

Important: This is an open book test. You can use any books, notes, or paper, but not exchange anything with other students. You are not allowed to use any electronic/communication device, including a calculator and e-books. *Do not log into the computer during the test. Change your cell phones to silent mode. Any other device with an ON-OFF switch should have its switch in the OFF position.* Any calculations and rough work can be done on the backside of the test pages. If there is a syntax error in any program segment, just point it out and you will get full credit for the problem. Please write legibly; if I cannot read what you wrote, I'll give you a zero. You will lose five points for not writing your name.

1. [6 pt] Consider the following program (called `hello.c`):

```
#include <stdio.h>

int main()
{
    printf ( "Hello World\n" );
    fprintf ( stdout, "Hello Galaxy\n );
    fprintf ( stderr, "Hello Universe\n" );
    return ( 0 );
}
```

I compiled and executed the code as follows:

```
gcc -o hello hello.c
hello > hello 2>&1
```

What is the content of the file `hello` after executing those commands in `bash`?

2. [6 pt] I am currently working in the directory `/usr/local/bin`. I execute the following commands in `bash`:

```
pwd ; { cd /tmp; pwd; }; pwd
```

What will be the output?

3. [6 pt] Give me the command to extract the penultimate letter in each word in an input string (use a tool of your choice). If the input is:

`Life is good`

the output will be `f i o`. The output characters can be on the same line or separate lines.

4. [4 pt] How do you find the number of elements in a bash array named `shades`?

5. [6 pt] What is the purpose of the file `HEAD` in your directory `.git` when you have a project under version control in `git`?

6. [6 pt] I want to extract the first and last column in a text file. The columns are separated by whitespace and tabs at random places. The input format is:

```
The 2007 Atlantic hurricane season was an active Atlantic
hurricane season that produced 17 tropical cyclones, 15
tropical storms, six hurricanes, and two major hurricanes.
It officially started on June 1 and ended on November 30,
dates which conventionally delimit the period during which
most tropical cyclones form in the Atlantic Ocean.
```

The output should be:

```
The Atlantic
hurricane 15
tropical hurricanes.
It 30,
dates which
most Ocean.
```

Give me the command in `awk` to achieve this.

7. [6 pt] Consider the following code segment in C.

```
char a[80];
char b[] = "Hello";
char c[] = "World";
```

Give me the set of statements in C such that `a` contains "Hello World" using the variables `b` and `c`.

8. [10 pt] Write a function in C *using bit operations* that will take one integer argument and return 1 if the number in argument is divisible by 4. It should return 0 otherwise.

9. [10 pt] Can you create an indexed sequential file with a variable sized record? How will you access a record in such a file? Describe your approach in pseudocode that could be readily translated into a C program (that is, supply the C function names to achieve your pseudocode objectives).

10. [6 pt] What is the purpose of `assert` macro in C?

11. [6 pt] What is a memory leak? How can you avoid it?

12. [6 pt] What is the purpose of a process group? How do you create one?

13. [6 pt] Write a C macro to find the maximum of two numbers.

14. [6 pt] What is a zombie? How do you create one? How do you kill it?