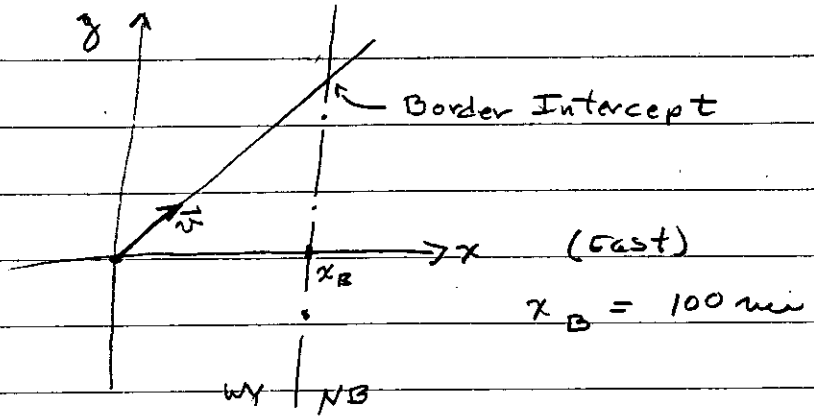
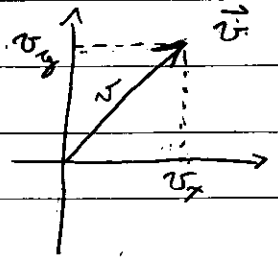
Physics 3 Homework Due 2Jul03 YJB

(No 4)

1.



$v = |\vec{v}| = 141$ mi/hr



$\vec{v} = v_x \hat{\imath} + v_y \hat{\jmath}$

$= v\frac{\sqrt{2}}{2}\hat{\imath} + v\frac{\sqrt{2}}{2}\hat{\jmath}$

Time to cross border is time for x to increase to $x = x_B$

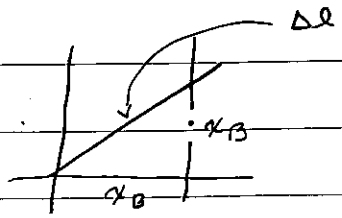
$x_B = x = \cancel{x_0}^{\,0} + v_x t$ $\qquad x_0 = 0$

$v_x = 100$ mi/hr

$x_B = v_x t$

$t = \frac{x_B}{v_x} = \frac{100\,\text{mi}}{100\,\text{mi/hr}} = 1$ hr

OR....



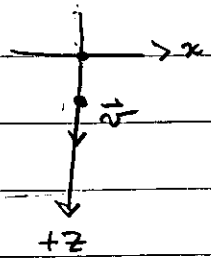
$\Delta l = \sqrt{2}\, x_B$

$v = \frac{\Delta l}{\Delta t}$ v is magnitude of velocity, ie speed

$\Delta t = \frac{\Delta l}{v}$

$= \frac{\sqrt{2} x_B}{v} = \frac{\sqrt{2} \times 100 \text{ mi}}{141 \text{ mi/hr}} = 1 \text{ hr}$

2.



$$\vec{v} = v_z \hat{k}$$

$$v_z = at$$

The given expression for the velocity v_z indicates that the velocity increases steadily with time. The unit of a is

$$[a] = \frac{[v_z]}{[t]} = \frac{m/s}{s} = m/s^2$$

The velocity increases by a m/s each second.

The position $z(t)$ increases at a constantly increasing rate. By definition

$$v_z = \frac{dz(t)}{dt}$$

$$dz(t) = v_z\, dt$$

$$z(t) = \int v_z(t)\, dt$$

$$z(t) = \int at\, dt$$

$$= a\int t\, dt$$

$$z(t) = \frac{at^2}{2} + C$$

To find the constant of integration C, Use the fact that at $t=0$, $z=0$

$$z(0) = 0$$

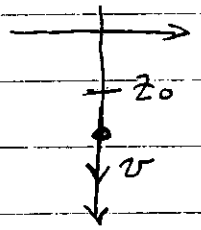
$$z(t) = \frac{a t^2}{2} + C$$

set $t=0$

$$0 = z(0) = \frac{a \cdot 0^2}{2} + C$$

$$C = 0.$$

Suppose we choose a different origin, one where the object is released from a starting position $z(0) = z_0$



In this case

$$z_0 = z(0) = C$$

So the general solution is

$$z(t) = z_0 + \frac{1}{2} a t^2$$