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ORGANIZATION OF COMPUTER LAB WORK TO STUDY THE POWER OF AN ELECTRICAL CIRCUIT OOZED ON AN EXTERIOR LOADING

Abstract. The paper proposes a model of the computer lab work organization for the study of the capacity of the internal resistance of the current source to be externally supported and the experimental determination of the resistance to the external resistance of the consumer. The model of the form includes brief information from the theory, control questions for checking students' readiness for work, introductory assignments with a computer model and preparation for work, tasks with subsequent experimental verification on a computer model and research assignments. Introductory tasks with a computer model include the ability to collect the necessary electrical circuit on the model's mounting table, set the necessary parameters of the circuit elements and determine the intervals of their change. In problems with subsequent experimental verification of answers to a computer model, it is necessary to solve problems on paper beforehand and then compare the results with the indications of the elements of the computer model. The course of solving problems must be submitted together with the form. Research tasks provide for establishing the dependence of the allocated power on the external load on its resistance, plotting the graph of this dependence and determining the condition for allocating maximum power on an external load. The proposed model of the form is approved in Nazarbayev intellectual school of physical and mathematical direction in Shymkent, the regional school "Daryn" waiting for gifted children and in the school-gymnasium named after M. Auezov of Aris. Most of the students carried out assignments with great interest.

Keywords: internal resistance of the current source, external resistance, power.

President of the Republic of Kazakhstan N.Nazarbayev in the Address to the people of Kazakhstan "Strategy "Kazakhstan-2050" - a new political course of the state", having outlined the priorities in the sphere of education, said: "We are to modernize teaching methods and actively develop on-line education systems, creating regional School centers. We must intensively introduce innovative methods, solutions and tools into the domestic education system, including distance learning and on-line training, accessible to all comers [1].

To realize the tasks set, the Department of Theory and Methods of Teaching Physics at the SKSU named after Auezov of the MES of the Republic of Kazakhstan since the 2011-2012 academic year introduced the discipline "Information technologies in education", "Information technologies in the teaching of physics", "Methodology of the use of electronic textbooks" in the curriculum. These programs envisage the development and use of modern information technology in the teaching of physics.

One of the difficult tasks of implementing the results of using information technologies in educational institutions is the insufficient practical ability of teachers of schools to use computer models of physical phenomena to organize laboratory work. From the organization of computer laboratory works, activization, motivation and, ultimately, the effectiveness of training, largely depends. On the creation and use of models of forms of organization of computer laboratory works on the study of various physical phenomena in the educational process we have previously written [2-17].

A powerful means of teaching electricity, in the opinion of many domestic foreign experts, is products [18] created under the guidance of Professor V.V. Kashkarov (Kazakh National University

named after Al-Faraby). The peculiarity of this resource is that all the elements of the electrical circuits (resistor, capacitor, inductance, current source, etc.) on the computer model resemble the real elements produced by the industry. Using this resource, we have developed a model of the form of organization of computer laboratory work to study the power released on the external load, which is proposed.

Purpose of work: Investigation of the dependence of power allocation on external resistance in DC circuits and determination of the condition of matching current sources with external load.

Class ..... Full name of the student .....

1. Brief information from the theory.

Any real source of current has an internal resistance. Therefore, when connecting a current source to the load, heat will be released both in the load and inside the current source (at its internal resistance). At what load, connected to this current source, will the maximum power be allocated?

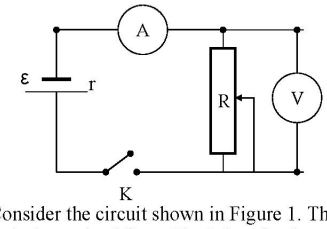

Figure 1 - Consider the circuit shown in Figure 1. The current flowing in the loop is determined from Ohm's law for the complete circuit:

$$I = \frac{\varepsilon}{R + r}, \tag{1}$$

Where e is the EMF of the current source, r is the internal resistance of the source, R is the load resistance.

The voltage U on the load R will be equal to:

$$U = R \cdot I = \frac{\varepsilon \cdot R}{R + r}, \tag{2}$$

And the power P allocated to the external resistance R (consumer) will be:

$$P = U \cdot I = \frac{\varepsilon^2 \cdot R}{(R + r)^2}, \tag{3}$$

As can be seen from the formula (3), the power released on the load R will be small if the load resistance R is small (R << r). The power will also be low at very high load resistance (R >> r). Calculation shows that the maximum power will be allocated to the load when the internal resistance r and the load resistance R = r are equal. In this case:

$$P_{max} = \frac{\varepsilon^2}{4R}, \tag{4}$$

The coordination of the external load and the internal resistance of the current source is of great practical importance.

2. Control questions for checking the readiness for work.

2.1. Why does the voltage increase on it with increasing load resistance?

Answers: ....

2.2. Explain why the power dissipated on the load is small, if the load resistance is very different from the internal resistance of the source? Note the formulas for the current (1) and voltage (2) on the load.

Explanation:..... .....

3. Introductory tasks with a computer model.

3.1. Assemble the circuit of the computer model on the mounting board of the computer model in Fig. 1 (the key is in the open position).

3.2. To what extent can the operating voltage (EDS) and the internal resistance (operating power) of the current source be changed?

Answers: ....

3.3. In what limits it is possible to change the resistance of the rheostat (variable resistor)?

Answers: ....

3.4. Specify the limit of current measurement with a multimeter. Answers: .....

3.5. Specify the voltage measurement limit of the multimeter. Answers: .....

4. Preparation for work.

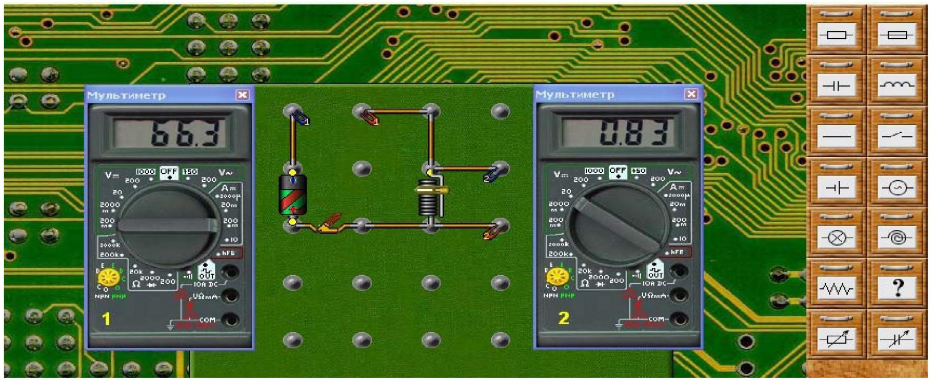

Figure 2

4.1. Assemble the diagram shown in Fig. 2 on the mounting table.

Select the values for the element parameters as follows: Battery: e = 1.5 V; R = 10 Ohm; Rheostat: to R = 30 ohms and turn on the key.

5. Tasks with subsequent verification of the answers according to the indications of the computer model.

(The tasks must be solved first on paper, then compare the results with the indications of the computer model.) The task solution should be submitted together with the form.

5.1. Calculate the readings of the ammeter and voltmeter with a resistance of 3 ohms rheostat and compare the readings on a computer model.

Answers:

5.2. Calculate the readings of the ammeter and voltmeter with a 10 ohm rheostat and compare the readings to a computer model.

Answers:

5.3. Calculate the readings of the ammeter and voltmeter with a 15 ohm resistor and compare the readings on a computer model.

Answers:

5.4. Calculate the readings of the ammeter and voltmeter with a rheostat resistance of 20 ohms and compare the readings on a computer model.

Answers:

5.5. Calculate the readings of the ammeter and voltmeter with the resistance of the rheostat 24 ohms and compare the readings on the computer model.

Answers:

5.6. Calculate the readings of the ammeter and voltmeter with a rheostat resistance of 30 Ohm and compare the readings on a computer model.

Answers:

6. Research assignments.

6.1. Changing the position of the rheostat, measure the current in the circuit and the voltage on the rheostat (load). Record the data (rheostat resistance R, current I and voltage U) in table 1. Make an analysis and conclusion: ....

Table 1

R, Ohm	I, A	U, B	P = U I,Watt
***	***	***	****

6.2. Calculate the power P allocated to the load for different values of resistance rheostat, according to the formula P = UI and put the result in Table 1. Make the analysis and conclusion: ....

6.3. Construct a graph of power versus load resistance. Determine from the graph the value of the external load resistance, on which the maximum power is allocated. Make an analysis and conclusion: ....

6.4. Compare the value of the external load resistance obtained by you, at which the maximum power with theoretical (4)

Draw conclusions and conclusion: ....

Number of completed tasks	Number of errors	Teacher rating

The proposed model of the form was approved in Nazarbayev intellectual school of the physical and mathematical direction of Shymkent, the regional school "Daryn" waiting for gifted children and in the school-gymnasium named after M. Auezov of Arys. Most students with great interest completed all the tasks.

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ЭЛЕКТР ТІЗБЕГІНІҢ СЫРТҚЫ КЕДЕРГІСІНДЕ БӨЛІНЕТІН ҚУАТТЫ ЗЕРТТЕУГЕ АРНАЛҒАН КОМПЬЮТЕРЛІК ЗЕРТХАНАЛЫҚ ЖҰМЫСТЫ ОРЫНДАУДЫ ҰЙЫМДАСТЫРУ

Аннотация. Мақалада электр тізбегінің сыртқы кедергісінде бөлінетін қуатты зерттеуге арналған компьютерлік зертханалық жұмысты орындауды ұйымдастыруға арналған, оқырмандарға алдын-ала таратылатын бланкі үлгісі ұсынылады. Үлгіде теориядан қысқаша мәліметтер, жұмысты орындауға дайындығын тексеруге арналған бақылау сұрақтары, компьютерлік модельмен танысу тапсырмалары, нәтижесін компьютерлік тәжірибе арқылы тексеруге арналған есептер, тәжірибелік және зерттеулік тапсырмалар қамтылған.

Компьютерлік модельмен танысу тапсырмаларында монтаждық столда қажетті электр тізбегін құрастыру, тізбек элементтерінің параметрлерін өзгерту мен өзгеру интервалын анықтау қамтылған. Нәтижелерін компьютерлік тәжірибе арқылы тексеру есептерінде оқырман есептерді алдымен қағазда шығарып соңынан компьютерлік тәжірибе нәтижесімен салыстырылады. Қағазда шығарылған есептер бланкімен бірге тапсырылады.

Зерттеулік тапсырмаларда сыртқы кедергіде бөлінетін қуаттың кедергіге тәуелдігін анықтау, бөлінген қуаттың ке-дергіге тәуелділік графигін салу және қуаттың максимал бөліну шартын анықтау қарастырылған. Ұсынылған бланкі үлгілері Шымкент қаласындағы Физика- математика бағытындағы Назарбаев зияткерлік мектебінде, дарынды балаларға арналған облыстық «Дарын» мектебінде және Арыс қаласындағы М.Әуезов атындағы мектеп-гимназиясында физика сабақтарын өту барысында қолданылды. Оқушылардың басым көпшілігі тапсырмаларды аса қызығушылықпен орындады.

Тірек сөздер: тоқ көзінің ішкі кедергісі, сыртқы кедергі, қуат.

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ОРГАНИЗАЦИЯ ВЫПОЛНЕНИЯ КОМПЬЮТЕРНОЙ ЛАБОРАТОРНОЙ РАБОТЫ ПО ИССЛЕДОВАНИЮ МОЩНОСТИ ВЫДЕЛЯЕМОЙ НА ВНЕШНЕЙ НАГРУЗКЕ ЭЛЕКТРИЧЕСКОЙ ЦЕПИ

Аннотация. В статье предложена модель бланка организации компьютерной лабораторной работы по исследованию мощности выделяемой на внешнем сопротивлении и экспериментальном определении условия согласования внутреннего сопротивления источника тока с внешним сопротивлением потребителя. Модель бланка включает краткие сведения из теории, контрольные вопросы для проверки готовности учащихся к работе, ознакомительные задания с компьютерной моделью и подготовка к работе, задачи с последующей экспериментальной проверкой на компьютерной модели и исследовательские задания. Ознакомительные задания с компьютерной моделью предусматривают умения собирать необходимую электрическую цепь на монтажном столе модели, устанавливать необходимые параметры элементов цепи и определять интервалы их изменения. В задачах с последующей экспериментальной проверкой ответов на компьютерной модели необходимо предварительно решать задачи на бумаге и затем сравнивать результаты с показаниями элементов компьютерной модели. Ход решения задач необходимо представить вместе с бланком. Исследовательские задания предусматривают установление зависимости выделяемой мощности на внешней нагрузке от ее сопротивления, построение графика этой зависимости и определение условия выделения максимальной мощности на внешней нагрузке. Предлагаемая модель бланка апробирована в Назарбаев интеллектуальной школе физико-математического направления г.Шымкент, областной школе «Дарын» для одаренных детей и в школе-гимназии им. М.Ауэзова г.Арысь. Большинство учащихся выполняли заданияс большой заинтересованностью.

Ключевые слова: внутреннее сопротивление источника тока, внешнее сопротивление, мощность.

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