

Homework for Lecture 8

Problem 8.1

3.36 in Rao

(Ans: 1.696×10^{-4} m)

Problem 8.2

The crude-oil-pumping rig shown in the accompanying figure is driven at 20 rpm, and the stroke of the top of the rod at A is 45 in. The inside diameter of the well pipe is 2 in., and the diameter of the pump rod is 0.75 in. The length of the pump rod and the length of the column of oil lifted during the stroke are essentially the same, and equal 6000 ft. During the downward stroke a valve at the lower end of the pump rod opens to let a quantity of oil into the well pipe, and the column of oil is then lifted to obtain a discharge into the connecting pipeline at B. Thus, the amount of oil pumped in a given time depends upon the stroke of the lower end of the pump rod. Assuming the upper end of the rod is essentially sinusoidal with a stroke of 45 in., and that the damping factor for the system is $\zeta = 0.5$, determine the output of the well in barrels per hour (bbl/hr). What would the output of the well be if the pump rod were rigid? The following data are pertinent to the solution:

- Specific gravity of crude oil = 0.9
- Specific weight of steel = 490 lbf/ft^3
- Specific weight of water 62.4 lbf/ft^3
- 1 bbl of oil = 42 gal
- $1 \text{ ft}^3 = 7.481 \text{ gal}$

Answer: 21.7 bbl/hr (flexible), 15 bbl/hr (rigid)

