ÉRETTSÉGI VIZSGA ● 2013. május 16.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ ÍRÁSBELI ÉRETTSÉGI VIZSGA

JAVÍTÁSI-ÉRTÉKELÉSI ÚTMUTATÓ

EMBERI ERŐFORRÁSOK MINISZTÉRIUMA

The examination papers should be corrected and evaluated clearly, according to the instructions of the evaluation guide. Markings should be in red ink, using the conventional notations.

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

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

Total: 40 points.

SECOND PART

Problem 1

Data: $\Delta x = 4$ cm, $t = 9$ s, $N = 24$ stitches, $D = 1$ cm, $\Delta l = 4$ mm/stitch

a) *Formulating and calculating the amplitude of harmonic motion:*

1 + 1 points

$A = \frac{\Delta x}{2} = 2\text{ cm}$ (formula + calculation, 1 + 1 points)

Formulating and calculating the angular frequency of harmonic motion:

1 + 1 points

$\omega = 2\pi \cdot \frac{24}{9\text{ s}} = 16.76\,\frac{1}{\text{s}}$ (formula + calculation, 1 + 1 points)

Formulating and calculating the maximum velocity of harmonic motion:

1 + 1 points

$v_{\text{max}} = A \cdot \omega = 33.5\,\frac{\text{cm}}{\text{s}}$ (formula + calculation, 1 + 1 points)

Formulating and calculating the maximum acceleration of harmonic motion:

1 + 1 points

$a_{\text{max}} = A \cdot \omega^2 = 562\,\frac{\text{cm}}{\text{s}^2}$ (formula + calculation, 1 + 1 points)

b) *Formulating and calculating the number of stitches completed during one minute:*

1 + 1 points

$N = 60\text{ s} \cdot \frac{24}{9\text{ s}} = 160$ (formula + calculation, 1 + 1 points)

Calculating the circumference of the reel:

1 point

$K = D \cdot \pi = 31.4\text{ mm}$

Formulating and calculating the length of the thread consumed in one minute:

1 + 1 points

$l = N \cdot \Delta l = 640\text{mm}$ (formula + calculation, 1 + 1 points)

Formulating and calculating the reel's number of revolutions per minute:

1 + 1 points

$R = \frac{l}{K} = 20.4 \approx 20$ (formula + calculation, 1 + 1 points)

Total 15 points

Problem 2

Data: m = 78 kg, A_{ice} = 0.5 m^2, L = 334 kJ/kg, P_{Sun} = 400 W/m^2, η = 25%

Formulating and calculating the energy required to melt half of the ice slab:

2 + 2 points

$E = \frac{m}{2} \cdot L = 13\,206 \text{ kJ}$ (formula + calculation, 2 + 2 points)

Formulating and calculating the average power with which the Sun heats the ice slab:

6 points
(may be divided)

The average power incident on the slab's surface:
$P_{incident} = P_{Sun} \cdot A_{ice} = 200 \text{ W}$ (formula + calculation, 2 + 1 points)

Therefore the average power heating the slab is:
$P_{heating} = P_{incident} \cdot \eta = 50 \text{ W}$ (formula + calculation, 2 + 1 points)

Formulating and calculating the time required to melt half of the ice:

5 points
(may be divided)

$t = \frac{E}{P_{heating}} = 260\,520 \text{ s}$ (formula + calculation, 2 + 1 points)

Considering that the Sun shines only 12 hours a day, this time is:

$t = 260\,520 \text{ s} \cdot \frac{1 \text{ day}}{12 \cdot 3600 \text{ s}} = 6.03 \text{ days} \approx 6 \text{ days}$ So it takes six days for half of the ice slab to melt. (2 points)

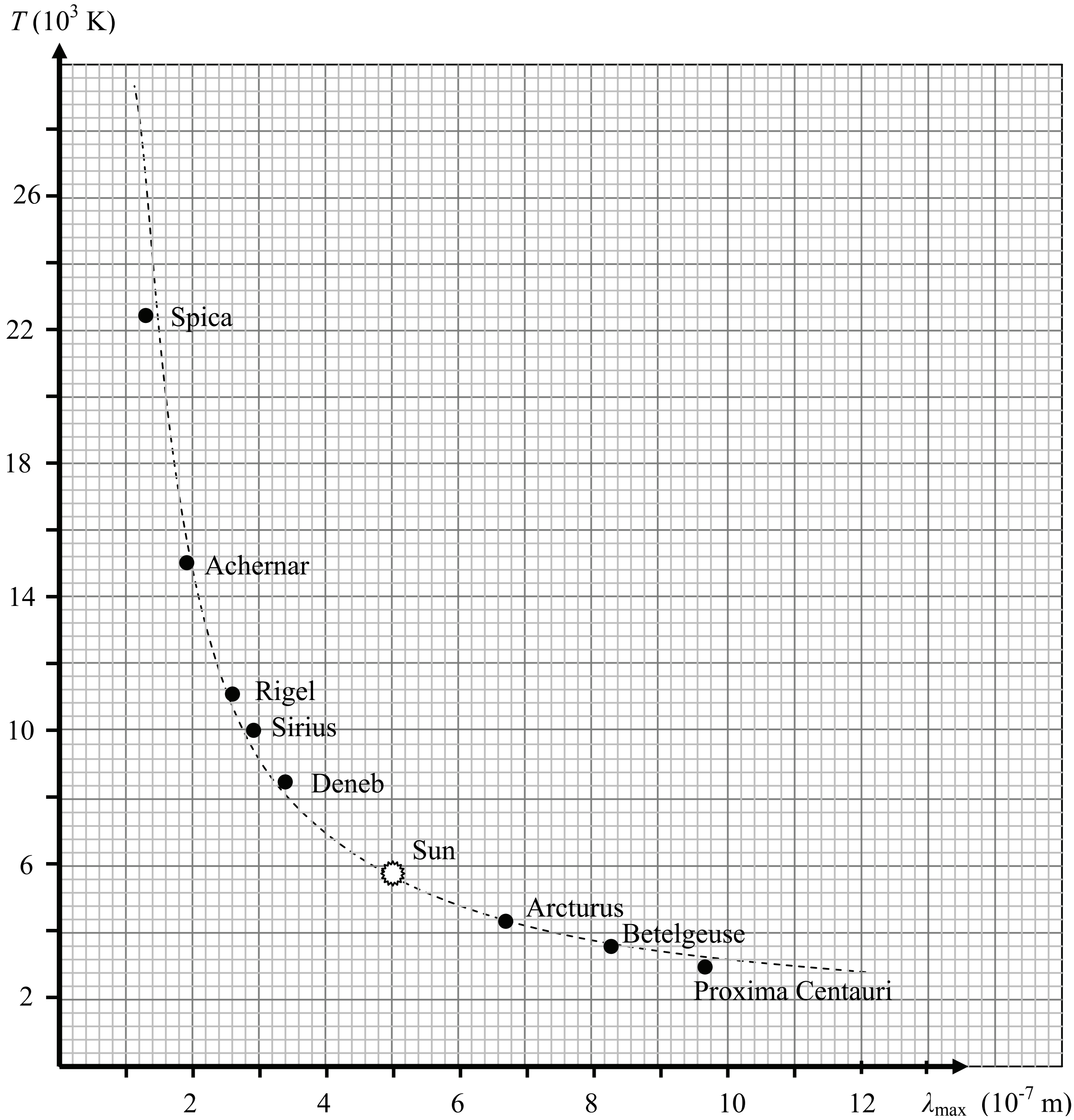
Total 15 points

Problem 3/A

a) *Drawing a suitable graph and correctly plotting the data:*

6 points
(may be divided)

(The properly scaled and labeled axes are worth 1 point each, plotting the data pairs is worth 3 points altogether. One point should be deduced if 2-3 data points are plotted incorrectly, 2 points should be deduced if 4-5 data points are plotted incorrectly. Drawing the line of best fit is worth 1 point. Should the examinee just join the points on the graph instead of fitting a curve, the point for the line of best fit may not be awarded. Labeling the data points with the names of the stars is not absolutely necessary; an omission does not count as an error.)



b) Positioning the Sun on the graph:

4 points
(may be divided)

The point corresponding to the Sun should be placed at the predetermined $\lambda_{max} = 5 \cdot 10^{-7}$ m position along the horizontal axis (1 point), such that it lies on the hyperbola drawn using the data points already plotted (2 points). The point corresponding to the Sun should be marked, distinguished from the rest of the data points unambiguously by labeling it or by the use of some symbol (1 point).

Determining the surface temperature of the Sun using the graph:

3 points

For the surface temperature of the Sun, any value between the temperatures 5400 K and 6400 K must be accepted.

c) Listing those stars where the intensity maximum of the radiation is in the ultraviolet region:

3 points
(may be divided)

The stars Sirius, the Rigel, the Spica the Achernar and the Deneb.
(Listing 3-4 stars from the above list is worth 2 points, listing 1-2 stars is worth 1 point.)

d) Listing those stars which look red to our eyes:

4 points
(may be divided)

The stars Arcturus, the Betelgeuse and the Proxima Centauri.
(Listing of the three stars is worth 1 + 1 + 1 points. If the Betelgeuse or the Proxima Centauri is present in the list one additional point should be awarded for realizing that a star whose radiation intensity maximum lies in the infrared looks red to our eyes.)

Total 20 points

Problem 3/B

Recognizing that the cause of the phenomenon is induction:

4 points
(may be divided)

When we push the magnet into the ring, the changing magnetic field induces a current (2 points). In the magnetic field, a force is acting on the ring, which is a current carrying conductor (2 points) that is why the ring starts moving.

Explaining the ring's direction of motion using Lenz's law:

6 points
(may be divided)

According to Lenz's law (2 points), the magnetic field generated by the ring, which is a current carrying loop, is such that it repels the approaching magnet (2 points). For this reason the ring starts moving in the same direction as the approaching magnet. When we pull the magnet out, i.e. we move it away, the magnetic field of the current induced in the ring attracts the magnet (2 points), so the ring starts moving in the same direction as the motion of the magnet again.

Analysis of the equilibrium position of the ring after the magnet was inserted:

6 points
(may be divided)

After the magnet was inserted and all movement ceased, the ring was left hanging in its original position (2 points), because in the absence of movement or change, there is no current in the ring (2 points), so there is no force to displace it (2 points).

Analyzing how pushing the north pole of the magnet into the ring changes the phenomenon:

4 points
(may be divided)

If we reverse the magnet and push its north pole into the ring, what takes place looks completely the same as in the previous case (2 points). Naturally, the direction of the currents flowing in the ring is opposite (2 points) to that of the currents in the previous experiment.

Total 20 points