ECE 3600 homework # 19

b

1. 17.31. A 12.6-V. permanent-magnet-field dc motor is used to power a window lift in an automobile. The motor requires 10.2 A and runs at 1180 rpm when lifting the window, but requires only 7.6 A and turns at 1220 rpm when lowering the window (with reversed voltage, current, and direction of rotation). Assume friction and rotational losses are proportional to speed and hence can be represented by a constant loss torque.

   a) Determine the armature resistance.

   b) Determine the torque required to lift the window, excluding the effects of friction.

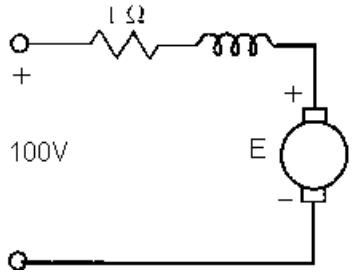
   Hint: $\tau_{up} = \tau_{lift} + \tau_{fiction}$ and $\tau_{dn} = -\tau_{lift} + \tau_{fiction}$ so: $\tau_{lift} = \frac{\tau_{up} - \tau_{dn}}{2}$

2. 17.35. An engineer purchased a dc motor with a permanent-magnet field. The nameplate gives 90 V and 9.2 A but does not give the rated power. The engineer applied 90 V to the unloaded motor and measured the input current (0.5 A) and speed (1843 rpm). The engineer then loaded the motor mechanically until the current reached 9.2 A and measured the speed (1750 rpm). The engineer assumed that rotational losses were constant, and determined from these data the output power at nameplate load. What was the result?

3. 17.37. The circuit at right shows a series-excited motor. Ignore rotational losses.

   a) Find the current for 1 hp out.

   b) If the load torque is decreased by a factor of 2, what is the new current, assuming no magnetic saturation?



4. 17.39. A series-connected dc motor runs at 1200 rpm with an input voltage of 180 V and an output power of 1 hp. Ignore all losses in this problem. Fill in the table at right.

   Hint: The key here is to ignore R_A and R_S as well and show that P_{conv} is proportional to $\frac{V_T^2}{n}$

Voltage (V)	Power (hp)	Speed (rpm)
180	1	1200
120	0.5	_____
120	_____	1800
_____	1	800

5. 17.41. An 80-V, series-excited dc motor draws 8 A at an output torque of 6 N-m. Find the torque at a speed of 1200 rpm. Ignore losses and magnetic nonlinearities.

   Hint: Again ignore R_A and R_S and modify the proportionality from the previous problem

6. 17.51. A hand-held drill powered by a universal motor runs at 1200 rpm with no load. With a 3/8-in. drill bit in operation, the drill slows down to 900 rpm. Ignore electrical loss and also the effects of inductance. Mechanical loss is assumed to be proportional to speed. Determine at the slower speed the following ratio: the output power to the bit divided by the rotational loss at the lower speed.

   Hint: Again ignore R_A and R_S and show that $I_A \cdot n$ = constant

Answers

1. a) $0.145\cdot\Omega$ b) $0.117\cdot Nm$
2. $741\cdot W$ $(739\cdot W)$ closer
3. a) $8.12\cdot A$ b) $5.74\cdot A$
4. $1067\cdot rpm$ $0.296\cdot hp$ $147\cdot V$
5. $4.32\cdot Nm$
6. 0.778