## Exercise Set 2.5

Represent the decimal integers in 1-6 in binary notation.

1. 19
2. 55
3. 287
4. 458
5. 1609
6. 1424

Represent the integers in 7-12 in decimal notation.
7. $1110_{2}$
8. $10111_{2}$
9. $110110_{2}$
10. $1100101_{2}$
11. $1000111_{2}$
12. $1011011_{2}$

Perform the arithmetic in 13-20 using binary notation.
13. $1011_{2}$ $\begin{array}{r}101_{2} \\ \hline\end{array}$
14. $\quad 1001_{2}$ $+1011_{2}$

15. $101101_{2}$ | $+11101_{2}$ |
| :--- |
16. $110111011_{2}$

$$
+1001011010_{2}
$$

17. $10100_{2}$
$-\quad 1101_{2}$
18. $11010_{2}$

$$
-\quad 1101_{2}
$$

19. $101101_{2}$ $-\quad 10011_{2}$
20. $1010100_{2}$

| $-\quad 10111_{2}$ |
| :--- |

21. Give the output signals $S$ and $T$ for the circuit in the right column if the input signals $P, Q$, and $R$ are as specified. Note that this is not the circuit for a full-adder.
a. $P=1, Q=1, R=1$
b. $P=0, Q=1, R=0$
c. $P=1, Q=0, R=1$

22. Add $11111111_{2}+1_{2}$ and convert the result to decimal notation, to verify that $11111111_{2}=\left(2^{8}-1\right)_{10}$.

Find the 8-bit two's complements for the integers in 23-26.
23. 23
24. 67
25. 4
26. 115

Find the decimal representations for the integers with the 8 -bit representations given in 27-30.
27. 11010011
28. 10011001
29. 11110010
30. 10111010

Use 8-bit representations to compute the sums in 31-36.
31. $57+(-118)$
32. $62+(-18)$
33. $(-6)+(-73)$
34. $89+(-55)$
35. $(-15)+(-46)$
36. $123+(-94)$

* 37. Show that if $a, b$, and $a+b$ are integers in the range 1 through 128 , then

$$
\left(2^{8}-a\right)+\left(2^{8}-b\right)=\left(2^{8}-(a+b)\right)+2^{8} \geq 2^{8}+2^{7}
$$

Explain why it follows that if the 8-bit binary representation of the sum of the negatives of two numbers in the given range is computed, the result is a negative number.

Convert the integers in $38-40$ from hexadecimal to decimal notation.
38. $\mathrm{A} 2 \mathrm{BC}_{16}$
39. $E 0 D_{16}$
40. $39 \mathrm{~EB}_{16}$

Convert the integers in 41-43 from hexadecimal to binary notation.
41. $1 \mathrm{COABE}_{16}$ 42. $\mathrm{B}_{16} 3 \mathrm{DF} 8_{16}$ 43. $4 \mathrm{ADF}_{16} 3_{16}$

Convert the integers in 44-46 from binary to hexadecimal notation.
44. $00101110_{2} \quad$ 45. $1011011111000101_{2}$
46. $11001001011100_{2}$
47. Octal Notation: In addition to binary and hexadecimal, computer scientists also use octal notation (base 8) to represent numbers. Octal notation is based on the fact that any integer can be uniquely represented as a sum of numbers of the form $d \cdot 8^{n}$, where each $n$ is a nonnegative integer and each $d$ is one of the integers from 0 to 7 . Thus, for example, $5073_{8}=5 \cdot 8^{3}+0 \cdot 8^{2}+7 \cdot 8^{1}+3 \cdot 8^{0}=2619_{10}$.
a. Convert $61502_{8}$ to decimal notation.
b. Convert $20763_{8}$ to decimal notation.
c. Describe methods for converting integers from octal to binary notation and the reverse that are similar to the methods used in Examples 2.5.12 and 2.5.13 for converting back and forth from hexadecimal to binary notation. Give examples showing that these methods result in correct answers.

