

## Module 03

### Two-Dimensional Kinematics

#### QUESTIONS

**Question 1 (LV1):** An elephant with a tracking device is moving at 8 m/s and heading at  $210^\circ$  counter-clockwise from the positive  $x$ -axis. Find the  $x$  and  $y$  components of its velocity.

**Question 2 (LV2):** An airplane with airspeed 370 km/h flies West before taking a sharp turn heading North. If the speedometer reading remains constant, find the direction of the airplane's average acceleration vector relative to the West direction.

**Question 3 (LV3):** A ball is thrown from the top of a building at an angle of  $30^\circ$  to the horizontal and with an initial speed of 10 m/s. Find the maximum height reached by the ball with respect to the ground, if the building is 100-m high.

**Question 4 (LV4):** Jane and Mike are riding on a merry-go-round. Jane rides on a horse at the outer edge of the platform. Mike rides on an inner horse, at half the distance from the center of the circular platform compared to Jane. If Jane is rotating at a constant speed of 2.00 m/s, find Mike's speed.

**Question 5 (LV5):** A 30-cm diameter pottery wheel requires 3.00 s to reach 300 rev/min when starting from rest. Find the tangential acceleration of a point at the edge of the wheel.

**PROBLEMS**

**Problem 1 (LV3):** A child throws a pebble into the air from the edge of a vertical cliff, with an initial velocity that makes an angle of  $45^\circ$  with the horizontal. Given that the pebble reaches a maximum height of 5.75 m above the cliff and travels a range of 1.00 m before reaching the ground, find (a) the initial speed of the pebble and (b) the height of the cliff.

**Problem 2 (LV4):** The *E. coli* bacterium is propelled by snapping a tail-like flagellum. The flagellum of the *E. coli* spins at 500 rev/s, propelling the bacterium at speeds around  $25 \mu\text{m/s}$ . How many revolutions does the flagellum make as the bacterium crosses a microscope's field of view ( $150 \mu\text{m}$ )?