

1.

$$\begin{aligned}
G_t - V_t(S_t) &= R_{t+1} + \gamma G_{t+1} - V_t(S_t) + \gamma V_t(S_{t+1}) - \gamma V_t(S_{t+1}) + \gamma V_{t+1}(S_{t+1}) - \gamma V_{t+1}(S_{t+1}) \\
&= (R_{t+1} + \gamma V_t(S_{t+1}) - V_t(S_t)) + (\gamma G_{t+1} - \gamma V_{t+1}(S_{t+1})) + (\gamma V_{t+1}(S_{t+1}) - \gamma V_t(S_{t+1})) \\
&= \delta_t + \gamma(G_{t+1} - V_{t+1}(S_{t+1})) + \gamma\alpha\delta_{t+1} \\
&= \delta_t + \gamma\alpha\delta_{t+1} + \gamma\delta_{t+1} + \gamma^2\alpha\delta_{t+2} + \gamma^2(G_{t+2} - V_{t+2}(S_{t+2})) = \dots \\
&= \sum_{k=t}^{T-1} \gamma^{k-t}(1 + \alpha)\delta_k
\end{aligned}$$