6.{4,9,10,11,14,20,21,22,26,36}

**4.** In Fig. 6-1 the resources are returned in the reverse order of their acquisition. Would

giving them back in the other order be just as good?

**9.** Fig. 6-3 shows the concept of a resource graph. Do illegal graphs exist, that is, graphs

that structurally violate the model we have used of resource usage? If so, give an example

of one.

Yes, illegal graphs exist. Any graph with multiple arcs leave a square and end in a different circle would make it illegal.

**10.** Consider Fig. 6-4. Suppose that in step (o) *C* requested *S* instead of requesting *R*.

Would this lead to deadlock? Suppose that it requested both *S* and *R*.

Because no circular wait in either case, neither change leads to deadlock.

**11.** Suppose that there is a resource deadlock in a system. Give an example to show that

the set of processes deadlocked can include processes that are not in the circular chain

in the corresponding resource allocation graph.

Process A has R1 resource and needs R2, process B holds R2 and needs R1, so A and B cause a circular chain. Process C needs R1. C is deadlocked because it is waiting on A to release R1, which is in an infinite loop.

**14.** Consider the following state of a system with four processes, *P1*, *P2*, *P3*, and *P4*, and

five types of resources, *RS1*, *RS2*, *RS3*, *RS4*, and *RS5*:

0

0

0

2

1

0

0

0

1

1

0

0

E = (24144)

A = (01021)

C = R =

1 2

1 0

0 1

1 0

1 1 0 2 1

0 1 0 2 1

0 2 0 3 1

0 2 1 1 0

Using the deadlock detection algorithm described in Section 6.4.2, show that there is a

deadlock in the system. Identify the processes that are deadlocked.

**20.** Can a system be in a state that is neither deadlocked nor safe? If so, give an example.

If not, prove that all states are either deadlocked or safe.

States that are neither safe or deadlocked, but lead to deadlock states.

For example

process: has: needs: available:

A R1 R2 R5

B R3 R4

C R5 R6

Actions can still take place, but when each process asks for remaining requirements a deadlock occurs.

**21.** Take a careful look at Fig. 6-11(b). If *D* asks for one more unit, does this lead to a safe

state or an unsafe one? What if the request came from *C* instead of *D*?

If D asks for one more unit the state becomes unsafe, because only one unit is left and each process needs at least 2 units to proceed. If request is from C it would be safe state because C only needs one more to reach max with one unit free.

**22.** A system has two processes and three identical resources. Each process needs a maximum

of two resources. Is deadlock possible? Explain your answer.

Deadlock is not possible here since the resources are the same. One process can get maximum of two resources. When a process finishes the resources are released and the next process can finish its task.

**26.** A system has four processes and five allocatable resources. The current allocation and

maximum needs are as follows:

*Allocated Maximum Available*

Process A 1 0 2 1 1 1 1 2 1 3 0 0 x 1 1

Process B 2 0 1 1 0 2 2 2 1 0

Process C 1 1 0 1 0 2 1 3 1 0

Process D 1 1 1 1 0 1 1 2 2 1

What is the smallest value of *x* for which this is a safe state?

When x = 0 deadlock, x = 1 process D can complete then 11221. Now A can complete, then 21432 is available vector. C then runs to complete returning 32442 Then B can complete, safe sequence DACB

**36.** Local Area Networks utilize a media access method called CSMA/CD, in which stations

sharing a bus can sense the medium and detect transmissions as well as collisions. In the Ethernet protocol, stations requesting the shared channel do not transmit

frames if they sense the medium is busy. When such transmission has terminated,

waiting stations each transmit their frames. Two frames that are transmitted at the same

time will collide. If stations immediately and repeatedly retransmit after collision detection,

they will continue to collide indefinitely.

(a) Is this a resource deadlock or a livelock? deadlock

(b) Can you suggest a solution to this anomaly? Do not allow stations to transmit at the same time.

(c) Can starvation occur with this scenario? Yes, since it is possible to deadlock it implies starvation as well.