

# 2.000 Homework # 4: Machine components

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**Name:** \_\_\_\_\_ **Weight: 100 pts**

Due: Day 10 at beginning of lecture (date differs from original syllabus)

You must return your screwdriver in working condition!

## 1. Screw driver stall torque

a). [10] Perform an experiment to determine if the stall torque listed by the manufacturer is correct. Provide a sketch of your experimental set up, the details of your calculation and the reasoning you used to make your decision about the manufacturer's claim.

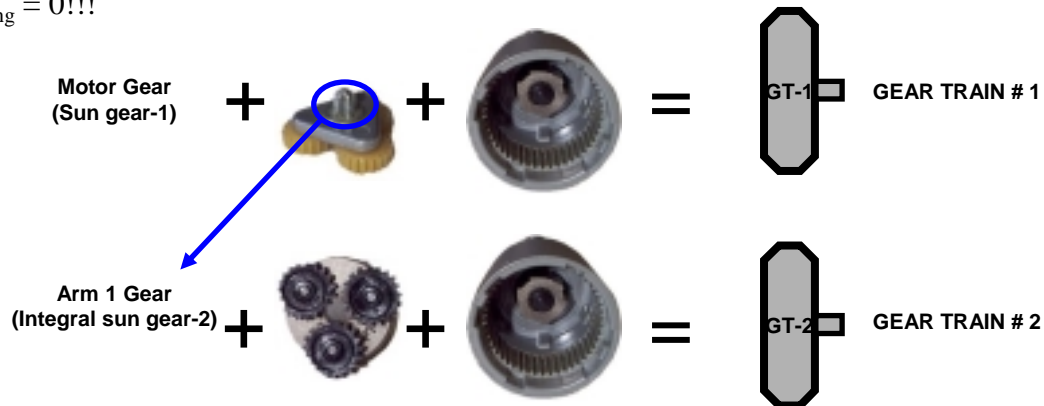
b). [5] Perform an experiment to determine if the no-load speed listed by the manufacturer is correct. Provide a sketch of your experimental set up, the details of your calculation and the reasoning you used to make your decision about the manufacturer's claim.

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## 2. Train ratio of combined planetary gear trains

a.). [5] Find  $T_r$  of the cordless screw driver. NOTE:  $\omega_{in} = \omega_{motor}$  and  $\omega_{out} = \omega_{screw\ driver\ shaft}$ .

1. Begin by solving for the speed of the arm in the first gear train as function of  $s_1$
2.  $\omega_{a1} = \omega_{s2}$  and  $\omega_{a2} = \omega_{screw\ driver\ shaft}$
3.  $\omega_{ring} = 0!!!$



b). [5] Perform an experiment to verify your calculation. Provide 1-2 sentence explanation of your experiment and the result.

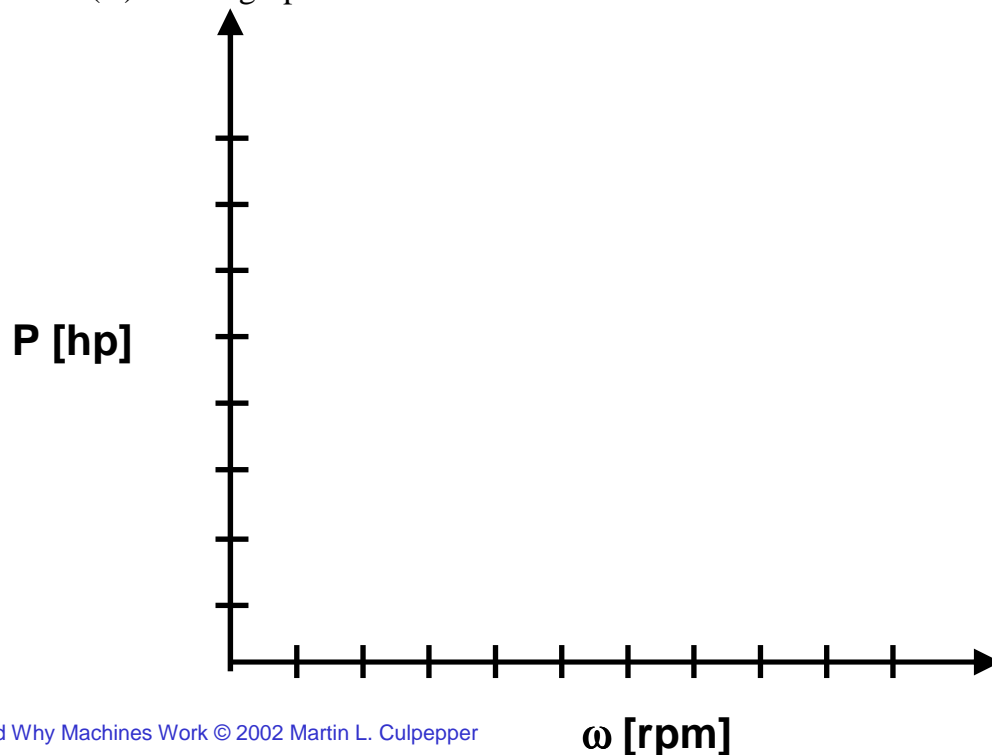
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## 3. Cordless screw driver power-speed characteristics

- a). [5] Use the no-load speed and stall torque you found in problem 1 to develop an expression for  $P(\omega)$ . The only variables in this equation should be  $P$  and  $\omega$ . **Units must be consistent (i.e. use units of rpm and hp).**

- b). [5] Plot  $P(\omega)$  on the graph below. **PAY ATTENTION TO THE UNITS!!!**



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## 4. DC Permanent magnet motor power-speed characteristics

- a). [10] Assume the screw driver is 100% efficient, what is  $P(\omega)$  of the motor? You will find the train ratio and control volume on the following page very helpful in solving this problem.

- b). [5] Plot  $P(\omega)$  on the graph below. **PAY ATTENTION TO THE UNITS!!!**

