ÉRETTSÉGI VIZSGA • 2020. május 19.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI 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

Principles for dividing allocated scores:

- The sentences printed in italics in the evaluation guide define the steps necessary for the solution. The scores indicated here may and should 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.
- 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 from the student. Comments in brackets that follow provide further guidance on the evaluation of possible errors, differences or incomplete answers.

Principles for evaluating alternative trains of thought:

- 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. what part 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.

Principles for the avoidance of multiple deductions:

- For errors that do not affect the correctness of reasoning (miscalculations, clerical errors, conversion errors, etc.) deduce points only once.
- Should the student 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.
- If an action or operation defined in the evaluation guide is completed, but the results are incorrect due to errors committed previously, full points allocated for this action are to be awarded. If the action can be broken down into steps, partial scores are indicated beside each line of the expected solution.

Principles regarding the use of units:

- 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).

Further comments:

- If, in case of problem 3. the student does not indicate his/her choice, and the choice is also not immediately obvious from the exam paper, the solution for the first problem of the two optional ones must be evaluated in every case.
- After evaluation, the appropriate scores should be entered in the summarizing tables at the bottom of the page.

PART ONE

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

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

Total: 40 points

PART TWO

When evaluating the calculations, care must be taken to deduce points for errors that do not affect the correctness of reasoning (miscalculations, clerical errors) only once. If the student uses a previously miscalculated result in further steps of the solution correctly, full points are to be awarded for these steps. Thus it may be possible that full points are due at certain steps for solutions that differ from the values given in the evaluation guide.

Problem 1

Data: v = 120 km/h, s = 100 km, P = 26 kW, V_p= 6 l, Q_p = 44 MJ/kg, ρ = 0.75 kg/dm³.

Determining the useful work performed by the engine:

6 points
(may be divided)

As $W = P \cdot t$ (2 points) and

$t = \frac{s}{v} = \frac{100\text{ km}}{120\text{ km/h}} \cdot 3600\text{ s/h} = 3000\text{ s}$ (Formula + calculation, 1 + 1 points), so

$W = 26\text{ kW} \cdot 3000\text{ s} = 78\text{ MJ}$ (substitution of data and calculation, 1 + 1 points).

Determining the energy released during the combustion of petrol:

6 points
(may be divided)

$E = Q_p \cdot m_p$ (2 points) and

$m_p = \rho \cdot V = 0.75 \cdot 6 = 4.5\text{ kg}$ (Formula + calculation, 1 + 1 points), therefore

$E = 44 \cdot 4.5 = 198\text{ MJ}$ (substitution of data and calculation, 1 + 1 points).

Calculating the ratio in question:

2 points

$\eta = \frac{78}{198} = 0.39$ that is 39%.

Total: 14 points

Problem 2

Data: $V = 4.5\ \text{cm}^3$, $t = 20\ ^\circ\text{C}$.

a) *Determining the forces acting on the spheres and the condition for floating:*

3 points
(may be divided)

The spheres in the fluid are acted upon by the gravitational force (1 point) and the hydrostatic buoyancy force (1 point). The relationship between them (1 point) determines whether a sphere floats or sinks.

b) *Explaining the thermometer's principle of operation:*

5 points
(may be divided)

As the temperature increases, the density of the fluid decreases (1 point), but the density of the spheres remains constant (1 point). When the density of a sphere becomes larger than the density of the fluid (1 point), it sinks. The sphere marking the lowest temperature has the highest average density (2 points).

c) *Determining the accuracy and discussion of the measurement range:*

4 points
(may be divided)

The accuracy of the thermometer is approximately 2 degrees (2 points). (Writing ± 1 degree is also acceptable.)

The measurement range depends on the number of the spheres (2 points). Or: on the difference between the densities of the most dense and least dense spheres.

d) *Determining the mass of the sphere:*

4 points
(may be divided)

As, in the case of flotation the densities of the sphere and the fluid are equal (1 point), we can read from the graph that the density of the sphere is approximately 790 kg/dm^3 (1 point).

Thus the mass of the sphere is:

$m = \rho \cdot V = 790 \frac{\text{kg}}{\text{m}^3} \cdot 4.5\ \text{cm}^3 = 3.6\ \text{g}$ (formula + calculation, 1 + 1 point).

Total: 16 points

Problem 3/A

a) *The detailed description of the type 1 brake's operation:*

6 points
(may be divided)

The electromagnet (1 point) attracts itself to the iron rail (1 point). The force pressing the rail and the friction surface together increases (2 points) so the friction force also increases (2 points).

b) *Explaining the effects of increasing the current:*

4 points
(may be divided)

If the current in the coil is increased, the force of attraction also increases (2 points), so the force pressing the surfaces together (1 point) and the friction force also increase (1 point).

c) *The detailed description of the type 2 brake's operation:*

6 points
(may be divided)

The magnetic field changes in the immediate vicinity of the rail (2 points), this induces eddy currents (2 points). According to Lenz's law these eddy currents slow the vehicle down (2 points).

d) *Examination of the stone and copper rails:*

4 points
(may be divided)

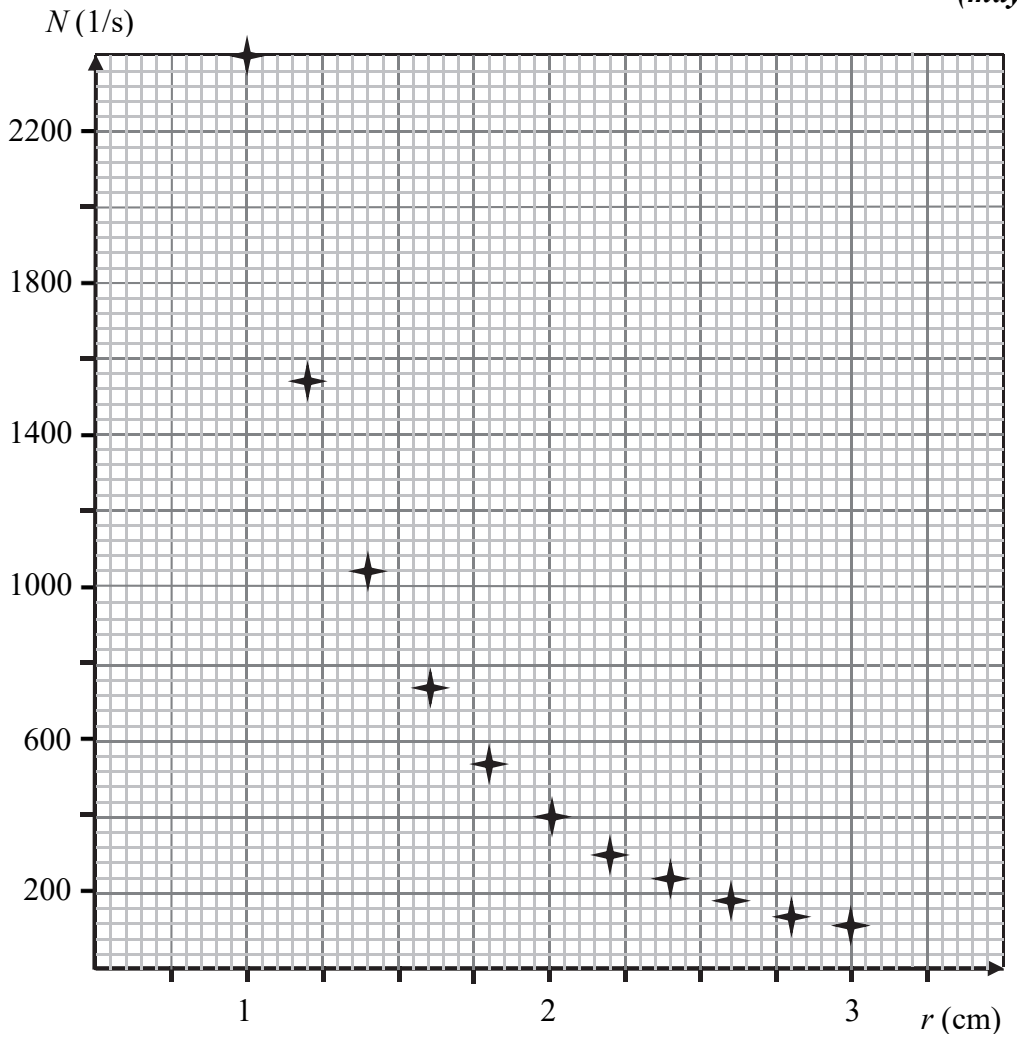
On a stone rail, neither brake system would work as a stone is not attracted by a magnet (1 point) and no eddy currents can be induced in it (1 point). On a copper rail, only brake system type 2 would work, as eddy currents can be induced in copper (1 point), but the magnet does not attract copper (1 point) so the type 1 brake system would not work.

Total: 20 points

Problem 3/B

a) *Plotting the data on the graph:*

5 points
(may be divided)



(The correct placement of 10-11 data points is worth 5 points, 8-9 data points is worth 4 points, 6-7 data points is worth 3 points, 4-5 data points is worth 2 points, 1-3 data points is worth 1 point.)

b) *The approximate determination of the particle number measurable at 1.3 cm:*

3 points

By taking the two adjacent values and averaging them, or by drawing the curve on the graph and reading the value:
$N \approx 1300$ (the value is acceptable in the range 1250–1320.)

c) *Answering the question on the decrease of radiation and justifying the answer:*

4 points
(may be divided)

Not true (2 points).

Justification (2 points):
Observing the data in the table we can compare the values corresponding to 1 cm and 2 cm and see that the particle number was not reduced by half (2400 → 400). (Reasoning with any other pair of values is acceptable if correct.)

d) *Answering the question on the decrease of radiation and justifying the answer:*

4 points
(may be divided)

Not true (2 points).

Justification (2 points):

I. According to the first three values in the table, between 1 cm and 1.2 cm the particle number decreased by 860, while between 1.2 cm and 1.4 cm it decreased by 500. (Reasoning with any other set of values is acceptable if correct.)
Or:
II. Drawing the curve traced out by the points on the graph it can be seen that it is not a straight line (the relationship is not linear).

e) *Explaining the effectiveness of a container with lead walls:*

4 points
(may be divided)

As lead is much more dense than air (2 points), the emitted alpha particles are absorbed sooner (2 points) than in air. (Any similar explanation is acceptable, e.g. they have a higher probability to collide, etc.)

Total: 20 points