Ch. 13 Prob 73

$I_F = 0.50\,A$ (full speed) $\quad V = 120\,V$

$I_s = 2.00\,A$ (starting)

$R_A = 10\,\Omega$ (armature coils)

a) Find the resistance of the field coils.

Assume the armature & field coils are in series. When starting, there is no back emf so all of the external voltage drops across the coils.

so $V = I_s(R_A + R_F) \rightarrow \frac{V}{I_s} - R_A = R_F$

$$R_F = \frac{120\,V}{2.0\,A} - 10\,\Omega = \boxed{50\,\Omega}$$

b) Find the back emf when the motor is running.

The total voltage experienced by the coils is the difference between external voltage and the emf of the coils.

so $V - \mathcal{E} = I_s(R_A + R_F)$

$$V - I_s(R_A + R_F) = \mathcal{E}$$

$$\mathcal{E} = 120 - (0.50\,A)(10\,\Omega + 50\,\Omega) = \boxed{90\,V}$$

c) Find the back emf when 1.0 A current is drawn.

$$\mathcal{E} = V - I(R_A + R_F)$$

$$= 120\,V - (1.0\,A)(10\,\Omega + 50\,\Omega)$$

$$\boxed{\mathcal{E} = 60\,V}$$