1. (1) $2^A = \{\emptyset, \{a\}, \{\{b\}\}, \{\{c\}\}, \{a, \{b\}\}, \{a, \{c\}\},$
$\{\{b\}, \{c\}\}, \{a, \{b\}, \{c\}\}\}$

$2^B = \{\emptyset, \{\emptyset\}, \{\varepsilon\}, \{\{\emptyset\}\}, \{\emptyset, \varepsilon\}, \{\emptyset, \{\emptyset\}\},$
$\{\varepsilon, \{\emptyset\}\}, \{\emptyset, \varepsilon, \{\emptyset\}\}\}$

(2) $A \times B = \{(a, \emptyset), (\{b\}, \emptyset), (\{c\}, \emptyset),$
$(a, \varepsilon), (\{b\}, \varepsilon), (\{c\}, \varepsilon),$
$(a, \{\emptyset\}), (\{b\}, \{\emptyset\}), (\{c\}, \{\emptyset\})\}$

2. $R_1 R_2 = \{(a, b), (a, a), (b, a), (b, d)\}$
$R_2 R_1 = \{(b, c), (b, d), (c, b), (c, d), (d, b), (d, d)\}$

$R_1^+ = \{(a, b), (a, d), (b, c), (b, d),$
$(a, c)\}$

$R_2^+ = \{(b, b), (c, a), (d, a), (c, d)\}$

$R_1^* = \{(a, b), (a, d), (b, c), (b, d), (a, c),$
$(a, a), (b, b), (c, c), (d, d)\}$

$R_2^* = \{(b, b), (c, a), (d, a), (c, d),$
$(a, a), (c, c), (d, d)\}$

3. 证：

$\because A \subseteq B$

$\therefore A \cap B = A$

$\Rightarrow 2^{A \cap B} = 2^{A}$

又 $\because 2^{A \cap B} = 2^{A} \cap 2^{B}$

$\therefore 2^{A} = 2^{A} \cap 2^{B}$

$\Rightarrow 2^{A} \subseteq 2^{B}$

4. 证：

由题可知：

R具有自反性 ①

$\therefore (a,a) \in R$

对 $\forall (a,b) \in R$

有 $(b,a) \in R$

$\Rightarrow$ R具有对称性 ②

取 $\forall (a,b)(a,c) \in R$

有 $(b,c) \in R$

$\because (a,b) \in R$

$\therefore (b,a) \in R$

$\Rightarrow \forall (b,a)(a,c) \in R, (b,c) \in R$

$\therefore$ R具有传递性 ③

$\therefore$ R是A上的等价关系

5. (1) $\{000\}\{0,1\}^{*}\{000\} \cup \{000\}$

(2) $\{0^{n},1 \mid n \geq 2\}^{*}$

(3) $\{0,1\}^{n}$，n为奇数

(4) $\{0,1\}^{*}\{011\}\{0,1\}^{*}\{101\}\{0,1\}^{*}$
$\cup \{0,1\}^{*}\{101\}\{0,1\}^{*}\{011\}\{0,1\}^{*}$