Solution for Tutorial Set 1

1. 1 Megabyte = 1048576 bytes = 1048576 $*$ 8 bits = 8388608 bits.

   First of all work out the number of parity bits required to store 1Mb. Use one parity bit for every **four** bits of data.

   $$\rightarrow (8388608)/4 \text{ bits} = 209717 \text{ bits}$$

   Then the total number of bits required is

   $$8388608 + 209717 = 10485760 \text{ bits} = 1.25 \text{ Megabytes}$$

   Assuming the data is read in chunks 32 bits wide, and each chunk is read out through a wire. The number of wires required is

   (8388608)/32+ the parity bits ((8388608)/4)/32) = 262144+65536 wires

2. (a)

   $$\left.\begin{array}{lcl} 2354/2 & = 1177 & \rightarrow 0 \\ 1177/2 & = 588 & \rightarrow 1 \\ 588/2 & = 294 & \rightarrow 0 \\ 294/2 & = 147 & \rightarrow 0 \\ 147/2 & = 73 & \rightarrow 1 \\ 73/2 & = 36 & \rightarrow 1 \\ 36/2 & = 18 & \rightarrow 0 \\ 18/2 & = 9 & \rightarrow 0 \\ 9/2 & = 4 & \rightarrow 1 \\ 4/2 & = 2 & \rightarrow 0 \\ 2/2 & = 1 & \rightarrow 0 \\ 1/2 & = 0 & \rightarrow 1 \end{array}\right\} \Rightarrow 2354_{10} = (100100110010)_2$$

   Converting to base 8:

   $$100100110010 \rightarrow \underbrace{100}\,\underbrace{100}\,\underbrace{110}\,\underbrace{010} \rightarrow (4462)_8$$

   Converting to base 16:

   $$100100110010 \rightarrow \underbrace{1001}\,\underbrace{0011}\,\underbrace{0010} \rightarrow (932)_{16}$$

(b)

$(fc12)_{16} \rightarrow (1111110000010010)_2 \rightarrow \underbrace{001}\,\underbrace{111}\,\underbrace{110}\,\underbrace{000}\,\underbrace{010}\,\underbrace{010} = (176022)_8$

Converting to base 10:

$(1111110000010010)_2 \rightarrow 2^{15}+2^{14}+2^{13}+2^{12}+2^{11}+2^{10}+2^4+2^1 = 64530$

(c)

$$\left.\begin{array}{ccc} 549/2 & = 274 & \rightarrow 1 \\ 274/2 & = 137 & \rightarrow 0 \\ 137/2 & = 68 & \rightarrow 1 \\ 68/2 & = 34 & \rightarrow 0 \\ 34/2 & = 17 & \rightarrow 0 \\ 17/2 & = 8 & \rightarrow 1 \\ 8/2 & = 4 & \rightarrow 0 \\ 4/2 & = 2 & \rightarrow 0 \\ 2/2 & = 1 & \rightarrow 0 \\ 1/2 & = 0 & \rightarrow 1 \end{array}\right\} \Rightarrow 549_{10} = (1000100101)_2$$

Converting to base 8:

$$(1000100101)_2 \rightarrow \underbrace{001}\,\underbrace{000}\,\underbrace{100}\,\underbrace{101} \rightarrow (1045)_8$$

Converting to base 16:

$$(1000100101)_2 \rightarrow \underbrace{0010}\,\underbrace{0010}\,\underbrace{0101} \rightarrow (225)_{16}$$

(d)
Converting to base 8

$(3efc)_{16} \rightarrow (0011111011111100)_2 \rightarrow \underbrace{000}\,\underbrace{011}\,\underbrace{111}\,\underbrace{011}\,\underbrace{111}\,\underbrace{100} = (037374)_8$

Converting to base 10

$$\begin{aligned}(0011111011111100)_2 &\rightarrow 2^{13}+2^{12}+2^{11}+2^{10}+2^9+2^7+2^6+2^5+2^4+2^3+2^2 \\ &= 16124\end{aligned}$$

3. (a)
Converting to base 10:

$$(100011101010)_2 = 2^{11}+2^7+2^6+2^5+2^3+2^1 = 2282$$

Converting to base 8:

$$(100011101010)_2 \rightarrow \underbrace{100}\underbrace{011}\underbrace{101}\underbrace{010} = (4352)_8$$

Converting to base 16:

$$(100011101010)_2 \rightarrow \underbrace{1000}\underbrace{1110}\underbrace{1010} = (8ea)_{16}$$

(b)
Converting to base 10:

$$(110101110)_2 = 2^8 + 2^7 + 2^5 + 2^3 + 2^2 + 2^1 = 430$$

Converting to base 8:

$$(110101110)_2 \rightarrow \underbrace{110}\underbrace{101}\underbrace{110} = (656)_8$$

Converting to base 16

$$(110101110)_2 \rightarrow \underbrace{0001}\underbrace{1010}\underbrace{1110} = (1ae)_{16}$$

Adding (a) + (b)

$$\begin{array}{cc} & 100011101010 \\ + & \underline{110101110} \\ & 10101001000 \end{array}$$

Adding (c) + (d)

$$\begin{array}{cc} & 1101 \\ + & \underline{1111010101} \\ & 1111100010 \end{array}$$

4. 2's complement of 5_{10} with 4 bits for the representation

$$\begin{array}{rcl} 5_{10} & = & 0101 \\ & \rightarrow & 1010 \\ & & +1 \\ & & \overline{1011} \end{array}$$

2's complement of 2_{10} with 4 bits for the representation

$$\begin{array}{rcl} 2_{10} & = & 0010 \\ & \rightarrow & 1101 \\ & & +1 \\ & & \overline{1110} \end{array}$$