Name ________________________________________________________________

1. What value is returned when evaluating the following expressions? Read the expressions carefully.

   a. 
      
      | block x |
      x := 5.
      block := [:each | each + x].
      x := 10.
      ^block value: 15

   b. ^'cat' asSortedCollection first

   c. ^ 5 + 2;
      + 3;
      + 5

2. The scope of a variable is where it can be accessed. That is which methods can access the variable. The lifetime of a variable is how long the variable exists. That is the time from which it is created to the time it no longer exists.

   a. What are the scope and lifetime of an instance variable?

   b. What are the scope and lifetime of a class instance variable?

3. Object-oriented programming languages normally have two types of equality. What are the two different types of equality? How do you indicate each type of equality in Smalltalk?
4. Given the classes and methods below what is the result of executing each of the following expressions individually with “print it”?

C new bar

C new topFoo

C new topTrouble
5. What is printed on the Transcript by each of the following?
   a. 
   | x y result |
   x := 10.
y := 0.
[result := x / y.
Transcript show: result printString]
on: ZeroDivide
do:[exception |
  y := 1.
  exception resume: 1 ]

   b. 
   | x y result |
   x := 10.
y := 0.
[result := x / y.
Transcript show: result printString]
on: ZeroDivide
do:[exception |
  y := 1.
  exception retry ]

   c.
   | answer |
   answer := #(1 2 3 4 5 6) inject: 1
   into: [:result :each |
     each odd
     ifTrue: [result * each]
     ifFalse: [result]].
Transcript show: answer printString.

6. We have two classes A and B. What relationship between A and B do the following phrases indicate. Please indicate the role of A and B in the relationship. For example: A is the parent of B.
   a. A is-kind-of B
   a. A has-a B
7. Define the following terms:
   a. Polymorphism
   b. Abstraction

8. What is the difference between the select: and reject: enumerations defined in the Collection class?

9. We have a class Bar with instance variable foo as given below. Write the method(s) needed to initialize foo to the value 5 each time a Bar object is created. Indicate when a method is a class or an instance method.

   Smalltalk defineClass: #Bar
   superclass: #{Core.Object}
   instanceVariableNames: 'foo '
   classInstanceVariableNames: "
   category: 'CS535'

10. Most methods in the Collection class are implemented using three methods do:, add: and remove:ifAbsent: Show how to implement collect: in a collection class using the method do:. You can return turn the result in an OrderedCollection.
1. What value is returned when evaluating the following expressions? Read the expressions carefully.
   
a. 
   
   ```smalltalk
   | block x |
   x := 5.
   block := [:each | each + x].
   x := 10.
   ^block value: x
   ```
   
   b. ^'cat' asSortedCollection first
   
   c. ^ 5 + 2 ; + 3 ; + 5
   
2. The scope of a variable is where it can be accessed. That is which methods can access the variable. The lifetime of a variable is how long the variable exists. That is the time from which it is created to the time it no longer exists. What are the scope and lifetime of an instance variable? What are the scope and lifetime of a class instance variable?

3. What are the standard naming conventions in Smalltalk for:
   a. Classes
   
   b. Methods
   
   c. Parameters of a method

4. Object-oriented programming languages normally have two types of equality. What are the two different types of equality? How do you indicate each type of equality in Smalltalk?

5. What is the precedence order of unary, binary and keyword messages? That is in what order are the messages executed in a statement?
6. Given the classes and methods below what is the result of executing each of the following expressions individually with “print it”?

```
C new bar
C new stef
C new trouble
```

<table>
<thead>
<tr>
<th>Class A</th>
<th>Class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superclass: Object</td>
<td>Superclass: A</td>
</tr>
<tr>
<td>Methods</td>
<td>Methods</td>
</tr>
<tr>
<td><code>x</code> ^'A'</td>
<td><code>x</code> ^'B'</td>
</tr>
<tr>
<td></td>
<td>foo ^self x</td>
</tr>
<tr>
<td></td>
<td>bar ^super x</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class C</th>
<th>Class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superclass: B</td>
<td></td>
</tr>
<tr>
<td>Methods</td>
<td></td>
</tr>
<tr>
<td><code>x</code> ^'C'</td>
<td></td>
</tr>
<tr>
<td>stef</td>
<td>foo ^super foo</td>
</tr>
<tr>
<td>trouble</td>
<td>bar ^super bar</td>
</tr>
</tbody>
</table>

7. We have a class Bar with instance variable foo as given below. Write the method(s) needed to initialize foo to the value 5 each time a Bar object is created. Indicate when a method is a class or an instance method.

```
Smalltalk defineClass: #Bar
    superclass: #{Core.Object}
    instanceVariableNames: 'foo '
    classInstanceVariableNames: "
    category: 'CS535'
```

8. Define the following terms:
   a. Polymorphism

   b. Abstraction

9. What is the difference between the detect: and collect: enumerations defined in the Collection class?
10 a. We have a class Bar. Write an instance method for the Bar class with two parameters, both numbers, that returns the sum of the two numbers. If the sum of the two variables is less than zero raise an IndexNotFoundError exception. The IndexNotFoundError class and the Bar class already exists.

10. b. Write a SUnit test method your method in 10 a.
1. Describe the Smalltalk naming convention for:
   a. Classes
   b. Instance variables
   c. Arguments to a method

2. What is the difference between True and true in Smalltalk?

3. Let aCollection contain a collection of numbers. Use inject:into: to find the smallest element in aCollection.

4. Explain the difference between an OrderedCollection and a Bag.

5. Write a Smalltalk program to print the odd numbers between 21 and 5342 on the Transcript.

6. What is the difference between == (double equals) and = (single equals) in Smalltalk?

7. What is the difference between select: and collect:? 

8. What is a Template method? Give an example of the use of Template Method in the Smalltalk class library.

9. Given the methods below what is printed on the Transcript by executing the expression: ‘Exam new a’

```smalltalk
Exam>>a
    Transcript
    show: 'Start a';
    cr.
    self b.
    Transcript
    show: 'End a';
    cr.

Exam>>b
    Transcript
    show: 'Start b';
```
cr.
self c: [^5].
Transcript
    show: 'End b';
cr.

Exam>>c: aBlock
    Transcript
    show: 'Start c';
cr.
aBlock value.
    Transcript
    show: 'End c';
cr.

10. What value is returned when evaluating the following expressions:
a.  
| block x |
   x := 5.
   block := [:a | a + x].
   x := 10.
   block value: x

b.  
   1 + 2 * 3 /2
11. Given the classes and methods below what is the result of executing each of the following expressions individually with “print it”?

C new foo

C new bar

A new foo

<table>
<thead>
<tr>
<th>Class</th>
<th>A</th>
<th>Superclass</th>
<th>Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods</td>
<td>x</td>
<td>^’A’</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class</th>
<th>B</th>
<th>Superclass</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods</td>
<td>x</td>
<td>^’B’</td>
<td></td>
</tr>
<tr>
<td></td>
<td>foo</td>
<td>^self x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>bar</td>
<td>^super x</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class</th>
<th>C</th>
<th>Superclass</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methods</td>
<td>x</td>
<td>^’C’</td>
<td></td>
</tr>
</tbody>
</table>

12. The method withdrawal: raises a NegativeBalance exception if the withdrawal will cause the balance of an account to become negative. Add to the code below print the text “Invalid withdrawal” on the Transcript if a NegativeBalance exception is raised.

account
withdrawal: 20.1s2;
withdrawal: 10s2.
1. Explain the difference between self and super. Give an example as part of your explanation. If you define classes for your example give the parent class, class name, instance variables and methods. The exact template for creating a class is not needed.

2a What is an overloaded method? Given an example.

2b What are the Smalltalk rules for overloading instance variables?

3a. What is a Smalltalk literal? Give two different examples.

3b. Show how to specify how to a number that has two decimals of accuracy.

3c. Show two ways to create an array.

4. Describe the Smalltalk naming convention for classes, method names and variables.

5. List the different type of Smalltalk variables and indicate the scope and lifetime of each variable. The scope of a variable is where it can be accessed. The lifetime is how long the variable exists.

6. Parenthesis the following expressions to indicate the order that messages will be sent in the expression. For keyword messages list separately the full keyword message name.

   a. collection asSet asBag printString.

   b. 1 + 2 * 3 + 4 / 5 * 6 - 1.

   c. circle origin = 1 @ 2.
d. age age age: age age + age age.

e. cat printString copyFrom: dog size to: mouse at: 2.

f. Circle new origin: 3 @ 2; radius: cat at: 2; color: dog displayColor.

7. What is polymorphism? Give an example.

12. Write Smalltalk code to take the vowels in 'this is an exercise' and place them in an OrderedCollection. isVowel is an instance method in the Character class.

7. Briefly describe the observer pattern. Explain how it reduces coupling.

8. What problems can arise from successful cutting and pasting of code segments in a project? By successful cutting and pasting means the original code works, and the code also works correctly in its new location. Briefly explain your answer.

9. What is a contract in the Wirfs-Brock design process? Give an example.