1. [10 pts.] Determine whether the argument is valid by either comparing it to a standard argument or using a truth table:

$$\begin{array}{l} \neg p \to q \\ \underline{\neg q} \\ \therefore \ \neg p \end{array}$$

2. [15 pts.] Determine whether the argument is valid using a truth table:

$$\begin{array}{l} p \leftrightarrow q \\ p \vee r \\ \underline{q \to r} \\ \therefore \ q \vee r \end{array}$$

3. [15 pts.] Translate the argument into symbolic form, then determine whether the argument is valid using a truth table: "If the soccer team wins the game, then Xavier played as goalkeeper. If Xavier played as goalkeeper, then the team is in third place. Therefore, if the soccer team wins the game, then the team is in third place."

4. [10 pts. each] Use an Euler diagram to determine whether the syllogism is valid.

   (a) All cars have engines.
       Some things with engines use gasoline.
       ∴ Some cars use gasoline.

   (b) No Pythagorean has squared the circle.
       Some who claim to have squared the circle are insane.
       All who are insane are not Pythagoreans.
       ∴ No Pythagorean has claimed to have squared the circle.

5. [10 pts.] In one of Mendel's experiments, he crossbred nonpure tall pea plants. The result was 787 tall second-generation plants, and 277 short second-generation plants. Find the empirical probability of a second-generation plant being short.

6. [5 pts. each] One card is selected at random from a deck of cards. Find the probability that the card selected is:

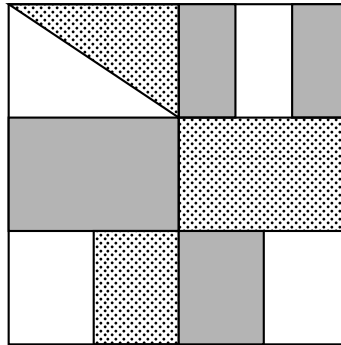   (a) A red card and a black card.

   (b) A black card or a red card.

   (c) A jack or a club.

   (d) Is not an ace.

7. A lentil is randomly thrown onto the square tabletop shown below without touching a line. Find the probability that the lentil lands on:

   (a) [10 pts.] A white area.

   (b) [5 pts.] A shaded or dotted area.

8. [10 pts.] A box contains 11 purple and 5 green marbles. If one marble is selected at random, find the odds against getting a green marble.

9. [10 pts.] The odds in favor of Colonel Tigh getting plastered on Colonial Day are 19:3. Find the probability that Colonel Tigh will not get plastered.

10. [10 pts.] An eight-sided die is rolled once. If a 2, 4, or 6 comes up you win $6; if a 1 or 3 comes up you lose $3; if a 5 or 7 comes up you neither win nor lose anything; and if an 8 comes up you lose $9. What's your expected value if you play this game?

11. 3200 raffle tickets are sold for $5 each. Three prizes will be awarded: one for $2000 and two for $500. Professor Tweedcoat purchases one of these tickets.

    (a) [10 pts.] Determine the professor's expected value.

    (b) [5 pts.] Determine the fair price of a ticket.