

JEE MAIN 2021 · QUESTION PAPER

27 Jul 2021 **Shift 2**

83 questions in exam order, with answer key

Subject	Section A multiple choice	Section B numerical value
● Physics	19 Q1 to Q19	9 Q20 to Q28
● Chemistry	17 Q29 to Q45	9 Q46 to Q54
● Mathematics	19 Q55 to Q73	10 Q74 to Q83
In this PDF	83 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.

prepwiser.in/pyqs/paper/2021-07-27-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?
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Q1 Alternating Current

[Step-by-step solution](#) › [prepwisar.in/questions/GmGIXgv39U](https://www.prepwisar.in/questions/GmGIXgv39U)

A 100Ω resistance, a $0.1\ \mu\text{F}$ capacitor and an inductor are connected in series across a 250 V supply at variable frequency. Calculate the value of inductance of inductor at which resonance will occur. Given that the resonant frequency is 60 Hz .

- (A) 0.70 H (B) 70.3 mH (C) $7.03 \times 10^{-5}\text{ H}$ (D) 70.3 H

Q2 Nuclear Physics

[Step-by-step solution](#) › [prepwisar.in/questions/sNX7aWHY9i](https://www.prepwisar.in/questions/sNX7aWHY9i)

Consider the following statements:

- A. Atoms of each element emit characteristics spectrum.
 B. According to Bohr's Postulate, an electron in a hydrogen atom, revolves in a certain stationary orbit.
 C. The density of nuclear matter depends on the size of the nucleus.
 D. A free neutron is stable but a free proton decay is possible.
 E. Radioactivity is an indication of the instability of nuclei.

Choose the correct answer from the options given below:

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

Q3 Units, Dimensions & Errors

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

Match List I with List II.

	List - I		List - II
(a)	Capacitance, C	(i)	$M^1 L^1 T^{-3} A^{-1}$
(b)	Permittivity of free space, ϵ_0	(ii)	$M^{-1} L^{-3} T^4 A^2$
(c)	Permeability of free space, μ_0	(iii)	$M^{-1} L^{-2} T^4 A^2$
(d)	Electric field, E	(iv)	$M^1 L^1 T^{-2} A^{-2}$

Choose the correct answer from the options given below

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

Q4 Current Electricity

[Step-by-step solution](#) › [prepwisar.in/questions/NhtS57c90F](https://www.prepwisar.in/questions/NhtS57c90F)

The resistance of a conductor at 15°C is 16Ω and at 100°C is 20Ω . What will be the temperature coefficient of resistance of the conductor?

- (A) 0.010°C^{-1} (B) 0.033°C^{-1} (C) 0.003°C^{-1} (D) 0.042°C^{-1}

Q5 Dual Nature of Radiation & Matter

[Step-by-step solution](#) › [prepwisar.in/questions/4kZZEmL5ul](https://www.prepwisar.in/questions/4kZZEmL5ul)

An electron and proton are separated by a large distance. The electron starts approaching the proton with energy 3 eV . The proton captures the electron and forms a hydrogen atom in second excited state. The resulting photon is incident on a photosensitive metal of threshold wavelength $4000\text{ \AA}$. What is the maximum kinetic energy of the emitted photoelectron?

- (A) 7.61 eV (B) 1.41 eV
 (C) 3.3 eV (D) No photoelectron would be emitted

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Q6 Semiconductors & Electronic Devices

Find the truth table for the function Y of A and B represented in the following figure.

(A)

A	B	Y
0	0	0
0	1	1
1	0	0
1	1	0

(B)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	1

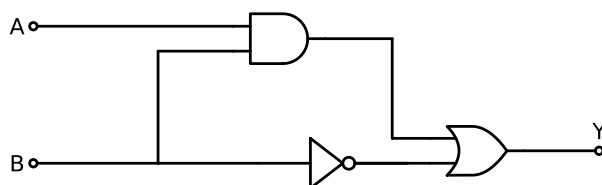
(C)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(D)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

[Step-by-step solution](https://www.prepwisar.in/questions/9Y8PWXIyp-) > prepwisar.in/questions/9Y8PWXIyp-



Q7 Electrostatics I: Charges, Field & Gauss's Law

[Step-by-step solution](https://www.prepwisar.in/questions/4yaB53Y61H) > prepwisar.in/questions/4yaB53Y61H

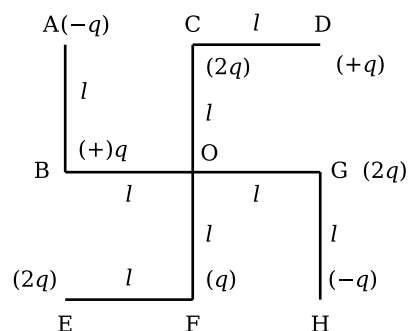
What will be the magnitude of electric field at point O as shown in the figure? Each side of the figure is l and perpendicular to each other?

(A) $\frac{1}{4\pi\epsilon_0} \frac{q}{l^2}$

(B) $\frac{1}{4\pi\epsilon_0} \frac{q}{(2l^2)} (2\sqrt{2} - 1)$

(C) $\frac{q}{4\pi\epsilon_0 (2l)^2}$

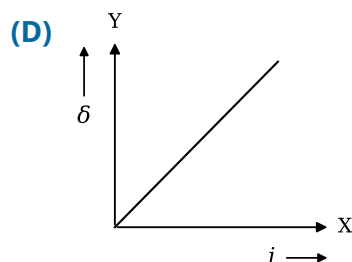
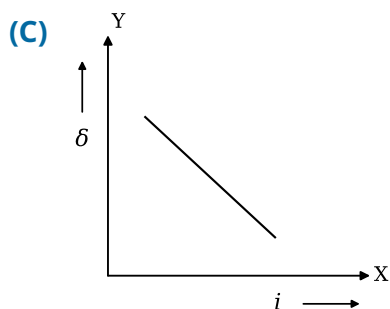
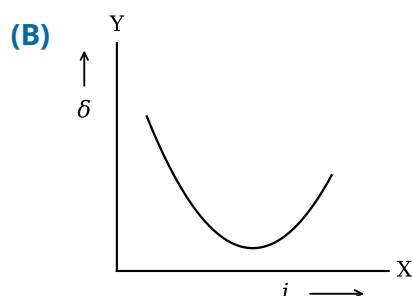
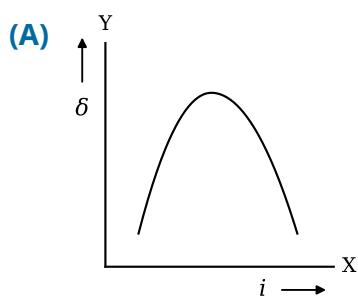
(D) $\frac{1}{4\pi\epsilon_0} \frac{2q}{2l^2} (\sqrt{2})$



Q8 Ray Optics

[Step-by-step solution](https://www.prepwisar.in/questions/-Zbeg6hfDT) > prepwisar.in/questions/-Zbeg6hfDT

The expected graphical representation of the variation of angle of deviation ' δ ' with angle of incidence ' i ' in a prism is:



Q9 Gravitation[Step-by-step solution](#) > [prepwisar.in/questions/Ac4MLSyaGP](https://www.prepwisar.in/questions/Ac4MLSyaGP)

Two identical particles of mass 1 kg each go round a circle of radius R , under the action of their mutual gravitational attraction. The angular speed of each particle is:

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

Q10 Gravitation[Step-by-step solution](#) > [prepwisar.in/questions/nGAwjAN7C_](https://www.prepwisar.in/questions/nGAwjAN7C_)

The planet Mars has two moons, if one of them has a period 7 hours, 30 minutes and an orbital radius of 9.0×10^3 km. Find the mass of Mars.

$$\left\{ \text{Given } \frac{4\pi^2}{G} = 6 \times 10^{11} \text{ N}^{-1} \text{ m}^{-2} \text{ kg}^2 \right\}$$

- (A) 5.96×10^{19} kg (B) 3.25×10^{21} kg (C) 7.02×10^{25} kg (D) 6.00×10^{23} kg

Q11 Kinetic Theory of Gases[Step-by-step solution](#) > [prepwisar.in/questions/Nryk9RcvHj](https://www.prepwisar.in/questions/Nryk9RcvHj)

One mole of an ideal gas is taken through an adiabatic process where the temperature rises from 27°C to 37°C . If the ideal gas is composed of polyatomic molecule that has 4 vibrational modes, which of the following is true? [$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$]

- (A) work done by the gas is close to 332 J (B) work done on the gas is close to 582 J
(C) work done by the gas is close to 582 J (D) work done on the gas is close to 332 J

Q12 Thermodynamics[Step-by-step solution](#) > [prepwisar.in/questions/IqoH-oxZiT](https://www.prepwisar.in/questions/IqoH-oxZiT)

Two Carnot engines A and B operate in series such that engine A absorbs heat at T_1 and rejects heat to a sink at temperature T . Engine B absorbs half of the heat rejected by Engine A and rejects heat to the sink at T_3 . When workdone in both the cases is equal, to value of T is:

- (A) $\frac{2}{3}T_1 + \frac{3}{2}T_3$ (B) $\frac{1}{3}T_1 + \frac{2}{3}T_3$ (C) $\frac{3}{2}T_1 + \frac{1}{3}T_3$ (D) $\frac{2}{3}T_1 + \frac{1}{3}T_3$

Q13 Newton's Laws of Motion[Step-by-step solution](#) > [prepwisar.in/questions/TwjFFUUYwd](https://www.prepwisar.in/questions/TwjFFUUYwd)

A particle of mass M originally at rest is subjected to a force whose direction is constant but magnitude varies with time according to the relation

$$F = F_0 \left[1 - \left(\frac{t-T}{T} \right)^2 \right]$$

Where F_0 and T are constants. The force acts only for the time interval $2T$. The velocity v of the particle after time $2T$ is:

- (A) $2F_0T/M$ (B) $F_0T/2M$ (C) $4F_0T/3M$ (D) $F_0T/3M$

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Q14 Moving Charges & Magnetism[Step-by-step solution](https://www.prepwiser.in/questions/ecSMw19x48) > prepwiser.in/questions/ecSMw19x48

Figure A and B shown to long straight wires of circular cross-section (a and b with $a < b$), carrying current I which is uniformly distributed across the cross-section. The magnitude of magnetic field B varies with radius r and can be represented as:

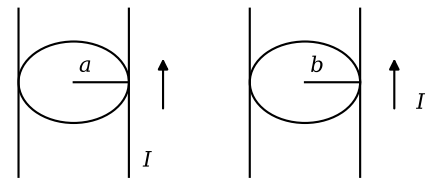
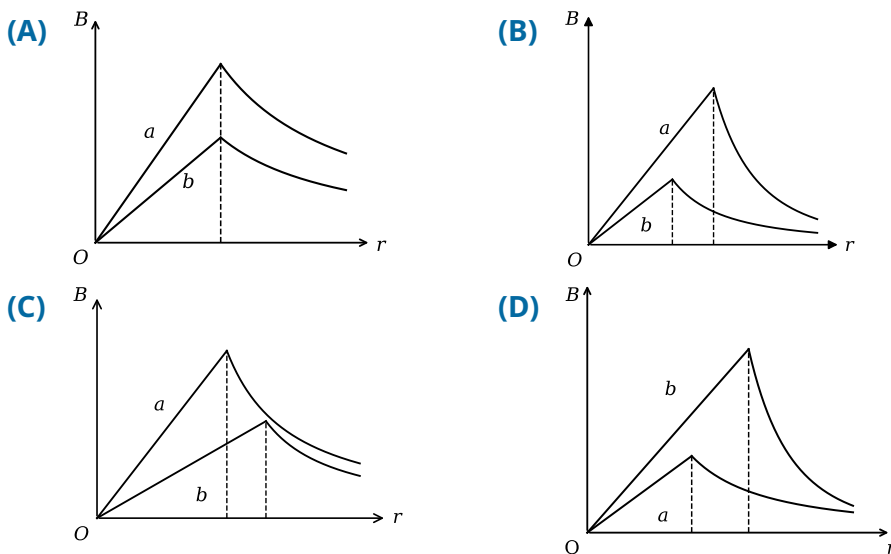


Fig. A

Fig. B

**Q15** Fluid Mechanics[Step-by-step solution](https://www.prepwiser.in/questions/UYd-VrnOAq) > prepwiser.in/questions/UYd-VrnOAq

A raindrop with radius $R = 0.2$ mm falls from a cloud at a height $h = 2000$ m above the ground. Assume that the drop is spherical throughout its fall and the force of buoyancy may be neglected, then the terminal speed attained by the raindrop is:

[Density of water $\rho_w = 1000 \text{ kg m}^{-3}$ and Density of air $\rho_a = 1.2 \text{ kg m}^{-3}$, $g = 10 \text{ m/s}^2$, Coefficient of viscosity of air $= 1.8 \times 10^{-5} \text{ Nsm}^{-2}$]

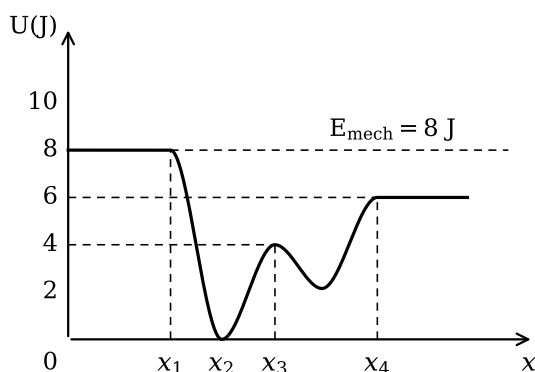
- (A) 250.6 ms^{-1} (B) 43.56 ms^{-1} (C) 4.94 ms^{-1} (D) 14.4 ms^{-1}

Q16 Simple Harmonic Motion[Step-by-step solution](https://www.prepwiser.in/questions/rvu4ejfRg-) > prepwiser.in/questions/rvu4ejfRg-

An object of mass 0.5 kg is executing simple harmonic motion. Its amplitude is 5 cm and time period (T) is 0.2 s. What will be the potential energy of the object at an instant $t = \frac{T}{4}$ s starting from mean position. Assume that the initial phase of the oscillation is zero.

- (A) 0.62 J (B) $6.2 \times 10^{-3} \text{ J}$ (C) $1.2 \times 10^3 \text{ J}$ (D) $6.2 \times 10^3 \text{ J}$

Given below is the plot of a potential energy function $U(x)$ for a system, in which a particle is in one dimensional motion, while a conservative force $F(x)$ acts on it. Suppose that $E_{\text{mech}} = 8 \text{ J}$, the incorrect statement for this system is:



[where K.E. = kinetic energy]

- (A) at $x > x_4$ K.E. is constant throughout the region.
 (B) at $x < x_1$, K.E. is smallest and the particle is moving at the slowest speed.
 (C) at $x = x_2$, K.E. is greatest and the particle is moving at the fastest speed.
 (D) at $x = x_3$, K.E. = 4 J.

An automobile of mass ' m ' accelerates starting from origin and initially at rest, while the engine supplies constant power P . The position is given as a function of time by:

- (A) $\left(\frac{9P}{8m}\right)^{\frac{1}{2}} t^{\frac{3}{2}}$ (B) $\left(\frac{8P}{9m}\right)^{\frac{1}{2}} t^{\frac{2}{3}}$ (C) $\left(\frac{9m}{8P}\right)^{\frac{1}{2}} t^{\frac{3}{2}}$ (D) $\left(\frac{8P}{9m}\right)^{\frac{1}{2}} t^{\frac{3}{2}}$

A physical quantity ' y ' is represented by the formula $y = m^2 r^{-4} g^x l^{-\frac{3}{2}}$

If the percentage errors found in y , m , r , l and g are 18, 1, 0.5, 4 and p respectively, then find the value of x and p .

- (A) 5 and ± 2 (B) 4 and ± 3 (C) $\frac{16}{3}$ and $\pm \frac{3}{2}$ (D) 8 and ± 2

Physics Section B · Numerical value

Q20 to Q28

The K_{α} X-ray of molybdenum has wavelength 0.071 nm. If the energy of a molybdenum atoms with a K electron knocked out is 27.5 keV, the energy of this atom when an L electron is knocked out will be _____ keV. (Round off to the nearest integer)

[$h = 4.14 \times 10^{-15} \text{ eVs}$, $c = 3 \times 10^8 \text{ ms}^{-1}$]

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Q21 Current Electricity **NUMERICAL**[Step-by-step solution](#) > prepwisar.in/questions/ds2DI-0-xW

For the circuit shown, the value of current at time $t = 3.2$ s will be _____ A.

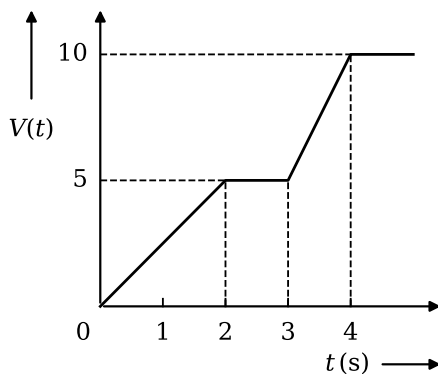


Figure 1

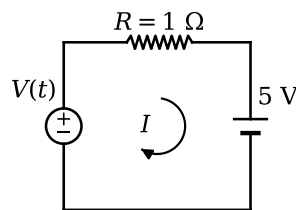


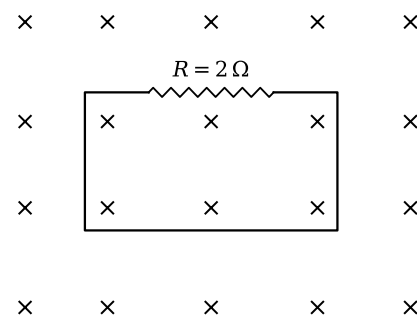
Figure 2

[Voltage distribution $V(t)$ is shown by Fig. (1) and the circuit is shown in Fig. (2)]

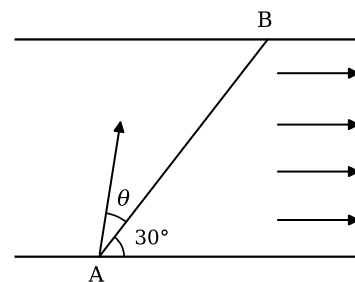
Q22 Electromagnetic Induction **NUMERICAL**[Step-by-step solution](#) > prepwisar.in/questions/zBGhQxYQTM

In the given figure the magnetic flux through the loop increases according to the relation $\phi_B(t) = 10t^2 + 20t$, where ϕ_B is in milliwebers and t is in seconds.

The magnitude of current through $R = 2\Omega$ resistor at $t = 5$ s is _____ mA.

**Q23** Projectile Motion & Relative Motion **NUMERICAL**[Step-by-step solution](#) > prepwisar.in/questions/v91JrTHONp

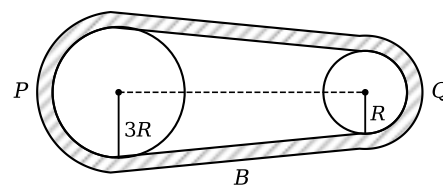
A swimmer wants to cross a river from point A to point B. Line AB makes an angle of 30° with the flow of river. Magnitude of velocity of the swimmer is same as that of the river. The angle θ with the line AB should be _____ $^\circ$, so that the swimmer reaches point B.

**Q24** Projectile Motion & Relative Motion **NUMERICAL**[Step-by-step solution](#) > prepwisar.in/questions/T2HWLWFNP5

The water is filled upto height of 12 m in a tank having vertical sidewalls. A hole is made in one of the walls at a depth 'h' below the water level. The value of 'h' for which the emerging stream of water strikes the ground at the maximum range is _____ m.

Q25 Rotational Motion **NUMERICAL**[Step-by-step solution](#) > prepwisar.in/questions/-qfze7PUr3

In the given figure, two wheels P and Q are connected by a belt B. The radius of P is three times as that of Q. In case of same rotational kinetic energy, the ratio of rotational inertias $\left(\frac{I_1}{I_2}\right)$ will be $x : 1$. The value of x will be _____.



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Q26 Simple Harmonic Motion **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/2JlhREdFy8) > prepwiser.in/questions/2JlhREdFy8

A particle executes simple harmonic motion represented by displacement function as

$$x(t) = A \sin(\omega t + \phi)$$

If the position and velocity of the particle at $t = 0$ s are 2 cm and 2ω cm s⁻¹ respectively, then its amplitude is $x\sqrt{2}$ cm where the value of x is _____.

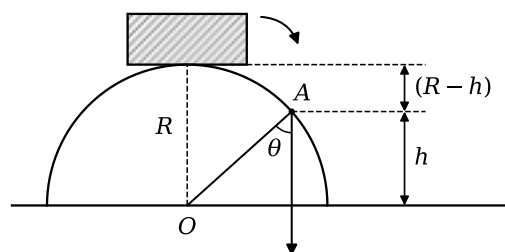
Q27 Ray Optics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/LMcxPj-ymm) > prepwiser.in/questions/LMcxPj-ymm

The difference in the number of waves when yellow light propagates through air and vacuum columns of the same thickness is one. The thickness of the air column is _____ mm. [Refractive index of air = 1.0003, wavelength of yellow light in vacuum = $6000 \text{ \AA}$]

Q28 Circular Motion **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/e5SHO1H16g) > prepwiser.in/questions/e5SHO1H16g

A small block slides down from the top of hemisphere of radius $R = 3$ m as shown in the figure. The height ' h ' at which the block will lose contact with the surface of the sphere is _____ m.

(Assume there is no friction between the block and the hemisphere)

**Chemistry Section A · Multiple choice**

Q29 to Q45

Q29 Carbohydrates & Biomolecules[Step-by-step solution](https://www.prepwiser.in/questions/SuhknDKSkr) > prepwiser.in/questions/SuhknDKSkr

Compound A gives D-Galactose and D-Glucose on hydrolysis. The compound A is:

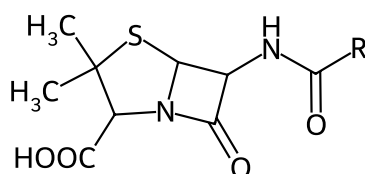
- (A) Amylose (B) Sucrose (C) Maltose (D) Lactose

Q30 Chemistry in Everyday Life[Step-by-step solution](https://www.prepwiser.in/questions/2LHti5wCj6) > prepwiser.in/questions/2LHti5wCj6

Given below are two statements:

Statement I : Penicillin is a bacteriostatic type antibiotic.

Statement II : The general structure of Penicillin is:



Choose the correct option:

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

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Given below are two statements:

Statement I: $[Mn(CN)_6]^{3-}$, $[Fe(CN)_6]^{3-}$ and $[Co(C_2O_4)_3]^{3-}$ are d^2sp^3 hybridised.

Statement II: $[MnCl_6]^{3-}$ and $[FeF_6]^{3-}$ are paramagnetic and have 4 and 5 unpaired electrons, respectively.

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

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

The number of neutrons and electrons, respectively, present in the radioactive isotope of hydrogen is:

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

Which one of the following set of elements can be detected using sodium fusion extract?

- (A) Sulfur, Nitrogen, Phosphorous, Halogens
- (B) Phosphorous, Oxygen, Nitrogen, Halogens
- (C) Nitrogen, Phosphorous, Carbon, Sulfur
- (D) Halogens, Nitrogen, Oxygen, Sulfur

The addition of silica during the extraction of copper from its sulphide ore :-

- (A) converts copper sulphide into copper silicate
- (B) converts iron oxide into iron silicate
- (C) reduces copper sulphide into metallic copper
- (D) reduces the melting point of the reaction mixture

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

Assertion A: $SO_2(g)$ is absorbed to a large extent than $H_2(g)$ on activated charcoal.

Reason R: $SO_2(g)$ has a higher critical temperature than $H_2(g)$.

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

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

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Match List - I with List - II:

	List - I (compound)		List - II (effect/affected species)
(a)	Carbon monoxide	(i)	Carcinogenic
(b)	Sulphur dioxide	(ii)	Metabolized by pyrus plants
(c)	Polychlorinated biphenyls	(iii)	haemoglobin
(d)	Oxides of Nitrogen	(iv)	Stiffness of flower buds

Choose the correct answer from the options given below:

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

Number of Cl = O bonds in chlorous acid, chloric acid and perchloric acid respectively are:

- (A) 3, 1 and 1 (B) 4, 1 and 0 (C) 1, 1 and 3 (D) 1, 2 and 3

The correct order of first ionisation enthalpy is:

- (A) Mg < S < Al < P (B) Mg < Al < S < P (C) Al < Mg < S < P (D) Mg < Al < P < S

Match List - I with List - II:

	List - I		List - II
(a)	Li	(i)	photoelectric cell
(b)	Na	(ii)	absorbent of CO_2
(c)	K	(iii)	coolant in fast breeder nuclear reactor
(d)	Cs	(iv)	treatment of cancer
		(v)	bearings for motor engines

Choose the correct answer from the options given below:

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

Select the correct statements

- (A) Crystalline solids have long range order.
 (B) Crystalline solids are isotropic
 (C) Amorphous solid are sometimes called pseudo solids.
 (D) Amorphous solids soften over a range of temperatures.
 (E) Amorphous solids have a definite heat of fusion.

Choose the most appropriate answer from the options given below.

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

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If the Thompson model of the atom was correct, then the result of Rutherford's gold foil experiment would have been:

- (A) All of the α -particles pass through the gold foil without decrease in speed.
 (B) α -particles are deflected over a wide range of angles.
 (C) All α -particles get bounced back by 180°
 (D) α -particles pass through the gold foil deflected by small angles and with reduced speed.

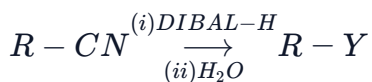
Given below are two statements:

Statement I : Hyperconjugation is a permanent effect.

Statement II : Hyperconjugation in ethyl cation $(CH_3 - \overset{+}{C}H_2)$ involves the overlapping of $C_{sp^2} - H_{1s}$ bond with empty 2p orbital of other carbon.

Choose the correct option:

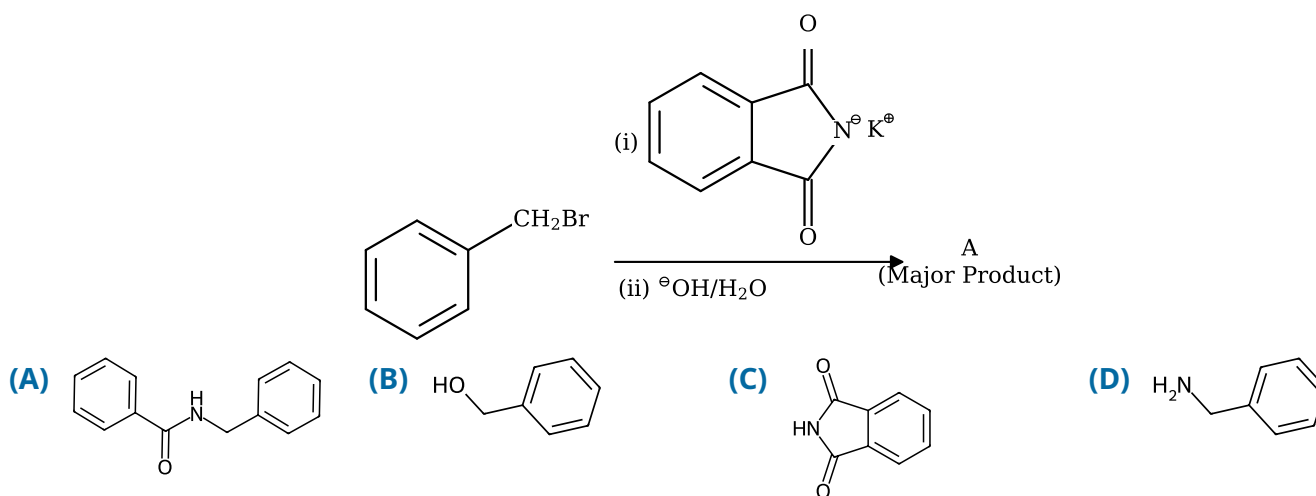
- (A) Both statement I and statement II are false
 (B) Statement I is incorrect but statement II is true
 (C) Statement I is correct but statement II is false
 (D) Both statement I and statement II are true.



Consider the above reaction and identify "Y"

- (A) $-CH_2NH_2$ (B) $-CONH_2$ (C) $-CHO$ (D) $-COOH$

What is A in the following reaction?



To an aqueous solution containing ions such as Al^{3+} , Zn^{2+} , Ca^{2+} , Fe^{3+} , Ni^{2+} , Ba^{2+} and Cu^{2+} was added conc. HCl, followed by H_2S .

The total number of cations precipitated during this reaction is/are:

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

Chemistry Section B · Numerical value

Q46 to Q54

The total number of electrons in all bonding molecular orbitals of O_2^{2-} is _____.
(Round off to the nearest integer)

3 moles of metal complex with formula $\text{Co(en)}_2\text{Cl}_3$ gives 3 moles of silver chloride on treatment with excess of silver nitrate. The secondary valency of Co in the complex is _____.
(Round off to the nearest integer)

For the cell



the cell potential $E_1 = 0.3095 \text{ V}$

For the cell

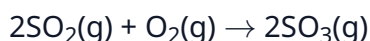


the cell potential = _____ $\times 10^{-2} \text{ V}$. (Round off the nearest integer).

[Use: $\frac{2.303RT}{F} = 0.059$]

10.0 mL of 0.05 M KMnO_4 solution was consumed in a titration with 10.0 mL of given oxalic acid dihydrate solution. The strength of given oxalic acid solution is _____ $\times 10^{-2} \text{ g/L}$.
(Round off to the nearest integer)

In a solvent 50% of an acid HA dimerizes and the rest dissociates. The van't Hoff factor of the acid is _____ $\times 10^{-2}$.
(Round off to the nearest integer)



The above reaction is carried out in a vessel starting with partial pressure $P_{\text{SO}_2} = 250 \text{ m bar}$, $P_{\text{O}_2} = 750 \text{ m bar}$ and $P_{\text{SO}_3} = 0 \text{ bar}$. When the reaction is complete, the total pressure in the reaction vessel is _____ m bar. (Round off of the nearest integer).

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Q52 Chemical Thermodynamics **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/p2gc2ZSj3B) › prepwiser.in/questions/p2gc2ZSj3B

When 400 mL of 0.2 M H_2SO_4 solution is mixed with 600 mL of 0.1 M NaOH solution, the increase in temperature of the final solution is _____ $\times 10^{-2}$ K. (Round off to the nearest integer).

[Use : $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}; \Delta_r H = -57.1 \text{ kJ mol}^{-1}$]

Specific heat of $\text{H}_2\text{O} = 4.18 \text{ J K}^{-1} \text{ g}^{-1}$

density of $\text{H}_2\text{O} = 1.0 \text{ g cm}^{-3}$

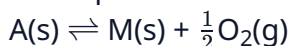
Assume no change in volume of solution on mixing.

Q53 Hydrocarbons: Alkanes **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/a2O2sOC3oi) › prepwiser.in/questions/a2O2sOC3oi

The dihedral angle in staggered form of Newman projection of 1, 1, 1-Trichloro ethane is _____ degree. (Round off to the nearest integer)

Q54 Chemical Equilibrium **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/-5FzcUIH7T) › prepwiser.in/questions/-5FzcUIH7T

The equilibrium constant for the reaction



is $K_p = 4$. At equilibrium, the partial pressure of O_2 is _____ atm. (Round off to the nearest integer)

Mathematics Section A · Multiple choice

Q55 to Q73

Q55 Three Dimensional Geometry[Step-by-step solution](https://www.prepwiser.in/questions/r6ZX141863) › prepwiser.in/questions/r6ZX141863

For real numbers α and $\beta \neq 0$, if the point of intersection of the straight lines

$\frac{x-\alpha}{1} = \frac{y-1}{2} = \frac{z-1}{3}$ and $\frac{x-4}{\beta} = \frac{y-6}{3} = \frac{z-7}{3}$, lies on the plane $x + 2y - z = 8$, then $\alpha - \beta$ is equal to:

- (A) 5 (B) 9 (C) 3 (D) 7

Q56 Binomial Theorem[Step-by-step solution](https://www.prepwiser.in/questions/EiMTIJZkxZ) › prepwiser.in/questions/EiMTIJZkxZ

A possible value of 'x', for which the ninth term in the expansion of

$$\left\{ 3^{\log_3 \sqrt{25^{x-1}+7}} + 3^{\left(-\frac{1}{8}\right)\log_3(5^{x-1}+1)} \right\}^{10}$$

in the increasing powers of $3^{\left(-\frac{1}{8}\right)\log_3(5^{x-1}+1)}$ is equal to 180, is:

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

Q57 Circles[Step-by-step solution](https://www.prepwiser.in/questions/toNBLJwrWD) › prepwiser.in/questions/toNBLJwrWD

Consider a circle C which touches the y-axis at (0, 6) and cuts off an intercept $6\sqrt{5}$ on the x-axis. Then the radius of the circle C is equal to:

- (A) $\sqrt{53}$ (B) 9 (C) 8 (D) $\sqrt{82}$

Q58 Complex Numbers[Step-by-step solution](https://www.prepwiser.in/questions/80gQ5tDwCk) › prepwiser.in/questions/80gQ5tDwCk

Let C be the set of all complex numbers. Let

$$S_1 = \{z \in \mathbb{C} : |z - 2| \leq 1\} \text{ and}$$

$$S_2 = \{z \in \mathbb{C} : z(1+i) + \bar{z}(1-i) \geq 4\}.$$

Then, the maximum value of $\left|z - \frac{5}{2}\right|^2$ for $z \in S_1 \cap S_2$ is equal to:

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

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Q59 Applications of Derivatives[Step-by-step solution](https://www.prepwiser.in/questions/wMw9V8dABU)

Let $f : (a, b) \rightarrow \mathbb{R}$ be twice differentiable function such that $f(x) = \int_a^x g(t)dt$ for a differentiable function $g(x)$. If $f(x) = 0$ has exactly five distinct roots in (a, b) , then $g(x)g'(x) = 0$ has at least:

- (A) twelve roots in (a, b) (B) five roots in (a, b)
(C) seven roots in (a, b) (D) three roots in (a, b)

Q60 Differential Equations[Step-by-step solution](https://www.prepwiser.in/questions/LtS9VT96Yh)

Let $y = y(x)$ be the solution of the differential equation $(x - x^3)dy = (y + yx^2 - 3x^4)dx$, $x > 2$. If $y(3) = 3$, then $y(4)$ is equal to:

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

Q61 Functions (Advanced)[Step-by-step solution](https://www.prepwiser.in/questions/LxTxKL6Ihn)

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be defined as $f(x + y) + f(x - y) = 2f(x)f(y)$, $f\left(\frac{1}{2}\right) = -1$. Then, the value of $\sum_{k=1}^{20} \frac{1}{\sin(k)\sin(k+f(k))}$ is equal to:

- (A) $\operatorname{cosec}^2(21) \cos(20) \cos(2)$ (B) $\sec^2(1) \sec(21) \cos(20)$
(C) $\operatorname{cosec}^2(1) \operatorname{cosec}(21) \sin(20)$ (D) $\sec^2(21) \sin(20) \sin(2)$

Q62 Limits[Step-by-step solution](https://www.prepwiser.in/questions/FWk8h7-SS8)

The value of

$$\lim_{x \rightarrow 0} \left(\frac{x}{\sqrt[8]{1 - \sin x} - \sqrt[8]{1 + \sin x}} \right)$$

is equal to:

- (A) 0 (B) 4 (C) -4 (D) -1

Q63 Continuity & Differentiability[Step-by-step solution](https://www.prepwiser.in/questions/6CqOwK9HM2)

Let $f : [0, \infty) \rightarrow [0, 3]$ be a function defined by

$$f(x) = \begin{cases} \max\{\sin t : 0 \leq t \leq x\}, & 0 \leq x \leq \pi \\ 2 + \cos x, & x > \pi \end{cases}$$

Then which of the following is true?

- (A) f is continuous everywhere but not differentiable exactly at one point in $(0, \infty)$
(B) f is differentiable everywhere in $(0, \infty)$
(C) f is not continuous exactly at two points in $(0, \infty)$
(D) f is continuous everywhere but not differentiable exactly at two points in $(0, \infty)$

Q64 Determinants[Step-by-step solution](https://www.prepwiser.in/questions/wFHI4_CXjD)

Let A and B be two 3×3 real matrices such that $(A^2 - B^2)$ is invertible matrix. If $A^5 = B^5$ and $A^3B^2 = A^2B^3$, then the value of the determinant of the matrix $A^3 + B^3$ is equal to:

- (A) 2 (B) 4 (C) 1 (D) 0

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A student appeared in an examination consisting of 8 true-false type questions. The student guesses the answers with equal probability. the smallest value of n, so that the probability of guessing at least 'n' correct answers is less than $\frac{1}{2}$, is:

- (A) 5 (B) 6 (C) 3 (D) 4

Let $\alpha = \max_{x \in R} \{8^{2 \sin 3x} \cdot 4^{4 \cos 3x}\}$ and $\beta = \min_{x \in R} \{8^{2 \sin 3x} \cdot 4^{4 \cos 3x}\}$. If $8x^2 + bx + c = 0$ is a quadratic equation whose roots are $\alpha^{1/5}$ and $\beta^{1/5}$, then the value of $c - b$ is equal to:

- (A) 42 (B) 47 (C) 43 (D) 50

Let N be the set of natural numbers and a relation R on N be defined by $R = \{(x, y) \in N \times N : x^3 - 3x^2y - xy^2 + 3y^3 = 0\}$. Then the relation R is:

- (A) symmetric but neither reflexive nor transitive (B) reflexive but neither symmetric nor transitive
(C) reflexive and symmetric, but not transitive (D) an equivalence relation

Let the mean and variance of the frequency distribution

$$\begin{array}{ccccccc} x : & x_1 = 2 & x_2 = 6 & x_3 = 8 & x_4 = 9 \\ f : & 4 & 4 & \alpha & \beta \end{array}$$

be 6 and 6.8 respectively. If x_3 is changed from 8 to 7, then the mean for the new data will be:

- (A) 4 (B) 5 (C) $\frac{17}{3}$ (D) $\frac{16}{3}$

Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three vectors such that $\vec{a} = \vec{b} \times (\vec{b} \times \vec{c})$. If magnitudes of the vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ are $\sqrt{2}$, 1 and 2 respectively and the angle between $\vec{b}$ and $\vec{c}$ is θ ($0 < \theta < \frac{\pi}{2}$), then the value of $1 + \tan \theta$ is equal to:

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

The area of the region bounded by $y - x = 2$ and $x^2 = y$ is equal to:

- (A) $\frac{16}{3}$ (B) $\frac{2}{3}$ (C) $\frac{9}{2}$ (D) $\frac{4}{3}$

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Q71 Straight Lines[Step-by-step solution](https://www.prepwiser.in/questions/wfjnnqOE5y) › prepwiser.in/questions/wfjnnqOE5y

The point P (a, b) undergoes the following three transformations successively:

- (a) reflection about the line $y = x$.
- (b) translation through 2 units along the positive direction of x-axis.
- (c) rotation through angle $\frac{\pi}{4}$ about the origin in the anti-clockwise direction.

If the co-ordinates of the final position of the point P are $\left(-\frac{1}{\sqrt{2}}, \frac{7}{\sqrt{2}}\right)$, then the value of $2a + b$ is equal to:

- (A) 13 (B) 9 (C) 5 (D) 7

Q72 Straight Lines[Step-by-step solution](https://www.prepwiser.in/questions/VQo9P5U6ZX) › prepwiser.in/questions/VQo9P5U6ZX

Two sides of a parallelogram are along the lines $4x + 5y = 0$ and $7x + 2y = 0$. If the equation of one of the diagonals of the parallelogram is $11x + 7y = 9$, then other diagonal passes through the point:

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

Q73 Trigonometric Ratios & Identities[Step-by-step solution](https://www.prepwiser.in/questions/NvZrK0ir99) › prepwiser.in/questions/NvZrK0ir99

If $\tan\left(\frac{\pi}{9}\right), x, \tan\left(\frac{7\pi}{18}\right)$ are in arithmetic progression and $\tan\left(\frac{\pi}{9}\right), y, \tan\left(\frac{5\pi}{18}\right)$ are also in arithmetic progression, then $|x - 2y|$ is equal to:

- (A) 4 (B) 3 (C) 0 (D) 1

Mathematics Section B · Numerical value

Q74 to Q83

Q74 Three Dimensional Geometry **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/dI_RliMz4C) › prepwiser.in/questions/dI_RliMz4C

The distance of the point P(3, 4, 4) from the point of intersection of the line joining the points Q(3, -4, -5) and R(2, -3, 1) and the plane $2x + y + z = 7$, is equal to _____.

Q75 Complex Numbers **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/h6iHdCeBp8) › prepwiser.in/questions/h6iHdCeBp8

If the real part of the complex number

$$z = \frac{3 + 2i \cos \theta}{1 - 3i \cos \theta}, \theta \in \left(0, \frac{\pi}{2}\right)$$

is zero, then the value of $\sin^2 3\theta + \cos^2 \theta$ is equal to _____.

Q76 Definite Integration **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/vKfohzwrJl) › prepwiser.in/questions/vKfohzwrJl

If

$$\int_0^\pi (\sin^3 x) e^{-\sin^2 x} dx = \alpha - \frac{\beta}{e} \int_0^1 \sqrt{t} e^t dt$$

, then $\alpha + \beta$ is equal to _____.

Q77 Differential Equations **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/vLglhDYSDf) › prepwiser.in/questions/vLglhDYSDf

Let $y = y(x)$ be the solution of the differential equation $dy = e^{\alpha x + y} dx$; $\alpha \in \mathbb{N}$. If $y(\log_e 2) = \log_e 2$ and $y(0) = \log_e\left(\frac{1}{2}\right)$, then the value of α is equal to _____.

Q78 Ellipse **NUMERICAL**[Step-by-step solution](https://www.prepwiser.in/questions/e0qrXG4Aji) › prepwiser.in/questions/e0qrXG4Aji

Let E be an ellipse whose axes are parallel to the co-ordinates axes, having its center at (3, -4), one focus at (4, -4) and one vertex at (5, -4). If $mx - y = 4$, $m > 0$ is a tangent to the ellipse E, then the value of $5m^2$ is equal to _____.

If

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$$

and $M = A + A^2 + A^3 + \dots + A^{20}$, then the sum of all the elements of the matrix M is equal to _____.

Let n be a non-negative integer. Then the number of divisors of the form " $4n + 1$ " of the number $(10)^{10} \cdot (11)^{11} \cdot (13)^{13}$ is equal to _____.

The number of real roots of the equation $e^{4x} - e^{3x} - 4e^{2x} - e^x + 1 = 0$ is equal to _____.

Let $A = \{n \in \mathbb{N} \mid n^2 \leq n + 10,000\}$, $B = \{3k + 1 \mid k \in \mathbb{N}\}$ and $C = \{2k \mid k \in \mathbb{N}\}$, then the sum of all the elements of the set $A \cap (B - C)$ is equal to _____.

Let $\vec{a} = \hat{i} - \alpha\hat{j} + \beta\hat{k}$, $\vec{b} = 3\hat{i} + \beta\hat{j} - \alpha\hat{k}$ and $\vec{c} = -\alpha\hat{i} - 2\hat{j} + \hat{k}$, where α and β are integers. If $\vec{a} \cdot \vec{b} = -1$ and $\vec{b} \cdot \vec{c} = 10$, then

$$(\vec{a} \times \vec{b}) \cdot \vec{c}$$

is equal to _____.

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Physics

1. D	2. B	3. A	4. C	5. B	6. B	7. B	8. B
9. B	10. D	11. B	12. D	13. C	14. C	15. C	16. A
17. B	18. D	19. C	20. 10	21. 1	22. 60	23. 30	24. 6
25. 9	26. 2	27. 2	28. 2				

Chemistry

29. D	30. B	31. D	32. C	33. A	34. B	35. B	36. A
37. D	38. C	39. D	40. D	41. D	42. C	43. C	44. D
45. A	46. 10	47. 6	48. 28	49. 1575	50. 125	51. 875	52. 82
53. 60	54. 16						

Mathematics

55. D	56. D	57. B	58. D	59. C	60. B	61. C	62. C
63. B	64. D	65. A	66. A	67. B	68. C	69. B	70. C
71. B	72. B	73. C	74. 7	75. 1	76. 5	77. 2	78. 3
79. 2020	80. 924	81. 2	82. 832	83. 9			

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