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VCE Specialist Mathematics ½

Combinatorics I [5.1]

Test Solutions

26.5 Marks. 1 Minute Reading. 27 Minutes Writing.

Results:

Test Questions	_____ / 26.5

Section A: Test Questions (26.5 Marks)

Question 1 (3.5 marks)

Tick whether the following statements are **true** or **false**.

Statement	True	False
a. The multiplication principle states that if there are n ways to perform the first task and m ways to perform the second task, then there are $n \times m$ ways to perform both tasks.	✓	
b. In a permutation, order matters.	✓	
c. Combinations are used when order doesn't matter.	✓	
d. The formula for combinations is $\frac{n!}{r! \times (n-r)!}$.	✓	
e. In combination, the number of subsets of size r that can be chosen from a set of size n is given by ${}^nC_r$.	✓	
f. The number of ways to choose k objects from a set of n identical objects is ${}^nC_k$.		✓
g. The addition principle states that if there are m ways to do one thing and n ways to do another, then there are $m + n$ ways to do both things.		✓

False. The addition principle states that if there are m ways to do one thing and n ways to do another, and the two things cannot be done at the same time, then there are $m + n$ ways to do either one of them.

Space for Personal Notes

Question 2 (1 mark)

An ice cream shop offers 4 types of cones and 6 different flavours of ice cream. How many possible ice cream cone combinations are there?

For each of the 4 cones there are 6 possible toppings so altogether there are $4 \times 6 = 24$ possible ice-cream cone combinations.

Space for Personal Notes

Question 3 (4 marks) **Tech-Active.**

a. A teacher wants to randomly choose four people from the class of 20 to help out at the open-day BBQ. In how many ways can this be done? (2 marks)

When the 4 people are chosen, it does not matter who is chosen first, so we have:

$$C_4^{20} = \frac{20!}{4!\,16!} = 4845$$

ways to choose the students with those conditions.

b. A teacher wants to award prizes for $1^{st}, 2^{nd}, 3^{rd}$ and 4^{th} in the class of 20. In how many ways can the prizes be awarded (assuming no two students tie)? (2 marks)

Here, we also have 4 people chose, but the chosen order does matter, so there are:

$$P_4^{20} = \frac{20!}{16!} = 116280$$

ways to choose the students with those conditions. This is significantly more as expected.

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Question 4 (8 marks)

Decide whether or not the order of selection is important, and then write the formula to work out the following:

a. How many different sets of four colours can be selected from the colours red, orange, yellow, green, blue, and violet? (2 marks)

Not important, ${}^{6}C_{4}$

b. In how many ways can a team of female basketball players (5 people) be selected from 9 girls? (2 marks)

Not important, ${}^{9}C_{5}$

c. A race has 24 runners. In how many ways can the first three places be decided? (2 marks)

Important, ${}^{24}P_{3}$

d. A secretary has eight letters and only five distinct stamps. How many ways can he select the letters for posting? (2 marks)

Important (if stamps are distinct), ${}^{8}P_{5}$

Question 5 (3 marks) **Tech-Active.**

How many arrangements of the letters of the word "arrangements" are there?

There are 12 letters. If the letters were all different, there would be 12! arrangements. However, there are two a's, r's, n's and e's. So, we need to divide by $2!^4$. Therefore, the answer is $\frac{12!}{2!^4}$.

TUTORS: The changing of orders of same letters are not relevant. Hence, we divide them.

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Question 6 (4 marks)

For each of the following, write the answer in factorial notation:

a. In a lottery, you select 8 numbers out of 50. How many ways are there to do this? (2 marks)

$$\frac{50!}{8!\,42!}$$

b. A student must select 6 subjects. In how many ways can they do that if there are 20 subjects and 1 is compulsory? (2 marks)

$$\frac{19!}{5!\,14!}$$

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Question 7 (3 marks)

In how many ways can you choose 3 chocolates from a bag containing 12 different chocolates?

$^{12}C_3 = 220$

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