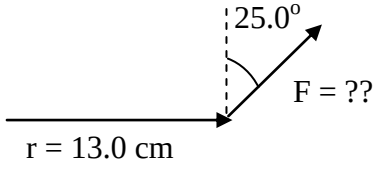
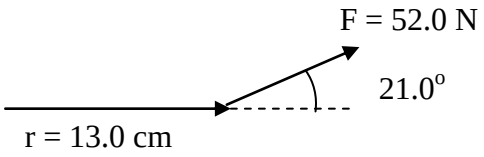
**Angular Dynamics problems from 8.2**

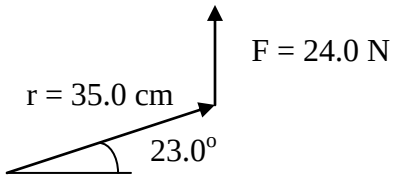
A. What force acting at $25.0^o$ with a line perpendicular to the end of a 13.0 cm long wrench will generate 7.80 mN of torque about the left side of the wrench? (66.2 N)



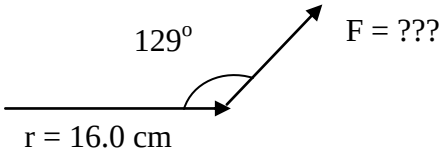

B. Calculate the torque about the left side of the wrench if 52.0 N acts at an $21.0^o$ angle with the end of a 13.0 cm long wrench. (2.42 mN)




C. A 35.0 cm wrench makes a $23.0^o$ angle above the horizontal. What is the torque about the left side of the wrench if a 24.0 N force is exerted vertically upward at the end? (7.73 mN)




D. A force is exerted at an angle of $129^o$ with a 16.0 cm wrench as shown below. Calculate the force needed to create 3.80 mN of torque about the left side of the wrench. (30.6 N)




Moments of inertia: Cylinder: $I = {}^1/_2\, mr^2$, Sphere: $I = {}^2/_5 mr^2$, Thin Ring or Point Mass: $I = mr^2$

Simple F = ma problems: $\boldsymbol{\Gamma = I\alpha}$

1. A baton requires 5.70 mN of torque to accelerate at 18.4 rad/s/s about its center. What is the moment of inertia? (0.310 $kgm^2$)
2. A flywheel with a moment of inertia of 0.859 kg $m^2$ accelerates at 13.0 rad/s/s. What is the torque? (11.2 mN)
3. A motor with 43.0 mN of torque accelerates at 153 rad/s/s. What is its moment of inertia? (0.281 $kgm^2$)
4. A torque of 21.0 mN acts on a motor with a moment of inertia of 1.53 kg $m^2$. What is the angular acceleration? (13.7 rad/s/s)
5. What torque will accelerate a motor with a moment of inertia of 3.87 kg $m^2$ at 6.60 rad/s/s? (25.5 mN)

F = ma problems, but $I = {}^1/_2\, mr^2$ (cylinder), $I = {}^2/_5 mr^2$ (sphere), or kinematics, or $\Gamma = rF$

6. A 0.400 m diameter, 4.30 kg sphere accelerates about its center at 6.80 rad/s/s. What is the torque? (0.468 mN)
7. A drill with a moment of inertia of 0.0180 kg $m^2$ is slowed by a frictional torque of 0.270 mN. If it is moving at 142 rad/s, how many radians will it go through before it stops? (672 rad)
8. A grinding wheel with a diameter of 0.640 m and a moment of inertia of 0.172 kg $m^2$ decelerates at -8.90 rad/s/s because of a tangential friction force applied at the edge. What is this force? (4.78 N)
9. A torque of 19.0 mN acts on a flywheel with a moment of inertia of 3.20 kg $m^2$. If it starts at rest, in what time will it go through 16.0 radians? (2.32 s)
10. A torque of 3.50 mN acts on a 7.10 kg, 0.132 m diameter shot put. (a sphere) What is the angular acceleration of the sphere? (283 rad/s/s)

Same as above with unit conversions:

11. A 0.219 m diameter bowling ball has a tangential force 5.50 N acting on it and it accelerates from rest going through 13.0 rotations in 3.21 seconds. What is the moment of inertia of the ball? (0.0380 $kgm^2$)
12. A 0.310 m radius flywheel (essentially a thin ring) with a mass of 3.20 kg. What is its rate of deceleration if you exert a force of 2.20 N tangentially at its edge? (2.22 rad/s/s)
13. A flywheel is a 13.2 kg 1.80 m diameter thin ring. If you exert a force of 51.0 N tangentially at its edge, what is its angular acceleration? (4.29 rad/s/s)
14. A flywheel that is a 0.730 m diameter thin ring with a mass of 16.0 kg would require what torque to accelerate from rest to 1120 RPM in 8.10 seconds? (30.9 mN)
15. What is the moment of inertia of a 0.258 m radius flywheel if when you exert a tangential force of 11.5 N at the edge it accelerates from rest to 680. RPMs in 123 rotations? (0.904 $kgm^2$)

Same as above with unit conversions and kinematics:

16. A 161 kg 4.72 m diameter (cylindrical) merry go round is sped up from rest by a 25.0 N force applied tangentially at its edge. What is its speed in RPMs after 38.0 seconds? (47.8 RPM)
17. A 2.10 m radius, 351 kg (cylindrical) merry go round spinning at 75.0 RPM slows to a halt in 11.5 rotations. What force applied tangentially at the edge would cause this? (157 N)
18. A 232 kg 4.10 m diameter (cylindrical) Merry go round is stopped from a speed of 94.0 RPM in 55.0 seconds. What frictional force applied tangentially at the edge would cause this? (42.6 N)
19. A 243 kg 1.70 m radius (cylindrical) merry go round stops from a speed of 68.0 RPM because of a frictional force applied at the edge of 8.50 N. How many rotations does it go through in stopping? (98.1 rotations)
20. A 4.60 m diameter (cylindrical) merry go round speeds up from rest going through 5.10 rotations in 41.0 seconds because of a 15.0 N force applied tangentially at the edge. What is the mass of the merry go round? (342 kg)