Name: _____ Roll Number: _____

1. (5 points) In the binary cross-entropy function

$$L(\mathbf{W}) = -\frac{1}{N}\sum_{n=1}^{N} t_n \ln(y_n) + (1 - t_n)\ln(1 - y_n) \tag{1}$$

   (a) $\mathbf{W}$ is _____.
   (b) N is _____.
   (c) t_n is _____.
   (d) y_n is _____.
   (e) the expression inside the sum selects the -ve log probability of _____.

2. (5 points) (a) Describe the output layer of neural networks for the following problems. Your description must include i) the number of neurons, and ii) the type of activation functions.
   i. (1 point) Classification of images of chairs, sofas and tables.

   ii. (1 point) Learning a vector function $\mathbf{f} \in \mathbb{R}^{13}$.

   (b) (3 points) The softmax function for K inputs $a_1, a_2, \ldots, a_K$ is written as

$$y_k = \frac{e^{a_k}}{\sum_{j=1}^{K} e^{a_j}}$$

   Prove that the softmax function outputs multiclass probabilities. You must show that
   1. each output $y_k \geq 0$,
   2. each output $y_k \leq 1$, and
   3. sum of outputs $y_1, \ldots, y_K$ is exactly 1.