CS 220 Spring 22 Exam 2 **Name:**_____

For partial credit make sure to show all work where appropriate. Some answers are better than other answers. Full credit for the best answer.

1. [5] What is the clock cycle time for a processor that has a 2.4 GHz clock. Express your answer in nanoseconds (ns).

2. [5] What is the clock rate (frequency) for a processor that has a cycle time of .67 ns (nanoseconds)?

3. [3] What does the command **`mkdir ../hw1`** do?

4. [3] What does the command **`mv ./main.c ..`** do?

5. [10] In the table provided, trace the values of **`whatdoido(11)`** by filling in the table on the right.

```
whatdoido:
    mov     r1, #0
while:
    cmp     r0, #0
    beq     endwhile
    and     r2, r0, #1
    lsr     r0, r0, #1
    add     r1, r1, r2
    b while
endwhile:
    mov     r0, r1
    bx      lr
```

r0	r1	r2

6. Answer questions about the object dump provided. I drew lines to separate the columns. This is an object dump of my solution to the study question where you had to write **`f`**, **`g`**, and **`h`**.

    a. [3] In one short sentence explain what information is provided in the first column.

    b. [3] In one short sentence explain what information is provided in the second column.

    c. [3] In one short sentence explain what information is provided in the second column.

    d. [3] What is the value in the link register **`lr`** immediately after f is called?

    e. [3] What is the value in **`lr`** the second time **`h`** is called?

    f. [3] What value is passed to **`h`** the first time **`h`** is called?

7. Consider the C variable declarations below

```
int a, *p, *t;
p = &a;
a = 23;
```

    a. [3] What would be printed by **printf("%d\n", *p);**

    b. [3] What would be the effect of the statement **`*t = a;`**

    c. [3] What is the type of **`p`**?

    d. [3] What is the type of **`&t`**?

    e. [3] What is the type of **`*&a`**?

8. [30] Programming problem. Write an ARM assembly function digitsum that returns the sum of the digits of an unsigned integer passed to it. For example **`digitsum(123)`** would return 6 because 1 + 2 + 3 is 6.
    a. Create a directory **`exam2`** in your repo and put the file **`digitsum.s`** in it.
    b. Write a **`main.c`** that takes a command line argument and calls **`digitsum`** with the argument.
    c. push your files to your repo but be careful and make sure to pull first!
    d. Verify that your files were successfully pushed by going to github.com and making sure they are there.