General instructions:
- Please wait to open this exam booklet until you are told to do so.
- This examination booklet has 13 pages. You also have been issued a bubble sheet.
- Fill in the identifying information below (signature, name, ID and date) Also, write your name and ID number on your bubble sheet, and fill in the bubbles for your ID.
- You may have up to five pages of your own notes. No electronic devices or books may be used.
- The exam is worth a total of 137 points. Your grade counts for 10% of your final grade.
- You have 1.25 hours to complete the exam. Be a smart test taker: if you get stuck on one problem go on to the next.
- Use your bubble sheet to answer all multiple-choice questions. Make sure that the question number and the bubble row number match.
- Other than this page, you may tear any other page out of this booklet that does not contain numbered answers.
- If you cannot effectively erase erroneous answers from the bubble sheet, please clearly cross them out.

On my honor, I affirm that I have neither given nor received inappropriate aid in the completion of this exam.

Signature: ____________________________  Name: ____________________________
ID Number: __________________________  Date: __________________________

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Part I. Types and Objects

1. (4 points) What is printed by this block of code?

```java
String s1 = "XHT";
String s2 = "xHt";
s2.toUpperCase();
if (s1.equals(s2)) {
    System.out.println("Yes:" + s1);
} else {
    System.out.println("No:" + s2);
}
```

A. No:xHt  B. No:XHT  C. Yes:xHt  D. Yes:XHT  E. Compilation error or answer not shown

2. (4 points) What is printed by this block of code?

```java
int a = 4;
double c = 11;
int b = c+7;
c += b;
System.out.println(c);
```

A. 15.0  B. 18.0  C. 22.0  D. 29.0  E. Compilation error or answer not shown

3. (4 points) What is printed by this block of code?

```java
int i1 = 7;
int i2 = 5;
System.out.println(i1/i2);
```

A. 0   B. 1   C. 1.4   D. 12   E. Compilation error or answer not shown

4. (4 points) What is printed by this block of code?

```java
String a = "OOM";
Integer b = -5;
Integer c = new Integer(19);
System.out.println(c + b + a);
```

A. 14OOM  B. 19-5M  C. 19-5OOM  D. -519OOM  E. Compilation error or answer not shown
5. (4 points) What is printed by this block of code?

```java
1 int a = 3;
2 int b = 7;
3 String c = "7117";
4 System.out.println(c + (a + b));
```

A. 7127  B. **711710**  C. 711737  D. 711773  
E. Compilation error or answer not shown

6. (4 points) What is printed by this block of code?

```java
1 int a = 32;
2 String b = "4EB";
3 int c = 8;
4 System.out.println(a + c + b);
```

A. 324EB8  B. 3284EB  C. **404EB**  D. 84EB32  
E. Compilation error or answer not shown

7. (4 points) What is printed by this block of code?

```java
1 int a = 17;
2 String b = "YYO";
3 int c = 22;
4 System.out.println(b + c + a);
```

A. YY39  B. YYO39  C. YYO1722  D. **YYO2217**  
E. Compilation error or answer not shown

8. (4 points) What is printed by this block of code?

```java
1 int i1 = 42;
2 String s = "s";
3 System.out.println(i1 + s);
```

A. 6  B. 50  C. **428**  D. 842  E. Compilation error or answer not shown
Part II. Inheritance and Polymorphism
Consider the following class definitions:

```java
public class A {
    private int val;

    public A(int val) {
        this.val = val;
    }

    public int getVal() {
        return val;
    }

    public String toString() {
        return "A: " + this.getVal();
    }
}

public class B extends A {
    private String name;

    public B(int val, String name) {
        super(val);
        this.name = name;
    }

    public String getName() {
        return name;
    }
}

public class C extends B {
    private int val;

    public C(int val, String name) {
        super(val*2, name);
        this.val = val;
    }

    public C(String name, int val) {
        super(val, name.toLowerCase());
        this.val = -1;
    }

    public int getVal() {
        return val;
    }

    public int getSuperVal() {
        return super.getVal();
    }

    public String toString() {
        return "C: " + this.getName() + ": " + super.toString();
    }
}
```
9. (7 points) What is printed by this block of code?

```java
C e = new C("Ann", 3);
System.out.println(e.getVal() + e.getSuperVal());
```

A. -1  B. 1  C. 2  D. 3  E. Answer not shown

10. (7 points) What is printed by this block of code?

```java
C d = new C("Henry", 19);
System.out.println(d);
```


11. (7 points) What is printed by this block of code?

```java
B b = new B(79, "Bob");
System.out.println(b);
```

A. A:79  B. B:79  C. Bob:79  D. B:Bob:79  E. Answer not shown

12. (7 points) What is printed by this block of code?

```java
A a = new A(42);
System.out.println(a);
```

A. A:  B. A:42  C. A:84  D. A:A:42  E. Answer not shown

13. (7 points) What is printed by this block of code?

```java
C c = new C(83, "Joe");
System.out.println(c);
```

A. C:Joe:A:-1  B. C:Joe:A:-2  C. C:Joe:A:83  D. C:Joe:166  E. Answer not shown
Part III. UML and Object Oriented Design

14. (6 points) Which UML diagram corresponds to the following code?

```java
public class Person {
    private String Name;
}

public class Coach extends Person {
    private ArrayList<Player> players;
}

public class Player extends Person {
    private Coach coach;
}

public class Team {
    private Coach coach;
    private ArrayList<Player> players;
}
```

A.  

![Option A Diagram]

B.  

![Option B Diagram]

C.  

![Option C Diagram]

D.  

![Option D Diagram]

E. Answer not shown
15. (4 points) **Carefully examine** the following UML models and select the one that corresponds to the following code.

```java
public class MyClass {
    private double val;
    protected char c;

    public MyClass(char c, double val) {
        this.val = val;
        this.c = c;
    }

    private void print() {
        System.out.println(c);
    }

    public double doubleValue() {
        return val * 2;
    }
}
```

A.  
```
- val: double  
- c: char  
+ MyClass(c:char, val:double)  
- print(): void  
+ doubleValue(): double
```

B.  
```
- val: double  
- c: char  
+ MyClass(c:char, val:double)  
- print(): void  
+ doubleValue(): double
```

C.  
```
- c: char  
# val: double  
+ MyClass(c:char, val:double)  
- print(): void  
+ doubleValue(): double
```

D.  
```
- val: double  
# c: char  
+ MyClass(c:char, val:double)  
- print(): void  
+ doubleValue(): double
```

E. Answer not shown
16. (4 points) Which set of class definitions corresponds to the following UML diagram?

A. 
```java
public abstract class One {...}
public abstract class Two extends One {...}
public class Four extends Two {...}
```

B. 
```java
public interface One {...}
public interface Two implements One {...}
public class Three extends Two {...}
public class Four implements One {...}
```

C. 
```java
public class One {...}
public class Two extends One {...}
public class Three extends Two {...}
public class Four extends One {...}
```

D. 
```java
public abstract class One {...}
public abstract class Two extends One {...}
public class Three extends Two {...}
public class Four extends One {...}
```

E. Answer not shown
Part IV. Abstract Classes and Interfaces

17. (4 points) Which line (if any) will cause the program not to compile?

```java
public interface MyInterface {
    public int value;
    public abstract double setDouble(double v) {
        value = v;
    }
    public abstract String toString();
}
```

A. 3  B. 5  C. 7  D. Multiple lines  E. Answer not shown

18. (4 points) Which line (if any) will cause the program not to compile?

```java
public interface MyList {
    public abstract void add(Integer i);
    public abstract Integer get(int j);
    public abstract void insert(Integer i, int j);
}
```

A. 1  B. 3  C. 4  D. 5  E. Answer not shown

19. (4 points) Which line (if any) will cause the program not to compile?

```java
public abstract class Worker {
    private double workRate;
    public Worker(double workRate) {
        this.workRate = workRate;
    }
    public abstract boolean canDoWork();
    public double doWork() {
        if (this.canDoWork()) {
            return this.workRate;
        } else {
            return 0;
        }
    }
}
```

A. 7  B. 10  C. 14  D. 16  E. Answer not shown
20. (4 points) Any class that extends an abstract class must provide implementations for all of the abstract methods.

A. True  B. False  C. Answer not shown

Solution: If the abstract class extends another abstract class, then it may leave some of the interface’s methods unimplemented.

Consider the following class definition for the next two questions:

```java
public class Course implements Comparator<Course> {
    private String name;
    private int grade;

    public Course(int name, String grade) {
        this.name = name;
        this.grade = grade;
    }

    /**
     * Sort first by grade and then by the natural order of the names.
     * @return 1 if c1 comes after c2; -1 if c1 comes before c2; and 0 if they are equal
     */
    public int compare(Course c1, Course c2) {
        if (c1.grade < c2.grade) {
            return -1;
        } else if (c1.grade > c2.grade) {
            return 1;
        } else {
            return c2.name.compareTo(c1.name);
        }
    }
}
```

21. (4 points) Which one line can be changed to fix a bug in the class definition or the Course constructor?

A. 1  B. 6  C. 8  D. 9  E. Answer not shown

22. (4 points) Which one line can be changed to fix a bug in the compare() method?

A. 18  B. 20  C. 24  D. 30  E. Answer not shown
Part V. Exceptions and Error Handling

Consider the following program:

```java
public class ExceptionsOnExam {
    public static int doSubJob(int value) {
        if (value <= 5) {
            throw new IllegalArgumentException("Error 1");
        } else if (value > 8) {
            throw new IllegalStateException("Error 2");
        } else {
            return 42;
        }
    }

    public static int doJob(int arg) {
        int value = -1;
        if (arg <= 10 && arg >= 2) {
            try {
                return doSubJob(arg + value);
            } catch (IllegalArgumentException e) {
                return value;
            }
        } else {
            return doSubJob(2 * value);
        }
    }

    public static void main(String[] args) {
        int value = ???;
        try {
            int ret = doJob(value);
            System.out.println(ret);
        } catch (Exception e) {
            System.out.println(e.getMessage());
        }
    }
}
```

Note that both `IllegalArgumentException` and `IllegalStateException` are `RuntimeException`.


23. (7 points) Assume that value = 10 in main(), what is printed by the program?
   A. Error 1  B. Error 2  C. -1  D. 42  E. Answer not shown

24. (7 points) Assume that value = 6 in main(), what is printed by the program?
   A. Error 1  B. Error 2  C. -1  D. 42  E. Answer not shown

25. (7 points) Assume that value = 7 in main(), what is printed by the program?
   A. Error 1  B. Error 2  C. -1  D. 42  E. Answer not shown

26. (7 points) Assume that value = 1 in main(), what is printed by the program?
   A. Error 1  B. Error 2  C. -1  D. 42  E. Answer not shown
Part VI. Miscellaneous

Consider the following program:

```java
public class MyClass {
    private double val;
    protected char c;

    public MyClass(char c, double val) {
        this.val = val;
        this.c = c;
    }

    private void print() {
        System.out.println(c);
    }

    public double doubleValue() {
        return val * 2;
    }

    public static void main(String[] args) {
        MyClass m = new MyClass('a', 7.2);
        int a = 4;
        System.out.println(m + a);
    }
}
```

27. (2 points) In which part of memory is the variable declared on line 4 stored?
   A. Heap   B. Stack   C. Answer not shown

28. (2 points) In which part of memory is the variable declared on line 22 stored?
    A. Heap   B. Stack   C. Answer not shown