ME333 Introduction to Mechatronics
Quiz 9: Gears and Brushed DC Motor Control

Name Sean Morton

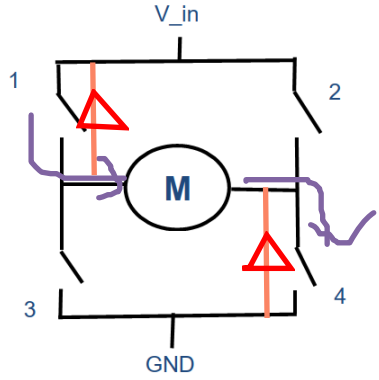
No books, computers, or calculators!

1. Gears are often used to reduce motor speed and increase output torque. List two complications that gears add to a system and why they are disadvantageous:

   Friction: when gear teeth slide against each other, they rub together and dissipate energy via friction. This reduces the overall efficiency of the system.

   Backlash: To reduce friction, gear teeth are usually touching each other in a loose way, so the teeth touch in one place rather than two. This means if you've ben rotating a gear clockwise and then reverse direction to counterclockwise, it will take a second for the gear's teeth to engage in the other direction. This reduces accuracy of angular rotation.

2. Draw a motor connected to 4 switches in an h-bridge configuration, label the switches 1 through



   Flyback diodes shown in red
   Switches 1 and 4 have been closed for a long time, and will be opened

3. Pretend a pair of switches has been closed for a long time while the motor has been stalled. The switches are then opened. Add two flyback diodes to protect the two switches from sparks to your picture in #1, clearly showing which switches just opened and the relative position of the diodes that protect them.

4. Why does a current control loop typically occur much more frequently than a position control loop?

   Position control is limited by physical concepts like mass and inertia, which cause position to change slowly in the real world. Current, however, can change instantaneously, which means to achieve a desired waveform, current should be updated much more frequently.