JEE Main (Phase-II) 2020

Memory Based Questions & Solutions

SUBJECT

PHYSICS

Date: 03 September, 2020 (Shift-1)

Time: 9 PM to 12 PM

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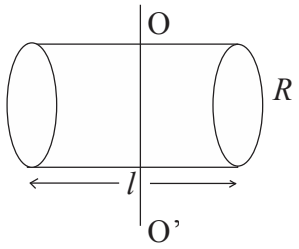
Q1. For a given volume of solid cylinder find the ratio $\frac{\ell}{R}$ such that moment of inertia of cylinder about axis OO' will be minimum.



(1) $\frac{\sqrt{3}}{2}$ (2) $\frac{2}{\sqrt{3}}$ (3) $\frac{2}{1}$ (4) $\frac{\sqrt{3}}{1}$

Ans. (1)

sol. $I = \frac{MR^2}{4} + \frac{M\ell^2}{12}$

$V = \pi R^2 \ell \Rightarrow R^2 = \frac{V}{\pi\ell}$

$\Rightarrow I = \frac{MV}{4\pi\ell} + \frac{M\ell^2}{12}$

$\frac{dI}{d\ell} = \frac{MV}{4\pi}\left(\frac{-1}{\ell^2}\right) + \frac{2M\ell}{12}$

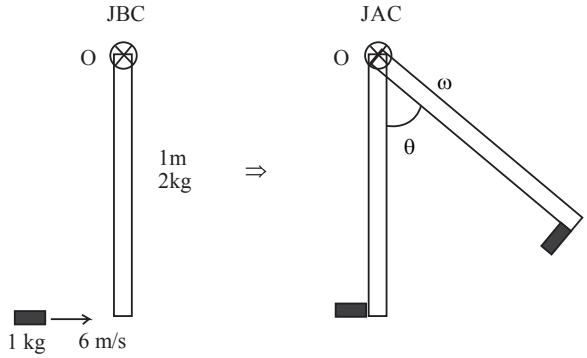
for I to be minimum $\Rightarrow \frac{dI}{d\ell} = 0$

$\Rightarrow \frac{MV}{4\pi\ell^2} = \frac{2M\ell}{12}$ (use $V = \pi R^2 \ell$)

$\Rightarrow \frac{\ell}{R} = \frac{\sqrt{3}}{2}$

Q2. A uniform rod of length 1 m and mass 2kg is vertical and hinged at top end. A block of mass 1 kg moving with speed 6m/s horizontally strikes at bottom point and stick to rod. Find maximum angular displacement of rod from vertical

Sol.



$$\vec{L}_{BC_0} = \vec{L}_{AC_0}$$

$$1\times 6\times (1) = \left[\frac{2\times 1^2}{3} + 1(1)^2\right]\omega$$

$$6 = \frac{5}{3}\omega$$

$$\omega = \left(\frac{18}{5}\right) rad/\sec$$

$$E_i = E_t$$

$$\frac{1}{2}\left[\frac{2\times 1^2}{3} + 1(1)^2\right]\left(\frac{18}{5}\right)^2 = \frac{1}{2}(1-\cos\theta)\times 2\times 10 + 1(1-\cos\theta)1\times 10$$

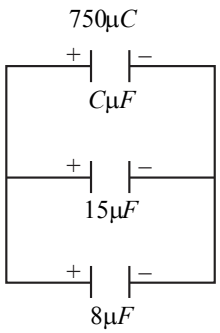
$$\frac{1}{2}\left(\frac{5}{3}\right)\left(\frac{18}{5}\right)^2 = 20 - 20\cos\theta$$

$$\cos\theta = \frac{23}{50}$$

Q3. A capaciter of capacitance C is connected to a battery of unknown emf & charge on the capaciter is $750\mu C$. Now this charged capacter is connected in parallel with the two other capacters of $15\mu F$ & $8\mu F$, potential difference across capaciter C becomes 30 volt. Find C.

(1) $1\mu F$ (2*) $2\mu F$ (3) $3\mu F$ (4) $4\mu F$

Sol.



Charge $Q = 750\mu C$

splits on 3 parallel capaciter

$C_{eq} = C+15+8$

$= C+23\mu F$

$(C + 23\mu F)\times 30 = 750$

$C + 23\mu F = 25\mu F$

$C = 2\mu F$

Q4. A baloon filled with helium suddenly bursts at certain temperature. The process will be

(1) Reversible isothermal (2) Irreversible isothermal

(3) Reversible adiabatic (4) Irreversible adiabatic

sol. Instantaneous and fast processes are adiabatic and irrevirsible.

Q5. A cylindrical container of volume 500 cc is partially filled with mercury at 30°C . The container is then heated. After heating the free volume remains same.

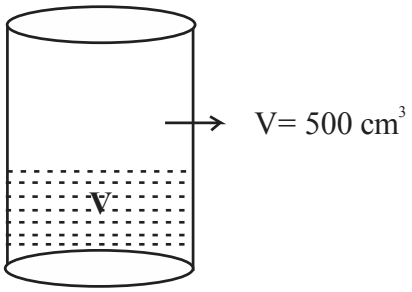
$\gamma_{\text{container}} = 6\times10^{-6}, \gamma_{Hg} = 4\times10^{-4}$

Find the volume of mercury filled in the container.

(1) $15cm^3$ (2) $7.5cm^3$ (3) $10cm^3$ (4) $50cm^3$

Ans. (2)

Sol.



$500 - V = 500(1+6\times10^{-6}\times30) - V(1+4\times10^{-4}\times30)$

$4\times10^{-4}\times30V = 500\times6\times10^{-6}\times30$

$V = 7.5cm^3$

Q6. A molecule with three atoms at corners of a triangle. Find internal energy of molecule.

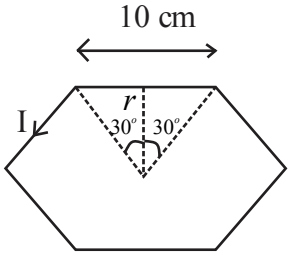
(1) KT (2) 2 KT (3) 3 KT (4) 4 KT

Ans. (3)

sol. $U_{molecule} = \frac{fKT}{2} = \frac{6KT}{2} = 3KT$

Q7. Current I is flowing in a regular hexagon of side length 10 cm & no of turns 50 . Find magnetic field intensity at the centre of hexagon.

sol.



$\tan 30^o = \frac{5}{r}$

$r = 5\sqrt{3}cm$

due to one side

$\vec{B}_{centre} = \frac{\mu_0}{4\pi}\frac{NI}{r}[\sin\alpha + \sin\beta]$

total magnetic field $B = 6\times\left[\frac{\mu_0}{4\pi}\frac{I}{r}\left(\sin 30^o + \sin 30^o\right)\right]\times50$

$$B_{centre} = \frac{500\sqrt{3}\mu_0 I}{\pi}$$

Q8. If the max. KE of electron illuminated with light of wavelength 200 nm is 3 times that of the max. KE when illuminated by $\lambda = 500nm$. Find work function of the material.

sol. $K_{max} = \frac{hc}{\lambda} - \phi$

$K_1 = \frac{hc}{2000} - \phi$ $\quad [\lambda_1 = 2000A^o]$

$K_2 = \frac{hc}{5000} - \phi$ $\quad [\lambda_2 = 5000A^o]$

$K_1 = 3K_2$ (given)

$\frac{hc}{2000} - \phi = 3\left(\frac{hc}{5000} - \phi\right)$ [Take hc = 12400]

$\Rightarrow \phi = 0.62eV = 1\times10^{-19}J$

Q9. A satellite rotating around earth near surface ($R = R_e$) has speed V. IF speed in made $\sqrt{\frac{3}{2}}V$. Find max distance from centre of earth?

sol. $\frac{GMm}{R^2} = \frac{mv^2}{R}$

$K.E = \frac{1}{2}mv^2 = \frac{GMm}{2R}$

$T.E = -\frac{GMm}{R} + \frac{GMm}{2R} = \frac{-GMm}{2R}$

when $v' = \sqrt{\frac{3}{2}}v$

$K.E.' = \frac{1}{2}m\left(\sqrt{\frac{3}{2}}v\right)^2 = \frac{3}{2}\frac{GMm}{2R}$

$T.E' = \frac{-GMm}{R} + \frac{3GMm}{2(2R)}$

$= -\frac{GMm}{4R} = \frac{-GMm}{2a}$ $\quad (2a = 4R)$

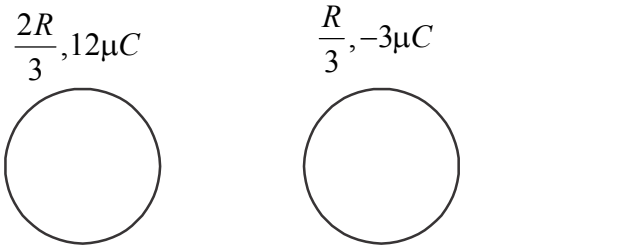
$a = 2R$

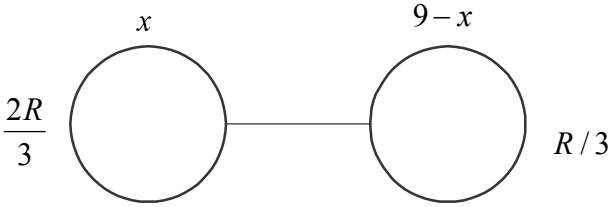
Q10. A sphere (s_1) of radius $\frac{2}{3}R$ has charge $12\mu C$ and other sphere (s_2) of radius $\frac{R}{3}$ has charge $-3\mu C$. They are placed very far from each other. They are connected by a conducting wire, then find the charges after connecting the wire on s_1 & s_2 respectively.

(1) $4.5\mu C$ *each* (2) $+4.5\mu C, -4.5\mu C$ (3) $6\mu C, 3\mu C$ (4) $3\mu C, 6\mu C$

Ans. 3

Sol.





$$\frac{x}{9-x}=\frac{2R/3}{R/3}\Rightarrow x=18-2x$$

$$\Rightarrow x=6\mu C$$

Q11. Pressure inside two soap bubbles is 1.01 atm &1.02 atm. Find the ratio of their volumes.

(1) $\frac{4}{1}$ (2) $\frac{9}{4}$ (3) $\frac{8}{1}$ (4) $\frac{1}{8}$

Ans. (3)

Sol. as excess pressure inside a bubble $(P)=\frac{4T}{R}$

$P_1 = 1.01\text{atm} \Rightarrow (P_{excess})_1 = 0.01\text{atm}$

$P_2 = 1.02\,\text{atm} \Rightarrow (P_{excess})_2 = 0.02\text{atm}$

$$P \propto \frac{1}{R}$$

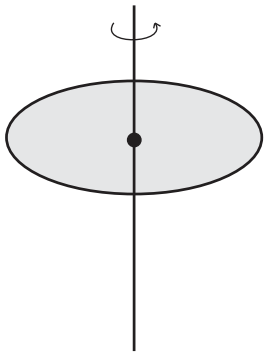
$$\Rightarrow \frac{P_1}{P_2}=\frac{R_2}{R_1}$$

$$\Rightarrow \frac{R_1}{R_2}=\frac{0.02}{0.01}$$

$$\Rightarrow \frac{V_1}{V_2}=\frac{R_1^3}{R_2^3}=\frac{(0.02)^3}{(0.01)^3}=\frac{8}{1}$$

Q12. A disc of mass 200 kg is rotaing in horizonjtal plane with angular velocity 5 rpm, about its centred axis perpendicular to its plane. A man of mass 80 kg standing on the circumference moves to the centre of disc. Find the new angular velocity.

sol.



as $\vec{\tau}_{axis} = 0$

$\Rightarrow \vec{L}_{axis}$ will be curved

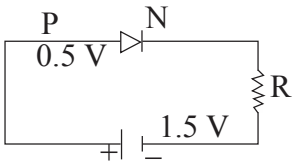
$\vec{L}_i = \vec{L}_f$

$\Rightarrow I_1\omega_1 = I_2\omega_2$

$$\Rightarrow \left(\frac{200R^2}{2} + 80R^2\right) \times \omega_1 = \frac{200R^2}{2} \times \omega_2$$

$\Rightarrow \omega_2 = 9rpm$

Q13. A PN junction diode when forward biased has a drop of 0.5 V which is assumed to be independent of current. The current in excess of 10 mA through the diode produces large joule heating which damages the diode. If we want to use a 1.5 V battery to forward biased diode, the minimum resistor used in series should be



(1) 200Ω (2) 100Ω (3) 50Ω (4) 25Ω

Ans. (2)

sol. $R = \frac{v}{i} = \frac{1}{10 \times 10^{-3}} = \frac{1000}{10} = 100\Omega$

Q14. An elliptical ring with semic major axis 'a' & semi minor axis 'b' rotates about diameter with angular speed ω in uniforming magnetic field 'B' find the value of average power. (Resistance = R)

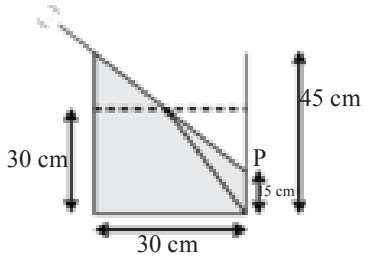
sol. $e = \frac{-d\phi}{dt} = BA\omega \sin \omega t$

$$P_{average} = \frac{\int_0^T \frac{e^2}{R} dt}{T}$$

$$= \frac{B^2A^2\omega^2}{R} \frac{\int_0^T \sin^2 \omega t dt}{T}$$

$$H = \frac{B^2A^L\omega^2}{2R} = \frac{\pi^2B^2a^2b^2\omega^2}{2R}$$

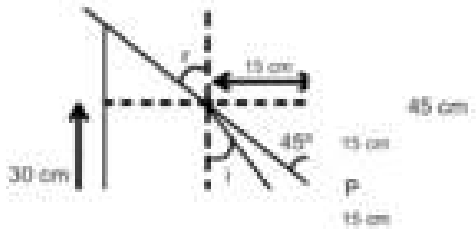
Q15. An obsever's line of sight is at P , when container of diameter 30 cm and height 45 cm is empty. If this container is filled with a liquid up to 30 cm height he is able to see the edge of container. Find refractive index of liquid.



(1) $\sqrt{\frac{5}{2}}$ (2) $\frac{5}{\sqrt{2}}$ (3) $\frac{\sqrt{5}}{2}$ (4) $\frac{5}{2}$

Ans. (1)

sol.



From Shell's Law

$\mu \times \sin i = 1 \times \sin r$

$\mu \times \frac{15}{\sqrt{15^2 + 30^2}} = 1 \times \sin 45^o$

$\mu = \sqrt{\frac{5}{2}}$

Q16. Screw guage of pitch 0.1 cm and 50 division on circular scale, measure thickness of an object. Which of the following measurement is possible for thickness

(1) 2.123 cm (2) 2.124 cm (3) 2.125 cm (4) 2.127 cm

Ans. (2)

Sol. Thickness = M. S. Reading + Circular Scale Reading (L. C.)

Here, $LC = \frac{0.1}{50} = 0.002cm$

Q17. A bowling machine projects a ball of mass 0.15 kg in upward direction. If ball displaced along bowling machine 0.2m and released . After the released from bowling machine ball attain 20 m height then find the force exerted by bowling machine on the ball.

(1) 145.5 N (2) 165. 5 N (3) 175.5 N (4) 151.5 N

Ans. (4)

Sol. From work energy theorem F(0.2) - mg(20.2) = 0

$F = mg\frac{(20.2)}{0.2}$

$= 0.15 \times 10 \times \frac{202}{2}$

$=15\times10.1N$

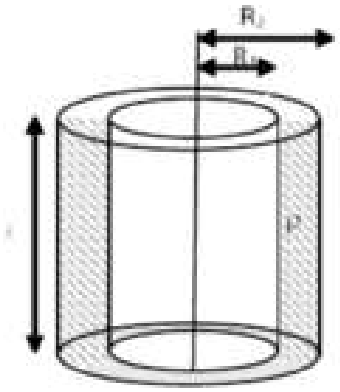
$=151.5N$

Q18. The hollow cylinder of length ℓ and inner and outer radius R_1 and R_2 respectively. Find resistance of cylinder if current flows radially outward in the cylinder. Resistivity of material of cylinder is ρ.

(1) $\frac{\rho}{\pi\ell}\ell n\frac{R_2}{R_1}$ (2) $\frac{\rho}{4\pi\ell}\ell n\frac{R_2}{R_1}$ (3) $\frac{\rho}{3\pi\ell}\ell n\frac{R_2}{R_1}$ (4) $\frac{\rho}{2\pi\ell}\ell n\frac{R_2}{R_1}$

Ans. (4)

Sol.



The resistance of small element

$$\Delta R=\frac{\rho dr}{2\pi r\ell}$$

$$R=\frac{\rho}{2\pi\ell}\int_{R_1}^{R_2}\frac{dr}{r}$$

$$R=\frac{\rho}{2\pi\ell}\ell n\frac{R_2}{R_1}$$

Q19. In YDSE wavelength of light used is 500 nm and seperation between slits is 0.05mm. then the angular fringe width will be

(1) 1.8^o (2) 3.2^o (3) 0.57^o (4) 0.48^o

Ans. (3)

Sol. $\beta_0=\frac{\lambda}{d}=\frac{500\times10^{-9}}{5\times10^{-5}}=10^{-2}\,Radian=0.57^o$

Q20. $\frac{9}{16}th$ portion of a radioactive sample remians undecayed after time t. How much sample remains undecayed after time $\frac{t}{2}$

(1) $\frac{3}{4}$ (2) $\frac{9}{16}$ (3) $\frac{4}{3}$ (4) $\frac{16}{9}$

Ans. (1)

Sol. $N=N_0e^{-\lambda t}$ .....(1)

$N' = N_0 e^{-\frac{\lambda t}{2}}$ .....(2)

From (1) & (2)

$$\left(\frac{N'}{N_0}\right) = \left(\frac{N}{N_0}\right)^{\frac{1}{2}} = \left(\frac{9}{16}\right)^{\frac{1}{2}} = \frac{3}{4}$$

Q21. Electomagnetic wave is given by $B = 3\times10^{-8}\sin(ky+\omega t)(\hat{i})$ find E = ?

(1) $9\sin(ky+\omega t)(-\hat{k})$ v/ m (2) $9\sin(ky+\omega t)(\hat{k})$ v/ m

(3) $6\sin(ky+\omega t)(-\hat{k})$ v/ m (4) $4\sin(ky+\omega t)(-\hat{k})$ v/ m

Ans. (1)

Sol. $E_0 = cB_0$

$\vec{E} = 3\times10^8\times3\times10^{-8}\sin(ky+\omega t)(-\hat{k}) = 9\sin(ky+\omega t)(-\hat{k})$

Q22. Energy of electron in its nth orbit is given as $\left(E_n = -\frac{13.6}{n^2}\times z\right)eV$ .Consider a hydrogen atom, find the amount of energy needed to transfer electron from 1st orbit to 3rd orbit:

(1) 13.6 eV (2) 1.51 eV (3) 3.4 eV (4) 12.09 eV

Ans. ;(4)

Sol. For hydrogen, Z = 1

Energy of 1st orbit $= E_1 = -\frac{13.6}{12}eV = -13.6eV$

Energy of 3rd orbit $= E_3 = -\frac{13.6}{12}eV = -1.5eV$

Energy difference DE $= E_3 - E_1 = 12.08eV$

Q23. An external pressure P is applied on a cube at 273 K hence it compresses equally from all sides, α is the coefficient of linear expansion & K is the bulk modulus of material,. To bring hthe cube to its original size by heating, the temperature rise must be

(1) $\frac{P}{3\alpha k}$ (2) $\frac{P}{\alpha k}$ (3) $\frac{P}{2\alpha k}$ (4) $\frac{P}{4\alpha k}$

Ans. (1)

Sol. $K = -\frac{P}{\Delta v/v} \Rightarrow \left(\frac{\Delta v}{v}\right)_1 = -\frac{P}{k}$ & due to thermal expansion

$\left(\frac{\Delta v}{v}\right)_2 = \gamma\Delta\theta$ [where $\Delta\theta$ is increase i8n temp]

Also, $(\gamma = 3\alpha)$

$\Rightarrow \left(\frac{\Delta v}{v}\right)_1 + \left(\frac{\Delta v}{v}\right)_2 = 0$ [for restoring shape]

$\Rightarrow \frac{-P}{K} + 3\alpha\Delta\theta = 0$

$$\Delta\theta = \frac{P}{3\alpha K}$$

Q24. In the series LCR circuit as shown in figure, due to the heat developed in t seconds temperature of resistance increases by 10°C. If heat capacity of resistance material is 100 J/°C. then calculate the value of t.

(1) 10 second (2) 20 second (3) 30 second (4) 40 second

Ans. (2)

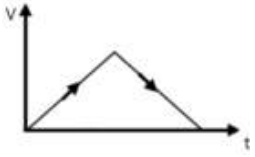
Sol. H $Heat = (i_{rms})^2 .Rt$

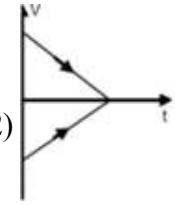
$$i_{rms} = \frac{25}{Z\sqrt{2}} \text{ where } Z = \sqrt{R^2 + (x_L - x_C)^2} = \sqrt{4^2 + (7-4)^2} = 5\Omega$$

$$\Rightarrow Heat = \left(\frac{25}{5\sqrt{2}}\right)^2 \times 4 \times t = ms\Delta\theta = 100 \times 10$$

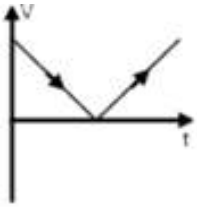
t = 20 second

Q25. A body is shown vertically upwards. Which graph represents the variation of velocity wrt time?

(1) 

(2) 

(3) 

(4) 

Ans. (3)

Sol. Using 1st equation of motion

Initial velcoty = u

acceleration = - g

$v = u + at \Rightarrow v = u - gt$ .....(1)

Equatio n (1) represents a straight line curve with (-ve) slope. Hence answer is (3)

Gravity
Orienting Intelligence

JEE Main - 2020

Best Result in U.P.

Aditya Pandey

Percentile

99.936

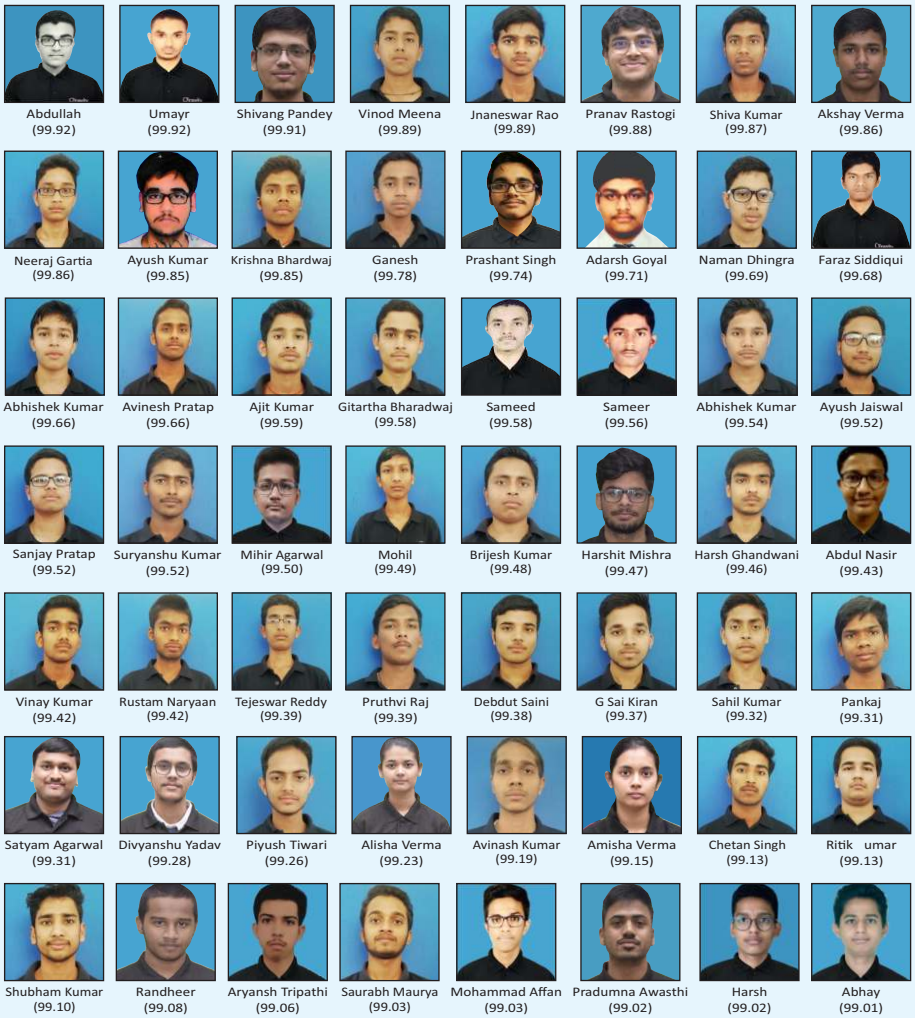
City Topper

Application No. 200310320565
DOB - 23-12-2002

65 Students Above 99 Percentile

145 Students Above 98 Percentile

208 Students Above 97 Percentile



SCHOOL INTEGRATED PROGRAM (SIP)

Tradition of Gravity Continues,
Once Again Historical Result,
100% Students Cracked
JEE Main
(Based on Last Yr Cut off)

2020

80 Out of 80
Cracked JEE Main

We had three Batches
of 55, 15 and 10.

Many Top Ranks are
from these Batches

2019

79 Out of 80 in JEE Main	50 Out of 79 in JEE Adv.

2018

83 Out of 85 in JEE Main	62 Out of 83 in JEE Adv.

2017

80 Out of 85 in JEE Main	63 Out of 80 in JEE Adv.

2016

39 Out of 40 in JEE Main	31 Out of 39 in JEE Adv.

Selections Engineering 2019

gravity
Orienting Intelligence

194 AIR (General)

Tarun

337 AIR (General)

Aniket Agarwal

494 AIR (General)

Shubh Sahu

497 AIR (General)

Shlok Nemani

50 out of 79 Cracked JEE Advanced from SIP (School Integrated Program)

4 Ranks under 500 (General Category) | 2 Ranks under 10 (Reserved Category)

126 Selections in JEE Advanced | 61 Students above 99 Percentile in JEE Main 2019

Sanjana

AIR - 3*

Akash

AIR - 4*

Priyanka

AIR - 68*

Bibek Lakra

AIR - 150*

Neha Raj

AIR - 177*

Arindam

AIR - 809 (General EWS)

Priyam

AIR - 1378 (General)

Mihir Chawla

AIR - 2237 (General)

Madhur Kumar

AIR - 2382 (General)

Manish Kumar

AIR - 2388 (General)

Saumya Raj

AIR - 2656 (General)

Raghav

AIR - 2659 (General)

Ritveek

AIR - 2709 (General)

Vanshaj

AIR - 2787 (General)

Subir Gupta

AIR - 2881 (General)

Aryan Rastogi

AIR - 3167 (General)

Devansh

AIR - 3600 (General)

Abhisht Bose

AIR - 3784 (General)