203: Homework 11 Due November 17

1. Let $M = \{P + sA + tB : s, t \in \mathbb{R}\}$, where $P = (1, -1, 1)$, $A = (1, 2, -1)$ and $B = (2, 1, 2)$. Determine which of these points lie on M:
(a) $(9, 6, 4)$ (b) $(8, 5, 3)$ (c) $(0, -3, 0)$.

2. For the plane M from the previous problem, give two different normal vectors, and calculate the distance of M from the origin. Give a Cartesian equation for M.

3. Find two unit vectors orthogonal to A and B, where $A = (1, 2, 1)$ and $B = (-1, 1, 2)$.

4. Use cross-products to calculate the area of the triangle with vertices $(1, 2, 3), (2, 3, 5)$ and $(1, 4, 8)$.

5. Let $A = 2\mathbf{i} - \mathbf{j} + 2\mathbf{k}$, and let $B = 3\mathbf{i} + 4\mathbf{j} - \mathbf{k}$.
a) Find a vector C so that $A \times C = B$. Is the vector C unique?
b) Find a vector C so that $A \times C = B$ and $A \cdot C = 1$. Is the vector C unique?

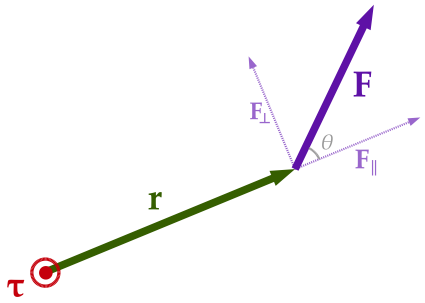

Figure 1: Picture from Wikipedia by StradivariusTV

6. The torque of a force $\mathbf{F}$ applied at $\mathbf{r}$ to turn around the axis through τ has magnitude equal to the product of $\|\mathbf{F}_\perp\|$ with $\|\mathbf{r}\|$. Express this in terms

of the cross-product. Calculate the torque that a force of 150 Newtons would produce if the angle θ is 70 degrees and $\|r\|$ is 30 cm (the unit of torque is the Newton meter).

7. Find the volume of the parallelepiped determined by the vectors $(6, 3, -1), (0, 1, 2)$ and $(4, -2, 4)$.