You may only use a simple calculator that does not communicate in any wireless manner. Cell phones and all other communications devices must be turned off during the quiz. All work (free body diagrams, algebra, etc) is required to receive full credit.

1. (25 points) Consider the three link robot arm shown in the figure below (left). For this problem, we will use the simplified diagram for the robot arm shown below (right). You may assume the robot arms have constant density and the cross-sectional area of each arm is small relative to its length.
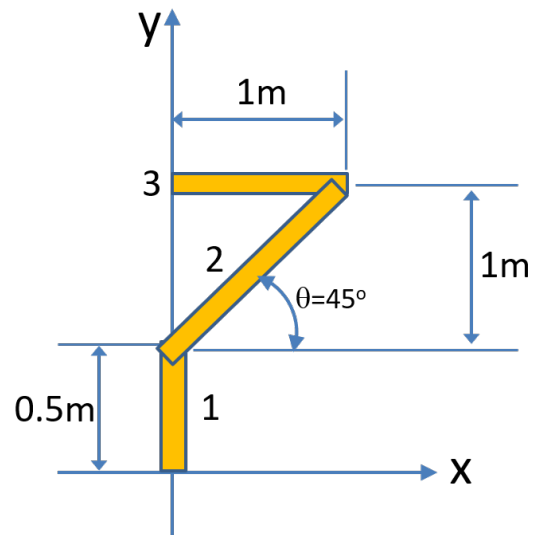

(a) What is the (x, y) coordinate for the centroid of link 1?

(b) What is the (x, y) coordinate for the centroid of link 2?

(c) What is the (x, y) coordinate for the centroid of link 3?

(d) What is the total length of the three-link robot?

(e) What is the (x, y) coordinate for the centroid of the entire three-link robot?

2. (24 points) Consider the distributed load shown below
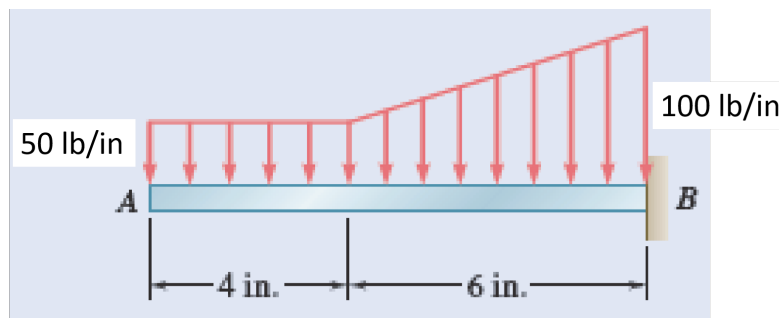
(a) What is the magnitude of resultant of the distributed load?

(b) What is the location of resultant of the distributed load?

3. (27 points) Consider the truss shown below.
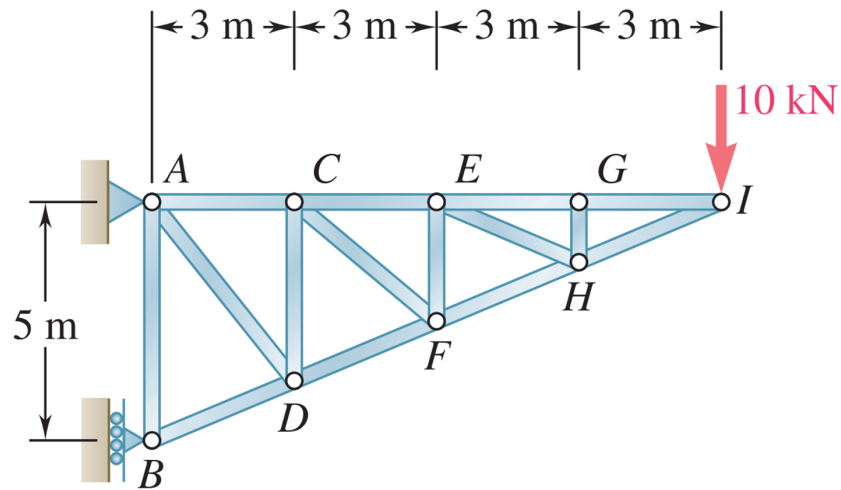
(a) What is the angle between the horizontal member GI and member IH?

(b) Draw a section of the truss that can be used to compute the force in members CD and DF.

(c) Determine the force in members CD and DF of the truss.

4. (24 points) A trailer weighing 2400 lb is attached to a 2900-lb pickup truck by a ball-and-socket joint at D. The truck and trailer are at rest so you may assume there is no horizontal reaction forces at the joint D.
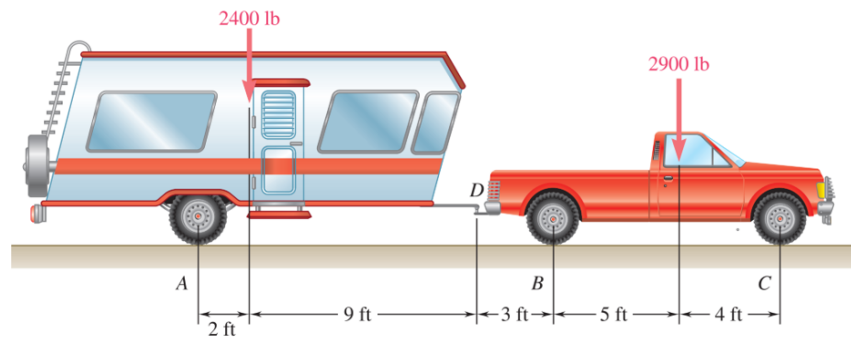
(a) Draw separate free body diagrams for the trailer and truck. Clearly label the reaction force at D on both of your diagrams.

(b) What is the reaction force at D?