1. What does `mystery(9870)` return?

```java
public int mystery(int n) {
    String m = "";
    while (n > 0) {
        m = m + n%10;
        n = n/10;
    }
    return m;
}
```

(a) "9870"
(b) "987"
(c) "0"
(d) "789"
(e) "7890"

2. What are the values of `a` and `b` after the following loop?

```java
int b = 2;
for (int a = 0; a < 10 || b < 20; a++) {
    a = a + b;
    b = b + a;
}
```

(a) `a` is 10 and `b` is 12
(b) `a` is 12 and `b` is 11
(c) `a` is 16 and `b` is 16
(d) `a` is 16 and `b` is 26
(e) (*) `a` is 20 and `b` is 30
3. What are the values of the following expressions, respectively?

\[ \frac{756d}{10} / 10 \]
\[ 756 / 10d / 10 \]
\[ 756 / 10 / 10d \]

(a) 7.5, 7.5, and 7.0
(b) 7.56, 7.5, and 7
(c) 7.56, 7.5, and 7.5
(d) (*) 7.56, 7.56, and 7.5
(e) 7.56, 7.56, and 7.56

4. Which sentence best describes the collective effect of the following statements?

\[ a = b; \]
\[ b = c; \]
\[ c = a; \]

(a) They swap the values of \( a \) and \( b \).
(b) They swap the values of \( a \) and \( c \).
(c) (*) They swap the values of \( b \) and \( c \).
(d) They swap the values of all three variables.
(e) The values of the variables are unchanged.

5. What is the effect of the following declaration?

\[ \text{String } s; \]

(a) It creates a variable \( s \) with an unspecified initial value.
(b) (*) It creates a variable \( s \) with initial value \text{null}.
(c) It creates a variable \( s \) with initial value "".
(d) It creates a variable \( s \) with initial value "s".
(e) It causes a syntax error, as it is not permitted to declare a variable of reference type without creating the associated object.
6. What does mysteryFlag() draw on the screen?

```java
public void mysteryFlag() {
    int z = 600;
    SimpleCanvas sc = new SimpleCanvas("What am I?", z, z);
    sc.setForegroundColour(new java.awt.Color(0, 255, 0));
    for (int i = 0; i < z; i++) sc.drawLine(0, i, z, i);
    sc.setForegroundColour(new java.awt.Color(0, 0, 255));
    for (int i = 0; i < z/2; i++) sc.drawLine(0, i, z/2, i);
}
```

(a) A square split horizontally into two coloured rectangles.
(b) A square split vertically into two coloured rectangles.
(c) (*) A square with a smaller square in its top-left corner.
(d) A square uniformly in one colour.
(e) Nothing.

7. Assuming BankAccount is defined as in the lectures, what are the values of x and y after the following statements?

```java
BankAccount b = new BankAccount("Lyndon", 666, 1000);
BankAccount c = b;
b.deposit(200);
int x = b.getBalance();
int y = c.getBalance();
```

(a) x is 1000, y is 1000.
(b) x is 1200, y is 1000.
(c) (*) x is 1200, y is 1200.
(d) x is 1200, y is 800.
(e) The statements contain a syntax error.
8. The source code for a class

(a) must explicitly define exactly one constructor.
(b) must explicitly define at least one constructor.
(c) can explicitly define at most one constructor.
(d) (* ) can explicitly define zero, one or more constructors.
(e) should never contain any explicitly defined constructors.

9. What is the value of a[8] after the following statements?

```java
int[] a;
a = new int[9];
a[0] = 1;
a[1] = -1;
for (int i = 2; i < 9; i++) a[i] = a[i-1] - a[i-2];
```

(a) (*) -2
(b) -1
(c) 0
(d) 1
(e) 2

10. What are the values of the following expressions, respectively?

0.3 == 0.3
0.3 == 0.2 + 0.1
0.0 == 0.2 - 0.2

(a) false, false, and false
(b) false, false, and true
(c) true, false, and false
(d) (*) true, false, and true
(e) true, true, and true
11. How many iterations does the following loop perform?

```java
for (int i = 5; i < 15; i++) {
    i++;
    i++;
}
```

(a) 0
(b) 3
(c) (*) 4
(d) 5
(e) 10

12. Which sentence best describes what the following method does?

```java
public void mystery(int[] a) {
    for (int i = 0; i < a.length / 2; i++)
        a[a.length - 1 - i] = a[i];
}
```

(a) It swaps the first and last elements of a.
(b) It swaps the front half and the back half of a.
(c) (*) It copies the front half of a into the back half, reversed.
(d) It copies the back half of a into the front half, reversed.
(e) It reverses the elements of a.
13. Which of the following expressions return true if exactly one of x and y is true, and false otherwise?

\[(x \&\& \neg y) \lor (\neg x \&\& y)\]
\[(x \lor y) \&\& (\neg x \lor \neg y)\]
\[x \neq y\]

(a) None of them  
(b) 1 and 2  
(c) 1 and 3  
(d) 2 and 3  
(e) (*) All of them

14. What are the values of x and y after the following statements?

```cpp
int x = 18;
int y = x;
x = 22;
```

(a) x is 18, y is 18.  
(b) (*) x is 22, y is 18.  
(c) x is 22, y is 22.  
(d) x is 40, y is 18.  
(e) The statements contain a syntax error.
The next six questions refer to the following source code, which defines a class that represents circles.

```java
class Circle {
    // represents a circle with its centre at (centreX, centreY)
    private double centreX, centreY, radius;

    public Circle(double x, double y, double r) {
        centreX = x;
        centreY = y;
        radius = r;
    }

    public Circle(double r) {
        this(0, 0, r);
    }

    public Circle() {
        this(1d);
    }

    // area() returns the area of the circle
    public double area() {
        return Math.PI * radius * radius;
    }

    // scale() enlarges/shrinks the circle
    public void scale(double factor) {
        radius = radius * factor;
    }

    // bigger() returns the circle with the larger area
    public Circle bigger(Circle other) {
        if (this.area() >= other.area()) return this;
        else return other;
    }

    // duplicate() returns a circle identical to this one
    public Circle duplicate() {
        return new Circle(centreX, centreY, radius);
    }

    // the mystery method does something unclear
    public Circle mystery() {
        return new Circle(centreX+r, centreY+r, r);
    }
}
```
15. What are the instance variables of Circle?

(a) x, y, and r
(b) (*) centreX, centreY, and radius
(c) area, scale, bigger, duplicate, and mystery
(d) factor and other
(e) x, y, r, factor, and other

16. How many of the following statements correctly construct a Circle?

1. Circle c = Circle(5);
2. Circle c = new Circle(1, 2, 1);
3. Circle c = new Circle(Math.PI);
4. Circle c = Circle(3, 2, 1).new();

(a) 0
(b) 1
(c) (*) 2
(d) 3
(e) 4

17. During the following sequence of statements, how many Circle objects are constructed?

Circle c1, c2, c3, c4, c5;
c1 = c2;
c2 = new Circle(1);
c3 = c1.duplicate();
c4 = c3.bigger(c1);
c5 = c4.duplicate();

(a) 1
(b) 2
(c) (*) 3
(d) 4
(e) 5
18. What does the **mystery** method do?

(a) It returns a circle that lies outside and touches the original circle.
(b) It returns a circle that lies inside and touches the original circle.
(c) It returns a circle whose centre lies on the original circle.
(d) (*) It returns a circle that intersects the original circle.
(e) It returns a circle that does not touch or intersect the original circle.

19. What value is stored in `c_area` after the following code (rounded to six decimal places)?

```java
Circle c = new Circle(2);
c.scale(Math.sqrt(2));
double c_area = c.area();
```

(a) 3.141593 
(b) 2.828427 
(c) 8.000000 
(d) 8.885766 
(e) (*) 25.132741

20. If `c1` is a circle with centre (2, 2) and radius 3, and `c2` is a circle with centre (1, 1) and radius 3, what is the value of `c1.bigger(c2)`

(a) (*) An object reference equal to `c1`.
(b) An object reference equal to `c2`.
(c) A reference to a new `Circle` object representing a circle with centre (2, 2) and radius 3.
(d) A reference to a new `Circle` object representing a circle with centre (1, 1) and radius 3.
(e) It causes an error.
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