20. The KOT club has 12 pledges. On a club workday, four pledges are assigned to the Red Cross, six are assigned to the Salvation Army, and two are not assigned. In how many ways can the groups be selected?

4 pledges to the Red Cross
6 pledges to the Salvation Army
2 pledges are not assigned

\[ c(12,4) = \frac{12!}{4! \cdot 8!} = 495 \]
\[ c(12,6) = \frac{12!}{6! \cdot 6!} = 924 \]
\[ 495 \times 924 = 457,380 \]

The groups can be selected in 457,380 ways.

Slight adjustment: see below

Select 4 of 12 pledges to go to Red Cross and select 6 of the remaining 8 to go to Salvation Army and last 2 to stay home

\[ c(12,4) \quad c(8,6) \quad c(2,2) = 495 \times 28 \times 1 \]
\[ = 13,860 \]

There are 13,860 ways to select the groups.
22. The Spirit Shop had a sale on records, books, and T-shirts. A cashier observed the purchases of 38 people and found that

- 16 bought records.
- 15 bought books.
- 19 bought T-shirts.
- 5 bought books and records.
- 7 bought books and T-shirts.
- 6 bought records and T-shirts.
- 3 bought all three.

(a) How many bought records and T-shirts but no books?
(b) How many bought records but no books?
(c) How many bought T-shirts but no books and no records?
(d) How many bought none of the three?

Let $B =$ # of Books
Let $R =$ # of Records
Let $S =$ # of Shirts

![Venn Diagram]

(a) 3
(b) Number of people who only bought records + # of people who bought records and shirts only
   $8 + 3 = \boxed{11}$
(c) 9
(d) 3
25. Mrs. Bass has five bracelets, eight necklaces, and seven sets of earrings. In how many ways can she select one of each to wear?

\[
\begin{align*}
\binom{5}{1} & \quad \text{1 of 5 ways to pick a bracelet} \\
\binom{8}{1} & \quad \text{1 of 8 ways to pick a necklace} \\
\binom{7}{1} & \quad \text{1 of 7 ways to pick a set of earrings} \\
\end{align*}
\]

\[5 \times 8 \times 7 = 280 \text{ ways she can select one of each to wear.}\]
31. An Honor Council consists of 4 seniors, 4 juniors, 3 sophomores, and 1 freshman. Fifteen seniors, 20 juniors, 25 sophomores, and 11 freshmen apply. In how many ways can the Honor Council be selected? Leave your answer in symbolic form.

\[
\begin{align*}
\text{Seniors} & \quad \text{Juniors} & \quad \text{Sophomores} & \quad \text{Freshmen} \\
15 & \quad 20 & \quad 25 & \quad 11 \\
\end{align*}
\]

\[
\begin{align*}
\text{Ways to select} & \quad \text{Honor Council} \\
\therefore & = \left( \text{Select 4 of 15} \right) \quad \text{AND} \quad \left( \text{Select 4 of 20} \right) \quad \text{AND} \quad \left( \text{Select 3 of 25} \right) \quad \text{AND} \quad \left( \text{Select 1 of 11} \right) \\
\therefore & = \binom{15}{4} \cdot \binom{20}{4} \cdot \binom{25}{3} \cdot \binom{11}{1} \\
\end{align*}
\]

- Since we are selecting groups of seniors, juniors, sophomores, and freshmen and there are no specific assignments (order) within the groups, we should use combination rather than permutation.
- Use MULTIPLICATION RULE - see above: "AND"
32. An art gallery has eight oil paintings and four watercolors. A display of five oil paintings and two watercolors arranged in a row is planned. How many different displays are possible with a watercolor at each end and the oils in the center?

TO CHOOSE FIVE OILS FROM A SET OF EIGHT WHERE ORDER IS IMPORTANT IN ARRANGEMENT WE USE PERMUTATION.

\[ P(8,5) = 6720 \]

TO CHOOSE TWO WATERCOLORS FROM SET OF FOUR AGAIN USE PERMUTATION

\[ P(4,2) = 12 \]

THEN WE MULTIPLY THE TWO PERMUTATIONS TOGETHER BECAUSE WE'RE USING BOTH WATERCOLORS AND OILS

\[ P(8,5) \cdot P(4,2) = 6720 \times 12 = 80,640 \]