CMSC 202 Final **May 23, 2006**

Name: ______________________________ **UserID:** __________________

(Circle your section)

Section: **101** – Tuesday 11:30 **102** – Thursday 11:30

105 – Tuesday 1:30 **104** – Thursday 12:30

Directions

- This is a closed-book, closed-note, closed-neighbor exam.
- Read through the entire test before you begin.
- Start with the questions that are easiest for you, come back to the rest.
- Write CLEARLY, if I cannot read your writing, you will receive a zero for the problem in question.
- Feel free to continue your answer on the backs of the pages, but make sure that you indicate where your answer continues.
- When you are done, read over your answers and then bring your exam to the front of the room.
- **Show your Picture ID AND Exam paper to a TA/Instructor, place in correct pile.**

Score

Page Number	Points Possible	Points Earned
2	10	
3	10	
4	10	
5	15	
6	10	
7	10	
8	10	
9	15	
10 (EC)	6	
11 (EC)	9	
TOTAL	100 (+15 EC)	

True/False (10 pts total, 1 pt each)

Read each statement ***carefully*** and write **true** or **false** on the blank to the left.

_____________ 1. The following code ***does not*** create a memory leak

```
int* ptr = new int(b);
ptr = new int(a);
delete ptr;
```

_____________ 2. Like the assignment operator, we must protect an object from self-assignment in the copy-constructor using the following:

```
if (this != &rhs)
```

_____________ 3. Copy constructors, assignment operators and destructors are ***not*** inherited in polymorphism

_____________ 4. An abstract class is defined as a class that has **at least one** ***virtual*** method and ***cannot*** be instantiated.

_____________ 5. Class methods (member functions) ***cannot*** be declared as protected.

_____________ 6. The default overloaded operator= (provided by the compiler) results in a deep copy of memory.

_____________ 7. Functions cannot be templated, only classes

_____________ 8. Given this templated prototype of the class Stack:

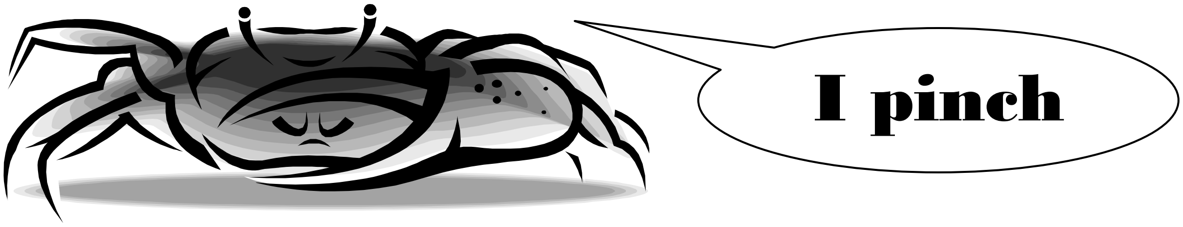
```
template <class T>  class Stack;
```

The following is an appropriate way of defining a Stack object:

```
Stack<T = int> myStack;
```

_____________ 9. When polymorphism is used in C++, the base-class constructor is called ***before*** the derived-class constructor.

_____________ 10. When an **exception** is thrown in a **constructor**, the object creation is completed, but the object is set as invalid, or a Zombie object.



Short Answer

Complete each of the short-answer coding questions. You may assume that the questions build on each other and that previously implemented lines can be used in later questions.

Assume there is a class named **`Crab`** with derived classes named **`HermitCrab`** and **`BlueCrab`**.

11. (2 pt) Define a **dynamic array** of **`Crab` pointers**. Assume that the size of the array is in a variable named **`'size'`**.

12. (2 pt) Assume there are already 2 **Crabs** (of various subtypes) in the array. **Add** a **`BlueCrab`** to the array. Assume **`size`** > 2.

13. (6 pts) Assume that the **Clone()** method is **overloaded** for all **Crab** types. Using the **Clone**() method, implement the code that will **allocate new memory** for the **Crab array** such that the old array information is **copied** into the new array of **`size = size * 2`** (the new array is twice the size of the old).

_______ pts

14. (5 pts) Assume the **HermitCrab** has an overloaded **constructor** that accepts a **shell-size** (integer size > 0). Assume there are also a **related mutator** and an **accessor**. Assume the following lines are defined:

```
    HermitCrab a(1);
    const HermitCrab b(3);
```

Identify whether the following lines are **compilable.** If not, ***describe why***. Assume each chunk of code is examined in isolation of the others.

Will Compile (Yes/No)? **Code…**

____

```
HermitCrab* const q = &a;
q->MoveIntoShell(8);
```

____

```
const HermitCrab* p = &a;
p->MoveIntoShell(8);
```

____

```
HermitCrab* const m = &b;
m->MoveIntoShell(2);
```

____

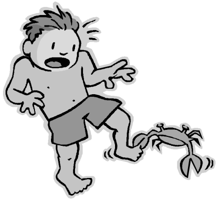
```
const HermitCrab* r = &b;
r->MoveIntoShell(8);
```

____

```
const HermitCrab* p = &b;
p = &a;
```

15. (5 pts) **Prototype** the **accessor** of the **HermitCrab** class so that the following code **compiles**.

```
const HermitCrab* t = &b;
b.GetShellSize();
```



16. (10 pts) Assume that the HermitCrab **MoveIntoShell()** used in the previous question **throws** a **ShellTooSmall** and **some other exception**. Assume there are **5** (five) Crabs in the **dynamic arr**ay from page 3.
    a. Write a **loop** that will call **MoveIntoShell**() to move each Crab into a new shell. Use **srand**() and **rand**() to generate random shell sizes to pass as the parameter.
    b. Using a **try/catch** block, correctly **catch** the exceptions thrown by MoveIntoShell().
        i. If a ShellTooSmall exception is **caught**, use the GetShellSize() method and move the Crab into a shell one greater than its current size. Continue processing the next crab.
        ii. If some other **exception** is caught, the exception should be **re-thrown**.

17. (5 pts) **Implement** the HermitCrab **MoveIntoShell** that accepts a single **integer** parameter (shellSize). Assume there is a **data member** named **'m_currShell'**. If the **new shell size** is **less than or equal** to m_currShell, **throw** a **ShellTooSmall** exception. Ignore the other exception described in the previous question.

Class Implementations

18. (10 pts) Write the **class definition** (header file) for the **Crab** class. Use **static**, **constants**, **virtual** and **references** whenever appropriate. The **Crab** class has the following members:
    a. **name** – dynamic data member, string
    b. **Default constructor** – sets name to empty string [may combine with non-default]
    c. **Non-default constructor** – sets name to parameter [may combine with default]
    d. **Copy constructor** – performs a deep copy of parameter
    e. **Destructor** – destroys object
    f. **GetName** – returns the Crab's name
    g. **NewShell** – Crab obtains a new shell, this ***may*** be overridden by derived classes
    h. **Move** – Crab moves "ahead", this ***must*** be overridden by derived classes

19. (4 pts) Discuss the **difference** between a **shallow** and **deep** copy for the **copy-constructor** of the **Crab** class. **Draw** a **picture** to illustrate your argument.

20. (3 pts) **Implement** the **copy** constructor of the **Crab** class using a **deep** copy.

21. (3 pts) **Implement** the **destructor** for the **Crab** class.

22. (2 pts) Assume that we would like to create a **collection** of Crabs without using polymorphism, called a **Bushel**. **Prototype** (i.e. forward-declare) the **Bushel** class as a class **templated** on a **single type** of Crab.

23. (2 pts) Define the **collection** data member of the **Bushel** class using a **vector** of **pointers** to the **type of Crab**. Ignore the rest of the class definition.

24. (2 pts) Create a **Bushel** of **HermitCrab**s.

25. (4 pts) **Implement** the **AddItem** method for the **Bushel** class. The method **accepts a single object** to **add** to the collection and then **stores** it in the **collection** item from #23.

Exposition

26. (5 pts) **Describe** the **differences** between method **overriding** and method **overloading**. Provide an **example** to **support** your comparison.

27. (5 pts) Briefly **discuss** the **pros** and **cons** of using **inline** functions.

28. (5 pts) **Why** is it **important** to **protect** an object from **self-assignment** (i.e. assigning A to itself)? (Hint: think about **dynamic memory**)

_______ pts

Extra Credit

For Problems 29 and 30, assume that you want to implement a **templated** **Stack** (push, pop), but ***only*** have access to a **Vector** with the following methods:

- `insert(iter)`, inserts an item before the position pointed to by the iterator parameter
- `erase(iter)`, removes the object pointed to by the iterator from the vector
- Assume that the methods `begin`(), `end`(), and `size`() work exactly as in the STL vector class, you may also assume that the ++ and -- operators work with these iterators.

[Hint: think of the Vector as the data member of the Stack class]

29. (3 pts) **Implement** the **push**() method for your **Stack** using the **Vector**.

30. (3 pts) **Implement** the **pop**() method for your **Stack** using the **Vector**.

31. (3 pts) If I had asked you to **build** a **Vector** on a **Linked-List**, what would be the **greatest difficulty** with implementing an at(i) method that returns the object in the ith position?

32. (4 pts) Use the STL algorithm **'for_each'** to **print** all of the items in your **Stack**.

33. (2 pts) If you were a crab, what would you say if I told you that I had some tongs and butter in the back of my SUV?