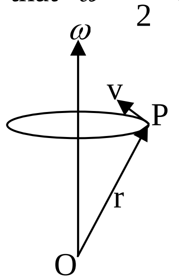
HOMEWORK #1 (Chapter 9 Vector Calculus)

(1). Suppose $\nabla f(a,b) = 4\underset{\sim}{i} + 3\underset{\sim}{j}$. Find a unit vector **u** so that: (Exercises 9.5 problem 33).

(a). $D_u f(a,b) = 0$.
(b). $D_u f(a,b)$ is a maximum.
(c). $D_u f(a,b)$ is a minimum.

(2). Let $r = x\underset{\sim}{i} + y\underset{\sim}{j} + z\underset{\sim}{k}$ be the position vector of a mass m_1 and let the mass m_2 be located at the origin. If the force of gravitational attraction is $F = -\dfrac{Gm_1m_2}{\|r\|^3} r$, verify that curl $F = 0$ and div $F = 0$, $r \neq 0$. (Exercises 9.7 problem 39).

(3).Suppose a body rotates with a constant angular velocity ω about an axis. If **r** is the position vector of a point ***P*** on the body measured form the origin, then the linear velocity vector **v** of rotation is $v = \omega \times r$. See Figure. If $r = x\underset{\sim}{i} + y\underset{\sim}{j} + z\underset{\sim}{k}$ and $\omega = \omega_1\underset{\sim}{i} + \omega_2\underset{\sim}{j} + \omega_3\underset{\sim}{k}$, show that $\omega = \dfrac{1}{2}$ curl **v**. (Exercises 9.7 problem 40).

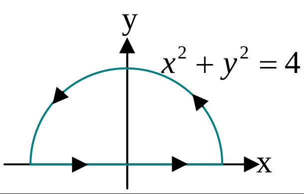


In problem 4, Find the length of the curve traced by the given vector function on the indicated interval. (Exercises 9.1 problem 44).

(4). $r(t) = 3t\underset{\sim}{i} + \sqrt{3}t^2\underset{\sim}{j} + \dfrac{2}{3}t^3\underset{\sim}{k}$; $0 \le t \le 1$.

In problem 5-6, evaluate $\oint_C (x^2 + y^2)dx - 2xydy$ on the given closed curve C. (Exercises 9.8 problem 19 and 20).

(5).



(6).