# Kinematics Review

1. A hiker walks **300 m 15° east of south**. Find the **x** and **y** components.

2. A student walks 200 m south, then 150 m east. Find the resultant displacement.

3. Bob walks 500 m 25° east of south, then 600 m north. What is his total displacement?

4. A cabin is **(4 km, 0)** east of a trailhead; a lake is **(0, 3 km)** north of the trailhead. What is the displacement **from cabin to lake**?

5. A runner starts at **2 km west, 1 km south** of the stadium and finishes **1 km east, 2 km north** of the stadium. Find the displacement from start to finish.

6. A car is initially 6 km east of home. Thirty minutes later, it is 3 km south of home.
   a) What is the displacement of the car during the 30 minutes?
   b) If the **path driven to get there** was **10.5 km** in 30 min, what was the **average speed**?

7. A plane travels with an airspeed of 600 km/h and aims 40° west of north. An 80 km/h wind blows south. Draw a vector diagram of the plane relative to the ground?

8. A plane flies **due north at 600 km/h** with a **headwind** of **80 km/h** from the west, what is the **ground speed** of the plane?

9. Bob instead walks **500 m 25° east of south**, then **600 m north**, **then 200 m west**.
   a) What is his final displacement from the start?
   b) What **single bearing** should Bob have taken to end at the same point in **one straight walk**?
   c) If Bob's walk took **18 minutes**, what are his **average speed** and **average velocity**?

10. A ball rolls off the **50 m** cliff at **12 m/s** horizontally. Find **time of flight**, **range**, and **impact angle**.

11. Two balls are launched from a 50 m high cliff as shown.
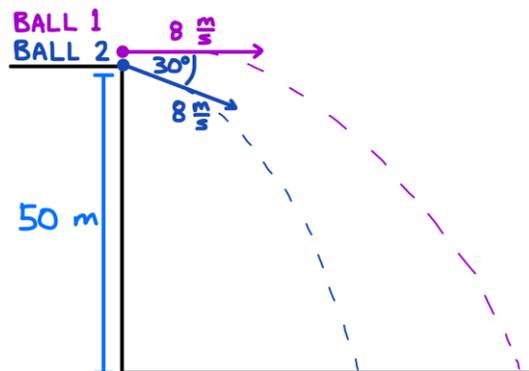
    a) Determine the range and impact velocity of each ball.
    b) If both balls are launched at **the same speed** but at **different angles** (one above, one below horizontal), which has the **greater range** and why?
    c) How would a **headwind** vs. **tailwind** qualitatively change range and impact angle?
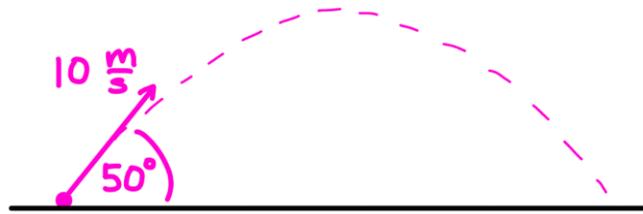
12. A ball is launched from level ground at a velocity of 10 m/s 50° above the horizontal.
   a) Determine the maximum height
   b) Determine the range
   c) Determine the impact velocity
   d) Imagine you need the ball to travel a horizontal distance **of 9.0 m** with the **same 10 m/s** speed. Find **two possible angles** that achieve it.
   e) If the launch **speed limit** is **8.0 m/s**, what **single angle** maximizes the range, and what is that **maximum range**?