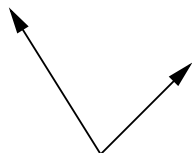


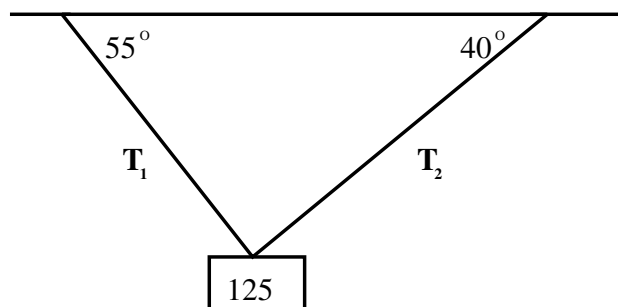
## Merit Worksheet 2 - Math 242, Fall 2005

1. Calculate the angle  $\theta$  in the following diagram



2. A weight of 125 kilograms is suspended by two cables, as shown in the following diagram.

Find the tension in each cable.



3. Use vectors to show that the line segment joining the midpoint of two sides of a triangle is parallel to the third side and half its length.
4. Prove that the diagonals of a parallelogram  $ABCD$  bisect each other.
5. Find a vector in  $\mathbb{R}^3$
- (a) of length 5 in the same direction as  $12\mathbf{i} + 4\mathbf{j} + 3\mathbf{k}$ .
  - (b) of length 8 in the opposite direction to  $2\sqrt{2}\mathbf{i} + 3\mathbf{j} + 2\sqrt{2}\mathbf{k}$ .
  - (c) of length 1 in the same direction as  $1\mathbf{i} + 3\sqrt{7}\mathbf{j} + 15\mathbf{k}$ .
6. Do these three points lie on a single straight line?  
 $(0, -2, 4), (1, -3, 5), (4, -6, 8)$
7. Sketch the graph of  $x^2 + y^2 + z^2 + 8x + 4y - 10z - 4 = 0$ .
8. Let  $\underline{a} = 2\mathbf{i} + 3\mathbf{j} + 2\mathbf{k}$ ,  $\underline{b} = -4\mathbf{i} + 1 + 3\mathbf{k}$  and let  $\underline{c} = -4\mathbf{i} + 6\mathbf{j} - 5\mathbf{k}$ . Use the Pythagorean Theorem to say whether  $\underline{a}$  and  $\underline{b}$  are perpendicular. Are  $\underline{a}$  and  $\underline{c}$  perpendicular?

9. The dot product of two vectors  $\underline{a} = a_1\mathbf{i} + a_2\mathbf{j}$  and  $\underline{b} = b_1\mathbf{i} + b_2\mathbf{j}$  in  $\mathbb{R}^2$  is  $a_1b_1 + a_2b_2$ . It is written  $\underline{a} \cdot \underline{b}$ .

Let  $\underline{a} = -4\mathbf{i} + 6\mathbf{j}$ ,  $\underline{b} = 1\mathbf{i} + 3\mathbf{j}$ ,  $\underline{c} = 3\mathbf{i} + 2\mathbf{j}$ , and  $\underline{d} = 6\mathbf{i} - 2\mathbf{j}$ . Sketch these vectors on a single graph.

(a) Calculate  $\underline{a} \cdot \underline{b}$ ,  $\underline{a} \cdot \underline{c}$ ,  $\underline{b} \cdot \underline{c}$ ,  $\underline{b} \cdot \underline{d}$ .

(b) Do you notice anything?

(c) Find  $\underline{b} \cdot \underline{b}$ ,  $\underline{c} \cdot \underline{c}$ ,  $\underline{a} \cdot \underline{a}$ .

(d) Find  $\|\underline{a}\|$ ,  $\|\underline{b}\|$ .

10. (Notation you will need for class) Let  $\underline{a} = (0, 1)$  and  $\underline{b} = (2, -3)$ . Sketch the following:

(a)  $S^1(\underline{a}, 5)$ .

(b)  $\overline{B}^2(\underline{b}, 4)$ .

(c)  $B^2(\underline{a}, 3)$ .

(d)  $\overline{D}(\underline{a}, 3)$ .

(e)  $C(\underline{b}, 2)$ .

### Warm-Up Problems for Thursday

1. Are  $\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$  and  $-\mathbf{i} + \mathbf{j} - \mathbf{k}$  perpendicular?
2. What are all the vectors parallel to  $\mathbf{i} + 7\mathbf{j} - 3\mathbf{k}$ ?
3. Let  $\underline{a}$  and  $\underline{b}$  be as in question 10. What is  $\text{comp}_{\underline{b}} \underline{a}$ ?