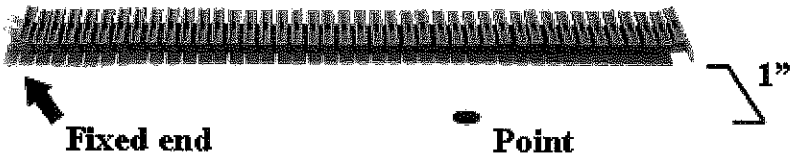
10.1 Worksheet: Degrees of Freedom

Name: _____ **Class/Period:** _____ **Date:** _____

Answer the following questions:

1 Find an everyday object in your home or classroom with 2 or more degrees of freedom. Sketch it and describe its motion.

2 Imagine you have a 44-link section of Vex tread lying flat on a table with one end anchored. How many degrees of freedom does it have? Can it reach a point 1" to the side? Why or why not? Assume there is no torque.



10.2 Activity: Building a Turret

Name: **Class/Period:** **Date:**

Question Sheet

Question 1 How many degrees can the turret rotate without affecting the position of the servo? This phenomenon is known as slop.

Question 2 Now hold the gear connected to the servo in place so that it cannot rotate, and measure the slop present (represent this number in degrees).

Question 3 Where does this looseness come from? Would this be a problem if you were operating this arm?

Question 4 Over how many degrees can the turret rotate with this gear configuration, when servo driven?

Question 5 How smooth is the turret's movement?

Question 6 How precisely can you control the turret's position? Can this servo design be improved?

10.3 Worksheet: Homing

Name: _____ **Class/Period:** _____ **Date:** _____

Answer the following questions:

1 If you had an encoder for your projects, how many lines would you like it to have? Why?

_____

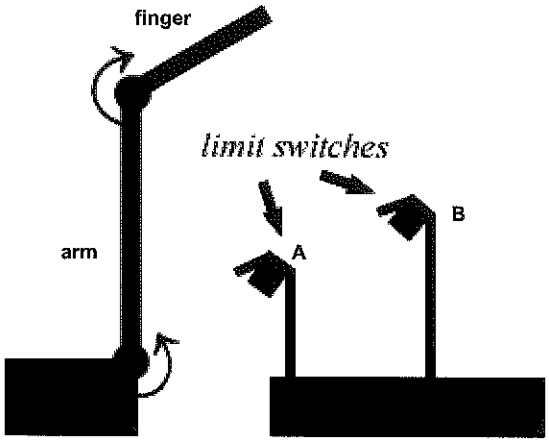
_____

_____

_____

_____

2 Using a theoretical arm with two axes and two limit switches (see diagram below), write out how you would home the device using pseudocode.



10.4F Installing the Potentiometer - Fundamental

Name: **Class/Period:** **Date:**

Question Sheet

Question 1 How many variables did you declare for your program?

Question 2 What is the smallest number of variables you might need?

Question 3 What might you add to your program to keep the turret from hitting the motor?

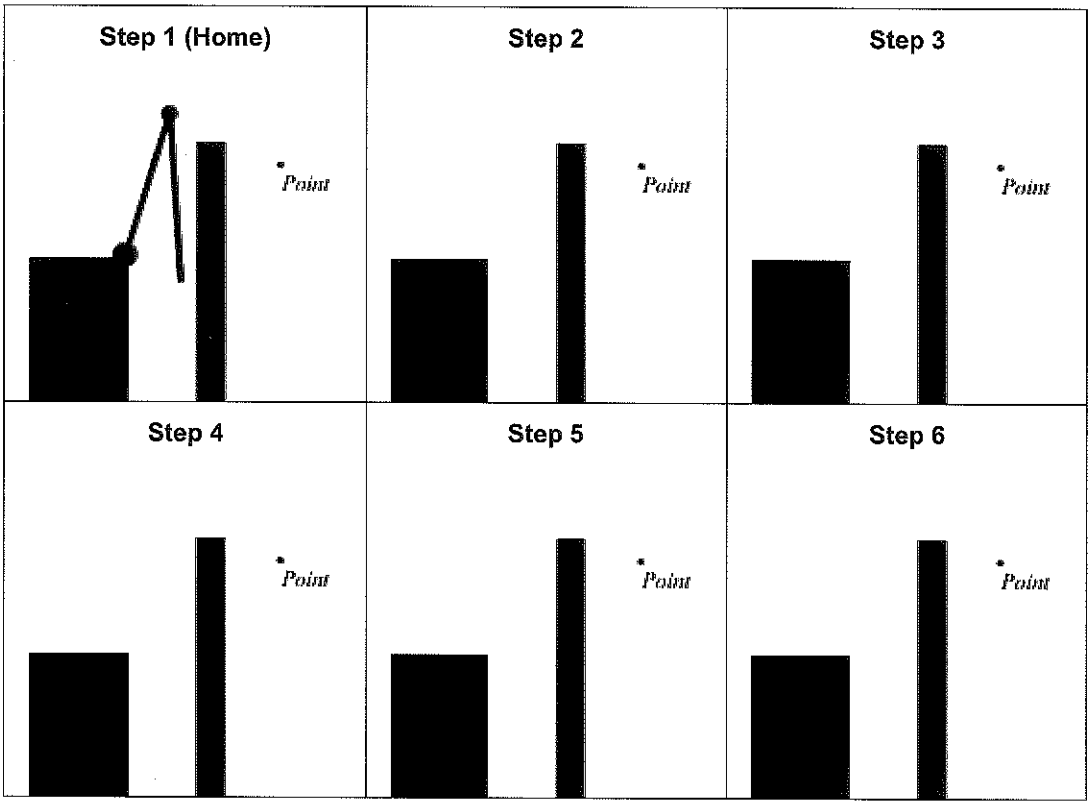
Question 4 How would you manipulate these equations so you could multiply by an integer k_p? Is this feasible?

10.5 Worksheet: Teaching Coordinates

Name: _____ **Class/Period:** _____ **Date:** _____

Answer the following questions:

1 You will be adding an elbow joint to your robot in the next activity, greatly enhancing its range of motion. Starting from the "home" position shown below, draw the robot in each of the positions you would give it (using a teach pendant) in order to touch the point on the other side of the wall.



2 Should you teach the steps outlined above using joint or Cartesian co-ordinates? Why?

_____

_____

_____

_____

_____

10.6F Completing the Arm - Fundamental

Name: **Class/Period:** **Date:**

Question Sheet

Question 1 At what potentiometer readings did you begin to slow your arm movement?

Question 2 How far were these "early limits" from the maximum and minimum physical limitations?

Question 3 How did you choose these values?

Question 4 Could you use a PID loop in your design?