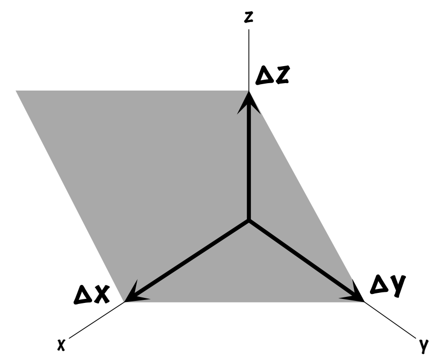
Assignment 1, Due Tuesday, July 9 at 4:30 pm.

1. This is an old exam problem.

   (a) Expand the product $(\mathbf{u}+\mathbf{v})\cdot(\mathbf{u}-\mathbf{v})$, using the properties of the dot product (p. 801) to simplify your answer as much as possible.

   (b) Suppose $\mathbf{u}$ and $\mathbf{v}$ are not parallel. If the vectors $\mathbf{u}+\mathbf{v}$ and $\mathbf{u}-\mathbf{v}$ are mutually orthogonal (perpendicular), how must the vectors $\mathbf{u}$ and be $\mathbf{v}$ related?

2. Create an oriented surface area element for use in Chapter 16. As shown, the vectors $\mathbf{\Delta x} = \langle \Delta x, 0, 0 \rangle$, $\mathbf{\Delta y} = \langle 0, \Delta y, 0 \rangle$, and $\mathbf{\Delta z} = \langle 0, 0, \Delta z \rangle$ point at three of the parallelogram's four vertices. The increments Δx, Δy, and Δz are positive.



(a) Give the vector $\mathbf{u} = \mathbf{\Delta z} - \mathbf{\Delta y}$ in component form. Draw $\mathbf{u}$ on the parallelogram (p. 793) and label it.

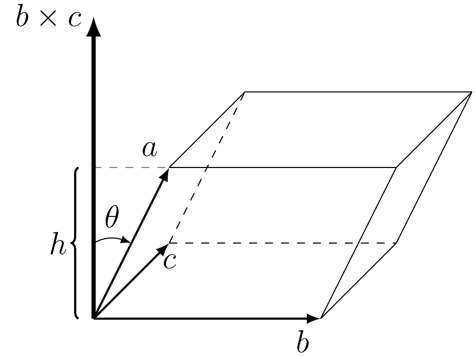
(b) Give the vector $\mathbf{v} = \mathbf{\Delta x} - \mathbf{\Delta y}$ in component form. Draw $\mathbf{v}$ on the parallelogram and label it.

(c) Create a new vector $\mathbf{\Delta S}$ from $\mathbf{u}$ and $\mathbf{v}$. $\mathbf{\Delta S}$ should have positive components, be perpendicular to the plane of the parallelogram and have a magnitude equal to the area of the parallelogram (page 811).

(d) Briefly describe what you did in this problem.

3. Show that $|a \cdot (a \times b)|$ is the volume of the parallelepiped determined by three vectors a, b and c. ($| \cdot |$ denotes the absolute value). You might use properties of the cross product (page 812).

   (a) What is the area A of the base of the parallelepiped?



   (b) Describe h in terms of a and θ.

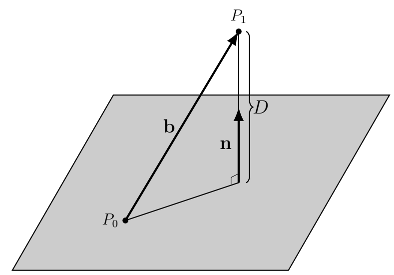
   (c) Use the formula $V = Ah$ to get the final result.

   (d) Let $a = \langle 0, 1, 2 \rangle, b = \langle 0, 2, 0 \rangle, c = \langle 1, 0, 0 \rangle$. Find the volume of the parallelepiped determined by a, b and c. (recall that $a \cdot (b \times c) = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}$)

4. Find a formula for the distance D of a point $P_1(x_1, y_1, z_1)$ from a plane $ax+by+cz+d = 0$.

(a) Let $P_0(x_0, y_0, z_0)$ be any point in the given plane, and let $b = \overrightarrow{P_0P_1}$.

- $b =$
- $n =$



(b) $D = \dfrac{|n \cdot b|}{|n|} =$

(c) Since P_0 is in the plane, it's coordinates satisfy the equation of the plane and so we have $ax_0 + by_0 + cz_0 + d = 0$. Use this to simplify your answer in part (b).

5. Reading assignments:
    (a) Theorem 11: Page 812
    (b) Torque: pages 813-814
    (c) Example 3: Page 819
    (d) Example 5: page 829
    (e) Table 1: Page 830 (Also see the maple worksheets)
6. Suggested problems from the book (do NOT turn in):
    (a) Section 12.1: # 5, 9, 10a, 10e, 13, 20, 21, 31, 33, 37, 44
    (b) Section 12.2: # 4, 8, 13, 22, 25, 27, 29, 36, 38, 47, 48
    (c) Section 12.3: # 1, 12, 13, 24c, 27, 28, 45, 53, 55, 56, 61, 62, 64
    (d) Section 12.4: # 9, 11, 13, 37, 44, 45, 46, 50, 51, 52, 53
    (e) Section 12.5: # 1, 59, 63, 73, 75, 76, 82
    (f) Section 12.6: # 1, 9 19, 37, 46, 49