1.)

a)

- x_1 = the number of Collegiate backpacks produced in a week. Must be >= 0 backpacks
- x_2 = the number of Mini backpacks produced in a week. Must be >= 0 backpacks

b) Maximize: $Z = 32x_1 + 24x_2$

c)

- Fabric in square feet: $3x_1 + 2x_2$ <= 5000 sq ft of material
- Labor in minutes $45x_1 + 40x_2$ <= 84,000 minutes total
- Sales upper bounds:
  - x_1 <= 1000 dollars
  - X_2 <= 1200 dollars
- Subject to: x_1 and x_2 >= 0 backpacks

d)

- Maximize: $Z = 32x_1 + 24x_2$
- Subject to:
  - $3x_1 + 2x_2$ <= 5000
  - $45x_1 + 40x_2$ <= 84,000
  - x_1 <= 1000
  - x_2 <= 1200
  - x_1, x_2 >= 0

2.)

a)

- x_{1L} = large product
- x_{2M} = medium product
- x_{3S} = small product
- All x_i >= 0
- Where alpha is the fraction of each plant's capacity used for the product
- Plant capacities:
  - c_1 = 750 units/day
  - c_2 = 900 units/day
  - c_3 = 450 units/day

- Plant storage:
  - b_1 = 13,000 sq ft/day
  - b_2 = 12,000 sq ft/day
  - b_3 = 5000 sq ft/day
- Storage per-unit
  - Large = 20 sq ft
  - Medium = 15 sq ft
  - Small = 12 sq ft
- Demand caps
  - Large = 900 units/day
  - Medium = 1200 units/day
  - Small = 750 units/day

b)

- Maximize: $Z = 420(x_{1L} + x_{2L} + x_{3L}) + 360(x_{1M} + x_{2M} + x_{3M}) + 300(x_{1S} + x_{2S} + x_{3S})$
- Constraints:
  - $x_{1L} + x_{1M} + x_{1S} = 750\text{alpha}$
  - $x_{2L} + x_{2M} + x_{2S} = 900\text{alpha}$
  - $x_{3L} + x_{3M} + x_{3S} = 450\text{alpha}$
- Storage limits per plant:
  - Plant 1: $20_{x1L} + 15_{x1M} + 12_{x1S} <= 13{,}000$
  - Plant 2: $20_{x2L} + 15_{x2M} + 12_{x2S} <= 12{,}000$
  - Plant 3: $20_{x3L} + 15_{x3M} + 12_{x3S} <= 5000$
- Market limits or daily sales caps:
  - Large: $x_{1L} + x_{1M} + x_{1S} <= 900$
  - Medium: $x_{2L} + x_{2M} + x_{2S} <= 1200$
  - Small: $x_{3L} + x_{3M} + x_{3S} <= 750$
- $x_{ij} >= 0$; Where i = all plants, j = all unit sizes
- alpha must be between 0 and 100% ($0 <= \text{alpha} <= 1$)