1.

(a) In unsigned binary under, the overflow is from 0000 (0 in decimal) to 1111 (15 in decimal).
(b) In 2's complement integer, the overflow is from 0111 (+7 in decimal) to 1000 (-8 in decimal).

2.

(a) An unsigned number
11001001.0101_2
$= 1 * 2^7 + 1 * 2^6 + 1 * 2^3 + 1 * 2^0 + 1 * 2^{-2} + 1 * 2^{-4}$
$= 128 + 64 + 8 + 1 + 0.25 + 0.0625$
$= 201.3125_{10}$
(b) A 2's complement number
11001001.0101_2
$= -128 + 64 + 8 + 1 + 0.25 + 0.0625$
$= -54.6875_{10}$

3.

(a) 101101_2
$= 32 + 8 + 4 + 1$
$= 45_{10}$
(b) $BEEF_{16}$
$= 11 * 16^3 + 14 * 16^2 + 14 * 16 + 15$
$= 48879_{10}$

4.

(a) 150_{10} to base 2

150/2	Q = 75	R = 0
75/2	Q = 37	R = 1
37/2	Q = 18	R = 1
18/2	Q = 9	R = 0
9/2	Q = 4	R = 1
4/2	Q = 2	R = 0
2/2	Q = 1	R = 0

Thus, $150_{10} = 10010110_2$
(b) 1500_{10} to base 16

1500/16	Q = 93	R = 12
93/16	Q = 5	R = 13
5/15	Q = 0	R = 5

Thus, $1500_{10} = 5DC_{16}$

5.

(a) 0.9_{10} to base 2
$0.9 * 2 = 1.\underline{8}$
$0.8 * 2 = 1.6$
$0.6 * 2 = 1.2$
$0.2 * 2 = 0.4$
$0.4 * 2 = 0.\underline{8}$
Thus, $0.9_{10} = 0.1110_2$ (= 0.875, not exactly, but close enough?)

(b) 0.9_{10} to base 16
$0.9 * 16 = 14.\underline{4}$
$0.4 * 16 = 6.\underline{4}$
Thus, $0.9_{10} = 0.E_{16}$ (= 0.8984375)

6.

(a) $ACE5_{16} = 1010\ 1100\ 1110\ 0101_2$
(b) $FA.CE_{16} = 1111\ 1010.\ 1100\ 1110_2$
(c) $101011.01101_2 = 0010\ 1011.\ 0110\ 1000_2 = 2B.68_{16}$

7.

(a) $01010101 = 64 + 16 + 4 + 1 = 85_{10}$ (because the most significant bit is 0, so this is positive, just do polynomial evaluation)
(b) $10101010 = -128 + 32 + 8 + 2 = -86_{10}$
(c) $1000.0001 = -8 + 0.0625 = -7.9375_{10}$
(d) $1001.0110 = -8 + 1 + 0.25 + 0.125 = -6.625_{10}$
(e) $0111.1110 = 4 + 2 + 1 + 0.5 + 0.25 + 0.125 = 7.875_{10}$ (positive)

8.

(a) -6.7
-8 + 1 + 0.25 + 0.0625 = -6.6875 (pretty close I would say)
Thus, -6.7's representation in 2's complement is 1001.0101_2

(b) -37.1
-64 + 16 + 8 + 2 + 0.5 + 0.25 + 0.125 = 37.125
Thus, -37.1's representation in 2's complement is 1011010.111_2

(c) -100
-128 + 16 + 8 + 4 = -100
Thus, -100's representation in 2's complement is 10011100_2

(d) -7.7
-8 + 0.25 + 0.0625= -7.6875
Thus, -7.7's representation in 2's complement is 1000.0101_2

9.

(a) 10101011
(b) 01010110

(c) 0111.1111
(d) 0110.1010
(e) 1000.0010

10.
(a) $2^{-(n-2)}$
(b) When n = 8, the bit with 1 should be the sixth bit from the decimal point, so 00.000001
(c) $-2^{-(n-2)}$
(d) 11.111111

11.
Most positive: $011111 = 31_{10}$
Most negative: $100000 = -32_{10}$

12.
Minimum: $000000 = 0_{10}$
Maximum: $111111 = 64_{10}$

13.
When we are dealing with unsigned number.

14.
No, they are different.
For example, in 2's complement, $0111 = +7_{10}$, $1000 = -8_{10}$

15.
(a) 0.324_7 to base 10
$324_7 = 3 * 7^2 + 2 * 7 + 4 = 165_{10}$
Thus, $0.324_7 = 165/7^3 = 0.4810495627_{10}$
(b) 400_{10} to base 7
400/7 Q = 57 R = 1
57/7 Q = 8 R = 1
8/7 Q = 1 R = 1
Thus, $400_{10} = 1111_7$
(c) 0.9_{10} to base 3
0.**9** * 3 = 2.7
0.7 * 3 = 2.1
0.1 * 3 = 0.3
0.3 * 3 = 0.**9**
Thus, $0.9_{10} = 0.220_3$
(d) 12.34_5 to base 7
$1234_5 = 1 * 5^3 + 2 * 5^2 + 3 * 5 + 4 = 194_{10}$
$12.34_5 = 194/5^2 = 7.76_{10}$

$7_{10} = 10_7$

$0.\underline{\mathbf{76}} * 7 = 5.32$

$0.32 * 7 = 2.24$

$0.24 * 7 = 1.68$

$0.68 * 7 = 4.\underline{\mathbf{76}}$

Thus, $12.34_5 = 10.5214$

(e) 35.2_7 to base 10

$352_7 = 3 * 7^2 + 5 * 7 + 2 = 184_{10}$

Thus, $35.2_7 = 184/7 = 26.28571429_{10}$

(f) 35.2_{10} to base 7

$35_{10} = 50_7$

$0.\underline{\mathbf{2}} * 7 = 1.4$

$0.4 * 7 = 2.8$

$0.8 * 7 = 5.6$

$0.6 * 7 = 4.\underline{\mathbf{2}}$

Thus, $35.2_{10} = 50.1254_7$

16.

(a) $FACE_{16} = 1111\ 1010\ 1100\ 1110_2 = 001\ 111\ 101\ 011\ 001\ 110_2 = 175316_8$

(b) $1011.0111_2 = 001\ 011.\ 011\ 100_2 = 13.34_8$

(c) $232.1_4 = 10\ 11\ 10.\ 01_2 = 101\ 110.\ 010_2 = 56.2_8$

(d) $17.6_9 = 0121.20_3$

(e) $1100011.11001_2 = 001\ 100\ 011.110\ 010_2 = 143.62_8$

(f) $71.3_8 = 111\ 001.011_2 = 11\ 10\ 01.01\ 10_2 = 321.12_4$

17.

$\frac{1}{6} = 0.1666666667$

$0.125 + 0.03125 + 0.0078125 = 0.1640625 = \frac{21}{128}$

$\frac{1}{6} \rightarrow 0.00101010_2$

$\text{Error} = \left|\frac{1}{6} - \frac{21}{128}\right| = \left|\frac{128 - 21 * 6}{128 * 6}\right| = \left|\frac{2}{768}\right| = \frac{1}{384} = 0.002604167$

18.

For example,

(13-bit) $0.0001110001101_2 = 0.1109619140625_{10} \approx 0.111_{10}$

$0.111 * 2 = 0.222$

$0.222 * 2 = 0.444$

$0.444 * 2 = 0.888$

$0.888 * 2 = 1.776$

$0.776 * 2 = 1.552$

$1.552 * 2 = 1.104$

$0.104 * 2 = 0.208$

$0.208 * 2 = 0.416$

$0.416 * 2 = 0.832$
$0.832 * 2 = 1.664$
$0.664 * 2 = 1.328$
$0.328 * 2 = 0.656$
$0.656 * 2 = 1.312$
(12-bit) $0.000111000110_2 = 0.11083984375_{10} \approx 0.111_{10}$
(11-bit) $0.00011100011_2 = 0.11083984375_{10} \approx 0.111_{10}$
(10-bit) $0.0001110001_2 = 0.1103515625_{10} \approx 0.110_{10}$

Another example, just to check.
$0.123 * 2 = 0.246$
$0.246 * 2 = 0.492$
$0.492 * 2 = 0.984$
$0.984 * 2 = 1.968$
$0.968 * 2 = 1.936$
$0.936 * 2 = 1.872$
$0.872 * 2 = 1.744$
$0.744 * 2 = 1.488$
$0.488 * 2 = 0.976$
$0.976 * 2 = 1.952$
$0.952 * 2 = 1.904$
(11-bit) $0.00011111011_2 = 0.12255859375_{10} \approx 0.123_{10}$
(10-bit) $0.0001111101_2 = 0.1220703125_{10} \approx 0.122_{10}$

Thus, we should have at least 11 bits of binary numbers.