PHYSICS

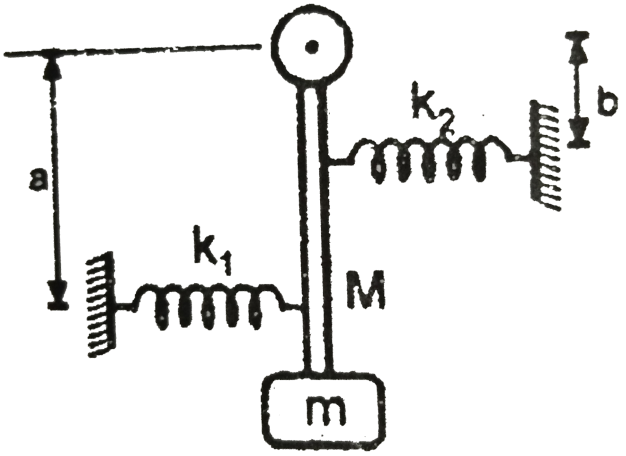
BOOKS - NTA MOCK TESTS

NTA JEE MOCK TEST 91

Physics

1. A rod of mass M and length K is hinged at its one end n carries a block f mass m at its other end. A spring of force constant k_1 is installed

at distance a form the hinge and another of force constant k_2 at a distance b as shown in the figure. If the whole arrangement rests on a smooth horizontal table top. Find the frequency of vibrations.



A. $\frac{1}{2\pi}\sqrt{\frac{k_1a^2+k_2b^2}{L^2\left(m+\frac{M}{3}\right)}}$

B. $\frac{1}{2\pi}\sqrt{\frac{k_1a^2+k_2b^2}{L^2\left(m-\frac{M}{3}\right)}}$

C. $\frac{1}{2\pi}\sqrt{\frac{k_1a^2-k_2b^2}{L^2\left(m+\frac{M}{3}\right)}}$

D. $\frac{1}{4\pi}\sqrt{\frac{k_1a^2+k_2b^2}{L^2\left(m-\frac{M}{3}\right)}}$

Answer: A

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2. Velocity of a particle moving in a straight line varies with its displacement as $v=\left(\sqrt{4+4s}\right)m/s.$ Displacement of

particle at time $t = 0$ is $s = 0$. Find displacement of particle at time $t = 2s$.

A. 8 m

B. 6 m

C. 4 m

D. 10 m

Answer: A

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3. The wavelength of the first spectral line in the Balmer series of hydrogen atom is $6561A^{\circ}$. The wavelength of the second spectral line in the Balmer series of singly - ionized helium atom is

A. $1215Å$

B. $1640Å$

C. $2320Å$

D. $4687Å$

Answer: A

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4. Figure shows the variation in the internal energy U with the volume V of $2.0mol$ of an ideal gas in a cyclic process abcda. The temperatures of the gas at b and c are $500K$ and $300K$ respectively. Calculate the heat absorbed by the gas during the process.

A. 400 R ln 2

B. 500 R ln 2

C. 700 R ln 2

D. 800 R ln 2

Answer: A

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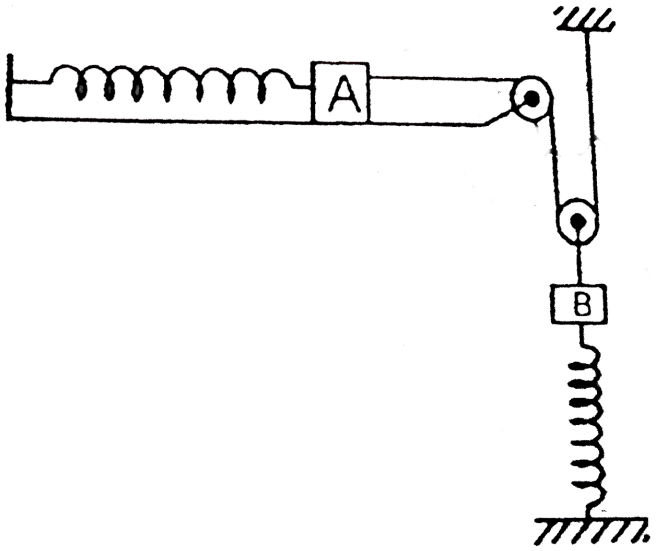
5. The system is released from rest with both the springs in unstretched positions. Mass of each block is $1kg$ and force constant of each spring is $10N/m$. Then choose the incorrect option(s). Assume pulley and strings are

massless and all contacts are smooth. $(g = 10m/s^2)$



A. Extension of horizontal spring in equilibrium is 2/5 m

B. Extension of vertical spring in equilibrium is 1/5 m

C. Maximum speed of the block A is $\sqrt{\frac{8}{5}}m/s$

D. Maximum speed of the block A is $\sqrt{14}m/s$

Answer: D

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6. Two wires are fixed in a sanometer. Their tension are in the ratio $8:1$ The lengths are in the ratio $36:35$ The diameter are in the ratio

$4:1$ Densities of the materials are in the ratio $1:2$ if the lower frequency in the setting is $360Hz$. The beat frequency when the two wires are sounded together is

A. 8

B. 5

C. 10

D. 6

Answer: C

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7. A signal wave of frequency 12 kHz is modulated with a carrier wave of frequency 2-51 MHz. The upper and lower side band frequencies are respectively.

A. 2512 kHz and 2508 kHz

B. 2522 kHz and 2488 kHz

C. 2522 kHz and 2498 kHz

D. 2512 kHz and 2488 kHz

Answer: C

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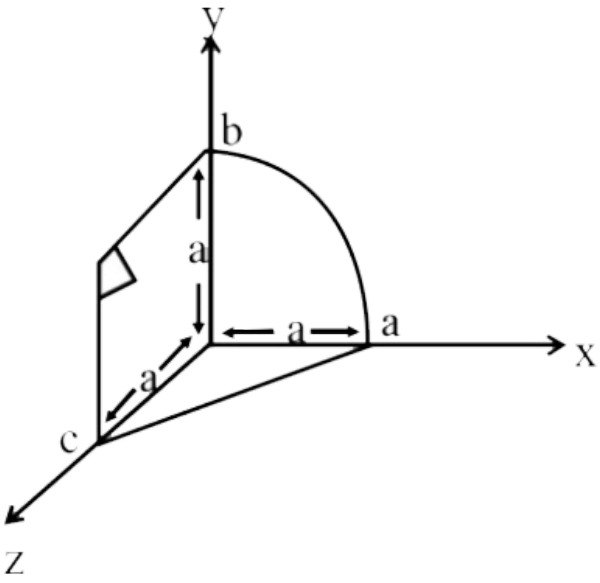
8. In given figure, a wire loop has been bent so that it has three segments ab (a quarter circle), bc (a square corner) & ca (straight line). Here are three choices for a magnetic field through the loop -



(1) $\overrightarrow{=}(B_1) = 3\hat{i} + 7\hat{j} - 5t\hat{k}$

(2) $\overrightarrow{B_2} = 5t\hat{i} - 4\hat{j} - 15\hat{k}$

(3) $\overrightarrow{B_3} = 2\hat{i} - 5t\hat{j} - 12\hat{k}$

where B is in milli tesla and t is in second. If the induced current in the loop due to $\overrightarrow{B_1}, \overrightarrow{B_2}, \overrightarrow{B_3}$ are i_1, i_2, i_3 respectively then

A. $i_1 > i_2 > i_3$

B. $i_2 > i_1 > i_3$

C. $i_3 > i_2 > i_1$

D. $i_1 = i_2 = i_3$

Answer: B

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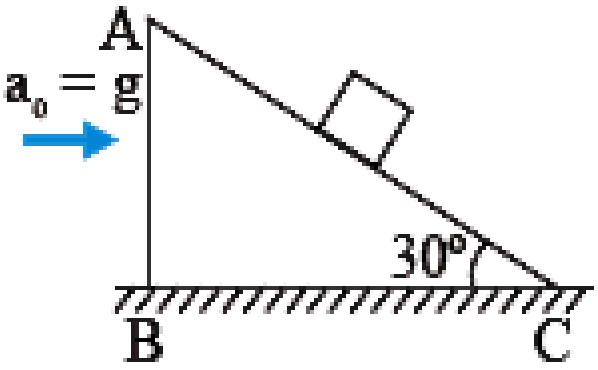
9. A block is placed on an inclined plane moving towards right horizontally with an acceleration $a_0 = g$. The length of the plane

AC = 1m. Friction is absent everywhere. The time taken by the block to reach from C to A is : $(g = 10m/s^2)$



A. 1.2 s

B. 0.74 s

C. 2.56 s

D. 0.42 s

Answer: B

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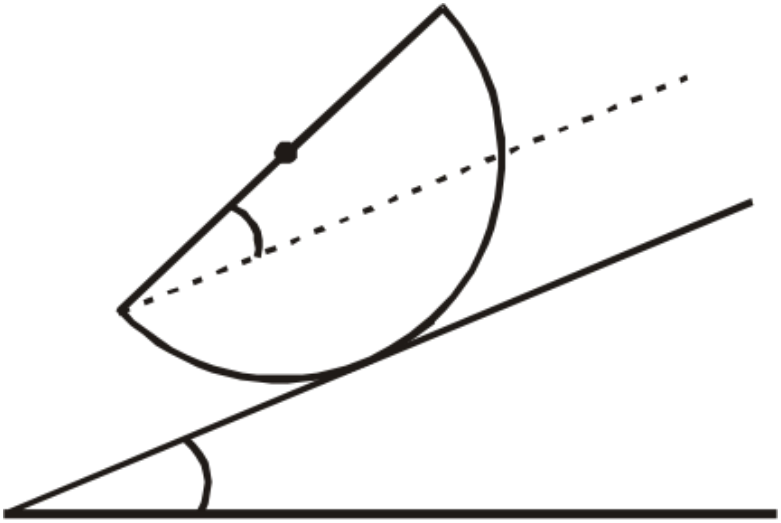
10. A uniform thin hemispherical shell is kept at rest and in equilibrium on an inclined plane of angle of inclination $\theta = 30^\circ$ as shown in figure. If the surface of the inclined plane is sufficiently rough to prevent sliding then the angle α made by the plane of hemisphere with

inclined plane is :



A. value of μ is needed

B. 30°

C. 45°

D. 60°

Answer: D

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11. A rod of length l and cross-section area A has a variable thermal conductivity given by K = α T, where α is a positive constant and T is temperature in kelvin. Two ends of the rod are maintained at temperature T_1 and T_2 $(T_1 > T_2)$. Heat current flowing through the rod will be

A. $\frac{A\alpha\left(T_1^2 - T_2^2\right)}{3l}$

B. $\frac{A\alpha\left(T_1^2 + T_2^2\right)}{l}$

C. $\frac{A\alpha\left(T_1^2+T_2^2\right)}{3l}$

D. $\frac{A\alpha\left(T_1^2-T_2^2\right)}{2l}$

Answer: D

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12. A monochromatic beam of light falls on Young's double slit experiment apparatus as shown in figure. A thin sheet of glass is inserted in front of lower slit $S_2(\lambda = 600nm$ is wavelength of source)

If central bright fringe is obtained on screen at 'O' then

A. $(\mu - 1)t = d \sin \theta$

B. $(\mu - 1)t = d \cos \theta$

C. $(\mu t) = d\theta$

D. Not possible

Answer: A

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13. The frequency f of vibrations of a mass m suspended from a spring of spring constant k is given by $f = Cm^x k^y$, where C is a dimensionless constant. The values of x and y are, respectively,

A. $x = \frac{1}{2}, y = \frac{1}{2}$

B. $x = -\frac{1}{2}, y = -\frac{1}{2}$

C. $x = \frac{1}{2}, y = -\frac{1}{2}$

D. $x = -\frac{1}{2}, y = \frac{1}{2}$

Answer: D

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14. A body of mass 2 m moving with velocity v makes a head - on elastic collision with another body of mass m which is initially at rest. Loss of kinetic energy of the colliding body (mass 2 m) is

A. $\frac{1}{9}$ of its initial kinetic energy

B. $\frac{1}{6}$ of its initial kinetic energy

C. $\frac{1}{2}$ of its initial kinetic energy

D. $\frac{8}{9}$ of its initial kinetic energy

Answer: D

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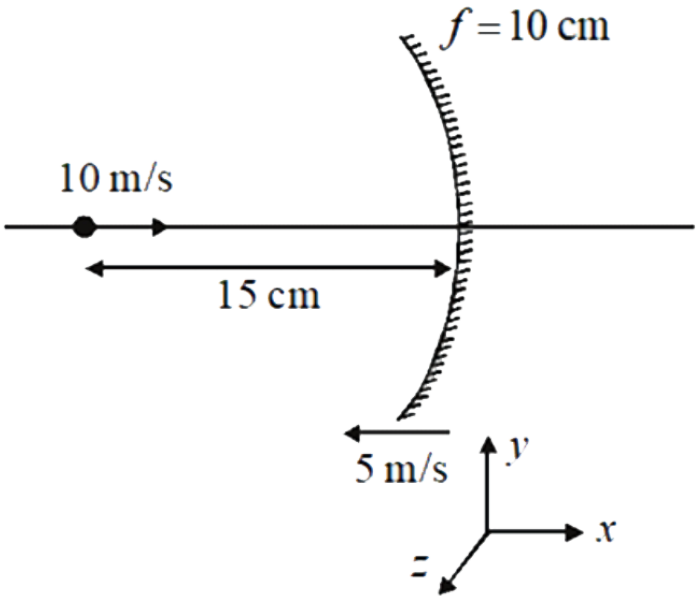
15. An object and a concave mirror are approaching each other with velocities 10 m/s and 5 m/s as shown in figure. The velocity of image of object at the instant shown in figure

is



A. $65m/s\hat{i}$

B. $65m/s\left(-\hat{i}\right)$

C. $40m/s\hat{i}$

D. $40m/s\left(-\hat{i}\right)$

Answer: B

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16. The temperature of equal masses of three different liquids A,B and C are $12^\circ C, 19^\circ C$ and $28^\circ C$ respectively. The temperature when A and B are mixed is $16^\circ C$ and when B and C are mixed it is $23^\circ C$. What should be the temperature when A and C are mixed?

A. $18.2^\circ C$

B. $22^\circ C$

C. $20.2^\circ C$

D. $25.2^\circ C$

Answer: C

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17. In a photoelectric effect measurement, the stoppingg potential for a given metal is found to be V_0 volt, when radiation of wavelength λ_0

is used. If radiation of wavelength $2\lambda_0$ is used with the same metal, then the stopping potential (in V) will be

A. $\frac{V_0}{2}$

B. $2V_0$

C. $V_0 + \frac{hc}{2e\lambda_0}$

D. $V_0 - \frac{hc}{2e\lambda_e}$

Answer: D

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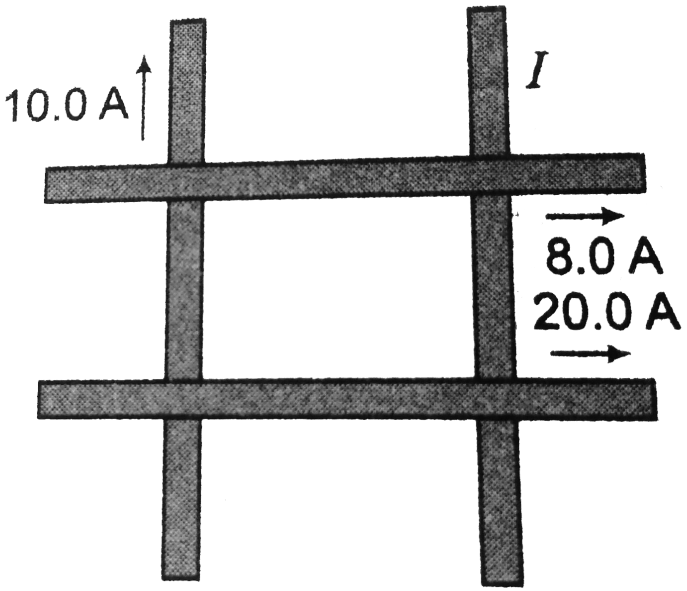
18. Four very long, current carrying wires in the same plane intersect to form a square $40.0cm$ on each side as shown in figure. Find the magnitude and direction of the current I so that the magnetic field at the centre of square is zero. Wires are insulated from each other.



A. 22 A

B. 38 A

C. $2A$

D. 18 A

Answer: C

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19. If the ratio of the radius of a nucleus with 61 neutrons to that of helium nucleus is 3, then the atomic number of this nucleus is

A. 27

B. 47

C. 51

D. 61

Answer: B

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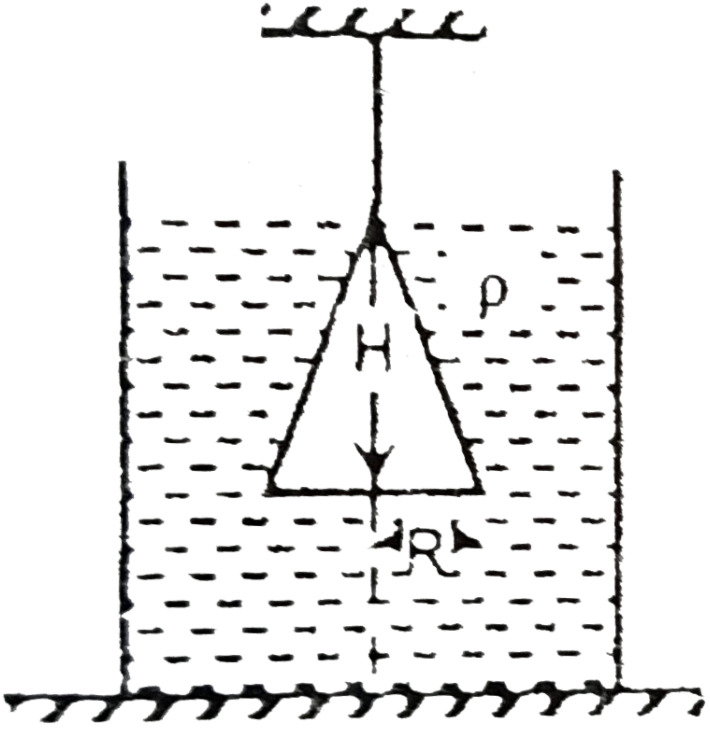
20. A cone of radius R and height H, is hanging inside a liquid of density ρ by means of a string as shown in figure. The force due to

the liquid acting on the slant surface of the cone is



A. $\rho\pi HR^2$

B. $\pi\rho HR^2$

C. $\frac{4}{3}\pi\rho HR^2$

D. $\frac{2}{3}\pi\rho gHR^2$

Answer: D

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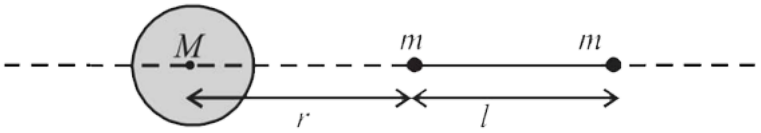
21. A larger spherical mass M is fixed at one position and two identical point masses m are kept on a line passing through the centre of M. The point masses are connected by rigid massless rod of length l and this assembly is free to move along the line connecting them.

All three masses interact only throght their mutual gravitational interaction. When the point mass nearer to M is at a distance r =3l form M, the tensin in the rod is zero for $m = k\left(\frac{M}{288}\right)$. The value of k is



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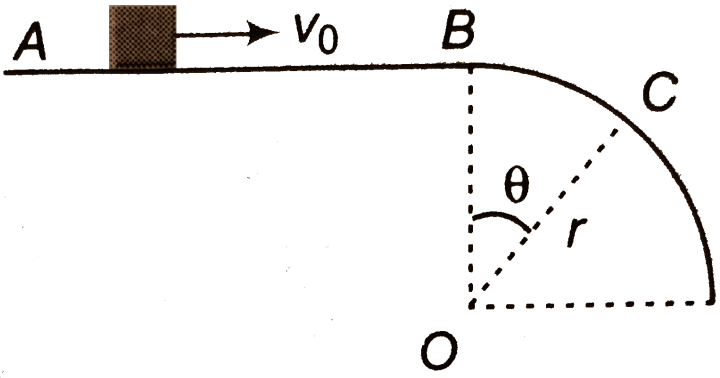
22. A small block slides with velocity $0.5\sqrt{gr}$ on the horizontal frictionless surface as shown in the figure. The block leaves the surface at point C. Calculate angle θ in the figure.



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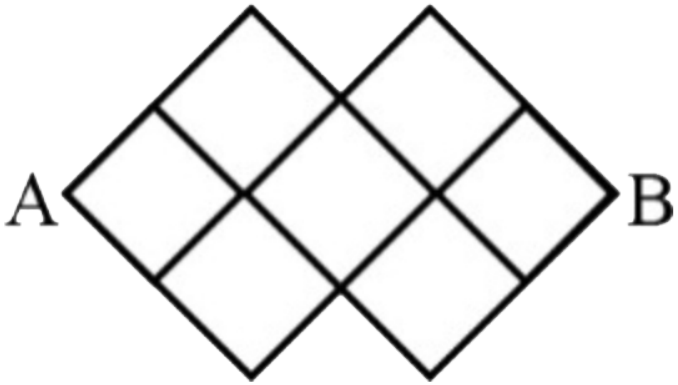
23. In the shown wireframe, each side of a square (the smallest square) has a resistance 7Ω. What is the equivalent resistance value (in ohm) of the circuit between the points A and B ?



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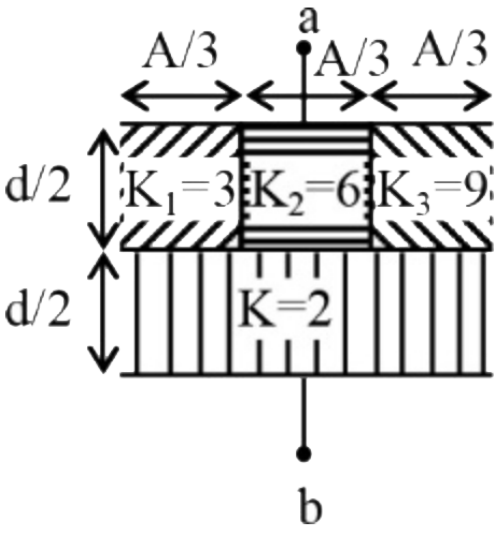
24. A parallel plate capacitor with plate area A and separation between the plates d is filled with different dielectrics as shown in the figure. If the equivalent capacitance between $a\&b$ is $\frac{mA\varepsilon_0}{nd}$ then find the value of $(m+n)$, where m and n are least positive integers.



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25. Two magnets held together in earth's magnetic field when the same polarity together causes 12 vib/min and when opposite poles 4 vib/min. What is the ratio of magnetic moments?

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