Static Equilibrium Problem

A birdfeeder is suspended by a cable from a tree branch.
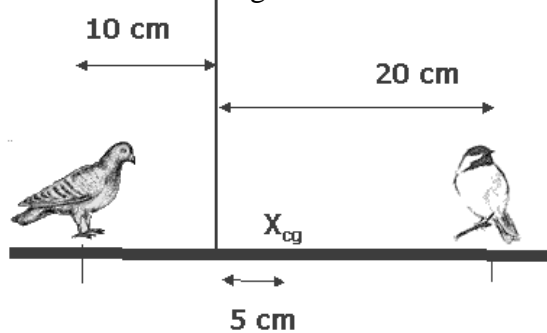The mass of the birdfeeder is 0.5 kg.
The weight of the birdfeeder acts at the center of gravity which is 0.05m to the **right** of the cable. (see figure below)

A chickadee sits on the right at a distance of 0.20 m from the cable
and a big pigeon sits on the left 0.10 m from the cable.
The mass of the chickadee is 0.015 kg. The feeder is in static equilibrium.

a)Draw a diagram showing **ALL** the forces acting on the feeder
and their directions ALSO **indicate the location of the pivot point**(also known as the axis of rotation)

b)Which of the forces cause negative torques?

c)Which of the forces cause positive torques?

d)What is the mass of the pigeon?

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A) All the forces acting in the birdfeeder and the location of the pivot point
Choose the pivot point where the tension force is, thus torque will be zero there.
And we do not know the value of the tension force.
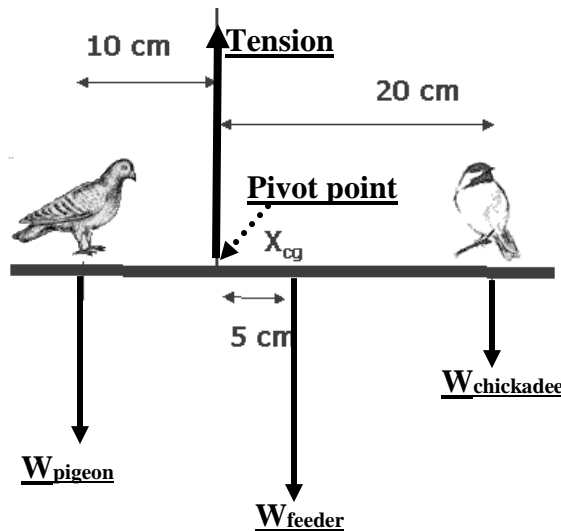
$$Torque = Frsin\theta$$

Conditions for static equilibrium:
$$\sum Torque = 0 \quad and \quad \sum Forces = 0$$
Many of these forces are the weight and W = mg and the angle is 90 degrees
Torque is calculated relative to the pivot point
Make sure to include the correct signs

Chickadee weight causes negative(clockwise) torque:
$$\tau = -(m_{ch}g)(.2)$$
Feeder Weight causes negative torque:
$$\tau = -(m_f \, g)(.05)$$

Pigeon weight causes positive torque: $\tau = +(m_p g)(.10)$

No torque from tension force since R is zero for tension force

Sum of torques:
$$\sum \tau = -(.015g)(.2) - (0.5g)(.05) + (m_p g)(.10) = 0$$
Cancel all the g

$$m_{pigeon} = \frac{[(.015)(.2) + (1.5)(.05)]}{0.10} = 2.80x10^{-1} \, kg \ = \ 0.280 \, kg \ = 280 \, g$$

BTW: average mass of a real pigeon is 400 grams