UNIVERSIDADE DE CAXIAS DO SUL – UCS
CENTRO DE CIÊNCIAS EXATAS E TECNOLOGIA – CCET
DEPARTAMENTO DE INFORMÁTICA – DEIN
PROFA. MÁRCIA RODRIGUES NOTARE

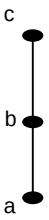
Respostas da Lista de Exercícios 5

1. a) reflexiva, anti-simétrica
   b) simétrica
   c) simétrica, transitiva
   d) reflexiva, simétrica, transitiva

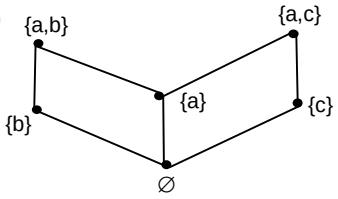
2.
a) FECHO-{reflexivo}(R) = {(0,0),(1,1),(2,2),(4,4),(6,6),(0,1),(1,2),(2,4),(4,6)} = R
FECHO-{simétrico}(R) = {(0,0),(1,1),(2,2),(4,4),(6,6),(0,1),(1,2),(2,4),(4,6),**(1,0),(2,1),(4,2),(6,4)**}
FECHO-{transitivo}(R) = {(0,0),(1,1),(2,2),(4,4),(6,6),(0,1),(1,2),(2,4),(4,6),**(0,2),(1,4),(2,6),(0,4),(1,6),(0,6)**}
b) FECHO-{reflexivo}(R) = {(0,1),(1,0),(2,4),(4,2),(4,6),(6,4),**(0,0),(1,1),(2,2),(4,4),(6,6)**}
FECHO-{simétrico}(R) = {(0,1),(1,0),(2,4),(4,2),(4,6),(6,4)} = R
FECHO-{transitivo}(R) = {(0,1),(1,0),(2,4),(4,2),(4,6),(6,4)),**(0,0),(1,1),(2,2),(4,4),(6,6),(2,6),(6,2)**}
c) FECHO-{reflexivo}(R) = {(0,1),(1,2),(0,2),(2,0),(2,1),(1,0),(0,0),(1,1),(2,2),**(4,4),(6,6)**}
FECHO-{simétrico}(R) = {(0,1),(1,2),(0,2),(2,0),(2,1),(1,0),(0,0),(1,1),(2,2)} = R
FECHO-{transitivo}(R) = {(0,1),(1,2),(0,2),(2,0),(2,1),(1,0),(0,0),(1,1),(2,2) = R
d) FECHO-{reflexivo}(R) = FECHO-{simétrico}(R) = FECHO-{transitivo}(R) = R

3. a) reflexiva, transitiva
   b) simétrica, reflexiva, transitiva
   c) simétrica
   d) transitiva

4. A relação de item b) é uma relação de equivalência, pois apresenta as propriedades reflexiva, transitiva e simétrica. As classes de equivalência são:
[0] = [3] = [6] = [9] = {0, ±3, ±6, ±9, ...}
[1] = [4] = [7] = [10] = {..., -8, -5, -2, 1, 4, 7, 10, ...}
[2] = [5] = [8] = [11] = {..., -7, -4, -1, 2, 5, 8, 11, ...}

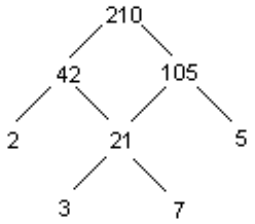
5.
a)


b)


c)


6. a) elemento mínimo = elemento minimal = a
   elemento máximo = elemento maximal = c
   b) não há elemento mínimo
   elemento minimal = a, d
   elemento maximais = b, c, d
   não há elemento máximo
   c) elemento mínimo = elemento minimal = ∅
   elemento maximais = {a,b} e {a,c}
   não há elemento máximo

7.



Elemento mínimo = não há
Elementos minimais = 2, 3, 5, 7
Elemento máximo = 210
Elemento maximal = 210

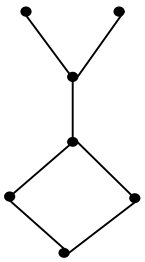
8. a) $R = \{\langle 1,1\rangle, \langle 2,2\rangle, \langle 3,3\rangle, \langle 4,4\rangle, \langle 5,5\rangle, \langle 1,3\rangle, \langle 1,5\rangle, \langle 3,5\rangle, \langle 2,4\rangle, \langle 2,5\rangle, \langle 4,5\rangle\}$
   b) $R = \{\langle a,a\rangle, \langle b,b\rangle, \langle c,c\rangle, \langle d,d\rangle, \langle e,e\rangle, \langle f,f\rangle, \langle a,d\rangle, \langle b,e\rangle, \langle c,f\rangle\}$
   c) $R = \{\langle 1,1\rangle, \langle 2,2\rangle, \langle 3,3\rangle, \langle 4,4\rangle, \langle 5,5\rangle, \langle 1,2\rangle, \langle 2,4\rangle, \langle 4,5\rangle, \langle 1,3\rangle, \langle 3,4\rangle, \langle 1,4\rangle, \langle 1,5\rangle, \langle 2,5\rangle, \langle 3,5\rangle\}$

9. $R^{-1} = \{\langle 2,1\rangle, \langle 3,2\rangle, \langle 3,5\rangle, \langle 5,4\rangle\}$

10. a) $R \circ S = \{\langle 1,3\rangle, \langle 3,3\rangle, \langle 3,4\rangle, \langle 4,1\rangle, \langle 4,2\rangle\}$
    b) $S \circ R = \{\langle 1,1\rangle, \langle 1,4\rangle, \langle 2,1\rangle, \langle 3,1\rangle, \langle 4,2\rangle, \langle 4,3\rangle\}$
    c) $R \circ R = \{\langle 1,1\rangle, \langle 3,1\rangle, \langle 3,2\rangle, \langle 3,3\rangle, \langle 4,1\rangle, \langle 4,4\rangle\}$
    d) $R \circ R \circ R = \{\langle 1,1\rangle, \langle 3,1\rangle, \langle 3,4\rangle, \langle 4,1\rangle, \langle 4,2\rangle, \langle 4,3\rangle\}$

11. $R = \{\langle a,b\rangle, \langle a,c\rangle, \langle b,a\rangle\}$
    $R^{-1} = \{\langle b,a\rangle, \langle c,a\rangle, \langle a,b\rangle\}$
    $R \circ R^{-1} = \{\langle a,a\rangle, \langle b,b\rangle\}$

12.



13. [a] = [c] = {a,c}

14. $R = \{\langle 1,1\rangle, \langle 1,2\rangle, \langle 2,1\rangle, \langle 2,2\rangle, \langle 3,3\rangle, \langle 3,4\rangle, \langle 4,3\rangle, \langle 4,4\rangle\}$

15. [3] = {1,2,3}
    [4] = {4,5}

16. $R = \{\langle a,a\rangle, \langle a,b\rangle, \langle a,c\rangle, \langle b,a\rangle, \langle b,b\rangle, \langle b,c\rangle, \langle c,a\rangle, \langle c,b\rangle, \langle c,c\rangle, \langle d,d\rangle, \langle d,e\rangle, \langle e,d\rangle, \langle e,e\rangle\}$