Homework on program correctness: Solutions

**Question 1**. Write the formula for the number of values in the range b..c: \_\_\_\_\_\_\_\_c+1–b\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 2.** In the video on ranges, we gave a mnemonic for remembering the number of values in a range. Write that formula here: Follower – First

**Question 3.** Below are four array segments. To the right, using what you wrote in answering question 2, write the number of values in each segment in terms of the relevant variables.

b[h..k] \_\_\_\_\_\_k+1–h\_\_\_\_\_\_\_\_

b[k+1..m] \_m+1 – (k+1)\_\_\_\_\_\_

segment 1 segment 2 segment 3 segment 4

b

h k m n p

b[m+1..n–1] \_\_n – (m+1)\_\_\_

**Question 4.** State the formula that says segment b[p..q] is empty: \_\_p = q+1\_\_\_\_\_\_\_\_\_

**Question 5.** Below, draw an array diagram that represents this assertion:

b[h..j-1] ≤ x && b[j] = x && b[j+1..k ≥ x]

<= x x >= x

h j k

b

**Question 6.** Write down the meaning of the Hoare triple {B} C {D} :

Execution of C in a state in which B is true is guaranteed to terminate, and when it does, D is true.

**Question 7.** Using the definition of the assignment statement {R[x:= e]} x= e; {R}, calculate the preconditions of the following assignment statements. You do not have to simplify them.

{ (y+1) \* y = z } { x + 2\*x + z = 2\*x } { x + y + 2 = 8}

x= y+1; y= 2\*x; y= y+2;

{x \* y = z} {x + y + z = 2\*x} {x + y = 8}

**Question 8.** Calculate the precondition of the following two sequences of assignments. It’s recommended to simplify a precondition after calculating it before moving on the next step. Here’s one reason to do that. Since x and y are being replaced in each one, it helps to keep the number of occurrences of them to a minimum. For example, you can rewrite

x = B && y = x + A as x = B && y = B + A .

{ y = B and x = C } { x = C and y = B }

{ x + B = B + C and y = B }

{ x + y = B + C and y = B }

t= x; x= x + y;

{ x = B + C and y = B }

{ x = B + C and B + C – y = C }

{ y = B and t = C } { x – C = B and x – y = C }

x= y; y= x – y;

{ x - C = B and y = C }

{ x = B and t = C } { x - y = B and y = C }

y= t; x= x – y;

{x = B and y = C} {x = B and y = C}

**Question 9.** We gave the following rule for determining when an if-else statement is correct:

**Hoare triple for if-else**:

If {Q && B} S1{R} and {Q && !B} S2 {R}  
 then {Q} **if** (B) S1 **else** S2 {R}

Write below a similar rule for determining when an if-statement is correct:

**Hoare triple for the if-statement**:

If {Q && B} S1{R} and Q && !B => R

then {Q} **if** (B) S1 {R}