

JEE MAIN 2021 · QUESTION PAPER

20 Jul 2021 **Shift 2**

84 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	20 Q1 to Q20	10 Q21 to Q30
● Chemistry	17 Q31 to Q47	10 Q48 to Q57
● Mathematics	18 Q58 to Q75	9 Q76 to Q84
In this PDF	84 questions · answer key at the end	

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

Attempt this paper online

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

prepwisar.in/pyqs/paper/2021-07-20-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 Alternating Current

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

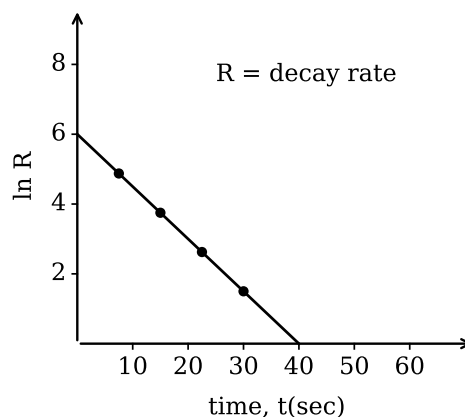
For a series LCR circuit with $R = 100 \Omega$, $L = 0.5 \text{ mH}$ and $C = 0.1 \text{ pF}$ connected across $220\text{V} - 50 \text{ Hz}$ AC supply, the phase angle between current and supplied voltage and the nature of the circuit is:

- (A) 0° , resistive circuit (B) $\approx 90^\circ$, predominantly inductive circuit
(C) 0° , resonance circuit (D) $\approx 90^\circ$, predominantly capacitive circuit

Q2 Nuclear Physics

[Step-by-step solution](#) › [prepwisar.in/questions/mz0jB0Zikv](https://www.prepwisar.in/questions/mz0jB0Zikv)

For a certain radioactive process the graph between $\ln R$ and $t(\text{sec})$ is obtained as shown in the figure. Then the value of half life for the unknown radioactive material is approximately:



- (A) 9.15 sec (B) 6.93 sec (C) 2.62 sec (D) 4.62 sec

Q3 Work, Energy & Power

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

If the Kinetic energy of a moving body becomes four times its initial Kinetic energy, then the percentage change in its momentum will be:

- (A) 100% (B) 200% (C) 300% (D) 400%

Q4 Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwisar.in/questions/600jUyqkUX](https://www.prepwisar.in/questions/600jUyqkUX)

An electron having de-Broglie wavelength λ is incident on a target in a X-ray tube. Cut-off wavelength of emitted X-ray is:

- (A) 0 (B) $\frac{2m^2c^2\lambda^2}{h^2}$ (C) $\frac{2mc\lambda^2}{h}$ (D) $\frac{hc}{mc}$

Q5 Electromagnetic Waves

[Step-by-step solution](#) › [prepwisar.in/questions/7x-9t3qwMQ](https://www.prepwisar.in/questions/7x-9t3qwMQ)

In an electromagnetic wave the electric field vector and magnetic field vector are given as $\vec{E} = E_0\hat{i}$ and $\vec{B} = B_0\hat{k}$ respectively. The direction of propagation of electromagnetic wave is along:

- (A) $(\hat{k})$ (B) $\hat{j}$ (C) $(-\hat{k})$ (D) $(-\hat{j})$

Q6 Gravitation

[Step-by-step solution](#) › [prepwisar.in/questions/Kjd5ZtpH1k](https://www.prepwisar.in/questions/Kjd5ZtpH1k)

A satellite is launched into a circular orbit of radius R around earth, while a second satellite is launched into a circular orbit of radius $1.02 R$. The percentage difference in the time periods of the two satellites is:

- (A) 1.5 (B) 2.0 (C) 0.7 (D) 3.0

Q7 Gravitation[Step-by-step solution](https://www.prepwisar.in/questions/v6O4pBPuN-)

Consider a binary star system of star A and star B with masses m_A and m_B revolving in a circular orbit of radii r_A and r_B , respectively. If T_A and T_B are the time period of star A and star B, respectively, Then:

(A) $\frac{T_A}{T_B} = \left(\frac{r_A}{r_B}\right)^{\frac{3}{2}}$

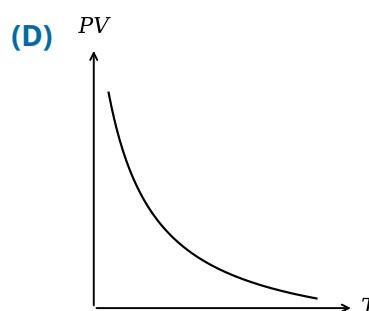
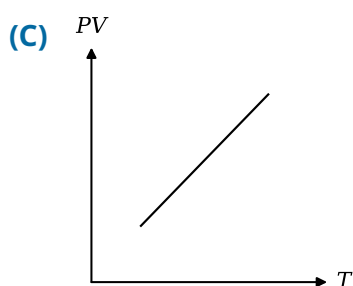
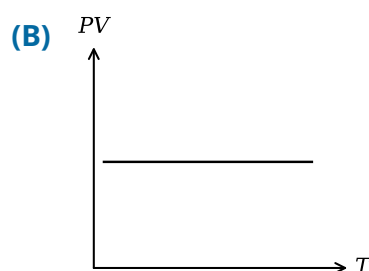
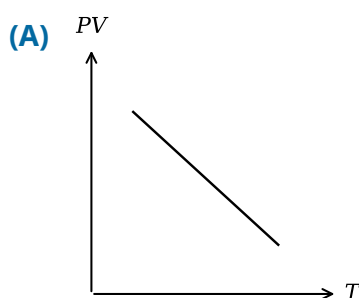
(B) $T_A = T_B$

(C) $T_A > T_B$ (if $m_A > m_B$)

(D) $T_A > T_B$ (if $r_A > r_B$)

Q8 Kinetic Theory of Gases[Step-by-step solution](https://www.prepwisar.in/questions/hxkrU9rLsj)

Which of the following graphs represent the behavior of an ideal gas? Symbols have their usual meaning.

**Q9** Kinetic Theory of Gases[Step-by-step solution](https://www.prepwisar.in/questions/SfirlZwuGj)

The correct relation between the degrees of freedom f and the ratio of specific heat γ is:

(A) $f = \frac{2}{\gamma-1}$

(B) $f = \frac{2}{\gamma+1}$

(C) $f = \frac{\gamma+1}{2}$

(D) $f = \frac{1}{\gamma+1}$

Q10 Magnetism & Matter[Step-by-step solution](https://www.prepwisar.in/questions/GjAkOVJeJU)

At an angle of 30° to the magnetic meridian, the apparent dip is 45° . Find the true dip:

(A) $\tan^{-1} \sqrt{3}$

(B) $\tan^{-1} \frac{1}{\sqrt{3}}$

(C) $\tan^{-1} \frac{2}{\sqrt{3}}$

(D) $\tan^{-1} \frac{\sqrt{3}}{2}$

Q11 Magnetism & Matter[Step-by-step solution](https://www.prepwisar.in/questions/gjvQna8Vph)

The magnetic susceptibility of a material of a rod is 499. Permeability in vacuum is $4\pi \times 10^{-7}$ H/m. Absolute permeability of the material of the rod is:

(A) $4\pi \times 10^{-4}$ H/m

(B) $2\pi \times 10^{-4}$ H/m

(C) $3\pi \times 10^{-4}$ H/m

(D) $\pi \times 10^{-4}$ H/m

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Q12 Projectile Motion & Relative Motion[Step-by-step solution](https://www.prepwiser.in/questions/rYdWCCUu8y) > prepwiser.in/questions/rYdWCCUu8y

A boy reaches the airport and finds that the escalator is not working. He walks up the stationary escalator in time t_1 . If he remains stationary on a moving escalator then the escalator takes him up in time t_2 . The time taken by him to walk up on the moving escalator will be:

- (A) $\frac{t_1 t_2}{t_2 - t_1}$ (B) $\frac{t_1 + t_2}{2}$ (C) $\frac{t_1 t_2}{t_2 + t_1}$ (D) $t_2 - t_1$

Q13 Elasticity[Step-by-step solution](https://www.prepwiser.in/questions/lyhuwqShgv) > prepwiser.in/questions/lyhuwqShgv

The length of a metal wire is l_1 , when the tension in it is T_1 and is l_2 when the tension is T_2 . The natural length of the wire is:

- (A) $\sqrt{l_1 l_2}$ (B) $\frac{l_1 T_2 - l_2 T_1}{T_2 - T_1}$ (C) $\frac{l_1 T_2 + l_2 T_1}{T_2 + T_1}$ (D) $\frac{l_1 + l_2}{2}$

Q14 Surface Tension[Step-by-step solution](https://www.prepwiser.in/questions/XhoCqNrRGS) > prepwiser.in/questions/XhoCqNrRGS

Two small drops of mercury each of radius R coalesce to form a single large drop. The ratio of total surface energy before and after the change is:

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

Q15 Rotational Motion[Step-by-step solution](https://www.prepwiser.in/questions/GbirGRXKsc) > prepwiser.in/questions/GbirGRXKsc

A body rolls down an inclined plane without slipping. The kinetic energy of rotation is 50% of its translational kinetic energy. The body is:

- (A) Solid sphere (B) Solid cylinder (C) Hollow cylinder (D) Ring

Q16 Simple Harmonic Motion[Step-by-step solution](https://www.prepwiser.in/questions/OI_CLAq0ag) > prepwiser.in/questions/OI_CLAq0ag

A particle is making simple harmonic motion along the X-axis. If at a distances x_1 and x_2 from the mean position the velocities of the particle are v_1 and v_2 respectively. The time period of its oscillation is given as:

- (A) $T = 2\pi \sqrt{\frac{x_2^2 + x_1^2}{v_1^2 - v_2^2}}$ (B) $T = 2\pi \sqrt{\frac{x_2^2 + x_1^2}{v_1^2 + v_2^2}}$ (C) $T = 2\pi \sqrt{\frac{x_2^2 - x_1^2}{v_1^2 + v_2^2}}$ (D) $T = 2\pi \sqrt{\frac{x_2^2 - x_1^2}{v_1^2 - v_2^2}}$

Q17 Wave Optics[Step-by-step solution](https://www.prepwiser.in/questions/5BZVas5FiQ) > prepwiser.in/questions/5BZVas5FiQ

With what speed should a galaxy move outward with respect to earth so that the sodium-D line at wavelength $5890 \text{ \AA}$ is observed at $5896 \text{ \AA}$?

- (A) 306 km/sec (B) 322 km/sec (C) 296 km/sec (D) 336 km/sec

Q18 Work, Energy & Power[Step-by-step solution](https://www.prepwiser.in/questions/5eH3H_0-7L) > prepwiser.in/questions/5eH3H_0-7L

A body at rest is moved along a horizontal straight line by a machine delivering a constant power. The distance moved by the body in time 't' is proportional to:

- (A) $t^{\frac{3}{2}}$ (B) $t^{\frac{1}{2}}$ (C) $t^{\frac{1}{4}}$ (D) $t^{\frac{3}{4}}$

Q19 Units, Dimensions & Errors[Step-by-step solution](https://www.prepwiser.in/questions/DRrxdO0Tnf) > prepwiser.in/questions/DRrxdO0Tnf

If time (t), velocity (v), and angular momentum (l) are taken as the fundamental units. Then the dimension of mass (m) in terms of t, v and l is:

- (A) $[t^{-1} v^1 l^{-2}]$ (B) $[t^1 v^2 l^{-1}]$ (C) $[t^{-2} v^{-1} l^1]$ (D) $[t^{-1} v^{-2} l^1]$

Q20 Vectors[Step-by-step solution](#) › [prepwiser.in/questions/qgPTuFhiHj](#)

Two vectors $\vec{P}$ and $\vec{Q}$ have equal magnitudes. If the magnitude of $\vec{P} + \vec{Q}$ is n times the magnitude of $\vec{P} - \vec{Q}$, then angle between $\vec{P}$ and $\vec{Q}$ is:

- (A) $\sin^{-1} \left(\frac{n-1}{n+1} \right)$ (B) $\cos^{-1} \left(\frac{n-1}{n+1} \right)$ (C) $\sin^{-1} \left(\frac{n^2-1}{n^2+1} \right)$ (D) $\cos^{-1} \left(\frac{n^2-1}{n^2+1} \right)$

Physics Section B · Numerical value

Q21 to Q30

Q21 Alternating Current **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/IMrjKN04en](#)

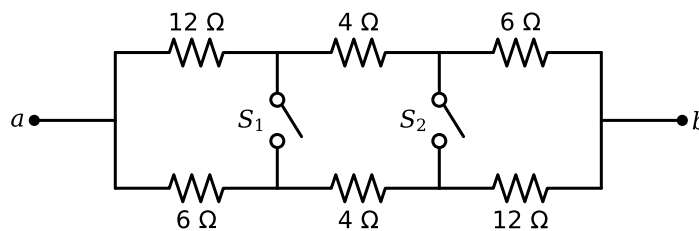
A series LCR circuit of $R = 5\Omega$, $L = 20 \text{ mH}$ and $C = 0.5 \mu\text{F}$ is connected across an AC supply of 250 V , having variable frequency. The power dissipated at resonance condition is _____ $\times 10^2 \text{ W}$.

Q22 Nuclear Physics **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/YU1VaZlqfV](#)

A radioactive substance decays to $\left(\frac{1}{16}\right)^{\text{th}}$ of its initial activity in 80 days. The half life of the radioactive substance expressed in days is _____.

Q23 Current Electricity **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/ouIV1ZsXV5](#)

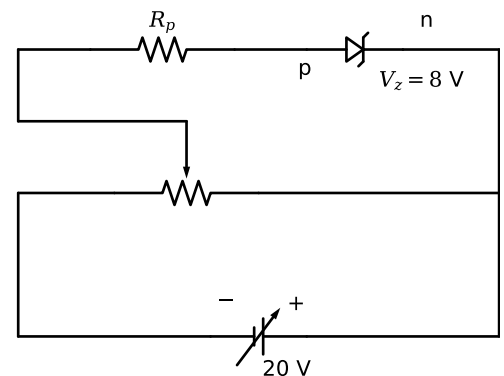
In the given figure switches S_1 and S_2 are in open condition. The resistance across ab when the switches S_1 and S_2 are closed is _____ Ω .

**Q24** Dual Nature of Radiation & Matter **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/b_QJACVezF](#)

A certain metallic surface is illuminated by monochromatic radiation of wavelength λ . The stopping potential for photoelectric current for this radiation is $3V_0$. If the same surface is illuminated with a radiation of wavelength 2λ , the stopping potential is V_0 . The threshold wavelength of this surface for photoelectric effect is _____ λ .

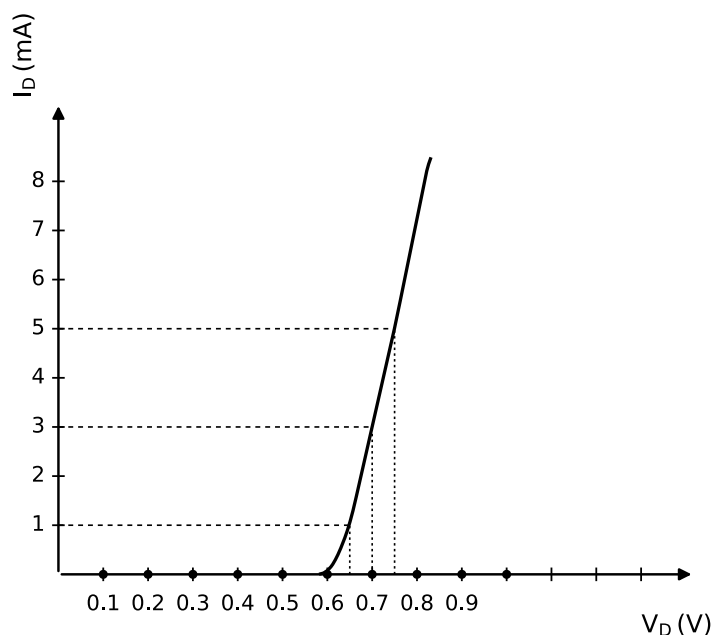
Q25 Semiconductors & Electronic Devices **NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/cXfaLdMNVm](#)

A zener diode having zener voltage 8 V and power dissipation rating of 0.5 W is connected across a potential divider arranged with maximum potential drop across zener diode is as shown in the diagram. The value of protective resistance R_p is Ω .

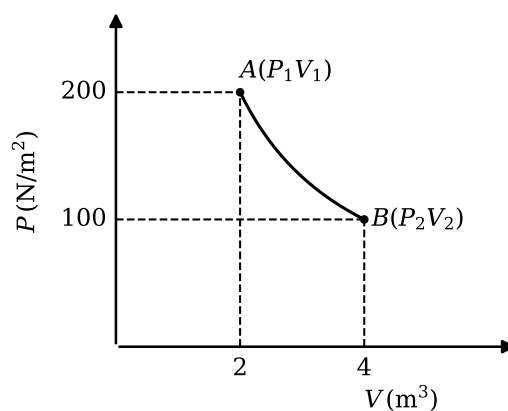


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For the forward biased diode characteristics shown in the figure, the dynamic resistance at $I_D = 3 \text{ mA}$ will be _____ Ω .



One mole of an ideal gas at 27° is taken from A to B as shown in the given PV indicator diagram. The work done by the system will be _____ $\times 10^{-1} \text{ J}$. [Given : $R = 8.3 \text{ J/mole K}$, $\ln 2 = 0.6931$] (Round off to the nearest integer)



A body of mass 'm' is launched up on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of friction between the body and plane is $\frac{\sqrt{x}}{5}$ if the time of ascent is half of the time of descent. The value of x is _____.

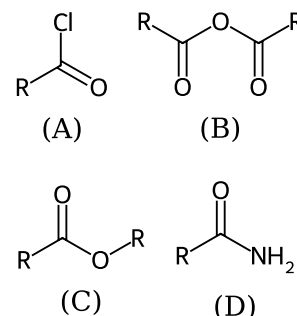
Two bodies, a ring and a solid cylinder of same material are rolling down without slipping an inclined plane. The radii of the bodies are same. The ratio of velocity of the centre of mass at the bottom of the inclined plane of the ring to that of the cylinder is $\frac{\sqrt{x}}{2}$. Then, the value of x is _____.

A body rotating with an angular speed of 600 rpm is uniformly accelerated to 1800 rpm in 10 sec. The number of rotations made in the process is _____.

Q31 Carboxylic Acids & Their Derivatives[Step-by-step solution](https://www.prepwiser.in/questions/HJ9L4-VzQp) › prepwiser.in/questions/HJ9L4-VzQp

The correct order of their reactivity towards hydrolysis at room temperature is:

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

**Q32** Carbohydrates & Biomolecules[Step-by-step solution](https://www.prepwiser.in/questions/9TiRO0moEo) › prepwiser.in/questions/9TiRO0moEo

Which one of the following statements is not true about enzymes?

- (A) Enzymes are non-specific for a reaction and substrate.
(B) Almost all enzymes are proteins.
(C) Enzymes work as catalysts by lowering the activation energy of a biochemical reaction.
(D) The action of enzymes is temperature and pH specific.

Q33 Chemical Bonding & Molecular Structure[Step-by-step solution](https://www.prepwiser.in/questions/yKnTwxjUZ2) › prepwiser.in/questions/yKnTwxjUZ2

The hybridisations of the atomic orbitals of nitrogen in NO_2^- , NO_2^+ and NH_4^+ respectively are.

- (A) sp^3 , sp^2 and sp (B) sp , sp^2 and sp^3 (C) sp^3 , sp and sp^2 (D) sp^2 , sp and sp^3

Q34 Coordination Compounds[Step-by-step solution](https://www.prepwiser.in/questions/_yGvo5SdL) › prepwiser.in/questions/_yGvo5SdL

Spin only magnetic moment of an octahedral complex of Fe^{2+} in the presence of a strong field ligand in BM is:

- (A) 4.89 (B) 2.82 (C) 0 (D) 3.46

Q35 d & f Block Elements[Step-by-step solution](https://www.prepwiser.in/questions/84aaX25gaf) › prepwiser.in/questions/84aaX25gaf

Which one of the following species doesn't have a magnetic moment of 1.73 BM, (spin only value)?

- (A) O_2^+ (B) CuI (C) $[\text{Cu}(\text{NH}_3)_4]\text{Cl}_2$ (D) O_2^-

Q36 Hydrogen & s-Block Elements[Step-by-step solution](https://www.prepwiser.in/questions/QDWOxNnqBe) › prepwiser.in/questions/QDWOxNnqBe

Metallic sodium does not react normally with:

- (A) gaseous ammonia (B) But-2-yne (C) Ethyne (D) tert-butyl alcohol

Q37 Hydrocarbons: Aromatic (Arenes)[Step-by-step solution](https://www.prepwiser.in/questions/hUWVjb4nvZ) › prepwiser.in/questions/hUWVjb4nvZ

Benzene on nitration gives nitrobenzene in presence of HNO_3 and H_2SO_4 mixture, where:

- (A) both H_2SO_4 and HNO_3 act as a bases
(B) HNO_3 acts as an acid and H_2SO_4 acts as a base
(C) both H_2SO_4 and HNO_3 act as an acids
(D) HNO_3 acts as a base and H_2SO_4 acts as an acid

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The single largest industrial application of dihydrogen is:

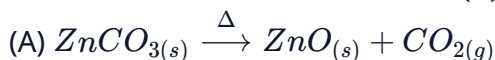
- (A) Manufacture of metal hydrides (B) Rocket fuel in space research
(C) In the synthesis of ammonia (D) In the synthesis of nitric acid

A solution is 0.1 M in Cl^- and 0.001 M in CrO_4^{2-} . Solid AgNO_3 is gradually added to it. Assuming that the addition does not change in volume and $K_{\text{sp}}(\text{AgCl}) = 1.7 \times 10^{-10} \text{ M}^2$ and $K_{\text{sp}}(\text{Ag}_2\text{CrO}_4) = 1.9 \times 10^{-12} \text{ M}^3$.

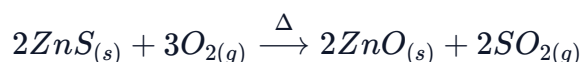
Select correct statement from the following:

- (A) AgCl precipitates first because its K_{sp} is high.
(B) Ag_2CrO_4 precipitates first as its K_{sp} is low.
(C) Ag_2CrO_4 precipitates first because the amount of Ag^+ needed is low.
(D) AgCl will precipitate first as the amount of Ag^+ needed to precipitate is low.

Consider two chemical reactions (A) and (B) that take place during metallurgical process:



(B)



The correct option of names given to them respectively is:

- (A) (A) is calcination and (B) is roasting
(B) Both (A) and (B) are producing same product so both are roasting
(C) Both (A) and (B) are producing same product so both are calcination
(D) (A) is roasting and (B) is calcination

Bakelite is a cross-linked polymer of formaldehyde and:

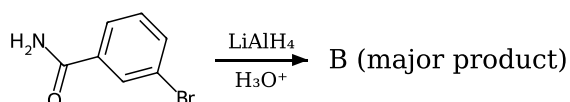
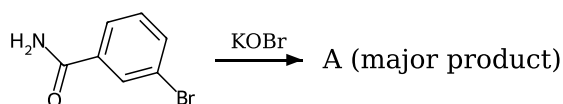
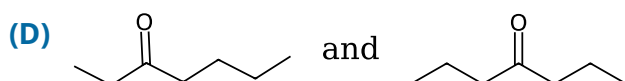
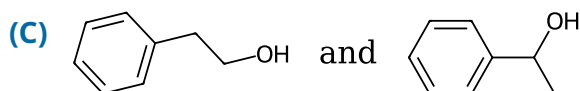
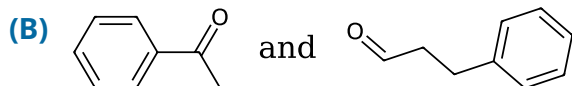
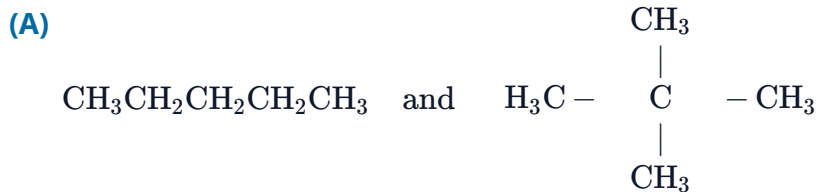
- (A) PHBV (B) Buna-S (C) Novolac (D) Dacron

Outermost electronic configuration of a group 13 element, E, is $4s^2, 4p^1$. The electronic configuration of an element of p-block period-five placed diagonally to element, E is:

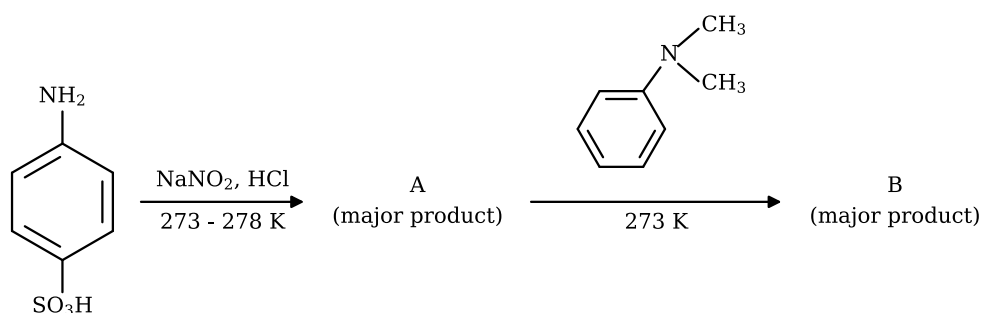
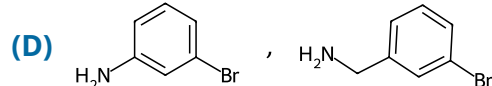
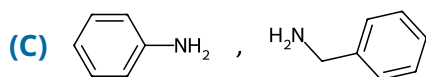
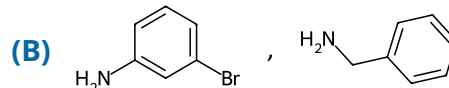
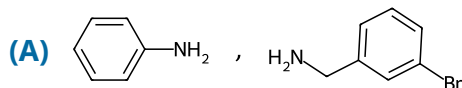
- (A) $[\text{Kr}] 3d^{10} 4s^2 4p^2$ (B) $[\text{Ar}] 3d^{10} 4s^2 4p^2$ (C) $[\text{Xe}] 5d^{10} 6s^2 6p^2$ (D) $[\text{Kr}] 4d^{10} 5s^2 5p^2$

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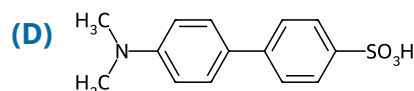
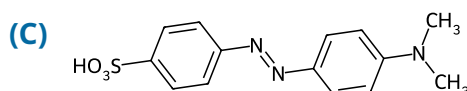
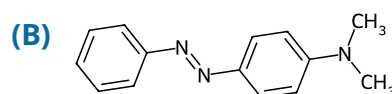
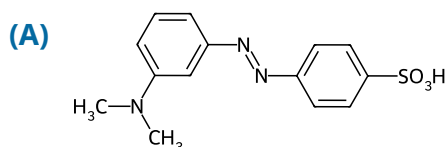
Which one of the following pairs of isomers is an example of metamerism?



In the above reactions, product A and product B respectively are:



Consider the above reaction, compound B is:



In Carius method, halogen containing organic compound is heated with fuming nitric acid in the presence of:

- (A) HNO_3 (B) AgNO_3 (C) CuSO_4 (D) BaSO_4

Cu^{2+} salt reacts with potassium iodide to give

- (A) Cu_2I_2 (B) Cu_2I_3 (C) CuI (D) $\text{Cu}(\text{I}_3)_2$

Chemistry Section B · Numerical value

Q48 to Q57



In the above first order reaction the concentration of PCl_5 reduces from initial concentration 50 mol L^{-1} to 10 mol L^{-1} in 120 minutes at 300 K. The rate constant for the reaction at 300 K is $x \times 10^{-2} \text{ min}^{-1}$. The value of x is _____. [Given $\log 5 = 0.6989$]

An aqueous solution of NiCl_2 was heated with excess sodium cyanide in presence of strong oxidizing agent to form $[\text{Ni}(\text{CN})_6]^{2-}$. The total change in number of unpaired electrons on metal centre is _____.

Potassium chlorate is prepared by electrolysis of KCl in basic solution as shown by following equation.
 $6\text{OH}^- + \text{Cl}^- \rightarrow \text{ClO}_3^- + 3\text{H}_2\text{O} + 6\text{e}^-$

A current of $x\text{A}$ has to be passed for 10h to produce 10.0g of potassium chlorate. The value of x is _____. (Nearest integer)

(Molar mass of $\text{KClO}_3 = 122.6 \text{ g mol}^{-1}$, $F = 96500 \text{ C}$)

Diamond has a three dimensional structure of C atoms formed by covalent bonds. The structure of diamond has face centred cubic lattice where 50% of the tetrahedral voids are also occupied by carbon atoms. The number of carbon atoms present per unit cell of diamond is _____.

The vapour pressures of A and B at 25°C are 90 mm Hg and 15 mm Hg respectively. If A and B are mixed such that the mole fraction of A in the mixture is 0.6, then the mole fraction of B in the vapour phase is $x \times 10^{-1}$. The value of x is _____. (Nearest integer)

4g equimolar mixture of NaOH and Na_2CO_3 contains x g of NaOH and y g of Na_2CO_3 . The value of x is _____ g. (Nearest integer)

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Q54 Atomic Structure **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/cbEjTmMUcQ)

The wavelength of electrons accelerated from rest through a potential difference of 40 kV is $x \times 10^{-12}$ m. The value of x is _____. (Nearest integer)

Give : Mass of electron = 9.1×10^{-31} kg

Charge on an electron = 1.6×10^{-19} C

Planck's constant = 6.63×10^{-34} Js

Q55 Surface Chemistry **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/BYI3hmkFdC)

100 ml of 0.0018% (w/v) solution of Cl^- ion was the minimum concentration of Cl^- required to precipitate a negative sol in one h. The coagulating value of Cl^- ion is _____ (Nearest integer)

Q56 Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/TvbwsfCxBR)

For a given chemical reaction $\text{A} \rightarrow \text{B}$ at 300 K the free energy change is $-49.4 \text{ kJ mol}^{-1}$ and the enthalpy of reaction is 51.4 kJ mol^{-1} . The entropy change of the reaction is _____ $\text{JK}^{-1} \text{ mol}^{-1}$.

Q57 Purification & Characterisation of Organic Compounds **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/Z3RPzAc2o-)

When 0.15 g of an organic compound was analyzed using Carius method for estimation of bromine, 0.2397 g of AgBr was obtained. The percentage of bromine in the organic compound is _____. (Nearest integer)

[Atomic mass : Silver = 108, Bromine = 80]

Mathematics Section A · Multiple choice

Q58 to Q75

Q58 Three Dimensional Geometry[Step-by-step solution](https://www.prepwisar.in/questions/XyG88d3vU-)

The lines $x = ay - 1 = z - 2$ and $x = 3y - 2 = bz - 2$, ($ab \neq 0$) are coplanar, if:

- (A) $b = 1, a \in \mathbb{R} - \{0\}$ (B) $a = 1, b \in \mathbb{R} - \{0\}$ (C) $a = 2, b = 2$ (D) $a = 2, b = 3$

Q59 Three Dimensional Geometry[Step-by-step solution](https://www.prepwisar.in/questions/IEqsyqoQIG)

Consider the line L given by the equation

$$\frac{x-3}{2} = \frac{y-1}{1} = \frac{z-2}{1}.$$

Let Q be the mirror image of the point (2, 3, -1) with respect to L. Let a plane P be such that it passes through Q, and the line L is perpendicular to P. Then which of the following points is on the plane P?

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

Q60 Applications of Derivatives[Step-by-step solution](https://www.prepwisar.in/questions/7J-s9Pa-j2)

The sum of all the local minimum values of the twice differentiable function $f : \mathbb{R} \rightarrow \mathbb{R}$ defined by

$$f(x) = x^3 - 3x^2 - \frac{3f''(2)}{2}x + f''(1) \text{ is:}$$

- (A) -22 (B) 5 (C) -27 (D) 0

Q61 Binomial Theorem[Step-by-step solution](https://www.prepwisar.in/questions/flo9h6zUWh)

For the natural numbers m, n, if $(1 - y)^m(1 + y)^n = 1 + a_1y + a_2y^2 + \dots + a_{m+n}y^{m+n}$ and $a_1 = a_2 = 10$, then the value of (m + n) is equal to:

- (A) 88 (B) 64 (C) 100 (D) 80

Q62 Circles[Step-by-step solution](#) > prepwiser.in/questions/zPuJJCdAtY

Let r_1 and r_2 be the radii of the largest and smallest circles, respectively, which pass through the point $(-4, 1)$ and having their centres on the circumference of the circle $x^2 + y^2 + 2x + 4y - 4 = 0$. If

$\frac{r_1}{r_2} = a + b\sqrt{2}$, then $a + b$ is equal to:

- (A) 3 (B) 11 (C) 5 (D) 7

Q63 Definite Integration[Step-by-step solution](#) > prepwiser.in/questions/GObIrFjv8S

If $[x]$ denotes the greatest integer less than or equal to x , then the value of the integral

$\int_{-\pi/2}^{\pi/2} [[x] - \sin x] dx$ is equal to:

- (A) $-\pi$ (B) π (C) 0 (D) 1

Q64 Complex Numbers[Step-by-step solution](#) > prepwiser.in/questions/s0Wr7uhaPA

If the real part of the complex number $(1 - \cos \theta + 2i \sin \theta)^{-1}$ is $\frac{1}{5}$ for $\theta \in (0, \pi)$, then the value of the integral $\int_0^\theta \sin x dx$ is equal to:

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

Q65 Definite Integration[Step-by-step solution](#) > prepwiser.in/questions/ZN5rmVCdp1

Let

$$g(t) = \int_{-\pi/2}^{\pi/2} \cos\left(\frac{\pi}{4}t + f(x)\right) dx$$

, where $f(x) = \log_e(x + \sqrt{x^2 + 1})$, $x \in R$. Then which one of the following is correct?

- (A) $g(1) = g(0)$ (B) $\sqrt{2}g(1) = g(0)$ (C) $g(1) = \sqrt{2}g(0)$ (D) $g(1) + g(0) = 0$

Q66 Differential Equations[Step-by-step solution](#) > prepwiser.in/questions/J_pKVjt7nh

Let $y = y(x)$ satisfies the equation $\frac{dy}{dx} - |A| = 0$, for all $x > 0$, where

$$A = \begin{bmatrix} y & \sin x & 1 \\ 0 & -1 & 1 \\ 2 & 0 & \frac{1}{x} \end{bmatrix}$$

. If $y(\pi) = \pi + 2$, then the value of $y\left(\frac{\pi}{2}\right)$ is:

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

Q67 Relations & Functions (Basic)[Step-by-step solution](#) > prepwiser.in/questions/q0zM3CNv7_

Let $f: R - \left\{\frac{\alpha}{6}\right\} \rightarrow R$ be defined by $f(x) = \frac{5x+3}{6x-\alpha}$. Then the value of α for which $(f \circ f)(x) = x$, for all $x \in R - \left\{\frac{\alpha}{6}\right\}$, is:

- (A) No such α exists (B) 5 (C) 8 (D) 6

Q68 Inverse Trigonometric Functions[Step-by-step solution](#) > prepwiser.in/questions/INhRvvrUGg

The value of

$$\tan\left(2\tan^{-1}\left(\frac{3}{5}\right) + \sin^{-1}\left(\frac{5}{13}\right)\right)$$

is equal to:

- (A) $-\frac{181}{69}$ (B) $\frac{220}{21}$ (C) $-\frac{291}{76}$ (D) $\frac{151}{63}$

Q69 Definite Integration[Step-by-step solution](https://www.prepwisar.in/questions/NxKSSvaaVT) › prepwisar.in/questions/NxKSSvaaVT

If $f : R \rightarrow R$ is given by $f(x) = x + 1$, then the value of

$$\lim_{n \rightarrow \infty} \frac{1}{n} \left[f(0) + f\left(\frac{5}{n}\right) + f\left(\frac{10}{n}\right) + \dots + f\left(\frac{5(n-1)}{n}\right) \right]$$

is:

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

Q70 Determinants[Step-by-step solution](https://www.prepwisar.in/questions/e7x-BDPMK2) › prepwisar.in/questions/e7x-BDPMK2

The value of $k \in R$, for which the following system of linear equations

$$3x - y + 4z = 3,$$

$$x + 2y - 3z = -2$$

$$6x + 5y + kz = -3,$$

has infinitely many solutions, is:

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

Q71 Parabola[Step-by-step solution](https://www.prepwisar.in/questions/MgbcHR9B7y) › prepwisar.in/questions/MgbcHR9B7y

Let P be a variable point on the parabola $y = 4x^2 + 1$. Then, the locus of the mid-point of the point P and the foot of the perpendicular drawn from the point P to the line $y = x$ is:

- (A) $(3x - y)^2 + (x - 3y) + 2 = 0$ (B) $2(3x - y)^2 + (x - 3y) + 2 = 0$
(C) $(3x - y)^2 + 2(x - 3y) + 2 = 0$ (D) $2(x - 3y)^2 + (3x - y) + 2 = 0$

Q72 Probability: Basic[Step-by-step solution](https://www.prepwisar.in/questions/QcB2NGznzV) › prepwisar.in/questions/QcB2NGznzV

Let A, B and C be three events such that the probability that exactly one of A and B occurs is $(1 - k)$, the probability that exactly one of B and C occurs is $(1 - 2k)$, the probability that exactly one of C and A occurs is $(1 - k)$ and the probability of all A, B and C occur simultaneously is k^2 , where $0 < k < 1$. Then the probability that at least one of A, B and C occur is:

- (A) greater than $\frac{1}{8}$ but less than $\frac{1}{4}$ (B) greater than $\frac{1}{2}$
(C) greater than $\frac{1}{4}$ but less than $\frac{1}{2}$ (D) exactly equal to $\frac{1}{2}$

Q73 Sequences & Series[Step-by-step solution](https://www.prepwisar.in/questions/NzB9ENVtul) › prepwisar.in/questions/NzB9ENVtul

If sum of the first 21 terms of the series $\log_{9^{1/2}} x + \log_{9^{1/3}} x + \log_{9^{1/4}} x + \dots$, where $x > 0$ is 504, then x is equal to

- (A) 243 (B) 9 (C) 7 (D) 81

Q74 Statistics[Step-by-step solution](https://www.prepwisar.in/questions/IZOrx8FEsG) › prepwisar.in/questions/IZOrx8FEsG

If the mean and variance of six observations 7, 10, 11, 15, a, b are 10 and $\frac{20}{3}$, respectively, then the value of $|a - b|$ is equal to:

- (A) 9 (B) 11 (C) 7 (D) 1

Q75 Vectors[Step-by-step solution](https://www.prepwisar.in/questions/5ss6Th0djt) › prepwisar.in/questions/5ss6Th0djt

In a triangle ABC, if $|\vec{BC}| = 3$, $|\vec{CA}| = 5$ and $|\vec{BA}| = 7$, then the projection of the vector $\vec{BA}$ on $\vec{BC}$ is equal to:

- (A) $\frac{19}{2}$ (B) $\frac{13}{2}$ (C) $\frac{11}{2}$ (D) $\frac{15}{2}$

Q76 Differential Equations **NUMERICAL**

[Step-by-step solution](#) › [prepwise.in/questions/SW2XD4C1ut](https://www.prepwise.in/questions/SW2XD4C1ut)

Let a curve $y = y(x)$ be given by the solution of the differential equation

$$\cos\left(\frac{1}{2}\cos^{-1}(e^{-x})\right)dx = \sqrt{e^{2x} - 1}dy$$

. If it intersects y-axis at $y = -1$, and the intersection point of the curve with x-axis is $(\alpha, 0)$, then e^α is equal to _____.

Q77 Continuity & Differentiability **NUMERICAL**

[Step-by-step solution](#) › [prepwise.in/questions/Du9XA7ZEny](https://www.prepwise.in/questions/Du9XA7ZEny)

Let a function $g : [0, 4] \rightarrow \mathbb{R}$ be defined as

$$g(x) = \begin{cases} \max_{0 \leq t \leq x} \{t^3 - 6t^2 + 9t - 3\}, & 0 \leq x \leq 3 \\ 4 - x, & 3 < x \leq 4 \end{cases}$$

, then the number of points in the interval $(0, 4)$ where $g(x)$ is NOT differentiable, is _____.

Q78 Limits **NUMERICAL**

[Step-by-step solution](#) › [prepwise.in/questions/rTxc1I84xZ](https://www.prepwise.in/questions/rTxc1I84xZ)

If

$$\lim_{x \rightarrow 0} \frac{\alpha x e^x - \beta \log_e(1+x) + \gamma x^2 e^{-x}}{x \sin^2 x} = 10, \alpha, \beta, \gamma \in \mathbb{R}$$

, then the value of $\alpha + \beta + \gamma$ is _____.

Q79 Determinants **NUMERICAL**

[Step-by-step solution](#) › [prepwise.in/questions/mj4qUc57Xm](https://www.prepwise.in/questions/mj4qUc57Xm)

Let $A = \{a_{ij}\}$ be a 3×3 matrix, where

$$a_{ij} = \begin{cases} (-1)^{j-i} & \text{if } i < j, \\ 2 & \text{if } i = j, \\ (-1)^{i+j} & \text{if } i > j \end{cases}$$

then $\det(3Adj(2A^{-1}))$ is equal to _____.

Q80 Applications of Derivatives **NUMERICAL**

[Step-by-step solution](#) › [prepwise.in/questions/FSM11viMa-](https://www.prepwise.in/questions/FSM11viMa-)

If the point on the curve $y^2 = 6x$, nearest to the point $(3, \frac{3}{2})$ is (α, β) , then $2(\alpha + \beta)$ is equal to _____.

Q81 Indefinite Integration **NUMERICAL**

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

For $k \in \mathbb{N}$, let

$$\frac{1}{\alpha(\alpha+1)(\alpha+2)\dots(\alpha+20)} = \sum_{K=0}^{20} \frac{A_K}{\alpha+K}$$

, where $\alpha > 0$. Then the value of $100\left(\frac{A_{14}+A_{15}}{A_{13}}\right)^2$ is equal to _____.

Q82 Sequences & Series **NUMERICAL**

[Step-by-step solution](#) › [prepwise.in/questions/E7RX3DVcy4](https://www.prepwise.in/questions/E7RX3DVcy4)

Let $\{a_n\}_{n=1}^\infty$ be a sequence such that $a_1 = 1$, $a_2 = 1$ and $a_{n+2} = 2a_{n+1} + a_n$ for all $n \geq 1$. Then the value of $47 \sum_{n=1}^\infty \frac{a_n}{2^{3n}}$ is equal to _____.

For $p > 0$, a vector $\vec{v}_2 = 2\hat{i} + (p+1)\hat{j}$ is obtained by rotating the vector $\vec{v}_1 = \sqrt{3}p\hat{i} + \hat{j}$ by an angle θ about origin in counter clockwise direction. If

$$\tan \theta = \frac{(\alpha\sqrt{3} - 2)}{(4\sqrt{3} + 3)}$$

, then the value of α is equal to _____.

Consider a triangle having vertices $A(-2, 3)$, $B(1, 9)$ and $C(3, 8)$. If a line L passing through the circum-centre of triangle ABC , bisects line BC , and intersects y -axis at point $(0, \frac{\alpha}{2})$, then the value of real number α is _____.

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Physics

1. D	2. D	3. A	4. C	5. D	6. D	7. B	8. C
9. A	10. D	11. B	12. C	13. B	14. A	15. B	16. D
17. A	18. A	19. D	20. D	21. 125	22. 20	23. 10	24. 4
25. 192	26. 25	27. 17258	28. 3	29. 3	30. 200		

Chemistry

31. A	32. A	33. D	34. C	35. B	36. B	37. D	38. C
39. D	40. A	41. C	42. D	43. D	44. D	45. C	46. B
47. C	48. 1	49. 2	50. 1	51. 8	52. 1	53. 1	54. 6
55. 1	56. 336	57. 68					

Mathematics

58. A	59. D	60. C	61. D	62. C	63. A	64. A	65. B
66. A	67. B	68. B	69. D	70. B	71. B	72. B	73. D
74. D	75. C	76. 2	77. 1	78. 3	79. 108	80. 9	81. 9
82. 7	83. 6	84. 9					

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