Ex. 3.2A

12. (a) $6 + 3 = 3 + 6$ — commutative property
    (b) $(6 + 3) + 5 = 6 + (3 + 5)$ — associative property
    (c) $(6 + 3) + 5 = (3 + 6) + 5$ — commutative property
    (d) $5 + 0 = 5 = 0 + 5$ — additive identity
    (e) $5 + 0 = 0 + 5$ — commutative property
    (f) $(a + c) + d = a + (c + d)$ — associative property
    (g) $5 + 0$ is a unique whole number — closure property

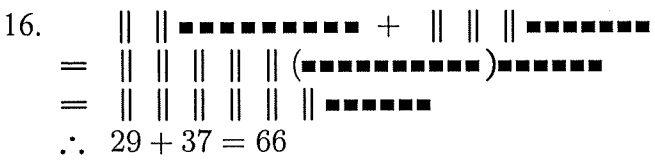
13. (a) $x + (y + z) = (x + y) + z$ — *associative property*
    $= z + (x + y)$ — *commutative property*
    $\therefore\ x + (y + z) = z + (x + y)$.
    (b) $x + (y + z) = (y + z) + x$ — *commutative property*
    $= y + (z + x)$ — *associative property*
    $= y + (x + z)$ — *commutative property*
    $\therefore\ x + (y + z) = y + (x + z)$

14. (a) $3 + (4 + 7) = (3 + x) + 7$
    $(3 + 4) + 7 = (3 + x) + 7$ — associative property
    $x = 4$
    (b) $8 + 0 = x$
    $8 + 0 = x + 0$ — additive identity
    $x = 8$
    (c) $5 + 8 = 8 + x$
    $5 + 8 = x + 8$ — commutative property
    $x = 5$
    (d) $x + 8 = 12 + 5$
    $x + 8 = (9 + 3) + 5$ — addition
    $x + 8 = 9 + (3 + 5)$ — associative property
    $x + 8 = 9 + 8$ — addition
    $x = 9$
    (e) $x + 8 = 5 + (x + 3)$
    $x + 8 = (x + 3) + 5$ — commutative property
    $x + 8 = x + (3 + 5)$ — associative property
    $x + 8 = x + 8$
    x can be any whole number.
    (f) $x - 2 = 9$
    $x - 2 = 11 - 2$ — subtraction
    $x = 11$
    (g) $x - 3 = x + 1$
    no solution
    (h) $0 + x = x + 0$
    $0 + x = 0 + x$ — commutative property
    x can be any whole number.

Ex. 3.2A

15. $16 + 31$

$$
\begin{aligned}
&= (1 \cdot 10 + 6) + (3 \cdot 10 + 1) && \textit{expanded form} \\
&= ((1 \cdot 10 + 6) + 3 \cdot 10) + 1 && \textit{associative property} \\
&= (1 \cdot 10 + (6 + 3 \cdot 10)) + 1 && \textit{associative property} \\
&= (1 \cdot 10 + (3 \cdot 10 + 6)) + 1 && \textit{commutative property} \\
&= ((1 \cdot 10 + 3 \cdot 10) + 6) + 1 && \textit{associative property} \\
&= (1 \cdot 10 + 3 \cdot 10) + (6 + 1) && \textit{associative property} \\
&= (1 + 3) \cdot 10 + (6 + 1) && \textit{distributive property} \\
&= 4 \cdot 10 + 7 && \textit{addition} \\
&= 47 && \textit{expanded form}
\end{aligned}
$$

16. 

$\therefore\ 29 + 37 = 66$

18. (a)

$$
\begin{array}{r}
4\ 3\ 5\ 8 \\
+\ 3\ 8\ 6\ 4 \\
\hline
\end{array}
$$

$^{0}/_{7}$	$^{1}/_{1}$	$^{1}/_{1}$	$^{1}/_{2}$

$/\ 8\ /\ 2\ /\ 2\ /\ 2$

$= 8222$

(b)

$$
\begin{array}{r}
4\ 9\ 2\ 3 \\
+\ 9\ 8\ 9\ 7 \\
\hline
\end{array}
$$

$^{1}/_{3}$	$^{1}/_{7}$	$^{1}/_{1}$	$^{1}/_{0}$

$1\ /\ 4\ /\ 8\ /\ 2\ /\ 0$

$= 14820$

21. (a)

$$
\begin{array}{r}
43_5 \\
+\ 23_5 \\
\hline
121_5
\end{array}
$$

(b)

$$
\begin{array}{r}
432_5 \\
+\ 23_5 \\
\hline
1010_5
\end{array}
$$

(c)

$$
\begin{array}{r}
110_2 \\
+\ 11_2 \\
\hline
1001_2
\end{array}
$$

40. (a) base 10

$$
\begin{array}{r}
4\ 3\ 2 \\
\not{9}_4\not{7}_1 6 \\
+\ 1\ 4\ 1\ \not{8}_6 \\
\hline
2\ 8\ 2\ 6
\end{array}
$$

(b) base 5

$$
\begin{array}{r}
\not{3}_1\ 2 \\
1\ \not{3}_0 \\
2\ 2 \\
\not{4}_3\ \not{3}_0 \\
\not{2}_0\ 3 \\
+\ 1\ \not{2}_0 \\
\hline
3\ 1\ 0_5
\end{array}
$$

Ex. 3.2B

29. Given
$$\begin{array}{rr} & A \\ + & B \\ \hline & CD \end{array}$$
(a) $C = 1$ because C has to be between 1 and 9 and the maximum for $A + B$ is $8 + 9$ which is 17.
(b) No, D cannot be 1 because $C = 1$ and A, B, C, D stand for four different digits.
(c) If $D = 7$ then the sum must be 17 thus A and B must be either 8 or 9.
(d) If A is 6 greater than B then the only possibilities are $A = 7$, $B = 1$ or $A = 8$, $B = 2$, or $A = 9$, $B = 3$. The only one that will make $C = 1$ and $D > 1$ is $A = 9$, $B = 3$ so $D = 2$.

MC 3.2

14. $7 + 2$ is not equal to $9 + 3$ and $9 + 3$ is not equal to $12 + 8$ etc. It is a misuse of the equal sign. The proper way to present it is:
$7 + 2 = 9$
$9 + 3 = 12$
$12 + 8 = 20$
$20 + 11 = 31$

Ex. 3.3A

1. (a) [set model]
The result of $8 - 5$ is the number of objects left after taking away 5 objects from a group of 8 objects.
(b) [missing addend model]
The result of $8 - 5$ is the number when added to 5 yields 8.
(d) [number line model]
The result of $8 - 5$ is the final location on the number line after we begin at 0, move forward to the right 8 units on the number line, turn around facing left and move forward 5 more steps on the number line.

4. a must be greater than or equal to b.

5. (a) $9 - 7 = x$ is equivalent to $7 + x = 9$
(b) $x - 6 = 3$ is equivalent to $6 + 3 = x$
(c) $9 - x = 2$ is equivalent to $x + 2 = 9$.

Ex. 3.3B

10. (b)
$$\begin{array}{r} 1\,\boxed{3}\,\boxed{2}\,\boxed{9}\,6 \\ -\quad 8\;3\;0\;9 \\ \hline 4\;9\;8\;7 \end{array}$$

16. (a)
$$\begin{array}{r} 43_5 \\ -\;\; 24_5 \\ \hline 14_5 \end{array}$$

(b)
$$\begin{array}{r} 32_5 \\ -\;\; 23_5 \\ \hline 4_5 \end{array}$$

(c)
$$\begin{array}{r} 10001_2 \\ -\;\; 101_2 \\ \hline 1100_2 \end{array}$$

MC. 3.3

6. Yes, the set $\{0\}$ is closed under subtraction.