Probability & Statistics Workbook

Probability

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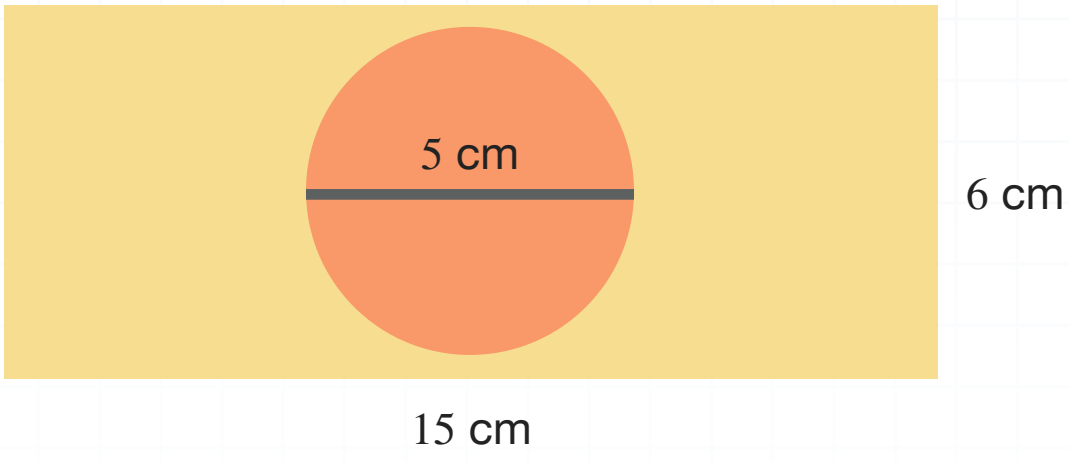
MATH

SIMPLE PROBABILITY

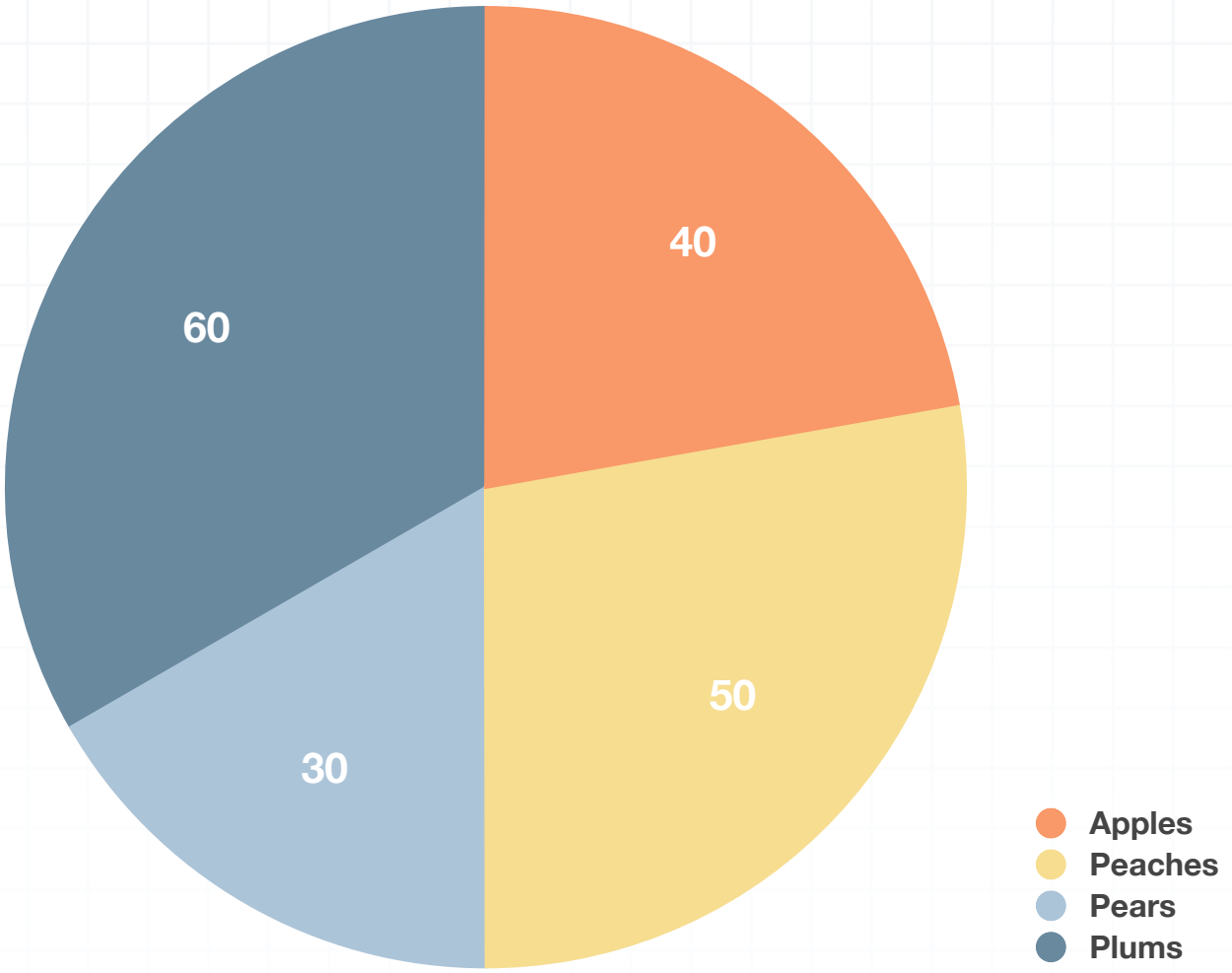
1. A child drops a marble onto a board. Suppose that it is equally likely for it to fall anywhere on the board. What is the probability, to the nearest percent, that it lands on the red circle?



2. A 12-sided number cube is rolled 60 times. Use the table to calculate $P(\text{rolling an } 11)$. Is this theoretical or experimental probability? Why?

Number rolled	1	2	3	4	5	6	7	8	9	10	11	12
Frequency	5	8	2	0	10	1	6	5	2	8	12	1

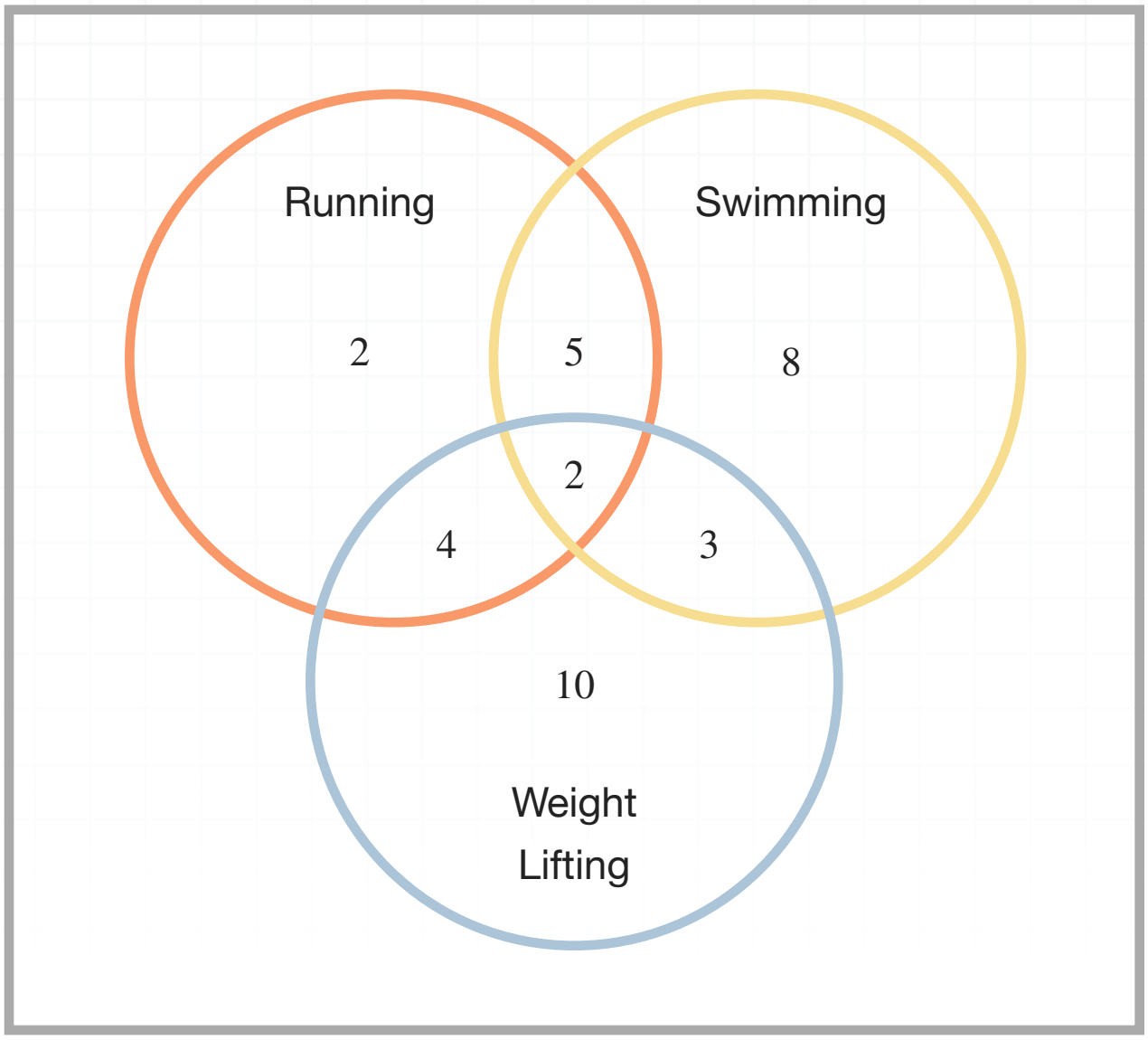
3. Monica's class went on a trip to an orchard. At the end of the trip they put all of the fruit they picked into one big basket. The chance of picking any fruit from the basket is equally likely. Monica's teacher picks out a fruit for her to eat at random. What is the probability that it's a plum (Monica's favorite)? Is this an experimental or theoretical probability? Why?



4. Jamal surveyed the people at his local park about their favorite hobby and recorded his results in a table. Based on the survey, what's the probability that someone who visits the park will choose Art as their favorite hobby? Is this a theoretical or experimental probability? Why?

Hobby	Count
Reading	14
Sports	28
Art	15
Total	**57**

5. What is the probability that someone's favorite exercise was weight lifting only?

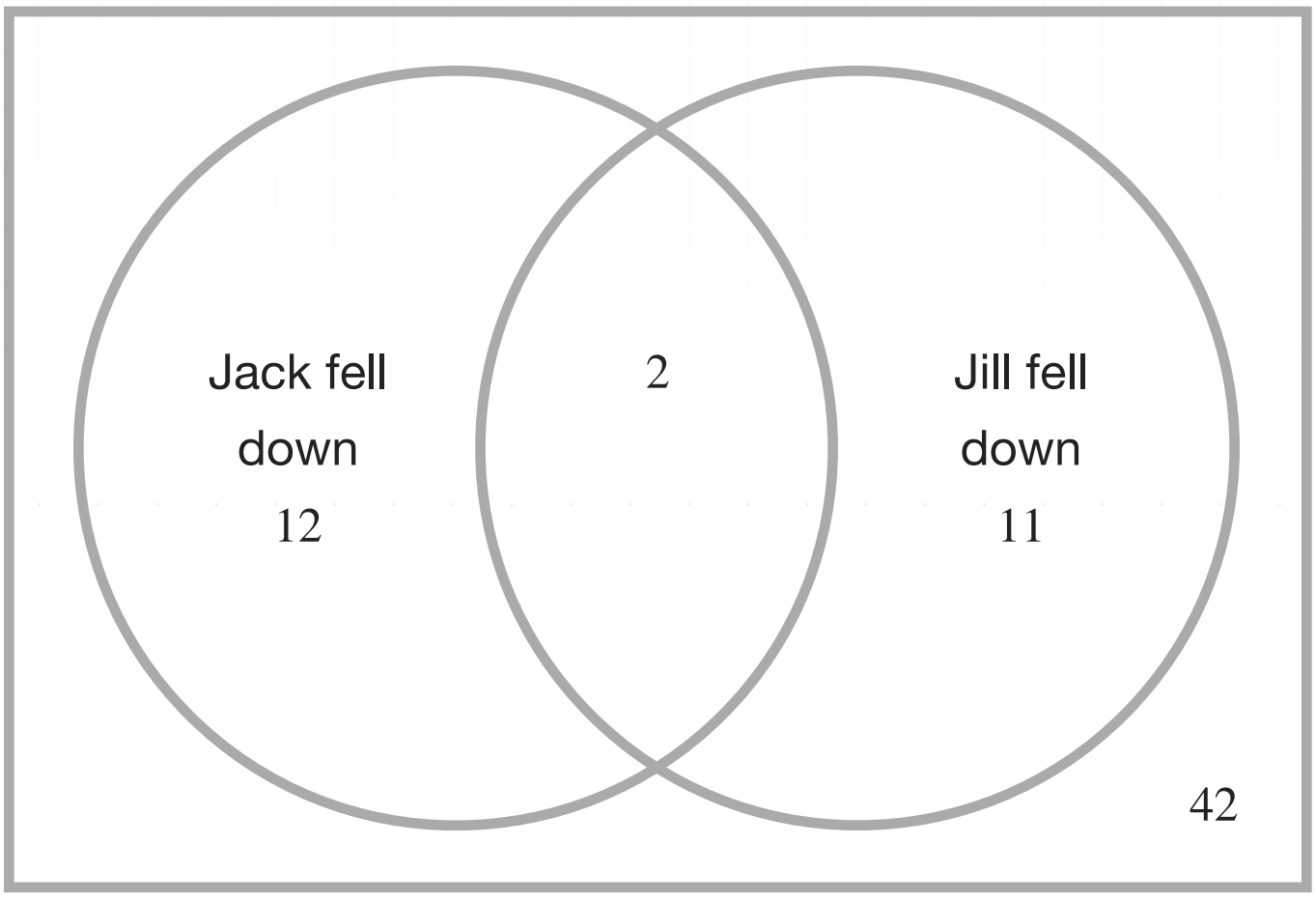


6. What is the sample space for rolling two six-sided dice (the list of all possible outcomes)? What's the probability that the sum of the two dice is an odd number? Is this a theoretical or experimental probability? Why?

THE ADDITION RULE, AND UNION VS. INTERSECTION

■ 1. Given the probabilities $P(A) = 0.3$, $P(B) = 0.6$ and $P(A \cap B) = 0.05$, what is $P(A \cup B)$? Are A and B mutually exclusive events? Why or why not?

■ 2. The Venn diagram shows the number of times Jack and Jill fell when going up the hill. What is the probability that Jack fell down and Jill fell down? What is the probability that Jack fell down or Jill fell down?

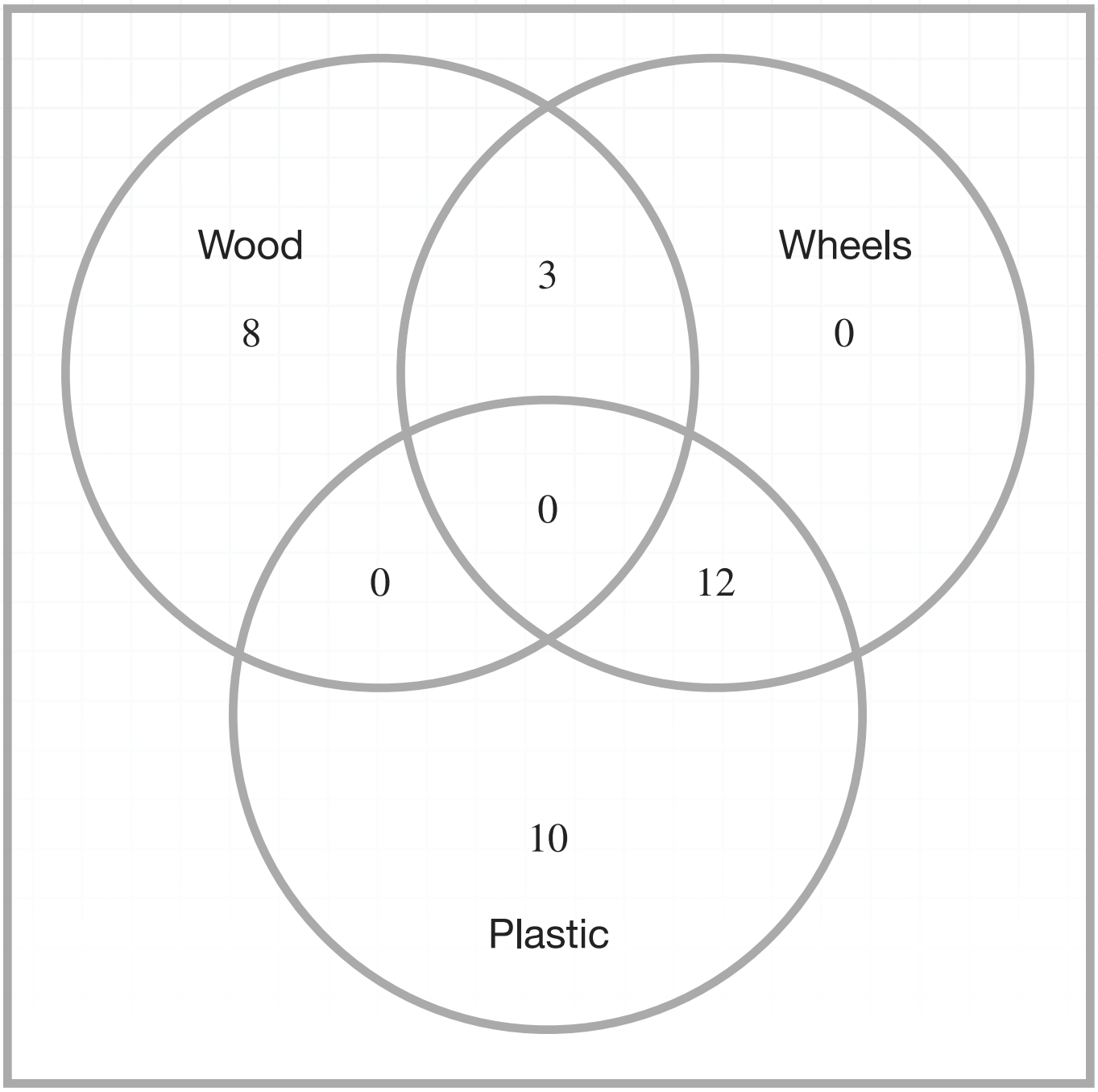


■ 3. When people buy a fish at a pet store the cashier can check off the color of the fish as mostly red, mostly orange or mostly yellow. Currently the probability of buying a red fish is 0.31, the probability of buying an

orange fish is 0.23, and the probability of buying a mostly yellow fish is 0.13 (there are colors of fish other than red, orange, and yellow).

Are the events buying a mostly red fish and buying a mostly orange fish mutually exclusive? Find the probability that the purchase of a randomly selected fish is either mostly red or mostly orange.

■ 4. The Venn diagram shows Mason's toy car collection. Are the events "plastic" and "wood" mutually exclusive? What is the probability that a vehicle is made from plastic or wood? Are the events "wood" and "wheels" mutually exclusive? What is the probability that a vehicle is made from wood and has wheels?



■ 5. Every student at a certain high school needs to choose exactly one fine arts elective. The frequency table shows the enrollment of electives for all students. Are the events “junior” and “architecture” mutually exclusive? What is the probability that a student is taking architecture and a junior? What is the probability that a student is a junior or is taking architecture?

		Extracurricular activities			
		Art	**Architecture**	**Music**	**Total**
Grade	**Freshmen**	40	25	55	**120**
	Sophomore	52	12	71	**135**
	Junior	56	45	54	**155**
	Senior	30	60	20	**110**
	Total	**178**	**142**	**200**	**520**

6. James tosses a coin and rolls a six-sided die. What is the sample space for this situation? What is the probability the coin lands on heads and the die lands on a 2 or a 3?

INDEPENDENT AND DEPENDENT EVENTS AND CONDITIONAL PROBABILITY

■ 1. What is the probability of getting four heads in a row when you flip a fair coin four times?

■ 2. An old dog finds and eats $60\,\%$ of food that's dropped on the floor. A toddler wanders through the house and drops 10 pieces of cereal. What's the probability the dog finds and eats all 10 pieces?

■ 3. Amelia is choosing some pretty stones from the gift shop at the museum. The gift shop has a grab bag that contains 5 amethyst stones, 6 fluorite stones, 2 pink opals, and 7 yellow calcite stones. Amelia looks into the bag and takes out two stones, one at a time, at random. What is the probability that she gets an amethyst first and then a pink opal?

■ 4. Emily counted the shape and type of blocks that her little sister owns and organized the information into a frequency table.

		Block Shape		
		Cube	**Rectangular Prism**	**Total**
Block Color	**Red**	5	9	**14**
	Blue	4	10	**14**
	Total	**9**	**19**	**28**

Are events A and B dependent or independent events? Use the formula to explain your answer.

Event A is that the block is a cube.

Event B is that block is red.

Let $P(A)$ be the probability that a block drawn at random is a cube.

Let $P(B)$ be the probability that a block drawn at random is red.

■ 5. A bag has 4 cinnamon candies, 6 peppermint candies, and 12 cherry candies. Sasha draws 3 candies at random from the bag one at a time without replacement. Does the situation describe dependent or independent events? What is the probability of drawing a cinnamon first, then a cherry, and then a peppermint?

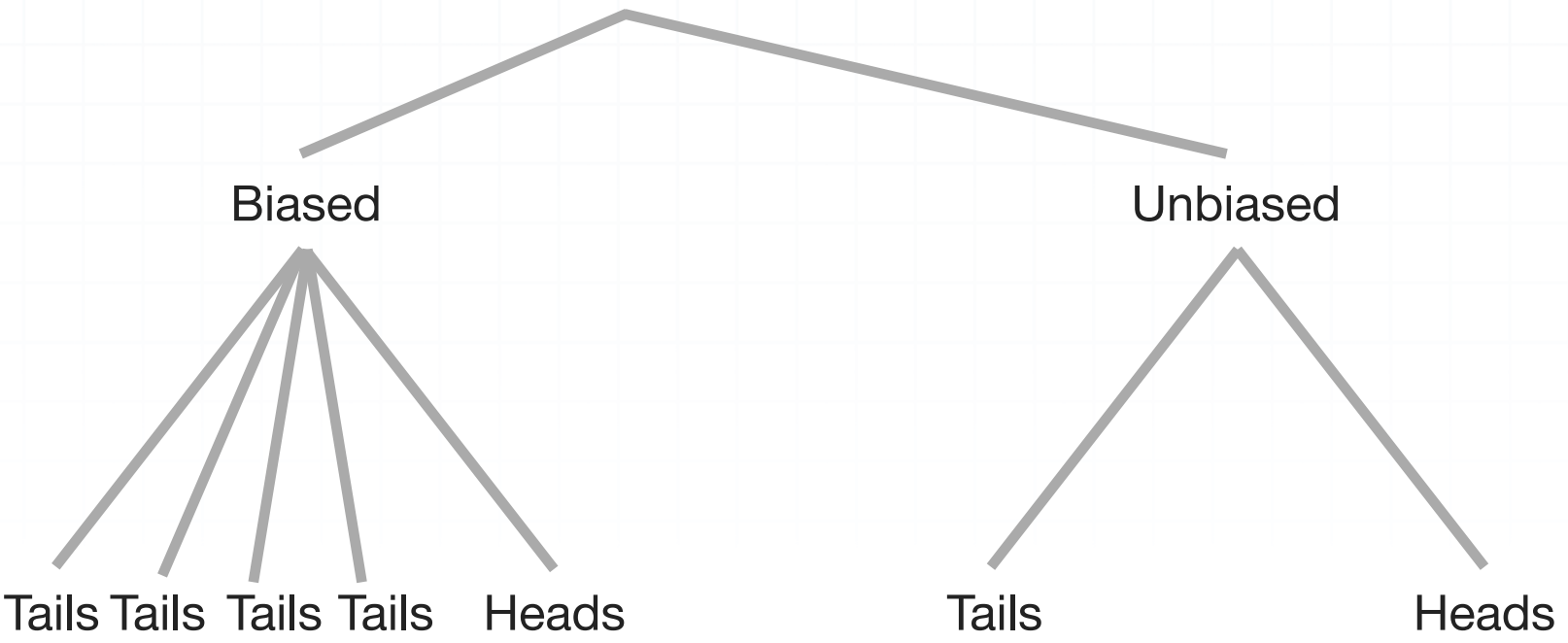
■ 6. Nyla has 12 stuffed animals, 7 of which are elephants (4 of the elephants play music and light up) and 5 of which are bears (2 of the bears play music and light up). Her mother randomly selects an animal to bring

with them on vacation. Let A be the event that she selects an elephant and B be the event that she selects an animal that plays music and lights up.

Find $P(A)$, $P(B)$, $P(A\,|\,B)$, and $P(B\,|\,A)$. State if events A and B are dependent or independent events, then find $P(A \text{ and } B)$.

BAYES' THEOREM

■ 1. You have two coins. One is fair and the other one is weighted to land on tails $4/5$ of the time. Without knowing which coin you're choosing, you pick one at random, toss the coin and get tails. What is the probability you flipped the biased coin? Complete the tree diagram to answer the question.



■ 2. You have two dice. One is fair and the other is biased. The biased die is weighted to land on 6 every 1 out of 36 rolls. There's an equal probability for all of the other five faces on the biased die. Without knowing which one you're choosing, you pick one of the dice, roll it, and get a 6.

Calculate the following and use them to answer the question: What is the probability that you rolled the fair die?

$$P(6 \mid \text{fair})$$

$P(\text{fair})$

$P(6)$

■ 3. Charlie knows that, at his school,

$P(\text{senior}) = 0.40$

$P(\text{playing soccer}) = 0.15$

$P(\text{soccer and senior}) = 0.05$

Solve for the probability $P(\text{senior} \mid \text{soccer})$, then state whether or not Bayes' Theorem can be used to solve the problem.

■ 4. You have two coins. One is fair and the other is weighted to land on tails $3/4$ of the time. Without knowing which coin you're choosing, you pick one at random, toss the coin, and get tails. What's the probability you flipped the biased coin?

■ 5. A company is giving a drug test to all of its employees. The test is $90\,\%$ accurate, given that a person is using drugs, and $85\,\%$ accurate, given that the person is not using drugs. It's also known that $10\,\%$ of the general population of employees uses drugs. What is the probability that an employee was actually using drugs, given that they tested positive?

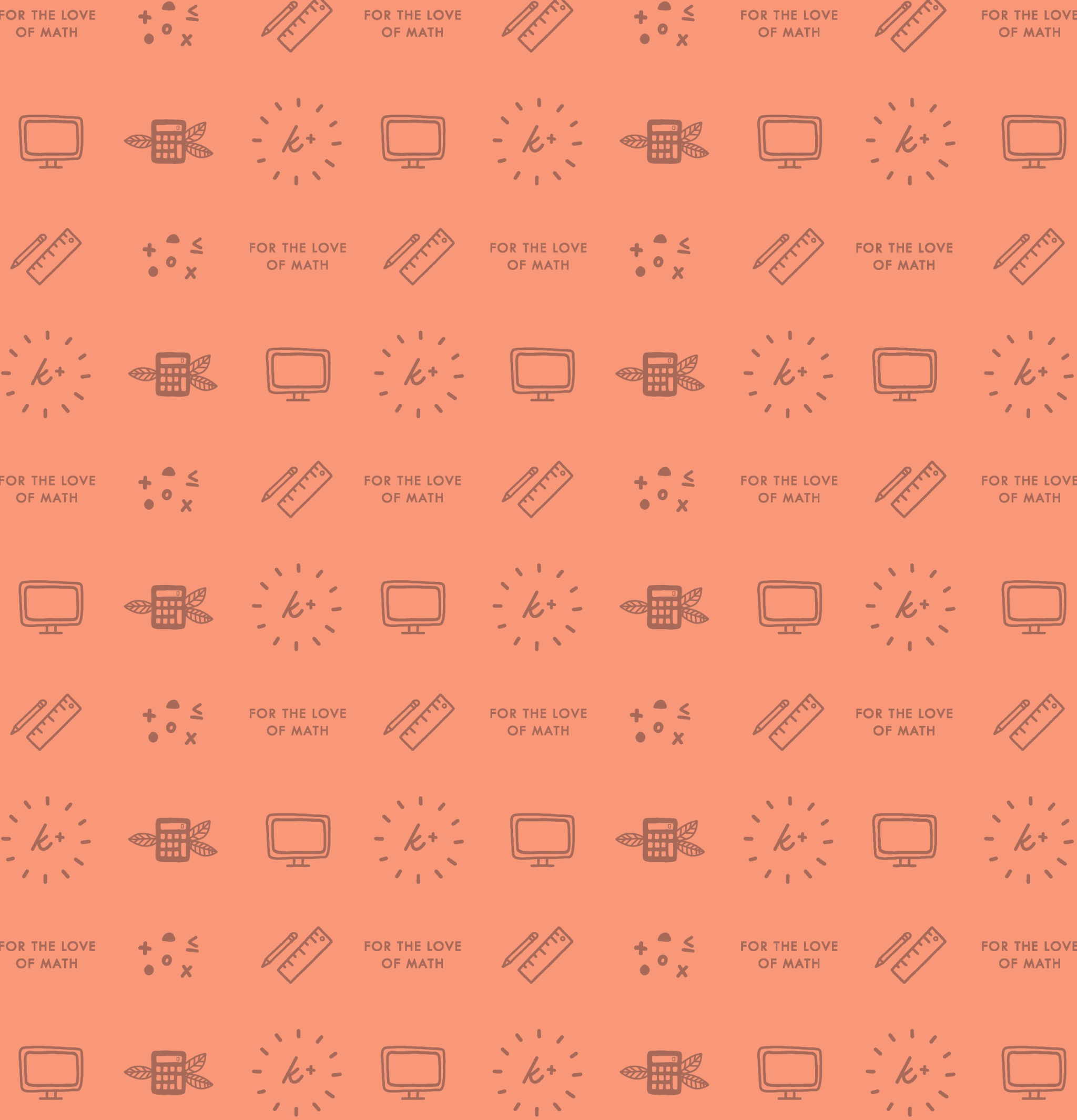
Let P represent a positive test for an individual.

Let N represent a negative test for an individual.

Let D represent the event that an employee is a drug user.

6. Two factories A and B produce heaters for car seats. A customer received a defective car seat heater and the manager at factory B would like to know if it came from her factory. Use the table below to determine the probability that the heater came from factory B.

Factory	% of production	Probability of defective heaters
A	0.55	0.020 P(DIA)
B	0.45	0.014 P(DIB)



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