PROBLEM SOLVING

EXAMPLE 4 on p. 957 for Exs. 50–51

50. GOLF Use the equation $x = \frac{1}{32}v^2 \sin 2\theta$ from Example 4 on page 957 to find the horizontal distance a golf ball will travel if it is hit at an initial speed of 50 feet per second and at an initial angle of 40°.

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51. SOCCER Suppose you are attempting to kick a soccer ball from ground level. Through what range of angles can you kick the soccer ball with an initial speed of 80 feet per second to make it travel at least 150 feet?

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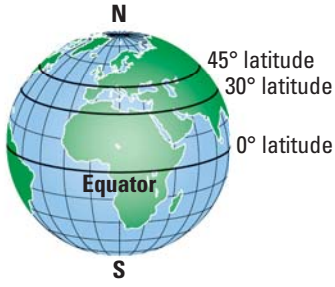
52. MULTI-STEP PROBLEM At latitude L, the acceleration due to gravity g (in centimeters per second squared) at sea level can be approximated by:

$$g = 978 + 5.17 \sin^2 L - 0.014 \sin L \cos L$$



a. Simplify the equation above to show that $g = 978 + 5.17 \sin^2 L - 0.007 \sin 2L$.

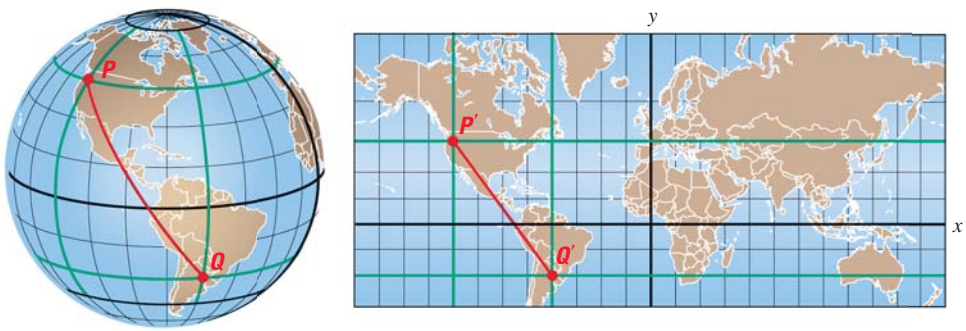
b. Graph the function from part (a).

c. Use the graph to approximate the acceleration due to gravity when the latitude is 45°, 30°, and 0°.

53. MACH NUMBER An airplane's Mach number M is the ratio of its speed to the speed of sound. When an airplane travels faster than the speed of sound, the sound waves form a cone behind the airplane. The Mach number is related to the apex angle θ of the cone by the equation $\sin \frac{\theta}{2} = \frac{1}{M}$. Find the angle θ that corresponds to a Mach number of 2.5.

54. TAKS REASONING A *Mercator projection* is a map projection of the globe onto a plane that preserves angles. On a globe with radius r, consider a point P that has latitude L and longitude T. The coordinates (x, y) of the corresponding point P' on the plane can be found using these equations:

$$x = rT \qquad y = r \ln\left[\tan\left(\frac{\frac{\pi}{2} + L}{2}\right)\right]$$



a. Use half-angle and sum formulas to show that the equation for the y-coordinate can be written as $y = r \ln\left(\frac{1 + \sin L}{\cos L}\right)$.

b. What is a reasonable domain for the equation in part (a)? *Explain*.