ÉRETTSÉGI VIZSGA ● 2011. május 17.

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ANGOL NYELVEN

KÖZÉPSZINTŰ ÍRÁSBELI
ÉRETTSÉGI VIZSGA

JAVÍTÁSI-ÉRTÉKELÉSI
ÚTMUTATÓ

NEMZETI ERŐFORRÁS
MINISZTÉRIUM

EVALUATION GUIDE

FIRST PART

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.

SECOND PART

The individual scores shown in the evaluation guide may not be broken up unless explicitly indicated.

The sentences printed in italics in the evaluation guide define the steps necessary for the solution. The scores indicated here may be awarded if the action or operation described by the text in italics can be clearly identified in the work of the examinee and is basically correct and complete. Wherever the action can be broken down into smaller steps, partial scores are indicated beside each line of the expected solution. The „expected solution" is not necessarily complete; its purpose is to indicate the depth of detail required of the examinee when writing the solution. Comments in brackets that follow provide further guidance on the evaluation of possible errors, differences or incomplete answers.

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 fraction of the full score may be awarded for correct interpretation of the question, for stating relationships, for calculations, etc.

Should the examinee 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 may be awarded if the reasoning is correct. The purpose of indicating scores for intermediate results is to make the evaluation of incomplete solutions easier.

For errors that do not affect the correctness of reasoning (miscalculations, clerical errors, conversion errors, etc.) deduce points only once.

Should the examinee write more than one solutions, or 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 examinee.

The lack of units during calculation should not be considered a mistake – unless it causes an error. However, the results questioned by 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).

If, in case of problem 3 the examinee does not indicate his/her choice, the procedure described in the exam description should be followed.

Following the evaluation, the appropriate scores should be entered into the tables at the bottom of each page.

FIRST PART

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

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

Total 40 points.

SECOND PART

Problem 1.

Data: m = 20 kg, l = 3 m, $\alpha = 30°$, $g = 10\frac{\text{m}}{\text{s}^2}$

Two different courses of the solution are denoted by I. and II.

a) *Formulation of a necessary condition of equilibrium:*

1 point

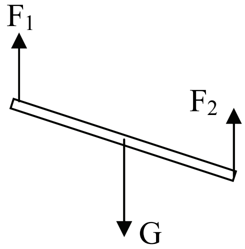
I.: The sum of the forces acting on the beam is zero.
or II.: The sum of the torques acting on the beam (relative to a certain point) is zero.
(If the explicit formulation of the condition is missing, but it is evident from the solution that the examinee consciously utilizes it, the point is to be awarded.)

A quantitative formulation of the equilibrium:

4 points
(may be divided)

I.: A diagram of the three forces with parallel lines of action acting on the beam (1 point).
(The point is to be awarded even if F_1 and F_2 do not look equal in magnitude on the drawing.)

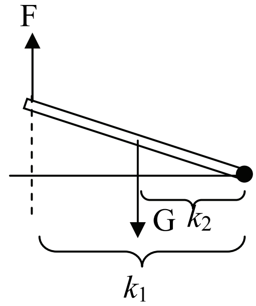
The equation for the forces in some form e.g. : $F_1 + F_2 = G$ (1 point)



Because the sum of the parallel F_1 and F_2 forces act at the middle of the beam,
$F_1 = F_2$ (1 point) and so $2F = G$. (1 point)

or II.: A diagram of two forces that act on the beam and the corresponding lever arms (1 point)

and the equation for the torques in some form e.g.: $F \cdot k_1 = G \cdot k_2$ (1 point)
(provided that the pivot point is on the line of action of the third force).



Because $k_1 = 2\,k_2$, (1 point)
thus $2\,F = G$. (1 point)

Determining the tension in the rope:

1 point

$$F = \frac{G}{2} = 100\ \text{N}$$

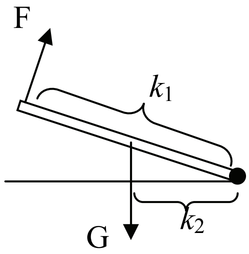
b) *Recognizing that the sum of the torques is zero:*

1 point

$F \cdot k_F = G \cdot k_G$ (provided that the pivot point is the end of the beam resting on the ground)

Determining the lever arms on a diagram:

3 points
(may be divided)



$k_1 = l$, k_2 is the distance between the pivot point and the line of action of G.
(If the examinee recognizes these, the three points should be awarded even in the absence of a drawing.)

Calculation and results:

4 points
(may be divided)

$$k_2 = \frac{l}{2} \cdot \cos\alpha$$

$$F \cdot l = G \cdot \frac{l}{2} \cdot \cos\alpha$$

$$F = G \cdot \frac{1}{2} \cdot \cos 30°$$

$$F = 87\ \text{N}$$

Total 14 points

Problem 2.

Data: P = 500 MW, $H = 12\,\frac{\text{MJ}}{\text{kg}}$

a) *Determining the number of fusion reactions occurring per second:*

7 points

As $1\,\text{eV} = 1.6\cdot10^{-19}\,\text{J}$,

1 point

so the energy released in a single D-T reaction is
$E_{DT} = 17.6\,\text{MeV} = 17.6\cdot10^{6}\cdot1.6\cdot10^{-19}\,\text{J} = 2.82\cdot10^{-12}\,\text{J}$,

1 point

$E = P\cdot t = 500\,\text{MW}\cdot1\text{s} = 5\cdot10^{8}\,\text{J}$ energy is released during one second,

1+1 points

thus the number of reactions is given by the ratio $\frac{5\cdot10^{8}}{2.82\cdot10^{-12}}$.

1 point

So the number of reactions occurring per second is
$N_{reaction} = 1.77\cdot10^{20}$

2 points

($1.8\cdot10^{20}$ is also acceptable.)

b) *Realizing that the fuel consumption may be calculated from the molar mass and the number of moles:*

2 points

(Any element of the solution may indicate this recognition; an explicit expression is not necessary.)

Calculating the number of reactions occurring per second expressed in moles:

$$n = \frac{1.77\cdot10^{20}}{6\cdot10^{23}} \approx 0.3\cdot10^{-3} = 3\cdot10^{-4}\,\text{mol}$$

2 points
(may be divided)

Determining the molar mass of the fuel:

4 points

In a plasma state the fuel is a monatomic gas, so the molar masses are equal to the atomic masses.

1 point

$M_{\text{D}} = 2\frac{\text{g}}{\text{mol}}$, $M_{\text{T}} = 3\frac{\text{g}}{\text{mol}}$

1+1 points

$M_{\text{fuel}} = M_D + M_T = 5\frac{\text{g}}{\text{mol}}$.

1 point

Calculating the mass of fuel consumed during one second:

2 points
(may be divided)

$m = n \cdot M = 1.5 \cdot 10^{-3}\, g$

Calculating the mass of fuel consumed during one minute:

1 point

$m = 90 \cdot 10^{-3}\, g = 0.09\, g$

b) Second solution (outline)

For realizing that knowing the molar mass and the number of moles is necessary: (2 points)
Plasma state $\Rightarrow$ M = A (1 point)
$M_D = 2\frac{g}{mol}$, $M_T = 3\frac{g}{mol}$ (1 + 1 points)
The number of reactions occurring during a minute $N = 60 \cdot 1.77 \cdot 10^{20}$ (1 point)
The number of moles per minute $n = \frac{60 \cdot 1.77 \cdot 10^{20}}{6 \cdot 10^{23}} = 1.77 \cdot 10^{-2}$ mol
(2 points, may be divided)
$m_D = n \cdot M_D = 3.5 \cdot 10^{-2}\, g$ (1 point)
$m_T = n \cdot M_T = 5.3 \cdot 10^{-2}\, g$ (1 point)
The total is $m = 8.8 \cdot 10^{-2}\, g \approx 0.09\, g$ (1 point)

b) Third solution (outline)

Realizing that deuterium is composed of two nucleons, while tritium is composed of three, so five nucleons take part in each reaction: (4 points, may be divided)
The amount of fuel consumed in one second is $N = 5 \cdot 1.77 \cdot 10^{20}$ nucleons (2 points)
The mass of which is approximately $5 \cdot 1.77 \cdot 10^{20} \cdot m_p$ (or m_n) (2 points)
Finding the mass of a nucleon: (1 point)
Calculation: $m = 8.8 \cdot 10^{-2}\, g \approx 0.09 g$ (2 points, may be divided)

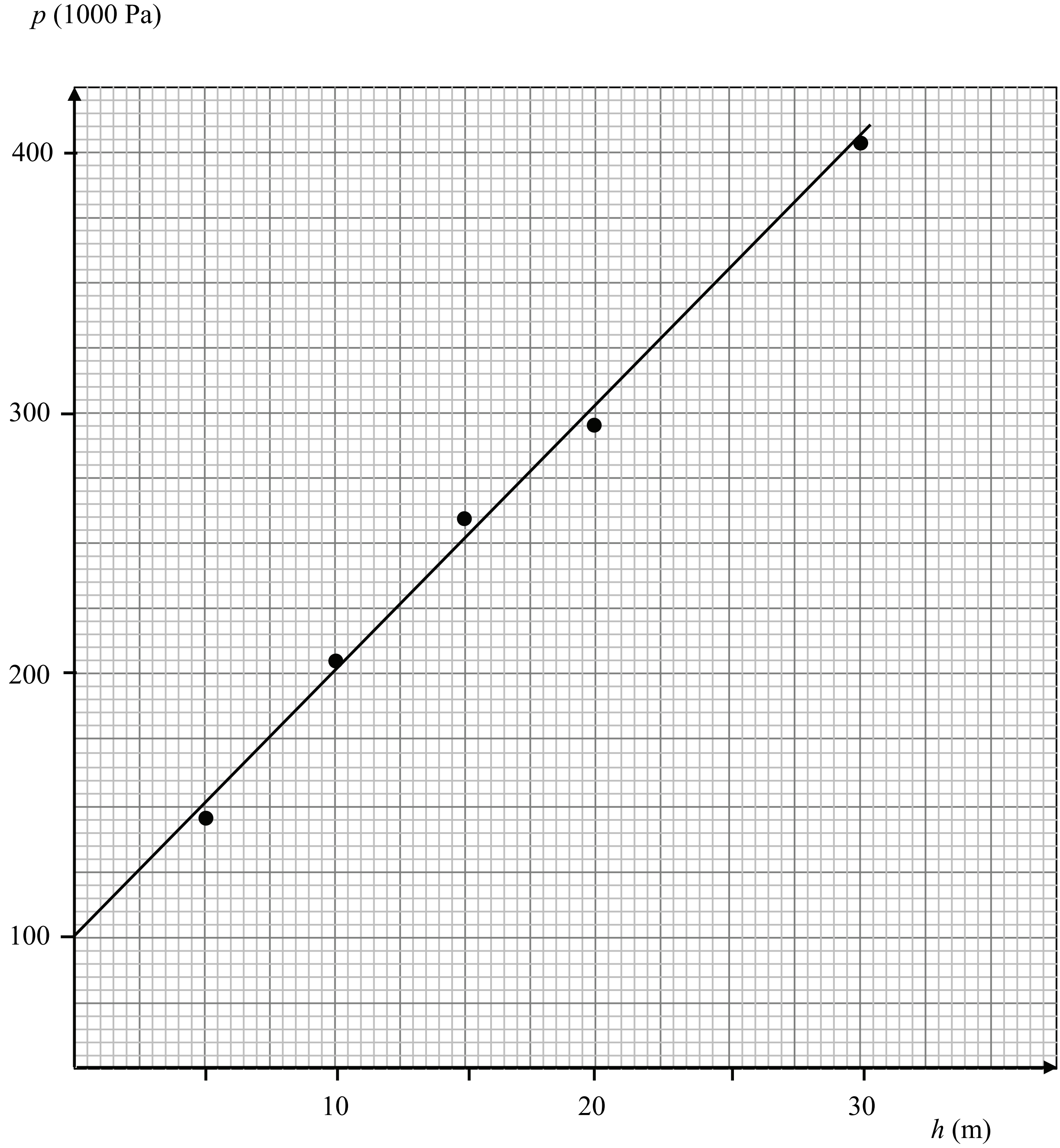
Total 18 points

Problem 3/A

The pressures determined by the examinee may differ from those given in the evaluation guide by ± 5000 Pa if the course of the solution is correct.

a) *Plotting the data provided:*

8 points
(may be divided)



(Drawing the axis with scaling and labeling is worth 2 points each, plotting the data is worth 4 points. Physical units for the axis labels are necessary, in the absence of which only one point per axis may be awarded.)

b) *Determining the pressure at a depth of 25 m:*

2 points

The pressure may be determined by fitting a line to the data and reading the value from the graph to be approximately 350 000 Pa. (It may also be determined by averaging the pressures at depths of 20 meters and 30 meters provided in the table.)

c) *Determining the pressure at the surface of the lake (atmospheric pressure):*

3 points

Atmospheric pressure may be determined by fitting a line to the data and identifying the intersection of the line and the vertical axis at $h = 0$ m: $p_0 = 100\,000$ Pa

(Should the examinee provide the correct answer without indication of how it was derived, only one point may be awarded.)

d) *Applying Boyle's law for the relation between the bubble's pressure and volume:*

3 points
(may be divided)

$p_1 \cdot V_1 = p_0 \cdot V_0 = p_0 \cdot 3 \cdot V_1$ (2 points)
so the pressure within the shipwreck is $p_1 = p_0 \cdot 3 = 300\,000\ \text{Pa}$. (1 point)

Determining the depth of the shipwreck:

1 + 1 points

The pressure within the bubble is always equal to the external pressure. (1 point)
The depth corresponding to a pressure of 300 000 Pa may be found in the table or read from the graph to be 20 m. (1 point)

Total 18 points

Problem 3/B

a) *Naming the phenomena depicted by the two series of photographs:*

2 + 2 points

The first series shows the phases of the Moon, the second one a lunar eclipse.

b) *Explaining the reasons for the darkening in the first and second cases:*

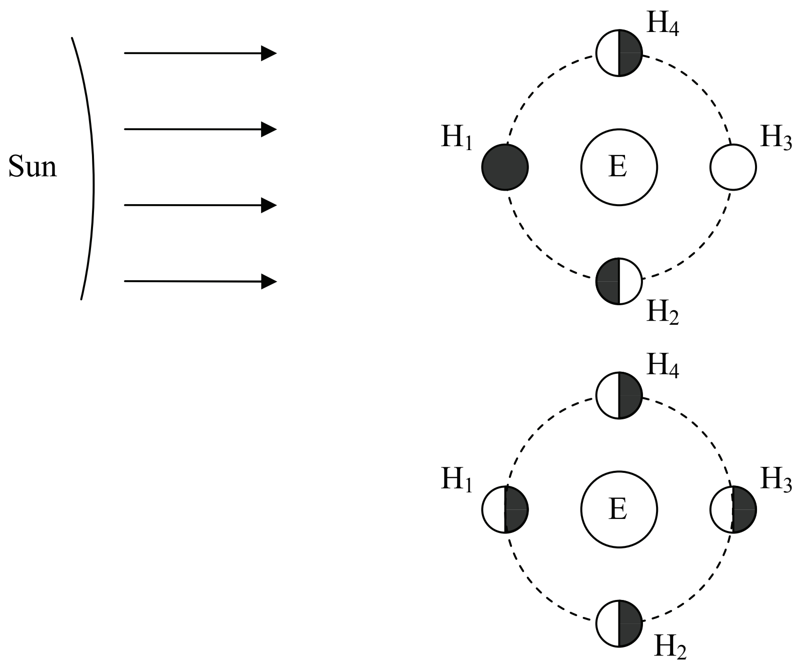
2 + 2 points

In the first case, the relative positions of the Moon, Earth and Sun are such, that we do not see the whole of Moon's illuminated hemisphere.
In the second case, the Moon resides in the shadow cast by Earth, so light from the Sun does not reach it and therefore appears dark.

c) In case of choice I.

Preparing a drawing that depicts the lunar phases:

10 points
(may be divided)



A drawing of the Sun, the Earth and Moon's orbit around Earth (2 points). Indicating the Sun is not necessary as long as e.g. arrows depict the light coming from the Sun. A point-like light source is also acceptable, but in the absence of any light source, no point is to be awarded here.

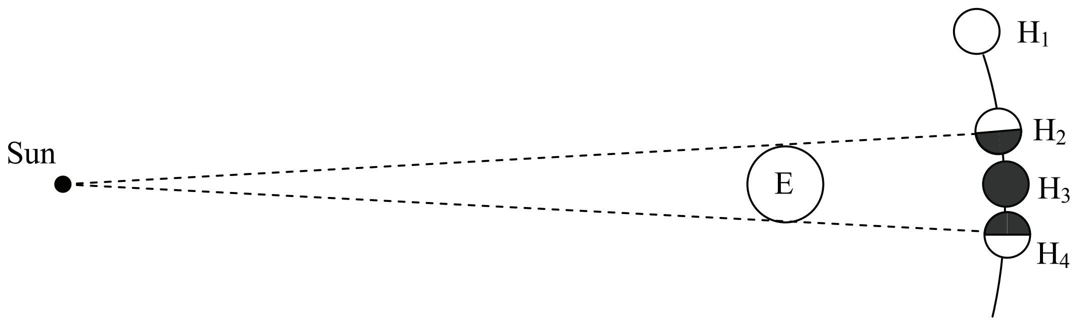
Indication of the Moon's positions corresponding to the lunar phases (2 points each).
A drawing of the Moon at the correct position and in the corresponding phase is worth two points, otherwise no point is to be given. Indicating the phase may be via numbering according to the picture (H_1, etc.) or by sketching the phase on the drawing. This latter may also be performed in two different ways, as shown on the figures. In the first one, the view of the Moon was drawn as seen from Earth. In the second one, the view of the Moon was drawn as seen from "farther out" in space, which is always a sphere illuminated from one side, but the illuminated side is not always the one towards Earth. Either method is acceptable, as long as it is consistent.

(As the relation between the view and the direction of the orbit is not to be discussed, the labels H_2 and H_4 are interchangeable.)

In case of choice II.

Preparing a drawing that shows the lunar eclipse:

10 points
(may be divided)



A drawing of the Sun, the Earth and the section of Moon's orbit around Earth, as well as indicating the shadow cast by Earth (2 points which may be divided).

(Drawing a shadow due to a point-like light source is acceptable. Drawing or discussing the total and partial shadows is not necessary.)

Drawing the positions of the Moon corresponding to the numbered pictures (2 points each).
As long as the numbering of the positions is correct, deviations in the amount of coloring are not to be considered a mistake.

Total 18 points