ÉRETTSÉGI VIZSGA • 2008. november 3.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ ÍRÁSBELI ÉRETTSÉGI VIZSGA

JAVÍTÁSI-ÉRTÉKELÉSI ÚTMUTATÓ

OKTATÁSI ÉS KULTURÁLIS MINISZTÉRIUM

In marking the examination papers follow the instructions of the markscheme, making clear corrections and comments. Do all marking in red ink (in case of the second correction green) using the conventional notations.

PART ONE

In the multiple choice questions, the 2 points are only 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 subtotals given in the markscheme cannot be broken up further, unless indicated otherwise.

The lines in the markshceme 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 markscheme 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 the possible errors, differences and incomplete answers.

Correct solutions using a different reasoning from the one(s) given in the markscheme 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 results algebraically without calculating quantities shown by the markscheme 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 the 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.

Graphs, diagrams and notations are considered correct if they can be clearly interpreted (i.e. if it is clear what they show, they contain the necessary notations, unconventional notations are explained, etc.) The labels of the axes in a graph do not need to indicate the units if they are clear from somewhere else. (E.g. if the graph represents quantities given in a table that all have the same unit.)

If the choice of the candidate is not indicated in problem 3, follow the description of the examination.

Enter the appropriate scores in the table at the bottom of each page.

PART ONE

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

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

Total: ***40 points***.

PART TWO

Problem 1

Data: $l = 30\ \text{cm}$, $A = 0.5\ cm^2$, $Q = 5\ \text{kJ}$, $c = 900\ \text{J/kg K}$, $\rho = 2700\ \text{kg/m}^3$

Setting up the equation for the absorbed heat:

2 points

$$Q = c \cdot m \cdot \Delta t$$

Expressing the mass of the rod in terms of the data of the rod:

1 point

$$m = \rho \cdot l \cdot A$$

Calculating the mass with the correct units:

2+1 point

$$m = \rho \cdot l \cdot A = 0.04\ kg$$

Finding the change in the temperature, rearranging the equation and calculation:

1+1+1 point

$$\Delta t = \frac{Q}{c \cdot m} = 137\ ^\circ C$$

Calculating the final temperature of the rod from the change of the temperature:

1 point

$$T_v = T_0 + \Delta T = 155\ ^\circ\text{C}$$

Finding the change in the internal energy:

1+1 point

$$\Delta E = Q = 5\ \text{kJ}$$

Total: 12 points

Problem 2

Data: $R_1 = R_2 = R_3 = 10\,\Omega$, $U = 5\,\mathrm{V}$

a) Calculation of the powers if the switch is closed:

Expressing the equivalent resistance of R_1 and R_3, and calculation:

1+1 point

$$\frac{1}{R_1}+\frac{1}{R_3}=\frac{1}{R_{13}} \quad \Rightarrow \quad R_{13}=5\ \Omega$$

Expressing the equivalent resistance of the three resistors and calculation:

$R_e = R_2 + R_{13} = 15\ \Omega$

1+1 point

Finding the voltages across the resistors <u>or</u> the currents which flow through them:

1 + 1 + 1 point

The total current in the circuit: $I_e = \frac{U}{R_e} = \frac{1}{3} A = 0.33\,A$. This current flows through R_2; and through R_1 and R_3 only half of this current, $\frac{1}{6} A = 0.167\,A$ flows through.

<u>or:</u>

The voltage across the resistors is proportional to the resistance of the resistors:

$U_2 = U \cdot \frac{R_2}{R_e} = \frac{10}{3} V = 3.33\,V$, and $U_1 = U_3 = U \cdot \frac{R_{13}}{R_e} = \frac{5}{3} V = 1.67\,V$.

Writing the formula for the power:

$P = U \cdot I$ *or* $P = I^2 \cdot R$ *or* $P = \frac{U^2}{R}$.

1 point

Calculating the power at each resistor with the voltage and the current:

1 + 1 + 1 point

$P_1 = P_3 = 0.28\ W$, $P_2 = 1.11\ W$

b) Calculation of the powers if the switch is open:

Expressing the equivalent resistance of the three resistors and calculation:

$R_e = R_2 + R_1 = 20\,\Omega$

1+1 point

Finding the voltage across each resistor <u>or</u> the current through each resistor:

1 + 1 + 1 point

The total current which flows in the circuit is: $I_e = \frac{U}{R_e} = \frac{1}{4}\,A = 0.25\,A$. This current flows through R_2 and R_1, and there is no current through R_3.

<u>or:</u>

The voltage across the resistors is proportional to the resistance of the resistors: $U_1 = U_2 = U \cdot \frac{R_2}{R_e} = 2.5\,V$, and $U_3 = 0\,\mathrm{V}$.

Calculating the power at each resistor with the voltage and the current:

1 + 1 point

$P_1 = P_2 = 0.625\,W$, $P_3 = 0\,W$

Total: 18 points

3/A

Each subtotal can be broken up further.

In the description of the phenomenon award points for the following statements:

- *During the boiling process water vapour replaced some air.*

5 points

- *In the sealed flask there was water and water vapour above it.*

2 points

If the candidate does not mention that the water vapour replaced the air in the flask, and supposes that after closing the flask there was water, water vapour and air in the flask award only three points instead of the first two subtotals.

- *Some portion of the cooled water vapour condensed.*

4 points

If the candidate states that because the water vapour cooled down quickly, therefore its pressure decreased, do not award points here, only the next subtotal (3 points) can be given.

- *Thus the pressure above the water decreased.*

3 points

- *At the lower pressure water was boiling at a lower boiling point.*

3 points

- *The external atmospheric pressure is greater than the internal pressure of the water vapour, thus the inward force exerted on the bung by the air is greater than the outward force exerted by the water vapour. .*

3 points

If the candidate mentions only the difference in the pressure without referring to the forces award only 2 points.

Total: 20 points

3/B

Each subtotal can be broken up further.

a) Plotting the data in a graph:

3 points

Award all the points if the first linear part and the "break", after which the extension of the spring does not follow the original rate of the increase of force, are clearly indicated in the graph.

b) Evaluation of the graph:

In the initial part of the graph the elongation of the spring is proportional to the pulling force. (The extension is elastic.)

2 points

For the "top" of the graph the direct proportionality is not true, the spring is fully extended.

2 points

c) Determining the spring constant:

4 points

$$D = \frac{\Delta F}{\Delta l} = 2\ \frac{\text{N}}{\text{cm}}$$

(The spring constant can be determined either from the data in the table, or by reading it from the graph. From the data in the table: $D = \frac{2\ \text{N}}{0.9\ \text{cm}} = 2.22\ \frac{\text{N}}{\text{cm}}$, or $D = \frac{2\ \text{N}}{1.2\ \text{cm}} = 1.67\ \frac{\text{N}}{\text{cm}}$ or $D = \frac{2\ \text{N}}{1.1\ \text{cm}} = 1.82\ \frac{\text{N}}{\text{cm}}$ can be calculated, which exceeds the 5 % error due to the rounding of the numbers. This may happen if the candidate uses only one pair of data. In this case 1 point should be taken off because the error is greater than 5 %.)

Determining the unstretched length of the spring:

4 points

The unstretched length of the spring can also be calculated either graphically or with the help of the spring constant: $l_0 = l - \frac{F}{D}$, using the data in the table: $l_0 = 9\ \text{cm}$.

d) Calculating the work done:

5 points

Either using the spring constant and the data in the table or finding the area under the graph.

$$W = \frac{1}{2} D \cdot \Delta l_v^{\,2} - \frac{1}{2} D \cdot \Delta l_k^{\,2} = 0.08 \text{ J}$$

(If the candidate determines the asked work as the elastic potential energy of the spring at the final state 2 points can be awarded.

Naturally other correct solutions are acceptable and full points can be awarded, e.g. from the difference between the elastic potential energies or by using an average force the correct result can be calculated too.)

Total: 20 points