1. (a) The economic order quantity is found by:

\[ Q^* = \sqrt{\frac{2K\lambda}{Ic}} = \sqrt{\frac{2 \times 20 \times 3,600}{0.25 \times 3}} = 438.18 \text{ units.} \]

The optimal total annual cost is:

\[ K\lambda + \frac{1cQ^*}{2} + \frac{3 \times 3,600 + 0.25 \times 3 \times 438.18}{2} = $11,128.63 \]

(b) The reorder point:

\[ R = \tau\lambda = \frac{5}{365} \times 3,600 = 49.32 \text{ units.} \]

(c) The cycle time:

\[ T = \frac{Q^*}{\lambda} = \frac{438.18}{3,600} = 0.1217 \text{ years} = 44.42 \text{ days.} \]

(d) The cycle time does not change based on the lead time. However, the reorder point will change. The fractional part of the remainder for \( \frac{T}{\frac{60}{365}} = 0.35 \) is 0.35 cycle, which equals 0.35 \times 44.42 = 15.55 days. Therefore \( R = 15.55 \times \frac{3,600}{365} = 153.35 \text{ units} \) is the new reorder point.

(e) Since the total cost function is convex and 30 days \( \leq T \leq 60 \) days, we need to try cycle times of 30 and 60 days to see which results in less cost. For \( T = 30 \) days, we get:

\[ Q = \lambda T = 3,600 \times \frac{30}{365} = 295.89 \text{ units.} \]

Total cost \[ \frac{K\lambda}{Q} + \frac{1cQ}{2} = \frac{20 \times 3,600}{295.89} + \frac{0.25 \times 3 \times 295.89}{2} = $354.29. \]

For \( T = 60 \) days:

\[ Q = \lambda T = 3,600 \times \frac{60}{365} = 591.78 \text{ units.} \]

Total cost \[ \frac{K\lambda}{Q} + \frac{1cQ}{2} = \frac{20 \times 3,600}{591.78} + \frac{0.25 \times 3 \times 591.78}{2} = $343.58. \]

Hence a cycle time of 60 days is optimal under this constraint, with an order quantity of 591.78 units.

2. First, we find the first EOQ value that is realizable, starting from the EOQ at the lowest unit price:

\[ Q^{(3)} = \sqrt{\frac{2K\lambda}{1c_3}} = \sqrt{\frac{2 \times 150 \times 520}{0.20 \times 200}} = 62.44 \text{ units, which is not realizable.} \]

\[ Q^{(2)} = \sqrt{\frac{2K\lambda}{1c_2}} = \sqrt{\frac{2 \times 150 \times 520}{0.20 \times 212.5}} = 60.59 \text{ units, which is not realizable.} \]

\[ Q^{(1)} = \sqrt{\frac{2K\lambda}{1c_1}} = \sqrt{\frac{2 \times 150 \times 500}{0.20 \times 225}} = 58.88 \text{ units, which is realizable.} \]

Next, we compare the annual cost at the EOQ corresponding to \( c_1 = $225 \) per unit to the costs at the breakpoints \( Q = 150 \) and \( Q = 500 \). Let \( G(Q) \) denote the total annual cost (including variable
purchase cost) under the order quantity \( Q \). We have:

\[
G(58.88) = 520 \times 225 + \frac{520 \times 150}{58.88} + \frac{0.2 \times 225 \times 58.88}{2} = $119,649.53 \text{ per year},
\]

\[
G(150) = 520 \times 212.5 + \frac{520 \times 150}{150} + \frac{0.2 \times 212.5 \times 150}{2} = $114,207.50 \text{ per year},
\]

\[
G(500) = 520 \times 200 + \frac{520 \times 150}{500} + \frac{0.2 \times 200 \times 500}{2} = $114,156.00 \text{ per year}.
\]

Thus, the optimal order quantity is 500 units.