ÉRETTSÉGI VIZSGA • 2010. május 18.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ ÍRÁSBELI ÉRETTSÉGI VIZSGA

JAVÍTÁSI-ÉRTÉKELÉSI ÚTMUTATÓ

OKTATÁSI ÉS KULTURÁLIS MINISZTÉRIUM

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. 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.

FIRST PART

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

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

Total ***40 points***.

SECOND PART

Problem 1

Data: $R_1 = R = 10\ \Omega$, $U = 10$ V

a) *Writing down the formula for the equivalent resistance in the first case and calculating it:*

1 + 1 points

$R_e = R_1 + R = 20\ \Omega$

Writing down the formula for the equivalent resistance in the second case and calculating it:

1 + 1 points

$R_e' = R_1 + 2R = 30\ \Omega$

Writing down the formula for the change of equivalent resistance case and calculating it:

1 + 1 points

$\Delta R_e = R_e' - R_e = 10\ \Omega$

(Full score should be awarded if the examinee calculates the change of equivalent resistance without calculating the individual values in the first and second cases, provided the answer is justified properly.)

b) *Writing down the formula for the current flowing in the circuit in the first case and calculating it:*

1 + 1 points

$$I = \frac{U}{R_e} = 0{,}5\ \text{A}$$

Writing down the formula for the current flowing in the circuit in the second case and calculating it:

1 + 1 points

$$I' = \frac{U}{R_e'} = 0{,}33\ \text{A}$$

c) *Writing down the formula for the power on the resistor in the first case and calculating it:*

1 + 1 points

$P_1 = I^2 \cdot R_1 = 2{,}5$ W (using I = 0,5 A)

Writing down the formula for the power on the resistor in the second case and calculating it:

1 + 1 points

$P_1' = I'^2 \cdot R_1 = 1{,}1$ W (using I′ = 0,33 A)

Writing down the formula for the change of power and calculating it:

1 + 1 points

$\Delta P_1 = P_1' - P_1 = -1{,}4$ W

(Full points are to be awarded only if the sign is correct. If the magnitude is correct, but the sign is not, and it is not otherwise evident from the solution that the power decreases, the second point is not to be awarded.)

Total: 16 points

Problem 2

Data: m = 2 kg, R =1 m, f = 0,4 Hz, $g = 10\frac{\text{m}}{\text{s}^2}$

a) *Providing a correct interpretation of the dynamic situation:*

3 points

$F_{cp} = F_s$

(This can be stated in text: the centripetal force needed to keep the body in circular orbit is provided by static friction.)

Writing down the formula for the tangential velocity and calculating it:

2 + 2 points

$v = 2\pi \cdot R \cdot f = 2{,}51\frac{\text{m}}{\text{s}}$ (or $\omega = 2\pi \cdot f = 2{,}51\frac{1}{s}$)

Writing down the formula for the centripetal force (i.e. the force of static friction) and calculating it:

2 + 2 points

$F_s = F_{cp} = m \cdot a_{cp} = m \cdot \frac{v^2}{R} = 12{,}6$ N (or $F_s = F_{cp} = m \cdot R \cdot \omega^2 = 12{,}6$ N)

(Should the examinee omit the explicit calculation of the tangential velocity, carrying on the calculation parametrically, full points are to be awarded if the final result is correct.

b) *Writing down the formula for the coefficient of static friction and calculating it:*

2 + 3 points

$F_s \le \mu \cdot m \cdot g \Rightarrow \frac{F_s}{m \cdot g} \le \mu \Rightarrow \mu \ge 0{,}63$

If the examinee writes equality instead of greater than or equal to, one point should be deduced.

Total: 16 points

Problem 3/A

a) *Identifying and naming the object distance and the image distance:*

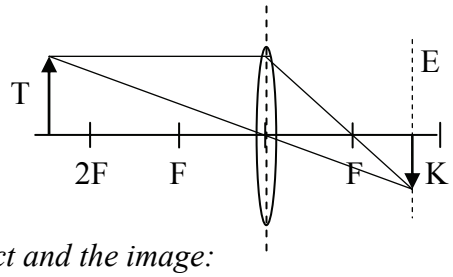
1 + 1 points

The distance between the lens and the film (light-sensitive surface) is the image distance.
The distance between the lens and the object to be photographed is the object distance.

(Writing that the object distance is the distance between the camera and the object to be photographed is – although correct by order of magnitude – not acceptable.)

b) *Naming the type of image formed and explaining it:*

diagram of the image formation



2 points

Determining the position of the object and the image:

1 + 1 points

The object is at a distance that is greater than twice the focal distance.
The image is at a distance between the focal distance and twice the focal distance.

The type of image:

1 + 1 points

The image is real and inverted.

c) *Writing down the thin-lens equation:*

2 points

$$\frac{1}{f}=\frac{1}{k}+\frac{1}{t}$$

Analysis of the mathematical relation between the object distance and the image distance based on the thin-lens equation:

2 points

The quantity on the left hand side is constant, so if one of the fractions on the right hand side increases, the other must decrease. This means that the object distance and the image distance always change in opposite sense. (The relation between k and t can also be deduced by transforming the thin-lens equation.)

Drawing the conclusions relevant to the present problem:

4 points
(may be divided)

Photographing a more distant object means that the object distance increases, which requires a smaller image distance.
To achieve a smaller image distance, the lens should be moved closer to the film.

Or, using an indirect reasoning:
Moving the lens farther from the film increases the image distance, a greater image distance means a smaller object distance, but this contradicts the requirement that we wish to photograph an object farther away, so the lens should be moved nearer to the film.

(If the examinee finds that the lens should be neared to the film by experimenting, and a logical deduction is missing, only one point may be awarded for this question.)

d) *Giving the smallest practical image distance and the corresponding object distance:*
1 + 1 points

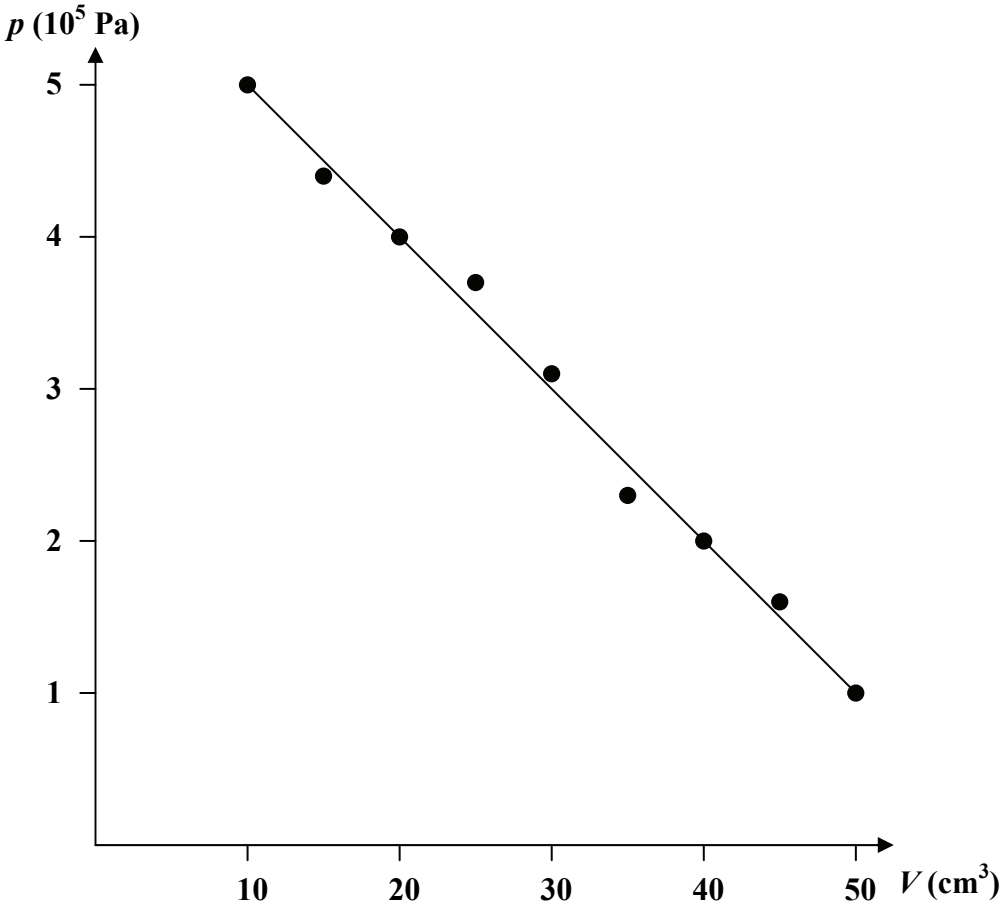
The smallest image distance arises when photographing a very distant object (infinite object distance). The image distance is then (practically) equal to the focal length.

Total: 18 points

Problem 3/B

a) *Creating a graph and drawing the straight line to fit the data points:*

5 + 2 points



In the plot, a *proper scaling and labeling of the axis is worth **2 points*** (with at least two numerical labels on each axis), *plotting the data points is worth **3 points***. The quality of the line of best fit should be judged benignly, according to general practice (***2 points*** are to be awarded if the line is acceptable, ***0 points*** if it is not).

b) *Writing down the formula for the work done on the gas and calculating it:*

3 + 2 points

The work done on the gas is given by the area under the graph:

$$W = \frac{p_{\text{initial}} + p_{\text{final}}}{2} \cdot \Delta V = 12\ \text{J}$$

(The calculation should be considered correct if $\Delta V = 40\ \text{cm}^3$ and the values for the pressure are in accordance with the line drawn. Depending on the precise values, the final result may deviate from 12 J.)

c) *Comparison of the initial and final temperatures:*

i) Realizing the fact that initial and final pressures are inversely proportional to the initial and final volumes:

3 points

ii) Realizing that the inverse proportionality of pressure and volume implies that the temperatures are the same:

3 points

(These two findings need not be separated; investigating the equation of state may yield the required result in one step, e.g. $\frac{p \cdot V}{T} = const.$ and since $p_{\text{initial}} \cdot V_{\text{initial}} = p_{\text{final}} \cdot V_{\text{final}}$, the final temperature of the gas must be the same as the initial one.)

Total: 18 points