

## Section A

1) C, 2) Process image 3) Weak 4) Race condition

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5) - Blocking receive is synchronous where receiver is blocked until a message arrives.

- Non-blocking receive is asynchronous where receiver receives the message or attempts to receive and continue.

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6) Deadlock 7) Binary 8) Critical section

9) Mutexes allow multiple threads to access a single resource one at a time, but semaphores allow multiple threads to access the resource whenever it is available.

10)  $d \rightarrow b \rightarrow a \rightarrow c \rightarrow e$

11) b

12) a) Running - both

Threads can also be considered as a lightweight process.

b) Suspend- Process only

c) Blocked- both

13)	State
i)	Ready
ii)	Blocked
iii)	Blocked/Suspend

14)	Transition
i)	Running $\rightarrow$ blocked
ii)	Ready/suspend $\rightarrow$ Ready
iii)	Blocked $\rightarrow$ Ready

15) Harder to debug or terminate.

16) d,, 17) c,, 18) a,, 19) d of c

## Section B

Q1. 1) Thread: -1  
process 0: 0

process 2: 11

2) i) wait(NULL) makes it so that parent process has to wait for child process,

ii) In child process:  $x = 2$  so  $x = -1$  which is outputted by thread

iii) Then  $x = -1 + 1$   $x = 0$

iv) Then in parent  $x$  is still  $x = -1$  then  $x + 1$  results in  $x = 0$

Q2 1)

$$S = 1, n = 0, e = 10$$

when consumer takes an item

$$n = 0 \text{ becomes } n = -1$$

$$e = 10 \text{ becomes } e = 9$$

2) i) Producer changes  $e = 9$  to  $e = 10$   
and  $S = 1$  to  $S = 0$

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ii) After produce and adding data

$S = 0$  to  $S = 1$

$n = -1$  to  $n = 0$