Homework on program correctness

This homework concerns the video-module on the correctness of programs.

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

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

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**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] \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b[k+1..m] \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

segment 1 segment 2 segment 3 segment 4

b

h k m n p

b[m+1..n–1] \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b[n..p–1] \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

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

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

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

**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.

{ } { } { }

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 .

{ } { }

t= x; x= x + y;

{ } { }

x= y; y= x – y;

{ } { }

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 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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