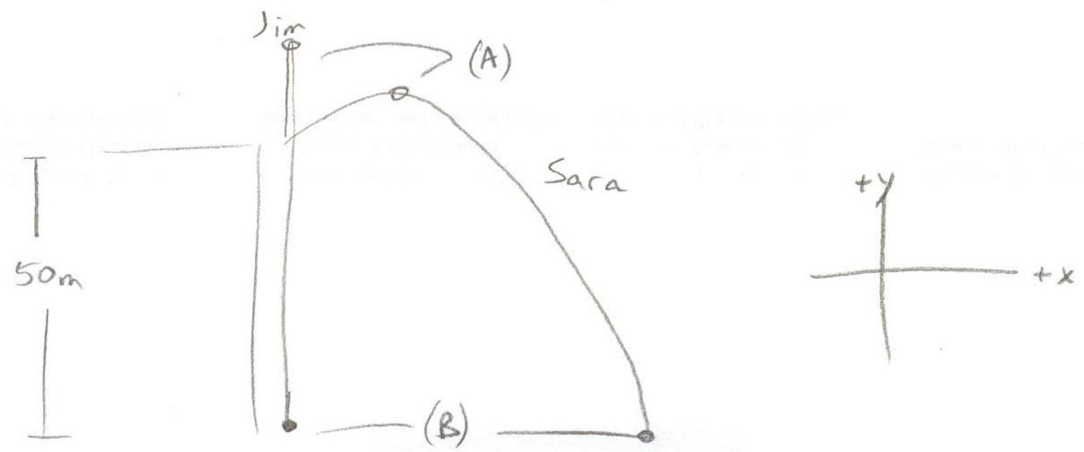

call right the positive -x direction
call up the positive-y direction

(a) At the highest point in flight, the ball's vertical velocity must be zero.

Therefore, Jim's ball has no velocity whatsoever: no x-velocity, no y-velocity, no magnitude of the velocity vector.

Sara's ball had an initial horizontal velocity of $20\frac{m}{s}\cos 30° = 17\frac{m}{s}$ to the right. With no horizontal acceleration, this velocity does not change. At the ball's peak, $\vec{V}_y = 0$, $\vec{V}_x = +17\frac{m}{s}$, and the magnitude of the velocity vector is $17\frac{m}{s}$.

(b) Jim's ball to ground

V_0	$+20\frac{m}{s}$
V_f	
Δy	$-50\,m$
a	$-10\frac{m}{s^2}$
t	

$$V_f^2 = V_0^2 + 2a\Delta y$$

$$V_f = \sqrt{(20\tfrac{m}{s})^2 + 2(-10\tfrac{m}{s^2})(-50m)}$$

$V_f = 37\frac{m}{s}$, downward

this is Jim's ball's vertical velocity.
Jim's ball has no x-velocity.
So Jim's ball's velocity magnitude is $37\frac{m}{s}$

Sara's ball to ground

horizontal

V_0	$+20\frac{m}{s}\cos 30°$
V_f	$+20\frac{m}{s}\cos 30°$
Δy	
a	0
t	

$\overrightarrow{V_{f,x}} = 17\frac{m}{s}$ to the right

vertical

V_0	$+20\frac{m}{s}\sin 30°$
V_f	?
Δy	-50 m
a	$-10\frac{m}{s^2}$
t	

$$V_f^2 = V_0^2 + 2a\Delta y$$

$$V_{f,y} = \sqrt{\left(20\tfrac{m}{s}\sin 30\right)^2 + 2\left(-10\tfrac{m}{s^2}\right)\left(-50\text{ m}\right)}$$

$\overrightarrow{V_{f,y}} = 33\frac{m}{s}$, down

to find sara's ball's velocity magnitude, add horizontal + vertical velocities using Pythagoras:

$$|\vec{V_f}| = \sqrt{\left(17\tfrac{m}{s}\right)^2 + \left(33\tfrac{m}{s}\right)^2} = 37\frac{m}{s}$$

Same as Jim's!

[Coincidence? No. See the follow-up quiz.]