Questions from end of chapter 24

END OF CHAPTER PROBLEMS 24–1

Convert the following binary numbers to decimal numbers:

1. 111_2
2. 101_2
3. 1010_2
4. 1101_2
5. 1101_2
6. 1000_2
7. 10111_2
8. 11001_2
9. 100110_2
10. 111001_2
11. 111000_2
12. 101010_2
13. 1100101_2
14. 1001101_2
15. 1110111_2
16. 1111111_2
17. 11110000_2
18. 10101010_2
19. 11000011_2
20. 10011001_2

Convert the following decimal numbers to binary numbers:

21. 5
22. 5
23. 12
24. 14

25. 21
26. 31
27. 45
28. 55
29. 59
30. 60
31. 68
32. 84
33. 96
34. 117
35. 135
36. 180
37. 210
38. 254

END OF CHAPTER PROBLEMS 24–2

Convert the following numbers from octal to decimal:

1. 14_8
2. 25_8
3. 77_8
4. 100_8
5. 276_8
6. 676_8
7. 4176_8
8. 6237_8
9. $11{,}714_8$
10. $24{,}576_8$

Convert the following numbers from decimal to octal:

11. 20_{10}
12. 46_{10}
13. 80_{10}
14. 103_{10}
15. 360_{10}
16. 617_{10}
17. 1417_{10}
18. 5916_{10}
19. 3789_{10}
20. 6063_{10}

END OF CHAPTER PROBLEMS 24–3

Convert the following numbers from hexadecimal to decimal:

1. $1A_{16}$
2. $B1_{16}$
3. $4C_{16}$
4. $1AC_{16}$
5. 200_{16}
6. 500_{16}
7. $11AA_{16}$
8. $FADE_{16}$
9. $A02B_{16}$
10. $84AB_{16}$

Convert the following numbers from decimal to hexadecimal:

11. 22_{10}
12. 50_{10}
13. 97_{10}
14. 127_{10}
15. 512_{10}
16. 873_{10}
17. 2700_{10}
18. 5606_{10}
19. 6075_{10}
20. 8088_{10}

END OF CHAPTER PROBLEMS 24–4

Convert the following binary numbers to (a) octal numbers and then (b) hexadecimal numbers.

1. 11001010_2
2. 10110110_2
3. 10011011_2
4. 11100011_2
5. 10000001_2
6. 10101111_2
7. 1100110010012
8. 110011001100_2
9. 1010110000112
10. 110100011010_2

Convert the following numbers to binary numbers.

11. 17_8
13. 44_8
15. 200_8
17. 560_8
19. 1000_8
21. C_{16}
23. 24_{16}
25. $4F_{16}$
27. $E3_{16}$
29. $19A_{16}$
12. 25_8
14. 61_8
16. 400_8
18. 777_8
20. 1102_8
22. E_{16}
24. 40_{16}
26. $C4_{16}$
28. $B7_{16}$
30. $2EF_{16}$

END OF CHAPTER PROBLEMS 24–5

1. 75_8 =	_____	2 =	_____	10 =	_____	16
2. 112_8 =	_____	2 =	_____	10 =	_____	16
3. 140_8 =	_____	2 =	_____	10 =	_____	16
4. 165_8 =	_____	2 =	_____	10 =	_____	16
5. $2A_{16}$ =	_____	2 =	_____	8 =	_____	10
6. $6D_{16}$ =	_____	2 =	_____	8 =	_____	10
7. $1A7_{16}$ =	_____	2 =	_____	8 =	_____	10
8. $3EC_{16}$ =	_____	2 =	_____	8 =	_____	10
9. 100110_2 =	_____	8 =	_____	10 =	_____	16
10. 101101_2 =	_____	8 =	_____	10 =	_____	16
11. 111000101_2 =	_____	8 =	_____	10 =	_____	16
12. 101111011011_2 =	_____	8 =	_____	10 =	_____	16
13. 10_{10} =	_____	2 =	_____	8 =	_____	16
14. 200_{10} =	_____	2 =	_____	8 =	_____	16
15. 290_{10} =	_____	2 =	_____	8 =	_____	16
16. 433_{10} =	_____	2 =	_____	8 =	_____	16

END OF CHAPTER PROBLEMS 24–6

Add the following octal numbers:

1. 123 + 234
2. 451 + 116
3. 456 + 317
4. 517 + 126
5. 667 + 107
6. 273 + 706
7. 604 + 617
8. 376 + 412
9. 726 + 161
10. 571 + 707

END OF CHAPTER PROBLEMS 24–7

Add the following hexadecimal numbers:

1. 4A + A3
2. D2 + 1C

3. A07
   29E
4. B38
   398
5. 4AB
   8AB
6. C37
   8B9
7. ABF
   CDE
8. FED
   ABC
9. F0C6
   E9A6
10. BA09
    F6E4

END OF CHAPTER PROBLEMS 24–8

Add the following binary numbers:

1. 1100
   1001
2. 1011
   1111
3. 11100
   10111
4. 10011
   11101
5. 10011
   10110
6. 10111
   11101
7. 110011
   101111
8. 111001
   011101
9. 101110
   111011
10. 111101
    101111

END OF CHAPTER PROBLEMS 24–9

Subtract the following octal numbers:

1. 73
   (−)26
2. 64
   (−)40
3. 616
   (−)554
4. 624
   (−)267
5. 540
   (−)273
6. 405
   (−)267
7. 2004
   (−)1445
8. 3001
   (−)2653
9. 6334
   (−)4617
10. 5503
    (−)3573

END OF CHAPTER PROBLEMS 24–10

Subtract the following hexadecimal numbers:

1. A6
   (−)8C
2. CA
   (−)A9
3. E06
   (−)A25
4. C0A
   (−)2A9
5. 9A0
   (−)3AF
6. 8B4
   (−)4E8

7. C00
(−)103

8. CA0
(−)6A6

9. B029
(−)A04D

10. E24A
(−)174C

END OF CHAPTER PROBLEMS 24–11

Subtract the following binary numbers:

1. 1011
(−)0110

2. 1101
(−)0011

3. 1101
(−)1011

4. 1101
(−)0110

5. 11001
(−)10111

6. 111011
(−)010011

7. 10010
(−)01111

8. 110110
(−)100111

9. 110011
(−)011101

10. 111001
(−)011001

END OF CHAPTER PROBLEMS 24–12

Find the two's complement of:

1. 1010_2
2. 10110_2
3. 101101_2
4. 11001110_2

Use the one's complement method to find:

5. 11001_2
(−)01100_2

6. 11100_2
(−)11011_2

7. 101101_2
(−)001010_2

8. 1101001_2
(−)0100110_2

Use the two's complement method to find:

9. 10110_2
(−)01011_2

10. 10011_2
(−)01000_2

11. 1011001_2
(−)0010110_2

12. 11100101_2
(−)10110010_2

END OF CHAPTER PROBLEMS 24–13

Find the eight's complement of:

1. 64_8
2. 436_8
3. 635_8
4. 3732_8

Find the sixteen's complement of:

5. $A3_{16}$
6. $4C3_{16}$
7. $C1E_{16}$
8. $3E04_{16}$

Use the eight's complement method to find:

9. 63_8
(−)25_8

10. 503_8
(−)236_8

11. 626_8
$(-)\underline{377_8}$

12. 6026_8
$(-)\underline{3662_8}$

Use the sixteen's complement method to find:

13. $A2_{16}$
$(-)\underline{8C_{16}}$

14. $E4D_{16}$
$(-)\underline{AAB_{16}}$

15. $6A2_{16}$
$(-)\underline{4FF_{16}}$

16. $F40B_{16}$
$(-)\underline{6BDD_{16}}$

Solutions for end of chapter 24 questions

CHAPTER 24

PRACTICE PROBLEMS 24–1

1. 5
2. 7
3. 9
4. 14
5. 22
6. 25
7. 37
8. 59
9. 84
10. 121
11. 100_2
12. 1000_2
13. 1010_2
14. 11011_2
15. 100111_2
16. 111001_2
17. 1001110_2
18. 1100100_2
19. 10010110_2
20. 11001000_2

END OF CHAPTER PROBLEMS 24–1

1. 7
3. 10
5. 13
7. 23
9. 38
11. 56
13. 101
15. 119
17. 240
19. 195
21. 101_2
23. 1100_2
25. 10101_2
27. 101101_2
29. 111011_2
31. 1000100_2
33. 1100000_2
35. 10000111_2
37. 11010010_2

PRACTICE PROBLEMS 24–2

1. (a) 38_{10}
   (b) 73_{10}
   (c) 132_{10}
   (d) 256_{10}
   (e) 511_{10}
2. (a) 33_8
   (b) 131_8
   (c) 144_8
   (d) 400_8
   (e) 620_8

END OF CHAPTER PROBLEMS 24–2

1. 12_{10}
3. 63_{10}
5. 190_{10}
7. 2174_{10}
9. 5068_{10}
11. 24_8
13. 120_8
15. 550_8
17. 2611_8
19. 7315_8

PRACTICE PROBLEMS 24–3

1. (a) 13_{10}
   (b) 63_{10}
   (c) 164_{10}
   (d) 461_{10}
   (e) 4286_{10}
2. (a) $1B_{16}$
   (b) 55_{16}
   (c) 64_{16}
   (d) 100_{16}
   (e) $5DC_{16}$

END OF CHAPTER PROBLEMS 24–3

1. 26_{10}
3. 76_{10}
5. 512_{10}
7. 4522_{10}
9. $41{,}003_{10}$
11. 16_{16}
13. 61_{16}
15. 200_{16}
17. $A8C_{16}$
19. $17BB_{16}$

PRACTICE PROBLEMS 24–4

1. (a) 1515_8
   (b) $34D_{16}$
2. (a) 1031_8
   (b) 219_{16}
3. (a) 1461_8
   (b) 331_{16}
4. (a) 7165_8
   (b) $E75_{16}$
5. (a) 75306_8
   (b) $7AC6_{16}$
6. 111011_2
7. 1010111_2
8. 110001111_2
9. 101000110_2
10. 1010000111_2
11. 10100110_2
12. 1001100_2
13. 1100000011012
14. 1011101000012
15. 1111001000112

END OF CHAPTER PROBLEMS 24–4

1. $312_8 = CA_{16}$
3. $233_8 = 9B_{16}$
5. $201_8 = 81_{16}$
7. $6311_8 = CC9_{16}$
9. $5303_8 = AC3_{16}$
11. 1111_2
13. 100100_2
15. 100000000_2
17. 101110000_2
19. 1000000000_2
21. 1100_2
23. 100100_2
25. 1001111_2
27. 11100011_2
29. 110011010_2

PRACTICE PROBLEMS 24–5

1. $73_8 = 3B_{16} = 111011_2 = 59_{10}$
2. $273_8 = BB_{16} = 10111011_2 = 187_{10}$
3. $A3_{16} = 243_8 = 10100011_2 = 163_{10}$
4. $12E_{16} = 456_8 = 100101110_2 = 302_{10}$
5. $1101001_2 = 151_8 = 69_{16} = 105_{10}$
6. $10111100_2 = 274_8 = BC_{16} = 188_{10}$

END OF CHAPTER PROBLEMS 24–5

1. $75_8 = 111101_2 = 61_{10} = 3D_{16}$
3. $140_8 = 1100000_2 = 96_{10} = 60_{16}$
5. $2A_{16} = 101010_2 = 52_8 = 42_{10}$
7. $1A7_{16} = 110100111_2 = 647_8 = 423_{10}$
9. $100110_2 = 46_8 = 38_{10} = 26_{16}$
11. $111000101_2 = 705_8 = 453_{10} = 1C5_{16}$
13. $10_{10} = 1010_2 = 12_8 = A_{16}$
15. $290_{10} = 100100010_2 = 442_8 = 122_{16}$

SELF-TEST 24–1 THROUGH 24–5

1. 38
2. 190
3. 246
4. 3130
5. 91
6. 202
7. (a) 1010_2
   (b) 12_8
   (c) A_{16}
8. (a) 11100_2
   (b) 34_8
   (c) $1C_{16}$
9. (a) 1011101_2
   (b) 273_8
   (c) BB_{16}
10. (a) 1001110001_2
    (b) 1161_8
    (c) 271_{16}
11. (a) 1011101_2
    (b) 135_8
    (c) $5D_{16}$
12. (a) 111000011010_2
    (b) 7032_8
    (c) 3610_{10}
13. (a) 3226_8
    (b) 1686_{10}
    (c) 696_{16}
14. (a) 101111011_2
    (b) 379_{10}
    (c) $17B_{16}$

PRACTICE PROBLEMS 24–6

1. 522_8
2. 642_8
3. 1533_8
4. 1306_8
5. 1157_8

END OF CHAPTER PROBLEMS 24–6

1. 357_8
3. 775_8
5. 776_8
7. 1423_8
9. 1107_8

PRACTICE PROBLEMS 24–7

1. DF_{16}
2. $15B_{16}$
3. 1121_{16}
4. $E7D_{16}$
5. $111CF_{16}$

END OF CHAPTER PROBLEMS 24–7

1. ED_{16}
3. $CA5_{16}$
5. $D56_{16}$
7. $179D_{16}$
9. $1DA6C_{16}$

PRACTICE PROBLEMS 24–8

1. 10111_2
2. 11000_2
3. 101000_2
4. 110111_2
5. 1101010_2

END OF CHAPTER PROBLEMS 24–8

1. 10101_2
3. 110011_2
5. 101001_2
7. 1100010_2
9. 1101001_2

SELF-TEST 24–6 THROUGH 24–8

1. $E5_{16}$
2. $DC8_{16}$
3. $1F323_{16}$
4. 161_8
5. 124_8
6. 141_8
7. 1100_2
8. 11000_2
9. 110100_2

PRACTICE PROBLEMS 24–9

1. 15_8
2. 77_8
3. 475_8
4. 337_8
5. 2545_8

END OF CHAPTER PROBLEMS 24–9

1. 45_8
3. 42_8
5. 245_8
7. 337_8
9. 1515_8

PRACTICE PROBLEMS 24–10

1. $7AC_{16}$
2. 483_{16}
3. $4E60_{16}$
4. $3A8C_{16}$
5. $CE9F_{16}$

END OF CHAPTER PROBLEMS 24–10

1. $1A_{16}$
3. $3E1_{16}$
5. $5F1_{16}$
7. AFD_{16}
9. FDC_{16}

PRACTICE PROBLEMS 24–11

1. 101_2
2. 1001_2
3. 1011_2
4. 11010_2
5. 1101_2

END OF CHAPTER PROBLEMS 24–11

1. 101_2
3. 10_2
5. 10_2
7. 11_2
9. 10110_2

PRACTICE PROBLEMS 24–12

1. (a) 82 (b) 83
2. (a) 63 (b) 64
3. (a) 11 (b) 12
4. (a) 723 (b) 724
5. (a) 1023 (b) 1024
6. (a) 0010 (b) 0011
7. (a) 0110 (b) 0111
8. (a) 011001 (b) 011010
9. (a) 001110 (b) 001111
10. (a) 00111100 (b) 00111101

11. (a) 1

```
   11001
   10010   (one's complement)
1  01011
   └──→1
   01100
```

(b) 1

```
   11001
   10011   (two's complement)
 ✗ 01100
```

12. (a) 1

```
   101101
   110100   (one's complement)
1  100001
   └──→1
   100010
```

(b) 1

```
   101101
   110101   (two's complement)
 ✗ 100010
```

13. (a) 1

```
     11
   1100011
   1100110   (one's complement)
1  1001001
   └──→1
   1001010
```

(b) 1

```
     111
   1100011
   1100111   (two's complement)
 ✗ 1001010
```

14. (a) 1

```
   10110010
   11100010   (one's complement)
1  10010100
   └──→1
   10010101
```

(b) 1

```
     11  1
   10110010
   11100011   (two's complement)
 ✗ 10010101
```

15. (a) 1

```
     11  1
   11100100
   11100100   (one's complement)
1  11001000
   └──→ 1
   11001001
```

(b) 1

```
     11  1
   11100100
   11100101   (two's complement)
 ✗ 11001001
```

END OF CHAPTER PROBLEMS 24–12

1. 0110_2
3. 010011_2
5. 01101_2
7. 100011_2
9. 01011_2
11. 1000011_2

PRACTICE PROBLEMS 24–13

1. (a) 1 (b) 2
2. (a) 65 (b) 66
3. (a) 21 (b) 22
4. (a) 604 (b) 605

5. (a) 051 (b) 052
7. (a) D3 (b) D4
9. (a) B5C (b) B5D
11. (a) 11010011
    11000011 (two's complement)
    ✗ 10010110_2
    (b) 1101 0011 = D3
    1100 0011 = C3 (sixteen's complement)
    ✗ 96_{16}
    (c) 011 010 011 = 323
    111 000 011 = 703 (eight's complement)
    ✗ 226_8

6. (a) 5 (b) 6
8. (a) 78 (b) 79
10. (a) 0DF6 (b) 0DF7

The subtrahend is 00111101. The two's complement is 11000011. Since we have already found the two's complement of 00111101 to be 11000011, we separate the two's complement into two 4-bit groups. Then 1100 0011 = C3, which is the sixteen's complement. To find the eight's complement, we must separate the subtrahend into three 3-bit groups. Since we have only 8 bits, we add a zero to the subtrahend in the original problem to get 000 111 101. The two's complement is 111 000 011. The eight's complement is 703.

12. (a) 10011101
    11001101 (two's complement)
    ✗ 01101010_2
    (b) 1001 1101 = 9D
    1100 1101 = CD (sixteen's complement)
    ✗ $6A_{16}$
    (c) 010 011 101 = 235 (eight's complement)
    111 001 101 = 715
    ✗ 152_8

13. (a) 10111100
    10110010 (two's complement)
    ✗ 01101110_2
    (b) 1011 1100 = BC
    1011 0010 = B2 (sixteen's complement)
    ✗ $6E_{16}$
    (c) 010 111 100 = 274 (eight's complement)
    110 110 010 = 662
    ✗ 156_8

14. (a) 11110000
    11000100 (two's complement)
    ✗ 10110100_2
    (b) 1111 0000 = F0
    1100 0100 = C4 (sixteen's complement)
    ✗ $B4_{16}$ (eight's complement)
    (c) 011 110 000 = 360
    111 000 100 = 704
    ✗ 264_8

15. (a) 11001111
01111101 (two's complement)
χ 01001100_2

(b) 1100 1111 = CF
0111 1101 = 7D (sixteen's complement)
χ $4C_{16}$

(c) 011 001 111 = 317
101 111 101 = 575 (eight's complement)
χ 114_8

END OF CHAPTER PROBLEMS 24–13

1. 14_8
3. 143_8
5. $5D_{16}$
7. $3E2_{16}$
9. 36_8
11. 227_8
13. 16_{16}
15. $1A3_{16}$

SELF-TEST 24–9 THROUGH 24–13

1. 10011110_2
2. 101011_2
3. 25_8
4. 217_8
5. BC_{16}
6. 255_{16}