A farm tractor manufacturing company called HNC in Detroit, Michigan is using a special environment friendly engine in its brand new tractor model. The tractor sales for this model show a fairly steady demand of 5600 tractors per year. HNC purchases these engines from an engine producer in Detroit area at a price of $4000. This supplier sends the engines in batches of 100 immediately (zero lead time) when HNC orders. It costs HNC $10,000 to place an order. Inventory holding costs are based on an annual interest rate of 20% and HNC works 50 weeks in a year.

(i) (1 point) Find the current cycle time between the orders.

(ii) (2 points) Suppose there is a positive lead-time for delivery of the engines from supplier. Calculate the reorder point R when this lead time is:
   a. 0.5 week
   b. 1 week

(iii) (4 points) HNC realized that ordering batches of 100 is not the optimal policy. Find the optimal number of engines to order as well as the optimal cycle time between the orders.

(iv) (2 points) How much more does it cost HNC by using Q=100 instead of the EOQ (c)?

(v) (7 points) Suppose that the engine supplier is offering a quantity discount applied to all units with the following schedule:

\[
 C(Q) = \begin{cases} 
 4000Q & \text{for } \leq Q < 200 \\
 3800Q & \text{for } 200 \leq Q < 400 \\
 3500Q & \text{for } 400 \leq Q 
\end{cases}
\]

   a. What is the optimal order quantity in this case?
   b. What is the average total cost including purchasing cost?

(vi) (4 points) Now, suppose that HNC decided to produce engines in-house. The production capacity allows HNC to produce 11,200 engines per year. The cost of starting a production run is $10,000 but each engine cost them half the price of outsourcing (namely $2000/engine).
   a. What is the optimal batch size of each run for HNC?
   b. What is the cycle time if produced in house? What is the percentage of production uptime in a cycle time?
   c. What is the maximum level of inventory this new system can reach?
   d. What is the average cost of the optimal system for this new case?