1.No, they are different.

Let $\forall x\, P(x) \wedge Q(x)$ be True then $\forall x\, P(x)$ is True and $Q(x)$ is True

from $\forall x\, P(x)$ is True we got $P(x)$ is True

then $\exists x(P(x) \wedge Q(x))$ Is True

but $\forall x P(x) \wedge Q(x)$ is different to $\exists x(P(x) \wedge Q(x))$

2.$\exists y \forall x P(x, y)$ imply $\forall x \exists y P(x, y)$,

We suppose $\exists y \forall x P(x, y)$ is true, then for any constant c

$\exists y P(c, y)$ is true so $\forall x \exists y P(x, y)$ is true

3.wp's of the assignment statement is

(x>y) -> (temp:=x; x:=y; y:=temp;) = {x < y} $\wedge$ ¬ (x>y) -> {nothing} = {x < y}

For (x>y) -> (temp:=x; x:=y; y:=temp;) = {x < y}, x in post condition will becomes to y and y will becomes to x so ((x>y) -> (y<x) and ¬ (x>y) -> {nothing} = {x < y} no change which is ¬ (x>y) -> (x<y).

((x>y) -> (y>x) also can write to ((x>y) -> (x>y) which is True because A->A will always be True.

¬ (x>y) -> (x<y) can be write to (x>y) $\vee$ (x<y).

Wp = ¬ (x>y) -> (x<y) $\wedge$ ((x>y) -> (y>x)

= (x>y) $\vee$ (x<y) $\vee$ True

= (x>y) $\vee$ (x<y)

4.(a) $\exists x(P(x) \rightarrow Q(x))$

$\equiv \exists x(\neg P(x) \vee Q(x))$ ------ Implication law

$\equiv \exists x\, \neg P(x) \vee \exists x\, Q(x)$ ------ associative

$\equiv \neg \exists x\, P(x) \vee \exists x\, Q(x)$ ------ Commutativity?

$\equiv \forall x\, P(x) \rightarrow \exists x\, Q(x)$ ------ De Morgan's laws and Implication law

(b) p: people L(p): people have license D(p): people drive car

we want to prove

$(\forall p\ (D(p) \rightarrow L(p)) \wedge (\exists p(\neg L(p))) \rightarrow \exists p(\neg D(p)))$ is correct

From LHS

Let $(\forall p(D(p) \rightarrow L(p)) \wedge (\exists p(\neg L(p)))$ be true

$\equiv \neg(\forall p(D(p) \wedge \neg\forall p\ L(p)) \wedge (\exists p(\neg L(p)))$

-----Implication law and associative

$\equiv(\neg\forall p\ D(p) \vee \forall p\ L(p)) \wedge (\exists p\ \neg L(p))$ ------ Associativity

$\equiv(\exists p\ \neg D(p) \wedge \exists p\ \neg L(p)) \vee (\forall p\ L(p) \wedge (\forall p\ \neg L(p)))$

-----De Morgan's laws and Distributive rules

$\equiv(\exists p\ \neg D(p) \wedge \exists p\ \neg L(p)) \vee$ False -----negation law

$\equiv \exists p\ \neg D(p) \wedge \exists p\ \neg L(p)$ -----Identity

So $(\exists p\ \neg D(p)$ is true

so$(\forall p\ (D(p) \rightarrow L(p)) \wedge (\exists p(\neg L(p))) \rightarrow \exists p(\neg D(p)))$ is correct

(c) s: statements F(s): Statements is false K(s): speaker knows it is false

Lies = $K(s) \wedge F(s)$

So the description can be write as

$\exists s(\neg K(s) \wedge F(s)) \rightarrow \exists s\ (F(s) \wedge \neg\ (K(s) \wedge F(s)))$,to prove it's correct

Let $\exists s(\neg K(s) \wedge F(s))$ be true

RHS can be simplify,

$\exists s\ (F(s) \wedge \neg\ (K(s) \wedge F(s)))$

$\equiv \exists s\ (F(s) \wedge (\neg K(s) \vee \neg F(s)))$ ------ De Morgan's laws

$\equiv \exists s\ ((F(s) \wedge \neg K(s)) \vee (F(s) \wedge \neg F(s)))$ -----Distributive rules

$\equiv \exists s\ ((F(s) \wedge \neg K(s)) \vee$ False -----Negation

$\equiv \exists s\ (F(s) \wedge \neg K(s)$ -----Identity

which is same to LHS

So let LHS be True, $\exists s(\neg K(s) \wedge F(s)) \rightarrow \exists s\ (F(s) \wedge \neg\ (K(s) \wedge F(s)))$ is correct

5.

(a). Returns the location of the last 0 in the list

If there is no 0 in the array, return -1

(b).Input must not smaller than 1,

return value must in domain(-1,n-1)

all the index values after the index of return value in array should not equals to 0

the index value of return value in array should equals to 0.

(c)

We want to prove

$r \in [-1, n-1] \wedge (\forall i \in [r+1, n-1] A[i] != 0) \wedge \neg (r != -1 \&\& A[r] != 0)$

$\equiv$

$r \in [-1, n-1] \wedge (\forall i \in [r+1, n-1] A[i] != 0) \wedge (r \in [0, n-1] \rightarrow A[r] = 0)$

so we have to prove $\neg (r != -1 \&\& A[r] != 0) \equiv (r \in [0, n-1] \rightarrow A[r] = 0)$

$\neg (r != -1 \&\& A[r] != 0)$

$\equiv r == -1 \mid\mid A[r] == 0$

$\equiv r != -1 -> A[r] == 0$

And if $r \in [-1, n-1]$ is True then

$\neg (r != -1 \&\& A[r] != 0) \equiv (r \in [0, n-1] \rightarrow A[r] = 0)$

And whatever we suppose

$\equiv r \in [0, n -1] -> A[r] == 0$ LHS or RHS is True, $r \in [-1, n-1]$ will also be True

So

$r \in [-1, n-1] \wedge (\forall i \in [r+1, n-1] A[i] != 0) \wedge \neg (r != -1 \&\& A[r] != 0)$

$\equiv$

$r \in [-1, n-1] \wedge (\forall i \in [r+1, n-1] A[i] != 0) \wedge (r \in [0, n-1] \rightarrow A[r] = 0)$