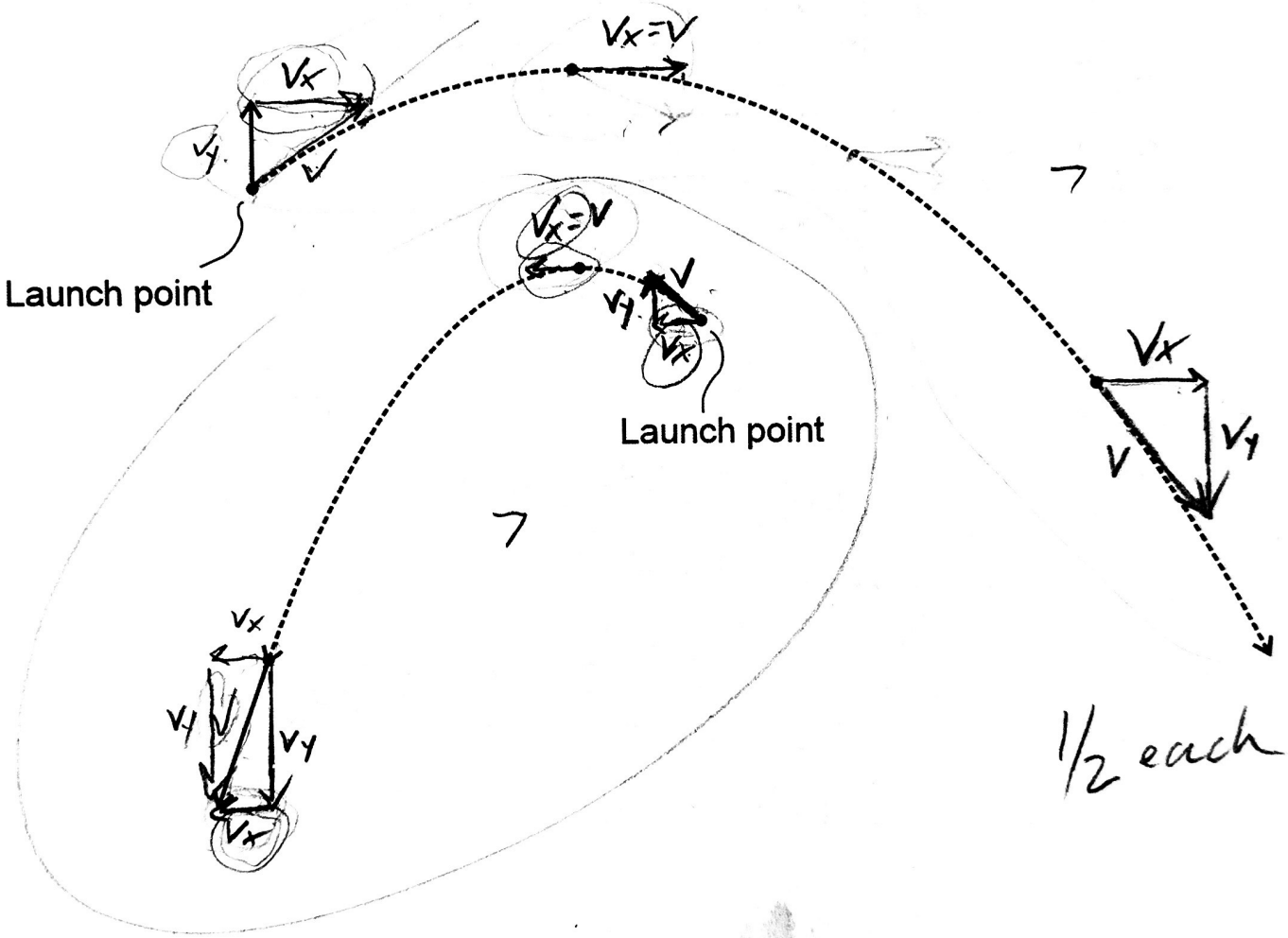
Physics 200 (Stapleton)
Test: 25-26 Projectile Motion

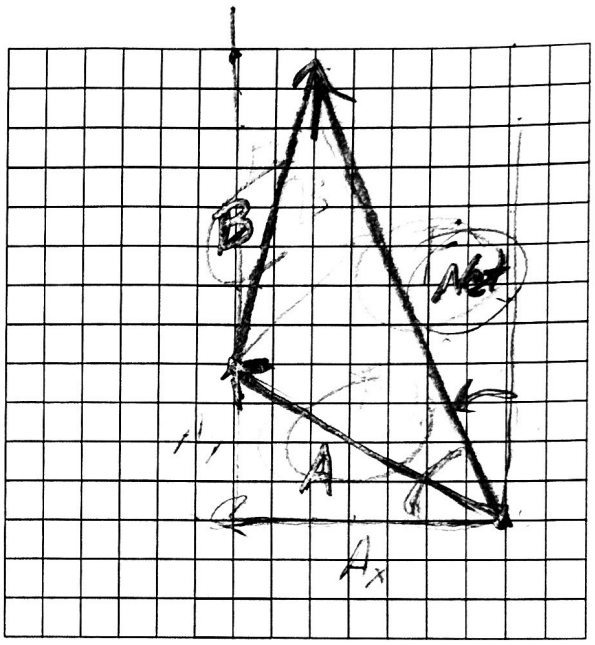
Name: Key

36/36

1. **Drawing velocity vectors:** For each projectile path, one velocity vector is given for one of the points (circular dots)...
   - Correctly label the given vector with its name.
   - Draw and label the other velocity vectors for that point.
   - Draw and label all velocity vectors at the rest of the points indicated by circular dots.
   - For every circular dot, include the net velocity vector (v), as well as any other component vector (e.g. v_x and/or v_y that exists at that point.
   - For every vector drawn along the same projectile path, make sure that the vector directions are correct and that their lengths are in correct proportion to one another.



2. Force vector A has an x-component of -7N and a y-component of 4N. Force vector B has a magnitude of 8N and a direction 10° rightward of the positive y axis.



a. In the box on the right, use the head-to-tail method to create an approximate scaled sketch showing the two vectors A and B and their vector sum when added together. Let the length of each square = 1N.

b. Find the x and y components of force vector B.

B_x = 1.39N B_y = 7.88N

c. When force vectors A and B are both applied to an object (and no other forces are applied), what are the magnitude and direction of the net force experienced by the object?

Magnitude of Net Force = 13.1 N

Direction of Net Force = 64.7° above -x
25.3° left of positive y

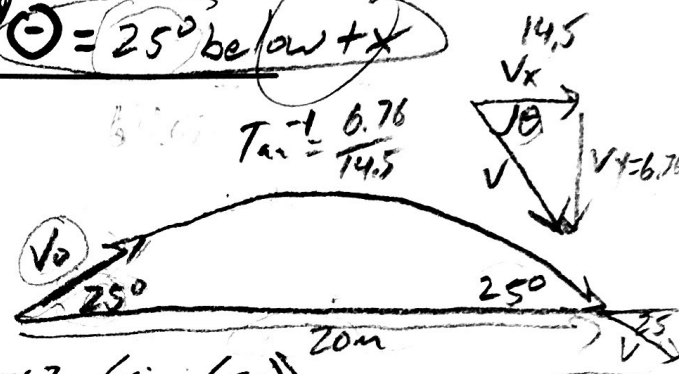
□ = given ○ = obvious

(3) A skier leaves a jump in a direction 25° above positive X and travels a horizontal distance of 20m before landing at the same height at which she left the jump.

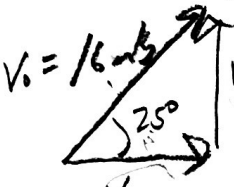
Symmetric

y Dimension	x Dimension	2 Dimensions
(3) $V_{oy} = 6.76 m/s$	(2) $V_{ox} = 14.5 m/s$	(1) $V_o = 16 m/s$
(5) $V_y = -6.76 m/s$	$V_x = 14.5 m/s$	$\theta_o = 25°$ above +x
(6) $\bar{V}_y = 0 m/s$	$\bar{V}_x = 14.5 m/s$	(9) $V = 16 m/s$
(7) $\Delta V_y = -13.5 m/s$	$\Delta V_x = 0 m/s$	(8) $\theta = 25°$ below +x
$a_y = -9.8 m/s^2$	$a_x = 0 m/s^2$	
(8) $\Delta y = 0 m$	$\Delta x = 20 m$	
(4) $\Delta t = 1.38 s$	(9) $\Delta t = 1.38 s$	

1/4



$$\text{Range} = \frac{V_o^2 \sin 2\theta}{g} \Rightarrow 20m = \frac{V_o^2 (\sin(50))}{9.8 m/s^2} \Rightarrow V_o = 16.0 m/s$$



$V_{ox} = 16 m/s (\cos 25°) = 14.5 m/s$

$V_{oy} = 16 m/s (\sin 25°) = 6.76 m/s$

$$V_x = \frac{\Delta x}{\Delta t} \Rightarrow 14.5 m/s = \frac{20m}{\Delta t} \Rightarrow \Delta t = 1.38 s$$

$$V_y = V_{oy} + at = 6.76 m/s + (-9.8 m/s^2)(1.38 s) = -6.76 m/s$$

$$\bar{V} = \frac{V_{oy} + V_y}{2} = \frac{6.76 m/s + (-6.76 m/s)}{2} = 0 m/s$$

$$\bar{V} = \frac{\Delta y}{\Delta t} \Rightarrow 0 m/s = \frac{\Delta y}{1.38 s} \Rightarrow \Delta y = 0m \qquad \Delta y = V_{oy} t + \tfrac{1}{2} a t^2$$

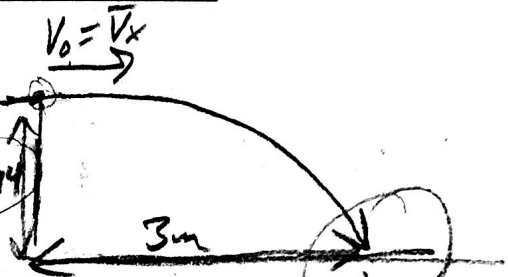
$$\Delta V_y = V_y - V_{oy} = -6.76 m/s - 6.76 m/s = -13.5 m/s$$

10/10 $$V = \sqrt{V_y^2 + V_x^2} = \sqrt{(-6.76 m/s)^2 + (14.5 m/s)^2} = 16 m/s$$

$V_0 \rightarrow$

#4 You launch a projectile horizontally, in the positive X direction, from a table top. The projectile flies 3m horizontally before it hits the floor. The launch point is 0.94m above the floor.

y Dimension	x Dimension	2 Dimensions
$V_{oy} = 0 m/s$	$V_{ox} = 6.85$	(6) $V_0 = 6.85 m/s$
(2) $V_y = -4.29 m/s$	$V_x = 6.85$	$\theta_0 = 0°$ Rightward
(3) $\bar{V}_y = -2.15 m/s$	(5) $\bar{V}_x = 6.85 m/s$	(8) $V = 8.08 m/s$
(4) $\Delta V_y = -4.29 m/s$	$\Delta V_x = 0$	(7) $\theta = 32°$ Below +X
$a_y = -9.8 m/s^2$	$a_x = 0$	
$\Delta y = -0.94 m$	$\Delta x = 3m$	
(1) $\Delta t = 0.438 s$	(1) $\Delta t = 0.438 s$	



$\Delta y = V_{oy} t + \frac{1}{2} a_y t^2 \Rightarrow -0.94m = 0(t) + \frac{1}{2}(-9.8 m/s^2) t^2 \Rightarrow t = 0.438 s$

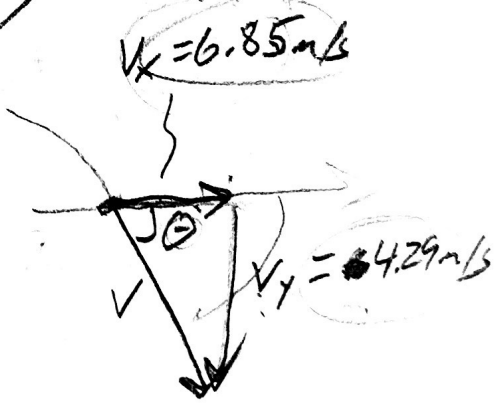
$V_y = V_{oy} + a_y t = 0 m/s + (-9.8 m/s^2)(0.438 s) = -4.29 m/s$

$\bar{V}_y = \frac{0 m/s + (-4.29 m/s)}{2} = -2.15 m/s$

$\Delta V = V - V_0 = -4.29 m/s - 0 m/s = -4.29 m/s$

$\bar{V}_x = \frac{\Delta x}{\Delta t} = \frac{3m}{0.438 s} = 6.85 m/s$

$\bar{V}_x = V_0 = 6.85 m/s$



$\theta = \tan^{-1}\left(\frac{4.29}{6.85}\right)$

$\theta = 32°$

$V = \sqrt{6.85^2 + 4.29^2}$

$V = 8.08 m/s$

8/8

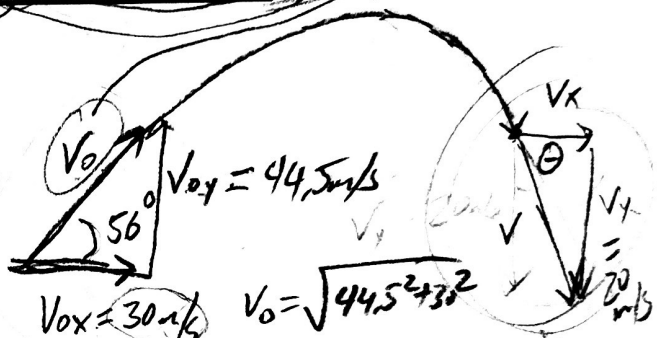
(5)

A projectile is launched in a direction 56° above positive x. The projectile's initial x velocity is 30m/s, and its final y velocity at the moment of impact is -20m/s.

y Dimension	x Dimension	2 Dimensions
① $V_{oy} = 44.5\ m/s$	$V_{ox} = 30$	⑦ $V_o = 53.7\ m/s$
$V_y = -20\ m/s$	$V_x = 30$	$\theta_o = 56°$ above +x
③ $\bar{V}_y = 12.3\ m/s$	$\bar{V}_x = 30\ m/s$	$V = 36\ m/s$
④ $\Delta V_y = -64.5\ m/s$	$\Delta V_x = 0$	$\theta = 33.7°$ below +x
$a_y = -9.8\ m/s^2$	$a_x = 0$	
⑤ $\Delta y = 80.9\ m$	⑥ $\Delta x = 197.4\ m$	
② $\Delta t = 6.58\ s$	② $\Delta t = 6.58\ s$	

Not scaled

$V_o = \sqrt{44.5^2 + 30^2} =$



$\tan 56° = \frac{V_{oy}}{30\ m/s} \Rightarrow V_{oy} = 44.5\ m/s$

$V_o = \sqrt{44.5^2 + 30^2} = 53.7$

$V_y = V_{oy} + a_y t \Rightarrow -20\ m/s = 44.5\ m/s + (-9.8\ m/s^2)\, t \Rightarrow t = 6.58\ s$

$\bar{V}_y = \frac{44.5\ m/s - 20\ m/s}{2} =$

$\Delta y = V_{oy} t + \frac{1}{2} a_y t^2$

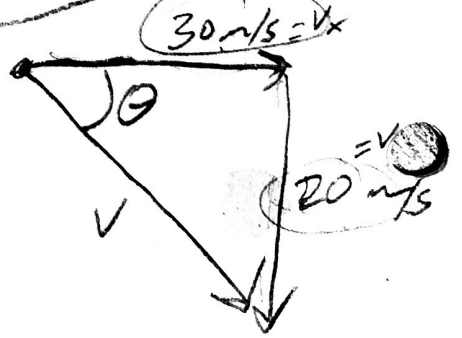
$\Delta V_y = V_y - V_{oy} = -20\ m/s - 44.5\ m/s = -64.5\ m/s$

$\bar{V}_y = \frac{\Delta y}{\Delta t} \quad 12.3\ m/s = \frac{\Delta y}{6.58\ s} \Rightarrow \Delta y = 80.9\ m$

$\bar{V}_x = \frac{\Delta x}{\Delta t} \quad 30\ m/s = \frac{\Delta x}{6.58\ s} \Rightarrow \Delta x = 197.4\ m$

$\theta = \tan^{-1}\left(\frac{20}{30}\right) = 33.7°$

$V = \sqrt{20^2 + 30^2} = 36\ m/s$



9/9