MET 4501 Fall 2024: Practice In-Class Quiz 7 Name: SOLUTION

INSTRUCTIONS:

This quiz is open-book and open-note, and you may work with your classmates. Please answer all questions and show all of your work.

GIVEN:

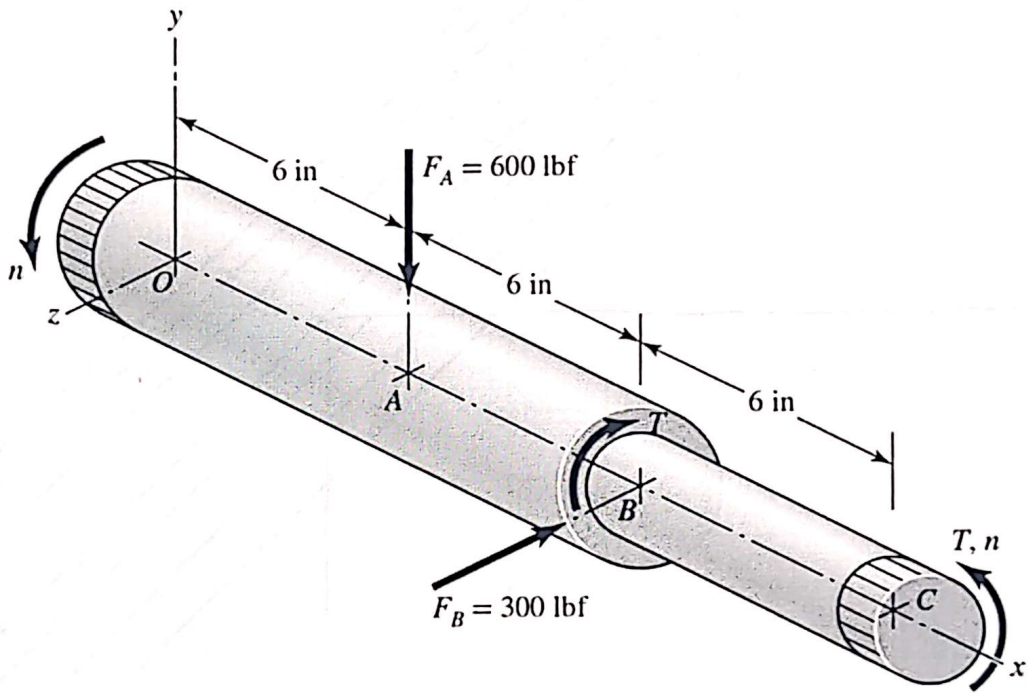
The steel shaft shown is supported by journal bearings at locations *O* and *C*. Dimensions are in inches.

The lubricant is SAE 40 and the operating temperature is 200 °F.

The shaft rotates at 1200 rpm.

The shaft diameter at *O* is 3.250 in and the bearing (bore) diameter is 3.256 in. The bearing is 3 in long.

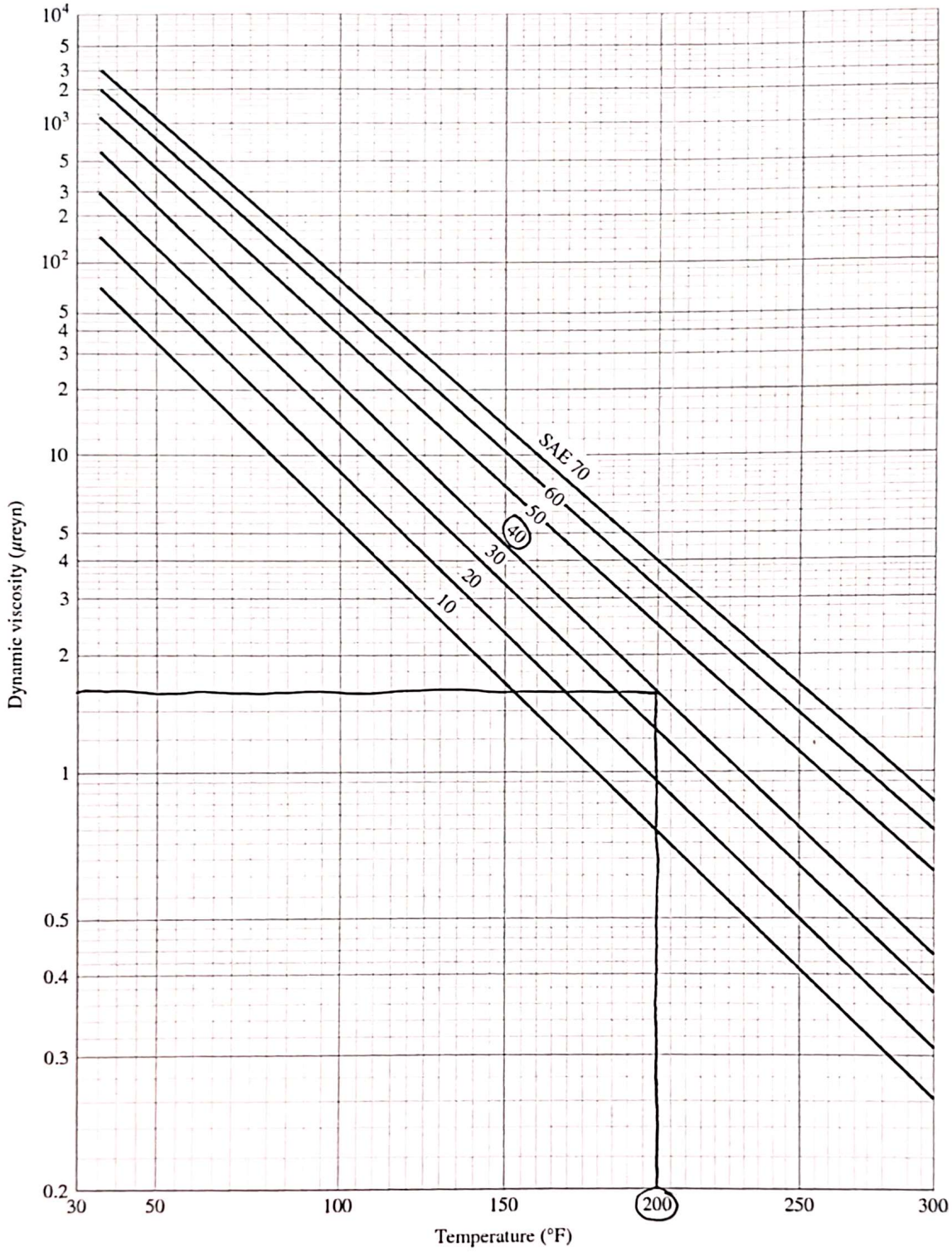
Note that 1 reyn = 1 lbf·s/in^2= 1 psi·s



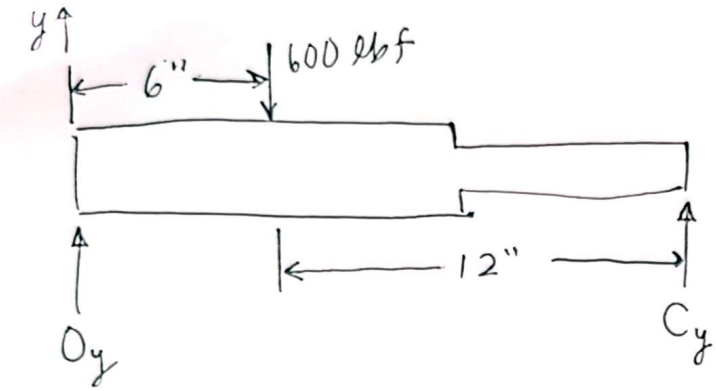
FIND:

(a) The radial load supported by bearing *O*.

(b) The Sommerfeld number S for the bearing at *O*.

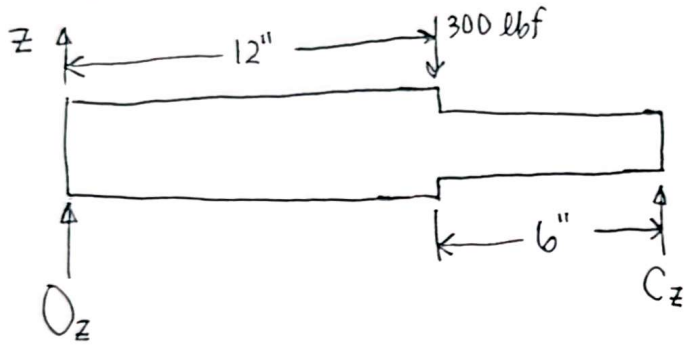


(a)



$$\Sigma M_C = 0 \rightarrow (600\ lbf)(12") - O_y(18") = 0$$

$$O_y = 400\ lbf$$



$$\Sigma M_E = 0 \rightarrow (300\ lbf)(6") - O_z(18") = 0$$

$$O_z = 100\ lbf$$

$$|\vec{F}_O| = \sqrt{O_y^2 + O_z^2} = \sqrt{400^2 + 100^2}$$

$$= \underline{412.3\ lbf}$$

(b) $S = \left(\frac{r}{c}\right)^2 \frac{\mu N}{P}$

$$r = \frac{3.25\ in}{2} = 1.625\ in$$

$$c = \frac{3.256" - 3.25"}{2} = 0.003\ in$$

$$\mu = 1.6\ \mu reyn$$

$$N = 1200 \frac{rev}{min} \cdot \frac{1\ min}{60\ s} = 20 \frac{rev}{s}$$

$$P = \frac{W}{2rl} = \frac{412.3\ lbf}{(3.25\ in)(3\ in)} = 42.29\ psi$$

$$S = \left(\frac{1.625\ in}{0.003\ in}\right)^2 \frac{1.6 \times 10^{-6}\ psi \cdot s \cdot 20\ rev/s}{42.29\ psi}$$

$$= \underline{0.222}$$