

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

**FIZIKA  
ANGOL NYELVEN**

**KÖZÉPSZINTŰ  
ÍRÁSBELI VIZSGA**

a 2020-as Nat szerint tanulók számára

**JAVÍTÁSI-ÉRTÉKELÉSI  
ÚTMUTATÓ**

**OKTATÁSI HIVATAL**

The examination papers should be evaluated and graded clearly, according to the instructions of the evaluation guide. Markings should be in red ink, using the conventional notations.

## PART ONE

For the multiple choice questions, the two points may only be awarded for the correct answer given in the evaluation guide. Enter the score (0 or 2) in the gray rectangle next to the question as well as the table for total scores at the end of the exam paper.

## PART TWO

### *Principles for dividing allocated scores:*

- The sentences printed in italics in the evaluation guide define the steps necessary for the solution. The scores indicated here may and should be awarded if the action or operation described by the text in italics can be clearly identified in the work of the student and is basically correct and complete.
- The „expected solution” is not necessarily complete; its purpose is to indicate the nature and extent of the expected solution, and the depth of detail required from the student. Comments in brackets that follow provide further guidance on the evaluation of possible errors, differences or incomplete answers.

### *Principles for evaluating alternative trains of thought:*

- Correct answers that differ from the reasoning of the one (ones) given in the evaluation guide should also be evaluated. The lines in italics provide guidance in allocating scores, e.g. what part of the full score may be awarded for a correct interpretation of the question, for stating relationships, for calculations, etc.
- Should the student combine some steps, or carry on calculations algebraically, he/she may skip the calculation of intermediate results shown in the evaluation guide. If these intermediate results are not being explicitly asked for in the original problem, the scores indicated for them should be awarded if the reasoning is otherwise correct. The purpose of indicating scores for intermediate results is to make the evaluation of incomplete solutions easier.

### *Principles for the avoidance of multiple deductions:*

- For errors that do not affect the correctness of reasoning (miscalculations, clerical errors, conversion errors, etc.) deduce points only once.
- Should the student display multiple attempts at solving the problem, and does not indicate clearly which one of those he/she wants evaluated, the last one should be considered (i.e. the one at the bottom of the page if there is nothing to indicate otherwise). If the solution contains a mixture of two different trains of thought, the elements of only one of them should be evaluated: that one which is more favorable for the student.
- If an action or operation defined in the evaluation guide is completed, but the results are incorrect due to errors committed previously, full points allocated for this action are to be awarded. If the action can be broken down into steps, partial scores are indicated beside each line of the expected solution.

***Principles regarding the use of units:***

- The lack of units during calculation should not be considered a mistake – unless it causes an error. However, the results asked for in the problem are acceptable only with proper units.
- Graphs, diagrams and notations are acceptable only if they are unambiguous (it must be clear what the graphs show, markings should be in place, unconventional notations must be explained, etc.). The lack of units on the axis labels of graphs should not be considered a mistake however, if the units are otherwise obvious (e.g. quantities given in a table must be plotted, all with the same units).

***Further comments:***

- If, in case of problem 3 the student does not indicate his/her choice, and the choice is also not immediately obvious from the exam paper, the solution for the first problem of the two optional ones must be evaluated in every case.
- After evaluation, the appropriate scores should be entered in the summarizing tables at the bottom of the page.

## PART ONE

1. B
2. B
3. B
4. A
5. C
6. B
7. A
8. B
9. C
10. C
11. B
12. A
13. D
14. A
15. C
16. D
17. C
18. C
19. D
20. A

*2 points for each correct answer.*

**Total: 40 points**

## PART TWO

*When evaluating the calculations, care must be taken to deduce points for errors that do not affect the correctness of reasoning (miscalculations, clerical errors) only once. If the student uses a previously miscalculated result in further steps of the solution correctly, full points are to be awarded for these steps. Thus it may be possible that full points are due at certain steps for solutions that differ from the values given in the evaluation guide.*

### Problem 1

Data:  $U_0 = 18 \text{ V}$ ,  $U_{\text{nom}} = 6 \text{ V}$ ,  $P_{\text{nom}} = 3 \text{ W}$ .

*Determining the resistance of the light-bulb:*

**6 points**  
(may be divided)

$$P_{\text{nom}} = \frac{U_{\text{nom}}^2}{R_{\text{bulb}}} \Rightarrow R_{\text{bulb}} = \frac{U_{\text{nom}}^2}{P_{\text{nom}}} = 12 \, \Omega$$

(formula + rearranging the formula + substitution of data + calculation, 2 + 2 + 1 + 1 points)

*Writing down the voltage ratios for resistors connected in series and determining the necessary resistance:*

**9 points**  
(may be divided)

As, for nominal power  $U_{\text{bulb}} = 6 \text{ V}$  (1 points),

and because of the serial connection:

$$U_{\text{bulb}} + U_1 = U_0 \Rightarrow U_1 = 12 \text{ V} \text{ (formula + calculation, 2 + 1 points)}$$

$$\frac{U_1}{U_{\text{bulb}}} = \frac{R_1}{R_{\text{bulb}}} \Rightarrow R_1 = R_{\text{bulb}} \cdot \frac{U_1}{U_{\text{bulb}}} = 24 \, \Omega$$

(formula + rearranging the formula + substitution of data + calculation, 2 + 1 + 1 + 1 points)

**Total: 15 points**

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**Problem 2**

Data:

- a) *Explaining the role of the ground surface in the greenhouse effect:*

**4 points**  
*(may be divided)*

The surface absorbs (visible) sunlight (2 points) and emits part of the energy in the form of infrared radiation (2 points).

- b) *Naming the contribution of humans:*

**3 points**

Humans increase the amount of CO<sub>2</sub> in the atmosphere (3 points).

(The more general term “greenhouse gases” is also acceptable.)

- c) *Mentioning the consequences of the greenhouse effect:*

**4 points**  
*(may be divided)*

Naming any two consequences: 2 + 2 points  
(e.g. climate change, melting of polar icecaps/glaciers, the rise of sea levels, etc.)

- d) *Calculating the ratios of the data in the table and giving the correct answer:*

**4 points**  
*(may be divided)*

2006: 58.97 kg/GJ

2011: 60.17 kg/GJ

2016: 58.88 kg/GJ

(If the student evidently knows what ratio must be calculated, 1 point must be awarded.  
3 correctly calculated ratios are worth + 2 points, 1–2 correctly calculated ratios are worth + 1 point.)

→ it was the lowest in 2016. (1 point)

(If the student does not indicate the units, 1 point must be deduced.  $10^3 \text{ t} / 10^{15} \text{ J}$  is also acceptable as a unit.)

**Total: 15 points**

**Problem 3/A**

- a) *Reading the data values from the graph and filling the table with the corresponding data:*  
**4 points**  
*(may be divided)*

letter of the measurement	a	b	c	d	e	f	g
object distance $t$ (cm)	40	25	22	20	17	14	13
image distance $k$ (cm)	13	10	18	20	25	33	50

(7 correct data pairs are worth 4 points, 5–6 correct data pairs are worth 3 points, 3–4 correct data pairs are worth 2 points, 1–2 correct data pairs are worth 1 point.)

- b) *Identifying the erroneous measurement and giving an explanation:*

**3 points**  
*(may be divided)*

The one marked with “b” (1 point). The appropriate explanation is worth 2 points. Any quantitative explanation (e.g. the value of  $1/k + 1/t$  differs in this case from the value determined by all the other measurement points) or qualitative explanation (e.g. the point lies visibly very far from the line defined by all the other measurements) is acceptable.

- c) *Determining the focal length:*

**4 points**  
*(may be divided)*

Using any one (correct) pair of data values:

$$\frac{1}{k} + \frac{1}{t} = \frac{1}{f} = 10 \frac{1}{\text{m}}, \text{ from which } f = 10 \text{ cm}$$

(formula + substitution of data + calculation, 2 + 1 + 1 points)

- d) *Preparing a drawing of the image formation and characterizing the image:*

**5 points**  
*(may be divided)*

The sketch is acceptable if:

- It is prepared using an image distance and an object distance that belong together, they are drawn on opposite sides of the lens and the student makes clear which mark belongs to which one (1 point).
- At least two notable ray traces are drawn (1 point).
- The sizes in the drawing indicate the presence of magnification or reduction (1 point).

Characterizing the image: real, inverted (1 point), and (depending on the data) magnified or reduced (1 point).

- e) *Listing the magnified and the reduced images and determining the case of the largest image:*

**4 points**  
*(may be divided)*

As the image is magnified if  $k > t$  (1 point), the measurements marked by “e”, “f” and “g” have magnified images (1 point), whereas those marked by “a” and “c” have reduced images (1 point). The greatest magnification belongs to measurement “g” (1 point).

**Total: 20 points**

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**Problem 3/B**

a) *Explaining the notion of the comet:*

**4 points**  
**(may be divided)**

A small celestial body which consist of a nucleus containing frozen gases (2 points) and a tail (2 points) (consisting of gases and dust) that is generated in the vicinity of the Sun.

b) *Explaining the trajectory-modifying effect of Jupiter:*

**4 points**  
**(may be divided)**

The velocity relative to Jupiter increases (2 points), its direction is turned towards Jupiter (2 points).

c) *Determining the change of the orbital period and justifying the answer:*

**4 points**  
**(may be divided)**

The orbital period decreases ( $T' < T$ ) (2 points), because the major axis of the new trajectory is smaller than that of the original one ( $A' < A$ ) (2 points).

d) *Giving the relationship between the average distances:*

**2 points**

The average distance of the comet from the Sun is smaller than that of Jupiter.

e) *Giving the relationship between the maximum speeds:*

**4 points**  
**(may be divided)**

On the new trajectory the maximum speed is greater (2 points), because the new trajectory passes closer to the Sun (2 points).

f) *Drawing the comet's tail correctly:*

**2 points**

**Total: 20 points**

**The origin of the sources for the problem sheet (pictures, drawings, data):**

**I/10.** <https://eandt.theiet.org/content/articles/2021/08/summer-stem-challenge-the-bernoulli-magic-roundabout/>

**II/2.** text: wiki / ksh.hu

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