ÉRETTSÉGI VIZSGA • 2022. május 17.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

a 2012-es Nat-ra épülő vizsgakövetelmények szerint

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

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: $T_1 = 18$ mm, $T_2 = 24$ mm, $K_1 = 45$ cm, $K_2 = 60$ cm.

a) *Determining the magnification:*

4 points
(may be divided)

$$N = \frac{K_1}{T_1} = \frac{450\text{ mm}}{18\text{ mm}} = 25$$

(formula + substitution of two appropriate data values + calculation 1 + 1 + 1 + 1 points)
The formula can be written using the K_2 , T_2 data pair as well.

b) *Determining the image distance and giving the position of the screen:*

4 points
(may be divided)

$$N = \frac{k}{t} \Rightarrow k = N \cdot t = 25 \cdot 3 = 75\text{ cm}$$

(formula + rearrangement + calculation, 1 + 1 + 1 points).

Thus the screen should be placed 75 cm from the lens (1 point).
(If the student does not make it evident using text or a diagram that the above distance is measured from the lens, this point should not be given.)

c) *Determining the diopter of the lens:*

6 points
(may be divided)

$$\frac{1}{f} = \frac{1}{k} + \frac{1}{t} = \frac{1}{3} + \frac{1}{75} = \frac{26}{75} \Rightarrow f = \frac{75}{26}\text{ cm} \approx 2.88\text{ cm}$$

(formula + substitution of data + calculation, 1 + 1 + 2 points).

$$D = \frac{1}{f(\text{m})} = \frac{1}{0.0288} = 34.7 \approx 35 \text{ (2 points)}$$

Total: 14 points

Problem 2

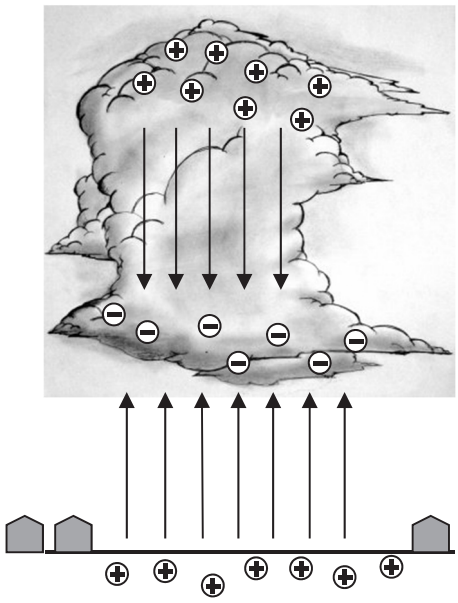
Data: $I = 30$ kA, $\Delta Q = 15$ C.

a) *Preparing a suitable drawing based on the text:*

5 points
(may be divided)

The drawing must depict:

positive charges around the top of the cloud – 1 point
negative charges around the bottom of the cloud – 1 point
electric field pointing downward in the inside of the cloud – 1 point
positive charges near the ground surface – 1 point
electric field pointing upward between the ground and the bottom of the cloud – 1 point



The electric field may be depicted by vectors (even a single arrow is sufficient), or arrows showing the direction of the electric field, or electric field lines drawn from charge to charge. The answer is acceptable if the field direction is unambiguous.

b) *Explaining the reason for the time difference between perceiving the thunder and the lightning:*

5 points
(may be divided)

Light and sound are generated <u>simultaneously</u> (2 points) at the location of the electric discharge, but the <u>speed of light is much greater than the speed of sound</u> (1 point), so <u>light reaches our eyes almost at once</u> (1 point), while sound reaches our ears <u>several second later</u> (1 point).

c) *Determining the average duration of the lightning discharge:*

6 points
(may be divided)

$$I = \frac{\Delta Q}{\Delta t} \Rightarrow \Delta t = \frac{\Delta Q}{I} = \frac{15\text{ C}}{30000\text{ A}} = 0.5\text{ ms}$$

(formula 2 points, rearrangement 1 point, substitution of the appropriate data 1 + 1 points, calculation 1 point).

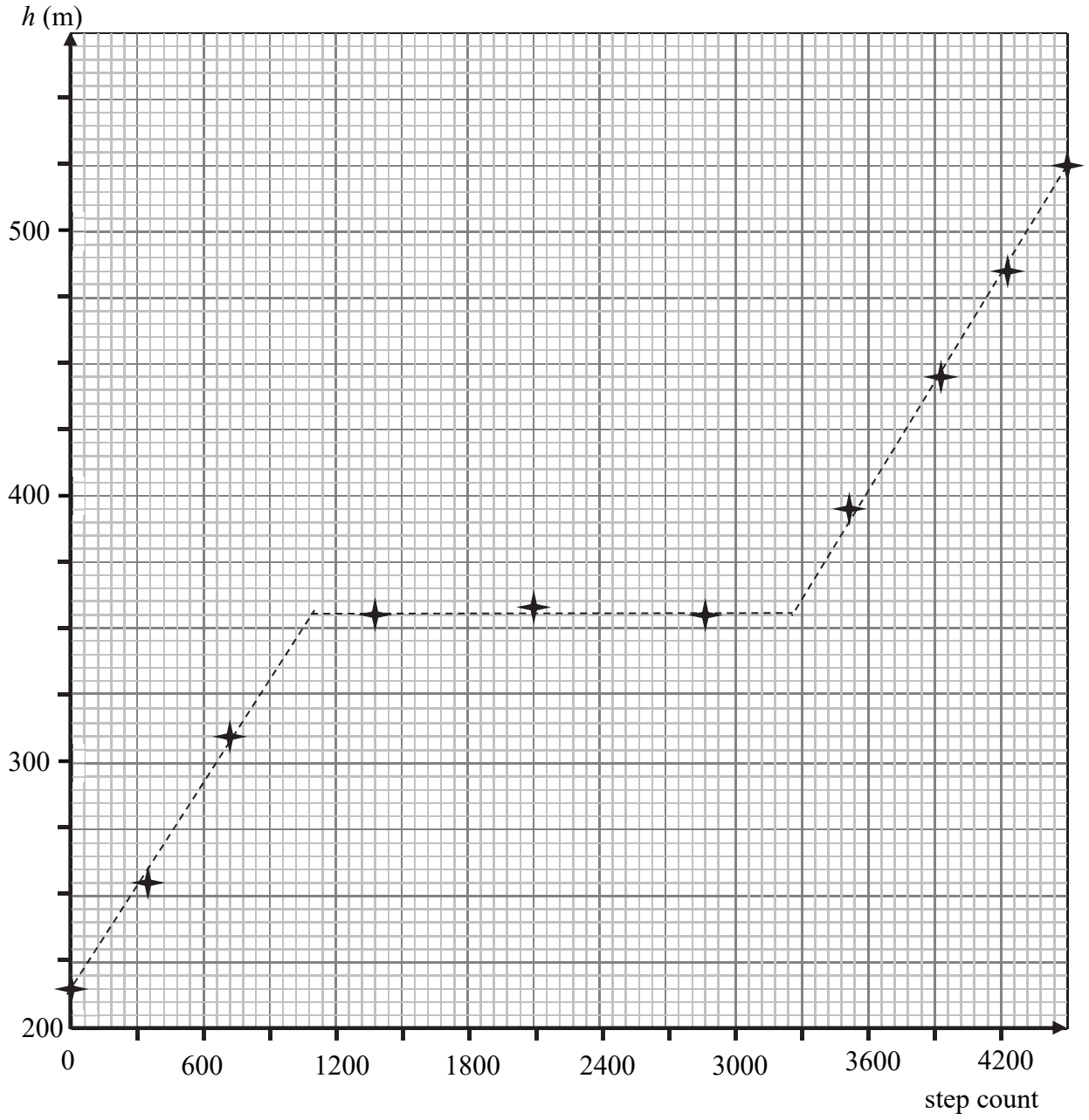
Total: 16 points

Problem 3/A

Data: $l_1 = 55$ cm, $l_2 = 70$ cm

a) *Plotting the data on the graph:*

6 points
(may be divided)



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

b) *Determining the approximate location of the horizontal section's starting- and endpoint:*

6 + 2 points

The values sought can be determined by fitting straight lines on the data. The horizontal section stretches from a step count of approximately 1080, to about 3240. Fitting the straight lines is worth 2 + 2 + 2 points, reading the start and end of the horizontal section is worth 1 + 1 points.
(If the student uses step counts 1372 and 2868, or similar, rounded values as the start and end of the horizontal section, 1 + 1 points should be awarded.)

c) *Determining the required distance:*

6 points
(may be divided)

As the hiker covers about 2160 steps on horizontal ground (1 point)
and about 2340 steps on climbing paths (1 point),

$s = 2160 \cdot l_2 + 2340 \cdot l_1 = 2160 \cdot 0.7 + 2340 \cdot 0.55 \approx 2800$ m
(formula + substituting data + calculation, 2 + 1 + 1 points).

Total: 20 points

Problem 3/B

a) *Explaining the advantages of a short half-life:*

4 points
(may be divided)

As a given amount of isotope will have a higher activity (2 points) if its half-life is shorter, it is easier to locate the leak. At the same time, radioactivity at the location will decrease faster (2 points), so the health hazard disappears sooner.

b) *Naming the type of radiation and explaining the answer:*

4 points
(may be divided)

Gamma radiating isotopes (2 points) are the most convenient, because this type of radiation is the most penetrating (2 points), this is the one easiest to detect above the ground surface. (Any sensible formulation is acceptable. Reasoning with the absorption of the other two types of radiation is also acceptable.)

c) *Discussing the effects of doubling the isotope amount:*

6 points
(may be divided)

If the amount of isotope is doubled, an equal amount of fluid (that contaminates the ground at the location of the leak) contains a double amount of isotopes (1 point), so the activity measurable in the ground will also be doubled (2 points). As the activity is reduced by half during one half-life of time (1 point) doubling the amount of isotopes leads to the detectability of the leak being one half-life longer (2 points.

d) *Writing down the reaction equation and naming the decay product:*

6 points
(may be divided)

$$^{131}_{53}\mathrm{I} \rightarrow {}^{131}_{54}\mathrm{Xe} + e^{-} + \gamma$$

Correctly indicating the isotopes on the left and right hand-side of the reaction equation (with atomic numbers and mass numbers) are worth 2 points each, indicating the electron is worth 1 point. Omitting the gamma photon is not to be considered an error.
The decay product is xenon (1 point).

Total: 20 points