

1.(o) 10110111100_2

$$2^{10} + 2^8 + 2^7 + 2^5 + 2^4 + 2^3 + 2^2 = 1468_{10}$$

(b) $3AGE_{16}$

$$3 \cdot 16^3 + 10 \cdot 16^2 + 6 \cdot 16 + 14 = 14958_{10}$$

(c) 1110000011010_2

$$2^{12} + 2^{11} + 2^{10} + 2^4 + 2^3 + 2 = 7194_{10}$$

(d) 164_8

$$8^2 + 6 \cdot 8 + 4 = 116_{10}$$

(e) 1004_6

$$6^3 + 4 = 220_{10}$$

2.(o) 11101011_2

$$-2^7 + 2^6 + 2^5 + 2^3 + 2 + 1 = -21_{10}$$

(b) 1111_2

$$-2^3 + 2^2 + 2 + 1 = -1$$

(c) 0.213_4

$$2 \cdot 4^{-1} + 4^{-2} + 3 \cdot 4^{-3} = 0,609375_{10}$$

(d) $0,387_{15}$

$$9 \cdot 15^{-1} + 8 \cdot 15^{-2} + 7 \cdot 15^{-3} = 0,637629629_{10}$$

3. (b) 2021_{10}

rest

$$2021/2 = 1010 \quad 1$$

$$1010/2 = 505 \quad 0$$

$$505/2 = 252 \quad 1$$

$$252/2 = 126 \quad 0$$

$$126/2 = 63 \quad 0$$

$$63/2 = 31 \quad 1$$

$$31/2 = 15 \quad 1$$

$$15/2 = 7 \quad 1$$

$$7/2 = 3 \quad 1$$

$$3/2 = 1 \quad 1$$

$$1/2 = 0 \quad 1$$

11111100101_2

(b) 666_8

$$6 \cdot 8^2 + 6 \cdot 8 + 6 = 438_{10}$$

rest

$438/2$	$= 219$	0
$219/2$	$= 109$	1
$109/2$	$= 54$	1
$54/2$	$= 27$	0
$27/2$	$= 13$	1
$13/2$	$= 6$	1
$6/2$	$= 3$	0
$3/2$	$= 1$	1
$1/2$	$= 0$	1

110110110_2

(c') $(1BD7)_{16}$

$$16^3 + 11 \cdot 16^2 + 13 \cdot 16 + 7 = 7127$$

rest

$7127/2$	$= 3563$	1
$3563/2$	$= 1781$	1
$1781/2$	$= 890$	1
$890/2$	$= 445$	0
$445/2$	$= 222$	1
$222/2$	$= 111$	0
$111/2$	$= 55$	1
$55/2$	$= 27$	1
$27/2$	$= 13$	1

$$\begin{array}{rcl}
 13/2 & = 6 & 1 \\
 6/2 & = 3 & 0 \\
 3/2 & = 1 & 1 \\
 1/2 & = 0 & 1
 \end{array}$$

1101111010111_2

(d) $7,75_{10}$

$$\begin{array}{rcl}
 7/2 & = 3 & \text{rest} \\
 3/2 & = 1 & 1 \\
 1/2 & = 0 & 1
 \end{array}$$

111_2

$$\begin{aligned}
 0,75_{10} \\
 0,75 \cdot 2 &= 1,50 \\
 0,50 \cdot 2 &= 1,00
 \end{aligned}$$

11_2

$\Rightarrow 111.11_2$

(e) AD 141₁₆

$$10 \cdot 16^3 + 13 \cdot 16^2 + 16 + 1 = 44308$$

rest

$$44308 / 2 = 22154 \quad 0$$

$$22154 / 2 = 11077 \quad 0$$

$$11077 / 2 = 5538 \quad 1$$

$$5538 / 2 = 2769 \quad 0$$

$$2769 / 2 = 1384 \quad 1$$

$$1384 / 2 = 692 \quad 0$$

$$692 / 2 = 346 \quad 0$$

$$346 / 2 = 173 \quad 0$$

$$173 / 2 = 86 \quad 1$$

$$86 / 2 = 43 \quad 0$$

$$43 / 2 = 21 \quad 1$$

$$21 / 2 = 10 \quad 1$$

$$10 / 2 = 5 \quad 0$$

$$5 / 2 = 2 \quad 1$$

$$2 / 2 = 1 \quad 0$$

$$1 / 2 = 0 \quad 1$$

1010110100010100₂

$4.(01) - 104_{10}$

rest

$$104/2 = 52 \quad 0$$

$$52/2 = 26 \quad 0$$

$$26/2 = 13 \quad 0$$

$$13/2 = 6 \quad 1$$

$$6/2 = 3 \quad 0$$

$$3/2 = 1 \quad 1$$

$$1/2 = 0 \quad 1$$

$$104_{10} = 1101000_2$$

Sign/magnitude: 11101000_2

1's complement: 10010111_2

2's complement: 10011000_2

Excess 128: $-104 + 128 = 24$

rest

$$24/2 = 12 \quad 0$$

$$12/2 = 6 \quad 0$$

$$6/2 = 3 \quad 0$$

$$3/2 = 1 \quad 1$$

$$1/2 = 0 \quad 1$$

$$00011000_2$$

(b) -69_{10}

rest

$69/2$	$= 34$	1
$34/2$	$= 17$	0
$17/2$	$= 8$	1
$8/2$	$= 4$	0
$4/2$	$= 2$	0
$2/2$	$= 1$	0
$1/2$	$= 0$	1

Signed magnitude : 11000101_2

1's Complement : 10111010_2

2's Complement : 10111011_2

Excess 128 : $-69 + 128 = 59$

rest

$59/2$	$= 29$	1
$29/2$	$= 14$	1
$14/2$	$= 7$	0
$7/2$	$= 3$	1
$3/2$	$= 1$	1
$1/2$	$= 0$	1

00111011_2

-128_{10}

rest

$$\begin{array}{rcl} 128/2 & = 64 & 0 \\ 64/2 & = 32 & 0 \\ 32/2 & = 16 & 0 \\ 16/2 & = 8 & 0 \\ 8/2 & = 4 & 0 \\ 4/2 & = 2 & 0 \\ 2/2 & = 1 & 0 \\ 1/2 & = 0 & 1 \end{array}$$

Signed magnitude: Out of range

One's complement: Out of range

Two's complement: $1000\ 0000_2$

Excess 128:

$$-128_{10} + 128 = 0$$

$0000\ 0000_2$

$$(b) -3D_{16} \\ - (3 \cdot 16 + 13) = -61_{10}$$

rest

$61/2 = 30$	1
$30/2 = 15$	0
$15/2 = 7$	1
$7/2 = 3$	1
$3/2 = 1$	1
$1/2 = 0$	1

Signed magnitude: $1011\ 1101_2$

One's complement: $1100\ 0010_2$

Two's complement: $1100\ 0011_2$

Excess 128:

$$-61 + 128 = 67$$

$$0011\ 1101_2 + 0000\ 0110_2 \\ = 0100\ 0011_2$$

$$5.(a) \text{ Exponent} = 2^7 + 2^3 + 2^2 + 2 = 142_{10}$$

$$\Rightarrow \text{excess 127: } 142 - 127 = 15$$

$$+ 1.0011101 \cdot 2^5$$

$$(b) \text{ Exponent} = 2^5 + 2^4 + 2^3 + 2^2 = 60$$

$$\Rightarrow \text{Excess 127: } 60 - 127 = -67$$

$$-1.1011 \cdot 2^{-67}$$

(c') $\rightarrow \infty$

(d) De-normalized:

$$2^{-126} \cdot 2^{-3} \cdot 2^{-5} \cdot 2^{-7} \cdot 2^{-8} \cdot 2^{-9} = 2^{-158}$$

(e) Exponent: $2^4 + 2^2 = 20$

\Rightarrow Excess 127: $20 - 127 = -107$

$$-1.1110011 \cdot 2^{-107}$$

(f) No, N

(g) Exponent: $2^3 + 2 + 1 = 11$

\Rightarrow Excess 127: $11 - 127 = -116$

$$1.01101 \cdot 2^{-116}$$

6. (01) 2078.25₁₀

rest

$$2078/2 = 1039 \quad 0$$

$$1039/2 = 519 \quad 1$$

$$519/2 = 259 \quad 1$$

$$259/2 = 129 \quad 1$$

$$129/2 = 64 \quad 1$$

$$64/2 = 32 \quad 0$$

$$32/2 = 16 \quad 0$$

$$16/2 = 8 \quad 0$$

$$8/2 = 4 \quad 0$$

$$4/2 = 2 \quad 0$$

$$2/2 = 1 \quad 0$$

$$1/2 = 0 \quad 1$$

$$\cdot 25 \cdot 2 = 0.50$$

$$\cdot 50 \cdot 2 = 1.00$$

100000011110.01₂

$$\Rightarrow 1.0000001111001 \cdot 2^{11}$$

$$11 + 127 = 138$$

rest

$$138/2 = 69 \quad 0$$

$$69/2 = 34 \quad 1$$

$$34/2 = 17 \quad 0$$

$$17/2 = 8 \quad 1$$

$$8/2 = 4 \quad 0$$

$$4/2 = 2 \quad 0$$

$$2/2 = 1 \quad 0$$

$$1/2 = 0 \quad 1$$

0 10001010 00000011110010000000000

(b) 2010_{10}

rest

$$2010/2 = 1005 \quad 0$$

$$1005/2 = 502 \quad 1$$

$$502/2 = 251 \quad 0$$

$$251/2 = 125 \quad 1$$

$$125/2 = 62 \quad 1$$

$$62/2 = 31 \quad 0$$

$$31/2 = 15 \quad 1$$

$$15/2 = 7 \quad 1$$

$$7/2 = 3 \quad 1$$

$$3/2 = 1 \quad 1$$

$$1/2 = 0 \quad 1$$

11111011010₂

$$\text{Exponent} : 10 + 127 = 137$$

rest

$137/2 = 68$	1
$68/2 = 34$	0
$34/2 = 17$	0
$17/2 = 8$	1
$8/2 = 4$	0
$4/2 = 2$	0
$2/2 = 1$	0
$1/2 = 0$	1

0 10001001 11110110100000000000000000

(c) 0 11111111 011011100000000000000000

(d) -42,666₁₀

rest

$42/2 = 21$	0
$21/2 = 10$	1
$10/2 = 5$	0
$5/2 = 2$	1
$2/2 = 1$	0
$1/2 = 0$	1

$$\begin{aligned}
 & .666 \cdot 2 = 1.332 \\
 & .332 \cdot 2 = 0.664 \\
 & .664 \cdot 2 = 1.328 \\
 & .328 \cdot 2 = 0.656 \\
 & .656 \cdot 2 = 1.312 \\
 & .312 \cdot 2 = 0.624 \\
 & .624 \cdot 2 = 1.248 \\
 & .248 \cdot 2 = 0.496 \\
 & .496 \cdot 2 = 0.992 \\
 & .992 \cdot 2 = 1.984 \\
 & .984 \cdot 2 = 1.968 \\
 & .968 \cdot 2 = 1.936 \\
 & .936 \cdot 2 = 1.872 \\
 & .872 \cdot 2 = 1.744 \\
 & .744 \cdot 2 = 1.488 \\
 & .488 \cdot 2 = 0.976 \\
 & .976 \cdot 2 = 1.952 \\
 & .952 \cdot 2 = 1.904
 \end{aligned}$$

101010.10101010011111011

$$\text{Exponent: } 5 + 127 = 132$$

rest

$$\begin{aligned}
 132/2 &= 66 & 0 \\
 66/2 &= 33 & 0 \\
 33/2 &= 16 & 1 \\
 16/2 &= 8 & 0 \\
 8/2 &= 4 & 0 \\
 4/2 &= 2 & 0 \\
 2/2 &= 1 & 0 \\
 1/2 &= 0 & 1
 \end{aligned}$$

1 1000 0100 0101010101010100111111011

(e) +∞

0 1111 1111 0000000000000000000000000000

(f) +0

0 00000000 0000000000000000000000000000

(g) 0 0000 0000 001 1100 00000000000000000000

(h) 333.666_{10}

rest

$$333/2 = 166 \quad 1$$

$$166/2 = 83 \quad 0$$

$$83/2 = 41 \quad 1$$

$$41/2 = 20 \quad 1$$

$$20/2 = 10 \quad 0$$

$$10/2 = 5 \quad 0$$

$$5/2 = 2 \quad 1$$

$$2/2 = 1 \quad 0$$

$$1/2 = 0 \quad 1$$

101001101.101010100111111

Exponent : $8+127 = 135$

	rest
$135/2 = 67$	1
$67/2 = 33$	1
$33/2 = 16$	1
$16/2 = 8$	0
$8/2 = 4$	0
$4/2 = 2$	0
$2/2 = 1$	0
$1/2 = 0$	1

0 1000 0111 0100 1101 1010 10 100 111111

$$7.(a) \text{ Basis: } 8^4 = 4096_{10}$$

$$(b) -1412 + 4096 = 3954_{10}$$

	rest
$3954/2 = 1977$	0
$1977/2 = 988$	1
$988/2 = 494$	0
$494/2 = 247$	0
$247/2 = 123$	1
$123/2 = 61$	1
$61/2 = 30$	1
$30/2 = 15$	0
$15/2 = 7$	1
$7/2 = 3$	1
$3/2 = 1$	1
$1/2 = 0$	1

111101110010₂

$$(c') \quad 8^{1034} \cdot 8^9 = 8^{1085}$$

$$(d) \quad 8^{-4095} \cdot 8^{-9} = 8^{-4104}$$