1 course Unit 1. Newton's Law. **Surname Name Group**

READ THE TEXT.

Sir Isaac Newton, an English physicist, mathematician, and astronomer, revolutionized our understanding of the universe with his groundbreaking laws of motion and universal gravitation.

Newton's first law of motion, often referred to as the law of inertia, states that an object at rest will remain at rest, and an object in motion will continue in motion at a constant velocity unless acted upon by an external force. It challenges our everyday intuition, as we often observe objects coming to rest due to forces like friction.

Newton's second law of motion defines force as the product of an object's mass and its acceleration. This means that the more massive an object is, the more force is required to change its velocity. This law also explains that to achieve a certain speed, one can apply a small force over a long period or a large force over a short period.

Newton's third law of motion, often referred to as the reaction principle, states that for every action, there is an equal and opposite reaction. This means that when one object exerts a force on another object, the second object exerts an equal and opposite force on the first object. This principle is evident in the recoil felt when firing a gun, where the force of the expanding gases propelling the bullet forward is met with an equal and opposite force pushing back on the gun.

Newton's law of universal gravitation, a cornerstone of his work, states that every particle in the universe attracts every other particle with a force proportional to the product of their masses and inversely proportional to the square of the distance between their centers. This means that the force of gravity between two objects increases with their masses and decreases with the square of the distance between them.

Task 1. Answer the questions.

1. **What does Newton's first law of motion state?**
   A. An object will change its state only if an external force acts on it.
   B. Objects move faster when no force is applied.
   C. An object in motion stops automatically after some time.

2. **According to Newton's second law of motion, what affects the force needed to move an object?**
   A. The object's speed and distance.
   B. The object's mass and acceleration.
   C. The object's shape and size.

3. **Which example best illustrates Newton's third law of motion?**
   A. A car stopping at a red light.
   B. A ball rolling down a hill.
   C. The recoil of a gun when fired.

4. **What happens to the gravitational force if the distance between two objects increases?**
   A. It decreases.
   B. It stays the same.
   C. It increases.

5. **Which of the following best explains Newton's law of universal gravitation?**
   A. Objects in space move randomly without attraction.
   B. Objects attract each other based on their mass and the distance between them.
   C. Gravity only works on Earth, keeping objects from floating away.

Task 2. Match the terms with the correct definitions.

Term	Definition
1. Universal Gravitation	A. The speed of an object in a specific direction.
2. Inertia	B. A force coming from outside an object that can change its motion, speed, or direction.
3. Object at Rest	C. A force that opposes the movement of objects when they touch each other, causing them to slow down or stop.
4. Object in Motion	D. The force that attracts all objects in the universe toward each other, depending on their masses and the distance between them.
5. External Force	E. The tendency of an object to resist changes in its state of motion or rest unless acted upon by an external force.
6. Velocity	F. The rate at which an object's velocity changes, either by speeding up, slowing down, or changing direction.
7. Friction	G. An object that is moving in a specific direction and continues to move unless a force slows it down or stops it.
8. Acceleration	H. An object that is not moving and stays in its position until a force causes it to move.

Task 3. Fill in the gaps with the correct term from task 2.

1. The car's _____ caused it to keep moving forward even after the driver applied the brakes.
2. The train moved with a constant _____ of 80 kilometers per hour toward the next station.

3. _____ between the tires and the road helps cars slow down when the brakes are applied.
4. A rolling ball is an _____ that will keep moving unless friction or another force stops it.
5. The car showed quick _____ as the driver pressed the gas pedal hard.
6. The wind acted as an _____, pushing the sailboat across the lake.
7. The planets stay in orbit around the sun due to the force of _____.
8. A book on the table is an example of an _____ until someone moves it.

Task 4. Think and decide what Newton's law can be applied in each situation.

- **Situation**: A soccer player kicks a ball. The harder the player kicks (more force), the faster the ball accelerates. If the player kicks a heavier ball with the same force, it will accelerate less than a lighter ball. **Law Applied**: _____

- **Situation**: When a swimmer pushes against the wall of a pool, the swimmer moves in the opposite direction, because the push against the wall (action) results in the wall pushing back (reaction). **Law Applied**: _____

- **Situation**: A person drops a stone from the top of a building. The stone is attracted toward the Earth due to gravity, and the force of gravity increases as the stone's mass increases or as it gets closer to the Earth. **Law Applied**: _____

- **Situation**: When a person jumps off a small boat into the water, the boat moves backward. The force of the person pushing off the boat (action) is met with an equal and opposite force, which makes the boat move in the opposite direction (reaction). **Law Applied**: _____

- **Situation**: You are sitting in a car that suddenly stops. Your body tends to lurch forward because it was in motion and wanted to keep moving at the same speed. The seatbelt is the external force that stops you from continuing forward.
Law Applied: _____

- **Situation**: A rocket is launched into space. The engines apply a large force to the rocket, causing it to accelerate rapidly. The mass of the rocket plays a key role in determining how much force is needed to achieve the desired acceleration.
Law Applied: _____

- **Situation**: A puck slides on ice. Because there is little friction, the puck continues to move at a constant speed until an external force, like the stick or the edge of the rink, slows it down. **Law Applied**: _____

- **Situation**: The planets stay in orbit around the sun due to the force of universal gravitation. **Law Applied**: _____

Task 5. Decide if the statements are TRUR or FALSE.

- _____ Newton's first law of motion states that an object in motion will stop moving unless acted upon by an external force.

- _____ Newton's second law of motion shows that force is directly proportional to an object's acceleration and mass.

- _____ Newton's third law of motion states that for every action, there is an equal and opposite reaction.

- _____ Newton's law of universal gravitation explains that the force of gravity decreases with the square of the distance between two objects.

- _____ According to Newton's first law, friction is not necessary to stop an object in motion.

- _____ Newton's second law of motion implies that a heavier object requires more force to achieve the same acceleration as a lighter object.

- _____ Newton's third law of motion is only applicable to mechanical systems and does not apply to forces in fluid dynamics.

- _____ Newton's law of universal gravitation only applies to objects on Earth and does not work in space.

- _____ An engineer designing a bridge would apply Newton's third law to ensure that the forces between the bridge and the load it carries are balanced.

- _____ Newton's first law of motion helps engineers design safety features like seatbelts, which apply external forces to stop passengers from continuing in motion during sudden stops.

Task 6. Dialogue. Fill in gaps in the dialogue with the correct phrase.

Tom: How do we initiate motion in this machine?

George: According to Newton's first law, an object at rest **(1)**_____, requiring an external force to overcome its inertia.

Tom: And once it's in motion, how do we **(2)** _____?

George: Friction will act against the motion. To counter this, we'll need to **(3)** _____ through lubrication or optimizing the contact surfaces.

Tom: What determines how fast it moves?

George: The velocity is determined by the **(4)** _____, in accordance with Newton's second law.

Tom: So heavier objects **(5)** _____?

George: Exactly. **(6)** _____ acceleration, so we must apply more force to achieve the desired motion.