

ÉRETTSÉGI VIZSGA • 2011. október 27.

**FIZIKA
ANGOL NYELVEN**

**KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA**

2011. október 27. 14:00

Az írásbeli vizsga időtartama: 120 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

**NEMZETI ERŐFORRÁS
MINISZTERIUM**

Instructions for the examinee

The time allowed for the examination is 120 minutes.

Read the instructions for the problems very carefully and use your time wisely.

You may solve the problems in arbitrary order.

Allowable materials: pocket calculator, data tables

Should the space provided for the solution of a problem be insufficient, you may continue the solution on one of the empty sheets at the end of the examination paper. Please indicate the number of the problem on the sheet.

Please indicate here which of the two problems 3/A and 3/B you have chosen (that is, which one you would like evaluated):

3/ ☐

PART ONE

Precisely one of the possible solutions for each of the following questions is correct. Write the corresponding letter in the white square on the right. (Verify your answer with calculations if necessary.)

- 1. Two cars are moving along the same straight line, in the same direction. As the faster one catches up with the slower one, a perfectly inelastic collision takes place. Which of the two cars suffered a greater change of speed during the inelastic collision?**

- A) The one that was moving faster.
B) The one that was moving slower.
C) It cannot be determined using the information at hand.

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2 points	
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- 2. The star Proxima Centauri is about 4.5 light-years away. Approximately how many times farther is it from us, than the Sun?**

- A) Approximately 300000 times.
B) Approximately 30000 times.
C) Approximately 3000 times.

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2 points	
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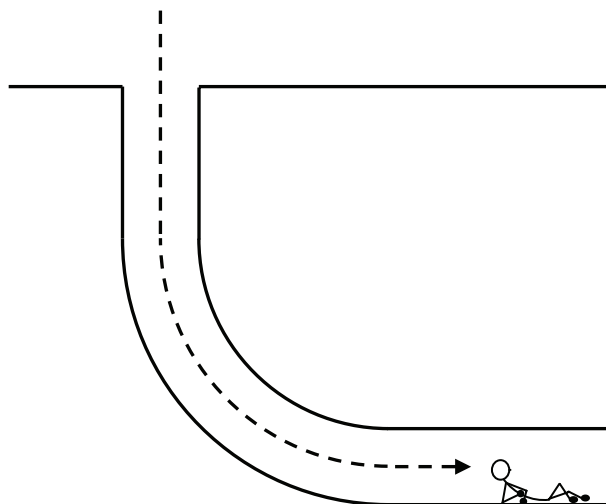
- 3. How can we increase the temperature of a gas that is in a cylinder enclosed with a piston, if the cylinder and the piston are both insulated?**

- A) By increasing the volume of the gas.
B) If the cylinder is insulated, we cannot increase the temperature of the gas.
C) By decreasing the volume of the gas.

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2 points	
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4. Towards the end of the film *The Empire Strikes Back*, Luke Skywalker plummets into the deep and falls directly into a tube that starts vertically, but then follows a circular curve to make a turn. In the tube, he is not smashed to death, but slows down gradually to stop unharmed. Should something like this happen in real life, which force could possibly slow the falling hero so that he can be saved?



- A) The normal force exerted by the tube wall could break the body gradually provided the curve of the tube is suitable.
B) The force of friction could break the body gradually provided the curve of the tube and the coefficient of friction are suitable.
C) The centripetal force arising in the curve could break the body gradually provided the curve of the tube is suitable.

☐

2 points

5. Can white light always be decomposed using a glass prism?

- A) Yes it can, because white light is never monochromatic.
B) No, not always, because white light may be either monochromatic or composite and only composite light can be decomposed.
C) No, because white light does not contain any colours.

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2 points

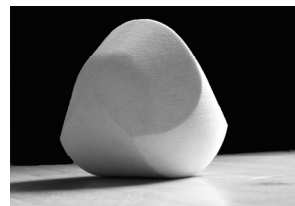
6. We empty an aerosol can by pressing the actuator until no more spray is emitted. What is in the can after we have emptied it?

- A) There is vacuum in the can.
B) There is only air in the can.
C) There are the remnants of the original content in the can.

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2 points

7. The object called „Gömböc” returns to the same equilibrium position regardless of how it is placed initially. What happens to its center of mass during the process?



- A) The center of mass of the Gömböc is lowered.
B) The center of mass of the Gömböc is raised.
C) That depends on how it was placed on the table initially.

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2 points

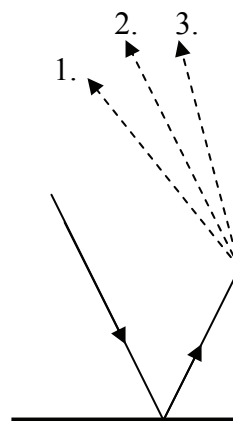
8. What nucleus is created during the γ decay of actinium, whose atomic number is 89?

- A) Radium, whose atomic number is 88.
B) Thorium, whose atomic number is 90.
C) No new nucleus is created, despite the radioactive decay it remains actinium.

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2 points

9. A ray of light is incident on two planar mirrors that enclose a right angle with each other. The light is reflected first from one mirror and then from the other mirror as shown on the figure. In which direction does the ray propagate after the second reflection?



- A) After the second reflection, the light propagates in a direction turning towards the incident ray (1.)
B) After the second reflection, the light propagates in a direction parallel to the incident ray (2.)
C) After the second reflection, the light propagates in a direction turning away from the incident ray (3.)

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2 points

10. Which of the following is a unit of force?

- A) $\text{kg} \frac{\text{m}}{\text{s}^2}$
B) $\text{kg} \frac{\text{m}^2}{\text{s}^2}$
C) $\text{kg} \frac{\text{m}}{\text{s}}$

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2 points	
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11. Is it possible for water to be present in all three states simultaneously (ice, water and water vapour) in a closed container?

- A) No, the presence of only one state is possible in the container at any one time (either ice, or water, or water vapour).
B) No, the presence of only two states is possible in the container simultaneously (either ice and water, or water and water vapour).
C) Yes, it is possible.

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2 points	
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12. Is it true, that considering wires of the same cross-section, the longer one always has a greater resistance?

- A) Yes, always.
B) No, never.
C) It depends on the material the wires are made of whether it is true or not.

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2 points	
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13. Which of the following phenomena can be explained using the thermal expansion of solids?

- A) The fact that in high mountains water freezing in the cracks can break rocks up.
B) The fact that in summer heat rail tracks may develop humps.
C) The fact that in dry spells during summer cracks develop in the soil.

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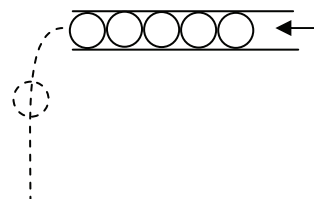
2 points	
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14. What is an artificial radioactive isotope?

- A) A radioactive isotope that does not decay in nature, only as a result of human intervention.
- B) A radioactive isotope that cannot be found in nature, but may be synthesized artificially.
- C) A radioactive isotope that does not decay via one of the naturally occurring types of radioactive decay.

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2 points

15. Balls are placed in a horizontal tube, touching each other. The row of balls is pushed out of the tube with a small, constant speed. What can we say about the series of bangs we hear when the balls hit the ground? (Air drag is negligible.)

- A) We hear one single bang.
- B) We hear a series of bangs at roughly equal time intervals.
- C) The time that elapses between the bangs increases.

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2 points

16. Is it possible for the electric field lines to intersect each other?

- A) Yes it is, provided that at least two different charges are present that generate the field.
- B) No, because the electric field lines are parallel to the direction of the force exerted on a test charge by the electric field everywhere.
- C) No, because if more than one charge generates the field, the field lines of the smaller charge bend to evade the field lines of the greater charge.

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2 points

17. Two resistors of different resistance are inserted in parallel into an electric circuit. Which of the following statements is true?

- A) The current in the electric circuit flows through only the resistor with the smaller resistance.
- B) The current in the electric circuit flows through only the resistor with the greater resistance.
- C) The current in the electric circuit flows through both resistors.

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2 points

18. What is the mass number?

- A) The number of neutrons within an atom.
- B) The overall mass of protons and neutrons within an atom.
- C) The number of nucleons within an atom.

2 points	
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19. Two spherical objects of different masses accelerate towards each other in space due to their mutual gravitational attraction. Which of the two will have a greater acceleration?

- A) The one with the greater mass, as the force of attraction acting on the object with the greater mass is bigger.
- B) They will be equal as gravitational acceleration does not depend on mass.
- C) The one with the smaller mass, because in case of equal forces, acceleration is inversely proportional to the mass.

2 points	
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20. According to Bohr's theory, the energy levels of the electron of a hydrogen atom is given by the formula: $E_n = -\frac{2.2\text{aJ}}{n^2}$. What is the energy required for the ionization of a hydrogen atom in its ground state?

- A) With an energy of 2.2 aJ.
- B) With an energy of 0.55 aJ.
- C) With an energy of 1.65 aJ.

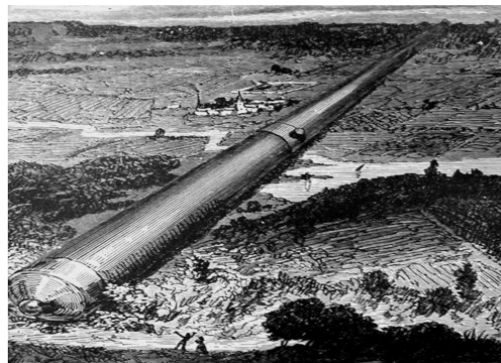
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PART TWO

Solve the following problems. Justify your statements using calculations, diagrams or explanations, depending on the nature of the questions. Make sure that the notations you use are unambiguous.

- 1. French writer Jules Verne imagined a journey to the Moon in his novel at the end of the 19th century, with the travelers being placed in a hollow projectile and fired from a great cannon. In the novel, the length of the cannon's barrel is 900 feet, i.e. 275 m, while the speed required for reaching the Moon was estimated to be 12 000 m/s.**

- a) What could the acceleration of the projectile in the novel be, if we can assume the acceleration to the desired speed in the cannon to be constant? What is the net force that accelerates a 75 kg traveler within the projectile? How many times is this force greater, than the weight of the traveler on Earth's surface?
- b) Modern spaceships carrying astronauts (e. g. the Space Shuttle) accelerate with 3 g at the most during takeoff. How much time does it require to reach the speed above with this acceleration? What distance would the spaceship cover during this time?



a)	b)	Total
12 points	4 points	16 points

2. We use blue vitriol solution in an electrolysis experiment, from which Cu^{2+} ions are deposited on the cathode.

- a) How many ions are deposited on the cathode during a five minute interval, if the ammeter measures the current to be 1 mA?
- b) What is the mass of the copper deposited on the cathode during this time?

The molar mass of copper is $M_{\text{Cu}} = 63.55 \frac{\text{g}}{\text{mol}}$.

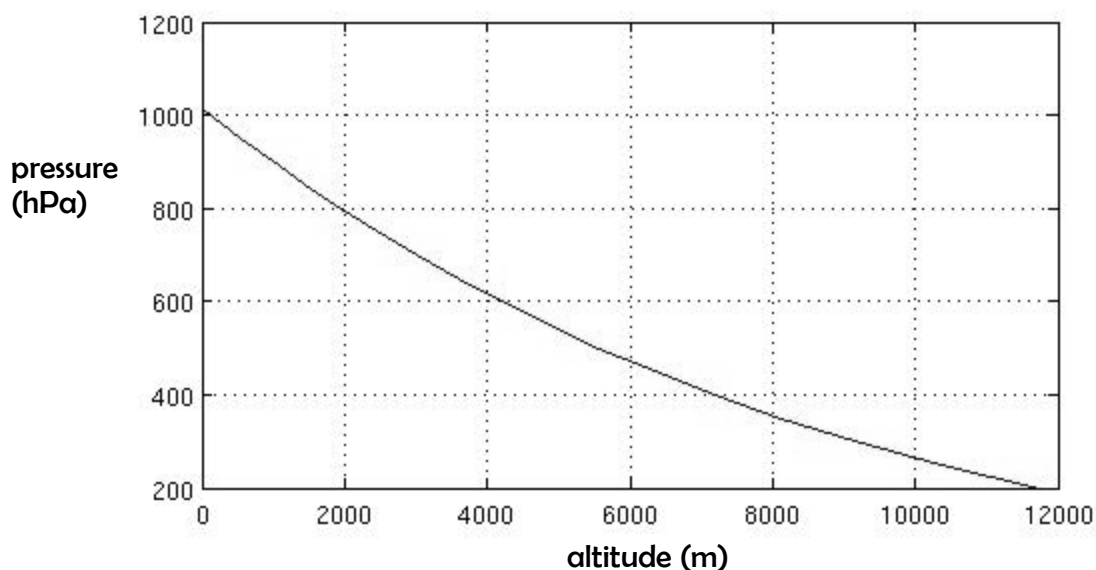
a)	b)	Total
10 points	4 points	14 points

You need to solve only one of the two problems 3/A and 3/B. Indicate your choice on the inside of the front cover.

3/A The following table contains the boiling point of water at different pressures. The graph shows the average atmospheric pressure as a function of altitude. Based on the data in the table and on the graph, answer the following questions:

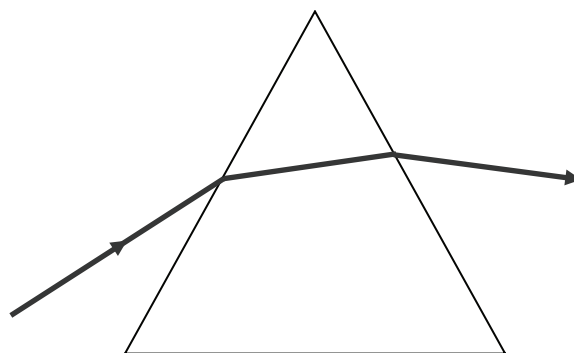
- Why is a barometric altimeter (or pressure altimeter) suitable for measuring altitude?
- Approximately what is the pressure at the altitude of the summit of Kékestető (1014 m) and Mount Everest (8848 m)?
- At about what altitude is the atmospheric pressure half of the pressure measured at sea level?
- Mountaineers are boiling water at camp in the evening. They find that the water boils at 90 degrees Celsius. How high are they?
- Why does atmospheric pressure deviate on a daily basis from the average values? What consequences does this have when determining altitude?

p [Pa]	1228	2338	4245	7381	12345	19933	31177	47375	70119	101325
t [°C]	10	20	30	40	50	60	70	80	90	100

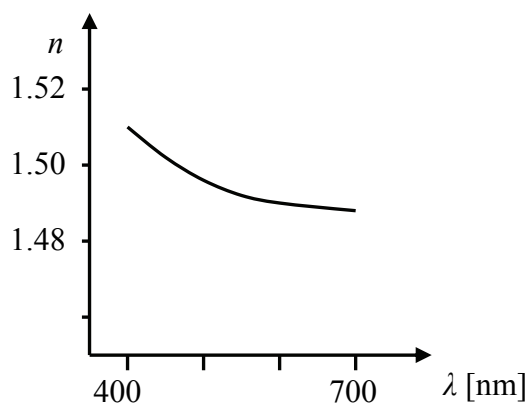


a)	b)	c)	d)	e)	Total
4 points	6 points	3 points	4 points	3 points	20 points

3/B A prism is depicted on the figure, with a ray of red light that is incident on it from the left and passes through the prism.



- Give a detailed analysis of the path the light takes through the prism. What law describes the passage of light through the first and second interface? How does this rule influence the light's direction of propagation during passage?
- The following graph depicts the index of refraction of the prism's material as a function of the wavelength of light. Sketch the path that a ray of blue light, incident together with the red one, would take when passing through the prism. In what way is it different from the path of the red light and why?
- What happens if white light is incident on the prism as depicted on the figure? Which properties of the prism are important in determining the occurrence and magnitude of the phenomenon?



a)	b)	c)	Total
6 points	8 points	6 points	20 points

To be filled out by the examiner evaluating the paper!

	maximum score	score attained
I. Multiple choice questions	40	
II. Complex problems	50	
Total score of the written exam	90	

examiner

Date:

	Score attained rounded to the nearest integer (elért pontszám egész számra kerekítve)	Integer score entered in the program (programba beírt egész pontszám)
I. Multiple choice questions (Feleletválasztós kérdéssor)		
II. Complex problems (Összetett feladatok)		

examiner (javító tanár)

notary (jegyző)

Date (Dátum):

Date (Dátum):