



STEP III, 2004, Q13

- 13 A men's endurance competition has an unlimited number of rounds. In each round, a competitor has, independently, a probability p of making it through the round; otherwise, he fails the round. Once a competitor fails a round, he drops out of the competition; before he drops out, he takes part in every round. The grand prize is awarded to any competitor who makes it through a round which all the other remaining competitors fail; if all the remaining competitors fail at the same round the grand prize is not awarded.

If the competition begins with three competitors, find the probability that:

- (i) all three drop out in the same round;
- (ii) two of them drop out in round r (with $r \geq 2$) and the third in an earlier round;
- (iii) the grand prize is awarded.



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