

Worksheet — Velocity Components Simulation

Use with *Simulation - Velocity components.html* • A.1 Kinematics: velocity of a projectile — components, speed, direction, $\Delta v = g\Delta t$; goes with video (or strobe-photo) analysis of a thrown ball

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Name: _____ Class: _____ Date: _____

How to use this worksheet

Scan the QR code or open school.taneski.com/physics/dp/13-velocity-components in a browser (offline: *Simulation - Velocity components.html*). Set the launch, press  Launch or set the time probe with  . The velocity diagram draws the velocities every 0.2 s from one point. • **Record reading** saves the probe values.

Part 1 before the lab (≈ 15 min) • **Part 2** during the video analysis (≈ 15 min) • **Part 3** homework (≈ 30 min).

$v_x = u \cos \theta$ (constant) • $v_y = u \sin \theta - gt$ • $v = \sqrt{v_x^2 + v_y^2}$ • $\phi = \tan^{-1}(v_y/v_x)$. Use $g = 9.81 \text{ m s}^{-2}$, up positive.



Scan to open

Part 1 — Pre-lab: predict, then test

$u = 12 \text{ m s}^{-1}$ at 50° from the ground. Predict **before** you look, then test and explain.

Question	My prediction (before)	What the simulation showed	Physics explanation
1. Where on the path is the speed smallest? What is it there?			
2. How does the velocity change from one 0.2 s vector to the next?			
3. Landing speed and direction compared with the launch (same height)?			
4. Is there a point where the acceleration is zero?			

5. Calculate the speed of the ball at the top of its path.

Part 2 — During the lab: video analysis

Video. Film a thrown ball next to a metre rule (or use a strobe photo). Read its position every 0.10 s.

Average velocity between two frames = $\Delta(\text{position}) \div \Delta t$.

t / s	x / m	y / m	$v_x = \Delta x / \Delta t / \text{m s}^{-1}$	$v_y = \Delta y / \Delta t / \text{m s}^{-1}$	at t = ... s (midpoint)

1. Simulation (12 m s^{-1} , 50°): record the positions at $t = 0.40 \text{ s}$ and 0.60 s . Calculate the average v_y between them.

2. At which time does the simulation's v_y equal your answer to Q1? Why that time?

3. Record v_y every 0.2 s and fit a line on the Data tab. $g = \underline{\hspace{2cm}} \text{ m s}^{-2}$

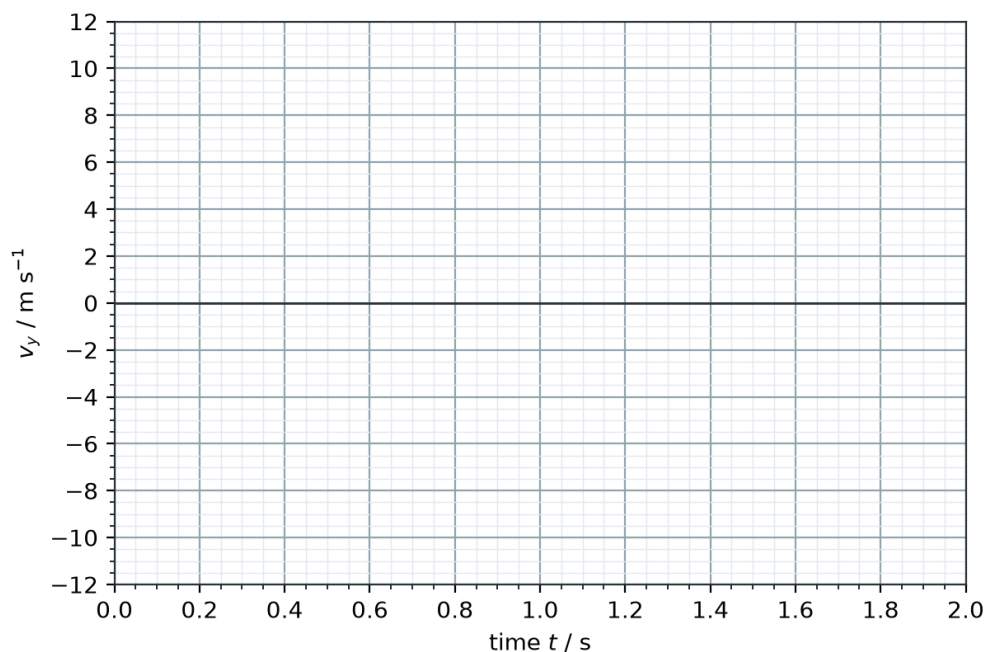
4. g from your video: $\underline{\hspace{2cm}} \text{ m s}^{-2}$. Give one reason the two values differ.

Part 3 — Homework: analyse

Simulation, 12 m s^{-1} at 50° : record v_y at each time.

t / s	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
$v_y / \text{m s}^{-1}$										

1. Plot v_y against t and draw the best-fit line. Gradient = _____ ; intercept = _____. What do they represent?



2. A ball is thrown from the ground at 20 m s^{-1} , 60° above the horizontal. Calculate its speed 1.5 s after the throw.

3. At what angle to the horizontal is it moving at that moment? Draw the velocity triangle.

4. At what time is the ball moving at 45° below the horizontal?

5. What is the speed of the ball when it is 10 m above the ground?

6. Ball P is thrown at 20 m s^{-1} at 30° , ball Q at 20 m s^{-1} at 70° . When each is 5 m above the launch point, which is faster? Explain.
