

JEE MAIN 2021 · QUESTION PAPER

18 Mar 2021 Shift 2

85 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	18 Q30 to Q47	10 Q48 to Q57
● Mathematics	18 Q58 to Q75	10 Q76 to Q85
In this PDF	85 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/2021-03-18-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](#) > [prepwisar.in/questions/u9qNO5kBn7](https://www.prepwisar.in/questions/u9qNO5kBn7)

In a series LCR circuit, the inductive reactance (X_L) is 10Ω and the capacitive reactance (X_C) is 4Ω . The resistance (R) in the circuit is 6Ω . The power factor of the circuit is:

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

Q2 Nuclear Physics

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

The decay of a proton to neutron is:

- (A) always possible as it is associated only with β^+ decay
(B) possible only inside the nucleus
(C) not possible as proton mass is less than the neutron mass
(D) not possible but neutron to proton conversation is possible

Q3 Collision

[Step-by-step solution](#) > [prepwisar.in/questions/7PsGWqoXkt](https://www.prepwisar.in/questions/7PsGWqoXkt)

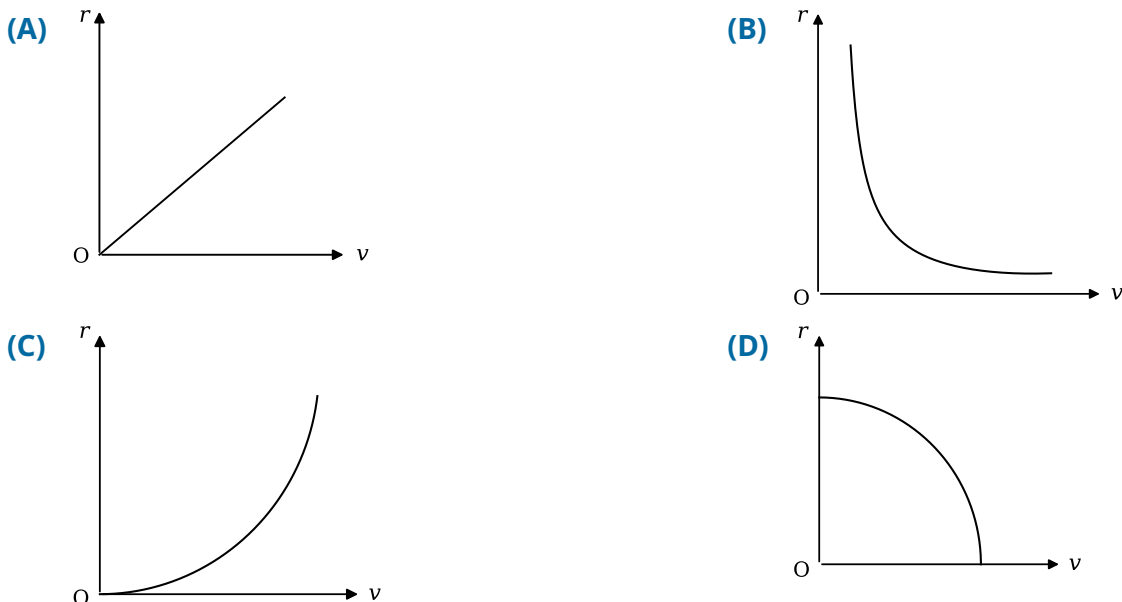
An object of mass m_1 collides with another object of mass m_2 , which is at rest. After the collision the objects move with equal speeds in opposite direction. The ratio of the masses $m_2 : m_1$ is:

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

Q4 Gravitation

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

A particle of mass m moves in a circular orbit under the central potential field, $U(r) = -\frac{C}{r}$, where C is a positive constant. The correct radius – velocity graph of the particle's motion is:



Q5 Dual Nature of Radiation & Matter

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

The speed of electrons in a scanning electron microscope is $1 \times 10^7 \text{ ms}^{-1}$. If the protons having the same speed are used instead of electrons, then the resolving power of scanning proton microscope will be changed by a factor of:

- (A) $\frac{1}{1837}$ (B) 1837 (C) $\sqrt{1837}$ (D) $\frac{1}{\sqrt{1837}}$

Q6 Electromagnetic Induction[Step-by-step solution](https://www.prepwiser.in/questions/miPSZkkg9K) > prepwiser.in/questions/miPSZkkg9K

The time taken for the magnetic energy to reach 25% of its maximum value, when a solenoid of resistance R , inductance L is connected to a battery, is:

- (A) infinite (B) $\frac{L}{R} \ln 10$ (C) $\frac{L}{R} \ln 2$ (D) $\frac{L}{R} \ln 5$

Q7 Electromagnetic Waves[Step-by-step solution](https://www.prepwiser.in/questions/uarH3d_oWP) > prepwiser.in/questions/uarH3d_oWP

A plane electromagnetic wave propagating along y -direction can have the following pair of electric field ($\vec{E}$) and magnetic field ($\vec{B}$) components.

- (A) E_x, B_z or E_z, B_x (B) E_x, B_y or E_y, B_x (C) E_y, B_y or E_z, B_z (D) E_y, B_x or E_x, B_y

Q8 Semiconductors & Electronic Devices[Step-by-step solution](https://www.prepwiser.in/questions/5r-s3um0Q2) > prepwiser.in/questions/5r-s3um0Q2

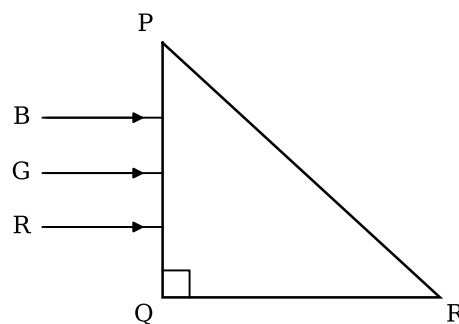
The correct relation between α (ratio of collector current to emitter current) and β (ratio of collector current to base current) of a transistor is:

- (A) $\beta = \frac{\alpha}{1+\alpha}$ (B) $\alpha = \frac{\beta}{1-\alpha}$ (C) $\alpha = \frac{\beta}{1+\beta}$ (D) $\beta = \frac{1}{1-\alpha}$

Q9 Ray Optics[Step-by-step solution](https://www.prepwiser.in/questions/4JoWcS7-Hj) > prepwiser.in/questions/4JoWcS7-Hj

Three rays of light, namely red (R), green (G) and blue (B) are incident on the face PQ of a right angled prism PQR as shown in the figure.

The refractive indices of the material of the prism for red, green and blue wavelength are 1.27, 1.42 and 1.49 respectively. The colour of the ray(s) emerging out of the face PR is:



- (A) green (B) blue and green (C) blue (D) red

Q10 Circular Motion[Step-by-step solution](https://www.prepwiser.in/questions/28dzKmTyIk) > prepwiser.in/questions/28dzKmTyIk

If the angular velocity of earth's spin is increased such that the bodies at the equator start floating, the duration of the day would be approximately : [Take $g = 10 \text{ ms}^{-2}$, the radius of earth, $R = 6400 \times 10^3 \text{ m}$, Take $\pi = 3.14$]

- (A) 84 minutes (B) 1200 minutes (C) 60 minutes (D) does not change

Q11 Gravitation[Step-by-step solution](https://www.prepwiser.in/questions/guQwzRPTYn) > prepwiser.in/questions/guQwzRPTYn

The angular momentum of a planet of mass M moving around the sun in an elliptical orbit is $\vec{L}$. The magnitude of the areal velocity of the planet is:

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

Q12 Kinetic Theory of Gases[Step-by-step solution](https://www.prepwiser.in/questions/rzx5BytW7C) > prepwiser.in/questions/rzx5BytW7C

Consider a sample of oxygen behaving like an ideal gas. At 300 K, the ratio of root mean square (rms) velocity to the average velocity of gas molecule would be:

(Molecular weight of oxygen is 32g/mol; $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$)

- (A) $\sqrt{\frac{3\pi}{8}}$ (B) $\sqrt{\frac{3}{3}}$ (C) $\sqrt{\frac{8}{3}}$ (D) $\sqrt{\frac{8\pi}{3}}$

Q13 Thermodynamics[Step-by-step solution](https://www.prepwisar.in/questions/-GrN9Wqnb-)

For an adiabatic expansion of an ideal gas, the fractional change in its pressure is equal to (where γ is the ratio of specific heats):

- (A) $-\frac{1}{\gamma} \frac{dV}{V}$ (B) $-\gamma \frac{V}{dV}$ (C) $-\gamma \frac{dV}{V}$ (D) $\frac{dV}{V}$

Q14 Thermodynamics[Step-by-step solution](https://www.prepwisar.in/questions/qKwyGMQJVj)

An ideal gas in a cylinder is separated by a piston in such a way that the entropy of one part is S_1 and that of the other part is S_2 . Given that $S_1 > S_2$. If the piston is removed then the total entropy of the system will be:

- (A) $S_1 - S_2$ (B) $\frac{S_1}{S_2}$ (C) $S_1 \times S_2$ (D) $S_1 + S_2$

Q15 Magnetism & Matter[Step-by-step solution](https://www.prepwisar.in/questions/TN447EMaNL)

Which of the following statements are correct?

- (A) Electric monopoles do not exist whereas magnetic monopoles exist.
(B) Magnetic field lines due to a solenoid at its ends and outside cannot be completely straight and confined.
(C) Magnetic field lines are completely confined within a toroid.
(D) Magnetic field lines inside a bar magnet are not parallel.
(E) $\chi = -1$ is the condition for a perfect diamagnetic material, where χ is its magnetic susceptibility.

Choose the correct answer from the options given below:

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

Q16 Moving Charges & Magnetism[Step-by-step solution](https://www.prepwisar.in/questions/ddiTk7UG9O)

A proton and an α -particle, having kinetic energies K_p and K_α respectively, enter into a magnetic field at right angles.

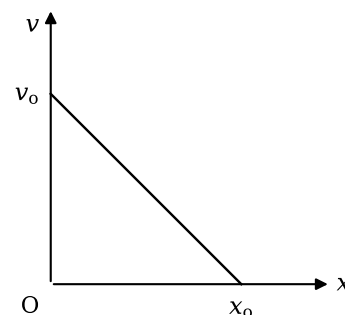
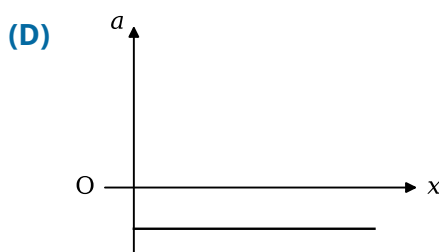
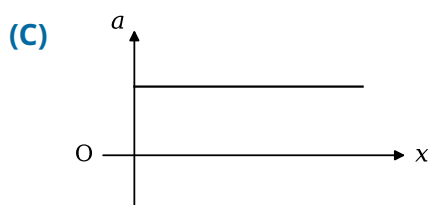
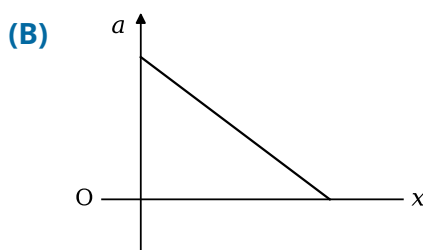
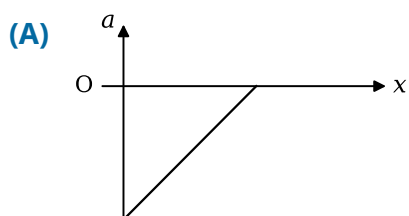
The ratio of the radii of trajectory of proton to that of α -particle is 2 : 1. The ratio of K_p : K_α is:

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

Q17 Rectilinear Motion[Step-by-step solution](https://www.prepwisar.in/questions/gl3scEZWrc)

The velocity – displacement graph of a particle is shown in the figure.

The acceleration – displacement graph of the same particle is represented by:



Q18 Rotational Motion[Step-by-step solution](#) › [prepwise.in/questions/cbf6tIqw3K](https://www.prepwise.in/questions/cbf6tIqw3K)

Consider a uniform wire of mass M and length L . It is bent into a semicircle. Its moment of inertia about a line perpendicular to the plane of the wire passing through the center is:

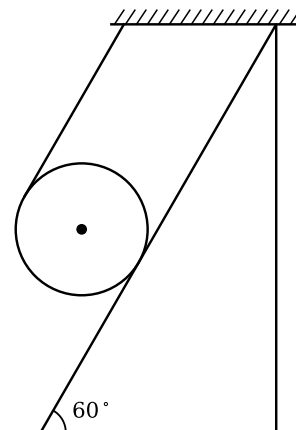
- (A) $\frac{1}{4} \frac{ML^2}{\pi^2}$ (B) $\frac{1}{2} \frac{ML^2}{\pi^2}$ (C) $\frac{2}{5} \frac{ML^2}{\pi^2}$ (D) $\frac{ML^2}{\pi^2}$

Q19 Friction[Step-by-step solution](#) › [prepwise.in/questions/ojZLC3T44U](https://www.prepwise.in/questions/ojZLC3T44U)

A solid cylinder of mass m is wrapped with an inextensible light string and, is placed on a rough inclined plane as shown in the figure. The frictional force acting between the cylinder and the inclined plane is:

[The coefficient of static friction, μ_s is 0.4]

- (A) 0 (B) $5mg$ (C) $\frac{7}{2}mg$ (D) $\frac{mg}{5}$

**Q20** Simple Harmonic Motion[Step-by-step solution](#) › [prepwise.in/questions/EewNPTmBmj](https://www.prepwise.in/questions/EewNPTmBmj)

The function of time representing a simple harmonic motion with a period of $\frac{\pi}{\omega}$ is:

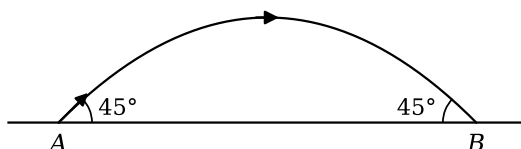
- (A) $\cos(\omega t) + \cos(2\omega t) + \cos(3\omega t)$ (B) $\sin^2(\omega t)$
(C) $\sin(\omega t) + \cos(\omega t)$ (D) $3\cos\left(\frac{\pi}{4} - 2\omega t\right)$

Physics Section B · Numerical value

Q21 to Q29

Q21 Projectile Motion & Relative Motion**NUMERICAL**[Step-by-step solution](#) › [prepwise.in/questions/MBaM9f3_4k](https://www.prepwise.in/questions/MBaM9f3_4k)

The projectile motion of a particle of mass 5 g is shown in the figure.



The initial velocity of the particle is $5\sqrt{2} \text{ ms}^{-1}$ and the air resistance is assumed to be negligible. The magnitude of the change in momentum between the points A and B is $x \times 10^{-2} \text{ kgms}^{-1}$. The value of x , to the nearest integer, is _____.

Q22 Current Electricity**NUMERICAL**[Step-by-step solution](#) › [prepwise.in/questions/7ZmEMw6UG-](https://www.prepwise.in/questions/7ZmEMw6UG-)

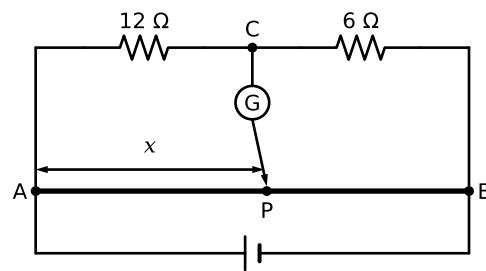
Two wires of same length and thickness having specific resistances $6\Omega \text{ cm}$ and $3\Omega \text{ cm}$ respectively are connected in parallel. The effective resistivity is $\rho\Omega \text{ cm}$. The value of ρ , to the nearest integer, is _____.

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Q23 Current Electricity **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/sgzIznDrKe) > prepwiser.in/questions/sgzIznDrKe

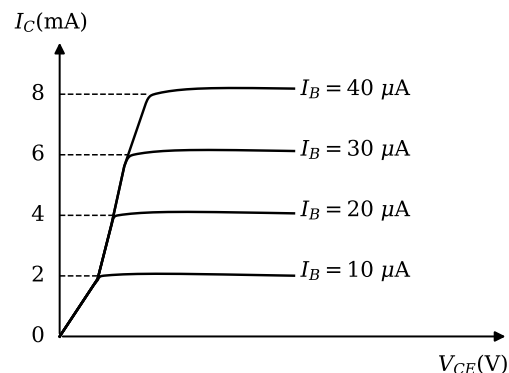
Consider a 72 cm long wire AB as shown in the figure. The galvanometer jockey is placed at P on AB at a distance x cm from A. The galvanometer shows zero deflection.

The value of x , to the nearest integer, is _____.

**Q24** Semiconductors & Electronic Devices **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/Gnbs_2WCnm) > prepwiser.in/questions/Gnbs_2WCnm

The typical output characteristics curve for a transistor working in the common-emitter configuration is shown in the figure.

The estimated current gain from the figure is _____.

**Q25** Electrostatics I: Charges, Field & Gauss's Law **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/cKrDUB4kbM) > prepwiser.in/questions/cKrDUB4kbM

An infinite number of point charges, each carrying $1 \mu C$ charge, are placed along the y -axis at $y = 1$ m, 2 m, 4 m, 8 m

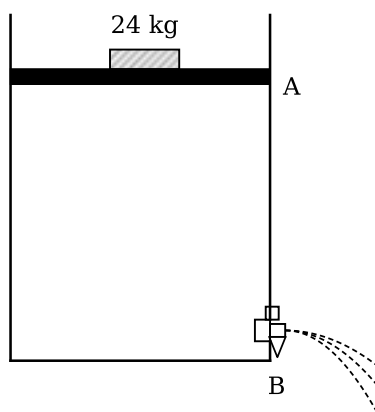
The total force on a $1C$ point charge, placed at the origin, is $x \times 10^3$ N.

The value of x , to the nearest integer, is _____. [Take $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$]

Q26 Fluid Mechanics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/iyX4s2QWzy) > prepwiser.in/questions/iyX4s2QWzy

Consider a water tank as shown in the figure. It's cross-sectional area is 0.4 m^2 . The tank has an opening B near the bottom whose cross-section area is 1 cm^2 . A load of 24 kg is applied on the water at the top when the height of the water level is 40 cm above the bottom, the velocity of water coming out the opening B is $v \text{ ms}^{-1}$.

The value of v , to the nearest integer, is _____. [Take value of g to be 10 ms^{-2}]

**Q27** Wave Optics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/h9aVhcOGpg) > prepwiser.in/questions/h9aVhcOGpg

A galaxy is moving away from the earth at a speed of 286 kms^{-1} . The shift in the wavelength of a redline at 630 nm is $x \times 10^{-10} \text{ m}$. The value of x , to the nearest integer, is _____. [Take the value of speed of light c , as $3 \times 10^8 \text{ ms}^{-1}$]

A ball of mass 4 kg, moving with a velocity of 10 ms^{-1} , collides with a spring of length 8 m and force constant 100 Nm^{-1} . The length of the compressed spring is x m. The value of x , to the nearest integer, is _____.

The radius of a sphere is measured to be (7.50 ± 0.85) cm. Suppose the percentage error in its volume is x .

The value of x , to the nearest x , is _____.

Chemistry Section A · Multiple choice

Q30 to Q47

Deficiency of vitamin K causes:

- (A) Cheilosis (B) Decrease in blood clotting time
(C) Increase in blood clotting time (D) Increase in fragility of RBC's

Match List - I with List - II: Choose the most appropriate match:

- (A) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)
(B) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)
(C) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)
(D) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

	List - I (Class of Chemicals)		List - II (Example)
(a)	Antifertility drug	(i)	Meprobamate
(b)	Antibiotic	(ii)	Alitame
(c)	Tranquilizer	(iii)	Norethindrone
(d)	Artificial Sweetener	(iv)	Salvarsan

The secondary valency and the number of hydrogen bonded water molecule(s) in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, respectively, are:

- (A) 5 and 1 (B) 4 and 1 (C) 6 and 5 (D) 6 and 4

The oxide that shows magnetic property is:

- (A) MgO (B) SiO_2 (C) Mn_3O_4 (D) Na_2O

Given below are two statements:

Statement I : $\text{C}_2\text{H}_5\text{OH}$ and AgCN both can generate nucleophile.

Statement II : KCN and AgCN both will generate nitrile nucleophile with all reaction conditions.

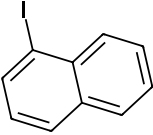
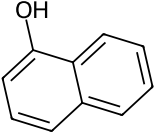
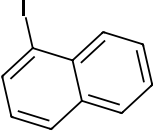
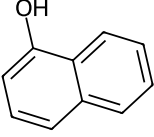
Choose the most appropriate option:

- (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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Q35 Alcohols, Phenols & Ethers[Step-by-step solution](https://www.prepwiser.in/questions/z5pqUBwyFG) › prepwiser.in/questions/z5pqUBwyFG

Main products formed during a reaction of 1-methoxy naphthalene with hydroiodic acid are:

- (A)  and CH_3I
- (B)  and CH_3OH
- (C)  and CH_3OH
- (D)  and CH_3I

Q36 Redox Reactions[Step-by-step solution](https://www.prepwiser.in/questions/_6kxfCFdy4) › prepwiser.in/questions/_6kxfCFdy4

In basic medium, H_2O_2 exhibits which of the following reactions?

- (A) $\text{Mn}^{2+} \rightarrow \text{Mn}^{4+}$
(B) $\text{I}^2 \rightarrow \text{I}^-$
(C) $\text{PbS} \rightarrow \text{PbSO}_4$

Choose the most appropriate answer from the options given below:

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

Q37 Metallurgy[Step-by-step solution](https://www.prepwiser.in/questions/20X2DQsDA2) › prepwiser.in/questions/20X2DQsDA2

Match List - I with List - II:

	List - I		List - II
(a)	Mercury	(i)	Vapour phase refining
(b)	Copper	(ii)	Distillation refining
(c)	Silicon	(iii)	Electrolytic refining
(d)	Nickel	(iv)	Zone refining

Choose the most appropriate answer from the option given below:

- (A) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i) (B) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)
(C) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv) (D) (a)-(i), (b)-(iv), (c)-(ii), (d)-(iii)

Q38 Periodic Table & Periodicity[Step-by-step solution](https://www.prepwiser.in/questions/MSeh_dLRtG) › prepwiser.in/questions/MSeh_dLRtG

The first ionization energy of magnesium is smaller as compared to that of elements X and Y, but higher than that of Z. The elements X, Y and Z, respectively, are:

- (A) neon, sodium and chlorine (B) argon, chlorine and sodium
(C) chlorine, lithium and sodium (D) argon, lithium and sodium

Q39 Redox Reactions[Step-by-step solution](https://www.prepwiser.in/questions/cxiOZAAIGn) › prepwiser.in/questions/cxiOZAAIGn

The oxidation states of nitrogen in NO , NO_2 , N_2O and NO_3^- are in the order of:

- (A) $\text{N}_2\text{O} > \text{NO}_2 > \text{NO} > \text{NO}_3^-$ (B) $\text{NO} > \text{NO}_2 > \text{N}_2\text{O} > \text{NO}_3^-$
(C) $\text{NO}_2 > \text{NO}_3^- > \text{NO} > \text{N}_2\text{O}$ (D) $\text{NO}_3^- > \text{NO}_2 > \text{NO} > \text{N}_2\text{O}$

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Match List - I with List - II:

	List - I		List - II
(a)	Be	(i)	treatment of cancer
(b)	Mg	(ii)	extraction of metals
(c)	Ca	(iii)	incendiary bombs and signals
(d)	Ra	(iv)	windows of X-ray tubes
		(v)	bearings for motor engines

Choose the most appropriate answer from the option given below:

(A) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)**(B)** (a)-(iii), (b)-(iv), (c)-(v), (d)-(ii)**(C)** (a)-(iii), (b)-(iv), (c)-(ii), (d)-(v)**(D)** (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

A hard substance melts at high temperature and is an insulator in both solid and in molten state. This solid is most likely to be a/an:

(A) Covalent solid**(B)** Molecular solid**(C)** Ionic solid**(D)** Metallic solid

Given below are two statements:

Statement I : Bohr's theory accounts for the stability and line spectrum of Li^+ ion.

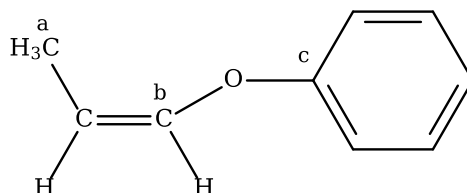
Statement II : Bohr's theory was unable to explain the splitting of spectral lines in the presence of a magnetic field.

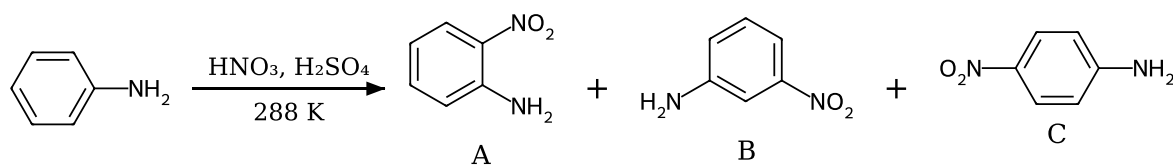
In the light of the above statements, choose the most appropriate answer from the options given below:

(A) Statement I is false but statement II is true.**(B)** Both statement I and statement II are true.**(C)** Statement I is true but statement II is false.**(D)** Both statement I and statement II are false.The charges on the colloidal CdS sol and TiO_2 sol are, respectively:**(A)** positive and positive**(B)** positive and negative**(C)** negative and negative**(D)** negative and positive

In the following molecule,

Hybridisation of Carbon a, b, and c respectively are:

(A) sp^3 , sp^2 , sp^2 **(B)** sp^3 , sp, sp^2 **(C)** sp^3 , sp^2 , sp**(D)** sp^3 , sp, spAttempt this paper online with instant answer checking › [prepwiser.in/pyqs/paper/2021-03-18-evening](https://www.prepwiser.in/pyqs/paper/2021-03-18-evening)

Q45 Amines & Diazonium Salts[Step-by-step solution](https://www.prepwiser.in/questions/kqi2wDWVx3) > prepwiser.in/questions/kqi2wDWVx3

Consider the given reaction, percentage yield of:

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

Q46 Amines & Diazonium Salts[Step-by-step solution](https://www.prepwiser.in/questions/ORRkxl_H-T) > prepwiser.in/questions/ORRkxl_H-T

In the reaction of hypobromite with amide, the carbonyl carbon is lost as:

- (A) CO_2 (B) CO (C) HCO_3^- (D) CO_3^{2-}

Q47 Amines & Diazonium Salts[Step-by-step solution](https://www.prepwiser.in/questions/aDasEs-ydv) > prepwiser.in/questions/aDasEs-ydv

An organic compound "A" on treatment with benzene sulphonyl chloride gives compound B. B is soluble in dil. NaOH solution. Compound A is:

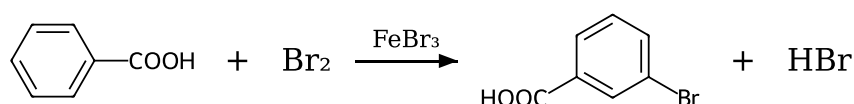
- (A) $\text{C}_6\text{H}_5 - \underset{\text{CH}_3}{\text{CH}} - \text{NH}_2$ (B) $\text{C}_6\text{H}_5 - \text{NHCH}_2\text{CH}_3$
 (C) $\text{C}_6\text{H}_5 - \text{N} - (\text{CH}_3)_2$ (D) $\text{C}_6\text{H}_5 - \text{CH}_2\text{NHCH}_3$

Chemistry Section B · Numerical value

Q48 to Q57

Q48 Aldehydes & Ketones **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/TquuU5Hj4d) > prepwiser.in/questions/TquuU5Hj4d

In Tollen's test for aldehyde, the overall number of electron(s) transferred to the Tollen's reagent formula $[\text{Ag}(\text{NH}_3)_2]^+$ per aldehyde group to form silver mirror is _____. (Round off to the Nearest Integer).

Q49 Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/4lbPDdTgaZ) > prepwiser.in/questions/4lbPDdTgaZ

Consider the above reaction where 6.1 g of Benzoic acid is used to get 7.8 g of m-bromo benzoic acid. The percentage yield of the product is _____. (Round off to the Nearest Integer).

[Given : Atomic masses : C : 12.0 u, H : 1.0 u, O : 16.0 u, Br : 80.0 u]

Q50 Chemical Bonding & Molecular Structure **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/OhCMnO6NXn) > prepwiser.in/questions/OhCMnO6NXn

The number of species below that have two lone pairs of electrons in their central atom is _____. (Round off to the Nearest Integer).

SF_4 , BF_4^- , ClF_3 , AsF_3 , PCl_5 , BrF_5 , XeF_4 , SF_6

Q51 Chemical Kinetics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/3YUAKRuH7Y) > prepwiser.in/questions/3YUAKRuH7Y

A reaction has a half life of 1 min. The time required for 99.9% completion of the reaction is _____ min. (Round off to the Nearest Integer). [Use : $\ln 2 = 0.69$; $\ln 10 = 2.3$]

Q52 Electrochemistry **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/RV77Y6N75u

The molar conductivities at infinite dilution of barium chloride, sulphuric acid and hydrochloric acid are 280, 860 and 426 S cm² mol⁻¹ respectively. The molar conductivity at infinite dilution of barium sulphate is _____ S cm² mol⁻¹. (Round off to the Nearest Integer).

Q53 Ionic Equilibrium **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/4_bopgSg6r

The solubility of CdSO₄ in water is 8.0×10^{-4} mol L⁻¹. Its solubility in 0.01 M H₂SO₄ solution is _____ $\times 10^{-6}$ mol L⁻¹. (Round off to the Nearest Integer). (Assume that solubility is much less than 0.01 M)

Q54 p-Block Elements: Part II (Group 15-18) **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/VqaDVcxR0P

A xenon compound 'A' upon partial hydrolysis gives XeO₂F₂. The number of lone pair of electrons present in compound A is _____. (Round off to the Nearest Integer)

Q55 Solutions & Colligative Properties **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/kSk5QqGoGj

A solute A dimerizes in water. The boiling point of a 2 molal solution of A is 100.52°C. The percentage association of A is _____. (Round off to the Nearest Integer).

[Use : K_b for water = 0.52 K kg mol⁻¹ Boiling point of water = 100°C]

Q56 Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/3Ubg7kh-Dv

10.0 mL of Na₂CO₃ solution is titrated against 0.2 M HCl solution. The following titre values were obtained in 5 readings:

4.8 mL, 4.9 mL, 5.0 mL, 5.0 mL and 5.0 mL

Based on these readings, and convention of titrimetric estimation the concentration of Na₂CO₃ solution is _____ mM.

(Round off to the Nearest Integer).

Q57 Chemical Equilibrium **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/LbIXQdS-Sw

The gas phase reaction $2A(g) \rightleftharpoons A_2(g)$ at 400 K has $\Delta G^\circ = +25.2$ kJ mol⁻¹.

The equilibrium constant K_c for this reaction is _____ $\times 10^{-2}$. (Round off to the Nearest Integer).

[Use : R = 8.3 J mol⁻¹ K⁻¹, ln 10 = 2.3 log₁₀ 2 = 0.30, 1 atm = 1 bar]

[antilog (-0.3) = 0.501]

Mathematics Section A · Multiple choice

Q58 to Q75

Q58 Circles[Step-by-step solution](#) › prepwiser.in/questions/5S2EKq9RC

Let S₁: x² + y² = 9 and S₂: (x - 2)² + y² = 1. Then the locus of center of a variable circle S which touches S₁ internally and S₂ externally always passes through the points:

- (A) $\left(\frac{1}{2}, \pm \frac{\sqrt{5}}{2}\right)$ (B) (1, ± 2) (C) $\left(2, \pm \frac{3}{2}\right)$ (D) (0, ± √3)

Q59 Complex Numbers[Step-by-step solution](#) › prepwiser.in/questions/vxZLgpOkdT

Let a complex number be $w = 1 - \sqrt{3}i$. Let another complex number z be such that |zw| = 1 and arg(z) - arg(w) = $\frac{\pi}{2}$. Then the area of the triangle with vertices origin, z and w is equal to:

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

Q60 Definite Integration[Step-by-step solution](#) > [prepwiser.in/questions/1Oti_ym-Vs](https://www.prepwiser.in/questions/1Oti_ym-Vs)

Let $g(x) = \int_0^x f(t)dt$, where f is continuous function in $[0, 3]$ such that $\frac{1}{3} \leq f(t) \leq 1$ for all $t \in [0, 1]$ and $0 \leq f(t) \leq \frac{1}{2}$ for all $t \in (1, 3]$. The largest possible interval in which $g(3)$ lies is:

- (A) $\left[-1, -\frac{1}{2}\right]$ (B) $\left[-\frac{3}{2}, -1\right]$ (C) $[1, 3]$ (D) $\left[\frac{1}{3}, 2\right]$

Q61 Differential Equations[Step-by-step solution](#) > [prepwiser.in/questions/eML1DIR9I2](https://www.prepwiser.in/questions/eML1DIR9I2)

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

$\frac{dy}{dx} = (y+1) \left((y+1)e^{x^2/2} - x \right)$, $0 < x < 2.1$, with $y(2) = 0$. Then the value of $\frac{dy}{dx}$ at $x = 1$ is equal to:

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

Q62 Ellipse[Step-by-step solution](#) > [prepwiser.in/questions/j1KfmzX56U](https://www.prepwiser.in/questions/j1KfmzX56U)

Let a tangent be drawn to the ellipse $\frac{x^2}{27} + y^2 = 1$ at $(3\sqrt{3}\cos\theta, \sin\theta)$ where $0 \in (0, \frac{\pi}{2})$. Then the value of θ such that the sum of intercepts on axes made by this tangent is minimum is equal to:

- (A) $\frac{\pi}{6}$ (B) $\frac{\pi}{3}$ (C) $\frac{\pi}{8}$ (D) $\frac{\pi}{4}$

Q63 Functions (Advanced)[Step-by-step solution](#) > [prepwiser.in/questions/H97AOaZdp0](https://www.prepwiser.in/questions/H97AOaZdp0)

Let $f: \mathbb{R} - \{3\} \rightarrow \mathbb{R} - \{1\}$ be defined by $f(x) = \frac{x-2}{x-3}$.

Let $g: \mathbb{R} \rightarrow \mathbb{R}$ be given as $g(x) = 2x - 3$. Then, the sum of all the values of x for which $f^{-1}(x) + g^{-1}(x) = \frac{13}{2}$ is equal to:

- (A) 3 (B) 5 (C) 2 (D) 7

Q64 Hyperbola[Step-by-step solution](#) > [prepwiser.in/questions/Pl-aUo7vzJ](https://www.prepwiser.in/questions/Pl-aUo7vzJ)

Consider a hyperbola $H: x^2 - 2y^2 = 4$. Let the tangent at a point $P(4, \sqrt{6})$ meet the x -axis at Q and latus rectum at $R(x_1, y_1)$, $x_1 > 0$. If F is a focus of H which is nearer to the point P , then the area of $\triangle QFR$ is equal to:

- (A) $\sqrt{6} - 1$ (B) $\frac{7}{\sqrt{6}} - 2$ (C) $4\sqrt{6} - 1$ (D) $4\sqrt{6}$

Q65 Continuity & Differentiability[Step-by-step solution](#) > [prepwiser.in/questions/Vb5TbCfA_o](https://www.prepwiser.in/questions/Vb5TbCfA_o)

Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be a function defined as

$$f(x) = \begin{cases} \frac{\sin(a+1)x + \sin 2x}{2x}, & \text{if } x < 0 \\ b, & \text{if } x = 0 \\ \frac{\sqrt{x+bx^3} - \sqrt{x}}{bx^{5/2}}, & \text{if } x > 0 \end{cases}$$

If f is continuous at $x = 0$, then the value of $a + b$ is equal to:

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

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Q66 Determinants[Step-by-step solution](#) > [prepwisar.in/questions/PNayGcDZG_](https://www.prepwisar.in/questions/PNayGcDZG_)

Let the system of linear equations

$$4x + \lambda y + 2z = 0$$

$$2x - y + z = 0$$

$$\mu x + 2y + 3z = 0, \lambda, \mu \in \mathbb{R}.$$

has a non-trivial solution. Then which of the following is true?

- (A) $\mu = 6, \lambda \in \mathbb{R}$ (B) $\lambda = 3, \mu \in \mathbb{R}$ (C) $\mu = -6, \lambda \in \mathbb{R}$ (D) $\lambda = 2, \mu \in \mathbb{R}$

Q67 Probability: Advanced[Step-by-step solution](#) > [prepwisar.in/questions/BlTt9kyHK](https://www.prepwisar.in/questions/BlTt9kyHK)

Let in a Binomial distribution, consisting of 5 independent trials, probabilities of exactly 1 and 2 successes be 0.4096 and 0.2048 respectively. Then the probability of getting exactly 3 successes is equal to:

- (A) $\frac{40}{243}$ (B) $\frac{128}{625}$ (C) $\frac{80}{243}$ (D) $\frac{32}{625}$

Q68 Sequences & Series[Step-by-step solution](#) > [prepwisar.in/questions/oHaWrYaxGf](https://www.prepwisar.in/questions/oHaWrYaxGf)

Let S_1 be the sum of first $2n$ terms of an arithmetic progression. Let S_2 be the sum of first $4n$ terms of the same arithmetic progression. If $(S_2 - S_1)$ is 1000, then the sum of the first $6n$ terms of the arithmetic progression is equal to:

- (A) 7000 (B) 1000 (C) 3000 (D) 5000

Q69 Relations & Functions (Basic)[Step-by-step solution](#) > [prepwisar.in/questions/eMx8OEj7IZ](https://www.prepwisar.in/questions/eMx8OEj7IZ)

Define a relation R over a class of $n \times n$ real matrices A and B as

" $A R B$ iff there exists a non-singular matrix P such that $PAP^{-1} = B$ ".

Then which of the following is true?

- (A) R is reflexive, transitive but not symmetric (B) R is symmetric, transitive but not reflexive.
(C) R is reflexive, symmetric but not transitive (D) R is an equivalence relation

Q70 Statistics[Step-by-step solution](#) > [prepwisar.in/questions/G_vIs2zq_H](https://www.prepwisar.in/questions/G_vIs2zq_H)

Let in a series of $2n$ observations, half of them are equal to a and remaining half are equal to $-a$. Also by adding a constant b in each of these observations, the mean and standard deviation of new set become 5 and 20, respectively. Then the value of $a^2 + b^2$ is equal to:

- (A) 425 (B) 250 (C) 925 (D) 650

Q71 Vectors[Step-by-step solution](#) > [prepwisar.in/questions/PH05gYm3Ac](https://www.prepwisar.in/questions/PH05gYm3Ac)

Let $\vec{a}$ and $\vec{b}$ be two non-zero vectors perpendicular to each other and $|\vec{a}| = |\vec{b}|$. If $|\vec{a} \times \vec{b}| = |\vec{a}|$, then the angle between the vectors

$$(\vec{a} + \vec{b} + (\vec{a} \times \vec{b}))$$

and $\vec{a}$ is equal to:

- (A) $\sin^{-1} \left(\frac{1}{\sqrt{6}} \right)$ (B) $\cos^{-1} \left(\frac{1}{\sqrt{2}} \right)$ (C) $\sin^{-1} \left(\frac{1}{\sqrt{3}} \right)$ (D) $\cos^{-1} \left(\frac{1}{\sqrt{3}} \right)$

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

In a triangle ABC, if

$$|\overrightarrow{BC}| = 8, |\overrightarrow{CA}| = 7, |\overrightarrow{AB}| = 10$$

, then the projection of the vector $\overrightarrow{AB}$ on $\overrightarrow{AC}$ is equal to:

- (A) $\frac{25}{4}$ (B) $\frac{127}{20}$ (C) $\frac{85}{14}$ (D) $\frac{115}{16}$

Q73 Area Under Curves[Step-by-step solution](#) › [prepwiser.in/questions/Pcgtipimj6B](#)

The area bounded by the curve $4y^2 = x^2(4 - x)(x - 2)$ is equal to:

- (A) $\frac{\pi}{16}$ (B) $\frac{\pi}{8}$ (C) $\frac{3\pi}{2}$ (D) $\frac{3\pi}{8}$

Q74 Straight Lines[Step-by-step solution](#) › [prepwiser.in/questions/yt-siggQpl](#)

Let the centroid of an equilateral triangle ABC be at the origin. Let one of the sides of the equilateral triangle be along the straight line $x + y = 3$. If R and r be the radius of circumcircle and incircle respectively of $\triangle ABC$, then $(R + r)$ is equal to:

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

Q75 Trigonometric Ratios & Identities[Step-by-step solution](#) › [prepwiser.in/questions/NjZD4KFofm](#)

If $15\sin^4\alpha + 10\cos^4\alpha = 6$, for some $\alpha \in \mathbb{R}$, then the value of $27\sec^6\alpha + 8\operatorname{cosec}^6\alpha$ is equal to:

- (A) 500 (B) 400 (C) 250 (D) 350

Mathematics Section B · Numerical value

Q76 to Q85

Q76 Three Dimensional Geometry **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/ytwZLIqeZM](#)

Let the mirror image of the point $(1, 3, a)$ with respect to the plane

$$\vec{r} \cdot (2\hat{i} - \hat{j} + \hat{k}) - b = 0$$

be $(-3, 5, 2)$. Then, the value of $|a + b|$ is equal to _____.

Q77 Three Dimensional Geometry **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/P2h-qZoIcJ](#)

Let P be a plane containing the line $\frac{x-1}{3} = \frac{y+6}{4} = \frac{z+5}{2}$ and parallel to the line $\frac{x-1}{4} = \frac{y-2}{-3} = \frac{z+5}{7}$. If the point $(1, -1, \alpha)$ lies on the plane P, then the value of $|5\alpha|$ is equal to _____.

Q78 Binomial Theorem **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/5sI71-K3by](#)

The term independent of x in the expansion of

$$\left[\frac{x+1}{x^{2/3} - x^{1/3} + 1} - \frac{x-1}{x - x^{1/2}} \right]^{10}$$

, $x \neq 1$, is equal to _____.

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Q79 Binomial Theorem **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/98RjEVpkC_

Let ${}^nC_r$ denote the binomial coefficient of x^r in the expansion of $(1+x)^n$. If

$$\sum_{k=0}^{10} (2^2 + 3k)^{10} C_k = \alpha \cdot 3^{10} + \beta \cdot 2^{10}, \alpha, \beta \in R$$

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

Q80 Applications of Derivatives **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/_XCeb7-7W4

Let $P(x)$ be a real polynomial of degree 3 which vanishes at $x = -3$. Let $P(x)$ have local minima at $x = 1$, local maxima at $x = -1$ and $\int_{-1}^1 P(x) dx = 18$, then the sum of all the coefficients of the polynomial $P(x)$ is equal to _____.

Q81 Differential Equations **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/h6fUfReTXA

Let $y = y(x)$ be the solution of the differential equation $x dy - y dx = \sqrt{x^2 - y^2} dx$, $x \geq 1$, with $y(1) = 0$. If the area bounded by the line $x = 1$, $x = e^\pi$, $y = 0$ and $y = y(x)$ is $\alpha e^{2\pi} + \beta$, then the value of $10(\alpha + \beta)$ is equal to _____.

Q82 Complex Numbers **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/qzZ4fk0ttX

If $f(x)$ and $g(x)$ are two polynomials such that the polynomial $P(x) = f(x^3) + x g(x^3)$ is divisible by $x^2 + x + 1$, then $P(1)$ is equal to _____.

Q83 Functions (Advanced) **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/ebVgUpuwb9

Let $f: R \rightarrow R$ satisfy the equation $f(x+y) = f(x) \cdot f(y)$ for all $x, y \in R$ and $f(x) \neq 0$ for any $x \in R$. If the function f is differentiable at $x = 0$ and $f'(0) = 3$, then $\lim_{h \rightarrow 0} \frac{1}{h} (f(h) - 1)$ is equal to _____.

Q84 Matrices **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/7qONzcZgnA

Let I be an identity matrix of order 2×2 and $P = \begin{bmatrix} 2 & -1 \\ 5 & -3 \end{bmatrix}$. Then the value of $n \in N$ for which $P^n = 5I - 8P$ is equal to _____.

Q85 Sequences & Series **NUMERICAL**[Step-by-step solution](#) › prepwiser.in/questions/kB3CKMpXo5

If $\sum_{r=1}^{10} r!(r^3 + 6r^2 + 2r + 5) = \alpha(11!)$, then the value of α is equal to _____.

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Physics

1.	C	2.	B	3.	B	4.	B	5.	B	6.	C	7.	A	8.	C	9.	D	10.	A
11.	B	12.	A	13.	C	14.	D	15.	C	16.	B	17.	A	18.	D	19.	D	20.	D
21.	5	22.	4	23.	48	24.	200	25.	12	26.	3	27.	6	28.	6	29.	34		

Chemistry

30.	C	31.	B	32.	B	33.	C	34.	D	35.	D	36.	B	37.	A	38.	B	39.	D
40.	D	41.	A	42.	A	43.	D	44.	A	45.	D	46.	D	47.	A	48.	2	49.	78
50.	2	51.	10	52.	288	53.	64	54.	19	55.	100	56.	50	57.	2				

Mathematics

58.	C	59.	D	60.	D	61.	D	62.	A	63.	B	64.	B	65.	D	66.	A	67.	D
68.	C	69.	D	70.	A	71.	D	72.	C	73.	C	74.	B	75.	C	76.	1	77.	38
78.	210	79.	19	80.	8	81.	4	82.	0	83.	3	84.	6	85.	160				

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