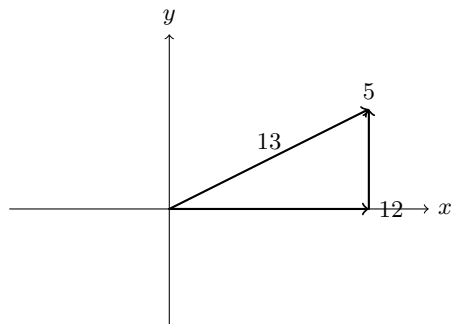


Question 4

A boat moves at 12 km/h due east relative to the water while a current flows at 5 km/h due north. Find the ground velocity, speed, and direction north of east.

Question 4 – Solution

Strategy Write every vector in matching component order. Perform scalar multiplication before addition or subtraction, then interpret the resulting components in the context of the problem.



Step 1 Add the velocity vectors: $\vec{v}_g = \langle 12, 0 \rangle + \langle 0, 5 \rangle = \langle 12, 5 \rangle$.

Step 2 The ground speed is $\sqrt{12^2 + 5^2} = 13$ km/h.

Step 3 The direction satisfies $\tan \theta = 5/12$, so $\theta = \tan^{-1}(5/12) \approx 22.6^\circ$ north of east.

Verification The result follows from the defining vector formulas used above, and each component, magnitude, or scalar condition has been checked against the information in the question.

Key idea Vector equations behave like ordinary algebra provided that every operation is performed component by component. A final component check is often the fastest verification.