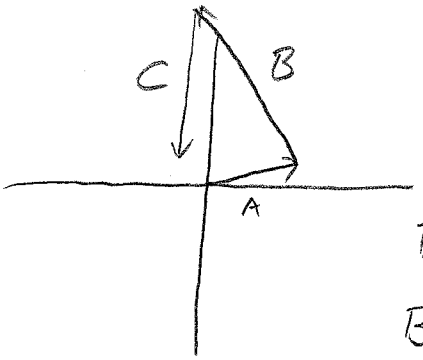
Quiz #3B

Clearly indicate (with a box) your answers to the following questions. SHOW ALL WORK.

1. Three forces are acting on an object.

Force A is 124 N in a direction 22.5° above the +x direction.
Force B is 371 N in a direction 62.0° above the -x direction.
Force C is 327 N straight down (-y direction).

What is the magnitude and direction of the resultant of these three forces?



$A_x = 124 \cos 22.5° = 114.56$

$A_y = 124 \sin 22.5° = 47.45$

$B_x = -371 \cos 62° = -174.17$

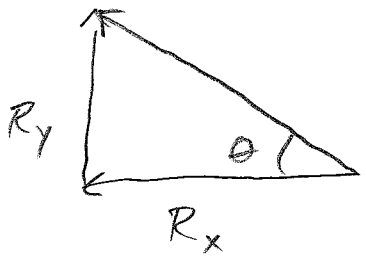
$B_y = 371 \sin 62° = 327.57$

$C_x = 0$

$C_y = -327$

$R_x = A_x + B_x + C_x = -59.61$

$R_y = A_y + B_y + C_y = 48.02$



$|\vec{R}| = \sqrt{(59.61)^2 + (48.02)^2}$

$= \boxed{76.5\ N}$

$\theta = \tan^{-1}\left(\frac{R_y}{R_x}\right) = 38.9°$

$= \boxed{38.9° \text{ above } -x}$

2. A ball is initially at rest in the barrel of a cannon. The cannon is tilted up at 31° with respect to the horizontal. The ball accelerates at a rate of 1500 meters/sec^2 along the 1.0 meter barrel of the cannon. Upon leaving the cannon, the ball is in free fall. The cannon is positioned on the shore of a river that is 140 meters wide.

Does the ball make it to the other bank of the river (or beyond) before it lands? For simplicity, you may assume that the ball is at ground level when it leaves the cannon.

Cannon

$\Delta s = 1.0\ m$

$v_0 = 0$

$v = ?$

$a = 1500\ m/s^2$

$t = ?$

$v^2 = v_0^2 + 2a\Delta s$

$= 0 + 2(1500)(1)$

$v = 54.8\ m/s$

Free Fall

$\Delta x = 140$

$v_{0x} = 54.8 \cos 31^\circ = 46.95$

$v_x = 46.95$

$a_x = 0$

$t = ?$

$\Delta x = v_{0x} t + \frac{1}{2} a_x t^2$

$140 = 46.95\, t$

$t = 2.98\ s$

$\Delta y = ?$

$v_{0y} = 54.8 \sin 31^\circ = 28.2$

$v_y = ?$

$a_y = -9.8\ m/s^2$

$t = 2.98\ s$

$\Delta y = v_{0y} t + \frac{1}{2} a_y t^2$

$\Delta y = 28.2(2.98) + \frac{1}{2}(-9.8)(2.98)^2$

$\Delta y = 84.11 - 43.51$

$\Delta y > 0$, so it makes it over

or set $\Delta y = 0$

or $v_y = -28.2$

$\Rightarrow t = 5.76\ s \rightarrow \Delta x > 140$