

JEE MAIN 2024 · QUESTION PAPER

31 Jan 2024 **Shift 2**

83 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	20 Q1 to Q20	9 Q21 to Q29
● Chemistry	15 Q30 to Q44	9 Q45 to Q53
● Mathematics	20 Q54 to Q73	10 Q74 to Q83
In this PDF	83 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/2024-01-31-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 Alternating Current

[Step-by-step solution](#) › [prepwise.in/questions/-h_l43cGUU](https://www.prepwise.in/questions/-h_l43cGUU)

An AC voltage $V = 20 \sin 200\pi t$ is applied to a series LCR circuit which drives a current $I = 10 \sin (200\pi t + \frac{\pi}{3})$. The average power dissipated is:

- (A) 21.6 W (B) 200 W (C) 173.2 W (D) 50 W

Q2 Nuclear Physics

[Step-by-step solution](#) › [prepwise.in/questions/Eok9uGrpKH](https://www.prepwise.in/questions/Eok9uGrpKH)

The mass number of nucleus having radius equal to half of the radius of nucleus with mass number 192 is:

- (A) 32 (B) 24 (C) 20 (D) 40

Q3 Current Electricity

[Step-by-step solution](#) › [prepwise.in/questions/t6dHfIm_zS](https://www.prepwise.in/questions/t6dHfIm_zS)

By what percentage will the illumination of the lamp decrease if the current drops by 20%?

- (A) 26% (B) 36% (C) 46% (D) 56%

Q4 Current Electricity

[Step-by-step solution](#) › [prepwise.in/questions/TDxsFM9tKO](https://www.prepwise.in/questions/TDxsFM9tKO)

The resistance per centimeter of a meter bridge wire is r , with $X\Omega$ resistance in left gap. Balancing length from left end is at 40cm with 25Ω resistance in right gap. Now the wire is replaced by another wire of $2r$ resistance per centimeter. The new balancing length for same settings will be at

- (A) 10 cm (B) 80 cm (C) 40 cm (D) 20 cm

Q5 Dual Nature of Radiation & Matter

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

In a photoelectric effect experiment a light of frequency 1.5 times the threshold frequency is made to fall on the surface of photosensitive material. Now if the frequency is halved and intensity is doubled, the number of photo electrons emitted will be:

- (A) doubled (B) halved (C) Zero (D) quadrupled

Q6 Electromagnetic Waves

[Step-by-step solution](#) › [prepwise.in/questions/EaQ1Q3vtAZ](https://www.prepwise.in/questions/EaQ1Q3vtAZ)

Given below are two statements:

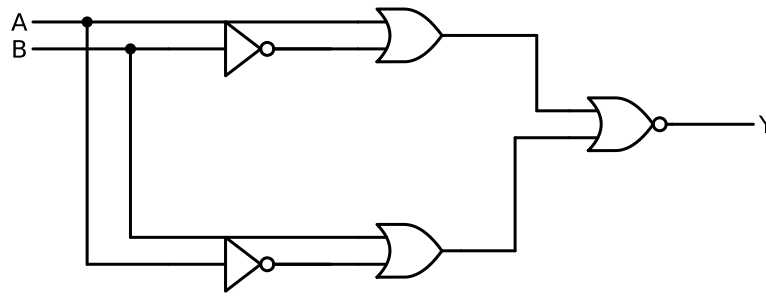
Statement I: Electromagnetic waves carry energy as they travel through space and this energy is equally shared by the electric and magnetic fields.

Statement II: When electromagnetic waves strike a surface, a pressure is exerted on the surface.

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

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

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The output of the given circuit diagram is -

(A)

A	B	Y
0	0	0
1	0	0
0	1	1
1	1	0

(B)

A	B	Y
0	0	0
1	0	0
0	1	0
1	1	1

(C)

A	B	Y
0	0	0
1	0	1
0	1	1
1	1	0

(D)

A	B	Y
0	0	0
1	0	0
0	1	0
1	1	0

Force between two point charges q_1 and q_2 placed in vacuum at ' r ' cm apart is F . Force between them when placed in a medium having dielectric constant $K = 5$ at ' $r/5$ ' cm apart will be:

(A) $5F$

(B) $25F$

(C) $F/5$

(D) $F/25$

The mass of the moon is $\frac{1}{144}$ times the mass of a planet and its diameter is $\frac{1}{16}$ times the diameter of a planet. If the escape velocity on the planet is v , the escape velocity on the moon will be:

(A) $\frac{v}{4}$

(B) $\frac{v}{6}$

(C) $\frac{v}{12}$

(D) $\frac{v}{3}$

The speed of sound in oxygen at S.T.P. will be approximately: (given, $R = 8.3 \text{ J K}^{-1}$, $\gamma = 1.4$)

(A) 341 m/s

(B) 333 m/s

(C) 325 m/s

(D) 315 m/s

A gas mixture consists of 8 moles of argon and 6 moles of oxygen at temperature T . Neglecting all vibrational modes, the total internal energy of the system is:

(A) 29 RT

(B) 27 RT

(C) 20 RT

(D) 21 RT

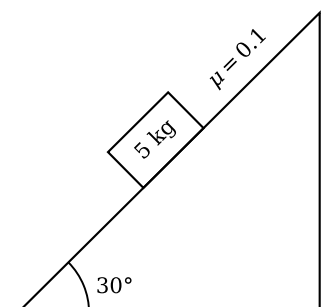
A block of mass 5 kg is placed on a rough inclined surface as shown in the figure. If $\vec{F}_1$ is the force required to just move the block up the inclined plane and $\vec{F}_2$ is the force required to just prevent the block from sliding down, then the value of $|\vec{F}_1| - |\vec{F}_2|$ is : [Use $g = 10 \text{ m/s}^2$]

(A) $5\sqrt{3} \text{ N}$

(B) $\frac{5\sqrt{3}}{2} \text{ N}$

(C) 10 N

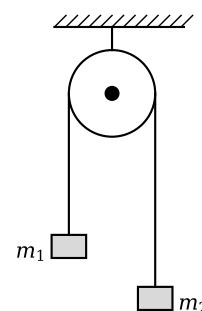
(D) $25\sqrt{3} \text{ N}$



Q13 Newton's Laws of Motion[Step-by-step solution > prepwiser.in/questions/B9h7updrJQ](https://www.prepwiser.in/questions/B9h7updrJQ)

A light string passing over a smooth light fixed pulley connects two blocks of masses m_1 and m_2 . If the acceleration of the system is $g/8$, then the ratio of masses is:

- (A) $\frac{8}{1}$ (B) $\frac{9}{7}$ (C) $\frac{5}{3}$ (D) $\frac{4}{3}$

**Q14** Moving Charges & Magnetism[Step-by-step solution > prepwiser.in/questions/sXnpTpKpY0](https://www.prepwiser.in/questions/sXnpTpKpY0)

A uniform magnetic field of $2 \times 10^{-3} \text{ T}$ acts along positive Y -direction. A rectangular loop of sides 20cm and 10cm with current of 5A is in $Y - Z$ plane. The current is in anticlockwise sense with reference to negative X axis. Magnitude and direction of the torque is:

- (A) $2 \times 10^{-4} \text{ N-m}$ along negative Z -direction (B) $2 \times 10^{-4} \text{ N-m}$ along positive X -direction
(C) $2 \times 10^{-4} \text{ N-m}$ along positive Y -direction (D) $2 \times 10^{-4} \text{ N-m}$ along positive Z -direction

Q15 Fluid Mechanics[Step-by-step solution > prepwiser.in/questions/H5rzZRvz2Z](https://www.prepwiser.in/questions/H5rzZRvz2Z)

A small spherical ball of radius r , falling through a viscous medium of negligible density has terminal velocity ' v '. Another ball of the same mass but of radius $2r$, falling through the same viscous medium will have terminal velocity:

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

Q16 Wave Optics[Step-by-step solution > prepwiser.in/questions/I0eSL0Vh4s](https://www.prepwiser.in/questions/I0eSL0Vh4s)

When unpolarized light is incident at an angle of 60° on a transparent medium from air, the reflected ray is completely polarized. The angle of refraction in the medium is:

- (A) 60° (B) 90° (C) 30° (D) 45°

Q17 Work, Energy & Power[Step-by-step solution > prepwiser.in/questions/FUPcjwMskV](https://www.prepwiser.in/questions/FUPcjwMskV)

A body of mass 2kg begins to move under the action of a time dependent force given by $\vec{F} = (6t\hat{i} + 6t^2\hat{j}) \text{ N}$. The power developed by the force at the time t is given by:

- (A) $(3t^3 + 6t^5) \text{ W}$ (B) $(9t^5 + 6t^3) \text{ W}$ (C) $(6t^4 + 9t^5) \text{ W}$ (D) $(9t^3 + 6t^5) \text{ W}$

Q18 Units, Dimensions & Errors[Step-by-step solution > prepwiser.in/questions/QYzH9aicwH](https://www.prepwiser.in/questions/QYzH9aicwH)

Consider two physical quantities A and B related to each other as $E = \frac{B-x^2}{At}$ where E , x and t have dimensions of energy, length and time respectively. The dimension of AB is

- (A) $L^{-2}M^1T^0$ (B) $L^2M^{-1}T^1$ (C) $L^0M^{-1}T^1$ (D) $L^{-2}M^{-1}T^1$

Q19 Units, Dimensions & Errors[Step-by-step solution > prepwiser.in/questions/GRHzdglRxZ](https://www.prepwiser.in/questions/GRHzdglRxZ)

The measured value of the length of a simple pendulum is 20cm with 2mm accuracy. The time for 50 oscillations was measured to be 40 seconds with 1 second resolution. From these measurements, the accuracy in the measurement of acceleration due to gravity is $N\%$. The value of N is:

- (A) 6 (B) 5 (C) 4 (D) 8

Q20 Vectors[Step-by-step solution](https://www.prepwisar.in/questions/1amf7Re25B) › prepwisar.in/questions/1amf7Re25B

If two vectors $\vec{A}$ and $\vec{B}$ having equal magnitude R are inclined at angle θ , then

(A) $|\vec{A} + \vec{B}| = 2R \cos\left(\frac{\theta}{2}\right)$

(B) $|\vec{A} - \vec{B}| = 2R \cos\left(\frac{\theta}{2}\right)$

(C) $|\vec{A} - \vec{B}| = \sqrt{2}R \sin\left(\frac{\theta}{2}\right)$

(D) $|\vec{A} + \vec{B}| = 2R \sin\left(\frac{\theta}{2}\right)$

Physics Section B • Numerical value

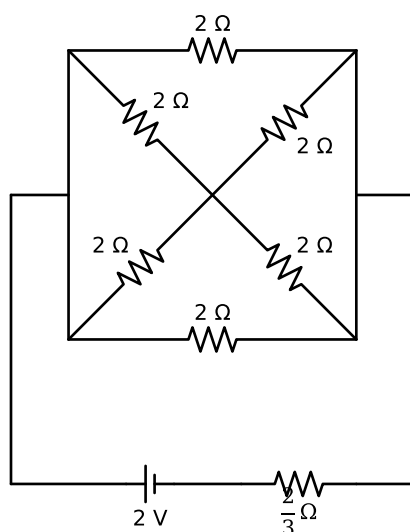
Q21 to Q29

Q21 Nuclear Physics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/it2ZbFLWiD) › prepwisar.in/questions/it2ZbFLWiD

A nucleus has mass number A_1 and volume V_1 . Another nucleus has mass number A_2 and Volume V_2 . If relation between mass number is $A_2 = 4A_1$, then $\frac{V_2}{V_1} = \underline{\hspace{2cm}}$.

Q22 Current Electricity **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/gUMWfyFRCs) › prepwisar.in/questions/gUMWfyFRCs

In the following circuit, the battery has an emf of 2V and an internal resistance of $\frac{2}{3}\Omega$. The power consumption in the entire circuit is $\underline{\hspace{2cm}}$ W.

**Q23** Electromagnetic Induction **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/usYPv48VmK) › prepwisar.in/questions/usYPv48VmK

The magnetic flux ϕ (in weber) linked with a closed circuit of resistance 8Ω varies with time (in seconds) as $\phi = 5t^2 - 36t + 1$. The induced current in the circuit at $t = 2s$ is $\underline{\hspace{2cm}}$ A.

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

Light from a point source in air falls on a convex curved surface of radius 20cm and refractive index 1.5. If the source is located at 100cm from the convex surface, the image will be formed at $\underline{\hspace{2cm}}$ cm from the object.

Q25 Moving Charges & Magnetism **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/DLMTL40Nmc) › prepwisar.in/questions/DLMTL40Nmc

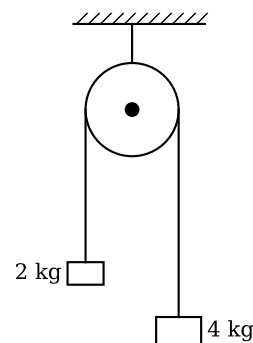
Two circular coils P and Q of 100 turns each have same radius of π cm. The currents in P and R are 1A and 2A respectively. P and Q are placed with their planes mutually perpendicular with their centers coincide. The resultant magnetic field induction at the center of the coils is $\sqrt{x}mT$, where $x = \underline{\hspace{2cm}}$.

[Use $\mu_0 = 4\pi \times 10^{-7} \text{TmA}^{-1}$]

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Q26 Elasticity **NUMERICAL**[Step-by-step solution](#) › prepwisar.in/questions/itUYAJ5emL

Two blocks of mass 2kg and 4kg are connected by a metal wire going over a smooth pulley as shown in figure. The radius of wire is $4.0 \times 10^{-5}\text{m}$ and Young's modulus of the metal is $2.0 \times 10^{11}\text{N/m}^2$. The longitudinal strain developed in the wire is $\frac{1}{\alpha\pi}$. The value of α is _____. [Use $g = 10\text{m/s}^2$]

**Q27** Rotational Motion **NUMERICAL**[Step-by-step solution](#) › prepwisar.in/questions/JMQ-o445o_

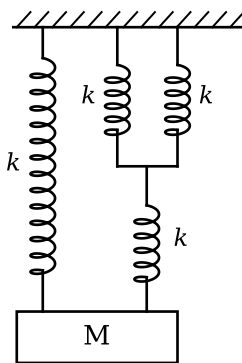
A body of mass ' m ' is projected with a speed ' u ' making an angle of 45° with the ground. The angular momentum of the body about the point of projection, at the highest point is expressed as $\frac{\sqrt{2}mu^3}{Xg}$. The value of ' X ' is _____.

Q28 Rotational Motion **NUMERICAL**[Step-by-step solution](#) › prepwisar.in/questions/EE0zRE7_of

Two identical spheres each of mass 2kg and radius 50cm are fixed at the ends of a light rod so that the separation between the centers is 150cm. Then, moment of inertia of the system about an axis perpendicular to the rod and passing through its middle point is $\frac{x}{20}\text{kgm}^2$, where the value of x is _____.

Q29 Simple Harmonic Motion **NUMERICAL**[Step-by-step solution](#) › prepwisar.in/questions/OBPgHe_kH7

The time period of simple harmonic motion of mass M in the given figure is $\pi\sqrt{\frac{\alpha M}{5k}}$, where the value of α is _____.

**Chemistry** Section A · Multiple choice

Q30 to Q44

Q30 Chemical Bonding & Molecular Structure[Step-by-step solution](#) › prepwisar.in/questions/j25j-n5qbM

Which of the following is least ionic?

(A) CoCl_2 **(B)** KCl **(C)** BaCl_2 **(D)** AgCl

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Select the option with correct property -

- (A) $[\text{Ni}(\text{CO})_4]$ and $[\text{NiCl}_4]^{2-}$ both Paramagnetic
 (B) $[\text{Ni}(\text{CO})_4]$ and $[\text{NiCl}_4]^{2-}$ both Diamagnetic
 (C) $[\text{NiCl}_4]^{2-}$ Diamagnetic, $[\text{Ni}(\text{CO})_4]$ Paramagnetic
 (D) $[\text{Ni}(\text{CO})_4]$ Diamagnetic, $[\text{NiCl}_4]^{2-}$ Paramagnetic

Match List I with List II

	List - I (Complex ion)		List - II (Electronic Configuration)
(A)	$[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$	(I)	$t_{2g}^2 e_g^0$
(B)	$[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$	(II)	$t_{2g}^3 e_g^0$
(C)	$[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$	(III)	$t_{2g}^3 e_g^2$
(D)	$[\text{V}(\text{H}_2\text{O})_6]^{3+}$	(IV)	$t_{2g}^6 e_g^2$

Choose the correct answer from the options given below:

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

Choose the correct statements from the following

- A. Mn_2O_7 is an oil at room temperature
 B. V_2O_4 reacts with acid to give VO_2^{2+}
 C. CrO is a basic oxide
 D. V_2O_5 does not react with acid

Choose the correct answer from the options given below:

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

Given below are two statements:

Statement I: Group 13 trivalent halides get easily hydrolyzed by water due to their covalent nature.

Statement II: AlCl_3 upon hydrolysis in acidified aqueous solution forms octahedral $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ ion.

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

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

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Given below are two statements:

Statement I: S_8 solid undergoes disproportionation reaction under alkaline conditions to form S^{2-} and $S_2O_3^{2-}$.

Statement II: ClO_4^- can undergo disproportionation reaction under acidic condition.

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

Choose the correct statements from the following

- A. All group 16 elements form oxides of general formula EO_2 and EO_3 , where E = S, Se, Te and Po. Both the types of oxides are acidic in nature.
B. TeO_2 is an oxidising agent while SO_2 is reducing in nature.
C. The reducing property decreases from H_2S to H_2Te down the group.
D. The ozone molecule contains five lone pairs of electrons.

Choose the correct answer from the options given below:

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

A sample of $CaCO_3$ and $MgCO_3$ weighed 2.21g is ignited to constant weight of 1.152g. The composition of mixture is:

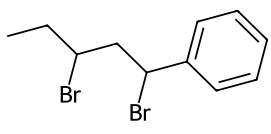
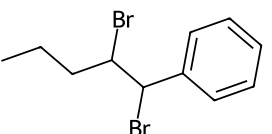
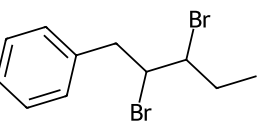
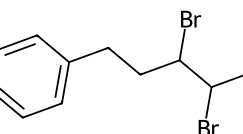
(Given molar mass in $g\text{mol}^{-1}$ $CaCO_3$: 100, $MgCO_3$: 84)

- (A) $1.187gCaCO_3 + 1.187gMgCO_3$ (B) $1.187gCaCO_3 + 1.023gMgCO_3$
(C) $1.023gCaCO_3 + 1.187gMgCO_3$ (D) $1.023gCaCO_3 + 1.023gMgCO_3$

The four quantum numbers for the electron in the outer most orbital of potassium (atomic no. 19) are

- (A) $n = 3, l = 0, m = 1, s = +\frac{1}{2}$ (B) $n = 4, l = 0, m = 0, s = +\frac{1}{2}$
(C) $n = 2, l = 0, m = 0, s = +\frac{1}{2}$ (D) $n = 4, l = 2, m = -1, s = +\frac{1}{2}$

Identify structure of 2,3-dibromo-1-phenylpentane.

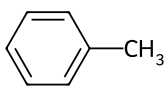
- (A)  (B)  (C)  (D) 

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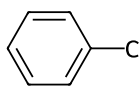
The correct order of reactivity in electrophilic substitution reaction of the following compounds is:



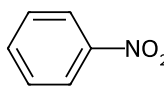
A



B



C



D

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

$A_{(g)} \rightleftharpoons B_{(g)} + \frac{C}{2}_{(g)}$ The correct relationship between K_P , α and equilibrium pressure P is

(A) $K_P = \frac{\alpha^{1/2} P^{3/2}}{(2+\alpha)^{3/2}}$

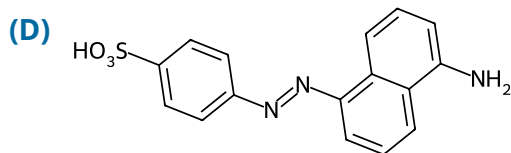
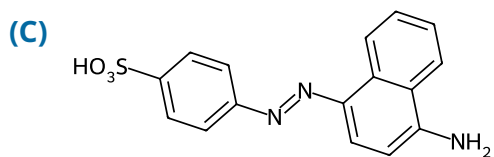
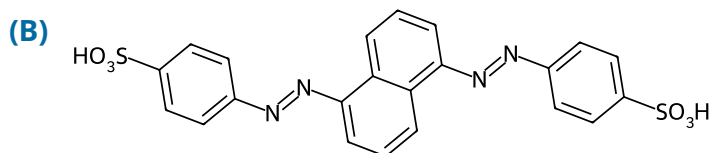
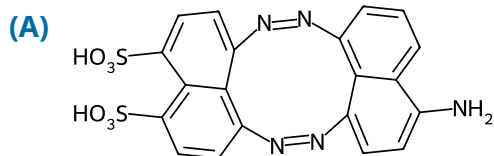
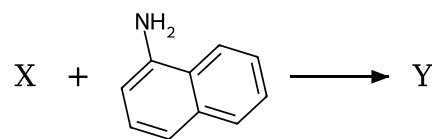
(B) $K_P = \frac{\alpha^{3/2} P^{1/2}}{(2+\alpha)^{1/2}(1-\alpha)}$

(C) $K_P = \frac{\alpha^{1/2} P^{1/2}}{(2+\alpha)^{3/2}}$

(D) $K_P = \frac{\alpha^{1/2} P^{1/2}}{(2+\alpha)^{1/2}}$

The azo-dye (Y) formed in the following reactions is

Sulphanilic acid + NaNO_2 + $\text{CH}_3\text{COOH} \rightarrow \text{X}$.



Given below are two statements:

Statement I: Aniline reacts with con. H_2SO_4 , followed by heating at 453 – 473K gives p-aminobenzene sulphonic acid, which gives blood red colour in the 'Lassaigne's test'.

Statement II: In Friedel - Craft's alkylation and acylation reactions, aniline forms salt with the AlCl_3 catalyst. Due to this, nitrogen of aniline acquires a positive charge and acts as deactivating group.

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

(A) Both statement I and statement II are true

(B) Statement I is true but statement II is false

(C) Statement I is false but statement II is true

(D) Both statement I and statement II are false

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The fragrance of flowers is due to the presence of some steam volatile organic compounds called essential oils. These are generally insoluble in water at room temperature but are miscible with water vapour in vapour phase. A suitable method for the extraction of these oils from the flowers is -

- (A) distillation (B) steam distillation
(C) distillation under reduced pressure (D) crystallisation

Chemistry Section B · Numerical value

Q45 to Q53

From the vitamins

A, B₁, B₆, B₁₂, C, D, E

and K, the number of vitamins that can be stored in our body is _____.

$r = k[A]$ for a reaction, 50% of A is decomposed in 120 minutes. The time taken for 90% decomposition of A is _____ minutes.

The values of conductivity of some materials at $298.15\text{K}^{-1}\text{inSm}^{-1}$ are 2.1×10^3 , 1.0×10^{-16} , 1.2×10 , 3.91 , 1.5×10^{-2} , 1×10^{-7} , 1.0×10^3 .

The number of conductors among the materials is _____.

In the reaction of potassium dichromate, potassium chloride and sulfuric acid (conc.), the oxidation state of the chromium in the product is (+) _____.

Number of moles of H^+ ions required by 1mole of MnO_4^- to oxidise oxalate ion to CO_2 is _____.

The molarity of 1L orthophosphoric acid (H_3PO_4) having 70% purity by weight (specific gravity 1.54gcm^{-3}) is _____ M.

(Molar mass of $\text{H}_3\text{PO}_4 = 98\text{gmol}^{-1}$)

If 5 moles of an ideal gas expands from 10L to a volume of 100L at 300K under isothermal and reversible condition then work, w , is $-x\text{J}$. The value of x is _____.

(Given $R = 8.314\text{ J K}^{-1}\text{ mol}^{-1}$)

Number of isomeric products formed by monochlorination of 2-methylbutane in presence of sunlight is _____.

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A compound (x) with molar mass 108g mol^{-1} undergoes acetylation to give product with molar mass 192g mol^{-1} . The number of amino groups in the compound (x) is _____.

Mathematics Section A · Multiple choice

Q54 to Q73

Q54 Three Dimensional Geometry

Step-by-step solution > prepwiser.in/questions/OqJk0YpePg

Let (α, β, γ) be the mirror image of the point $(2, 3, 5)$ in the line $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$. Then, $2\alpha + 3\beta + 4\gamma$ is equal to

- (A) 32 (B) 31 (C) 33 (D) 34

Q55 Three Dimensional Geometry

Step-by-step solution > prepwiser.in/questions/vYN9Lc4P-h

The shortest distance, between lines L_1 and L_2 , where $L_1 : \frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+4}{2}$ and L_2 is the line, passing through the points $A(-4, 4, 3)$, $B(-1, 6, 3)$ and perpendicular to the line $\frac{x-3}{-2} = \frac{y}{3} = \frac{z-1}{1}$, is

- (A) $\frac{141}{\sqrt{221}}$ (B) $\frac{24}{\sqrt{117}}$ (C) $\frac{42}{\sqrt{117}}$ (D) $\frac{121}{\sqrt{221}}$

Q56 Limits

Step-by-step solution > prepwiser.in/questions/-BRZpb2Kt_

Let $f : \mathbb{R} \rightarrow (0, \infty)$ be strictly increasing function such that $\lim_{x \rightarrow \infty} \frac{f(7x)}{f(x)} = 1$. Then, the value of $\lim_{x \rightarrow \infty} \left[\frac{f(5x)}{f(x)} - 1 \right]$ is equal to

- (A) 0 (B) 4 (C) 1 (D) 7/5

Q57 Functions (Advanced)

Step-by-step solution > prepwiser.in/questions/-q12mImL7K

If the function $f : (-\infty, -1] \rightarrow (a, b]$ defined by $f(x) = e^{x^3-3x+1}$ is one - one and onto, then the distance of the point $P(2b+4, a+2)$ from the line $x + e^{-3}y = 4$ is:

- (A) $2\sqrt{1+e^6}$ (B) $\sqrt{1+e^6}$ (C) $3\sqrt{1+e^6}$ (D) $4\sqrt{1+e^6}$

Q58 Straight Lines

Step-by-step solution > prepwiser.in/questions/EjWqmf_Wh6

Let a variable line passing through the centre of the circle $x^2 + y^2 - 16x - 4y = 0$, meet the positive co-ordinate axes at the points A and B . Then the minimum value of $OA + OB$, where O is the origin, is equal to

- (A) 12 (B) 20 (C) 24 (D) 18

Q59 Complex Numbers

Step-by-step solution > prepwiser.in/questions/oc9fiEkX0H

Let z_1 and z_2 be two complex numbers such that $z_1 + z_2 = 5$ and $z_1^3 + z_2^3 = 20 + 15i$. Then, $|z_1^4 + z_2^4|$ equals -

- (A) $15\sqrt{15}$ (B) $30\sqrt{3}$ (C) $25\sqrt{3}$ (D) 75

Q60 Definite Integration

Step-by-step solution > prepwiser.in/questions/ymUSbs04wW

Let $f, g : (0, \infty) \rightarrow \mathbb{R}$ be two functions defined by $f(x) = \int_{-x}^x (|t| - t^2) e^{-t^2} dt$ and $g(x) = \int_0^{x^2} t^{1/2} e^{-t} dt$. Then, the value of $9(f(\sqrt{\log_e 9}) + g(\sqrt{\log_e 9}))$ is equal to:

- (A) 10 (B) 9 (C) 8 (D) 6

Q61 Differential Equations[Step-by-step solution](#) › [prepwisar.in/questions/uQ1JOUI8-X](https://www.prepwisar.in/questions/uQ1JOUI8-X)

The temperature $T(t)$ of a body at time $t = 0$ is 160°F and it decreases continuously as per the differential equation $\frac{dT}{dt} = -K(T - 80)$, where K is a positive constant. If $T(15) = 120^\circ\text{F}$, then $T(45)$ is equal to

- (A) 90°F (B) 85°F (C) 80°F (D) 95°F

Q62 Ellipse[Step-by-step solution](#) › [prepwisar.in/questions/bhgog5CD8q](https://www.prepwisar.in/questions/bhgog5CD8q)

Let P be a parabola with vertex $(2, 3)$ and directrix $2x + y = 6$. Let an ellipse $E : \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, a > b$, of eccentricity $\frac{1}{\sqrt{2}}$ pass through the focus of the parabola P . Then, the square of the length of the latus rectum of E , is

- (A) $\frac{512}{25}$ (B) $\frac{656}{25}$ (C) $\frac{385}{8}$ (D) $\frac{347}{8}$

Q63 Inverse Trigonometric Functions[Step-by-step solution](#) › [prepwisar.in/questions/2Ap-uDHWSm](https://www.prepwisar.in/questions/2Ap-uDHWSm)

If $a = \sin^{-1}(\sin(5))$ and $b = \cos^{-1}(\cos(5))$, then $a^2 + b^2$ is equal to

- (A) 25 (B) $4\pi^2 + 25$ (C) $8\pi^2 - 40\pi + 50$ (D) $4\pi^2 - 20\pi + 50$

Q64 Continuity & Differentiability[Step-by-step solution](#) › [prepwisar.in/questions/ceFSBZuiEW](https://www.prepwisar.in/questions/ceFSBZuiEW)

Consider the function $f : (0, \infty) \rightarrow \mathbb{R}$ defined by $f(x) = e^{-|\log_e x|}$. If m and n be respectively the number of points at which f is not continuous and f is not differentiable, then $m + n$ is

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

Q65 Matrices[Step-by-step solution](#) › [prepwisar.in/questions/wjRuWo3yz8](https://www.prepwisar.in/questions/wjRuWo3yz8)

Let A be a 3×3 real matrix such that

$$A \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} = 2 \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}, A \begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix} = 4 \begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix}, A \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} = 2 \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}.$$

Then, the system

$$(A - 3I) \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$$

has:

- (A) exactly two solutions (B) infinitely many solutions
(C) unique solution (D) no solution

Q66 Permutations & Combinations[Step-by-step solution](#) › [prepwisar.in/questions/G03Gf5W2KN](https://www.prepwisar.in/questions/G03Gf5W2KN)

The number of ways in which 21 identical apples can be distributed among three children such that each child gets at least 2 apples, is

- (A) 130 (B) 136 (C) 142 (D) 406

Q67 Permutations & Combinations[Step-by-step solution](#) › [prepwisar.in/questions/gRSKbEVmAT](https://www.prepwisar.in/questions/gRSKbEVmAT)

If for some m, n ; ${}^6C_m + 2({}^6C_{m+1}) + {}^6C_{m+2} > {}^8C_3$ and ${}^{n-1}P_3 : {}^nP_4 = 1 : 8$, then ${}^nP_{m+1} + {}^{n+1}C_m$ is equal to

- (A) 380 (B) 376 (C) 372 (D) 384

A coin is biased so that a head is twice as likely to occur as a tail. If the coin is tossed 3 times, then the probability of getting two tails and one head is

- (A) $\frac{1}{9}$ (B) $\frac{2}{9}$ (C) $\frac{1}{27}$ (D) $\frac{2}{27}$

Let 2^{nd} , 8^{th} and 44^{th} terms of a non-constant A. P. be respectively the 1^{st} , 2^{nd} and 3^{rd} terms of a G. P. If the first term of the A. P. is 1, then the sum of its first 20 terms is equal to -

- (A) 990 (B) 980 (C) 960 (D) 970

Let the mean and the variance of 6 observations $a, b, 68, 44, 48, 60$ be 55 and 194, respectively. If $a > b$, then $a + 3b$ is

- (A) 180 (B) 210 (C) 190 (D) 200

The area of the region enclosed by the parabolas $y = 4x - x^2$ and $3y = (x - 4)^2$ is equal to:

- (A) $\frac{32}{9}$ (B) $\frac{14}{3}$ (C) 4 (D) 6

Let $A(a, b)$, $B(3, 4)$ and $C(-6, -8)$ respectively denote the centroid, circumcentre and orthocentre of a triangle. Then, the distance of the point $P(2a + 3, 7b + 5)$ from the line $2x + 3y - 4 = 0$ measured parallel to the line $x - 2y - 1 = 0$ is

- (A) $\frac{17\sqrt{5}}{6}$ (B) $\frac{15\sqrt{5}}{7}$ (C) $\frac{17\sqrt{5}}{7}$ (D) $\frac{\sqrt{5}}{17}$

The number of solutions, of the equation $e^{\sin x} - 2e^{-\sin x} = 2$, is:

- (A) 0 (B) 1 (C) 2 (D) more than 2

Mathematics Section B · Numerical value

Q74 to Q83

A line passes through $A(4, -6, -2)$ and $B(16, -2, 4)$. The point $P(a, b, c)$, where a, b, c are non-negative integers, on the line AB lies at a distance of 21 units, from the point A . The distance between the points $P(a, b, c)$ and $Q(4, -12, 3)$ is equal to _____.

Let the coefficient of x^r in the expansion of

$$(x + 3)^{n-1} + (x + 3)^{n-2}(x + 2) + (x + 3)^{n-3}(x + 2)^2 + \dots + (x + 2)^{n-1}$$

be α_r . If $\sum_{r=0}^n \alpha_r = \beta^n - \gamma^n$, $\beta, \gamma \in \mathbb{N}$, then the value of $\beta^2 + \gamma^2$ equals _____.

$$\left| \frac{120}{\pi^3} \int_0^{\pi} \frac{x^2 \sin x \cos x}{\sin^4 x + \cos^4 x} dx \right| \text{ is equal to}$$

_____.

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

$$\sec^2 x dx + (e^{2y} \tan^2 x + \tan x) dy = 0, 0 < x < \frac{\pi}{2}, y(\pi/4) = 0$$

.
If $y(\pi/6) = \alpha$, then $e^{8\alpha}$ is equal to _____.

If

$$\lim_{x \rightarrow 0} \frac{ax^2 e^x - b \log_e(1+x) + cxe^{-x}}{x^2 \sin x} = 1$$

, then $16(a^2 + b^2 + c^2)$ is equal to _____.

Let A be a 3×3 matrix and $\det(A) = 2$. If

$$n = \det(\underbrace{\text{adj}(\text{adj}(\dots(\text{adj } A)))}_{2024\text{--times}})$$

, then the remainder when n is divided by 9 is equal to _____.

Let a, b, c be the lengths of three sides of a triangle satisfying the condition

$(a^2 + b^2)x^2 - 2b(a+c)x + (b^2 + c^2) = 0$. If the set of all possible values of x is the interval (α, β) , then $12(\alpha^2 + \beta^2)$ is equal to _____.

Let $A = \{1, 2, 3, \dots, 100\}$. Let R be a relation on A defined by $(x, y) \in R$ if and only if $2x = 3y$. Let R_1 be a symmetric relation on A such that $R \subset R_1$ and the number of elements in R_1 is n . Then, the minimum value of n is _____.

Let $\vec{a} = 3\hat{i} + 2\hat{j} + \hat{k}$, $\vec{b} = 2\hat{i} - \hat{j} + 3\hat{k}$ and $\vec{c}$ be a vector such that $(\vec{a} + \vec{b}) \times \vec{c} = 2(\vec{a} \times \vec{b}) + 24\hat{j} - 6\hat{k}$ and $(\vec{a} - \vec{b} + \hat{i}) \cdot \vec{c} = -3$. Then $|\vec{c}|^2$ is equal to _____.

Let $A(-2, -1)$, $B(1, 0)$, $C(\alpha, \beta)$ and $D(\gamma, \delta)$ be the vertices of a parallelogram $ABCD$. If the point C lies on $2x - y = 5$ and the point D lies on $3x - 2y = 6$, then the value of $|\alpha + \beta + \gamma + \delta|$ is equal to _____.

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Physics

1.	D	2.	B	3.	B	4.	C	5.	C	6.	B	7.	D	8.	A
9.	D	10.	D	11.	B	12.	A	13.	B	14.	A	15.	D	16.	C
17.	D	18.	B	19.	A	20.	A	21.	4	22.	3	23.	2	24.	200
25.	20	26.	12	27.	8	28.	53	29.	12						

Chemistry

30.	D	31.	D	32.	C	33.	C	34.	B	35.	A	36.	A	37.	B
38.	B	39.	C	40.	B	41.	B	42.	C	43.	A	44.	B	45.	5
46.	399	47.	4	48.	6	49.	8	50.	11	51.	28721	52.	6	53.	2

Mathematics

54.	C	55.	A	56.	A	57.	A	58.	D	59.	D	60.	C	61.	A
62.	B	63.	C	64.	B	65.	C	66.	B	67.	C	68.	B	69.	D
70.	A	71.	D	72.	C	73.	A	74.	22	75.	25	76.	15	77.	9
78.	81	79.	7	80.	36	81.	66	82.	38	83.	32				

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