Procedure, Data, and Calculations

1. Mark the three spring balances F_1, F_2, and F_3. They may be conveniently labeled with bits of masking tape. With the balances flat on the table apply a small tension force to one of the balances by means of the chain and the ring. Slowly remove the tension and let go of the ring and the chain. Take a zero reading for that balance to the nearest tenth of a Newton. If the pointer is below 0, be sure to include a minus sign with the zero reading. Mark the zero reading on the piece of masking tape attached to the balance. Repeat that procedure for the other two balances and use those readings to correct all later reading before entering them on the Data Table.

2. Place a piece of plain 8.5 in x 11 in paper on the force board.

3. Set the chain of the spring balance marked F_1 into a slot in the force board. Let this slot represent the zero degree position on the board.

4. Set the chain of the spring balance marked F_2 into another slot. This slot may be anywhere from about 40° to 140° from the slot used for the first balance.

5. Set up the third balance in such a way that all three balances apply forces of reasonable magnitudes to the ring. Spring balances (like many other laboratory instruments) are subject to large percent errors if the reading is only a small fraction of full scale. At least one balance should read over 12 N; and the other balances should read over 4 N. Be sure that all three balances are pointing to the center of the ring. Move and rotate the paper if necessary to make the setup resemble Figure 4. Lift the ring a small fraction of a cm out from the table while avoiding applying any sideways force. Slowly let the spring go back to the table. This procedure should make friction inside the balances have the same direction as when the zero readings were taken.

6. Write the identifying symbol (F_1, F_2, or F_3) on the paper near each balance (and near the edge of the paper). Write down the reading of each balance on the paper next to the symbol. Correct it by subtracting the zero reading. (If the balance happened to read below zero with no applied force, the zero reading would be a negative number. Subtraction of a negative number is the same as arithmetic addition. Hence, if this should be the case, you would add the absolute magnitude of the zero reading to the actual reading to get the final value of the force.)

7. Draw a dot on the paper under the center of the ring. Draw dim lines on the paper to mark the edges of the balance. Mark the sheet of paper "Trial I." Remove the paper from the force board. It should resemble the figure below, although the magnitudes and angles of the forces may be different.