Study Guide : Motion and Forces

Lesson 1: Motion

1- **Position and Motion**:

- **Summary**: Position is the exact place where an object is, and it can change when the object moves. Direction is the way an object faces, like north or south. For example, if you turn around while standing still, your direction changes but your position does not.

- **Example**: The blue car is "12 meters behind the red car." If it stays 12 meters behind, its relative position does not change.

- **Question**: What is the relative position of the red car if the blue car is "12 meters behind" it?

- **Answer**: The relative position of the red car is "12 meters ahead" of the blue car.

2- **Relative Motion**:

- **Summary**: Relative motion is the change in an object's position compared to another object's position. If the blue car passes the red car, the relative position of the blue car changes, moving from behind to in front of the red car. This shows that motion has occurred.

- **Example**: If you are riding in the blue car, you can see that you're moving by comparing your position to trees and buildings. But your position compared to a friend sitting next to you does not change.

- **Question**: What is relative motion?

- **Answer**: Relative motion is when the position of an object changes compared to another object.

3- **Changes in Speed:**

- **Summary**: A man and his dog maintain a constant speed as they cross the street, meaning they move at the same rate without speeding up or slowing down. However, their speed might change once they reach the next intersection, where they could either slow down or speed up depending on different factors.

- **Question**: How could the man's and dog's speed vary during their walk?

- **Answer**: Their speed could vary by either slowing down or speeding up as they continue to the next intersection.

Lesson 2: Patterns in Motion

1- **Patterns of Motion:** Motion can be described by patterns, like a swing moving back and forth, which helps predict future movements. Some patterns are clear, like a seesaw going up and down, while others, like the vibrations of sound speakers, are not visible.

- **Question**: How does observing a swing's motion help with predictions?

- **Answer:** By identifying the swing's back-and-forth pattern, you can predict its future movement.

- **Question**: What happens when you bounce a ball?-

- **Answer**: The ball will hit the ground and bounce back up, creating a pattern of movement up and down.

2- **Changing Motion:**

- **Summary**: When strong wind blows, a wind chime swings back and forth quickly. If the wind stops, the chime gradually slows down until it stops moving. In a mild breeze, the chime moves more slowly than in strong wind. Additionally, if the wind changes direction, the chime will also move in different directions, altering its movement pattern.

- **Example**: A pendulum clock moves in a consistent swinging pattern. It swings back and forth at regular intervals, maintaining a steady rhythm.

- **Question**: What happens to a wind chime when strong wind blows?

- **Answer**: It swings back and forth quickly.

- **Question**: How does the movement of the chime change when the wind stops?

- **Answer**: It swings more slowly until it eventually stops.

3- Motion Without a Pattern:

- **Summary**: Some motions lack a clear pattern, making them unpredictable. For instance, wasps are difficult to avoid because their flight paths are erratic, and they can change direction quickly. When forces act on an object from various directions, it becomes challenging to predict its motion.

- **Question**: Which animal's motion could you more easily predict, a fly or a dog? Explain your answer.

- **Answer**: You could more easily predict a dog's motion because dogs generally follow more consistent movement patterns, like running in a straight line or following their owner's commands, whereas flies, like wasps, move erratically and change directions suddenly.

Lesson 3: Forces and Motion

1. Force:

- Summary: A force is a push or a pull that can make an object start moving, stop moving, or change direction. Forces can also change the speed of an object.

- Example: When you push a toy car, you are applying a force to make it move.

- Question: What is a force?

- Answer: A force is a push or a pull that can change the motion of an object.

2. Exert:

- Summary: To exert means to apply strength or effort on something. When you push or pull on an object, you are exerting a force on it.

- Example: When you pull up a zipper, you exert a force to move it up.

- Question: What does it mean to exert a force?

- **Answer**: To exert a force means to use effort or strength to push or pull on something.

3. Contact Forces:

- **Summary**: Contact forces occur when objects touch, like pushing, pulling, friction, tension, and spring force. These forces can make objects move or slow them down.

- **Question**: What is an example of a contact force?

- **Answer**: Friction is a contact force that acts against the motion of an object, like a bike's tires rubbing against the road.

4. Noncontact Forces:

- **Summary**: Noncontact forces, like gravity, magnetism, and electric forces, can affect objects without touching them. Gravity pulls, magnetism attracts or repels, and electric forces push or pull charged objects.

- **Question**: Give an example of a noncontact force.

- **Answer**: Gravity is a noncontact force because it pulls objects toward each other without needing to touch them.

5. Magnetism:

- **Summary**: Magnetic force is a noncontact force that can attract or repel objects without touching them. It affects objects like iron and other magnets.

- **Question**: What happens when two magnets with the same poles face each other?

- **Answer**: The magnets will repel each other.

6. Electricity:

- **Summary**: Electric forces act between objects that are electrically charged. Oppositely charged objects are attracted to each other and tend to move toward each other, while objects with the same charge repel each other and tend to move away.

- **Example**: If you rub a balloon on your hair and then hold it near a cat, the - balloon might attract the cat's hair if they have opposite charges.

- **Question**: Does the balloon attract or repel the cat's hair when it is rubbed and brought close?

- **Answer**: The balloon will attract the cat's hair if they have opposite charges.

7. Gravity:

- **Summary**: Gravity is a force that pulls objects toward each other, like Earth pulling objects downward. It's what keeps us on the ground and causes objects to fall.

- **Question**: What force pulls an apple towards the ground when it falls from a tree?

- **Answer**: Gravity pulls the apple towards the ground.

8. Equal and Opposite Forces:

- Summary: When you sit on a chair, you exert a downward force while the chair exerts an equal upward force, resulting in no change in motion. Similarly, if two soccer players kick a ball with equal but opposite forces, the ball remains still because the forces are balanced.

To make the ball move, the forces must be unbalanced. This occurs when one player kicks the ball harder than the other, causing a change in motion.

-Question: What happens when you sit on a chair?

- Answer: You push down on the chair, and it pushes up on you with equal force, so there's no change in motion.

- Question: Why doesn't the soccer ball move with equal kicks?

- Answer: The ball remains still because the forces are balanced and equal but opposite.

9. Combined Forces:

- **Summary**: Different forces can act on an object at the same time, like when you ride a bike. The push from your feet, the friction from the ground, and the force you use to steer all work together.

Lesson 4: Balanced and Unbalanced Forces

1. Net Force:

- **Summary**: Net force is the sum of all the forces acting on an object. When forces are balanced, the net force is zero, and the object's motion does not change. When forces are unbalanced, the net force is not zero, causing the object to speed up, slow down, or change direction.

- **Question**: What is the net force when you and a friend push a box with equal force but in opposite directions?

- **Answer**: The net force is 0 because the forces are balanced.

2. Equation:

- **Summary**: Equations can show the balance or unbalance of forces. For example, if two people push a box with 3 N each in the same direction, the net force is 3 N + 3 N = 6 N.

- **Question**: What is the net force if one person pushes a box with 4 N to the right and another pushes with 4 N to the left?

- **Answer**: The net force is 0 because the forces are balanced.

3. Balanced Forces:

- **Summary**: Balanced forces occur when two forces of equal strength act in opposite directions on an object. These forces cancel each other out, resulting in no change in motion.

- **Example**: A piano held in the air by a crane has a balanced force. The upward force of the crane and the downward pull of gravity are equal.

- **Question**: Describe what happens to a box resting on a table in terms of balanced forces.

- **Answer**: The upward force from the table and the downward force from gravity are balanced, so the box stays in place with a net force of 0.

4. Unbalanced Forces:

- **Summary**: Unbalanced forces occur when the forces acting on an object are not equal, leading to a change in motion. This could mean the object starts moving, speeds up, or changes direction.

- **Question**: What must happen to make a soccer ball move if two players kick it from opposite directions?

- **Answer**: The forces must be unbalanced, meaning one player needs to kick the ball harder than the other.

- **Answer**: The forces include the dog pulling the boy, friction between the boy's feet and the ground, and gravity pulling both downward.

Compare and Contrast:

1- How are the forces of friction and gravity alike? How are they different?

- **Answer:**

- **Alike**: Both friction and gravity are forces that affect how objects move. They can slow down or stop an object.

- **Different**: Gravity pulls objects downward, while friction opposes motion between surfaces that are in contact.

Predict and Describe:

Predict: If you drop a ball from a higher height, what will happen?

- **Answer**: The ball will bounce higher than before because it has more energy from falling a longer distance.

Describe: Identify an object that moves in a pattern, like a swing.

- **Answer**: A swing moves back and forth in a regular pattern, just like a pendulum.