MPS21H - Combinations and Probability
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The following problem is an example of combinations to probability

Suppose we have an experiment in which a single action is repeated identically n times. The results of the action are deemed either a success or a failure. If all of these repeated actions are independent, then we can find the probability of the number of k successes in these n trials. This is known as a **Bernoulli** trial and we can apply what is known as the **binomial probability formula**:

The probability of k successes in n trials is $\binom{n}{k}(p)^k(q)^{n-k}$, where n is the number of trials, k is the number of successes (what does $n-k$ represent?), p is the probability of success in a single trial and q is the probability of failure in a single trial (can we represent q in terms of p?)

Example: The probability that James will score 90 or above on a test is $\frac{4}{5}$. What is the probability that he will score 90 or above on exactly 3 of the 4 tests?

Solution: The probability that James scores 90 or above on a test is $\frac{4}{5}$, which means that the probability that he scores below a 90 is $1 - \frac{4}{5} = \frac{1}{5}$.

Now, the number of ways that he will score 90 or above on exactly 3 tests is $\binom{4}{3} = 4$. What we have to do now to complete the problem is put everything together:

Number of successful tests: 4
Probability of 1 test 90 or above: $\frac{4}{5}$
Probability of 3 tests 90 or above: $(\frac{4}{5})^3 = \frac{64}{125}$
Probability of 1 test below 90: $\frac{1}{5}$

Now use the fundamental counting principle (since all the events are independent) and multiply all these values together $\Rightarrow 4 * \frac{64}{125} * \frac{1}{5} = \frac{256}{625}$