Assuming 4-core CPU chip with total die area=3.1cm^2, defect rate=0.6 defect/cm^2, and α=4.

<u>Question</u>: Find the probability that at least 3 out of 4 cores are working (so you can sell the chip as a 3-core CPU).

<u>Solution</u>:
We can assume 4 independent cores, each with area=0.775cm^2.

DieYield$_{core}$ = 1 * ((1 + 0.6 * 0.775 / 4))^-4 = 0.644

This problem is similar to tossing an unfair coin, where P(heads)=0.644, P(tails)=0.356. The probabilities of each core containing a defect are independent.

Say G=good core, B=bad core, and $C_1C_2C_3C_4$ = status of each core (G or B)

P(0 defect) = P(GGGG) = 0.644^4 = **0.172**

P(1 defect) = P(GGGB U GGBG U GBGG U BGGG) = P(GGGB) + ... + P(BGGG) because probabilities are independent.
The individual scenario GGGB has P(GGGB) = P(GGBG) = P(GBGG) = P(BGGG)
= 0.644^3 * 0.356^1 = 0.095
so P(1 defect) = (4 choose 1) * 0.095 = 0.380

finally, the problem asks for P(1 defect U 0 defect) = P(1 defect) + P(0 defect) = 0.172 + 0.380 = **0.552**.

<u>Question:</u> Find the probability that at least 2 out of 4 cores are working (so you can sell the chip as a 2-core, 3-core or 4-core CPU).

P(0 defect) = 0.172
P(1 defect) = 0.380
P(2 defects) = (4 choose 2) * P(GGBB), since all permutations are equally likely
= 6 * (0.644^2 * 0.356^2) = 0.315
The problem asks for P(2 defects or less) = 0.315 + 0.380 + 0.172 = **0.867**

<u>Question:</u> Find the probability that at least 1 out of 4 cores are working (so you can sell the chip as a 1-core, 2-core, 3-core or 4-core CPU).

P(0 defect) = 0.172
P(1 defect) = 0.380
P(2 defects) = 0.315
P(3 defects) = (4 choose 3) * P(GGBB), since all permutations are equally likely
= 4 * (0.644^1 * 0.356^3) = 0.116
The problem asks for P(3 defects or less) = 0.315 + 0.380 + 0.172 + 0.116= **0.983**