ÉRETTSÉGI VIZSGA • 2008. május 14.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ ÍRÁSBELI ÉRETTSÉGI VIZSGA

JAVÍTÁSI-ÉRTÉKELÉSI ÚTMUTATÓ

OKTATÁSI ÉS KULTURÁLIS MINISZTÉRIUM

In marking the examination papers follow the instructions of the evaluation guide, making clear corrections and comments. Do all marking in red ink using the conventional notations.

PART ONE

In the multiple-choice questions, the 2 points are 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 evaluation guide cannot be broken up further, unless indicated otherwise. Do not give partial credit.

The lines in the evaluation guide 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 evaluation guide 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 possible errors, differences, and incomplete answers.

Correct solutions using a different reasoning from the one(s) given in the evaluation guide 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 result algebraically without calculating quantities shown by the evaluation guide 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 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 on the axes in a graph do not need to indicate the units if they are clear from somewhere else. (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 the page.

PART ONE

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

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

Total **40 points**.

PART TWO

Problem 1

Realising the essence of the comparison: the prices of the same quantities of different energies or the quantities of the different energy sources that can be bought for the same price should be compared.

3 points

(Award the three points if there is no verbal reasoning but it is clear in the candidate's work that he or she attempted to use one of the above stated methods.)

Conversion of units:

3 points

1 kWh = 1000 W· 3600 s = 3600000 J = 3.6 MJ

or

1 MJ = $\frac{1}{3.6}$ kWh = 0.278 kWh

(J, kJ or MJ are all acceptable. Stating the result is enough.)

Calculating the comparable quantities:

6 points
(it can be further divided)

e.g.: 1 m^3 gas give off 34 MJ energy.

Price of 1 MJ gas is $\frac{58.34}{34}$ = 1.72 Ft

Price of 3,6 MJ electric energy is 26.8 Ft,

Price of 1 MJ is $\frac{26.8}{3.6}$ = 7.45 Ft

(If the candidate solved the problem in a different way, the 6 point should be split in the ratio of the number of steps in which the solution can be derived.)

Drawing the conclusion:

2 points

Comparing the calculated unit prices, it can be stated that the gas fired boiler is more efficient. (Any clear notation which shows the selection of the candidate and which comes from the calculations is acceptable.)

Total: 14 points

Problem 2

a) Realising that Kepler's laws are true for the satellite Earth system as well:

3 points

(Setting up the equation of Kepler's third law shows this; the 3 points are due without any further explanation.)

Setting up Kepler's third law for the problem:

2 points

$\frac{T_1^2}{T_2^2} = \frac{r_1^3}{r_2^3}$, where *T-s* stand for the periods and *r-s* stand for the radii of orbits.

(The 2 points are due only if it is clear from the candidate's solution that he or she is aware of the correct meaning of the letters (e.g. substitution of the data shows this) the points are also due if the meaning of the letters is clear but the substituted values are not correct.)

Determining the period and the radius of the geostationary satellite:

$T_2 = 24$ h

2 points

$r_2 = 6380$ km + 35 786 km = 42166 km

2 points

Finding the period of the smaller satellite:

4 points
(it can be further divided)

$$\frac{T_1^2}{T_2^2} = \frac{r_1^3}{r_2^3}; \quad \frac{T_1^2}{T_2^2} = \left(\frac{r_1}{r_2}\right)^3 = \left(\frac{20180}{42166}\right)^3 = 0.1096; \quad \frac{T_1}{T_2} = \sqrt{0.1096} = 0.331;$$

$T_1 = 0.331 \cdot 24\text{ h} = 7.94\text{ h} \approx 8\text{ h}$

Answer to question a):

2 points

Comparing the periods it can be seen that the smaller satellite does not lag behind a chosen point on the equator of the Earth, on the contrary it orbits faster than the Earth rotates.
(If the candidate refers to the above proportionalities on the basis of Kepler's third law and gives the answer without calculations the two points are due.

b) Calculating the distance covered by the smaller satellite in 1 hour:

3 points
(it can be further divided)

During $T = 8$ h it covers a distance of $2r\pi$, thus during one hour it covers one-eight of it, so it covers:

$$s = \frac{2 \cdot 20180\,\text{km} \cdot 3.14}{8} = 15\,841\,\text{km}\,.$$

(If the candidate did not calculate anything in part a) and did the calculations in part b) the points which are due to that part should be awarded here.)

Total: **18 points**

Problem 3.A

a) *Filling the missing part of the table.*
Connection between the change in the temperature of the hot and cold water:

4 points

$cm_{cold}|\Delta t_{cold}| = cm_{hot}|\Delta t_{hot}|$, *so* $m_{cold}|\Delta t_{cold}| = m_{hot}|\Delta t_{hot}|$
(c is the specific heat capacity of water which is considered constant.)

(If the relationship is not stated but it is clear from the further calculations that the candidate considers that the absolute values of the changes in the themperature and the masses are inversely proportional the *three* points are due.)

Filling in the given table:

8 points
(It can be further divided)

$t_{mixture}$ (°C)	$m_{mixture}$ (kg)	m_{cold} (kg)	m_{hot} (kg)	Δt_{cold} (°C)	Δt_{hot} (°C)
30	1.2	1	0.2	10	50
40	1.5	1	0.5	20	40
42.5	1.6	1	0.6	22.5	37.5
50	2	1	1	30	30

(Count 0.5 point for reading each datum from the graph and filling in each empty space in the first two columns of the table, count 0.25 point for each correct result in the fourht and the fifth column , and count 1 point for each correct result in the sixth column . If the sum of these points is not an integer award only the greatest integer part of the sum.)

b) Calculating the temperature of the hot water. ***2 points***
e.g.: When the decrease of the temperature of the hot water was 30°C, the common temperature was 50°C, thus the temperature of the hot water was 80°C.
(Calculations using any pair of data and any other way of solution resulting the correct answer are acceptable.)

c) Realising that the increase of the temperature of the mixture is not directly proportional to the mass of one of the components (the mass of the added hot water) and giving a simple explanation.

4 points
(It can be further divided)

Example for the reasoning: The common temperature depends on the ratio of the cold and hot water. If the amount of the mixture is increased uniformly, that is the same amount of hot water is added to the mixture, than the common temperature is not changing uniformly, because the internal energy and the total mass of the system increases with the same quantity but not increased by the same factor.

(Any simple explanation can be accepted which explains the nonlinear connection between the two quantities.)

Total: 18 points

Problem 3.B

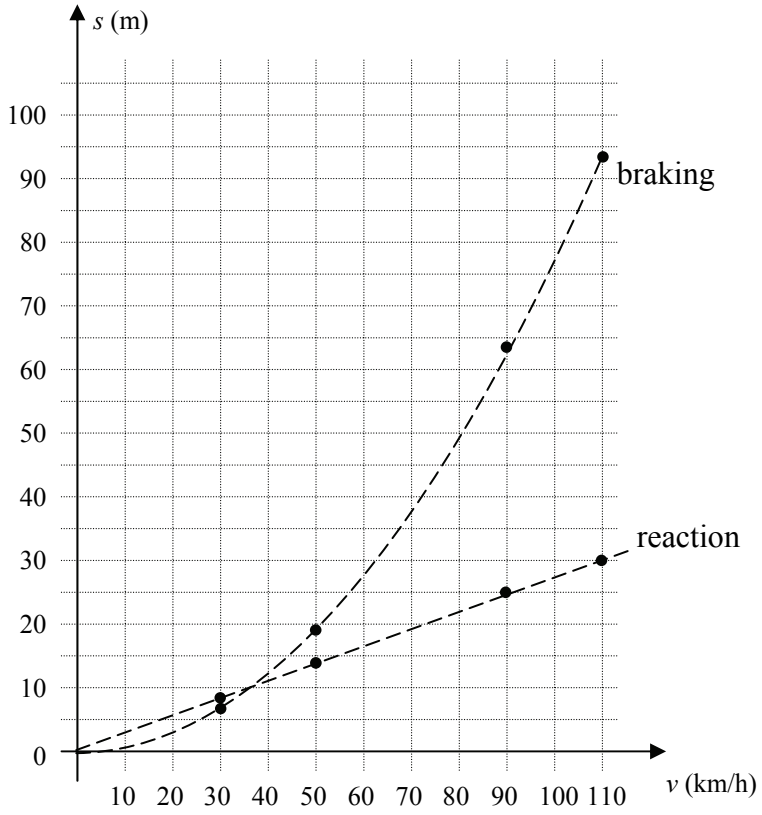
a) Plotting the reaction distance versus speed graph (drawing the straight line passing through the origin):

2 points

Plotting the breaking distance-speed graph (a curve similar to a parabola through the origin):

3 points
(It can be further divided)

(If the curve does not pass through the origin but it is similar to the parabola award 1 point.)



b) Stating that the car moves uniformly along the reaction distance:

1 point

Stating that the distance covered and the velocity are directly proportional; realising that the reaction time is constant:

2 points
(It can be further divided)

The reaction distance is directly proportional to the initial speed, because the motion is uniform, thus the ratio of the two quantities, the reaction time, is constant.

Identifying the uniformly accelerated motion:

2 points

Realising that the braking distance is proportional to the square of the speed :

4 points
(It can be further divided)

(It is not necessary to find the proportionality constant.!)

Comparing the distances covered in the two different types motions:

2 points

Above the speed approximately. 35 km/h the braking distance is longer than the reaction distance.

(If the candidate implies that at the speed of 30 km/h the braking distance is smaller than the reaction distance but at a speed of 50 km/h the braking distance is greater than the reaction distance the two points can be awarded.)

c) *Filling in the table, and realising that the critical stopping distance is the sum of the reaction distance and the braking distance.*

2 points
(it can be further divided)

Speed (km/h)	Reaction distance (m)	Braking distance (m)	Critical stopping distance (m)
30	8	7	15
50	14	19	33
90	25	63	88
110	31	93	124

(The addition of the reaction and the breking distances should not be reasoned, the correct calculation shows that the candidate realised this.)

Total: 18 points