

Problem 7.28 (In Excel)

The time, t , for a flywheel, with moment of inertia I , to reach angular velocity ω , from rest, depends on the applied torque, T , and the following flywheel bearing properties: the oil viscosity μ , gap δ , diameter D , and length L . Use dimensional analysis to find the Π parameters that characterize this phenomenon.

Given: Time to speed up depends on inertia, speed, torque, oil viscosity and geometry

Find: Π groups

Solution

We will use the workbook of Example Problem 7.1, modified for the current problem

The number of parameters is: $n = 8$

The number of primary dimensions is: $r = 3$

The number of repeat parameters is: $m = r = 3$

The number of Π groups is: $n - m = 5$

Enter the dimensions (**M, L, t**) of the repeating parameters, and of up to four other parameters (for up to four Π groups). The spreadsheet will compute the exponents a , b , and c for each.

REPEATING PARAMETERS: Choose ω, D, T

	M	L	t
ω	-1		
D	1		
T	1 2 -2		

Π GROUPS:

Two Π groups can be obtained by inspection: δ/D and L/D . The others are obtained below

	M	L	t		M	L	t	
t	0	0	1		μ	1	-1	-1
$\Pi_1:$	$a =$	1			$\Pi_2:$	$a =$	1	
	$b =$	0				$b =$	3	
	$c =$	0				$c =$	-1	