Key to Midterm Exam S1
Computer Architecture

Answer on the worksheet   **Duration: 1 hr 30 min.**

Last name: .... First name: .... Group: ....

Exercise 1 (3 points)

Simplify the following expressions. Give each result in a power-of-two form. Write down the result only (do not show any calculation).

Expression	Result
$\dfrac{32^8 \cdot 16^5 \cdot 64^{-4}}{(512^{-7} \cdot 16^{16})^4}$	2^{32}
$\dfrac{(4^{-8} \cdot 128^{12}) \cdot (8000 + 192)^{-10}}{(8^{-5} \cdot (2^{15} - 2^{14}))^{-3} \cdot 64^4}$	2^{-89}
$\dfrac{((16384 \cdot 128^{-3})^3 \cdot 1024^{10})^7}{(64^{-8} \cdot 2048)^{-7} \cdot 128}$	2^{287}

Exercise 2 (3 points)

1. How many bytes do the following values contain? **Use a power-of-two notation**. Write down the result only (do not show any calculation).

   - 32 KiB = | 2^{15} **bytes** |

   - 256 Mib = | 2^{25} **bytes** |

   - 64 Gib = | 2^{33} **bytes** |

2. How many bits do the following values contain? Use binary prefixes (Ki, Mi or Gi). **Choose the most appropriate prefix so that the integer numerical value will be as small as possible**. Write down the result only (do not show any calculation).

   - 2^{28} bits = | **256 Mib** |

   - 1 GB = | **8 Gib** |

   - 2^{33} bytes = | **64 Gib** |

Exercise 3 (5 points)

Convert the following numbers from the source form into the destination form. Do not write down the result in a fraction or a power form (e.g. write down 0.25 and not ¼ or 2^{-2}). Write down the result only (do not show any calculation).

Number to Convert	Source Form	Destination Form	Result
11101001.00011	Binary	Decimal	**233.09375**
DA.18	Hexadecimal	Decimal	**218.09375**
99.99	Decimal	Hexadecimal (2 digits after the point)	**63.FD**
103.09375	Decimal	Binary	**110 0111.00011**
134.64	Base 8	Binary	**101 1100.1101**
741.735	Base 8	Hexadecimal	**1E1.EE8**
D9.B7	Hexadecimal	Base 8	**331.556**
80.25	Decimal	Base 13 (2 digits after the point)	**62.33**
42	Base 5	Base 7	**31**
100110011.10011	Binary	Hexadecimal	**133.98**

Exercise 4 (5 points)

Perform the operations below. **Show all calculations.**

Base 2

		1	0	1	0	1	1	0	1	0
−			1	0	1	0	0	1	1	1
			1	**0**	**1**	**1**	**0**	**0**	**1**	**1**

Base 16

		5	9	8	7
+		D	F	A	7
	1	**3**	**9**	**2**	**E**

Base 2

1	0	1	0	1	0	0	0	1	1	1	0
−	1	1	1	0				**1**	**1**	**0**	**0**
		1	1	1	0						
	−	1	1	1	0						
			0	0	0						

Base 8

		5	4	7	2
+		3	5	2	1
	1	**1**	**2**	**1**	**3**

Base 2

							1	0	0	0	1	1	1	1	1	0	0	
						×				1	0	1	0	1	1	0			
					1	0	0	0	1	1	1	1	1	0	0				
+				1	0	0	0	1	1	1	1	1	0	0					
+		1	0	0	0	1	1	1	1	1	0	0							
+	1	0	0	0	1	1	1	1	1	0	0								
	1	1	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0		

Exercise 5 (4 points)

1. Work out the following negative powers of two:

Power	Answer
2^{-8}	**0.00390625**
2^{-9}	**0.001953125**
2^{-10}	**0.0009765625**

2. In how many patterns can a byte be arranged?

256

3. Determine the minimum number of bits required to encode the following signed number: **8192**

15

4. Determine the minimum number of bits required to encode the following signed number: **-8192**

14

Feel free to use the blank space below if you need to: