ÉRETTSÉGI VIZSGA ● 2011. október 27.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ ÍRÁSBELI ÉRETTSÉGI VIZSGA

JAVÍTÁSI-ÉRTÉKELÉSI ÚTMUTATÓ

NEMZETI ERŐFORRÁS MINISZTÉRIUM

The examination papers should be corrected and evaluated 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. 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. **A**
3. **C**
4. **B**
5. **A**
6. **C**
7. **A**
8. **C**
9. **B**
10. **A**
11. **C**
12. **C**
13. **B**
14. **B**
15. **B**
16. **B**
17. **C**
18. **C**
19. **C**
20. **A**

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

Total: 40 points.

SECOND PART

Problem 1.

Data: s_1 = 275 m, v = 12000 m/s, m = 75 kg, a_2 = 3 g, g = 10 m/s^2.

a) *Formulating the relationships of a motion with constant acceleration for the calculation of the acceleration in the present case and calculating it:*

8 points
(may be divided)

Formulating the relationships of a motion with constant acceleration:

$s_1 = \frac{a_1}{2} \cdot t_1^{\,2}$, and $v = a_1 \cdot t_1$ (2 + 2 points), from which $s_1 = \frac{v^2}{2a_1}$ (2 points)

and calculating the acceleration: $a_1 = \frac{v^2}{2s_1} \approx 2.62 \cdot 10^5 \ \frac{\text{m}}{\text{s}^2}$ (1 + 1 points).

Formulating and calculating the force that accelerates the traveler:

1 + 1 points

$F_1 = m \cdot a_1 \approx 1.96 \cdot 10^7$ N

Formulating and calculating the relationship between the accelerating force and the gravitational force on Earth:

1 + 1 points

$\frac{F_1}{m \cdot g} = \frac{a_1}{g} \approx 26200$

b) *Formulating and calculating the time required for the acceleration:*

1 + 1 points

$t_2 = \frac{v}{3g} = 400\,\text{s}$

Formulating and calculating the distance covered during acceleration:

1 + 1 points

$s_2 = \frac{a_2}{2} \cdot t_2^2 = 2400\,\text{km}$

Total 16 points

Problem 2.

Data: $M_{Cu} = 63.55\,\frac{\text{g}}{\text{mol}}$; $I = 1$ mA; $t = 5$ minutes.

a) *Formulating and calculating the amount of charge that flows through during the five minute interval:*

2 + 2 points
(may be divided)

$Q = I \cdot t = 10^{-3}\ \text{A} \cdot 300\,\text{s} = 0.3\,\text{C}$

Formulating and calculating the number of electrons flowing through:

2 + 2 points
(may be divided)

$$N_e = \left|\frac{Q}{e}\right| = 1.88 \cdot 10^{18}$$

Determining the number of copper ions deposited on the cathode:

1 + 1 points

As a single Cu^{2+} ion requires two electrons to become neutral, the number of copper ions deposited on the cathode is $N_{Cu} = \frac{N_e}{2} = 9.4 \cdot 10^{17}$.

b) *Formulating and calculating the mass of the copper deposited on the cathode:*

2 + 2 points
(may be divided)

The molar mass of copper is 63.55 g, so

$$m = M_{Cu} \cdot \frac{N_{Cu}}{6 \cdot 10^{23}} = 63.55 \cdot \frac{9.4 \cdot 10^{17}}{6 \cdot 10^{23}}\ \text{g} = 0.1\,\text{mg}$$

Total 14 points

Problem 3/A

a) *Justifying the usability of the barometric altimeter:*

4 points
(may be divided)

As atmospheric pressure changes with the altitude, by measuring the pressure (2 points), one may deduce the altitude of the place where the measurement was performed (2 points).

b) *Reading the pressures from the graph:*

3 + 3 points

At the altitude of the summit of Kékestető atmospheric pressure is about 900 hPa, while at the altitude of the summit of Mount Everest it is about 300 hPa.

c) *Reading the required altitude from the graph:*

3 points

Atmospheric pressure will be half of the value measured at sea level at an altitude of about 5500 m.

d) *Determining the altitude of the mountaineers' camp:*

4 points
(may be divided)

Using the table it can be determined, that if the boiling point of water is 90 ºC then the atmospheric pressure at the camp is about 70100 Pa, i. e. 701 hPa (2 points). From the graph one can see that an altitude of about 3000 m corresponds to this pressure (2 points).

e) *The barometric altimeter:*

3 points
(may be divided)

Atmospheric pressure at any given location changes in time due to atmospheric conditions (or weather conditions) (1 point), so different values of the altitude may correspond to the same value of pressure at different times (2 points).

Total 20 points

Problem 3/B

a) *Detailed analysis of the path taken by the red light through the prism:*

6 points (may be divided)

Upon incidence on the surface of the prism, the ray of light is refracted. As it passes from a medium of lower optical density into a medium of higher optical density, the ray is bent toward the normal. (1 + 1 + 1 points)

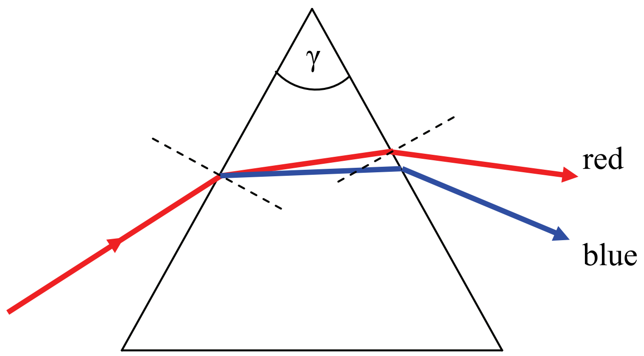
(The answer can be phrased in a number of other, acceptable ways. Instead of writing about passing from a medium of lower into a medium of higher optical density, one can write e.g. $n_1 < n_2$ or write about the velocity of light in the medium, e. g. $c_{glass} < c_{air}$. Bending towards the normal may alternatively be expressed by, for example, a formula like α > β provided the examinee defines in the text, or on the figure, which one is the angle of incidence and which one the angle of refraction.)

Upon reaching the far side of the prism, the ray of light is refracted again. As it now passes from a medium of higher optical density into a medium of lower optical density, the ray is bent away from the normal. (1 + 1 + 1 points)

b) *A correct sketch of the path taken by the ray of blue light through the prism and an explanation of the difference:*

8 points (may be divided)

The sketch of the path of the blue light that is incident together with the red one is correct if, at the first interface it is bent more than the red one (2 points), it reaches the second interface at a slightly different location (2 points), and is again bent more than the ray of red light, that is, the angle enclosed between the two paths increases (2 points). The reason for the difference in paths is, that (as can be seen from the graph), the index of refraction of the prism's material is greater for blue light, than for red light (2 points).



c) *Analysis of the passage of white light:*

6 points (may be divided)

The prism decomposes white light into its constituents. (2 points)

The index of refraction of the prism's material depends on the wavelength (2 points). This relationship, and the apex angle of the prism (2 points) are the two most important factors that influence the occurrence and magnitude of the phenomenon.

Total 20 points