I. Fill in the Blank (30 pts)

1. A __________ is a class definition which contains an instance variable whose type is the class definition.

2. A __________ is used to hold a unique collection of objects.

3. We use the keyword __________ to indicate that the value of an instance variable won’t be included when the instance of the class is serialized.

4. Java implements the __________ model of exception handling.

5. __________ is at the top of the hierarchy of classes that deal with exceptions that occur during execution.

6. We know that we are done reading from a BufferedReader when the method __________ returns null.

7. The keyword __________ precedes a block of code that might cause an exception to occur so that we can catch and handle that exception.

8. The __________ class is used to write primitive types to an underlying stream in a platform independent way.

9. We use the method __________ to determine the intersection of two Collections.

10. We use the method __________ to advance the file pointer in a RandomAccessFile.

11. A __________ occurs if we have an integer division with the denominator 0.

12. A queue is known as a __________ structure because the last thing placed in the queue is the last thing taken out.

13. A __________ occurs if we try to reference an instance method on an object reference which does not refer to an actual object.
14. ____________ is the process of converting an object into a form that can be written to a stream.

15. If a primitive numeric type is signed, the first bit in its bit representation is set to ____________.

16. The variable ____________ is created for a Serializable class if it doesn’t already contain one.

17. The ____________ class is used as a bridge between byte and character streams so that we can read characters from the stream.

18. In order to write an instance of a class to a file, the class definition must implement the ____________ interface.

19. The major difference between the Vector and ArrayList classes is that the methods in the Vector class are ____________.

20. The keyword ____________ can be used as a debugging mechanism.

21. ____________ represents exceptions that occur during execution that a programmer is not expected to recover from.

22. Java uses ____________ to encode characters.

23. The keyword ____________ is used to cause an exception to occur.

24. We use the keyword ____________ on a method header to indicate that a method might cause an exception to occur.

25. A ____________ contains a unique collection of objects sorted according to their natural order or based on a Comparator.

26. A stack is known as a ____________ structure because the first thing placed in the stack is the last thing taken out.

27. The write methods in the ____________ class for writing byte streams do not cause IOExceptions.

28. The ____________ is the class we use to establish a basic byte connection to send output to a file.

29. ____________ bits are used to store a byte.

30. We normally wrap a FileReader in a ____________ for efficiency.
II. Matching (10 pts)

31. unchecked exceptions ______ A. Error, RuntimeException, and their subclasses.

32. stack trace ______ B. HashSet<String> set = new HashSet<String>();

33. push ______ C. The operation on a stack that removes an element from the stack.

34. get(int) ______ D. TreeSet<String> set = new HashSet<String>();

35. finally ______ E. The operation on a stack that examines the first element in the stack.

36. checked exceptions ______ F. Set<String> set = new HashSet<String>();

37. “rw” ______ G. Throwable, Exception, and subclasses of Exception that are not subclasses of RuntimeException.

38. Programming to an interface ______ H. Error, Throwable, ClassCastException, and IOException and their subclasses.

39. NumberFormatException ______ and not an interpretation I. The mode used to open a RandomAccessFile for reading.

40. ClassCastException ______ J. The operation on a stack that places an element on the stack.

K. Occurs if we cast a reference type to Object.

L. Occurs when we attempt to cast a reference to a subclass reference, but the object is not an instance of that subclass.

M. The mode used to open a RandomAccessFile for both reading and writing.

N. A block that must always be included with a try block.

O. A method for retrieving an element from a certain position in a set.

P. Error and Exception.

Q. Contains a list of the methods called up to a certain point in a program.

R. The method used to retrieve an element from a certain position in a list.

S. An abbreviation for the MTV Show “The Real World”.

T. Occurs if we try to convert a String to a primitive type when that String doesn’t contain that primitive type.

U. A block of code associated with a try block that will only be executed if an exception occurs during the try block.

V. Occurs if we try to divide by an integer 0.

W. A block that is associated with a try block that will execute regardless of whether or not an exception occurs in the try block.

X. Occurs at compile-time if we cast a reference to a final class to an interface that class doesn’t implement.

Y. A list of all methods in a class definition that haven’t been called.
III. Short Answer (20 pts)

41. (2 pts) If a line of code within a block executes, what can we guarantee has not happened when previous lines in the block were executed?

42. (4 pts) If we inherit a method from a superclass, what is the restriction on the checked exceptions we can list on the method in the subclass? What is the restriction on the unchecked exceptions that can be listed in the subclass?

43. (2 pts) Are the byte and char primitive types signed or unsigned? What is the implication?

44. (2 pts) What is the difference between writing character data and binary data to a stream?
45. (4 pts) Suppose we have an array with the contents 15 45 20 17 18 5 10 17 14 5. If we use the first element as the pivot element, what are the contents of the array after one pass of QuickSort?

46. (2 pts) Give an example of using the for each construct to iterate through the elements of a Set named set that contains Strings and print each one.

47. (2 pts) What method do we use to find the union of two Collections?

48. (2 pts) What are the first and last nodes in a list called?
IV. Discussion (10 pts)

49. (4 pts) What are the three criteria of a well-defined recursive method? Give an example of a well-defined recursive method and point out how the criteria are satisfied.

50. (3 pts) What are the key points in the hashCode() contract? What is the implication of not honoring the hashCode() contract?

51. (3 pts) What is important about the relationship between the way the add and remove methods work for a structure that implements a queue?
V. Problem Solving and Coding (30 pts)

52. (5 pts) Point out the three major errors in the following code.

```java
public class Question52 extends Question1 {
    public void print(int number) throws java.io.IOException {
        try {
            System.out.println(number);
            double d = 1/0.0;
            System.out.println(number);
        } catch (ArithmeticException ae) {
            System.out.println(ae);
        } catch (NullPointerException npe) {
            System.out.println(npe);
        } catch (ClassCastException cce) {
            System.out.println(cce);
        } catch (Exception e) {
            System.out.println(e);
        } catch (java.io.IOException ie) {
            System.out.println(ie);
        }
    }
}

class Question1 {
    public void print(int number) throws InterruptedException, ClassCastException {
    }
}
```

53. (5 pts) Suppose we have the following class definition. What is the output of this program? Does this agree with what you would intuitively think it should print. What are two reasons for the discrepancy?

```java
import java.util.*;
public class Question53 {
    private int num;
    public Question53(int num) {
        this.num = num;
    }
    public boolean equals(Question53 question53) {
        return(num == question53.num);
    }
    public int hashcode() {
        return(1);
    }
    public static void main(String[] args) {
        Question53 question531 = new Question53(1);
        Question53 question532 = new Question53(1);
        Set<Question53> set = new HashSet<Question53>();
        set.add(question531);
        set.add(question532);
        System.out.println(set.size());
    }
}
```
public class Question54 {
    public class LinkedList {
        private Node head;
        public class Node {
            Object datum;
            Node next;
            public Node(Object datum, Node next) {
                this.datum = datum;
                this.next = next;
            }
        }
        public LinkedList() {
            head = null;
        }
        public void add(Object datum) {
            Node current = head;
            while (current.next != null)
                current = current.next;
            current.next = new Node(datum, null);
        }
        public void traverse(Node head) {
            if (head != null) {
                System.out.println(head.datum);
                traverse(head.next);
            }
        }
        public void traverse() {
            traverse(head);
        }
    }
    public static void main(String[] args) {
        LinkedList list = new Question54().new LinkedList();
        list.add(1);
        list.add(2);
        list.add(3);
        list.add(4);
        list.add(5);
        list.traverse();
    }
}
Choose two of the following problems. If you solve more than two correctly, then it will count as extra credit.

55. (7.5 pts) Show how you would implement the enqueue and dequeue methods of a queue by using a linked list.

56. (7.5 pts) Write a class definition in which 20 random digits less than 50 and 20 random lowercase characters are generated. You should add these to a collection where no digit or character is repeated and the contents are arranged so that the characters arranged in ascending order appear first and the digits sorted in descending order appear after the characters. Recall that the ASCII value of lowercase a is 97.
57. (7.5 pts) Write a class definition which contains two instance variables, a String and a double. Include a method which will write the current instance to a specified filename, and a class method which will read an object of this type in from a specified file. Make sure that you include all necessary code.

58. (7.5 pts) Write a class definition containing a String and show the read and write methods for how an instance of the class would be stored and retrieved from a RandomAccessFile.