ÉRETTSÉGI VIZSGA ● 2015. május 18.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ ÍRÁSBELI
ÉRETTSÉGI VIZSGA

JAVÍTÁSI-ÉRTÉKELÉSI
ÚTMUTATÓ

EMBERI ERŐFORRÁSOK
MINISZTÉRIUMA

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

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 student 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 nature and extent of the expected solution, and the depth of detail required of the student. 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 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.

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

Should the student 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 student.

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).

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

After evaluation, the appropriate scores should be entered in the summarizing tables at the bottom of the page.

PART ONE

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

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

Total: 40 points.

PART TWO

Problem 1

Data: h = 132 m, $g = 9.8\,\frac{\mathrm{m}}{\mathrm{s}^2}$

a) Formulating and calculating the speed of the first body at the instant of the meeting:

4 points
(may be divided)

Because the distance covered by the first body until the meeting is $h/2$,

$v_1 = \sqrt{g \cdot h} = 36\,\frac{\mathrm{m}}{\mathrm{s}}$ (formula + calculation: 2 + 2 points).

b) Formulating and calculating the time elapsed until the meeting:

2 + 1 points

$t = \sqrt{\frac{h}{g}} = 3.67\ \mathrm{s}$ or $t = \frac{v_1}{g} = 3.67\ \mathrm{s}$

Formulating and calculating the initial speed of the second body:

5 points
(may be divided)

As the second body also covered a distance of $h/2$ until the meeting,

$\frac{h}{2} = v_0 \cdot t - \frac{g}{2} \cdot t^2 \Rightarrow v_0 \cdot t = h$, so $v_0 = 36\,\frac{\mathrm{m}}{\mathrm{s}}$

(formula + rearrangement + calculation: 2 + 2 + 1 points)

c) Formulating and calculating the speed of the second body at the instant of the meeting:

3 points
(may be divided)

$v_2 = v_0 - g \cdot t = 0\,\frac{\mathrm{m}}{\mathrm{s}}$ (formula + calculation: 2 + 1 points).

Total: 15 points

Problem 2

Data: $c_{water} = 4200 \dfrac{\text{J}}{\text{kg} \cdot \text{K}}$, $L_{ice} = 334 \dfrac{\text{kJ}}{\text{kg}}$, m = 1 kg.

a) Determining the time in question and justifying the answer:

2 + 2 points

$t_1 = 20$ minutes, because that is when the temperature of the water starts to increase.

b) Determining the power of the electrode:

5 points
(may be divided)

Because the temperature change of the water during the given time interval is
$\Delta T = 10$ °C (1 point),
the heat absorbed by the water is $Q_1 = c_{water} \cdot m \cdot \Delta T = 42000\,\text{J}$
(formula + calculation: 1 + 1 points),
from which the power in question is $P = \dfrac{Q}{\Delta t} = 70$ W (formula + calculation: 1 + 1 points).

c) Determining the initial quantity of the water in the calorimeter:

6 points
(may be divided)

The heat generated by the electrode during the first 20 minutes:
$Q_2 = P \cdot \Delta t_2 = 84\,\text{kJ}$ (formula + calculation: 1 + 1 points),

Because this heat is just enough to melt the ice that was in the calorimeter initially,
$m_{ice} = \dfrac{Q_2}{L_{ice}} = 0.25\,\text{kg}$ (formula + calculation: 1 + 1 points).

Therefore initially $m_{water} = 1\,\text{kg} - m_{ice} = 0.75\,\text{kg}$ (formula + calculation: 1 + 1 points).

Total: 15 points

Problem 3/A

a) *A detailed explanation of why the coin keeps hopping on the bottle:*

10 points
(may be divided)

Our hand warms the air in the bottle (2 points) through the glass, so its pressure increases (2 points). The difference between the pressures (2 points) of the air inside the bottle and outside lifts the coin from time to time.
When the coin lifts off, air escapes from the bottle (2 points), so the pressure in the bottle decreases (2 points) and the coin drops back onto the opening of the bottle.

b) *Determining the end of the process:*

2 points

If the temperature of the air inside the bottle reaches (or gets close to) the ambient temperature, the increased pressure in the bottle will not be sufficient to lift the coin, the hopping will cease.

c) *Explaining the effect of using a heavier coin:*

4 points
(may be divided)

For a heavier coin to be lifted, a larger pressure difference (2 points) is necessary, so in this case a longer time is required for the sufficient warming of the air, the hopping will be less frequent (2 points).

d) *Explaining what happens if we do not place our hands on the bottle:*

2 points

In this case the air will be slower to warm up and the hopping of the coin will be less frequent.

e) *Explaining the role of the water on the opening of the bottle:*

2 points

The small amount of water on the opening of the bottle seals the narrow gap that may be between the rim and the coin. Thus the water serves to seal the bottle hermetically.

Total: 20 points

Problem 3/B

a) *Explaining why the radiation that reaches Earth's surface is less than that reaching the top of the atmosphere:*

4 points
(may be divided)

Constituents of the atmosphere will absorb (2 points) or reflect (2 points) certain part of the solar radiation.

b) *Stating that the absorption of the atmosphere's constituents is not uniform:*

4 points

Any phrasing of this fact is acceptable if correct. For example the absorption of different materials for different wavelengths is not uniform or the absorption of different materials is much stronger in certain ranges etc.

Listing the materials responsible for absorption indicated on the graph:

4 points
(may be divided)

O_2, O_3, H_2O, CO_2 (1 + 1 + 1 + 1 points). Points may be awarded only for materials indicated on the graph.

c) *Determining the absorption frequency of carbon-dioxide:*

4 points
(may be divided)

The graph shows that carbon-dioxide absorbs radiation with ~2000 nm wavelength (1 point) the most.

The frequency of this is $f = \frac{c}{\lambda} = 1.5 \cdot 10^{14}\,\frac{1}{\text{s}} = 150\ \text{THz}$

(formula + calculation: 1 + 1 points),
which, according to the table lies in the range of the near infrared (1 point).
(No point is to be awarded for only infrared!)

d) *Determining the absorption frequency of the ozone molecule:*

4 points
(may be divided)

The graph shows that ozone absorbs radiation in the wavelength range of 250 nm – 300 nm (1 point).
(Answering around 250 nm or around 300 nm is also acceptable.)

The frequency of this is $f = \frac{c}{\lambda} = 1\ \text{PHz} - 1.2\ \text{PHz}$ (formula + calculation: 1 + 1 points).

Full points are to be awarded also if only one of these frequency values is given.
According to the table, this radiation lies in the ultraviolet range (1 point).

Total: 20 points