

Questions 1–3 refer to the Time class declared below:

```
public class Time
{
    private int hrs;
    private int mins;
    private int secs;

    public Time()
    { /* implementation not shown */ }

    public Time(int h, int m, int s)
    { /* implementation not shown */ }

    /** Resets time to hrs = h, mins = m, secs = s. */
    public void resetTime(int h, int m, int s)
    { /* implementation not shown */ }

    /** Advances time by one second. */
    public void increment()
    { /* implementation not shown */ }

    /** @return true if this time equals t, false otherwise */
    public boolean equals(Time t)
    { /* implementation not shown */ }

    /** @return true if this time is earlier than t, false otherwise */
    public boolean lessThan(Time t)
    { /* implementation not shown */ }

    /** @return a String with the time in the form hrs:mins:secs */
    public String toString()
    { /* implementation not shown */ }
}
```

1. Which of the following is a *false* statement about the methods?
 - (A) equals, lessThan, and toString are all accessor methods.
 - (B) increment is a mutator method.
 - (C) Time() is the default constructor.
 - (D) The Time class has three constructors.
 - (E) There are no static methods in this class.

2. Which of the following represents correct *implementation code* for the constructor with parameters?

- (A) `hrs = 0;
mins = 0;
secs = 0;`
- (B) `hrs = h;
mins = m;
secs = s;`
- (C) `resetTime(hrs, mins, secs);`
- (D) `h = hrs;
m = mins;
s = secs;`
- (E) `Time = new Time(h, m, s);`

3. A client class has a display method that writes the time represented by its parameter:

```
/** Outputs time t in the form hrs:mins:secs.  
 * @param t the time  
 */  
public void display (Time t)  
{  
    /* method body */  
}
```

Which of the following are correct replacements for */* method body */*?

- I `Time T = new Time(h, m, s);
System.out.println(T);`
 - II `System.out.println(t.hrs + ":" + t.mins + ":" + t.secs);`
 - III `System.out.println(t);`
- (A) I only
 - (B) II only
 - (C) III only
 - (D) II and III only
 - (E) I, II, and III

4. Which statement about parameters is *false*?

- (A) The scope of parameters is the method in which they are defined.
- (B) Static methods have no implicit parameter `this`.
- (C) Two overloaded methods in the same class must have parameters with different names.
- (D) All parameters in Java are passed by value.
- (E) Two different constructors in a given class can have the same number of parameters.

Questions 5–11 refer to the following `Date` class declaration:

```
public class Date
{
    private int day;
    private int month;
    private int year;

    public Date()                //default constructor
    {
        ...
    }

    public Date(int mo, int da, int yr)    //constructor
    {
        ...
    }

    public int month()            //returns month of Date
    {
        ...
    }

    public int day()             //returns day of Date
    {
        ...
    }

    public int year()            //returns year of Date
    {
        ...
    }

    //Returns String representation of Date as "m/d/y", e.g. 4/18/1985.
    public String toString()
    {
        ...
    }
}
```

5. Which of the following correctly constructs a `Date` object in a client class?

- (A) `Date d = new (2, 13, 1947);`
- (B) `Date d = new Date(2, 13, 1947);`
- (C) `Date d;`
`d = new (2, 13, 1947);`
- (D) `Date d;`
`d = Date(2, 13, 1947);`
- (E) `Date d = Date(2, 13, 1947);`

6. Which of the following will cause an error message?

- I `Date d1 = new Date(8, 2, 1947);`
`Date d2 = d1;`
- II `Date d1 = null;`
`Date d2 = d1;`
- III `Date d = null;`
`int x = d.year();`

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

7. A client program creates a `Date` object as follows:

```
Date d = new Date(1, 13, 2002);
```

Which of the following subsequent code segments will cause an error?

- (A) `String s = d.toString();`
- (B) `int x = d.day();`
- (C) `Date e = d;`
- (D) `Date e = new Date(1, 13, 2002);`
- (E) `int y = d.year;`

8. Consider the implementation of a `write()` method that is added to the `Date` class:

```
/** Write the date in the form m/d/y, for example 2/17/1948. */  
public void write()  
{  
    /* implementation code */  
}
```

Which of the following could be used as */* implementation code */*?

- I `System.out.println(month + "/" + day + "/" + year);`
 - II `System.out.println(month() + "/" + day() + "/" + year());`
 - III `System.out.println(this);`
- (A) I only
 - (B) II only
 - (C) III only
 - (D) II and III only
 - (E) I, II, and III

9. Here is a client program that uses Date objects:

```
public class BirthdayStuff
{
    public static Date findBirthdate()
    {
        /* code to get birthDate */
        return birthDate;
    }

    public static void main(String[] args)
    {
        Date d = findBirthdate();
        ...
    }
}
```

Which of the following is a correct replacement for
/ code to get birthDate */*?

- I System.out.println("Enter birthdate: mo, day, yr: ");
int m = IO.readInt(); //read user input
int d = IO.readInt(); //read user input
int y = IO.readInt(); //read user input
Date birthDate = new Date(m, d, y);
- II System.out.println("Enter birthdate: mo, day, yr: ");
int birthDate.month() = IO.readInt(); //read user input
int birthDate.day() = IO.readInt(); //read user input
int birthDate.year() = IO.readInt(); //read user input
Date birthDate = new Date(birthDate.month(), birthDate.day(),
birthDate.year());
- III System.out.println("Enter birthdate: mo, day, yr: ");
int birthDate.month = IO.readInt(); //read user input
int birthDate.day = IO.readInt(); //read user input
int birthDate.year = IO.readInt(); //read user input
Date birthDate = new Date(birthDate.month, birthDate.day,
birthDate.year);

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

10. A method in a client program for the Date class has this declaration:

```
Date d1 = new Date(mo, da, yr);
```

where mo, da, and yr are previously defined integer variables. The same method now creates a second Date object d2 that is an exact copy of the object d1 refers to. Which of the following code segments will *not* do this correctly?

I Date d2 = d1;

II Date d2 = new Date(mo, da, yr);

III Date d2 = new Date(d1.month(), d1.day(), d1.year());

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

11. The Date class is modified by adding the following mutator method:

```
public void addYears(int n)    //add n years to date
```

Here is part of a poorly coded client program that uses the Date class:

```
public static void addCentury(Date recent, Date old)
{
    old.addYears(100);
    recent = old;
}

public static void main(String[] args)
{
    Date oldDate = new Date(1, 13, 1900);
    Date recentDate = null;
    addCentury(recentDate, oldDate);
    ...
}
```

Which will be true after executing this code?

- (A) A NullPointerException is thrown.
- (B) The oldDate object remains unchanged.
- (C) recentDate is a null reference.
- (D) recentDate refers to the same object as oldDate.
- (E) recentDate refers to a separate object whose contents are the same as those of oldDate.

12. Here are the private instance variables for a Frog object:

```
public class Frog
{
    private String species;
    private int age;
    private double weight;
    private Position position;    //position (x,y) in pond
    private boolean amAlive;
    ...
}
```

Which of the following methods in the Frog class is the best candidate for being a static method?

- (A) swim //frog swims to new position in pond
- (B) getPondTemperature //returns temperature of pond
- (C) eat //frog eats and gains weight
- (D) getWeight //returns weight of frog
- (E) die //frog dies with some probability based
//on frog's age and pond temperature

13. What output will be produced by this program?

```
public class Mystery
{
    public static void strangeMethod(int x, int y)
    {
        x += y;
        y *= x;
        System.out.println(x + " " + y);
    }

    public static void main(String[] args)
    {
        int a = 6, b = 3;
        strangeMethod(a, b);
        System.out.println(a + " " + b);
    }
}
```

- (A) 36
9
- (B) 3 6
9
- (C) 9 27
9 27
- (D) 6 3
9 27
- (E) 9 27
6 3

Questions 14–17 refer to the following definition of the Rational class:

```
public class Rational
{
    private int numerator;
    private int denominator;

    /** default constructor */
    Rational()
    { /* implementation not shown */ }

    /** Constructs a Rational with numerator n and
     * denominator 1. */
    Rational(int n)
    { /* implementation not shown */ }

    /** Constructs a Rational with specified numerator and
     * denominator. */
    Rational(int numer, int denom)
    { /* implementation not shown */ }

    /** @return numerator */
    int numerator()
    { /* implementation not shown */ }

    /** @return denominator */
    int denominator()
    { /* implementation not shown */ }

    /** Returns (this + r). Leaves this unchanged.
     * @return this rational number plus r
     * @param r a rational number to be added to this Rational
     */
    public Rational plus(Rational r)
    { /* implementation not shown */ }

    //Similarly for times, minus, divide
    ...
    /** Ensures denominator > 0. */
    private void fixSigns()
    { /* implementation not shown */ }

    /** Ensures lowest terms. */
    private void reduce()
    { /* implementation not shown */ }
}
```

14. The method `reduce()` is not a public method because
- (A) methods whose return type is void cannot be public.
 - (B) methods that change this cannot be public.
 - (C) the `reduce()` method is not intended for use by clients of the `Rational` class.
 - (D) the `reduce()` method is intended for use only by clients of the `Rational` class.
 - (E) the `reduce()` method uses only the private data fields of the `Rational` class.

15. The constructors in the Rational class allow initialization of Rational objects in several different ways. Which of the following will cause an error?

- (A) Rational r1 = new Rational();
- (B) Rational r2 = r1;
- (C) Rational r3 = new Rational(2,-3);
- ☒ (D) Rational r4 = new Rational(3.5);
- (E) Rational r5 = new Rational(10);

16. Here is the implementation code for the plus method:

```
/** Returns (this + r). Leaves this unchanged.
 * @return this rational number plus r
 * @param r a rational number to be added to this Rational
 */
public Rational plus(Rational r)
{
    fixSigns();
    r.fixSigns();
    int denom = denominator * r.denominator;
    int numer = numerator * r.denominator
               + r.numerator * denominator;
    /* more code */
}
```

Which of the following is a correct replacement for */* more code */*?

- (A) Rational rat(numer, denom);
 rat.reduce();
 return rat;
- (B) return new Rational(numer, denom);
- (C) reduce();
 Rational rat = new Rational(numer, denom);
 return rat;
- (D) Rational rat = new Rational(numer, denom);
 Rational.reduce();
 return rat;
- (E) Rational rat = new Rational(numer, denom);
 rat.reduce();
 return rat;

17. Assume these declarations:

```
Rational a = new Rational();
Rational r = new Rational(numer, denom);
int n = value;
//numer, denom, and value are valid integer values
```

Which of the following will cause a compile-time error?

- (A) r = a.plus(r);
- (B) a = r.plus(new Rational(n));
- (C) r = r.plus(r);
- (D) a = n.plus(r);
- (E) r = r.plus(new Rational(n));

Questions 18–20 refer to the Temperature class shown below:

```
public class Temperature
{
    private String scale; //valid values are "F" or "C"
    private double degrees;

    /** constructor with specified degrees and scale */
    public Temperature(double tempDegrees, String tempScale)
    { /* implementation not shown */ }

    /** Mutator. Converts this Temperature to degrees Fahrenheit.
     * Precondition: Temperature is a valid temperature
     *                in degrees Celsius.
     * @return this temperature in degrees Fahrenheit
     */
    public Temperature toFahrenheit()
    { /* implementation not shown */ }

    /** Mutator. Converts this Temperature to degrees Celsius.
     * Precondition: Temperature is a valid temperature
     *                in degrees Fahrenheit.
     * @return this temperature in degrees Celsius
     */
    public Temperature toCelsius()
    { /* implementation not shown */ }

    /** Mutator.
     * @param amt the number of degrees to raise this temperature
     * @return this temperature raised by amt degrees
     */
    public Temperature raise(double amt)
    { /* implementation not shown */ }

    /** Mutator.
     * @param amt the number of degrees to lower this temperature
     * @return this temperature lowered by amt degrees
     */
    public Temperature lower(double amt)
    { /* implementation not shown */ }

    /** @param tempDegrees the number of degrees
     * @param tempScale the temperature scale
     * @return true if tempDegrees is a valid temperature
     *         in the given temperature scale, false otherwise
     */
    public static boolean isValidTemp(double tempDegrees,
                                      String tempScale)
    { /* implementation not shown */ }

    //Other methods are not shown.
}
```

18. A client method contains this code segment:

```
Temperature t1 = new Temperature(40, "C");
Temperature t2 = t1;
Temperature t3 = t2.lower(20);
Temperature t4 = t1.toFahrenheit();
```

Which statement is *true* following execution of this segment?

- (A) t1, t2, t3, and t4 all represent the identical temperature, in degrees Celsius.
- (B) t1, t2, t3, and t4 all represent the identical temperature, in degrees Fahrenheit.
- (C) t4 represents a Fahrenheit temperature, while t1, t2, and t3 all represent degrees Celsius.
- (D) t1 and t2 refer to the same Temperature object; t3 refers to a Temperature object that is 20 degrees lower than t1 and t2, while t4 refers to an object that is t1 converted to Fahrenheit.
- (E) A NullPointerException was thrown.

19. Consider the following code:

```
public class TempTest
{
    public static void main(String[] args)
    {
        System.out.println("Enter temperature scale: ");
        String tempScale = IO.readString();    //read user input
        System.out.println("Enter number of degrees: ");
        double tempDegrees = IO.readDouble();  //read user input
        /* code to construct a valid temperature from user input */
    }
}
```

Which is a correct replacement for */* code to construct... */*?

```
I Temperature t = new Temperature(tempDegrees, tempScale);
   if (!t.isValidTemp(tempDegrees,tempScale))
       /* error message and exit program */

II if (isValidTemp(tempDegrees,tempScale))
    Temperature t = new Temperature(tempDegrees, tempScale);
else
    /* error message and exit program */

III if (Temperature.isValidTemp(tempDegrees,tempScale))
    Temperature t = new Temperature(tempDegrees, tempScale);
else
    /* error message and exit program */
```

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

20. The formula to convert degrees Celsius C to Fahrenheit F is

$$F = 1.8C + 32$$

For example, 30°C is equivalent to 86°F .

An `inFahrenheit()` accessor method is added to the `Temperature` class. Here is its implementation:

```
/** Precondition: The temperature is a valid temperature
 *              in degrees Celsius.
 * Postcondition:
 *   - An equivalent temperature in degrees Fahrenheit has been
 *     returned.
 *   - Original temperature remains unchanged.
 * @return an equivalent temperature in degrees Fahrenheit
 */
public Temperature inFahrenheit()
{
    Temperature result;
    /* more code */
    return result;
}
```

Which of the following correctly replaces `/* more code */` so that the postcondition is achieved?

```
I result = new Temperature(degrees * 1.8 + 32, "F");

II result = new Temperature(degrees * 1.8, "F");
   result = result.raise(32);

III degrees *= 1.8;
   this = this.raise(32);
   result = new Temperature(degrees, "F");
```

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

21. Consider this program:

```
public class CountStuff
{
    public static void doSomething()
    {
        int count = 0;
        ...
        //code to do something - no screen output produced
        count++;
    }

    public static void main(String[] args)
    {
        int count = 0;
        System.out.println("How many iterations?");
        int n = IO.readInt();    //read user input
        for (int i = 1; i <= n; i++)
        {
            doSomething();
            System.out.println(count);
        }
    }
}
```

If the input value for n is 3, what screen output will this program subsequently produce?

(A) 0
0
0

(B) 1
2
3

(C) 3
3
3

(D) ?
?
?

where ? is some undefined value.

(E) No output will be produced.

22. This question refers to the following class:

```
public class IntObject
{
    private int num;

    public IntObject()           //default constructor
    { num = 0; }

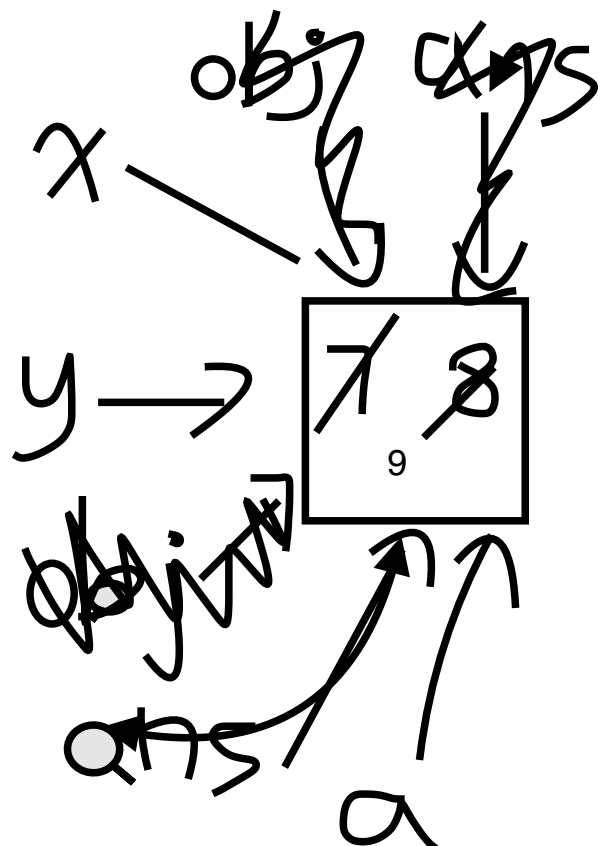
    public IntObject(int n)      //constructor
    { num = n; }

    public void increment()      //increment by 1
    { num++; }
}
```

Here is a client program that uses this class:

```
public class IntObjectTest
{
    public static IntObject someMethod(IntObject obj)
    {
        IntObject ans = obj;
        ans.increment();
        return ans;
    }

    public static void main(String[] args)
    {
        IntObject x = new IntObject(2);
        IntObject y = new IntObject(7);
        IntObject a = y;
        x = someMethod(y);
        a = someMethod(x);
    }
}
```



Just before exiting this program, what are the object values of x, y, and a, respectively?

- (A) 9, 9, 9
(B) 2, 9, 9
(C) 2, 8, 9
(D) 3, 8, 9
(E) 7, 8, 9

23. Consider the following program:

```
public class Tester
{
    public void someMethod(int a, int b)
    {
        int temp = a;
        a = b;
        b = temp;
    }
}

public class TesterMain
{
    public static void main(String[] args)
    {
        int x = 6, y = 8;
        Tester tester = new Tester();
        tester.someMethod(x, y);
    }
}
```

~~x~~ = 6

9 = 6

Just before the end of execution of this program, what are the values of x, y, and temp, respectively?

- (A) 6, 8, 6
- (B) 8, 6, 6
- ☒ (C) 6, 8, ?, where ? means undefined
- (D) 8, 6, ?, where ? means undefined
- (E) 8, 6, 8