Instructions for written homework.

- You are encouraged to work with others on these problems. You are expected to write the solutions yourself.

- Your solutions should be legible and well organized. **Graders will deduct points for solutions that are difficult to read, or are disorganized.** For the benefit of the grader, please turn in solutions to problems in the assigned order, i.e. #1, then #2, then #3, etc.

- Staple your pages together. Do not turn in notebook paper with tattered edges. **Homework that is unstapled or is lacking a name will not be graded.**

**Problem 1** (Fall 2008). Which of the following equations in $x$ and $y$ is equivalent to the statement that the vectors

$$A = (x + y, 1, y) \text{ and } B = (1, x - y, -1)$$

are perpendicular to each other?

(A) $x - 2y = 0$  
(B) $2x - y = 0$  
(C) $2x + y = 0$  
(D) $x - y = 0$  
(E) $x + 2y = 0$  
(F) none of the above
Problem 2 (Fall 2008). Let \( \mathbf{v} = (0, 7, 0) \) and let \( \mathbf{u} \) be a vector of length 5 which starts at the origin and lies in the \( x - y \) plane. Find the maximum value of the length of the vector \( \mathbf{u} \times \mathbf{v} \).

(A) \( |\mathbf{u} \times \mathbf{v}| = 12 \)  
(B) \( |\mathbf{u} \times \mathbf{v}| = 30 \)  
(C) \( |\mathbf{u} \times \mathbf{v}| = 35 \)  
(D) \( |\mathbf{u} \times \mathbf{v}| = 1 \)  
(E) \( |\mathbf{u} \times \mathbf{v}| = 140 \)  
(F) none of the above
Problem 3 (Fall 2010). Find the components of the vector from the point $A$ to the midpoint of $BC$, where

$A = (1, 0, 1)$  $B = (1, 1, 0)$  and  $C = (0, 1, 1)$

(A) $\langle 1, 1/2, 1/2 \rangle$
(B) $\langle 1, -1/2, -1/2 \rangle$
(C) $\langle 1/2, 1, 1/2 \rangle$
(D) $\langle 1, 0, 1 \rangle$
(E) $\langle 1, 1/2, 1 \rangle$
(F) $\langle 0, 1/2, -1/2 \rangle$
(G) $\langle -1/2, 1, -1/2 \rangle$
(H) $\langle 1, -1/2, -1 \rangle$
Problem 4 (Spring 2011). The set of points equidistant from the points $(2, -1, 1)$ and $(4, 3, -5)$ is a plane. What is the equation of the plane?

(A) $3x + y - 2z = 0$  
(B) $2x + 4y - 6z = -6$  
(C) $x + 2y - 3z = 11$  
(D) $2x + 14y + 10z = 15$  
(E) $6x + 2y - 4z = 5$  
(F) $x + y + z = 2$  
(G) $2x + 2y + 2z = 7$  
(H) $x + 7y + 5z = 0$
Problem 5 (Fall 2011). Find the area of the parallelogram three of whose vertices are 
(0, 0, 0), (1, 2, 3) and (−1, 1, −1).

(A) $\sqrt{29}$                        (E) $\sqrt{5}$
(B) $\sqrt{38}$                        (F) $2\sqrt{5}$
(C) $\sqrt{30}$                        (G) 6
(D) 8
Problem 6 (Fall 2009). True or false. Given a reason or a counterexample.

(A) If \( \vec{a} \) is a non-zero vector in three space, then \( \text{proj}_{\vec{a} \times \vec{k}}(\vec{a}) = \vec{0} \).

(B) The vector \( (\vec{j} \times (\vec{k} \times \vec{j})) \times \vec{i} \) is a unit vector.

(C) If \( \vec{a} \) and \( \vec{b} \) are perpendicular and non-zero, then \( 3\vec{a} + 2\vec{b} \) and \( -3\vec{a} + 2\vec{b} \) have the same length.