LESSON 1

ATHOMIC THEORY OF MATTER

Vocabulary

- indivisible –nedjeljiv
- to credit – pripisati
- tortuous- krivudav, zavojit, kaotičan
- 10^{-10m} -ten to the power of ten, to the power of ten, to the tenth power
- repulsive – odbojan
- in an array- po uzorku
- every which way- u svakom smjeru, kaotično

Answer the following questions:

- 1.Explain the idea that matter is made of atoms which dates to the ancient Greeks!
- 2.Explain the modern atomic theory!
- 3.Explain the Brownian motion!
- 4. What is Einstein famous for (1905)?
- 5.Explain the 3 common states of matter!

Exercises:

- I.Give nouns related to these adjectives:

  electric, attractive, relative, chemical, perfect, continual

- II.Make sentences using these words as a noun or as a verb:

  rest, place, support, lecture, leak

- Fill in the missing words given below:
  (imagination, altered, rest, motion, observation, predictions)
- 1. One important aspect of science is_____, which includes the design and carrying out of
  experiments.
- 2. Observation requires_____, for scientists can never include everything in a description of what
  they observe.
- 3. Aristotle argued that the natural state of an object is at_____,
- 4. Galileo concluded that for an object to be in_____ was just as natural.
- 5. Einstein's theory of relativity gives _____that differ very little from the older theories of Galileo
  and Newton.
- 6. As a result of Einstein's theory of relativity, our concepts of space and time have been completely
- _____.

LESSON 2

TEMPERATURE AND THERMOMETERS

- temeperature- a mesure of how hot or cold something ist
- properties of matter change with temperature
- thermometers – instruments designed to measure temperature
- the first idea of thermometer by Galilea
- the Celsius scale/the Centigrade scale
- freezing point, boiling point of water
- a Galileo thermometer – due to the principle of buoyancy

EXERCISES:

- I .Answer the following questions:
- 1. What are thermometers?
- 2. How does a Galilean thermometer measure temperature?
- 3. What do common thermometers consist of?
- 4. What are the most common numerical scales today?
- 5. What is the difference between the Celsius and Fahrenheit scale?
- 6. Describe the Galileo thermometer?
- 7. How does it work?

II. Write an adjective in front of a noun:

- _____ temperature
- _____ theory
- _____ force
- _____ gas
- _____ law

III. Summarize the text using the key words:

temperature, thermometer, numerical scale, Fahrenheit, Celsius, Kelvin, Galileo thermometer

LESSON 3

VIBRATIONS AND WAVES

- many objects vibrate
- atoms vibrate within a molecule
- atoms of a solid vibrate about their fixed position
- mechanicl vibrations are described on the basis of Newtonian mechanics
- transversal wave
- longitudinal wave
- high point-crest
- low point- trough
- amplitude
- the wavelength- the distance between two crests
- the wave velocity –equal to the product of wavelength and frequency

EXERCISES:

- 1. Choose the most appropriate word or phrase and fill in the blanks

FORCE

Motion cannot be induced in a body without the _____ (removal, model, application) and, except in certain theoretical cases, that _____ (exertion, motion, force) cannot be maintained without the continued _____ (exertion, balance, behaviour) of some force. Equally, and less obviously at first sight, a body at rest is also_____ (provided by, applied to, subject to) to forces which are in balance when it is stationary. Forces are therefore responsible for promoting and preventing movement, and it is clear that they are very important in _____ (explaining, determining, requiring) whether a process of material transport can take place.

A force is an action in a specified direction which tends to change the state of motion of a body and is always balanced by an _____ (equal, greater, smaller) called the _____ (reaction, limit, level). If we imagine a boulder resting upon the ground it is quite apparent that it _____ (removes, exerts, releases) a vertical force on the ground due to its own weight. Equally, the ground must exert a force of the same _____ (amount, quantity, magnitude) in the opposite direction on the boulder; if this were not the case, the boulder would sink into the ground due to its weight.

- 1. Translate the text about vibrations and waves

  Many objects vibrate or oscillate – an object on the end of a spring, a plastic ruler held firmly over the edge of a table and gently struck, the strings of a guitar or piano. Electrical oscillations occur in radio and television sets. At the atomic level, atoms vibrate within a molecule, and the atoms of a solid vibrate about their relatively fixed position. Because it is so common in everyday life and occurs in so may areas of physics, oscillatory or vibrational motion is of great importance. Mechanical vibrations are fully described on the basis of Newtonian mechanics.

  Vibrations and wave motion are intimately related subjects. Waves, whether ocean waves, waves on a string,earthquake waves or sound waves in air – have as their source a vibration

In a transverse wave, the oscillations are perpendicular to the direction in which the wave travels. An example is a wave on a string. In a longitudinal wave, the oscillations are along the line of travel; sound is an example.

The high points on a wave are called crests and the low points troughs. The amplitude is the maximum height of a crest, or depth of a trough, relative to the normal level. The total swing from a cresto a trough is twice the amplitude. The distance between two successive crests is called the wavelength. The frequency is the number of crests that pass a given point per unit time. The wave velocity is equal to the product of wavelength and frequency.

When two waves pass through the same region of space at the same time, they interfere. Waves change direction, or refract, when travelling from one medium into a second medium where their speed is different. Waves spread,or diffract, as they travel and encounter obstacles.

LESSON 4

FOUR DIMENSIONAL SPACE-TIME

- three dimensions of space- a definite relationship with the dimension of time
- the theories of Minkowski
- advanced mathematical foundation upon which the special theory of relativity could be based
- more than four dimensions- as many as ten theories
- almost infinite numer of little dimensions all over the place

EXERCISES:

- I. Answer the questions:
- 1. What is the importance of Hermann Minkowski?
- 2. What is the problem with the fourth dimension of space?
- 3. What can we understand better thanks to the four-dimensional thinking?
- 4. How many dimensions actually do exist in our universe

- II. Supply the correct preposition in the gaps:
- 1. We can no longer regard time ..... an absolute quantity.
- 2. The time interval between two events depends..... the observer’s reference frame.
- 3. Einstein’s theory required us to give ..... commonsense notions ..... time and space.
- 4. Relativity has shown that space and time are not independent .... one another.
- 5. Space and time are seen to be intimately connected, ... the time being the fourth dimension ..... addition
- to the three dimensions of space.
- 6. The photoelectric effect has placed the particle theory ..... light ..... a firm experimental basis.

- III. Complete the text with the words given in brackets

  The great Danish physicist Niels Bohr proposed his famous principle of complementarity. It states that to understand an experiment, sometimes we find an explanation using wave theory and sometimes using a particle theory. Yet we must be …… of both the wave and particle aspects of light if we are to have a full understanding of light. Therefore these two aspects of light ……. one another.

  It is not easy to visualize this duality. We cannot readily …….. a combination of wave and particle. Instead, we must recognize that the two aspects of light are different faces that light shows to experimenters.

Part of the difficulty stems from how we think. Visual pictures in our minds are based on what we see in the everyday world. We ……. the concepts of waves and particles to light because in the macroscopic world we see that energy is …….. from place to place by these two methods. We cannot see directly whether light is a wave or particle – so we do indirect experiments. To explain the experiments we apply the models of waves or of particles to the nature of light. But these are abstractions of the human mind. When we try to conceive of what light really is, we ……. on a visual picture. Yet there is no reason why light should ……. to thesemodels (or visual images) taken from the macroscopic world. The true nature of light is not possible to visualize.

(complement, apply, conform, insist, transferred, picture, aware)

LESSON 5

BIG BANG THEORY

- The Big Bang Theory: an effort explain what happened at the very beginning of our universe
- “the singularity”-a zone which defy our current understanding of physics
- “the singularity”- a zone of infinite denity
- Common misconceptions:
- A giant explosion? No.
- An expansion? Yes.
- Space did not exist prior to the Big Bang
- In 1968 and 1970 Hawking, Ellis, Penrose; time and space had a finite beginning
- The singularity did not appear in space; space began inside of the singularity

- Big Bang –Evidence for the Theory :
- the universe had a beginning
- gallaxies appear to be moving away from us at speeds proportional to their distance
- “Hubble’s Law”

EXERCISES:

- 1st group:
- What is the Big Bang Theory?
- Explain the standard theory!
- Explain the term Singularity!
- What happened after the Big Bang innitial appearance?

- 2nd group:
- Explain the misconceptions of the BB Theory!
- What was published in 1968 and 1970?

- 3rd group:
- Explain the evidence for the theory!
- Explain “Hubble s Law”
- What do Hydrogen and Helium support?

EXERCISES:

- 1. Write notes of the text mentioning the most important pieces of information
- 2. Choose a paragraph from the text and translate it.
- 3.Write a verb behind a noun
- to detect _____
- to observe _____
- to apply _____
- to clarify _____
- to visualize_____
- to develop_____

4. Film:

The Big Bang Theory –to the Stars-Behind the Scenes

What were the main theses given in the film? Describe them!

LESSON 6

HOW DOES A SATELLITE STAY IN ORBIT

Vocabulary:

- plummeting-naglo, okomitog opadati
- to exert-povući
- drag-teret
- out of proportion-nepravilno
- to catch up-nadoknaditi
- perpetual-stalan
- friction-trenje
- loop-petlja , omča
- to boost-pojačati
- to dock-spojiti se
- orbital decay-orbitalna propadanja
- curvature of the Earth-zakrivljenost zemlje
- centripetal force- centripetalne sile
- counter-balance-protuteža
- circular orbit-kružna orbita
- elliptical orbit-eliptična orbita
- langrage points
- to gum up-pokvariti

Exercises:

1. **Answer the following questions:**

1. What is the problem with staying in orbit?
2. How does a sattelite maintain in orbit?
3. What are Langrage Points?

2. **Use key words (p.13) in your own sentences.**

3. **Read the text, answer the questions and and translate the text**

How do satellites orbit the Earth?

Satellites are, to some degree, "mysterious" objects. They travel in space, which feels like an exotic place because most of us have never been there. They are so far away that we cannot see them. They usually cost millions or billions of dollars, which means none of us will ever own one personally. And so on…

Orbital mechanics can also be mysterious because there is no easy way for us to experience orbital mechanics personally. However, with a little imagination, you can understand the basic idea behind orbital mechanics very easily. It turns out that we play with orbital mechanics all the time!

Now imagine that you shot a rifle straight and level instead of throwing a ball. The bullet might travel a mile (1.6 km) before succumbing to gravity and hitting the ground.

Now imagine that you shoot a very large cannon that is able to give its shell an extremely high initial velocity. Also imagine that our world is completely covered in water to remove any worries about hills, and that the cannon is shot straight and level. Its path might look like the image to the right.

- In this diagram you can see that the shell is going far enough to actually follow the curve of the earth for a period of time before hitting the ground.

One thing that gums these examples up is air resistance, so imagine that you took this cannon to the moon and mounted it on top of the highest mountain. The moon has no atmosphere and is completely surrounded by the vacuum of space. If you adjusted the speed of the shell just right and shot the cannon, the shell would follow the curve of the moon perfectly.

It would fall at exactly the same rate that the curve of the moon falls away from it, so it would never hit the ground. Eventually it would curve all the way around the moon and ram right into the back of the cannon! On the moon you could actually have satellites in extremely low orbits like that -- just a mile or two off the ground to avoid the mountains. And satellites could conceivably be launched from cannons.

On earth, it's not so easy because satellites have to get up above the atmosphere and into the vacuum of space to orbit for any length of time. 200 miles (320 km) up is about the minimum to avoid atmospheric interference. The Hubble space telescope orbits at an altitude of 380 miles (600 km) or so. But the principle is exactly the same. The speed of the satellite is adjusted so that it falls to earth at the same rate that the curve of the earth falls away from the satellite. The satellite is perpetually falling, but it never hits the ground!

- 1. Explain what “orbital mechanics” means!
- 2. Explain the thesis : The satellite is perpetually falling, but it never hits the ground!

4.Replace the underlined words with expressions which have a similar meaning:

- 1. We cover fundamental aspects of the wave nature.
- 2. The most important simple optical instrument is no doubt the thin lens.
- 3. Accurate measurements are an important part of physics.
- 4. Scientists normally do their work as if the accepted laws and theories were true.
- 5. They are obliged to keep an open mind in case new information should change the validity of any given law or theory.
- 6. Physical quantities can be divided into two categories: base quantities and derived quantities

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LESSON 7

WHY DO THINGS FLOAT ?

- **Introduction:**
- What do you know about Archimedes?
- Do you know what this is? (the picture of the Archimedes screw)
- Do you know what this is used for?
- There is a saying Eureka! What does it mean? (I have found it)

- **Vocabulary:**
- lever-poluga,ručica
- siege engines
- claim-tvrdnja
- screw pump- vijka crpe (Arhimedov vijak)
- array of mirrors- niza ogledala
- laurel wrath-lovorov vijenac
- goldsmith-zlatar

- incompressible- nestješljiv
- submerged-potopljen, uronjen
- to displace-premijestiti
- to obtain-dobiti ,biti u uporabi
- treatise-rasprava
- to immerse-uroniti,umočiti
- buoyant –istisnuta voda
- irrigation ditch-jarak za navodnjavanje

Exercises:

- **1.Read the text (p.16) and answer the questions:**
- What was Archimedes of Syracuse famous for?
- What claims have modern experiments tested?
- What was the widely known anegdote about Archimedes ?
- What was made for King Hiero II?

2.Describe the Archimedes Principle in hydrostatics!

3.Choose one of the paragraphs and translate it!

LESSON 8

TIME TRAVEL…

IS IT REALLY POSSIBLE ?

- **Introduction:**
- Have you ever seen or read something obout time travel?
- Do you think time travel is possible?
- What could you change with time travel? Could it be dangerous?

- **Vocabulary:**
- objection-primjedba
- common-čest,opći,zajednički
- successive,adj-uzastopan
- rate-tempo, tečaj, brzina
- common sense-zdrav razum
- to alter-mijenjati

- mishap-neuspjeh
- intact,adj-čitav
- quantum rules-kvantna pravila
- subatomic, adj.-subatomski
- essence- suština
- quantum-tunnelling-kvantno tuneliranje
- velocity-brzina
- realm-carstvo, područje

Exercises:

- 1 .Read each paragraph of the text (p.17) and translate them in group work, answer the questions:
- A) Explain the paradox of time-travelling!
- B) Explain the two statements:
- past is totally defined;
- the quantum rules which govern the subatomic level of the universe;

- 2. What is the secret of traveling through time?

- 3. Write synonyms for the following words from the text:
  main - _____ , attempt - _____, journey - _____, to alter - _____,
  obvious - _____, velocity - _____, complex- _____, remain - _____
  faster - _____, answer - _____, kill - _____