

- 4 The pitch diameters and pitch radii of pinion and gear are found from equation 11.4a.

$$d_p = \frac{N_p}{p_d} = \frac{19}{6} = 3.167 \text{ in}, \quad r_p = \frac{d_p}{2} = 1.583 \text{ in} \quad (d)$$

$$d_g = \frac{N_g}{p_d} = \frac{37}{6} = 6.167 \text{ in}, \quad r_g = \frac{d_g}{2} = 3.083 \text{ in} \quad (e)$$

- 5 The nominal center distance  $C$  is the sum of the pitch radii:

$$C = r_p + r_g = 4.667 \text{ in} \quad (f)$$

- 6 The addendum and dedendum are found from the equations in Table 11-1 (p. 695):

$$a = \frac{1.0}{p_d} = \frac{1}{6} = 0.167 \text{ in}, \quad b = \frac{1.25}{p_d} = \frac{1.25}{6} = 0.208 \text{ in} \quad (g)$$

- 7 The whole depth  $h_t$  is the sum of the addendum and dedendum.

$$h_t = a + b = 0.167 + 0.208 = 0.375 \text{ in} \quad (h)$$

- 8 The clearance is the difference between dedendum and addendum.

$$c = b - a = 0.208 - 0.167 = 0.042 \text{ in} \quad (i)$$

- 9 The outside diameter of each gear is the pitch diameter plus two addenda:

$$D_{o_p} = d_p + 2a = 3.500 \text{ in}, \quad D_{o_g} = d_g + 2a = 6.500 \text{ in} \quad (j)$$

- 10 The contact ratio is found from equations 11.2 and 11.7 (pp. 688 and 697).

$$\begin{aligned} Z &= \sqrt{(r_p + a_p)^2 - (r_p \cos \phi)^2} + \sqrt{(r_g + a_g)^2 - (r_g \cos \phi)^2} - C \sin \phi \\ &= \sqrt{(1.583 + 0.167)^2 - (1.583 \cos 20^\circ)^2} \\ &\quad + \sqrt{(3.083 + 0.167)^2 - (3.083 \cos 20^\circ)^2} - 4.667 \sin 20^\circ = 0.798 \text{ in} \\ m_p &= \frac{Z}{p_b} = \frac{0.798}{0.492} = 1.62 \quad (k) \end{aligned}$$

- 11 If the center distance is increased from the nominal value due to assembly errors or other factors, the effective pitch radii will change by the same percentage. The gears' base radii will remain the same. The new pressure angle can be found from the changed geometry. For a 2% increase in center distance (1.02 $\times$ ):

$$\phi_{new} = \cos^{-1} \left( \frac{r_{\text{base circle } p}}{1.02 r_p} \right) = \cos^{-1} \left( \frac{r_p \cos \phi}{1.02 r_p} \right) = \cos^{-1} \left( \frac{\cos 20^\circ}{1.02} \right) = 22.89^\circ \quad (l)$$

- 12 This example was solved both with *Mathcad* and *TKSolver*. Its files EX11-01 can be found on the book's CD-ROM.