Homework 1 – due 5/24/04

1-7) Express the following numbers in decimal:
$(10110.0101)_2$=22.3125,
$(16.5)_{16}$ = (1 0110.0101)2,
$(26.24)_8$ = (10 110.010 100)2

$(10110.0101)_2=2^4+2^2+2^1+2^{-2}+2^{-4}$ = 16+4+2+.25+0625=22.3125_{10}
$(16.5)_{16}$ = $(1\ \ 0110.0101)_2=22.3125_{10}$
$(26.24)_8$ = $(10\ \ 110.010\ \ 100)_2=22.3125_{10}$

1-11)Do the following conversions:
a) $(34.4375)_{10}$ to binary = (100010.0111)2
b) Calculate $(1/3)_{10}$ to 8 binary places. Convert result to decimal. How close is result to $(1/3)_{10}$?
c)Convert the binary result in (b) to hexadecimal, then convert to decimal. Is the answer the same?
(0.55)16 = 0.34375

a)
34.4375 = 34 + .4375
34 = 17*2 + 0
17 = 8*2 + 1
8 = 4*2 + 0
4 = 2*2 + 0
2 = 2*1 + 0
0 result $34_{10} = 100010_2$

.4375 = .5*0+.4375
.875 = .5*1 + .375
.75 = .5*1 + .25
.5 = .5*1 + 0 result $.4375_{10} = 0.0111_2$
final result $344375_{10} = 100010.0111_2$

b)
divide 1/3 to 8 binary places:

```
   0 .01 01 01 01
11)1.00 00 00 00
    0 11
    0 01 00
         0 11
         0 01 00
              0 11
                  1 00
                    11
                     1
```

Convert result to decimal:
0.01010101_2 = .25 + .0625 + .015625 + .00390625 = $.33203125_{10}$
Difference = $2^{-10} < .001302083 < 2^{-9}$

c)
$0.01010101_2 = 0.55_{16} = 5*16^{-1} + 5*16^{-2}$ = 5*.0625 + 5*.00390625 = .33203125 – same result

1-13)Perform the following division in binary 1011111/101

```
        00 10 01 1
    101)10 11 11 1
        10 1
           01 11
            1 01
              10 1
              10 1
                 0
```

To check, perform the multiplication 10011*101=1011111

```
            1 00 11
           x   1 01
            1 00 11
          1 00 11
          1 01 11 11
```

1-20) Convert decimal +61 and +27 to binary using the signed-2's complement representation and enough digits to accommodate the numbers. Then perform the binary equivalent of (+27) + (-61), (-27) + (+61) and (-27) + (-61). Convert the answers back to decimal and verify that they are correct.

61_{10} = 32+16+8+4+1 = 111101_2
27_{10} = 16+8+2+1 = 11011_2

The sum (61 + 27) will exceed 64, so we need to represent numbers from –128 - +127, requiring 8 bits

$+61_{10}$ = 00111101_2
-61_{10} = 11000011_2
$+27_{10}$ = 00011011_2
-27_{10} = 11100101_2

(+27) + (-61): -34

```
   0001 1011
  +1100 0011
   1101 1110 = -(0010 0001 + 1) = -(0010 0010) -(32 + 2) = -34
```

(-27) + (+61): +34

```
   1110 0101
  +0011 1101
(1)0010 0010 = (0010 0010) = +34
```

(-27) + (-61): +88

```
   1110 0101
  +1100 0011
(1)1010 1000 = -(0101 0111 + 1) = -(0101 1000) = -(64+16+8) = +88
```