Name:_____ **Date:**_____

Gravitational Simple Harmonic Motion

Last class we developed the following equation describing the acceleration of a person falling through the earth:

$$a = -\left(\frac{GM_E}{R_E}\right)r$$

where G is the Universal Gravitational Constant, M_E is the mass of the earth, R_E is the radius of the earth, and r is the person's distance from the earth's center. Using accepted values for G, M_E, and R_E, calculate, in minutes, the time it takes a person to fall from one side of the earth to the other through the center.

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7. A 1.00-kg object is attached to a horizontal spring. The spring is initially stretched by 0.100 m, and the object is released from rest there. It proceeds to move without friction. The next time the speed of the object is zero is 0.500 s later. What is the maximum speed of the object?

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9. A 7.00-kg object is hung from the bottom end of a vertical spring fastened to an overhead beam. The object is set into vertical oscillations having a period of 2.60 s. Find the force constant of the spring.

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13. A particle moving along the x axis in simple harmonic motion starts from its equilibrium position, the origin, at $t = 0$ and moves to the right. The amplitude of its motion is 2.00 cm, and the frequency is 1.50 Hz. (a) Find an expression for the position of the particle as a function of time. Determine (b) the maximum speed of the particle and (c) the earliest time ($t > 0$) at which the particle has this speed. Find (d) the maximum positive acceleration of the particle and (e) the earliest time ($t > 0$) at which the particle has this acceleration. (f) Find the total distance traveled by the particle between $t = 0$ and $t = 1.00$ s.