Q5.

Ans 5. equation for v_* in terms of q_*.

$$v_*(s) = \max_a \sum_{s'} \sum_r p(s', r | s, a) \left[r + \gamma v_*(s') \right]$$

$$= \max_a E\left[R_{t+1} + \gamma v_*(S_{t+1}) \,\middle|\, S_t = s, A_t = a \right]$$

$$= \max_a E_{\pi_*}\left(R_{t+1} + \gamma G_{t+1} \,\middle|\, S_t = s, A_t = a \right]$$

$$= \max_a E_{\pi_*}\left(G_t \,\middle|\, S_t = s, A_t = a \right)$$

$$= \max_{a \in A(s)} q_{\pi_*}(s, a)$$

$$\therefore \quad v_*(s) = \max_{a \in A(s)} q_{\pi_*}(s, a) .$$