Text *B2 Number Classification and Bases* Answers

B2.1 Number Classification

1. (a) rational (terminating) (b) rational (reccurring) (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

B2.2 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

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B2.2

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.

B2.3 Adding and Sutracting 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

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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 → 29 in base 10, 1110 → 14 in base 10 (b) 29 + 14 = 43

(c) 11101 + 1110 = 101011 (d) 101011 → 43 in base 10

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

8. (a) 11101 → 29 in base 10, 10111 → 23 in base 10 (b) 29 – 23 = 6

(c) 6 → 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

B2.4 Multiplying Binary Numbers

1. (a) 1110 (check 7 × 2 = 14) (b) 110000 (check 12 × 4 = 48)

(c) 101000 (check 5 × 8 = 40) (d) 11101000 (check 29 × 8 = 232)

(e) 110000 (check 24 × 2 = 48) (f) 10100000 (check 20 × 8 = 160)

(g) 1010 (check 20 ÷ 2 = 10) (h) 11 (check 12 ÷ 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 × 11111 = 1111000001

5. (a) 11001 (b) 1010001 (c) 100100001 (d) 10001000001

1000001 × 1000001 = 1000010000001

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

7. (a) 1011110100 (b) 1000000001

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

(d) 101101 × 100001 = 10111001101, the same answer as part (b).

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B2.5 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

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(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

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