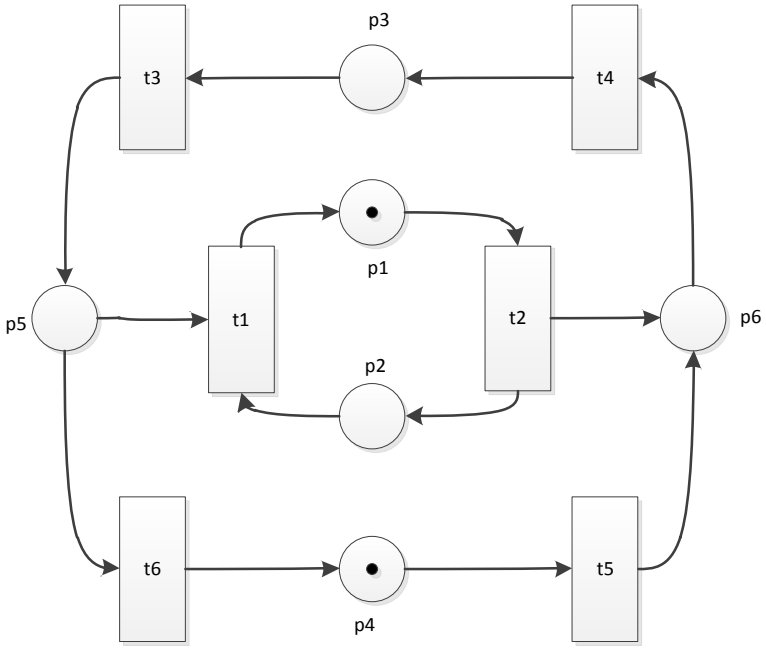
Exercises (based on questions 25-32 of exam 10 April 2017)

Consider the Petri net in the figure below.



If this is an Event/Condition (E/N) net, its dynamic behavior is described by the following table.

Marking	P1	P2	P3	P4	P5	P6	Enabled transitions
M0	1	0	0	1	0	0	t2 -> M1, t5 -> M2
M1	0	1	0	1	0	1	t4 -> M3
M2	1	0	0	0	0	1	t4 -> M4
M3	0	1	1	1	0	0	t5 -> M5, t3 -> M6
M4	1	0	1	0	0	0	t2 -> M7, t3 -> M8
M5	0	1	1	0	0	1	t3 -> M9
M6	0	1	0	1	1	0	t5 -> M10, t1 -> M11
M7 = M5	0	1	1	0	0	1	Back to M5
M8	1	0	0	0	1	0	t2 -> M12, t6 -> M13
M9	0	1	0	0	1	1	t1 -> M14, t4 -> M15, t6 -> M16
M10 = M9	0	1	0	0	1	1	Back to M9
M11 = M0	1	0	0	1	0	0	Back to M0
M12 = M9	0	1	0	0	1	1	Back to M9
M13 = M0	1	0	0	1	0	0	Back to M0
M14 = M2	1	0	0	0	0	1	Back to M2
M15	0	1	1	0	1	0	t1 -> M17, t6 -> M18
M16 = M1	0	1	0	1	0	1	Back to M1
M17 = M4	1	0	1	0	0	0	Back to M4
M18 = M3	0	1	1	1	0	0	Back to M3

From the table you can see that there are never more than 3 tokens in the network (question 25). The maximum number of tokens is present in the states denoted by markings M1, M3, M5, M6, M9, and M15.

There are 10 unique markings in the table: M0-M6, M8-M9, and M15 (question 26).

Some markings enable more than on transition. However, inspection of the table shows that shows that the following two transactions are never enabled at the same time (i.e., with the same marking): t1 and t2, t3 and t4, and t4 and t5 (question 27).

The maximum number of transitions enabled at the same time is 3 (question 27). This happens with marking M9.

If we treat the same net representation as an Place/Transition (P/T) net, we have a different dynamic behavior. This behavior is described by the following table. (Extra markings and transitions compared to those possible with an E/C net are in red. The easiest way to make this table is by extending the previous table for the E/C net: if for a particular marking of the E/C net the number of tokens is greater than the number of enabled transitions, you should check whether the same marking of the P/T net would enable an additional transition).

Marking	P1	P2	P3	P4	P5	P6	Enabled transitions
M0	1	0	0	1	0	0	t2 -> M1, t5 -> M2
M1	0	1	0	1	0	1	t4 -> M3, t5 -> M27
M2	1	0	0	0	0	1	t4 -> M4, t2 -> M18a
M3	0	1	1	1	0	0	t5 -> M5, t3 -> M6
M4	1	0	1	0	0	0	t2 -> M7, t3 -> M8
M5	0	1	1	0	0	1	t3 -> M9, t4 -> M19
M6	0	1	0	1	1	0	t5 -> M10, t1 -> M11, t6 -> M20
M7 = M5	0	1	1	0	0	1	Back to M5
M8	1	0	0	0	1	0	t2 -> M12, t6 -> M13
M9	0	1	0	0	1	1	t1 -> M14, t4 -> M15, t6 -> M16
M10 = M9	0	1	0	0	1	1	Back to M9
M11 = M0	1	0	0	1	0	0	Back to M0
M12 = M9	0	1	0	0	1	1	Back to M9
M13 = M0	1	0	0	1	0	0	Back to M0
M14 = M2	1	0	0	0	0	1	Back to M2
M15	0	1	1	0	1	0	t1 -> M17, t6 -> M18, t3 -> M24
M16 = M1	0	1	0	1	0	1	Back to M1
M17 = M4	1	0	1	0	0	0	Back to M4
M18 = M3	0	1	1	1	0	0	Back to M3
M18a	0	1	0	0	0	2	t4 -> M21
M19	0	1	2	0	0	0	t3 -> M22
M20	0	1	0	2	0	0	t5 -> M23
M21 = M5	0	1	1	0	0	1	Back to M5
M22 = M15	0	1	1	0	1	0	Back to M15
M23 = M1	0	1	0	1	0	1	Back to M1
M24	0	1	0	0	2	0	t1 -> M25, t6 -> M26
M25 = M8	1	0	0	0	1	0	Back to M8

M26 = M6	0	1	0	1	1	0	Back to M6
M27 = M18a	0	1	0	0	0	2	Back to M18a

Inspection of the table shows that:

- the maximum number of tokens in the network is 3 (question 29).
- the number of different markings is 14 (question 30).
- Transitions t1 and t2 are never enabled at the same time, but t2 and t3, t3 and t4, and t4 and t5 can be enabled at the same time (question 31). You can immediately see that if you represent the enabled transitions per unique marking as follows:

	t1	t2	t3	t4	t5	t6
M0		x			x	
M1				x	x	
M2		x		x		
M3			x		x	
M4		x	x			
M5			x	x		
M6	x				x	x
M8		x				x
M9	x			x		x
M15	x		x			x
M18a				x		
M19			x			
M20					x	
M24	x					x

- The maximum number of transitions is 3 (question 32).