1. $3 \cdot 2 \cdot 3 \cdot 12$ = 216 customization options.

2. 72^{16} password combinations. If 1 trillion passwords can be guessed per second, it would take ${72^{16}}/{1{,}000{,}000{,}000{,}000\ seconds} = {72^{16}}/{1{,}000{,}000{,}000{,}000} \cdot {1}/{(365 \cdot 24 \cdot 60 \cdot 60)}$
$16{,}539{,}155{,}711$ years to guess every possible combination of password.

3. For this rule, passwords of lengths 12, 13, 14, 15, and 16 must be considered. For n being one of the previous values 72^n is the total number of passwords not considering the rule. 52^n is the total number of passwords that break the rule because they do not consider the special character. Calculations are as follows:

   For length 12:
   $72^{12} – 52^{12}$
   For length 13:
   72^{13} - 52^{13}
   For length 14:
   72^{14} - 52^{14}
   For length 15:
   72^{15} - 52^{15}
   For length 16:
   $72^{16} – 52^{16}$

   Therefore, the total number of possible combinations that follow the rule is:
   $72^{12} + 72^{13} + 72^{14} + 72^{15} + 72^{16} - (52^{12} + 52^{13} + 52^{14} + 52^{15} + 52^{16})$

4. The queen can receive the dignitaries in 4! ways. This is because the first dignitary is one of four choices, the second being one of three choices, the third being one of two choices, and the last being one of one choice. Therefore, the queen has 4! = 24 ways of receiving the dignitaries.

5. The first choice in the random election will be 1 out of 100000, the next being 1 out of 99999, up to 1 out of 99901. The number of possible outcomes of the election can be rewritten as: $\frac{100000!}{99!}$

6. The total number of functions from a set with m elements to a set with n elements is n^m. The total number of functions in this set are 7^5. $[{7 \atop 5}]$ = 21 represents the total number of elements that are one-to-one, so subtract 7^5 – 21 = 16786.

7. The total number of combinations of the demographics can be found by: $8 \cdot 7 \cdot 5 \cdot 6 = 1680$. By the pigeonhole principle, if 1680 + 1 people are interviewed it is guaranteed that there will be at least two interviewees that have identical demographics information. To guarantee there has to be at least three that have the same information, first you have to guarantee that at least two people have the same information, so $1680 \cdot 2 = 3360$ must be interviewed. Then if one other person is interviewed it is guaranteed that he will share the same information as at least two other individuals. $(1680 \cdot 2) + 1 = 3361$ people must be interviewed.

8. (a) Because there are 20 dog owners, and more cat owners, at most all 20 of those dog owners could have cats. Therefore, there are at most 20 people who own a dog and a cat.

   (b) If there are 41 people at the meeting, we can use the inclusion formula to derive the equation: $20 + 35 - 41 = 14$. Therefore, there are at least 14 people that have both a cat and a dog.

9. EXTRA CREDIT

main.py

```python
from itertools import permutations

nums = [0, 1, 2, 3, 4]
l = list(permutations(range(0, 5)))

def compareElement(a, b):
    for i in range(len(a)):
        if a[i] == b[i]:
            return False
    return True

for i in range(len(l)):
    if compareElement(nums, l[i]):
        print(str(l[i]))
```

```
Windows PowerShell

PS C:\Users\WillJedynak\OneDrive\ASU Online\Fall 2022\Session B\MAT 243\Homework\Homework 6\Extra Credit> python3 .\main.py
(1, 0, 3, 4, 2)
(1, 0, 4, 2, 3)
(1, 2, 0, 4, 3)
(1, 2, 3, 4, 0)
(1, 2, 4, 0, 3)
(1, 3, 0, 4, 2)
(1, 3, 4, 0, 2)
(1, 3, 4, 2, 0)
(1, 4, 0, 2, 3)
(1, 4, 3, 0, 2)
(1, 4, 3, 2, 0)
(2, 0, 1, 4, 3)
(2, 0, 3, 4, 1)
(2, 0, 4, 1, 3)
(2, 3, 0, 4, 1)
(2, 3, 1, 4, 0)
(2, 3, 4, 0, 1)
(2, 3, 4, 1, 0)
(2, 4, 0, 1, 3)
(2, 4, 1, 0, 3)
(2, 4, 3, 0, 1)
(2, 4, 3, 1, 0)
(3, 0, 1, 4, 2)
(3, 0, 4, 1, 2)
(3, 0, 4, 2, 1)
(3, 2, 0, 4, 1)
(3, 2, 1, 4, 0)
(3, 2, 4, 0, 1)
(3, 2, 4, 1, 0)
(3, 4, 0, 1, 2)
(3, 4, 0, 2, 1)
(3, 4, 1, 0, 2)
(3, 4, 1, 2, 0)
(4, 0, 1, 2, 3)
(4, 0, 3, 1, 2)
(4, 0, 3, 2, 1)
(4, 2, 0, 1, 3)
(4, 2, 1, 0, 3)
(4, 2, 3, 0, 1)
(4, 2, 3, 1, 0)
(4, 3, 0, 1, 2)
(4, 3, 0, 2, 1)
(4, 3, 1, 0, 2)
(4, 3, 1, 2, 0)
PS C:\Users\WillJedynak\OneDrive\ASU Online\Fall 2022\Session B\MAT 243\Homework\Homework 6\Extra Credit>
```