



Sample Activity:  
*Probabilities of A or B and/or A and B*

from the Pre-AP workshop

Pre-AP<sup>®</sup>: Strategies in Mathematics –  
Chance, Variation, and Probability

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Pre-AP: Strategies in Mathematics –  
Chance, Variation, and Probability  
Sample Activity

*Probabilities of A or B and/or A and B*

The following problems are common in real life, and involve the calculation of probabilities where different parts act together in a system. Real systems can be very complex, and these problems will be unrealistically simple; however, the principles involved in calculating the probabilities are the same whether the system is small or large. One method of visualizing interacting systems is to view them graphically as networks. Because there is an obvious match between the problem and the graphic representations, in the exercises to follow we will consider the problem of delivering water from point A to point B through pipelines. Along these routes there exist water pumps that move the water along the network. (Such pumps are needed mostly to elevate water as the terrain changes in altitude.) We will label these pumps P1, P2, etc., in these problems.

**Directions**

Each day the managers of the pumping stations decide whether or not to shut down for an hour of maintenance. Thus, for that hour the pump will not be supplying water. To simplify our calculations, we will assume the (unlikely) circumstance that the managers of the pumping system do not communicate with each other, and that the probability that maintenance is needed on any random day is 0.5 for each pump. (Since the managers do not communicate, each decision to perform maintenance is independent of all other decisions.)

For each system of pumps below, you are to:

1. Explain in a few sentences the pump conditions (actively pumping, or down for maintenance) that will affect water flow in the system from point A to point B.
2. Calculate the probability of water's being delivered from point A to point B.

For these pump systems, the calculation may involve these formulae:

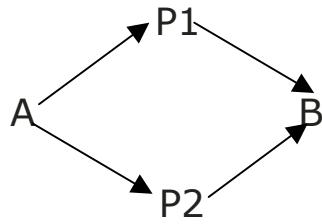
$P(A \text{ and } B) = P(A)P(B)$ , if A and B are independent.

$P(A \text{ or } B) = P(A) + P(B)$ , if A and B are mutually exclusive.

Water-pumping system #1

$$A \rightarrow P1 \rightarrow P2 \rightarrow B$$

Water-pumping system #2



Water-pumping system #3

