

1. (6 points) For the machine shown on the monitor, identify the four parts indicated:

- A. ___Commutator_____ B. ___Armature windings or coils ___
C. ___Bearing_____ D. ___Field winding or coil _____

2. (10 points) A separately excited DC motor operated with a terminal voltage of 180V and an armature current of 50A. Its armature resistance is 0.14 Ohms and its field resistance is 300 Ohms. The field voltage, being separately excited, is 240V. Mechanical losses are insignificant. Its saturation curve at 3000 RPM is given on the other side of this page.

a. (5 points) Find its speed of rotation.

$$V_A := 180 \cdot V \quad I_A := 50 \cdot A \quad R_A := 0.14 \cdot \Omega \quad R_F := 300 \cdot \Omega \quad V_F := 240 \cdot V$$

Find the field current.

$$\omega_0 := 3000 \cdot \left(\frac{2 \cdot \pi}{60} \right) \cdot \frac{\text{rad}}{\text{sec}} = 314.159 \cdot \frac{\text{rad}}{\text{sec}}$$

$$I_F := \frac{V_F}{R_F} = 0.8 \text{ A}$$

At 3000 RPM and 0.8 Amps Field, the generated voltage E_A is 250V.

$$E_{A0} := 250 \cdot V$$

Find the generated voltage at the operating conditions.

$$E_A := V_A - I_A \cdot R_A = 173 \text{ V}$$

Set up the ratio of generated voltage and speed.

$$\frac{E_A}{E_{A0}} = \frac{K\Phi\omega}{K\Phi\omega_0}$$

Solve for ω .

$$\text{RPM} := \frac{\text{rad}}{\text{sec}} \cdot \frac{2 \cdot \pi}{60}$$

$$\omega := \frac{E_A \cdot \omega_0}{E_{A0}} = 217 \cdot \frac{\text{rad}}{\text{sec}}$$

$$\omega = 2076 \cdot \text{RPM}$$

b. (2 points) Find $K\Phi$, its machine constant.

$$K\Phi := \frac{E_{A0}}{\omega_0} = 0.796 \cdot V \cdot \text{sec}$$

$$K\Phi = 0.796 \cdot \frac{\text{N} \cdot \text{m}}{\text{A}}$$

c. (3 points) Find its torque.

$$\tau := K\Phi \cdot I_A = 39.789 \cdot \text{N}\cdot\text{m}$$

3. (2 points) If we raise the armature current by adding load, the speed of our separately excited machine will _____ decrease _____.
(increase / remain the same / decrease)
4. (2 points) If we raise the field current of our machine by increasing the field voltage, the speed of our separately excited machine will _____ decrease _____.
(increase / remain the same / decrease)

