

Question 0. (answer omitted)

Question 1. (a) All parameters and local variables are created when the frame for the call is drawn, before execution of the method body.

(b) $y = y + (h - 1) + 101$;

(c) 1. How does it start? (How do you truthify the invariant?) 2. When can it stop? 3. How does the repetend make progress toward termination? 4. How does the repetend maintain the invariant?

Question 2.

true, Error, 20, 30, "meow", "", "meow", Error, "", Error.

Question 3.

/** = ob is a non-null dog with the same fields as this Dog */

```
public boolean equals(Object ob) {
    if (ob == null) return false;
    if (!(ob instanceof Dog)) return false;
    Dog dob = (Dog) ob;
    return getName().equals(dob.getName())
        && getAge() == dob.getAge()
        && breed.equals(dob.breed);
}
```

/** Constructor: a Dog that is a terrier, has name Spot, and is y years old */

```
public Dog(int y) {
    super("Spot", y);
    breed = "terrier";
}
```

Question 4.

/** Remove all CATs from v and return a Vector that contains the removed CATs */

```
public static Vector<Cat> remCats(
    Vector<Animal> v) {
    Vector<Cat> res = new Vector<Cat>();
    int k = 0;
```

```
// inv: v[0..k-1] contains no Cats and
// res contains the Cats that have been
// removed from v[0..k-1]
```

```
while (k != v.size()) {
    Animal a = v.get(k);
    if (a instanceof Cat) {
        Cat c = (Cat)a;
        res.add(c);
        v.remove(k);
    }
    else k = k + 1;
}
return res;
}
```

Question 5.

/** Draw a sierpinski carpet of width and height w with top left corner at (x, y). Precondition: w is a power of 3 Precondition: the square to be drawn on is black and the pen color is white. */

```
public static void sc(int x, int y, int w) {
    if (w < 3)
        return;
    int wn = w / 3;
    for (int k = 0; k != 9; k = k + 1) {
        if (k != 4) {
            int i = k / 3;
            int j = k % 3;
            sc(x + i * wn, y + j * wn, wn);
        }
        else {
            graphics.fillRect(
                x + wn, y + wn, wn, wn);
        }
    }
}
```