Rotary DC Motors

(1) A permanent magnet DC motor with $K_v = 0.7$*V-s* is tested under the following two conditions.

Test 1: Apply 120*V*; motor is unloaded, $I_a = 1$*A* and ω=160 *rad/s*

Test 2: Apply 120*V:* increase load torque until $I_a = 2$*A* and ω=148.6 *rad/s*

Find the torque due to rotational loss and the torque due to the load in test 2 assuming rotational power loss is linear with speed.

(2) A permanent magnet DC motor is rated for 24*V* and 2*A* at 1500 *rpm*. The motor is 85% efficient at rated conditions. Assume no rotational losses. Find K_v. Find the back EMF at 1500 *rpm*.

(3) A permanent magnet DC motor has a machine constant, $K_v = 0.5$*V-s*. The no-load torque is 1.0 *N-m* assuming rotational power loss is linear with speed. Determine the mechanical power developed by the unloaded motor at 1250 *rpm*. Find the back EMF at 1250 *rpm* and the armature current.