Assignment

circumference
\[ = 2\pi r \]

\[ \Delta \theta \cdot r \]

\[ \frac{\Delta \theta}{\Delta t} = \omega \]

\[ v = v_1 \text{ translational velocity} \]
\[ v_2 \text{ tangential velocity} \]

\[ v = v_1w_1 = v_2w_2 \]

since

\[ \begin{cases} r_1 < r_2 \\ \omega_1 > \omega_2 \end{cases} \]
torque = \tau \times F

torque apply on circle 1

\tau_1 = \tau_1 \times F_1

\tau_2 = \tau_2 \times F_1

Don't know \ F_1 ?

So we cons. of energy

\tau_1 \cdot W_1 = \tau_2 \cdot W_2

\frac{\tau_1}{\tau_2} = \frac{W_2}{W_1}

\frac{\tau_1}{\tau_2} = \frac{r_1}{r_2}

\frac{\tau_1}{\tau_2} = \frac{F_1 \cdot d_1}{F_2 \cdot d_2}

\tau_1 \cdot \theta_1 = \tau_2 \cdot \frac{d_2}{d_1}

\tau_1 = r_1 \cdot F_1

\theta_1 = \frac{d_2}{d_1} \cdot \theta_2
Find \( \omega \), \( \omega_2 \) and compare with the theoretical calc.

**Question 1: Find \( \omega \)**

- Formula: 
  
  \[
  \omega = \frac{\Delta \theta}{\Delta t}
  \]

- Instruction:
  
  - Attach gear #1 on motor, mark gear on the gear with sharpie
  
  - Set power at 1
  
  - Count how many revolutions the gear goes thru in 60 sec
Knowing the point of contact is same velocity on the

(or else the gears will be slipping)

\[ V_{\text{tangential on } 1} = V_{\text{tangential on } 2} \]

\[ r_1 \omega_1 = r_2 \omega_2 \]

\[ \frac{r_1}{r_2} = \frac{W_2}{W_1} \]

(Question 2:

\& couple motor gear to a difference size gear \infty

\begin{enumerate}
\item Calc. \( W_2 \) based on the value you got from \( W_1 \) (use same condition as in question 1)
\item Now using the same procedure as in question 1 & find \( W_2 \)
\item Compare the results \( W_2 \) & \( \infty \)
\[ \text{Work} = F \cdot \Delta x \quad \text{(dot product)} \]

\[ \text{Force is going same direction as } \Delta x \]
\[ \text{Therefore work} = F \Delta x \]

\[ \text{F is same between wheel} \]
\[ \text{conservation of energy} \]

\[ W_1 = W_2 \]

\[ F_1 \Delta x_1 = F_2 \Delta x_2 \]
\[ (\text{Newton's 3rd Law}) \]

\[ F_1 r_1 \theta_1 = F_2 r_2 \dot{\theta}_2 \]

\[ \text{power} = F_1 r_1 \frac{\Delta \theta_1}{\Delta t} = F_2 r_2 \frac{\Delta \theta_2}{\Delta t} = \text{power} \]

\[ \frac{F_1 r_1}{F_2 r_2} \frac{W_1}{W_2} = \frac{\dot{\theta}_1}{\dot{\theta}_2} \frac{W_1}{W_2} \]

\[ (F_1 r_1) W_1 = (F_2 r_2) W_2 \]

\[ \frac{\dot{\theta}_1}{\dot{\theta}_2} \frac{W_1}{W_2} \]

**Question 3:**

\[ \frac{\dot{\theta}_2}{\dot{\theta}_1} = \frac{W_1}{W_2} = \frac{r_2}{r_1} \]

(eg. 2)

\( \text{(a) calculate the ratio of output torque } \frac{\dot{\theta}_2}{\dot{\theta}_1} \)

\( \text{use same given condition in input torque } \frac{\dot{\theta}_1}{\dot{\theta}_2} \)
(c) Do the same by using ratio $\frac{V_2}{V_1}$ obtained from question 2.

(c) Compare your results in a & b. What conclusion can you make from this?

- Larger torque is created by output having a larger gear coupled to a smaller input gear.

- Angular velocity is smaller when larger torque is produced.