Torque

Phet Simulation :
https://phet.colorado.edu/sims/html/balancing-act/latest/balancing-act_en.html

Choose "Intro" tab. Play around with the simulation for a few minutes to understand/ explore the functionalities of the different components. To check if the board is balanced at the pivot, remove supports under the board by toggling the switch at bottom of the screen to right.

PART 1: Balancing torques on a seesaw

Choose "Balance Lab" tab. Select the following options in right corner of the screen:
Mass Labels, Level, Rulers

For each of the following cases, balance the board at the pivot. Don't forget to remove the supports under the board.

For each case, calculate total clockwise torque ($\Sigma \tau_{cw}$), total counterclockwise torque ($\Sigma \tau_{ccw}$) and net torque ($\Sigma \tau = \Sigma \tau_{cw} + \Sigma \tau_{ccw}$). Don't forget to convert masses to weights and the signs of toques (cw torque is negative & ccw torque is positive).

NOTE: Show calculation steps. Do not just compute on calculator and write the answer. Instead write the complete expression showing what numbers you multiplied/added to get the answers.

Case 1.

5 kg on right of the pivot, 10 kg on left of the pivot

$\Sigma \tau_{cw}$ =
$\Sigma \tau_{ccw}$ =
$\Sigma \tau$ = $\Sigma \tau_{cw} + \Sigma \tau_{ccw}$ =

Case 2.

5 kg & 10 kg on right of the pivot, 15 kg on left of the pivot

$\Sigma \tau_{cw}$ =
$\Sigma \tau_{ccw}$ =
$\Sigma \tau$ = $\Sigma \tau_{cw} + \Sigma \tau_{ccw}$ =

Case 3.

5 kg & 20 kg on right of the pivot, 10 kg & 15 kg on left of the pivot

$\Sigma\ \tau_{cw}\ =$

$\Sigma\ \tau_{ccw}\ =$

$\Sigma\ \tau\ =\ \Sigma\ \tau_{cw} + \Sigma\ \tau_{ccw} =$

Case 4.

5 kg, 10 kg & 15 kg on right of the pivot, 20 kg on left of the pivot

$\Sigma\ \tau_{cw}\ =$

$\Sigma\ \tau_{ccw}\ =$

$\Sigma\ \tau\ =\ \Sigma\ \tau_{cw} + \Sigma\ \tau_{ccw} =$

Case 5.

5 kg , 15 kg & 20 kg on right of the pivot, 10 & 15 kg on left of the pivot

$\Sigma\ \tau_{cw}\ =$
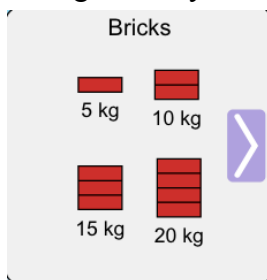
$\Sigma\ \tau_{ccw}\ =$

$\Sigma\ \tau\ =\ \Sigma\ \tau_{cw} + \Sigma\ \tau_{ccw} =$

PART 2: Finding unknown masses

Choose "Balance Lab" tab. Select the following options in right corner of the screen:
Mass Labels, Level, Rulers
In the "Bricks" section on the right of the screen, click on the right arrow. Keep on clicking to the right until you see "Mystery Objects".

Find out the mass of each of the Mystery Objects "E", "F", "G" and "H" by balancing each of these against the bricks of known masses.

For each Mystery Object, paste a screenshot of balanced seesaw and show all calculation steps.

Mystery Object "E"

Screenshot of balanced seesaw:

Calculations:

Mystery Object "F"

Screenshot of balanced seesaw:

Calculations:

Mystery Object "G"

Screenshot of balanced seesaw:

Calculations:

Mystery Object "H"

Screenshot of balanced seesaw:

Calculations: