

ÉRETTSÉGI VIZSGA • 2012. május 17.

**FIZIKA
ANGOL NYELVEN**

**KÖZÉPSZINTŰ ÍRÁSBELI
ÉRETTSÉGI VIZSGA**

**JAVÍTÁSI-ÉRTÉKELÉSI
ÚTMUTATÓ**

**NEMZETI ERŐFORRÁS
MINISZTERIUM**

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.

FIRST PART

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.

SECOND PART

The individual scores shown in the evaluation guide may not be broken up unless explicitly indicated.

The sentences printed in italics in the evaluation guide define the steps necessary for the solution. The scores indicated here may be awarded if the action or operation described by the text in italics can be clearly identified in the work of the examinee and is basically correct and complete. Wherever the action can be broken down into smaller steps, partial scores are indicated beside each line of the expected solution. The „expected solution” is not necessarily complete; its purpose is to indicate the depth of detail required of the examinee when writing the solution and the type of solution expected. Comments in brackets that follow provide further guidance on the evaluation of possible errors, differences or incomplete answers.

Correct answers that differ from the reasoning of the one (ones) given in the evaluation guide are also acceptable. The lines in italics provide guidance in allocating scores, e.g. how much of the full score may be awarded for correct interpretation of the question, for stating relationships, for calculations, etc.

Should the examinee 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.

For errors that do not affect the correctness of reasoning (miscalculations, clerical errors, conversion errors, etc.) deduce points only once.

Should the examinee write more than one solutions, or 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 examinee.

The lack of units during calculation should not be considered a mistake – unless it causes an error. However, the results questioned by 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).

If, in case of problem 3 the examinee does not indicate his/her choice, the procedure described in the exam description should be followed.

Following the evaluation, the appropriate scores should be entered into the tables at the bottom of each page.

FIRST PART

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

Award **2 *points*** for each correct answer.

Total: 40 points.

SECOND PART

Problem 1

Data: $g = 10 \text{ m/s}^2$, $L = 30 \text{ cm}$, $t_1 = 0.15 \text{ s}$, $s_2 = 20 \text{ cm}$

- a) *Writing down the formula for determining the position at which the first person catches the ruler and calculating it:*

3 + 1 points

$$s_1 = \frac{g}{2} \cdot t_1^2 = 11.3 \text{ cm, i.e. the first person catches the ruler at about the 11 cm mark.}$$

- b) *Writing down the formula for determining the reaction time of the second person and calculating it:*

2 + 1 points

$$t_2 = \sqrt{\frac{2 \cdot s_2}{g}} = 0.2 \text{ s}$$

(Should the examinee write down the formula $s_2 = \frac{g}{2} \cdot t_2^2$ but make no further progress – transformation or calculation – only one point is to be awarded here.)

Writing down the formula for determining the speed of the ruler and calculating it:

2 + 1 points

$$v_2 = g \cdot t_2 = 2 \frac{\text{m}}{\text{s}}$$

- c) *Determining whether the third person is able to catch the ruler:*

**3 points
(may be divided)**

Because the distance covered by the ruler during the reaction time given is

$s_3 = \frac{g}{2} (2t_1)^2 = 45 \text{ cm}$ (1 point), which is greater than the length of the ruler (1 point), the third person will not be able to catch the ruler (1 point).

It is not necessary to calculate the distance covered by the ruler explicitly. A textual argument is fully acceptable as long as it is clear that the examinee compares the distance covered by the ruler to its length. (e.g. During twice the time of t_1 the ruler covers four times the distance, which is greater than the overall length of the ruler.)

Simply stating that the third person will not catch the ruler without any calculation or justification is worth one point only.

Total: 13 points

Problem 2

Data: $m_{\text{glass}} = 300 \text{ g}$, $T_{\text{glass}} = 20 \text{ }^{\circ}\text{C}$, $m_{\text{milk}} = 200 \text{ g}$, $T_{\text{milk}} = 10 \text{ }^{\circ}\text{C}$, $T_{\text{final}} = 38 \text{ }^{\circ}\text{C}$,

$$c_{\text{milk}} = 4000 \frac{\text{J}}{\text{kg} \cdot ^{\circ}\text{C}}, c_{\text{glass}} = 840 \frac{\text{J}}{\text{kg} \cdot ^{\circ}\text{C}}, P_{\text{net}} = 90 \text{ W}, P_{\text{nominal}} = 120 \text{ W}.$$

a) *Determining the temperature change of the milk and the nursing bottle:*

1 + 1 points

$\Delta T_{\text{milk}} = T_{\text{final}} - T_{\text{milk}} = 28 \text{ }^{\circ}\text{C}$, $\Delta T_{\text{glass}} = T_{\text{final}} - T_{\text{glass}} = 18 \text{ }^{\circ}\text{C}$ (It is not necessary to formulate the temperature changes explicitly. If the examinee uses the correct values later when calculating the heat transfer, full points are to be awarded.)

Formulating the heat transfer of the food warmer and calculating it:

4 + 2 points
(may be divided)

$$Q = m_{\text{milk}} \cdot c_{\text{milk}} \cdot \Delta T_{\text{milk}} + m_{\text{glass}} \cdot c_{\text{glass}} \cdot \Delta T_{\text{glass}} \text{ (writing down the two terms 1 + 1 points),}$$

from which $Q = 27 \text{ kJ}$ (substitution in the two terms 1 + 1 point, calculation 2 points).

b) *Formulating the time required for the heating and calculating it:*

3 + 2 points
(may be divided)

As the heat transferred is $Q = P_{\text{net}} \cdot t$ (2 points),

$$t = \frac{Q}{P_{\text{net}}} = 300 \text{ s} = 5 \text{ minutes (rearranging the formula + calculation: 1 + 2 points).}$$

c) *Formulating the amount of heat lost and calculating it:*

2 + 2 points
(may be divided)

Since the nominal power of the heater is $P_{\text{nominal}} = P_{\text{net}} + P_{\text{loss}}$ (1 point),

the heat loss is $Q_{\text{loss}} = P_{\text{loss}} \cdot t = 9 \text{ kJ}$ (formulation and calculation: 1 + 2 points)

or:

Since the nominal power of the heater is 120 W, the overall energy consumption is

$$Q_{\text{total}} = P_{\text{nominal}} \cdot t = 36 \text{ kJ (formulation and calculation: 1 + 1 points),}$$

from which $Q_{\text{loss}} = Q_{\text{total}} - Q = 9 \text{ kJ}$ (formulation and calculation: 1 + 1 points).

Total: 17 points

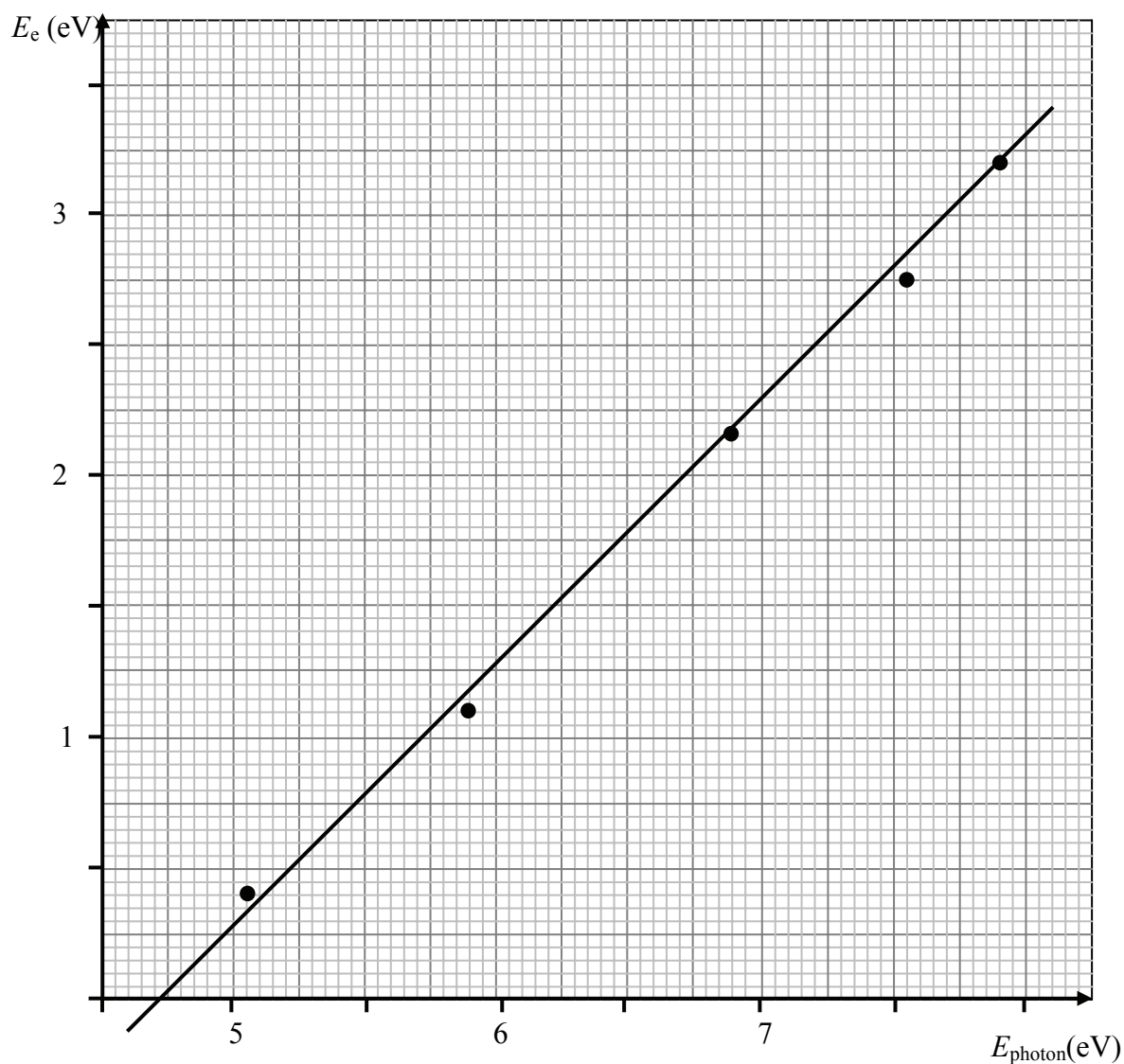
Problem 3/A

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

a) *Preparing a suitable graph and plotting the data:*

6 points
(may be divided)

(In the plot, the properly scaled and labeled axes are worth 1 point each. The correct plotting of the data in the table is worth 2 points. If only 3 or 4 data points are plotted correctly, 1 point may be awarded. Drawing the line of best fit is worth 2 points).



b) *Determining the work function of silver:***4 points**
(may be divided)

The work function of silver may be determined from any one of the data pairs in the table:

$$W_{out} = E_{photon} - E_{electron} = 4.75 \text{ eV} \text{ (formulation + calculation: 2 + 2 points),}$$

(Should the examinee simply write down the basic formula of the photoelectric effect without relating it to the present case, only one point may be awarded.)

or it may be determined from the intersection of the line of best fit and the horizontal axis (extending the line to the horizontal axis 2 points, reading the location of the intersection 2 points).

c) *Recognizing that the smallest photon energy for which electron ejection still occurs is equal to the work function:***2 points**

(Should the examinee fail to state this recognition, but use it later on in the calculation, the two points are to be awarded.)

Formulating and calculating the greatest photon wavelength at which the ejection of electrons still happens:

6 points
(may be divided)

$E_{photon} = W_{out} = \frac{h \cdot c}{\lambda}$ (1 point), from which $\lambda = \frac{h \cdot c}{W_{out}} = 2.7 \cdot 10^{-7} \text{ m} = 270 \text{ nm}$ (rearranging, conversion and calculation: 1 + 2 + 2 points).

d) *Determining the data missing from the table:***2 points**
(may be divided)

The missing photon energy may be determined via calculation:

$$E_{photon} = E_e + W_{out} = 6.27 \text{ eV} \text{ (formulation + calculation: 1 + 1 points),}$$

or using the line of best fit on the graph, by reading the value.

Total 20 points

Problem 3/B

(Each score may be divided)

a) *Explanation of the absence of electrocution:*

5 points

The voltage drop across the two legs of the bird is very small, so the current flowing through it is negligible.

(Any similar phrasing is also acceptable.)

b) *Explanation of the electrocution:*

2 points

E.g. The voltage difference between the legs and the wings of the bird is great or the bird's legs and wings connect two points with a great voltage difference between them.

(Any similar phrasing is also acceptable.)

c) *Explanation of the electrocution:*

2 points

E.g. The voltage difference between the legs and the wings of the bird is great in this case as well, or the bird's legs and wings connect two points with a great voltage difference between them.

(Any similar phrasing is also acceptable. The two points must be awarded also if the examinee answers question b) correctly and indicates here that the explanation is the same as that for question b). The examinee need not be aware of the fact that the wires carry different phases of a three-phase system.)

d) *Explaining the difference between different power lines:*

3 points

The distance between the wires of the higher voltage power lines is greater than that between the wires of a lower voltage power line. Therefore the chance that the wings of birds touch two wires at once is smaller.

e) *Phrasing two suggestions for measures to prevent electrocution:*

4 + 4 points

Any sensible suggestion may be accepted, even if it is not practical, for example because it is too expensive. Examples: insulation of the wires, insulation of the poles, usage of underground cables, usage of poles where the wires are farther away from each other, fixing perching rods on the tops of the poles, etc.

Total: 20 points