Név: ..... osztály:.....

ÉRETTSÉGI VIZSGA • 2013. október 25.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

2013. október 25. 14:00

Az írásbeli vizsga időtartama: 120 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

EMBERI ERŐFORRÁSOK
MINISZTÉRIUMA

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. 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! (Check your answer with calculations if necessary.)

1. Earth exerts a 20 N gravitational force on a body at rest on a table. What is the reaction force of this force?

A) The 20 N supporting force exerted on the body by the table.
B) The weight of the body pressing on the table.
C) The 20 N force exerted by the body on the Earth.

2 points	

2. We would like to refresh the air in a room in winter by ventilation, but we would also like to save energy. We continue ventilating until the air in the room cools from 20 °C to 10 °C. Which way of ventilation is more energy efficient: opening the windows wide for a short while, or opening them only a little but for a longer time?

A) Ventilation is more energy efficient if it lasts only a short time.
B) Ventilation is more energy efficient if it lasts long.
C) There is no difference between the two methods of ventilation from the point of view of energy efficiency.

2 points	

3. We connect two resistors of different resistance in series and wire them to a battery. Which of the following statements is true?

A) The current flowing through the one with greater resistance is greater.
B) The heat generated on the one with greater resistance is greater.
C) The voltage drop on the one with the greater resistance is smaller.

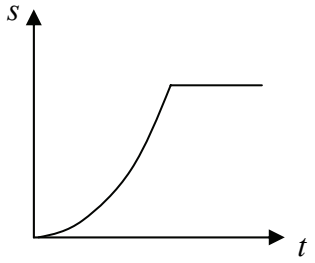
2 points	

4. Can white light be used to induce the photoelectric effect?

A) No, the photoelectric effect can only be induced by monochromatic light.
B) Yes, provided the white light contains frequency components above the threshold frequency.
C) Yes, but only if all the frequency components of the white light are above the threshold frequency. ☐

2 points

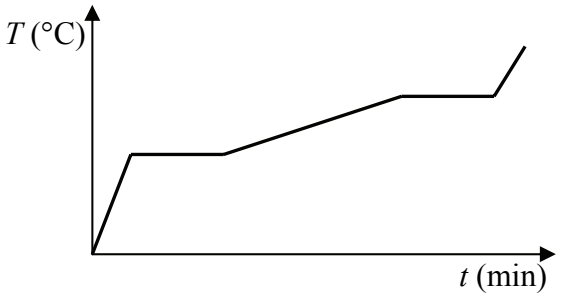
5. The adjacent diagram shows the distance vs. time graph of a body that moved along a straight line. What kind of motion did it perform?



A) At first it was moving with a constant velocity and then it stopped.
B) At first it was accelerating and then it moved with a constant velocity.
C) At first it was accelerating and then it stopped. ☐

2 points

6. We start heating a piece of solid material from a temperature of 0 °C such that the power of the heating apparatus remains constant in time. The temperature of the sample is plotted on the graph as a function of time. What can we see from the graph?



A) That the specific heat of the material in the solid state is greater than in the liquid state.
B) That the specific heat of the material in the liquid state is greater than in the solid state.
C) That the specific heats of the material in the two states are equal. ☐

2 points

7. The basic units of the system of physical units in an imaginary country are the following:

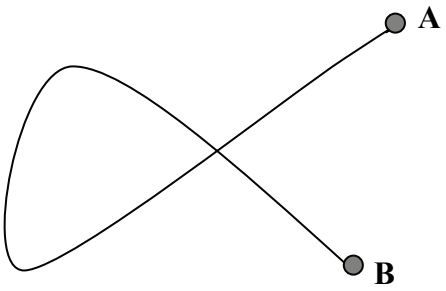
- **The force, whose unit is 1 F.**
- **The velocity, whose unit is 1 V.**
- **The time, whose unit is 1 T.**

What is the derived unit of work in this country?

A) 1 F·V·T
B) 1 F/T
C) 1 $F \cdot V^2 / T^2$

2 points	

8. A long wire is bent into a loop as depicted in the figure. The two halves of the loop touch each other as shown. When will the resistance between the points A and B be greater? If the loop is made from insulated wire, or if it is made from wire without insulation?



A) If the loop is made from insulated wire.
B) If the loop is made from wire without insulation.
C) The resistance will be the same in the two cases.

2 points	

9. Which of the following statements is true?

A) Geostationary satellites are so far from Earth's surface (about 36000 km high), that Earth's gravitation has no effect there at all. That is why they hover motionless above a single location on Earth.
B) Geostationary satellites always orbit around Earth above the Equator.
C) Geostationary satellites must use their thrusters continuously in order to orbit together with Earth and thus hover motionless above a single location.

2 points	

10. Heating our homes is often done by so called condensing gas boilers. They function with increased efficiency by condensing the water vapor that forms when gas is burned. How can the efficiency of the boiler increase as a result of condensation?

A) Because the specific heat of the water obtained from condensation is greater than that of the water circulating in the system.
B) Because heat is released during condensation that warms the water circulating in the system.
C) Because the water condensing from the steam has a higher temperature than its boiling point. ☐

2 points

11. The tip shape effect (or tip effect) plays an important part in the functioning of one of the following apparatuses. Which one?

A) In the functioning of the lightning rod.
B) In the functioning of the capacitor (condenser).
C) In the functioning of the electric motor. ☐

2 points

12. We throw a body vertically with velocity *v*. Provided that air drag can be neglected, in which case does it hit the ground with greater velocity: if we throw it upwards, or if we throw it downwards?

A) If we throw it upwards.
B) If we throw it downwards.
C) It hits the ground with the same velocity in both cases. ☐

2 points

13. Can we regard a solitary proton to be an ion?

A) No, we cannot, because an ion can only be created from an atom by removing one or more electrons.
B) No, we cannot, because a solitary proton does not possess any electrons.
C) Yes, we can, because if we remove the electron from a hydrogen atom, whose atomic number is 1, we obtain a solitary proton. ☐

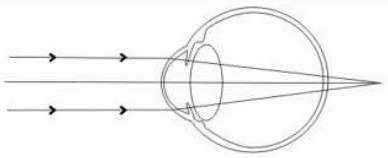
2 points

14. Two pistons that can move easily separate a given quantity of gas from the environment in a cylinder with both ends open as depicted in the figure. What happens to the piston on the left if we move the piston on the right slowly towards the outside by 10 cm? (The temperature during the process is constant.)

A) The piston on the left also moves by 10 cm.
B) The piston on the left also moves, but by less than 10 cm.
C) The piston on the left remains at rest.

2 points	

15. The adjacent figure is a sketch of a human eye. Does this eye have a refractive error (image formation defect)? If so, what type of lens can be used to correct it?



A) This eye does not have an image formation defect.
B) This eye can be corrected with a converging lens.
C) This eye can be corrected with a diverging lens.

2 points	

16. We divide a given quantity of radioactive isotopes in two equal parts for experimental purposes. How does the half-life of the two separated parts change as a result of this?

A) The half-life is reduced to a quarter of its original value.
B) The half-life is reduced to a half of its original value.
C) The half-life remains the same.

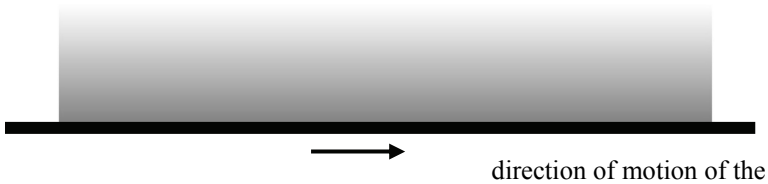
2 points	

17. Two pieces of a satellite (space debris), one with a mass of 1 kg and one with a mass of 2 kg, move around Earth in a circular orbit with equal orbital radii. Which of the two has a greater velocity?

A) The one with a mass of 1 kg.
B) The one with a mass of 2 kg.
C) The velocities of the two bodies are equal in magnitude.

2 points	

18. Let us suppose, that a straight conductor lies on the paper along the heavy line, in which electrons are moving from left to right. What will be the direction of the magnetic field induced by the current in the plane of the paper, in the region colored gray?



A) It will be perpendicular to the paper, pointing down.
B) It will be perpendicular to the paper, pointing up.
C) It will be parallel to the conductor pointing from left to right. ☐

2 points	

19. A nuclear reactor at a power plant operates with a constant power of 400 MW. Later the same reactor operates with a constant power of 300 MW. In which case is the neutron multiplication factor greater?

A) The multiplication factor is greater when the reactor is operating at a power of 400 MW.
B) The multiplication factor is greater when the reactor is operating at a power of 300 MW.
C) The multiplication factor is the same in both cases. ☐

2 points	

20. The weight of a tightrope walker is *G*, which presses the rope strung between two poles down by a few centimeters. With what force does the rope pull on the poles?

A) The force on the poles is somewhat less than the *G* weight of the tightrope walker standing on the rope.
B) The force on the poles is approximately equal to half of the *G* weight of the tightrope walker.
C) The force on the poles is much greater than the *G* weight of the tightrope walker. ☐

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. Sufficient atmospheric pressure must be maintained in the passenger cabin of airliners during flight, independent of the outside pressure. At the take-off time of a Boeing 747 aircraft, atmospheric pressure at the airport was $1.01 \cdot 10^5$ Pa, outside temperature and interior temperature were both 25 °C. During flight, at an altitude of 11 000 m, the outside pressure is only $2.5 \cdot 10^4$ Pa, the outside temperature is -60 °C. The interior temperature of the passenger cabin is maintained at 25 °C, while the interior pressure is adjusted to be $0.76 \cdot 10^5$ Pa.

a) How many kg-s of air leave the passenger cabin, whose volume is 875 m^3, by the time the plane reaches the cruising altitude of 11 000 m?
b) What is the force acting on the 25 cm wide, 40 cm high windows at the altitude of 11 km?

$R = 8.31 \frac{\text{J}}{\text{mol} \cdot \text{K}}$, the molar mass of air is 29 g/mol, assume that the windows are rectangular in shape.

a)	b)	Total
10 points	5 points	15 points

2. The 900 kg rover 'Curiosity' has successfully landed on Mars recently, and is looking for signs of life on the red planet.

a) Using the given data, determine the gravitational acceleration, and the weight of Curiosity on the surface of Mars. (Neglect the effect of Mars' rotation around its axis.)
b) What is the first cosmic velocity on the surface of Mars, with respect to Mars?

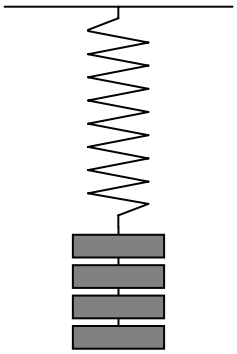
The gravitational constant: $\gamma = 6.67 \cdot 10^{-11} \frac{\mathrm{N} \cdot \mathrm{m}^2}{\mathrm{kg}^2}$,
the mass of Mars $M_{Mars} = 6.42 \cdot 10^{23}$ kg, the radius of Mars $R_{Mars} = 3400\,\mathrm{km}$.

<u>Calculate the required quantities using the given data. In the absence of any calculations, the problem cannot be evaluated.</u>

a)	b)	Total
8 points	7 points	15 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 Peter and Paul were examining two different springs with the setup depicted in the figure. Peter hung weights with different masses on the springs and measured their extension with each load. Unfortunately Paul, who made note of the results, was careless. He did not write down whether a given data pair came from the measurement with the first spring, or the second one. Therefore the data pairs in the table below are mixed up.



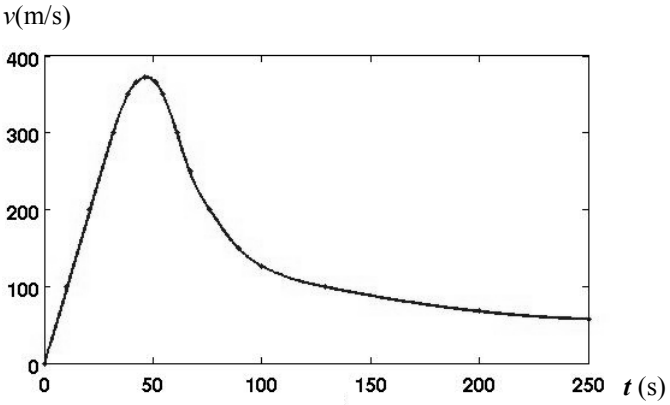
a) Plot the data found in the table on a graph. Determine which of the data pairs correspond to one or the other of the springs. How can this be accomplished?
b) What are the spring constants of the two springs?
c) What will the overall extension of the two springs be, if we hang one, join the other to its lower end and hang a 6 kg load on the lower spring?

Δl (cm)	1.3	5.1	3.8	10.2	6.3	14.9	8.8	20.0	11.3	25.2	13.8	30.0
m (kg)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0

(We can neglect the weight of the springs, $g = 10 \frac{\mathrm{m}}{\mathrm{s}^2}$.)

a)	b)	c)	Total
10 points	4 points	6 points	20 points

3/B In 1012 Felix Baumgartner broke several records with a special skydive. He jumped from a height of 39 km above Earth's surface (atmospheric pressure at this altitude is about 430 Pa, the temperature was -57 °C) and spent 4 minutes 22 seconds in freefall without opening his parachute. He attained a maximum speed of 1342.8 km/h, 1.24 times the velocity of sound. For a while, he was spinning as he fell, but at some point he managed to stabilize his position by extending his hands and feet. He opened his parachute in the 262nd second, fairly close to the ground at a height of about 3000 m. He wore a special protective suit during the dive. The suit, similar to the spacesuits worn by astronauts, was equipped with an oxygen tank, was made of a material with good thermal insulation properties and the visor of his helmet could be heated separately.



a) The graph shows the speed of the skydiver as a function of the time elapsed since the beginning of the freefall, during the time interval before the parachute was opened. Describe the motion of the falling skydiver during the time interval depicted on the graph. Approximately when did the skydiver reach his maximum velocity?

b) List the forces acting on the skydiver and determine their directions. Using the graph, determine the time when the net force on the skydiver was zero.

c) Explain the changes in the skydiver's speed depicted on the graph.

d) Explain why the properties of the protective suit listed above were of vital importance for the skydiver. Why did the helmet's visor need to be heatable?

a)	b)	c)	d)	Total
3 points	5 points	9 points	3 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): .....