ÉRETTSÉGI VIZSGA • 2019. május 20.

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 can 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 favourable 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. **A**
3. **C**
4. **A**
5. **B**
6. **C**
7. **B**
8. **C**
9. **A**
10. **A**
11. **A**
12. **C**
13. **B**
14. **B**
15. **C**
16. **D**
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: $V = 3$ dl, $t_1 = 25$ °C, $t_2 = 10$ °C, $t_3 = 0$ °C, $t_{\text{ice}} = 0$ °C, $c = 4183 \ \frac{\text{J}}{\text{kg} \cdot \text{K}}$, $L = 334 \ \frac{\text{kJ}}{\text{kg}}$, $\rho = 1 \ \frac{\text{kg}}{\text{l}}$.

a) *Determining the amount of heat given off by the drink:*

3 points
(may be divided)

$Q_{drink} = c \cdot m_{drink} \cdot \Delta t_{drink} = c \cdot V \cdot \rho \cdot (t_2 - t_1) = -18824$ J
(formula + substitution of data + calculation, 1 + 1 + 1 points)
Points should not be deduced for the lack of the negative sign, provided that it does not cause an error later.

Determining the mass of the ice necessary:

7 points
(may be divided)

As $Q_{ice} = -Q_{drink}$ (2 points),

$Q_{ice} = L \cdot m_{ice} + c \cdot m_{ice} \cdot \Delta t_{ice}$ (2 points), from which

$m_{ice} = \frac{Q_{ice}}{L + c \cdot \Delta t_{ice}} = 0.05$ kg (rearrangement + calculation, 2 + 1 points).

b) *Determining the amount of ice in question:*

5 points
(may be divided)

$Q_{drink} = c \cdot m_{drink} \cdot \Delta t'_{drink} = c \cdot V \cdot \rho \cdot (t_3 - t_1) = -31373$ J
(substitution of data + calculation, 1 + 1 points)

$-Q_{drink} = Q_{ice} = L \cdot m_{ice}'$ (1 point), from which

$m_{ice}' = \frac{Q_{ice}}{L} = 0.093$ kg (rendezés + számítás, 1 + 1 pont).

Total 15 points

Problem 2

Data: $v = 90$ km/h, $f = 250$ Hz.

a) *Determining how the pitch of the sound changes and giving an explanation:*

5 points
(may be divided)

When the spacing of the ridges is more dense, the wheel will be hit more often (2 points), so the vibrations in the cabin will have a higher frequency (2 points), i.e. the pitch of the sound will be higher (1 point).

b) *Determining how the pitch of the sound changes and giving an explanation:*

5 points
(may be divided)

When driving with a greater speed, the wheel will be hit more often (2 points) on the same set of ridges, so the vibrations in the cabin will have a higher frequency (2 points), i.e. the pitch of the sound will be higher (1 point).

c) *Determining the ridge spacing necessary for the given sound pitch:*

5 points
(may be divided)

Because a car driving at 90 km/h covers a distance of 25 meters (1 point) each second,

and during this time the wheel has to be hit 250 times (1 point),

250 ridges / 25 meters i.e. 10 ridges/m are necessary (2 points).

Therefore, the ridge spacing is 10 cm (1 point).

Total 15 points

Problem 3/A

a) Filling out the first two columns of the table correctly with the values of the acceleration and the net force:

8 points
(may be divided)

Each correct numerical value is worth 1 point.

section	average acceleration (m/s^2)	average net force (N)	change of kinetic energy (kJ)	average useful power (kW)
0–100 km/h	11.11	20978	728.4	291.4
100–200 km/h	5.79	10926	2185.2	455.3
200–300 km/h	2.96	5579	3642	387.4
300–400 km/h	0.73	1369	5098.8	133.1

b) Filling out the last two columns of the table correctly with the values of the kinetic energy change and average useful power:

8 points
(may be divided)

Each correct numerical value is worth 1 point.

c) Determining the section with the lowest air drag:

4 points
(may be divided)

The smallest air drag has to be overcome on the first section (2 points) because air drag increases with speed (2 points).

Total 20 points

Problem 3/B

a) Energy is given off towards space through electromagnetic radiation (2 points) by stars and planets alike (2 points).

b) Thermal radiation emitted by a hotter body has a shorter wavelength (or higher frequency) (2 points) than that emitted by a cooler body.

c) Radiation in the visible range mostly passes through the atmosphere (2 points), a considerable amount of the radiation reaching the surface is absorbed by Earth (2 points). This energy heats Earth's surface (2 points). (It is not necessary to mention that part of the radiation is reflected by the atmosphere and by the surface. It is also correct to state that part of the energy is absorbed by the atmosphere.)

d) Energy emitted as infra-red radiation by the ground is mostly absorbed (2 points) by greenhouse gases (2 points) in the atmosphere.

e) If the carbon-dioxide content of the atmosphere increases, the fraction of Earth's thermal radiation that is absorbed in the atmosphere increases (2 points), thereby contributing to the gradual heating of the atmosphere (2 points).

Total 20 points