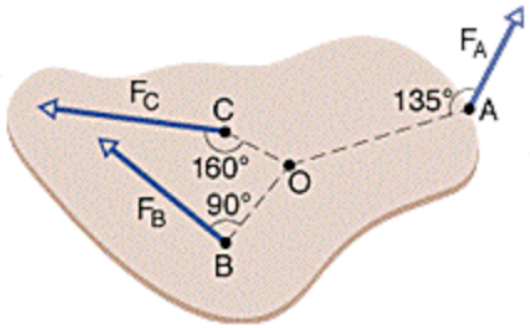
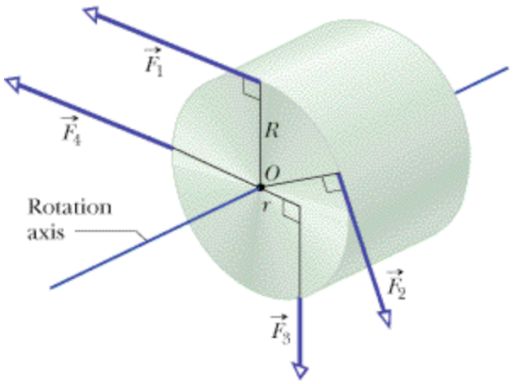
1. **The body in the figure is pivoted at O. Three forces act on it in the directions shown on the figure. $F_A$ = 11 [N] at point A, 8.0 m from O. $F_B$ = 15 [N] at point B, 4.0 [m] from O. $F_C$ = 17 [N] at point C, 3.0 [m] from O. What is the net torque about the pivot point O? Assume clockwise to be positive.**




2. **In the figure below a cylinder having a mass of 4 [kg] can rotate about its central axis through point O. Forces are applied as shown: $F_1$ = 9 [N], $F_2$ = 6 [N], $F_3$ = 3 [N], and $F_4$ = 4 [N]. Also, r = 5 [cm] and R = 12 [cm]. What is the net torque about the pivot point O? Assume clockwise to be positive.**



3. **You apply a force to a non-linear spring to compress it. The force you applied to the spring is given by the expression $F = kx^4$, where F is in [N] and x is in [m].**
   a. **What is the expression for the work you did in compressing the spring?**
   b. **What is the constant of integration if W(0) = 0 [J]?**
   c. **What is the potential energy function for this spring?**

4. **A 3 [kg] object is moving along the x-axis in a frictionless region where the potential energy as a function of x is given by $U(x) = 4x^2$, where U in [J] and x in [m]. When the object passes the point x = 0.5 [m], its velocity is +2 [m/s].**
   a. **Calculate the total mechanical energy of the object at x = 0.5 [m] (i.e., the sum of the kinetic and potential energies)**
   b. **Calculate the x-coordinate of any points at which the object has zero kinetic energy (consider both positive and negative values of x)**
   c. **Calculate the magnitude of the momentum of the object at x = 0.6 [m].**
   d. **Calculate the magnitude of the acceleration of the object as it passes x = 0.6 [m].**

**AP FRQs**

5. **2000 #2 (Writing Differential Equations)**

**Extra Problems**

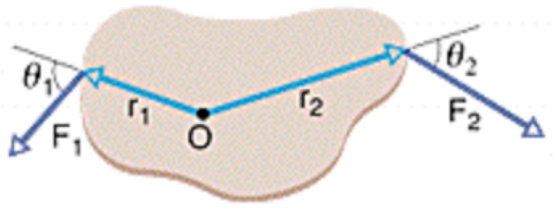
**E1. The angular position of a point on the rim of a rotating wheel is given by:**

$$\theta = 9t - 2t^2 + t^3$$

**where θ is in radians and t is in seconds.**

a. **What is the angular velocity at t = 4 [s]?**
b. **What is the angular velocity at t = 6.0 [s]?**
c. **What is the average angular acceleration for the time interval that begins at t = 4 [s] and ends at t = 6.0 [s]?**
d. **What is the instantaneous angular acceleration at the beginning of this time interval?**
e. **What is the instantaneous angular acceleration at the end of this time interval?**

**E2. The body in the figure below is pivoted at O, and two forces act on it as shown. Assume clockwise to be positive.**




**If $r_1$ = 1.40 [m], $r_2$ = 2.14 [m], $F_1$ = 3.70 [N], $F_2$ = 5.31 [N], $\theta_1$ = 75.0°, and $\theta_2$ = 60.0°, what is the net torque about the pivot point O?**

**E3. A force F(t) = 4sin(2t) [N] acts on an object for the time interval 1 [s] to 5 [s].**

a. **What is the impulse that acts on the object?**
b. **If the mass of the object is 0.15 [kg], what is the change in velocity of the object? (use radian mode for trig functions)**

1. -19.7 [Nm] (negative implies counterclockwise net torque)

2. -0.21 [Nm] (negative implies counterclockwise net torque)

3a. $U = kx^5/5 + C$ [J]
3b. $C = 0$
3c. $U = kx^5/5$

4a. 7 [J]
4b. +/- 1.3 [m]
4c. 5.77 [kg m/s]
4d. 1.6 [$m/s^2$]

5. Will review in class

**Extra Problem(s)**

E1 a. 41 [rad/s]
E1 b. 93 [rad/s]
E1 c. 26 [$rad/s^2$]
E1 d. 20 [$rad/s^2$]
E1 e. 32 [$rad/s^2$]

E2. 4.84 [Nm] (positive implies clockwise net torque)

E3a. 0.846 [Ns]
E3b. 5.64 [m/s]