FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

2024. május 22. 8:00

Időtartam: 188 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

OKTATÁSI HIVATAL

Important information

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

You may solve the problems in arbitrary order.

Resources that may be used: pocket calculator, data tables

Should the space provided for the solution of a problem be insufficient, you may continue the solution on the empty pages of the examination paper or on auxiliary sheets. Please indicate the number of the problem on the pages.

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. (You may write calculations or draw figures on this problem sheet if necessary.)

1. **An object is thrown vertically up. In what way does the magnitude and direction of its acceleration change while going up and while going down? (Air drag is negligible.)**

   A) The magnitude of the acceleration decreases while going up and increases while going down, its direction points downward all along.
   B) Both the magnitude and the direction of the acceleration are the same while going up and down.
   C) The magnitude of the acceleration is the same while going up and down, but the direction is opposite.

   2 points

2. **Ideal gas with temperature -10 °C and pressure 10^5 Pa is enclosed in a rigid wall container. At approximately what temperature will its pressure be $2 \cdot 10^5$ Pa?**

   A) At a temperature of –20 ºC.
   B) At a temperature of +10 ºC.
   C) At a temperature of +20 ºC.
   D) At a temperature of +253 ºC.

   2 points

3. **The masses of the three solid copper cylinders in the figure are equal. The resistance of which cylinder is the smallest between its two opposite bases (circular facets)?**
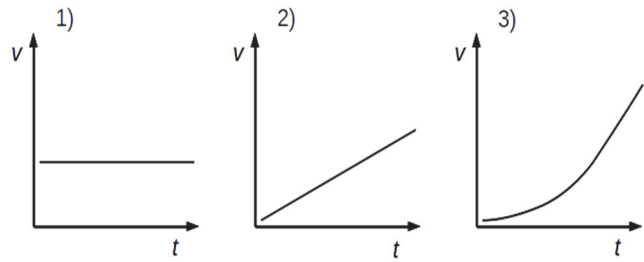

   1.)   2.)   3.)
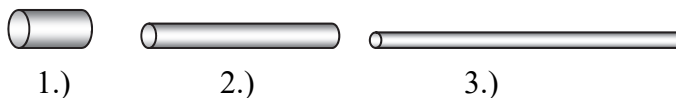
   A) The one marked by number 1.
   B) The one marked by number 2.
   C) The one marked by number 3.
   D) The resistances of all three are equal.

   2 points

4. The *v(t)* graphs of three linear motions along a straight line are depicted on the adjacent figure. Which of the three motions is an accelerating motion?

 A) Only the one corresponding to graph 2.
 B) Only the one corresponding to graph 3.
 C) The ones corresponding to graphs 2 and 3.
 D) All three motions are accelerating motions.

2 points

5. On which particle is the magnitude of the electrostatic force exerted by a given homogeneous electric field greater? An electron or a proton?

 A) An electron, because it is lighter.
 B) A proton, because its charge is positive.
 C) The magnitude of the force acting on them is equal because the magnitudes of their charges are equal.

2 points

6. Earth and Jupiter orbit around the Sun. Which planet has a greater acceleration?

 A) Earth, because it is closer to the Sun.
 B) Jupiter, because the attractive force between the Sun and the Jupiter is greater than the force between the Earth and the Sun.
 C) Their accelerations are equal because the acceleration does not depend on the mass.

2 points

7. We place some amount of –5 °C ice and some amount of –10 °C ice in an insulated thermos flask. What is the lowest possible value of the equilibrium temperature that may occur in the flask?

 A) Approximately –7,5 ºC.
 B) It may be close to –10 ºC.
 C) It may be as low as –15 ºC.

2 points

8. **There is an equal amount of water in two identical glasses on the table. We drop a ball in each glass, both with 3 cm diameter. The figure depicts their state of equilibrium – one ball floats, the other one sinks. Which glass exerts a greater force on the table?**
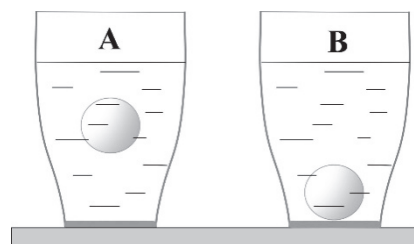
   A) The glass marked „A".
   B) The glass marked „B".
   C) They exert an equal amount of force on the table.

2 points

9. **Chlorine has two isotopes, one with mass number 35, and the other with 37. Which table of the isotopes below is correct?**

isotope	proton number	neutron number
Cl-35	17	18
Cl-37	17	20

A)

isotope	proton number	neutron number
Cl-35	18	17
Cl-37	20	17

B)

isotope	proton number	neutron number
Cl-35	17	35
Cl-37	18	37

C)

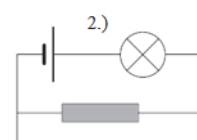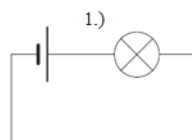| isotope	proton number	neutron number
Cl-35	35	17
Cl-37	37	17

D)

   A) Table A).
   B) Table B).
   C) Table C).
   D) Table D).

2 points

10. **We operate an incandescent light-bulb using an ideal 12 V battery first in the circuit depicted by figure 1), then in the one depicted by figure 2). In which case will its light be stronger?**

   A) In the circuit shown in figure 1).
   B) In the circuit shown in figure 2).
   C) Its light will be equally strong in the two circuits.

2 points

11. **A mechanic is worried that he will over-tighten a delicate screw. What could he do to tighten the screw „carefully"? (The mechanic grabs the end of the wrench's handle.)**

    A) He should decrease the friction coefficient between the head of the screw and the wrench.
    B) He should use a wrench with a longer handle.
    C) He should increase the force exerted on the handle of the wrench.
    D) He should use a wrench with a shorter handle.

2 points

12. **An astronaut lands on a planet whose mass is half of Earth's mass, but its radius is equal to Earth's radius. Which statement is true? (We can neglect the rotation of Earth and the planet around the axis.)**

    A) The mass and the weight of the astronaut have both decreased by half.
    B) The mass of the astronaut did not change, but its weight has decreased by half.
    C) The mass of the astronaut has decreased by half, but its weight did not change.

2 points

13. **The frequency of a sound wave determines its pitch, the frequency of light determines its color. Which of the following statements is true?**

    A) The frequency of blue light is greater than that of red light, the frequency of a high-pitch sound is greater than that of a low-pitch one.
    B) The frequency of blue light is greater than that of red light, the frequency of a high-pitch sound is smaller than that of a low-pitch one
    C) The frequency of blue light is smaller than that of red light, the frequency of a high-pitch sound is greater than that of a low-pitch one.
    D) The frequency of blue light is smaller than that of red light, the frequency of a high-pitch sound is smaller than that of a low-pitch one.
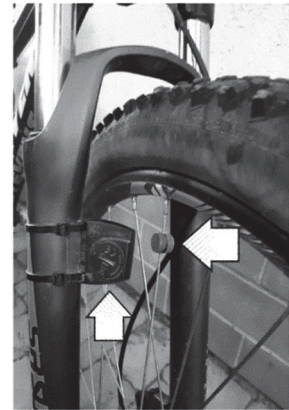
2 points

14. **Which of the phenomena below <u>can not</u> be interpreted by the wave nature of light?**

    A) The photoelectric effect.
   **B)** Two-slit interference.
    C) Polarization.

2 points

15. The speedometer of a bicycle is composed of a sensor attached to the fork (frame) holding the wheel, which signals the small computer for each revolution of the wheel when a small magnet attached to the spokes passes by it. What speed does the computer register if the little magnet passes by the sensor six times per second?

- **A)** A speed of 6 km/h.
- **B)** A speed of 6 m/s.
- **C)** It is impossible to say, it depends on the diameter of the wheel.

2 points

16. Air is flowing in the Venturi-tube in the picture. Which figure depicts correctly the position of the water columns in the U-shaped part of the tube?

A)   **B)**   **C)**
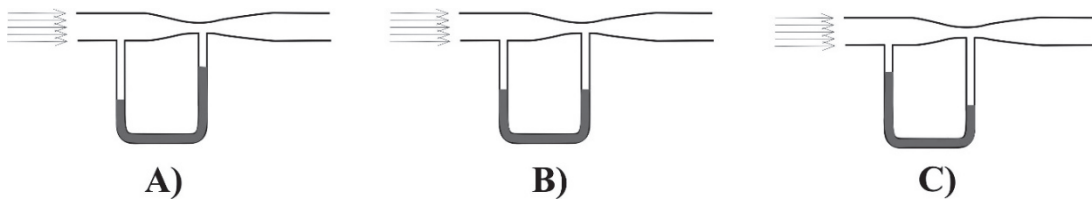
- **A)** Figure „A" depicts the water columns' position in the U-shaped tube correctly.
- **B)** Figure „B" depicts the water columns' position in the U-shaped tube correctly.
- **C)** Figure „C" depicts the water columns' position in the U-shaped tube correctly.

2 points

17. Is there a magnetic field inside a bar magnet?

- **A)** Yes, and the field is more or less homogeneous, similar to the inside of an electromagnet.
- **B)** No, the magnet is made of metal, so the magnetic field inside is canceled (Faraday-cage).
- **C)** Yes, there is and the direction of the field close to the northern and southern poles are opposite to each other.
- **D)** No, but if we break the magnet, then a field is induced.
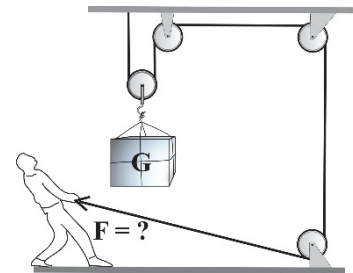
2 points

18. **A light ray is incident upon a plane mirror at an angle of 30 degrees. What is the angle of reflection if the mirror is completely submerged in water?**

   A) Less than 30 degrees.
   B) Precisely 30 degrees.
   C) Greater than 30 degrees.

2 points

19. **What is the force _F_ required to hold the load with weight _G_ in equilibrium using the system of pulleys depicted on the figure?**

   A) $F = G/2$
   B) $F = G/4$
   C) $F = G/8$

2 points

20. **What information does Rutherford's scattering experiment yield on the inner structure of atoms?**

   A) There is a dense nucleus in the middle of the atom.
   B) Electrons follow circular trajectories in the atom.
   C) There are neutral particles (neutrons) inside the atomic nucleus.
   D) Positive charges are distributed uniformly inside the atom.

2 points

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. **The comet Neowise came closest to the Sun in summer 2020, when its distance from the Sun was 43 million kilometers (~0.3 AU). The orbital period of the comet is 6766 years. (1 AU ~ 150 million kilometers, corresponding to the mean distance between Earth and the Sun.)**

   a) When will the comet be the farthest from the Sun the next time?
   b) Make a drawing of the comet's trajectory around the Sun. Mark the major axis of the trajectory on the drawing.
   c) What is the length of the major axis of the comet's trajectory?
   d) What is the greatest distance of the comet from the Sun on its trajectory?

a)	b)	c)	d)	Total
3 points	2 points	9 points	2 points	16 points

2. *Fission tracks are 10-20 μm long linear lattice defects generally found in solid materials containing uranium, for example minerals. Their formation is due to the spontaneous nuclear fission of uranium (primarily the ^{238}U isotope), because the fragments (fission products) that are formed during the fission process damage the crystal structure of the mineral containing uranium, while they decelerate. These fission tracks can be used for dating, because their number is proportional to the time that passed since the formation of the rock containing uranium. The number of fission tracks formed also depends on the concentration of uranium. The tracks can be made visible for optical microscopy using chemical etching, which makes counting (mostly manually), and thus age determination possible.*

   a) Explain why the number of fission tracks is influenced by the concentration of uranium.
   b) In what way does the time elapsed since the formation of the rock influence the number of fission tracks?
   c) Why is this method unsuitable for determining the age of the rock if we don't know the initial concentration of uranium in it?
   d) Approximately how many times are fission tracks larger than the wavelength of visible light?

a)	b)	c)	d)	Total
3 points	3 points	3 points	5 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 **According to ancient legend, Archimedes was instructed by the king of Syracuse to determine whether the goldsmith really did use the pure gold he had been given to make the ruler's crown or whether he kept some of the gold and substituted it with some other metal. (The weight of the crown was of course the same as the weight of the gold that the king had given the goldsmith.) According to legend, the scientist found the solution to the problem while bathing. He borrowed pure gold from the king, weighting exactly the same as his crown. This was verified by placing the crown in one pan of a balance scale, while placing the gold in the other pan and checking that the scale was precisely in equilibrium. The scientist then submerged the scale together with the crown and the gold in water and soon declared that the goldsmith cheated. Some of the gold had been replaced by a different metal with smaller density.**

a) What forces act upon the crown and the gold when submerged in water?
   What do these forces depend on?
b) Give a detailed explanation of why the measurement of weight is different when performed under water than when it is performed on dry land.

The experiment revealed that the goldsmith mixed a different metal, with smaller density than gold into the material of the crown.

c) What happened when the experiment was performed under the water by the scientist? Which way did the scale tip?

| a)	b)	c)	Total
5 points	8 points	7 points	20 points

3/B **The table below contains values of the atmospheric pressure at a uniform 0 °C, at sea level and at the summits of mountains with various heights.**

	altitude (m)	pressure (Pa)
sea level	0	101325
János mountain	527	94822
Kékes	1014	89118
Rozsutec (Fatra)	1610	82517
Dumbier Peak (Low Tatras)	2043	77975
Lomnicky Peak (Tatra mountains)	2634	72105
Grossglockner (Alps)	3798	61588
Mont Blanc (Alps)	4810	53487
Mount Elbrus (Caucasus)	5642	47494
Aconcagua (Andes)	6962	39109
Mount Everest (Himalaya)	8848	29246

The boiling point of water depends on the atmospheric pressure. The table below contains information on the boiling point of water for different values of the atmospheric pressure:

Atmospheric pressure (Pa)	Boiling point temperature (°C)
25006	65
31155	70
38549	75
47356	80
57800	85
70107	90
84523	95
101324	100

a) Plot the atmospheric pressure as a function of altitude on a graph.
b) At approximately what altitude will the boiling point be 80 °C?
c) At approximately what temperature will water boil at the summit of the Mont Blanc?
d) How many times is the density of air at constant temperature less at the peak of Mount Everest, than at sea level?

P (kPa)

100

80

60

40

20

2000   4000   6000   8000   *h* (m)
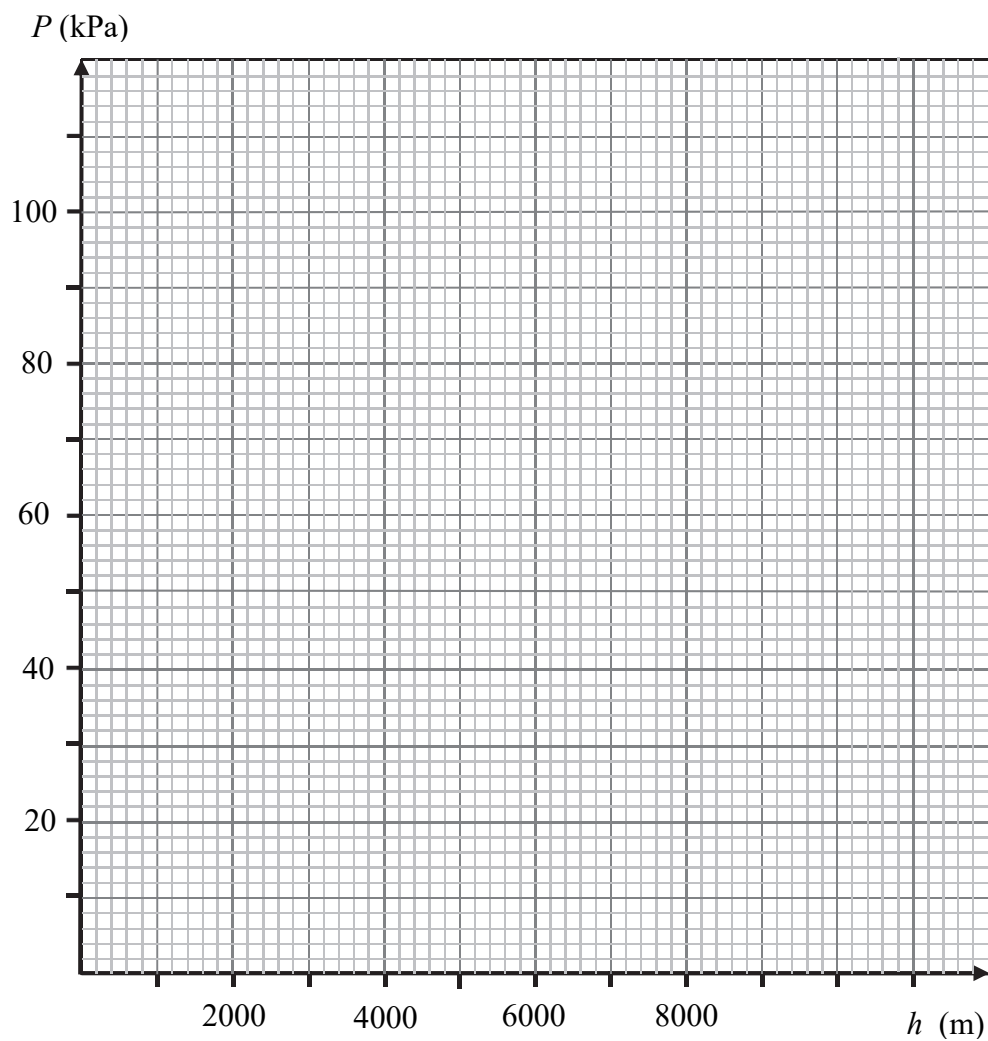
a)	b)	c)	d)	Total
5 points	4 points	6 points	5 points	20 points

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

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date   examiner

	pontszáma **egész számra** kerekítve	
	elért	programba beírt
I. Feleletválasztós kérdéssor		
II. Összetett feladatok		

_____ _____

dátum   dátum

_____ _____

javító tanár   jegyző