

Name: \_\_\_\_\_

Please complete the following exercises. You are encouraged to work with others, but you must write up your own answer. Please turn this in at the start of Friday's class (12/1).

A standard deck of cards contains 52 cards. Each card consists of a rank and a suit. There are 13 ranks:  $R := \{A, 2, 3, \dots, 9, 10, J, Q, K\}$ ; there are four suits:  $S := \{\spadesuit, \heartsuit, \diamondsuit, \clubsuit\}$ . Thus, a deck of cards corresponds to  $R \times S$ . A bridge hand has 13 cards. A poker hand has 5 cards.

For each question, write an expression that is equal to the number of hands matching the given condition.

### Warm up exercises

1. A bridge hand that is void of hearts (i.e., only has cards from suits  $\{\spadesuit, \diamondsuit, \clubsuit\}$ ).
2. A bridge hand with one spade.
3. A bridge hand with all four kings.
4. A bridge hand with no queens.
5. A bridge hand with exactly two jacks.
6. A bridge hand with exactly two jacks and two queens.
7. A poker hand with four of a kind.
8. A bridge hand with *high honors* in hearts. (A hand has high honors if it contains  $\{10, J, Q, K, A\}$  in the same suit.)

**More challenging exercises**

9. A bridge hand with *high honors*. (*Warning: be sure to avoid double counting!*) (*Hint: if you're stumped try counting bridge hands with high honors in either spades or hearts.*)
  
10. A poker hand with a full house (three cards of one rank, two cards of another rank).
  
11. A poker hand with two pairs (two cards of one rank, two cards of another rank, and one card of a third rank). (*Warning: be sure to avoid double counting!*)
  
12. A poker hand with a *straight*. A straight is five cards in consecutive rank but in any suit. Note that *A* can be high or low, as in  $\{A\heartsuit, 2\clubsuit, 3\heartsuit, 4\spadesuit, 5\diamondsuit\}$ , or  $\{10\clubsuit, J\heartsuit, Q\spadesuit, K\diamondsuit, A\heartsuit\}$ . However, a straight *cannot* “wrap around,” as in  $\{Q\spadesuit, K\diamondsuit, A\heartsuit, 2\clubsuit, 3\heartsuit\}$ .
  
13. A poker hand with a high card. This is the least valuable hand: it contains no pairs, no three of a kind, no four of a kind. In addition, it's not a straight and it's not a flush (all cards of same suit).