ÉRETTSÉGI VIZSGA • 2022. október 27.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

a 2012-es Nat-ra épülő vizsgakövetelmények szerint

JAVÍTÁSI-ÉRTÉKELÉSI
ÚTMUTATÓ

OKTATÁSI HIVATAL

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

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: a = 30 cm, ρ = 600 kg/m^3, ρ_{water} = 1000 kg/m^3, g = 9.81 m/s^2

a) Stating the equilibrium of forces acting on the cube:

2 points

$mg = F_{\text{buoy}}$

Expressing the forces using geometrical sizes and densities, and determining the depth that the cube submerges:

5 points
(may be divided)

$a^3 \cdot \rho \cdot g = a^2 \cdot h \cdot \rho_{\text{water}} \cdot g$ (Expressing the two sides of the equation, 1 + 1 points),

from which: $h = \dfrac{\rho}{\rho_{\text{water}}} \cdot a = \dfrac{6}{10} \cdot 30 = 18$ cm

(rearrangement + substitution of data + calculation, 1 + 1 + 1 points).

b) Stating the equilibrium of forces acting on the cube and the lead weight in the second case:

2 points

$mg + G_{weight} = F_{buoy}'$

Expressing the forces using the densities and determining the mass of the lead weight:

5 points
(may be divided)

$m_{weight} \cdot g + a^3 \cdot \rho \cdot g = a^3 \cdot \rho_{water} \cdot g$

(expressing the buoyancy force and the force due to the lead weight, 1 + 1 points),

i.e.: $m_{weight} = a^3 \cdot (\rho_{water} - \rho) = 10.8$ kg

(rearrangement + substitution of data + calculation, 1 + 1 + 1 points).

Total: 14 points

Problem 2

a) Drawing Earth's position during the first and the second measurements:

2 + 2 points

It is sufficient to place the positions somewhere near the line connecting the Sun and Jupiter, especially in the second case (when it is farther from Jupiter). If the student does not indicate, which position corresponds to which measurement, only one point should be given for each position.

b) Determining the orbital period of Io:

4 points
(may be divided)

It can be found in the text that during half a year (1 point), Io orbits the Jupiter 103 times (1 point), so:

$T = \frac{365}{2 \cdot 103} = 1.77$ days = 42.5 hours (formula + calculation, 1 + 1 points).

c) Determining the speed of light using the data in the text:

4 points
(may be divided)

Because the distance between Earth and Jupiter increased by 300 million kilometers (1 point) between the two measurements, and light covers this distance in 1200 s (1 point),

$c = \frac{3 \cdot 10^8}{1200} = 250000 \ \frac{\text{km}}{\text{s}}$ (formula + calculation, 1 + 1 points).

d) Drawing up the statement on the orbital periods of the Galilean moons and justifying it:

4 points
(may be divided)

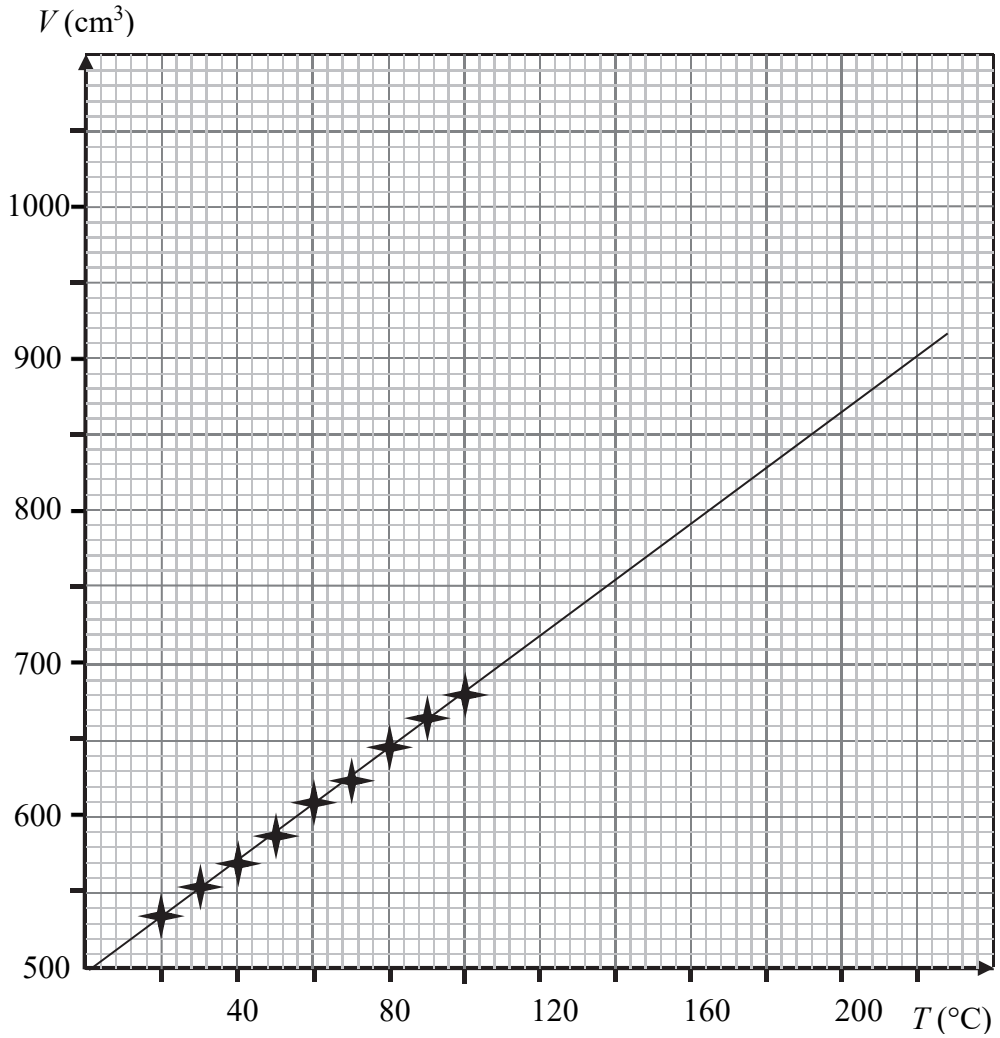
The orbital periods of the other Galilean moons are greater (2 points), because their distances from Jupiter are larger (2 points) than the distance of Io.

Total: 16 points

Problem 3/A

a) Plotting the data in the table on a graph:

5 points
(may be divided)



9 correct values are worth 5 points, 7-8 correct values 4 points, 5-6 correct values 3 points, 3-4 correct values 2 points, 1-2 correct values are worth 1 points.

b) Naming the nature of the relationship:

2 points

Linear relationship – the relationship must be named, a line drawn on the graph in itself is not sufficient. (Proportionality is not acceptable as an answer.)

c) Extrapolating the relationship to a temperature of 0 °C:

2 points

The volume would be about 500 cm^3 as seen on the graph.

d) Extrapolating the relationship to a temperature of 200 °C:

2 points

The volume would be about 860 cm^3 as seen on the graph.

e) Determining the temperature in question:

5 points
(may be divided)

The temperature in question can be determined using ratios of data pairs from the table or the graph, e.g.:

As the decrease of volume between 100-0 °C was 180 cm^3 (2 points),

for a further decrease of 500 cm^3, the required decrease of temperature is
$100 \cdot \frac{500}{180} \approx 278$ °C (2 points)

so the temperature in question is −278 °C (1 point).

(A more accurate reading of volume leads to a solution closer to the theoretical value (-273 °C). Any value between -260 °C and -285 °C must be accepted.)

f) Naming the significance of this temperature and naming the associated temperature scale:

4 points
(may be divided)

This temperature is the absolute zero (2 points),

the null-point of the Kelvin scale (2 points).

(Whether the student writes the theoretical value (-273 °C) or the calculated one, full points are to be given.)

Total: 20 points

Problem 3/B

Analyzing the passage of the bar magnet through the closed ring:

14 points
(may be divided)

The magnetic field of the bar magnet is inhomogeneous (2 points), so the aluminum ring is in a changing magnetic field (2 points) when the magnet gets closer to it. A voltage is induced in the ring (2 points) by the changing magnetic field. Because aluminum is a good conductor, a current is induced (2 points) in the closed ring due to the induced voltage. The current induced in the closed ring interacts (2 points) with the magnetic field of the bar magnet, such that it opposes (2 points) the effect that lead to its induction (i.e. the nearing of the magnet) according to Lenz's law (2 points).

Analyzing the case when the magnet nears the ring with the other pole:

3 points
(may be divided)

The phenomenon is not influenced by the direction of the magnetic field, as its cause is the changing of the field (2 points), so the device will turn just the same (1 point).

Analyzing the case of the open ring:

3 points
(may be divided)

Because the ring is open, no significant current will flow (2 points) due to the induced voltage, so there will be no rotating force due to the interaction between the bar magnet and the magnetic field of the induced current (1 point).

Total: 20 points

The origin of the sources for the problem sheet (pictures, drawings, data):

I/6. https://de.123rf.com
I/18. picture: en.wikipedia.org
III/A. picture: wikipedia.hu
III/B. picture: https://motokzn.ru/kocsi/lenz-torveny/; https://balazs-diak.hu/lenz-law-bemutato-eszkoz-11375