Chapter 1 HW Solutions

$\boxed{1.3 \text{ a-d}}$

(a) $(4310)_5$

$= (4 \cdot 5^3) + (3 \cdot 5^2) + (1 \cdot 5^1) + (0 \cdot 5^0)$

$= (4 \cdot 125) + (3 \cdot 25) + (1 \cdot 5) + (0 \cdot 1)$

$= 500 + 75 + 5 + 0$

$= 580$ or $(580)_{10}$

(b) $(198)_{12}$

$= (1 \cdot 12^2) + (9 \cdot 12^1) + (8 \cdot 12^0)$

$= 144 + 108 + 8$

$= (260)_{10}$

(c) $(435)_8$

$= (4 \cdot 8^2) + (3 \cdot 8^1) + (5 \cdot 8^0)$

$= (4 \cdot 64) + (3 \cdot 8) + (5 \cdot 1)$

$= 256 + 24 + 5$

$= (285)_{10}$

(d) $(345)_6$

$= (3 \cdot 6^2) + 4 \cdot 6^1 + 5 \cdot 6^0$

$= (3 \cdot 36) + (4 \cdot 6) + (5 \cdot 1)$

$= 108 + 24 + 5$

$= (137)_{10}$

$\boxed{1.7}$

$(64CD)_{16}$

$6 \quad 4 \quad 12 \quad 13$

$(0110\ 0100\ 1100\ 1101)_2$

Group into 3s

$[\,2^3 = 8\,]$

$(6\ \ 2\ \ 3\ \ 1\ \ 5)_8$

$\boxed{1.8}$ (a) $(431)_{10}$

Remainder Method: divide by 2 + Keep Remainder (0 or 1)

431 $\div 2$	1
215	1
107	1
53	1
26	0
13	1
6	0
3	1
1	1
0	0

$\Rightarrow (01\ 1010\ 1111)_2$

(b) $(431)_{10}$

1. Divide by 16

$$\begin{array}{r} 26 \\ 16\overline{)431} \\ -32\downarrow \\ \hline 111 \\ -96 \\ \hline R\ 15 \end{array}$$

2. Divide $26 \div 16$

$$\begin{array}{r} 1 \\ 16\overline{)26} \\ -16 \\ \hline R\ 10 \end{array}$$

3. Divide $1 \div 16$

$$16\overline{)1}^{\,0} \quad R1$$

4. Take Remainders + convert to hex

$15 \to F$

$10 \to A$

$1 \to 1$

5. Rewrite in most to least significant digit in HEX System
(1, 2, 3, ..., A, B, C, ...)

$(431)_{10} == (1AF)_{16}$

$(0001\ \ 1010\ \ 1111)_2$

$\boxed{1.9}$

(a) $(10110.0101)_2$

$\cdots\ 2^0 \quad 2^{-1} \cdots$

$16+4+2+0 = 22$

$0+.25+0+.0625 = .3125$

$+$

$(22.3125)_{10}$

(b) $(16.5)_{16}$

$1*16^1 + 6*16^0$

$16+6$

22

$5*16^{-1}$

$+ \quad 0.3125$

$(22.3125)_{10}$

(c) $(26.24)_8$

$2*8^1 + 6*8^0$

$16+6$

22.3125

$2*8^{-1} + 4*8^{-2}$

$.25 + 0.0625$

(d) $(DADA.B)_{16}$

$B = 11$

$A = 10$ $\quad 13 \times 16^3 + 10 \times 16^2 + 13 \times 16^1 + 10 \times 16^0$ $\quad 11 \times 16^{-1}$

$\vdots$ $\quad = 53248 + 2560 + 208 + 10$ $\quad = .6875$

$D = 13$ $\quad = 56026.6875$

(e) $(1010.1101)_2$ $\quad \frac{1}{2}$ $\quad 2^{-1}$

$8 + 2$ $\quad .5 + .25 + .0625$

10 $\quad 0.8125$

$= 10.8125$

1.14 Obtain the 1's and 2's complements of the following binary numbers:

(a) 00010000 (b) 00000000
(c) 11011010 (d) 10101010
(e) 10000101 (f) 11111111.

.

1.14 a

0001 0000
⬇
1110 1111 (1's complement)
+ 1
1111 0000 (2's complement)

1.14 b

0000 0000
⬇
1111 1111 (1's complement)
+ 1
1 0000 0000 → we can ignore bit overflow → 0000 0000 (2's complement)

1.14 c

1101 1010
⬇
0010 0101 (1's complement)
+ 1
0010 0110 (2's complement)

1.14 d

1010 1010
⬇
0101 0101 (1's complement)
+ 1
0101 0110 (2's complement)

1.14 e

1000 0101
⬇
0111 1010 (1's complement)
+ 1
0111 1011 (2's complement)

1.18 Perform subtraction on the given unsigned binary numbers using the 2's complement of the subtrahend. Where the result should be negative, find its 2's complement and affix a minus sign.

(a) 10011 − 10010 (b) 100010 − 100110

(c) 1001 − 110101 (d) 101000 − 10101

1.18 a) 10011 – 10010

Minuend: 10011 = 19 (in decimal)

Subtrahend: 10010 = 18 (in decimal) → 2's complement: 10010 → 01101 → 01110

10011

+ 01110

100001 → we only need 5 bits so ignore the bit overflow → 00001

1.18 b) 100010 – 100110

Minuend: 100010 = 34 (in decimal)

Subtrahend: 100110 = 38 (in decimal) → 2's complement: 100110 → 011001 → 011010

100010

+011010

111100 → find 2's complement & affix minus sign: 111100 → 000011 → -000100

1.18 c) 1001 – 110101

Minuend: 1001 = 001001 = 9 (in decimal)

Subtrahend: 110101 = 53 (in decimal) → 2's complement: 110101 → 001010 → 001011

001001

+001011

010100 → find 2's complement & affix minus sign: 010100 → 101011 → -101100

1.18 d) 101000 – 10101

Minuend: 101000 = 40 (in decimal)

Subtrahend: 10101 = 010101 = 21 (in decimal)

→ 2's complement: 010101 → 101010 → 101011

101000

+101011

1010011 → we only need 6 bits so ignore the bit overflow → 010011

1.15 Find the 9's and the 10's complement of the following decimal numbers:

(a) 25,478,036 (b) 63, 325, 600

(c) 25,000,000 (d) 00,000,000.

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1.15 a)

25,478,036

⬇ (subtract 9 from each digit)

74,521,963 (9's complement)

\+ 1

74,521,964 (10's complement)

1.15 b)

63,325,600

⬇ (subtract 9 from each digit)

36,674,300 (9's complement)

\+ 1

36,674,301 (10's complement)

1.15 c)

25,000,000

⬇ (subtract 9 from each digit)

74,999,999 (9's complement)

\+ 1

75,000,000 (10's complement)

1.15 d)

00,000,000

⬇ (subtract 9 from each digit)

99,999,999

\+ 1

100,000,000 → we can ignore bit overflow → 00,000,000 (10's complement)

1.17 Perform subtraction on the given unsigned numbers using the 10's complement of the subtrahend. Where the result should be negative, find its 10's complement and affix a minus sign. Verify your answers.

(a) 4,637 – 2,579
(b) 125 – 1,800
(c) 2,043 – 4,361
(d) 1,631 – 745

1.17 a) 4637 – 2579

Minuend = 4637
Subtrahend = 2579 → 10's complement: 2579 → 7420 → 7421

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 4637
+7421
12058 → drop extra digit → 2058
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1.17 b) 125 – 1800

Minuend = 125 = 0125
Subtrahend = 1800 → 10's complement: 1800 → 8199 → 8200

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 0125
+8200
 8325 → find 10's complement & append minus sign: 8325 → 1674 → -1675
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1.17 c) 2043 – 4361

Minuend = 2043
Subtrahend = 4361 → 10's complement: 4361 → 5638 → 5639

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 2043
+5639
 7682 → find 10's complement & append minus sign: 7682 → 2317 → - 2318
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1.17 d) 1631 – 745

Minuend = 1631
Subtrahend = 745 = 0745 → 10's complement: 0745 → 9254 → 9255

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 1631
+9255
10886 → drop extra digit → 886
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1.25 Represent the decimal number 6,248 in (a) BCD, (b) excess-3 code, (c) 2421 code, and (d) a 6311 code.

1.25 a) 6248 (in decimal) to BCD (binary coded decimal)

6 → 0110
2 → 0010
4 → 0100
8 → 1000

6248 (decimal) = 0110 0010 0100 1000 (BCD)

1.25 b) 6248 (in decimal) to excess-3 code

6 → 6+3 = 9 → 1001
2 → 2+3 = 5 → 0101
4 → 4+3 = 7 → 0111
8 → 8+3 = 11 → 1011

6248 (decimal) = 1001 0101 0111 1011 (excess-3 code)

1.25 c) 6248 (in decimal) to 2421 code

6 → 2(1) + 4(1) + 2(0) + 1(0) = 6 → 1100 (0110 is also a valid answer)
2 → 2(1) + 4(0) + 2(0) + 1(0) = 2 → 1000
4 → 2(0) + 4(1) + 2(0) + 1(0) = 4 → 0100
8 → 2(1) + 4(1) + 2(1) + 1(0) = 8 → 1110

6248 (decimal) = 1100 1000 0100 1110 (2421 code)
(**0110** 1000 0100 1110 is also a valid answer)

1.25 d) 6248 (in decimal) to 6311 code

6 → 6(1) + 3(0) + 1(0) + 1(0) = 6 → 1000
2 → 6(0) + 3(0) + 1(1) + 1(1) = 2 → 0011
4 → 6(0) + 3(1) + 1(1) + 1(0) = 4 → 0110 (0101 is also a valid answer)
8 → 6(1) + 3(0) + 1(1) + 1(1) = 8 → 1011

6248 (decimal) = 1000 0011 0110 1011 (6311 code)
(1000 0011 **0101** 1011 is also a valid answer)

1.33* The state of a 12-bit register is 100010010111. What is its content if it represents
(a) Three decimal digits in BCD?
(b) Three decimal digits in the excess-3 code?
(c) Three decimal digits in the 84-2-1 code?
(d) A binary number?

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1.33 a) 1000 1001 0111 BCD to decimal
1000 = 8
1001 = 9
0111 = 7
1000 1001 0111 (BCD) = 897 (decimal)

1.33 b) 1000 1001 0111 excess-3 code to decimal
1000 = 8 → 8-3 = 5
1001 = 9 → 9-3 = 6
0111 = 7 → 7-3 = 4
1000 1001 0111 (excess-3 code) = 564 (decimal)

1.33 c) 1000 1001 0111 84-2-1 code to decimal
1000 → 8(1) + 4(0) -2(0) -1(0) = 8
1001 → 8(1) + 4(0) -2(0) -1(1) = 7
0111 → 8(0) + 4(1) -2(1) -1(1) = 1
1000 1001 0111 (84-2-1 code) = 871 (decimal)

1.33 d) 1000 1001 0111 binary to decimal
2^11 + 2^7 + 2^4 + 2^2 + 2^1 + 2^0 = 2199 (decimal)

1.35 By means of a timing diagram similar to Fig. 1.5, show the signals of the outputs f and g in Fig. P1.35 as functions of the three inputs a, b, and c. Use all eight possible combinations of a, b, and c.

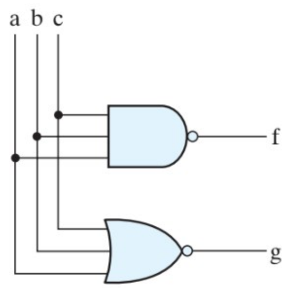

FIGURE P1.35

a	b	c	f = NOT(a AND b AND c)	g = NOT(a OR b OR c)
0	0	0	0	1
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	1	0
1	0	1	1	0
1	1	0	1	0
1	1	1	1	0

1.36 By means of a timing diagram similar to Fig. 1.5, show the signals of the outputs f and g in Fig. P1.36 as functions of the two inputs a and b. Use all four possible combinations of a and b.

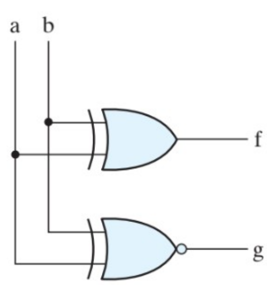

FIGURE P1.36

a	b	f = a XOR b	g = NOT(a XOR b)
0	0	0	1
0	1	1	0
1	0	1	0
1	1	0	1