

## MATH 2590 – Exercises on Digital Hearing Aids

Hearing aids use binary numbers (0's and 1's) to represent sound. Here are some activities that can be completed after listening to the podcast on digital hearing aids.

### PART I

For the following exercise you will be required to convert decimals into binary numbers. In order to compute the binary number, multiply the decimal by 2. If the value is less than 1, then record a 0. If the value is greater than 1, then subtract 1 and record a 1. Repeat this procedure until you have 7 digits in your binary number.

1. 0.62

2. 0.58

3. 0.95

### PART II

For the following exercises you will be required to add binary numbers. In the following chart, x represents your first binary number, y represents the second binary number and c represents the 1 or 0 that has been carried over. The 'x+y+c' column tells you the sum and the 'carry' column tells you if a 1 or 0 should be carried over to the next column.

1. 1001100  
+1100101

2. 1010  
+1111

3. 0111  
+1110

Operators			Results	
x	y	c	x+y+c	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

### Part III

For the following exercises you will be required to convert binary numbers back into decimals. For these seven digit binary numbers, use the decimals in the chart in order to find the decimal number it represents. A 1 represents  $1 \times 2^{-b}$ , where b represents the digit number (i.e. if the 1 is the third digit of the binary number then it would be  $1 \times 2^{-3}$ ). A 0 represents  $0 \times 2^{-b}$  (i.e. if the 0 is in the fifth digit of the binary number then it would be  $0 \times 2^{-5}$ ). Add everything together in order to find out the decimal.

1. 0.1100101

2. 0.1001111

3. 0.1111001

Base 2	Fraction	Decimal
$2^{-1}$	1/2	0.5
$2^{-2}$	4	0.25
$2^{-3}$	8	0.125
$2^{-4}$	16	0.0625
$2^{-5}$	32	0.03125
$2^{-6}$	64	0.015625
$2^{-7}$	128	0.0078125