Reliable INSTITUTE
Unleashing Potential

JEE MAIN 2023

APRIL ATTEMPT

PAPER-1 (B.Tech / B.E.)

SHIFT - 1

QUESTIONS & SOLUTIONS

Reproduced from Memory Retention

13 APRIL, 2023

9:00 AM to 12:00 Noon

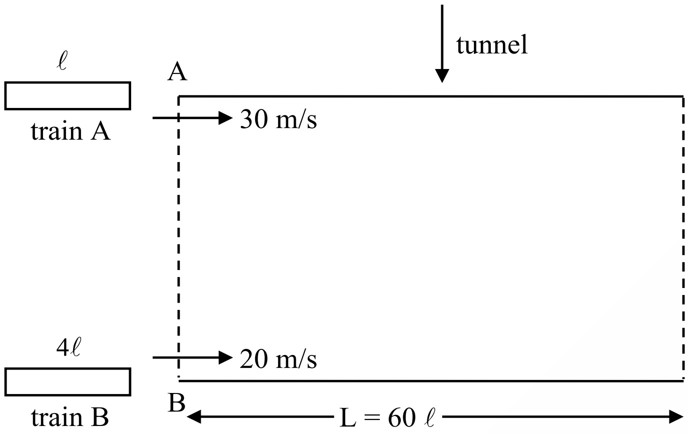
Duration : 3 Hours

Maximum Marks : 300

SUBJECT - PHYSICS

PHYSICS

1. Train A takes 35 sec less than train B. Find length of tunnel.



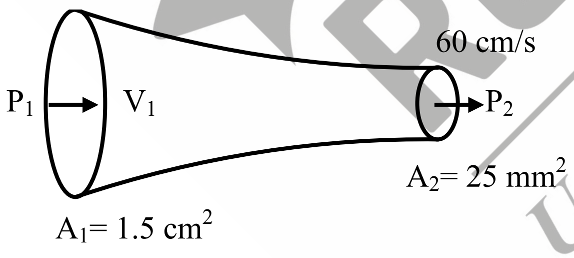
Ans. 1800

Sol. $\frac{60\ell + 4\ell}{20} - \frac{61\ell}{30} = 35$

$\Rightarrow \quad \ell = \frac{1050}{35}$

$\Rightarrow \quad L = 60\ell = \frac{1050}{35} \times 60 = 1800$ m

2. Find $P_1 - P_2$.



Ans. 175

Sol. $A_1V_1 = A_2V_2$

$1.5 \times V_1 = 25 \times 10^{-2} \times 60$

$V_1 = \frac{25 \times 60 \times 10^{-2} \times 10}{1.5}$

$V_1 = 10$ cm/s

By Bernoulli's

$P_1 + \frac{1}{2} \times 1000 \times (0.1)^2 = P_2 + \frac{1}{2} \times 1000 \times (0.6)^2$

$$P_1 + 5 = P_2 + \frac{1}{2} \times 1000 \times 36 \times 10^{-2}$$

$$P_1 + 5 = P_2 + 180$$

$$P_1 - P_2 = 175 \text{ Pas.}$$

3. For a polytropic process $P = av^{-3}$. Find Bulk Modulus :

(1) 2P (2) P (3) 3 P (4) 0

Ans. **(3)**

Sol. $B = -\frac{dP}{dv/v}$

$Pv^3 = a$

difference wrt to pressure

$v^3 + P3v^2 \frac{dv}{dP} = 0$

$v = -3\frac{Pdv}{dP} = 0$

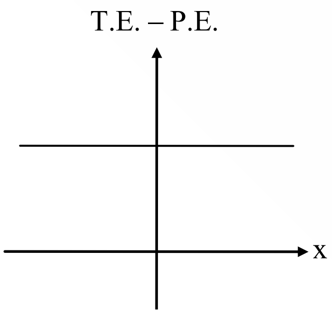
$v = -3\frac{Pdv}{dP}$

$\frac{dP.v}{dv} = -3P$

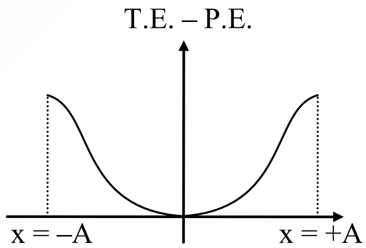
$B = -\left(\frac{dPv}{dv}\right) = -(-3P) = 3P$

4. In an SHM draw the graph of T.E. – P.E. Vs x.

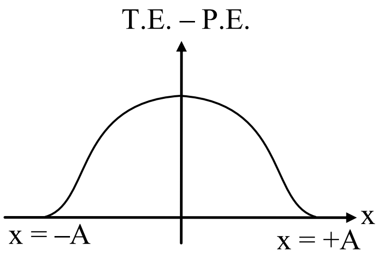
(1)



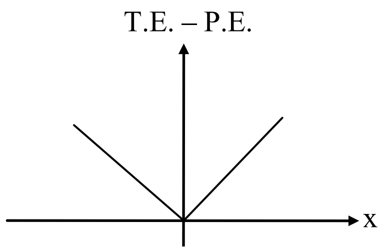
(2)



(3)



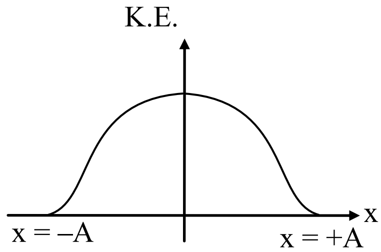
(4)



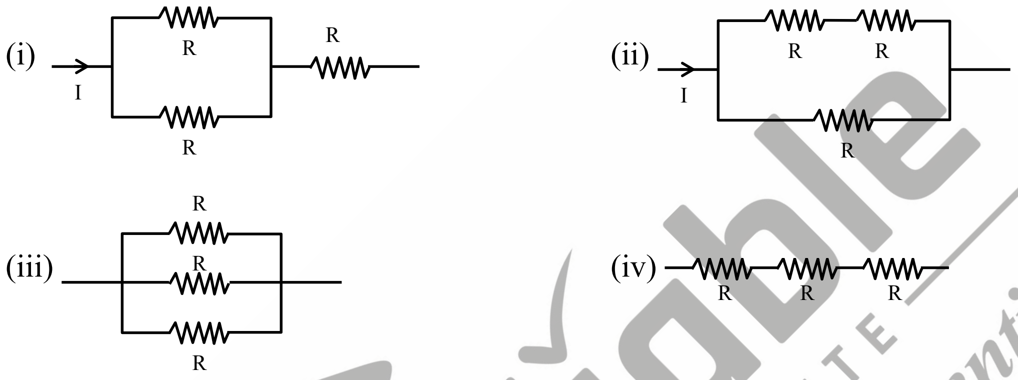
Ans. **(3)**

Sol. T.E. – P.E. = K.E.

K.E. = $\frac{1}{2}m\omega^2(A^2 - x^2)$



5. Increasing order of power dissipation?



(1) iv > i > ii > iii (2) iv > i > iii > ii (3) i > ii > iii > iv (4) iv > iii > ii > i

Ans. **(1)**

Sol. $P = i^2R$

$R_1 = \frac{3R}{2}$, $R_2 = \frac{2R}{3}$, $R_3 = \frac{R}{3}$, $R_4 = 3R$; $R_4 > R_1 > R_2 > R_3$

6. Which of the following Maxwell equation is time dependant?

(1) $\oint \vec{E}.d\vec{s} = \frac{q_{in}}{\varepsilon_0}$ (2) $\oint \vec{B}.d\vec{s} = 0$ (3) $\oint \vec{E}.d\vec{\ell} = \frac{-dQ_B}{dt}$ (4) $\oint \vec{B}.d\vec{\ell} = \mu_0 I_{en}$

Ans. **(4)**

Sol. n^n : → Ampere's Circuital law charges in time varying condition. Ans. (4)

7. If ratio of kinetic energy of two particle is $\frac{16}{9}$. If linear momentum of two particle are same then ratio of mass $\frac{m_1}{m_2}$ is:

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

Ans. **(1)**

Sol. $\frac{K_1}{K_2} = \frac{p_1^2}{2m_1} \times \frac{2m_2}{p_2^2} = \frac{m_2}{m_1} = \frac{16}{9}$

$\frac{m_1}{m_2} = \frac{9}{16}$

8. Mass of a planet is equal to 9 times of mass of earth and radius is 4 times the radius of earth. Find escape velocity (in km/sec.) of the planet. [Given; escape velocity of earth V_e = 11.2 km/sec]

Ans. 16.8

Sol. $V_P = \sqrt{\frac{2GM_P}{R_P}}$ $V_E = \sqrt{\frac{2GM_E}{R_E}}$

$$\frac{V_P}{V_E} = \frac{\sqrt{\frac{2GM_P}{R_P}}}{\sqrt{\frac{2GM_E}{R_E}}} = \sqrt{\frac{R_E}{R_P} \times \frac{M_P}{M_E}}$$

$$V_P = \sqrt{\frac{1}{4} \times 9} \times V_E = \frac{3}{2} V_E$$

$$V_P = \frac{3}{2} \times 11.2 \text{ km/sec.}$$

$= 16.8$ km/sec

9. Find the value of x, if elastic potential energy per unit volume is x × 10^9 J stored in the wire of length L = 50 mm. Young's modulus Y = 2 × 10^{11} N/m^2 and change in length ΔL is the wire is 10 mm.

Ans. 4 × 10^9 J/m^3

Sol. $\frac{\text{Energy}}{\text{Volume}} = \frac{1}{2} \times \text{stress} \times \text{strain}$

$$= \frac{1}{2} \times Y \times (\text{strain})^2$$

$$= \frac{1}{2} \times 2 \times 10^{11} \times \left[\frac{10 \times 10^{-3}}{50 \times 10^{-3}}\right]^2$$

$$= 10^{11} \times \left[\frac{1}{5}\right]^2 = 4 \times 10^9 \text{ J/m}^3$$

10. Find the ratio of radius of 2^{nd} orbit of He^{+} and 4^{th} orbit of Be^{3+}

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

Ans. (1)

Sol. $r \propto \frac{n^2}{z}$

$$\frac{r_{He^+}}{r_{Be^{3+}}} = \frac{2^2 \times 4}{2 \times 4 \times 4} = \frac{1}{2}$$

11. If the height of the tower used for L.D.S. is increased by 21% then percentage change in range is :

(1) 10% (2) 21% (3) 19% (4) 42%

Ans. (1)

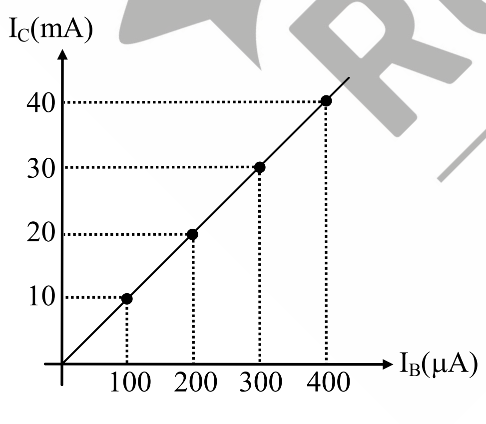
Sol. $R_1 = \sqrt{2HRe}$ … (1)

$R_2 = \sqrt{2\left(\frac{H121}{100}\right)Re}$ … (2)

$$\% \text{ change} = \frac{(R_2 - R_1)}{R_1} \times 100 = \frac{\sqrt{\frac{121}{100}} - 1}{1} \times 100 = \frac{\frac{11}{10} - 1}{1} \times 100$$

$= 10\%$

12.



Given $R_B = 10\ k\Omega$, $R_C = 1\ k\Omega$, power gain is 10^x. Find x

(1) 1 (2) 2 (3) 0 (4) 3

Ans. (1)

Sol. Power gain = $A_V.A_I = B\frac{R_C}{R_B}.B = B^2\frac{R_C}{R_B} = \left(\frac{(20-10)\times 10^3}{(200-100)\times 10^{-6}}\right)^2 \times \frac{1\times 10^3}{10\times 10^3} = 10$

Hence x = 1

13. Mass (m) = (5 ± 0.5)kg, speed (v) = (20 ± 0.4) m/s. Find the kinetic energy.

(1) (1000 + 70) J
(2) (1000 ± 140) J
(3) (500 ± 140) J
(4) (500 ± 70) J

Ans. **(2)**

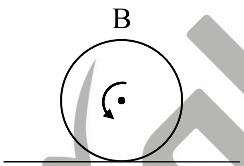
Sol. $k = mv^2$

$$k = \frac{1}{2} \times 5 \times 400 = 5 \times 200 = 1000 \text{ J}$$

$$\frac{\Delta k}{2k} = \frac{\Delta m}{m} + \frac{2\Delta v}{v} = \frac{0.5}{5} + \frac{2 \times 0.4}{20}$$

$$\Delta k = 1000\left(\frac{1}{10} + \frac{4}{100}\right) = 1000\left(\frac{10+4}{100}\right) = 140\,\text{J}$$

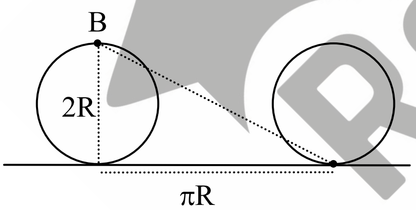
14. Radius of the cylinder is R find displacement of point B in half rotation. [Cylinder performs pure rolling]



(1) 2R
(2) $R\sqrt{4+\pi^2}$
(3) R
(4) $R\sqrt{1+\pi^2}$

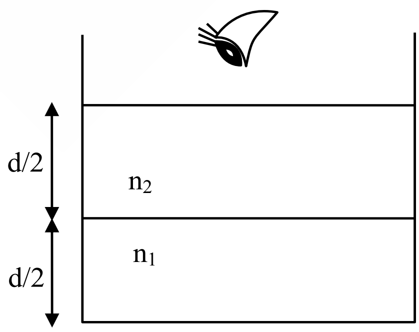
Ans. **(2)**

Sol.



Displacement = $\sqrt{(2R)^2 + (\pi R)^2} = R\sqrt{4+\pi^2}$

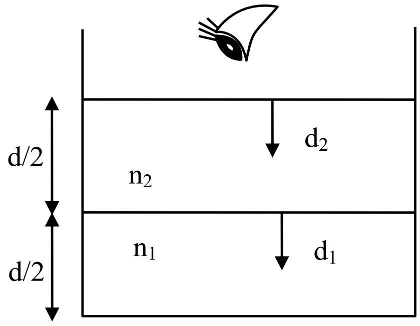
15. Find the apparent depth of the bottom surface of the tank, when seen from above (in air)?



(1) $\frac{d}{2}\left[\frac{n_1+n_2}{n_1 n_2}\right]$
(2) $\frac{d}{2}\left[\frac{n_2-n_1}{n_2 n_1}\right]$
(3) $d\left[\frac{n_1+n_2}{n_1 n_2}\right]$
(4) $d\left[\frac{n_2-n_1}{n_2 n_1}\right]$

Ans. **(1)**

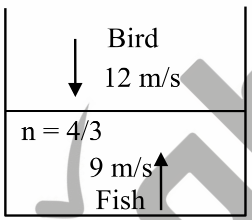
Sol.



Formula used : $d_{app} = \frac{d_1}{n_1} + \frac{d_2}{n_2}$

$$d_{app} = \frac{d}{2}\left[\frac{n_1 + n_2}{n_1 n_2}\right]$$

16. Find out apparent speed of bird as seen by fish :



(1) 16 m/s (2) 25 m/s (3) 21 m/s (4) 24 m/s

Ans. **(2)**

Sol. $\mathbf{v} = v_{fish} + \frac{v_{Bird} \times 4/3}{1}$

$= 9 + 12 \times \frac{4}{3}$

$= 9 + 16 = 25$ m/s

17. If a wire of resistance R is connected across V_0, then power is P. The wire is cut into two equal parts 2nd connected with V_0 individually then sum of power P_2. Find out $\frac{P}{P_2}$ is $\frac{1}{x}$ find out x?

Ans. **4**

Sol. $P = \frac{V_0^2}{R}$

$$P_2 = \frac{V_0^2}{R/2} + \frac{V_0^2}{R/2} = \frac{4V_0^2}{R} = 4P$$

$$\frac{P}{P_2} = \frac{1}{4}$$

18. A particle is performing SHM having position x = A cos 30°, and A = 40 cm. If its kinetic energy at this position is 200 J, the value of force constant (in kilo-N/m) is

Ans. 10

Sol. $\frac{1}{2}k(A^2 - x^2) = 200$ $\quad [x = \frac{\sqrt{3}A}{2}]$

$\frac{1}{2}k\left(A^2 - \frac{3A^2}{4}\right) = 200$ $\quad [\omega = \sqrt{\frac{k}{m}}]$

$\frac{1}{2}k\frac{A^2}{4} = 200$

$k = \frac{200 \times 2 \times 4 \times 100 \times 100}{40 \times 40} = 10^4$

$= 10 \times 10^3$

$= 10$ k N/m

19. For a ideal gas relation between its average speed (V_{avg}) and r.m.s. speed (V_{rms}) is

(Use : $\pi = \frac{22}{7}$]

$V_{rms} = \left(1 + \frac{5}{x}\right)^{\frac{1}{2}} V_{avg}$

Then value of 'x' is :

Ans. 28

Sol. $\sqrt{\frac{3RT}{M}} = \left(1 + \frac{5}{x}\right)^{\frac{1}{2}} \sqrt{\frac{8RT}{\pi M}} \Rightarrow \frac{3 \times 22}{7 \times 8} = 1 + \frac{5}{x} \Rightarrow x = 28$

20. An electric dipole is placed in an external electric field 4×10^{-4} N/c at angle 30°. Magnitude of charge of dipole is 10^{-2} C and separation between them is 0.2 mm. Find torque acting on dipole.

(1) 6×10^{-10} N-m (2) 14×10^{-8} N-m (3) 4×10^{-10} N-m (4) 8×10^{-10} N-m

Ans. (3)

Sol. $\vec{\tau} = \vec{P} \times \vec{\varepsilon}$

$P = qd = 10^{-2} \times 0.2 \times 10^{-3}$

$\tau = P\varepsilon \sin 30$

$= 2 \times 10^{-6} \times 4 \times 10^{-4} \times \frac{1}{2}$

$= 4 \times 10^{-10}$ N–m

21. A solid sphere is Rolling on a flat horizontal surface. If the ratio of angular momentum to total kinetic energy is $\frac{\pi}{22}$, then find the angular speed (in rad/sec) with which sphere is moving?

Ans. 14

Sol. $$\frac{\text{Angular momentum}}{\text{Total kinetic energy}} = \frac{\left(\frac{2}{5}mR^2 + mR^2\right)\omega}{\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2} = \frac{\pi}{22}$$

(Taking $v = \omega R$)

$$\frac{\frac{7}{5}mR^2.\omega}{\frac{7}{10}mv^2} = \frac{\pi}{22} \qquad \Rightarrow \qquad \omega = 14 \text{ rad/sec}$$

22. Match the following lists.

(A) Troposphere	(P) 300 km
(B) E part of stratosphere	(Q) 80 km
(C) F_2 part of thermosphere	(R) 20 km
(D) D-part of stratosphere	(S) 100 km

(1) (A)$\rightarrow$ R; (B) $\rightarrow$ S; (C) $\rightarrow$ P; (D) $\rightarrow$ Q

(2) (A)$\rightarrow$ S; (B) $\rightarrow$ R; (C) $\rightarrow$ Q; (D) $\rightarrow$ P

(3) (A)$\rightarrow$ Q; (B) $\rightarrow$ S; (C) $\rightarrow$ P; (D) $\rightarrow$ R

(4) (A)$\rightarrow$ R; (B) $\rightarrow$ P; (C) $\rightarrow$ Q; (D) $\rightarrow$ S

Ans. (1)

23. Two metals A and B having work function $\phi_A = 9$ eV and $\phi_B = 4.5$ eV. Find difference of threshold wavelength.

(1) 1378 Å (2) 2100 Å (3) 1500 Å (4) 1100 Å

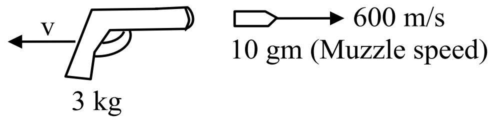
Ans. (1)

Sol. $\lambda_A = \left(\frac{12400}{9}\right)Å = 1377.77Å$

$\lambda_B = \left(\frac{12400}{4.5}\right)Å = 2755.55Å$

$\lambda_B - \lambda_A = 1377.78$ Å

24. A bullet of mass 10 gm is fired with muzzle speed 600 m/s from 3 kg gun of barrel length 30 cm. Find impulse on gun :



(1) 60 Ns (2) 3 Ns (3) 8 Ns (4) 6 Ns

Ans. **(4)**

Sol. By momentum conservation

$0 = 3\,(-v) + 0.01\,(600 - v)$

$v \simeq 2\text{m/s}$

Impulse on gun $= 3 \times 2 = 6$ Ns

25. For the given radioactive decay

${}^{298}_{94}X \rightarrow {}^{294}_{92}Y + {}^{4}_{2}\alpha + Q$, binding energy per nucleon of x, y and α are a, b and c.

The Q-value is equal to:

(1) $294b + 4c - 298a$ (2) $92b + 2c - 94a$

(3) $294b + 4c + 298a$ (4) $92b + 2c + 94a$

Ans. **(1)**

Sol. $Q = u_i - u_f$

$Q = (B.E)_f - (B.E)_i$

$= 294b + 4c - 298a$

25. For the given radioactive decay

${}^{298}_{94}X \rightarrow {}^{294}_{92}Y + {}^{4}_{2}\alpha + Q$, binding energy per nucleon of x, y and α are a, b and c.

The Q-value is equal to:

(1) $294b + 4c - 298a$

(2) $92b + 2c - 94a$

(3) $294b + 4c + 298a$

(4) $92b + 2c + 94a$

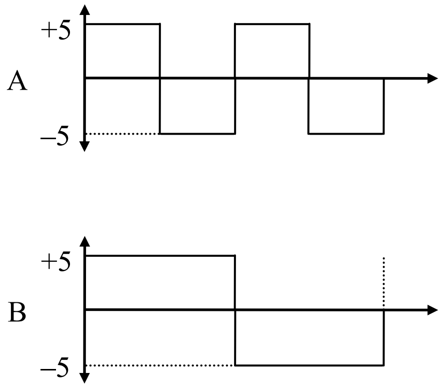
Ans. **(1)**

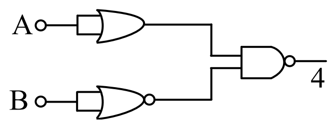
Sol. $Q = u_i - u_f$

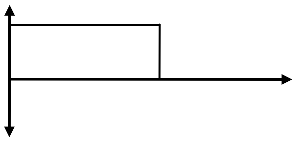
$Q = (B.E)_f - (B.E)_i$

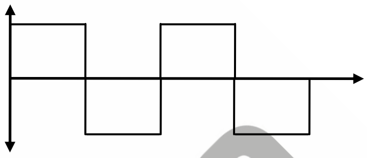
$= 294b + 4c - 298a$

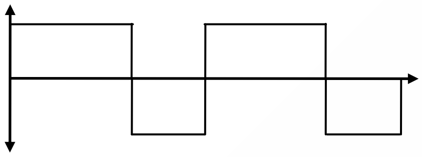
26. Which of the following represents wave form of output.

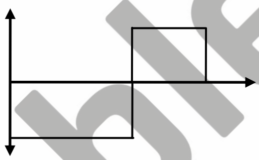




(1) 

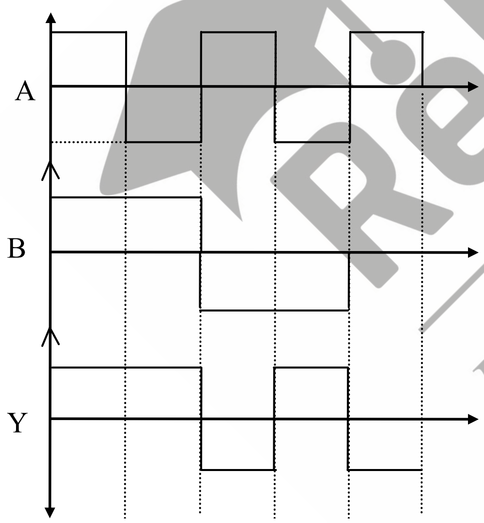
(2) 

(3) 

(4) 

Ans. **(3)**

Sol. $Y = \overline{A\overline{B}} = \overline{A} + B$



Reliable
INSTITUTE
Unleashing Potential

SATYAM CHAKRAVORTY

(Classroom) ··→

selected for

- ☑ **ASIAN PACIFIC MATHEMATICS OLYMPIAD (APMO) 2023**
- ☑ **IMOTC 2023 Camp** (Conducted by HBCSE)
- **BRONZE MEDAL IN INOI** (Indian National Olympiad in Informatics 2023)

Success Delivered to the Deserving

RELIABLE INSTITUTE : A-10, Road No.1, IPIA, Kota-324005 (Rajasthan), India

Tel. : 0744-3535544, 2665544 I Website : www.reliablekota.com I E-mail : info@reliablekota.com

reliablekota   reliablekota   reliableinstitutekota   reliable_kota   reliablekota