UNIVERSITY OF WATERLOO

Faculty of Mathematics
Waterloo, Ontario N2L 3G1

Centre for Education in
Mathematics and Computing

Grade 6 Math Circles

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Counting Part II - Problem Set

1. State if the question is a Fundamental Counting Principle problem, a basic Permutations problem (learnt in the previous lesson), a Permutation with Repeats problem, or a Combinations problem:

   (a) Calvin Klein has 4 shirts, 7 pants and 2 pairs of shoes. How many different outfits can Calvin Klein put together?

   (b) A student club with 10 members wishes to select a president, a secretary, and a treasurer from its membership. No member may be selected for more than 1 position. In how many ways can this be done?

   (c) How many different 6-digit PIN codes are there using digits from 0 to 9?

   (d) How many different ways can the letters in the word CALCULATOR be arranged?

   (e) How many ways can Jenny the Jeweller make a keychain with 20 distinct beads if she has 30 distinct beads? Note: The keychain is a straight piece of string.

2. Christmas is coming up and Emily wants to plan out how she will decorate her fireplace mantel. Emily has 12 ornaments in total. She has:

   - 3 red stockings
   - 2 orange ball ornaments
   - 4 green ball ornaments
   - 2 angel ornaments
   - 1 blue ball ornament

   (a) How many **different** ways can Emily arrange her ornaments on the mantel if she wants to use all 12 ornaments?

3. Luc, Ryan, Alysha and Vince liked Frozen 2 so much that they are going to see it a second time, and this time they're bringing Tim. When the friends go to the theatre they all sit in a row of 5 seats. Ryan and Tim want to sit together. How many different seating arrangements of the five friends are possible in a row with 5 seats?

4. How many words can you make rearranging the letters of the following words:

   (a) MATHEMATICS

   (b) MISSISSIPPI

5. Suppose a lottery ticket can have 5-digits from 0 to 9 on it with no repeating digits.

   (a) How many different possibilites of the winning 5-digits are there if the order of the digits don't matter?

   (b) How many different possibilites of the winning 5-digits are there if the order of the digits matter?

6. Florean Fortescue's Ice Cream Parlour has 53 flavours of ice cream. How many different types of sundaes could Harry get if he wanted:

   (a) 1 scoop?

   (b) 2 differently flavoured scoops?

   (c) 5 differently flavoured scoops?

7. At a cafeteria, a student is allowed to pick 4 items from the following list (one of each): pop, juice, milk, water, burger, hotdog, vegetable soup, banana, orange, apple pie.

   (a) Does order matter?

   (b) Is repetition allowed?

   (c) How many ways can a student have a 4 piece meal?

   (d) How many ways can a student have a 4 piece meal if they need to take exactly one drink?

8. Bathilda Bagshot bought a bag of Bertie Bott's Beans. There are 21 bad tasting beans and 8 good tasting beans (all the beans are different). Bathilda wants to eat 4 beans.

   (a) How many ways can Bathilda pick her beans?

   (b) How many ways can Bathilda pick all good beans?

(c) How many ways can Bathilda pick all bad beans?

(d) How many ways can Bathilda pick 2 good beans AND 2 bad beans?

(e) ** How many ways can Bathilda have more good beans than bad?

9. A school has 380 female students and 120 male students. They must create a 5-person student council.

   (a) In how many ways can they do this if there must be 4 boys and 1 girl?

   (b) ** In how many ways can they do this if there must be more girls than boys?

10. Complete the following rows of Pascal's Triangle. (**Hint:** You can do this by writing out the entire triangle or use $\binom{n}{k}$ to find each entry).

    (a) Complete the 6th row.

    (b) Complete the 9th row.

11. Find the missing number in this row. (**Hint:** Looking at the numbers is useful, but how many entries are there?)

1 _ 78 186 715 1287 1716 1716 1287 715 186 78 _ 1