

BE1010 – Fall 2004

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Quiz # 5 (15 minutes. You may use only the course webpage)

**Choose only one problem and solve!**

- I. (10 points) Consider the following perfect vertical bracing of the Lego geared motor. Find the two heights  $h1$  &  $h2$ ) of the motor in Lego units. Show detailed work.

Vertical beam from peg to peg = 30 Lego units

Subtract three horizontal beams(12 units from hole to hole) = 18 Units

**H2= 18 Lego Units**

Subtract 2 lego plates (2 plates \* 2 units/plate= 4 units) = 14 units

**H1= 14 Lego Units**

- II. (15 points) Consider the following Lego wheel assembly utilizing a differential gear. Let the wheel radius be  $r$  and the distance between the wheels be  $L$ . The wheels are to drive in a circular trajectory where the outer wheel travels along a circle of radius  $R$  (assume  $R > L$ ). Derive an expression for the number of turns of the differential gear casing as a function of  $R$ ,  $r$ , and  $L$ .

Wheel circumference:  $2\pi r$

Outer circle circumference:  $2\pi R$

Inner circle circumference:  $2\pi(R-L)$

The differential casing rotation speed (rpm)  $O_{AV}$  is related to the wheel spin speeds  $I_1$  &  $I_2$  by:

$$O_{AV} = (I_1 + I_2)/2$$

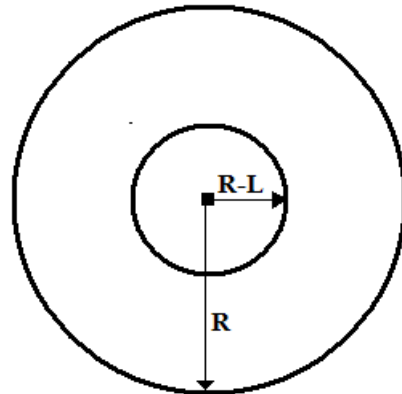
Now, multiplying the above equation by time  $t$  we get the formula for number of turns for a differential gear:

$$N_{diff} = (N_1 + N_2)/2$$

Where,

$$N_1 = (\text{outer circum})/(\text{wheel circum}) = R/r$$

$$N_2 = (\text{Inner circum})/(\text{wheel circum}) = (R-L)/r$$



$$N_{diff} = ((R/r) + ((R-L)/r))/2 = (2R-L)/2r$$