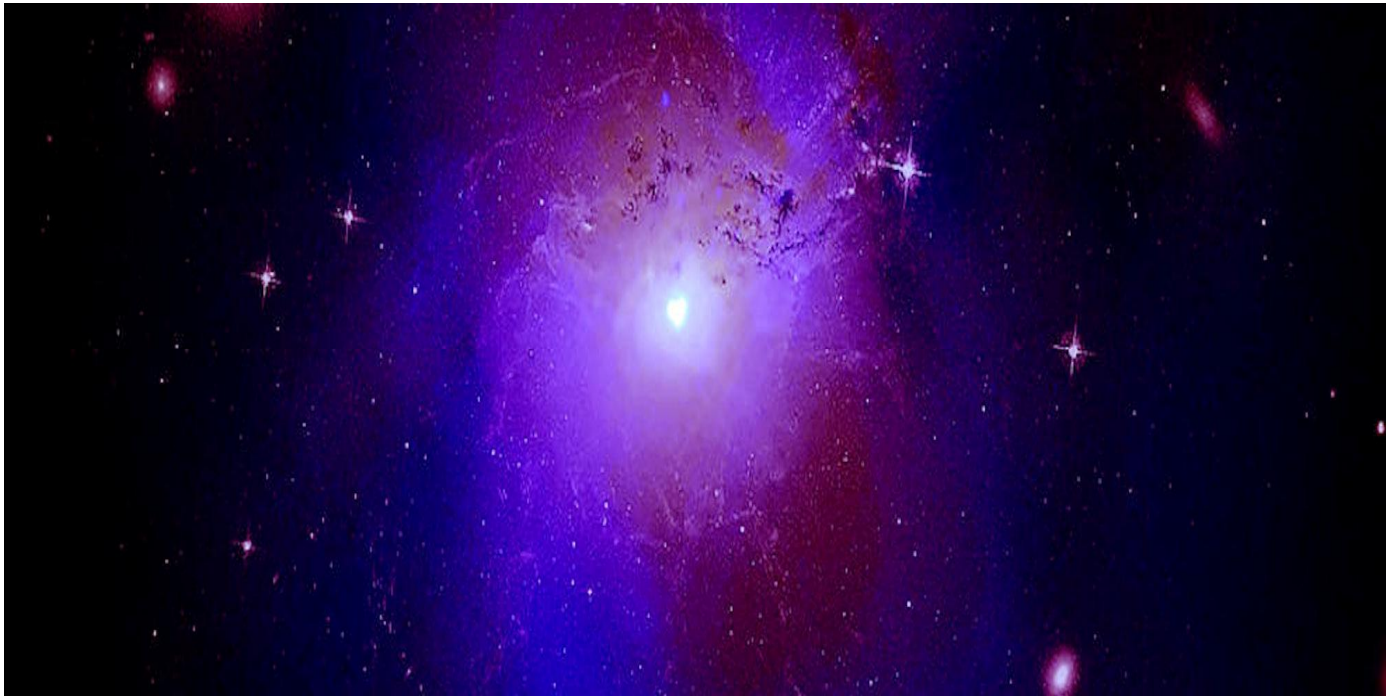
Unit 3

MATTER



Activity I.

Learn the words and phrases

attraction – *тяжіння*	uniformly – *рівномірно*
incompressible – *нестислий*	promising – *перспективний*
melting - *плавлення*	crushing - *подрібнення*
boiling - *кипіння*	to compose - *складати*
dissolving - *розчиняння*	toattain – *досягати, добиватися*
evaporating - *випаровування*	to conclude – *робити висновок*
liquid – *рідина, рідкий*	toconform – *відповідати (у відповідності до)*
solid – *тверда речовина*	to obtain – *отримувати, одержувати*
vessel – *посудина*	to refer to – *відноситися до*

Activity II.

Study the words and phrases.
Translate the sentences paying attention to the words and phrases in bold.

Matter *(n)*	**Matter** *(v)*
1) Речовина, матеріал; 2) Матерія; 3) Матеріал, зміст; 4) Суть, предмет (обговорення тощо) 5) Справа, питання; 6) Причина, привід	мати значення

ЗАПАМ'ЯТАЙ!

A matter of dispute – *спірне питання*
A subject matter – *основна тема*
No matter – *неважливо*
A matter of time – *питання часу*
Non- living matter – *нежива матерія*

Activity II.

Study the words and phrases.
Translate the sentences paying attention to the words and phrases in bold.

1. All **matter** in the universe is composed of atoms.
2. But they believe it's only a **matter of time** before the disease crosses the county boundary.
3. Nick Diamos once said that everybody lies, but **it doesn't matter** because nobody listens.
4. Please phone me back - **it's a matter** of some importance.
5. Can **matter** and energy be changed into each other?
6. Gravity is a force of nature that works between two bodies of **matter** in the universe to try and pull them together.
7. Weight change occurs because the **matter** would be much denser than it is on the Earth.
8. Could I talk to you about a personal **matter**?
9. The book contains much useless **matter**.
10. The nature of the secondary star is a **matter** of dispute.
11. Do you find the subject **matter** of the book interesting?

Activity III.

Read and translate the text

What is matter?

There are many possible definitions for matter. In science, matter is the term for any type of material. It is anything that has mass and takes up space. Volume and mass are two fundamental properties of the matter. Volume simply refers to the space an object takes up. When we talk about mass, we are referring to how much "stuff" is in an object. Some substances are not considered matter because they have no mass. These include photons, light, and sound. Even though matter can be found all over the Universe, you will only find it in a few forms (states) on Earth.

There are five main states of matter solids, liquids, gases, plasmas, and new one called Bose-Einstein condensates. But what makes a state of matter? It's about the physical state of molecules and atoms.

In a solid, particles are packed tightly together so they don't move much. The electrons of each atom are constantly in motion, so the atoms have a small vibration, but they are fixed in their position. Because of this, particles in a solid have very low kinetic energy. Solids have a definite shape, as well as mass and volume, and do not conform to the shape of the container in which they are placed. Solids cannot be compressed.

Activity III.

Read and translate the text

In a liquid, the particles are more loosely packed than in a solid and are able to flow around each other, giving the liquid an indefinite shape. Therefore, the liquid will conform to the shape of its container. Much like solids, liquids (most of which have a lower density than solids) are incredibly difficult to compress.

In a gas, the particles have a great deal of space between them. Bonds between particles are very weak. Molecules move quickly and are free to move in any direction, spreading out over long distances. As the temperature of a gas increases, the amount of movement of individual molecules increases. Gases expend to fill their containers and have low density. Because individual molecules are widely separated and can move around easily in the gas state, gases can be compressed easily, and they have an undefined shape.

Plasma can occur by subjecting matter to very high temperatures, to radiation or high voltages, as in a lightning bolt. At low temperatures, atoms lock together to form solids, such as a crystal. Higher temperatures loosen the bonds between atoms, bringing them into a liquid state. At even higher temperatures, the bonds between atoms loosen further, turning substances into a gases. Extremely high temperatures, such as that of the sun, strip some or all of the electrons away from atoms, creating a “soup” of atomic nuclei, ions and electrons; this is the plasma state.Like gases and unlike solids, plasmas drift and flow freely; if enclosed, plasmas expand to fill the container. Like gases, plasmas have density and pressure.

Activity III.

Read and translate the text

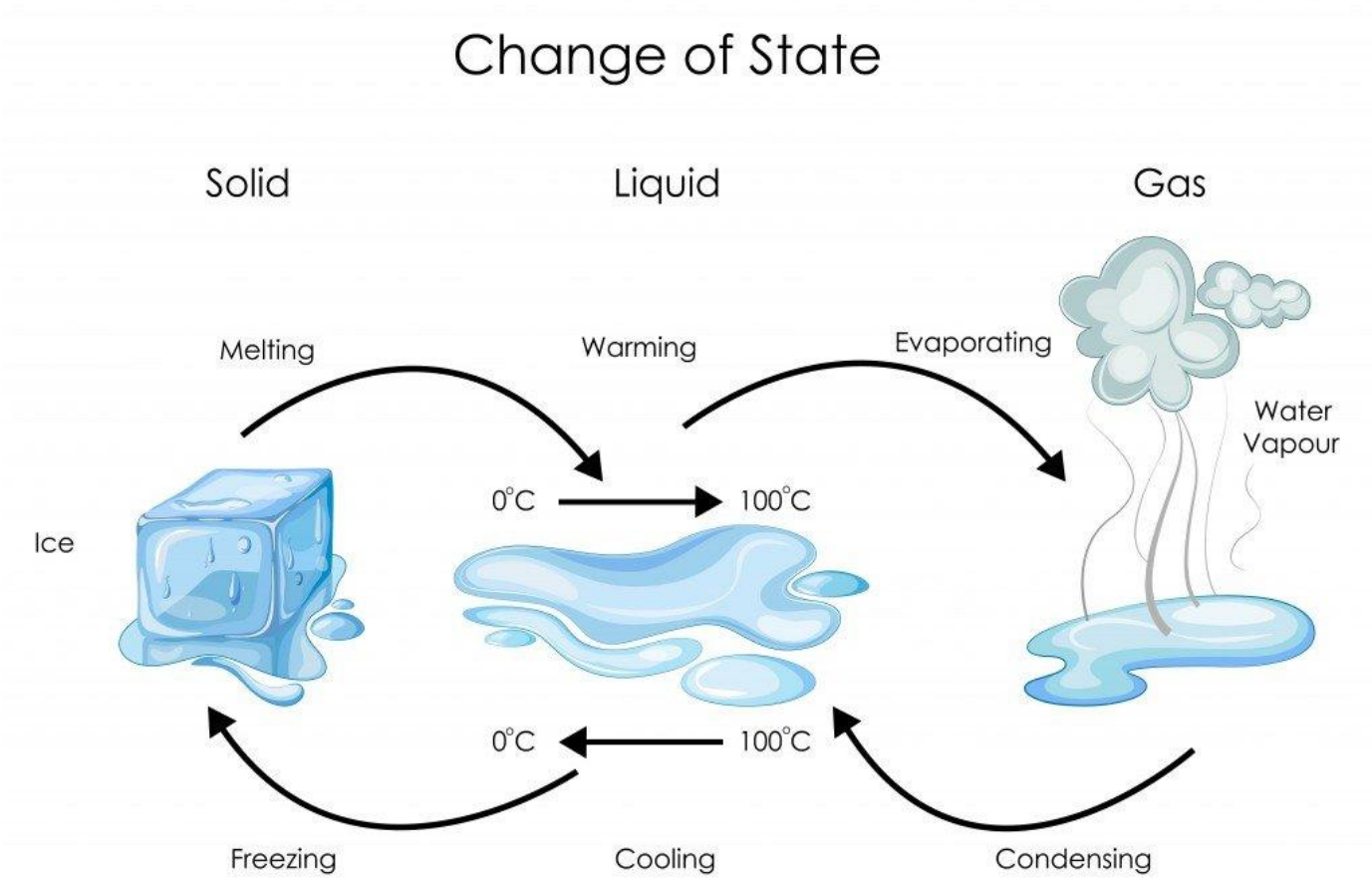
Bose-Einstein Condensates(BEC) represent a fifth state of matter only seen for the first time in 1995. The state is named after Satyendra Nath Bose and Albert Einstein who predicted its existence in the 1920's. B-E condensates are gaseous superfluid cooled to temperatures very near absolute zero. In this weird state, all the atoms of the condensate attain the same quantum-mechanical state and can flow past one another without friction. Even more strangely, BEC condensates can actually "trap" light, releasing it when the state breaks down.

Some samples of matter appear to have properties of solids, liquids, and/or gases at the same time. This can occur when the sample is composed of many small pieces. For example, we can pour sand as if it were a liquid because it consists of many small grains of solid sand. Matter can also have properties of more than one state when it is a mixture, such as with clouds. Clouds appear to behave somewhat like gases, but they are actually mixtures of air (gas) and tiny particles of water (liquid or solid).

The transformation of one state of matter into another state is called a phase transition. The more common phase transitions even have names; for example, the terms melting and freezing describe phase transitions between the solid and liquid state, and the terms evaporation and condensation describe transitions between the liquid and gas state.

Activity III.

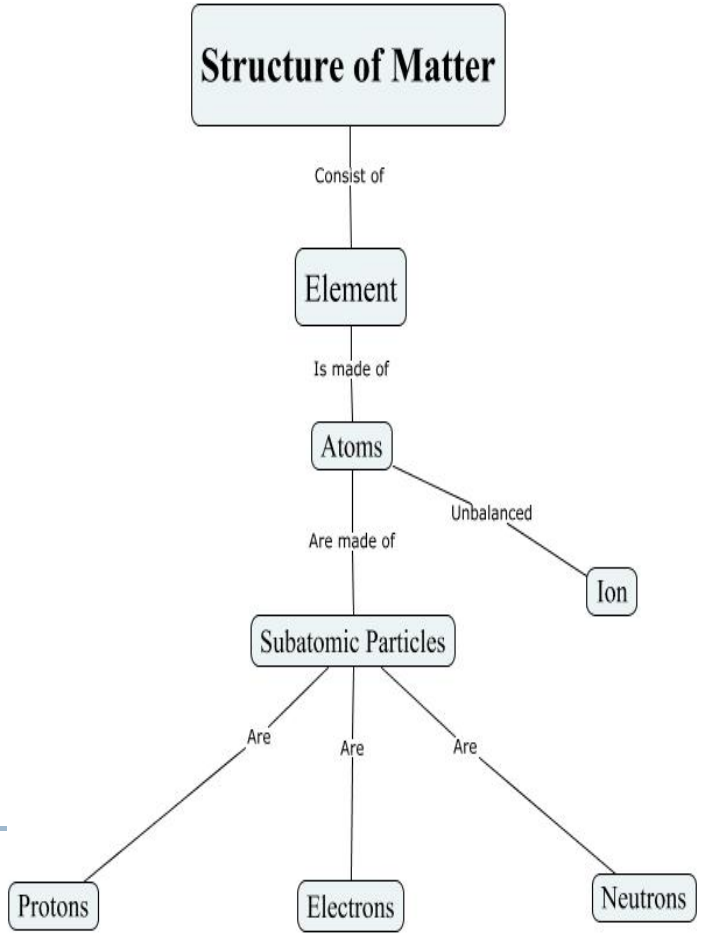
Read and translate the text



Activity IV.

Answer the questions

1. What is matter? What are the states of matter?
2. What is matter made of?
3. What are the physical characteristics of the states of matter?
4. What are some examples of materials in different states?
5. What are the specific properties of plasma?
6. What is the characteristic property of a gas?
7. What do the states of matter depend on?
8. Can matter be created or destroyed?
9. What is the weakest state of matter? And why?
10. What is transition?



Activity V.

Define whether the sentences are true or false

1. There are four physical states of matter.
2. A solid object can keep a definite shape and a definite volume.
3. A liquid has a definite volume.
4. If some air is let into a container, it will fill its whole volume uniformly.
5. Diffusion is the characteristic property of a liquid and a gas.
6. All matter in the Universe is composed of atoms.
7. Any liquid has both a definite size and shape.
8. Usually water is liquid and can never be solid or gas.
9. Adding or removing energy from matter doesn't cause any physical changes.
10. The BEC happens at super high temperatures.

Activity VI.

Define the part of speech these words belong to, translate them:

fundamental, condensate, vibration, container, density, undefined, substance, quantum, pour, pure, mixture, phase, confinement

Activity VII.

Insert the words into the following sentences:

equipment, investigation, success, methods, fusion, confinement, hydrogen

When plasma physics became a subject of ..... , the laboratories started research into controlled thermonuclear ..... . The ..... achieved by the scientists of the Institute led to the studies carried out in the field of high-temperature plasma physic.

At the early stage of fusion research, new experimental ..... and installations were designed and built, and new ..... of measurements of plasma were developed.

Plasma research with the Tokomak installations, the type of closed magnetic system for heating and ..... of plasma, was accepted as the most promising line of research. Now ..... ions can be heated to temperatures of few million degrees and hot plasma can be maintained for tenths of a second.

Activity VIII.

Match the following words with their definitions:

1	Solid	a)	negligible compressibility
2	Liquid	b)	can flow in any direction
3	Gas	c)	very fast diffusion
4	Plasma	d)	may be produced by heating a gas to an extremely high temperature
		e)	kinetic energy is very low do not possess the property of diffusion
		f)	no definite shape or distinct boundaries but have a fixed volume
		g)	has moderate density
		h)	happens at super low temperatures
		i)	neither a definite shape nor a definite volume

Activity IX.

Match the definitions with the words:

1.	boiling point	a)	the term referring to mass divided by volume
2.	state of matter	b)	anything that takes up space and has mass
3.	evaporation	c)	the ability to do work or cause change
4.	pressure	d)	the temperature at which a substance changes from a solid to a liquid
5.	energy	e)	the upward force of displaced fluid causing flotation
6.	buoyant force	f)	the temperature at which attractive forces begin to trap particles here and there, and crystals begin to form
7.	matter	g)	temperature where some of a liquid begins to enter the gaseous state
8.	density	h)	the process by which individual particles of liquid escape from the surface and form a gas
9.	melting point	i)	the process by which particles move slowly enough for their attraction to bring them together to form a droplet of liquid
10	condensation	j)	tells you whether a material is a solid, liquid or gas
11.	freezing point	k)	the amount of force applied per unit of area

Activity X.

Pay attention to the following facts:

1. A plasma is an extremely hot gas that is composed of free-floating ions and free electrons and conducts electrical current.
2. A gas is matter that has no shape or size of its own. Gases have no colour.
3. Stars are made of plasma, so plasma is the most abundant form of matter in the Universe.
4. A plasma created from water would include electrons, protons (hydrogen atom nuclei), and oxygen atom nuclei (protons and neutrons).
5. The air in the Earth's atmosphere is mostly a mixture of different types of gases. A gas usually has much lower density than a solid or liquid.
6. Solids are usually much denser than liquids and gases, but not always. Mercury, a metallic element that is a liquid at room temperature, is denser than many solids. Aerogel, a very unusual human-made solid, is 500 times less dense than water.
7. Liquids and gases are called fluids because they can be made to flow or move.
8. Solids are transferable into liquid forms by melting and can also be changed directly into gaseous form by the sublimation process.
9. A plasma is a fluid, like a liquid or gas, but because of the charged particles present in a plasma, it responds to and generates electro-magnetic forces.
10. The matter could be categorized into two forms, one is pure substances, and the other is a mixture. Furthermore, a pure substance can be broken down into compounds and elements, whereas; mixtures are physically combined structures capable of separating into original components. Chemical substances consist of one type of atom or molecule.
11. As the atoms and other particles have very little space between them, compressing a liquid is very difficult. Moreover, the attractive force between the particles is much weaker than that of solids. Liquid also has a higher diffusion rate compared to solids.

Activity XI.

Choose the correct answer:

1. How many states of matter are there?
a) two b) three c) four d) five
2. Which has the least energetic molecules?
a) solids b) liquids c) gases d) plasmas
3. What force pulls liquids towards the ground?
a) Pressure b) temperature c) gravity d) centrifugal
4. Which of these choices will NOT change the state of matter?
a) temperature b) crushing a crystal c) pressure d) electricity
5. If you leave water in a glass and some molecules turn into a gas, it is called ...
a) elaboration b) evaporation c) extinction d) solidification
6. Which of the follow terms best describes the conversion of a solid to a liquid?
a) condensation b) evaporation c) melting d) solidification
7. Which of the substance takes the shape of the container and has a definite volume
a) Helium gas b) salt crystals c)glass of juice d) stainless steel wire
8. What eventually happens if energy is continually removed from a liquid?
a) it freezes b) it evaporates c) it boils d) it condenses

Activity XIII.

Find English equivalents:

поняття матерії _____

чиста речовина _____

рухомі частинки _____

розпадатися на кусочки _____

стани матерії _____

сили тяжіння _____

відштовхуватися _____

вдарятися в молекули _____

підняття температури _____

форма контейнера _____

Activity XIV.

Give Ukrainian equivalents:

a piece of pitch _____

assume a form _____

characteristic property _____

depend on the freedom _____

distribute uniformly _____

electric discharge _____

electrons are torn from _____

in common state _____

ionized gas _____

to be subjected _____

Activity XV.

Translate into English:

Матерія, в науці, це загальний термін, що застосовується до всього. В класичній фізиці матерія і енергія вважаються двома окремими поняттями, які лежать в основі всіх фізичних явищ. Сучасні фізики показали, що можливо перетворити матерію в енергію і енергію в матерію, зруйнували класичну відмінність між двома поняттями. Маючи справу з великою кількістю явищ, таких як рух, поведінка рідин і газів, тепло, науковці вважають, що простіше і зручніше продовжити розглядати матерію і енергію як окремо існуючі поняття.

Звичайні частинки матерії об'єднуються, щоб утворити молекули. Властивості окремих молекул та їх розташування надає матерії в усіх її формах різноманітні якості, такі як маса, міцність, в'язкість, текучість, колір, смак, питомий електричний опір і теплопровідність та інші.

Матерія існує в трьох станах: твердий, рідкий і газоподібний. Твердий стан, наприклад камінь, має конкретну форму і конкретний об'єм; рідкий стан, наприклад олія, має конкретний об'єм, але неконкретну форму; газоподібний стан, наприклад водень, немає ні конкретної форми, ні об'єму.

Word-study

1W. Insert the words:

also — too — as well — either — neither

1. My friend is ... a software engineer. 2. My friend is a software engineer ... . 3. My friend isn't a software engineer ... . 4. My friend isn't a software engineer. ... am I. 5. There were other software engineers at the conference ... .

Translate into English choosing the right word.

1. Я теж був присутній на лекції професора Джонсона. 2. Я був присутній на тій лекції теж. 3. Я теж не був присутній на тій лекції. 4. Я не був присутній на тій лекції. — Я теж. 5. На лекції професора Джонсона були присутні студенти інших факультетів також.

such as — so as

1.Try to have everything ready ... not to keep us waiting. 2. At the art exhibition we could see the canvases of famous British painters ...Gainsborough, Reynolds, Constable, and Turner. 3. Don't let your television blare ... to disturb your neighbours. 4. She walked home the long way round ... not to bump into anybody. 5. Ukraine is rich in mineral resources ... iron, manganese, titanium ores, coal and others.

Translate into English choosing the right word.

1.Частину розрахунків Джейн зробила сама задля того, аби полегшити роботу Роберту. 2. Ті, хто спізнився, заходили до аудиторії дуже тихо, аби не заважати лекторові. 3. Це така цікава тема для обговорення. 4. Вони такі успішні студенти.

Word-study

2W. Summarize your knowledge on the meaning of "as". Translate the sentences paying special attention to different meanings of "as".

1. As we know the first personal computer of new type appeared in 1972. 2. As the manufacturing technology had improved, mechanical calculators could be produced. 3. Software and peripherals were compatible with all versions and with earlier models as well. 4. At that time Babbage worked as a professor of mathematics at Cambridge. 5. Peripheral equipment is slow as compared with computers. 6. As for the first personal computer Altair, it appeared in 1975. 7. In 1976 Steve Jobs as well as Stephen Wozniak began assembling a microcomputer.

3W. Summarize your knowledge on "the ... the" construction.

1. The more up-to-date computers a Research Institute uses, the more progressive it is believed to be. 2. The more we study human brain, the better we realize that no computer can be equal to it. 3. The younger a child is, the less time he/she should work with a computer. 4. The longer you study a subject, the more interested in it you become.
b) Finish the sentences given below. 1. The harder you work, ... 2. The more we have, ... 3. The less you know about a problem, ... 4. The longer we live, ...

Word-study

4W. Match the phrases:

as plain as daylight	зовсім незрозумілий
as changeable as the moon	швидкий, як блискавка.
as clear as a bell	сім п'ятниць на тиждень
as brown as a berry	абсолютно незворушний
as quick as a flash	засмаглий
as clear as mud	добре чутний
as common as dirt	звичайненький
as cool as a cucumber	повністю зрозуміло

5W. Translate the sentences. Choose the correct usage with the help of a dictionary if necessary.

1. Arranged marriages are very common in Asian countries like /as India and Pakistan.
2. Paula looks very much like /as her sister.
3. Kate swims like /as well as Pam does.
4. Carl looks like /as if he needs a nap.
5. He worked for a long time like /as a teacher in Africa.
6. Like /as the other students, he finds it a bit difficult to get to lectures early in the morning.

Additional reading passage

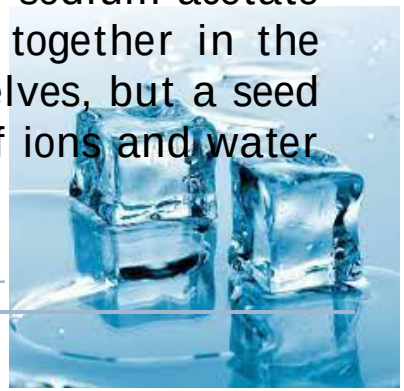
Melting Point and Freezing Point

Pure, crystalline solids have a characteristic **melting point,** the temperature at which the solid melts to become a liquid. The transition between the solid and the liquid is so sharp for small samples of a pure substance that melting points can be measured to 0.1°C. The melting point of solid oxygen, for example, is -218.4°C.

Liquids have a characteristic temperature at which they turn into solids, known as their **freezing point**. In theory, the melting point of a solid should be the same as the freezing point of the liquid. In practice, small differences between these quantities can be observed.

It is difficult, if not impossible, to heat a solid above its melting point because the heat that enters the solid at its melting point is used to convert the solid into a liquid. It is possible, however, to cool some liquids to temperatures below their freezing points without forming a solid. When this is done, the liquid is said to be *supercooled*.

A liquid can become supercooled because the particles in a solid are packed in a regular structure that is characteristic of that particular substance. Some of these solids form very easily; others do not. Some need a particle of dust, or a seed crystal, to act as a site on which the crystal can grow. In order to form crystals of sodium acetate trihydrate, Na^+ ions, $CH_3CO_2^-$ ions, and water molecules must come together in the proper orientation. It is difficult for these particles to organize themselves, but a seed crystal can provide the framework on which the proper arrangement of ions and water molecules can grow.



Additional reading passage

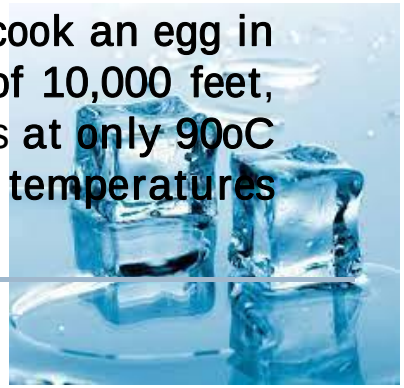
Because it is difficult to heat solids to temperatures above their melting points, and because pure solids tend to melt over a very small temperature range, melting points are often used to help identify compounds. We can distinguish between the three sugars known as glucose (MP = 150oC), fructose (MP = 103-105oC), and sucrose (MP = 185-186oC), for example, by determining the melting point of a small sample.

Measurements of the melting point of a solid can also provide information about the purity of the substance. Pure, crystalline solids melt over a very narrow range of temperatures, whereas mixtures melt over a broad temperature range. Mixtures also tend to melt at temperatures below the melting points of the pure solids.

Boiling Point

When a liquid is heated, it eventually reaches a temperature at which the vapor pressure is large enough that bubbles form inside the body of the liquid. This temperature is called the boiling point. Once the liquid starts to boil, the temperature remains constant until all of the liquid has been converted to a gas.

The normal boiling point of water is 100oC. But if you try to cook an egg in boiling water while camping in the Rocky Mountains at an elevation of 10,000 feet, you will find that it takes longer for the egg to cook because water boils at only 90oC at this elevation. In theory, you shouldn't be able to heat a liquid to temperatures above its normal boiling point.



Additional reading passage

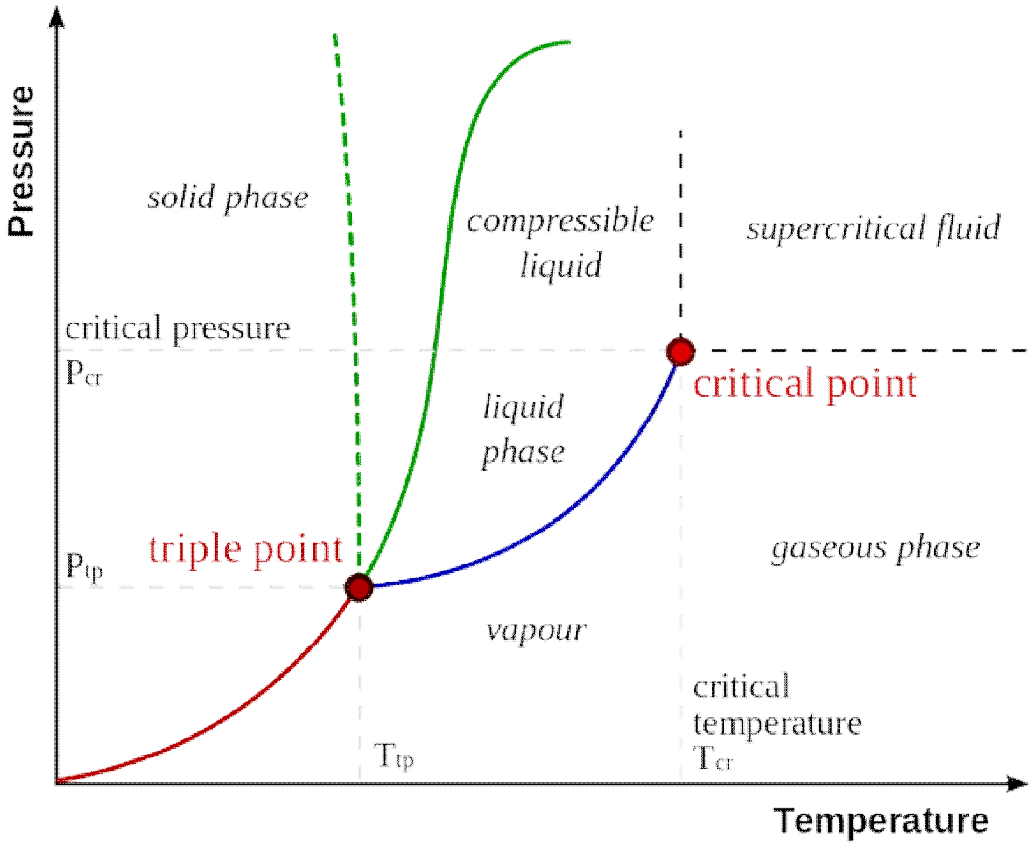
Before microwave ovens became popular, however, pressure cookers were used to decrease the amount of time it took to cook food. In a typical pressure cooker, water can remain a liquid at temperatures as high as 120°C, and food cooks in as little as one-third the normal time. To explain why water boils at 90°C in the mountains and 120°C in a pressure cooker, even though the normal boiling point of water is 100°C, we have to understand why a liquid boils. By definition, a liquid boils when the vapor pressure of the gas escaping from the liquid is equal to the pressure exerted on the liquid by its surroundings

The normal boiling point of water is 100°C because this is the temperature at which the vapor pressure of water is 760 mmHg, or 1 atm. Under normal conditions, when the pressure of the atmosphere is approximately 760 mmHg, water boils at 100°C. At 10,000 feet above sea level, the pressure of the atmosphere is only 526 mmHg. At these elevations, water boils when its vapor pressure is 526 mmHg, which occurs at a temperature of 90°C.

Pressure cookers are equipped with a valve that lets gas escape when the pressure inside the pot exceeds some fixed value. This valve is often set at 15 psi, which means that the water vapor inside the pot must reach a pressure of 2 atm before it can escape. Because water doesn't reach a vapor pressure of 2 atm until the temperature is 120°C, it boils in this container at 120°C.

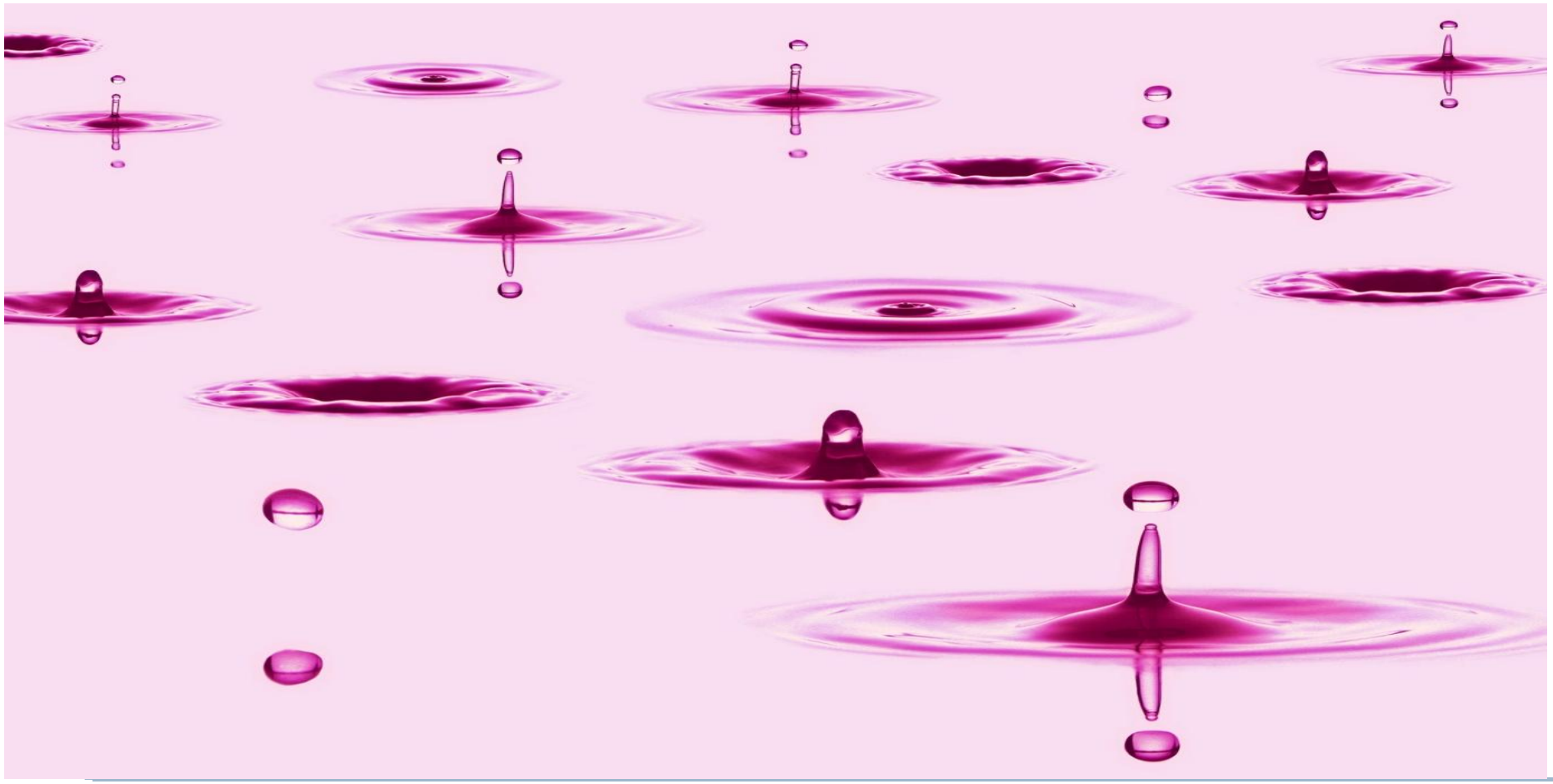
Additional reading passage

Liquids often boil in an uneven fashion, or *bump*. They tend to bump when there aren't any scratches on the walls of the container where bubbles can form. Bumping is easily prevented by adding a few boiling chips to the liquid, which provide a rough surface upon which bubbles can form. When boiling chips are used, essentially all of the bubbles that rise through the solution form on the surface of these chips.



Unit 4

MOTION



Activity I.

Learn the words and phrases

average speed– *середня швидкість*	relativebspeed – *відносна швидкість*
acceleration –*прискорення*	reference point– *точка відліку*
constant (*adj*) – *постійний*	frame of reference–*система координат*
displacement –*переміщення*	straight-line motion – *прямолінійний рух*
deceleration – *зменшення швидкості, гальмування*	scalar – *скаляр, скалярна величина*
elapsed time – *час проходження*	stationary (*adj) - нерухомий, незмінний*
initial (adj)– *початковий, вихідний*	velocity– *швидкість*
germinal speed – *критична швидкість*	weightlessness–*невагомість*

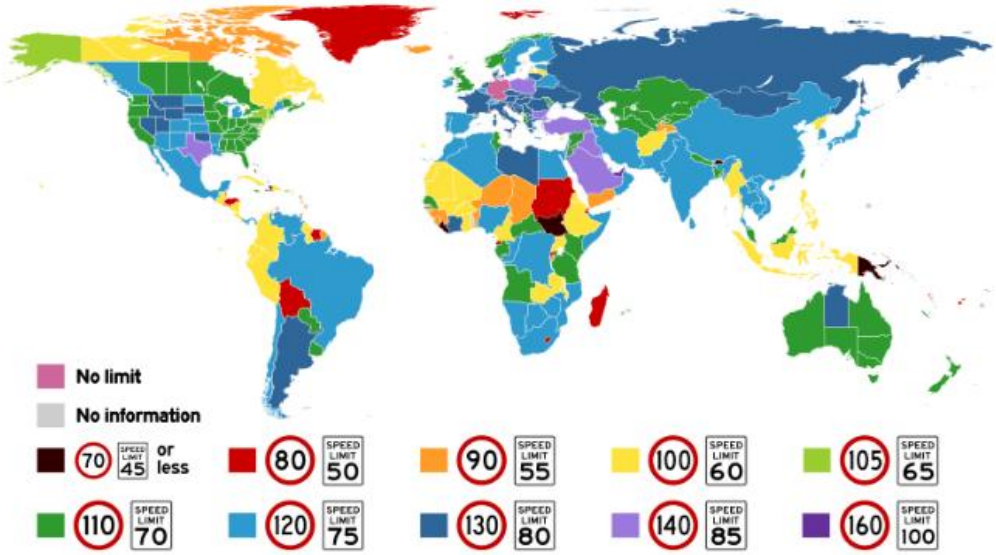
Activity II.

Study the words and phrases.
Translate the sentences paying attention to the words and phrases in bold.

Motion (*n*)	***Motion*** (*v*)
1) рух 2) хід (машини, годинника) 3) жест, рух тіла 4) спонука, спонукання 5) пропозиція (на зборах) 6) *юр.* клопотання 7) *спец.* механізм	1) показувати жестом (знаком) 2) виносити пропозицію ***Motional*** (*adj*) — рухомий ***Motionless*** (*adj*) — нерухомий

ЗАПАМ'ЯТАЙ!

to be in motion — в русі, на ходу
swinging motion —*маятниковий рух*;
brownian motion — броунівський рух
Circula rmotion — круговий рух
decelerated motion — сповільнений рух
Motion path — шлях переміщення
motion sensor — датчик руху
perpetual motion — вічний рух



Activity II.

Study the words and phrases.
Translate the sentences paying attention to the words and phrases in bold.

1. He **motioned** us to come forward.
2. We can't stop now, the procedures are already in **motion**.
3. A **motion** can be used to ask the court for anything that a party needs in a case.
4. Balanced forces do not change an objects motion.
5. Galileo helped us to understand **motion** and gravity when he began to study falling bodies.
6. The **motion** has been seconded.
7. Measurements of the intensity of an earthquake evaluate the severity of ground **motion** at a specific location.
8. Brownian **motion** is the random movement of particles in a liquid or gas.
9. Isaac Newton once said, "I can calculate the **motion** of heavenly bodies, but not the madness of people.
10. Methods for achieving the appearance of perpetual **motion** were published in many places.

Activity III.

Read and translate the text

Motion happens all around us. Every day, we see objects such as cars, people, and soccer balls move in different directions with different speeds.We are so familiar with the idea of motion that it requires a special effort to analyze motion as a physicist does.

The most important idea when studying motion is that you have to know where you are. The word position describes your location (where you are). However, saying that you are here is meaningless, and you have to specify your position relative to a known reference point. For example, if you are 2 m from the doorway, inside your classroom then your reference point is the doorway. This defines your position inside the classroom. Notice that you need a reference point (the doorway) and a direction (inside) to define your location.

A frame of reference is similar to the idea of a reference point. A frame of reference is defined as a reference point combined with a set of directions. For example, a boy is standing still inside a train as it pulls out of a station. You are standing on the platform watching the train move from left to right. To you it looks as if the boy is moving from left to right, because relative to where you are standing (the platform), he is moving. According to the boy, and his frame of reference (the train), he is not moving.

Activity III.

Read and translate the text

For example, if the initial position of a car is xi and it moves to a final position of xf , then the displacement is: $x_f - x_i$

However, subtracting an initial quantity from a final quantity happens often in Physics, so we use the shortcut Δ to mean final - initial. Therefore, displacement can be written:

$$\Delta x = x_f - x_i$$

Important: The symbol Δ is read out as delta. Δ is a letter of the Greek alphabet and is used in Mathematics and Science to indicate a change in a certain quantity, or a final value minus an initial value. For example, Δx means change in x while Δt means change in t.

Important: The words initial and final will be used very often in Physics. Initial will always refer to something that happened earlier in time and final will always refer to something that happened later in time. It will often happen that the final value is smaller than the initial value, such that the difference is negative. This is ok!

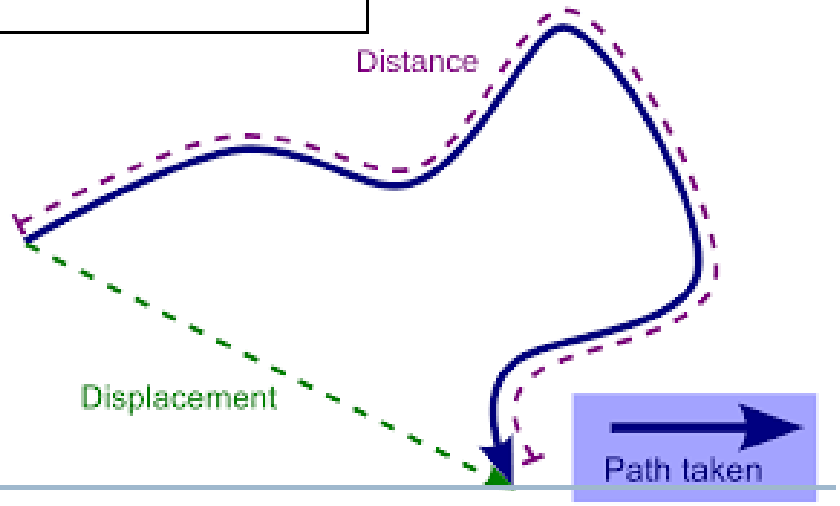
Displacement does not depend on the path travelled, but only on the initial and final positions. We use the word distance to describe how far an object travels along a particular path. Distance is the actual distance that was covered. Distance (symbol d) does not have a direction, so it is a scalar. Displacement is the shortest distance from the starting point to the endpoint. Displacement has direction and is therefore a vector.

Activity III.

Read and translate the text

The differences between distance and displacement can be summarized as:

Distance	Displacement
a) depends on the path	a) independent of path taken
a) always positive	a) can be positive or negative
a) is a scalar	a) is a vector



Activity III.

Read and translate the text

Speed, Average Velocity and Instantaneous Velocity

When an object moves in a straight line at a steady speed, you can calculate its average speed if you know how far it travels and how long it takes. The following equation shows the relationship between average speed, distance moved and time taken:

Average speed = Distance moved/Time taken

Thus, if a car travels 100 meters in 5 seconds its average speed can be calculated as;

Average speed = 100/5 = 20 meters per second.

Average speed is used to give the speed of an object over a given interval of time, if however the speed of an object is required for a particular moment then the instantaneous speed is used.

Instantaneous speed is the speed of an object at a given moment.

In this case the equation is similar to that of average speed but the time taken is a much smaller interval. A speedometer in the car gives an instantaneous speed as it gives the speed of the moving car at that specific time, whereas the average speed would be used as a measure of speed for the whole journey.

Velocity can be defined as “speed having direction”. As you can understand from the definition velocity is a vector quantity having both magnitude and direction. In daily life we use speed and velocity interchangeably but in physics they have different meanings. We can define velocity as the “rate of change of displacement” whereas “the speed is rate of change of distance”. While we calculate speed we look at the total distance, however, in calculating velocity we must consider the direction and in short we can just look at the change in position not the whole distance traveled.

Activity III.

Read and translate the text

If a man walks 5m to east and then 5m to west speed of that man calculated by dividing total distance traveled which is 10m to the time elapsed, however, velocity calculated by dividing the displacement to the elapsed time, which is 0m divided elapsed time gives us zero. In other words, if the displacement is zero we can not talk about the velocity.

Acceleration is the rate of change in the speed of an object. To determine the rate of acceleration, you use the formula below. The units for acceleration are meters per second or m/s2.

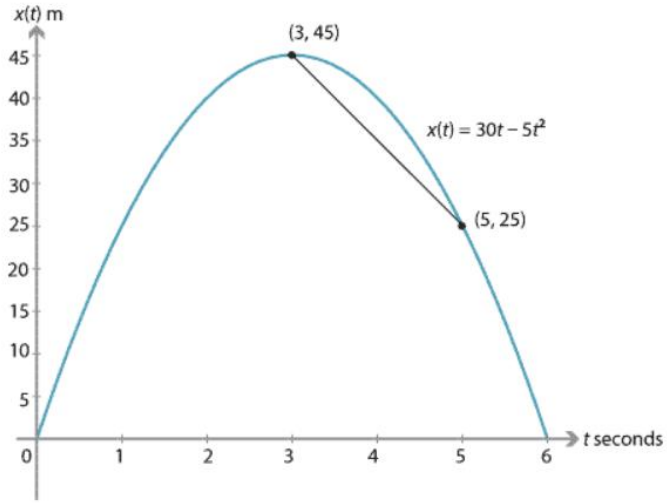
$$\text{Acceleration} = \frac{\text{Final speed} - \text{Beginning speed}}{\text{Time}}$$

$$a = \frac{v_2 - v_1}{t}$$

A positive value for acceleration shows speeding up, and negative value for acceleration shows slowing down. Slowing down is also called deceleration. The acceleration formula can be rearranged to solve for other variables such as final speed (v2) and time (t).

$$v_2 = v_1 + at$$

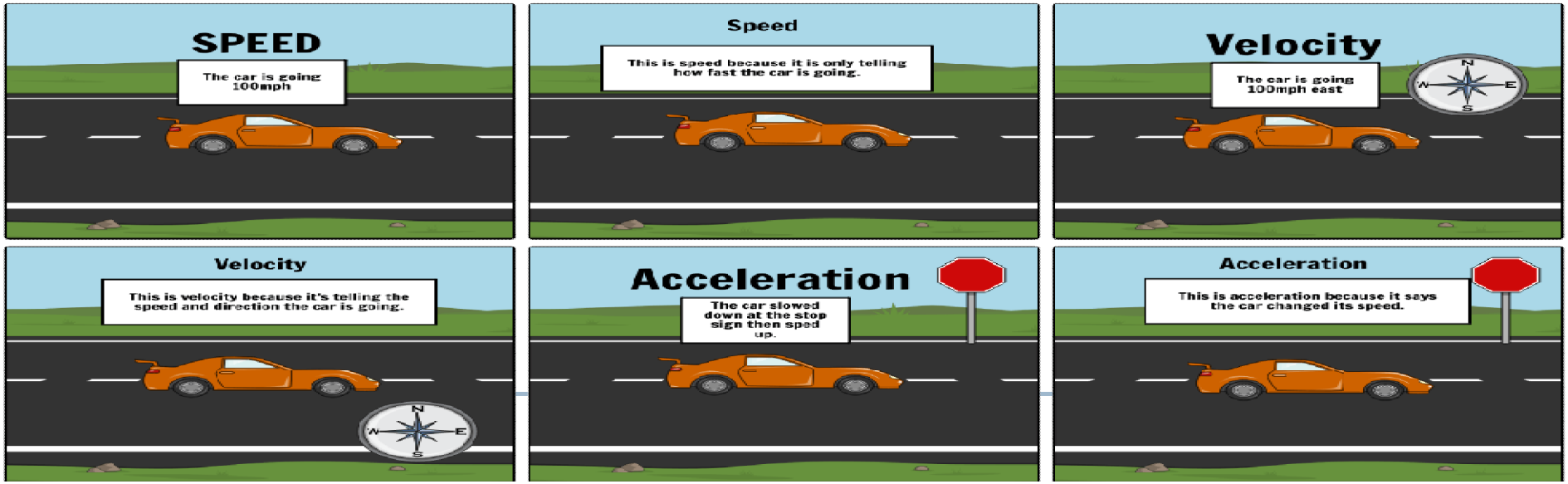
$$t = \frac{v_2 - v_1}{a}$$



Activity IV.

Answer the questions

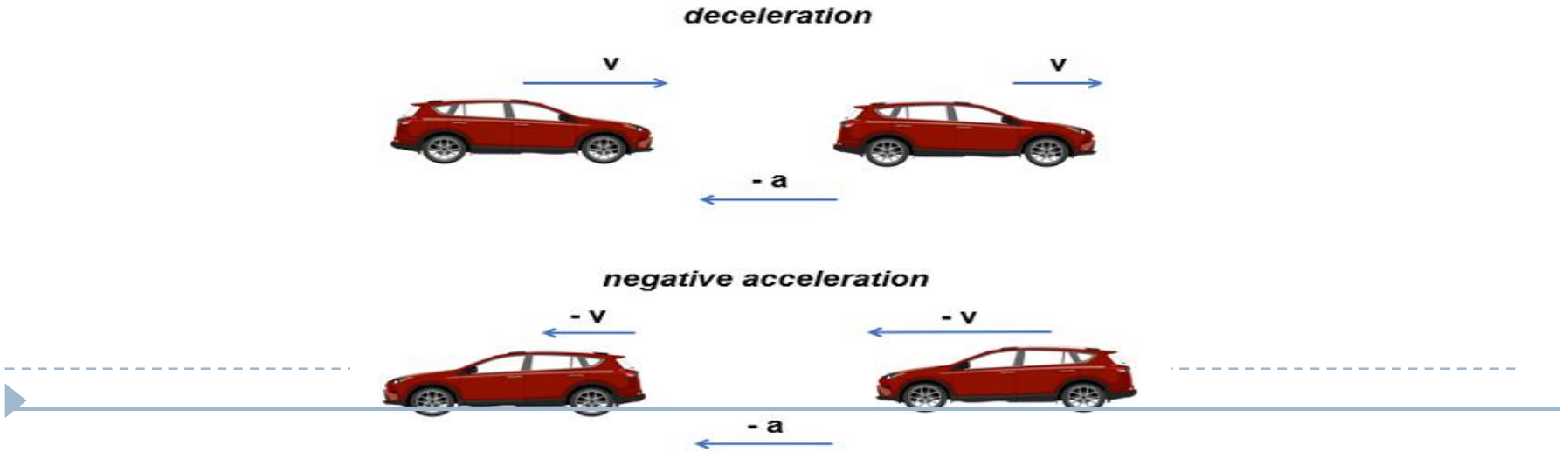
1. Explain the concept of reference point.
2. How frame of reference affects the motion?
3. What is Instantaneous speed?
4. What is the Speed of an Object which is Stationary?
5. What unit is Velocity measured in?
6. What is the Difference between Speed and Velocity?
7. What is the difference between distance and displacement?
8. What does Constant Velocity mean?
9. What does Acceleration mean?
10. What is Negative Acceleration sometimes called?
11. What does Constant Acceleration mean?



Activity V.

Define whether the sentences are true or false

1. Kinematics does not take account of forces involved in the motion.
2. Any motion can be detected with human senses.
3. We can describe the motion of two objects in terms of either speed, acceleration or direction.
4. To describe speed at a certain time, we resort to the term instantaneous speed
5. Velocity is a scolar quantity having both magnitude and direction.
6. Acceleration is the time an object travels a certain distance.
7. Speed is Distance an object travels in a certain time (with direction).
8. There is no difference between distance and disposition.
9. Deceleration is slowing down.
10. We use speed and velocity interchangeably in physics.

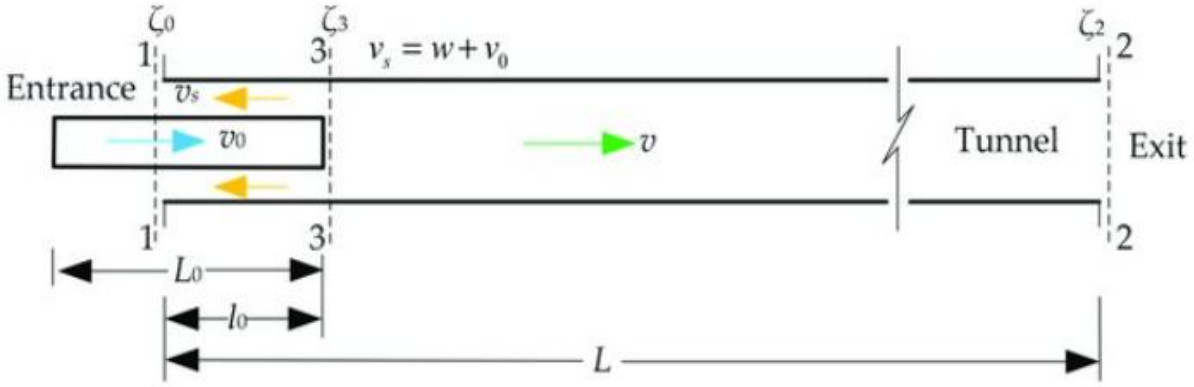


Activity VI.

Insert the words into the following sentences:

magnitude, far, meter, scalar quantity, the same, average velocity, direction, displacement

1. ... is a change of position in a certain direction, not the total distance traveled. 2. The ... of an object during some time interval is equal to the displacement of the object divided by the time interval. 3. The difference between velocity and speed is that velocity is speed in certain ... . 4. If an object is moving in a straight line, then its speed and velocity will be ... . 5. Distance is a ... because it does not take into account direction. 6. The base unit for both displacement and distance is the ... .
7. Both speed and velocity tell us how ... something is travelling in unit time.
8. Speed does not show us the direction of the motion it just gives the ... of what distance taken in a given time.



Activity VII.

Match the following words with their definitions:

1	stationary	a)	a reference point combined with a set of directions
2	acceleration	b)	the change in an object's position
3	deceleration	c)	a measurement of a location, with reference to an origin
4	position	d)	slowing down
5	displacement	e)	the rate of change in the speed of an object
6	a frame of reference	f)	velocity of an accelerating body at a specific instant in time
7	velocity	g)	not moving
8	instantaneous velocity	h)	the time rate of change of position of a body in a specified direction

Activity VIII.

Choose the correct answer:

1. _____ is a quantity that has both size and direction;

a. average speed b.speed c. velocity d. vector

2. The acceleration of a person going from 50 m/s to 40 m/s in 10 seconds is 1 m/s a few matters in motion.

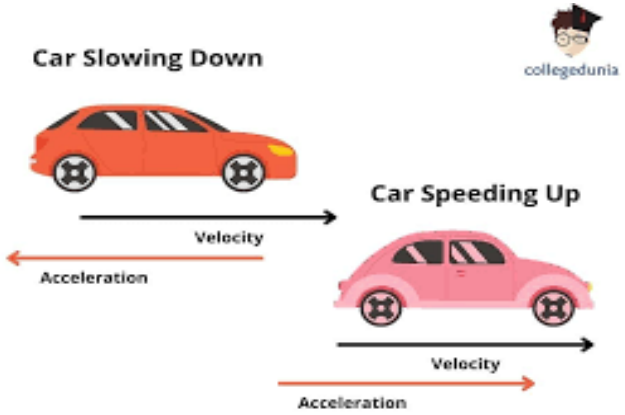
a.-1 m/s b.9 m/s^2 c.9 m/s^2 d.1m/s

4. A person walks towards East for 10 meters and then towards North for 10 meters. The total distance traveled is

a.10 m b.20 m c.14 m d.40 m

5. An object speeds up to 100 m/s over the course of 10 seconds. In order to calculate acceleration what other information do you need.

a. initial speed
b. initial velocity
c. the object final speed
d. the object final velocity



Activity IX.

Choose the correct answer:

6. Which vehicle - a motorbike or a truck - would have the greatest inertia?

a.the truck b.the car c.the motorbike d.they are the same

7. A rocket is launched at a speed of 10 kilometres per second. How far will it travel in 1⁄2 minute?

a.300 km b.3000 km c.500 km d.100 km

8. An example of velocity is:

a.100 km/h b.100 m/s c.100 m/s up d.10 km/s

9. Factors that affect the braking distance of the vehicle are:

a.experience and age of the driver

b.age of the engine and suspension

c.tyre and road conditions

d.age of the engine and suspensionall of them

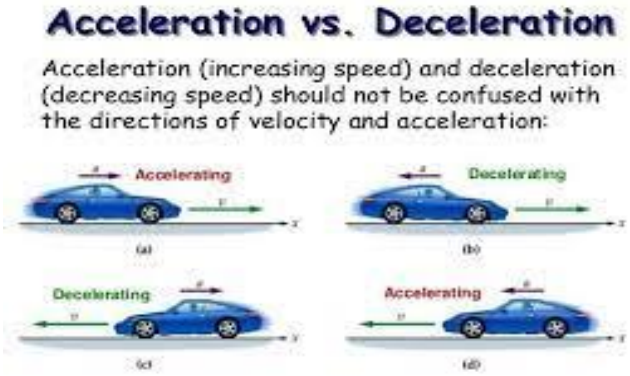
10. A position describes an object's location compared to

a.its motion

b.a reference point

c.its speed

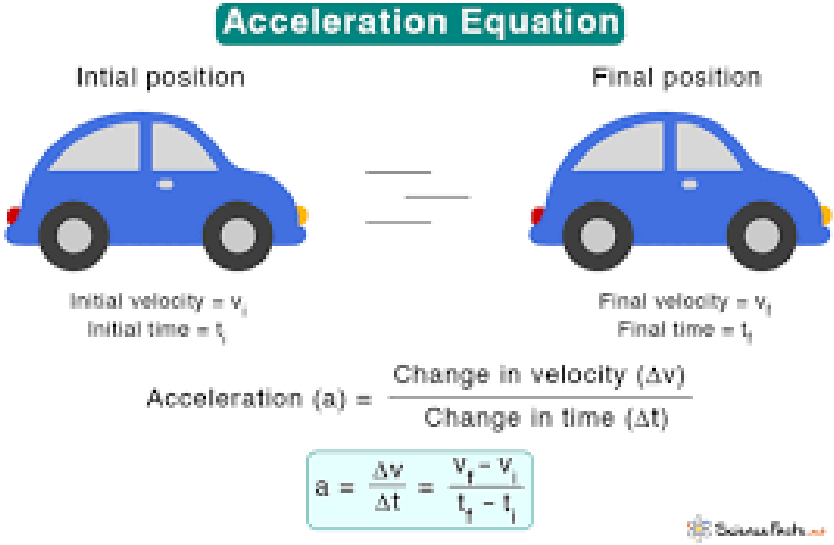
d.a vector



Activity X.
Give the right answer:

How do we call … ?

a. the rate of change of the speed for a moving body that moves along a straight line
b. a vector that indicates the rate of change of speed or direction of a moving object.
c. the distance an object moves in a specific amount of time divided by that time.
d. the motion in which a body moves around a circle.
e. a negative value for the acceleration, meaning the object's speed is decreasing.
f. the resistance of matter to any change in its velocity.
g. the resultant force when more than one force acts on an object.



Activity XI

Pay attention to the following facts:

1. Everything in the world is moving. Even things that seem still are in motion, because the atoms inside them are vibrating.
2. As there is no absolute reference system, *absolute motion* cannot be determined and only motion relative to a point of reference can be determined; this is emphasised by the term *relative motion*.
3. Relative motion is a change in location relative to a reference point, as measured by a particular observer in a particular frame of reference. Essentially, an object is in relative motion when its distance from another object is changing. However, whether the object appears to be moving or not depends on the point of view. For example, a woman riding in a bus is not moving in relation to the seat she is sitting on, but she is moving in relation to the buildings the bus passes.
4. The more mass an object has, the more kinetic energy it will have. If two objects, such as a bicycle and a car, are going at the same speed, the car will have great kinetic energy because it has a greater mass.
5. Complex motions occur when an object's direction is changing, like, curved movements such as circular motion.
6. When two objects move towards each other in a straight line, it is considered to be simple motion, the simplest one would be objects moving at constant velocity.
7. The place or object used for comparison to determine the change in position of an object is known as the reference point. Thus, if it is assumed that the reference point is stationary, an object can be said to be in motion if it changes position relative to a reference point. A classic misinterpretation of relative motion was the incorrect assumption that the Sun moved around the Earth rather than the other way around.

Activity XII.

Find English equivalents:

механічний рух _____

одиниця швидкості _____

векторна фізична величина _____

система відліку _____

остійний _____

перебувати у спокої _____

спосіб виміру часу _____

середня швидкість _____

доцентрове прискорення _____

Activity XIII.

Find Ukrainian equivalents:

relative motion _____

centripetal _____

the resistance _____

the rate of change _____

interchangeably _____

a reference point _____

object's location _____

frame of reference _____

surface _____

Activity XIV.

Translate into English:

Механічним рухом називають зміну розташування тіла (або його частин) щодо інших тіл. Наприклад, людина котра їде на ескалаторі в метро, перебуває у спокої щодо самого ескалатора і переміщається щодо стін тунелю. Гора Ельбрус перебуває у спокої щодо Землі та рухається разом із Землею щодо Сонця. З положень цих прикладів видно, що завжди слід зазначити тіло, щодо якого розглядається рух, його називають тілом відліку. Система координат, тіло відліку, з яким вона пов'язана, і обраний спосіб виміру часу утворюють систему відліку.

Механічний рух характеризується трьома фізичними величинами: переміщенням, швидкістю і прискоренням. Спрямований відрізок прямої, проведений з початкового положення точки, що рухається у її кінцеве положення, називається переміщенням. Це величина векторна. Одиницею переміщення є метр.

WORD STUDY

1W. Translate the following sentences into Ukrainian trying to avoid translating the word thing.

1. It's a strange thing she knows nothing about that. 2. It is typical for Julia to think hard things about her daughter's friends. 3. There, by the fire, they would often talk of one thing and another. 4. It appeared that he did not know a thing about computers. 5. I'm very sorry; I forgot to call you up. I was preparing my speech for today's academic council, and I had my mind full of other things. 6. I have never seen such an absent-minded person as you are. You can never concentrate on the most important things! 7. It doesn't mean a thing to me. 8. At my office I've got to sign papers, participate in the talks, discuss the terms of the contracts and do many other things. 9. This is the thing I don't like about all this matter. 10. I'll tell him about it, first thing tomorrow morning.

2W.Choose the right word.

assume — know — think

1. I … you're here to learn English. 2. I … I should practice English every day, but I never seem to have the time. 3. He … an air of confidence in spite of his dismay. 4. Why do some people … they know what other people think about something? 5. I … English is a global language.

WORD STUDY

Translate into English choosing the right word.

1. Завжди добре подумай перед тим, як відповісти. 2. Припустимо, що кожен із нас зробить одну й ту ж помилку в розрахунках. 3. Вони наші сусіди, але ми не знаємо їх. 4. Ця гіпотеза набула обґрунтованого вигляду після проведення нашою лабораторією низки експериментів. 5. Я думаю, ти повинен знати це правило.

accept — except

1. Everything is arranged ... for the tickets to the exhibition. 2. I always ... good advice.3. The authors do not ... any responsibility for the content added by users. 4. I study every day ... Sunday. 5. ... whatever it is that is being heaped upon you due to your earlier non-appearance and get on with it.

Translate into English choosing the right word.

1. Усі студенти, крім Ніка, отримали дипломи та запрошення працювати в різних відділеннях нашої компанії. 2. Щодня ми маємо по два практичних заняття, за винятком четверга, який вважають лекційним днем. 3. Я можу прийняти твої вибачення, але прошу тебе ніколи більше не робити так. 4. Наше керівництво приймає на роботу лише людей із досвідом роботи та вищою освітою. 5. Я завжди беру на себе відповідальність за свою команду, крім випадків, коли треба приймати колективне рішення.

WORD STUDY

3W. Learn the following speech patterns.

A

It is worth pointing out that your project is much better this time .
It is worth noting that you worked hard and achieved your goals.
This book is worth the reader's attention.
If a job is worth doing, it is worth doing properly.

B

One might think it is impossible to use the computer without mouse.
One cannot always be right, can one?
It is not easy to convince one in the reality of these facts.
See those two girls? Helen is the one on the left.
Natural flowers are much better than artificial ones.

4W. Begin the following sentences with the given expressions.

A) be sure of, be fond of, be interested in, be engaged in, be proud of.
B) rely on, insist on, prevent from, succeed in, result in.
A) ... meeting his friends at the conference. ... setting his business. ... working day and night at the project. ... surfing through the Net. ... having found the solution for the problem.
B) ... our going on with the work. ... working out a new televised course. ... using the Web as a tool for exchanging scientific information. ... his having done everything well. ... making a wrong decision.

WORD STUDY

5W. Find synonyms

Adverbs

1. rapidly	a) actually
2. actively	b) likely
3. previously	c) essentially
4. truly	d) formerly
5. originally	e) idly
6. in vain	f) quickly

Verbs

1. predict	a) correct
2. propose	b) spread
3. extract from	c) defend
4. protect	d) derive from
5. drop	e) go down
6. advance	f) forecast
7. fix up	g) offer

6W. Arrange the sentences in their logical sequence using *so, as a result, after, before.*

1. Cruise lines have Web pages showing various types of cruises. 2. These pages offer information concerning tours and hotel accommodations as well as forms of transportation. 3. Planning a vacation becomes now much easier. 4. Many cities sponsor Web pages as well. 5. Many Web sites can help you in planning your travel or give your ideas of places you should visit. 6. You can learn about restaurants, sightseeing and shopping opportunities.

decision.

Text 1

ADDITIONAL READING PASSAGE

When you reach for a glass of water and bring it to your lips, you know what to expect.The glass is at rest, and you accelerate it with your hand-not too fast or you'll spill the water-and you bring it to a halt so you can drink from it. You also know what would happen if itslipped from your grip. More than likely, you would move your feet to avoid the falling glass. Because almost everything you do requires moving something about, whether you're turning a page or merely taking a breath, you know all this a head of time. That is, you have a feeling that is based on experience for how things move.

The Greek philosopher Aristotle took this kind of intuition very seriously. He wrote about motion around 350 B.C. Aristotle knew that if he pushed a plate across a table and then took away his hand, the motion of the plate would stop. To describe this, he wrote: "All that is moved is moved by something else". He reasoned that when the push from the "something else" stopped, so did the motion; from this he decided that rest must be the nature of any matter. But this explanation didn't explain how a spear continues to flight once it leaves the hand, or why an arrow keeps going once it leaves the bow. So Aristotle decided that the front surface of any object moving through the air must compress the air at that surface and cause the air in the space directly behind the object to be rarefied, or thin. He argued that the air from the front must rush to the rear to fill the partial vacuum, and that as the air filled in this space it pushed the projectile along. To explain why an arrow in flight eventually slows, he said the transfer of air was never complete.

ADDITIONAL READING PASSAGE

This false premise led to another wrong deduction, namely, that motion must be impossible in the absence of air. Aristotle deduced his “laws” just from watching things move. Many of the early Greek philosophers like Aristotle who wrote about motion believed that intense mental concentration and pure thought would solve the riddles of nature and that philosophers should never have to perform experiments to gain understanding. Aristotle said, for example, that heavier bodies always fall faster toward the Earth than do lighter bodies. (Some do, of course, because of the effect of air resistance). And since heavier bodies make no more noise and larger dents when they strike the ground, which was easy to believe. Furthermore, it is harder to lift a heavier body, so it’s certainly attracted more strongly towards the ground.

Aristotle’s unproved ideas were still taught when the Italian scholar Galileo Galilei (1564-1642) lived and worked. Then Galileo introduced the experimental procedures-careful observation by measurements – that made physics a science of accurate predictions. Galileo deduced that all falling objects would move with a uniform acceleration if air were absent. He deduced that force is not necessary to keep things moving, that instead forces of friction bringmoving things to a halt. But Galileo fully realized that he had begun to understand motion. He wrote that he “had opened up to this vast and most excellent science of which my work ismerely a beginning, ways and means by which other minds more acute than mine will exploreits remote corners”.

Text 2

ADDITIONAL READING PASSAGE

Isaac Newton made the next steps and his contributions to physics are so immense that they may be unmatched in greatness in the whole history of science. Isaac Newton was born in Christmas Day, 1642, in a stone farmhouse in Lincolnshire,England. He was a premature baby, so tiny that his mother said she could have put him in a beer mug. But as a schoolboy he was healthy and very creative in making things, such as water clocks, sundials, and even a wheelchair. He boldly carved his name in his desk at school, and one of his notebooks, still preserved, has and article he copied – it tells how to get birds drunk! One of his projects, a kite carrying a homemade paper lantern, startled the local populace one night... This dimly lit spectacle hovering in the dark sky very likely summoned rumors of witches and comets rather than UFOs.

Although Newton's father had been a farmer, as had his father before him, the local schoolmaster persuaded Newton's mother to let her 18-year-old son enroll at Trinity College in Cambridge. Newton came along with an exciting time. Seventy years before, the philosopher – writer Giordano Bruno had visited England and had written that lectures at the universities were fineif they were critical of Aristotle's ideas. Indeed, only 20 years before Newton's arrival atCambridge, Galileo had died under house arrest in Italy for writing that the planets revolve around the sun. Besides his experiments in physics, Galileo built a telescope and turn itskyward. He discovered four large moons orbiting Jupiter, and he saw that Venus wasilluminated by the sun, because it showed "phase" like the moon.

Text 3

ADDITIONAL READING PASSAGE

Galileo's astronomical discoveries were there for anyone to see through a telescope, and his experiments on motioncould be checked anywhere. Progressive scholars formed groups such as the Royal Society of London for Improving Natural Knowledge (today, it is known as the Royal Society). But Newton, who was poor, worked part-time jobs and graduated without distinction in 1665.The summer of college closed, for the plague was raging nearby London, killing over 10 percent of the city's people within three months. Newton returned to his family home and inthe peace and quit of the country side devoted to mathematics and "natural philosophy" as physics was called in those days. During 18 months of intense, uninterrupted study, heaccomplished wonders. He discovered how to predict motion, he began his investigations of gravity and the colors of light, and he invented the methods of calculus. But Newton, beingsomewhat introverted, kept to himself and did not publish much of this work for some 20 years.His study led him to the laws of motion, extending, and in a sense completing, the work begun by Galileo. These three laws together tell us how thing move, and today they areknown as Newton's laws.