Azonosító jel:

ÉRETTSÉGI VIZSGA • 2010. május 18.

FIZIKA
ANGOL NYELVEN

EMELT SZINTŰ ÍRÁSBELI VIZSGA

2010. május 18. 8:00

Az írásbeli vizsga időtartama: 240 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

OKTATÁSI ÉS KULTURÁLIS MINISZTÉRIUM

Instructions to Candidates

Time allowed for this question paper is 240 minutes.

Read the instructions of the problems carefully, and make sure that you do not run out of time.

You may solve the problems in any order.

Materials allowed: calculator, data tables.

If there is not enough space provided for the solution of a problem ask for an extra sheet.

On the sheet attached indicate the number of problem.

PART ONE

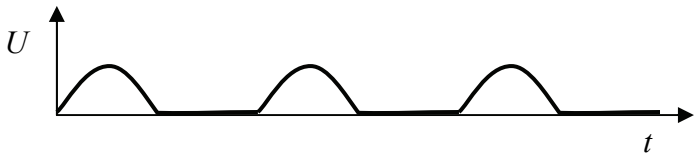
Exactly one of the answers to each of the following questions below is correct. Write the appropriate letter in the white square on the right. If necessary you may write your calculations or draw figures on this sheet.

1. The image of an object formed by a converging lens is real. Then the object is placed to the site where the image was formed. Which statement is true?

A) In this case the image will also be real.
B) Depending on the focal length of the lens the image will be either virtual or real.
C) In this case the image will be virtual.

2 points

2. If a 230-V alternating voltage input is rectified and a capacitor is connected to the output voltage, what is the maximum voltage across the capacitor? (Rectification cuts off the negative half-cycles, as shown in the figure. The ohmic resistance is negligible.)



Rectified alternating voltage

A) It will be smaller than 115 V.
B) It will be exactly 115 V.
C) It will be between 115 V and 230 V.
D) It will be greater than 230 V.

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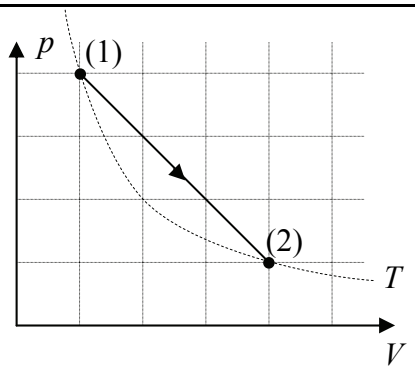
2 points

3. In a radioactive sample the number of active nuclides decreases to 95 % in each hour. How does the rate of decay (the number of disintegrating nuclides in one hour) change?

A) It decreases by 5 %.
B) It decreases by less than 5 %.
C) It decreases by more than 5 %.
D) The rate of decay does not change.

2 points

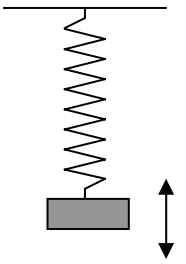
4. The figure shows the p-V diagram of a sample of ideal gas. Which statement is true for the process (1)→(2)?



A) During the process the internal energy of the gas did not change.
B) The temperature of the gas initially increased, then decreased.
C) During the process the pressure and the volume of the gas are inversely proportional.
D) While the gas warmed up, it did work on its environment and while it cooled work was done on it.

2 points

5. An object of mass *m* hanging on a vertical spring undergoes simple harmonic motion. What is the force exerted by the spring when the object is at the lowest point?



A) $F_{spring} < |m \cdot g|$
B) $F_{spring} = |m \cdot g|$
C) $F_{spring} > |m \cdot g|$
D) It depends on the amplitude of the oscillation.

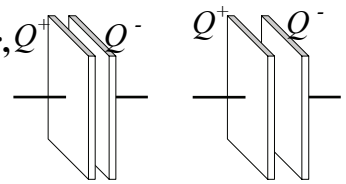
2 points

6. What do you mean by mass defect?

A) During the radioactive decay the nucleus ejects particles, thus it will be lighter.
B) The mass of a fast particle (whose speed is comparable with the speed of light) is greater than the rest mass of the particle.
C) If a nucleus is split to its nucleons, the sum of their masses is not equal to the mass of the original nucleus.

2 points

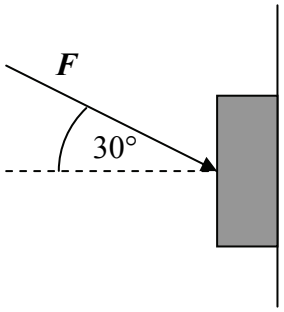
7. The separation between the plates of a charged capacitor, which is not connected to the voltage supply, is increased a bit. How do the electric field and the energy of the capacitor change? (The electric field between the plates can be considered as uniform.)



A) The electric field decreases, the energy remains the same.
B) Both the electric field and the energy remains the same.
C) The electric field decreases, the energy increases.
D) The electric field remains the same, the energy increases.

2 points

8. A brick is pushed against a vertical wall by a force directed 30° below the horizontal, as shown in the figure. Is it possible to keep the brick at rest?



A) Yes, if the brick is hard enough.
B) No, because the force exerted by the wall cannot be vertical.
C) Yes, if the frictional force between the wall and the brick is big enough.
D) No, because the force has a vertically downward component.

2 points

9. Which quantity has the unit of $\frac{\mathrm{J}}{\mathrm{mol}\cdot\mathrm{K}}$?

A) Molar heat capacity.
B) Specific heat capacity.
C) Coefficient of linear expansion.
D) Universal gas constant.

2 points

10. Nowadays it is well known that "falling stars" are meteoroids which enter the Earth's atmosphere and become brightly visible. Why do they "burn" in the atmosphere?

A) Because the top of the atmosphere is very hot– though it is very rare.
B) Because the speed of the meteoroids is very big and due to the friction with the atmosphere a huge amount of heat is released.
C) Because meteoroids contains a lot of flammable compounds, which immediately react with the Oxygen of the atmosphere.

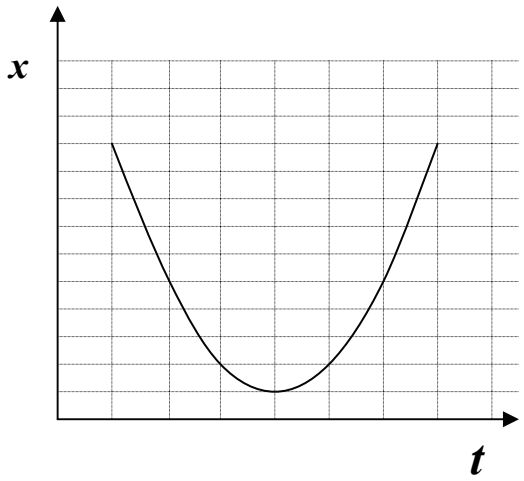
2 points

11. A free-fall experiment is carried out in space, on an asteroid of radius *R*. A small test object is released at a height of *R/4* above the surface of the asteroid, and it takes time *t* to fall. How long would it take for this test object to fall if it was released at a height of R?

A) It would take less than $\sqrt{2}\cdot t$.
B) It would take exactly $\sqrt{2}\cdot t$.
C) It would take $2\cdot t$.
D) More than $2\cdot t$.

2 points

12. The displacement versus time graph of a motion is a parabola which is shown in the figure. What kind of motion is it?



A) Uniform straight line motion.
B) Uniformly accelerated straight line motion.
C) A motion which changes periodically.
D) Simple harmonic motion.

2 points

13. Two identical balloons are blown to the same size, one at sea-level and the other is at the top of a mountain. Both balloons are at the same temperature. Which one of the following statements is true?

A) The samples of air confined in the balloons have the same pressure, but different mass.

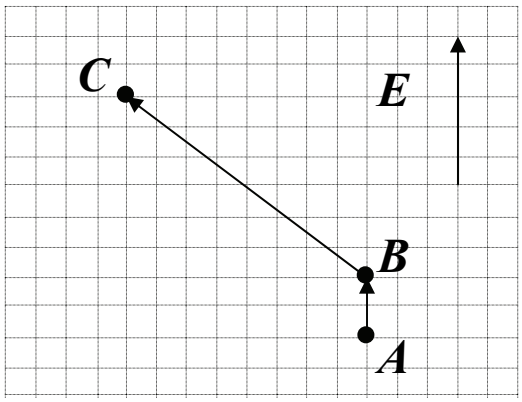
B) The samples of air confined in the balloons have the same mass, but different pressure.

C) Both the mass and the pressure values of the two samples of air in the balloons are equal.

D) Neither the values of mass nor the values of pressure of the two samples of air in the balloons are equal.

2 points

14. A charge q is moved in uniform electric field of E first along segment A-B, then along segment B-C. By what factor is the performed work greater along segment B-C than along segment A-B?



A) They are equal.
B) Three times as much.
C) Four times as much.
D) Five times as much.

2 points

15. Which quantity has the unit of eV?

A) Charge.
B) Voltage.
C) Energy.

2 points

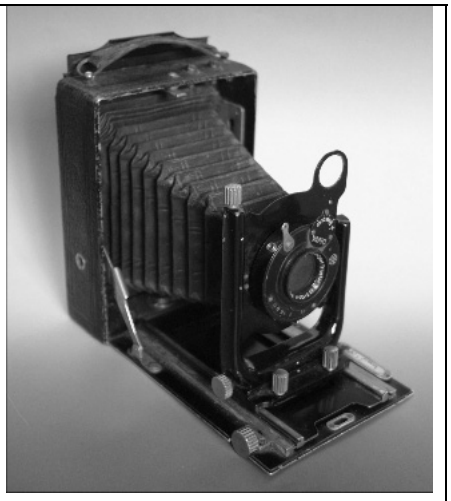
PART TWO

Choose one out of the three topics below and develop your opinion in a coherent composition of 1.5-2 pages. Make sure that your essay is clear, accurate and comprehensible, pay attention to the spelling, since these are assessed as well. It is not necessary to expound your opinion in the order of the given aspects. You may write your composition on the next page.

1. Secrets of Photography

"The first daguerreotype pictures, which were shown to the astonished Parisian public in the winter of 1838-39 by their inventor Louis-Jacques-Mandé Daguerre, were praised for their richness of details. It was told that if the pictures were viewed through a magnifying glass, it would be the same as if nature was observed with a telescope. According to William Henry Fox Talbot the English rival of the inventor in many cases the photographer notices some fine details in the picture, well after the picture has been taken; like a number of a year or an inscription engraved on a wall, or a poster or a distant clock, which were unobserved at the time of the exposure."

Britannica Hungarica



State the thin lens formula. Describe the concepts of quantities in the formula in case of a camera. How does the position of the objective lens change when the picture of a close or a distant object is taken? What is the object distance when the object the photo of which is taken is located at infinity? Reason your answers with the help of the thin lens formula. What kind of adjustments can the photographer do in order to regulate the amount of light that passes through the camera lens? What are the points of view according to which these adjustments should be done? What is the most important difference between the technique of classical and digital photography?

2. Mass and Its Measurement

"Impenetrability is the property of objects by which they impede other objects to occupy the space where they are at that certain time. Due to this impenetrability objects can be touched (...) The amount of the impenetrable object which confines the space is the amount of matter which is called the mass of the object."

Schirkhuber Móricz: Elméleti és tapasztalati természettan alaprajza (1851)

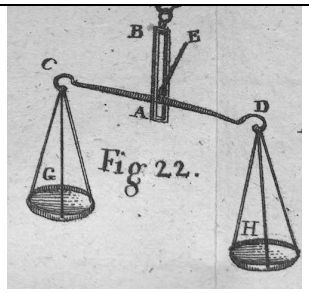


Fig 22.

State Newton's second law. With the help of the law describe the dynamical method for the measurement of the inertial mass of an object. Describe the concept of the method for the measurement of mass, which become more general in the everyday practice (which is based on the effect of a gravitational field on the object) and reason the applicability of the method. Describe a method for the measurement of mass which leads to the correct result on the Earth, but not on the Moon. Describe a method which can be used both on the Earth and on the Moon, but it does not work in the state of weightlessness. Describe a method for the measurement of mass which can be applied in the state of weightlessness as well.

3. Saturated and Unsaturated Vapour

"Dew is nothing else than the collection of those water vapours which rise from the ground to the air during a clear night, and due to the coldness of the air they get "denser" and become drops and fall back to the ground."

Fábián József: Természeti tudomány a köznépnek a babonaságok orvoslására és a köznép közül való kiirtására... (1803)

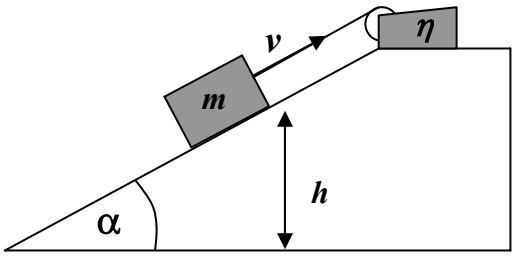
Describe the concept of relative humidity and how it depends on the temperature. Define saturated vapour and describe its characteristics. Write down the most important processes which may occur when a sample of unsaturated water vapour is compressed isothermally at room temperature, and describe the processes on the p-V diagram.
Explain why breath becomes visible in winter. Explain the formation of dew. (It is not necessary to give formulae.)

Content	Presentation	Total
18 points	5 points	23 points

PART THREE

Solve the following problems. Justify your answers by means of explanations, diagrams or calculations, depending on the nature of the problem. Make sure that the meaning of all notations used is clear.

1. An electric hoist is used to pull up an object of mass *m* on an incline at a steady speed of *v*.



a) Calculate the power of the electric hoist if the efficiency of the motor is $\eta = 0.6$.

b) After the object stopped at the top, it is released, and slides back from a height of $h = 10$ m with zero initial speed. How long does it take to get back to the bottom of the incline?

Data: the mass of the object is $m = 10\,\text{kg}$, its speed is $v = 3\,\frac{\text{m}}{\text{s}}$, the coefficient of kinetic friction between the object and the slope is $\mu = 0.4$, the angle of the incline is $\alpha = 30^\circ$, and $g = 10\,\frac{\text{m}}{\text{s}^2}$.

a)	b)	Total
6 points	6 points	12 points

2. A glowing piece of iron of mass $m_{iron} = 2\,kg$, and of temperature $T_0 = 1000\,^{\circ}C$ is immersed to water in order to cool it down. The piece of iron was placed to an insulated container in which there was water at a temperature of $T_1 = 20\,^{\circ}C$, and then the container was closed. While the iron was immersed into the water it immediately boiled some portion of the surrounding water, and the $100\,^{\circ}\mathrm{C}$ steam escaped to the above air. After a little while the container was opened and it was found that the common temperature of the water and the iron was $60\,^{\circ}\mathrm{C}$, and the mass of the remaining water was $4.2\,\mathrm{kg}$.

How much water was boiled when the piece of iron was placed into the water?

Data: the specific heat capacity of water is $c_{water} = 4.18\frac{\mathrm{kJ}}{\mathrm{kg}\cdot{}^{\circ}\mathrm{C}}$, the specific latent heat of vaporization of water is $L = 2.25\frac{\mathrm{MJ}}{\mathrm{kg}}$, the specific heat capacity of iron is $c_{iron} = 465\ \frac{\mathrm{J}}{\mathrm{kg}\cdot{}^{\circ}\mathrm{C}}$.

Total
10 points

3. The light emitted by a gas discharge-tube was examined by a spectrometer, and the wavelengths of three sharp spectral lines were measured as: $\lambda_1 = 405\,\text{nm}$**,** $\lambda_2 = 696\,\text{nm}$**, and** $\lambda_3 = 768\,\text{nm}$**. In the tables below some of the energy levels of the outermost electron of two elements: sodium and potassium are listed. This electron is the only electron of the atom which is located in the outer shell and not in a closed shell, and this is the one which can the most easily make transition from the ground state to an exited state. In the table the name of the atomic energy levels and the values of excitation energy (the difference in energy between the particular state and the ground state) are given. Using the table determine which element is present in the gas of the discharge-tube and give the names of the atomic energy levels corresponding to the transitions in which the detected photons were emitted.**

Data: $h = 6.62 \cdot 10^{-34}\,\text{Js}$, $e = 1.6 \cdot 10^{-19}\,\text{C}$, $c = 3 \cdot 10^{8}\,\frac{\text{m}}{\text{s}}$

Na	
Name of atomic energy levels :	Excitation energy
3s	0 (ground state)
3p	2.103 eV
5s	4.116 eV
5d	4.592 eV

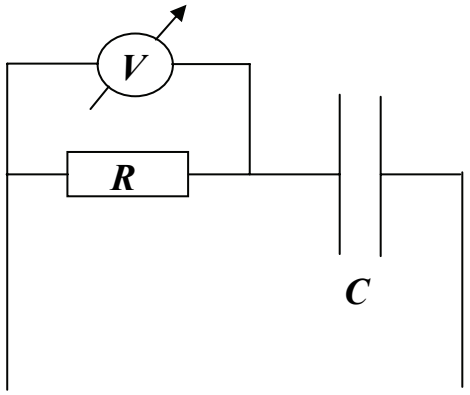
K	
Name of atomic energy levels:	Excitation energy
4s	0 (ground state)
4p	1.615 eV
5p	3.064 eV
4d	3.397 eV

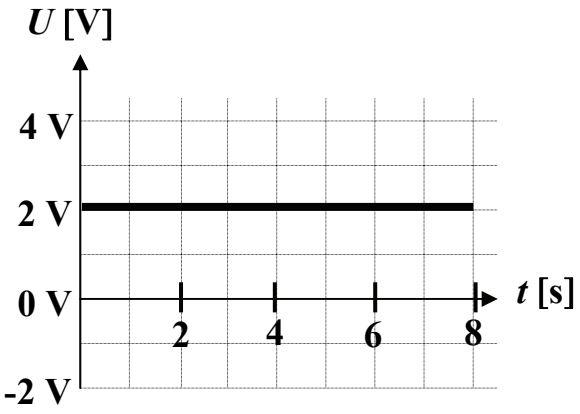
Total
11 points

4. The figure shows a capacitor and a resistor connected in series with a current source, and the capacitor is charged through the resistor. The voltage across the resistor R is measured with a voltmeter. The graph shows the result of the measurement.

a) Determine the relationship between the voltage across the capacitor and the time and draw the voltage across the capacitor versus time graph. (The initial voltage across the capacitor was zero.)
b) Find the energy of the capacitor after 8 s elapsed.
c) How much heat is dissipated in the resistor during this 8 s?

Data: $R = 0.5\,\mathrm{M\Omega}$, $C = 4\,\mu\mathrm{F}$





a)	b)	c)	Total
8 points	3 points	3 points	14 points

To be filled by the examiner:

	maximum score	score attained
I. Multiple Choice Questions	30	
II. Essay: Content	18	
II. Essay: Presentation	5	
III. Extended Response Problems	47	
TOTAL	**100**	

Examiner

Date

	score attained rounded to the **nearest integer** (elért pontszám **egész számra** kerekítve)	Integer score entered in the program (programba beírt **egész** pontszám)
I. Multiple Choice Questions Feleletválasztós kérdéssor		
II. Essay: Content Esszé: tartalom		
II. Essay: Presentation Esszé: kifejtés módja		
III. Extended Response problems Összetett feladatok		

Examiner/ javító tanár

Registrar/ jegyző

Date /dátum

Date / dátum