value of the product of two positive integers when their sum is 66. Let the sample space  $S = \{x \in \mathbb{Z} : x(66 - x) \geq \frac{5}{9}M\}$  and the event  $A = \{x \in S : x \text{ is a multiple of } 3\}$ . Then  $P(A)$  is equal to:

(A)  $\frac{1}{3}$

(B)  $\frac{1}{5}$

(C)  $\frac{7}{22}$

(D)  $\frac{15}{44}$

**Q71** Statistics[Step-by-step solution](https://www.prepwiser.in/questions/zfzkM1xNRB) › prepwiser.in/questions/zfzkM1xNRB

The mean and variance of the marks obtained by the students in a test are 10 and 4 respectively. Later, the marks of one of the students is increased from 8 to 12. If the new mean of the marks is 10.2, then their new variance is equal to:

(A) 3.92

(B) 4.08

(C) 3.96

(D) 4.04

**Q72** Vectors[Step-by-step solution](https://www.prepwiser.in/questions/pDJiUU0aql) › prepwiser.in/questions/pDJiUU0aql

The vector  $\vec{a} = -\hat{i} + 2\hat{j} + \hat{k}$  is rotated through a right angle, passing through the y-axis in its way and the resulting vector is  $\vec{b}$ . Then the projection of  $3\vec{a} + \sqrt{2}\vec{b}$  on  $\vec{c} = 5\hat{i} + 4\hat{j} + 3\hat{k}$  is:

(A)  $\sqrt{6}$

(B)  $2\sqrt{3}$

(C) 1

(D)  $3\sqrt{2}$

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**Q73** Vectors[Step-by-step solution](#) › [prepwise.in/questions/Zdcj9yrujr](#)

Let  $\vec{a}$ ,  $\vec{b}$  and  $\vec{c}$  be three non zero vectors such that  $\vec{b} \cdot \vec{c} = 0$  and

$$\vec{a} \times (\vec{b} \times \vec{c}) = \frac{\vec{b} - \vec{c}}{2}$$

. If  $\vec{d}$  be a vector such that

$$\vec{b} \cdot \vec{d} = \vec{a} \cdot \vec{b}$$

, then

$$(\vec{a} \times \vec{b}) \cdot (\vec{c} \times \vec{d})$$

is equal to

**(A)**  $\frac{1}{2}$

**(B)**  $-\frac{1}{4}$

**(C)**  $\frac{1}{4}$

**(D)**  $\frac{3}{4}$

**Q74** Indefinite Integration[Step-by-step solution](#) › [prepwise.in/questions/OMSjMn6W4O](#)

Let  $f(x) = \int \frac{2x}{(x^2+1)(x^2+3)} dx$ . If  $f(3) = \frac{1}{2}(\log_e 5 - \log_e 6)$ , then  $f(4)$  is equal to

**(A)**  $\log_e 19 - \log_e 20$

**(B)**  $\log_e 17 - \log_e 18$

**(C)**  $\frac{1}{2}(\log_e 19 - \log_e 17)$

**(D)**  $\frac{1}{2}(\log_e 17 - \log_e 19)$

**Mathematics Section B · Numerical value**

Q75 to Q83

**Q75** Three Dimensional Geometry**NUMERICAL**[Step-by-step solution](#) › [prepwise.in/questions/qVHBd9NHod](#)

Let the equation of the plane passing through the line  $x - 2y - z - 5 = 0 = x + y + 3z - 5$  and parallel to the line  $x + y + 2z - 7 = 0 = 2x + 3y + z - 2$  be  $ax + by + cz = 65$ . Then the distance of the point  $(a, b, c)$  from the plane  $2x + 2y - z + 16 = 0$  is \_\_\_\_\_.

**Q76** Binomial Theorem**NUMERICAL**[Step-by-step solution](#) › [prepwise.in/questions/U-tQEC5v\\_Q](#)

The constant term in the expansion of  $(2x + \frac{1}{x^7} + 3x^2)^5$  is \_\_\_\_\_.

**Q77** Relations & Functions (Basic)**NUMERICAL**[Step-by-step solution](#) › [prepwise.in/questions/9i37KNdull](#)

For some  $a, b, c \in \mathbb{N}$ , let  $f(x) = ax - 3$  and  $g(x) = x^b + c, x \in \mathbb{R}$ . If  $(f \circ g)^{-1}(x) = (\frac{x-7}{2})^{1/3}$ , then  $(f \circ g)(ac) + (g \circ f)(b)$  is equal to \_\_\_\_\_.

**Q78** Hyperbola**NUMERICAL**[Step-by-step solution](#) › [prepwise.in/questions/droYaGwO5c](#)

The vertices of a hyperbola  $H$  are  $(\pm 6, 0)$  and its eccentricity is  $\frac{\sqrt{5}}{2}$ . Let  $N$  be the normal to  $H$  at a point in the first quadrant and parallel to the line  $\sqrt{2}x + y = 2\sqrt{2}$ . If  $d$  is the length of the line segment of  $N$  between  $H$  and the  $y$ -axis then  $d^2$  is equal to \_\_\_\_\_.

**Q79** Inverse Trigonometric Functions**NUMERICAL**[Step-by-step solution](#) › [prepwise.in/questions/LA0fIe9DFF](#)

If the sum of all the solutions of

$$\tan^{-1} \left( \frac{2x}{1-x^2} \right) + \cot^{-1} \left( \frac{1-x^2}{2x} \right) = \frac{\pi}{3}, -1 < x < 1, x \neq 0$$

, is  $\alpha - \frac{4}{\sqrt{3}}$ , then  $\alpha$  is equal to \_\_\_\_\_.

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Let  $A_1, A_2, A_3$  be the three A.P. with the same common difference  $d$  and having their first terms as  $A, A + 1, A + 2$ , respectively. Let  $a, b, c$  be the  $7^{\text{th}}, 9^{\text{th}}, 17^{\text{th}}$  terms of  $A_1, A_2, A_3$ , respectively such that

$$\begin{vmatrix} a & 7 & 1 \\ 2b & 17 & 1 \\ c & 17 & 1 \end{vmatrix} + 70 = 0$$

If  $a = 29$ , then the sum of first 20 terms of an AP whose first term is  $c - a - b$  and common difference is  $\frac{d}{12}$ , is equal to \_\_\_\_\_.

Let  $x$  and  $y$  be distinct integers where  $1 \leq x \leq 25$  and  $1 \leq y \leq 25$ . Then, the number of ways of choosing  $x$  and  $y$ , such that  $x + y$  is divisible by 5, is \_\_\_\_\_.

Let  $S = \{1, 2, 3, 5, 7, 10, 11\}$ . The number of non-empty subsets of  $S$  that have the sum of all elements a multiple of 3, is \_\_\_\_\_.

If the area enclosed by the parabolas  $P_1 : 2y = 5x^2$  and  $P_2 : x^2 - y + 6 = 0$  is equal to the area enclosed by  $P_1$  and  $y = \alpha x, \alpha > 0$ , then  $\alpha^3$  is equal to \_\_\_\_\_.

# Answer key: JEE Main 2023 · 25 Jan · Shift 1

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## Physics

|               |               |                |               |               |               |               |              |
|---------------|---------------|----------------|---------------|---------------|---------------|---------------|--------------|
| 1. <b>A</b>   | 2. <b>B</b>   | 3. <b>D</b>    | 4. <b>C</b>   | 5. <b>D</b>   | 6. <b>C</b>   | 7. <b>C</b>   | 8. <b>D</b>  |
| 9. <b>B</b>   | 10. <b>D</b>  | 11. <b>B</b>   | 12. <b>C</b>  | 13. <b>B</b>  | 14. <b>A</b>  | 15. <b>C</b>  | 16. <b>D</b> |
| 17. <b>C</b>  | 18. <b>A</b>  | 19. <b>100</b> | 20. <b>27</b> | 21. <b>10</b> | 22. <b>45</b> | 23. <b>52</b> | 24. <b>5</b> |
| 25. <b>17</b> | 26. <b>18</b> | 27. <b>2</b>   | 28. <b>4</b>  |               |               |               |              |

## Chemistry

|                  |               |                |              |              |               |                 |               |
|------------------|---------------|----------------|--------------|--------------|---------------|-----------------|---------------|
| 29. <b>D</b>     | 30. <b>D</b>  | 31. <b>A</b>   | 32. <b>A</b> | 33. <b>B</b> | 34. <b>C</b>  | 35. <b>D</b>    | 36. <b>D</b>  |
| 37. <b>B</b>     | 38. <b>B</b>  | 39. <b>A</b>   | 40. <b>D</b> | 41. <b>D</b> | 42. <b>A</b>  | 43. <b>C</b>    | 44. <b>B</b>  |
| 45. <b>A</b>     | 46. <b>6</b>  | 47. <b>60</b>  | 48. <b>4</b> | 49. <b>2</b> | 50. <b>10</b> | 51. <b>9079</b> | 52. <b>12</b> |
| 53. <b>41500</b> | 54. <b>42</b> | 55. <b>360</b> |              |              |               |                 |               |

## Mathematics

|                |                |               |                |                 |                 |                |              |
|----------------|----------------|---------------|----------------|-----------------|-----------------|----------------|--------------|
| 56. <b>B</b>   | 57. <b>B</b>   | 58. <b>C</b>  | 59. <b>A</b>   | 60. <b>D</b>    | 61. <b>A</b>    | 62. <b>D</b>   | 63. <b>B</b> |
| 64. <b>A</b>   | 65. <b>A</b>   | 66. <b>B</b>  | 67. <b>B</b>   | 68. <b>C</b>    | 69. <b>B</b>    | 70. <b>A</b>   | 71. <b>C</b> |
| 72. <b>D</b>   | 73. <b>C</b>   | 74. <b>D</b>  | 75. <b>9</b>   | 76. <b>1080</b> | 77. <b>2039</b> | 78. <b>216</b> | 79. <b>2</b> |
| 80. <b>495</b> | 81. <b>120</b> | 82. <b>43</b> | 83. <b>600</b> |                 |                 |                |              |

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