Problem 1.21 in the text.

The linear machine shown in Firgure P1-15 has a magnetic flux density of 0.5T directed into the page, a resistance of 0.25 ohms, a bar length of 1.0 meters, and a battery voltage of 100V.
a. What is the initial force on the bar at starting? What is the initial current flow?
b. What is the no-load steady state speed of the bar?
c. If the bar is loaded with a force of 25N opposite the direction of motion, what is the new steady state speed? What is the efficiency of the machine under these circumstances?

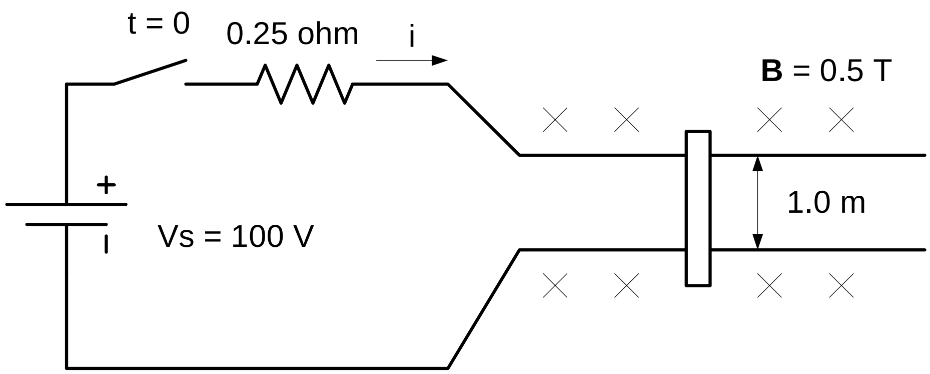

Figure P1-15
Linear Machine for Problem 1.21

Part a. We assume negligible inductance in the loop.

$f = B \cdot l \cdot i \qquad B := 0.5 \cdot T \qquad l := 1.0 \cdot m \qquad V_s := 100 \cdot V \qquad R_s := 0.25 \cdot ohm$

$$i := \frac{V_s}{R_s} \qquad i = 400\,A$$

$$f := B \cdot l \cdot i \qquad f = 200\,N$$

Part b. We assume negligible losses to friction; the only losses are in the resistance. Steady state means that the generated voltage in the bar is the same as the input voltage. As a result, the current goes to zero in steady state.

$e = B \cdot l \cdot v \qquad e := 100 \cdot V \qquad B = 0.5\,T \qquad l = 1\,m$

$$v := \frac{e}{B \cdot l} \qquad v = 200\,\frac{m}{s}$$

Part c. The given force must be generated by a current in the given field.

$$F_l := 25 \cdot N \qquad i := \frac{F_l}{B \cdot l} \qquad i = 50\,A$$

From here, we find the generated voltage and the velocity.

$e := V_s - i \cdot R_s$ $\qquad e = 87.5\,V$

$v := \dfrac{e}{B \cdot l}$ $\qquad v = 175\,\dfrac{m}{s}$

Problem 2.

Identify the following parts of a dc machine:

Armature
Field
Stator
Rotor
Leads or cables
Terminals
Brushes
Field pole
Field winding
Field magnets
Frame
End caps
Commutator
Armature windings
Teeth
Slots
Bearings
Shaft

These machine parts are best shown by the student on the recorded lesson.