1. Answer:

a) States

- *New*: a process that has just been created but not yet been admitted to the pool of executable processes by the OS
- *Ready*: a process that is prepared to execute when given the opportunity
- *Running*: the process is currently being executed
- *Blocked*: a process that cannot execute until some event occurs, such as the completion of an I/O operation
- *Exit*: a process that has been released from the pool of executable processes by the OS, either because it halted or because it aborted for some reason.

b) State transition

1. *Ready*→*Running*: OS scheduler picks this process to run
2. *Running*→*Ready*: OS scheduler picks another process to run
3. *Running*→*Blocked*: the process waits for an event
4. *Blocked*→*Ready*: the event for which the process has been waiting occurs

c)

5. *Blocked*→*Running*: it is possible. Suppose that a process is blocked on an I/O operation. When the I/O finishes, if the CPU happens to be idle at that moment, the process could go directly from blocked to running.
6. *Ready*→*Blocked*: it is not likely. A ready process is currently queueing for its CPU time, so it cannot do I/O or anything else that might block it. Typically, a ready process cannot be blocked until it has run.

2. **Answer:**

a) There are two independent concepts: whether a process is waiting on an event (blocked or not), and whether a process has been swapped out of main memory (suspended or not). To accommodate this 2 × 2 combination, we need two Ready states and two Blocked states.

b)

i) Yes, this can make room for another process that is not blocked, in particular, when the currently running process or a ready process that the OS would like to dispatch requires more main memory to maintain adequate performance.

ii) Yes, if this is the only way to free up a sufficiently large block of main memory or the OS may choose to suspend a lower-priority ready process rather than a higher-priority blocked process if it believes that the blocked process will be ready soon.

iii) Yes, if the process in the Ready/Suspend state has higher priority than any of the ready processes. Otherwise, there is swapping cost.

3. **Answer:**

There are 16 processes created.

Self-test

1. C
2. D
3. A
4. D
5. D
6. D