

- Show all your work on this paper (use both sides if necessary).
- No electronics, no notes, no book.

- (1) (4 pts) State the Principle of Inclusion and Exclusion (PIE) for the case of a set  $S$  (the “universe”) and three properties,  $P_1, P_2, P_3$ , that each element of  $S$  may or may not have. Let  $A_i =$  the subset of  $S$  that contains the elements with property  $P_i$ .
- (2) (8 pts) Let  $M$  be the multiset  $\{13 \cdot a, 13 \cdot b, 13 \cdot c\}$ . Use the PIE to find the number of 30-combinations of  $M$ . State what your universe is and what your properties are. Numerical answers may be stated using binomial coefficients.