PPG2013 Midterm 5

1. In this problem we will work through the static model of congestion when there are some people who are rich and some people who are poor. The inverse demand for traveling on the highway for the rich is $D_r(q_r) = 150 - 2 \cdot q_r$. This function tells us how much the q_rth rich driver values traveling on the road; it also tells us what total cost of travel will cause q_r drivers to use the road (i.e., to get exactly 20 rich drivers to use the road, the total cost of travel must be \$110). The inverse demand for traveling on the highway for the poor is $D_p(q_p) = 100 - 4 \cdot q_p$. The rich value their time at \$2 per minute, while the poor value their time at \$1 per minute. If $q = q_r + q_p$ drivers use the road, then travel times (measured in minutes) are $T(q) = 20 + 4 \cdot q$.

   (a) (4 points) Consider when there is no toll. Write down an equation that defines how many rich drivers use the road. Recall that drivers will continue to get on the road until their private benefit equals their private cost. Write down a similar