

**ÉRETTSÉGI VIZSGA • 2010. május 18.**

**FIZIKA  
ANGOL NYELVEN**

**EMELT SZINTŰ ÍRÁSBELI  
ÉRETTSÉGI VIZSGA**

**JAVÍTÁSI-ÉRTÉKELÉSI  
ÚTMUTATÓ**

**OKTATÁSI ÉS KULTURÁLIS  
MINISZTERIUM**

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In marking the examination papers follow the instructions of the evaluation guide, making clear corrections and comments.

### **PART ONE**

In the multiple-choice questions, the 2 points are due for the correct answer as given below. Enter the scores (0 or 2) in the grey rectangles next to the individual questions as well as the total score in the table at the end of the question paper.

### **PART TWO**

The candidate should expound his opinions about the chosen topic in a continuous, coherent composition using whole sentences, thus sketchy answers cannot be accepted. The only exceptions are the labels of sketches or explanatory notes added to the figures. Points can only be awarded for the facts or data pointed out in the evaluation guide if they are mentioned in the appropriate context. Tick the correct statements, and write the awarded points to the margin of the sheets, as well as indicate the point in the evaluation guide according to which the credits were given. Also enter the scores in the table below part two.

### **PART THREE**

The lines in the evaluation guide printed in italics define the steps necessary for the solution. The indicated number of points is due if the activity or operation described in italics can be clearly identified in the work of the candidate, and it is basically correct and complete. Where the activity can be divided into smaller steps, the subtotals are indicated next to each line of the expected solution. The sample solution as given in the evaluation guide is not necessarily complete. It aims to illustrate what kind of solution (length, types, depth, details, etc) is expected of the candidate. The remarks in brackets at the end of the unit give further guidance in the judgement of possible errors, differences, and incomplete answers.

Correct solutions using a different reasoning from the one(s) given in the evaluation guide are also acceptable. The lines in italics help in judging the appropriate proportions, i.e. what part of the full score can be awarded for the correct interpretation of the question, for setting up relationships between quantities, for calculation, etc.

If the candidate combines steps and expresses the result algebraically without calculating quantities shown by the evaluation guide but not asked for in the original problem, award full mark for these steps, provided that the reasoning is correct. The purpose of giving intermediate results and the corresponding subtotals is to make the marking of incomplete solutions easier.

Take off points only once for errors not affecting the correctness of reasoning (e.g. miscalculations, slips of the pen, conversion errors, etc.)

If the candidate's response contains more than one solution or more than one attempt without making clear which one they want to be assessed, assume that the last version is the final version (i.e. the one at the bottom of the page if there is no other way to decide the order.) If the candidate's response contains a mixture of elements of two different chains of reasoning, evaluate only one of the two. Select the one that is more favourable for the candidate.

The lack of units during calculation should not be considered a mistake if it does not cause an error in the result. The answers to the questions asked by the problem, however, are only acceptable with the appropriate units.

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**PART ONE**

- 1. A
- 2. D
- 3. A
- 4. B
- 5. C
- 6. C
- 7. D
- 8. C
- 9. A or D
- 10. B
- 11. D
- 12. B
- 13. D
- 14. B
- 15. C

Award 2 points for each correct answer.

**Total**

**30 points**

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## PART TWO

*In all three topics all subtotals can be further divided.*

### 1. Secrets of Photography

*Stating the lens formula:*

**1 point**

*Defining the focal length, object and image distances:*

**1+1+1 points**

*Location of the lens when a distant object is photographed; reasoning with the lens equation:*

**3 points**

(1 point without reasoning.)

*Location of the lens when a close object is photographed; reasoning with the lens equation:*

**3 points**

(1 point without reasoning.)

*Determining the image distance if the picture is taken about an object located at infinity:*

**2 points**

(1 point without reasoning.)

*Adjustments which regulates the amount of light which passes the lens of the camera:*

**1+1 points**

Time and area of the diaphragm (the area of the aperture).

**2 points**

It is easier to take the picture of a moving object if the time is short, but – the amount of light is given – in this case the cross section of the aperture must be increased and the image is blurred an less sharp.

(If the candidate mentions only the advantage of short time award 1 point.)

*Stating the most important difference between the classical and digital methods of photography.*

**2 points**

The two points are only due if it is clearly stated that in case of classical photography the picture is fixed by a chemical way, and in case of digital pictures electric signals are stored. (Award only 1 point if the candidate only states that in case of the digital photography there is no film.)

**Total**

**18 points**

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**2. Mass and Its Measurement**

*Stating Newton's 2<sup>nd</sup> law:*

**2 points**

*Describing the dynamical method of the measurement of the inertial mass:*

**3 points**

*Description of the determination of mass with the help of the weight of the object, and reasoning the applicability of the method:*

**2+3 points**

It is supposed that the objects which have the same weights have the same inertia, (so they have the same accelerations if equal forces are exerted on them.

(The 3 points are due if it is clear from the answer that the candidate clearly understands the theoretical difference between the “inertial mass” and the “gravitational mass”. It is not necessary to use the terms “inertial mass” and “gravitational mass”.

*Methods for the measurement of the mass of an object:*

**3+3+2 points**

If the candidate refers to a previously mentioned method correctly the total subtotal is due.

**Total**

**18 points**

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### 3. Saturated and Unsaturated Vapour

*Qualitative description of relative humidity:*

**3 points**

*Stating that the relative humidity depends on the temperature:*

**1 points**

*Concept of saturated vapour, stating the characteristics:*

**2+1+1 points**

It is enough to mention that at a certain temperature a characteristic vapour pressure and a density belongs to the saturated state. Neither their symbols nor their precise names (e.g.: equilibrium vapour density, saturation vapour pressure) are necessary.

*Description of the continuous isothermal compression of unsaturated water vapour, drawing the  $p$ - $V$  diagram:*

**4+2 points**

*Explanation why breath becomes visible in winter:*

**2 points**

*Explanation of the formation of dew:*

**2 points**

**Total**

**18 points**

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Assessing the presentation according to the description of the exam.

*Grammar:*

***0-1-2 points***

- The essay is clear, understandable and contains grammatically correct sentences.
- There are no spelling mistakes in the scientific terms, names and notations.

*Coherence of the text:*

***0-1-2-3 points***

- The essay is complete and can be understood as a whole;
- The composition is coherent, the set of ideas described by the candidate is consistent, and clear.

If the candidate wrote less than 100 words, no points can be rewarded for the presentation.

If the chosen topic is not clear, evaluate the one, which was written last.

## PART THREE

### Problem 1

Data:  $m = 10 \text{ kg}$ ,  $v = 3 \frac{\text{m}}{\text{s}}$ ,  $\mu = 0.4$ ,  $\alpha = 30^\circ$ ,  $\eta = 0.6$ ,  $h = 10 \text{ m}$  and  $g = 10 \frac{\text{m}}{\text{s}^2}$

a) Setting up an equation for the forces:

**1 point**

(An appropriate figure can be accepted.)

*Determining the forces and the calculating the pulling force*

**1 + 1 points**

$$F_{\text{pulling}} = m \cdot g \cdot \sin \alpha + \mu \cdot m \cdot g \cdot \cos \alpha = 84.6 \text{ N}$$

*Calculating the useful power of the electric hoist:*

**1 point**

$$P_u = F_{\text{pulling}} \cdot v$$

*Calculation of the electric power of the hoist:*

**1 + 1 points**

$$\eta \cdot P_{\text{electric}} = P_u, \quad P_{\text{electric}} = 423 \text{ W}$$

b) *Applying Newton's second law for the object:*

**1 point**

*Calculation of the forces and the acceleration:*

**1 + 1 points**

$$m \cdot a = m \cdot g \cdot \sin \alpha - \mu \cdot m \cdot g \cdot \cos \alpha, \quad a = 1.54 \frac{\text{m}}{\text{s}^2}$$

*Calculating the time while the object slides down:*

**1 + 1 + 1 points**

$$t = \sqrt{\frac{2 \cdot s}{a}} = \sqrt{\frac{2 \cdot h}{a \cdot \sin \alpha}} = 5.1 \text{ s}$$

**Total: 12 points**

**Problem 2**

Data:  $m_{\text{iron}} = 2 \text{ kg}$ ,  $T_0 = 1000 \text{ }^\circ\text{C}$ ,  $T_{\text{common}} = 60 \text{ }^\circ\text{C}$   $T_1 = 20 \text{ }^\circ\text{C}$   $m_{\text{water}} = 4.2 \text{ kg}$

$$c_{\text{water}} = 4.18 \frac{\text{kJ}}{\text{kg}\cdot^\circ\text{C}}, \quad L = 2.25 \frac{\text{MJ}}{\text{kg}}, \quad c_{\text{iron}} = 465 \frac{\text{J}}{\text{kg}\cdot^\circ\text{C}}$$

*Determining the heat released by the iron:*

**1 + 1 points**

$$Q_{\text{iron}} = c_{\text{iron}} \cdot m_{\text{iron}} \cdot (T_0 - T_{\text{common}}) = 874200 \text{ J}$$

*Determining the heat absorbed by that portion of water which warmed up:*

**1 + 1 points**

$$Q_{\text{water}} = c_{\text{water}} \cdot m_{\text{water}} \cdot (T_{\text{common}} - T_1) = 702240 \text{ J}$$

*Determining the heat absorbed during the boiling process:*

**1 + 1 points**

$$Q_2 = Q_{\text{iron}} - Q_{\text{water}} \approx 172000 \text{ J}$$

*Expressing the heat absorbed during the boiling process in terms of the mass of the water which became steam, and calculating this mass:*

**4 points**  
**(it can be further divided)**

$$Q_2 = m_{\text{steam}} \cdot (c_{\text{water}} \cdot 80 \text{ }^\circ\text{C} + L) \text{ from which } m_{\text{steam}} \approx 0.067 \text{ kg}$$

**Total: 10 points**

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**Problem 3**

*Stating the connection between the energy of the photons in the spectrum, and the atomic energy levels:*

**2 points**

$$E_{\text{photon}} = E_2 - E_1$$

*Stating the connection between the energy of a photon and its wavelength:*

**2 points**

$$E_{\text{photon}} = \frac{h \cdot c}{\lambda}$$

(Other forms of this formula can be accepted as well.)

*Determining the transitions:*

**2 + 2 + 2 points**

$\lambda_1 = 405 \text{ nm}$ : K 5p  $\rightarrow$  4s transition

$\lambda_2 = 696 \text{ nm}$ : K 4d  $\rightarrow$  4p transition

$\lambda_3 = 768 \text{ nm}$ : K 4p  $\rightarrow$  4s transition

*Stating that there is potassium in the gas but there is no sodium:*

**1 point**

(The answer that there is no sodium in the gas can only be accepted if the candidate found all the three transitions of the potassium.)

If the candidate changed the energy levels from eV to Joule correctly, but did not calculate anything else, award only two points.

**Total: 11 points**

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**Problem 4**

All subtotals can be further divided.

Data:  $R = 0.5 \text{ M}\Omega$ ,  $C = 4 \text{ }\mu\text{F}$

a) *Writing the formula for the voltage across the capacitor as a function of time:*

**6 points**

**(It can be further divided)**

$$U_C = \frac{Q}{C} = \frac{I \cdot t}{C} = \frac{U \cdot t}{R \cdot C} = 1 \frac{\text{V}}{\text{s}} \cdot t$$

*Drawing the graph of the function:*

**2 points**

b) *Determining the energy of the capacitor:*

**3 points**

$$E = \frac{1}{2} C \cdot U_{C(t=8\text{s})}^2 = 1.28 \cdot 10^{-4} \text{ J}$$

c) *Calculation the heat dissipated in the resistor:*

**3 points**

$$W_R = U^2 \cdot R \cdot t = 6.4 \cdot 10^{-5} \text{ J}$$

**Total: 14 points**