# 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 |
|---|---|
| $\dfrac{64^5 \cdot 8^6 \cdot 16^3}{\left(256^{-5} \cdot 128^2\right)^{-4}}$ | |
| $\dfrac{\left(8^8 \cdot 512^{-7}\right) \cdot \left(11000 + 5384\right)^{-9}}{\left(16^{-5} \cdot \left(2^{20} - 2^{19}\right)\right)^6 \cdot 256^{-7}}$ | |
| $\dfrac{\left(\left(8192 \cdot 32^7\right)^4 \cdot 32768^{-4}\right)^6}{\left(8^{-9} \cdot 1024\right)^{-9} \cdot 4096}$ | |

## 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).

    · 16 Mib =

    · 512 MiB =

    · 64 KiB =

    ·

2.  How many bytes do the following values contain? Use binary prefixes (Ki, Mi or Gi). **<u>Choose the 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).

    · 64 Mib =

    · $2^{33}$ bits =

    · $2^{25}$ bytes =

## 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 |
|---|---|---|---|
| 10111001.0101 | Binary | Decimal | |
| E8.5 | Hexadecimal | Decimal | |
| 167.7 | Decimal | Hexadecimal (2 digits after the point) | |
| 92.3125 | Decimal | Binary | |
| 13.25 | Base 8 | Binary | |
| 2705.14 | Base 8 | Hexadecimal | |
| 4BC.23 | Hexadecimal | Base 8 | |
| 80.25 | Decimal | Base 5 (2 digits after the point) | |
| 40 | Base 9 | Base 3 | |
| 100110011.10011 | Binary | Hexadecimal | |

## Exercise 4  (5 points)

1.  Work out the value of the base $b$ so that the identity below is true. **Show all calculations.**
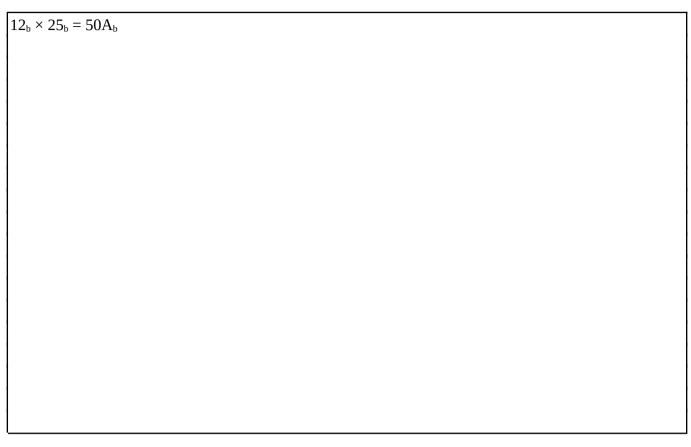
$22_b \times 25_b = 50A_b$

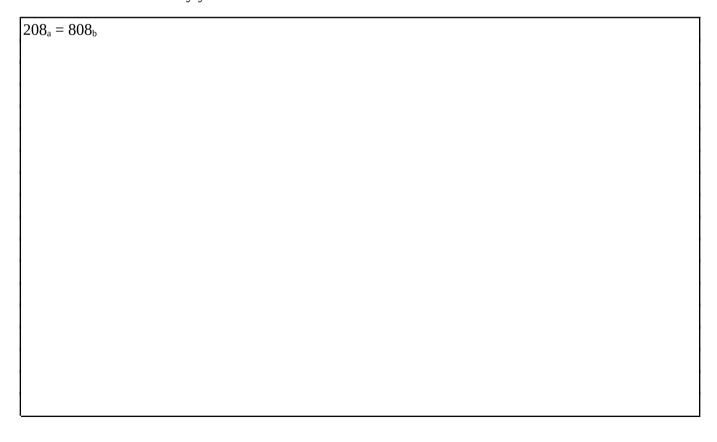1. Work out the value of the base $b$ so that the identity below is true. **Show all calculations.**

$12_b \times 25_b = 50A_b$

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.**

$208_a = 808_b$

## Exercise 5  (4 points)

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

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

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

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

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

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

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