Homework #4

1) Given the three vectors $\vec{A} = 1.00\,\hat{\imath} - 4.00\,\hat{\jmath}$, $\vec{B} = 3.00\,\hat{\imath}$, and $\vec{C} = -2.00\,\hat{\jmath}$ evaluate the following expressions if they are allowed mathematically: (a) $\vec{C} \cdot (\vec{A} + \vec{B})$; (b) $\vec{C} \cdot (\vec{A} \cdot \vec{B})$; (c) $C + \vec{A} \cdot \vec{B}$

2) Given three vectors, $\vec{A} = 2.00\,\hat{\imath} - 5.00\,\hat{\jmath}$, $\vec{B} = 4.00\,\hat{\jmath}$, and $\vec{C} = 3.00\,\hat{\imath}$, evaluate the following expressions if they are mathematically allowed: (a) $C(\vec{A} \times \vec{B})$; (b) $\vec{C} \cdot (\vec{A} \times \vec{B})$; (c) $\vec{C} \times (\vec{A} \cdot \vec{B})$

3) Consider two vectors $\vec{A}$ and $\vec{B}$ where:

$$\vec{A} = -6.00\,\hat{\imath} + 3.00\,\hat{\jmath} + 3.00\,\hat{k}$$
$$\vec{B} = 6.00\,\hat{\imath} - 8.00\,\hat{\jmath} + 4.00\,\hat{k}$$

If we want to find the angle between these two vectors, we have two possible options: we can use the magnitude of the dot product, or the magnitude of the cross product.

$$\vec{A} \cdot \vec{B} = AB\cos(\theta)$$
$$\left|\vec{A} \times \vec{B}\right| = AB\sin(\theta)$$

However, these approaches give conflicting answers for the value of θ.

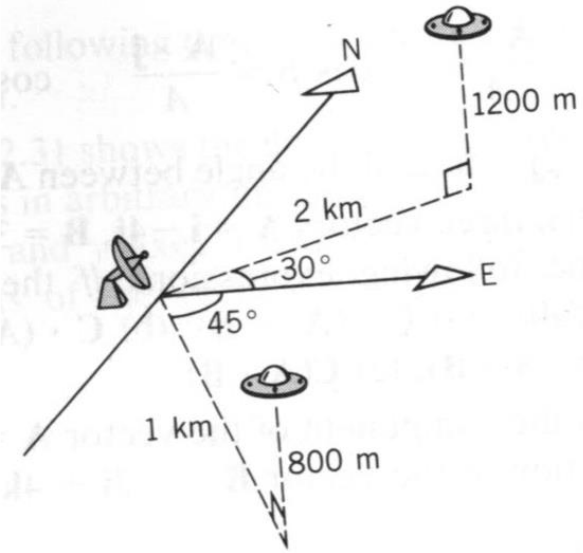
a) What is the correct value of theta?

b) Why does the other formula give the wrong answer?

4) The position of an object as a function of time is given by $r(t) = (3.00\,t^2 - 2.00\,t)\,\hat{\imath} - 1.00\,t^3\,\hat{\jmath}$ m . Find: (a) its velocity at *t*=2.00 s; (b) its acceleration at t=4.00 s; (c) its average acceleration between *t*=1.00 s and *t* = 3.00 s.

5) At *t* = 0 a particle at the origin has a velocity of 15.1 m/s at 36° above the horizontal x axis. At *t* = 5.00 s it is at *x* = 21.0 m and *y* = 35.0 m and its velocity is 30.0 m/s at 53° above the horizontal. Find: (a) its average velocity; (b) its average acceleration.

6) Personnel at an airport control tower track a UFO. At 11:02 a.m. it is located at a horizontal distance of 2.00 km in the direction 30°N of E at an altitude of 1200 m. At 11:15a.m. the location is 1.00 km at 45° S of E at an altitude of 800 m. What was the displacement of the UFO? Express your result in component notation.



7) A fastball pitcher can throw a baseball at a speed of 90.0 mi/h. (a) Assuming the pitcher can release the ball 16.7 m from home plate so the ball is moving horizontally, how long does it take the ball to reach home plate? (b) How far does the ball drop between the pitcher's hand and home plate?

6) A soccer goal is 2.44 m high. A player kicks the ball at a distance 10.0 m from the goal at an angle of 25.0°. The ball hits the crossbar at the top of the goal. What is the initial speed of the soccer ball?