Student Name: _____ Student Number: _____

Scientific Computing

Sample Midterm

Instructor: Blair Jamieson

Actual Midterm will be 24 Oct 2018, 7:00 pm

Instructions:

- You have up to **1.5 hours** to complete all of the following problems.
- This is a **closed book exam**: no books, notes, assignments, worksheets, etc.
- You are permitted to use a **non-programmable calculator**.
- **Hand in all exam materials** including this question sheet and all solution booklets.
- All questions conform to the **C++ 11 standard**. Your solutions must also conform to this standard.

The midterm is worth 25% of your overall grade.

1 Multiple Choice (20 questions totalling 20 marks)

1. What function must exist in every C++ program?

   (a) There is no required function.

   (b) int main();

   (c) cout;

   (d) int begin(int argc, char * argv[]);

   (e) double sqrt(double);

2. What does the following lines of code print to the screen? The single quotes are there to show spaces.

```
int a=4;
string s="I am okay";
cout << "'";
for (unsigned i=s.size()-1; i!=a; --i){
  cout << s[i];
}
cout << "'" << endl;
```

   (a) 'I am '

   (b) 'I am'

   (c) 'I am okay'

   (d) 'yako '

   (e) 'yako'

3. What is the variable a at the end of evaluating the following code:

```
int a=1.9;
for ( int i=0; i<5; ++i ){
  a += i%3;
}
```

(a) 16.9
(b) 16
(c) 5.9
(d) 5
(e) 7.9
(f) 7

4. What is the value of x after running the following code:

```
double inner_product( const vector<double> & v1, const vector<double> &v2){
  double retval=0.0;
  if ( v1.size() != v2.size() ) error("inner_product not possible");
  for ( unsigned i=0; i!=v1.size(); ++i) {
    retval += v1[i]*v2[i];
  }
  return retval;
}
int main(){
  vector<double> v {0.1,-0.1,0.9,1.1,9.0};
  double x = inner_product( v, v );
}
```

(a) 11.0
(b) 2.9
(c) 83.04
(d) 0.0891
(e) -0.1
(f) error is called

5. Which of the following variable types can represent the largest number?

(a) short
(b) double
(c) long
(d) unsigned long long
(e) float
(f) int

6. What is in the string s after running the code below?

```
string s="my this is a lovely string";
for ( auto & c : s ) {
  if ( c > s[0] ) c = toupper( c );
}
```

(a) “My this is a lovely string.”
(b) “MY THIS IS A LOVELY STRING.”
(c) “mY ThiS iS a lOVelY STRiNg.”
(d) “my this is a lovely string.”
(e) “.”

7. Which of the following initializes a vector to hold ten fives?

   (a) `vector<int> vec(10) = {5};`

   (b) `vector<int> vec(10,5);`

   (c) `vector<int> vec{5,5,5,5,5,5,5,5,5,5};`

   (d) `vector<int> vec{5,10};`

   (e) Both (b) and (c) will work.

8. In the following code, what is the type of b?

```
const std::vector< std::string > s = { "one", "two", "three"};
auto b = s.begin();
```

   (a) std::string

   (b) std::vector::iterator

   (c) std::vector::const_iterator

   (d) std::vector<std::string>::const_iterator

   (e) char *

   (f) "one"

9. What is the value of c after running the code below?

```
vector<int> v={9,7,5,3,1,2,4,6,8};
auto b = v.begin();
int c = *(b+3) * *(b+1) / *(b+5);
```

   (a) 10

   (b) 11

   (c) 10.5

   (d) 0.6

   (e) 0

10. What can you enter at the keyboard to exit the following loop of code?

```
double val;
vector<double> temps;
while ( cin >> val ) temps.push_back( val );
```

   (a) a

   (b) ^D

   (c) -1

   (d) |

   (e) All of the above

   (f) Any of (a), (b) or (d)

11. What operators can be used on `int`s that you cannot use on `string`s?

   (a) +

   (b) -, *, and /

   (c) -=, *=, /=, and %=

   (d) >=, >, <, and <=

   (e) All of the above

   (f) (b) and (c)

12. What C++ keyword is used to exit a `for` or `while` loop and continue execution on the next command after the loop?

    (a) exit;

    (b) error();

    (c) break;

    (d) return;

    (e) (c) or (d)

13. What is the value of c after running the code below?

```
int b=1;
int a=0;
int c=3;
if ( a=b ) c=5;
else c*=2;
```

    (a) 3

    (b) 5

    (c) 6

    (d) 0

    (e) 1

14. What is the value of c after running the code below?

```
vector<int> v{0,1,2,3,-1,4,5};
int c = 10;
auto iter = v.begin();
while ( iter != v.end() && *iter>=0 ) c+=*iter++;
```

    (a) 10

    (b) 16

    (c) 24

    (d) 14

    (e) 20

    (f) The while loop never ends

15. What does the code below print to the screen?

```
int T=20;
cout <<"Today is " <<( (T<0) ? "cold " : (T>30) ? "hot " : "fine" )<<endl;
```

    (a) Today is cold hot fine

    (b) Today is cold

    (c) Today is hot

    (d) Today is fine

    (e) Today is false cold false hot fine

16. What is in the vector v after the following code is executed?

```
vector<int> v{20,30,40,50};
int i=60;
for (   ; i<100; i+=10 );
{
   v.push_back(i);
}
```

(a) 20,30,40,50

(b) 20,30,40,50,60,70,80,90

(c) 20,30,40,50,60

(d) 20,30,40,50,100

(e) 100

17. What is the value of c after the following code is executed?

```
double c=3.14;
{
  c*=2;
  double c = 3.0;
  {
    double c = 4.0;
    c*=2.0;
  }
}
```

(a) 3.14

(b) 6.28

(c) 3.0

(d) 4.0

(e) 8.0

18. What is the value of c after the following code is executed?

```
int c=1;
for ( int i=1; ; i+=3 ){
  if ( (c*=i) > 100 ) break;
}
```

(a) 1

(b) 100

(c) 140

(d) 280

(e) the loop executes forever

19. What does the following program print to the screen?

```
int A(int a, int *b){ return a + *b; }
int B(int a, int *b){ return a - *b; }
int C(int a, int *b){ return a * *b; }
int main(){
  int aa=10, bb=6;
  int * cc = & bb;
  int dd=B(aa, cc);
  cout << C( A(bb, cc), &dd ) << endl;
}
```

(a) 16

(b) 60

(c) 4

(d) 48

(e) Depends on the address of dd

20. What types of errors are found by the programmer looking for the causes of erroneous results?

(a) compile-time errors

(b) link-time errors

(c) run-time errors

(d) logic errors

(e) all of the above

2 Short Answer (5 questions totalling 25 marks)

1. Given the definition of a Token:

```
class Token {
  public:
  char kind;
  double value;
};
```

   Write the `Token Token_stream::get()` function that handles the tokens print ';', quit 'q', the math operators '+', '-', '*', '/', brackets, and numbers.

2. Describe in words what each of the following lines of code do, assuming that a sorted `vector<string> words` and a `string valueSearched` have already been filled with values. What is the likely purpose of the algorithm?

```
1 auto first = words.begin();  auto last = words.end();
2 auto mid = words.begin() + (last-first)/2;
3 while ( mid != last && *mid != valueSearched ){
4   if ( valueSearched < *mid ) last = mid;
5   else first = mid + 1;
6   mid  = first + (last-first)/2;
7 }
```

3. Rewrite the function below to fix the errors, and add an appropriate check and action whenever $c < -273.15$.

```
double ctok( double c) // convert Celsius to Kelvin
{
  int k = c + 273.15;
  return int
}
```

4. Write a `main()` function that calls the main program loop called `calculator()`. The main function should properly handle `runtime_error` and other exceptions.

5. What does testing pre-conditions and post-conditions mean? When might you not want to do this (give at least three reasons)?