# Key to Midterm Exam S1 Computer Architecture

#### Answer on the worksheet

Duration: 1 hr 30 min.

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

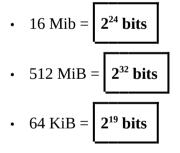
### Exercise 1 (3 points)

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

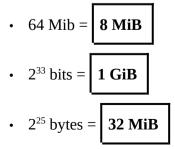
Expression	Result
$\frac{64^5 {\cdot} 8^6 {\cdot} 16^3}{(256^{-5} {\cdot} 128^2)^{-4}}$	2 <sup>-44</sup>
$\frac{(8^8 \cdot 512^{-7}) \cdot (11000 + 5384)^{-9}}{(16^{-5} \cdot (2^{20} - 2^{19}))^6 \cdot 256^{-7}}$	2-103
$\frac{((8192\cdot 32^7)^4\cdot 32768^{-4})^6}{(8^{-9}\cdot 1024)^{-9}\cdot 4096}$	2 <sup>627</sup>

#### Exercise 2 (3 points)

1. How many bits do the following values contain? <u>Use a power-of-two notation</u>. Write down the result only (do not show any calculation).



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



### 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  $\frac{1}{4}$  or  $2^{-2}$ ). Write down the result only (do not show any calculation).

Number to Convert	Source Form	Destination Form	Result	
10111001.0101	Binary	Decimal	185.3125	
E8.5	Hexadecimal	Decimal	232.3125	
167.7	Decimal	Hexadecimal (2 digits after the point)	A7.B3	
92.3125	Decimal	Binary	101 1100.0101	
13.25	Base 8	Binary	1011.010101	
2705.14	Base 8	Hexadecimal	5C5.3	
4BC.23	Hexadecimal	Base 8	2274.106	
80.25	Decimal	Base 5 (2 digits after the point)	310.11	
40	Base 9	Base 3	1100	
100110011.10011	Binary	Hexadecimal	133.98	

## Exercise 4 (5 points)

1. Work out the value of the base *b* so that the identity below is true. **Show all calculations.** 

$$22_{b} \times 25_{b} = 50A_{b} \qquad \mathbf{b} > \mathbf{10}$$

$$(2b + 2)(2b + 5) = 5b^{2} + 10$$

$$4b^{2} + 10b + 4b + 10 = 5b^{2} + 10$$

$$b^{2} - 14b = 0$$

$$b(b - 14) = 0$$

$$\mathbf{b1} = 0$$

$$\mathbf{b2} = \mathbf{14}$$

$$\mathbf{b} = \mathbf{14}$$

- 1. Work out the value of the base *b* so that the identity below is true. **Show all calculations.**
- $12_b \times 25_b = 50A_b$  **b** > **10** (b + 2)(2b + 5) =  $5b^2 + 10$  $2b^2 + 5b + 4b + 10 = 5b^2 + 10$  $3b^2 - 9b = 0$  $b^2 - 3b = 0$ b(b - 3) = 0b = 0b = 3**There is no solution.**

2. According to the identity below, determine the relation between the *a* and *b* bases and work out their smallest values. Justify your answer. **Show all calculations.** 

```
208_{a} = 808_{b}  a > 8 and b > 8
2a^{2} + 8 = 8b^{2} + 8
2a^{2} = 8b^{2}
a^{2} = 4b^{2}
a = 2b
b<sub>min</sub> = 9
a<sub>min</sub> = 18
```

#### Exercise 5 (4 points)

1. In terms of *n*, how many *n*-bit unsigned integers can be encoded?

2<sup>*n*</sup>

2. In terms of *n*, how many *n*-bit signed integers can be encoded?

2<sup>*n*</sup>

3. In terms of *n*, what is the largest *n*-bit unsigned integer that can be encoded?

2<sup>*n*</sup>-1

4. In terms of *n*, what is the largest *n*-bit signed integer that can be encoded?

$2^{n-1}-1$			

5. In terms of *n*, what is the smallest *n*-bit signed integer that can be encoded?

 $-2^{n-1}$ 

6. The one's complement inverts each bit of a word. Answer true or false.

True

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