Python Probability, Randomness & Math — Q&A; (Set 21)

Q1. What is a probability distribution?

A probability distribution describes the likelihood of outcomes for a random variable. Individual outcomes are unpredictable, but the overall pattern of frequencies across many trials is predictable.

Q2. True random vs pseudo-random numbers

True random: generated from physical processes (e.g., radioactive decay).
Pseudo-random: generated by deterministic algorithms (PRNGs) from a seed.
PRNGs are 'good enough' because they pass statistical tests of randomness, are reproducible, fast, and uniform.

Q3. Two main factors of a normal distribution

1. Mean (μ) $\rightarrow$ center.
2. Standard deviation (σ) $\rightarrow$ spread.

Q4. Real-life example of normal distribution

Human height, IQ scores, exam results, blood pressure, or measurement errors.

Q5. Short vs long term behavior

Short term: random fluctuations.
Long term: frequencies stabilize to theoretical probabilities (law of large numbers).

Q6. Objects that can be shuffled by random.shuffle

Any mutable sequence, mainly lists. Example:
import random
cards = [1,2,3,4]
random.shuffle(cards)

Q7. Math package categories

- Trigonometric (sin, cos, tan, hypot)
- Exponential & logarithmic (exp, log, log10, log2)
- Power & roots (pow, sqrt)
- Special functions/constants (pi, e, factorial, gcd, comb, perm)

Q8. Exponentiation vs logarithms

Inverse operations: a^b = c ↔ log_a(c) = b.

Q9. Three logarithmic functions in Python

math.log(x, base) → natural log by default or any base.
math.log10(x) → base-10 log.
math.log2(x) → base-2 log.