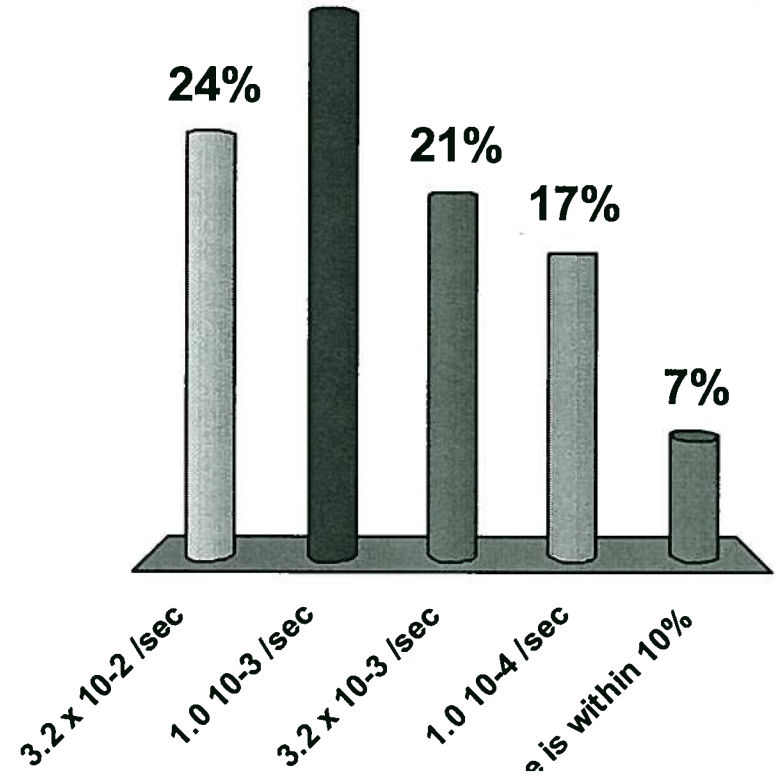
J. GRIFFIN 4/12/08 ②

A cylindrical space habitat is made to rotate on its axis to simulate earth's gravity for the inhabitants. If its radius is 10^4 km, at what angular speed (in radians/sec) should it rotate in order to yield a centrifugal acceleration equal to g at its inner surface?

a) 3.2 x 10^{-2} /sec
b) 1.0 10^{-3} /sec
c) 3.2 x 10^{-3} /sec
d) 1.0 10^{-4} /sec
e) None is within 10%



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The correct answer is (b), $\omega = 1.0 \times 10^{-3}$ /sec; as follows,

- The rotation must produce an inertial pseudo-force = Mg = 10*M kg-m/s^2.
- The centrifugal inertial pseudo-force at a distance R from the axis is

  $F_{pseudo} = MR\,\omega^2$, outward.
- Therefore $Mg = MR\,\omega^2$,
- or $\omega = (g/R)^{1/2} = 10/(10^4 * 10^3)^{1/2}$ sec^{-2}
- $= (10^{-6})^{1/2} = 1 \times 10^{-3}$/sec.