JEE Main (Phase-II) 2020

Memory Based Questions & Solutions

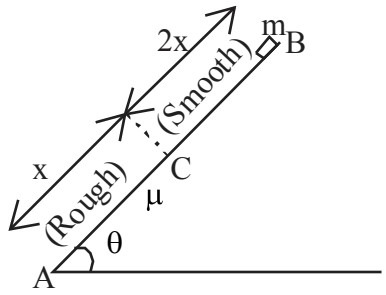
SUBJECT

PHYSICS

Date: 02 September, 2020 (Shift-1)

Time: 9 AM to 12 PM

Q1. A block of mass m starts slipping from B & comes to rest at A.
Find K, where $\mu = K \tan\theta$ & BC = 2AC



Sol. Applying work energy theorem [as $\Delta K = 0$]

$mg3x\sin\theta - \mu mg\cos\theta x = 0$

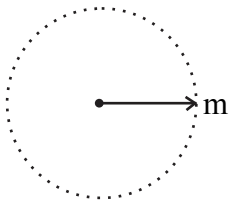
$\Rightarrow \mu = 3\tan\theta$

$\Rightarrow K = 3$

Q2. There are two magnets P and T; P is used as permanent magnet while T is used in transformers; Then correct option is
(A) P has high retentivity and low coercivity
(B) P has low retentivity and high coercivity
(C*) T has low coercivity and low retentivity.
(D) T has high coercivity and high retentivity.

Q3. In a hypothetical galaxy the mass density is given by $\rho = \frac{k}{r}$. If a planet is rotating at distance R from centre, find relation between time period T and radius R

Sol.



$$M_{enclosed} = \int_0^R \rho dV$$

$$M = \int_0^R \frac{k}{r} \times 4\pi r^2 dr$$

$$M = 4\pi k \frac{R^2}{2}$$

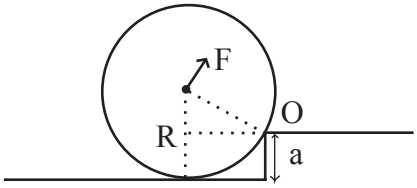
$$\frac{GMm}{R^2} = \frac{mv^2}{R}$$

$$v = \sqrt{\frac{GM}{R}} \Rightarrow \propto \sqrt{\frac{R^2}{R}} = \sqrt{R}$$

$$T = \frac{2\pi R}{V} \Rightarrow T \propto \frac{R}{V}$$

$$T \propto R^{\frac{1}{2}}$$

Q4. Find min value of F required to lift the body?



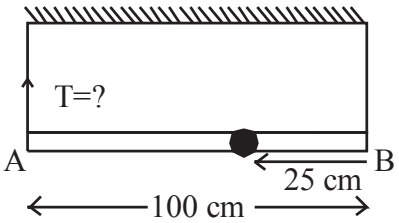
(1) $\frac{mg\sqrt{2Ra-a^2}}{R}$ (2) $\frac{mg\sqrt{2Ra+a^2}}{R}$ (3) $\frac{mg\sqrt{Ra+a^2}}{2R}$ (4) $\frac{mg\sqrt{Ra-a^2}}{2R}$

Ans. (1)

Sol. $\tau_0 > 0 \Rightarrow FR > mg\sqrt{R^2-(R-a^2)}$

$$F > \frac{mg\sqrt{2Ra-a^2}}{R}$$

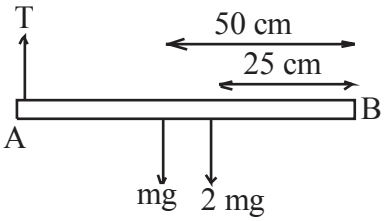
Q5. A uniform rod of mass m and length 100 cm is attached by 2 strings as shown in figure. A block of mass 2m is placed on the rod at 25 cm from point B. Find tension T.



Sol. Rod is in equilibrium

$\Rightarrow \vec{F}_{net} = 0$ & $\vec{\tau}_{net} = 0$

$\Rightarrow$ Taking torque about point B



$\Rightarrow \vec{\tau}_B = 0$

$\Rightarrow 2mg \times 25 + mg \times 50 - T \times 100 = 0$

$\Rightarrow T = mg$

6. A capacitor of $5\mu F$ is charged by a battery of 220 V & battery is disconnected. Another uncharged capacitor of $2.5\mu F$ is connected across the $5\mu F$ capacitor . Find heat loss in the circuit.

(1) $\frac{121}{3}\times 10^4\,\mu J$ (2) $\frac{121}{3}\times 10^3\,\mu J$ (3) $\frac{121}{3}\times 10^{-4}\,\mu J$ (4) $\frac{121}{3}\times 10^{-3}\,\mu J$

Ans. (2)

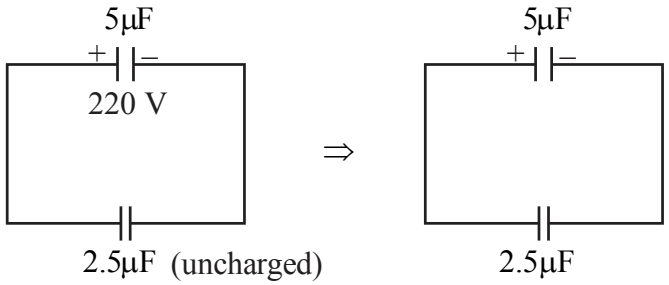
Sol. Potential on $5\mu F$ capacitor $= 220\ V$

$$\text{Energy loss} = \frac{1}{2}\frac{C_1C_2}{C_1+C_2}(V_1-V_2)^2$$

$$= \frac{1}{2}\times\left(\frac{5\times 2.5}{5+2.5}\right)(220-0)^2$$

$$= \frac{121}{3}\times 10^3\,\mu J$$

ALTERNATE METHOD



$$U_i = \frac{1}{2}5(220)^2$$

$$U_f = \frac{1}{2}\frac{q^2}{C_{eq}} = \frac{(5\times 220)^2}{2\times 7.5}$$

$$\Delta H = U_i - U_f = \frac{121}{3}\times 10^3\,\mu J$$

Q.7 Two strings X and Y of same length and same material having natural frequency 450 Hz and 300 Hz respectively. Find $\frac{T_X}{T_Y}$, where T_X & T_Y are tensions in string X & Y respectively.

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

Ans. (3)

Sol. $f_{nat} = \frac{V}{2\ell} = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}}$

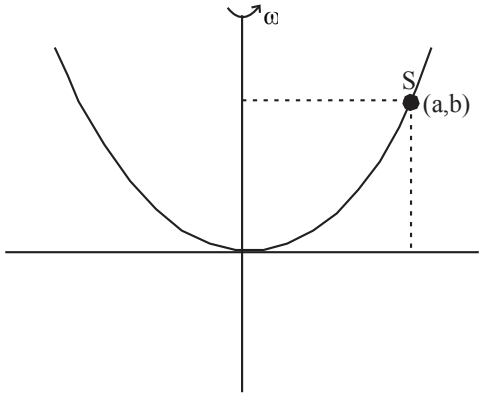
$$f_{natural} \propto \sqrt{T}$$

$$\frac{f_X}{f_Y} = \sqrt{\frac{T_X}{T_Y}}$$

$$\left(\frac{f_X}{f_Y}\right)^2 = \frac{T_X}{T_Y}$$

$$\Rightarrow \frac{T_X}{T_Y} = \left(\frac{450}{300}\right)^2 = \frac{9}{4}$$

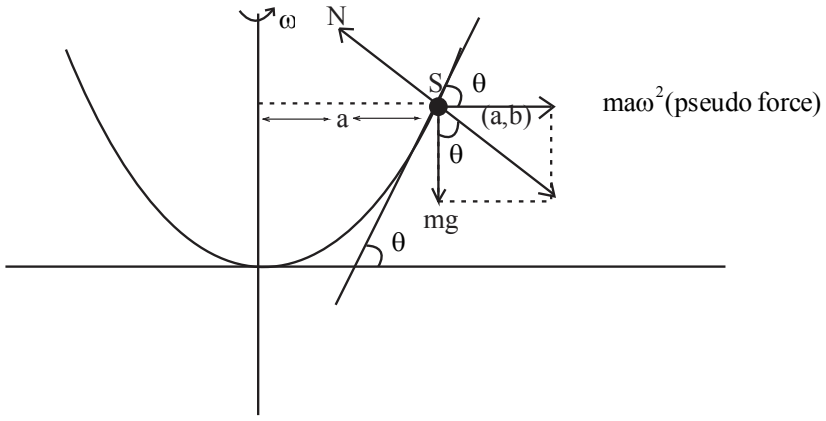
Q8. A bead of mass m is at rest with respect to the wire of shape as shown. Given equation of wire $y = 4cx^2$, which is rotating with ω as shown in figure. Find ω.



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

Ans. 4

sol. FBD of bead (with respect to wire)



as bead is in equilibrium $\Rightarrow \vec{F}_{net} = 0$

Resultant vector of $ma\omega^2$ & mg should be equal & opposite to normal (N)

$$\Rightarrow \tan\theta = \frac{ma\omega^2}{mg} = 0$$

$$\Rightarrow \frac{dy}{dx} = \frac{a\omega^2}{g} \quad .....(1)$$

Now for parabolic curve

$y = 4cx^2$

Point (a,b) lies on parabola so

$b = 4ca^2$

as $y = 4cx^2$

$$\Rightarrow \frac{dy}{dx} = 8cx$$

$\Rightarrow \frac{dy}{dx}(at\ x=a)=8ca$ .....(2)

from (1) & (2)

$\frac{a\omega^2}{g}=8ca$

$\omega=\sqrt{8cg}=2\sqrt{2cg}$

Q9. In standard YDSE setup, given d = 1 mm and D = 1m, given $\lambda = 632$ nm and at y = 1.270 mm a bright fringe in formed. Find path difference for this point.

(1) 1.27×10^{-6} m (2) 1.37×10^{-6} m (3) 1.37×10^{-5} m (4) 1.27×10^{-5} m

Ans. (1)

Sol. $\Delta x = d\sin\theta$

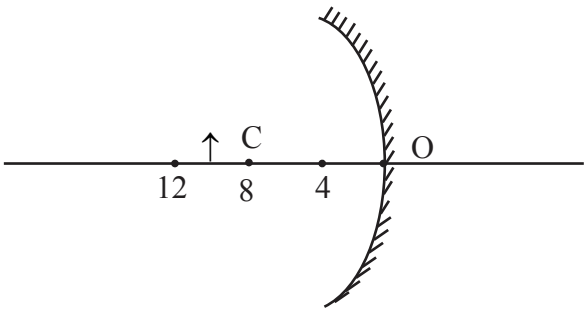
$= d\theta$

$= \frac{dy}{D}$

$= 1\text{mm}\times\left(\frac{1.270\text{mm}}{10^3\text{mm}}\right)$

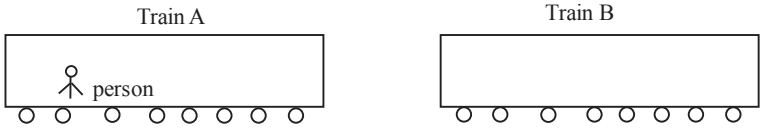
$= 1.27\times10^{-6}$ m

Q10. On the axis of a concane mirrior with pole at origin marking are made as shown. If centre C is at 8, and object placed as shown.the image is :



Sol. As object is beyond C, image will be between C and F and
Real, diminished, inverted

Q11. Train A travels towards left with 36 km/hr and train B towards right with 72 km/hr. A man moves with 1.8 km/hr towards right with respect to train A. Find velocity of man w.r.t train B.



(1) 28.5 m/s (2) 29.5 m/s (3) 30.5 m/s (4) 27.5 m/S

Ans. (2)

sol. $V_A = -36\hat{i}$

$V_B = 72\hat{i}$

$V_{m-A} = 1.8\hat{i}$

$V_m = -34.2\hat{i}$

$V_{m-B} = -106.2\hat{j}$

$|V_{m-B}| = 106.2 \times \frac{5}{18}$

$= 29.5 m/s$

Q12. When wave length λ is used stopping potential is V_0, if wavelength used is 3λ then new stopping potential is $\frac{V_0}{4}$. If threshold wavelength $= n\lambda$ .find n?

(1) 7 (2) 8 (3) 9 (4) 10

Ans. (3)

sol. $\lambda \rightarrow V_0$ $\lambda' \rightarrow$ threshold wavelength

$3\lambda \rightarrow \frac{V_0}{4}$

$eV_0 = \frac{hc}{\lambda} - \phi$

$\frac{eV_0}{4} = \frac{hc}{3\lambda} - \phi$

$\phi = \frac{hc}{9\lambda} = \frac{hc}{\lambda'}$

$\lambda' = 9\lambda$

$n = 9$

Q13. 3 mole of O_2 is mixed with 5 mole Argon at temp T. Find total internal energy?

(1) 15 RT (2) 13 RT (3) 14 RT (4) 12 RT

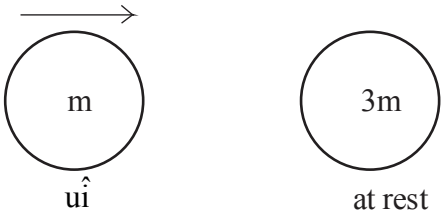
Ans. (1)

Sol. $U = \frac{f_1}{2} n_1 RT + \frac{f_2}{2} n_2 RT$

$= \frac{5}{2}(3)RT + \frac{3}{2} \times 5RT$

$= 15RT$

Q14. Body of mass m strikes with another body of mass 3m as shown in figure. After collision velocity of mass m is $v\hat{j}$. Find v ,if collision is perfectly elastic.



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

Ans. (2)

Sol. Conservation of momentum $mu\hat{i}+0=mv\hat{j}+3m\overline{v_1}$

($\vec{v}_1$ is velocity of mass 3m after the collision)

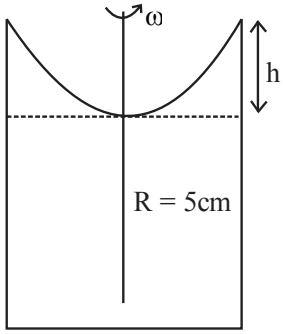
$\overline{v_1}=\frac{u}{3}\hat{i}-\frac{v}{3}\hat{j}$

By energy conservation

$$\frac{1}{2}mu^2=\frac{1}{2}mv^2+\frac{1}{2}(3m)\left(\left(\frac{u}{3}\right)^2+\left(\frac{v}{3}\right)^2\right)$$

$$v=\frac{u}{\sqrt{2}}$$

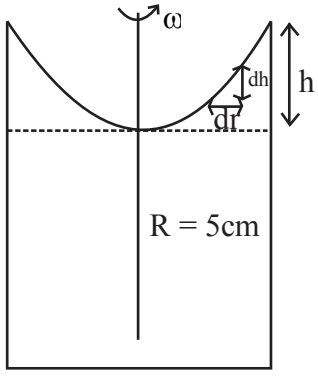
Q15. A cylindrical container rotates with constant angular speed $\omega=10$ radian / s. Radius of cylinder is R = 5 cm. Find height h as shown at which water is in equilibrium with respect to container



(1) 2.25 cm (2) 1.25 cm (3) 2.50 cm (4) 1.00 cm

Ans. 2

Sol.



$\rho dr\omega^2=\rho gdh$

$$\omega^2\int_0^R rdr = g\int_0^h dh$$

$$\frac{\omega^2R^2}{2} = gh$$

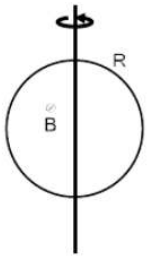
$$h = \frac{\omega^2R^2}{2g}$$

$$= \frac{10^2\times(5\times10^{-2})^2}{2\times10} = 125\times10^{-4}\,m$$

$= 1.25$ cm

Q.16 A coil of radius R rotating about a diametrical axis with angular velocity ω in a uniform magnetic field B. Find the value of maximum voltage developed, if it takes 0.2 sec for half revolution.

R = 10 cm, $B = 5\times10^{-5}T$



(1) $3\times10^{-5}V$ (2) $5\times10^{-6}V$ (3) $2.5\times10^{-5}V$ (4) $5\times10^{-5}V$

Ans. (3)

Sol. Flux as a function of time $\phi = \vec{B}.\vec{A} = AB\cos(\omega t)$

Emf induced,

$$e = \frac{-d\phi}{dt} = AB\omega\sin(\omega t)$$

Max. value of $Emf = AB\omega$

$$= \pi R^2B\omega$$

$$= 3.14\times0.1\times0.1\times5\times10^{-5}\times\frac{\pi}{0.2}$$

$$= 2.46\times10^{-5}V$$

$$\approx 2.5\times10^{-5}V$$

Q.17 If force, velocity and area is considered as a fundamental physical quantities then find the dimensional formula of Young modulus of elasticity:

(1) $Y = F^1v^0A^{-1}$ (2) $Y = F^{-1}v^1A^{-1/2}$ (3) $Y = F^1v^{-1}A^{1/2}$ (4) $Y = F^1v^1A^{1/2}$

Ans. 1

Sol. $Y \propto F^aV^bA^c$ $Y = \left(\frac{F}{A}\right)$

$$\frac{MLT^{-2}}{L^2} \propto (M^1L^1T^{-2})^a (L^1T^{-1})^b (L^2)^c$$

$$M^1L^{-1}T^{-2} \propto M^aL^{a+b+2c}T^{-2a-b}$$

$$-2a+b=-2$$

$$a=1, b=0, c=-1$$

$$Y = F^1v^0A^{-1}$$

Q.18 Correct order of resistivity will be for $A\ell, Hg, Cu, W$

(1) $\rho_{Cu} < \rho_{A\ell} < \rho_W < \rho_{Hg}$ (2) $\rho_W < \rho_{hg} < \rho_{A\ell} < \rho_{Cu}$

(3) $\rho_{Cu} < \rho_{hg} < \rho_{A\ell} < \rho_W$ (4) $\rho_{Hg} < \rho_W < P_{A\ell} < \rho_{Cu}$

Ans. (1)

Sol. $\rho_{Hg} = 98\times10^{-8}$

$\rho_{A\ell} = 2.65\times10^{-8}$

$\rho_{Cu} = 1.724\times10^{-8}$

$\rho_W = 5.65\times10^{-8}$.

Q.19 A proton enter in uniform magnetic field of 2.0 mT at an angle of 60^o with the magnetic field with speed 10 m/s. Find the pitch of path.

(1) $30\,\pi\mu m$ (2) $50\,\pi\mu m$ (3) $80\,\pi\mu m$ (4) $10\,\pi\mu m$

Ans. (2)

Sol. $\text{Pitch} = (V\cos\theta)T$

$$= (V\cos\theta)\frac{2\pi m}{eB}$$

$$= \frac{5\pi}{10^{-3}}\times10^{-8} = 5\pi\times10^{-5} = 50\pi\mu m$$

Q20. Amplitude of carrier wave and message wave are 5 unit and 3 unit respectably, then ratio of maximum and minimum Amplitude of modulated wave.

(1) 2 (2) 4 (3) 6 (4) 8

Ans. (2)

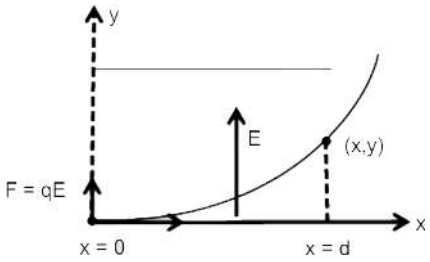
Sol. $\frac{A_{max}}{A_{min}} = \frac{A_m + A_c}{A_m - A_c} = \frac{5+3}{5-3} = \frac{8}{2} = 4$

Q21. A charge particle having charge q and speed V is moving in xy plane in x directions. It enters in a region of uniform electric field directed in y direction and extended up to x = 0 to x = d. Then what is equation of path in terms of d.

(1) $y = \frac{1}{2}\frac{qE}{m}\frac{d^2}{v^2}$ (2) $y = \frac{qE}{m}\frac{d^2}{v^2}$ (3) $y = \frac{2}{3}\frac{qE}{m}\frac{d^2}{v^2}$ (4) $y = \frac{2qE}{m}\frac{d^2}{v^2}$

Ans. (1)

Sol.



$$x = Vt$$

$$y = \frac{1}{2}at^2 = \frac{1}{2}\frac{qE}{m}t^2$$

$$y = \frac{1}{2}\frac{qE}{m}\frac{x^2}{v^2}$$

$$y = \frac{1}{2}\frac{qE}{m}\frac{d^2}{v^2}$$

Gravity
Orienting Intelligence

JEE Main - 2020

Best Result in U.P.

Aditya Pandey

Percentile

99.936

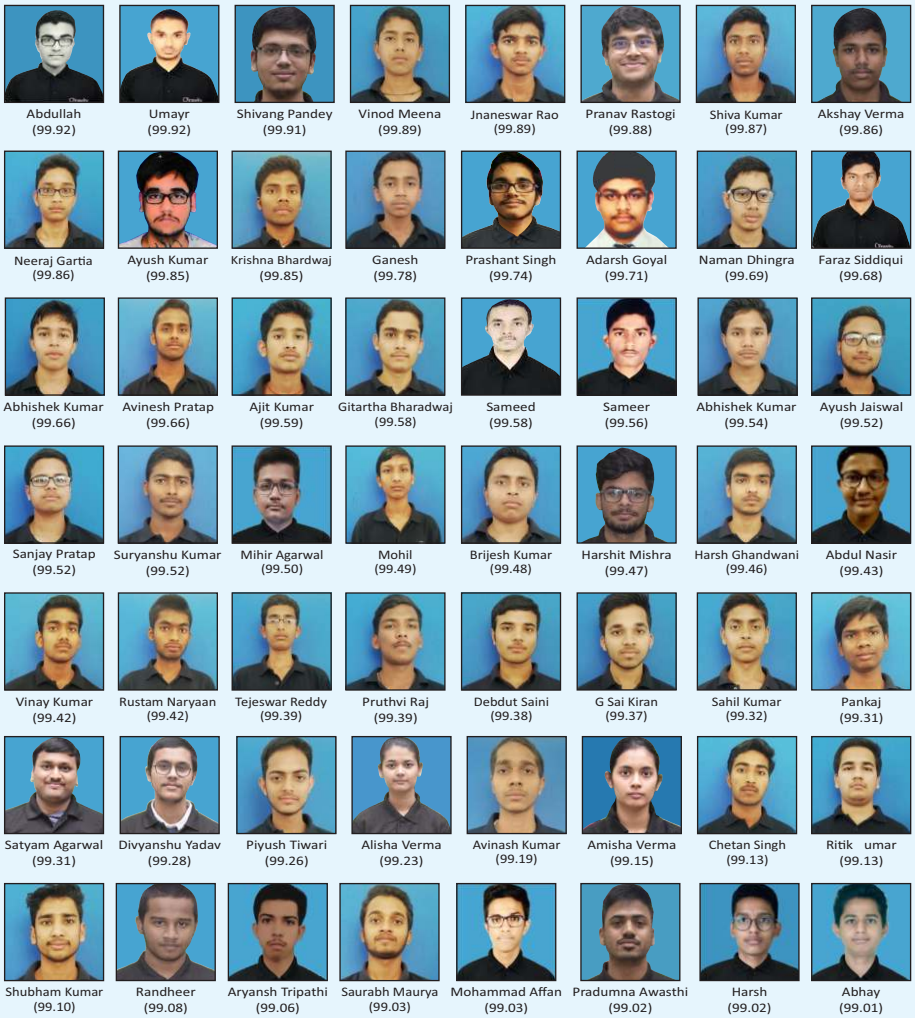
City Topper

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)