

**Worksheet 2-2: Theoretical Probability**

Theoretical probability is another measure of the likelihood of an event. It is the ratio of the number of successful outcomes and the total number of possible outcomes.

**Theoretical Probability of An Event**

$$P(\text{Event A}) = \frac{\text{Number of Successful Outcomes}}{\text{Total Number of Possible Outcomes}}$$

To calculate the theoretical probability, all outcomes must be equally likely.

“Equally likely” means the same chance of occurring because the conditions are fair.

For example, in the toss of a fair coin, the chances of getting heads or tails are equally likely.

Experiment	Event	Total Number of Possible Outcomes	Number of Successful Outcomes	Theoretical Probability
Toss a coin	Turning up heads	2	1	$\frac{1}{2}$
Roll one die	Turning up 4	6	1	$\frac{1}{6}$
Draw a playing card	Drawing an ace	52	4	$\frac{1}{13}$

1. A standard deck of playing cards has 52 cards, 13 of each suit. If one card is drawn from the deck, find the probability of each event.



(a) a heart

(b) a heart, a club or a jack

(c) a black diamond

(d) a heart, a club, a spade, or a diamond

2. What is the probability of rolling doubles with a pair of dice?

3. Suppose you roll two six-sided dice. Find the theoretical probability of rolling each sum. Express each answer as a fraction in lowest terms.



(a) 2

(b) 11

(c) 7

(d) not 7

(e) a sum greater than 5

4. During a game of musical chairs, 10 people walk around eight chairs waiting for the music to stop. Find the probability of a person not getting a chair.

5. Suppose you roll two six-sided dice.

(a) Explain why the probability of rolling a sum of 14 is 0.

(b) Explain why the probability of rolling a sum from 2 to 12 is 1.

6. A card is randomly selected from a standard deck of cards. Write the theoretical probability of each event as a fraction in lowest terms.

(a) a red king

(b) a face card

**Answers:** 1. (a)  $\frac{1}{4}$ , (b)  $\frac{7}{13}$ , (c) 0, (d) 1; 2.  $\frac{1}{6}$ ; 3. (a)  $\frac{1}{36}$ , (b)  $\frac{1}{18}$ , (c)  $\frac{1}{6}$ , (d)  $\frac{5}{6}$ , (e)  $\frac{13}{18}$ ; 4.  $\frac{1}{5}$ ;

5. (a) greatest possible sum is 12 since biggest number for each die is 6, (b) any sum from 2 to 12 can be rolled with two six-sided dice, so all 36 sums are possible outcomes; 6. (a)  $\frac{1}{26}$ , (b)  $\frac{3}{13}$ .