Chapter 4 Trigonometry

Course/Section Lesson Number Date

Section 4.8 Applications and Models

Section Objectives: Students will know how to solve applications involving trigonometric functions.

I. Applications Involving Right Triangles (pp. 353−354) Pace: 10 minutes

- State that in this section, angles will be labeled with the uppercase letters *A*, *B*, and *C* (*C* is the right angle), and their opposite sides with the lowercase letters *a*, *b*, and *c* (*c* is the hypotenuse).

Example 1. If a right triangle has $A = 24°$ and $c = 5$, find b.
$b/5 = \cos 24° \Rightarrow b = 5 \cos 24° \approx 4.6$

Example 2. A man at ground level measures the angle of elevation to the top of a building to be 67°. If, at this point, he is 15 feet from the building, what is the height of the building?
$h/15 = \tan 67° \Rightarrow h = 15 \tan 67° \approx 35.3$ feet

Example 3. The same man now stands atop a building. He measures the angle of elevation to the building across the street to be 27° and the angle of depression (to the base of the building) to be 31°. If the two buildings are 50 feet apart, how tall is the taller building?
$h = 50(\tan 31° + \tan 27°) \approx 55.5$ feet

II. Trigonometry and Bearings (p. 355) Pace: 5 minutes

- Define **bearing** to be an acute angle measured from the north-south line.

Example 4. A ship leaves port and sails 12 miles due west. It then turns and sails due north for 20 miles. At this point, at what bearing should the ship sail to get back to port?
The course should be S θ E, where $\theta = \tan^{-1}(12/20) \approx 31.0°$.

III. Harmonic Motion (pp. 356−358) Pace: 10 minutes

- State that a point that moves on a coordinate line is said to be in **simple harmonic motion** if its distance d from the origin at time t is given by either $d = a \sin \omega t$ or $d = a \cos \omega t$, where a and ω are real numbers such that $\omega > 0$. The motion has amplitude $|a|$, period $2\pi/\omega$, and frequency $\omega/2\pi$.

- State that this would be the case with a bouncing spring, for example.

Example 5. Write the equations describing the motion of a ball that is attached to a spring suspended from the ceiling, with period 3 seconds and maximum displacement from equilibrium of 7 inches.
Because $2\pi/\omega = 3$, $\omega = 2\pi/3$. $d = 7 \sin [(2\pi/3)t]$.

Example 6. Given the equation for simple harmonic motion

$$d = 8 \cos 4t$$

find the following.

a) Maximum displacement from equilibrium. $|a| = 8$

b) Period. $2\pi/\omega = 2\pi/4 = \pi/2$

c) Frequency. $\omega/2\pi = 4/2\pi = 2/\pi$

d) Find the smallest positive number such that $d = 0$.

$$8\cos 4t = 0$$
$$\cos 4t = 0$$
$$4t = \cos^{-1} 0$$
$$t = \frac{\cos^{-1} 0}{4} = \frac{\pi/2}{4} = \frac{\pi}{8}$$