Problem 1: Give a table analogous to that in Ex. 3.3, but for $p(s', r | s, a)$. It should have columns for s, a, s', r, and $p(s', r | s, a)$, and a row for every 4-tuple for which $p(s', r | s, a) > \emptyset$.

s	a	s'	$r(s,a,s')$	$p(s',r|s,a)$
high	search	high	r_{search}	α
high	search	low	r_{search}	$1 - \alpha$
low	search	high	-3	$1 - \beta$
low	search	low	r_{search}	β
high	wait	high	r_{wait}	1
low	wait	low	r_{wait}	1
low	recharge	high	$\emptyset$	1

Problem 2: Rewrite the four Bellman equations for the four value functions (v_π, v_*, q_π, q_*) in terms of the three-argument function $p(s'|s,a)$:

$$p(s'|s,a) \doteq Pr\{S_t = s' | S_{t-1} = s, A_{t-1} = a\}$$

$$= \sum_{r \in R} p(s', r | s, a)$$

and the two-argument function $r(s,a)$:

$$r(s,a) \doteq \mathbb{E}[R_t | S_{t-1} = s, A_{t-1} = a]$$

$$= \sum_{r \in R} r \sum_{s' \in S} p(s', r | s, a)$$

$$v_\pi(s) = \sum_{a \in A} \pi(a|s) q_\pi(s,a)$$

$$= \boxed{\sum_{a \in A} \pi(a|s) \sum_{s'} p(s'|s,a)[r(s,a) + v_\pi(s')]}$$

$$v_*(s) = \max_\pi v_\pi(s) = \boxed{\max_\pi \sum_{s'} p(s'|s,a)[r(s,a) + v_\pi(s')]}$$

$$q_\pi(s, a) = R_s^a + \gamma \sum_{s' \in S} P_{ss'}^a v_\pi(s')$$

$$= \boxed{\sum_{s'} p(s'|s,a)\left[r(s,a) + \gamma \sum_{a'} \pi(a'|s') q_\pi(s', a')\right]}$$

$$q_*(s,a) = \max_\pi q_\pi(s,a)$$

$$= R_s^a + \gamma \sum_{s' \in S} P_{ss'}^a \max_{a'} q_*(s', a')$$

$$= \boxed{\sum_{s'} p(s'|s,a)\left[r(s,a) + \gamma \max_{a'} q_*(s', a')\right]}$$