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FEATURES OF USING MATHEMATICAL KNOWLEDGE AND LAWS OF PHYSICS IN TEACHING ASTRONOMY

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Abstract
This article discusses the use of mathematical knowledge and the laws of physics in teaching astronomy. So, since the integration of subjects is one of the directions in the search for new pedagogical solutions related to the unification of individual sections of different disciplines into a single whole in order, firstly, to overcome the uniformity of goals and functions of teaching; secondly, to create in students a holistic idea of their future profession (integration here represents the goal of learning) and to provide a common space for the convergence of subject knowledge (integration here represents the means of learning). An example of the use of mathematical knowledge in the study of astronomy is given. Thus, one of the forms of attracting students to independent creative activity is to perform computational work that allows them to deepen theoretical knowledge and apply it to solve practical problems. This teaching method contributes to the achievement of the following goal: it forms in students the necessary system of knowledge and skills and ensures a high level of self-development, as well as development for self-learning. Interdisciplinary integration has successfully contributed to increasing the theoretical and practical knowledge of university students, within the framework of which, on the basis of cognitive activity, opportunities are created for the formation of the competitiveness of young people.

Keywords: planet, radius, diameter, eccentricity, mass, volume, axis, period of rotation, density, space velocity, acceleration, area, ellipse.

Introduction

Exact and natural sciences have been widely developed in Uzbekistan for several centuries, and the territory of Central Asia has been the intellectual center of the world since ancient times. The periods of the first and second Renaissance (in the XI and XV centuries), which took place on the territory of our country, gave us the names of great geniuses recognized throughout the world. The scientific research of Muhammad al-Khorezmi, Ahmad al-Ferghani, Abu Nasr Farobi, Abu Rayhan Beruni, Mahmoud Kashgari, Abu Ali ibn Sino, Nasriddin Tusi, Kazizade Rumi, Jamshid Kashi, Mirzo Ulugbek, Ali Kushchi and other scientists of the East have made an invaluable contribution to the development of world science.

Today, 200 educational places and 150 places of residence have been created in new Uzbekistan for the development and study of new achievements in the field of astronomy and aeronautics in order to create the necessary conditions at the Academy of Sciences of Uzbekistan and the Institute of Astronomy for talented youth. For the in-depth study of subjects such as mathematics, astronomy, physics and computer science, the need to organize a state specialized secondary boarding school named after Mirza Ulugbek was introduced (Presidential Decree PP-3275 of September 14, 2017). The Resolution says that the task of providing young people with a new generation of literature on the subject of "Astronomy" is entrusted to specialists in this field of science.

Based on the above, in order to educate a harmoniously developed generation in the higher education system, the primary task is to improve the content of the educational subject, create a new generation of literature corresponding to the introduction of theoretical knowledge into practice, and organize training sessions based on advanced pedagogical and information technologies. We, teachers, educators of a harmoniously developed young generation, must make all our efforts and efforts.

Modern civilization is rapidly entering a new era – the era of high innovative, information and educational technologies and very quickly changing the face of the world we are familiar with.Higher education must learn to meet the challenges of the new era. Thanks to information technology conditions, new pedagogical technologies and active teaching methods are being introduced. One of the innovative technologies that contribute to the realization of creative abilities and the formation of the needs of the younger generation in self-education is the technology of inter-subject integration.

With the development of science, the process of cognition of the world is deepening and expanding. Modern science strives for a comprehensive study of all objects and the establishment of a connection between processes and phenomena in unity with the outside world. Astronomy is most closely related to physics, mechanics, mathematics, and chemistry.

Physical knowledge in astronomy is used to investigate and explain the nature of celestial objects, phenomena and processes. And physics itself uses the data obtained during astronomical observations to test known physical theories, to discover new physical phenomena and patterns. Space has become a natural laboratory in which physicists can explore phenomena and processes that are impossible or very difficult to reproduce on the Globe.

Astrophysicists and physicists study together the ongoing nuclear reactions in the bowels of stars, explosions of stars, neutron stars and black holes, pulsations of the Universe, etc. High energy physics and cosmology jointly develop a theory of Grand Unification, reducing the types of physical interactions to a single beginning and explaining the prospects for the development of the material world as a whole. The interaction of physics and astronomy has an impact on the development of other sciences: engineering, energy, and various sectors of the national economy. For example, the development of aeronautics, the development of thermonuclear reactors, etc.

In modern educational practice of higher educational institutions, the integration of subjects is one of the directions of the search for new pedagogical solutions related to the unification of separate sections of different disciplines into a single whole in order, firstly, to overcome the uniformity of learning goals and functions; secondly, to create a holistic view of their future profession among students (integration represents the purpose of learning here) and to provide a common space for the convergence of subject knowledge (integration represents a means of learning here).

Here is an example of using knowledge of mathematics and physics in teaching an astronomy course. Astronomy, mathematics and physics, which grew out of the once unified science of nature - philosophy – have never lost touch with each other. As we know, mathematics, physics and their laws are studied in educational institutions earlier than astronomy. Let's consider the application of these laws using the example of studying the topic "The Moon is a natural satellite of the Earth" from the astronomy course. As we know, the Moon is the only natural satellite of the Earth and is located at a distance of 384,400 kilometers from Earth. Knowing the distances between the Earth and the Moon, it is possible to calculate the length of the Moon's orbit (path) using mathematical knowledge. The orbit of a natural

satellite is circular (ellipse), and the length of the circle is calculated using the formula: $L_{круг} = 2\pi \cdot r = l_{Меркурий} = 6{,}28 \cdot 384400 \;\; km = 2414000 \; км = 0{,}016 \;\; аст.ед.длины$,

and the eccentricity of the satellite is equal (It is equal to half the ratio of the focal length of the ellipse to its large semi-axis):

$$e = \frac{F_1F_2}{2a} = \frac{OF_1}{a} = \frac{OF_2}{a}$$

$$e = 0{,}0546$$

The eccentricity of the Moon is approximately equal to the eccentricity of the planet Saturn.

The moon is small in size, the diameter and radius of which are equal $D_{Луна} = 3476 \;\; км; \;\; r_{Луна} = 1738 \;\; км$

.

Knowing the above parameters, you can calculate the volume and area of the planet using the following formulas

$$:V_{Луна} = \frac{4}{3}\pi R^3 = 4{,}18 \cdot (1738км)^3 = 21{,}94 \cdot 10^9 \, км^3$$

$$S_{Луна} = 4\pi R^2 = 12{,}56 \cdot (1738 \, км)^2 = 37{,}9 \cdot 10^6 \, км^2$$

The volume was calculated as a ball, and the area as a sphere.

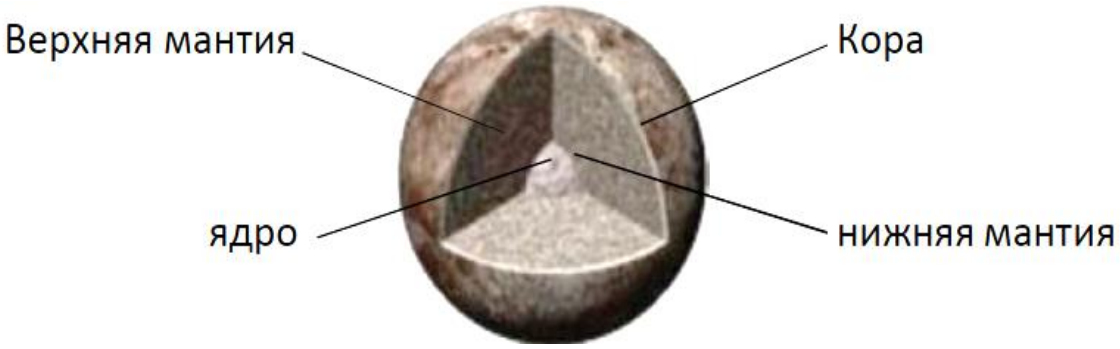
The mass of the Moon is 81 times less than the mass of the Earth:

$$m_{Луна} = \frac{M_{земля}}{81} = \frac{6 \cdot 10^{24}{}_{кг}}{81} = 7{,}35 \cdot 10^{22} \;\; kg$$

When the mass and volume of the planet are known, it is possible to calculate the average density of the Moon using the formula: $\rho_{Луна} = \frac{m}{V} = \frac{7{,}35 \cdot 10^{22}}{21{,}94 \cdot 10^{18}} \frac{kg}{m^3} = 3300 \frac{кг}{м^3} = 3{,}3 \frac{g}{sm^3}$

The mass and radius of the Moon are known, then, according to physical laws, it is possible to determine the acceleration of gravity on the planet using the formula:

$$g_{Луна} = \Omega \frac{M_{Луна}}{R^2} = 6{,}67 \cdot 10^{-11} \frac{H \cdot м^2}{кг^2} \cdot \frac{7{,}35 \cdot 10^{22}}{(1738)^2} \frac{кг}{км} = 1{,}62 \frac{м}{с^2}$$



The inner structure of the Moon

The period of rotation of the Moon around the Earth is 29.53 earth days (meaning the duration of the year on the planet is 29.53 earth days) $T_{Луна} = 29{\cdot},53 \;\; Земные \;\; сутки$,

and the period of rotation of the satellite around its axis is equal to $T = 29{,}53 \;\; Земные \;\; сутки$

With the data obtained, it is possible to determine the orbital velocity of the Moon, along which it moves:

$$v_{Луна} = \frac{L_{орбита}}{T} = \frac{2414000км}{29{,}53 \cdot 86400c} = 1{,}023\frac{км}{c}$$

Taking into account these data, it is possible to determine the cosmic velocities on the surface of the planet (cosmic velocities for celestial bodies have different values, because the acceleration of gravity and the size of celestial bodies are not the same) using the following formulas:

$$\upsilon_I = \sqrt{g \cdot R} = \sqrt{1{,}62\ \frac{m}{s^2} \cdot 1738000\ m} = 1678\ \frac{m}{s} \approx 1{,}68\ \frac{km}{s}$$

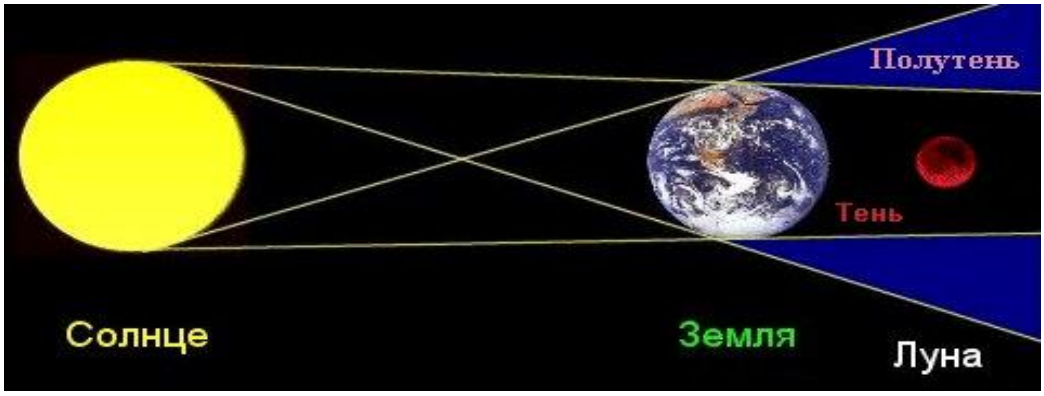
$$\upsilon_{II} = \sqrt{2 \cdot g \cdot R} = \sqrt{2 \cdot 1{,}62\ \frac{m}{s^2} \cdot 1738000\ m} = 2373\ \frac{m}{s} \approx 2{,}37\ \frac{km}{s}$$

Recent research by scientists has shown that the moon does not have an atmosphere because the satellite has a small mass.

Lunar eclipse It occurs when the Moon enters the cone of shadow cast by the Earth. The diameter of the Earth's shadow spot at a distance of 363,000 km (the minimum distance of the Moon from the Earth) is about 2.5 diameters of the Moon, so the Moon can be completely obscured.

A lunar eclipse can be observed on the entire hemisphere of the Earth facing the Moon at that moment (that is, where the Moon is above the horizon at the time of the eclipse).

The maximum theoretically possible duration of the total phase of a lunar eclipse is 108 minutes; such were, for example, the lunar eclipses of July 26, 1953, July 16, 2000. At the same time, the Moon passes through the center of the earth's shadow; total lunar eclipses of this type are called central, they differ from the non-central one by the longer duration and lower brightness of the Moon during the total eclipse phase.

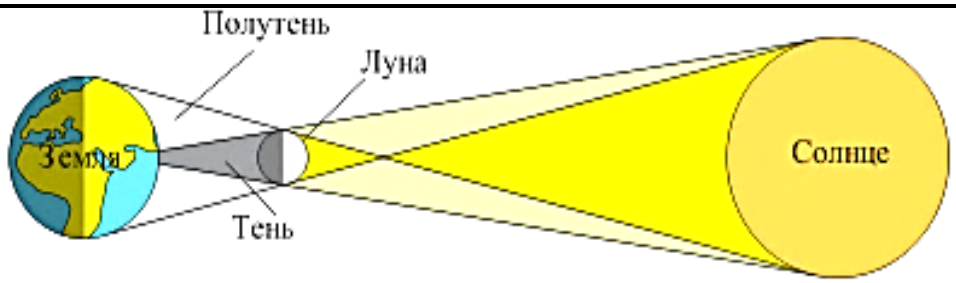


Total Lunar Eclipse

If the Moon falls into the full shadow of the Earth only partially, a partial eclipse is observed.

Solar eclipse — In this case, the Moon completely or partially obscures the Sun from the observer on Earth. A solar eclipse is possible only during the new moon, when the side of the Moon facing the Earth is not illuminated and the Moon itself is not visible.

The width of the Moon's shadow on the Earth's surface does not exceed 260 = 270 km and there is a total eclipse of the Sun (changes in the width of the shadow are associated with changes in the distances between the Earth and the Moon).



The scheme of the total solar eclipse

A total solar eclipse is observed only in the shadow of the moon and can last up to 460 seconds (7 minutes 40 seconds).

Thus, one of the forms of attracting students to independent creative activity is their performance of computational work, which allows them to deepen theoretical knowledge and apply it to solve practical problems. This method of teaching contributes to the realization of the following goal: it forms the necessary system of knowledge and skills for students and provides a high level of self-development, as well as development for self-learning.

As practice has shown, interdisciplinary integration has successfully contributed to the improvement of theoretical and practical knowledge of university students, within which, on the basis of cognitive activity, opportunities are created for the formation of competitiveness of young people.

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