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Comparative analysis of solutions the problems on the Maxwell theory with the use of traditional and interactive technologies

At the moment, the section «Electricity and Magnetism» general physics course is the foundation of knowledge, which is great importance not only for the formation of scientific horizons of students and school pupils, but also for the understanding of modern methods for solving practical problems. We offer a comparative analysis of solutions of the problem with the use of animation and static pattern. It is the use of animation is one of the methodological characteristics of the proposed material. With regard to the theme we used animation to problems. We are talking about the tasks on the phenomenon of electromagnetic induction and Maxwell's theory.

Key words: electromagnetic induction, vortex electric field, Maxwell's theory, interactive technology, animation.

In order to enter into the XXI century educated person can only well owning information technology. Human activities are increasingly dependent on their ability to use different information. For a free orientation in information flow specialist of any type is learning to receive process and use information using two data fields:

- The natural information (information of creative interaction with the world). Vision, hearing, thinking, and other information methods relating to biological objects are considered natural.
- Imitation of information (data bank of accumulated civilization in development). It is widely known the use of telescopes, microscopes, radios and other devices. The computer allows you to combine various artificial methods.

Computerization will ensure the transition from an industrial society to an information type of development [1].

The rapid development of computer technology and information technology was the impetus for the development of a society based on the use of various information and known as the Information Society.

The aim of the work is to use modern educational technology in the classroom for physics in extracurricular activities as a means of enhancing cognition, motivate student learning.

Tasks use of modern educational technology in the study of physics:

– Creating conditions for increasing students' interest in physics, the active involvement of students in the creative and research activities;

– The formation of skills of students in the classroom with modern educational technology;

– The development of creativity in the learning activities, the formation of his positive motivation to academic subject;

– To reveal the benefits of using modern education technology in the classroom physics as a means of enhancing cognitive functions at different stages of the learning process;

– To show the effectiveness of the use of modern educational technology in secondary school physics lessons as an example).

This paper attempts to identify ways and means of enhancing cognitive functions, improve efficiency in various stages of learning through modern education technology.

New views on the outcome of learning contributed to the emergence of new technologies and the abandonment of obsolete. Today, new methods of using the modern education technology are opposed to the traditional study of physics [2].

Explanatory and illustrative method — one of the most efficient ways to transfer the younger generation of a generalized and systematic human experience. The effectiveness of this method is verified by long practice, and it took a permanent place in schools of all countries, at all levels of education.

If during the centuries of knowledge transfer used almost exclusively by word of mouth teachers, instructional books and rather meager arsenal of visual aids, but now it became possible for the concentrated communication with modern technical facilities. Together with the word of the teacher in the classroom more often it sounds distinguished scholars and writers, actors and artists, designers, inventors, reproduced

using a tape recorder, radio and television. Along with the usual classy tables, which give a static image of the studied objects and phenomena, film and television greatly expand the boundaries of sensible paintings phenomena. Sitting in the classroom, students can observe the movement of the ring in a uniform magnetic field, observe the movement of planets throughout the year in a few minutes. Film and TV can show different phenomena occurring in space and in a microcosm, the idea of students transferred to the distant past and in the foreseeable future.

Due to the increase in school courses material in physics, chemistry, mathematics, the role of symbolic images — different formulas, graphs that appear in the dynamic form to students not only in the records on the board, but also on the silver screen or on the TV screen.

Along with this, more widely used in schools must find a demonstration of natural objects, volumetric models and working models of various experiments.

Section «Electricity and Magnetism» general physics course is the foundation of knowledge, which are of great importance not only for the formation of scientific horizons of students and school pupils, but also for the understanding of modern methods of solving the practical problems associated with the use of electromagnetic phenomena in industry, agriculture, health, in the field of telecommunications, information and computer technology, electronics and optoelectronics.

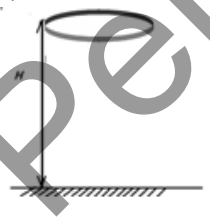
The proposed textbooks for schools and universities description of the properties of electromagnetic waves is based on the analysis of solutions of Maxwell's equations. The perception of Maxwell's theory at the university for the first years of difficult, because of the use of second-order differential equations. Given the level of mathematical preparation of undergraduate students, we use the simplest formulation of the problems, allowing a visual explanation of the effects observed with the use of interactive technologies. This allowed to make informed generalizations without resorting to sophisticated calculations, the characteristic methods of theoretical physics [3].

The relevance of this work is caused by interactive technology to actively enter our lives. Throughout the world, interactive technologies are used in education, they can be used on all the lessons and in particular the teaching of physics. Turns an ordinary lesson on problem solving section «Electricity and Magnetism» in the extraordinary, it is that the use of these tools in the classroom to help inspire pupils and students an interesting material, and most importantly to understand the meaning of the material presented in class

One of the methodological characteristics of the proposed material is the use of modern educational technologies for solving problems. This is reflected in the creation of animations as an accompaniment to the task. Animation — its techniques produce moving images, illusions of movement and changes in the shape of objects (morphing) with just a few or multiple still images and scenes. Animation (from Fr. Animation — revival, animation) is a western name of animation: view of cinema and its product (cartoon) [4]. The regard of theme we used animation to problems. We are talking about the tasks on the phenomenon of electromagnetic induction and Maxwell's theory. We offer a comparative analysis of solutions of the problem with the use of animation and static pattern.

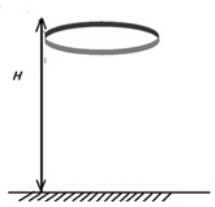
1. In a magnetic field from a great height falls ring of radius r and mass m. The resistance of R. The plane of the ring is no parallel to the horizontal. Determine the steady speed of fall of the ring, if the vertical component of the magnetic field varies with altitude: $B = B_0 (1 + \alpha h)$ [5].

1.



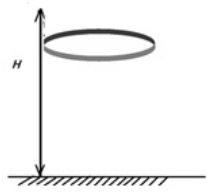
1. Consider the falling of ring in the uniform magnetic field. The force which acting on the ring is proportional to the current, the current which going around the ring is proportional to the induced EMF excited in the ring by moves. The EMF in turn is proportional to the rate of change of the magnetic flux, through the plane of the ring, and thus proportional to the speed of his fall.

2.



2. Therefore, the force which acting on ring in a magnetic field will be equal to the force of gravity when the speed of the ring is established. This speed is the speed of the steady motion of the ring.

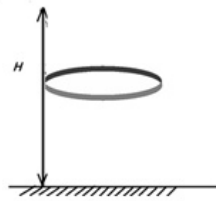
3.



3. By the law of electromagnetic induction electromotive force excited in the ring during its moves:

$$\xi = -\frac{\Delta \Phi}{\Delta t}. \tag{1.1}$$

4.

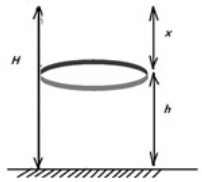


4. Magnetic flux:

$$\Phi = \frac{\pi d^2}{4} B = \frac{\pi d^2}{4} B_0 (1 + \alpha h). \tag{1.2}$$

$$\frac{\Delta \Phi}{\Delta t} = \frac{\pi d^2}{4} B_0 \alpha \frac{\Delta h}{\Delta t}. \tag{1.3}$$

5.



5. Connect the path traveled by the ring and the height *h*:

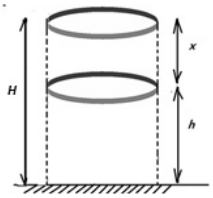
$$H = h + x. \tag{1.4}$$

And enter the speed:

$$\frac{\Delta x}{\Delta t} = \vartheta. \tag{1.5}$$

$$\xi = \frac{\pi d^2}{4} B_0 \alpha \vartheta. \tag{1.1'}$$

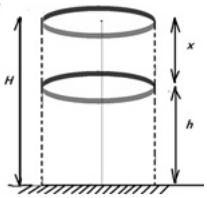
6.



6. By the Ohm's law:

$$I = \frac{\xi}{R} = \frac{\pi d^2}{4} B_0 \alpha \vartheta. \tag{1.6}$$

7.



7. The speed of ring is established when the lower of potential energy will be equal the heat energy.

$$mg\Delta x = I^2 R \Delta t. \tag{1.7}$$

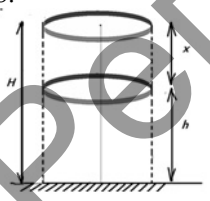
$$mg\vartheta = I^2 R. \tag{1.8}$$

$$mg\vartheta = \frac{\pi^2 d^4}{16R} B_0{}^2 \alpha^2 \vartheta^2. \tag{1.9}$$

Therefore:

$$\vartheta = \frac{16Rmg}{\pi^2 d^4 B_0{}^2 \alpha^2}.$$

8.



8. Thus:

$$\vartheta = \frac{16Rmg}{\pi^2 d^4 B_0{}^2 \alpha^2}.$$

At any problem with a picture can make the animation, but there are such problems, the contents of which cannot be described by animation. For example, consider the next problem.

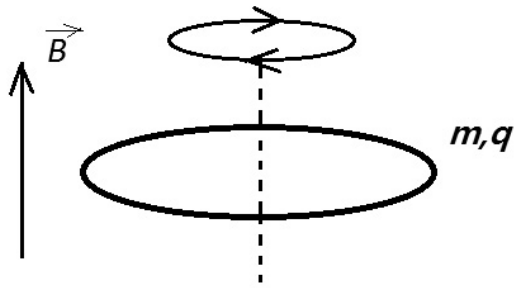
2. Non-conductive thin ring of mass *m*, having charge *q*, is free to rotate around its axis. Initially the ring rested and the magnetic fields were absent. Then include a uniform magnetic field is normal to the plane of the ring, which began to grow in time according to some law $\overline{B}(t)$. Find the angular velocity $\overline{\omega}$ ring depending on the induction $\overline{B}(t)$ [6].

Given:

m
q
r

$\omega - ?$

Solution:



By the second Maxwell equation:

$$\oint_{(l)} E_l dl = -\frac{\partial}{\partial t}\int_{(S)} B_n dS. \tag{2.1}$$

Since the line of force of the electric field coincides with the ring, thus have modulo:

$$E \cdot 2\pi R = \frac{\partial B}{\partial t} \cdot \pi R^2 \tag{2.2}$$

Where $\vec{E}$ — tension of vortex electrical field. We have:

$$E = \frac{1\partial B}{2\partial t} R. \tag{2.3}$$

Electrical force:

$$F = qE = \frac{1}{2} qR \frac{\partial B}{\partial t}. \tag{2.4}$$

According to the basic equation of dynamics of rotational motion of a solid body:

$$M = I\beta. \tag{2.5}$$

I — the moment of inertia of circle, β — the angular acceleration, M — the moment of force.

$$M = FR = \frac{1\partial B}{2\partial t} qR^2 = mR^2\beta. \tag{2.5'}$$

We have:

$$\beta = \frac{q}{2m}\frac{\partial B}{\partial t}. \tag{2.6}$$

The angular velocity: $\omega = \int \beta dt + c$

$$\omega = \frac{q}{2m}\int B(t)dt + c$$

$$\omega = \frac{q}{2m} B(t), \tag{2.7}$$

By condition $c = 0$. The vector form with the sign «-» from the equation (2, 1).

$$\overline{\omega}(t) = -\frac{q}{2m}\overline{B}(t) \tag{2.8}$$

Answer: $\overline{\omega}(t) = -\frac{q}{2m}\overline{B}(t)$

Thus the angular velocity is antiparallel to the vector $\overline{B}(t)$. It is interesting to note that such an equation is determined the angular velocity of the Larmor precession of the electron orbits in a magnetic field.

At the present stage of development of the education system is put forward is the move from traditional training to a qualitatively new system of education — to train a competent, productive thinking person, adapted to the new conditions of life in society. The realities of modern education are such that the amount of information that is necessary to master the student increases each academic year. And the features of teaching, such as physics are such that almost every lesson brings a new volume of information. Time isn't sufficient for comprehension and retention. There is a problem of human adaptation to the information society. And the use of advanced computer technology solves this problem. If the student does not have a clue

what was going on in the problem, it is experiencing enormous difficulties and lose interest as the process of learning as well as to the subject matter.

The images were drawn using the program paint. While working on the animations on one task was painted at least 30 images. Convert animation of the drawings is a program for creating and editing videos Windows Movie Maker. Begin to create and edit video FastGIF software was used to convert images to animations in the format GIF. Unfortunately, this program was not relevant, is not convenient to use. As the time for each image was exhibited in milliseconds, it was difficult to navigate, how many runs one frame. Time exhibited the same for all frames, it also makes the work is hurt of handling time-to frame. Because of these features are not of this program, the program has been used Windows Movie Maker, which creates video format WMV.

Based on the proposed two objectives, it should be concluded that it is possible to use two types of methods of solving problems — in the dynamics and statics. And the perception of using interactive technologies facilitated. But the explanation of solving problems with static images is difficult, as «missed» many nuances that give away the problems with animations [7].

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Дәстүрлі және интерактивті технологияларды қолдана отырып Максвелл теориясы бойынша есеп шешімдеріне салыстырмалы сараптама жүргізу

Қазіргі кезде жалпы физика курсының «Электр және магнетизм» тарауы білімнің негізі болып табылады, студенттер мен оқушылар үшін қазіргі заманның тәжірибелік есептердің шешімінің әдісін түсіну үшін, есептер шешімінің салыстырмалы сараптамасы жасалды. Есептердің шешімі анимация колданысымен және статикалық суретпен көрсетілген. Анимация қолданысы материалдың әдістемелік өзгешеліктерінің бірі болып табылады. Тақырыпқа сәйкес мультипликацияларды есептерге пайдаланду ұсынылған.

Л.Ф.Ильина, Ж.Ш.Куралбаева

Сравнительный анализ решения задач по теории Максвелла с использованием традиционных и интерактивных технологий

В данный момент раздел «Электричество и магнетизм» курса общей физики составляет фундамент знаний, имеющих большое значение не только для формирования научного кругозора студентов и учащихся школ, но и для понимания современных методов решения практических задач. Проведен сравнительный анализ решения задачи с использованием анимации и со статическим рисунком. Именно применение анимации является одной из методических особенностей предлагаемого материала. Применительно к теме использована мультипликация к задачам. Речь идёт о задачах на явление электромагнитной индукции и теорию Максвелла.