

Part 1—Circle the best answer for each problem. Each problem is worth two (2) points.

- Which one of the following is used to declare an input file stream object?
 - infile
 - ifstream
 - istream
 - instream
- Suppose a function has a formal argument x of type double. If x is to be passed by reference, which one of the following is the correct syntax for including x in the function header?
 - double x
 - double *x
 - double ~x
 - double &x
- Suppose the 2-D array x is declared and initialized as follows:

`float x[3][2] = { 6.3, 7.1, -8, 5.7, 3.14 };`

Which one of the following is true?

- `x[3][2] = 0.0`
- `x[2][1] = -8.0`
- `x[1][1] = 5.7`
- `x[2][1]` is not defined

$$X = \begin{pmatrix} 6.3 & 7.1 \\ -8 & 5.7 \\ 3.14 & 0 \end{pmatrix}$$

- True or False: When passing arrays as function arguments, arrays are automatically passed by reference.
 - True
 - False
 - 2.71828
 - None of the above
- A string is a one-dimensional array of type char that is terminated by what character?
 - '\n'
 - '\t'
 - '\a'
 - '\0'

6. Which one of the following statements about closing files is FALSE?
- (a) The output file stream object `my_file` can be closed by using `my_file.close()`.
 - (b) Open files are closed automatically at program termination.
 - (c) When an output stream object goes out of scope, the file is automatically closed.
 - (d) A program cannot successfully terminate unless all files have been explicitly closed.
7. True or False: In the body of a function that has been passed a function `f` as an argument, `f` must be dereferenced by using `(*f)` each time it is called.
- (a) True
 - (b) False
 - (c) Tuesday
 - (d) $x = 13.9$
8. If we want the actual arguments of a function to be manipulated, the arguments must be passed by _____.
- (a) reference
 - (b) value
 - (c) instantiation
 - (d) characterization
9. Suppose the function `f` takes a double and returns a float. Which one of the following is the correct header for a function that has `f` as a argument?
- (a) `double func(float (*f)(double x), float a, float b);`
 - (b) `double func(float f(double x), float a, float b);`
 - (c) `double func(float (&f)(double x), float a, float b);`
 - (d) `double func(double (*f)(float x), float a, float b);`
10. The string `Hello world` is to be stored in a character array. What size character array is required?
- (a) 10 or smaller
 - (b) 11
 - (c) 12 or bigger
 - (d) None of the above

11. Is it possible for a constant to be passed by reference?

- (a) Yes.
- (b) No.
- (c) It depends on the context.
- (d) Only on Fridays.

12. When referencing an element of a one-dimensional array, $*(&a[0]+i)$ means the same as _____.

- (a) $a[i]$
- (b) $a[0]$
- (c) a
- (d) None of the above

13. An array is declared as follows. How many elements does it have?

```
int x[6][3][4];
```

- (a) 13
- (b) 30
- (c) 72
- (d) 140

$$6 \times 3 \times 4 = 72$$

14. Which one of the following could be used to test for end-of-file from keyboard input?

- (a) `eof.cin()`
- (b) `input.eof()`
- (c) `cout.eof()`
- (d) `cin.eof()`

15. How do we pass an array as a function argument?

- (a) We pass the base element.
- (b) We pass the address of the base element.
- (c) We pass the address of the last element.
- (d) We pass the last element.

Part 2—Fill in the blank or provide a short answer. Each problem is worth two (2) points.

1. What is the output? Why? `cout << (7 > 7);`

THE OUTPUT IS 0.

THE EXPRESSION EVALUATES TO FALSE.

2. If a , b , and c have all been assigned the value 3, what will their values be after the statement `a += b * ++c` is executed.

$$a = 3 + 3 * 4 = 15$$

$$b = 3$$

$$c = 4$$

3. Explain why the following loop will probably never terminate.

```
int sum = 1;
for ( unsigned i = 10; i >= 0; --i )
    sum += 2 * i + 1;
```

SINCE i IS AN UNSIGNED INT,

ITS VALUE WILL ALWAYS BETWEEN ≥ 0 .

4. What is the output? `cout << int(sqrt(2.0 * 14.5) + 13.52);`

$$\sqrt{29} + 13.52 \approx 18.905$$

THE OUTPUT IS 18.

5. Suppose the following values have been assigned: $a = 5$, $b = 2$, $d = 6$ and $e = 3$. What is the value of `!(a * b) && (d > e)`? Explain.

!(10) AND TRUE = FALSE AND TRUE

= FALSE

6. If a function is designed such that it does not return any value under its name, its type must be _____.

VOID

7. Before a function can be called, it must be either _____ or _____.

DECLARED OR DEFINED.

8. What (exact) output will the following statement produce?

```
cout << setw(10) << setiosflags(ios::right) << setiosflags(ios::fixed)
      << setiosflags(ios::showpoint) << setprecision(3) << 13.1;
```

_____ 13.100

9. In addition to `#include<iostream>`, what header file must be included in order that the code fragment above compiles correctly.

`#include <iomanip>`

10. Two keywords that typically appear in class declarations are _____ and _____.

PUBLIC AND PRIVATE

Part 3—Show all work. Supply explanations when necessary.

1. (5 points) Use the formulas we derived in class to find an equation of the line that best fits the following data.

(1.1, 3.6), (2.4, 6.1), (2.6, 6.3), (3.0, 6.9), (3.5, 8.3), (4, 9.6), (4.1, 10.2)

$$m = \frac{\sum x_i y_i - \bar{y} \sum x_i}{\sum x_i^2 - \bar{x} \sum x_i}$$

$$m = \frac{14.1357\dots}{6.5771\dots} \approx 2.15$$

$$b = \bar{y} - m\bar{x}$$

$$b = \bar{y} - m\bar{x} \approx 0.93$$

$$\sum x_i = 20.7$$

$$\sum x_i^2 = 67.79$$

$$\sum y_i = 51$$

$$\bar{x} = 20.7/7$$

$$\sum x_i y_i = 164.95$$

$$\bar{y} = 51/7$$

$$y = 2.15x + 0.93$$

2. (10 points) Use the Trapezoid rule with $n = 10$ to approximate $\int_0^2 \cos(x/4) dx$. Then determine a bound on the error made in the approximation.

$$\Delta x = \frac{2}{10} = \frac{1}{5} = 0.2$$

PARTITION:

$$0 < 0.2 < 0.4 < \dots < 1.8 < 2$$

$$T = \frac{0.2}{2} \left[\cos 0 + 2 \cos \frac{0.2}{4} + 2 \cos \frac{0.4}{4} + \dots + 2 \cos \frac{1.8}{4} + \cos \frac{2}{4} \right]$$

$$\approx 1.917302616\dots$$

$$T \approx 1.9173$$

$$|E| \leq \frac{2^3}{12(10)^2} \max_{0 \leq x \leq 2} \frac{1}{16} |\cos \frac{x}{4}| = \frac{2^3}{12(10)^2 16} = \frac{8}{19200} \approx 0.000417$$

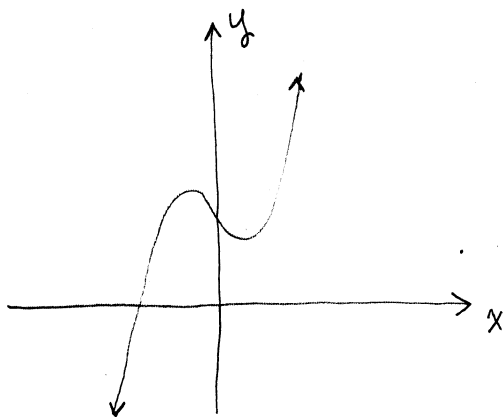
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$$|E| \leq 0.00042$$

$$f'(x) = -\frac{1}{4} \sin \frac{x}{4}$$

$$f''(x) = -\frac{1}{16} \cos \frac{x}{4}$$

3. (7 points) Sketch the graph of $f(x) = x^3 - x + 3$. Then explain why using Newton's method to solve $f(x) = 0$ might not work if you start with $x_0 = 0$. Start with $x_0 = 0$ and compute x_k for $k = 1, 2, \dots, 10$.



Improved solutions will "bounce" around the relative min, but won't get past the rel max.

$$f(x) = x^3 - x + 3$$

$$f'(x) = 3x^2 - 1$$

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

$$x_0 = 0$$

$$x_1 = 3$$

$$x_2 = 1.9615\dots$$

$$x_3 = 1.1471\dots$$

$$x_4 = 0.006579\dots$$

$$x_5 = 3.000389\dots$$

$$x_6 = 1.961818\dots$$

$$x_7 = 1.14743\dots$$

$$x_8 = 0.007256\dots$$

$$x_9 = 3.00047\dots$$

$$x_{10} = 1.96187\dots$$

4. (3 points) Write $P(x)$ in nested form and count the operations required in using the nested form to evaluate $P(2)$.

$$P(x) = 6x^4 + 4x^3 - 5x^2 + 2x + 1$$

$$P(x) = 1 + x(2 + x(-5 + x(4 + x(6))))))$$

$P(2)$ would require 8 operations.