Counting and Probability Foundations

Sets, counting principles, permutations, combinations, and probability basics.

Name _____ Date _____

32 main 2-up grid 2 pages

Completion Reward

Shown here as a small pack artifact, not a preview destination.

1. If there are 3 shirt choices and 4 pants choices, how many outfits are possible?

shirt	pants 1	pants 2	pants 3	pants 4
A	A1	A2	A3	A4
B	B1	B2	B3	B4
C	C1	C2	C3	C4

If each shirt can pair with each pair of pants, multiply the number of choices.

A. 7
B. 12
C. 1
D. 24

2. When does order matter?

ordered outcome	counted as same?
AB	no
BA	no
committee {A,B}	yes

When rearranging the same choices makes a different outcome, order matters and the setting is a permutation situation.

A. Permutation problems
B. Combination problems only
C. Set notation only
D. Any counting problem with order irrelevant

3. What is probability in a uniform setting?

outcome	favorable?
1	no
2	yes
3	no
4	yes
5	no
6	yes

In an equally likely setting, probability is the fraction of all outcomes that support the event.

A. Favorable outcomes divided by total outcomes
B. Total outcomes divided by favorable outcomes
C. The product of favorable and total outcomes
D. The sum of all outcomes

4. What does A union B mean?

A. Only the overlap of A and B
B. Elements in A but not B
C. All elements in A or B or both
D. The order of A followed by B

5. What does A intersection B mean?

A. All elements from A and B
B. Elements in A only
C. Elements common to both A and B
D. The size of set A

6. Which situation is a permutation?

A. Choosing 3 toppings for a pizza
B. Selecting 2 team captains without titles
C. Picking 4 books to borrow
D. Assigning gold, silver, and bronze medals

7. Which situation is a combination?

A. Assigning first, second, and third place
B. Making a 4-digit code
C. Ordering 5 runners in a race
D. Choosing 3 club members for a committee

8. What is the best first question when deciding between a permutation and a combination?

situation	order matters?
medals	yes
committee	no

The first decision between permutation and combination is whether changing the order creates a new outcome.

A. Are there any fractions?
B. Is the set empty?
C. Does order matter?
D. Can you graph the outcomes?

9. A student adds n(A) + n(B) without subtracting the overlap. What goes wrong?

A. Elements in A disappear.
B. Elements in the overlap get counted twice.
C. The union becomes smaller than each set automatically.
D. The calculation only works for empty sets.

10. A cafe offers 2 sizes and 5 flavors. How many drink choices are there? Answer with a number.

11. There are 3 routes, 2 lunch choices, and 4 activities. How many day plans are possible? Answer with a number.

12. A fair die is rolled. What is the probability of getting an even number? Enter as a decimal. Answer with a number.

roll	even?
1	no
2	yes
3	no
4	yes
5	no
6	yes

Three of the six equally likely outcomes are even.

13. A fair die is rolled. What is the probability of getting a number greater than 4? Enter as a decimal. Answer with a number.

14. How many ways can 3 books be arranged on a shelf? Answer with a number.

15. How many 2-person committees can be chosen from 4 people? Answer with a number.

pair 1	pair 2	pair 3
AB	AC	AD
BC	BD	CD

Combinations list each unordered pair only once.

16. If set A has 8 elements, set B has 7 elements, and they share 3 elements, how many are in A union B? Answer with a number.

n(A)	n(B)	n(A intersection B)	n(A union B)
8	7	3	12

Add both sets and subtract the shared part once.

17. Out of 20 students, 6 are absent. How many are present? Answer with a number.

18. How many ways can 2 winners be chosen for president and vice president from 4 people? Answer with a number.

19. How many ways can 2 students be chosen from 5 for a committee? Answer with a number.

20. A fair coin is tossed twice. What is the probability of getting exactly one head? Enter as a decimal. Answer with a number.

HH	HT	TH	TT
0 heads	1 head	1 head	0 heads

Exactly one head occurs in two of the four equally likely outcomes.

21. A bag has 3 red and 2 blue marbles. What is the probability of drawing a blue marble? Enter as a decimal. Answer with a number.

color	count
red	3
blue	2
total	5

Probability compares the count of blue marbles with the total marbles in the bag.

22. If the probability of rain is 0.3, what is the probability of no rain? Answer with a number.

23. If n(A) = 9, n(B) = 4, and n(A intersection B) = 2, find n(A union B). Answer with a number.

24. Find 5!. Answer with a number.

25. How many 3-person committees can be chosen from 5 people? Answer with a number.

26. How many ordered 2-person officer teams can be chosen from 5 people? Answer with a number.

27. Write the simple probability formula. Answer as an equation.

28. Write the set-count formula for A union B. Answer as an equation.

29. Write 4! as a product. Answer as an equation.

30. Write the combination expression for choosing 2 from 5. Answer as an expression.

31. Write the complement rule for an event E. Answer as an equation.

32. Which student chooses the right method for selecting 2 toppings from 6 without order?

A. Student A: use a combination because order does not matter.
B. Student B: use a permutation because any two toppings are a ranking.
C. Student C: use a determinant because there are 6 choices.
D. Student D: use an exponential model because toppings branch.