JEE Main January 2026

Question Paper With Text Solution

21 January | Shift-1

PHYSICS

MATRIX

JEE Main & Advanced | XI-XII Foundation| VI-X Pre-Foundation

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JEE MAIN JANUARY 2026 | 21 JANUARY SHIFT-1

SECTION – A

Question ID : 8606541170

26. In an experiment the values of two spring constants were measured as $k_1 = (10 \pm 0.2)$ N/m and $k_2 = (20 \pm 0.3)$ N/m. If these springs are connected in parallel, then the percentage error in equivalent spring constant is :

(1) 1.67% (2) 2.67% (3) 2.33% (4) 1.33%

Ans. Official answer NTA (1)

Sol. In parallel combination $k = k_1 + k_2$

$\Rightarrow k = (10 + 20) \pm (0.2 + 0.3)$

$\Rightarrow k = 30 \pm 0.5$

$\Rightarrow k = 30 \pm 1.67\%$

Question ID : 8606541153

27. A 4 kg mass moves under the influence of a force $\vec{F} = \left(4t^3\hat{i} - 3t\hat{j}\right)N$ where t is the time in second.

If mass starts from origin at t = 0, the velocity and position after t = 2 s will be :

(1) $\vec{v} = 4\hat{i} + \frac{5}{2}\hat{j} \quad \vec{r} = \frac{8}{5}\hat{i} + 2\hat{j}$ (2) $\vec{v} = 4\hat{i} - \frac{3}{2}\hat{j} \quad \vec{r} = \frac{6}{5}\hat{i} - \hat{j}$

(3) $\vec{v} = 3\hat{i} + \frac{3}{2}\hat{j} \quad \vec{r} = \frac{6}{5}\hat{i} + \hat{j}$ (4) $\vec{v} = 4\hat{i} - \frac{3}{2}\hat{j} \quad \vec{r} = \frac{8}{5}\hat{i} - \hat{j}$

Ans. Official answer NTA (4)

Sol. $\vec{F} = 4t^3\hat{i} - 3t\hat{j}$

$\Rightarrow \vec{a} = t^3\hat{i} - \frac{3t}{4}\hat{j}$

$\Rightarrow \vec{v} = \frac{t^4}{4}\hat{i} - \frac{3t^2}{8}\hat{j}$

$\Rightarrow \vec{r} = \frac{t^5}{20}\hat{i} - \frac{t^3}{8}\hat{j}$

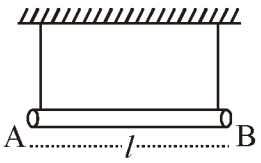
$\therefore \vec{v}(t = 2) = 4\hat{i} - \frac{3}{2}\hat{j}$

and $\vec{r}(t = 2) = \frac{8}{5}\hat{i} - \hat{j}$

Question ID : 8606541159

28. A uniform rod of mass m and length *l* suspended by means of two identical inextensible light strings as shown in figure. Tension in one string immediately after the other string is cut, is _____.

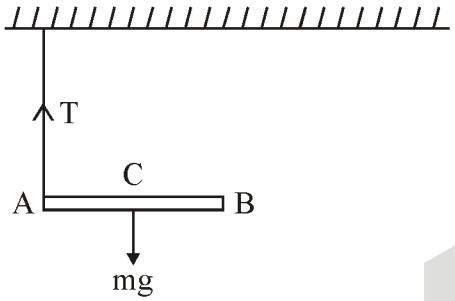
(g acceleration due to gravity)



(1) mg/4 (2) mg/3 (3) mg (4) mg/2

Ans. Official answer NTA (1)

Sol.



about A

$$mg\left(\frac{\ell}{2}\right)=\frac{m\ell^2}{3}\alpha$$

$$\Rightarrow \alpha=\frac{3g}{2\ell}$$

$$\therefore a_t(at\ c)=\alpha\frac{\ell}{2}=\frac{3g}{4}$$

for translatory motion

$$mg-T=m\left(\frac{3g}{4}\right)$$

$$\Rightarrow T=\frac{mg}{4}$$

Question ID : 8606541167

29. A gas based geyser heats water flowing at the rate of 5.0 litres per minute from 27°C to 87% C. The rate of consumption of the gas is _____g/s.

(Take heat of combustion of gas = 5.0×10^4 J/g) specific heat capacity of water = 4200 J/kg.°C

(1) 2.1 (2) 0.21 (3) 0.42 (4) 4.2

Ans. Official answer NTA (3)

Sol. Flow rate = 5 litre per minute

$\Delta T = 60\ ^\circ C$

$\therefore\ \Delta Q$ (reqd.) $= 5 \times 4200 \times 60 = 1260000$ J/min.

$$\Rightarrow \frac{dQ}{dt} = \frac{1260000}{60} = 21000 \text{ J/sec.}$$

$$\because \frac{dQ}{dt} = \frac{dm}{dt} \times \text{heat of combination}$$

$$\therefore \frac{dm}{dt} = \frac{21000}{5\times10^4} = 0.42 \text{ g/sec.}$$

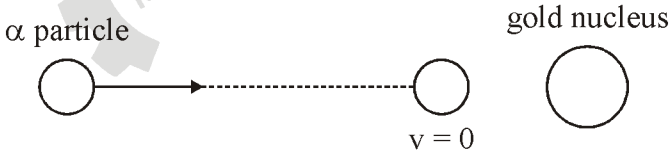
Question ID : 8606541166

30. If an alpha particle with energy 7.7 MeV is bombarded on a thin gold foil, the closest distance from nucleus it can reach is _____ m. (Atomic number of gold = 79 and $\frac{1}{4\pi \in_0} = 9\times10^9$ in SI units)

(1) 3.85×10^{-14} (2) 3.85×10^{-16} (3) 2.95×10^{-16} (4) 2.95×10^{-14}

Ans. Official answer NTA (4)

Sol.



applying conservation of M.E

$$7.7\,\text{MeV} = \frac{q_1 q_2}{4\pi\varepsilon_0 r}$$

$$\Rightarrow 7.7\times1.6\times10^{-13} = \frac{2\times1.6\times10^{-19}\times79\times1.6\times10^{-19}}{r}\times9\times10^9$$

$$\Rightarrow r = 2.95 \times 10^{-14}\ \text{m}$$

Question ID : 8606541169

31. A point charge of 10^{-8} C is placed at origin. The work done in moving a point charge 2 μC from point A(4, 4, 2) m to B (2, 2, 1) m is _____ J. ($\frac{1}{4\pi \in_0} = 9\times10^9$ in SI units)

(1) 45×10^{-6} (2) 0 (3) 30×10^{-6} (4) 15×10^{-6}

Ans. Official answer NTA (3)

Sol. Initial distance $= \sqrt{4^2+4^2+2^2} = 6\,\text{m}$

final distance $= \sqrt{2^2+2^2+1^2} = 3\,\text{m}$

$\therefore$ work done $= kq_1q_2\left(\frac{1}{r_2}-\frac{1}{r_1}\right)$

$= \frac{9\times10^9\times10^{-8}\times2\times10^{-6}}{6}$

$= 30 \times 10^{-6}$ J

Question ID : 8606541165

32. A light wave described by E = 60 [sin(3×10^{15})t + sin(12×10^{15})t] (in SI units) falls on a metal surface of work function 2.8 eV. The maximum kinetic energy of ejected photoelectron is (approximately) _____ eV. (h = 6.6×10^{-34} J.s. and e = 1.6×10^{-19} C)

(1) 7.8 (2) 6.0 (3) 5.1 (4) 3.8

Ans. Official answer NTA (3)

Sol. Photon with $\omega = 12 \times 10^{15}$ will have more energy

$\therefore k_{max} = h\nu - \phi$

$= \frac{6.6\times10^{-34}\times12\times10^{15}}{1.6\times10^{-19}\times2\pi}\text{eV} - 2.8\,\text{eV}$

$= 7.88 - 2.8\,\text{eV} \simeq 5.1\,\text{eV}$

Question ID : 8606541161

33. A current carrying solenoid is placed vertically and a particle of mass m with charge Q is released from rest. The particle moves along the axis of solenoid. If g is acceleration due to gravity then the acceleration (a) of the charged particle will satisfy:

(1) a > g (2) 0 < a < g (3) a = 0 (4) a = g

Ans. Official answer NTA (4)

Sol. The magnetic field is opposite to direction of motion of charge so magnetic force is zero. It will only experience gravitational force and move with acceleration g.

Question ID : 8606541164

34. In a double slit experiment the distance between the slits is 0.1 cm and the screen is placed at 50 cm from the slits plane. When one slit is covered with a transparent sheet having thickness t and refractive index n(= 1.5), the central fringe shifts by 0.2 cm. The value of t is _____ cm.

(1) 5.0×10^{-3} (2) 8×10^{-4} (3) 5.6×10^{-4} (4) 6.0×10^{-3}

Ans. Official answer NTA (2)

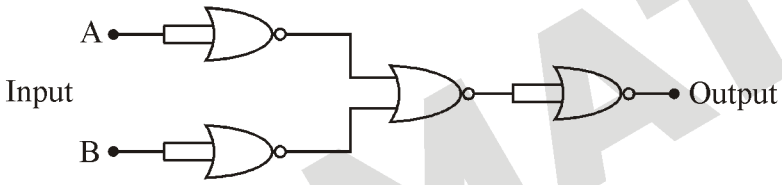
Sol. Shift y of fringe pattern is given by

$$(\mu - 1)t = \frac{yd}{D}$$

$$\Rightarrow t = \frac{0.2 \times 0.1}{50 \times 0.5} = 8 \times 10^{-4} \text{ cm}$$

Question ID : 8606541168

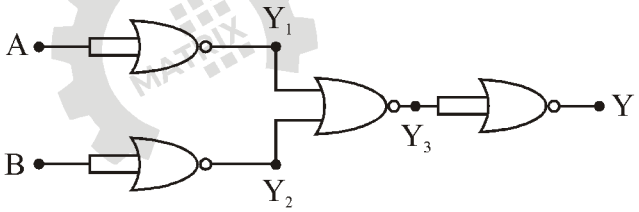
35. The given circuit works as:



(1) OR gate (2) NAND gate (3) NOR gate (4) AND gate

Ans. Official answer NTA (2)

Sol.



Truth table

A	B	Y_1	Y_2	Y_3	Y
0	0	1	1	0	1
0	1	1	0	0	1
1	0	0	1	0	1
1	1	0	0	1	0

NAND gate

Question ID : 8606541157

36. Two strings (A, B) having linear densities $\mu_A = 2 \times 10^{-4}$ kg/m and, $\mu_B = 4 \times 10^{-4}$ kg/m and lengths $L_A = 2.5$ m and $L_B = 1.5$ m respectively are joined. Free ends of A and B are tied to two rigid supports C and D, respectively creating a tension of 500 N in the wire. Two identical pulses, sent from C and D ends, take time t_1 and t_2, respectively, to reach the joint. The ratio t_1/t_2 is:

(1) 1.08 (2) 1.18 (3) 1.90 (4) 1.67

Ans. Official answer NTA (2)

Sol. $\because V = \sqrt{\frac{T}{\mu}}$

$$\Rightarrow \frac{V_A}{V_B} = \sqrt{\frac{\mu_B}{\mu_A}} = \sqrt{2}$$

$$\because t = \frac{\ell}{V}$$

$$\Rightarrow \frac{t_1}{t_2} = \frac{\ell_A}{\ell_B}\frac{V_B}{V_A} = \frac{2.5}{1.5\sqrt{2}} \simeq 1.18$$

Question ID : 8606541160

37. A parallel plate capacitor has capacitance C, when there is vacuum within the parallel plates. A sheet having thickness $\left(\frac{1}{3}\right)^{rd}$ of the separation between the plates and relative permittivity K is introduced between the plates. The new capacitance of the system is:

(1) $\frac{3CK^2}{(2K+1)^2}$ (2) $\frac{CK}{2+K}$ (3) $\frac{3KC}{2K+1}$ (4) $\frac{4KC}{3K-1}$

Ans. Official answer NTA (3)

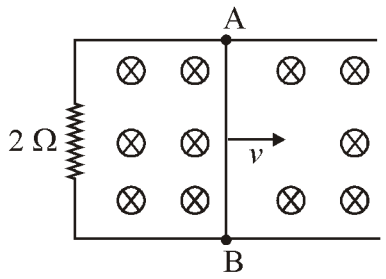
Sol. $C = \frac{\varepsilon_0 A}{d}$

After inserting plate

$$C^1 = \frac{\varepsilon_0 A}{\frac{2d}{3} + \frac{d}{3K}} = \frac{3KC}{2K+1}$$

Question ID : 8606541163

38. A 1 m long metal rod AB completes the circuit as shown in figure. The area of circuit is perpendicular to the magnetic field of 0.10 T. If the resistance of the total circuit is 2 Ω then the force needed to move the rod towards right with constant speed (v) of 1.5 m/s is _____ N.



(1) 5.7×10^{-2} (2) 5.7×10^{-3} (3) 7.5×10^{-3} (4) 7.5×10^{-2}

Ans. Official answer NTA (3)

Sol. Induced emf $\varepsilon = Blv = 0.15$ V

$$\text{Power} = \frac{\varepsilon^2}{R} = 0.01125 \text{ W}$$

$$\because P = FV \Rightarrow F = \frac{0.01125}{1.5} = 7.5 \times 10^{-3} \text{ N}$$

Question ID : 8606541162

39. A conducting circular loop of area 1.0 m^2 is placed perpendicular to a magnetic field which varies as $B = \sin(100\,t)$ Tesla. If the resistance of the loop is 100 Ω, then the average thermal energy dissipated in the loop in one period is _____ J.

(1) π^2 (2) 2π (3) $\pi/2$ (4) π

Ans. Official answer NTA (4)

Sol. Flux $\phi = BA = \sin(100t)$

$$\text{induced emf } \varepsilon = \frac{d\phi}{dt} = 100\cos(100t)$$

$$\text{power } P = \frac{\varepsilon^2}{R} = 100\cos^2(100t)$$

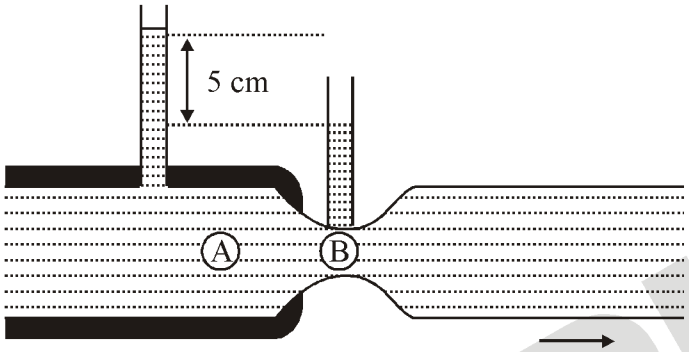
$$\text{average power } p_{avg} = 100 < \cos^2(100t) > = 100 \times \frac{1}{2} = 50 \text{ W}$$

in one rotation energy dissipated = 50 × T

$$= 50 \times \frac{2\pi}{\omega} = \pi \text{ J}$$

Question ID : 8606541155

40. Water flows through a horizontal tube as shown in the figure. The difference in height between the water columns in vertical tubes is 5 cm and the area of cross-sections at A and B are 6 cm^2 and 3 cm^2 respectively. The rate of flow will be _____ cm^3/s. (take g = 10 m/s^2)



(1) $200\sqrt{6}$ (2) $\frac{200}{\sqrt{3}}$ (3) $100\sqrt{3}$ (4) $200\sqrt{3}$

Ans. Official answer NTA (4)

Sol. For a venturimeter

$$\rho gh = \frac{1}{2}\rho\left(V_B^2 - V_A^2\right)$$

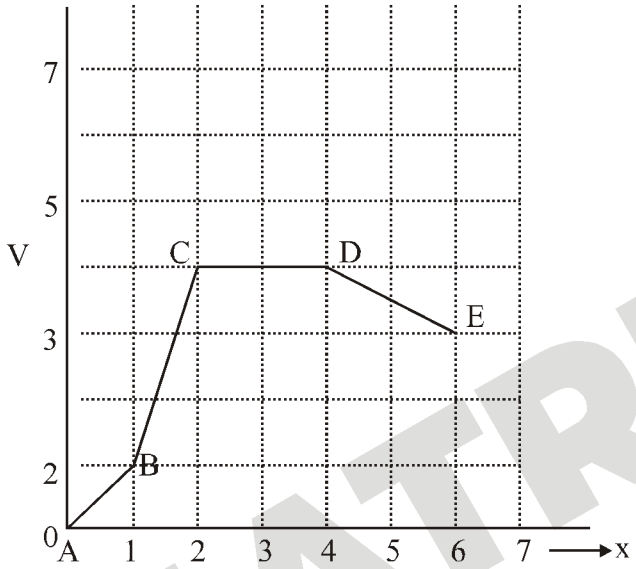
$$\Rightarrow V_A = \sqrt{\frac{2gh}{3}} \quad \{\because V_B = 2V_A\}$$

$\therefore$ volume flow rate $= V_A A_A$

$= 200\sqrt{3}$ cm^3/s

Question ID : 8606541152

41. Potential energy (V) versus distance (x) is given by the graph. Rank various regions as per the magnitudes of the force (F) acting on a particle from high to low.



(1) $F_{BC} > F_{CD} > F_{DE} > F_{AB}$ (2) $F_{CD} > F_{DE} > F_{AB} > F_{BC}$

(3) $F_{BC} > F_{AB} > F_{DE} > F_{CD}$ (4) $F_{CD} > F_{AB} > F_{BC} > F_{DE}$

Ans. Official answer NTA (3)

Sol. Magnitude of force = magnitude of slope

$\therefore F_{BC} > F_{AB} > F_{DE} > F_{CD}$

Question ID : 8606541154

42. An aluminium and steel rods having same lengths and cross-sections are joined to make total length of 120 cm at 30° C. The coefficient of linear expansion of aluminium and steel are 24×10^{-6} /°C and 1.2×10^{-5} / °C, respectively. The length of this composite rod when its temperature is raised to 100 °C, is _____ cm.

(1) 120.20 (2) 120.03 (3) 120.06 (4) 120.15

Ans. Official answer NTA (4)

Sol. Change in length $\Delta l = \Delta l_1 + \Delta l_2 = l_1\alpha_1\Delta T + l_2\alpha_2\Delta T$

$\Rightarrow \Delta l = 60 \times 24 \times 10^{-6} \times 70 + 60 \times 1.2 \times 10^{-5} \times 70$

$\Rightarrow \Delta l = 0.15$ cm

$\therefore$ length = 120 + 0.15 = 120.15 cm

Question ID : 8606541156

43. The electric field in a plane electromagnetic wave is given by:

$E_y = 69 \sin [0.6 \times 10^3 x - 1.8 \times 10^{11} t]$ V/m.

The expression for magnetic field associated with this electromagnetic wave is _____ T.

(1) $B_z = 2.3 \times 10^{-7} \sin[0.6 \times 10^3 x + 1.8 \times 10^{11} t]$

(2) $B_y = 69 \sin[0.6 \times 10^3 x + 1.8 \times 10^{11} t]$

(3) $B_y = 2.3 \times 10^{-7} \sin[0.6 \times 10^3 x - 1.8 \times 10^{11} t]$

(4) $B_z = 2.3 \times 10^{-7} \sin[0.6 \times 10^3 x - 1.8 \times 10^{11} t]$

Ans. Official answer NTA (4)

Sol. $\because$ wave is travelling in + x direction

& electric field is in y direction

so magnetic field is in z direction

$$B_0 = \frac{69}{3 \times 10^8} = 2.3 \times 10^{-7}$$

$\therefore B_z = 2.3 \times 10^{-7} \sin (0.6 \times 10^3 x - 1.8 \times 10^{11} t)$

Question ID : 8606541158

44. Initially a satellite of 100 kg is in a circular orbit of radius 1.5 R_E. This satellite can be moved to a circular orbit of radius 3 R_E by supplying $\alpha \times 10^6$ J of energy. The value of α is _____.

(Take Radius of Earth $R_E = 6 \times 10^6$ m and g = 10 m/s^2)

(1) 100 (2) 150 (3) 1000 (4) 500

Ans. Official answer NTA (3)

Sol. Initial energy of satellite $= \frac{-GMm}{2 \times 1.5R} = \frac{-GMm}{3R}$

Final energy of satellite $= \frac{-GMm}{2 \times 3R} = \frac{-GMm}{6R}$

Change in energy $= \frac{-GMm}{6R} + \frac{GMm}{3R} = \frac{GMm}{6R}$

$= \frac{mgR}{6} = 10^9$ J

$\therefore \alpha = 1000$

Question ID : 8606541151

45. Consider a modified Bernoulli equation.

$$\left(P+\frac{A}{Bt^2}\right)+\rho g(h+Bt)+\frac{1}{2}\rho V^2 = \text{ constant}$$

If t has the dimension of time then the dimensions of A and B are _____, _____ respectively.

(1) $[ML^0T^{-1}]$ and $[M^0LT^{-1}]$ (2) $[ML^0T^{-2}]$ and $[M^0LT^{-2}]$

(3) $[ML^0T^{-2}]$ and $[M^0LT^{-1}]$ (4) $[ML^0T^{-1}]$ and $[M^0LT]$

Ans. Official answer NTA (1)

Sol. Bt has dimensions of height h

$\therefore [B] = [M^0L^1T^{-1}]$

also $\frac{A}{Bt^2}$ has dimensions of pressure P

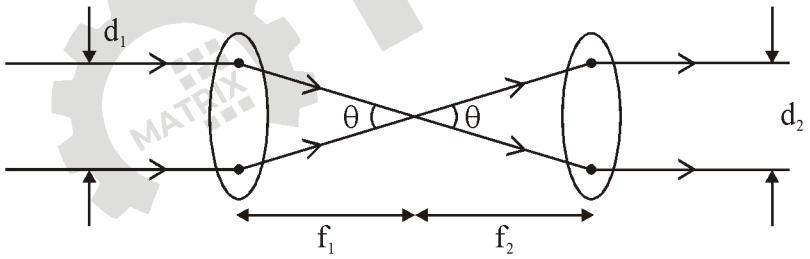
$\Rightarrow [A] = [PBt^2] = [M^1L^0T^{-1}]$

Question ID : 8606541172

46. A collimated beam of light of diameter 2 mm is propagating along x-axis. The beam is required to be expanded in a collimated beam of diameter 14 mm using a system of two convex lenses. If first lens has focal length 40 mm, then the focal length of second lens is _____ mm.

Ans. Official answer NTA (280)

Sol.



$\because \tan\theta = \frac{d_1}{f_1} = \frac{d_2}{f_2}$

$\Rightarrow f_2 = 280$ mm

Question ID : 8606541173

47. In a microscope the objective is having focal length $f_o = 2$ cm and eye-piece is having focal length $f_e = 4$ cm. The tube length is 32 cm. The magnification produced by this microscope for normal adjustment is _____.

Ans. Official answer NTA (100)

Sol. $\because m = \frac{LD}{f_0 f_e} = \frac{32 \times 25}{2 \times 4} = 100$

Question ID : 8606541175

48. 10 mole of oxygen is heated at constant volume from 30 °C to 40 °C. The change in the internal energy of the gas is _____ cal.

(The molecular specific heat of oxygen at constant pressure, $C_p = 7$ cal/mol. °C and R = 2 cal./mol. °C.)

Ans. Official answer NTA (500)

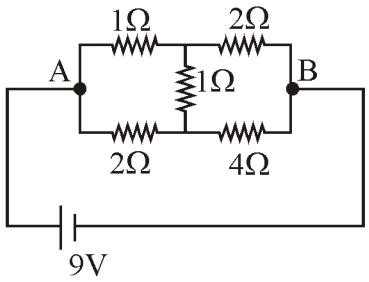
Sol. Change in internal energy

$\Delta U = nC_V\Delta T = 10 \times 5 \times 10$ Cal

$= 500$ Cal

Question ID : 8606541174

49. The heat generated in 1 minute between points A and B in the given circuit, when a battery of 9 V with internal resistance of 1 Ω is connected across these points is _____ J.



Ans. Official answer NTA (1080)

Sol. It is a balanced wheat stone bridge

$\therefore R_{eq} = 2\Omega$

$\because I = \frac{\varepsilon}{2 + r} = 3A$

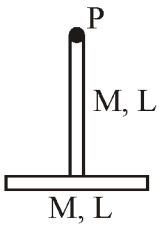
$\therefore P = 3^2 \times 2 = 18$ W

$\therefore$ Heat generated (1 min.) $= 18 \times 60$

$= 1080$ J

Question ID : 8606541171

50. Two identical thin rods of mass M kg and length L m are connected as shown in figure. Moment of inertia of the combined rod system about an axis passing through point P and perpendicular to the plane of the rods is $\frac{x}{12}ML^2 kg\ m^2$. The value of x is _____.



Ans. Official answer NTA (17)

Sol. Moment of inertia $= \left[\frac{m\ell^2}{3} + \left(\frac{m\ell^2}{12} + m\ell^2\right)\right]$

$= \frac{17m\ell^2}{12}$