ÉRETTSÉGI VIZSGA • 2014. május 19.

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 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 may be awarded if the reasoning is 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.

PART ONE

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

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

Total: ***40 points***.

PART TWO

Problem 1.

Data: $m_a = 60\,\text{kg}$, $m_c = 10\,\text{kg}$, v_a = 7.2 km/h, v_c = 10.8 km/h

a) *Realising that the conservation of momentum applies and writing it down for the case of an inelastic collision:*

1+1 points

$$m_a \cdot v_a + m_c \cdot v_c = (m_a + m_c) \cdot v_{common}$$

Substituting the data into the equation:

2 points

$60\ \text{kg} \cdot 7.2\ \text{km/h} - 10\ \text{kg} \cdot 10.8\ \text{km/h} = 70\ \text{kg} \cdot v_{\text{common}}$

(Points are to be awarded only if the sign of the two velocities substituted into the expression are opposite!)

Calculating the common velocity:

2 points

$v_{\text{common}} = 4.6\ \text{km/h} = 1.3\ \text{m/s}$

Determining and justifying the direction of motion:

1 point

The direction of motion after the collision is the same as that of the athlete.
(The direction of motion may be determined from the sign of the common velocity, or by comparing the momenta of the two bodies before the collision.)

b) *Calculating the kinetic energy of the athlete before and after the collision:*

1 + 1 + 1 points

$$E_a = \frac{1}{2} m_a \cdot v_a^2, \text{ whereof } E_a = \frac{1}{2} 60\,\text{kg} \cdot \left(2\frac{\text{m}}{\text{s}}\right)^2 = 120\,\text{J}$$

$$E_a' = \frac{1}{2} 60\,\text{kg} \cdot \left(1.3\frac{\text{m}}{\text{s}}\right)^2 = 51\,\text{J}$$

(Should the examinee write down the correct formula directly with the numerical values of the quantities, the point for the general formulation may also be awarded.)

Calculating the change of energy:

1 point

$\Delta E_a = E_a' - E_a = -69\,\text{J}$ (Should the sign be incorrect, no point is to be given! However, if the examinee omits the sign, but states that the kinetic energy decreases, the point should be awarded.)

Calculating the kinetic energy of the cart before and after the collision:

1 + 1 + 1 points

$E_c = \frac{1}{2} m_c \cdot v_c^2$, whereof $E_c = \frac{1}{2} 10\,\text{kg} \cdot \left(3 \frac{\text{m}}{\text{s}}\right)^2 = 45\,\text{J}$

$E_c' = \frac{1}{2} 10\,\text{kg} \cdot \left(1.3 \frac{\text{m}}{\text{s}}\right)^2 = 8.5\,\text{J}$

(Should the examinee write down the correct formula directly with the numerical values of the quantities, the point for the general formulation may also be awarded.)

Calculating the change of energy:

1 point

$\Delta E_c = E_c' - E_c = -36.5\,\text{J}$ (Should the sign be incorrect, no point is to be given! However, if the examinee omits the sign, but states that the kinetic energy decreases, the point should be awarded.)

Total: 15 points

Problem 2.

Data: $p_0 = 2 \cdot 10^5$ Pa , $V_0 = 2\,\text{dm}^3$, $V_2 = 5\,\text{dm}^3$, $Q_1 = 900$ J.

a) *Analysis of the first process and determining the energy change:*

1 + 1 + 1 points

The 1st process is an isochoric (or isovolumetric) process, whereby $W_1=0$, so $\Delta E_1 = Q_1 = 900$ J

Determining the energy change in the 2nd process:

$\Delta T_1 = \Delta T_2$

1 point

$\Delta E_1 = \Delta E_2$

2 points

Justification:

1 point

The change of internal energy depends only on the initial and final temperatures. (The point may be awarded also if the examinee **justifies** the equality of the energy change with the equality of the temperature change, without any further explanation. However, the examinee must make clear that the first fact follows from the second one.)

b) *Analysis of the second process:*

1 + 2 points

The second process is <u>isobaric</u>, so $\Delta E_2 = Q_2 + W_2$

Writing down and calculating the work:

2 + 1 points

$W_2 = -p \cdot \Delta V = -p_0 \cdot (V_2 - V_1) = -600\ \text{J}$

(If the sign is interpreted incorrectly, only one point can be given! The statement „600 J work was done by the gas" should be regarded as a correct interpretation of the sign. If the examinee uses the correct sign in the following calculations, the points may be awarded.)

Calculating the heat transfer:

2 points

$Q_2 = \Delta E_2 - W_2 = Q_1 - W_2 = 1500\ \text{J}$

Total: 15 points

Problem 3/A

a) *Realizing that the wire, the magnet, the screw and the battery together constitute an electric circuit:*

1 point

Stating that the current flows in a radial direction in the magnet, so that its direction is perpendicular to the magnetic field:

3 points

Stating, that the current in the screw is parallel to the magnetic field:

2 points

Stating, that in a magnetic field, a force is exerted upon a current carrying conductor (or a current) that depends on the direction of the current:

1 point

Stating, that a force is exerted upon the current in the magnet, as its direction is perpendicular to (and not parallel with) the magnetic field:

2 points

Stating that no force is exerted upon the current in the screw, as it is parallel to the magnetic field:

2 points

Drawing up the direction of the force that is exerted on the current in the magnet:

2 points

The direction of the force exerted upon the current is perpendicular both to the direction of the current and direction of the magnetic field. (Therefore, it is perpendicular to the radius of the magnet and lies in the horizontal plane.)

(It is unnecessary to formulate the right-hand rule more precisely.)

Realizing that the Lorenz force thus exerts a torque upon the magnet about the axis:

3 points

(It should not be considered a mistake if the examinee does not detail that the force exerted on the magnet is actually the reaction-force.)

Stating that the torque acts continuously as long as there is current:

1 point

b) Formulating the idea that reversing the terminals of the battery will reverse the current and thus the direction of rotation will also be reversed:

3 points
(may be divided)

Total: 20 points

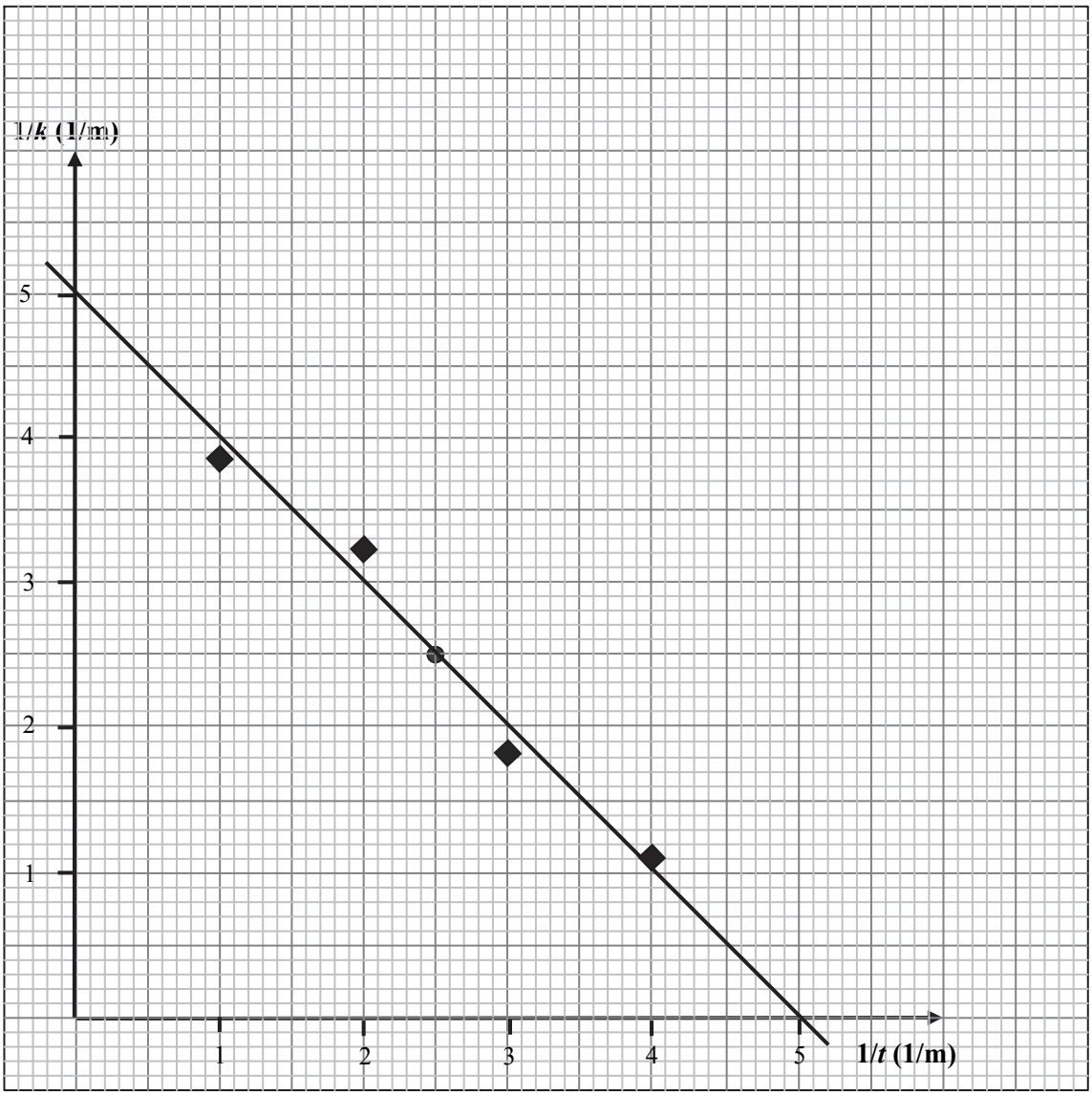
Problem 3/B

a) *Preparing the graph and fitting a straight line to the data:*

5 + 2 points
(may be divided)

Interpreting the intersections of the axis and the line and specifying the focal length:

3 points
(may be divided)



In preparing the graph, plotting the four data-pairs are worth 1 point each, and the correct labeling of the axis is also worth 1 point. (For the omission of units on the labeling, a total of 1 point is to be deduced.)

Reading the intersections of the axis – 1 point (it is sufficient to mark it on the graph), interpretation of the intersection – 1 point. It is sufficient if the examinee realizes that any of the intersections give the inverse of the focal length, which is thus f = 0.2 m. Writing the thin lens equation here is not necessary. The point may also be awarded for determining the focal length, if the examinee uses the data in the table and the thin lens equation to obtain it.

b) *Marking the t = k point on the graph and interpreting its role in image formation:*

2 + 4 points
(may be divided)

The object distance can be equal to the image distance only if the object distance is twice the focal length. Then the image is located at twice the focal length on the opposite side, it is inverted and real. (A proper sketch, usage of the thin lens equation or a written explanation may be accepted equally for justification.)

c) *Determining the distance between the slide and the lens:*

4 points
(may be divided)

In this case the distance of the screen from the lens is the image distance, so for the distance of the slide (object distance) the thin lens equation yields

$$\frac{1}{t}=\frac{1}{f}-\frac{1}{k}=\frac{1}{0.2\,\mathrm{m}}-\frac{1}{4.5\,\mathrm{m}}\Rightarrow d=t=\underline{0.21\ \mathrm{m}}$$

Total: 20 points