1. (i)

K = $10,000

C = $4,000

D = 5600 / year

Cycle time = T = Q / D = 100 / 5600 = 1/56 year = 0.0179 years = 0.895 weeks

(ii)

a. 0.5 weeks = 0.01 years. Thus R = (5600) * (0.01) = 56

b. 1 week = 0.02 years. Since 0.02 > 0.0179 we find the ratio

\[ \frac{0.02}{0.0179} = 1.117 \]

and use only the remainder of this ratio, which is 0.117 cycles that is equal to

\[ (0.117) * (0.0179) = 0.0021 \text{ years.} \]

Thus R = (0.0021) * (5600) \( \cong \) 12

(iii). EOQ model for HNC is as follows:

\[ Q^* = \sqrt{\frac{2DK}{C}} = \sqrt{\frac{2 * 5600 * 10000}{4000 * 0.2}} \cong 375 \]

Optimal cycle time \( T^* = \frac{Q^*}{D} = \frac{375}{5600} = 0.067 \text{ years} = 3.35 \text{ weeks} \)

(iv). \[ G = \frac{D}{Q^*} K + \frac{Q^*}{2} h = \frac{5600}{375} 10000 + \frac{375}{2} 800 = $299,333 \]

\[ \frac{G(Q)}{G^*} = \frac{1}{2} \left[ \frac{Q^*}{Q} + \frac{Q}{Q^*} \right] = \frac{1}{2} \left[ \frac{375}{100} + \frac{100}{375} \right] \cong 2. \]

Therefore, the total cost of using Q = 100 instead of optimal \( Q^* = 375 \) is two times the optimal cost. In the previous case HNC was paying twice as much to its inventory management of engines.
According to the discount schedule given, the largest realizable EOQ value is 400 with \( c_2 = \$3500 \). Since there is no breakpoint greater than 400, we can say that this gives the minimum cost and \( Q^* = 400 \) is optimum.

a. \( Q^* = 400 \)

b. \( G(400) = Dc_2 + \frac{DK}{Q} + \frac{Ic_2 Q}{2} \)
\[ = 5600 \cdot 3500 + \frac{5600 \cdot 10000}{400} + (0.2) \cdot 3500 \cdot \frac{400}{2} = \$19,880,000 \]

(vi) \( P = 11,200 \)

a. maximum inventory Level \( H = \frac{Q}{P} (P - D) \)
\( G(Q) = \frac{K}{T} + \frac{H}{2} h = \frac{D}{Q} K + \frac{Q}{2} h (1 - \frac{D}{P}) = \frac{D}{Q} K + \frac{Q}{2} h' \)
\[ h' = h (1 - \frac{D}{P}) = h (1 - \frac{5600}{11200}) = \frac{h}{2} = \frac{0.2 \cdot 2000}{2} = 200 \]

Then \( Q^* = \sqrt{\frac{2DK}{h'}} = \sqrt{\frac{2 \cdot 5,600 \cdot 10,000}{200}} \approx 749 \)

b. \( T^* = Q^*/D = 749 / 5600 = 0.13375 \text{ years} \)
\( T_1 = Q/P = 749 / 11200 = 0.066875 \text{ years} \)
\( T_1/T = 0.5, 50\% \text{ of the time production is running.} \)

c. \( H = \frac{Q}{P} (P - D) = \frac{749}{11200} (11200 - 5600) \approx 375 \)

d. \( G(Q^*) = \frac{D}{Q^*} K + \frac{Q^*}{2} h' = \frac{5600}{749} \cdot 10,000 + \frac{749}{200} \approx \$149,666 \)
2. a. PC industry and HP

b. **Holding cost:** money tied up to the inventory, physical cost of inventory in warehouses …etc.

**Component devaluation cost:** The time value of components as they constantly loose value.

**Price protection cost:** The difference paid to the channel partners when a price drop occurs.

**Product return cost:** Due to agreements or for earning the reliability of the partners, the cost of buying the unsold items back.

**Obsolescence cost:** Costs introduced during fire sales, high advertisement expenditures and deep price cuts due to about-to-be-discontinued products.

c. 5 scenarios are considered, the first one being the status quo. 2 and 3 are two step supply chains which keep the current basics of the scenario 1. Scenario number 4 and 5 are 1 step supply chains where the difference between these come from selecting a single advanced manufacturing plant as in scenario 5 or several plants as in scenario 4. HP finally implemented the 5th scenario. Because when the IDC metrics are employed, the savings of one step supply chain is revealed. The reason of selecting number 5 over 4 is that the risks associated with multiple plants were really high, plus it is more likely to loose control of IDCs in scenario 4. Therefore the selection of scenario 5 is justified due to its simplicity and being less risky.

d. Product level managers are now more flexibly in determining the true needs of their products within their own supply chain after considering the contributions of each IDC to the bottom line. Instead of simply cutting the inventory by 20%, now they can give better decisions, which eventually lead to better utilization of the overall supply chain considering all inventory related costs. They might now increase some costs but overall they are more confident since they are reducing the overall costs. The IDC metrics also treats each product uniquely as based on its own cost structure, which is an absolute advantage since it now enables the company to explore the improvement areas more clearly.