1. 3 Shirts
4 pants

$\frac{}{3} \times \frac{}{4} = 12$

2. license plate:

$\underset{(0-9)}{\downarrow} \; \underset{letter}{\downarrow} \; \underset{letter \; or \; digit}{\downarrow} \; \_ \; \_ \; \_ \; \_$

$10 \times 25 \times (25+10) = 10 \cdot 25 \cdot 35 \cdot 35 \cdot 35 \cdot 35 \cdot 35 =$
$\times 5$

$= 13 \, 130 \, 468 \, 750$

3. ① — 25

a) ball is removed $= 25 \times 24 \times 23 \times 22 = 303 \, 600$

b) ball is returned $= 25 \times 25 \times 25 \times 25 = 390 \, 625$

4. A B C D E

$5 \times 5 \times 5 + 5 \times 5 + 5 = 155$

word: $\frac{}{5} \cdot \frac{}{5} \cdot \frac{}{5} \, / \, \frac{}{5} \cdot \frac{}{5} \, / \, \frac{}{5}$

5. 4 Sons, 3 daughters, 7 seats, 2 boys next to each other

$\frac{S}{\wedge} \; \frac{S}{\wedge} \; \frac{D}{\cdot} \; \frac{D}{\cdot} \; \frac{D}{\cdot}$
$\;\; s \; s \; \; s \, s$

Only one incorrect way: $SDSDSDS =$

$= 4! \cdot 3! = 144$ $\qquad$ $7!$ - total

result $= 5040 - 144 = 4896$

6. $X_1 X_2 \ldots X_7$

1-5 $\searrow$
$$\underline{} \; \underline{} \; \underline{} \; \underline{} \; \underline{} \; \underline{} \; \underline{} \qquad = 5 \cdot 4^6 = 20480$$

4 choices 4 choices

7. 20 members
$\qquad$ 3 officers
$\qquad$ Ali $\xrightarrow{\text{hates}}$ Brenda

$$O \; O \; O \; O \; O \; \ldots \ldots \; O$$
$$O \; O \; O$$
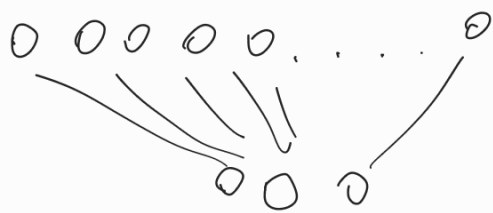
$$P = \frac{n!}{(n-k)!} = \frac{18!}{16!} = 17 \cdot 18 \cdot 18 =$$

$\cancel{5814}$ w/o Ali

$5814 + 818 =$

$= 6732$ $\quad \leftarrow$ w/ Ali

$$\uparrow \; \uparrow \; \uparrow$$
$$1 \quad 18 \; 17 \quad \cdot 3$$

8. PAPA $\qquad$ P - 2
$\qquad\qquad\qquad$ A - 2

$$C_n^k = \frac{4!}{2! \, 2!} = \frac{1 \cdot 2 \cdot 3 \cdot 4^{2}}{1 \cdot 2 \cdot 1 \cdot 2} = 6$$

$$\underline{} \; \underline{} \; \underline{} \; \underline{}$$

9.

$n = 6$
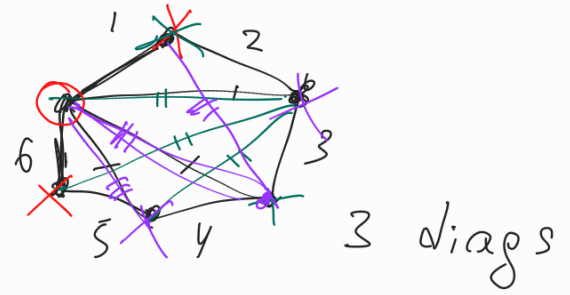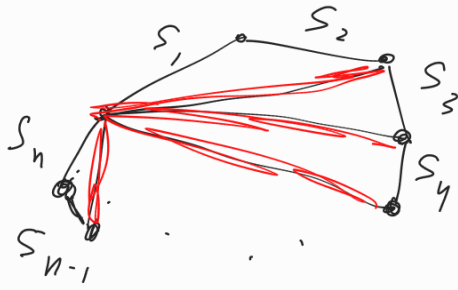
$\dfrac{6 \cdot 3}{2} = 9$

diags = $n - 3$ for each point

3 diags

$$\boxed{\dfrac{n(n-3)}{2}}$$

10.   48 balls   1 ... 48   6 chosen

$$S = 48 \times 47 \times 46 \times 45 \times 44 \times 43 \quad \leftarrow \text{order matters}$$

with overset numbers: $\overset{5}{48} \times \overset{10}{47} \times \overset{9}{46} \times \overset{8}{45} \times \overset{7}{44} \times \overset{6}{43}$

$$\boxed{\dfrac{S}{6!} = 12271512} \quad \leftarrow \text{order doesn't matter}$$

11.   12 players   2 refuse to play together

line up — 5 players

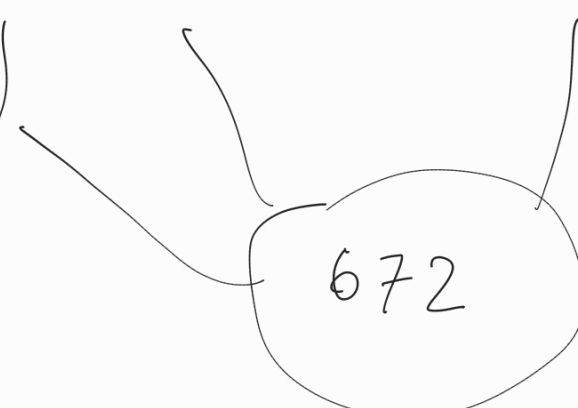if Bob   ___ ___ ___ ___ ___
         Bob $\binom{10}{4}$

if Yogi $\binom{10}{4}$

if neither $\binom{10}{5}$ ⟶ $\boxed{672}$

12. coefficient in $(x + 2y^2)^6$ for y^8

$\binom{6}{4}$ ways $\Rightarrow \binom{6}{4} x^2 (2y^2)^4 = \boxed{240}\, x^2 y^8$