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Week 6 Problem Set:

Section 9.3: 1, 5, 6, 7, 9, 16, 17

#1

a. $\begin{matrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{matrix}$

b. $\begin{matrix} 0 & 1 & 0 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{matrix}$

c. $\begin{matrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{matrix}$

d. $\begin{matrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \end{matrix}$

#5

The relation is irreflexive if and only if the main diagonal of the matrix contains only 0s.

#6

The relation is asymmetric if and only if $m_{ij} = 1$ with $i \neq j$, then $m_{ji} = 0$, or vice versa.

#7

a. Reflexive, Symmetric, Transitive
b. Antisymmetric, Transitive
c. Symmetric

#9

a. 4950
b. 9900
c. 99
d. 100
e. 1

#16

k nonzero entries

#17

$n^2 - k$

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Section 2.3: 7, 12, 13, 14, 21, 22, 33, 42

#7

a. <u>Domain:</u> Positive Integers
   <u>Range:</u> $[0, \infty)$
b. <u>Domain:</u> Positive Integers
   <u>Range:</u> $[0, 9]$
c. <u>Domain:</u> Set of Bit Strings
   <u>Range:</u> N
d. <u>Domain:</u> Set of Bit Strings
   <u>Range:</u> N

#12

a. One-To-One
b. Not One-To-One
c. One-To-One
d. One-To-One

#13

(a) and (d)

#14

a. Onto
b. Not Onto
c. Onto
d. Onto
e. Not Onto

#21

a. $f(x) = 3x + 1$ when $x \geq 0$
b. $f(x) = |x| + 1$
c. $f(x) = 2x + 1$ when $x \geq 0$
d. $f(x) = x^2 + 1$

#22

a. Bijection
b. Not Bijection
c. Bijection
d. Not Bijection

#33

a. Let x and y be distinct elements of A. Because g is one-to-one, g(x) and g(y) are distinct elements of B.
   Because f is one-to-one, $f(g(x)) = (f \circ g)(x)$ and $f(g(y)) = (f \circ g)(y)$ are distinct elements of C.
   Hence, $f \circ g$ is one-to-one.
b. Let $y \in C$. Because f is onto, $y = f(b)$ for some $b \in B$. Not because g is onto, $b = g(x)$ for some $x \in A$.
   Hence, $y = f(b) = f(g(x)) = (f \circ g)(x)$.
   It follows that $f \circ g$ is onto.

#42

a. $\{1\}$
b. $0 < x < 1$
c. $x > 16$

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Section 2.6: 3, 4 (Matrix Multiplication Problems)

#3

a. $\begin{matrix} 1 & 11 \\ 2 & 18 \end{matrix}$

b. $\begin{matrix} 2 & -2 & -3 \\ 1 & 0 & 2 \\ 9 & -4 & 4 \end{matrix}$

c. $\begin{matrix} -4 & 15 & -4 & 1 \\ -3 & 10 & 2 & -3 \\ 0 & 2 & -8 & 6 \\ 1 & -8 & 18 & -13 \end{matrix}$

#4

a. $\begin{matrix} -1 & 1 & -1 \\ 0 & 1 & -1 \\ 1 & -2 & 1 \end{matrix}$

b. $\begin{matrix} 4 & -1 & -7 & 6 \\ -7 & -5 & 8 & 5 \\ 4 & 0 & 7 & 3 \end{matrix}$

c. $\begin{matrix} 2 & 0 & -3 & -4 & -1 \\ 26 & -7 & 20 & 29 & 2 \\ -10 & 4 & -17 & -24 & -3 \end{matrix}$