Torque Problem Art Contest Name _____

Torque problems:

1. A lever is used to lift a boulder. The fulcrum is placed 1.60 m away from the end at which you exert a downward force,producing a torque with a magnitude of 400 N•m. If the angle between the force and the lever is 80.0°,what is the magnitude of the applied force? Assume that the lever is massless.

2. Suppose the applied force in problem 1 produces a counterclockwise torque. If the net torque exerted on the lever in problem 1 is 14.0 N•m counterclockwise,what is the weight of the boulder? Assume that the lever arm between the boulder's center of mass and the fulcrum is 0.200 m and that the angle between the boulder's weight and the lever arm is 80.0°.

3. Small windmills have been used for over a century to pump water on farms and ranches in the United States. The rotors of these mills consist of 18 metal blades called "sails." Even a small wind can provide enough torque for drawing water from underground wells. If the length of a sail is 2.44 m and the torque exerted by the wind is 50.0 N•m counterclockwise,what is the magnitude of the wind's force? Assume that this force is exerted perpendicular to the blade and at the blade's tip.

4. A force is applied to a door at an angle of 60.0° and 0.40 m from the hinge. What force produces a torque with a magnitude of 1.4 N•m? How large is the maximum torque this force can exert?

5. The force exerted by the driving rods ofa steam locomotive has a magnitude of 227 000 N. Each rod is connected to one of the driving wheels at a point halfway between the center and the rim of the wheel. Suppose the driving wheel has a radius of 0.660 m. How large is the maximum torque exerted on the driving wheels by the driving rods?

6. 6. The world's narrowest street,which is located in a small Italian village, is only 43 cm wide. Suppose a fish with a mass of 1.6 kg is hung from a string attached to a stick. The stick,slightly longer than the street is wide,is placed horizontally across the narrow street with each end resting on a windowsill. The fish hangs a horizontal distance of 15 cm from the windowsill on the right. If the axis of rotation for the stick is taken to be the end farthest from the fish,what is the magnitude of the torque produced by the fish? Assume the stick has negligible mass.

7. A golfer produces a torque with a magnitude of 0.46 N•m on a golf club.If the club exerts a force with a magnitude of 0.53 N on a stationary golfball,what is the length of the club?

8. In 1902,fresh water was provided to San Francisco,California,by two large Dutch-style windmills on the western edge of the city. Though not in use,both mills are still standing. Suppose a worker is restoring one of these windmills when the ladder shifts to the side. The worker grabs the end of one of the rotor vanes and hangs onto it until fellow workers come to the rescue. The worker hangs at an angle of 65.0° to the vane,exerting a counterclockwise torque of 8250 N•m. If the worker weighs 587 N,what is the length of the windmill vane?
9. skipped
10. At the moment before a diver jumps from a diving board,a force of 1200 N is exerted on the diver at an angle of 90.0° to the board. This force produces a torque in the clockwise direction. At the same time,the diver's weight produces a torque in the counterclockwise direction. The diver's mass is 60.0 kg,and the angle between the diver's weight and the board is 87.7°. If the net torque acting on the diver is 2985 N•m clockwise,what is the length of the diving board?

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11. The heaviest sea sponge ever collected had a mass of 40.0 kg,but after drying out,its mass decreased to 5.4 kg. Suppose two loads equal to the wet and dry masses of this giant sponge hang from the opposite ends of a horizontal meter stick of negligible mass and that a fulcrum is placed 70.0 cm from the larger of the two masses. How much extra force must be applied to the end of the meter stick with the smaller mass in order to provide equilibrium?

12. A Saguaro cactus with a height of 24 m and an estimated age of 150 years was discovered in 1978 in Arizona. Unfortunately,a storm toppled it in 1986. Suppose the storm produced a torque of 200 000 N•m that acted on the cactus. If the cactus could withstand a torque of only 120 000 N•m,what minimum force could have been applied to the cactus keep it standing? At what point and in what direction should this force have been applied? Assume that the cactus itself was very strong and that the roots were just pulled out of the ground.

13. In 1994,John Evans set a record for brick balancing by holding a load of bricks with a mass of 134 kg on his head for 10 s. Another,less extreme, method of balancing this load would be to use a lever. Suppose a board with a length of 7.00 m is placed on a fulcrum and the bricks are set on one end of the board at a distance of 2.00 m from the fulcrum. If a force is applied at a right angle to the other end of the board and the force has a direction that is 60.0° below the horizontal and away from the bricks, how great must this force be to keep the load in equilibrium? Assume the board has negligible mass.

14. In 1994,a vanilla ice lollipop with a mass of 8800 kg was made in Poland. Suppose this ice lollipop was placed on the end of a lever 15 m in length. A fulcrum was placed 3.0 m from the lollipop so that the lever made an angle of 20.0° with the ground. If the force was applied perpendicular to the lever,what was the smallest magnitude this force could have and still lift the lollipop? Neglect the mass of the lever.

15. The Galápagos fur seals are very small. An average adult male has a mass of 64 kg,and a female has a mass of only 27 kg. Suppose one average adult male seal and one average adult female seal sit on opposite ends of a light board that has a length of 3.0 m. How far from the male seal should the board be pivoted in order for equilibrium to be maintained?

16. Goliath,a giant Galápagos tortoise living in Florida,has a mass of 360 kg. Suppose Goliath walks along a heavy board above a swimming pool. The board has a mass of 600 kg and a length of 15 m,and it is placed horizontally on the edge of the pool so that only 5.0 m of it extends over the water. How far out along this 5.0 m extension of the board can Goliath walk before he falls into the pool?

17. The largest pumpkin ever grown had a mass of 449 kg. Suppose this pumpkin was placed on a platform that was supported by two bases 5.0 m apart . If the left base exerted a normal force of 2700 N on the platform,how far must the pumpkin have been from the platform's left edge? The platform had negligible mass.

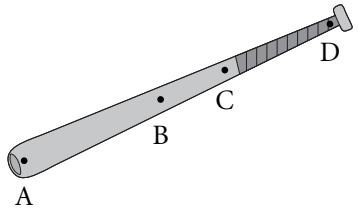
18. In 1991,a giant stick of Brighton rock (a type of rock candy) was made in England. The candy had a mass of 414 kg and a length of 5.00 m. Imagine that the candy was balanced horizontally on a fulcrum. A child with a mass of 40.0 kg sat on one end of the stick. How far must the fulcrum have been from the child in order to maintain equilibrium?

19. If a net torque is applied to an object,that object will experience which of the following?
    A) constant angular speed
    B) an angular acceleration
    C) a constant moment of inertia
    D) an increasing moment of inertia

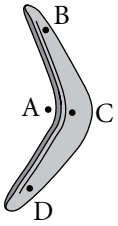
20. Which of the following statements is correct?
    A) The farther the force is from the axis of rotation,the more torque is produced.
    B) The closer the force is to the axis of rotation,the more torque is produced.
    C) The closer the force is to the axis of rotation,the easier it is to rotate the object.
    D) The farther the force is from the axis of rotation,the less torque is produced.

21. If you cannot exert enough force to loosen a bolt with a wrench,which of the following should you do?
    A) Use a wrench with a longer handle.
    B) Tie a rope to the end of the wrench and pull on the rope.
    C) Use a wrench with a shorter handle.
    D) You should exert a force on the wrench closer to the bolt.

22. At which point on the baseball bat above is the approximate center of mass?



23. At which point in the figure is the approximate center of mass?



24. A heavy bank-vault door is opened by the application of a force of 300N directed perpendicular to the plane of the door at a distance of 0.80 m from the hinges.What is the torque?
    A) 120 N • m
    B) 240 N • m
    C) 300 N • m
    D) 360 N • m

25. A bucket filled with water has a mass of 23 kg and is attached to a rope that is wound around a cylinder with a radius of 0.050 m at the top of a well.What torque does the weight of the water and bucket produce on the cylinder? ($g = 9.81\ m/s^2$)
    A) 34 N • m
    B) 17 N • m

C) 11 N • m
D) 23 N • m

26. A child with a weight of 450 N sits on a seesaw 0.60 m from the axis of rotation. How far from the axis of rotation on the other side should a child with a weight of 600 N sit so the seesaw will remain balanced?
A) 0.30 m
B) 0.40 m
C) 0.45 m
D) 0.50 m

27. Which ofthe following quantities measures the ability of a force to rotate or accelerate an object around an axis?
A) axis of rotation
B) lever arm
C) moment arm
D) torque

28. Where should a force be applied on a lever arm to produce the most torque?
A) closest to the axis of rotation
B) farthest from the axis of rotation
C) in the middle of the lever arm
D) it doesn't matter where the force is applied

29. If you want to open a swinging door with the least amount of force,where should you push on the door?
A) close to the hinges
B) in the middle
C) as far from the hinges as possible
D) it does not matter where you push

30. A heavy bank-vault door is opened by the application of a force of 300 N directed perpendicular to the plane of the door at a distance of 0.80 m from the hinges.What is the torque?
A) 120 N • m
B) 240 N • m
C) 300 N • m
D) 360 N • m

31. A uniform bridge span weighs 50 000 N and is 40.0 m long. An automobile weighing 15 000 N is parked with its center of gravity located 12.0 m from the right pier.What upward support force is provided by the left pier?
A) 2.95×10^4N
B) 3.55×10^4N
C) 6.50×10^4N
D) 3.25×10^4N

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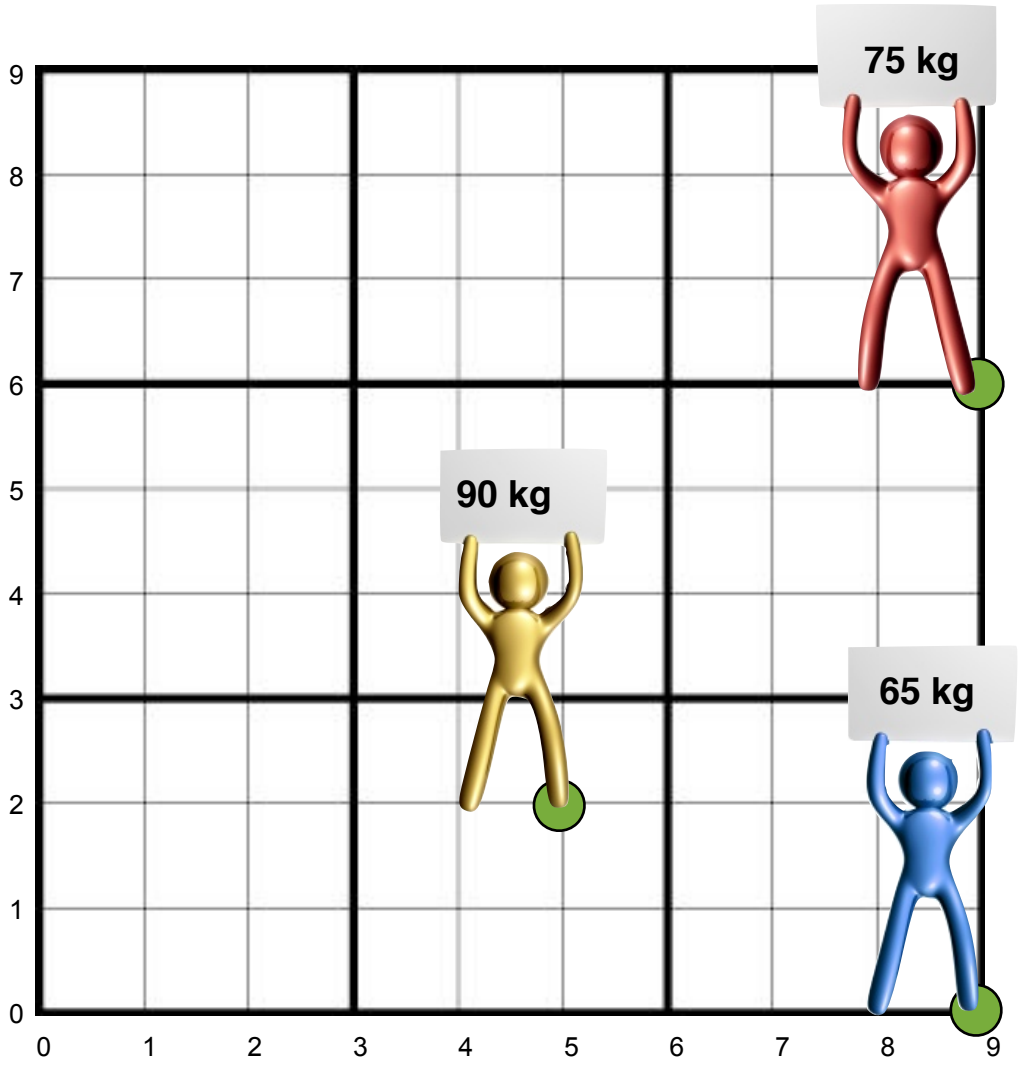
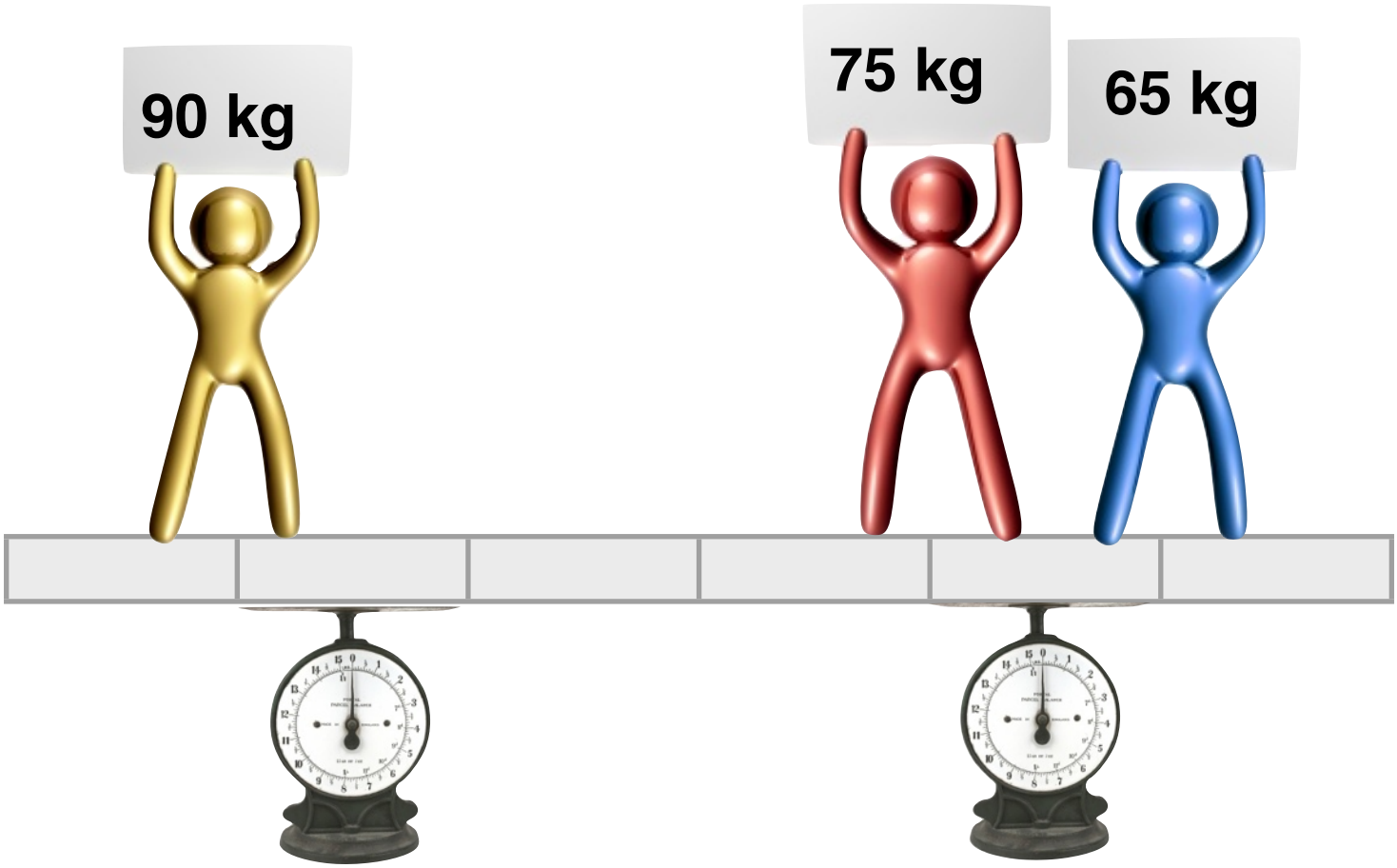


No, It's not sudoku! **Where is the center of mass for the students?** Use the dot at each student's feet as their location.

(_____ , _____)

Torque Problem Art Contest

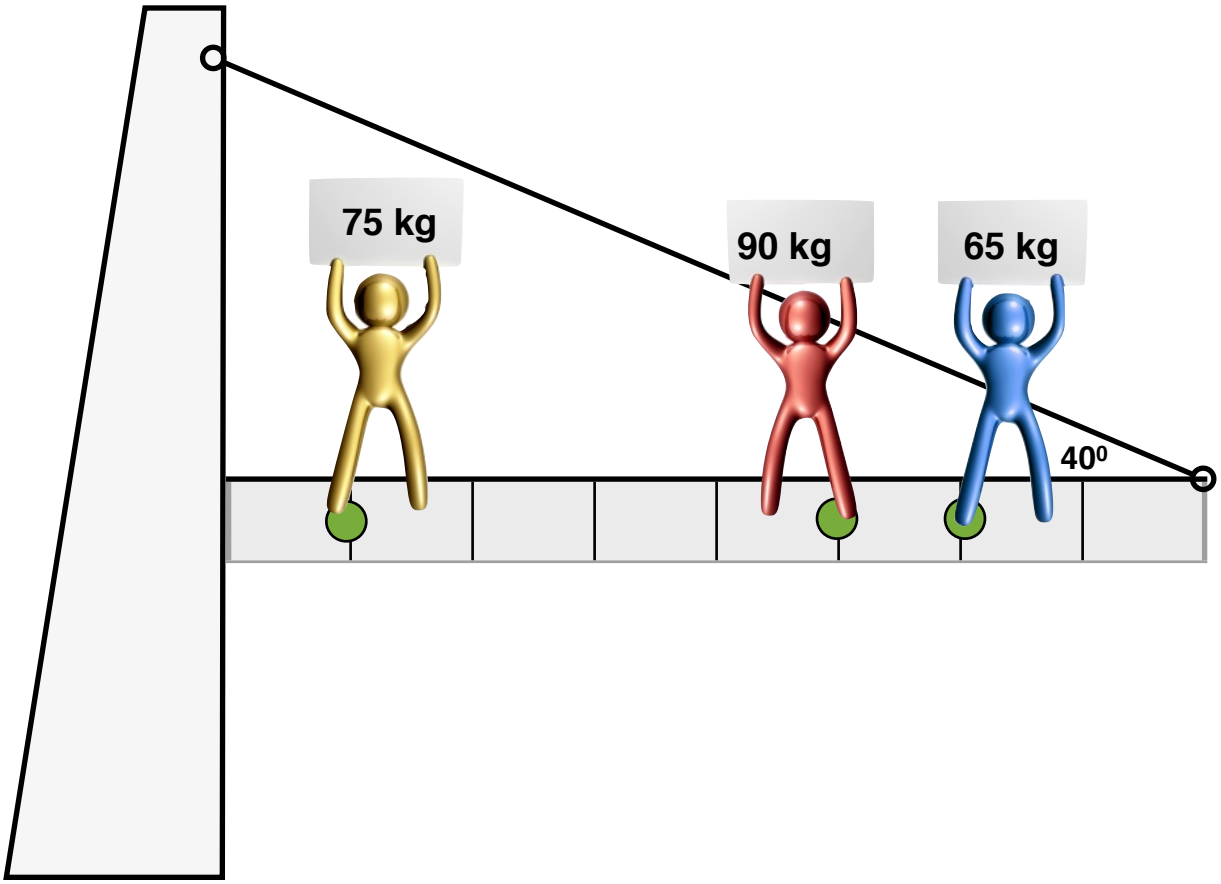
Name _____



Three students with known masses stand on a 6 meter board at 1m, 4m, and 5m locations. The board has a mass of 15 kg. Two scales support the bar at 1.5m and 4.5m. **Find the force on the right and left scales**.

Torque Problem Art Contest

Name _____



The students are on an 8m bridge at 1m, 5m, and 6m locations. The bridge has a mass of 50 kg. A support rope is tied to the end of the bridge and the wall forming angles as shown. **Find all forces**