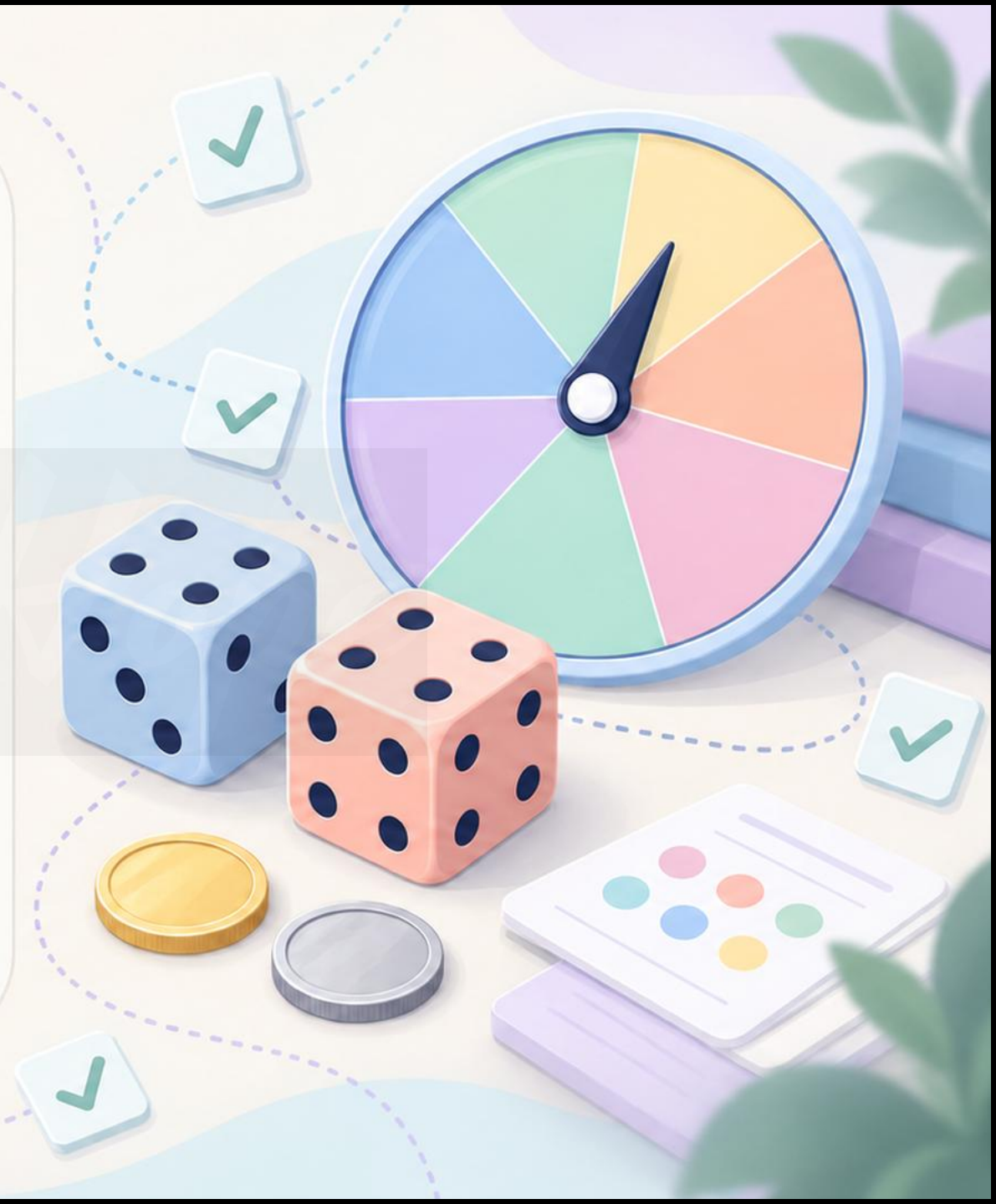


MATHEMATICS • CLASS 9

CHAPTER 7

The Mathematics of Maybe
Introduction to Probability

NCERT SOLUTIONS

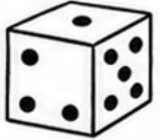


PROBABILITY, RANDOMNESS & CHANCE

- Probability measures how likely an event is to happen.
- An event is a possible result or group of results.
- Randomness means we know the possible outcomes, but we cannot predict the exact outcome of one trial.



coin toss $\rightarrow \{H, T\}$



fair die $\rightarrow \{1, 2, 3, 4, 5, 6\}$



rain tomorrow $\rightarrow \{\text{Rain, No Rain}\}$

trial / experiment
a repeatable random action.

SUBJECTIVE ESTIMATE

- based on a person's judgement or present evidence, e.g. chance of rain.

OBJECTIVE ESTIMATE

- based on repeated data or equally likely outcomes.

Probability tells what may happen, not what must happen next.

THINK AND REFLECT

Q: Why is a coin toss a fair way to decide which cricket team bats first?

Solution:

- With a fair, unbiased coin, Heads and Tails are equally likely.
- $P(H) = \frac{1}{2}$, $P(T) = \frac{1}{2}$
- Neither team is favoured, so the decision is impartial.

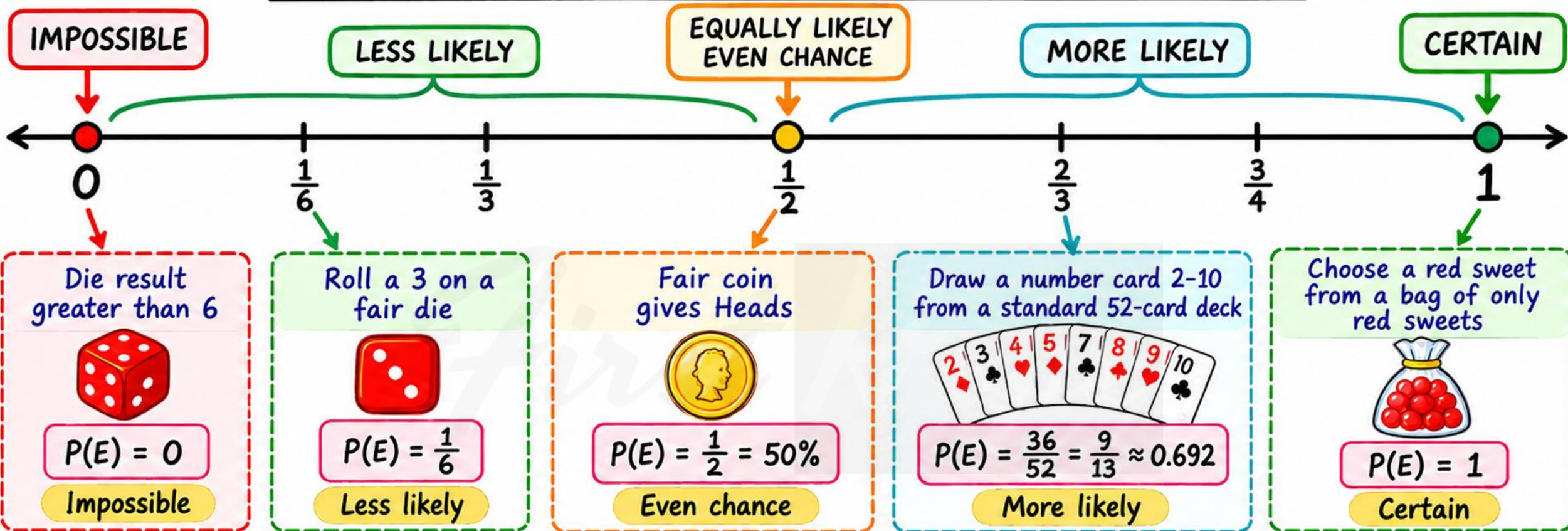
Q: Can a friend know the result of one coin toss in advance?

Solution:

- No. The friend may guess H or T, but cannot be certain. All possible outcomes are known; the single result is unpredictable.

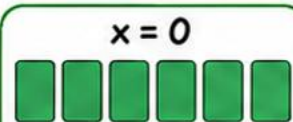
RANDOM $\neq$ WITHOUT POSSIBLE OUTCOMES | Random means the exact outcome is uncertain.

THE PROBABILITY SCALE: 0 TO 1

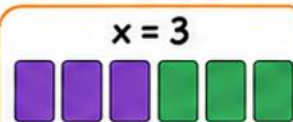


Six-card model

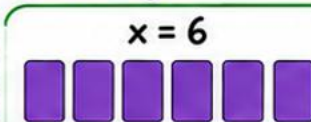
If x of 6 cards are purple, $P(\text{purple}) = \frac{x}{6}$



$$P(\text{purple}) = \frac{0}{6} = 0$$



$$P(\text{purple}) = \frac{3}{6} = \frac{1}{2}$$



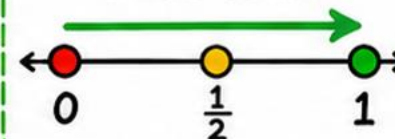
$$P(\text{purple}) = \frac{6}{6} = 1$$

Key facts

$$0 \leq P(E) \leq 1$$

(percentage = probability $\times$ 100%)

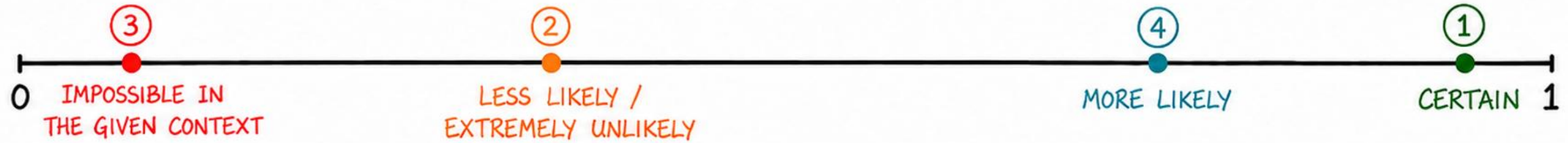
As the number of favourable cases increases, probability moves right on the scale.



Remember!

Probability compares likelihood; it does not guarantee the next result.

EXERCISE SET 7.1 – RANKING EVENTS



These are reasonable rankings; real-life evidence can change a subjective estimate.

- ① The next Monday will come after Sunday.
 - Reason: By the calendar order, Monday follows Sunday.
 - $P = 1$
- ② It will snow in Mumbai in July.
 - Reason: Mumbai's July weather normally brings rain, not snow; snow is not logically impossible.
 - $P \approx 0$ (but not taken as exactly 0 without absolute certainty).
- ③ An elephant will walk through your classroom today.
 - Reason: An ordinary classroom has no route or arrangement for an elephant.
 - $P = 0$ (usual context)
- ④ You will greet at least one friend at school tomorrow.
 - Reason: You usually meet friends at school, but absence or another change is possible.
 - $0.5 < P < 1$

	Event	Ranking	Reason
①	The next Monday will come after Sunday.	CERTAIN $P = 1$	By the calendar order, Monday follows Sunday.
②	It will snow in Mumbai in July.	LESS LIKELY / EXTREMELY UNLIKELY $P \approx 0$ (but not taken as exactly 0 without absolute certainty).	Mumbai's July weather normally brings rain, not snow; snow is not logically impossible.
③	An elephant will walk through your classroom today.	IMPOSSIBLE IN THE GIVEN CONTEXT $P = 0$ (usual context)	An ordinary classroom has no route or arrangement for an elephant.
④	You will greet at least one friend at school tomorrow.	MORE LIKELY $0.5 < P < 1$	You usually meet friends at school, but absence or another change is possible.

Certain = 1; impossible = 0; real-life judgements between them depend on evidence.

MEASURING PROBABILITY OBJECTIVELY

1. EVIDENCE FROM EXPERIENCE

- Collect actual data by repeating an experiment or studying past observations.
- Count how often the event occurs.

Experimental probability = $\frac{\text{number of times event occurred}}{\text{total number of trials}}$

This is also called "relative frequency".

★ Example: A die is rolled 50 times.
The number 4 appears 8 times.

$$P_{\text{exp}}(4) = \frac{8}{50} = 0.16 = 16\%$$

2. THEORETICAL METHOD

- Used in an ideal fair situation.
- All possible outcomes must be equally likely.
- No experiment is needed; reason from the sample space.

$$P(E) = \frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$$

★ Example: Fair die, getting 4.

$$P(4) = \frac{1}{6} \approx 0.167 = 16.7\%$$

Basis	Experimental	Theoretical
source	observed data	equally likely outcomes
may change?	yes, with trial results	fixed for the fair model
small number of trials	may differ noticeably	ideal expected value
many trials	tends to move closer	benchmark

★ KEY IDEA:

Experimental probability can differ from theoretical probability, especially in a small sample.

➡ more trials → more stable relative frequency



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