

Torque 1

Solve the following problems

1. Ned tightens a bolt in his car engine by exerting a 12 N force on his wrench at a distance of 0.40 m from the fulcrum. How much torque must Ned produce to turn the bolt?
2. A water faucet is turned on when a force of 2.0 N is exerted on the handle, at a distance of 0.060 m from the pivot point. How much torque must be produced to turn the handle?
3. Nancy, whose mass is 60 kg, is working at a construction site and she sits down for a bite to eat at noon. If Nancy sits on the very end of a 3.00-m long plank, pivoted in the middle on a saw horse, how much torque must her co-worker provide on the other end of the plank in order to keep Nancy from falling on the ground?
4. Which is better for prying open a stuck cover from a can of paint – a screwdriver with a thick handle or one with a long handle? Which is better for turning stubborn screws? Explain.
5. You cannot stand with heels and back to the wall and successfully lean over and touch your toes without toppling. Would either stronger legs or longer feet help you to do this. Defend your answer.
6. Where must a football be kicked so that it won't topple end over end as it sails through the air?
7. Calculate the torque produced by a 50-N perpendicular force at the end of a 0.2-m long wrench.

8. Calculate the torque produced by the same 50-N force when a pipe extends the length of the wrench to 0.50 m.
9. (Walker, p. 342, #1) To tighten a spark plug, it is recommended that a torque of $15 \text{ N}\cdot\text{m}$ be applied. If a mechanic tightens the spark plug with a wrench that is 25 cm long, what is the minimum force necessary to create the desired torque?
10. (Walker, p. 342, #3) A 1.61 kg bowling trophy is held at arm's length, a distance of 0.605 m from the shoulder joint. What torque does the trophy exert about the shoulder if the arm is (a) horizontal, or (b) at an angle of 22.5° below the horizontal?
11. (Walker, p. 342, #4) A person slowly lowers a 3.6-kg crab trap over the side of a dock, as shown in the figure below. What torque does the trap exert about the person's shoulder?



12. (Serway, P. 258, #1) Find the magnitude of the torque produced by a 3.0 N force applied to a door at a perpendicular distance of 0.25 m from the hinge.
13. (Serway, P. 258, #3) If the torque required to loosen a nut on the wheel of a car has a magnitude of $40.0 \text{ N}\cdot\text{m}$, what minimum force must be exerted by a mechanic at the end of a 30.0 cm wrench to loosen the nut?

Thinking PHYSIC:

WEIGHT LIFTING

Weight lifting, or “pumping iron” has become very popular in the last few years. When lifting a barbell, which grip will exert less force on the lifter’s arms: one in which the arms are extended straight upward from the body so they form right angles to the bars, or one in which the arms are spread so that the bar is gripped closer to the weights?

Only the force *perpendicular* to the barbell contributes to lifting it. A grip in which the arms are extended straight forward from the body, so that all the force exerted is perpendicular to the bar, will exert less force on the weightlifter’s arms. Spreading the arms so that the bar is gripped closer to the weights reduces the component of force perpendicular to the bar. The lifter must exert more total force for the perpendicular component to equal the force exerted when the arms are perpendicular to the bar.