

**ÉRETTSÉGI VIZSGA • 2025. május 20.**

**FIZIKA  
ANGOL NYELVEN**

**KÖZÉPSZINTŰ  
ÍRÁSBELI VIZSGA**

**2025. május 20. 8:00**

Időtartam: 188 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

**OKTATÁSI HIVATAL**

## Important information

Read the instructions for the problems carefully and use your time wisely.

You may solve the problems in arbitrary order.

Resources that may be used: pocket calculator, data tables

Should the space provided for the solution of a problem be insufficient, you may continue the solution on the empty pages of the examination paper or on auxiliary sheets. Please indicate the number of the problem on the pages.

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

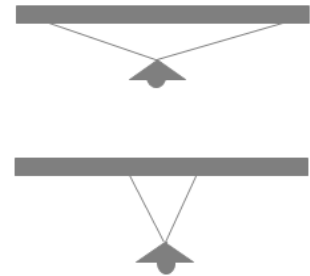
3/ ☐

*Sources not indicated on the problem sheet can be found in the evaluation guide.*

## 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. (You may write calculations or draw figures on this problem sheet if necessary.)*

1. We hang a lamp from the ceiling in two different ways as shown on the adjacent picture. In which case is the strain in the rope higher?



- A) When the lamp is hanging lower, as shown on the bottom picture.  
 B) When the lamp is hanging higher, as shown on the top picture.  
 C) The strain in the rope is equal in the two cases.

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2 points	
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2. We have two converging lenses one with diopter 1, the other diopter 2. Which of the two has a greater focal length?

- A) The one with diopter 1.  
 B) The one with diopter 2.  
 C) It is not possible to decide using the information at hand.

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2 points	
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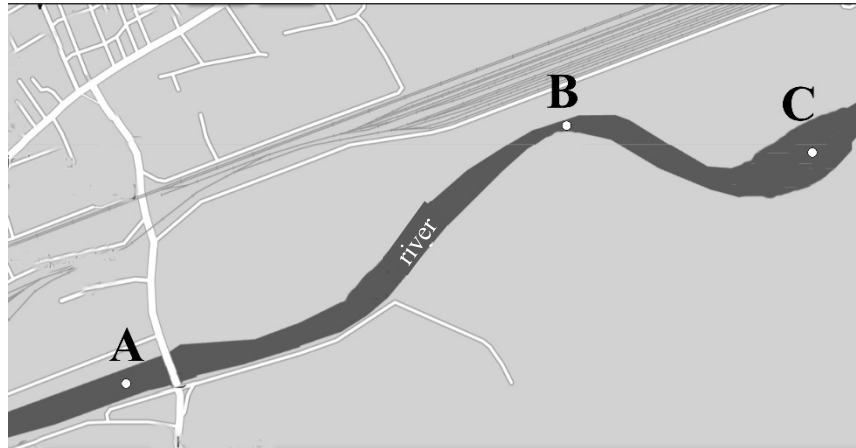
3. What is our distance to the Moon expressed in light-years?

- A)  $1.28 \text{ light-seconds} = 4 \cdot 10^{-8} \text{ light-years}$   
 B)  $8.3 \text{ light-minutes} = 1.58 \cdot 10^{-5} \text{ light-years}$   
 C) 4.24 light-years

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2 points	
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4. The map shows a river with constant depth, winding across a plain. At which of the points that are marked with letters will the speed of its flow be the greatest?

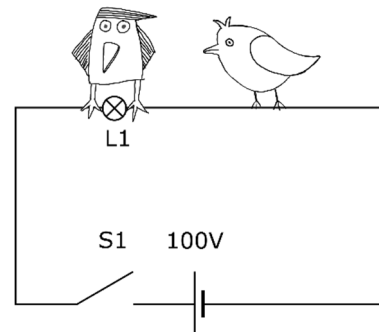


- A) At point A.  
B) At point B.  
C) At point C.

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2 points

5. Two birds are standing on an uninsulated wire. Which of the two is in danger if the switch is turned on?



- A) The one standing above the light-bulb (the one on the left).  
B) The one standing on the wire (the one on the right).  
C) Both of them.  
D) Neither one.

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2 points

6. We set in motion two small, identical rectangular objects with identical  $v_0$  initial velocity on two different tables. For the first table, the coefficient of kinetic friction is  $\mu = 0.2$ , the coefficient of static friction is  $\mu_0 = 0.6$ . For the second table, the coefficients of kinetic and static friction are equal,  $\mu = \mu_0 = 0.4$ . On which of the two tables will the object come to a stop sooner?

- A) On the first table.  
 B) On the second table.  
 C) The two objects will take an equal amount of time to stop.

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2 points	
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7. The photons of which electromagnetic radiation written below have the greatest energy?

- A) Microwave radiation.  
 B) FM-radio transmission.  
 C) Red light.  
 D) Infrared-light.

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2 points	
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8. Which of the energy sources below is renewable?

- A) The wind.  
 B) Uranium.  
 C) Mineral oil.  
 D) Coal.

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2 points	
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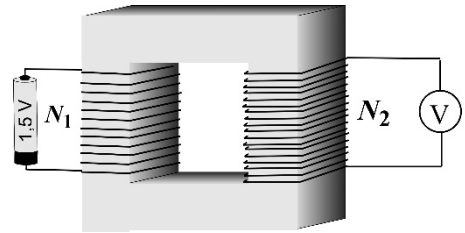
9. A manufacturer of car wheels states, that the nuts holding the wheels must be tightened with a torque of 120 Nm for the wheels to be fastened securely. What force must the driver exert on the wrench when he changes the wheel, if its handle is 50 cm long?

- A) A force of 2.4 N.  
 B) A force of 60 N.  
 C) A force of 120 N.  
 D) A force of 240 N.

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2 points	
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10. A 1.5 V, size AA battery is connected to the primary winding of the transformer in the adjacent figure, which has  $N_1$  turns in the winding. What is the voltage measurable on the poles of the secondary winding, which has  $N_2$  turns?



- A)  $N_1 / N_2 \cdot 1.5 \text{ V}$
- B)  $N_2 / N_1 \cdot 1.5 \text{ V}$
- C)  $N_1 \cdot N_2 \cdot 1.5 \text{ V}$
- D)  $0 \text{ V}$

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2 points

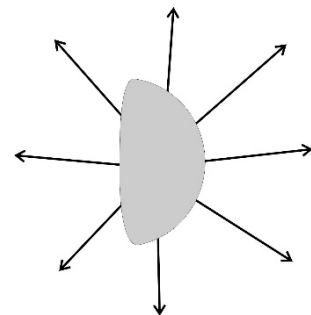
11. Which of the phenomena below is not characteristic of both sound waves and light waves?

- A) Reflection.
- B) Interference.
- C) Polarization.
- D) Refraction.

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2 points

12. The figure depicts the field lines of an electrostatic field formed around a metallic object. Decide whether the figure is correct.

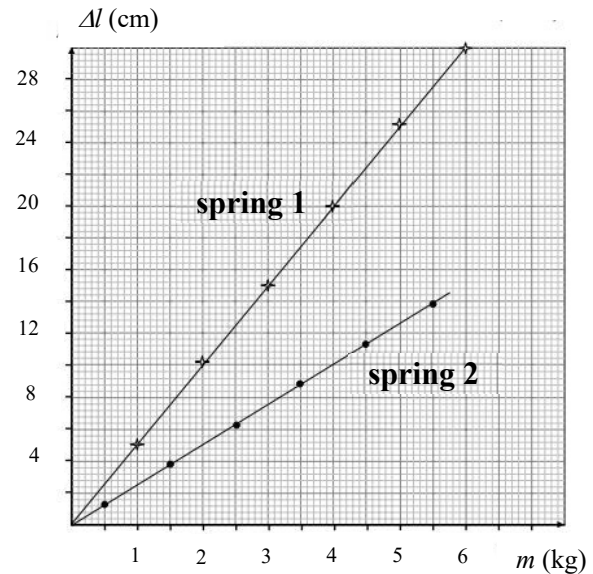


- A) The figure is correct if the object's charge is positive, because the field lines start from the object's surface.
- B) The figure is correct if the object's charge is negative, because the field lines start from the object's surface.
- C) The figure is not correct, because the field lines are not perpendicular to the object's surface at the start.

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2 points

13. The graph shows the extension of two vertical springs as a function of the weight hanging on them. Which of the two springs has a lower spring constant?



- A) Spring 1.  
 B) Spring 2.  
 C) The two spring constants are equal.

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2 points

14. We experiment with an ideal gas enclosed by a piston that moves without friction. The gas performs work during the process. Can the temperature of the gas remain constant during the process?

- A) No, because as a result of doing work, the internal energy of the gas is decreased.  
 B) Yes, because temperature can be decreased only by removing heat.  
 C) No, because an expanding gas always cools.  
 D) Yes, if the gas absorbs heat from its surroundings.

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2 points

15. We build a sundial from a horizontal, metal disc and a vertical pole perpendicular to it. We place the sundial to the bottom of a pool containing clear water. Can the sundial work here, i.e. can the changing of the pole's shadow indicate the passage of time underwater?

- A) Yes it can. The shadow of the sundial placed on the pool's bottom moves around the pole during the day similarly to one standing on dry land.  
 B) No, it cannot indicate time as the shadow of the pole under water always points in the same direction.  
 C) No, it cannot indicate time as the pole under water has no shadow.  
 D) Yes it can indicate time but must be calibrated as the direction of the shadow of a vertical pole is different under water than on dry land.

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2 points

**16. A parachutist jumps out of a plane 3000 meters above ground level. How does the force due to air drag change, while he is in free-fall at an increasing speed without changing his body's position or opening his parachute?**

- A) The force is constant until the parachute is opened.
- B) The force increases as the speed of the body in free-fall increases.
- C) The force decreases, because the falling body spend less and less time in a given volume of space.
- D) There is no air drag because the body accelerates downward.

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2 points	
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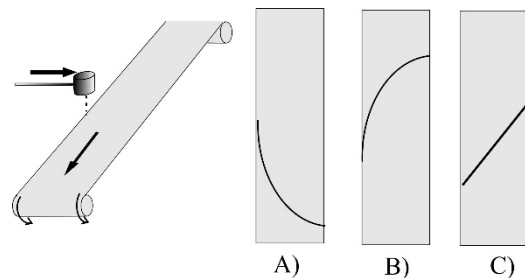
**17. As far as we know today, there is a supermassive black hole at the core of our galaxy. Does its gravitational attraction affect Earth?**

- A) Yes, because black holes engulf everything in their vicinity, Earth will also be swallowed up after a few thousand years.
- B) No, because our Solar System is about 27000 light-years from the galactic core, gravitation does not exert a force at this range.
- C) Yes, this is partly why Earth orbits around the galactic core together with the Solar System.

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2 points	
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**18. A horizontal conveyor belt moves with constant speed. A robotic arm moves a small container above the belt with constant speed, perpendicular to the belt. The container has a small hole, through which paint flows out at a constant rate. What sort of a track does the paint leave on the conveyor belt?**



- A) One like that in figure A).
- B) One like that in figure B).
- C) One like that in figure C).

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2 points	
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**19. High-voltage power lines present mortal danger, yet they are used worldwide to transport electric energy. Why?**

- A) High-voltage lines are affected less by Earth's magnetic field, so they bend much less when current is flowing in them.
- B) Energy loss is smaller in power lines with higher voltage.
- C) Energy transport in high-voltage power lines is faster.

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2 points	
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**20. A radioactive  $^A\text{X}$  nucleus decayed to a nucleus  $^A\text{Y}$  with the same mass number, but of a chemical element different from X in a single decay event. What type of decay was it?**

- A) It was certainly alpha decay.
- B) It was certainly beta decay.
- C) It was certainly the emission of gamma rays.
- D) It cannot be decided, it could have been beta decay or gamma decay as well.

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2 points	
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## 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 old MP3 player has a 1.6 V battery that can supply 18 mA current for a duration of 2.4 hours. After that, the battery is depleted, the MP3 player will stop and it must be recharged. The 2.3 V charger will completely recharge the battery in 4.2 hours with a charging current 13.5 mA.**
- a) How many mAh charge does the battery contain when fully charged?
  - b) How much energy is required to charge the battery completely?
  - c) How much energy does the battery supply after being charged?
  - d) With what efficiency does the MP3 player's battery work?

a)	b)	c)	d)	Total
4 points	4 points	4 points	3 points	15 points

**2. Trip to Mars**

*With the advance of technology, humans think about a manned mission to Mars more and more. The trip is not expected to be simple because space is a hostile place when we leave Earth's immediate surroundings. The flow of charged particles from the Sun and the high-energy particles arriving continuously from distant regions of the Universe present a serious health hazard. The atmosphere and magnetic field of our home protects us from most of this radiation, but when far from Earth, travelers are exposed to significant radiation. It is estimated, that during a six month trip to Mars, passengers may receive a dose of radiation equivalent to over half of the dose that we presently prescribe as a health limit during an entire human lifetime. Furthermore, Mars has a very thin atmosphere and contrary to Earth, has no magnetic field. Therefore radiation from space can be a significant problem also during the stay.*

- a) Where do charged particles, that people are exposed to on a trip to Mars, originate?
- b) Explain how Earth's atmosphere and magnetic field protects its inhabitants against charged particles coming from space.
- c) Does radiation present a danger to members of a Mars expedition only during the journey? Justify your answer.
- d) When Earth is close to Mars, their distance is about 0.5 A.U. Let us assume, that this is when a spaceship lands on Mars. How much time does a radio message of the successful landing take to reach Earth?

(The velocity of light is  $c = 3 \cdot 10^8$  m/s, 1 A.U. = 150 000 000 km)

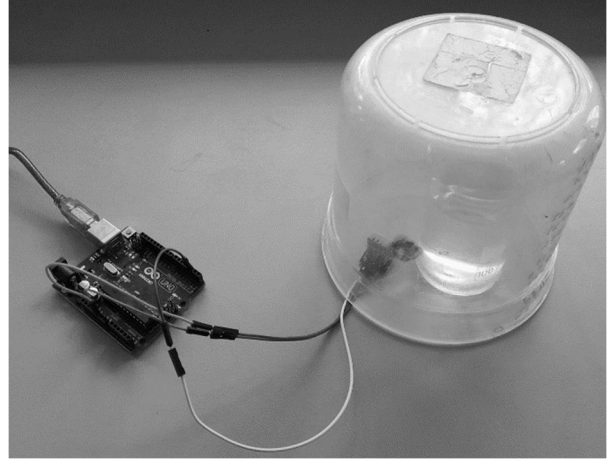
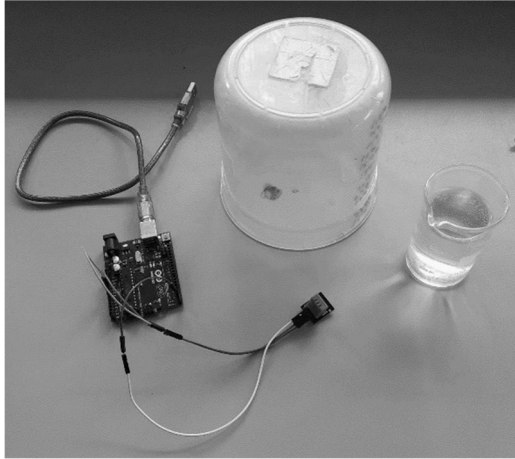
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a)	b)	c)	d)	Total
4 points	4 points	4 points	3 points	15 points

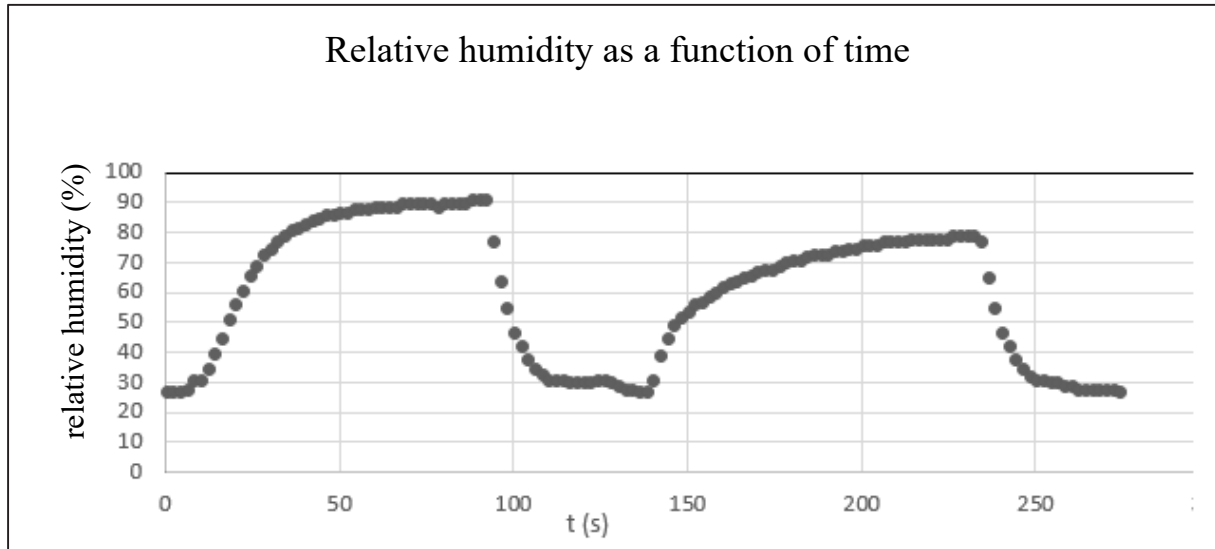
*You need to solve only one of the two problems 3/A and 3/B. Indicate your choice on the inside of the front cover.*

**3/A Using the apparatus shown in the pictures, we measure the relative humidity in the steps detailed below:**



- 1) We measure the humidity in the room, reading the data from a humidity-sensor.
- 2) We pour warm (about 40 °C) water in a small cup and cover it, together with the sensor, using a beaker turned upside down. (See picture on the right.)
- 3) When the sensor's readings change only very slowly, we remove the beaker and the water from the vicinity of the sensor. We continue the measurement until the reading on the sensor returns to the initial humidity value.
- 4) We then place cold water (about 15 °C) in a cup beside the sensor and cover them again.
- 5) When the sensor's readings change only very slowly, we remove the beaker and the water and continue the experiment until we measure the initial humidity value again.

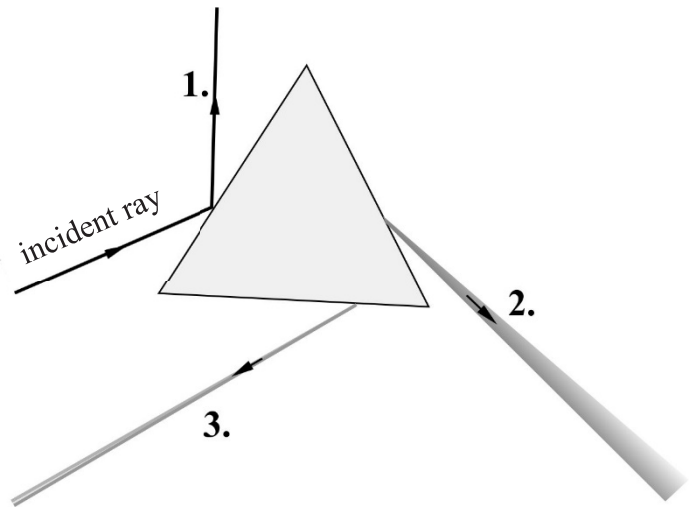
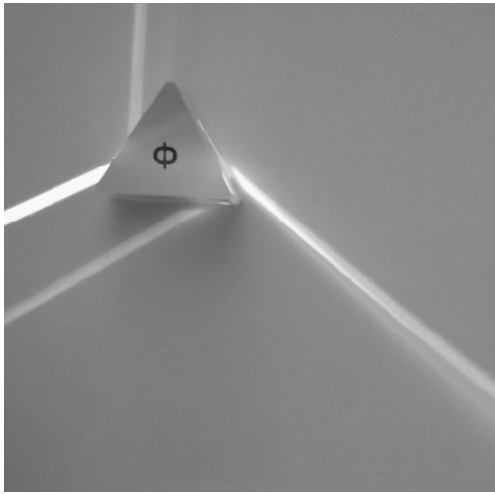
The results of the measurement are shown on the graph below:



- What was the relative humidity in the room during the experiment? What was the largest relative humidity value measured for hot water and for cold water?
- Determine the time duration for the five stages of the experiment using the graph.
- Why does relative humidity increase when we cover the sensor and the cup with the beaker? Why does it decrease when we remove the cover?
- Explain why the increase of relative humidity takes longer when using cold water.
- What relative humidity value would we get if we would continue our measurement with a cup of water under a closed beaker for a very long time? Justify your answer.

a)	b)	c)	d)	e)	Total
3 points	5 points	4 points	4 points	4 points	20 points

**3/B** We shine a ray of white light onto a glass prism. We indicated the incident ray on the figure. Several rays of light leave the prism as shown on the picture and indicated on the figure.



- Complete the figure showing the light rays, with the paths of light followed inside the prism. Using this, explain how the rays numbered 1., 2. and 3. are generated.
- Why will ray 2. show colors of the rainbow?
- Why will ray 1. not show the colors of the rainbow?
- How would the direction of ray 1. change, if we rotated the prism slightly left (counterclockwise) around its center, while keeping the direction of incident light unchanged? Justify your answer.

a)	b)	c)	d)	Total
10 points	4 points	2 points	4 points	20 points

	score	
	maximum	attained
I. Multiple-choice questions	40	
II. Complex problems	50	
<b>Total score for the written exam</b>	<b>90</b>	

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date

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examiner

	pontszáma <b>egész számra</b> kerekítve	
	elért	programba beírt
I. Feleletválasztós kérdéssor		
II. Összetett feladatok		

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