Title :

1. Find the shaft and hole dimensions for the below fit with a 34-mm basic size:
   (1) H11/c11

   (2) H7/s6

   (3) H7/k6

(1)

$H11: 34^{0.16}_{0}$

$C_{11}: 34^{-0.14}_{-0.33}$

(2)

$H_7: 34^{0.025}_{0}$

$S_6: 34^{0.059}_{0.043}$

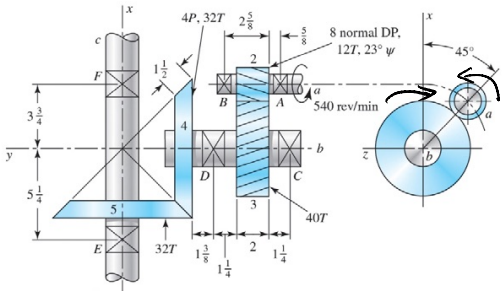
(3)

$H_7: 34^{0.025}_{0}$

$K_6: 34^{0.018}_{0.002}$

Title :

2. Find the speed and direction of rotation of shaft *c*.



$$e = \frac{N_2}{N_3}$$

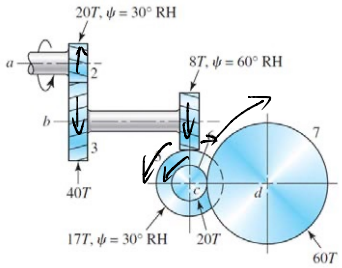
$$= \frac{40}{40} = \frac{3}{10}$$

$$\frac{N_2}{N_3} = \frac{n_3}{n_2}$$

$$n_3 = \frac{3}{10} \times 540$$

$$n_3 = 162 \text{ rev/min} \quad \text{counter-clockwise}$$

3. Shaft *a* in the figure rotates at 1000 rev/min in the direction shown. Find the speed and direction of rotation of shaft *d*.



$$\frac{n_2}{n_3} = \frac{N_3}{N_2}$$

$$e = \frac{N_2}{N_3} \cdot \frac{N_4}{N_5} \cdot \frac{N_6}{N_7}$$

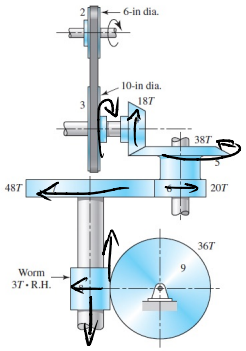
$$= \frac{20}{40} \cdot \frac{8}{17} \cdot \frac{20}{60}$$

$$n_7 = n_2 \cdot e$$

$$= 78.43 \text{ rev/min} \quad \text{clockwise}$$

Title :

4. Pulley 2 rotates at 1000 rev/min in the direction shown. Determine the speed and direction of rotation of gear 9.

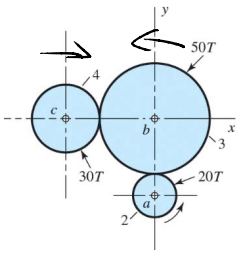


$$\frac{\omega_2}{\omega_3} = \frac{N_4}{N_5} \cdot \frac{N_6}{N_7} \cdot \frac{N_8}{N_9} \times 1000$$

$$= \frac{6}{10} \times \frac{18}{38} \times \frac{20}{48} \times \frac{3}{36} \times 1000$$

$$= 7.86842 \text{ rev/min, clockwise}$$

5. Pinion 2 in the below figure runs at 1750 rev/min and transmits 2.5 kW to idler gear 3. The teeth are cut on the 20° full-depth system and have a module of *mm* =2.5 mm. Draw a free-body diagram of gear 3 and show all the forces that act upon it.



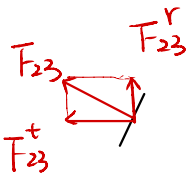
$$d = m \cdot N$$

$$\begin{cases} d_2 = m_2 \cdot N_2 = 20 \cdot 2.5 = 50 \\ d_3 = m_3 \cdot N_3 = 50 \cdot 2.5 = 125 \end{cases}$$

2-3

$$W_t = 60000 \frac{H}{\pi d n}$$

$$= 60000 \times \frac{2.5}{\pi \cdot 50 \cdot 1750} = 0.545674 \text{ kN}$$



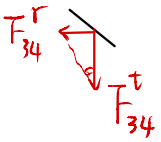
$$\frac{F_{23}^r}{F_{23}^t} = \tan 20^\circ$$

$$F_{23}^r = 0.545674 \text{ K} \cdot \tan 20^\circ$$

$$= 0.1986 \text{ kN}$$

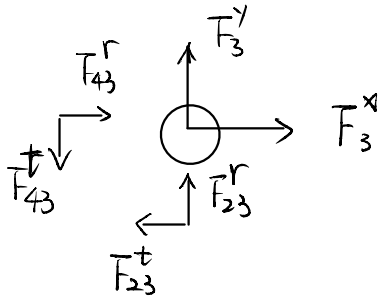
3-4

$$F_{34}^t = 0.545674 \text{ kN}$$



$$\frac{F_{34}^r}{F_{34}^t} = \tan 20^\circ$$

$$F_{34}^r = 0.1986 \text{ kN}$$



$$F_3^y = F_{23}^r - F_{43}^t$$
$$= 0.1986 - 0.545674$$
$$= -0.347\ kN \quad (\downarrow)$$

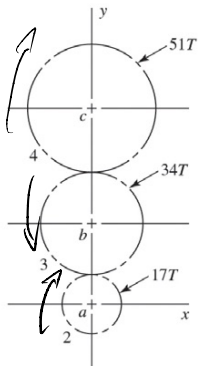
$$F_3^x = F_{43}^r - F_{23}^t$$
$$= 0.1986 - 0.545674$$
$$= -0.347\ kN \quad (\leftarrow)$$

∴ 3rd Newton

$$F_{b3}^x = 0.347\ kN \quad (\rightarrow)$$

$$F_{b3}^y = 0.347\ kN \quad (\uparrow)$$

6. Shaft *a* in the figure has a power input of 75 kW at a speed of 1000 rev/min in the counterclockwise direction. The gears have a module of 5 mm and a 20° pressure angle. Gear 3 is an idler.
   (a) Find the force F_{3b} that gear 3 exerts against shaft b.
   (b) Find the torque F_{4c} that gear 4 exerts on shaft c.



$d_2 = m_2 \cdot N$

$= 5 \times 17 = 85$

$d_3 = m_3 \cdot N$

$= 5 \times 34 = 170$

$d_4 = m_4 \cdot N$

$= 5 \times 51$

$= 255$

2-3

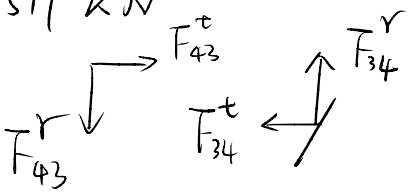
$$W_t = 60000 \cdot \frac{H}{\pi d n}$$

$$= 60000 \cdot \frac{75}{\pi \times 85 \times 1000}$$

$= 16.8517\ KN$

$F_{23}^t = 16.8517\ KN$

$F_{34}^t = 16.8517\ KN$



$$\frac{F_{23}^r}{F_{23}^t} = \tan 20^\circ$$

$F_{23}^r = 0.6134\ KN = F_{34}^r$

$F_{23}^t + F_{43}^t = F_{b3}^x$

$F_{b3}^x = 16.8517 \times 2$

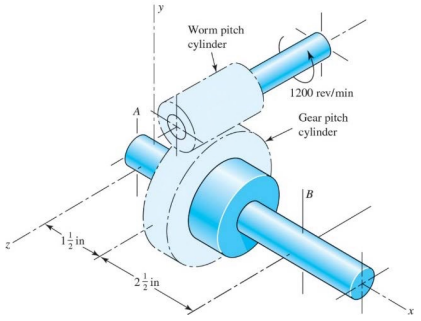
$= 33.7034\ KN$

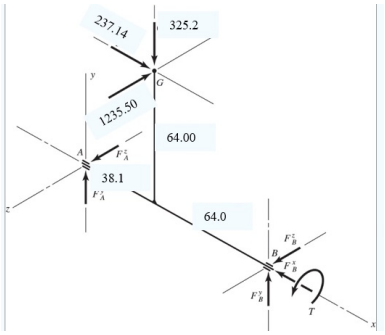
$$T = F_{34}^t \cdot \frac{d_3}{2}$$

$= 16.8517\ KN \times \frac{255}{2} = 2148.5875\ N.m$

Title :

7. A 2-tooth right-hand worm transmits 750 watts at 1200 rev/min to a 30-tooth worm gear. The gear has a transverse module of 4mm and a face width of 25mm. The worm has a pitch diameter of 50mmand a face width of 64mm The normal pressure angle is $14\frac{1}{2}^{\circ}$.
(*a*) Find the axial pitch, the center distance, the lead, and the lead angle.
(*b*) The below figure is a drawing of the worm gear oriented with respect to the coordinate system described earlier in this section; the gear is supported by bearings *A* and *B*. Find the forces exerted by the bearings against the worm-gear shaft, and the output torque.
Assumption: the coefficient of the friction for worm gearing $f = 0.03$.





$p_x = 4 \cdot \pi = 12.566$ mm.

$d_w = 50$ mm $\qquad d_G = N_G \cdot m$

$= 4 \times 30 = 120$ mm

$$C = \frac{50 + 120}{2} = 85.$$

$L = p_x N_w$

$= 12.566 \times 2$

$= 25.132$.

$$\tan\lambda = \frac{25.132}{\pi \cdot 50} = 0.16.$$

$\lambda = \tan^{-1}(0.16) = 9.09^{\circ}$

$$W_t = 60000 \frac{H}{\pi d n}$$

$$= 60000 \frac{750 \times 10^{-3}}{\pi \cdot 50 \cdot 1200}$$

$$= 0.2387 \ KN = 238.7 \ N.$$

$$W^x = W_t$$

$$238.7 = W[\cos(14\tfrac{1}{2}) \sin(\phi 0) + 0.03 \cos(\phi 0)]$$

$$W = \frac{238.7}{\cos(14\tfrac{1}{2}) \sin(\phi 0) + 0.03 \cos(\phi 0)}$$

$$= 1307.4 \ N$$

$$W^y = 1307.4 \cdot \sin(\phi 0)$$

$$= 206.55 \ N$$

$$W^z = 1307.4 [\cos(14\tfrac{1}{2}) \cdot \cos(\phi 0) - 0.03 \times \sin(\phi 0)]$$

$$= 1243.66 \ N.$$

$$W_{Ga} = -W^x = -238.7 \ N$$

$$W_{Gr} = -W^y = -206.55 \ N$$

$$W_{Gt} = -W^z = -1243.66 \ N.$$