Introduction to Inheritance

Objective 1 - "Is-A" and Has-A" Class Interaction

01. Inheritance is the process of

(A) using classes in the established standard Java Language library.
(B) using features from an existing class.
(C) combining data and the methods, which process the data, inside the same module.
(D) dividing a program into multiple related files for each class in the program.

02. The concept of inheritance is illustrated well with

(A) geometry.
(B) history.
(C) literature.
(D) economics.

03. The *has-a* relationship describes

(A) inheritance.
(B) encapsulation.
(C) polymorphism.
(D) composition.

04. The *is-a* relationship describes

(A) inheritance.
(B) encapsulation.
(C) polymorphism.
(D) composition.

05. A class, which can use all the features of an established superclass, is

(A) a static class.
(B) a superclass.
(C) a subclass.
(D) overloaded.

06. An established class, whose members can all be used by a newly declared class, is

(A) a static class.
(B) a superclass.
(C) a subclass.
(D) overloaded.

07. The *engine*, *transmission*, *seats* and other components required to make a *car* is an example of

(A) a superclass.
(B) inheritance.
(C) instantiation.
(D) composition.

08. A *truck*, which is a special *car* converted for off-roading with special shocks, mud tires and four-wheel drive is an example of

(A) a superclass.
(B) inheritance.
(C) instantiation.
(D) composition.

Objective 2 - GridWorld Inheritance Observations

09. Consider the following code segment and class declaration.

```
import info.gridworld.actor.ActorWorld;
import info.gridworld.actor.Actor;
import info.gridworld.grid.Location;
```

```
public class Question09
{
    public static void main(String[] args)
    {
        ActorWorld world = new ActorWorld();
        Actor actor1 = new Actor();
        Actor actor2 = new Actor();
        world.add(new Location(0,0),actor1);
        world.add(new Location(0,9),actor2);
        world.show();
    }
}

public class Spider
{

}
```

How will the **Spider** class object appear after the program segment above executes?

(A) Exactly the same as an **Actor** object at a random location

(B) Exactly the same as an **Actor** object at a specified location

(C) There will not be any visible evidence of a **Spider** object on the GridWorld

(D) There will be one **Spider** object at a random location

10. Consider the following code segment and class declaration.

```
import info.gridworld.actor.ActorWorld;
import info.gridworld.actor.Actor;
import info.gridworld.grid.Location;

public class Question10
{
```

```
        public static void main(String[] args)
        {
            ActorWorld world = new ActorWorld();
            Actor actor1 = new Actor();
            Actor actor2 = new Actor();
            world.add(new Location(0,0),actor1);
            world.add(new Location(0,9),actor2);
            world.add(new Location(4,4),new Spider());
            world.add(new Location(5,5),new Spider());
            world.show();
        }
    }

    public class Spider extends Actor
    {

    }
```

How will the **Spider** class objects appear after the program segment above executes?

(A) Exactly the same as an **Actor** object at random locations

(B) Exactly the same as an **Actor** object at specified locations

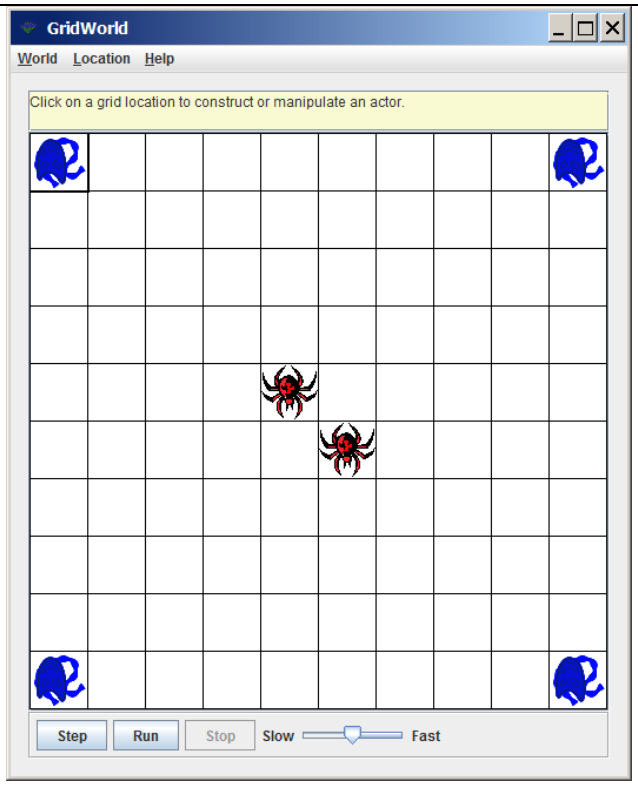
(C) There will not be any visible evidence of a **Spider** object on the GridWorld

(D) There will be two **Spider** objects at a random location

11.	Consider the following class declarations and the GridWorld output display in the next table cell. **public class Question11** **{** **public static void main(String[] args)** **{** **ActorWorld world = new ActorWorld();**	11.

```
        Actor actor1 = new Actor();
        Actor actor2 = new Actor();
        world.add(new Location(0,0),actor1);
        world.add(new Location(0,9),actor2);
        world.add(new Location(4,4),new Spider());
        world.add(new Location(5,5),new Spider());
        world.show();
    }
}

public class Spider extends Actor
{
    public Spider()
    {
        setColor(Color.red);
    }
}
```



The two **Spider** objects now look like spiders.
What must have been altered from the previous question to make the **Spider** objects appear like this?

(A) The **Spider** class declaration includes **extends Actor**.

(B) A **Spider.java** file is added to the GridWorld project folder.

(C) A **Spider.gif** file is added to the GridWorld project folder.

(D) An updated **gridworld.jar** file is attached to the GridWorld project.

12. Consider the following class declaration.
Assume that a GridWorld program has executed that includes a **Spider** object.

```
public class Spider extends Actor
{
    public void act()
    {

    }
}
```

How will a **Spider** class object behave when the **step** method is called?

(A) Like an **Actor** object

(B) Like a **Bug** object

(C) Like a **Flower** object

(D) Like a **Rock** object

Objective 3 - Accessing Inheritance Members

13. Consider the following class heading.

public class Person extends Student

What is <u>not true</u> about the class interaction of that class heading?

(A) It indicates an "is-a" class interaction between the two classes.

(B) It indicates an inheritance relationship between **Person** and **Student**

(C) It indicates that **Person** is the superclass and **Student** is the subclass.

(D) It indicates that **Student** is the superclass and **Person** is the subclass.

14. **Consider the following program for questions 14 and 15.**

```
public class Question1415
{
    public static void main(String args[])
    {
        Student tom = new Student();
        System.out.println("tom's age is    " + tom.getAge());
        System.out.println("tom's grade is " + tom.getGrade());
    }
}

class Person
{
    private int age;

    public int getAge()
    {
        return age;
    }
}

class Student extends Person
{
    private int grade;

    public int getGrade()
    {
        return grade;
    }
}
```

This program compiles and executes without error or logic problems.
What evidence exists that proves that inheritance is functional in this program?

(A) The **Student** class extends the **Person** class.

(B) The **tom** object has access to the **getGrade** method.

(C) The **tom** object has access to the **getAge** method.

(D) There is evidence of class interaction with composition, but not with inheritance.

15. What is the consequence of removing **extends Person** from the program above?

(A) The class interaction will change from inheritance to composition.

(B) The class interaction will change from composition to inheritance.

(C) The program will compile, but it will not execute correctly.

(D) There will no longer be any interaction between the **Person** class and the **Student** class.

16. Which of the following is not possible between classes that have an inheritance relationship?

(A) Access from superclass to any subclass members

(B) Access from subclass to superclass members

(C) Access from subclass methods to subclass data attributes

(D) Access from superclass methods to superclass data attributes

Use this program segment for questions 17 & 18.

```
public class Demo
{
	public static void main(String args[])
	{
		Student tom = new Student(12);
		tom.showData();
	}
}


class Person
{
	public int age;

	public Person()
	{
		System.out.println("Person Parameter Constructor");
		age = 17;
	}

	public int getAge()		{ return age; }
}


class Student extends Person
{
	private int grade;

	public Student(int g)
	{
		grade = g;
		System.out.println("Student Parameter Constructor");
	}

	public int getGrade()	{ return grade; }

	public void showData()
	{
		System.out.println("Student's Grade is " + grade);
		System.out.println("Student's Age is   " + age);
	}
}
```

17. What are the first 2 lines of output?

(A) Person Parameter Constructor
Student Parameter Constructor

(B) Student Parameter Constructor
Person Parameter Constructor

(C) Person Parameter Constructor
Person Parameter Constructor

(D) Student Parameter Constructor
Student Parameter Constructor

(E) No Output.
This program does not compile.

18. What are the last 2 lines of output?

(A) Student's Grade is 12
Student's Age is 17

(B) Student's Grade is 12
Student's Age is 17

(C) Student's Grade is 12
Student's Age is 17

(D) Student's Grade is 12
Student's Age is 17

(E) No Output.
This program does not compile.

Use this program segment for questions 19 & 20.

```
public class Demo
{
	public static void main(String args[])
	{
		Student tom = new Student(12);
		tom.showData();
	}
}


class Person
{
	private int age;

	public Person()
	{
		System.out.println("Person Parameter Constructor");
		age = 17;
	}

	public int getAge()		{ return age; }
}


class Student extends Person
{
	private int grade;

	public Student(int g)
	{
		grade = g;
		System.out.println("Student Parameter Constructor");
	}

	public int getGrade()	{ return grade; }

	public void showData()
	{
		System.out.println("Student's Grade is " + grade);
		System.out.println("Student's Age is   " + age);
	}
}
```

19. What are the first 2 lines of output?

(A) Person Parameter Constructor
Student Parameter Constructor

(B) Student Parameter Constructor
Person Parameter Constructor

(C) Person Parameter Constructor
Person Parameter Constructor

(D) Student Parameter Constructor
Student Parameter Constructor

(E) No Output.
This program does not compile.

20. What are the last 2 lines of output?

(A) Student's Grade is 12
Student's Age is 17

(B) Student's Grade is 17
Student's Age is 12

(C) Student's Grade is 17
Student's Age is 17

(D) Student's Grade is 12
Student's Age is 12

(E) No Output.
This program does not compile.

Use this program segment for questions 21 & 22.

```
public class Demo
{
	public static void main(String args[])
	{
		Student tom = new Student(12);
		tom.showData();
	}
}


class Person
{
	protected int age;

	public Person()
	{
		System.out.println("Person Parameter Constructor");
		age = 17;
	}

	public int getAge()		{ return age; }
}


class Student extends Person
{
	protected int grade;

	public Student(int g)
	{
		grade = g;
		System.out.println("Student Parameter Constructor");
	}

	public int getGrade()	{ return grade; }

	public void showData()
	{
		System.out.println("Student's Grade is " + grade);
		System.out.println("Student's Age is   " + age);
	}
}
```

21. What are the first 2 lines of output?

(A) Person Parameter Constructor
Student Parameter Constructor

(B) Student Parameter Constructor
Person Parameter Constructor

(C) Person Parameter Constructor
Person Parameter Constructor

(D) Student Parameter Constructor
Student Parameter Constructor

(E) No Output.
This program does not compile.

22. What are the last 2 lines of output?

(A) Student's Grade is 12
Student's Age is 17

(B) Student's Grade is 17
Student's Age is 12

(C) Student's Grade is 17
Student's Age is 17

(D) Student's Grade is 12
Student's Age is 12

(E) No Output.
This program does not compile.

Use this program segment for questions 23 & 24.

```
public class Demo
{
	public static void main(String args[])
	{
		Student tom = new Student(12,17);
		tom.showData();
	}
}


class Person
{
	private int age;

	public Person(int a)
	{
		System.out.println("Person Parameter Constructor");
		age = a;
	}

	public int getAge()		{ return age; }
}


class Student extends Person
{
	private int grade;

	public Student(int a, int g)
	{
		super(a);
		grade = g;
		System.out.println("Student Parameter Constructor");
	}

	public int getGrade()	{ return grade; }

	public void showData()
	{
		System.out.println("Student's Grade is " + getGrade());
		System.out.println("Student's Age is   " + getAge());
	}
}
```

23. What are the first 2 lines of output?

(A) Person Parameter Constructor
Student Parameter Constructor

(B) Student Parameter Constructor
Person Parameter Constructor

(C) Person Parameter Constructor
Person Parameter Constructor

(D) Student Parameter Constructor
Student Parameter Constructor

(E) No Output.
This program does not compile.

24. What are the last 2 lines of output?

(A) Student's Grade is 12
Student's Age is 17

(B) Student's Grade is 17
Student's Age is 12

(C) Student's Grade is 17
Student's Age is 17

(D) Student's Grade is 12
Student's Age is 12

(E) No Output.
This program does not compile.

Objective 4 - Inheritance Constructor Issues

Didn't like wording of this question

25. When an object of a subclass is instantiated, the constructor of the

(A) primary class, containing the **main** method, is called first.

(B) subclass is called first, followed by the constructor of the superclass.

(C) superclass is called first, followed by the constructor of the subclass.

(D) subclass is called first, followed by the constructor of the primary class, containing **main**.

26. If the **super** keyword is used, in a constructor, to send information, where must it be placed?

(A) Anywhere in the program

(B) Anywhere in the subclass

(C) Anywhere in the superclass

(D) Anywhere in the superclass constructor

(E) At the very beginning of the subclass constructor

27. How is information passed from the subclass constructor to the superclass constructor?

(A) The superclass constructor is automatically called before the subclass constructor.

(B) Use the **super** keyword followed by a parameter list for the superclass constructor.

(C) Use the **super** keyword followed by the superclass identifier.

(D) Use the **new** operator inside the subclass constructor to instantiate the superclass.

28. Consider the following class declaration.

```
public class Qwerty extends Widget
{
    private int count;

    public Qwerty(int c)
    {
        count = c;
    }
}
```

Which of the following **Qwerty** methods is identical to the one above?

(A)

```
public Qwerty(int c)
{
    super(c);
    count = c;
}
```

(B)

###

```
public Qwerty(int c)
{
    super();
    count = c;
}
```

(C)

```
public Qwerty(int c)
{
    super(Widget);
    count = c;
}
```

(D)

```
public Qwerty(int c)
{
    count = c;
    super();
}
```

29. Consider the program segment and class declarations.

```
int widgetCount = 10;
int pidgetCount = 20;
Widget widget = new Pidget(widgetCount,pidgetCount);

public Widget
{
    private int numWidgets;

    public Widget(int nW)
    {
        numWidgets = nW;
    }
}

public class Pidget extends Widget
{
    private int numPidgets;

}
```

Which of the following **Pidget** constructors correctly initializes the instances variables?

(A)

```
public Pidget(int nW, int nP)
{
    numWidgets = nW
    numPidgits = nP;
}
```

(B)

```
public Pidget(int nW, int nP)
{
    super(nw,nP);
}
```

(C)
###

```
public Pidget(int nW, int nP)
{
    super(nW);
    numPidgits = nP;
}
```

(D)

```
public Pidget(int nW, int nP)
{
    numPidgits = nP;
    super(nw);
}
```

30. Consider the program segment and class declarations.

```
int pidgetCount = 20;
Widget widget = new Widget(pidgetCount);

public Widget
{
    private int numWidgets;

    public Widget()
    {
        numWidgets = 0;
    }
}

public class Pidget extends Widget
{
    private int numPidgets;

}
```

Which of the following **Pidget** constructors correctly initializes the instances variables?

(A)

```
public Pidget(int nP)
{
    numWidgets = 0
    numPidgits = nP;
}
```

(B)

```
###  public Pidget(int nP)
     {
         super();
         numPidgets = nP;
     }
```

(C)

```
public Pidget(int nP)
{
    super(nP);
}
```

(D)

```
public Pidget(int nP)
{
    numPidgits = nP;
    super();
}
```

31. Consider the program segment and class declarations.

```
int widgetCount = 10;
double widgetCost = 3.75;
int pidgetCount = 20;
int pidgetCost = 6.25;
Widget widget = new Pidget(widgetCount,widgetCost,pidgetCount,pidgetCost);

public Widget
{
    private int widgetCount;
    private double widgetCost;

    public Widget(int count, double cost)
    {
        widgetCount = count;
        widgetCost = cost;
    }
}

public class Pidget extends Widget
{
    private int pidgetCount;
    private double pidgetCost;

}
```

Which of the following **Pidget** constructors correctly initializes the instances variables?

(A) ###

```
public Pidget(int w1, double w2, int p1, double p2)
{
    super(w1,w2);
    pidgetCount = p1;
    pidgetCost = p2;
}
```

(B)

```
public Pidget(int w1, double w2, int p1, double p2)
{
    super(p1,p2);
    widgetCount = w1;
    widgetCost = w2;
}
```

(C)

```
public Pidget(int w1, double w2, int p1, double p2)
{
    pidgetCount = p1;
    pidgetCost = p2;
    super(w1,w2);
}
```

(D)

```
public Pidget(int w1, double w2, int p1, double p2)
{
    widgetCount = w1;
    widgetCost = w2;
    super(p1,p2);
}
```

32. Consider the program segment and class declarations.

```
Widget widget = new Pidget(100,200,300);

public Kidget
{
    private int kidgetCount;
    public Kidget(int kC)
    {
        kidgetCount = kC;
    }
}

public Widget
{
    private int widgetCount;
    public Widget(int kC, int wC)
    {
        super(kC);
        widgetCount = wC;
    }
}

public class Pidget extends Widget
{
    private int pidgetCount;

}
```

Which of the following **Pidget** constructors correctly initializes the instances variables?

(A)
###
```
public Pidget(int kC, int wC, int pC)
{
    super(kC,wC);
    pidgetCount = pC;
}
```

(B)
```
public Pidget(int kC, int wC, int pC)
{
    pidgetCount = pC;
    super(kC,wC);
}
```

(C)
```
public Pidget(int kC, int wC, int pC)
{
    kidgetCount = kC;
    widgetCount = wC
    pidgetCount = pC;
}
```

(D)
```
public Pidget(int kC, int wC, int pC)
{
    super(pC);
    kidgetCount = kC;
    widgetCount = wC
}
```

Objective 5 - super Calling a Superclass Method

33. What happens to a superclass method when it is re-defined in a subclass?

(A) The superclass method is no longer available.

(B) The superclass method must be removed to avoid a compile error.

(C) Both methods in the superclass and subclass are available.

(D) The superclass method is only available with a superclass object.

---

34. Method **boo** is defined in super class **Alpha** and **boo** is re-defined in subclass **Beta**. Consider the following program segment.

```
Beta beta = new Beta();
beta.boo();
```

Which method(s) get called as a result of executing the code segment?

(A) **boo** defined in **Alpha**, followed by **boo** defined in **Beta**

(B) **boo** defined in **Beta**, followed by **boo** defined in **Alpha**

(C) **boo** defined in **Alpha** only

(D) **boo** defined in **Beta** only

---

35. Consider the following method, which is defined in the **Student** class and the **Person** class. Assume that the **Student** class is a subclass of the **Person** class.

```
public void showData()
{
        System.out.println(getData());
        System.out.println( super.getData());
}
```

What is printed when method **showData** is called?

(A) Two identical values

(B) A compile error message

(C) The value of the subclass **getData** followed by the value of the superclass **getData**

(D) The value of the superclass **getData** followed by the value of the subclass **getData**

36. Consider the following code segment, class **Xerson**, class **Person** and class **Student**.

```
Student tom = new Student(12,15,17);
tom.showData();
System.out.println();

class Xerson
{
    private int xer;

    public Xerson(int a)
    {
        xer = a;
    }

    public int getData()
    {
        return xer;
    }
}

class Person extends Xerson
{
    private int age;

    public Person(int a, int b)
    {
        super(a);
        age = b;
    }

    public int getData()
    {
        return super.getData();
    }
}
```

```
class Student extends Person
{
    private int grade;

    public Student(int a, int b, int c)
    {
        super(a,b);
        grade = c;
    }

    public int getData()
    {
        return grade;
    }

    public void showData()
    {
        System.out.println(getData());
        System.out.println(super.getData());
    }
}
```

What will be the printed as a result of executing the code segment?

(A)
```
12
12
```

(B)
```
15
17
```

(C)
```
17
### 12
```

(D)
```
12
15
17
```

(E) Compile error message

Objective 6 - Umbrella Classes

37. For the coded segment that follows assume the following class relationships.

Actor is the highest superclass.
Classes **Rock**, **Flower** and **Bug** are subclasses of **Actor**.
Class **Spider** is a subclass of **Bug**.

```
Actor actor = new Actor();
Rock rock = new Rock();
Flower flower = new Flower();
Bug bug = new Bug();
Spider spider = new Spider();
```

Which class is the *umbrella class* in the code segment?

(A) **Actor**
(B) **Rock**
(C) **Flower**
(D) **Bug**
(E) This code segment does not use an *umbrella class*.

38. For the coded segment that follows assume the following class relationships.

Actor is the highest superclass.
Classes **Rock**, **Flower** and **Bug** are subclasses of **Actor**.
Class **Spider** is a subclass of **Bug**.

```
Actor actor = new Actor();
Actor rock = new Rock();
Actor flower = new Flower();
Actor bug = new Bug();
Actor spider = new Spider();
```

Which class is the *umbrella class* in the code segment?

(A) **Actor**
(B) **Rock**
(C) **Flower**
(D) **Bug**
(E) This code segment does not use an *umbrella class*.

39. What computer science concept benefits from using *umbrella classes*?

(A) Inheritance
(B) Composition
(C) Encapsulation
(D) Polymorphism
(E) Concatenation

40. For the coded segment that follows assume the following class relationships.

Actor is the highest superclass.
Classes **Rock**, **Flower** and **Bug** are subclasses of **Actor**.
Class **Spider** is a subclass of **Bug**.

```
Actor actor = new Actor();
Actor rock = new Rock();
Actor flower = new Flower();
Actor bug = new Bug();
Actor spider = new Spider();
```

In the code segment which constructor is used to instantiate a new object?

(A) The constructor of the *umbrella class*.
(B) The constructor of the lowest subclass, which is **Spider**
(C) The constructor method that is used for each individual object.
(D) The constructor of the highest superclass.

41. _____ is the process of using features (both attributes and actions) from an established higher class.

(A) Encapsulation
(B) Instantiation
(C) Polymorphism
(D) Composition
(E) Inheritence

42. What is the output of this program?

```
public class Java0909
{
        public static void main(String args[])
        {
            Student tom = new Student();
            tom.showData();
        }
}

class Person
{
        protected int age;
        public Person()    { age = 18; }
        public getData()  { return age; }
}

class Student extends Person
{
        private int grade;
        public Student()   { grade = 12; }
        public getData()  { return grade; }
        public void showData()
        {
            System.out.println("Grade "+getData());
            System.out.println("Age    "+getData());
        }
}
```

(A) Grade 12
Age 18

(B) Grade 18
Age 12

(C) Grade 12
Age 12

(D) Age 18
Grade 18

(E) Error

43. What is the output of this program?

```
public class Java0910
{
        public static void main(String args[])
        {
            Student tom = new Student();
            tom.showData();
        }
}

class Person
{
        protected int age;
        public Person()    { age = 18; }
        public getData()  { return age; }
}

class Student extends Person
{
        private int grade;
        public Student()   { grade = 12; }
        public getData()  { return grade; }
        public void showData()
        {
            System.out.println("Grade "+getData());
            System.out.println("Age    "+super.getData());
        }
}
```

(A) Grade 12
Age 18

(B) Grade 18
Age 12

(C) Grade 12
Age 12

(D) Age 18
Grade 18

(E) Error

44. Look at the program below.
What commands should be used in place of the *missing commands* to allow the program to work properly?

```
public class Java0911
{
        public static void main(String args[])
        {
            Student tom = new Student(12,18);
            tom.showData();
        }
}

class Person
{
        private int age;
        public Person(int a)    { age = a; }
        public getAge) { return age; }
}

class Student extends Person
{
        private int grade;
        public Student(int a, int g) { missing commands }
        public getGrade() { return grade; }
        public void showData()
        {
            System.out.println("Grade "+getGrade());
            System.out.println("Age    "+getAge());
        }
}
```

Desired Output

```
Grade  12
Age    18
```

(A) super(a);
grade = g;

(B) super(g);
age = a;

(C) grade = g;
super(a);

(D) age = a;
super(g);

45. Look at the program below.
What commands should be used in place of the *missing commands* to allow the program to work properly?

```
public class Java0912
{
        public static void main(String args[])
        {
            Car car = new Car("Ford",350);
        }
}

class Engine
{
        private int horsePower;
        public Engine(int hp)  { horsePower = hp; }
}

class Car
{
        String type;
        Engine engine;
        public Car(String t, int hp)
        {
            missing
            commands
        }
}
```

(A) type = t;
horsePower = hp;

(B) type = t;
super(hp);

(C) super(hp);
super(t);

(D) super(t);
horsePower = hp;

(E) type = t;
engine = new Engine(hp);

46. Assume these 2 classes are in the same program.

```
class Tomato
{
}

class Microwave extends Tomato
{
}
```

Which of these statements does NOT construct an object properly?

(A) Microwave bob = new Microwave();
(B) Tomato bob = new Tomato();
(C) Microwave bob = new Tomato();
(D) Tomato bob = new Microwave();

---

47. What is the name of the class that ALL classes inherit from automatically?

(A) Object
(B) Class
(C) extends
(D) Inheritance
(E) Composition

---

48. When a subclass has a method with the same signature as the superclass, what is that called?

(A) instantiation
(B) composition
(C) overriding
(D) unnecessary

---

49. What is the keyword **super** used for in Java?

I. It calls a superclass constructor.
II. It allows you to call a superclass method when the subclass has a method with the same identifier.
III. It allows you to format your output to display "superscript" for things like exponents.

(A) I only
(B) II only
(C) III only
(D) I and II only
(E) I, II and III

---

50. Inheritance is one part of *Class Interaction*. What is the other?

(A) Encapsulation
(B) Instantiation
(C) Polymorphism
(D) Composition
