TEJ4M - Number Systems Review

1. Convert each of the following base 10 numbers to base 2 (show all work):
    1. 7_{10}
    2. 14_{10}
    3. 37_{10}
    4. 70_{10}
    5. 120_{10}
    6. 167_{10}
    7. 257_{10}

Use the repeated division by 2 method learned in grade 11.

1.

Divided by 2	**Remainder**
7/2 = 3	1
3/2 = 1	1
1/2 = 1	1

$7_{10} = 111_2$

2.

Divided by 2	**Remainder**
14/2 = 7	0
7/2 = 3	1
3/2	1
1/2	1

$14_{10} = 1110_2$

3.

Divided by 2	**Remainder**

37/2 = 18	1
18/2 = 9	0
9/2 = 4	1
4/2 = 2	0
2/2 = 1	0
1/2 = 0	1

$37_{10} = 0010\ 0101_2$

4

Divided by 2	**Remainder**
70/2 = 35	0
35/2 = 17	1
17/2 = 8	1
8/2 = 4	0
4/2 = 2	0
2/2 = 1	0
1/2 = 0	1

$70_{10} = 0100\ 0110_2$

5.

Divided by 2	**Remainder**
120/2 = 60	0
60/2 = 30	0
30/2 = 15	0

15/2 = 7	1
7/2 = 3	1
3/2 = 1	1
1/2 = 0	1

$120_{10} = 0111\ 1000_2$

6.

Divided by 2	**Remainder**
167/2 = 83	1
83/2 = 41	1
41/2 = 20	1
20/2 = 10	0
10/2 = 5	0
5/2 = 2	1
2/2 = 1	0
1/2 = 0	1

$167_{10} = 1010\ 0111_2$

7.

Divided by 2	**Remainder**
257/2 = 128	1
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

$257_{10} = 0001\ 0000\ 0001_2$

Convert each of the following base 2 numbers to decimal (show all work):

1. 0101
2. 11 0010
3. 1000 1100
4. 1010 1110
5. 1001 1001
6. 1111 1001

1. $1 \times 1 + 0 \times 2 + 1 \times 4 + 0 \times 8 = 5_{10}$
   $0101_2 = 5_{10}$

2. 0011 0010
   $0 \times 1 + 1 \times 2 + 0 \times 4 + 0 \times 8 + 1 \times 16 + 1 \times 32 + 0 \times 64 + 0 \times 128 = 50_{10}$
   $110010_2 = 50_{10}$

3. $0 \times 1 + 0 \times 2 + 1 \times 4 + 1 \times 8 + 0 \times 16 + 0 \times 32 + 0 \times 64 + 1 \times 128 = 140_{10}$
   $1000\ 1100_2 = 140_{10}$

4. $0 \times 1 + 1 \times 2 + 1 \times 4 + 1 \times 8 + 0 \times 16 + 1 \times 32 + 0 \times 64 + 1 \times 128 = 174_{10}$
   $1010\ 1110_2 = 174_{10}$

5. $1 \times 1 + 0 \times 2 + 0 \times 4 + 1 \times 8 + 1 \times 16 + 0 \times 32 + 0 \times 64 + 1 \times 128 = 153_{10}$

   $1001\ 1001_2 = 153_{10}$

6. $1 \times 1 + 0 \times 2 + 0 \times 4 + 1 \times 8 + 1 \times 16 + 1 \times 32 + 1 \times 64 + 1 \times 128 = 249_{10}$
   $1111\ 1001_2 = 249_{10}$

Convert each of the following Hexadecimal (base 16) to Decimal (base 10) (show all work):

1. A_{16}
2. $A1_{16}$
3. 12_{16}
4. $A1B_{16}$
5. CBC_{16}
6. FFF_{16}
7. $C2B4_{16}$

1. $A_{16,} = 10$
   $10 \times 16^0 = 10$
   $A_{16} = 10_{10}$

2. $A1_{16} = 10\ 1$
   $1 \times 16^0 \times 10 \times 16^1 = 161$
   $A1_{16} = 161_{10}$

3. 12_{16}
   $2 \times 16^0 + 1 \times 16^1 = 18$
   $12_{16} = 18_{10}$

4. $A1B_{16} = 10\ 1\ 11$
   $11 \times 16^0 + 1 \times 16^1 + 10 \times 16^2 = 2587_{10}$
   $A1B_{16} = 2587_{10}$

5. $CBC_{16} = 12\ 11\ 12$
   $12 \times 16^0 + 11 \times 16^1 + 12 \times 16^2 = 3260_{10}$
   $CBC_{16} = 3260_{10}$

6. $FFF_{16} = 15\ 15\ 15$
   $15 \times 16^0 + 15 \times 16^1 + 15 \times 16^2 = 4095_{10}$
   $FFF_{16} = 4095_{10}$

7. $C2B4 = 12\ 2\ 11\ 4$
   $4 \times 16^0 \times 11 \times 16^1 \times 2 \times 16^2 \times 12 \times 16^3 = 49844$

$C2B4_{16} = 49844_{10}$

Convert each of the following Decimal (base 10) to Hexadecimal (base 16) (show all work):

1. 13_{10}
2. 33_{10}
3. 79_{10}
4. 128_{10}
5. 576_{10}
6. 4644_{10}
7. 78429_{10}

1. $13_{10} = D_{16}$

2.

Divided by 16	**Remainder**
33/16 = 2	1
2/16 = 0	2

$33_{10} = 21_{16}$

3.

Divided by 16	**Remainder**
79/16 = 4	15
4/16 = 0	4

$79_{10} = 4F_{16}$

4.

Divided by 16	**Remainder**
128/16 = 8	0

8/16	8

$128_{10} = 80_{16}$

5.

Divided by 16	**Remainder**
576/16 = 36	0
36/16 = 2	4
2/16 = 0	2

$36_{10} = 240_{16}$

6.

Divided by 16	**Remainder**
4644/16 = 290	4
290/16 = 18	2
18/16 = 1	2
1/16 = 0	1

$4644_{10} = 1224_{16}$

7.

Convert $CSB4_{10}$ to decimal

$C2B4_{10}$ = 12 2 11 4

= $4 \times 16^0 \times 11 \times 16^1 \times 2 \times 16^2 \times 12 \times 16^3$

= 49844_{10}

Divided by 16	**Remainder**
49844/16 = 3115	4
3115/16 = 194	11 or B

194/16 = 17	10 or A
17/16 = 1	1
1/16 = 0	1

$C2B4_{10} = 11AB4_{16}$

Convert the below Binary (base 2) numbers to hexadecimal (base 16) form.

1. $1010\ 0011_2$
2. $0111\ 0001\ 0011_2$
3. $0001\ 0111\ 0011\ 1101\ 0010_2$
4. $0100\ 0101\ 0011_2$
5. $0010\ 1101\ 1000\ 1100_2$
6. $1011\ 1111_2$
7. $1111\ 1100\ 0000_2$
8. $0001\ 0101\ 1110_2$

1. $0 \times 2^0 + 1 \times 2^1 + 0 \times 2^2 + 1 \times 2^3 = 10_{16}$ or A_{16}
   $1 \times 2^0 + 1 \times 2^1 + 0 \times 2^2 + 0 \times 2^3 = 3$
   $1010\ 0011_2 = A3_{16}$

2. $1 \times 2^0 + 1 \times 2^1 + 1 \times 2^2 + 0 \times 2^3 = 7_{16}$
   $1 \times 2^0 + 0 \times 2^1 + 0 \times 2^2 + 0 \times 2^3 = 1_{16}$
   $1 \times 2^0 + 1 \times 2^1 + 0 \times 2^2 + 0 \times 2^3 = 3_{16}$
   $0111\ 0001\ 0011_2 = 713_{16}$

3. $1 \times 2^0 + 0 \times 2^1 + 0 \times 2^2 + 0 \times 2^3 = 1_{16}$
   $1 \times 2^0 + 1 \times 2^1 + 1 \times 2^2 + 0 \times 2^3 = 7_{16}$
   $1 \times 2^0 + 1 \times 2^1 + 0 \times 2^2 + 0 \times 2^3 = 3_{16}$
   $1 \times 2^0 + 0 \times 2^1 + 1 \times 2^2 + 1 \times 2^3 = 13_{16}$ or D_{16}
   $0 \times 2^0 + 1 \times 2^1 + 0 \times 2^2 + 0 \times 2^3 = 2_{16}$
   $0001\ 0111\ 0011\ 1101\ 0010_2 = 173D2_{16}$

4. $0 \times 2^0 + 0 \times 2^1 + 1 \times 2^2 + 0 \times 2^3 = 4_{16}$

$1 \times 2^0 + 0 \times 2^1 + 1 \times 2^2 + 0 \times 2^3 = 5_{16}$
$1 \times 2^0 + 1 \times 2^1 + 0 \times 2^2 + 0 \times 2^3 = 3_{16}$
$0100\ 0101\ 0011_2 = 453_{16}$

5. $0 \times 2^0 + 1 \times 2^1 + 0 \times 2^2 + 0 \times 2^3 = 2_{16}$
$1 \times 2^0 + 0 \times 2^1 + 1 \times 2^2 + 1 \times 2^3 = 13_{16}$ or D_{16}
$0 \times 2^0 + 0 \times 2^1 + 0 \times 2^2 + 1 \times 2^3 = 8_{16}$
$0 \times 2^0 + 0 \times 2^1 + 1 \times 2^2 + 1 \times 2^3 = 12_{16}$ or C_{16}
$0010\ 1101\ 1000\ 1100_2 = 2D8C_{16}$

6. $1 \times 2^0 + 1 \times 2^1 + 0 \times 2^2 + 1 \times 2^3 = 11_{16}$ or B_{16}
$1 \times 2^0 + 1 \times 2^1 + 1 \times 2^2 + 1 \times 2^3 = 15_{16}$ or F_{16}
$1011\ 1111_2 = BF_{16}$

7. $1 \times 2^0 + 1 \times 2^1 + 0 \times 2^2 + 1 \times 2^3 = 11_{16}$ or B_{16}
$1 \times 2^0 + 1 \times 2^1 + 1 \times 2^2 + 1 \times 2^3 = 15_{16}$ or F_{16}
$0 \times 2^0 + 0 \times 2^1 + 0 \times 2^2 + 0 \times 2^3 = 0$
$1111\ 1100\ 0000_2 = BF0_{16}$

8. $1 \times 2^0 + 0 \times 2^1 + 0 \times 2^2 + 0 \times 2^3 = 1_{16}$
$1 \times 2^0 + 0 \times 2^1 + 1 \times 2^2 + 0 \times 2^3 = 5_{16}$
$0 \times 2^0 + 1 \times 2^1 + 1 \times 2^2 + 1 \times 2^3 = 14_{16}$ or E_{16}
$0001\ 0101\ 1110_2 = 15E_{16}$

Convert the below hexadecimal (base 16) numbers to binary (base 2) form.

1. 6_{16}
2. $A6_{16}$
3. $FA6_{16}$
4. FFF_{16}
5. BAA_{16}

1.

Divided by 2	**Remainder**
6/2 = 3	0

3/2 = 1	1
1/2 = 0	1

$6_{16} = 0110_2$

2.

Divided by 2	**Remainder**
10/2 = 5	0
5/2 = 2	1
2/2 = 1	0
1/2 =0	1

Divided by 2	**Remainder**
6/2 = 3	0
3/2 = 1	1
1/2 = 1	1

$A6_{16} = 1010\ 0110_2$

3.

Divided by 2	**Remainder**
15/2 = 7	1
7/2 = 3	1
3/2 = 1	1
1/2 =0	1

Divided by 2	Remainder
10/2 = 5	0
5/2 = 2	1
2/2 = 1	0
1/2 =0	1

Divided by 2	Remainder
6/2 = 3	0
3/2 = 1	1
1/2 = 1	1

$FA6_{16} = 1111\ 1010\ 0110_2$

4.

Divided by 2	Remainder
15/2 = 7	1
7/2 = 3	1
3/2 = 1	1
1/2 = 1	1

Divided by 2	Remainder
15/2 = 7	1
7/2 = 3	1
3/2 = 1	1
1/2 = 1	1

Divided by 2	Remainder
15/2 = 7	1
7/2 = 3	1
3/2 = 1	1
1/2 = 1	1

$FFF_{16} = 1111\ 1111\ 1111_2$

5.

Divided by 2	Remainder
11/2 = 5	1
5/2 = 2	1
2/2 = 1	0
1/2 = 1	1

Divided by 2	Remainder
10/2 = 5	0
5/2 = 2	1
2/2 = 1	0
1/2 = 1	1

Divided by 2	Remainder
10/2 = 5	0
5/2 = 2	1

2/2 = 1	0
1/2 = 1	1

BAA_{16} = $1011\ 1010\ 1010_2$