

JEE MAIN 2025 · QUESTION PAPER

22 Jan 2025 **Shift 1**

74 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	20 Q1 to Q20	5 Q21 to Q25
● Chemistry	20 Q26 to Q45	5 Q46 to Q50
● Mathematics	19 Q51 to Q69	5 Q70 to Q74
In this PDF	74 questions · answer key at the end	

- 1 Set a 3 hour timer and attempt the paper in one sitting, like the real exam.
- 2 Check yourself against the answer key at the end. Every question names its chapter, so you can see where marks went.
- 3 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.

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Q1 Electrostatics I: Charges, Field & Gauss's Law

[Step-by-step solution](#) › [prepwisar.in/questions/Xlca5F0oq1](https://www.prepwisar.in/questions/Xlca5F0oq1)

An electron is made to enter symmetrically between two parallel and equally but oppositely charged metal plates, each of 10 cm length. The electron emerges out of the electric field region with a horizontal component of velocity 10^6 m/s . If the magnitude of the electric field between the plates is 9.1 V/cm , then the vertical component of velocity of electron is (mass of electron = $9.1 \times 10^{-31} \text{ kg}$ and charge of electron = $1.6 \times 10^{-19} \text{ C}$)

- (A) $1 \times 10^6 \text{ m/s}$ (B) $16 \times 10^6 \text{ m/s}$ (C) $16 \times 10^4 \text{ m/s}$ (D) 0

Q2 Electrostatics II: Potential & Capacitance

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

A parallel-plate capacitor of capacitance $40 \mu\text{F}$ is connected to a 100 V power supply. Now the intermediate space between the plates is filled with a dielectric material of dielectric constant $K = 2$. Due to the introduction of dielectric material, the extra charge and the change in the electrostatic energy in the capacitor, respectively, are

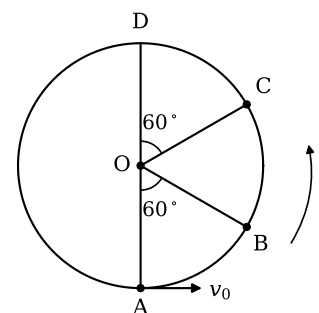
- (A) 8 mC and 2.0 J (B) 4 mC and 0.2 J (C) 2 mC and 0.2 J (D) 2 mC and 0.4 J

Q3 Circular Motion

[Step-by-step solution](#) › [prepwisar.in/questions/R2RVXMTmsL](https://www.prepwisar.in/questions/R2RVXMTmsL)

A bob of mass m is suspended at a point O by a light string of length l and left to perform vertical motion (circular) as shown in figure. Initially, by applying horizontal velocity v_0 at the point 'A', the string becomes slack when, the bob reaches at the point 'D'. The ratio of the kinetic energy of the bob at the points B and C is _____.

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



Q4 Current Electricity

[Step-by-step solution](#) › [prepwisar.in/questions/IglDZxU8ht](https://www.prepwisar.in/questions/IglDZxU8ht)

Given below are two statements:

Statement-I : The equivalent emf of two nonideal batteries connected in parallel is smaller than either of the two emfs.

Statement-II : The equivalent internal resistance of two nonideal batteries connected in parallel is smaller than the internal resistance of either of the two batteries.

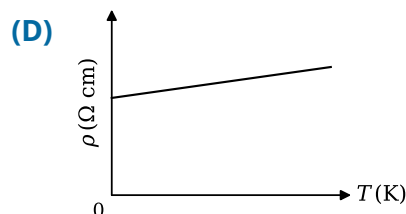
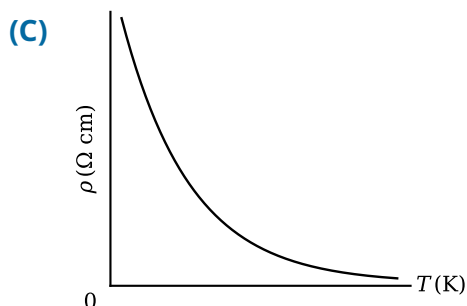
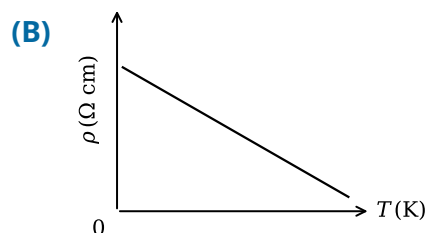
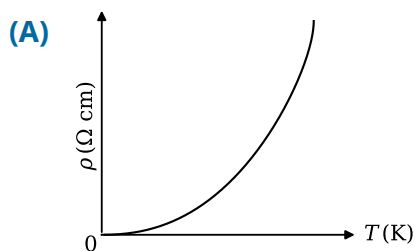
In the light of the above statements, choose the correct answer from the options given below.

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

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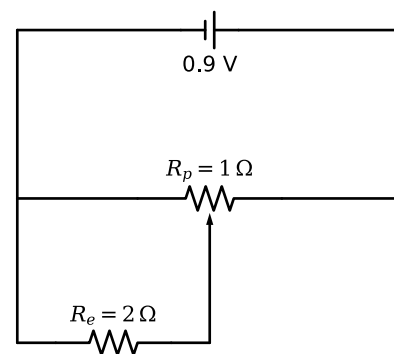
Q5 Current Electricity[Step-by-step solution](https://www.prepwise.in/questions/6fWguWSQV) › prepwise.in/questions/6fWguWSQV

Which of the following resistivity (ρ) v/s temperature (T) curves is most suitable to be used in wire bound standard resistors?

**Q6** Current Electricity[Step-by-step solution](https://www.prepwise.in/questions/mUcPN5o-8P) › prepwise.in/questions/mUcPN5o-8P

Sliding contact of a potentiometer is in the middle of the potentiometer wire having resistance $R_p = 1\Omega$ as shown in the figure. An external resistance of $R_e = 2\Omega$ is connected via the sliding contact. The electric current in the circuit is:

- (A) 1.35 A (B) 0.9 A (C) 1.0 A (D) 0.3 A

**Q7** Dual Nature of Radiation & Matter[Step-by-step solution](https://www.prepwise.in/questions/0qiS9GK_-f) › prepwise.in/questions/0qiS9GK_-f

The work functions of cesium (Cs) and lithium (Li) metals are 1.9 eV and 2.5 eV, respectively. If we incident a light of wavelength 550 nm on these two metal surfaces, then photo-electric effect is possible for the case of

- (A) Both Cs and Li (B) Neither Cs nor Li (C) Li only (D) Cs only

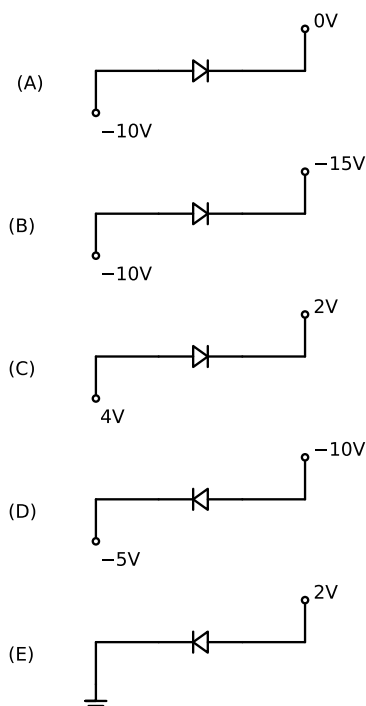
Q8 Atomic Physics[Step-by-step solution](https://www.prepwise.in/questions/1ZSFYzUpAz) › prepwise.in/questions/1ZSFYzUpAz

An electron in the ground state of the hydrogen atom has the orbital radius of $5.3 \times 10^{-11}\text{m}$ while that for the electron in third excited state is $8.48 \times 10^{-10}\text{m}$. The ratio of the de Broglie wavelengths of electron in the ground state to that in the excited state is

- (A) 4 (B) 3 (C) 9 (D) 16

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Which of the following circuits represents a forward biased diode?

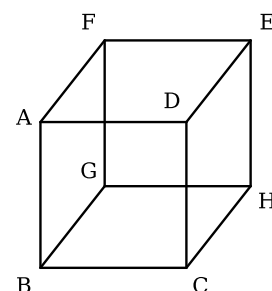


Choose the correct answer from the options given below:

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

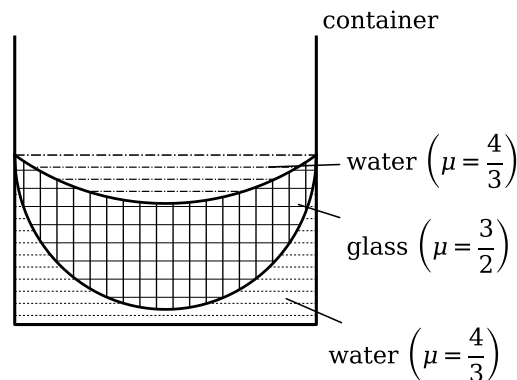
A line charge of length $\frac{a}{2}$ is kept at the center of an edge BC of a cube $ABCDEFGH$ having edge length ' a ' as shown in the figure. If the density of line charge is λC per unit length, then the total electric flux through all the faces of the cube will be _____. (Take, ϵ_0 as the free space permittivity)

- (A) $\frac{\lambda a}{2\epsilon_0}$ (B) $\frac{\lambda a}{8\epsilon_0}$ (C) $\frac{\lambda a}{4\epsilon_0}$ (D) $\frac{\lambda a}{16\epsilon_0}$



Q11 Ray Optics[Step-by-step solution > prepwisar.in/questions/OOWn16Ho8q](https://www.prepwisar.in/questions/OOWn16Ho8q)

In the diagram given below, there are three lenses formed. Considering negligible thickness of each of them as compared to $|R_1|$ and $|R_2|$, i.e., the radii of curvature for upper and lower surfaces of the glass lens, the power of the combination is



(A) $-\frac{1}{6} \left(\frac{1}{|R_1|} - \frac{1}{|R_2|} \right)$

(B) $-\frac{1}{6} \left(\frac{1}{|R_1|} + \frac{1}{|R_2|} \right)$

(C) $\frac{1}{6} \left(\frac{1}{|R_1|} + \frac{1}{|R_2|} \right)$

(D) $\frac{1}{6} \left(\frac{1}{|R_1|} - \frac{1}{|R_2|} \right)$

Q12 Ray Optics[Step-by-step solution > prepwisar.in/questions/LqLaY0Rixj](https://www.prepwisar.in/questions/LqLaY0Rixj)

Given is a thin convex lens of glass (refractive index μ) and each side having radius of curvature R . One side is polished for complete reflection. At what distance from the lens, an object be placed on the optic axis so that the image gets formed on the object itself?

(A) R/μ

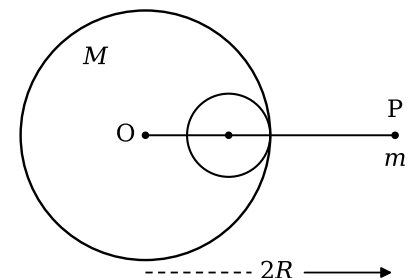
(B) $R/(2\mu - 1)$

(C) $R/(2\mu - 3)$

(D) μR

Q13 Gravitation[Step-by-step solution > prepwisar.in/questions/aY2l39mokP](https://www.prepwisar.in/questions/aY2l39mokP)

A small point of mass m is placed at a distance $2R$ from the centre 'O' of a big uniform solid sphere of mass M and radius R . The gravitational force on 'm' due to M is F_1 . A spherical part of radius $R/3$ is removed from the big sphere as shown in the figure and the gravitational force on m due to remaining part of M is found to be F_2 . The value of ratio $F_1 : F_2$ is



(A) 11 : 10

(B) 12 : 11

(C) 16 : 9

(D) 12 : 9

Q14 Heat Transfer[Step-by-step solution > prepwisar.in/questions/nUa8jdisgH](https://www.prepwisar.in/questions/nUa8jdisgH)

Two spherical bodies of same materials having radii 0.2 m and 0.8 m are placed in same atmosphere. The temperature of the smaller body is 800 K and temperature of the bigger body is 400 K. If the energy radiated from the smaller body is E , the energy radiated from the bigger body is (assume, effect of the surrounding temperature to be negligible),

(A) 64 E

(B) 16 E

(C) E

(D) 256 E

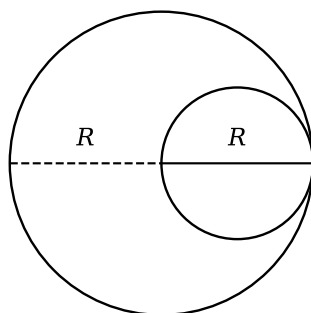
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Q15 Thermometry & Calorimetry[Step-by-step solution](https://www.prepwiser.in/questions/NPxfj8uno) > prepwiser.in/questions/NPxfj8uno

An amount of ice of mass 10^{-3}kg and temperature -10°C is transformed to vapour of temperature 110°C by applying heat. The total amount of work required for this conversion is, (Take, specific heat of ice $= 2100\text{Jkg}^{-1}\text{K}^{-1}$, specific heat of water $= 4180\text{Jkg}^{-1}\text{K}^{-1}$, specific heat of steam $= 1920\text{Jkg}^{-1}\text{K}^{-1}$, Latent heat of ice $= 3.35 \times 10^5\text{Jkg}^{-1}$ and Latent heat of steam $= 2.25 \times 10^6\text{Jkg}^{-1}$)

(A) 3022 J**(B)** 3043 J**(C)** 3003 J**(D)** 3024 J**Q16** Rotational Motion[Step-by-step solution](https://www.prepwiser.in/questions/UK8sGEdBfN) > prepwiser.in/questions/UK8sGEdBfN

A uniform circular disc of radius 'R' and mass 'M' is rotating about an axis perpendicular to its plane and passing through its centre. A small circular part of radius $R/2$ is removed from the original disc as shown in the figure. Find the moment of inertia of the remaining part of the original disc about the axis as given above.

**(A)** $\frac{17}{32}MR^2$ **(B)** $\frac{13}{32}MR^2$ **(C)** $\frac{9}{32}MR^2$ **(D)** $\frac{7}{32}MR^2$ **Q17** Wave Optics[Step-by-step solution](https://www.prepwiser.in/questions/PI42TH0zMx) > prepwiser.in/questions/PI42TH0zMx

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

Assertion-(A) : If Young's double slit experiment is performed in an optically denser medium than air, then the consecutive fringes come closer.

Reason-(R) : The speed of light reduces in an optically denser medium than air while its frequency does not change.

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

(A) (A) is false but (R) is true**(B)** Both (A) and (R) are true but (R) is not the correct explanation of (A)**(C)** Both (A) and (R) are true and (R) is the correct explanation of (A)**(D)** (A) is true but (R) is false**Q18** Mechanical Waves[Step-by-step solution](https://www.prepwiser.in/questions/UTIM7WUXfA) > prepwiser.in/questions/UTIM7WUXfA

A closed organ and an open organ tube are filled by two different gases having same bulk modulus but different densities ρ_1 and ρ_2 , respectively. The frequency of 9th harmonic of closed tube is identical with 4th harmonic of open tube. If the length of the closed tube is 10 cm and the density ratio of the gases is $\rho_1 : \rho_2 = 1 : 16$, then the length of the open tube is:

(A) $\frac{15}{7}\text{cm}$ **(B)** $\frac{20}{9}\text{cm}$ **(C)** $\frac{20}{7}\text{cm}$ **(D)** $\frac{15}{9}\text{cm}$

If B is magnetic field and μ_0 is permeability of free space, then the dimensions of (B/μ_0) is

- (A) $MT^{-2}A^{-1}$ (B) $L^{-1}A$ (C) $ML^2T^{-2}A^{-1}$ (D) $LT^{-2}A^{-1}$

Given below are two statements:

Statement I: In a vernier callipers, one vernier scale division is always smaller than one main scale division.

Statement II : The vernier constant is given by one main scale division multiplied by the number of vernier scale divisions.

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

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

Physics Section B · Numerical value

Q21 to Q25

The driver sitting inside a parked car is watching vehicles approaching from behind with the help of his side view mirror, which is a convex mirror with radius of curvature $R = 2m$. Another car approaches him from behind with a uniform speed of $90km/hr$. When the car is at a distance of $24 m$ from him, the magnitude of the acceleration of the image of the car in the side view mirror is ' a '. The value of $100a$ is _____ m/s^2 .

Three conductors of same length having thermal conductivity k_1, k_2 and k_3 are connected as shown in figure.

Area of cross sections of 1st and 2nd conductor are same and for 3rd conductor it is double of the 1st conductor. The temperatures are given in the figure. In steady state condition, the value of θ is _____ $^{\circ}C$. (Given: $k_1 = 60Js^{-1}m^{-1}K^{-1}$, $k_2 = 120Js^{-1}m^{-1}K^{-1}$, $k_3 = 135Js^{-1}m^{-1}K^{-1}$)

100 $^{\circ}C$	$\theta^{\circ}C$	0 $^{\circ}C$
1. k_1	3. k_3	
2. k_2		

A particle is projected at an angle of 30° from horizontal at a speed of $60m/s$. The height traversed by the particle in the first second is h_0 and height traversed in the last second, before it reaches the maximum height, is h_1 . The ratio $h_0 : h_1$ is _____.

[Take, $g = 10m/s^2$]

Two soap bubbles of radius $2 cm$ and $4 cm$, respectively, are in contact with each other. The radius of curvature of the common surface, in cm , is _____.

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The position vectors of two 1 kg particles, (A) and (B), are given by

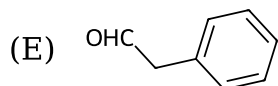
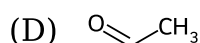
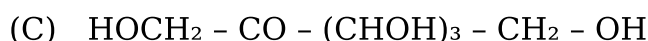
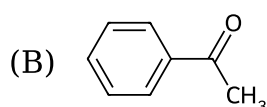
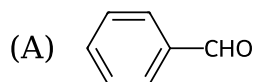
$$\vec{r}_A = (\alpha_1 t^2 \hat{i} + \alpha_2 t \hat{j} + \alpha_3 t \hat{k}) \text{ m and } \vec{r}_B = (\beta_1 t \hat{i} + \beta_2 t^2 \hat{j} + \beta_3 t \hat{k}) \text{ m, respectively;}$$

($\alpha_1 = 1\text{m/s}^2$, $\alpha_2 = 3\text{nm/s}$, $\alpha_3 = 2\text{m/s}$, $\beta_1 = 2\text{m/s}$, $\beta_2 = -1\text{m/s}^2$, $\beta_3 = 4\text{pm/s}$), where t is time, n and p are constants. At $t = 1\text{s}$, $|\vec{V}_A| = |\vec{V}_B|$ and velocities $\vec{V}_A$ and $\vec{V}_B$ of the particles are orthogonal to each other. At $t = 1\text{s}$, the magnitude of angular momentum of particle (A) with respect to the position of particle (B) is $\sqrt{L}\text{kgm}^2\text{s}^{-1}$. The value of L is _____.

Chemistry Section A · Multiple choice

Q26 to Q45

The compounds which give positive Fehling's test are:



Choose the correct answer from the options given below:

- (A) (A), (C) and (D) Only (B) (A), (B) and (C) Only (C) (A), (D) and (E) Only (D) (C), (D) and (E) Only

Which of the following acids is a vitamin?

- (A) Saccharic acid (B) Ascorbic acid (C) Aspartic acid (D) Adipic acid

Which of the following statement is not true for radioactive decay?

- (A) Half life is $\ln 2$ times of $\frac{1}{\text{rate constant}}$.
 (B) Decay constant increases with increase in temperature.
 (C) Decay constant does not depend upon temperature.
 (D) Amount of radioactive substance remained after three half lives is $\frac{1}{8}$ th of original amount.

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Q29 Coordination Compounds[Step-by-step solution](https://www.prepwisar.in/questions/EsKbvFvX7w) > prepwisar.in/questions/EsKbvFvX7w

From the magnetic behaviour of $[\text{NiCl}_4]^{2-}$ (paramagnetic) and $[\text{Ni}(\text{CO})_4]$ (diamagnetic), choose the correct geometry and oxidation state.

- (A) $[\text{NiCl}_4]^{2-}$: Ni(0), tetrahedral $[\text{Ni}(\text{CO})_4]$: Ni(0), square planar
(B) $[\text{NiCl}_4]^{2-}$: Ni^{II} , tetrahedral $[\text{Ni}(\text{CO})_4]$: Ni(0), tetrahedral
(C) $[\text{NiCl}_4]^{2-}$: Ni^{II} , tetrahedral $[\text{Ni}(\text{CO})_4]$: Ni^{II} , square planar
(D) $[\text{NiCl}_4]^{2-}$: Ni^{II} , square planar $[\text{Ni}(\text{CO})_4]$: Ni(0), square planar

Q30 Coordination Compounds[Step-by-step solution](https://www.prepwisar.in/questions/zlw9NO6YTT) > prepwisar.in/questions/zlw9NO6YTT

In which of the following complexes the CFSE, Δ_o will be equal to zero?

- (A) $\text{K}_3[\text{Fe}(\text{SCN})_6]$ (B) $[\text{Fe}(\text{en})_3]\text{Cl}_3$ (C) $[\text{Fe}(\text{NH}_3)_6]\text{Br}_2$ (D) $\text{K}_4[\text{Fe}(\text{CN})_6]$

Q31 d & f Block Elements[Step-by-step solution](https://www.prepwisar.in/questions/NAywj6SbmA) > prepwisar.in/questions/NAywj6SbmA

Lanthanoid ions with $4f^7$ configuration are:

- (A) Eu^{2+}
(B) Gd^{3+}
(C) Eu^{3+}
(D) Tb^{3+}
(E) Sm^{2+}

Choose the correct answer from the options given below:

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

Q32 Electrochemistry[Step-by-step solution](https://www.prepwisar.in/questions/0hCLYqhezq) > prepwisar.in/questions/0hCLYqhezq

Which of the following electrolyte can be used to obtain $\text{H}_2\text{S}_2\text{O}_8$ by the process of electrolysis?

- (A) Concentrated solution of sulphuric acid (B) Dilute solution of sodium sulphate.
(C) Acidified dilute solution of sodium sulphate. (D) Dilute solution of sulphuric acid

Q33 Electrochemistry[Step-by-step solution](https://www.prepwisar.in/questions/L8fP_Ht11i) > prepwisar.in/questions/L8fP_Ht11i

A solution of aluminium chloride is electrolysed for 30 minutes using a current of 2 A. The amount of the aluminium deposited at the cathode is _____.

[Given : molar mass of aluminium and chlorine are 27g mol^{-1} and 35.5g mol^{-1} respectively. Faraday constant = 96500C mol^{-1}]

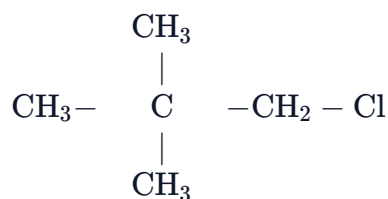
- (A) 1.660 g (B) 1.007 g (C) 0.336 g (D) 0.441 g

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Given below are two statements:

Statement I: $\text{CH}_3 - \text{O} - \text{CH}_2 - \text{Cl}$ will undergo $\text{S}_{\text{N}}1$ reaction though it is a primary halide.

Statement II:



will not undergo $\text{S}_{\text{N}}2$ reaction very easily though it is a primary halide.

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

Given below are two statements:

Statement I : One mole of propyne reacts with excess of sodium to liberate half a mole of H_2 gas.

Statement II : Four g of propyne reacts with NaNH_2 to liberate NH_3 gas which occupies 224 mL at STP.

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 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

Match List-I with List-II.

	List - I		List - II
(A)	$\text{Al}^{3+} < \text{Mg}^{2+} < \text{Na}^+ < \text{F}^-$	(I)	Ionisation Enthalpy
(B)	$\text{B} < \text{C} < \text{O} < \text{N}$	(II)	Metallic character
(C)	$\text{B} < \text{Al} < \text{Mg} < \text{K}$	(III)	Electronegativity
(D)	$\text{Si} < \text{P} < \text{S} < \text{Cl}$	(IV)	Ionic radii

Choose the correct answer from the options given below:

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

Which of the following electronegativity order is incorrect?

- (A) $\text{S} < \text{Cl} < \text{O} < \text{F}$ (B) $\text{Al} < \text{Si} < \text{C} < \text{N}$ (C) $\text{Al} < \text{Mg} < \text{B} < \text{N}$ (D) $\text{Mg} < \text{Be} < \text{B} < \text{N}$

Arrange the following solutions in order of their increasing boiling points.

(i) 10^{-4}MNaCl

(ii) 10^{-4}M Urea

(iii) 10^{-3}MNaCl

(iv) 10^{-2}MNaCl

(A) (i) < (ii) < (iii) < (iv)

(B) (ii) < (i) < (iii) < (iv)

(C) (iv) < (iii) < (i) < (ii)

(D) (ii) < (i) $\equiv$ (iii) < (iv)

Radius of the first excited state of Helium ion is given as: $a_0 \rightarrow$ radius of first stationary state of hydrogen atom.

(A) $r = \frac{a_0}{4}$

(B) $r = 2a_0$

(C) $r = 4a_0$

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

A liquid when kept inside a thermally insulated closed vessel at 25°C was mechanically stirred from outside. What will be the correct option for the following thermodynamic parameters?

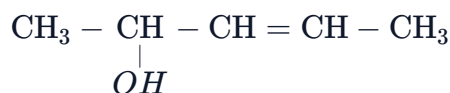
(A) $\Delta U = 0, q < 0, w > 0$

(B) $\Delta U > 0, q = 0, w > 0$

(C) $\Delta U = 0, q = 0, w = 0$

(D) $\Delta U < 0, q = 0, w > 0$

How many different stereoisomers are possible for the given molecule?



(A) 2

(B) 1

(C) 3

(D) 4

The incorrect statements regarding geometrical isomerism are:

(A) Propene shows geometrical isomerism.

(B) Trans isomer has identical atoms/groups on the opposite sides of the double bond.

(C) Cis-but-2-ene has higher dipole moment than trans-but-2-ene.

(D) 2-methylbut-2-ene shows two geometrical isomers.

(E) Trans-isomer has lower melting point than cis isomer.

Choose the correct answer from the options given below:

(A) (A) and (E) Only

(B) (A), (D) and (E) Only

(C) (C), (D) and (E) Only

(D) (B) and (C) Only

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The IUPAC name of the following compound is:

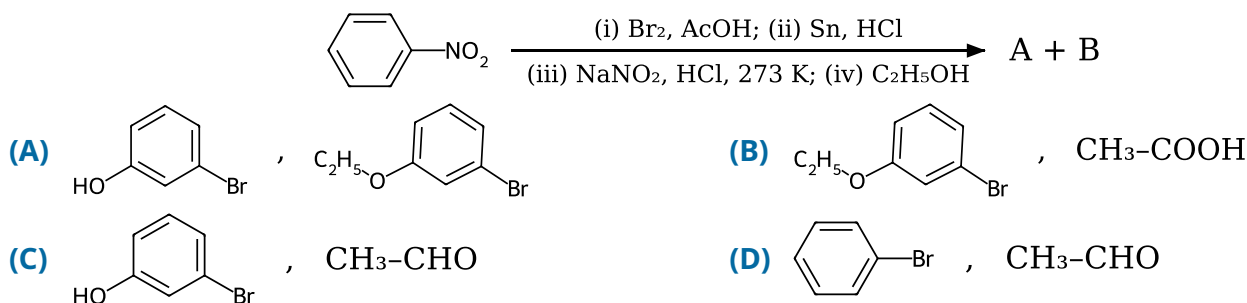


- (A) 5-Methoxycarbonyl-2-methylhexanoic acid (B) Methyl-5-carboxy-2-methylhexanoate.
(C) 2-Carboxy-5-methoxycarbonylhexane. (D) Methyl-6-carboxy-2,5-dimethylhexanoate.

A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of CO_2 is converted into CO on addition of graphite. If total pressure at equilibrium is 0.8 atm, then K_p is:

- (A) 0.18 atm (B) 0.3 atm (C) 3 atm (D) 1.8 atm

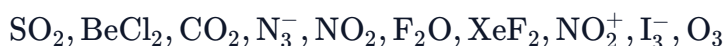
The products formed in the following reaction sequence are:



Chemistry Section B · Numerical value

Q46 to Q50

The number of molecules/ions that show linear geometry among the following is _____.



$\text{A} \rightarrow \text{B}$

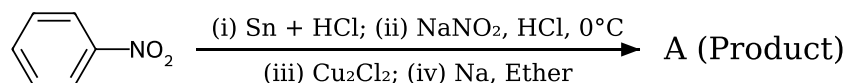
The molecule A changes into its isomeric form B by following a first order kinetics at a temperature of 1000 K. If the energy barrier with respect to reactant energy for such isomeric transformation is $191.48 \text{ kJ mol}^{-1}$ and the frequency factor is 10^{20} , the time required for 50% molecules of A to become B is _____ picoseconds (nearest integer). [$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$]

Some CO_2 gas was kept in a sealed container at a pressure of 1 atm and at 273 K. This entire amount of CO_2 gas was later passed through an aqueous solution of Ca(OH)_2 . The excess unreacted Ca(OH)_2 was later neutralized with 0.1 M of 40 mL HCl. If the volume of the sealed container of CO_2 was x , then x is _____ cm^3 (nearest integer). [Given : The entire amount of $\text{CO}_2(\text{g})$ reacted with exactly half the initial amount of Ca(OH)_2 present in the aqueous solution.]

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In Carius method for estimation of halogens, 180 mg of an organic compound produced 143.5 mg of AgCl. The percentage composition of chlorine in the compound is _____. (Given : molar mass in gmol^{-1} of Ag : 108, Cl : 35.5)

Consider the following sequence of reactions:



Molar mass of the product formed (A) is _____ gmol^{-1} .

Mathematics Section A · Multiple choice

Q51 to Q69

Let $L_1 : \frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $L_2 : \frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5}$ be two lines. Then which of the following points lies on the line of the shortest distance between L_1 and L_2 ?

- (A) $(\frac{14}{3}, -3, \frac{22}{3})$ (B) $(2, 3, \frac{1}{3})$ (C) $(\frac{8}{3}, -1, \frac{1}{3})$ (D) $(-\frac{5}{3}, -7, 1)$

A circle C of radius 2 lies in the second quadrant and touches both the coordinate axes. Let r be the radius of a circle that has centre at the point (2, 5) and intersects the circle C at exactly two points. If the set of all possible values of r is the interval (α, β) , then $3\beta - 2\alpha$ is equal to:

- (A) 10 (B) 12 (C) 14 (D) 15

Let z_1, z_2 and z_3 be three complex numbers on the circle $|z| = 1$ with $\arg(z_1) = \frac{-\pi}{4}$, $\arg(z_2) = 0$ and $\arg(z_3) = \frac{\pi}{4}$. If $|z_1\bar{z}_2 + z_2\bar{z}_3 + z_3\bar{z}_1|^2 = \alpha + \beta\sqrt{2}$, $\alpha, \beta \in \mathbb{Z}$, then the value of $\alpha^2 + \beta^2$ is:

- (A) 41 (B) 29 (C) 24 (D) 31

Let for $f(x) = 7\tan^8 x + 7\tan^6 x - 3\tan^4 x - 3\tan^2 x$, $I_1 = \int_0^{\pi/4} f(x)dx$ and $I_2 = \int_0^{\pi/4} xf(x)dx$. Then $7I_1 + 12I_2$ is equal to:

- (A) 2π (B) 1 (C) π (D) 2

Let $x = x(y)$ be the solution of the differential equation $y^2 dx + (x - \frac{1}{y}) dy = 0$. If $x(1) = 1$, then $x(\frac{1}{2})$ is:

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

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Q56 Functions (Advanced)[Step-by-step solution](#) › prepwiser.in/questions/AdUUVj4S1K

Let $f(x)$ be a real differentiable function such that $f(0) = 1$ and $f(x+y) = f(x)f'(y) + f'(x)f(y)$ for all $x, y \in \mathbf{R}$. Then $\sum_{n=1}^{100} \log_e f(n)$ is equal to:

- (A) 2406 (B) 5220 (C) 2525 (D) 2384

Q57 Area Under Curves[Step-by-step solution](#) › prepwiser.in/questions/j1aaj8xtYz

Let $f: \mathbf{R} \rightarrow \mathbf{R}$ be a twice differentiable function such that $f(x+y) = f(x)f(y)$ for all $x, y \in \mathbf{R}$. If $f'(0) = 4a$ and f satisfies $f''(x) - 3af'(x) - f(x) = 0$, $a > 0$, then the area of the region $R = \{(x, y) \mid 0 \leq y \leq f(ax), 0 \leq x \leq 2\}$ is:

- (A) $e^2 - 1$ (B) $e^4 + 1$ (C) $e^2 + 1$ (D) $e^4 - 1$

Q58 Hyperbola[Step-by-step solution](#) › prepwiser.in/questions/Fh164OPdHV

Let the foci of a hyperbola be $(1, 14)$ and $(1, -12)$. If it passes through the point $(1, 6)$, then the length of its latus-rectum is:

- (A) $\frac{25}{6}$ (B) $\frac{144}{5}$ (C) $\frac{288}{5}$ (D) $\frac{24}{5}$

Q59 Inverse Trigonometric Functions[Step-by-step solution](#) › prepwiser.in/questions/0h1dQoq_-L

Using the principal values of the inverse trigonometric functions, the sum of the maximum and the minimum values of $16 \left((\sec^{-1} x)^2 + (\operatorname{cosec}^{-1} x)^2 \right)$ is:

- (A) $24\pi^2$ (B) $18\pi^2$ (C) $22\pi^2$ (D) $31\pi^2$

Q60 Sequences & Series[Step-by-step solution](#) › prepwiser.in/questions/yHsFvONJpu

If $\sum_{r=1}^n T_r = \frac{(2n-1)(2n+1)(2n+3)(2n+5)}{64}$, then $\lim_{n \rightarrow \infty} \sum_{r=1}^n \left(\frac{1}{T_r} \right)$ is equal to:

- (A) $\frac{2}{3}$ (B) $\frac{1}{3}$ (C) 1 (D) 0

Q61 Parabola[Step-by-step solution](#) › prepwiser.in/questions/hRS8dqacfd

Let the parabola $y = x^2 + px - 3$, meet the coordinate axes at the points P, Q and R. If the circle C with centre at $(-1, -1)$ passes through the points P, Q and R, then the area of $\triangle PQR$ is:

- (A) 4 (B) 6 (C) 5 (D) 7

Q62 Permutations & Combinations[Step-by-step solution](#) › prepwiser.in/questions/ksXWMDynOK

From all the English alphabets, five letters are chosen and are arranged in alphabetical order. The total number of ways, in which the middle letter is 'M', is:

- (A) 6084 (B) 5148 (C) 14950 (D) 4356

Q63 Probability: Advanced[Step-by-step solution](#) › prepwiser.in/questions/Be_t3LJB0A

A coin is tossed three times. Let X denote the number of times a tail follows a head. If μ and σ^2 denote the mean and variance of X , then the value of $64(\mu + \sigma^2)$ is:

- (A) 64 (B) 32 (C) 51 (D) 48

Two balls are selected at random one by one without replacement from a bag containing 4 white and 6 black balls. If the probability that the first selected ball is black, given that the second selected ball is also black, is $\frac{m}{n}$, where $\gcd(m, n) = 1$, then $m + n$ is equal to:

- (A) 4 (B) 14 (C) 11 (D) 13

Let $a_1, a_2, a_3, \dots$ be a G.P. of increasing positive terms. If $a_1 a_5 = 28$ and $a_2 + a_4 = 29$, then a_6 is equal to:

- (A) 812 (B) 784 (C) 628 (D) 526

Let $A = \{1, 2, 3, \dots, 10\}$ and $B = \left\{ \frac{m}{n} : m, n \in A, m < n \text{ and } \gcd(m, n) = 1 \right\}$. Then $n(B)$ is equal to:

- (A) 29 (B) 31 (C) 37 (D) 36

The number of non-empty equivalence relations on the set $\{1, 2, 3\}$ is:

- (A) 7 (B) 4 (C) 5 (D) 6

The area of the region, inside the circle $(x - 2\sqrt{3})^2 + y^2 = 12$ and outside the parabola $y^2 = 2\sqrt{3}x$ is:

- (A) $3\pi - 8$ (B) $6\pi - 8$ (C) $3\pi + 8$ (D) $6\pi - 16$

Let the triangle PQR be the image of the triangle with vertices $(1, 3)$, $(3, 1)$ and $(2, 4)$ in the line $x + 2y = 2$. If the centroid of $\triangle PQR$ is the point (α, β) , then $15(\alpha - \beta)$ is equal to:

- (A) 21 (B) 19 (C) 22 (D) 24

Mathematics Section B · Numerical value

Q70 to Q74

Let $L_1 : \frac{x-1}{3} = \frac{y-1}{-1} = \frac{z+1}{0}$ and $L_2 : \frac{x-2}{2} = \frac{y}{0} = \frac{z+4}{\alpha}$, $\alpha \in \mathbf{R}$, be two lines, which intersect at the point B . If P is the foot of perpendicular from the point $A(1, 1, -1)$ on L_2 , then the value of $26\alpha(PB)^2$ is _____.

If $\sum_{r=0}^5 \frac{{}^{11}C_{2r+1}}{2^{r+2}} = \frac{m}{n}$, $\gcd(m, n) = 1$, then $m - n$ is equal to _____.

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Let the function,

$$f(x) = \begin{cases} -3ax^2 - 2, & x < 1 \\ a^2 + bx, & x \geq 1 \end{cases}$$

be differentiable for all $x \in \mathbf{R}$, where $a > 1, b \in \mathbf{R}$. If the area of the region enclosed by $y = f(x)$ and the line $y = -20$ is $\alpha + \beta\sqrt{3}$, $\alpha, \beta \in \mathbf{Z}$, then the value of $\alpha + \beta$ is _____.

Let A be a square matrix of order 3 such that $\det(A) = -2$ and $\det(3 \operatorname{adj}(-6 \operatorname{adj}(3A))) = 2^{m+n} \cdot 3^{mn}$, $m > n$. Then $4m + 2n$ is equal to _____.

Let $\vec{c}$ be the projection vector of $\vec{b} = \lambda\hat{i} + 4\hat{k}$, $\lambda > 0$, on the vector $\vec{a} = \hat{i} + 2\hat{j} + 2\hat{k}$. If $|\vec{a} + \vec{c}| = 7$, then the area of the parallelogram formed by the vectors $\vec{b}$ and $\vec{c}$ is _____.

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Physics

1. B	2. B	3. C	4. A	5. D	6. C	7. D	8. A
9. D	10. B	11. A	12. B	13. B	14. C	15. B	16. B
17. C	18. B	19. B	20. B	21. 8	22. 40	23. 5	24. 4
25. 90							

Chemistry

26. D	27. B	28. B	29. B	30. A	31. D	32. A	33. C
34. B	35. D	36. A	37. C	38. B	39. B	40. B	41. D
42. B	43. A	44. D	45. D	46. 6	47. 69	48. 45	49. 20
50. 154							

Mathematics

51. A	52. D	53. B	54. B	55. D	56. C	57. A	58. C
59. C	60. A	61. B	62. B	63. D	64. B	65. B	66. B
67. C	68. D	69. C	70. 216	71. 2035	72. 34	73. 34	74. 16

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