SAMPLE PAGES
from
The Competitive Edge

Passing the EOG 6 in Mathematics

❖ *SECOND EDITION* ❖

by Jane Hereford

Chapter 21 is enclosed to illustrate the quantity and quality of problems in this workbook.

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CHAPTER 21
PROBABILITY

Probability is the chance of something happening.

EXAMPLE

What are Jocalyn's chances of being first in her class when there are 40 students in her class?

$\frac{1}{40}$ (1 chance out of 40)

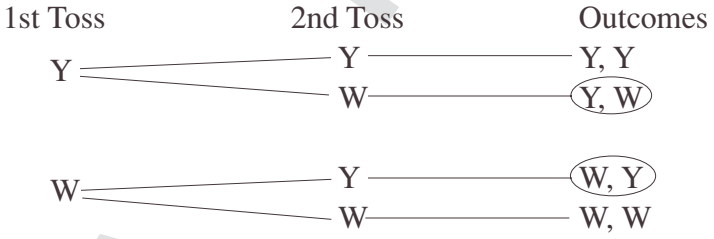
Change to percent by dividing top by bottom.

$$\begin{array}{r} 0.025 \\ 40\overline{)\,1.000} \\ \underline{0}\downarrow\downarrow\downarrow \\ 10\downarrow\downarrow\downarrow \\ \underline{\ 0}\downarrow\downarrow \\ 100\ \downarrow \\ \underline{-80}\downarrow \\ 200 \\ \underline{-200} \\ 0 \end{array}$$ = .025 = 2.5% chance of being first

Probability can also be done by a counting process. You use a tree diagram.

EXAMPLE

A plastic frisbee has one yellow side and one white side. If it is tossed 2 times, what are the chances of it landing showing one yellow side and one white?



There are 4 outcomes. **Two** of these contain a yellow and white.

FUNDAMENTAL COUNTING PRINCIPLE

To find the total number of outcomes, you can use multiplication instead of the counting process. This process is called the **Fundamental Counting Principle.**

EXAMPLE

How many total outcomes are there when you toss 3 of the plastic (yellow/white) frisbees?

There are 2 outcomes, (yellow or white) for each frisbee. There are 3 frisbees. Multiply.

$2 \times 2 \times 2$ = (2 outcomes for each of 3 frisbees)

8 outcomes

➢ *Permutations and Combinations*

PERMUTATIONS

A **permutation** is an arrangement or listing in which order is important.

EXAMPLE

Jasmine has only enough time to shop in 3 clothing stores at the mall. She must choose three of five clothing stores. She wonders how many possible arrangements there are.

There are 5 possible choices for the first store, there will be 4 possible choices for the second store, and 3 possible choices for the third store.

P(n,r) means the number of permutations of *n* things taken, *r* at a time.

P(5,3) represents the number of permutations of 5 things taken 3 at a time.

$P(5,3) = 5 \cdot 4 \cdot 3$

$P(5,3) = 60$

So, there are 60 possible arrangements.

COMBINATIONS

Arrangements or listings where order is *not* important are called **combinations**. To find the number of combinations without duplication, divide the number of permutations by the number of choices that can be made.

EXAMPLE

If Jasmine is not concerned about the order of stores in which she shops, you can find the number of combinations without duplication. Remember she has a choice of 5 stores, but must choose only 3 stores.

$$C(n,r) = \frac{P(n,r)}{r!} \qquad C(5,3) = \frac{P(5,3)}{3!} \qquad \frac{5 \cdot 4 \cdot 3}{3 \cdot 2 \cdot 1} = \frac{60}{6} = 10$$

Note: r! means the product of all counting numbers beginning with n and counting backwards to 1.

PRACTICE

1. Find the number of permutations of 6 teams taken 2 at a time. Order of teams is not important.

2. The Pizza Shop has a choice of 8 different toppings. They are having a special on pizzas with three toppings. How many different pizzas with three toppings can they serve?

3. Find the value of 4!.

4. Find the value of P(5,2).

5. Find the value of 6!.

6. Find the value of P(8,3).

7. Find the value of 3!.

8. Find the value of C(5,2).

9. Find the value of C(12,3).

10. Find the value of C(5,4).

11. Find the value of C(7,4).

12. Find the value of C(8,5).

13. Find the value of 7!.

14. Find the value of P(5,4).

15. Find the value of P(10,3).

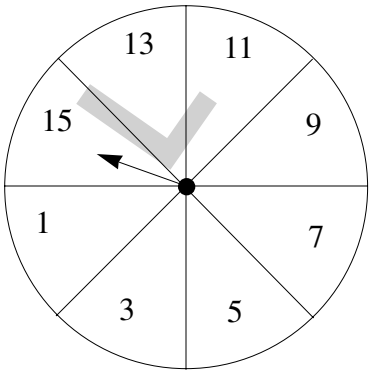
16. Six basketball teams are in a league. How many ways can the teams win the first and second place trophies?

➢ *Probability of an Event Happening*

$$P_{\text{(probability)}} = \frac{\text{number of ways an outcome can happen}}{\text{number of possible outcomes}}$$

EXAMPLES

What is the probability (chance) that you would spin an odd number?



$$P_{\text{(probability)}} = \frac{8 \text{ (8 odd numbers)}}{8 \text{ (8 outcomes)}} = \frac{1}{1}$$

1.00 = 100% (chance of spinning an odd number)

$$1\overline{)1.00}$$
$$-1$$
$$0$$
$$-0$$
$$00$$
$$-0$$
$$0$$

What is the probability of spinning a number larger than 7?

$$P = \frac{4 \text{ (numbers larger than seven)}}{8 \text{ (8 outcomes)}} = \frac{1}{2}$$

$$2\overline{)1.00}$$
$$-10$$
$$00$$
$$-0$$
$$0$$

.50 = 50% (chance of spinning a number larger than 7)

(Probabilities can be shown as fractions or percents.)

PRACTICE

1. Draw a tree diagram to show all the possible outcomes when 2 coins are tossed.

2. Draw a tree diagram to show all the possible outcomes when you have a choice of pork or fish with rice, fries, or baked potato.

3. Draw a tree diagram to show all the possible outcomes when you toss a dime and a die at the same time.

Use the following to answer 4–15.

What is the probability (in fraction form) of choosing _____?

4. a red (R) star _____
5. a blue (B) star _____
6. a yellow (Y) star _____
7. a white (W) star _____
8. a green (G) star _____
9. a pink (P) star _____
10. a red (R) or pink (P) star _____
11. a blue (B) or yellow (Y) star _____
12. a white (W) or green (G) star _____
13. a green (G) or pink (P) star _____
14. a red (R) or green (G) star _____
15. a white (W) or yellow (Y) star _____

➢ *Probability of an Independent Event*

The probability of two independent events can be found by multiplying the probability of the first event by the probability of the second event.

P (A and B) = P(A) • P(B)

EXAMPLE

Peter selects one ticket at random from a group of sports tickets and a group of concert tickets. The group of sports tickets contains 3 basketball tickets and a hockey ticket. The group of concert tickets contains 2 orchestra tickets and a jazz concert ticket. What is the probability that he will select a hockey ticket and an orchestra ticket?

The ticket he chooses from the first group does not affect the ticket he chooses from the second group. The outcome of one event does not affect the outcome of the other event. They are *independent* events.

P(hockey) = $\frac{1}{4}$ P(orchestra) = $\frac{2}{3}$

P(hockey and orchestra) • P(hockey) • P(orchestra)

$\frac{1}{4} \bullet \frac{2}{3} = \frac{2}{12} = \frac{1}{6}$

The probability that the two events will occur is $\frac{1}{6}$.

PRACTICE

Use the chart below that lists the number and types of bubble gum found in two boxes. A regular bubble gum is chosen at random. Then a sugar free bubble gum is chosen at random. Find the probability of each outcome.

Boxes	Fruit Flavor	Cotton Candy Flavor	Regular Flavor
Regular Bubble Gum	4	6	2
Sugar Free Bubble Gum	2	6	6

1. a regular bubble gum fruit flavor and a sugar free bubble gum fruit flavor

_____

2. a regular bubble gum fruit flavor and a sugar free bubble gum cotton candy flavor

_____

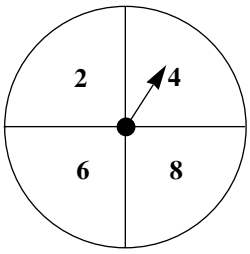
3. a regular flavor regular bubble gum and a sugar free bubble gum fruit flavor

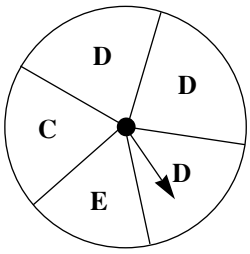
_____

4. a regular bubble gum cotton candy flavor and a regular flavor sugar free bubble gum

_____

Each spinner is spun once. Find the probability.





5. P(2,C) = _____
6. P(4,D) = _____
7. P(8,E) = _____
8. P(2,D) = _____
9. P(4 or 8 and a vowel) = _____
10. P(6 and a consonant) = _____

A coin is tossed, then a die is rolled. Find each probability.

11. P(heads and 6) = _____
12. P(tails and 5) = _____
13. P(heads and number less than 5) = _____
14. P(tails and a prime number) = _____
15. P(heads and 3) = _____
16. P(tails and an odd number) = _____
17. P(heads and a number greater than 3) = _____

➢ *Probability of Compound Events*

What is the probability of throwing a 3 or a 4 when you throw a die? Both events cannot happen at the same time, so these events are mutually exclusive.

EXAMPLE

P(A or B) = P(A) + P(B)

Event A is throwing a 3.

Event B is throwing a 4.

P(3 or 4) = P(3) + P(4)

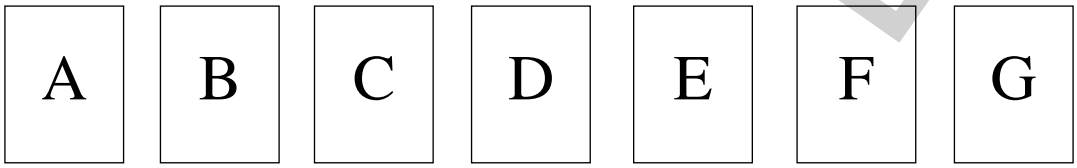
$$\frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3}$$

PRACTICE

A die is rolled.

1. What is P(3 or 5)? _____
2. What is P(even or odd)? _____
3. What is P(1 or 6)? _____
4. What is P(4 or prime)? _____
5. What is P(3 or 4)? _____

A card is drawn from these cards.



6. What is P(E or or a consonant)? _____

A coin is tossed and a die is rolled

7. What is P(heads or 3)? _____
8. What is P(tails or 4)? _____
9. What is P(tails or less than 3)? _____
10. What is P(heads or prime)? _____
11. What is P(heads or even)? _____

A ribbon is selected at random from a bag containing 5 white ribbons, 6 red ribbons, and 4 blue ribbons.

12. What is P(red or blue)? _____
13. What is P(red or white)? _____
14. What is P(white or blue)? _____
15. What is P(blue or not white)? _____

➢ *Probability of Dependent Events*

When two events are dependent, the first events outcome will change the size of the sample and affect the probability of the second event.

EXAMPLE:

What is the probability of drawing 2 red marbles (one marble at a time) from a box that contains 3 red marbles and 2 black marbles? (Do not replace marble after first draw.)

$\frac{3}{5}$ 3 red marbles
5 total marbles in box

1. Find the probability of drawing a red marble on the first draw.

$\frac{2}{4}$ 2 red marbles
4 total marbles in box

2. Reduce the sample by 1 because one drawing has been made. The number of possible favorable (red) outcomes must be reduced by 1 since a red marble may have been drawn.

$\frac{3}{5} \times \frac{2}{4} = \frac{6}{20} = \frac{3}{10}$

3. Multiply the probabilities.

PRACTICE

Find the probability.

Using a deck of cards, find the probability of choosing a card from column A (Do not replace in deck.) and then a card from column B.

	A	B	Probability
1.	queen	queen	_____
2.	black five	black five	_____
3.	3 of hearts	3 of hearts	_____
4.	black card	black card	_____
5.	red or black card	red or black card	_____
6.	jack of spades	queen of spades	_____
7.	black ace	red ace	_____
8.	a spade	a spade	_____
9.	a heart	a diamond	_____
10.	4 of clubs	3 of clubs	_____

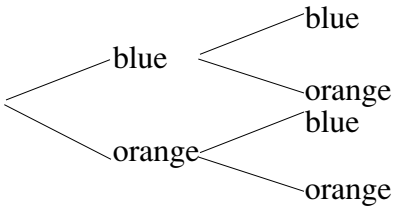
Using a bag containing 3 yellow marbles, 2 green marbles, and 6 orange marbles, find the probability of choosing a marble from column A (Do not replace in bag.) and then from column B.

	Column A	Column B	Probability
11.	a yellow marble	a yellow marble	_____
12.	a green marble	a green marble	_____
13.	an orange marble	an orange marble	_____
14.	a yellow marble	a green marble	_____
15.	a yellow marble	an orange marble	_____
16.	a green marble	an orange marble	_____

➢ *Review*

1. What is the probability that a roll of a die will show 2?
   a. $\frac{4}{6} = \frac{2}{3}$
   b. $\frac{1}{6}$
   c. $\frac{0}{6}$
   d. $\frac{1}{2}$

2. This tree diagram shows the possibilities for choosing a blue or orange disk when choosing a disk twice, returning the first disk after choosing the first time.



What are the chances that one choice is blue and one choice is orange?
   a. $\frac{3}{4}$
   b. $\frac{1}{2}$
   c. $\frac{1}{4}$
   d. $\frac{1}{3}$

3. How many outcomes are possible if you toss 4 coins?
   a. 8
   b. 4
   c. 16
   d. 32

(Use for 4 – 6.)

S	S	W	W	W	B

4. What is the probability of drawing a S ?
   a. $\frac{3}{4}$
   b. $\frac{2}{6} = \frac{1}{3}$
   c. $\frac{5}{6}$
   d. $\frac{3}{6} = \frac{1}{2}$

5. What is the probability of drawing two W 's in 2 draws (Do not replace first letter.)?
   a. $\frac{3}{4}$
   b. $\frac{6}{36} = \frac{1}{6}$
   c. $\frac{9}{36} = \frac{1}{4}$
   d. $\frac{6}{30} = \frac{1}{5}$

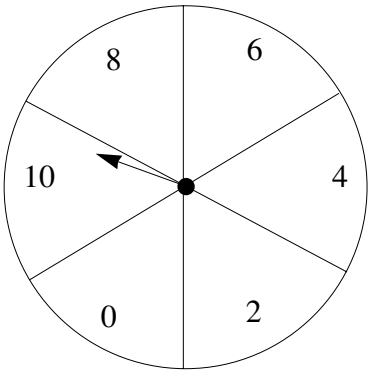
6. What is the probability of drawing a B ?
   a. $\frac{2}{6} = \frac{1}{3}$
   b. $\frac{1}{6}$
   c. $\frac{5}{6}$
   d. $\frac{4}{6} = \frac{2}{3}$

7. John, David and Sam are sitting on a bench. In how many different orders could they be sitting?
   a. 6
   b. 3
   c. 9
   d. 5

8. If you have a pink shirt, a sapphire shirt, a lime shirt, and a tangerine shirt, what is the probability of you choosing a tangerine shirt?
   a. 1
   b. $\frac{2}{4} = \frac{1}{2}$
   c. $\frac{1}{3}$
   d. $\frac{1}{4}$

9. Use the shirts from number 8 to find the probability of choosing a sapphire shirt or a lime shirt?
   a. $\frac{3}{4} = 75\%$
   b. $\frac{2}{4} = \frac{1}{2} = 50\%$
   c. $\frac{1}{4} = 25\%$
   d. $\frac{1}{8} = 12.5\%$

(Use for 10 – 12.)



10. What is the probability of spinning a 6?
    a. $\frac{0}{6}$
    b. $\frac{1}{6}$
    c. $\frac{3}{6} = \frac{1}{2}$
    d. $\frac{4}{6} = \frac{2}{3}$

11. What is the probability of spinning an 8 or a 10?

a. $\frac{2}{6} = \frac{1}{3}$

b. $\frac{0}{6}$

c. $\frac{1}{6}$

d. $\frac{3}{6} = \frac{1}{2}$

12. What is the probability of spinning a number less than 6?

a. $\frac{3}{6} = \frac{1}{2} = 50\%$

b. $\frac{4}{6} = \frac{2}{3} = 66\ ^{2}/_{3}\%$

c. $\frac{2}{6} = \frac{1}{3} = 33\ ^{1}/_{3}\%$

d. $\frac{0}{6} = 0\%$

13. If a bag contains 4 blue balls, 5 black balls, and 1 purple ball, what is the probability of choosing a blue ball in each of two draws (Do not replace first ball.)?

a. $\frac{2}{10} = \frac{1}{5} = 20\%$

b. $\frac{8}{45} = 17.8\%$

c. $\frac{12}{90} = \frac{2}{15} = 13\ ^{1}/_{3}\%$

d. $\frac{3}{250} = 1.2\%$

14. There are 4 kinds of ice cream (mint, walnut, cotton candy and cheesecake) and 4 kinds of toppings (pineapple, sprinkles, pecans, coconut). How many possible choices could you have with one ice cream and one topping?

a. 16

b. 8

c. 32

d. 20

15. How many different odd sums can be made when rolling 2 dice?

a. 12

b. 11

c. 9

d. 10

16. There are 3 striped marbles in a bag of 12 marbles. What is the probability of choosing a striped marble?

a. $\frac{1}{3}$

b. $\frac{6}{12} = \frac{1}{2}$

c. $\frac{3}{12} = \frac{1}{4}$

d. $\frac{1}{12}$

17. There are 10 purple beads, 6 gray beads, and 4 black beads in a jar. What is the probability of picking a purple bead?

a. $\frac{0}{20}$

b. $\frac{6}{20} = \frac{3}{10}$

c. $\frac{10}{20} = \frac{1}{2}$

d. $\frac{4}{20} = \frac{1}{5}$

18. A child has a chance of being a boy or girl. If a woman has 2 boys, what is her chance of having a girl the next time?
    a. There is a 50-50 chance.
    b. There is no way to predict this.
    c. She will have a boy.
    d. She will have a girl.

19. A box contains 15 towels, 3 of which are extra large. What is the probability of picking an extra large towel from the box?
    a. $\frac{15}{3} = 5$
    b. $\frac{0}{15}$
    c. $\frac{3}{15} = \frac{1}{5}$
    d. $\frac{3}{18} = \frac{1}{6}$

20. What is the probability of tossing a coin 1 time and having it show a tail?
    a. $\frac{0}{2}$
    b. $\frac{1}{2}$
    c. 2
    d. 1

21. Carrie wins her cross country meet 25% of the time. What is the probability that she will win her next meet?
    a. $\frac{1}{2}$
    b. $\frac{3}{4}$
    c. $\frac{1}{4}$
    d. $\frac{1}{3}$

22. If 2 coins are tossed, what is the probability of tossing 2 tails?
    a. $\frac{1}{4}$
    b. $\frac{2}{4} = \frac{1}{2}$
    c. $\frac{3}{4}$
    d. $\frac{0}{4}$

23. A barrel contains 16 apples. All 16 apples are Granny Smith. What is the probability of drawing an apple that is a Golden Delicious?
    a. $\frac{16}{16}$
    b. $\frac{13}{16}$
    c. $\frac{0}{16}$
    d. $\frac{1}{16}$

24. If you toss 2 green and blue sided disks, what result should occur most often?
    a. two greens
    b. two blues
    c. one green, one blue
    d. All combinations will occur at the same rate.

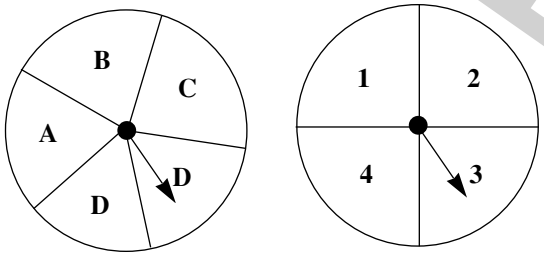
25. Disks numbered 1–17 are in a pail. What is the probability of choosing an odd number?
    a. $\frac{10}{17}$
    b. $\frac{3}{17}$
    c. $\frac{1}{17}$
    d. $\frac{9}{17}$

26. How many different outfits can be made with blue or gray slacks, a blue or pink shirt, and navy or black shoes?
    a. 6
    b. 8
    c. 3
    d. 16

27. A sixth grade class can choose three museums to visit. Their choices are the Science Museum, History Museum, Aviation Museum, and Fossil Museum. Find the number of permutations if order is not important.
    a. 15
    b. 45
    c. 60
    d. 20

28. Find the value of C(8,5).
    a. 40
    b. 56
    c. 13
    d. 48

29. Each spinner is spun once. Find the probability P(3 and C).



    a. $\frac{2}{3}$
    b. $\frac{1}{10}$
    c. $\frac{5}{6}$
    d. $\frac{3}{4}$

30. What is the probability of rolling a 4 or 3 on a die?
    a. $\frac{1}{3}$
    b. $\frac{1}{6}$
    c. $\frac{3}{4}$
    d. $\frac{5}{6}$

31. Find the value of 5!.
    a. 30
    b. 60
    c. 120
    d. 100