JEE Main (Phase-II) 2020

Memory Based Questions & Solutions

SUBJECT

PHYSICS

Date: 04 September, 2020 (Shift-1)

Time: 9 PM to 12 PM

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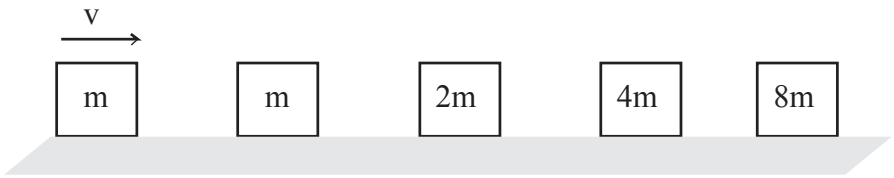
Q1. A block of mass m moving as shown collides with four other blocks of masses m, 2m, 4m and 8m placed as shown. All collision are inelastic, find % loss in K.E.



(1) 10 % (2) 24 % (3) 94% (4) 95%

Ans .(3)

Sol. Since all collision are inelastic and all stick toghter. $K.E_i = \frac{1}{2}mv^2$

By conserving momentum. $= K.E_0$

$mv = (m + m + 2m + 4m + 8m)v'$

$\Rightarrow v' = \frac{V}{16}$

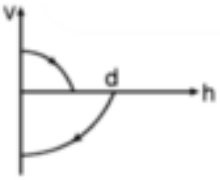
$K.E_f = \frac{1}{2} \times (16m)\left(\frac{V}{16}\right)^2 = \left(\frac{1}{2}mv^2\right)\left(\frac{1}{16}\right)$

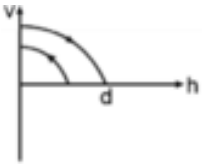
$K.E_f = \frac{K.E_0}{16}$

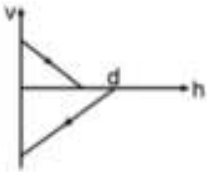
$\text{loss} = \Delta K.E \Rightarrow K.E_0 - \frac{K.E_0}{16} = \frac{15K.E_0}{16}$

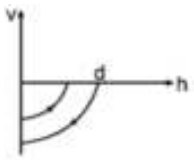
$\%\ loss = \left(\frac{15\frac{K.E_0}{16}}{K.E_0} \times 100\right) \simeq 93.75\%$

Q2. A particle is released from rest, from height h & it rebounds to height $\frac{h}{2}$ after stricking ground. Draw velocity (v) v/s height (h) curve.

(1) 

(2) 

(3) 

(4) 

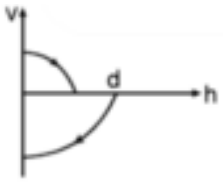
Ans. (1)

Sol. $v^2 - x^2 = 2as$

$\Rightarrow$ left facing parabola as $a = -g$

Initial velocity = 0

Initial position =+H.



A after collision velocity suddenly becomes positive.

Q3. In hydrogen spectrum difference of maximum and minimum wavelength of Lyman series is $304\,\text{Å}$. Find the difference of maximum and minimum wavelength of Paschen series?

Sol. For lymar series. $\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$n_1 = 1$

$\frac{1}{\lambda_1} = R\left(\frac{1}{1^2} - \frac{1}{\infty^2}\right) \Rightarrow \lambda_{\min} = \frac{1}{R}$

$\frac{1}{\lambda_2} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right) \Rightarrow \lambda_{\max} = \frac{4}{3R}$

$\frac{1}{\lambda_{\max}} = \frac{3R}{4}$

$\Delta\lambda = \frac{4}{3R} - \frac{1}{R}$

$\Delta\lambda = \frac{1}{3R} = 304 A^o$

For pascher series :

$n_1 = 3$

$n_2 = 4$

$\frac{1}{\lambda^1_{\max}} = R\left(\frac{1}{3^2} - \frac{1}{4^2}\right)$

$\lambda^1 = \frac{16 \times 9}{7R}$

$\frac{1}{\lambda^1_{\min}} = R\left(\frac{1}{3^2} - \frac{1}{\infty^2}\right)$

$\lambda^1_{\min} = \frac{9}{R}$

$\Delta\lambda^1 = \frac{16 \times 9}{7R} - \frac{9}{R} = \frac{9 \times 9}{7R}$

$$\Rightarrow \frac{1}{3R} = 304\,\overset{o}{A}$$

$$\frac{81}{7R} = \frac{81}{7R} \times \frac{304}{\frac{1}{3R}}$$

$$= \frac{81 \times 304}{7} \times 3 = 10553.1 A^{o}$$

Q4. A disc of mass 'M' and radius 'R' rotates with an angular velocity ω about on axis passing through its centre and perpendicular to its plane. A second stationary disc of mass 'M' and radius $\frac{R}{2}$ is placed gently over the first disc. Surface between discs is rough. Find percentage loss in Kinetic energy.

Sol. Conserving angular momentum. $I_1\omega_1 = (I_1 + I_2)\omega$

$$\frac{MR^2}{2} \times \omega = \left[\frac{MR^2}{2} + \frac{M}{2}\left(\frac{R}{2}\right)^2\right]\omega'$$

$$\omega' = \frac{4}{5}\omega$$

$$K.E_1 = \frac{1}{4}MR^2\omega^2$$

$$K.E_f = \frac{1}{2}\left(\frac{MR^2}{2} + \frac{MR^2}{4}\right)\left(\frac{4}{5}\omega\right)^2$$

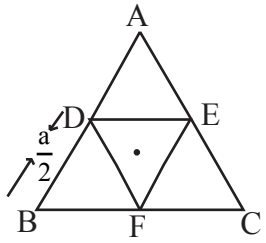
$$= \frac{1}{5}MR^2\omega^2$$

$$\frac{\Delta K.E}{K.E} \times 100$$

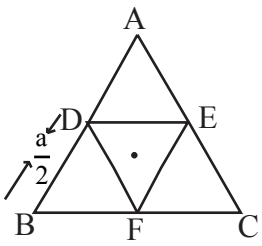
$$= \frac{\frac{1}{4}MR^2\omega^2 - \frac{1}{5}MR^2\omega^2}{\frac{1}{4}MR^2\omega^2} \times 100$$

$$= \frac{100}{5} = 20\%$$

Q5. An equilateral trangleular plate ABC has moment of inertia I_0 about centroied and axis passing through perpendicular to plane of plate D and E are mid point of AB & AC respectively. It we remove ADE part of plate then if moment of inertial of remaing plate about same axis is $\frac{n+0}{16}$ then find n?



sol.



$I_0 = kma^2$

$3I_1 + I_2 = I_0$ ..... (1)

$I_2 = k\left(\frac{m}{4}\right)\left(\frac{a}{2}\right)^2$

$= \frac{kma^2}{16} = \frac{I_0}{16}$

$3I_1 = \frac{15I_0}{16}$

$I_1 = \frac{5I_0}{16}$

Moment of inertia of BEDC

$I = 2I_1 + I_2 = \frac{2(SI_0)}{16} + \frac{I_0}{16} = \frac{11I_0}{16}$

$= \frac{NI_0}{16}$

$n = 11$ Ans.

6. Dimensional formula of thermal conductivity will be:

(1) $M^1L^1T^{-3}\theta^{-1}$ (2) $M^0L^1T^{-1}\theta^{-1}$ (3) $M^1L^0T^{-1}\theta^{-1}$ (4) $M^1L^1T^0\theta^{-1}$

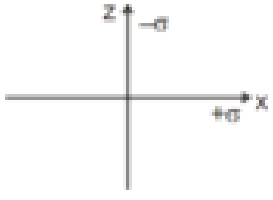
Ans. (1)

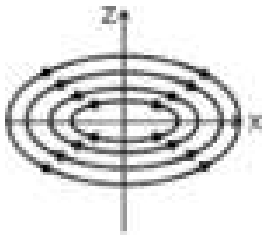
Sol. $k = \frac{(Q/t)\Delta x}{A\Delta T}$

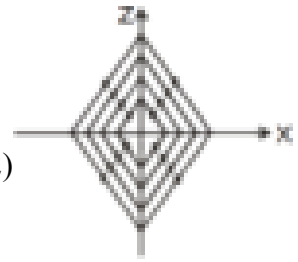
$= \frac{M^1L^2T^{-2}(L)}{L^2\theta(T)}$

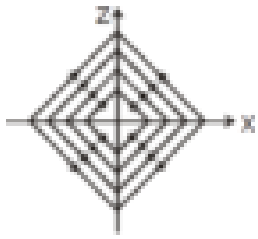
$= M^1L^1T^{-3}\theta^{-1}$

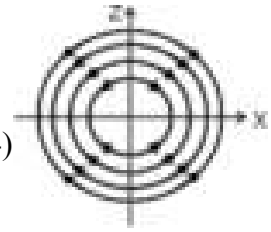
7. Two infinitely large charged planes having uniform surface charge density $+\sigma$ and $-\sigma$ are placed along x-y plane and yz plane respectively as shown in the figure. THen the nature of electric lines of forces in x-z plane is given by:



(1) 

(2) 

(3) 

(4) 

Ans. (3)

Sol. The electric field intensity due to eac uniformly charged infinite plane is uniform. The electric field intensity at points A,B, C and D due to plane 1, plane 2 and both planes are given by E_1, E_2 and E as shown in figure 1. Hence the electric lines of forces are as given in figure 2.

8. Gravitational field intensity is given by $E = \frac{Ax}{(A^2+x^2)^{3/2}}$, thenfind out potential at x. (Assume potential at infinity = 0)

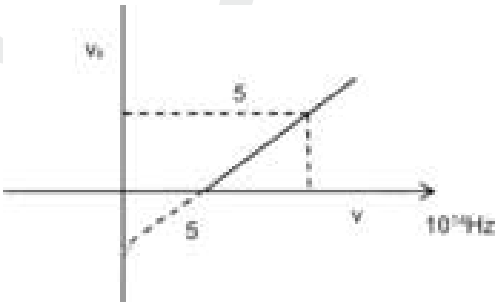
(1) $-\frac{2A}{\sqrt{A^2+x^2}}$ (2) $-\frac{A}{\sqrt{A^2+x^2}}$ (3) $-\frac{A}{3\sqrt{A^2+x^2}}$ (4) $-\frac{3A}{\sqrt{A^2+x^2}}$

Ans. (2)

Sol. $V_x = -\int_{\infty}^{x} \frac{Ax}{(A^2+x^2)^{3/2}}(-dx)$

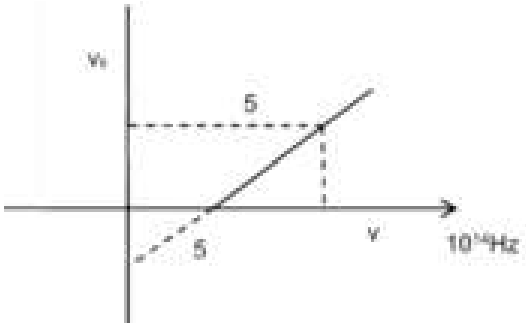
$V_x = -\frac{A}{\sqrt{A^2+x^2}}$

9. Graph between stopping potential and frequency of light as shown in figure.



(1) 4.01 (2) 2.01 (3) 5.01 (4) 2.04

Ans. (2)

SOl. 

Threshold energy = hv

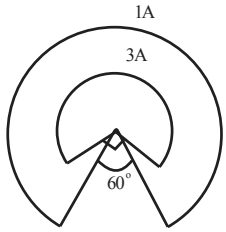
$= 6.6\times10^{-34}\times5\times10^{14}$ J

$$\text{Work fricition} = \frac{6.6\times5\times10^{-20}}{1.6\times10^{-19}}\text{eV}$$

$$= \frac{6.6\times5}{1.6}\times10^{-1}\text{eV}$$

$$= \frac{3.3}{1.6} = 2.01\text{eV}$$

10. Two concentrc circular current carrying arc of radius $R_1 = 4$ cm and $R_2 = 2$cm and direction of current in both arc are shown in figure. Find the ratio of magnetic field $\left(\frac{B_1}{B_2}\right)$ at centre produced by both arc.



(1) $\frac{6}{5}$ (2) $\frac{5}{6}$ (3) $\frac{3}{4}$ (4) $\frac{4}{3}$

Ans. (1)

Sol. $R_1 = 3m$ and $R_2 = 2m$

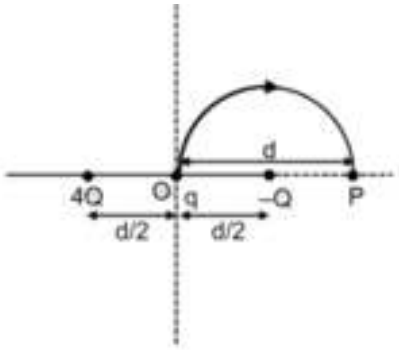
Find $\frac{B_1}{B_2}$

$$B = \frac{\mu_0 I}{4\pi R}\theta$$

$$\frac{B_1}{B_2} = \left(\frac{\theta_1 \times R_2}{R_1 \times \theta_2}\right)\times\frac{i_1}{i_2}$$

$= 3$

11. Find change in potential energy from origin to point P of charge q moving on the path as shown in figure.



(1) $-\frac{10KQ}{3d}$ (2) $-\frac{13KQ}{3d}$ (3) $-\frac{13KQ}{d}$ (4) $-\frac{16KQ}{3d}$

Ans. (4)

sol. Pontential at O,

$$\Rightarrow V_0 = \frac{K4Q}{\frac{d}{2}} + \frac{K(-Q)}{\frac{d}{2}} = \frac{6KQ}{d}$$

Potential at P,

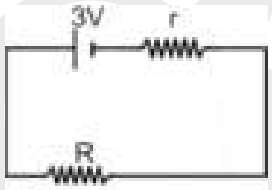
$$\Rightarrow V_P = \frac{K4Q}{\frac{3d}{2}} + \frac{K(-Q)}{\frac{d}{2}} = \frac{2KQ}{3d}$$

Change inpotential energy of a charge $q = q\Delta V = q(V_f - V_i)$

$= q(V_P - V_0)$

$$q = \left(\frac{2KQ}{3d} - \frac{6KQ}{d}\right) = -\frac{16KQ}{3d}$$

12. Terminal voltage of cell (emf = 3V & internal resistance = r) is equal to 2.5 V and heat loss in R is given by 0.5 watt, thenfind power loss in internal resistance.



(1) 0.3 (2) 0.5 (3) 0.1 (4) 1

Ans. (3)

Sol. $E = 3V$

$V_R = 2.5V$

By KVL

$V_r + V_R = E$

$V_r + 2.5 = 3$

$V_r = 0.5$

$$\frac{V_R}{V_r} = \frac{IR}{Ir} = \frac{2.5}{0.5} = 5 \quad \text{.....(1)}$$

$$\frac{R}{r} = 5$$

$$\frac{P_R}{P_r} = \frac{I^2R}{I^2R} = \frac{R}{r}$$

$$\frac{P_R}{P_r} = 5$$

$$P_r = \frac{P_R}{5} = \frac{0.5}{5} = 0.1\text{Watt}$$

13. Correct order of wavelength will be;

(1) Raio waves > microwaves > visible rays > X-rayx

(2) Microwaves > Radio waves > Visible rays > X-rays

(3) X-rays > Radio waves > Microwaves > Visible rays

(4) X-rays > Radio waves > Visible rays > Microwaves

Ans. (1)

Sol. Theory based

14. A particle at origin (0,0) moving with initial velcoity u = 5 m/s j and acceleration 10i+4j. After t time it reaches at position (20, y) then find t and y:

(1) t = 2, y =18 (2) t = 4, y = 16 (3) t = 6, y = 12 (4) t = 8, y = 10

Ans. (1)

Sol. Equation (1)

$$S_x = \frac{1}{2}a_x t^2$$

$$20 = \frac{1}{2}\times 10 \times t^2$$

$t = 2$

Equation (2)

$$S_y = u_y t + \frac{1}{2}a_y t^2$$

$$y = 5(2) + \frac{1}{2}(4)(2)^2$$

$y = 18$

15. Distance between through and crest of a waves is 1.5 m while distance between two trough is 5m. Which of the following wavelength is possible

(1) $\frac{1}{2},\frac{1}{4},\frac{1}{6},\ldots\ldots$ (2) 1, 2, 3, ... (3) $\frac{1}{1},\frac{1}{3},\frac{1}{5},\ldots\ldots$ (4) 1,3,5,.....

Ans.

sol. Trough to crest distance

$$1.5 = (2n_1 + 1)\frac{\lambda}{2} \ldots\ldots\ldots(1)$$

Trough to trough distance

$$= 5(n_2\lambda) \ldots\ldots(2)$$

from (1) & (2)

$$\frac{1.5}{5} = \frac{2n_1 + 1}{2(n_2)}$$

$$3n_2 = 10n_1 + 5$$

n_1 and n_2 are integer

$$(1) n_1 = 1, n_2 = 5\lambda, \lambda = 1$$

$$(2) n_1 = 4, n_2 = 15, \lambda = \frac{1}{3}$$

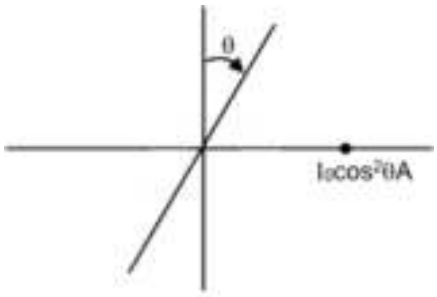
$$(3) n_1 = 7, n_2 = 25, \lambda = \frac{1}{5}$$

16. Intensity of plane polarized light is 3.3 W/m. Area of a plane $3\times10^{-4}\,m^2$ and polarizer rotates with $10\pi rad/sec.$ Energy transmitted in 1 complete cycle:

(1) 4.95×10^{-4} (2) 3.95×10^{-4} (3) 2.95×10^{-4} (4) 6.95×10^{-4}

Ans (1)

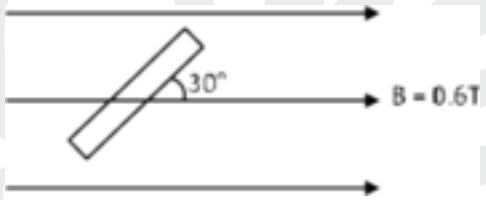
sol. Average energy $= I_o A < \cos^2\theta >$



$$= \frac{3.3\times 3\times 10^{-4}}{2}$$

$$= \frac{9.9}{2}\times 10^{-4} = 4.95\times 10^{-4}$$

17. A bar magnet experienced torque 0.018 N-m when placed inuniform magnetic field , B = 0.06 T and makes 30° angle with themagnetic field as shown in figure. Find out work done by external force if magnet rotates from minimum potential energy to maximum potential energy.



(1) 0.036 J (2) 0.018 J (3) 0.072 J (4) 0.36J

Ans. (3)

sol. $\tau = MB\sin\theta = 0.18$

$$M = \frac{0.018}{B\sin\theta} = \frac{0.018}{0.06\times 0.5} = 0.6A - m^2$$

$$\omega = \Delta U = U_f - U_i$$

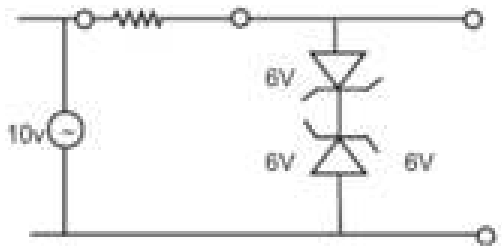
$$= -MB\cos 180^o - (-MB\cos\theta)$$

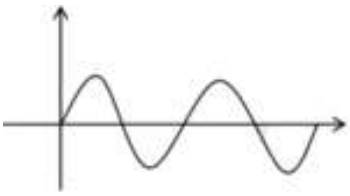
=2 MB

$$= 2\times 0.6\times 0.06$$

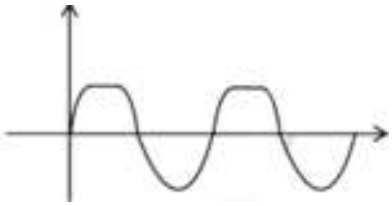
=0.072J

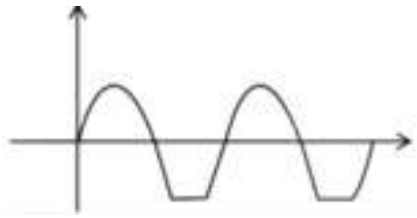
18. Correct graph of voltage across zener diode will be



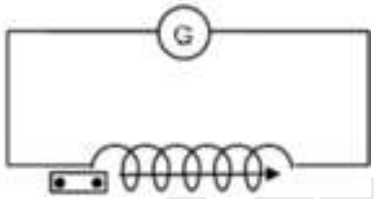
(1) 

(2) 

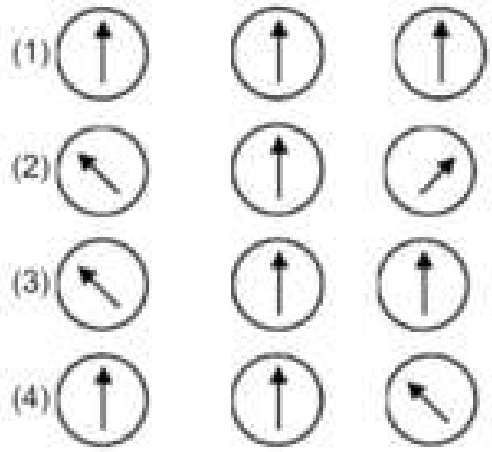
(3) 

(4) 

Ans. (2)

19. 

A bar magnet moves with constant velocity as shown in figure through a coil. Which of the following option is correctly represent the deflection of needle in Galvanometer.



Ans. (2)

20. In compound microscope fina image formed at 25 cm from eyepiece lens. Length of tube is 20 cm. Given that $f_0 = 1$ cm, m = 100. Find focal length of eyepiece lens

Ans. 06.25

sol. $$M = \frac{v_o}{u_o}\left(1+\frac{D}{f_e}\right)$$

$$M = \frac{L}{f_o}\left(1+\frac{D}{f_e}\right)$$

$$100 = \frac{20}{(1)}\left(1+\frac{25}{f_e}\right)\backslash$$

$$5 = 1 + \frac{25}{f_e}$$

$$4 = \frac{25}{4} = 6.25cm$$

21. 0.1 moleof a gas at 200 K is mixed with 0.05 mole of same gas at 400 K. If final temperature is equa to 10 $T_{0,}$ the find the value of T_0.

Ans. 26.67

sol. (0.1)(200)+(0.05)(400)=(0.15)T

$$T = \frac{20+20}{0.15} = \frac{800}{3} = 266.67$$

$$10T_o = 266.67$$

$$T_o = 26.67$$

22. Match column 1 with column 2

A. Mono atomic	(i) 7/5
B. Diatomic rigid molecule	(ii) 5/3
C.Diatomic non rigid molecule	(iii) 4/3
D. Triatomic rigid molecule	(iv) 9/7

Ans. A-(ii) , B-(i), C-(iv), D-(iii)

23. A ball has a acceleration of 98 cm/s^2 in a liquid of density 1g/cm^3. The radius of ball is 1 cm. Find mass of ball (g = 980 cm/sec^2)

Ans. 4.65 g

Sol. $F_{net} = mg - B = ma$

m = 4.65 g

Gravity
Orienting Intelligence

JEE Main - 2020

Best Result in U.P.

Aditya Pandey

Percentile

99.936

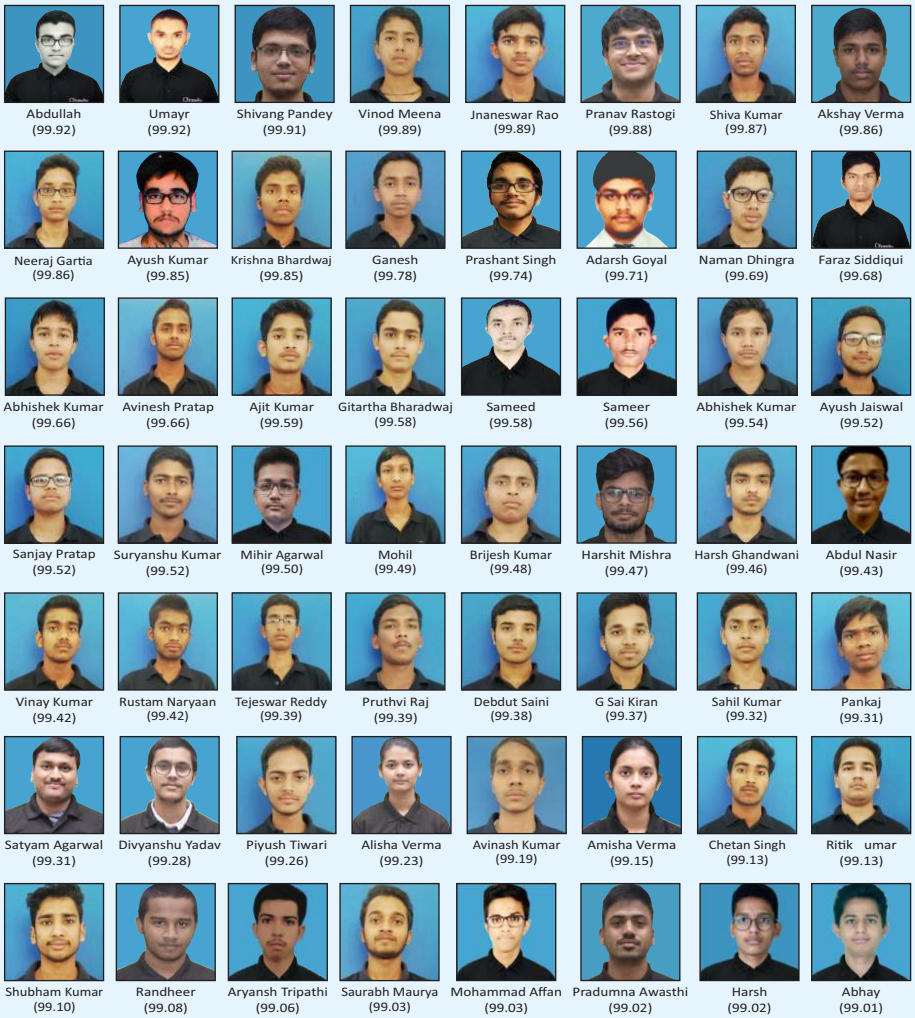
City Topper

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)