3.46 in and it is flat axially. The rotational axes of the cam and roller are parallel, which makes the angle between the two bodies zero. The force is 250 lb, normal to the contact plane.

Assumptions **Materials are steel. The relative motion is rolling with <1% sliding.**

Solution

1 Find the material constants from equation 7.9*b*.

$$m_1 = m_2 = \frac{1-\nu_1^2}{E_1} = \frac{1-0.28^2}{3E7} = 3.072E-8 \qquad (a)$$

2 Two geometry constants are needed from equations 7.19*a*.

$$A = \frac{1}{2}\left(\frac{1}{R_1}+\frac{1}{R_1'}+\frac{1}{R_2}+\frac{1}{R_2'}\right) = \frac{1}{2}\left(\frac{1}{1}+\frac{1}{20}+\frac{1}{3.46}+\frac{1}{\infty}\right) = 0.669\,5 \qquad (b)$$

$$B = \frac{1}{2}\left[\left(\frac{1}{R_1}-\frac{1}{R_1'}\right)^2+\left(\frac{1}{R_2}-\frac{1}{R_2'}\right)^2+2\left(\frac{1}{R_1}-\frac{1}{R_1'}\right)\left(\frac{1}{R_2}-\frac{1}{R_2'}\right)\cos 2\theta\right]^{\frac{1}{2}}$$

$$B = \frac{1}{2}\left[\left(\frac{1}{1}-\frac{1}{20}\right)^2+\left(\frac{1}{3.46}-\frac{1}{\infty}\right)^2+2\left(\frac{1}{1}-\frac{1}{20}\right)\left(\frac{1}{3.46}-\frac{1}{\infty}\right)\cos 2(0)\right]^{\frac{1}{2}} = 0.619\,5 \qquad (c)$$

The angle ϕ is found from their ratio,

$$\phi = \cos^{-1}\left(\frac{B}{A}\right) = \cos^{-1}\left(\frac{0.6195}{0.6695}\right) = 22.3^\circ \qquad (d)$$

and used in Table 7-5 (p. 476) to find the factors k_a and k_b. Cubic interpolation* for k_a and linear interpolation* for k_b gives

$$k_a = 3.444 \qquad k_b = 0.427 \qquad (e)$$

3 The material and geometry constants can now be used in equation 7.19*d* (p. 476).

$$a = k_a \sqrt[3]{\frac{3F(m_1+m_2)}{4A}} = 3.444\sqrt[3]{\frac{3(250)2(3.072E-8)}{4(0.6695)}} = 0.088\,9$$

$$b = k_b \sqrt[3]{\frac{3F(m_1+m_2)}{4A}} = 0.427\sqrt[3]{\frac{3(250)2(3.072E-8)}{4(0.6695)}} = 0.011\,0 \qquad (f)$$

where a is the half-width of the major axis, and b is the half-width of the minor axis of the contact patch. The contact-patch area is then

* The different interpolation methods are used to best fit the functions, one of which is linear and the other nonlinear. Plot the values in Table 7-5 to see this.