1 Derive the time evolution of the node degrees, telling us how many dances a node had.

Based on the given the probability of node i receiving a dance invitation, the rate of change in the number of dance partners a node has, or the degree of the node, over time is also

$$\frac{\eta_i}{t < \eta >}$$

To solve for the time evolution, we integrate over the amount of time that node is at the party. We add one since there is one already partying node.

$$k(t, t_i, \eta_i) = 1 + \int_{t_i}^{t} \frac{\eta_i}{t < \eta >} dt$$
$$k(t, t_i, \eta_i) = 1 + \frac{\eta_i}{< \eta >} \frac{t}{t_i}$$

2 Derive the degree distribution of nodes with attractiveness eta.

Solve for the probability that a node with attractiveness eta has degree k.

$$P(k| < \eta >) = \frac{d}{dk(t, t_i, \eta_i)} \cdot t_i \cdot P(t_i)$$
$$P(k| < \eta >) = \frac{d}{dk(t, t_i, \eta_i)} \cdot t_i \cdot \frac{1}{t}$$
$$P(k| < \eta >) = \frac{d}{dk(t, t_i, \eta_i)} \cdot te^{-\frac{<\eta>(k(t,t_i,\eta_i)-1)}{\eta_i}} \cdot \frac{1}{t}$$
$$P(k| < \eta >) = \frac{d}{dk(t, t_i, \eta_i)} \cdot e^{-\frac{<\eta>(k(t,t_i,\eta_i)-1)}{\eta_i}}$$
$$P(k| < \eta >) = \frac{\eta}{\eta_i} e^{-\frac{<\eta>(k(t,t_i,\eta_i)-1)}{\eta_i}}$$

3 If half of the nodes have eta = 2, and the other half eta = 1, what is the degree distribution of the network after a sufficiently long time?

$$\frac{1}{2}\frac{3}{4}e^{-\frac{3(k(t,t_i,\eta_i)-1)}{4}} + \frac{1}{2}\frac{3}{2}\frac{e^{-3(k(t,t_i,\eta_i)-1)}}{2}$$