Seminary 1 Vectors and kinematics

The unsolved problems are given as homework.

(I) VECTORS

DISCUSSIONS Briefly remember useful notions from the course: analytical representation of vectors, operations with vectors (vector sum, difference, scalar and vector products).

PROBLEMS

1) Two vectors are defined analytically as follows, $\vec{A} = 3\vec{\imath} + 4\vec{\jmath}$ şi $\vec{B} = 4\vec{\imath} + 2\vec{\jmath}$.

a) Graphically represent the two vectors.
b) Calculate and plot the sum, $\vec{A} + \vec{B}$, and the difference, $\vec{A} - \vec{B}$, of the two.
c) Calculate the scalar product of vectors $\vec{A}$ and $\vec{B}$.
d) Calculate and plot the projection of vector $\vec{B}$ on the direction of vector $\vec{A}$.
e) If vector $\vec{C}$ is given by $2\vec{\imath} + a\vec{\jmath}$, find the value of a so that $\vec{C}$ is perpendicular to $\vec{A}$.
f) Plot the two vectors $\vec{A}$ and $\vec{C}$.
g) What is the projection of $\vec{C}$ along the direction of $\vec{A}$?

2) If $\vec{A}$ and $\vec{B}$ are nonzero vectors, is it possible for $\vec{A} \cdot \vec{B}$ and $\vec{A} \times \vec{B}$ both to be zero? Explain your answer.

3) Vectors $\vec{A}$ and $\vec{B}$ and have scalar product -6.0 and their vector product has magnitude +9.0. What is the angle between these two vectors?

(II) KINEMATICS

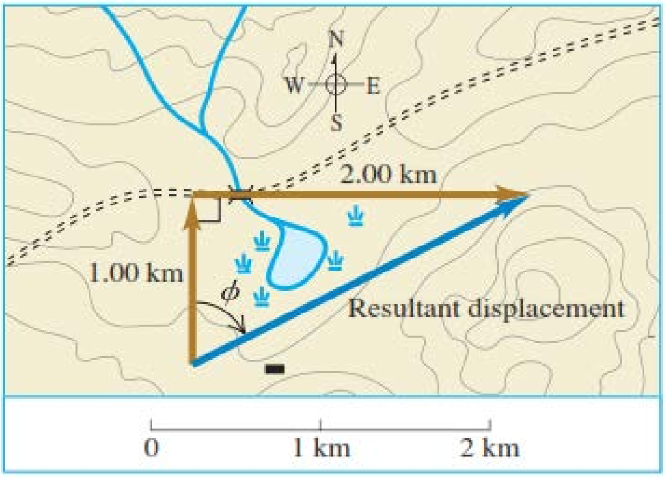
DISCUSSIONS Briefly remember useful definitions from kinematics, definitions of **r**(t), **v**(t), **a**(t)…

PROBLEMS

1) A car at point **A** on a straight road goes west for **20** seconds, arriving at point **B** which is 200m away from **A**. The car then heads back to the east for 30 seconds, arriving at point C which is 800 m away from B What is the displacement of the car from point **A** ? (Graphically analyze the problem). *Assume that + is east and is - west.*

2) A cross-country skier skis 1.00 km north and then 2.00 km east on a horizontal snowfield. How far and in what direction is she from the starting point?

The vector diagram, drawn to scale, for a ski trip.



3) The position vector of a particle has the following time dependence:

$$\vec{r}(t) = 3t\vec{i} - 4t\vec{j} + 7t\vec{k}$$

Determine:

(a) The velocity and the acceleration vectors time dependence laws.
(b) The position of the particle after t=3s.
(c) The particle's average velocity in the time range t_1=3s and t_2=5s.

4) The position of a squirrel running in a park along a straight line is given by:

$x = 0.28t - 0.036t^2$

a) What is the velocity of the squirrel as a function of time?
b) What is the acceleration of the squirrel as a function of time?
c) At t= 2.0 s, how far is the squirrel from the initial position?
d) What is the speed of the squirrel at t=0 and at t=2s?
e) Discuss the sign of the squirrel acceleration.

5) An object's velocity is measured to be $v_x(t)=\alpha-\beta t^2$, where α=4m/s and β=2m/s$^{3.}$ At t=0 the object is at x=0. (a) Calculate the object's position and acceleration as a function of time. (b) Graphically represent x(t), v_x(t), a_x(t). (c) What is the object's maximum positive displacement from the origin?