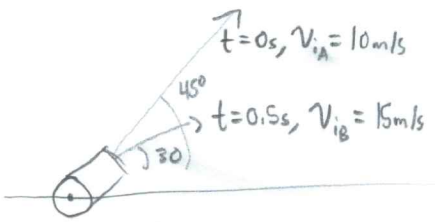
Marks by feel. Multiple approaches. This is probably the simplest.

Question 2

A cannon on infinitely flat ground is going to fire 2 balls. At time t = 0 seconds, ball A is fired with a speed of 10m/s [45° above horizontal]. At time t = 0.5 seconds, ball B is fired with a speed of 15m/s [30° above horizontal]. Show whether or not the two balls ever collide in mid-air.

Briefly explain what you are doing/finding at each significant step so that I can understand what's going on when I mark this.[6]



$v_{iAx} = 10\cos 45 = 5\sqrt{2}$ m/s

$v_{iAy} = 10\sin 45 = 5\sqrt{2}$ m/s

$v_{iBx} = 15\cos 30 = \frac{15\sqrt{3}}{2}$ m/s

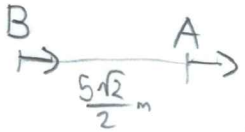
$v_{iBy} = 15\sin 30 = 7.5$ m/s

First we will see where A is after 0.5secs, in the x.

Find $d_{xA(0.5s)} = v_{iA}\cos 45°\,\Delta t = 10\cos 45\,(0.5) = \frac{5\sqrt{2}}{2}$ m

Now we can see if these balls collide in the x.

In the x



$d_{Bx} = d_{Ax} + \frac{5\sqrt{2}}{2}$

$\Rightarrow \frac{15\sqrt{3}}{2}\Delta t = 5\sqrt{2}\,\Delta t + \frac{5\sqrt{2}}{2}$

$\Rightarrow 5.919\,\Delta t = \frac{5\sqrt{2}}{2} \Rightarrow \Delta t_{\text{needed for x collision}} = 0.597\text{s}$

Note this is after t = 0.5s.
So this is technically at t = 1.097s.

In the y

We have the Δt needed for the x to collide, Just sub this into the y distances for A and B and see if they collide at the same y height. So t = 1.097s.

$\Delta d_{Ay(1.097s)} = v_{iAy}\Delta t + \frac{1}{2}a\Delta t^2 = 13.654\text{m}$

$\Delta d_{By(0.597s)} = v_{iBy}\Delta t + \frac{1}{2}a\Delta t^2 = 7.209\text{ m}$

$\Delta d_{Ay} \neq \Delta d_{By}$, thus no collision ever.