Név: ..... osztály:.....

ÉRETTSÉGI VIZSGA • 2012. május 17.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

2012. május 17. 8:00

Az írásbeli vizsga időtartama: 120 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

NEMZETI ERŐFORRÁS MINISZTÉRIUM

Instructions for the examinee

The time allowed for the examination is 120 minutes.
Read the instructions for the problems very carefully and use your time wisely.
You may solve the problems in arbitrary order.
Allowable materials: pocket calculator, data tables.
Should the space provided for the solution of a problem be insufficient, you may continue the solution on one of the empty sheets at the end of the examination. Please indicate the number of the problem on the sheet.

Please indicate here which of the two problems 3/A and 3/B you have chosen (that is, which one you would like evaluated):

3/ ☐

PART ONE

Precisely one of the possible solutions for each of the following questions is correct. Write the corresponding letter in the white square on the right! (Check your answer with calculations if necessary.)

1. Since the year 2006 astronomers no longer classify Pluto as a planet, it has been declared a dwarf planet. Which is the outermost planet of our Solar system now?

A) Saturn.
B) Uranus.
C) Neptune.

2 points	

2. How does a raindrop fall? We know that besides gravitation, air drag also exerts a force on it.

A) It moves with a constant acceleration, as both the gravitational force and the force due to air drag are constant, but the later one is smaller.
B) It starts with an accelerating motion, but its speed becomes practically constant after a while, because the force due to air drag increases with speed.
C) In the beginning its speed increases, but after a while it decreases again as the force due to air drag becomes greater than the gravitational force.

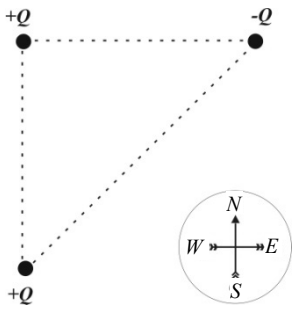
2 points	

3. Water is often employed as a coolant because it flows easily. Which other property of water is favorable from this point of view?

A) Water is a good coolant because its specific heat is large.
B) Water is a good coolant because it is a good conductor of heat.
C) Water is a good coolant because its latent heat of fusion is high.

2 points	

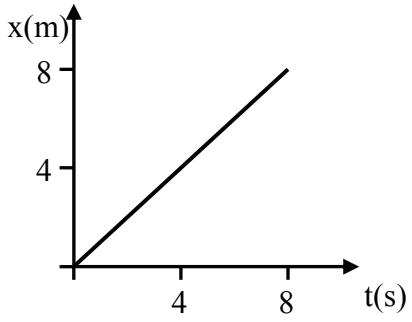
4. We fix point charges of magnitude $Q = 1$ μC at the three vertices of a right-angled isosceles triangle. As it can be seen on the figure, one charge is negative, the other two are positive. What is the direction of the electrostatic force exerted on the charge at the right-angled vertex of the triangle by the other two charges?

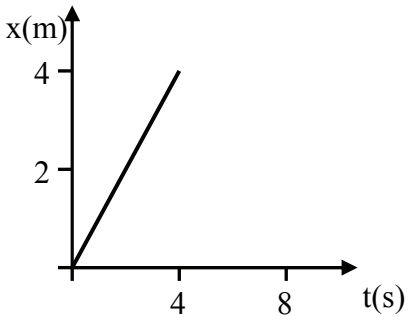


A) The electrostatic force points Northwest.
B) The electrostatic force points Northeast.
C) The electrostatic force is zero, because the sum of the other two charges is zero. ☐

2 points	

5. Each of the two position-time graphs below depict the motion of a point-like body with constant speed. Which graph depicts the motion of the faster body?





A) The motion of the faster body is depicted by the graph on the right.
B) The two bodies move with the same speed.
C) The motion of the faster body is depicted by the graph on the left. ☐

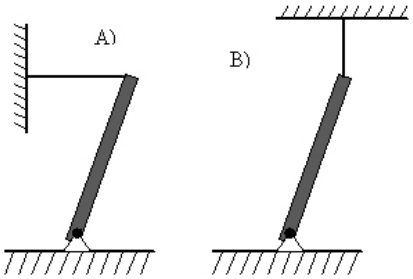
2 points	

6. We inflate a balloon. What can we say about the air pressure inside the balloon?

A) It is greater than the outside pressure.
B) It is equal to the outside pressure.
C) It is smaller than the outside pressure. ☐

2 points	

7. We hold a massive pole in equilibrium with a rope in two different ways. The pole can rotate without friction around the axle that is perpendicular to the plane of the paper. In which case will the force in the rope be greater? (The pole encloses an angle of about 75^0 with the ground.)



A) In the case depicted in figure A).
B) In the case depicted in figure B).
C) The force in the rope will be the same in both cases.

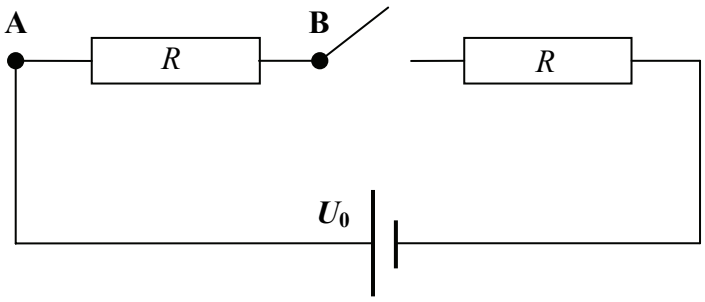
2 points

8. A flat mirror forms a virtual image. How does the image size change when the object distance is doubled?

A) The image size is also doubled.
B) The image size remains unchanged.
C) The image size is halved.

2 points

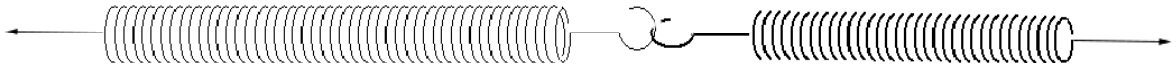
9. In the circuit depicted on the figure the voltage of the battery is $U_0 = 10$ V, while the resistance of the two resistors is the same. What is the voltage between the two points A and B when the switch is in an open position?



A) $U_{AB} = 10$ V.
B) $U_{AB} = 5$ V.
C) $U_{AB} = 0$ V.

2 points

10. A spring with a spring constant $D_2 = 400$ N/m is attached to the end of another spring whose spring constant is $D_1 = 200$ N/m such that the two springs lie along a straight line. The free ends of springs are pulled apart. Which of the two springs will be stretched more? (The springs are at rest!)



A) The spring with spring constant $D_1 = 200$ N/m will be stretched more.
B) The spring with spring constant $D_2 = 400$ N/m will be stretched more.
C) The two springs will stretch by the same amount.

2 points	

11. A metal is illuminated with 2.1 eV photons. This causes electrons to be emitted with a maximum energy of 0.7 eV. With what photon energy should we illuminate this metal in order to have electrons emitted with a maximum energy of 1.4 eV?

A) With 4.2 eV photon energy.
B) With 3.6 eV photon energy.
C) With 2.8 eV photon energy.

2 points	

12. The shadow of a pole points north at solar noon. In which direction will it move in the afternoon?

A) It will move in a clockwise direction.
B) It will move in a counterclockwise direction.
C) It will not move, only become longer.

2 points	

13. We use a 0.4 m focal length concave mirror to image a candle located 3 m from the mirror on a screen. How does the image distance change if we move the candle closer to the mirror?

A) The image distance decreases.
B) The image distance increases.
C) The image distance does not change.

2 points	

14. We have two samples that contain alpha-emitting radioactive isotopes with different half-lives. At a given moment, both samples contain the same number of radioactive nuclei. At this moment we switch on two GM counters to detect the alpha particles emitted from each of the samples. From which sample do we detect an alpha particle first?

A) From the sample whose half-life is smaller.
B) From the sample whose half-life is greater.
C) It is impossible to say which sample will emit an alpha particle sooner. ☐

2 points

15. A rock is at rest on the ground. Naturally, a force acts upon it due to Earth's gravity. What can we say about the reaction force of this gravitational force?

A) The reaction force of the gravitational force is just the force by which the rock attracts the Earth.
B) The reaction force of the gravitational force is the weight of the rock.
C) The reaction force of the gravitational force is the force exerted on the rock by the ground which supports it. ☐

2 points

16. We have two gas containers, one with a volume of 200 liters, and one with a volume of 400 liters. Both contain 5 kg of carbon dioxide gas. We have to cool this gas – which can be assumed to be an ideal gas – from 20 ^{o}C to -10 ^{o}C in both containers. In which case do we have to extract more heat from the gas to achieve this?

A) In the case of the 200 liter container, as the gas pressure there is greater.
B) In the case of the 400 liter container, as the gas pressure there is smaller.
C) We have to extract the same amount of heat in both cases. ☐

2 points

17. We would not be able to observe shooting stars while standing on the Moon. Why is that so?

A) Because the Moon does not possess an atmosphere.
B) Because gravity on Moon's surface is smaller than that of the Earth.
C) Because light cannot propagate through vacuum. ☐

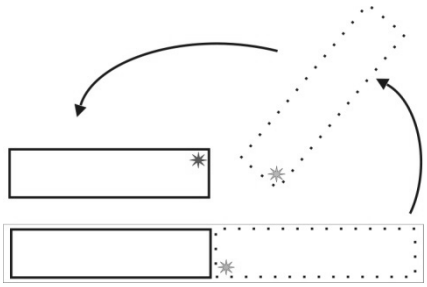
2 points

18. In the past, one cent coins in the United States of America were made purely of copper. Nowadays they are made of zinc, but are covered with copper, so that they look exactly the same as the old ones. We have two one cent coins in our hands, an old one and a new one, which look totally identical. Which property of the coins can we use to differentiate between them?

A) The mass of the old coin is certainly different from that of the new coin.
B) The old coin certainly looks more worn than the new one.
C) If the two coins look totally identical, we cannot differentiate between them. ☐

2 points	

19. We break a magnetic bar in two and turn one half of it parallel to the other half without lifting it from the table as shown on the figure. What kind of magnetic interaction will there be between the two pieces?



A) An attractive interaction.
B) A repulsive interaction.
C) There will not be any magnetic interaction between them. ☐

2 points	

20. Did Leó Szilárd have a role in developing the nuclear reactor?

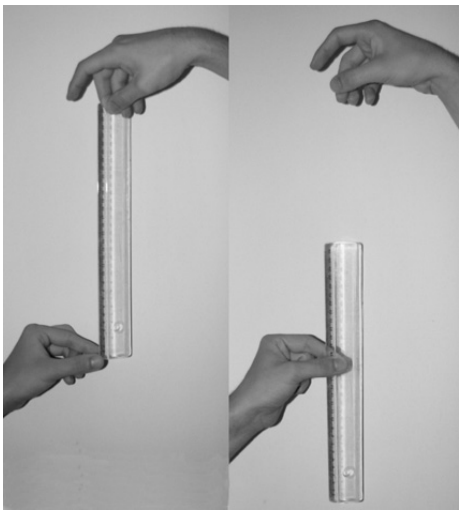
A) No, he could not have had a role, as he was kept away from the research of atomic energy all along because he was a suspicious foreigner.
B) No, he did not have a role. He obtained fame later when curing his own cancer with radiotherapy.
C) Yes he did, which is illustrated by the fact that for the patent of the nuclear reactor that he shared with Enrico Fermi the government of the United States paid him one dollar. ☐

2 points	

PART TWO

Solve the following problems. Justify your statements using calculations, diagrams or explanations, depending on the nature of the questions. Make sure that the notations you use are unambiguous.

1. An experiment to measure reaction time is depicted in the figure. In this experiment, we hold a ruler by the upper end, while our companion holds his hand with two fingers open at the lower end of the hanging ruler at the 0 cm mark, ready to catch it. Suddenly we release the ruler. Upon noticing this, our companion tries to catch the ruler by closing his fingers. He is not allowed to move his hand vertically! One can read the mark of the ruler where our companion caught it. It is then possible to determine the time elapsed between the release of the ruler and the closing of the fingers, i.e. the reaction time of our companion can be measured. We test three of our companions this way.



a) The reaction time of our first companion is 0.15 s. Where will he catch the ruler?
b) Our second companion caught the ruler at the 20 cm mark. What is his reaction time? How fast was the ruler moving when he caught it?
c) The reaction time of our third companion is twice that of the first one. Will he catch the ruler? If so, where?

$g = 10\ \mathrm{m/s^2}$, the length of the ruler is $L = 30$ cm.

a)	b)	c)	Total
4 points	6 points	3 points	13 points

2. We pour 200 grams of 10 °C milk into a 20 °C nursing bottle weighting 300 grams and insert it into an electric food warmer. The warmer heats the bottle and the milk to 38 °C.

a) How much heat did the warmer transfer to the milk and the bottle together?
b) How much time was required for the heating, if the warmer's net power is 90 W?
c) What is the amount of heat lost during the heating if the warmer's nominal power is 120 W?

Data: the specific heat of milk is $c_{milk} = 4000 \frac{\text{J}}{\text{kg} \cdot °\text{C}}$, the specific heat of glass is $c_{glass} = 840 \frac{\text{J}}{\text{kg} \cdot °\text{C}}$

a)	b)	c)	Total
8 points	5 points	4 points	17 points

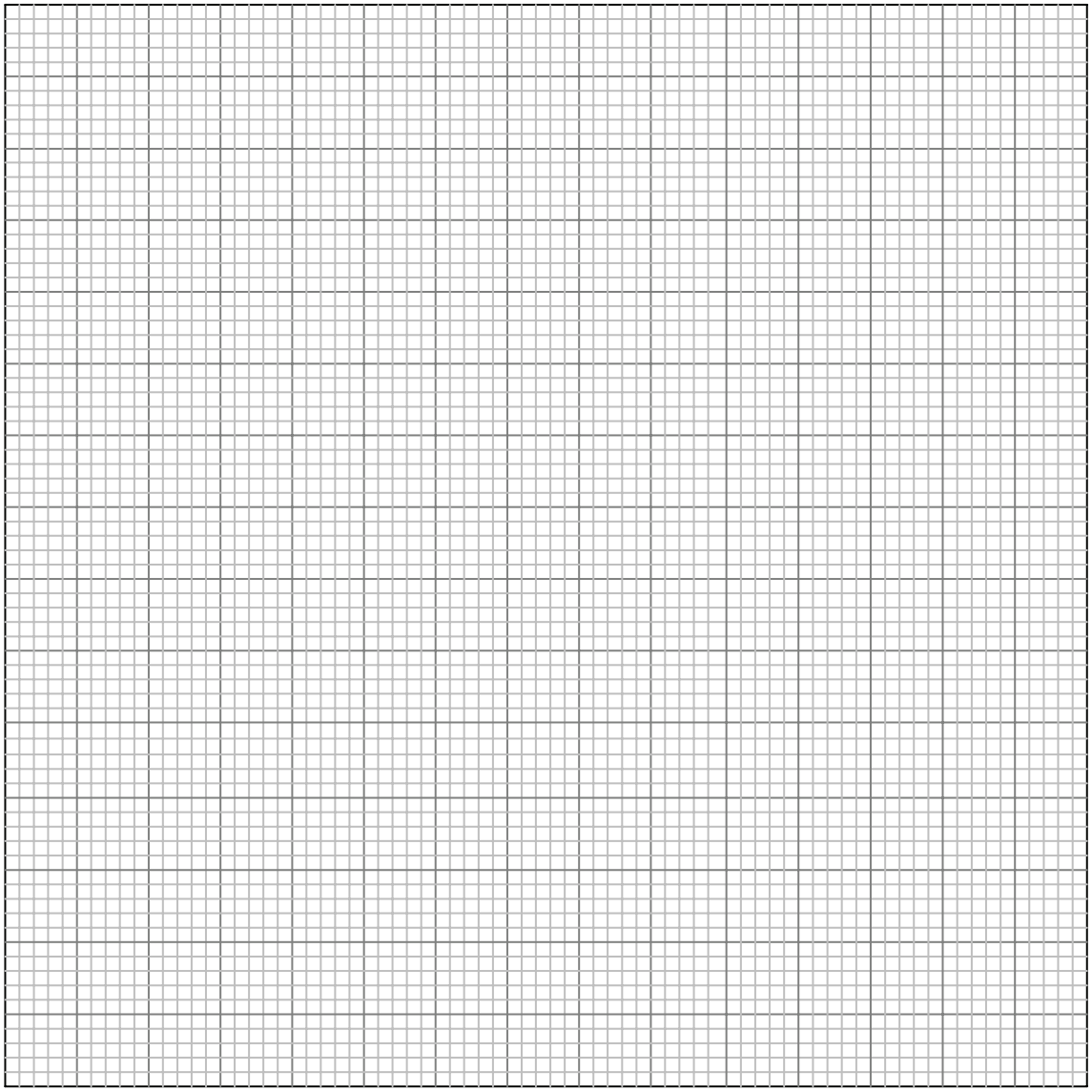
You need to solve only one of the two problems 3/A and 3/B. Indicate your choice on the inside of the front cover.

3/A In the course of the photoelectric effect, photons eject electrons from a silver plate. The table below contains the energy of the incident photons and the kinetic energy of the emitted electrons. (This latter has been determined by measuring voltage.) One piece of data is missing from the table.

photon energy - (eV)	5.12	5.88		6.92	7.55	7.92
electron energy - (eV)	0.41	1.12	1.52	2.17	2.77	3.20

a) Plot the kinetic energy of the emitted electrons as a function of the incident photon energy.
b) Using the data above, determine the work function of silver.
c) What is the greatest light wavelength at which the ejection of electrons still happens?
d) Determine the piece of data missing from the table using calculations or using the graph.

($h = 6.67 \cdot 10^{-34}$ Js, 1 eV = $1.6 \cdot 10^{-19}$ J, $c = 3 \cdot 10^{8}$ m/s)



a)	b)	c)	d)	Total
6 points	4 points	8 points	2 points	20 points

3/B Electric energy is transported via high tension power lines without insulation. We can often see birds perching on these cables without any harm coming to them. However we also know, that around 40 000 birds are killed a year in Hungary due to electric shock. Most often, the accidents happen on the poles of the 20 kV cables of the energy distribution network. The figures depict the two positions which lead to the electrocution of the birds most often.

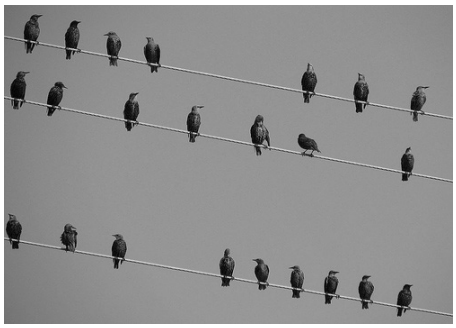


Fig. 1

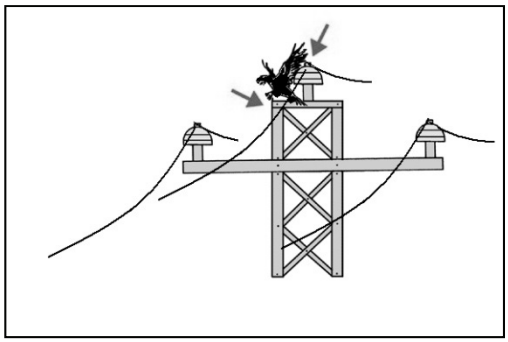


Fig. 2

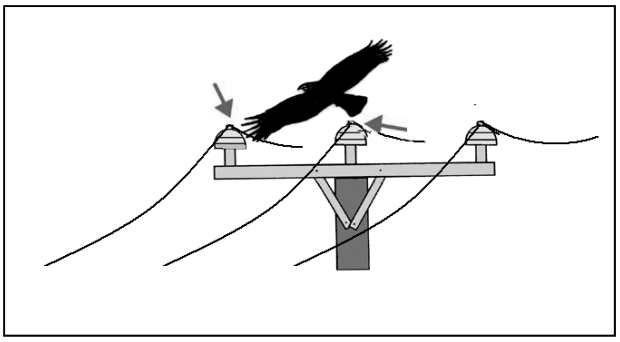


Fig. 3

Fig 4.

Fig. 5

Answer the following questions based on the introduction and the figures.

a) Why is a bird perching on the cable not electrocuted? (Fig.1)
b) Why is a bird perching on the grounded metal component of the pole electrocuted when it touches the cable? (Fig. 2)
c) Why is it fatal if a bird touches two cables at once? (Fig 3.)
d) Why does it happen much more rarely that a bird touches two cables at once on the taller, higher voltage poles (Fig. 4) than on the smaller, 20 kV poles (Fig 5.)?
e) Give <u>two</u> suggestions for measures that can be taken to avoid the electrocution of birds.

a)	b)	c)	d)	e)	Total
5 points	2 points	2 points	3 points	8 points	20 points

To be filled out by the examiner evaluating the paper!

	maximum score	score attained
I. Multiple choice questions	40	
II. Complex problems	50	
Total score of the written exam	**90**	

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. Complex problems (Összetett feladatok)		

examiner (javító tanár) notary (jegyző)

Date (Dátum): ..... Date (Dátum): .....