

JEE MAIN 2021 · QUESTION PAPER

27 Jul 2021 **Shift 1**

85 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	20 Q1 to Q20	9 Q21 to Q29
● Chemistry	17 Q30 to Q46	10 Q47 to Q56
● Mathematics	19 Q57 to Q75	10 Q76 to Q85
In this PDF	85 questions · answer key at the end	

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

Attempt this paper online

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

prepwis.in/pyqs/paper/2021-07-27-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? prepwis.in/feedback · Terms: prepwis.in/terms

Q1 Alternating Current

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

A 0.07 H inductor and a 12Ω resistor are connected in series to a 220V, 50 Hz ac source. The approximate current in the circuit and the phase angle between current and source voltage are respectively. [Take π as $\frac{22}{7}$]

- (A) 8.8 A and $\tan^{-1}\left(\frac{11}{6}\right)$ (B) 88 A and $\tan^{-1}\left(\frac{11}{6}\right)$
 (C) 0.88 A and $\tan^{-1}\left(\frac{11}{6}\right)$ (D) 8.8 A and $\tan^{-1}\left(\frac{6}{11}\right)$

Q2 Nuclear Physics

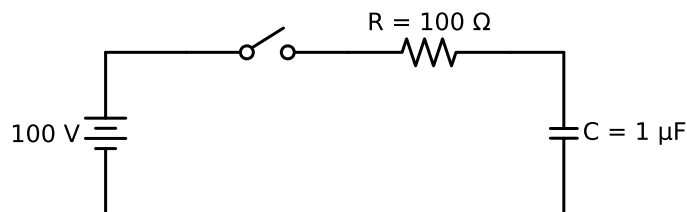
[Step-by-step solution](#) > [prepwisar.in/questions/9dGj0b5onS](https://www.prepwisar.in/questions/9dGj0b5onS)

If 'f' denotes the ratio of the number of nuclei decayed (N_d) to the number of nuclei at $t = 0$ (N_0) then for a collection of radioactive nuclei, the rate of change of 'f' with respect to time is given as: [λ is the radioactive decay constant]

- (A) $-\lambda(1 - e^{-\lambda t})$ (B) $\lambda(1 - e^{-\lambda t})$ (C) $\lambda e^{-\lambda t}$ (D) $-\lambda e^{-\lambda t}$

Q3 Electrostatics II: Potential & Capacitance

[Step-by-step solution](#) > [prepwisar.in/questions/qUoajK6h-](https://www.prepwisar.in/questions/qUoajK6h-)



A capacitor of capacitance $C = 1 \mu\text{F}$ is suddenly connected to a battery of 100 volt through a resistance $R = 100 \Omega$. The time taken for the capacitor to be charged to get 50 V is: [Take $\ln 2 = 0.69$]

- (A) $1.44 \times 10^{-4} \text{ s}$ (B) $3.33 \times 10^{-4} \text{ s}$ (C) $0.69 \times 10^{-4} \text{ s}$ (D) $0.30 \times 10^{-4} \text{ s}$

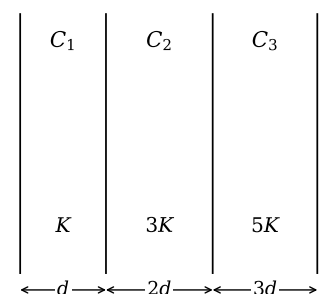
Q4 Electrostatics II: Potential & Capacitance

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

In the reported figure, a capacitor is formed by placing a compound dielectric between the plates of parallel plate capacitor. The expression for the capacity of the said capacitor will be:

(Given area of plate = A)

- (A) $\frac{15}{34} \frac{K\epsilon_0 A}{d}$ (B) $\frac{15}{6} \frac{K\epsilon_0 A}{d}$ (C) $\frac{25}{6} \frac{K\epsilon_0 A}{d}$ (D) $\frac{9}{6} \frac{K\epsilon_0 A}{d}$



Q5 Electrostatics II: Potential & Capacitance

[Step-by-step solution](#) > [prepwisar.in/questions/5FAFpv7HbD](https://www.prepwisar.in/questions/5FAFpv7HbD)

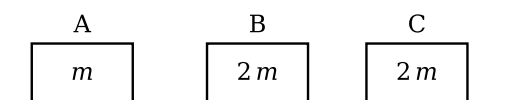
Two capacitors of capacities $2C$ and C are joined in parallel and charged up to potential V . The battery is removed and the capacitor of capacity C is filled completely with a medium of dielectric constant K . The potential difference across the capacitors will now be:

- (A) $\frac{V}{K+2}$ (B) $\frac{V}{K}$ (C) $\frac{3V}{K+2}$ (D) $\frac{3V}{K}$

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Q6 Collision[Step-by-step solution > prepwiser.in/questions/DmRILBDev9](https://www.prepwiser.in/questions/DmRILBDev9)

Three objects A, B and C are kept in a straight line on a frictionless horizontal surface. The masses of A, B and C are m , $2m$ and $2m$ respectively. A moves towards B with a speed of 9 m/s and makes an elastic collision with it. Thereafter B makes a completely inelastic collision with C. All motions occur along same straight line. The final speed of C is:



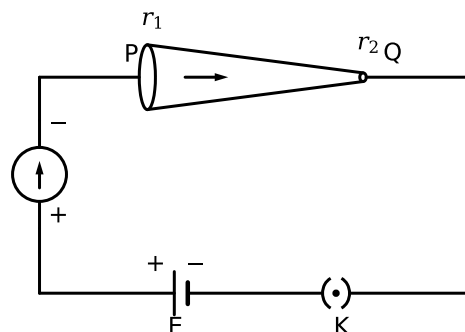
- (A) 6 m/s (B) 9 m/s (C) 4 m/s (D) 3 m/s

Q7 Current Electricity[Step-by-step solution > prepwiser.in/questions/6kn7CvUcHL](https://www.prepwiser.in/questions/6kn7CvUcHL)

In the given figure, a battery of emf E is connected across a conductor PQ of length ' l ' and different area of cross-sections having radii r_1 and r_2 ($r_2 < r_1$).

Choose the correct option as one moves from P to Q:

- (A) Drift velocity of electron increases.
 (B) Electric field decreases.
 (C) Electron current decreases.
 (D) All of these

**Q8** Electromagnetic Waves[Step-by-step solution > prepwiser.in/questions/j2JZxtnOJq](https://www.prepwiser.in/questions/j2JZxtnOJq)

The relative permittivity of distilled water is 81. The velocity of light in it will be:

(Given $\mu_r = 1$)

- (A) $4.33 \times 10^7 \text{ m/s}$ (B) $2.33 \times 10^7 \text{ m/s}$ (C) $3.33 \times 10^7 \text{ m/s}$ (D) $5.33 \times 10^7 \text{ m/s}$

Q9 Electrostatics I: Charges, Field & Gauss's Law[Step-by-step solution > prepwiser.in/questions/238f5d5SeF](https://www.prepwiser.in/questions/238f5d5SeF)

Two identical tennis balls each having mass ' m ' and charge ' q ' are suspended from a fixed point by threads of length ' l '. What is the equilibrium separation when each thread makes a small angle ' θ ' with the vertical?

- (A) $x = \left(\frac{q^2 l}{2\pi\epsilon_0 m g} \right)^{\frac{1}{2}}$ (B) $x = \left(\frac{q^2 l}{2\pi\epsilon_0 m g} \right)^{\frac{1}{3}}$
 (C) $x = \left(\frac{q^2 l^2}{2\pi\epsilon_0 m^2 g} \right)^{\frac{1}{3}}$ (D) $x = \left(\frac{q^2 l^2}{2\pi\epsilon_0 m^2 g^2} \right)^{\frac{1}{3}}$

Q10 Kinetic Theory of Gases[Step-by-step solution > prepwiser.in/questions/QLP1mWNIga](https://www.prepwiser.in/questions/QLP1mWNIga)

The number of molecules in one litre of an ideal gas at 300 K and 2 atmospheric pressure with mean kinetic energy $2 \times 10^{-9} \text{ J}$ per molecules is:

- (A) 0.75×10^{11} (B) 3×10^{11} (C) 1.5×10^{11} (D) 6×10^{11}

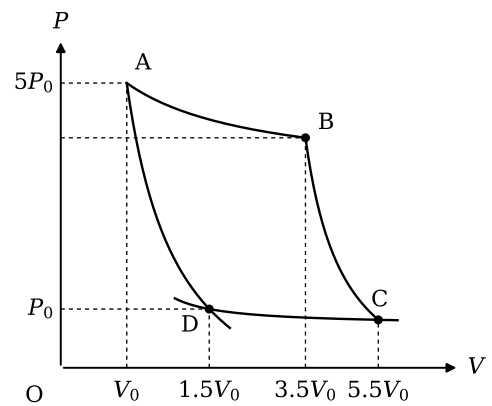
Attempt this paper online with instant answer checking > [prepwiser.in/pyqs/paper/2021-07-27-morning](https://www.prepwiser.in/pyqs/paper/2021-07-27-morning)

Q11 Thermodynamics[Step-by-step solution > prepwisar.in/questions/FAPgsTmKuv](https://www.prepwisar.in/questions/FAPgsTmKuv)

In the reported figure, there is a cyclic process ABCDA on a sample of 1 mol of a diatomic gas. The temperature of the gas during the process $A \rightarrow B$ and $C \rightarrow D$ are T_1 and T_2 ($T_1 > T_2$) respectively.

Choose the correct option out of the following for work done if processes BC and DA are adiabatic.

- (A) $W_{AB} = W_{DC}$ (B) $W_{AD} = W_{BC}$
 (C) $W_{BC} + W_{DA} > 0$ (D) $W_{AB} < W_{CD}$

**Q12** Rectilinear Motion[Step-by-step solution > prepwisar.in/questions/R1Za1yc2Kh](https://www.prepwisar.in/questions/R1Za1yc2Kh)

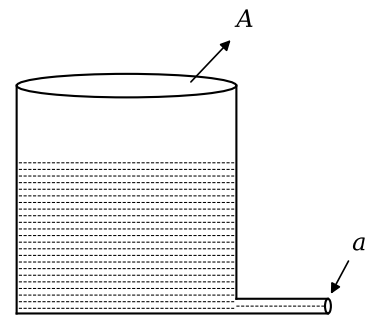
A ball is thrown up with a certain velocity so that it reaches a height 'h'. Find the ratio of the two different times of the ball reaching $\frac{h}{3}$ in both the directions.

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

Q13 Fluid Mechanics[Step-by-step solution > prepwisar.in/questions/HH_iaWRKhq](https://www.prepwisar.in/questions/HH_iaWRKhq)

A light cylindrical vessel is kept on a horizontal surface. Area of base is A. A hole of cross-sectional area 'a' is made just at its bottom side. The minimum coefficient of friction necessary to prevent sliding the vessel due to the impact force of the emerging liquid is ($a \ll A$):

- (A) $\frac{A}{2a}$ (B) None of these
 (C) $\frac{2a}{A}$ (D) $\frac{a}{A}$

**Q14** Heat Transfer[Step-by-step solution > prepwisar.in/questions/sGQH_pK56V](https://www.prepwisar.in/questions/sGQH_pK56V)

A body takes 4 min. to cool from 61°C to 59°C . If the temperature of the surroundings is 30°C , the time taken by the body to cool from 51°C to 49°C is:

- (A) 4 min. (B) 3 min. (C) 8 min. (D) 6 min.

Q15 Rotational Motion[Step-by-step solution > prepwisar.in/questions/0wd04uIC1b](https://www.prepwisar.in/questions/0wd04uIC1b)

List-I	List-II
(a) MI of the rod (length L, Mass M, about an axis $\perp$ to the rod passing through the midpoint)	(i) $8ML^2/3$
(b) MI of the rod (length L, Mass 2M, about an axis $\perp$ to the rod passing through one of its end)	(ii) $ML^2/3$
(c) MI of the rod (length 2L, Mass M, about an axis $\perp$ to the rod passing through its midpoint)	(iii) $ML^2/12$
(d) MI of the rod (Length 2L, Mass 2M, about an axis $\perp$ to the rod passing through one of its end)	(iv) $2ML^2/3$

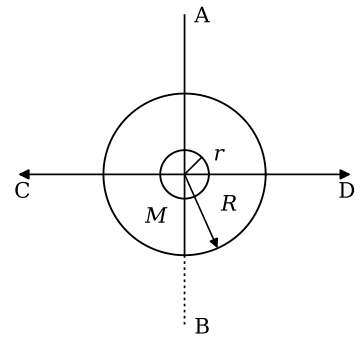
Choose the correct answer from the options given below:

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

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Q16 Rotational Motion[Step-by-step solution](https://www.prepwisar.in/questions/1X29G29w6w) › prepwisar.in/questions/1X29G29w6w

The figure shows two solid discs with radius R and r respectively. If mass per unit area is same for both, what is the ratio of MI of bigger disc around axis AB (Which is $\perp$ to the plane of the disc and passing through its centre) of MI of smaller disc around one of its diameters lying on its plane? Given 'M' is the mass of the larger disc. (MI stands for moment of inertia)



- (A) $R^2 : r^2$ (B) $2r^4 : R^4$ (C) $2R^2 : r^2$ (D) $2R^4 : r^4$

Q17 Simple Harmonic Motion[Step-by-step solution](https://www.prepwisar.in/questions/w6kdsCyHuu) › prepwisar.in/questions/w6kdsCyHuu

A particle starts executing simple harmonic motion (SHM) of amplitude 'a' and total energy E. At any instant, its kinetic energy is $\frac{3E}{4}$ then its displacement 'y' is given by:

- (A) $y = a$ (B) $y = \frac{a}{\sqrt{2}}$ (C) $y = \frac{a\sqrt{3}}{2}$ (D) $y = \frac{a}{2}$

Q18 Wave Optics[Step-by-step solution](https://www.prepwisar.in/questions/KpnaktWqV0) › prepwisar.in/questions/KpnaktWqV0

In Young's double slit experiment, if the source of light changes from orange to blue then:

- (A) the central bright fringe will become a dark fringe.
 (B) the distance between consecutive fringes will decrease.
 (C) the distance between consecutive fringes will increase.
 (D) the intensity of the minima will increase.

Q19 Experimental Skills[Step-by-step solution](https://www.prepwisar.in/questions/CXF_GIAm_q) › prepwisar.in/questions/CXF_GIAm_q

Assertion A : If in five complete rotations of the circular scale, the distance travelled on main scale of the screw gauge is 5 mm and there are 50 total divisions on circular scale, then least count is 0.001 cm.

Reason R:

$$\text{Least Count} = \frac{\text{Pitch}}{\text{Total divisions on circular scale}}$$

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

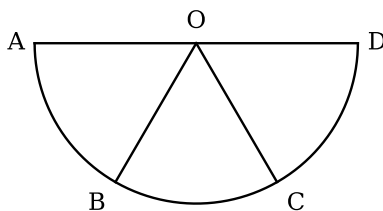
- (A) A is not correct but R is correct.
 (B) Both A and R are correct and R is the correct explanation of A.
 (C) A is correct but R is not correct.
 (D) Both A and R are correct and R is NOT the correct explanation of A.

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Q20 Vectors[Step-by-step solution](https://www.prepwisar.in/questions/ZAnrHIZciH) › prepwisar.in/questions/ZAnrHIZciH

Assertion A: If A, B, C, D are four points on a semi-circular arc with centre at 'O' such that $|\vec{AB}| = |\vec{BC}| = |\vec{CD}|$, then $\vec{AB} + \vec{BC} + \vec{CD} = 4\vec{AO} + \vec{OB} + \vec{OC}$

Reason R: Polygon law of vector addition yields $\vec{AB} + \vec{BC} + \vec{CD} + \vec{AD} = 2\vec{AO}$



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

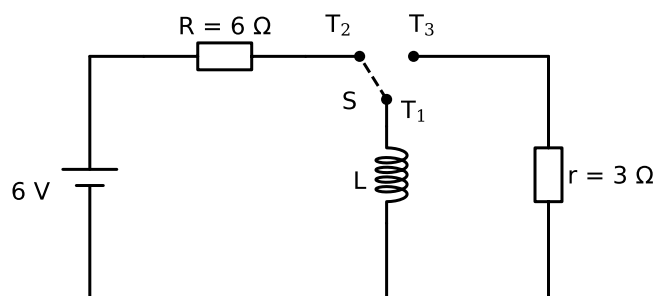
- (A) A is correct but R is not correct.
 (B) A is not correct but R is correct.
 (C) Both A and R are correct and R is the correct explanation of A.
 (D) Both A and R are correct but R is not the correct explanation of A.

Physics Section B · Numerical value

Q21 to Q29

Q21 Electromagnetic Induction **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/BJ1px4txHo) › prepwisar.in/questions/BJ1px4txHo

Consider an electrical circuit containing a two way switch 'S'. Initially S is open and then T_1 is connected to T_2 . As the current in $R = 6\Omega$ attains a maximum value of steady state level, T_1 is disconnected from T_2 and immediately connected to T_3 . Potential drop across $r = 3\Omega$ resistor immediately after T_1 is connected to T_3 is _____ V. (Round off to the Nearest Integer)

**Q22** Atomic Physics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/VueHsD9QQ9) › prepwisar.in/questions/VueHsD9QQ9

In Bohr's atomic model, the electron is assumed to revolve in a circular orbit of radius $0.5 \text{ \AA}$. If the speed of electron is $2.2 \times 10^6 \text{ m/s}$, then the current associated with the electron will be _____ $\times 10^{-2} \text{ mA}$. [Take π as $\frac{22}{7}$]

Q23 Nuclear Physics **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/fLqoE9HNTc) › prepwisar.in/questions/fLqoE9HNTc

A radioactive sample has an average life of 30 ms and is decaying. A capacitor of capacitance $200 \mu\text{F}$ is first charged and later connected with resistor 'R'. If the ratio of charge on capacitor to the activity of radioactive sample is fixed with respect to time then the value of 'R' should be _____ Ω .

Q24 Dual Nature of Radiation & Matter **NUMERICAL**[Step-by-step solution](https://www.prepwisar.in/questions/KfCqL05nXg) › prepwisar.in/questions/KfCqL05nXg

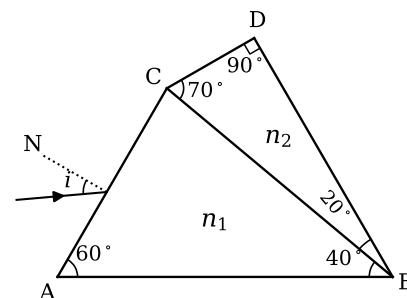
A particle of mass $9.1 \times 10^{-31} \text{ kg}$ travels in a medium with a speed of 10^6 m/s and a photon of a radiation of linear momentum 10^{-27} kg m/s travels in vacuum. The wavelength of photon is _____ times the wavelength of the particle.

A transistor is connected in common emitter circuit configuration, the collector supply voltage is 10 V and the voltage drop across a resistor of $1000\ \Omega$ in the collector circuit is 0.6 V. If the current gain factor (β) is 24, then the base current is _____ μA . (Round off to the Nearest Integer)

A prism of refractive index n_1 and another prism of refractive index n_2 are stuck together (as shown in the figure). n_1 and n_2 depend on λ , the wavelength of light, according to the relation

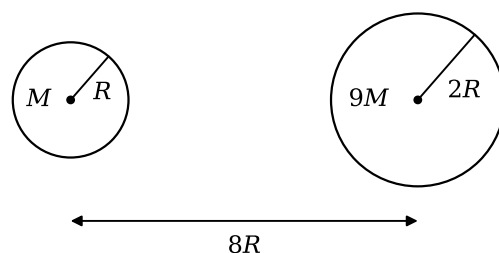
$$n_1 = 1.2 + \frac{10.8 \times 10^{-14}}{\lambda^2} \text{ and } n_2 = 1.45 + \frac{1.8 \times 10^{-14}}{\lambda^2}$$

The wavelength for which rays incident at any angle on the interface BC pass through without bending at that interface will be _____ nm.



Suppose two planets (spherical in shape) in radii R and $2R$, but mass M and $9M$ respectively have a centre to centre separation $8R$ as shown in the figure. A satellite of mass ' m ' is projected from the surface of the planet of mass ' M ' directly towards the centre of the second planet. The minimum speed ' v ' required for the satellite to reach the surface of the second planet is $\sqrt{\frac{a}{7} \frac{GM}{R}}$ then the value of ' a ' is _____.

[Given : The two planets are fixed in their position]



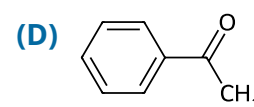
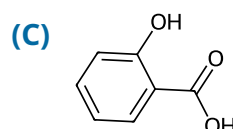
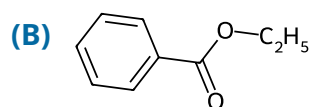
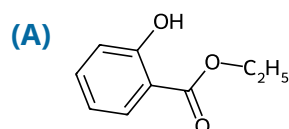
In a uniform magnetic field, the magnetic needle has a magnetic moment $9.85 \times 10^{-2} \text{ A/m}^2$ and moment of inertia $5 \times 10^{-6} \text{ kg m}^2$. If it performs 10 complete oscillations in 5 seconds then the magnitude of the magnetic field is _____ mT. [Take π^2 as 9.85]

A stone of mass 20 g is projected from a rubber catapult of length 0.1 m and area of cross section 10^{-6} m^2 stretched by an amount 0.04 m. The velocity of the projected stone is _____ m/s. (Young's modulus of rubber = $0.5 \times 10^9 \text{ N/m}^2$)

Chemistry Section A · Multiple choice

Q30 to Q46

Which one of the following compounds will give orange precipitate when treated with 2, 4-dinitrophenyl hydrazine?



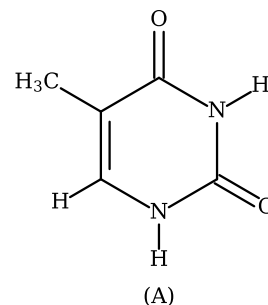
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Which one among the following chemical tests is used to distinguish monosaccharide from disaccharide?

- (A) Seliwanoff's test (B) Iodine test (C) Barfoed test (D) Tollen's test

The compound 'A' is a complementary base of _____ in DNA stands.

- (A) Uracil (B) Guanine (C) Adenine (D) Cytosine



For a reaction of order n , the unit of the rate constant is:

- (A) $\text{mol}^{1-n} \text{L}^{1-n} \text{s}$ (B) $\text{mol}^{1-n} \text{L}^{2n} \text{s}^{-1}$ (C) $\text{mol}^{1-n} \text{L}^{n-1} \text{s}^{-1}$ (D) $\text{mol}^{1-n} \text{L}^{1-n} \text{s}^{-1}$

Match List - I with List - II:

	List-I (Drug)		List-II (Class of Drug)
(a)	Furacin	(i)	Antibiotic
(b)	Arsphenamine	(ii)	Tranquilizers
(c)	Dimetone	(iii)	Antiseptic
(d)	Valium	(iv)	Synthetic antihistamines

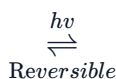
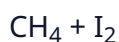
Choose the most appropriate match:

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

The type of hybridisation and magnetic property of the complex $[\text{MnCl}_6]^{3-}$, respectively, are:

- (A) sp^3d^2 and diamagnetic (B) d^2sp^3 and diamagnetic
 (C) d^2sp^3 and paramagnetic (D) sp^3d^2 and paramagnetic

Presence of which reagent will affect the reversibility of the following reaction, and change it to a irreversible reaction:



- (A) HOCl (B) dilute HNO_2 (C) Liquid NH_3 (D) Concentrated HIO_3

The statement is incorrect about Ellingham diagram is

- (A) provides idea about the reaction rate.
 (B) provides idea about free energy change.
 (C) provides idea about changes in the phases during the reaction.
 (D) provides idea about reduction of metal oxide.

The product obtained from the electrolytic oxidation of acidified sulphate solutions, is:

- (A) HSO_4^- (B) $\text{HO}_3\text{SOOSO}_3\text{H}$ (C) $\text{HO}_2\text{SOSO}_2\text{H}$ (D) $\text{HO}_3\text{SOSO}_3\text{H}$

Match List - I with List - II:

	List - I		List - II
(a)	NaOH	(i)	Acidic
(b)	$\text{Be}(\text{OH})_2$	(ii)	Basic
(c)	$\text{Ca}(\text{OH})_2$	(iii)	Amphoteric
(d)	$\text{B}(\text{OH})_3$		
(e)	$\text{Al}(\text{OH})_3$		

Choose the most appropriate answer from the options given below

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

The oxidation states of 'P' in $\text{H}_4\text{P}_2\text{O}_7$, $\text{H}_4\text{P}_2\text{O}_5$ and $\text{H}_4\text{P}_2\text{O}_6$, respectively, are:

- (A) 7, 5 and 6 (B) 5, 4 and 3 (C) 5, 3 and 4 (D) 6, 4 and 5

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

Assertion A : Lithium halides are some what covalent in nature.

Reason R : Lithium posses high polarisation capability.

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

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

The parameters of the unit cell of a substance are $a = 2.5$, $b = 3.0$, $c = 4.0$, $\alpha = 90^\circ$, $\beta = 120^\circ$, $\gamma = 90^\circ$.

The crystal system of the substance is:

- (A) Hexagonal (B) Orthorhombic (C) Monoclinic (D) Triclinic

Q43 Atomic Structure[Step-by-step solution](https://www.prepwiser.in/questions/G6o5Bq3_xI) > prepwiser.in/questions/G6o5Bq3_xI

Given below are two statements:

Statement I : Rutherford's gold foil experiment cannot explain the line spectrum of hydrogen atom.

Statement II : Bohr's model of hydrogen atom contradicts Heisenberg's uncertainty principle.

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

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

Q44 Hydrocarbons: Alkanes[Step-by-step solution](https://www.prepwiser.in/questions/zace0wI-hF) > prepwiser.in/questions/zace0wI-hF

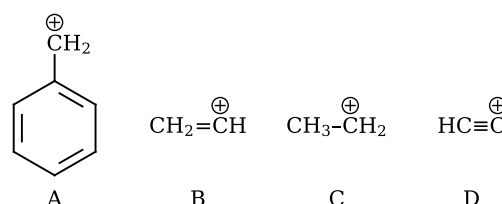
Staggered and eclipsed conformers of ethane are:

- (A) Polymers (B) Rotamers (C) Enantiomers (D) Mirror images

Q45 General Organic Chemistry (GOC)[Step-by-step solution](https://www.prepwiser.in/questions/6tho3PaWF9) > prepwiser.in/questions/6tho3PaWF9

The correct order of stability of given carbocation is:

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

**Q46** Amines & Diazonium Salts[Step-by-step solution](https://www.prepwiser.in/questions/7n3xDsmU2s) > prepwiser.in/questions/7n3xDsmU2s

Given below are two statements:

Statement I : Aniline is less basic than acetamide.

Statement II : In aniline, the lone pair of electrons on nitrogen atom is delocalized over benzene ring due to resonance and hence less available to a proton.

Choose the most appropriate option;

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

Chemistry Section B · Numerical value

Q47 to Q56

Q47 Chemical Bonding & Molecular Structure **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/FyAImjOGVS) > prepwiser.in/questions/FyAImjOGVS

The difference between bond orders of CO and NO^+ is $\frac{x}{2}$ where $x =$ _____. (Round off to the Nearest Integer)

Q48 Coordination Compounds **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/zB6Kxqn7N4) > prepwiser.in/questions/zB6Kxqn7N4

The number of geometrical isomers possible in triamminetrinitrocobalt (III) is X and in trioxalatochromate (III) is Y. Then the value of $X + Y$ is _____.

Q49 Electrochemistry **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/IEtIZS82-m) > prepwiser.in/questions/IEtIZS82-m

The conductivity of a weak acid HA of concentration 0.001 mol L^{-1} is $2.0 \times 10^{-5} \text{ S cm}^{-1}$. If $\Lambda_m^\circ(\text{HA}) = 190 \text{ S cm}^2 \text{ mol}^{-1}$, the ionization constant (K_a) of HA is equal to _____ $\times 10^{-6}$. (Round off to the Nearest Integer)

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Q50 Solutions & Colligative Properties **NUMERICAL**

[Step-by-step solution](https://www.prepwisar.in/questions/8zG7UwxZ6D) > prepwisar.in/questions/8zG7UwxZ6D

1.46 g of a biopolymer dissolved in a 100 mL water at 300 K exerted an osmotic pressure of 2.42×10^{-3} bar.

The molar mass of the biopolymer is _____ $\times 10^4$ g mol⁻¹. (Round off to the Nearest Integer)
[Use : R = 0.083 L bar mol⁻¹ K⁻¹]

Q51 Solutions & Colligative Properties **NUMERICAL**

[Step-by-step solution](https://www.prepwisar.in/questions/h1nnQfi-0X) > prepwisar.in/questions/h1nnQfi-0X

The density of NaOH solution is 1.2 g cm⁻³. The molality of this solution is _____ m. (Round off to the Nearest Integer)

[Use : Atomic mass : Na : 23.0 u, O : 16.0 u, H : 1.0 u, Density of H₂O : 1.0 g cm⁻³]

Q52 Surface Chemistry **NUMERICAL**

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

CO₂ gas adsorbs on charcoal following Freundlich adsorption isotherm. For a given amount of charcoal, the mass of CO₂ adsorbed becomes 64 times when the pressure of CO₂ is doubled. The value of n in the Freundlich isotherm equation is _____ $\times 10^{-2}$. (Round off to the Nearest Integer)

Q53 Chemical Thermodynamics **NUMERICAL**

[Step-by-step solution](https://www.prepwisar.in/questions/o39RMdMgxt) > prepwisar.in/questions/o39RMdMgxt

For water at 100° C and 1 bar,

$\Delta_{\text{vap}} H - \Delta_{\text{vap}} U =$ _____ $\times 10^2$ J mol⁻¹. (Round off to the Nearest Integer)
[Use : R = 8.31 J mol⁻¹ K⁻¹]

[Assume volume of H₂O(l) is much smaller than volume of H₂O(g). Assume H₂O(g) treated as an ideal gas]

Q54 Chemical Equilibrium **NUMERICAL**

[Step-by-step solution](https://www.prepwisar.in/questions/sAaF-cxf5m) > prepwisar.in/questions/sAaF-cxf5m



$$K_c = 1.844$$

3.0 moles of PCl₅ is introduced in a 1 L closed reaction vessel at 380 K. The number of moles of PCl₅ at equilibrium is _____ $\times 10^{-3}$. (Round off to the Nearest Integer)

Q55 Amines & Diazonium Salts **NUMERICAL**

[Step-by-step solution](https://www.prepwisar.in/questions/tlWm07rVux) > prepwisar.in/questions/tlWm07rVux

In gaseous triethyl amine the "—C—N—C—" bond angle is _____ degree.

Q56 Purification & Characterisation of Organic Compounds **NUMERICAL**

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

An organic compound is subjected to chlorination to get compound A using 5.0 g of chlorine. When 0.5 g of compound A is reacted with AgNO₃ [Carius Method], the percentage of chlorine in compound A is _____ when it forms 0.3849 g of AgCl. (Round off to the Nearest Integer)
(Atomic masses of Ag and Cl are 107.87 and 35.5 respectively)

Q57 Three Dimensional Geometry

[Step-by-step solution](#) › [prepwisar.in/questions/YCp8n86jNm](https://www.prepwisar.in/questions/YCp8n86jNm)

Let the plane passing through the point $(-1, 0, -2)$ and perpendicular to each of the planes $2x + y - z = 2$ and $x - y - z = 3$ be $ax + by + cz + 8 = 0$. Then the value of $a + b + c$ is equal to:

- (A) 3 (B) 8 (C) 5 (D) 4

Q58 Binomial Theorem

[Step-by-step solution](#) › [prepwisar.in/questions/4-LReEK6uW](https://www.prepwisar.in/questions/4-LReEK6uW)

If the coefficients of x^7 in $(x^2 + \frac{1}{bx})^{11}$ and x^{-7} in $(x - \frac{1}{bx^2})^{11}$, $b \neq 0$, are equal, then the value of b is equal to:

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

Q59 Circles

[Step-by-step solution](#) › [prepwisar.in/questions/HP7EDViwoM](https://www.prepwisar.in/questions/HP7EDViwoM)

Two tangents are drawn from the point $P(-1, 1)$ to the circle $x^2 + y^2 - 2x - 6y + 6 = 0$. If these tangents touch the circle at points A and B , and if D is a point on the circle such that length of the segments AB and AD are equal, then the area of the triangle ABD is equal to:

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

Q60 Circles

[Step-by-step solution](#) › [prepwisar.in/questions/0eyVrsTPGu](https://www.prepwisar.in/questions/0eyVrsTPGu)

Let P and Q be two distinct points on a circle which has center at $C(2, 3)$ and which passes through origin O . If OC is perpendicular to both the line segments CP and CQ , then the set $\{P, Q\}$ is equal to:

- (A) $\{(4, 0), (0, 6)\}$ (B) $\{(2 + 2\sqrt{2}, 3 - \sqrt{5}), (2 - 2\sqrt{2}, 3 + \sqrt{5})\}$
(C) $\{(2 + 2\sqrt{2}, 3 + \sqrt{5}), (2 - 2\sqrt{2}, 3 - \sqrt{5})\}$ (D) $\{(-1, 5), (5, 1)\}$

Q61 Circles

[Step-by-step solution](#) › [prepwisar.in/questions/y1B76-ZUnL](https://www.prepwisar.in/questions/y1B76-ZUnL)

Let $A = \{(x, y) \in R \times R | 2x^2 + 2y^2 - 2x - 2y = 1\}$, $B = \{(x, y) \in R \times R | 4x^2 + 4y^2 - 16y + 7 = 0\}$ and $C = \{(x, y) \in R \times R | x^2 + y^2 - 4x - 2y + 5 \leq r^2\}$.

Then the minimum value of $|r|$ such that $A \cup B \subseteq C$ is equal to

- (A) $\frac{3 + \sqrt{10}}{2}$ (B) $\frac{2 + \sqrt{10}}{2}$ (C) $\frac{3 + 2\sqrt{5}}{2}$ (D) $1 + \sqrt{5}$

Q62 Complex Numbers

[Step-by-step solution](#) › [prepwisar.in/questions/0mUyk94NF6](https://www.prepwisar.in/questions/0mUyk94NF6)

Let C be the set of all complex numbers. Let

$$S_1 = \{z \in C | |z - 3 - 2i|^2 = 8\}$$

$$S_2 = \{z \in C | \operatorname{Re}(z) \geq 5\} \text{ and}$$

$$S_3 = \{z \in C | |z - \bar{z}| \geq 8\}.$$

Then the number of elements in $S_1 \cap S_2 \cap S_3$ is equal to:

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

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The value of

$$\lim_{n \rightarrow \infty} \frac{1}{n} \sum_{j=1}^n \frac{(2j-1) + 8n}{(2j-1) + 4n}$$

is equal to:

- (A) $5 + \log_e \left(\frac{3}{2} \right)$ (B) $2 - \log_e \left(\frac{2}{3} \right)$ (C) $3 + 2\log_e \left(\frac{2}{3} \right)$ (D) $1 + 2\log_e \left(\frac{3}{2} \right)$

The value of the definite integral

$$\int_{-\frac{\pi}{4}}^{\frac{\pi}{4}} \frac{dx}{(1 + e^{x \cos x})(\sin^4 x + \cos^4 x)}$$

is equal to:

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

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

$$\log \left(\frac{dy}{dx} \right) = 3x + 4y, \text{ with } y(0) = 0.$$

If $y \left(-\frac{2}{3} \log_e 2 \right) = \alpha \log_e 2$, then the value of α is equal to:

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

A ray of light through $(2, 1)$ is reflected at a point P on the y -axis and then passes through the point $(5, 3)$. If this reflected ray is the directrix of an ellipse with eccentricity $\frac{1}{3}$ and the distance of the nearer focus from this directrix is $\frac{8}{\sqrt{53}}$, then the equation of the other directrix can be:

- (A) $11x + 7y + 8 = 0$ or $11x + 7y - 15 = 0$ (B) $11x - 7y - 8 = 0$ or $11x + 7y + 15 = 0$
(C) $2x - 7y + 29 = 0$ or $2x - 7y - 7 = 0$ (D) $2x - 7y - 39 = 0$ or $2x - 7y - 7 = 0$

Let $f : \left(-\frac{\pi}{4}, \frac{\pi}{4} \right) \rightarrow \mathbb{R}$ be defined as

$$f(x) = \begin{cases} (1 + |\sin x|)^{\frac{3a}{|\sin x|}}, & -\frac{\pi}{4} < x < 0 \\ b, & x = 0 \\ e^{\cot 4x / \cot 2x}, & 0 < x < \frac{\pi}{4} \end{cases}$$

If f is continuous at $x = 0$, then the value of $6a + b^2$ is equal to:

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

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a function such that $f(2) = 4$ and $f'(2) = 1$. Then, the value of $\lim_{x \rightarrow 2} \frac{x^2 f(2) - 4f(x)}{x-2}$ is equal to:

- (A) 4 (B) 8 (C) 16 (D) 12

Q69 Matrices[Step-by-step solution](#) › [prepwiser.in/questions/e6WGa7sRXT](#)

Let $A = \begin{bmatrix} 1 & 2 \\ -1 & 4 \end{bmatrix}$. If $A^{-1} = \alpha I + \beta A$, $\alpha, \beta \in \mathbb{R}$, I is a 2×2 identity matrix then $4(\alpha - \beta)$ is equal to:

- (A) 5 (B) $\frac{8}{3}$ (C) 2 (D) 4

Q70 Probability: Basic[Step-by-step solution](#) › [prepwiser.in/questions/INnDuOLR1q](#)

The probability that a randomly selected 2-digit number belongs to the set $\{n \in \mathbb{N} : (2^n - 2) \text{ is a multiple of } 3\}$ is equal to:

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

Q71 Quadratic Equations & Polynomial Inequalities[Step-by-step solution](#) › [prepwiser.in/questions/9-AEUgNBEY](#)

Let α, β be two roots of the equation $x^2 + (20)^{1/4}x + (5)^{1/2} = 0$. Then $\alpha^8 + \beta^8$ is equal to

- (A) 10 (B) 100 (C) 50 (D) 160

Q72 Statistics[Step-by-step solution](#) › [prepwiser.in/questions/dIO3ZrTT5j](#)

If the mean and variance of the following data : 6, 10, 7, 13, a, 12, b, 12 are 9 and $\frac{37}{4}$ respectively, then $(a - b)^2$ is equal to:

- (A) 24 (B) 12 (C) 32 (D) 16

Q73 Vectors[Step-by-step solution](#) › [prepwiser.in/questions/-6L8UfZASW](#)

Let $\vec{a} = \hat{i} + \hat{j} + 2\hat{k}$ and $\vec{b} = -\hat{i} + 2\hat{j} + 3\hat{k}$. Then the vector product

$$(\vec{a} + \vec{b}) \times \left(\left(\vec{a} \times \left((\vec{a} - \vec{b}) \times \vec{b} \right) \right) \times \vec{b} \right)$$

is equal to:

- (A) $5(34\hat{i} - 5\hat{j} + 3\hat{k})$ (B) $7(34\hat{i} - 5\hat{j} + 3\hat{k})$ (C) $7(30\hat{i} - 5\hat{j} + 7\hat{k})$ (D) $5(30\hat{i} - 5\hat{j} + 7\hat{k})$

Q74 Area Under Curves[Step-by-step solution](#) › [prepwiser.in/questions/v1a8IKMVKc](#)

If the area of the bounded region

$R = \{(x, y) : \max\{0, \log_e x\} \leq y \leq 2^x, \frac{1}{2} \leq x \leq 2\}$ is,

$\alpha(\log_e 2)^{-1} + \beta(\log_e 2) + \gamma$, then the value of $(\alpha + \beta - 2\lambda)^2$ is equal to:

- (A) 8 (B) 2 (C) 4 (D) 1

Q75 Trigonometric Ratios & Identities[Step-by-step solution](#) › [prepwiser.in/questions/d3otF6K8P0](#)

If $\sin \theta + \cos \theta = \frac{1}{2}$, then $16(\sin(2\theta) + \cos(4\theta) + \sin(6\theta))$ is equal to:

- (A) 23 (B) -27 (C) -23 (D) 27

Mathematics Section B · Numerical value

Q76 to Q85

Q76 Three Dimensional Geometry**NUMERICAL**[Step-by-step solution](#) › [prepwiser.in/questions/luc2PXv-4e](#)

Let a plane P pass through the point $(3, 7, -7)$ and contain the line, $\frac{x-2}{-3} = \frac{y-3}{2} = \frac{z+2}{1}$. If distance of the plane P from the origin is d, then d^2 is equal to _____.

Let the domain of the function

$$f(x) = \log_4 (\log_5 (\log_3 (18x - x^2 - 77)))$$

be (a, b). Then the value of the integral

$$\int_a^b \frac{\sin^3 x}{(\sin^3 x + \sin^3(a + b - x))} dx$$

is equal to _____.

Let $F : [3, 5] \rightarrow \mathbb{R}$ be a twice differentiable function on (3, 5) such that

$$F(x) = e^{-x} \int_3^x (3t^2 + 2t + 4F'(t)) dt. \text{ If } F'(4) = \frac{\alpha e^\beta - 224}{(e^\beta - 4)^2}, \text{ then } \alpha + \beta \text{ is equal to } \underline{\hspace{2cm}}.$$

If $y = y(x)$, $y \in [0, \frac{\pi}{2})$ is the solution of the differential equation

$$\sec y \frac{dy}{dx} - \sin(x + y) - \sin(x - y) = 0, \text{ with } y(0) = 0, \text{ then } 5y' \left(\frac{\pi}{2} \right) \text{ is equal to } \underline{\hspace{2cm}}.$$

Let $S = \{1, 2, 3, 4, 5, 6, 7\}$. Then the number of possible functions $f : S \rightarrow S$

such that $f(m \cdot n) = f(m) \cdot f(n)$ for every $m, n \in S$ and $m \cdot n \in S$ is equal to _____.

Let $f : [0, 3] \rightarrow \mathbb{R}$ be defined by $f(x) = \min\{x - [x], 1 + [x] - x\}$ where $[x]$ is the greatest integer less than or equal to x . Let P denote the set containing all $x \in [0, 3]$ where f is discontinuous, and Q denote the set containing all $x \in (0, 3)$ where f is not differentiable. Then the sum of number of elements in P and Q is equal to _____.

For real numbers α and β , consider the following system of linear equations:

$$x + y - z = 2, x + 2y + \alpha z = 1, 2x - y + z = \beta. \text{ If the system has infinite solutions, then } \alpha + \beta \text{ is equal to } \underline{\hspace{2cm}}.$$

Let

$$f(x) = \begin{vmatrix} \sin^2 x & -2 + \cos^2 x & \cos 2x \\ 2 + \sin^2 x & \cos^2 x & \cos 2x \\ \sin^2 x & \cos^2 x & 1 + \cos 2x \end{vmatrix}, x \in [0, \pi]$$

. Then the maximum value of $f(x)$ is equal to _____.

If $\log_3 2, \log_3(2^x - 5), \log_3(2^x - \frac{7}{2})$ are in an arithmetic progression, then the value of x is equal to _____.

Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b}$ and $\vec{c} = \hat{j} - \hat{k}$ be three vectors such that $\vec{a} \times \vec{b} = \vec{c}$ and $\vec{a} \cdot \vec{b} = 1$. If the length of projection vector of the vector $\vec{b}$ on the vector $\vec{a} \times \vec{c}$ is 1, then the value of $3l^2$ is equal to _____.

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Physics

1. A	2. C	3. C	4. A	5. C	6. D	7. A	8. C
9. B	10. C	11. B	12. C	13. C	14. D	15. C	16. D
17. D	18. B	19. A	20. A	21. 3	22. 112	23. 150	24. 910
25. 25	26. 600	27. 4	28. 8	29. 20			

Chemistry

30. D	31. C	32. C	33. C	34. D	35. D	36. D	37. A
38. B	39. B	40. C	41. D	42. C	43. D	44. B	45. A
46. B	47. 0	48. 2	49. 12	50. 15	51. 5	52. 17	53. 31
54. 1396	55. 108	56. 19					

Mathematics

57. D	58. C	59. C	60. D	61. C	62. A	63. D	64. B
65. A	66. C	67. C	68. D	69. D	70. C	71. C	72. D
73. B	74. B	75. C	76. 3	77. 1	78. 16	79. 2	80. 490
81. 5	82. 5	83. 6	84. 3	85. 2			

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