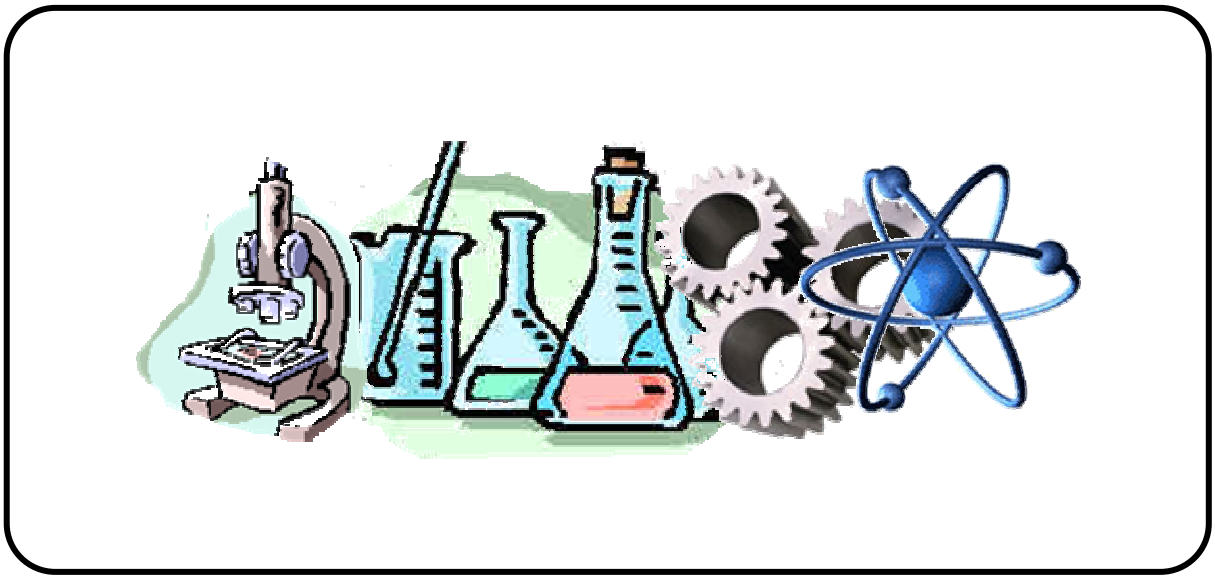
Project EASE

(Effective and Alternative Secondary Education)

INTEGRATED SCIENCE I



MODULE 7

BUREAU OF SECONDARY EDUCATION

Department of Education
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Module 7
The Nature of Forces

What this module is about

Motion occurs all around us. We see it in our everyday activities, in children playing in the neighborhood, in animals roaming in the field, in trees swaying in the wind, and even in the stars at night. There is also motion that we cannot directly see, like the vibration of atoms responsible for heat and sound and the flow of electrons that constitutes electricity. Truly, motion is everywhere.

But what is responsible for all these type of motion? What causes motion? Based on our experiences, whenever an object at rest moves, we presume that something acting on it made it move and whenever a moving object slows down and eventually stops, something acting on it made it stop. In science, this thing that affects motion is called **force**.

What is a force? What changes are brought about by forces acting on bodies? How do forces affect motion? What are the different types of forces? How does force and surface area affect pressure? This module presents some simple activities that will help you understand the basic concepts about forces.

This module discusses the following lessons:

- **Lesson 1 - The Effects of Forces**
- **Lesson 2 - Classification of Forces**
- **Lesson 3 - Pressure**

What you are expected to learn

After going through this module, you should be able to:

1. describe the effects of forces on objects
2. identify contact and non-contact forces
3. define different types of forces
4. show how pressure is related to force and area

How to learn from this module

This module has been designed to help you understand the basic concepts about forces. The simple activities that you will perform will help you comprehend the concepts about forces as they apply to real life situations. By engaging in these learning activities, you become an active participant in the learning process.

As you go through the module, you are in complete control of the learning process. Here's a simple guide for you in going about the module:

1. Read and follow all instructions carefully.
2. Answer the pretest before going over the lessons.
3. Check your answers with the given answer key at the end of this module. This will help you assess your understanding of the concepts you are about to learn.
4. Read the learning objectives for this module.
5. Translate these learning objectives into questions that you desire to answer after learning from the module. This will give direction to the learning process you will be engaging in.
6. Relate your experiences and previous knowledge to the concepts you have to learn.
7. Read the procedure for the learning activities carefully. Reflect on how these activities could help you answer your questions.
8. Gather all the materials needed before engaging in the learning activities.
9. Answer the guide questions based on the results of the activities you have just performed.
10. Relate the answers to the guide questions to your learning objectives.
11. Assess your understanding of the basic concepts derived from activities by answering the self-test.
12. After finishing the entire module, assess your understanding by answering the posttest. If you still find the lessons difficult to comprehend, try again. This time, try to address the needs that you were not able to meet.

What to do before (Pretest)

Instructions: Choose the letter of the correct answer. Write the letter on your answer sheet.

1. Which of the following is **not** a consequence of a force?
    a. change in the mass of a body
    b. change in the shape of a body
    c. change in the speed of a body
    d. change in the direction of motion of a body

2. What force is responsible for keeping the planets in their orbits as they revolve around the sun?
    a. nuclear
    b. magnetic
    c. electrical
    d. gravitational

3. Which of the following devices can be used to measure forces?
    a. spring balance
    b. balance beam
    c. triple beam balance
    d. all of the above

4. Which of the following is an example of a non–contact force?
    a. friction
    b. tension
    c. normal force
    d. gravitational

5. A sack of rice is hanging from a rope. What term refers to the force exerted by the rope pulling the sack of rice up?
    a. friction
    b. tension
    c. normal force
    d. elastic force

6. What term refers to the force by which all bodies are attracted to the earth?
    a. weight
    b. tension
    c. friction
    d. normal force

7. What term refers to the quantity force per unit area?
    a. mass
    b. weight
    c. density
    d. pressure

8. What type of force is responsible for the slowing down of moving objects on a surface?
    a. friction
    b. weight
    c. tension
    d. normal force

9. How does a negatively charged body interact electrically with a positively charged body?
    a. attract
    b. repel
    c. either attract or repel
    d. it depends on their masses

10. When an atomic bomb explodes, tremendous amount of energy is released. With what force is this energy associated?
    a. weak
    b. electric
    c. nuclear
    d. magnetic

11. For the same force applied, what happens to the pressure if the surface area where the force is acting is decreased?
    a. increases
    b. decreases
    c. does not change
    d. not enough information is given

12. A balloon is squeezed by pushing on its opposite sides. How would this affect the air pressure inside the balloon?
    a. the air pressure increases
    b. the air pressure decreases
    c. the air pressure does not change
    d. not enough information is provided

Key to answers on page 21

Lesson 1 The Effects of Forces

Forces have always been a part of our everyday experiences. Whether we are doing our household chores, working in the field, or even playing at school, we can see the effects of forces in action. For example, in fetching water from a well, you need to exert a force by pulling the rope up. In moving a car stuck in the mud, you need to exert a force by pushing it. And in a tug–of–war game, you need to exert a force by pulling the rope as hard as possible in order to win. These are just some of the many instances that show forces in action. From these instances, can you see the changes brought about by forces acting on certain bodies? What are these changes? The following activities will help you find out the answers to these questions.

What you will do

Activity 1.1 Changes brought about by forces

Materials: inflated balloon, two books with different sizes, small ball

Procedure:

1. Describe the size and shape of an inflated balloon.

   (a) Squeeze the balloon by pushing on opposite sides. Describe what happens to the balloon.

   _____
   _____

   (b) Pull on the opposite sides of the balloon. Describe what happens to the balloon.

   _____
   _____

2. Place two different books on top of a table.
   (a) How do you make the books move?

   _____
   _____

   (b) Which is harder to move, the big book or the small book?

   _____
   _____

3. Make a small ball roll along the surface of a table.

   (a) How do you make it move faster?

   _____
   _____

   (b) How do you make it move slower?

   _____
   _____

4. Make the small ball roll along the flat surface of a table.

   (a) Describe the path taken by the ball.

   _____
   _____

   (b) How do you deflect the ball from its path while it is moving?

   _____
   _____

The activities you have just performed illustrate the changes brought about by forces acting on certain bodies. You may have noticed the following changes:

Part 1: the size and shape of the balloon changed
Part 2: the state of motion of the ball changed
(a ball at rest eventually moved)
Part 3: the speed of the moving ball changed
Part 4: the direction of motion of the moving ball changed

What is responsible for such changes? It is a force. A **force** is a push or a pull. In part 1, the size and shape of the balloon can be changed either by pushing or pulling on the opposite sides of the balloon. In part 2, what made the books move was either a push or a pull. However, the big book required more effort for it to move than the small book. In part 3, the speed of the rolling ball can be changed by pushing the ball. If the push given to the ball is in the same direction as its motion, it will move faster. However, if the push given to the rolling ball is in the opposite direction, it will move slower and will eventually stop. In the last part, the direction of motion of the rolling ball can be changed by pushing it sideways either to the right or to the left of its straight-line path.

The activities you have just performed demonstrated what a force could do to an object. To summarize:

- **A force can change the size and shape of an object.**
- **A force can change the state of motion of objects.**
  (makes objects at rest move and objects moving stop)
- **A force can change the speed of moving objects.**
  (makes it move faster or slower)
- **A force can change the direction of motion.**

What is a force? A force is a push or pull that may cause a change in the object's motion, size and shape, or both. How is force measured? A device used in measuring force in the laboratory is called **spring balance**. It consists of a coil spring, enclosed in a case for protection, with a pointer attached to one end. When forces are applied to the ends of a spring balance, the pointer indicates the amount of elongation that is proportional to the force applied. The SI unit of force is Newton (N). The weighing scale you see in the market and the bathroom scale used in weighing a baby are all used to measure force which is the weight. However, these weighing scales are not calibrated in newtons but in kilograms.

What you will do

Self-Test 1.1

Instruction: Answer the following questions completely.

1. What is a force? Give examples of forces acting on objects.
2. What can a force do to an object?
3. What is the standard unit of force?
4. What instrument is used to measure force? How does it measure force?
5. Identify the effect of force in the following situations
   (change in size/ shape, change in speed, change in direction of motion)
   a. making a clay pot from mud
   b. pushing a cart
   c. kicking a rolling ball sideways
   d. bending a bamboo stick
   e. a strong typhoon blowing over the field

Key to answers on page 21

Lesson 2 Classification of Forces

In lesson 1, you learned that a force could either be a push or a pull capable of changing the size or shape, the speed, and the direction of motion of objects. By pulling on the rope, you can direct a carabao and its cart in the right direction. By pushing a cart, you can make it move. Based on these instances, it seems that forces are always exerted through contact. But there are other forces exerted even without physical contact between the interacting bodies. So how are forces exerted on interacting bodies? The following activity will help you classify forces based on the way they act on bodies.

What you will do

Activity 2.1 Making an object move

Materials: small ball

Procedure:

1. (a) How do you make a ball at rest on top of a table move?

   _____
   _____

   (b) Was there contact between your hand and the ball as you try to make it move?

   _____
   _____

2. (a) Hold the same ball at shoulder level and then let go. What happened to the ball?

   _____
   _____

   (b) Was there contact between the floor and the ball while it was falling after being released from your hand?

   _____
   _____

The activity you have just performed illustrates that there are two different ways by which forces act on objects. In part (1), in order for the ball at rest to move, you need to exert a force on the ball. This force that you exerted on the ball could either be a push or a pull. As you push or pull the ball, there is physical contact between your hand and the ball.

However in part (b), when you let go of the ball at shoulder level, it falls to the floor. As the ball falls, there must be a force exerted on it that makes it fall. But what could have exerted this force? It is the floor. The floor exerts an attractive force on the ball even if there is no physical contact between them. These observations point out that forces could either be contact forces or non – contact forces.

- **Contact forces** are types of forces in which the two interacting bodies are in contact as they exert forces on one another.
- **Non–contact forces or action at a distance forces** are types of forces in which the two interacting bodies are not in contact as they exert forces on one another.

What you will do

Activity 2.2 Different Types of Forces

Materials: book, marble, stone, string, spring, plastic comb, small bits of acetate, two bar magnets

Procedure:

1. Place a book on top of a table. What keeps the book from falling? How is this possible?

   _____
   _____
   _____
   _____

2. Roll a marble on top of a level surface. Make it stop. Slide a light book on top of the same level surface by giving it an initial push. Did the book continue to slide? What is responsible for making the sliding book slow down and eventually stop?

   _____
   _____
   _____
   _____

3. Tie a small stone at the end of the string. Allow the stone to hang. What keeps the stone from falling? How is this possible?

   _____
   _____
   _____
   _____

4. Drop a small stone and a piece of paper from the same height at the same time. Observe closely the motion of the stone and the paper as they fall. Which of them reached the ground first? Why didn't the other one reach the ground at the same time as the first? (Try orienting your palm against the direction of the wind. What do you feel?)

_____
_____
_____

5. Attach one end of a spring firmly on a wall. Compress the spring by pushing a small stone against the free end of the spring. Release the spring. What happens to the stone? How is this possible?

_____
_____
_____

6. Rub a plastic comb against your hair. After several strokes, let it approach small bits of acetate. (Make sure that the comb only approaches the bits of acetate, not actually touching them). What happens to the small pieces of acetate? How is this possible?

_____
_____
_____

7. Let the north pole of a bar magnet approach the north pole of another bar magnet. Bring them closer together. What do you notice? How do these magnets interact?

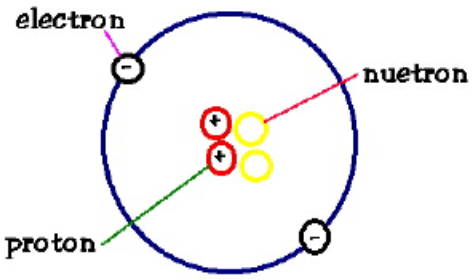
_____
_____
_____

This time, let the north pole of the magnet approach the south pole of another bar magnet. What do you observe? How do these magnets interact? How do you take them apart?

_____
_____
_____

Activities 1-7 show the different kinds of forces whose effects we can observe. How about in an atom which we cannot see? Are there forces in an atom?

Helium Atom



Read this:

An atom consists of three sub-atomic particles. The protons and neutrons are found in the nucleus while the electron is orbiting around the nucleus. Why do the protons and neutrons orbit instead of the electron? What keeps the nuclear particles together? The protons repel each other because they carry like charges. Evidently, electric forces do not hold the neutrons together. The gravitational force between the nucleus is too small to be of importance. There is a third force that holds the nuclear particles together. It is called nuclear force. The strong nuclear force is a force that holds protons and neutrons together to form atomic nucleus. The weak nuclear force acts between the elementary particles and is responsible for radioactive decay called beta decay. This force is involved in nuclear reactions that occur in stars like the sun.

The activities you have just performed illustrate the different kinds of forces acting on bodies.

A book on top of a table

In this activity, a book is at rest on top of a table. Without the table, the book will fall. Therefore, it is the table that supports the book. How does the table support the book? It is by applying an upward force on the book. This upward force exerted on the book by the surface of a table is the **normal force**. It is always perpendicular to the surface.

A sliding book on top of a table

A marble is rolling on a flat surface. How could the marble be stopped? It could be stopped by applying a force opposite to the direction of motion. A marble moving to the right can be stopped by pushing it to the left.

A book initially at rest on a flat surface can be set into motion by giving it a slight push. As the book moves, it slows down and then stops. Just like the marble, the book slowed down and eventually stopped. This means that there must be a force exerted on the book opposite to the direction of motion. But what object could have exerted this force? It is the flat surface. As the book slides, the surfaces of the book and the floor in contact offer opposition to motion. This opposition is the force exerted on the book opposite to the direction of motion. This force that opposes motion is called **friction**.

A stone at the end of a string

A small stone tied at the end of a string hangs at rest. What keeps the stone from falling? It is the string. How could the string prevent the stone from falling? It is by pulling the stone upward. This force exerted by a string on opposite sides is known as **tension**. The tensions on opposite sides of a string are equal.

A stone and a piece of paper dropped from the same height

When a stone and a piece of paper are dropped from the same height, which reaches the ground first? The stone reaches the ground first. Why? Is it because the stone is heavier than the paper? No.

Both the stone and the paper are attracted to the ground. The force of attraction exerted by the earth on objects in its surface is the **gravitational force**. However, as the paper falls, there is another force that acts on it. This force exerted by the air on the paper is opposite to the direction of motion just like friction. This force causes the paper to be left behind by the stone. This force exerted by the air opposite in direction to the motion of an object is known as **air resistance**.

The paper can be made to reach the ground at the same time as the stone by crumpling it. Doing so reduces the air resistance on the paper.

A stone attached to a spring

When the compressed spring is released, a stone attached at its free end is thrown forward. What made it possible for the stone to move forward? It is the force exerted on it by the spring. The force exerted by a compressed or stretched spring is known as the **elastic force**.

A plastic comb attracting bits of acetate

When a plastic comb is rubbed against your hair, it gains the ability to pick up bits of acetate. This happens because of the transfer of charges between the plastic comb and the hair. We say that the plastic comb is charged. The plastic comb interacts with small pieces of acetate by attracting them. The force exerted between electrically charged bodies is known as the **electric force**. Charges could either be positive or negative. Charges with like sign repel each other; charges with unlike sign attract each other.

Two bar magnets

When the north pole of one magnet is brought close to the north pole of another magnet, they repel each other. It will be harder to move them closer together as they approach one another. However, when the north pole of a magnet is brought close to the south pole of another magnet, they attract each other. This force exerted by the poles of a magnet is known as **magnetic force**.

The activities you have just performed illustrate that forces could be classified into contact and non–contact forces. The table below shows how these forces are classified.

Contact Forces	Non–Contact Force
Applied forces (push or pull)	Gravitational
Air resistance	Electrical
Elastic Force	Magnetic
Normal Force	Nuclear
Tension	Weak
Friction	

Different types of forces:

- **Tension** – the force exerted by a string or a rope when it is stretched
- **Friction** – force that opposes motion. It is always opposite to the direction of motion.
- **Air resistance** – air friction that opposes the motion of an object in air.
- **Elastic force** – force exerted on a spring when it is stretched or compressed.
- **Normal force** – support force provided by surface.
- **Applied force** – a push or a pull exerted on an object by something else.
- **Electric force** – force exerted among charged particles.
- **Magnetic force** – force exerted when magnets interact.
- **Nuclear force** – force responsible for keeping the particles in the nucleus of an atom intact.
- **Gravitational** – force of attraction of two bodies because of their masses.
- **Weak force** – force associated with the decay of the nucleus of an atom.

What you will do

Self-Test 2.1

Instruction: Answer each question by identifying the force being described. Identify whether that force is a contact force or a non – contact force.

1. What force is responsible for the downward motion of a falling fruit?
2. What force makes it possible for metallic clips to be attracted to an electromagnet?
3. What force is exerted on opposite sides of a rope being stretched in a tug – of – war game?
4. What is the support force for a vase on top of a table?
5. What force is responsible for the slowing down of a figure skater as he slides across the skating rink?

Key to answers on page 21

Lesson 3 Pressure

Whenever you listen to a weather forecast over the radio, you will usually hear the term low-pressure associated with a coming typhoon. When inflating a bicycle tire, you make sure that you inflate it with the right pressure because too much pressure on the tire might cause it to burst. In some subdivisions where water supply is insufficient, the flow of water out of the faucet is weak because of low water pressure. These instances show that we often make use of the word 'pressure' in everyday conversations. But what exactly is pressure?

This lesson discusses the basic concepts about pressure as it is used in science. It will describe how pressure is related to force and the surface area over which the force acts.

What you will do

Activity 3.1 Pressure – Its Relation to Force and Area

Materials: a wide pan filled with flour, about 5 cm deep, two identical rectangular wooden blocks, a heavy stone

Procedure:

1. (a) Lay the two rectangular wooden blocks horizontally on the flour. What do you notice about the depression on the flour made by the two blocks?

   _____
   _____
   _____

   (b) What happens to these depressions on the flour when you put a heavy stone on top of one of the blocks?

   _____
   _____
   _____

2. (a) Lay the first rectangular wooden block horizontally on the flour and the other vertically. What do you notice about the depression made by these blocks on the flour?

   _____
   _____
   _____

(b) How do you keep the depression made by the blocks constant without changing the orientation of the blocks?

_____
_____
_____

In the activity that you have just performed, the pressure exerted by the wooden blocks is indicated by the depression made on the flour. The greater the pressure, the deeper is the depression.

In activity 1, when the two wooden blocks were laid horizontally on the flour, they created the same extent of depression. Why? It is because the two wooden blocks have exerted the same force on the flour over the same surface area. The same force exerted on the flour because the wooden blocks are identical, having equal weights. The surface area of the application of the force is the same because the faces of the wooden blocks that are in contact with the floor are the same. However, when a heavy stone is placed on top of one of the blocks, the depression on the flour made by that block changes. What could be the reason for this? Clearly, it is not the area of the application of the force because identical faces of the blocks are still in contact with the flour. Therefore, it is the difference in the force applied to the flour that caused the difference in the extent of the depression. With the addition of the stone, the force applied by that block on the flour has increased. In turn, the depression on the flour has also increased. This means that pressure exerted by the block increases.

In activity 2, the two blocks differed in terms of extent of depression made on the flour. The block oriented vertically made the greater depression on the flour than the one oriented horizontally. This could not be attributed to the forces they exert on the flour because they have equal weights. Instead, this could be attributed to the difference in the area of the block in contact with the flour. The one oriented vertically has a smaller area of contact with the flour than the one oriented horizontally. This allows the block oriented vertically to exert a greater force per unit area on the flour.

The results of the activity you have just performed are summarized in the table below.

	Force	**Area**	**Pressure**
Activity 1	Big	Equal	Big
	Small	Equal	Small
Activity 2	Equal	Small	Big
	Equal	Big	Small

Based on the results of the activity, we can come up with two basic concepts about the relation of pressure, force and area.

- **For the same surfaces where force is applied, pressure is directly proportional to the force. The greater the force, the greater the pressure; the smaller the force, the smaller the pressure.**

- **For the same force applied, pressure is inversely proportional to the surface area where the force is applied. The greater the surface area, the smaller the pressure; the smaller the surface area, the greater the pressure.**

Therefore, in science, pressure is defined as the force exerted per unit area. In an equation:

Pressure = Force / Area 1 Pa = 1 N/ m^2

If force is expressed in newtons and the area in square meters, pressure is expressed in pascals.

What you will do

Self-Test 3.1

Instruction: Choose the letter of the correct answer. Write the letter only.

1. If you blow more air into a balloon, what happens to the pressure?
   a. increases
   b. decreases
   c. stays the same

2. For the same force applied, what happens to the pressure if the surface area where the force acting is decreased?
   a. increases
   b. decreases
   c. stays the same

3. What happens to the pressure if the force applied on the same surface area is decreased?
   a. increases
   b. decreases
   c. stays the same

4. In which case is the pressure exerted greater: object A with weight 10 N with surface area in contact with table equal to 5 cm^2 or object B with weight 20 N with surface area in contact with the table equal to 10 cm^2?
    a. object A
    b. object B
    c. the same pressure is exerted

5. A balloon is squeezed by pushing on its opposite sides. How would this affect the air pressure inside the balloon?
    a. the air pressure increases
    b. the air pressure decreases
    c. the air pressure does not change
    d. not enough information is provided

Key to answers on page 22

Let's summarize

After going through all the activities in this module, let us summarize the basic concepts about forces and how they affect objects.

1. A force is capable of changing the size and shape of an object, its speed, and its direction of motion. The SI unit of the force is the Newton.

2. Forces are classified into contact and non–contact forces. Contact forces are exerted on interacting bodies that are in physical contact with one another. Non – contact forces or action at a distance forces are exerted when the interacting bodies are not in physical contact with one another.

3. Normal force is the upward force exerted on an object by a surface. Friction is a force that opposes motion

4. Tension is the force exerted on opposite ends of a string or rope

5. The gravitational force is the force of attraction between any two objects in the universe.

6. Air resistance is the force exerted by the air opposite to the direction of the motion of a falling object.

7. Elastic force is the force exerted by a compressed or stretched spring.

8. Electric force is the force exerted by electrically charged objects

9. Magnetic force is the force exerted by the poles of a magnet.

10. Nuclear force is a force that holds the nuclear particles together.

11. Pressure is defined as force exerted over a certain surface area. Its SI unit is the Pascal. For the same force exerted, the greater the surface area, the smaller the pressure. For the same surface area, the greater the force, the greater is the pressure.

Posttest

Instructions: Choose the letter of the correct answer. Write the letter only on your answer sheet.

1. Which of the following is the effect of forces exerted on a balloon when it is squeezed?
    a. Increase in the mass of the balloon
    b. Decrease in the mass of the balloon
    c. Increase in the mass of the balloon
    d. Decrease in the mass of the balloon

2. Which of the following is NOT an example of a contact force?
    a. Friction
    b. Tension
    c. Normal force
    d. Elastic force

3. A girl hangs at rest at the end of a rope tied to the ceiling. What provides the support force for the girl?
    a. tension
    b. weight
    c. friction
    d. normal force

4. What will happen to a body made to slide across a frictionless level surface?
    a. Its speed will increase.
    b. Its speed will decrease
    c. Its speed will remain the same.
    d. It will stop.

5. In which of the following cases is there net force acting on a body?
    a. a body moving at constant speed along a circular path
    b. a body at rest on top of a table
    c. a body moving along a frictionless surface
    d. none of the above

6. A rock is hanging from a rope. What term refers to the force exerted by the rope on the rock?
    a. Elastic force
    b. Friction
    c. Normal force
    d. Tension

7. A nail is attracted to a magnet. What force is responsible for this attraction?
    a. Electrical force
    b. Gravitational force
    c. Magnetic force
    d. Nuclear force

8. When you rubbed a comb against your hair and put it near small bits of paper, the paper clings to the comb. What force explains this observation?
    a. weak force
    b. electrical force
    c. magnetic force
    d. nuclear Force

9. What force is responsible for keeping an electron in its orbit as it goes around the nucleus of an atom?
    a. weak force
    b. electrical force
    c. magnetic force
    d. nuclear Force

10. A ball is thrown upward. When it reaches its maximum height, it stops. What force acts on the ball?
    a. friction
    b. weight
    c. normal force
    d. air resistance

11. Two identical cars A and B have the same mass. What can you say about the pressure of the air in the tires if in car A the tires have a greater area of contact with the ground compared to that of car B?
    a. the air pressure of the tires in car A is greater than that in car B
    b. the air pressure of the tires in car A is less than that in car B
    c. the air pressure of the tires in car A is equal to that in car B
    d. cannot be determined from the information given

12. Two identical glasses are filled with different substances. Glass A is filled with water while glass B is filled with sand. Which of the two exerts a greater pressure on the table?
    a. Glass A
    b. Glass B
    c. Both A and B

Key to answers on page 22

Key to Answers

Pretest

1. a	6. a	11. a
2. d	7. d	12. a
3. a	8. a	
4. d	9. a	
5. b	10. c	

Self–Test 1.1

1. A force could either be a push or a pull.
   Examples of forces acting on bodies:
   a. the moon being pulled by the earth's gravity
   b. a boy pulling a rope tied to a dog
   c. a group of men pushing a stranded truck

2. A force is capable of doing any of the following:
   a. change the size and shape of a body
   b. change the speed of a moving body
   c. change the direction of motion of a moving body

3. The standard unit of force is the Newton. 1 N = 1 kgm/s^2

4. A spring balance can be used to measure forces. The amount of force being measured is proportional to the elongation of the spring. This elongation is calibrated in Newtons.

5. a. change in shape
   b. change in speed
   c. change in direction
   d. change in shape
   e. all the changes listed are possible

Self–Test 2.1

1. gravitational force (non – contact force)
2. magnetic force (non – contact force)
3. tension (contact force)
4. normal force (contact force)
5. friction (contact force)

Self–Test 3.1

1. a
2. a
3. b
4. c
5. a

Posttest

1. d
2. d
3. a
4. d
5. a
6. d
7. c
8. a
9. b
10. b
11. b
12. b

-End of Module-

Reference

Hewitt, P.G. (2000) *Conceptual Physics: The high school physics program.* New Jersey: Prentice – Hall Inc. New Jersey

References: