

JEE MAIN 2021 · QUESTION PAPER

24 Feb 2021 **Shift 2**

80 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	16 Q30 to Q45	9 Q46 to Q54
● Mathematics	16 Q55 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/2021-02-24-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?
prepwisar.in/feedback · Terms: prepwisar.in/terms

Q1 Atomic Physics

[Step-by-step solution](https://www.prepwiser.in/questions/BB7jG8UFH5) > prepwiser.in/questions/BB7jG8UFH5

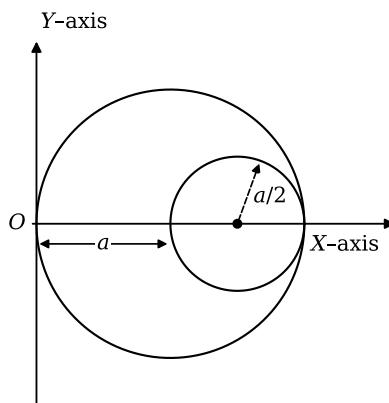
According to Bohr atomic model, in which of the following transitions will the frequency be maximum?

- (A) $n = 2$ to $n = 1$ (B) $n = 3$ to $n = 2$ (C) $n = 4$ to $n = 3$ (D) $n = 5$ to $n = 4$

Q2 Centre of Mass & Linear Momentum

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

A circular hole of radius $\left(\frac{a}{2}\right)$ is cut out of a circular disc of radius 'a' as shown in figure. The centroid of the remaining circular portion with respect to point 'O' will be:



- (A) $\frac{1}{6}a$ (B) $\frac{2}{3}a$ (C) $\frac{5}{6}a$ (D) $\frac{10}{11}a$

Q3 Atomic Physics

[Step-by-step solution](https://www.prepwiser.in/questions/ROWvRT3gbU) > prepwiser.in/questions/ROWvRT3gbU

An X-ray tube is operated at 1.24 million volt. The shortest wavelength of the produced photon will be:

- (A) 10^{-2} nm (B) 10^{-1} nm (C) 10^{-3} nm (D) 10^{-4} nm

Q4 Dual Nature of Radiation & Matter

[Step-by-step solution](https://www.prepwiser.in/questions/sueBbqp90g) > prepwiser.in/questions/sueBbqp90g

The de-Broglie wavelength of a proton and α -particle are equal. The ratio of their velocities is:

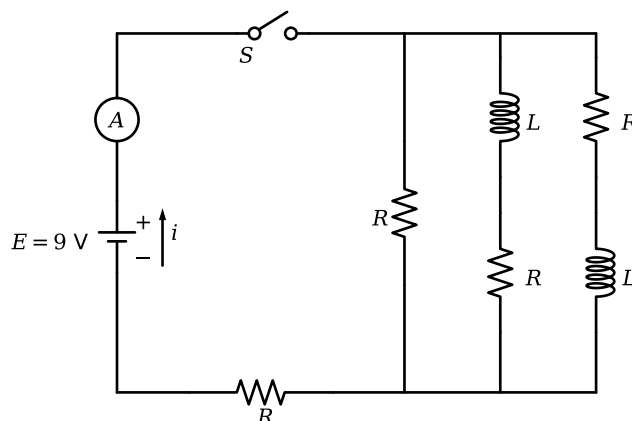
- (A) 4 : 2 (B) 4 : 3 (C) 4 : 1 (D) 1 : 4

Q5 Electromagnetic Induction

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

Figure shows a circuit that contains four identical resistors with resistance $R = 2.0\Omega$, two identical inductors with inductance $L = 2.0$ mH and an ideal battery with emf $E = 9$ V. The current 'i' just after the switch 'S' is closed will be:

- (A) 3.0 A (B) 3.37 A (C) 9 A (D) 2.25 A

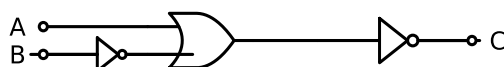


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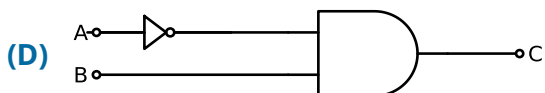
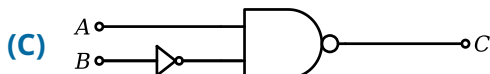
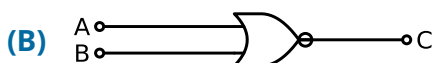
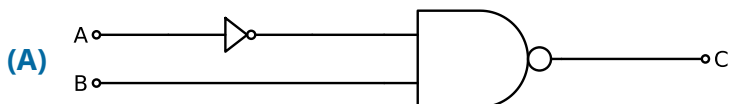
Match List - I with List - II.

	List I		List II
(a)	Source of microwave frequency	(i)	Radioactive decay of nucleus
(b)	Source of infrared frequency	(ii)	Magnetron
(c)	Source of Gamma Rays	(iii)	Inner shell electrons
(d)	Source of X-rays	(iv)	Vibration of atoms and molecules
		(v)	LASER
		(vi)	RC circuit

Choose the correct answer from the options given below:

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

The logic circuit shown above is equivalent to:



Given below are two statements:

Statement I : PN junction diodes can be used to function as transistor, simply by connecting two diodes, back to back, which acts as the base terminal.

Statement II : In the study of transistor, the amplification factor β indicates ratio of the collector current to the base current.

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 false but Statement II is true**(C)** Both Statement I and Statement II are true**(D)** Statement I is true but Statement II is false

Zener breakdown occurs in a p – n junction having p and n both:

(A) heavily doped and have wide depletion layer.**(B)** lightly doped and have narrow depletion layer.**(C)** heavily doped and have narrow depletion layer.**(D)** lightly doped and have wide depletion layer.

Q10 Simple Harmonic Motion[Step-by-step solution](https://www.prepwiser.in/questions/rNozBiYVQM)

Two electrons each are fixed at a distance '2d'. A third charge proton placed at the midpoint is displaced slightly by a distance x ($x \ll d$) perpendicular to the line joining the two fixed charges. Proton will execute simple harmonic motion having angular frequency : (m = mass of charged particle)

- (A) $\left(\frac{2q^2}{\pi\epsilon_0 md^3}\right)^{\frac{1}{2}}$ (B) $\left(\frac{q^2}{2\pi\epsilon_0 md^3}\right)^{\frac{1}{2}}$ (C) $\left(\frac{2\pi\epsilon_0 md^3}{q^2}\right)^{\frac{1}{2}}$ (D) $\left(\frac{\pi\epsilon_0 md^3}{2q^2}\right)^{\frac{1}{2}}$

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

A body weights 49N on a spring balance at the north pole. What will be its weight recorded on the same weighing machine, if it is shifted to the equator?

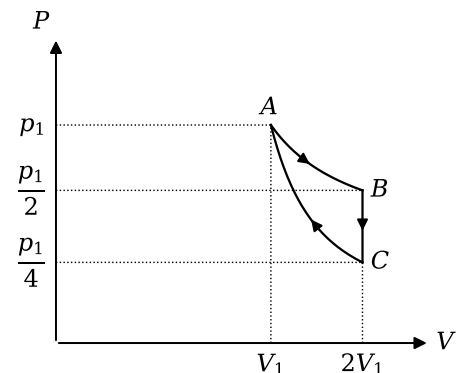
[Use $g = \frac{GM}{R^2} = 9.8 \text{ ms}^{-2}$ and radius of earth, $R = 6400 \text{ km}$.]

- (A) 49 N (B) 49.83 N (C) 48.83 N (D) 49.17 N

Q12 Thermodynamics[Step-by-step solution](https://www.prepwiser.in/questions/XiSj98bo1f)

If one mole of an ideal gas at (P_1, V_1) is allowed to expand reversibly and isothermally (A to B) its pressure is reduced to one-half of the original pressure (see figure). This is followed by a constant volume cooling till its pressure is reduced to one-fourth of the initial value ($B \rightarrow C$). Then it is restored to its initial state by a reversible adiabatic compression (C to A). The net workdone by the gas is equal to:

- (A) $-\frac{RT}{2(\gamma - 1)}$ (B) $RT \left(\ln 2 - \frac{1}{2(\gamma - 1)} \right)$
(C) $RT \ln 2$ (D) 0

**Q13** Kinetic Theory of Gases[Step-by-step solution](https://www.prepwiser.in/questions/5fk9ohAC_O)

On the basis of kinetic theory of gases, the gas exerts pressure because its molecules:

- (A) continuously lose their energy till it reaches wall.
(B) are attracted by the walls of container.
(C) suffer change in momentum when impinge on the walls of container.
(D) continuously stick to the walls of container.

Q14 Rectilinear Motion[Step-by-step solution](https://www.prepwiser.in/questions/SWjha-eDEJ)

A particle is projected with velocity v_0 along x-axis. A damping force is acting on the particle which is proportional to the square of the distance from the origin i.e. $ma = -\alpha x^2$. The distance at which the particle stops:

- (A) $\left[\frac{3mv_0^2}{2\alpha}\right]^{\frac{1}{3}}$ (B) $\left(\frac{2v_0}{3\alpha}\right)^{\frac{1}{3}}$ (C) $\left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{2}}$ (D) $\left(\frac{2v_0^2}{3\alpha}\right)^{\frac{1}{2}}$

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Q15 Magnetism & Matter[Step-by-step solution](https://www.prepwisar.in/questions/Y7oqdCgF8a) > prepwisar.in/questions/Y7oqdCgF8a

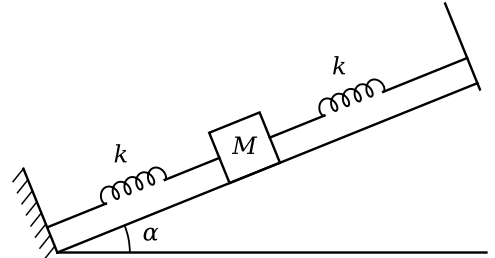
A soft ferromagnetic material is placed in an external magnetic field. The magnetic domains:

- (A) may increase or decrease in size and change its orientation.
- (B) increase in size but no change in orientation.
- (C) decrease in size and changes orientation.
- (D) have no relation with external magnetic field.

Q16 Simple Harmonic Motion[Step-by-step solution](https://www.prepwisar.in/questions/sAUSz8W0Hi) > prepwisar.in/questions/sAUSz8W0Hi

In the given figure, a body of mass M is held between two massless springs, on a smooth inclined plane. The free ends of the springs are attached to firm supports. If each spring has spring constant k , the frequency of oscillation of given body is:

- (A) $\frac{1}{2\pi} \sqrt{\frac{2k}{Mg \sin \alpha}}$
- (B) $\frac{1}{2\pi} \sqrt{\frac{k}{Mg \sin \alpha}}$
- (C) $\frac{1}{2\pi} \sqrt{\frac{2k}{M}}$
- (D) $\frac{1}{2\pi} \sqrt{\frac{k}{2M}}$

**Q17** Simple Harmonic Motion[Step-by-step solution](https://www.prepwisar.in/questions/D47jDBDyXD) > prepwisar.in/questions/D47jDBDyXD

When a particle executes SHM, the nature of graphical representation of velocity as a function of displacement is:

- (A) circular
- (B) straight line
- (C) parabolic
- (D) elliptical

Q18 Units, Dimensions & Errors[Step-by-step solution](https://www.prepwisar.in/questions/E8E9-xM8Ky) > prepwisar.in/questions/E8E9-xM8Ky

The period of oscillation of a simple pendulum is $T = 2\pi \sqrt{\frac{L}{g}}$. Measured value of 'L' is 1.0 m from meter scale having a minimum division of 1 mm and time of one complete oscillation is 1.95 s measured from stopwatch of 0.01 s resolution. The percentage error in the determination of 'g' will be:

- (A) 1.30%
- (B) 1.33%
- (C) 1.13%
- (D) 1.03%

Q19 Wave Optics[Step-by-step solution](https://www.prepwisar.in/questions/qbZ859bCVw) > prepwisar.in/questions/qbZ859bCVw

If the source of light used in a Young's double slit experiment is changed from red to violet:

- (A) the fringes will become brighter.
- (B) the intensity of minima will increase.
- (C) consecutive fringe lines will come closer.
- (D) the central bright fringe will become a dark fringe.

Q20 Mechanical Waves[Step-by-step solution](https://www.prepwisar.in/questions/fSQm2PzCjQ) > prepwisar.in/questions/fSQm2PzCjQ

Which of the following equations represents a travelling wave?

- (A) $y = Ae^x \cos(\omega t - \theta)$
- (B) $y = Ae^{-x^2} (vt + \theta)$
- (C) $y = A \sin(15x - 2t)$
- (D) $y = A \sin x \cos \omega t$

Q21 Alternating Current **NUMERICAL**

[Step-by-step solution](#) › [prepwiser.in/questions/jQtbt8ROeB](https://www.prepwiser.in/questions/jQtbt8ROeB)

A series L-C-R circuit is designed to resonate at an angular frequency $\omega_0 = 10^5$ rad/s. The circuit draws 16W power from 120V source at resonance. The value of resistance 'R' in the circuit is _____ Ω .

Q22 Centre of Mass & Linear Momentum **NUMERICAL**

[Step-by-step solution](#) › [prepwiser.in/questions/SBm99vwCv9](https://www.prepwiser.in/questions/SBm99vwCv9)

Two solids A and B of mass 1 kg and 2 kg respectively are moving with equal linear momentum. The ratio of their kinetic energies $(K.E.)_A : (K.E.)_B$ will be $\frac{A}{1}$, so the value of A will be _____.

Q23 Current Electricity **NUMERICAL**

[Step-by-step solution](#) › [prepwiser.in/questions/6Pz_8A3FT1](https://www.prepwiser.in/questions/6Pz_8A3FT1)

A cylindrical wire of radius 0.5 mm and conductivity 5×10^7 S/m is subjected to an electric field of 10 mV/m. The expected value of current in the wire will be $x^3\pi$ mA. The value of x is _____.

Q24 Electromagnetic Waves **NUMERICAL**

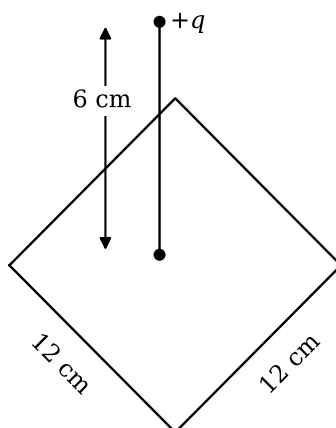
[Step-by-step solution](#) › [prepwiser.in/questions/S18GdfUehQ](https://www.prepwiser.in/questions/S18GdfUehQ)

An electromagnetic wave of frequency 3 GHz enters a dielectric medium of relative electric permittivity 2.25 from vacuum. The wavelength of this wave in that medium will be _____ $\times 10^{-2}$ cm.

Q25 Electrostatics I: Charges, Field & Gauss's Law **NUMERICAL**

[Step-by-step solution](#) › [prepwiser.in/questions/7wRpgx9KfN](https://www.prepwiser.in/questions/7wRpgx9KfN)

A point charge of $+12\mu\text{C}$ is at a distance 6 cm vertically above the centre of a square of side 12 cm as shown in figure. The magnitude of the electric flux through the square will be _____ $\times 10^3 \text{ Nm}^2/\text{C}$.



Q26 Kinetic Theory of Gases **NUMERICAL**

[Step-by-step solution](#) › [prepwiser.in/questions/laQkfD9F2Z](https://www.prepwiser.in/questions/laQkfD9F2Z)

The root mean square speed of molecules of a given mass of a gas at 27°C and 1 atmosphere pressure is 200 ms^{-1} . The root mean square speed of molecules of the gas at 127°C and 2 atmosphere pressure is $\frac{x}{\sqrt{3}} \text{ ms}^{-1}$. The value of x will be _____.

Q27 Elasticity **NUMERICAL**

[Step-by-step solution](#) › [prepwiser.in/questions/gZo8II519C](https://www.prepwiser.in/questions/gZo8II519C)

A uniform metallic wire is elongated by 0.04 m when subjected to a linear force F. The elongation, if its length and diameter is doubled and subjected to the same force will be _____ cm.

Q28 Rotational Motion **NUMERICAL**

[Step-by-step solution](#) › [prepwiser.in/questions/5UZ-u1k0OC](https://www.prepwiser.in/questions/5UZ-u1k0OC)

A uniform thin bar of mass 6 kg and length 2.4 meter is bent to make an equilateral hexagon. The moment of inertia about an axis passing through the centre of mass and perpendicular to the plane of hexagon is _____ $\times 10^{-1} \text{ kg m}^2$.

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Two cars are approaching each other at an equal speed of 7.2 km/hr. When they see each other, both blow horns having frequency of 676 Hz. The beat frequency heard by each driver will be _____ Hz. [Velocity of sound in air is 340 m/s.]

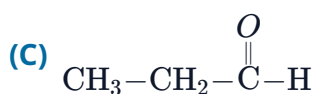
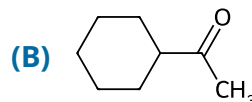
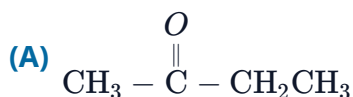
Chemistry Section A · Multiple choice

Q30 to Q45

Q30 Hydrocarbons: Alkenes & Alkynes

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

Which one of the following carbonyl compounds cannot be prepared by addition of water on an alkyne in the presence of HgSO_4 and H_2SO_4 ?



Q31 Chemistry in Everyday Life

Step-by-step solution > [prepwisar.in/questions/kQhXdt7sPZ](https://www.prepwisar.in/questions/kQhXdt7sPZ)

Match List - I and List - II.

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

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

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

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

	List I		List II
(a)	Valium	(i)	Antifertility drug
(b)	Morphine	(ii)	Pernicious anaemia
(c)	Norethindrone	(iii)	Analgesic
(d)	Vitamin B_{12}	(iv)	Tranquilizer

Q32 Chemical Bonding & Molecular Structure

Step-by-step solution > [prepwisar.in/questions/V-1ZpJUDtQ](https://www.prepwisar.in/questions/V-1ZpJUDtQ)

The correct set from the following in which both pairs are in correct order of melting point is:

(A) $\text{LiCl} > \text{LiF}$; $\text{NaCl} > \text{MgO}$

(B) $\text{LiCl} > \text{LiF}$; $\text{MgO} > \text{NaCl}$

(C) $\text{LiF} > \text{LiCl}$; $\text{NaCl} > \text{MgO}$

(D) $\text{LiF} > \text{LiCl}$; $\text{MgO} > \text{NaCl}$

Q33 Chemical Bonding & Molecular Structure

Step-by-step solution > [prepwisar.in/questions/PUbodL6COT](https://www.prepwisar.in/questions/PUbodL6COT)

The correct shape and $I - I - I$ bond angles respectively in I_3^- ion are:

(A) Linear; 180°

(B) T-shaped; 180° and 90°

(C) Trigonal planar; 120°

(D) Distorted trigonal planar; 135° and 90°

Q34 Coordination Compounds

Step-by-step solution > [prepwisar.in/questions/6x3-r8awUw](https://www.prepwisar.in/questions/6x3-r8awUw)

The calculated magnetic moments (spin only value) for species $[\text{FeCl}_4]^{2-}$, $[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$ and MnO_4^{2-} respectively are:

(A) 5.92, 4.90 and 0 BM (B) 4.90, 0 and 1.73 BM (C) 5.82, 0 and 0 BM (D) 4.90, 0 and 2.83 BM

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The **incorrect** statement among the following is:

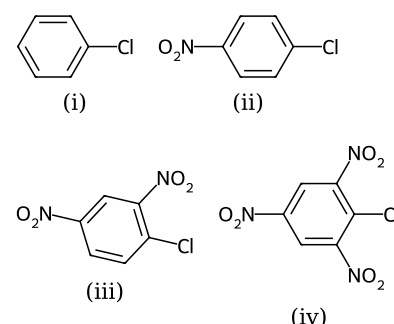
- (A) RuO_4 is an oxidizing agent
 (B) Cr_2O_3 is an amphoteric oxide.
 (C) VOSO_4 is a reducing agent
 (D) Red colour of ruby is due to the presence of Co^{3+}

What is the correct order of the following elements with respect to their density?

- (A) $\text{Cr} < \text{Zn} < \text{Co} < \text{Cu} < \text{Fe}$
 (B) $\text{Cr} < \text{Fe} < \text{Co} < \text{Cu} < \text{Zn}$
 (C) $\text{Zn} < \text{Cr} < \text{Fe} < \text{Co} < \text{Cu}$
 (D) $\text{Zn} < \text{Cu} < \text{Co} < \text{Fe} < \text{Cr}$

The correct order of the following compounds showing increasing tendency towards nucleophilic substitution reaction is:

- (A) (iv) < (i) < (ii) < (iii)
 (B) (iv) < (iii) < (ii) < (i)
 (C) (iv) < (i) < (iii) < (ii)
 (D) (i) < (ii) < (iii) < (iv)



Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.
 Assertion A : Hydrogen is the most abundant element in the Universe, but it is not the most abundant gas in the troposphere.

Reason R : Hydrogen is the lightest element.

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

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

Math List - I with List - II.

	List I (Metal)		List II (Ores)
(a)	Aluminium	(i)	Siderite
(b)	Iron	(ii)	Calamine
(c)	Copper	(iii)	Kaolinite
(d)	Zinc	(iv)	Malachite

Choose the correct answer from the options given below:

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

In polymer Buna-S : 'S' stands for:

- (A) Sulphur (B) Styrene (C) Strength (D) Sulphonation

Match List - I with List - II.

	List I (Salt)		List II (Flame colour wavelength)
(a)	LiCl	(i)	455.5 nm
(b)	NaCl	(ii)	670.8 nm
(c)	RbCl	(iii)	780.0 nm
(d)	CsCl	(iv)	589.2 nm

Choose the correct answer from the options given below:

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

According to Bohr's atomic theory:

- (A) Kinetic energy of electron is $\propto \frac{Z^2}{n^2}$.
 (B) The product of velocity (v) of electron and principal quantum number (n), $vn' \propto Z^2$.
 (C) Frequency of revolution of electron in an orbit is $\propto \frac{Z^3}{n^3}$.
 (D) Coulombic force of attraction on the electron is $\propto \frac{Z^3}{n^4}$.

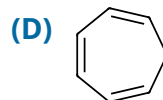
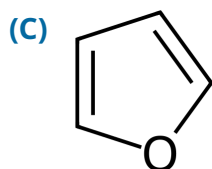
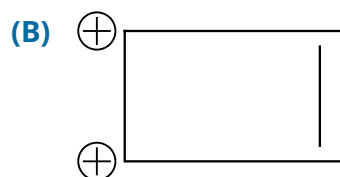
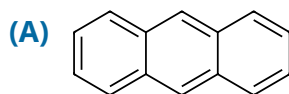
Choose the most appropriate answer from the options given below:

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

Most suitable salt which can be used for efficient clotting of blood will be:

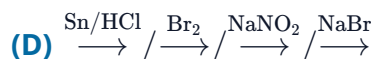
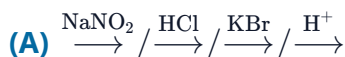
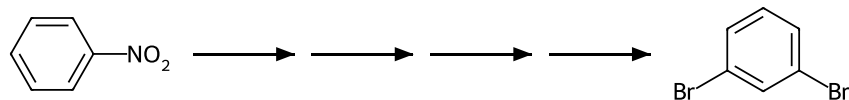
- (A) $\text{Mg}(\text{HCO}_3)_2$ (B) NaHCO_3 (C) FeCl_3 (D) FeSO_4

Which one of the following compounds is non-aromatic?



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What is the correct sequence of reagents used for converting nitrobenzene into m-dibromobenzene?



Chemistry Section B · Numerical value

Q46 to Q54

Sucrose hydrolyses in acid solution into glucose and fructose following first order rate law with a half-life of 3.33 h at 25°C. After 9 h, the fraction of sucrose remaining is f . The value of $\log_{10} \left(\frac{1}{f} \right)$ is $\times 10^{-2}$. (Rounded off to the nearest integer)
[Assume : $\ln 10 = 2.303$, $\ln 2 = 0.693$]

The magnitude of the change in oxidising power of the $\text{MnO}_4^- / \text{Mn}^{2+}$ couple is $x \times 10^{-4}$ V, if the H^+ concentration is decreased from 1M to 10^{-4} M at 25°C. (Assume concentration of MnO_4^- and Mn^{2+} to be same on change in H^+ concentration). The value of x is _____. [Given : $\frac{2.303RT}{F} = 0.059$]

The solubility product of PbI_2 is 8.0×10^{-9} . The solubility of lead iodide in 0.1 molar solution of lead nitrate is $x \times 10^{-6}$ mol/L. The value of x is _____. (Rounded off to the nearest integer) [Given $\sqrt{2} = 1.41$]

Among the following allotropic forms of sulphur, the number of allotropic forms, which will show paramagnetism is _____.

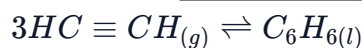
- (A) α -sulphur
- (B) β -sulphur
- (C) S_2 -form

C_6H_6 freezes at 5.5°C. The temperature at which a solution of 10g of C_4H_{10} in 200g of C_6H_6 freeze is _____ °C. (The molal freezing point depression constant of C_6H_6 is 5.12°C/m.)

The formula of a gaseous hydrocarbon which requires 6 times of its own volume of O_2 for complete oxidation and produces 4 times its own volume of CO_2 is C_xH_y . The value of y is _____.

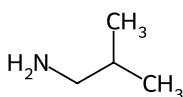
1.86 g of aniline completely reacts to form acetanilide. 10% of the product is lost during purification. Amount of acetanilide obtained after purification (in g) is $\times 10^{-2}$.

Assuming ideal behaviour, the magnitude of $\log K$ for the following reaction at 25°C is $x \times 10^{-1}$. The value of x is _____. (Integer answer)

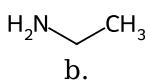


[Given: $\Delta_f G^\circ(\text{HC} \equiv \text{CH}) = -2.04 \times 10^5 \text{ J mol}^{-1}$; $\Delta_f G^\circ(\text{C}_6\text{H}_6) = -1.24 \times 10^5 \text{ J mol}^{-1}$; $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$]

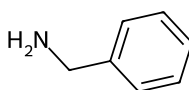
The total number of amines among the following which can be synthesized by Gabriel synthesis is _____.



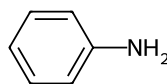
a.



b.



c.



d.

Mathematics Section A · Multiple choice

Q55 to Q70

Let $a, b \in \mathbb{R}$. If the mirror image of the point $P(a, 6, 9)$ with respect to the line

$\frac{x-3}{7} = \frac{y-2}{5} = \frac{z-1}{-9}$ is $(20, b, -a-9)$, then $|a + b|$, is equal to:

(A) 88

(B) 90

(C) 86

(D) 84

The vector equation of the plane passing through the intersection

of the planes $\vec{r} \cdot (\hat{i} + \hat{j} + \hat{k}) = 1$ and $\vec{r} \cdot (\hat{i} - 2\hat{j}) = -2$, and the point $(1, 0, 2)$ is:

(A) $\vec{r} \cdot (\hat{i} + 7\hat{j} + 3\hat{k}) = \frac{7}{3}$

(B) $\vec{r} \cdot (\hat{i} + 7\hat{j} + 3\hat{k}) = 7$

(C) $\vec{r} \cdot (3\hat{i} + 7\hat{j} + 3\hat{k}) = 7$

(D) $\vec{r} \cdot (\hat{i} - 7\hat{j} + 3\hat{k}) = \frac{7}{3}$

For which of the following curves, the line $x + \sqrt{3}y = 2\sqrt{3}$ is the tangent at the point $\left(\frac{3\sqrt{3}}{2}, \frac{1}{2}\right)$?

(A) $2x^2 - 18y^2 = 9$

(B) $y^2 = \frac{1}{6\sqrt{3}}x$

(C) $x^2 + 9y^2 = 9$

(D) $x^2 + y^2 = 7$

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

$$f(x) = \begin{cases} -55x, & \text{if } x < -5 \\ 2x^3 - 3x^2 - 120x, & \text{if } -5 \leq x \leq 4 \\ 2x^3 - 3x^2 - 36x - 336, & \text{if } x > 4, \end{cases}$$

Let $A = \{x \in \mathbb{R} : f \text{ is increasing}\}$. Then A is equal to:

- (A) $(-5, \infty)$ (B) $(-\infty, -5) \cup (4, \infty)$
 (C) $(-5, -4) \cup (4, \infty)$ (D) $(-\infty, -5) \cup (-4, \infty)$

If the curve $y = ax^2 + bx + c$, $x \in \mathbb{R}$, passes through the point $(1, 2)$ and the tangent line to this curve at origin is $y = x$, then the possible values of a, b, c are:

- (A) $a = -1, b = 1, c = 1$ (B) $a = 1, b = 1, c = 0$ (C) $a = \frac{1}{2}, b = \frac{1}{2}, c = 1$ (D) $a = 1, b = 0, c = 1$

If $n \geq 2$ is a positive integer, then the sum of the series

$${}^{n+1}C_2 + 2({}^2C_2 + {}^3C_2 + {}^4C_2 + \dots + {}^nC_2)$$

is:

- (A) $\frac{n(2n+1)(3n+1)}{6}$ (B) $\frac{n(n+1)(2n+1)}{6}$ (C) $\frac{n(n+1)^2(n+2)}{12}$ (D) $\frac{n(n-1)(2n+1)}{6}$

The value of the integral, $\int_1^3 [x^2 - 2x - 2] dx$, where $[x]$ denotes the greatest integer less than or equal to x , is:

- (A) -5 (B) $-\sqrt{2} - \sqrt{3} + 1$ (C) -4 (D) $-\sqrt{2} - \sqrt{3} - 1$

Let $f(x)$ be a differentiable function defined on $[0, 2]$ such that $f'(x) = f'(2-x)$ for all $x \in (0, 2)$, $f(0) = 1$ and $f(2) = e^2$. Then the value of $\int_0^2 f(x) dx$ is:

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

Let f be a twice differentiable function defined on $\mathbb{R}$ such that $f(0) = 1$, $f'(0) = 2$ and $f'(x) \neq 0$ for all $x \in \mathbb{R}$. If

$$\begin{vmatrix} f(x) & f'(x) \\ f'(x) & f''(x) \end{vmatrix}$$

$= 0$, for all $x \in \mathbb{R}$, then the value of $f(1)$ lies in the interval:

- (A) $(0, 3)$ (B) $(9, 12)$ (C) $(3, 6)$ (D) $(6, 9)$

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Q64 Differential Equations[Step-by-step solution](#) › [prepwiset.in/questions/mxNSyWvg75](https://www.prepwiset.in/questions/mxNSyWvg75)

If a curve $y = f(x)$ passes through the point $(1, 2)$ and satisfies $x \frac{dy}{dx} + y = bx^4$, then for what value of b , $\int_1^2 f(x) dx = \frac{62}{5}$?

- (A) $\frac{31}{5}$ (B) 10 (C) 5 (D) $\frac{62}{5}$

Q65 Inverse Trigonometric Functions[Step-by-step solution](#) › [prepwiset.in/questions/aroE80H6gp](https://www.prepwiset.in/questions/aroE80H6gp)

A possible value of $\tan \left(\frac{1}{4} \sin^{-1} \frac{\sqrt{63}}{8} \right)$ is:

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

Q66 Determinants[Step-by-step solution](#) › [prepwiset.in/questions/-f6K0YWZCH](https://www.prepwiset.in/questions/-f6K0YWZCH)

Let A and B be 3×3 real matrices such that A is symmetric matrix and B is skew-symmetric matrix. Then the system of linear equations $(A^2B^2 - B^2A^2)X = O$, where X is a 3×1 column matrix of unknown variables and O is a 3×1 null matrix, has:

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

Q67 Determinants[Step-by-step solution](#) › [prepwiset.in/questions/HR0LcgVXWc](https://www.prepwiset.in/questions/HR0LcgVXWc)

For the system of linear equations:

$$x - 2y = 1, x - y + kz = -2, ky + 4z = 6, k \in R,$$

consider the following statements:

- (A) The system has unique solution if $k \neq 2, k \neq -2$.
(B) The system has unique solution if $k = -2$
(C) The system has unique solution if $k = 2$
(D) The system has no solution if $k = 2$
(E) The system has infinite number of solutions if $k \neq -2$.

Which of the following statements are correct?

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

Q68 Applications of Derivatives[Step-by-step solution](#) › [prepwiset.in/questions/QYcNtTkkCA](https://www.prepwiset.in/questions/QYcNtTkkCA)

If P is a point on the parabola $y = x^2 + 4$ which is closest to the straight line $y = 4x - 1$, then the co-ordinates of P are:

- (A) $(-2, 8)$ (B) $(2, 8)$ (C) $(1, 5)$ (D) $(3, 13)$

Q69 Probability: Basic[Step-by-step solution](#) › [prepwiset.in/questions/O9-hOda5Nj](https://www.prepwiset.in/questions/O9-hOda5Nj)

The probability that two randomly selected subsets of the set $\{1, 2, 3, 4, 5\}$ have exactly two elements in their intersection, is:

- (A) $\frac{135}{2^9}$ (B) $\frac{65}{2^8}$ (C) $\frac{65}{2^7}$ (D) $\frac{35}{2^7}$

Q70 Area Under Curves[Step-by-step solution](#) › [prepwiset.in/questions/guRzaFSBcI](https://www.prepwiset.in/questions/guRzaFSBcI)

The area of the region: $R = \{(x, y) : 5x^2 \leq y \leq 2x^2 + 9\}$ is:

- (A) $6\sqrt{3}$ square units (B) $12\sqrt{3}$ square units (C) $11\sqrt{3}$ square units (D) $9\sqrt{3}$ square units

Q71 Three Dimensional Geometry **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/vRt9qa_ti

Let λ be an integer. If the shortest distance between the lines

$x - \lambda = 2y - 1 = -2z$ and $x = y + 2\lambda = z - \lambda$ is $\frac{\sqrt{7}}{2\sqrt{2}}$, then the value of $|\lambda|$ is _____.

Q72 Binomial Theorem **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/Lp9DgyLUF5

For integers n and r , let

$$\binom{n}{r} = \begin{cases} {}^nC_r, & \text{if } n \geq r \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

The maximum value of k for which the sum

$$\sum_{i=0}^k \binom{10}{i} \binom{15}{k-i} + \sum_{i=0}^{k+1} \binom{12}{i} \binom{13}{k+1-i}$$

exists, is equal to _____.

Q73 Straight Lines **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/1WWv_MLmoj

Let a point P be such that its distance from the point $(5, 0)$ is thrice the distance of P from the point $(-5, 0)$. If the locus of the point P is a circle of radius r , then $4r^2$ is equal to _____. (Round off to the nearest integer)

Q74 Circles **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/98-ZjIIW05

If the area of the triangle formed by the positive x -axis, the normal and the tangent to the circle $(x - 2)^2 + (y - 3)^2 = 25$ at the point $(5, 7)$ is A , then $24A$ is equal to _____.

Q75 Complex Numbers **NUMERICAL**

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

Let $i = \sqrt{-1}$. If

$$\frac{(-1 + i\sqrt{3})^{21}}{(1 - i)^{24}} + \frac{(1 + i\sqrt{3})^{21}}{(1 + i)^{24}} = k$$

, and $n = [|k|]$ be the greatest integral part of $|k|$. Then

$$\sum_{j=0}^{n+5} (j+5)^2 - \sum_{j=0}^{n+5} (j+5)$$

is equal to _____.

Q76 Functions (Advanced) **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/HiQhC_V7OP

If $a + \alpha = 1$, $b + \beta = 2$ and $af(x) + \alpha f\left(\frac{1}{x}\right) = bx + \frac{\beta}{x}$, $x \neq 0$, then the value of the expression $\frac{f(x) + f\left(\frac{1}{x}\right)}{x + \frac{1}{x}}$ is _____.

Q77 Permutations & Combinations **NUMERICAL**

[Step-by-step solution](#) › prepwiser.in/questions/dId0qsEMq8

The students $S_1, S_2, \dots, S_{10}$ are to be divided into 3 groups A, B and C such that each group has at least one student and the group C has at most 3 students. Then the total number of possibilities of forming such groups is _____.

Q78 Quadratic Equations & Polynomial Inequalities **NUMERICAL**

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

The number of the real roots of the equation $(x + 1)^2 + |x - 5| = \frac{27}{4}$ is _____.

The sum of first four terms of a geometric progression (G. P.) is $\frac{65}{12}$ and the sum of their respective reciprocals is $\frac{65}{18}$. If the product of first three terms of the G.P. is 1, and the third term is α , then 2α is _____.

If the variance of 10 natural numbers 1, 1, 1, ..., 1, k is less than 10, then the maximum possible value of k is _____.

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Physics

1. A	2. C	3. C	4. C	5. D	6. B	7. D	8. B
9. C	10. B	11. C	12. B	13. C	14. A	15. A	16. C
17. D	18. C	19. C	20. C	21. 900	22. 2	23. 5	24. 667
25. 226	26. 400	27. 2	28. 8	29. 8			

Chemistry

30. C	31. D	32. D	33. A	34. B	35. D	36. C	37. D
38. B	39. C	40. B	41. D	42. D	43. C	44. D	45. C
46. 81	47. 3776	48. 141	49. 1	50. 1	51. 8	52. 243	53. 855
54. 3							

Mathematics

55. A	56. B	57. C	58. C	59. B	60. B	61. D	62. A
63. D	64. B	65. B	66. C	67. D	68. B	69. A	70. B
71. 1	72. 12	73. 56	74. 1225	75. 310	76. 2	77. 31650	78. 2
79. 3	80. 11						

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