Year 10 Science: Forces and acceleration: F = ma, inertia and force pairs

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A 1200 kg car has a net forward force of 3600 N on it. What is its acceleration?

2. A cyclist and bike have a total mass of 80 kg and accelerate at 1.5 m/s². What net force is acting?

3. A 2 kg trolley is pulled with 10 N while friction acts against it with 4 N. Find the net force and the acceleration.

4. A swimmer pushes on the pool wall with 300 N. What force does the wall put on the swimmer, and why does the wall not move noticeably?

5. A ball bearing is dropped into a tall tube of cooking oil. Its speed rises at first, then stays steady. Explain this using forces.

Fix the mistake

6. Correct this statement: "If something is moving, there must be a net force pushing it forward."

7. Correct this statement: "The trolley has a 100 N push, so a = 100 ÷ 40 = 2.5 m/s²."

8. Correct this statement: "Action and reaction forces cancel out, so nothing can accelerate."

9. Correct this statement: "In a tackle, the heavier player pushes harder on the lighter one."

Answer key (for parents and tutors)

1. A 1200 kg car has a net forward force of 3600 N on it. What is its acceleration?
   $a = F \div m = 3600 \div 1200 = 3\ m/s^2$.
2. A cyclist and bike have a total mass of 80 kg and accelerate at 1.5 m/s^2. What net force is acting?
   $F = ma = 80 \times 1.5 = 120\ N$.
3. A 2 kg trolley is pulled with 10 N while friction acts against it with 4 N. Find the net force and the acceleration.
   Net force = 10 − 4 = 6 N, so $a = 6 \div 2 = 3\ m/s^2$ in the direction of the pull.
4. A swimmer pushes on the pool wall with 300 N. What force does the wall put on the swimmer, and why does the wall not move noticeably?
   300 N pushing the swimmer away from the wall (the reaction force); the wall is fixed to the ground and the whole Earth, so its mass is huge and its acceleration is too small to notice.
5. A ball bearing is dropped into a tall tube of cooking oil. Its speed rises at first, then stays steady. Explain this using forces.
   Weight pulls the ball down; the oil pushes up with drag (and a small buoyant force). Drag grows with speed until the upward forces equal the weight, the net force is zero and the ball falls at a steady terminal velocity.
6. Correct this statement: "If something is moving, there must be a net force pushing it forward."
   An object moving at a steady velocity has zero net force on it; a net force changes the velocity, it is not needed to keep it.
7. Correct this statement: "The trolley has a 100 N push, so $a = 100 \div 40 = 2.5\ m/s^2$."
   $F = ma$ uses the net force, so take away the friction first: $(100 - 20) \div 40 = 2\ m/s^2$.
8. Correct this statement: "Action and reaction forces cancel out, so nothing can accelerate."
   The two forces in a pair act on different objects, so they never cancel; only forces on the same object combine into a net force.
9. Correct this statement: "In a tackle, the heavier player pushes harder on the lighter one."
   The forces on the two players are equal and opposite; the lighter player is thrown back more because the same force on less mass gives more acceleration.