

1. (30 pts) Write a complete C++ program to solve the following problem, including

- an opening comment (*don't* put your name in the comment! -2 pts if you do!)
- all necessary “stuff” that goes before the main program
- a full main program complete with comments

Problem Statement: An American fills up his car with gas in Niagra Falls, New York, and notes the odometer reading (in miles). He then drives to Montréal, Québec, where he fills up his tank in liters, and pays in Canadian Dollars.

He wants to know two things: (1) The price he is paying per gallon of gas, and (2) the gas mileage (in miles per gallon) he got on his drive.

Prompt the user for the odometer reading before he left, the odometer reading when he fills the tank, the number of liters input, and the current exchange rate.

Declare a constant for the conversion factor you choose to use, either:

- 1 liters = 0.264172051 US gallons, or
- 1 US gallons = 3.7854118 liters

Your program should provide appropriate prompts to the user, and should also label the output appropriately and neatly.

If any of the numbers input might cause division by zero, check for that condition before you divide. In that case, print an error message using `cerr`, and terminate the program immediately.

Extra space in case you need it

2. (20 pts) Write a function (NOT a complete program) to find the maximum value in an array of integers.

For full credit, use recursion (not a loop). Using a loop will earn only half credit.

The parameters should be the array itself (passed by reference), and the size of the array (passed by value.)

Extra space in case you need it

Multiple Choice

3. (3 pts) Consider the function `inc1` contained in the program listing of Q5 .cpp shown on the following page of this exam.
- Which of the following are the *names* of the *formal parameters* of this function
- (a) r and s (b) 3 and 4 (c) &a and b
(d) n and m (e) none of the above
4. (3 pts) Which of the following are the *actual parameters* of `inc2`?
- (a) 3 and 4 (b) &a and b (c) r and s
(d) *r and s (e) none of the above
5. (3 pts) The line `inc2 (&a, b) ;` represents which of the following:
- (a) function definition (b) function prototype (c) function call
(d) function library (e) none of the above
6. (3 pts) The line `void inc1(int n, int m) ;` represents which of the following:
- (a) function definition (b) function prototype (c) function call
(d) function library (e) none of the above
7. (2 pts) The lines following the comment `/* +++ */` down to the end of the page, as a group, represent which of the following:
- (a) function definition (b) function prototype (c) function call
(d) function library (e) none of the above
8. (2 pts) When this program runs, the *first* line of output will be:
- (a) `main1: 3 4`
(b) `main1: 4 4`
(c) `main1: 4 5`
(d) `inc1: 4`
(e) `inc1: 5`
9. (2 pts) When this program runs, the *last* line of output will be:
- (a) `inc2: 3`
(b) `inc2: 4`
(c) `main3: 3 4`
(d) `main3: 4 4`
(e) `main3: 5 6`

```
/* Q5.cpp */

#include <iostream>
using std::cout;
using std::endl;

void incl(int n, int m);

void inc2(int a[], int i);

int main()
{
    int a = 3;
    int b = 4;

    cout << "main1: " << a << " " << b << endl;
    inc2(&a,b);
    cout << "main2: " << a << " " << b << endl;
    incl(a,b);
    cout << "main3: " << a << " " << b << endl;

    return 0;
}

void incl(int n, int m)
{
    n++;
    m++;
    cout << "incl: " << m << endl;
}

/* +++ */

void inc2(int a[], int i)
{
    a[0]++;
    i++;
    cout << "inc2: " << a[0] << endl;
}
```

What is the output? (Multiple choice)

Each of the questions in this section consists of a short C++ program.

For each one, **either**

- select the answer that matches the output of the program, **or**,
- if the program contains an error that would prevent you from determining the output— e.g. an access outside the bounds of an array, or printing a variable that has not been initialized— select “error” as your answer.

10. (4 pts) What is the output?

```
/* Q2.cpp */  
  
#include <iostream>  
int main(void)  
{  
    int a[4] = {13, 15, 15, 19};  
    cout << a[1] << endl;  
    return 0;  
}
```

- (a) 0 (b) 4 (c) 13 (d) 15 (e) error

11. (4 pts) What is the output?

```
/* Q3.cpp */  
  
#include <iostream>  
int main(void)  
{  
    int a[6] = {13, 15, 15, 19};  
    cout << a[5] << endl;  
    return 1;  
}
```

- (a) 0 (b) 1 (c) 4 (d) 13 (e) 15

12. (4 pts) What is the output?

```
/* Q6.cpp */  
  
#include <iostream>  
int main(void)  
{  
    int a[6] = {13, 15, 17, 19, 20, 21};  
    cout << a[6] << endl;  
    return 0;  
}
```

(a) 0 (b) 19 (c) 20 (d) 21 (e) error

13. (4 pts) What is the output?

```
/* Q4.cpp */  
  
#include <iostream>  
int main(void)  
{  
    int a[6] = {1};  
    cout << a[3] << endl;  
    return 0;  
}
```

(a) 0 (b) 1 (c) 3 (d) 6 (e) error

Addresses and Pointers

14. (2 pts) If the variable `x` is of type `int`, which of the following expressions would determine the address of that variable?

- (a) `*x` (b) `&x` (c) `addr(x)`
(d) `%x` (e) none of the above

15. (2 pts) If the variable `p` is of type `double *`, which of the following expressions would “dereference” the variable `p`?

- (a) `*p` (b) `&p` (c) `deref(p)`
(d) `%p` (e) none of the above

16. (2 pts) If you want the variable `a` to contain the address of an integer, which of the following would be a correct declaration of `a`?

- (a) `int a;` (b) `int &a;` (c) `int *a;`
(d) `int %a;` (e) none of the above

Functions (multiple choice)

All of the questions in this section deal with the following segment of a complete C++ program.

```
// Q8.cpp

...
int findMax(int a, int b);
int findLargest(int a[], int n);
double areaOfCircle(double r);
void interpolate(double x1, double y1, double x2, double y2,
                 double *x, double *y);

#include <iostream>

int main(void)
{
    int a=2, b=3, c=4;
    double d=5.0, e=-6.0, f=7.5;
    int scores[4] = {97, 65, 72, 80};
    double weights[4] = {0.15, 0.15, 0.2, 0.5};

    ...
}
```

17. (2 pts) Which of the following statements is true about the section of the C++ code above that appears *before* the line `#include <iostream>` ?
- (a) This is a list of function prototypes.
 - (b) This is a list of function calls.
 - (c) This is a list of function definitions.
 - (d) This is a list of header files.
 - (e) None of the above.
18. (2 pts) Which of the following could NOT appear legally later in this main program?
- (a) `cout << findMax(3, 4);`
 - (b) `cout << areaOfCircle(d);`
 - (c) `interpolate(4.0, 5.0, -2.0, -3.0, &d, &e);`
 - (d) `f = interpolate(4.0, 5.0, -2.0, -3.0, &d, &e);`

19. (2 pts) Which of the following could NOT appear legally later in this main program?

- (a) `cout << findMax(a * 2, b/3);`
- (b) `d = findMax(a, 3);`
- (c) `interpolate(4.0, 5.0, -2.0, -3.0, d, e);`
- (d) `a = findLargest(scores, 4);`

20. (2 pts) Which of the following could NOT appear legally later in this main program?

- (a) `interpolate(d, e, 0.0, 0.0, &d, &e);`
- (b) `a = findLargest(scores[0], 4);`
- (c) `e = areaOfCircle(f);`
- (d) `f = areaOfCircle(weights[1]);`

Total Points: 100