Math 101-002
Quiz 2, February 6

Name	CSU ID #

Be sure to read each question fully and carefully. Multiple choice answer bubbles must be fully filled in. There is space to the right of each multiple choice question to show work, if your work is correct you can get points even with an incorrect multiple choice answer.

1. Consider the Weighted Voting Scheme $[q : 9, 7, 1]$ formed by players P_1, P_2 and P_3.

   (a) What are the minimum and maximum possible values of q? (4 points) [Hint: Recall that the quota lies between half the total votes and the total votes.]

   - ◯ 7
   - ◯ 9
   - ◯ 11
   - ◯ 17
   - ◯ 23

   (b) Which value of q results in a dictator for this scheme? (2 points)

   - ◯ 7
   - ◯ 8
   - ◯ 9
   - ◯ 10
   - ◯ 11

   (c) For the previous value, who is a dictator, why? (2 points)

   - ◯ P_1 is a dictator because P_1 has enough votes to pass a motion single-handedly.
   - ◯ P_1 is a dictator because no motion can pass without their votes.
   - ◯ Both P_1 and P_2 are dictators because they have enough votes to pass motions together.
   - ◯ Both P_1 and P_2 are dictators because no motion can pass without both of their votes.

   (d) For the previous value, who has no power, why? (2 points)

   - ◯ Both P_2 and P_3 have no power because they can pass a motion together.
   - ◯ Both P_2 and P_3 have no power because P_1 is a dictator.
   - ◯ All players have no power because P_1 is a dictator.
   - ◯ All players have no power because no one can pass a motion single-handedly.

(e) For which value of q is there exactly one player with veto power? (2 points)

- ◯ 8
- ◯ 9
- ◯ 10
- ◯ 11
- ◯ 12

(f) For the previous value, which player has veto power, why? (2 points)

- ◯ P_1 has veto power because P_1 has enough votes to pass a motion single-handedly.
- ◯ P_1 has veto power because P_2 and P_3 together have only 8 votes.
- ◯ P_2 has veto power because P_2 has enough votes to pass a motion single-handedly.
- ◯ P_2 has veto power because P_1 and P_3 together have only 10 votes.

(g) Which values q guarantee that *two players* will have veto power? (2 points)

- ◯ 7
- ◯ 9
- ◯ 11
- ◯ 15
- ◯ 17

(h) For the previous values, which players have veto power, why? (2 points)

- ◯ Both P_1 and P_3 have veto power because no motion can pass without at least one of their votes.
- ◯ Both P_1 and P_2 have veto power because no motion can pass without at least one of their votes.
- ◯ Both P_1 and P_2 have veto power because no motion can pass without both of their votes.
- ◯ Both P_1 and P_3 have veto power because no motion can pass without both of their votes.

(i) Which value of q guarantees that all players have veto power? (2 points)

- ◯ 7
- ◯ 9
- ◯ 11
- ◯ 15
- ◯ 17

2. Assume you're on a family trip with your two uncles U and two cousins C (you are also represented by the letter C). Family trip decisions are decided by a majority of the votes (that is, at least three people must vote Yes), but at least one uncle must vote Yes (that is, the three children don't have enough weight to carry the motion).

   Using a scheme $[q : U, U, C, C, C]$ find the smallest possible values for q, U and C such that the conditions are held.