Center of mass worksheet

Use a separate sheet to show your work clearly
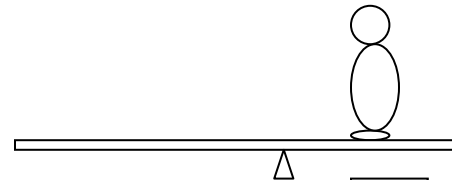
1) Define center of mass.
2) How is center of mass related to inertia?
3) How is center of mass related to gravity?
4) When is a free-standing object stable?
5) Why is the concept of center of mass useful?
6) A father and his young son get on a teeter-totter. The son sits 2 m from the center, but the father has to sit closer to balance. Where does the father have to sit to balance the teeter-totter if he weighs 4 times as much as his son?
7) On a meter stick, there are masses hanging. On the left are masses of 3 g at 0.20 m and 10 g at 0.40 m from the center. On the right is a 6 g mass at 0.50 m from the center. Where would a 4 g mass have to be hung to make the meter stick balance at the center (so that CM is at center)?
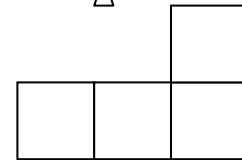8) Two masses are hanging from the ends of a 1 m bar. Where is the balance point (center of mass) of the system? m_1 is 1 kg, m_2 is 3 kg. Ignore the mass of the bar between the two masses.
9) Same as the previous question, but m_1 is 20 kg and m_2 is 50 kg and the masses are each 1 cm in from the ends of the bar, so they're 0.98 m apart.
10) A person is standing on the very end of a 2 m long board that is level and balanced. The balance point is 0.20 m from the end the person is on. The board has a mass of 20 kg.
    a) What is the mass of the person?
    b) How much does the person weigh?
11) A 98 N person is standing on a board, 1 m from the end. The board is balanced on a point that is 2m from the same end. The board is 49 N. How long is the board overall?
12) Describe three methods to find the center of mass of this L-shaped piece of cardboard. Draw diagrams to help your explanation.
13) Challenge question: Where is the center of mass of the object in the preceding question if the length of the sides of the squares is 1 m? Give numbers.
14) Challenge question: A honeybucket man is carrying his load. He has a pole 2 m long with a bucket hanging from each end. The buckets have a mass of 2 kg each. The pole has a mass of 1 kg. The front bucket has 5 kg of "honey" in it, and the rear bucket has 3 kg of "honey." How far from the center of the pole is the honeybucket man's shoulder?
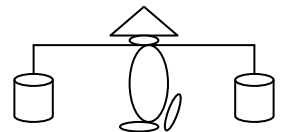
Answers
6. 0.5 m on opp side   7. 0.4m right of center   8. 0.25 m from the 3 kg mass
9. 0.28 m from the 50 kg   10. a) 80kg, b) 784N   11. 8m
13. The center of mass is 0.25 m to the left and 0.25 m below the inside corner of the L.
14. The man's shoulder is 0.15 m (2/13 m) forward of the center.