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Assignment 1

Q1) a) 32k bytes:

$$32k = 2^5 \times 2^{10} = 2^{15} = 32,768$$

b) 64M bytes $= 2^6 \times 2^{20} = 2^{26} = 67,108,864$

c) 6.4 G bytes:

2	6.4
2	3.2
2	1.6
2	0.8
2	0.4
2	0.2
	0.1

$\therefore 6.4 = 2^6 \times 0.1$

$$6.4 \text{ G bytes} = 2^6 \times 0.1 \times 2^{30} = 2^{36} \times 0.1$$

$$= 6,871,947,674.$$

Q2) i) Largest Binary number in 16 bits:

1111 1111 1111 1111

ii) Decimal form:

$$1 \cdot 2^{15} + 1 \cdot 2^{14} + 1 \cdot 2^{13} + 1 \cdot 2^{12} + 1 \cdot 2^{11} + 1 \cdot 2^{10} + 1 \cdot 2^{09} + 1 \cdot 2^{08} + 1 \cdot 2^{07} + 1 \cdot 2^{06} +$$
$$1 \cdot 2^{05} + 1 \cdot 2^{04} + 1 \cdot 2^{03} + 1 \cdot 2^{02} + 1 \cdot 2^{01} + 1 \cdot 2^{0} = 65535_{10}$$

iii) $1111\ 1111\ 1111\ 1111_2 = FFFF_{16}$

Q3) 64CD :

$$\begin{array}{cccc} 6 & 4 & C & D \\ 0110 & 0100 & 1100 & 1101 \end{array}$$

$$\begin{array}{cccccc} 0 & 110 & 010 & 011 & 001 & 101 \\ & 6 & 2 & 3 & 1 & 5 \end{array}$$

$\therefore (62315)_8$

Q4) a) 431 from decimal → Binary :

$$431 = 0\cdot 2^{11} + 0\cdot 2^{10} + 0\cdot 2^{09} + 1\cdot 2^{8} + 1\cdot 2^{7} + 0\cdot 2^{6} + 1\cdot 2^{5} + 0\cdot 2^{4} + 1\cdot 2^{3} + 1\cdot 2^{2}$$
$$+ 1\cdot 2^{1} + 1\cdot 2^{0} = 0001\ 1010\ 1111$$

b) 431 → Hexa

$$\begin{array}{r|l} 16 & 431 \\ 16 & 26 \rightarrow 15 \\ \hline & 10 \rightarrow 10 \end{array}$$

hexa: 1AF

$$\begin{array}{cccc} & 1 & 10 & 15 \\ 1AF \Rightarrow & 0001 & 0110 & 1111 \end{array}$$

Direct Decimal to binary is faster

Q5) a) $(10110.0101)_2 = 1\cdot 2^4 + \cancel{0\cdot 2^3} + 1\cdot 2^2 + 1\cdot 2^1 + \cancel{0\cdot 2^0} + \cancel{0\cdot 2^{-1}} + 1\cdot 2^{-2} + \cancel{0\cdot 2^{-3}} + 1\cdot 2^{-4} = 22.3125_{10}$

b) $(16.5)_{16} = (1\cdot 16^1 + 6\times 16^0) + (5\times 16^{-1}) = 22.3125_{10}$

c) $(26.24)_8 = (2\times 8^1 + 4\times 8^0) + (2\times 8^{-1} + 4\times 8^{-2}) = 20.3125_{10}$

d) $DABA.B = (13\times 16^3 + 10\times 16^2 + 11\times 16^1 + 10\times 16^0) + (11\times 16^{-1})$
$= (55{,}994.6875)_{10}$

A=10
B=11
C=12
D=13

e) $(1011.1001)_2 = (1\cdot 2^3 + \cancel{0\cdot 2^2} + 1\cdot 2^1 + 1\cdot 2^0) + (1\cdot 2^{-1} + \cancel{0\cdot 2^{-2}} + \cancel{0\cdot 2^{-3}} + 1\cdot 2^{-4})$

$= 11.5625$

Q6) a) i) 1011 + 101 = ?

$$\begin{array}{r} {}^{111} \\ 1011 \\ +\ \ 101 \\ \hline 10000 \end{array} \Longrightarrow (10000)_2$$

a ii) 1011 × 101 = ?

$$\begin{array}{r} 1011 \\ 101 \\ \hline 1011 \\ 0000 \\ 1011 \\ \hline 110111 \end{array} \Longrightarrow (110111)_2$$

b) i) 2E + 34 = ?

$$\begin{array}{r} {}^{1} \\ 2E \\ +\ 34 \\ \hline 62 \end{array} \Longrightarrow (62)_2$$

b ii) 2E × 34 = ?

$$\begin{array}{r} {}^{2}_{3} \\ 2E \\ \times\ 34 \\ \hline B8 \\ 8A \\ \hline 958 \end{array} \Longrightarrow (958)_{16}$$

Q7) a) convert decimal 27.315 to binary:

$$27.315 = (1\cdot 2^4 + 1\cdot 2^3 + 0\cdot 2^2 + 1\cdot 2^1 + 1\cdot 2^0) + (0\cdot 2^{-1} + 1\cdot 2^{-2} + 0\cdot 2^{-3} + 1\cdot 2^{-4} + 0\cdot 2^{-5} + 0\cdot 2^{-6} + 0\cdot 2^{-7} + 0\cdot 2^{-8} + 1\cdot 2^{-9} + 0\cdot 2^{-10} + 1\cdot 2^{-11} \ldots)$$

$$= 11011.01010000101\ldots$$

b) $\frac{2}{3} \simeq (0.1010\,1010)_2$ convert to decimal

$$= (1\cdot 2^{-1} + 0\cdot 2^{-2} + 1\cdot 2^{-3} + 0\cdot 2^{-4} + 1\cdot 2^{-5} + 0\cdot 2^{-6} + 1\cdot 2^{-7} + 0\cdot 2^{-8})$$

$= (0.66406)_{10}$ result close by -0.002606

c) convert $(0.1010\,1010)_2$ to hexa:

$$= (0.AA)_{16}$$

$(0.AA)_{16} \Rightarrow$ decimal

$$= (10\times 16^{-1}) + (10\times 16^{-2}) = 0.66406$$

Therefore the answer in (C) is the same as in (b).

Q8)

	1's complement	2's complement
a)	10010000	01101111
	+ 11111111	+ 00000001
	01101111	01110000
b)	0000 0000	1111 1111
	+ 1111 1111	+ 0000 0001
	1111 1111	1 0000 0000
c)	1101 1010	00100101
	+ 1111 1111	+ 0000 0001
	00100101	00100110
d)	1010 1010	0101 0101
	+ 1111 1111	+ 0000 0001
	01010101	0101 0110
e)	1010 0101	0101 1010
	+ 1111 1111	+ 0000 0001
	01011010	01011011
f)	1111 1111	0000 0000
	+ 1111 1111	+ 0000 0001
	1 00000000	0000 0001

Q9) Given: +49 , +29
signed 2's complement:
Range: $-2^{n-1} \rightarrow 2^{n-1}-1$

* (+29) ⇒ 011101
(+49) ⇒ 0110001
(−49) ⇒ 1001111

Addition:
```
  011101
+ 1001111
  1101100 = -20
```
∴ +29 − 49 = −20

*
```
  -29 => 11100011
+  49 => 00110001
   20    00010100
```

*
```
 -29 => 1110 0011
 -49 => +1100 1111
 -78    11011 0010
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