**Center Of Mass - 9.2**

|  |  |
| --- | --- |
|  | Teeter Totter Equation: |
| 0.73 Kg | 1. The center of mass between two objects is 12 cm from the one with a mass of 3.4 Kg. What is the mass of the other one if it is 56 cm from the COM? |
| 1.02 x1032 Kg | 2.A star is seen rotating about a point that is 4.2 x 109 m from its center. We can tell by its light output that it has a mass of 7.5 x 1031. What is the mass of the black hole in orbit around the star if it is 3.1 x 109 m from the COM? |
|  |  |
|  | The COM Equation |
| 22.7 cm | 3. How far is the COM from the larger of a 12 lb bowling ball and a 10 lb bowling ball that are 50 cm distant? |
| 37.5 cm | 4. A 5 Kg mass is on the 0 end of a meter stick, and a 3 Kg mass is on the 100 and of the stick. Where is the COM? (Neglect the mass of the meter stick) |
| 18.5 feet | 5. A 165 lb and 120 lb person sit on a see saw that is 32 feet long. How far is the balance point from the lighter person? |
| 4.49x102 km | 6. How far is the center of mass of the sun and Earth from the center of the sun? (The Earth-Sun distance is 1.50x1011 m - the sun has a mass of 1.99 x 1030 Kg, and Earth has a mass of 5.97 x 1024 Kg.) |
| At the 36.3 cm mark | 7. Someone clamps a 50 gram mass to the 15 cm mark of a 78 gram meter stick. Where is the center of mass of the meter stick and mass? (Treat the meter stick as a 78 gram mass at the 50 cm mark)  More than two objects: |
| At the 45.2 cm mark | 8. Someone puts a 45 gram clamp at the 12 cm mark and a 75 gram clamp at the 60 cm mark of a 82 gram meter stick. Where is the COM of the system now? (don't forget the meter stick itself) |
| 91.7 cm mark | 9. A 112 g uniform meter stick has a 14.0 g clamp at the 40.0 cm mark. Where would you clamp a 21.0 g clamp to make it balance at the 55.0 cm mark? |
| 36.9 g | 10. A 108 g uniform meter stick balances at the 44.0 cm mark when there is a 13.0 g clamp at the 85.0 cm mark and a what mass clamped at the 12.0 cm mark? |
| 7.98 x 105 m | 11. How far is the COM of the four inner planets and the sun from the center of the sun? (If they all lined up) |
| 7.98 x 105 m | 11. How far is the COM of the four inner planets and the sun from the center of the sun? (If they all lined up) |
| 66 feet from the ground | 12. Where is the COM of a 120 foot, 495 lb ladder with a 220 lb fireman 12 feet up, a 170 lb fireman 50 feet up and a 150 lb fireman all the way at the top? (The COM of the ladder is 80 feet from the ground) |
| 8.4 feet from the stern | 13. Where is the COM of a loaded 89 lb 18 foot canoe when there is a 160 lb person 1.5 feet from the stern, a 90 lb pack 9 feet from the stern, and a 140 lb bow person 15.5 feet from the stern? (Consider the canoe to be symmetric) |
| 55.6 cm mark | 14. Where is the COM of a 121 g uniform meter stick if there is a 12.0 g clamp at the 7.00 cm mark, a 34.0 g at the 23.0 cm mark and a 56.0 gram clamp at the 98.0 cm mark? |
| 9.80 cm mark | 15. A 68.0 g uniform meter stick has a 15.0 g clamp on the 17.0 cm mark, and it balances at the 32.0 cm mark. Where do you need to clamp a 45.0 g clamp to effect this? |
| 137 g | 16. A 145 g meter stick balances at the 66.6 cm mark. There is a 12.0 g clamp on the 92.0 cm mark, and what mass clamped at the 82.0 cm mark? |
|  | 17. (Extra credit) Devise a way to construct the center of mass of any triangle using a straight edge, and a compass. Explain this method. (Cut out your triangle from cardboard, and see if it balances on that point you've found. If it doesn't...try again) |

**Torsional Equilibrium - 9.2**

Find the missing quantity to put the system in torsional equilibrium around the pivot point:

1.20 m

1.60 m

14.0 N

7.20 N

1.90 m

F = ?

|  |  |
| --- | --- |
| 21. (1.77 N upward) | 22. (8.17 N downward)  6.00 m  13.0 m  118 N  135 N  11.0 m  F = ? |
| 23. (19.6 cm)  13.0 cm  x = ?  7.40 N  1.60 N  41.0 cm  1.20 N | 24. (60.0 cm - note where the distance is measured.)  35.0 cm  x = ?  6.00 N  7.20 N  45.0 cm  1.20 N |
| 25. The 56.0 kg beam is 12.0 m long, the 16.0 kg box is 5.00 m long. The 24.0 kg box is 3.20 m wide, and the supporting force is exerted 4.00 m from the left side. (1534 N)  56.0 kg  16.0 kg  F = ?  24.0 kg | 26. The 62.0 kg window washing scaffold is 9.00 m long, the big 85.0 kg worker is 3.80 m from the left side, and the 64.0 kg worker is 2.50 m from the right. Find the tension in the right cable. (pivot about the left cable) (1110 N)  62.0 kg  F = ? |
| 27. The 24.0 kg diving board is 5.10 m long, but its center of mass is 2.30 m from the left side. A 45.0 kg diver is 2.00 m from the left side, and a 57.0 kg diver is 0.500 m from the right side. How far from the pivot on the left side must the support be placed if the force on it cannot exceed 2150 N? (1.86 m)  24.0 kg  2150 N | 28. The stoplights each have a mass of 28.0 kg, with one hanging 1.80 m from the left side, and the other hanging 0.700 m from the right side. The supporting beam is uniform, 6.20 m long with a mass of 16.0 kg. How far from the left side must the supporting cable be attached if the tension is not to exceed 623 N? (4.00 m)  16.0 kg  623 N |