1. **(10 points)** TNBB computer manufacturer has been producing computers for 4 years. The computers have a common component which has been outsourced before. Now the company has the opportunity to produce that component itself. However, new equipment, which costs $60,000, is required for the production of this component and the marginal cost after acquiring that equipment will be $20 per unit. This key component costs $80 when outsourced.

   a. Find the yearly demand rate that will enable TNBB to make the investment worth in a year.

   b. Suppose that $20 is the cost of producing the first unit of this component in-house and there is an 80% experience curve (Hint: meaning that $0.8 = 2^{-b}$ where $y(x)$ refers to the cost of producing the $x^{th}$ unit). Write an equation to compute the break-even quantity for producing in-house. (You do not need to compute the break even quantity.)

2. **(15 points)** A recently graduated industrial engineer joined a paper company. She observed the production process for a new paper product and noticed that it took 150 minutes to produce the first case of papers, whereas the 80th case took 60 minutes to produce.

   a. Using the first and the 80th units (cases) calculate an estimate for the percentage of the learning curve. (Hint: you may use the linear equation after logarithm transformation \( \ln(Y(u)) = \ln(a) - bln(u) \))

   b. What is the estimated time required to produce the 200th unit (case)?

   c. Write an equation to compute the total time required to produce the first 100 units (cases).