

Instructor-Guided AI Agents for Newtonian Misconceptions in Moodle - Appendix D

Rabih Kahaleh^{1,2}

¹ Faculty of Engineering, University of Balamand, Koura, Lebanon

² Faculty of Education, Universitat Autònoma de Barcelona, Spain

E-mail: rabih.kahaleh@balamand.edu.lb, rabihelias.kahaleh@autonoma.cat

Appendix D. Quiz Items and Misconception Tags

Each multiple-choice question was adapted from the Force Concept Inventory and aligned with known Newtonian misconceptions. The correct option is marked with . Misconceptions are noted in parentheses after each distractor.

Question 1: Motion Without Force

A hockey puck slides across a perfectly frictionless ice surface at constant velocity. What will happen if no external forces act on it?

- A. It will gradually slow down and eventually stop (*M01: Motion requires a continuous force*)
- B. It will speed up until another force stops it (*M02: Natural tendency is to accelerate*)
-  C. It will continue moving at constant velocity
- D. It will immediately stop moving (*M03: Objects need a push to keep going*)

Question 2: Free Fall and Mass

If two objects of different masses are dropped from the same height in a vacuum, what happens?

- A. The heavier object falls faster (*M04: Heavier objects fall faster*)
- B. The lighter object falls slower (*M05: Lightness resists gravity more*)
-  C. Both fall at the same rate
- D. The heavier object hits the ground first because it has more force (*M06: Force equals weight only*)

Question 3: Action-Reaction Pairs

A car accelerates forward. What is the force that propels the car forward?

- A. The engine pushing forward on the car (*M07: Internal force causes acceleration*)
-  B. The road pushing on the tires
- C. The tires pushing on the road with friction (*M08: Only action, no reaction*)
- D. The air pushing from behind (*M09: Misplaced source of reaction force*)

Question 4: Net Force and Acceleration

A ball is moving to the right at constant speed. Which of the following is true about the net force acting on it?

- A. There must be a net force pushing it to the right (*M10: Motion implies unbalanced force*)
-  B. There is no net force; forces are balanced
- C. The force of motion is greater than friction (*M11: Confusion between motion and force balance*)
- D. Net force depends only on the object's mass (*M12: Misapplication of Newton's 2nd law*)

Question 5: Elevator and Apparent Weight

You are standing on a scale in an elevator that is accelerating upward. What will the scale read?

- A. Less than your actual weight (M13: Acceleration reduces weight)
- ☒ B. Greater than your actual weight
- C. The same as if you were standing still (M14: Confusion between acceleration and equilibrium)
- D. Zero, because weight is canceled by normal force (M15: Weight is negated by normal force)

Question 6: Projectile Motion

A cannonball is shot horizontally. What forces act on it after it leaves the cannon (ignoring air resistance)?

- A. A forward force from the explosion and a downward gravitational force (M16: Force continues after contact)
- ☒ B. Only the downward gravitational force
- C. A force forward and no vertical force (M17: Horizontal motion is force-driven only)
- D. No forces at all since it's in motion (M18: Motion without force idea misapplied)

Question 7: Force in Collision

A truck and a small car collide head-on. Which force is greater during the collision?

- A. The truck exerts a greater force on the car (M19: Larger mass = greater force)
- B. The car experiences more force because it crumples (M20: Deformation implies stronger force)
- ☒ C. Both exert equal and opposite forces
- D. The car's force is greater since it's moving faster (M21: Speed implies more force)