

**Question 20** (3 marks)

A student is investigating inertial and non-inertial frames of reference. The student carries out a series of activities on a boat floating on a large, calm lake. The boat remained level during these activities.

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Each activity and the student's observed results are recorded in the table.

Activity	Observation
Dropped a ball from a set height	Ball fell vertically with increasing velocity
Rolled a ball from one side of the boat to the other	Ball rolled across the floor with a constant velocity
Rolled a ball from the back of the boat towards the front of the boat	Ball rolled across the floor with a constant velocity

Justify the student's conclusion that: 'The boat can be regarded as an inertial frame of reference'.

An inertial frame of reference is one that is stationary or travelling at a constant speed relative to an observer.

- When the ball was dropped from the boat, the horizontal displacement of the ball was zero. This means that the boat was stationary relative to the ball's horizontal position. Note that since inertial frames of reference neglect gravity, the vertical velocity of the ball is not taken into account.
- When the ball was rolled across the boat from side to side and end to end, it moved with constant velocity. Therefore, the boat was moving at a constant speed relative to the ball.

These 3 results all justify the conclusion that the boat can be regarded as an inertial reference frame.