

JEE MAIN 2023 · QUESTION PAPER

8 Apr 2023 **Shift 2**

84 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	9 Q20 to Q28
● Chemistry	17 Q29 to Q45	10 Q46 to Q55
● Mathematics	19 Q56 to Q74	10 Q75 to Q84
In this PDF	84 questions · answer key at the end	

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

Attempt this paper online

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

prepwis.in/pyqs/paper/2023-04-08-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 Nuclear Physics

[Step-by-step solution](#) › [prepwisar.in/questions/DPrSdBe8f](https://www.prepwisar.in/questions/DPrSdBe8f)

A radio active material is reduced to $\frac{1}{8}$ of its original amount in 3 days. If $8 \times 10^{-3} \text{ kg}$ of the material is left after 5 days the initial amount of the material is

- (A) 64 g (B) 256 g (C) 32 g (D) 40 g

Q2 Atomic Physics

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

The waves emitted when a metal target is bombarded with high energy electrons are

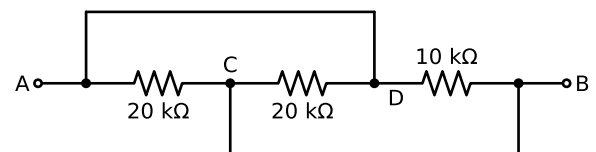
- (A) Infrared rays (B) Radio Waves (C) Microwaves (D) X-rays

Q3 Current Electricity

[Step-by-step solution](#) › [prepwisar.in/questions/B1aFGfYGlB](https://www.prepwisar.in/questions/B1aFGfYGlB)

The equivalent resistance between A and B as shown in figure is:

- (A) $30 \text{ k}\Omega$ (B) $20 \text{ k}\Omega$ (C) $5 \text{ k}\Omega$ (D) $10 \text{ k}\Omega$



Q4 Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwisar.in/questions/4s6pAGr92h](https://www.prepwisar.in/questions/4s6pAGr92h)

In photo electric effect

- A. The photocurrent is proportional to the intensity of the incident radiation
- B. Maximum Kinetic energy with which photoelectrons are emitted depends on the intensity of incident light.
- C. Max. K.E with which photoelectrons are emitted depends on the frequency of incident light.
- D. The emission of photoelectrons require a minimum threshold intensity of incident radiation.
- E. Max. K.E of the photoelectrons is independent of the frequency of the incident light.

Choose the correct answer from the options given below:

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

Q5 Electromagnetic Induction

[Step-by-step solution](#) › [prepwisar.in/questions/3PEh0p2xnv](https://www.prepwisar.in/questions/3PEh0p2xnv)

An emf of 0.08 V is induced in a metal rod of length 10 cm held normal to a uniform magnetic field of 0.4 T , when moves with a velocity of:

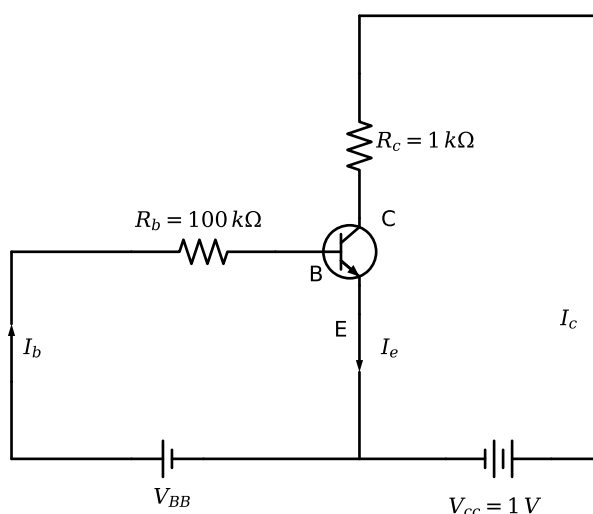
- (A) 20 ms^{-1} (B) 2 ms^{-1} (C) 3.2 ms^{-1} (D) 0.5 ms^{-1}

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For a given transistor amplifier circuit in CE configuration

$$V_{CC} = 1V, R_C = 1k\Omega, R_b = 100k\Omega$$

and $\beta = 100$. Value of base current I_b is



- (A) $I_b = 100\mu A$ (B) $I_b = 0.1\mu A$ (C) $I_b = 1.0\mu A$ (D) $I_b = 10\mu A$

Electric potential at a point 'P' due to a point charge of $5 \times 10^{-9}C$ is 50V. The distance of 'P' from the point charge is:

(Assume,

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 Nm^2C^{-2}$$

)

- (A) 0.9 cm (B) 90 cm (C) 3 cm (D) 9 cm

The acceleration due to gravity at height h above the earth if $h \ll R$ (Radius of earth) is given by

- (A) $g' = g \left(1 - \frac{2h}{R}\right)$ (B) $g' = g \left(1 - \frac{2h^2}{R^2}\right)$ (C) $g' = g \left(1 - \frac{h^2}{2R^2}\right)$ (D) $g' = g \left(1 - \frac{h}{2R}\right)$

The orbital angular momentum of a satellite is L , when it is revolving in a circular orbit at height h from earth surface. If the distance of satellite from the earth centre is increased by eight times to its initial value, then the new angular momentum will be -

- (A) $9L$ (B) $8L$ (C) $4L$ (D) $3L$

The temperature at which the kinetic energy of oxygen molecules becomes double than its value at $27^\circ C$ is

- (A) $627^\circ C$ (B) $927^\circ C$ (C) $327^\circ C$ (D) $1227^\circ C$

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Q11 Thermodynamics[Step-by-step solution > prepwisar.in/questions/Jjh-8a4FD5](https://www.prepwisar.in/questions/Jjh-8a4FD5)

Work done by a Carnot engine operating between temperatures 127°C and 27°C is 2kJ . The amount of heat transferred to the engine by the reservoir is:

- (A) 8 kJ (B) 2 kJ (C) 4 kJ (D) 2.67 kJ

Q12 Magnetism & Matter[Step-by-step solution > prepwisar.in/questions/tMH40oW40q](https://www.prepwisar.in/questions/tMH40oW40q)

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

Assertion A : Electromagnets are made of soft iron.

Reason R : Soft iron has high permeability and low retentivity.

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

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

Q13 Projectile Motion & Relative Motion[Step-by-step solution > prepwisar.in/questions/8EGaPyjkpQ](https://www.prepwisar.in/questions/8EGaPyjkpQ)

The trajectory of projectile, projected from the ground is given by $y = x - \frac{x^2}{20}$. Where x and y are measured in meter. The maximum height attained by the projectile will be.

- (A) 10 m (B) 5 m (C) 200 m (D) $10\sqrt{2}$ m

Q14 Rectilinear Motion[Step-by-step solution > prepwisar.in/questions/_MDLcXCtIj](https://www.prepwisar.in/questions/_MDLcXCtIj)

Given below are two statements

Statement I : Area under velocity- time graph gives the distance travelled by the body in a given time.

Statement II : Area under acceleration- time graph is equal to the change in velocity- in the given time.

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

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

Q15 Fluid Mechanics[Step-by-step solution > prepwisar.in/questions/aE8b4pNETe](https://www.prepwisar.in/questions/aE8b4pNETe)

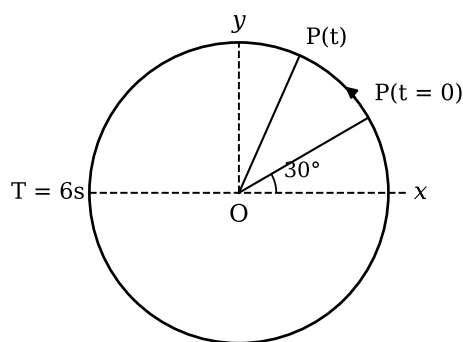
A hydraulic automobile lift is designed to lift vehicles of mass 5000kg . The area of cross section of the cylinder carrying the load is 250cm^2 . The maximum pressure the smaller piston would have to bear is [Assume $g = 10\text{m/s}^2$]

- (A) $20 \times 10^6\text{Pa}$ (B) $200 \times 10^6\text{Pa}$ (C) $2 \times 10^5\text{Pa}$ (D) $2 \times 10^6\text{Pa}$

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Q16 Simple Harmonic Motion[Step-by-step solution](#) > [prepwiser.in/questions/j7FFixjGL-](#)

For particle P revolving round the centre O with radius of circular path r and angular velocity ω , as shown in below figure, the projection of OP on the x -axis at time t is



(A) $x(t) = \cos(\omega t - \frac{\pi}{6}\omega)$

(B) $x(t) = \cos(\omega t)$

(C) $x(t) = r \cos(\omega t + \frac{\pi}{6})$

(D) $x(t) = r \sin(\omega t + \frac{\pi}{6})$

Q17 Wave Optics[Step-by-step solution](#) > [prepwiser.in/questions/KrhoA-s0Sf](#)

The width of fringe is 2mm on the screen in a double slits experiment for the light of wavelength of 400nm. The width of the fringe for the light of wavelength 600 nm will be:

(A) 4 mm

(B) 1.33 mm

(C) 2 mm

(D) 3 mm

Q18 Collision[Step-by-step solution](#) > [prepwiser.in/questions/9C7MoSMeIK](#)

A bullet of mass 0.1kg moving horizontally with speed 400ms^{-1} hits a wooden block of mass 3.9kg kept on a horizontal rough surface. The bullet gets embedded into the block and moves 20m before coming to rest. The coefficient of friction between the block and the surface is _____.

(Given $g = 10\text{m/s}^2$)

(A) 0.65

(B) 0.25

(C) 0.50

(D) 0.90

Q19 Units, Dimensions & Errors[Step-by-step solution](#) > [prepwiser.in/questions/fdRU-XwUIM](#)

Match List I with List II

	LIST I		LIST II
A.	Torque	I.	$\text{ML}^{-2}\text{T}^{-2}$
B.	Stress	II.	ML^2T^{-2}
C.	Pressure gradient	III.	$\text{ML}^{-1}\text{T}^{-1}$
D.	Coefficient of viscosity	IV.	$\text{ML}^{-1}\text{T}^{-2}$

Choose the correct answer from the options given below:

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

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

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

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

Physics Section B • Numerical value

Q20 to Q28

Q20 Alternating Current **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/gO-pIoKHII](#)

A series combination of resistor of resistance 100Ω , inductor of inductance 1H and capacitor of capacitance $6.25\mu\text{F}$ is connected to an ac source. The quality factor of the circuit will be _____

Q21 Atomic Physics **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/rIbKuoG9wT](#)

The ratio of wavelength of spectral lines H_α and H_β in the Balmer series is $\frac{x}{20}$. The value of x is _____.

A 600pF capacitor is charged by 200V supply. It is then disconnected from the supply and is connected to another uncharged 600pF capacitor. Electrostatic energy lost in the process is _____ μJ

The number density of free electrons in copper is nearly $8 \times 10^{28} \text{m}^{-3}$. A copper wire has its area of cross section = $2 \times 10^{-6} \text{m}^2$ and is carrying a current of 3.2A. The drift speed of the electrons is _____ $\times 10^{-6} \text{ms}^{-1}$

Two transparent media having refractive indices 1.0 and 1.5 are separated by a spherical refracting surface of radius of curvature 30cm. The centre of curvature of surface is towards denser medium and a point object is placed on the principle axis in rarer medium at a distance of 15cm from the pole of the surface. The distance of image from the pole of the surface is _____ cm.

A steel rod of length 1m and cross sectional area 10^{-4}m^2 is heated from 0°C to 200°C without being allowed to extend or bend. The compressive tension produced in the rod is _____ $\times 10^4 \text{N}$. (Given Young's modulus of steel = $2 \times 10^{11} \text{Nm}^{-2}$, coefficient of linear expansion = 10^{-5}K^{-1})

The ratio of magnetic field at the centre of a current carrying coil of radius r to the magnetic field at distance r from the centre of coil on its axis is $\sqrt{x} : 1$. The value of x is _____

A guitar string of length 90 cm vibrates with a fundamental frequency of 120 Hz. The length of the string producing a fundamental frequency of 180 Hz will be _____ cm.

A body of mass 5kg is moving with a momentum of 10kgms^{-1} . Now a force of 2N acts on the body in the direction of its motion for 5s. The increase in the Kinetic energy of the body is _____ J.

Chemistry Section A · Multiple choice

Q29 to Q45

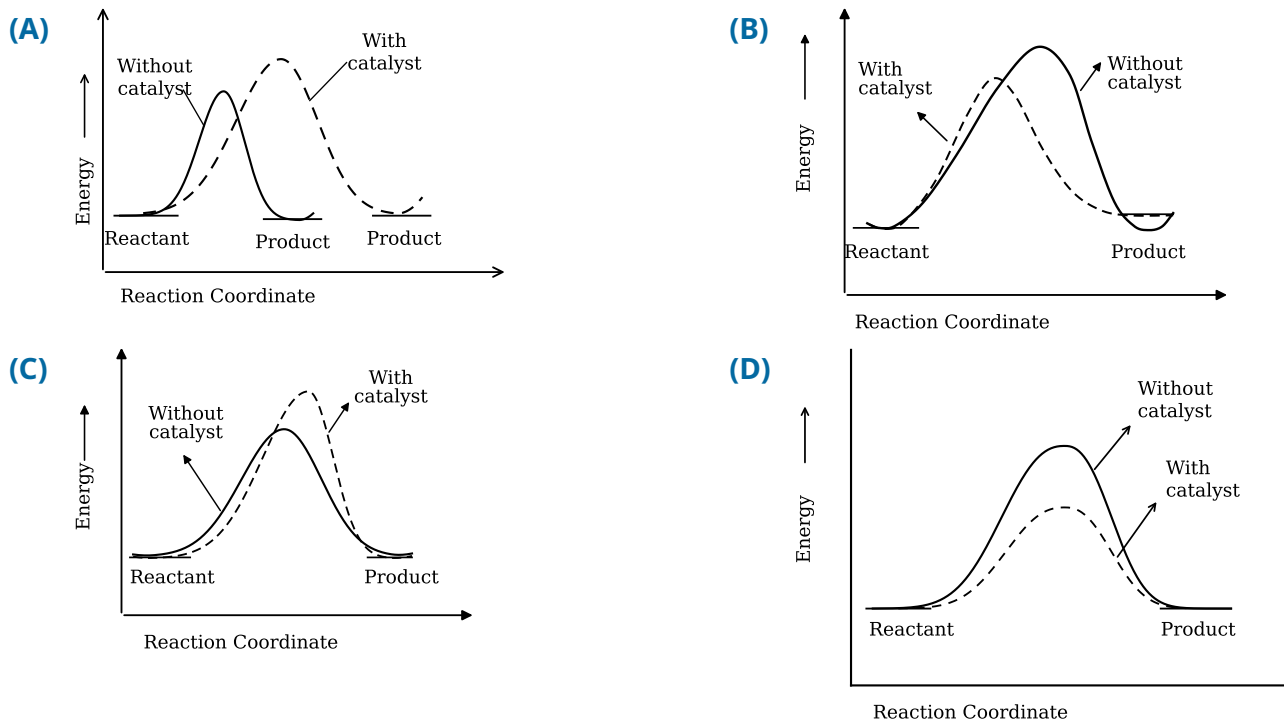
Match List I with List II

	LIST I Natural amino acid		LIST II One letter code
A.	Glutamic acid	I.	Q
B.	Glutamine	II.	W
C.	Tyrosine	III.	E
D.	Tryptophan	IV.	Y

Choose the correct answer from the options given below:

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

The correct reaction profile diagram for a positive catalyst reaction.



The statement/s which are true about antagonists from the following is/are:

- A. They bind to the receptor site.
- B. Get transferred inside the cell for their action.
- C. Inhibit the natural communication of the body.
- D. Mimic the natural messenger.

Choose the correct answer from the options given below:

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

Match List I with List II

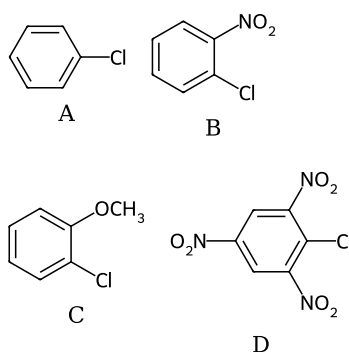
	LIST I Coordination Complex		LIST II Number of unpaired electrons
A.	$[\text{Cr}(\text{CN})_6]^{3-}$	I.	0
B.	$[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$	II.	3
C.	$[\text{Co}(\text{NH}_3)_6]^{3+}$	III.	2
D.	$[\text{Ni}(\text{NH}_3)_6]^{2+}$	IV.	4

Choose the correct answer from the options given below:

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

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The correct order of reactivity of following haloarenes towards nucleophilic substitution with aqueous NaOH is:



Choose the correct answer from the options given below:

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

Which of the following can reduce decomposition of H_2O_2 on exposure to light:

- (A) Urea (B) Glass containers (C) Alkali (D) Dust

In Hall - Heroult process, the following is used for reducing Al_2O_3 :-

- (A) Magnesium (B) CaF_2 (C) Graphite (D) Na_3AlF_6

Given below are two statements:

Statement I : In redox titration, the indicators used are sensitive to change in pH of the solution.

Statement II : In acid-base titration, the indicators used are sensitive to change in oxidation potential.

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

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

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

Assertion A : Sodium is about 30 times as abundant as potassium in the oceans.

Reason R : Potassium is bigger in size than sodium.

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

For a good quality cement, the ratio of lime to the total of the oxides of Si, Al and Fe should be as close as to:

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

Which of the following have same number of significant figures?

- A. 0.00253
B. 1.0003
C. 15.0
D. 163

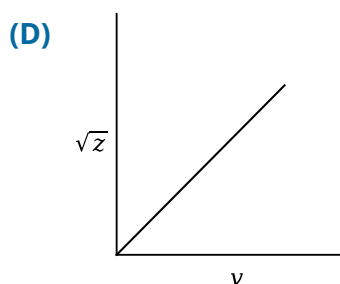
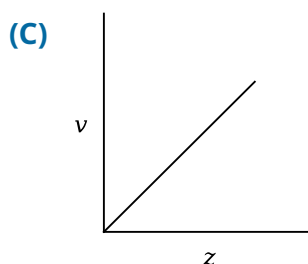
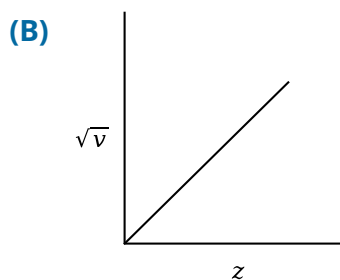
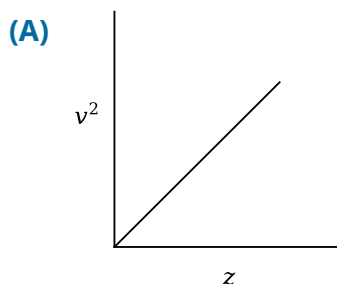
Choose the correct answer from the options given below

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

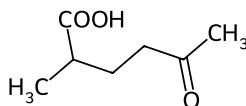
Henry Moseley studied characteristic X-ray spectra of elements. The graph which represents his observation correctly is

Given ν = frequency of X-ray emitted

Z = atomic number



The correct IUPAC nomenclature for the following compound is:



- (A) 2 - Formyl -5-methylhexan-6-oic acid (B) 5-Methyl-2-oxohexan-6-oic acid
(C) 5-Formyl -2-methylhexanoic acid (D) 2-Methyl-5-oxohexanoic acid

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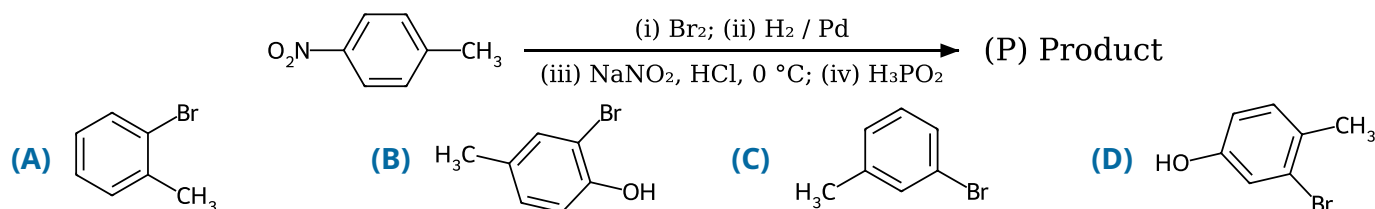
The descending order of acidity for the following carboxylic acid is-

- A. CH_3COOH
- B. $\text{F}_3\text{C} - \text{COOH}$
- C. $\text{ClCH}_2 - \text{COOH}$
- D. $\text{FCH}_2 - \text{COOH}$
- E. $\text{BrCH}_2 - \text{COOH}$

Choose the correct answer from the options given below:

- (A) $\text{B} > \text{C} > \text{D} > \text{E} > \text{A}$ (B) $\text{D} > \text{B} > \text{A} > \text{E} > \text{C}$ (C) $\text{B} > \text{D} > \text{C} > \text{E} > \text{A}$ (D) $\text{E} > \text{D} > \text{B} > \text{A} > \text{C}$

The product (P) formed from the following multistep reaction is:



A compound 'X' when treated with phthalic anhydride in presence of concentrated H_2SO_4 yields 'Y'. 'Y' is used as an acid/base indicator. 'X' and 'Y' are respectively

- (A) Toluidine, Phenolphthalein
- (B) Carboic acid, Phenolphthalein
- (C) Salicylaldehyde, Phenolphthalein
- (D) Anisole, methyl orange

Given below are two statements:

Statement I : Methyl orange is a weak acid.

Statement II : The benzenoid form of methyl orange is more intense/deeply coloured than the quinonoid form.

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

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

Q46 Chemical Bonding & Molecular Structure **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/yj5v87jScA

The number of species from the following carrying a single lone pair on central atom Xenon is _____.

**Q47** d & f Block Elements **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/pskfUFKpbt

The observed magnetic moment of the complex $[\text{Mn}(\underline{\text{NCS}})_6]^{x-}$ is 6.06 BM. The numerical value of x is _____.

Q48 Electrochemistry **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/AZ7UZ398RZ

The number of incorrect statements from the following is _____.

A. The electrical work that a reaction can perform at constant pressure and temperature is equal to the reaction Gibbs energy.

B. E°_{cell} cell is dependent on the pressure.

C.

$$\frac{dE^\theta_{\text{cell}}}{dT} = \frac{\Delta_r S^\theta}{nF}$$

D. A cell is operating reversibly if the cell potential is exactly balanced by an opposing source of potential difference.

Q49 Ionic Equilibrium **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/TEGIAACRJX

The solubility product of BaSO_4 is 1×10^{-10} at 298 K. The solubility of BaSO_4 in $0.1 \text{ M K}_2\text{SO}_4(\text{aq})$ solution is _____ $\times 10^{-9} \text{ g L}^{-1}$ (nearest integer).

Given: Molar mass of BaSO_4 is 233 g mol^{-1}

Q50 Chemical Bonding & Molecular Structure **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/K_Vs9NaBI

The ratio of sigma and π bonds present in pyrophosphoric acid is _____.

Q51 Redox Reactions **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/DzBbUwhkj_

The sum of oxidation state of the metals in $\text{Fe}(\text{CO})_5$, VO^{2+} and WO_3 is _____.

Q52 Solutions & Colligative Properties **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/91V4Iqznom

If the boiling points of two solvents X and Y (having same molecular weights) are in the ratio 2 : 1 and their enthalpy of vaporizations are in the ratio 1 : 2, then the boiling point elevation constant of X is $\underline{m}$ times the boiling point elevation constant of Y. The value of m is _____ (nearest integer)

Q53 Atomic Structure **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/H3apxrcolA

The number of atomic orbitals from the following having 5 radial nodes is _____.

7s, 7p, 6s, 8p, 8d

Q54 Surface Chemistry **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/TuYCVsLRbI

Coagulating value of the electrolytes AlCl_3 and NaCl for As_2S_3 are 0.09 and 50.04 respectively. The coagulating power of AlCl_3 is x times the coagulating power of NaCl . The value of x is _____.

For complete combustion of ethene.



the amount of heat produced as measured in bomb calorimeter is 1406kJmol^{-1} at 300K . The minimum value of $T\Delta S$ needed to reach equilibrium is $(-)$ _____ kJ . (Nearest integer)

Given: $R = 8.3\text{JK}^{-1}\text{mol}^{-1}$

Mathematics Section A · Multiple choice

Q56 to Q74

Q56 Three Dimensional Geometry

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

For $a, b \in \mathbb{Z}$ and $|a - b| \leq 10$, let the angle between the plane $P : ax + y - z = b$ and the line $l : x - 1 = a - y = z + 1$ be $\cos^{-1}\left(\frac{1}{3}\right)$. If the distance of the point $(6, -6, 4)$ from the plane P is $3\sqrt{6}$, then $a^4 + b^2$ is equal to:

- (A) 48 (B) 85 (C) 32 (D) 25

Q57 Three Dimensional Geometry

Step-by-step solution > prepwiser.in/questions/HN8b27Ys_O

Let P be the plane passing through the line

$$\frac{x-1}{1} = \frac{y-2}{-3} = \frac{z+5}{7} \text{ and the point } (2, 4, -3).$$

If the image of the point $(-1, 3, 4)$ in the plane P is (α, β, γ) then $\alpha + \beta + \gamma$ is equal to:

- (A) 10 (B) 12 (C) 9 (D) 11

Q58 Mathematical Induction

Step-by-step solution > prepwiser.in/questions/N-Wma_32SX

$25^{190} - 19^{190} - 8^{190} + 2^{190}$ is divisible by:

- (A) 14 but not by 34 (B) neither 14 nor 34 (C) both 14 and 34 (D) 34 but not by 14

Q59 Binomial Theorem

Step-by-step solution > prepwiser.in/questions/u6Jjj23jVF

The absolute difference of the coefficients of x^{10} and x^7 in the expansion of $\left(2x^2 + \frac{1}{2x}\right)^{11}$ is equal to:

- (A) $11^3 - 11$ (B) $13^3 - 13$ (C) $12^3 - 12$ (D) $10^3 - 10$

Q60 Circles

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

Let O be the origin and OP and OQ be the tangents to the circle $x^2 + y^2 - 6x + 4y + 8 = 0$ at the points P and Q on it. If the circumcircle of the triangle OPQ passes through the point $\left(\alpha, \frac{1}{2}\right)$, then a value of α is:

- (A) 1 (B) $-\frac{1}{2}$ (C) $\frac{5}{2}$ (D) $\frac{3}{2}$

Q61 Complex Numbers

Step-by-step solution > prepwiser.in/questions/2yPo3mtgiM

Let $A = \{\theta \in (0, 2\pi) : \frac{1+2i \sin \theta}{1-i \sin \theta} \text{ is purely imaginary}\}$. Then the sum of the elements in A is:

- (A) 3π (B) π (C) 2π (D) 4π

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Q62 Limits[Step-by-step solution](#) › [prepwisar.in/questions/W9pmPDd32y](https://www.prepwisar.in/questions/W9pmPDd32y)

If $\alpha > \beta > 0$ are the roots of the equation $ax^2 + bx + 1 = 0$, and

$$\lim_{x \rightarrow \frac{1}{\alpha}} \left(\frac{1 - \cos(x^2 + bx + a)}{2(1 - \alpha x)^2} \right)^{\frac{1}{2}} = \frac{1}{k} \left(\frac{1}{\beta} - \frac{1}{\alpha} \right), \text{ then } k \text{ is equal to}$$

:

- (A) 2β (B) β (C) α (D) 2α

Q63 Matrices[Step-by-step solution](#) › [prepwisar.in/questions/BsBgBStmN3](https://www.prepwisar.in/questions/BsBgBStmN3)

If

$$A = \begin{bmatrix} 1 & 5 \\ \lambda & 10 \end{bmatrix}, A^{-1} = \alpha A + \beta I$$

and $\alpha + \beta = -2$, then $4\alpha^2 + \beta^2 + \lambda^2$ is equal to:

- (A) 12 (B) 10 (C) 19 (D) 14

Q64 Determinants[Step-by-step solution](#) › [prepwisar.in/questions/eMMJ-KMFy0](https://www.prepwisar.in/questions/eMMJ-KMFy0)

Let S be the set of all values of $\theta \in [-\pi, \pi]$ for which the system of linear equations

$$x + y + \sqrt{3}z = 0$$

$$-x + (\tan \theta)y + \sqrt{7}z = 0$$

$$x + y + (\tan \theta)z = 0$$

has non-trivial solution. Then $\frac{120}{\pi} \sum_{\theta \in S} \theta$ is equal to:

- (A) 40 (B) 30 (C) 10 (D) 20

Q65 Parabola[Step-by-step solution](#) › [prepwisar.in/questions/TuId9UD8ax](https://www.prepwisar.in/questions/TuId9UD8ax)

Let A(0, 1), B(1, 1) and C(1, 0) be the mid-points of the sides of a triangle with incentre at the point D. If the focus of the parabola $y^2 = 4ax$ passing through D is $(\alpha + \beta\sqrt{2}, 0)$, where α and β are rational numbers, then $\frac{\alpha}{\beta^2}$ is equal to:

- (A) $\frac{9}{2}$ (B) 12 (C) 6 (D) 8

Q66 Permutations & Combinations[Step-by-step solution](#) › [prepwisar.in/questions/7y2cnF_tps](https://www.prepwisar.in/questions/7y2cnF_tps)

If the number of words, with or without meaning, which can be made using all the letters of the word MATHEMATICS in which C and S do not come together, is $(6!)k$, then k is equal to:

- (A) 5670 (B) 1890 (C) 2835 (D) 945

Q67 Probability: Advanced[Step-by-step solution](#) › [prepwisar.in/questions/v9kQxKC4pP](https://www.prepwisar.in/questions/v9kQxKC4pP)

If the probability that the random variable X takes values x is given by

$P(X = x) = k(x + 1)3^{-x}$, $x = 0, 1, 2, 3, \dots$, where k is a constant, then $P(X \geq 2)$ is equal to:

- (A) $\frac{7}{18}$ (B) $\frac{20}{27}$ (C) $\frac{7}{27}$ (D) $\frac{11}{18}$

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Q68 Sequences & Series[Step-by-step solution](#) › prepwiser.in/questions/OK5-Z1THqI

Let a_n be the n^{th} term of the series $5 + 8 + 14 + 23 + 35 + 50 + \dots$ and $S_n = \sum_{k=1}^n a_k$. Then $S_{30} - a_{40}$ is equal to:

- (A) 11280 (B) 11290 (C) 11310 (D) 11260

Q69 Relations & Functions (Basic)[Step-by-step solution](#) › prepwiser.in/questions/ececV5PKIs

Let $A = \{1, 2, 3, 4, 5, 6, 7\}$. Then the relation $R = \{(x, y) \in A \times A : x + y = 7\}$ is:

- (A) reflexive but neither symmetric nor transitive (B) transitive but neither symmetric nor reflexive
(C) symmetric but neither reflexive nor transitive (D) an equivalence relation

Q70 Statistics[Step-by-step solution](#) › prepwiser.in/questions/szKaV8O3sz

Let the mean and variance of 12 observations be $\frac{9}{2}$ and 4 respectively. Later on, it was observed that two observations were considered as 9 and 10 instead of 7 and 14 respectively. If the correct variance is $\frac{m}{n}$, where m and n are coprime, then $m + n$ is equal to:

- (A) 317 (B) 316 (C) 314 (D) 315

Q71 Vectors[Step-by-step solution](#) › prepwiser.in/questions/sAm7vgxiAq

Let the vectors $\vec{u}_1 = \hat{i} + \hat{j} + a\hat{k}$, $\vec{u}_2 = \hat{i} + b\hat{j} + \hat{k}$ and $\vec{u}_3 = c\hat{i} + \hat{j} + \hat{k}$ be coplanar. If the vectors

$$\vec{v}_1 = (a + b)\hat{i} + c\hat{j} + c\hat{k}, \vec{v}_2 = a\hat{i} + (b + c)\hat{j} + a\hat{k}$$

and $\vec{v}_3 = b\hat{i} + b\hat{j} + (c + a)\hat{k}$ are also coplanar, then $6(a + b + c)$ is equal to:

- (A) 12 (B) 6 (C) 0 (D) 4

Q72 Vectors[Step-by-step solution](#) › prepwiser.in/questions/4nIN6r6vi0

The area of the quadrilateral ABCD with vertices A(2, 1, 1), B(1, 2, 5), C(-2, -3, 5) and D(1, -6, -7) is equal to:

- (A) 48 (B) $8\sqrt{38}$ (C) 54 (D) $9\sqrt{38}$

Q73 Indefinite Integration[Step-by-step solution](#) › prepwiser.in/questions/-9NYvaGTBW

The integral $\int \left[\left(\frac{x}{2}\right)^x + \left(\frac{2}{x}\right)^x \right] \ln\left(\frac{ex}{2}\right) dx$ is equal to:

- (A) $\left(\frac{x}{2}\right)^x + \left(\frac{2}{x}\right)^x + C$ (B) $\left(\frac{x}{2}\right)^x - \left(\frac{2}{x}\right)^x + C$
(C) $\left(\frac{x}{2}\right)^x \log_2\left(\frac{2}{x}\right) + C$ (D) None

Q74 Trigonometric Ratios & Identities[Step-by-step solution](#) › prepwiser.in/questions/vwjutGRLKB

The value of $36(4\cos^2 9^\circ - 1)(4\cos^2 27^\circ - 1)(4\cos^2 81^\circ - 1)(4\cos^2 243^\circ - 1)$ is:

- (A) 18 (B) 36 (C) 54 (D) 27

Q75 Three Dimensional Geometry **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/KcY49dFcIn

Let P_1 be the plane $3x - y - 7z = 11$ and P_2 be the plane passing through the points $(2, -1, 0)$, $(2, 0, -1)$, and $(5, 1, 1)$. If the foot of the perpendicular drawn from the point $(7, 4, -1)$ on the line of intersection of the planes P_1 and P_2 is (α, β, γ) , then $\alpha + \beta + \gamma$ is equal to _____.

Q76 Definite Integration **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/6PR4hbVDxT

Let $[t]$ denote the greatest integer function. If

$$\int_0^{2.4} [x^2] dx = \alpha + \beta\sqrt{2} + \gamma\sqrt{3} + \delta\sqrt{5}$$

, then $\alpha + \beta + \gamma + \delta$ is equal to _____.

Q77 Differential Equations **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/0aC__qeImq

Let the solution curve $x = x(y)$, $0 < y < \frac{\pi}{2}$, of the differential equation

$$(\log_e(\cos y))^2 \cos y dx - (1 + 3x \log_e(\cos y)) \sin y dy = 0$$

satisfy $x\left(\frac{\pi}{3}\right) = \frac{1}{2 \log_e 2}$. If $x\left(\frac{\pi}{6}\right) = \frac{1}{\log_e m - \log_e n}$, where m and n are coprime, then mn is equal to _____.

Q78 Relations & Functions (Basic) **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/ejchNiML4G

Let $R = \{a, b, c, d, e\}$ and $S = \{1, 2, 3, 4\}$. Total number of onto functions $f : R \rightarrow S$ such that $f(a) \neq 1$, is equal to _____.

Q79 Inverse Trigonometric Functions **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/TBapLeB7UI

If domain of the function

$$\log_e \left(\frac{6x^2 + 5x + 1}{2x - 1} \right) + \cos^{-1} \left(\frac{2x^2 - 3x + 4}{3x - 5} \right)$$

is $(\alpha, \beta) \cup (\gamma, \delta]$, then $18(\alpha^2 + \beta^2 + \gamma^2 + \delta^2)$ is equal to _____.

Q80 Continuity & Differentiability **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/iVOJ9d0E09

Let k and m be positive real numbers such that the function

$$f(x) = \begin{cases} 3x^2 + k\sqrt{x+1}, & 0 < x < 1 \\ mx^2 + k^2, & x \geq 1 \end{cases}$$

is differentiable for all $x > 0$. Then $\frac{8f'(8)}{f'(\frac{1}{8})}$ is equal to _____.

Q81 Parabola **NUMERICAL**

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

The ordinates of the points P and Q on the parabola with focus $(3, 0)$ and directrix $x = -3$ are in the ratio $3 : 1$. If $R(\alpha, \beta)$ is the point of intersection of the tangents to the parabola at P and Q , then $\frac{\beta^2}{\alpha}$ is equal to _____.

Q82 Quadratic Equations & Polynomial Inequalities **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/saIMAMP1eb

Let m and n be the numbers of real roots of the quadratic equations $x^2 - 12x + [x] + 31 = 0$ and $x^2 - 5|x + 2| - 4 = 0$ respectively, where $[x]$ denotes the greatest integer $\leq x$. Then $m^2 + mn + n^2$ is equal to _____.

Let $0 < z < y < x$ be three real numbers such that $\frac{1}{x}, \frac{1}{y}, \frac{1}{z}$ are in an arithmetic progression and $x, \sqrt{2}y, z$ are in a geometric progression. If $xy + yz + zx = \frac{3}{\sqrt{2}}xyz$, then $3(x + y + z)^2$ is equal to _____.

Let the area enclosed by the lines $x + y = 2, y = 0, x = 0$ and the curve $f(x) = \min \left\{ x^2 + \frac{3}{4}, 1 + [x] \right\}$ where $[x]$ denotes the greatest integer $\leq x$, be A. Then the value of $12A$ is _____.

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Physics

1. B	2. D	3. C	4. D	5. B	6. D	7. B	8. A
9. D	10. C	11. A	12. A	13. B	14. C	15. D	16. C
17. D	18. B	19. B	20. 4	21. 27	22. 6	23. 125	24. 30
25. 4	26. 8	27. 60	28. 30				

Chemistry

29. D	30. D	31. C	32. C	33. B	34. A	35. C	36. A
37. C	38. B	39. A	40. B	41. D	42. C	43. A	44. B
45. A	46. 4	47. 4	48. 1	49. 233	50. 6	51. 10	52. 8
53. 3	54. 556	55. 1411					

Mathematics

56. C	57. A	58. D	59. C	60. C	61. D	62. D	63. D
64. D	65. D	66. A	67. C	68. B	69. C	70. A	71. A
72. B	73. B	74. B	75. 11	76. 6	77. 12	78. 180	79. 20
80. 309	81. 16	82. 9	83. 150	84. 17			

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