

JEE MAIN 2022 · QUESTION PAPER

25 Jun 2022 Shift 1

80 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	15 Q29 to Q43	9 Q44 to Q52
● Mathematics	18 Q53 to Q70	10 Q71 to Q80

In this PDF **80** 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.

prepwisar.in/pyqs/paper/2022-06-25-morning · Free, no signup needed to start

Answers follow NTA's final answer keys. Typing errors are possible, so check doubtful answers against the official key. Spotted a mistake?
prepwisar.in/feedback · Terms: prepwisar.in/terms

Q1 Alternating Current

[Step-by-step solution](#) · [prepwisar.in/questions/g8fekE2Okk](https://www.prepwisar.in/questions/g8fekE2Okk)

Match List-I with List-II.

	List - I		List - II
(A)	AC generator	(I)	Detects the presence of current in the circuit
(B)	Galvanometer	(II)	Converts mechanical energy into electrical energy
(C)	Transformer	(III)	Works on the principle of resonance in AC circuit
(D)	Metal detector	(IV)	Changes an alternating voltage for smaller or greater value

Choose the correct answer from the options given below:

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

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

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

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

Q2 Alternating Current

[Step-by-step solution](#) · [prepwisar.in/questions/JCNZ4I7kii](https://www.prepwisar.in/questions/JCNZ4I7kii)

If wattless current flows in the AC circuit, then the circuit is:

(A) Purely Resistive circuit

(B) Purely Inductive circuit

(C) LCR series circuit

(D) RC series circuit only

Q3 Atomic Physics

[Step-by-step solution](#) · [prepwisar.in/questions/L87o1z3Jyd](https://www.prepwisar.in/questions/L87o1z3Jyd)

The ratio for the speed of the electron in the 3rd orbit of He⁺ to the speed of the electron in the 3rd orbit of hydrogen atom will be:

(A) 1 : 1

(B) 1 : 2

(C) 4 : 1

(D) 2 : 1

Q4 Experimental Skills

[Step-by-step solution](#) · [prepwisar.in/questions/Ybw824n4Wy](https://www.prepwisar.in/questions/Ybw824n4Wy)

A teacher in his physics laboratory allotted an experiment to determine the resistance (G) of a galvanometer. Students took the observations for $\frac{1}{3}$ deflection in the galvanometer. Which of the below is true for measuring value of G?

(A) $\frac{1}{3}$ deflection method cannot be used for determining the resistance of the galvanometer.

(B) $\frac{1}{3}$ deflection method can be used and in this case the G equals to twice the value of shunt resistances.

(C) $\frac{1}{3}$ deflection method can be used and in this case, the G equals to three times the value of shunt resistances.

(D) $\frac{1}{3}$ deflection method can be used and in this case the G value equals to the shunt resistances.

Q5 Dual Nature of Radiation & Matter

[Step-by-step solution](#) · [prepwisar.in/questions/fDpl_8MYPY](https://www.prepwisar.in/questions/fDpl_8MYPY)

Given below are two statements:

Statement I : Davisson-Germer experiment establishes the wave nature of electrons.

Statement II : If electrons have wave nature, they can interfere and show diffraction.

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

(A) Both Statement I and Statement II are true.

(B) Both Statement I and Statement II are false.

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

(D) Statement I is false but Statement II is true.

Q6 Electromagnetic Waves

[Step-by-step solution](#) · [prepwisar.in/questions/px2tMk4TBf](https://www.prepwisar.in/questions/px2tMk4TBf)

The electric field in an electromagnetic wave is given by $E = 56.5 \sin \omega(t - x/c) \text{ NC}^{-1}$. Find the intensity of the wave if it is propagating along x-axis in the free space.

(Given: $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$)

(A) 5.65 Wm^{-2}

(B) 4.24 Wm^{-2}

(C) $1.9 \times 10^{-7} \text{ Wm}^{-2}$

(D) 56.5 Wm^{-2}

The photodiode is used to detect the optical signals. These diodes are preferably operated in reverse biased mode because:

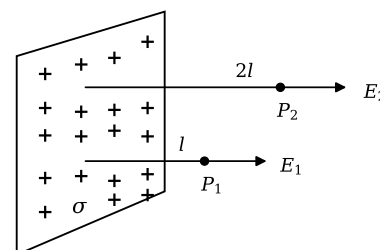
- (A) fractional change in majority carriers produce higher forward bias current
- (B) fractional change in majority carriers produce higher reverse bias current
- (C) fractional change in minority carriers produce higher forward bias current
- (D) fractional change in minority carriers produce higher reverse bias current

Q8 Electrostatics I: Charges, Field & Gauss's Law

[Step-by-step solution](https://www.prepwiser.in/questions/R1uo53oVdb) > prepwiser.in/questions/R1uo53oVdb

In the figure, a very large plane sheet of positive charge is shown. P_1 and P_2 are two points at distance l and $2l$ from the charge distribution. If σ is the surface charge density, then the magnitude of electric fields E_1 and E_2 at P_1 and P_2 respectively are:

- (A) $E_1 = \sigma/\epsilon_0$, $E_2 = \sigma/2\epsilon_0$
- (B) $E_1 = 2\sigma/\epsilon_0$, $E_2 = \sigma/\epsilon_0$
- (C) $E_1 = E_2 = \sigma/2\epsilon_0$
- (D) $E_1 = E_2 = \sigma/\epsilon_0$



Q9 Ray Optics

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

A light wave travelling linearly in a medium of dielectric constant 4, incidents on the horizontal interface separating medium with air. The angle of incidence for which the total intensity of incident wave will be reflected back into the same medium will be:

(Given : relative permeability of medium $\mu_r = 1$)

- (A) 10°
- (B) 20°
- (C) 30°
- (D) 60°

Q10 Ray Optics

[Step-by-step solution](https://www.prepwiser.in/questions/RR6fo5REFC) > prepwiser.in/questions/RR6fo5REFC

The difference of speed of light in the two media A and B ($v_A - v_B$) is 2.6×10^7 m/s. If the refractive index of medium B is 1.47, then the ratio of refractive index of medium B to medium A is : (Given : speed of light in vacuum $c = 3 \times 10^8$ ms $^{-1}$)

- (A) 1.303
- (B) 1.318
- (C) 1.13
- (D) 0.12

Q11 Gravitation

[Step-by-step solution](https://www.prepwiser.in/questions/9iI-xu2xTA) > prepwiser.in/questions/9iI-xu2xTA

The height of any point P above the surface of earth is equal to diameter of earth. The value of acceleration due to gravity at point P will be : (Given g = acceleration due to gravity at the surface of earth).

- (A) $g/2$
- (B) $g/4$
- (C) $g/3$
- (D) $g/9$

Q12 Kinetic Theory of Gases

[Step-by-step solution](https://www.prepwiser.in/questions/wSpmLZ2b6A) > prepwiser.in/questions/wSpmLZ2b6A

The relation between root mean square speed (v_{rms}) and most probable speed (v_p) for the molar mass M of oxygen gas molecule at the temperature of 300 K will be:

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

Q13 Moving Charges & Magnetism

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

A long straight wire with a circular cross-section having radius R , is carrying a steady current I . The current I is uniformly distributed across this cross-section. Then the variation of magnetic field due to current I with distance r ($r < R$) from its centre will be:

- (A) $B \propto r^2$
- (B) $B \propto r$
- (C) $B \propto \frac{1}{r^2}$
- (D) $B \propto \frac{1}{r}$

Q14 Fluid Mechanics

[Step-by-step solution](https://www.prepwiser.in/questions/6injDMh-Es) > prepwiser.in/questions/6injDMh-Es

The terminal velocity (v_t) of the spherical rain drop depends on the radius (r) of the spherical rain drop as:

- (A) $r^{1/2}$
- (B) r
- (C) r^2
- (D) r^3

Q15 Vectors[Step-by-step solution](#) > prepwiser.in/questions/mh6AZYprFZ

If force $\vec{F} = 3\hat{i} + 4\hat{j} - 2\hat{k}$ acts on a particle position vector $2\hat{i} + \hat{j} + 2\hat{k}$ then, the torque about the origin will be:

- (A) $3\hat{i} + 4\hat{j} - 2\hat{k}$ (B) $-10\hat{i} + 10\hat{j} + 5\hat{k}$ (C) $10\hat{i} + 5\hat{j} - 10\hat{k}$ (D) $10\hat{i} + \hat{j} - 5\hat{k}$

Q16 Wave Optics[Step-by-step solution](#) > prepwiser.in/questions/Dt4Cz_9GFa

The two light beams having intensities I and $9I$ interfere to produce a fringe pattern on a screen. The phase difference between the beams is $\pi/2$ at point P and π at point Q. Then the difference between the resultant intensities at P and Q will be:

- (A) $2I$ (B) $6I$ (C) $5I$ (D) $7I$

Q17 Units, Dimensions & Errors[Step-by-step solution](#) > prepwiser.in/questions/bDUykbJp4g

If $Z = \frac{A^2 B^3}{C^4}$, then the relative error in Z will be:

- (A) $\frac{\Delta A}{A} + \frac{\Delta B}{B} + \frac{\Delta C}{C}$ (B) $\frac{2\Delta A}{A} + \frac{3\Delta B}{B} - \frac{4\Delta C}{C}$
 (C) $\frac{2\Delta A}{A} + \frac{3\Delta B}{B} + \frac{4\Delta C}{C}$ (D) $\frac{\Delta A}{A} + \frac{\Delta B}{B} - \frac{\Delta C}{C}$

Q18 Vectors[Step-by-step solution](#) > prepwiser.in/questions/hjk94h26JH

$\vec{A}$ is a vector quantity such that $|\vec{A}| = \text{non-zero constant}$. Which of the following expression is true for $\vec{A}$?

- (A) $\vec{A} \cdot \vec{A} = 0$ (B) $\vec{A} \times \vec{A} < 0$ (C) $\vec{A} \times \vec{A} = 0$ (D) $\vec{A} \times \vec{A} > 0$

Q19 Vectors[Step-by-step solution](#) > prepwiser.in/questions/Zr4-fUD3iY

Which of the following relations is true for two unit vector $\hat{A}$ and $\hat{B}$ making an angle θ to each other?

- (A) $|\hat{A} + \hat{B}| = |\hat{A} - \hat{B}| \tan \frac{\theta}{2}$ (B) $|\hat{A} - \hat{B}| = |\hat{A} + \hat{B}| \tan \frac{\theta}{2}$
 (C) $|\hat{A} + \hat{B}| = |\hat{A} - \hat{B}| \cos \frac{\theta}{2}$ (D) $|\hat{A} - \hat{B}| = |\hat{A} + \hat{B}| \cos \frac{\theta}{2}$

Physics Section B · Numerical value

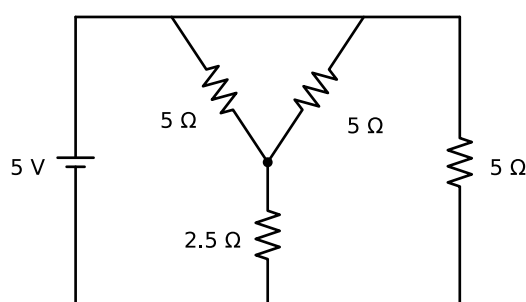
Q20 to Q28

Q20 Current Electricity **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/tZYDg1bFdX

A resistor develops 300 J of thermal energy in 15 s, when a current of 2 A is passed through it. If the current increases to 3 A, the energy developed in 10 s is _____ J.

Q21 Current Electricity **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/91zt0hwxrx

The total current supplied to the circuit as shown in figure by the 5 V battery is _____ A.

**Q22** Electromagnetic Induction **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/oPb-J5X4eK

The current in a coil of self inductance 2.0 H is increasing according to $I = 2 \sin(t^2)$ A. The amount of energy spent during the period when current changes from 0 to 2 A is _____ J.

Q23 Thermometry & Calorimetry **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/iJXIfVRnQm

A steam engine intakes 50 g of steam at 100°C per minute and cools it down to 20°C . If latent heat of vaporization of steam is 540 cal g^{-1} , then the heat rejected by the steam engine per minute is _____ $\times 10^3 \text{ cal}$.

(Given : specific heat capacity of water : $1 \text{ cal g}^{-1} ^\circ\text{C}^{-1}$)

Q24 Newton's Laws of Motion **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/k7tEj-1rSh

A force on an object of mass 100 g is $(10\hat{i} + 5\hat{j})$ N. The position of that object at $t = 2$ s is $(a\hat{i} + b\hat{j})$ m after starting from rest. The value of $\frac{a}{b}$ will be _____.

Q25 Fluid Mechanics **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/dYYzLd6jUN

The velocity of upper layer of water in a river is 36 kmh^{-1} . Shearing stress between horizontal layers of water is 10^{-3} Nm^{-2} . Depth of the river is _____ m. (Co-efficient of viscosity of water is 10^{-2} Pa.s)

Q26 Mechanical Waves **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/8S6h79Qlfd

The first overtone frequency of an open organ pipe is equal to the fundamental frequency of a closed organ pipe. If the length of the closed organ pipe is 20 cm. The length of the open organ pipe is _____ cm.

Q27 Friction **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/RySwwE8eVF

A uniform chain of 6 m length is placed on a table such that a part of its length is hanging over the edge of the table. The system is at rest. The co-efficient of static friction between the chain and the surface of the table is 0.5, the maximum length of the chain hanging from the table is _____ m.

Q28 Work, Energy & Power **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/HOjGf_QE-G

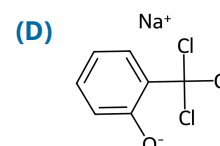
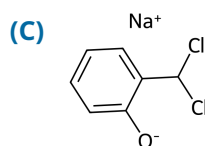
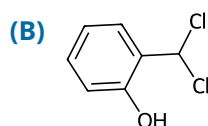
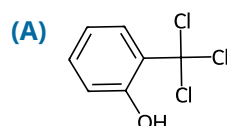
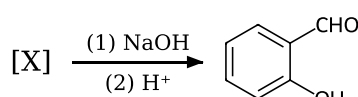
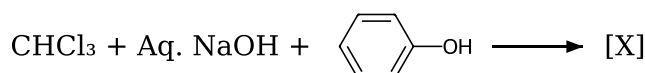
A 0.5 kg block moving at a speed of 12 ms^{-1} compresses a spring through a distance 30 cm when its speed is halved. The spring constant of the spring will be _____ Nm^{-1} .

Chemistry Section A · Multiple choice

Q29 to Q43

Q29 Alcohols, Phenols & Ethers[Step-by-step solution](#) > prepwiser.in/questions/kZHTR0eAXb

The intermediate X, in the reaction:

**Q30** Chemical Bonding & Molecular Structure[Step-by-step solution](#) > prepwiser.in/questions/_fH1UDayKU

Bonding in which of the following diatomic molecule(s) become(s) stronger, on the basis of MO Theory, by removal of an electron?

- (A) NO
- (B) N_2
- (C) O_2
- (D) C_2
- (E) B_2

Choose the most appropriate answer from the options given below:

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

Q31 Chemical Bonding & Molecular Structure[Step-by-step solution](#) > prepwiser.in/questions/KRa5yn2d2c

Number of electron deficient molecules among the following

PH_3 , B_2H_6 , CCl_4 , NH_3 , LiH and BCl_3 is

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

Which one of the following is an example of artificial sweetner?

- (A) Bithional (B) Alitame (C) Salvarsan (D) Lactose

Cerium (IV) has a noble gas configuration. Which of the following is correct statement about it?

- (A) It will not prefer to undergo redox reactions.
(B) It will prefer to gain electron and act as an oxidizing agent.
(C) It will prefer to give away an electron and behave as reducing agent.
(D) It acts as both, oxidizing and reducing agent.

Among the following, which is the strongest oxidizing agent?

- (A) Mn^{3+} (B) Fe^{3+} (C) Ti^{3+} (D) Cr^{3+}

Leaching of gold with dilute aqueous solution of NaCN in presence of oxygen gives complex [A], which on reaction with zinc forms the elemental gold and another complex [B]. [A] and [B], respectively are:

- (A) $[\text{Au}(\text{CN})_4]^-$ and $[\text{Zn}(\text{CN})_2(\text{OH})_2]^{2-}$ (B) $[\text{Au}(\text{CN})_2]^-$ and $[\text{Zn}(\text{OH})_4]^{2-}$
(C) $[\text{Au}(\text{CN})_2]^-$ and $[\text{Zn}(\text{CN})_4]^{2-}$ (D) $[\text{Au}(\text{CN})_4]^{2-}$ and $[\text{Zn}(\text{CN})_6]^{4-}$

White precipitate of AgCl dissolves in aqueous ammonia solution due to formation of:

- (A) $[\text{Ag}(\text{NH}_3)_4]\text{Cl}_2$ (B) $[\text{Ag}(\text{Cl})_2(\text{NH}_3)_2]$ (C) $[\text{Ag}(\text{NH}_3)_2]\text{Cl}$ (D) $[\text{Ag}(\text{NH}_3)\text{Cl}]\text{Cl}$

Which one of the following alkaline earth metal ions has the highest ionic mobility in its aqueous solution?

- (A) Be^{2+} (B) Mg^{2+} (C) Ca^{2+} (D) Sr^{2+}

The pair, in which ions are isoelectronic with Al^{3+} is:

- (A) Br^- and Be^{2+} (B) Cl^- and Li^+ (C) S^{2-} and K^+ (D) O^{2-} and Mg^{2+}

Incorrect statement for Tyndall effect is:

- (A) The refractive indices of the dispersed phase and the dispersion medium differ greatly in magnitude.
(B) The diameter of the dispersed particles is much smaller than the wavelength of the light used.
(C) During projection of movies in the cinemas hall, Tyndall effect is noticed.
(D) It is used to distinguish a true solution from a colloidal solution.

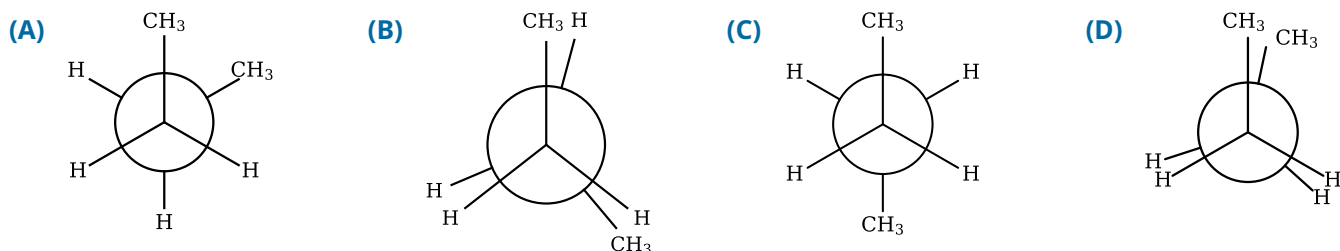
Using very little soap while washing clothes, does not serve the purpose of cleaning of clothes, because:

- (A) soap particles remain floating in water as ions.
(B) the hydrophobic part of soap is not able to take away grease.
(C) the micelles are not formed due to concentration of soap, below its CMC value.
(D) colloidal structure of soap in water is completely disturbed.

Phenol on reaction with dilute nitric acid, gives two products. Which method will be most efficient for large scale separation?

- (A) Chromatographic separation (B) Fractional Crystallisation
(C) Steam distillation (D) Sublimation

In the following structures, which one is having staggered conformation with maximum dihedral angle?



The IUPAC name of ethylidene chloride is:

- (A) 1-Chloroethene (B) 1-Chloroethyne (C) 1,2-Dichloroethane (D) 1,1-Dichloroethane

Chemistry Section B · Numerical value

Q44 to Q52

For a given chemical reaction

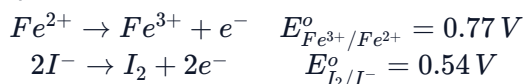


Concentration of C changes from 10 mmol dm^{-3} to 20 mmol dm^{-3} in 10 seconds. Rate of appearance of D is 1.5 times the rate of disappearance of B which is twice the rate of disappearance A. The rate of appearance of D has been experimentally determined to be $9 \text{ mmol dm}^{-3} \text{ s}^{-1}$. Therefore, the rate of reaction is _____ $\text{mmol dm}^{-3} \text{ s}^{-1}$. (Nearest Integer)

If $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$ absorbs a light of wavelength 600 nm for d-d transition, then the value of octahedral crystal field splitting energy for $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ will be _____ $\times 10^{-21} \text{ J}$. [Nearest Integer]

(Given : $h = 6.63 \times 10^{-34} \text{ Js}$ and $c = 3.08 \times 10^8 \text{ ms}^{-1}$)

In a cell, the following reactions take place



The standard electrode potential for the spontaneous reaction in the cell is $x \times 10^{-2} \text{ V}$ 298 K. The value of x is _____. (Nearest Integer)

The distance between Na^+ and Cl^- ions in solid NaCl of density 43.1 g cm^{-3} is _____ $\times 10^{-10} \text{ m}$. (Nearest Integer)

(Given : $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$)

The number of N atoms in 681 g of $\text{C}_7\text{H}_5\text{N}_3\text{O}_6$ is $x \times 10^{21}$. The value of x is ($N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$) (Nearest Integer)

Q49 Mole Concept & Stoichiometry **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/144973Cg_R](#)

Number of grams of bromine that will completely react with 5.0 g of pent-1-ene is _____ $\times 10^{-2}$ g. (Atomic mass of Br = 80 g/mol) [Nearest Integer]

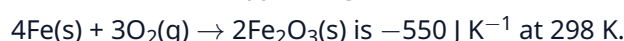
Q50 Atomic Structure **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/HkSvoYAL9s](#)

The longest wavelength of light that can be used for the ionisation of lithium atom (Li) in its ground state is $x \times 10^{-8}$ m. The value of x is _____. (Nearest Integer).

(Given : Energy of the electron in the first shell of the hydrogen atom is -2.2×10^{-18} J; $h = 6.63 \times 10^{-34}$ Js and $c = 3 \times 10^8$ ms $^{-1}$)

Q51 Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/tP43_OuCel](#)

The standard entropy change for the reaction



[Given : The standard enthalpy change for the reaction is -165 kJ mol $^{-1}$]. The temperature in K at which the reaction attains equilibrium is _____. (Nearest Integer)

Q52 Chemical Equilibrium **NUMERICAL**[Step-by-step solution](#) > [prepwiser.in/questions/Ycj_LZ421M](#)

The standard free energy change (ΔG°) for 50% dissociation of N_2O_4 into NO_2 at 27°C and 1 atm pressure is $-x$ J mol $^{-1}$. The value of x is _____. (Nearest Integer)

[Given : $R = 8.31$ J K $^{-1}$ mol $^{-1}$, $\log 1.33 = 0.1239$ $\ln 10 = 2.3$]

Mathematics Section A · Multiple choice

Q53 to Q70

Q53 Three Dimensional Geometry[Step-by-step solution](#) > [prepwiser.in/questions/AWRU2m0Yh6](#)

Let Q be the mirror image of the point P(1, 0, 1) with respect to the plane S : $x + y + z = 5$. If a line L passing through (1, -1, -1), parallel to the line PQ meets the plane S at R, then QR^2 is equal to:

- (A) 2 (B) 5 (C) 7 (D) 11

Q54 Sequences & Series[Step-by-step solution](#) > [prepwiser.in/questions/rD-JoUQG61](#)

If

$$\frac{1}{2 \cdot 3^{10}} + \frac{1}{2^2 \cdot 3^9} + \dots + \frac{1}{2^{10} \cdot 3} = \frac{K}{2^{10} \cdot 3^{10}}$$

, then the remainder when K is divided by 6 is:

- (A) 1 (B) 2 (C) 3 (D) 5

Q55 Circles[Step-by-step solution](#) > [prepwiser.in/questions/rHhSdZiwyC](#)

Let a circle C touch the lines $L_1 : 4x - 3y + K_1 = 0$ and $L_2 : 4x - 3y + K_2 = 0$, $K_1, K_2 \in R$. If a line passing through the centre of the circle C intersects L_1 at (-1, 2) and L_2 at (3, -6), then the equation of the circle C is:

- (A) $(x - 1)^2 + (y - 2)^2 = 4$ (B) $(x + 1)^2 + (y - 2)^2 = 4$
(C) $(x - 1)^2 + (y + 2)^2 = 16$ (D) $(x - 1)^2 + (y - 2)^2 = 16$

Q56 Complex Numbers[Step-by-step solution](#) > [prepwiser.in/questions/6ljKXQE6xI](#)

Let a circle C in complex plane pass through the points $z_1 = 3 + 4i$, $z_2 = 4 + 3i$ and $z_3 = 5i$. If $z (\neq z_1)$ is a point on C such that the line through z and z_1 is perpendicular to the line through z_2 and z_3 , then $\arg(z)$ is equal to:

- (A) $\tan^{-1} \left(\frac{2}{\sqrt{5}} \right) - \pi$ (B) $\tan^{-1} \left(\frac{24}{7} \right) - \pi$ (C) $\tan^{-1} (3) - \pi$ (D) $\tan^{-1} \left(\frac{3}{4} \right) - \pi$

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The value of

$$\int_0^{\pi} \frac{e^{\cos x} \sin x}{(1 + \cos^2 x)(e^{\cos x} + e^{-\cos x})} dx$$

is equal to:

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

Let $g : (0, \infty) \rightarrow \mathbb{R}$ be a differentiable function such that

$$\int \left(\frac{x(\cos x - \sin x)}{e^x + 1} + \frac{g(x)(e^x + 1 - xe^x)}{(e^x + 1)^2} \right) dx = \frac{xg(x)}{e^x + 1} + c$$

, for all $x > 0$, where c is an arbitrary constant. Then:

- (A) g is decreasing in $(0, \frac{\pi}{4})$ (B) g' is increasing in $(0, \frac{\pi}{4})$
 (C) $g + g'$ is increasing in $(0, \frac{\pi}{2})$ (D) $g - g'$ is increasing in $(0, \frac{\pi}{2})$

Let $y = y(x)$ be the solution of the differential equation $(x + 1)y' - y = e^{3x}(x + 1)^2$, with $y(0) = \frac{1}{3}$. Then, the point $x = -\frac{4}{3}$ for the curve $y = y(x)$ is:

- (A) not a critical point (B) a point of local minima
 (C) a point of local maxima (D) a point of inflection

If the solution curve $y = y(x)$ of the differential equation $y^2 dx + (x^2 - xy + y^2) dy = 0$, which passes through the point $(1, 1)$ and intersects the line $y = \sqrt{3}x$ at the point $(\alpha, \sqrt{3}\alpha)$, then value of $\log_e(\sqrt{3}\alpha)$ is equal to:

- (A) $\frac{\pi}{3}$ (B) $\frac{\pi}{2}$ (C) $\frac{\pi}{12}$ (D) $\frac{\pi}{6}$

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be defined as $f(x) = x^3 + x - 5$. If $g(x)$ is a function such that $f(g(x)) = x, \forall x' \in \mathbb{R}$, then $g'(63)$ is equal to _____.

- (A) $\frac{1}{49}$ (B) $\frac{3}{49}$ (C) $\frac{43}{49}$ (D) $\frac{91}{49}$

Let $f : \mathbb{N} \rightarrow \mathbb{R}$ be a function such that $f(x + y) = 2f(x)f(y)$ for natural numbers x and y . If $f(1) = 2$, then the value of α for which

$$\sum_{k=1}^{10} f(\alpha + k) = \frac{512}{3}(2^{20} - 1)$$

holds, is:

- (A) 2 (B) 3 (C) 4 (D) 6

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Q63 Applications of Derivatives[Step-by-step solution](#) › prepwiser.in/questions/T11axNKeO_

Let $f : R \rightarrow R$ and $g : R \rightarrow R$ be two functions defined by $f(x) = \log_e(x^2 + 1) - e^{-x} + 1$ and $g(x) = \frac{1-2e^{2x}}{e^x}$. Then, for which of the following range of α , the inequality

$$f\left(g\left(\frac{(\alpha-1)^2}{3}\right)\right) > f\left(g\left(\alpha - \frac{5}{3}\right)\right)$$

holds?

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

Q64 Limits[Step-by-step solution](#) › prepwiser.in/questions/Omphgyrs16

Let $f(x)$ be a polynomial function such that $f(x) + f'(x) + f''(x) = x^5 + 64$. Then, the value of $\lim_{x \rightarrow 1} \frac{f(x)}{x-1}$ is equal to:

- (A) -15 (B) -60 (C) 60 (D) 15

Q65 Matrices[Step-by-step solution](#) › prepwiser.in/questions/aiwrRnwPS8

Let A be a 3×3 real matrix such that

$$A \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}; A \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix}$$

and

$$A \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \\ 2 \end{pmatrix}$$

If $X = (x_1, x_2, x_3)^T$ and I is an identity matrix of order 3, then the system $(A - 2I)X = \begin{pmatrix} 4 \\ 1 \\ 1 \end{pmatrix}$ has:

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

Q66 Matrices[Step-by-step solution](#) › prepwiser.in/questions/B2UACUIy_

Let $A = \begin{bmatrix} 0 & -2 \\ 2 & 0 \end{bmatrix}$. If M and N are two matrices given by $M = \sum_{k=1}^{10} A^{2k}$ and $N = \sum_{k=1}^{10} A^{2k-1}$ then MN^2 is:

- (A) a non-identity symmetric matrix
(B) a skew-symmetric matrix
(C) neither symmetric nor skew-symmetric matrix
(D) an identity matrix

Q67 Parabola[Step-by-step solution](#) › prepwiser.in/questions/xlymCJsp3o

If $y = m_1x + c_1$ and $y = m_2x + c_2$, $m_1 \neq m_2$ are two common tangents of circle $x^2 + y^2 = 2$ and parabola $y^2 = x$, then the value of $8|m_1m_2|$ is equal to:

- (A) $3 + 4\sqrt{2}$ (B) $-5 + 6\sqrt{2}$ (C) $-4 + 3\sqrt{2}$ (D) $7 + 6\sqrt{2}$

Q68 Parabola[Step-by-step solution](#) › prepwiser.in/questions/FgpdZxQr4T

Let $x = 2t$, $y = \frac{t^2}{3}$ be a conic. Let S be the focus and B be the point on the axis of the conic such that $SA \perp BA$, where A is any point on the conic. If k is the ordinate of the centroid of the $\triangle SAB$, then $\lim_{t \rightarrow 1} k$ is equal to:

- (A) $\frac{17}{18}$ (B) $\frac{19}{18}$ (C) $\frac{11}{18}$ (D) $\frac{13}{18}$

Q69 Probability: Advanced[Step-by-step solution](#) > prepwiser.in/questions/wuZq6wU57J

Let E_1 and E_2 be two events such that the conditional probabilities $P(E_1|E_2) = \frac{1}{2}$, $P(E_2|E_1) = \frac{3}{4}$ and $P(E_1 \cap E_2) = \frac{1}{8}$. Then:

(A) $P(E_1 \cap E_2) = P(E_1) \cdot P(E_2)$

(B) $P(E'_1 \cap E'_2) = P(E'_1) \cdot P(E'_2)$

(C) $P(E_1 \cap E'_2) = P(E_1) \cdot P(E_2)$

(D) $P(E'_1 \cap E_2) = P(E_1) \cdot P(E_2)$

Q70 Vectors[Step-by-step solution](#) > prepwiser.in/questions/-hIztYLVW5

Let $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$, $a_i > 0$, $i = 1, 2, 3$ be a vector which makes equal angles with the coordinate axes OX, OY and OZ. Also, let the projection of $\vec{a}$ on the vector $3\hat{i} + 4\hat{j}$ be 7. Let $\vec{b}$ be a vector obtained by rotating $\vec{a}$ with 90° . If $\vec{a}$, $\vec{b}$ and x-axis are coplanar, then projection of a vector $\vec{b}$ on $3\hat{i} + 4\hat{j}$ is equal to:

(A) $\sqrt{7}$

(B) $\sqrt{2}$

(C) 2

(D) 7

Mathematics Section B · Numerical value

Q71 to Q80

Q71 Three Dimensional Geometry **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/thHWN6NBSd

Let the lines

$$L_1 : \vec{r} = \lambda (\hat{i} + 2\hat{j} + 3\hat{k}), \lambda \in R$$

$$L_2 : \vec{r} = (\hat{i} + 3\hat{j} + \hat{k}) + \mu (\hat{i} + \hat{j} + 5\hat{k}); \mu \in R$$

intersect at the point S. If a plane $ax + by - z + d = 0$ passes through S and is parallel to both the lines L_1 and L_2 , then the value of $a + b + d$ is equal to _____.

Q72 Binomial Theorem **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/uM7JVc7-7M

Let C_r denote the binomial coefficient of x^r in the expansion of $(1+x)^{10}$. If for $\alpha, \beta \in R$, $C_1 + 3.2C_2 + 5.3C_3 + \dots$ upto 10 terms

$$= \frac{\alpha \times 2^{11}}{2^\beta - 1} \left(C_0 + \frac{C_1}{2} + \frac{C_2}{3} + \dots \text{ upto 10 terms} \right)$$

then the value of $\alpha + \beta$ is equal to _____.

Q73 Circles **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/uvvXgKRFs_

Let the abscissae of the two points P and Q be the roots of $2x^2 - rx + p = 0$ and the ordinates of P and Q be the roots of $x^2 - sx - q = 0$. If the equation of the circle described on PQ as diameter is $2(x^2 + y^2) - 11x - 14y - 22 = 0$, then $2r + s - 2q + p$ is equal to _____.

Q74 Relations & Functions (Basic) **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/rO4MWGPpTl

Let $f : R \rightarrow R$ be a function defined by

$$f(x) = \left(2 \left(1 - \frac{x^{25}}{2} \right) (2 + x^{25}) \right)^{\frac{1}{50}}$$

. If the function $g(x) = f(f(f(x))) + f(f(x))$, then the greatest integer less than or equal to $g(1)$ is _____.

Q75 Permutations & Combinations **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/OSiRM0uTLy

The number of 3-digit odd numbers, whose sum of digits is a multiple of 7, is _____.

Q76 Matrices **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/I98ncj174p

Let A be a 3×3 matrix having entries from the set $\{-1, 0, 1\}$. The number of all such matrices A having sum of all the entries equal to 5, is _____.

Q77 Quadratic Equations & Polynomial Inequalities **NUMERICAL**[Step-by-step solution](#) > prepwiser.in/questions/1f11nEvSXR

For a natural number n, let $\alpha_n = 19^n - 12^n$. Then, the value of $\frac{31\alpha_9 - \alpha_{10}}{57\alpha_8}$ is _____.

The greatest integer less than or equal to the sum of first 100 terms of the sequence $\frac{1}{3}, \frac{5}{9}, \frac{19}{27}, \frac{65}{81}, \dots$ is equal to _____.

The number of values of x in the interval $(\frac{\pi}{4}, \frac{7\pi}{4})$ for which $14 \cos^2 x - 2 \sin^2 x = 21 - 4 \cos^2 x$ holds, is _____.

Let θ be the angle between the vectors $\vec{a}$ and $\vec{b}$, where $|\vec{a}| = 4$, $|\vec{b}| = 3$ and $\theta \in (\frac{\pi}{4}, \frac{\pi}{3})$. Then

$$\left| (\vec{a} - \vec{b}) \times (\vec{a} + \vec{b}) \right|^2 + 4(\vec{a} \cdot \vec{b})^2$$

is equal to _____.

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Physics

1. A	2. B	3. D	4. B	5. A	6. B	7. D	8. C
9. D	10. C	11. D	12. B	13. B	14. C	15. B	16. B
17. C	18. C	19. B	20. 450	21. 2	22. 4	23. 31	24. 2
25. 100	26. 80	27. 2	28. 600				

Chemistry

29. C	30. C	31. C	32. B	33. B	34. A	35. C	36. C
37. D	38. D	39. B	40. C	41. C	42. C	43. D	44. 1
45. 766	46. 23	47. 1	48. 5418	49. 1143	50. 4	51. 300	52. 710

Mathematics

53. B	54. D	55. C	56. B	57. C	58. D	59. B	60. C
61. A	62. C	63. A	64. A	65. B	66. A	67. C	68. D
69. C	70. B	71. 5	72. 286	73. 7	74. 2	75. 63	76. 414
77. 4	78. 98	79. 4	80. 576				

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