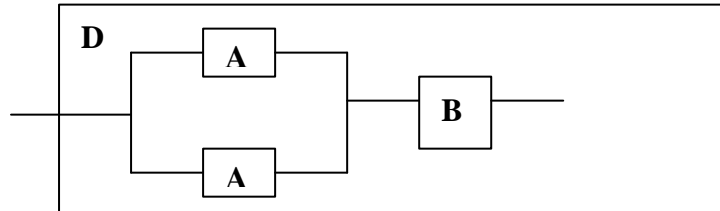## EXERCISES UD 3- BASIC CONCEPTS OF PROBABILITY CALCULATION

1) One mechanism D is formed by three components: two of type A connected in parallel, and one of type B connected in series as shown in the figure. The reliability of one type A component, after 1000 hours of operation, is 60% and the reliability of one type B component, after 1000 hours of operation, is 80%.

a) What is the reliability of mechanism D?

b) How many mechanisms of type D should we arrange in parallel in order to get a reliability after 1000 hours of at least 90%?

2) One factory manufactures devices formed by four components as shown in the following figure. Type A components present a reliability of 90% after 5000 hours of operation. Components of type B and C present a reliability of 70% and 95%, respectively, after 5000 hours. If the reliability of the whole device is 80% after 5000 hours of operation, what is the reliability of component D after 5000 hours?
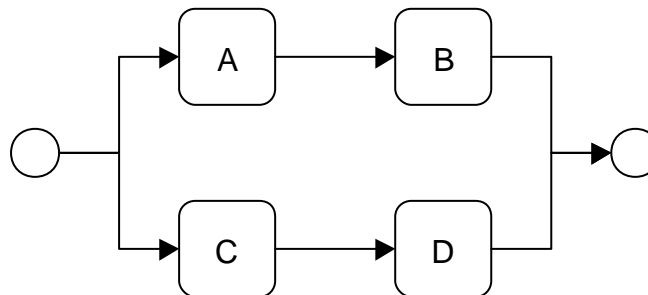
3) One mechanism formed by two identical components of type A, arranged in series, has a reliability of 60% after 1000 hours. A new component B is added in parallel in order to improve the reliability of the device up to 90% after 1000 hours. What should be the reliability of component B after 1000 hours?

4) One computer engineer is conducting a project for the installation of a computer network in a library of a big city. This project needs to be approved by technicians of the townhall, and two departments (A and B) can deal with this procedure. In department A, the probability of having a delay in the approval is 80% due to the lack of staff. In department B, that probability is just 10%. One machine assigns the requests randomly to either department A or B, with probabilities 2/3 and 1/3, respectively.

a) Before the project is assigned to any department, what is the probability of having a delay in the approval?

b) If the approval of the project finally does not suffer any delay, what is the probability of having been dealt by department B?

5) The percentage of defective pieces manufactured by three machines (A, B, C) is 5%, 20% and 10%, respectively. Machine A manufactures 200 pieces per hour, and the other two machines, 100 pieces per hour, each one. All pieces manufactured are taken to a store. If at the end of the day one piece is taken from the store and it turns out to be defective,

a) what is the probability of having been manufactured by machine A?
b) what is the probability of having been manufactured by machine B?
c) what is the probability of having been manufactured by machine C?

6) Fifty percent of the active population at a certain region work in the service sector, 12% work in the construction sector, 3% in the agricultural sector and the rest in the industrial sector. The rate of unemployment in the agricultural sector is 10%, in the industrial sector is 28%, in the construction sector is 30% and in the service sector is 18.6%.

a) Calculate the unemployment rate of the population in that region.

b) What percentage of unemployed people belong to the industrial sector?

7) Among the 150 students of a certain subject in a degree taught at UPV, 20% are from Valencia, 75 are from Alicante and the rest are from Castellón. We know that:
- 20 students are from Valencia and have passed the subject.
- If one student is from Alicante, the probability of passing the subject is 0.7.
- Among the students from Castellón, 35 have passed the subject.

Among the students who have passed the subject, what is the probability of being from Valencia?

8) In a population formed by 310 individuals, different data have been gathered about their favorite sport and they have been classified according to the gender of individuals as shown in the following contingency table:

	Tennis	Football	Formula 1	Sail
Men	27	86	35	22
Women	27	69	26	18

Are the following events independent in this population?
A: the individual prefers sail   B: the individual is a woman

9) Throwing an asymmetric dice, the number 1 is obtained with a frequency $2p$, the number 6 with a frequency $p/2$, the number 2 is obtained with a frequency p, and the same applies to numbers 3, 4 and 5. If this dice is thrown, what is the probability of obtaining a result lower or equal to 2?

10) In 2005 a virus for mobile telephones called "Commwarrior" was detected, which propagates rapidly through the Bluetooth technology, specially in public places. The virus affects devices with the operative system Symbian Series 60, which is present in some Nokia, Panasonic and Siemens models. The mobile phones of travelers waiting at the terminal of an airport were inspected, with the following results:
- 50% of the telephones were Nokia, 30% were Siemens and 20% were Panasonic.
- Among all mobiles inspected, 20% were Nokia and were not infected.
- 40% of Siemens mobiles have been infected by the virus.
- 1% of mobiles are Panasonic and are not infected.

a) If one mobile is randomly chosen and turns out to be Nokia, what is the probability of having the virus?
b) What percentage of the Panasonic mobiles inspected were not infected?
c) If one mobile is randomly chosen in the terminal, what is the probability of having the virus?

11) One company that sells products by mail considers three possible errors when sending an order:
A: the item sent is not the one requested
B: the item is lost (does not arrive to destination)
C: the item suffers damages in the transport

It is assumed that event A is independent from B; event A is independent from C; events B and C are mutually exclusive. The probabilities of each event are: P(A)=0.02, P(B)=0.01 and P(C)=0.04. If one order is randomly chosen, what is the probability of occurrence of any of these errors?

12) The system indicated in the figure is formed by 4 components (A, B, C, D). The reliability of component A is 95% after 1000 hours, and in the case of B, C and D, the reliability is 80% after 1000 hours. What is the reliability of the system after 1000 hours?
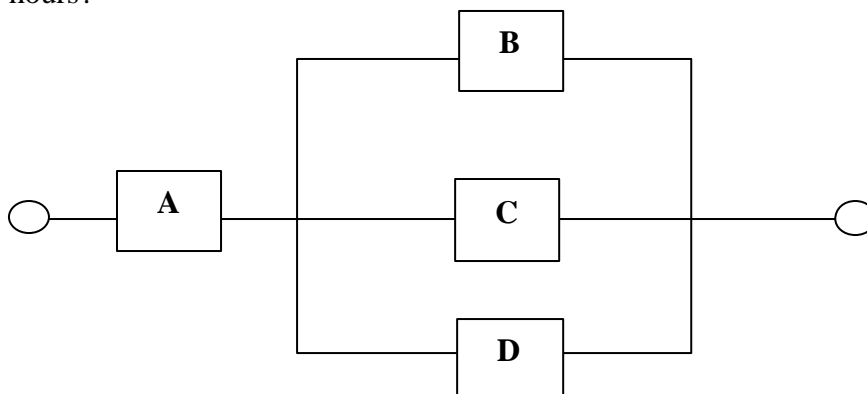
SOLUTIONS:

1) a: 0.672;   b: 3

2) 0.4836

3) 0.75

4) a: 0.567; b: 0.692

5) a: 0.25; b: 0.5; c: 0.25

6) a: 0.23; b: 0.426

7) 0.186

8) yes because $P(A/B) \sim P(A)$; $P(B/A) \sim P(B)$

9) 6/13

10) a: 3/5 ; b: 0.05; c: 0.61

11) 0.069

12) 0.942