

**ÉRETTSÉGI VIZSGA • 2023. október 27.**

**FIZIKA  
ANGOL NYELVEN  
KÖZÉPSZINTŰ  
ÍRÁSBELI VIZSGA**

**a 2020-as Nat szerint tanulók számára**

**2023. október 27. 14:00**

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/ ☐

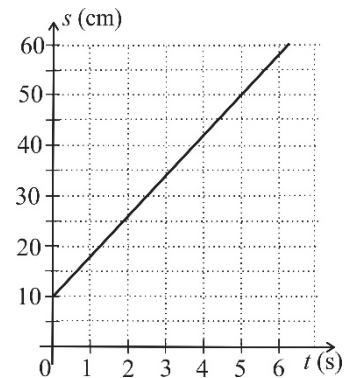
*Sources not indicated on the problem sheet can be found in the evaluation guide.*

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## 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. What is the velocity of the object, for which the position – time curve is shown on the adjacent graph?



- A) 10 cm/s.  
B) 8 cm/s.  
C) 6 cm/s.  
D) 4 cm/s.

☐

2 points

2. An electric hob with an operating voltage of 230 V is used first at 500 W power and later at 750 W power. In which case is the current through the heating element larger?

- A) When it is used at 500 W power.  
B) When it is used at 750 W power.  
C) The current is the same at both power levels.

☐

2 points

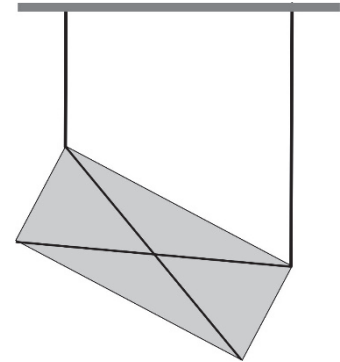
3. When did mankind first set foot on the Moon?

- A) In the first half of the 20<sup>th</sup> century.  
B) In the second half of the 20<sup>th</sup> century.  
C) In the beginning of the 21<sup>st</sup> century.

☐

2 points

4. A heavy, flat, rectangular object with a homogeneous mass distribution is suspended as shown in the figure by means of two vertical ropes. In which of the two ropes is the force greater?



- A) In the rope on the left.  
B) In the rope on the right.  
C) The two forces are equal.

☐

2 points

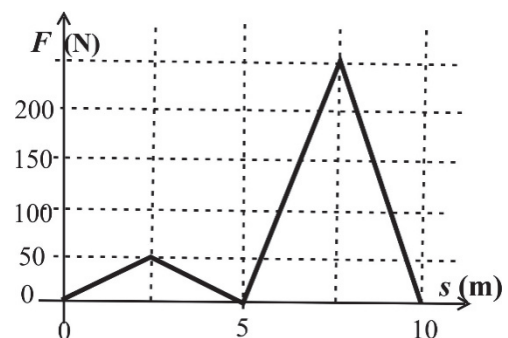
5. What conclusion can be drawn from the photoelectric effect?

- A) The electric field of a light wave can always free electrons from metals, no matter how weak the light is.  
B) Light can only free electrons from metals if the power of the light multiplied by the time of illumination is equal to or greater than the work function characteristic of the metal.  
C) Light can only free electrons from metals if the frequency of light multiplied by Planck's constant is equal to or greater than the work function characteristic of the metal.

☐

2 points

6. An object had a kinetic energy of 1000 J initially. The magnitude of the breaking force acting on the object varied during the motion as shown in the graph. Has the body stopped after moving 10 meters?



- A) It stopped.  
B) It did not stop.  
C) We could determine this only if the force were plotted as a function of time.

☐

2 points

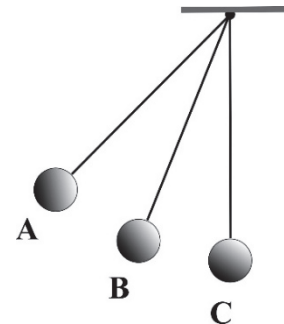
7. By rubbing two initially neutral pieces of material together, both were brought to an electrically charged state. What kind of force is generated between them?

- A) An attractive force.  
B) There is no force generated between them.  
C) A repulsive force.  
D) Depending on the types of the materials it may be attractive or repulsive as well.

☐

2 points

8. We suspend a body on a thread and then displace the resulting pendulum by 45 degrees to position "A". We then release it. In which of the sketched positions does the body move towards the ground at the highest speed while the pendulum is swinging?

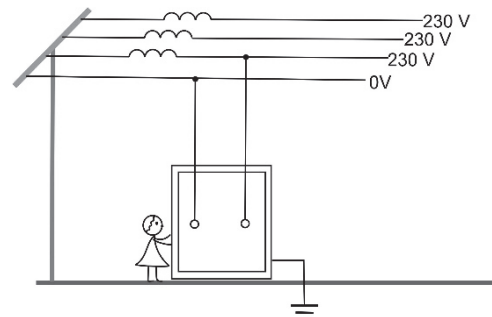


- A) In position "A", when the body commences its return from its turning point.  
B) In position "B", when the body is halfway between the turning point and the vertical position.  
C) In position "C", when the thread is vertical.  
D) The body moves towards the ground with equal speed in all three cases.

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2 points

9. An electrical installation operated from 230 V is placed in a large, grounded metal housing. A little girl touches the metal housing of the equipment with both hands. Is it dangerous to touch the metal housing? Which of the following statements is true?

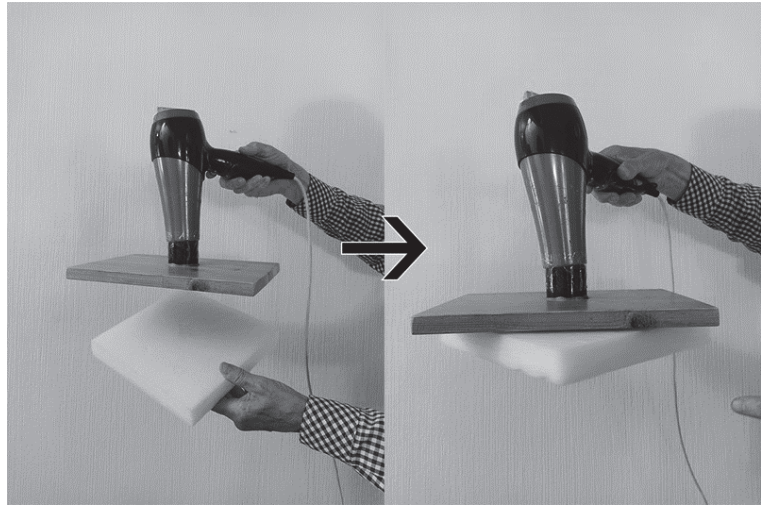


- A) If the little girl touched it with only one hand, it would not be dangerous, but two hands should not touch the metal housing.  
B) It is dangerous to touch the metal housing in any case, as the equipment is operated at 230 V and the metal housing conducts electricity.  
C) The metal housing is safe to touch because it is grounded and the 230 V is not connected to the metal housing.

☐

2 points

10. In the experiment shown in the picture, the hair dryer blows air out through a perforated wooden plate glued to it. If an EPS (polystyrene heat insulation) plate is placed close to the perforated wooden plate, it does not fall off. How can this phenomenon be explained?



- A) With the hydro-static pressure of air.  
B) With surface tension.  
C) With a pressure change according to Bernoulli's law.

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2 points

11. Two satellites orbit the Earth on circular orbits. Which one completes a full orbit in the shortest time?

- A) The one with the greater mass.  
B) The one which orbits at a lower altitude above the surface.  
C) The one which has a more streamlined shape.

☐

2 points

12. There is room temperature water in a container and an object is floating on top of it. How does the position of the object change in the water, if the water temperature increases, while the object's temperature does not change?

- A) It sinks lower, it submerges more into the water.  
B) Its position remains unchanged.  
C) It is raised higher, it submerges less into the water.

☐

2 points

**13. We create a real image of an object using a converging lens. The object is located at a distance of 10 cm from the lens, the image is created on the opposite side of the lens, 50 cm from it. What is the magnification of the lens?**

- A)  $M = 1/6$
- B)  $M = 1/5$
- C)  $M = 6$
- D)  $M = 5$

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2 points	
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**14. Anna and Bea heat 3 dl of milk each. They both took the milk from the fridge, so its temperature is 4 °C. Anna heats her drink to 18 °C, Bea to 36 °C. Which of the following statements is true?**

- A) Bea had to transfer more than twice as much heat to the milk as Anna did during the heating.
- B) Bea had to transfer precisely twice as much heat to the milk as Anna did during the heating.
- C) Bea had to transfer less than twice as much heat to the milk as Anna did during the heating.

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2 points	
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**15. In 2222, a tennis player from Earth traveled to the Martian Olympics. He uses a spring-loaded serving machine to warm up. How fast can the machine launch the ball on Mars compared to its launch speed on Earth?**

- A) At a higher speed, because the acceleration due to gravity is much lower on Mars than on Earth.
- B) At a lower speed, because the mass of Mars is smaller than that of Earth.
- C) It can launch the ball at the same speed.

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2 points	
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**16. A skydiver opens his parachute after a long fall. In the moments that follow, what is the direction of the skydiver's velocity and acceleration vector?**

- A) The acceleration points downward, the velocity points upward.
- B) Both the acceleration and the velocity point downward.
- C) Both the acceleration and the velocity point upward.
- D) The acceleration points upward, the velocity points downward.

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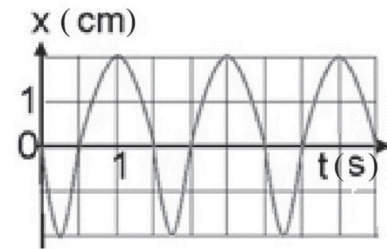
2 points	
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17. The frequency of domestic electricity is 50 Hz. How many times per second does the direction of the current change in the electric cables?

- A) 25 times.  
B) 50 times.  
C) 100 times.  
D) The direction of the current does not change, only its magnitude.

2 points

18. What is the period of the oscillation depicted on the picture below?



- A) 0.5 s  
B) 1 s  
C) 1.5 s

2 points

19. Which of the statements below is true?

- A) Both ultrasound and x-ray radiation are longitudinal waves.  
B) Both ultrasound and x-ray radiation are transverse waves.  
C) Ultrasound is a transverse, while x-ray radiation is a longitudinal wave.  
D) Ultrasound is a longitudinal, while x-ray radiation is a transverse wave.

2 points

20. Several radioactive isotopes are used in medicine, for example the  $^{60}\text{Co}$  isotope whose half-life is 5.3 years and the  $^{99}\text{Tc}$  isotope, whose half-life is 6 hours. Which of these should be used for radioactive tracing purposes, if we want to achieve the highest possible radiation activity for more accurate monitoring, while introducing as few isotopes as possible into the body?

- A) The  $^{99}\text{Tc}$  isotope.  
B) The  $^{60}\text{Co}$  isotope.  
C) Both radioactive isotopes may be used, irrespective of their half-lives.

2 points

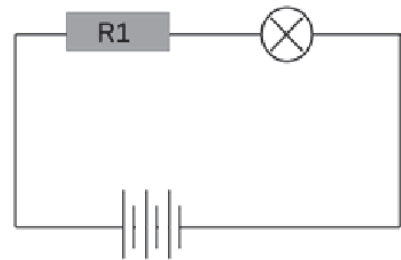


## PART TWO

*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. In the electric circuit depicted on the adjacent figure, the light-bulb bears the inscription “6 V / 3.0 W” and the battery voltage is 18 V.

What should the resistance  $R_1$  be chosen, in order for the power of the light-bulb to be precisely its nominal value?



<b>Total</b>
<b>15 points</b>

## 2. The greenhouse effect

*The greenhouse effect affects the heat balance of planets whose atmosphere transmits radiation from the planet's central star in certain frequency ranges, which is then partially absorbed by the planet. At the same time, the atmosphere does not transmit all of the thermal radiation from the warming planetary surface. The Earth's atmosphere, for example, transmits most of the radiation from the Sun in the visible range, much of which is absorbed by the Earth's surface. However, the thermal radiation from the warming surface falls in the infrared range, which is absorbed and to a large extent re-radiated by numerous gases in the atmosphere, such as CO<sub>2</sub>. As a result, some of the heat from the planet's surface is not directly returned to space, but becomes the cause of various physical and meteorological processes that increase the temperature of the surface and lower atmosphere. A similar, though not identical, process keeps the greenhouses – from which the phenomenon takes its name – warm.*

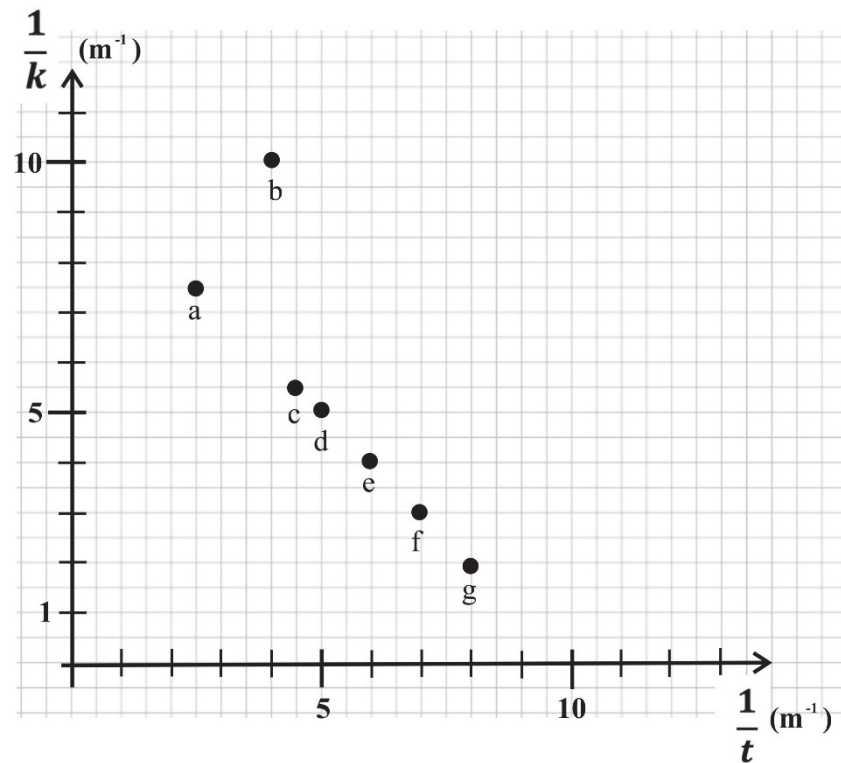
- What is the role of the ground surface in the greenhouse effect?
- How does human kind contribute to the greenhouse effect?
- Briefly mention at least two expected consequences of the greenhouse effect.
- Using the data below, determine the year in which the carbon dioxide emission per unit primary energy consumption in Hungary was the lowest.

year	2006	2011	2016
Primary energy consumption, 10 <sup>15</sup> J/year	1 175	1 096	1 079
CO <sub>2</sub> emission 10 <sup>3</sup> tons/year	69 295	65 950	63 535

a)	b)	c)	d)	Total
4 points	3 points	4 points	4 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** In the physics lab, we found a graph from an old measurement report, which is shown in the figure below. The measurement was made on an optical bench, and a focusing lens was used to produce a sharp image of an object on a screen at various object distances. The corresponding image and object distances were measured to determine the focal length of the lens. The graph plotted the reciprocal of the image distance as a function of the reciprocal of the object distance.



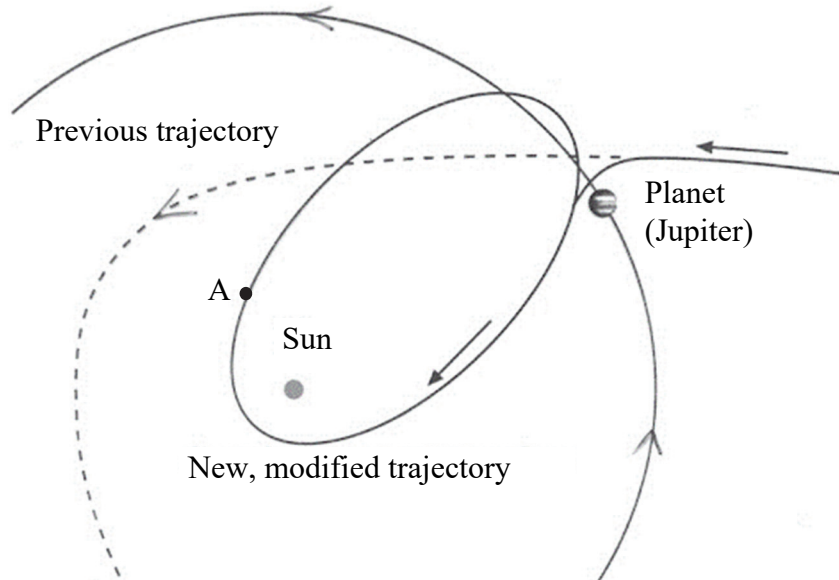
- Reconstruct the measurement data. Enter the data in the table below.
- One of the data points is likely erroneous. Which data point would you leave off the graph? Justify your answer.
- Determine the focal length of the lens using at least one data point, or using some other method. (Do not use the data point you consider to be incorrect, leave it out of further considerations.)
- Choose a data point, draw a sketch of the image formation using the notable ray traces. Characterize the resulting image.
- In which measurements were the images enlarged and in which cases were they reduced? In which measurement is the image size the largest.

Letter marking the measurement	a	b	c	d	e	f	g
Object distance $t$ (cm)							
Image distance $k$ (cm)							

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

**3/B The adjacent figure analyses the situation when the trajectory of a comet that comes close to Jupiter is modified by Jupiter's gravitational attraction.**

Answer the questions below using Kepler's laws.



- What is a comet?
- How was the magnitude and direction of the comet's velocity relative to Jupiter influenced by the planet when the comet was approaching it on its original trajectory?
- How did the orbital period of the comet change on its new trajectory, which was created by the deflection by Jupiter? Justify your answer.
- Assuming that Jupiter's trajectory is close to a circle, what can we say about the comet's average distance from the Sun, compared to that of Jupiter?
- On which trajectory does the comet accelerate to a higher maximum speed compared to the Sun, the old one or the new one? Justify your answer.
- Mark the position of the comet's tail at position "A" on the figure.

a)	b)	c)	d)	e)	f)	Total
4 points	4 points	4 points	2 points	4 points	2 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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