

Student Text *UNIT 7 Number System and Bases* Answers

7.1 Number System

1. (a) rational (terminating) (b) rational (recurring) (c) irrational
 (d) rational (recurring) (e) rational (terminating) (f) irrational
 (g) irrational (h) rational (terminating) (i) irrational
 (j) rational (recurring) (k) irrational (l) rational (terminating)
2. (a) $\frac{49}{100}$ (b) $\frac{1}{3}$ (c) $\frac{7}{4}$ (d) - (e) $\frac{417}{1000}$ (f) $\frac{1}{9}$
 (g) $\frac{1}{11}$ (h) $\frac{6}{11}$ (i) $\frac{1}{8}$ (j) $\frac{481}{500}$
3. (a) $\frac{41}{99}$ (b) $\frac{67}{1665}$ from $\frac{402}{9990}$ (c) $\frac{1}{7}$ (d) $\frac{8}{9}$
 (e) $\frac{812}{999}$ (f) $\frac{5}{9}$ (g) $\frac{101}{111}$
8. $\frac{2}{7}$ recurring; π non-recurring; $\frac{1}{17}$ recurring; $\sqrt{7}$ non-recurring; $\frac{6}{47}$ recurring
9. (a) 13, rational (b) $\sqrt{61}$, irrational (c) 3, rational (d) $\frac{5}{7}$, rational
10. (b) 2^{-2} , $4^{\frac{1}{2}}$, 4^{-2}
11. (a) (i) any recurring decimal (ii) "and does not repeat itself"
 (b) irrational, rational $\left(\frac{5}{2}\right)$, irrational, rational $\left(\frac{1}{3}\right)$
12. (a) e.g. any square root larger than 16 and less than 25
13. (a) (i) 237 (ii) any n between $225 < n < 256$ is such that $\sqrt{n}$ is irrational
 (b) 10.24 which has 3.2 or $\frac{16}{5}$ as a square root

7.2 Binary Numbers

1. (a) 6 (b) 15 (c) 9 (d) 13
 (e) 17 (f) 27 (g) 127 (h) 113
 (i) 170 (j) 205 (k) 455 (l) 102
2. (a) 1001 (b) 1000 (c) 1110 (d) 10001
 (e) 10010 (f) 11110 (g) 101111 (h) 110100
 (i) 1000011 (j) 1010100 (k) 11001000 (l) 111110100

Student Text *UNIT 7 Number System and Bases* Answers

- 7.2**
3. (a) 101 (b) 1001 (c) 10001 (d) 100001
 The binary equivalents always begin and end with 1 and the number of zeros in the middle increases by 1 each time.
 The next base 10 number that fits this pattern is 65 (corresponding to the binary number 1000001).
4. (a) 11 (b) 111 (c) 1111 (d) 11111
 The next base 10 number that fits this pattern is 63 (corresponding to the binary number 111111).
5. (a) Largest = 111, smallest = 100 (b) 7 and 4
6. Any whole number from 8 to 15
7. (a) 1100, 1010 and 1001 (b) 12, 10 and 9
8. (a) Largest = 255 (binary 11111111) (b) smallest = 128 (binary 10000000)
9. 999 converts to binary 1111100111 with 10 digits, so the binary equivalent has 7 more digits than the 3 digits in base 10.
10. The binary number 11111 is 31 in base 10, so the difference is $11111 - 31 = 11080$.

7.3 Adding and Subtracting Binary Numbers

1. (a) 100 (b) 110 (c) 1010 (d) 1001
 (e) 10101 (f) 10010 (g) 100100 (h) 100101
 (i) 11000 (j) 100101 (k) 11101 (l) 111100
2. (a) 1 (b) 100 (c) 1001 (d) 10
 (e) 1 (f) 101 (g) 111 (h) 10101
 (i) 1000 (j) 101011 (k) 10100 (l) 10111
3. (a) 110 (b) 1110 (c) 11110 (d) 111110
 The answers always end in a single zero and all the other digits are ones. Also, the number of ones increases by 1 each time.
 Alternatively, the answer is the binary number in the question with an extra zero on the right hand end. This is because adding a number to itself is the same as doubling, which in binary means multiplying by 10, so you just add a zero onto the right hand end of the number you are adding to itself.
4. (a) 100 (b) 1000 (c) 10000 (d) 100000
 The answer always begins with 1 and the remaining digits are all zero. Also, the number of zeros increases by 1 each time.
 Alternatively, the answer is the binary number in the question with an extra zero on the right hand end. Again this is because adding a number to itself is the same as doubling, which in binary means multiplying by 10, so you just add a zero onto the right hand end of the number you are adding to itself.
5. (a) 1010 (b) 111 (c) 101000 (d) 11
 (e) 10111 (f) 100110

Student Text *UNIT 7 Number System and Bases* Answers

7.3

6. (a) 1 (b) 11 (c) 111 (d) 1111

The answers only involve the digit one. Also, the number of ones increases by 1 each time. The number of ones is equal to the number of zeros in the original calculation.

7. (a) $11101 \rightarrow 29$ in base 10, $1110 \rightarrow 14$ in base 10 (b) $29 + 14 = 43$
(c) $11101 + 1110 = 101011$ (d) $101011 \rightarrow 43$ in base 10

The answers to (b) and (d) are the same.

8. (a) $11101 \rightarrow 29$ in base 10, $10111 \rightarrow 23$ in base 10 (b) $29 - 23 = 6$
(c) $6 \rightarrow 110$ in binary (d) $11101 - 10111 = 110$

The answers to (c) and (d) are the same.

9. (a) 10110001 (b) 11010011 (c) 100010 (d) 100100110

10. (a) 10000 (b) 1100111

7.4 Multiplying Binary Numbers

1. (a) 1110 (check $7 \times 2 = 14$) (b) 110000 (check $12 \times 4 = 48$)
(c) 101000 (check $5 \times 8 = 40$) (d) 11101000 (check $29 \times 8 = 232$)
(e) 110000 (check $24 \times 2 = 48$) (f) 10100000 (check $20 \times 8 = 160$)
(g) 1010 (check $20 \div 2 = 10$) (h) 11 (check $12 \div 4 = 3$)
2. (a) 10101 (b) 100111 (c) 1000001 (d) 1011010
(e) 100101001 (f) 100011110 (g) 1101001 (h) 10010011
(i) 1111110 (j) 111111011

3. (a) 10010 (b) 11001 (c) 1110 (d) 1001101

4. (a) 1001 (b) 110001 (c) 11100001

The number of ones at the start increases by 1 each time, as does the number of zeros that follow. The answer always ends with a single 1. Also, the number of ones in the original number being squared is one more than the number of ones at the start of the answer, and is the same as the number of zeros that follow.

$$11111 \times 11111 = 1111000001$$

5. (a) 11001 (b) 1010001 (c) 100100001 (d) 10001000001
 $1000001 \times 1000001 = 1000010000001$

6. (a) 1011111 (b) 1110101 (c) 10101 (d) 1001101

7. (a) 1011110100 (b) 1000000001

8. (a) 1485 (b) 10111001101 (c) $45 \rightarrow 101101$ in binary,
 $33 \rightarrow 100001$ in binary

- (d) $101101 \times 100001 = 10111001101$, the same answer as part (b).

Student Text *UNIT 7 Number System and Bases* Answers

7.5 Other Bases

1. (a) 107 (b) 63 (c) 593 (d) 48
(e) 825 (f) 303 (g) 139 (h) 13
2. (a) 220 (b) 100 (c) 2241 (d) 305
(e) 626 (f) 103 (g) 12021 (h) 4432
3. (a) 11 (b) 14 (c) 12 (d) 11
(e) 14 (f) 11
4. (a) Bases 4, 5, 6, 7, 8, 9 and 10 (b) Bases 3, 4, 5, 6, 7, 8, 9, and 10
(c) Bases 9 and 10
5. (a) 102 check $13 \rightarrow (1 \times 4) + (3 \times 1) = 7$
 $23 \rightarrow (2 \times 4) + (3 \times 1) = 11$
 $102 \rightarrow (1 \times 16) + (0 \times 4) + (2 \times 1) = 18$
and $7 + 11 = 18$
(b) 434
(c) 1101 check $222 \rightarrow (2 \times 9) + (2 \times 3) + (2 \times 1) = 26$
 $102 \rightarrow (1 \times 9) + (0 \times 3) + (2 \times 1) = 11$
 $1101 \rightarrow (1 \times 27) + (1 \times 9) + (0 \times 3) + (1 \times 1) = 37$
and $26 + 11 = 37$
(d) 1212
(e) 1063 check $624 \rightarrow (6 \times 49) + (2 \times 7) + (4 \times 1) = 312$
 $136 \rightarrow (1 \times 49) + (3 \times 7) + (6 \times 1) = 76$
 $1063 \rightarrow (1 \times 343) + (0 \times 49) + (6 \times 7) + (3 \times 1) = 388$
and $312 + 76 = 388$
(f) 403 (g) 1322 (h) 1120
6. (a) 12 (b) 22 (c) 12 (d) 23
(e) 11 (f) 71
7. (a) 2101 check $121 \rightarrow (1 \times 9) + (2 \times 3) + (1 \times 1) = 16$
 $11 \rightarrow (1 \times 3) + (1 \times 1) = 4$
 $2101 \rightarrow (2 \times 27) + (1 \times 9) + (0 \times 3) + (1 \times 1) = 64$
and $16 \times 4 = 64$
(b) 2322

Student Text *UNIT 7 Number System and Bases* Answers

7.5

(c) 422 check $13 \rightarrow (1 \times 5) + (3 \times 1) = 8$
 $24 \rightarrow (2 \times 5) + (4 \times 1) = 14$
 $422 \rightarrow (4 \times 25) + (2 \times 5) + (2 \times 1) = 112$
 and $8 \times 14 = 112$

(d) 3143

(e) 4554 check $161 \rightarrow (1 \times 49) + (6 \times 7) + (1 \times 1) = 92$
 $24 \rightarrow (2 \times 7) + (4 \times 1) = 18$
 $4554 \rightarrow (4 \times 343) + (5 \times 49) + (5 \times 7) + (4 \times 1) = 1656$
 and $92 \times 18 = 1656$

(f) 17744

(g) 20213

(h) 121121

8.

(a) Base 5

(b) Base 9

(c) Base 9

(d) Base 6

(e) Base 7

(f) Base 5

9.

(a) Base 8

(b) Base 3

(c) Base 6

(d) Base 5

10.

(a) 10211

(b) 111

(c) 2102

(d) 225