CS 743 - Software Verification and Validation

1. Prove that the two code fragments given below are equivalent (assume that 'a', 'b' and 'c' are integers).

Code fragment 1:

```
if (a == b && b == c)
    System.out.print (" All the three are equal");
else if (a == b || b == c)
    System.out.print (" Two of them are equal");
else System.out.print (" All the three are completely different");
```

Code fragment 2:

```
if (a == b)
    if (b == c)
        System.out.print (" All the three are equal");
    else System.out.print (" Two of them are equal");
else
    if (b == c)
        System.out.print (" Two of them are equal");
    else System.out.print (" All the three are completely different");
```

2. You are given a jar of one or more marbles, each of which is either RED or BLUE in color. You are also given an unlimited supply of RED marbles off to the side. Let K denote the number of BLUE marbles and M denote the number of RED marbles initially in the jar. Now you execute the following algorithm:

```
while (the number of marbles in the jar > 1)  {
   choose (any) two marbles from the jar;
   if (the two marbles are of the same color)  {
      take both of them out of the jar;
      place a RED marble into the jar;
   }
   else {   // one marble of each color was chosen
      take the chosen RED marble out of the jar;
      place the chosen BLUE marble back into the jar;
   }
}
```

Let n denote the number of BLUE marbles in the jar at any time. Prove that

(both K and n are odd at any time) OR (both K and n are even at any time)

is an invariant for the while loop in the above algorithm.

Hint: Consider the two cases - (i) K is odd and (ii) K is even.