Név: ..... osztály:.....

ÉRETTSÉGI VIZSGA • 2018. május 22.

# FIZIKA
# ANGOL NYELVEN

# KÖZÉPSZINTŰ
# ÍRÁSBELI VIZSGA

## 2018. május 22. 8:00

Időtartam: 150 perc

| Pótlapok száma | |
|---|---|
| Tisztázati | |
| Piszkozati | |

**EMBERI ERŐFORRÁSOK MINISZTÉRIUMA**

# Important information

The time available for the solution of the problems is 150 minutes.
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! (Check your answer with calculations if necessary.)*

**1. A car is speeding on a highway that crosses a hill. What can we say about the force exerted on the car by the road at the top of the hill?**

**A)** It is less than the gravitational force acting on the car.
**B)** It is equal to the gravitational force acting on the car.
**C)** It is greater than the gravitational force acting on the car.

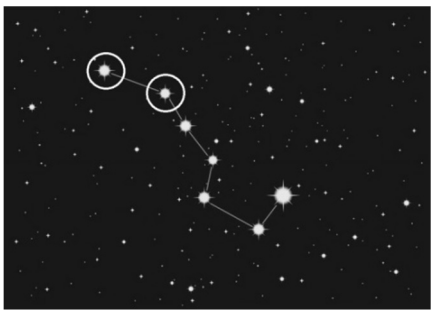
| 2 points | |
|---|---|

**2. Which of the statements is valid for isothermal processes in ideal gases?**

**A)** There is no heat exchange.
**B)** There is no change of the internal energy.
**C)** There is no work performed.

| 2 points | |
|---|---|

**3. Which objects are more distant from each other: the two stars marked in the Big Dipper (Ursa Major) constellation or the Earth and the Sun?**

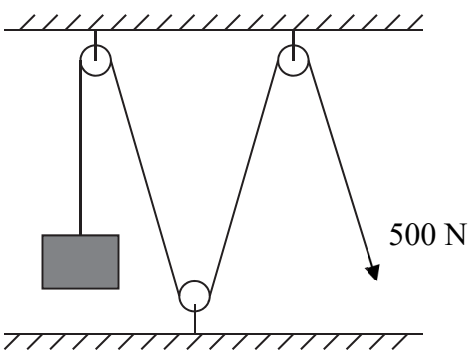


http://vilagbiztonsag.hu

**A)** The Earth and the Sun.
**B)** The two stars of the Big Dipper.
**C)** They are approximately at the same distance from each other.
**D)** This changes with the seasons because of Earth's elliptical orbit.

| 2 points | |
|---|---|

**4. We want to lift a load using the system of pulleys depicted on the adjacent drawing. Approximately what load are we able to lift using a 500 N force?**




**A)** Approximately 50 kg.
**B)** Approximately 100 kg.
**C)** Approximately 150 kg.
**D)** Approximately 200 kg.

| 2 points | |
|---|---|

**5. Where does light propagate faster: in the air inside a room or in water?**

**A)** In air.
**B)** In water.
**C)** Light propagates with the same speed in every medium because the speed of light is a physical constant.

| 2 points | |
|---|---|

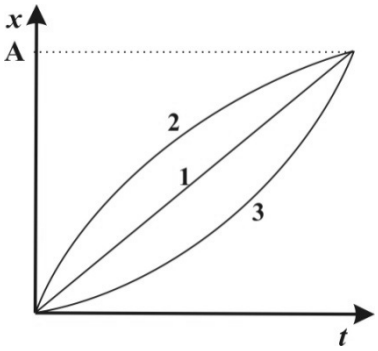
**6. Two identical soft-drink bottles are filled with a cold drink of equal temperatures. One of the bottles is wrapped in aluminum foil as shown on the picture and the bottles are left standing in the sunlight. In which bottle will the drink become warmer if they are both left standing for ten minutes in the sunlight?**



**A)** It will become warmer in the bottle wrapped in aluminium foil, because metals are good conductors of heat.
**B)** It will become warmer in the bottle without aluminium foil because the foil reflects the incident sunlight.
**C)** The drink in the two bottles will become equally warm.

| 2 points | |
|---|---|

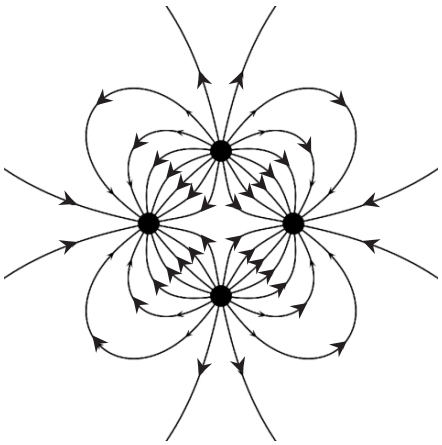
**7. On the adjacent graph the position – time curve of three bodies moving along the x-axis is depicted. Which body covered the smallest distance while going from the origin to point A?**




**A)** Body 1.
**B)** Body 2.
**C)** Body 3.
**D)** They all covered the same distance.

| 2 points | |
|---|---|

**8. The system of field lines generated by four point-like charges of equal magnitude can be seen in the adjacent figure. What can we say about the signs of the charges?**



**A)** All charges are of the same sign.
**B)** Three charges are of the same sign and one is of the opposite sign.
**C)** Two of the charges are positive and two negative.

| 2 points | |
|---|---|

**9. The Sun warms the Earth. How does the heat of the Sun reach the Earth?**

**A)** In the form of electromagnetic radiation.
**B)** By the radiation of invisible, charged particles.
**C)** By the heat conduction of cosmos.

| 2 points | |
|---|---|

**10. This multiple exposure picture depicts a bicycle jump. What is the shape of the trajectory that the joint center of mass of the cyclist and the bike moves along? (Air drag is negligible.)**

Image: www.radshot.com

**A)** The arc of a circle
**B)** Parabola
**C)** Hyperbola
**D)** Sine curve

| 2 points | |
|---|---|

**11. We would like to warm a room using one of several hot, homogeneous bodies that are of the same temperature. Which one will warm up the room the most?**

**A)** The one with the largest mass.
**B)** The one with the largest specific heat.
**C)** The one with the largest ratio of specific heat and mass.
**D)** The one with the largest product of specific heat and mass.

| 2 points | |
|---|---|

**12. Two identical, point-like, positive $Q$ charges are located at a distance $R$ from each other, there is an $F$ electrostatic repulsion between them. What should we change the magnitude of the charges to ($Q'$) in order that the repulsive force between them remains $F$ at a new distance of $2R$?**

**A)** $Q' = Q\sqrt{2}$
**B)** $Q' = 2Q$
**C)** $Q' = 4Q$

| 2 points | |
|---|---|

**13. Who is credited with the discovery of the atomic nucleus?**

**A)** Niels Bohr
**B)** Werner Heisenberg
**C)** Max Planck
**D)** Ernest Rutherford

| 2 points | |
|---|---|

**14. A ball dropped from a height *h* bounces back to a height of *h*/2. With what speed did it start its ascent if it reached the ground with speed *v*?**

**A)** $\frac{v}{2}$
**B)** $\frac{v}{\sqrt{2}}$
**C)** $\frac{v}{2\sqrt{2}}$

| 2 points | |
|---|---|

**15. Three identical light bulbs are connected in parallel to a battery with constant output voltage. However, two of them are faulty and burn out after a few seconds. How does the light given off by the third bulb change as a consequence of this?**

**A)** The third bulb will continue shining with the same intensity due to the constant voltage.
**B)** The light of the third bulb will increase due to the higher current.
**C)** The light of the third bulb will decrease due to the increased net resistance of the system.

| 2 points | |
|---|---|

**16. We would like to create a magnified, upright image of an object using a mirror. What should we do?**

**A)** We should use a concave mirror and place the object outside the focal distance.
**B)** We should use a concave mirror and place the object inside the focal distance
**C)** We should use a convex mirror and place the object outside the focal distance.
**D)** We should use a convex mirror and place the object inside the focal distance.

| 2 points | |
|---|---|

**17. The $^{40}_{19}$K isotope is transformed via $\beta^-$- decay. What isotope is created?**

**A)** $^{39}_{19}$K

**B)** $^{39}_{18}$Ar

**C)** $^{40}_{20}$Ca

**D)** $^{40}_{18}$Ar

| 2 points | |
|---|---|

**18. Approximately what is the gravitational attraction of Earth at a height of $R_E$ above its surface? ($R_E$ is the radius of Earth.)**

**A)** The same as on its surface.
**B)** About half of that measurable on its surface.
**C)** About quarter of that measurable on its surface.
**D)** Zero, Earth's gravitation does not extend this far.

| 2 points | |
|---|---|

**19. What is the relationship between the mass defect of an atomic nucleus and its binding energy?**

**A)** There is no direct relationship between the mass defect of an atomic nucleus and its binding energy.
**B)** The mass defect is inversely proportional to the binding energy.
**C)** The mass defect is directly proportional to the binding energy.

| 2 points | |
|---|---|

**20. Standing on top of a 5 m high building we throw two stones with identical velocities; one vertically upwards and one vertically downwards. Which one will have a greater speed upon reaching the ground at the base of the building? (Air drag is negligible.)**

**A)** The one that we threw downwards.
**B)** The one that we threw upwards.
**C)** They reach the ground with equal speeds.

| 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. A point-like body moving on a plane surface starts from a certain point at $t = 0$. The magnitude of its velocity is $v = 10$ m/s, the magnitude of its acceleration is $a = 6$ m/s$^2$. The <u>magnitudes</u> of both quantities remain constant during its motion.**

*a)* What kind of motion does the body follow?
*b)* When does the body return to the starting point and what is its greatest distance from this point during the course of its motion?

| a) | b) | Total |
|---|---|---|
| 3 points | 12 points | 15 points |
| | | |

**2. Read the text below carefully and answer the following questions using the information contained in it!**

## Sleet

source of image http://superiorhirek.hu

Sleet is precipitation that is composed of liquid droplets of water cooled below the freezing point, which immediately freezes upon reaching the ground creating a layer of ice. It is created when between two layers of cold air in the atmosphere there is a layer whose temperature is above the freezing point of water. Snow created in the upper cold layer will melt into water droplets in the middle layer and cool down below freezing point in the lowest cold layer. It does not solidify, but reaches a supercooled (or undercooled) state because there are no impurities in the water to help start crystallization, so the crystal ordering of the molecules does not start even though the temperature would make this possible. The raindrop will solidify upon reaching the ground. The phase-transition is triggered by the impact with the ground and takes place suddenly.

*(based on Wikipedia)*

*a)* The snowflake dropping from the cloud transforms into a supercooled water droplet near the ground. Describe the heat exchange between the snowflake and its environment during its trip to the ground, and the temperature changes and phase transitions as a result of the thermal interaction.

*b)* When the droplets hit the ground and freeze, some heat is released. Why?

*c)* How much heat is released by a water droplet of 0.2 g mass and 0 °C temperature when it freezes?

| The physical properties of water | |
|---|---|
| specific heat | 4183 J/kg·K |
| heat of vaporization (at 100 °C) | 2257 kJ/kg |
| heat of fusion | 335 kJ/kg |

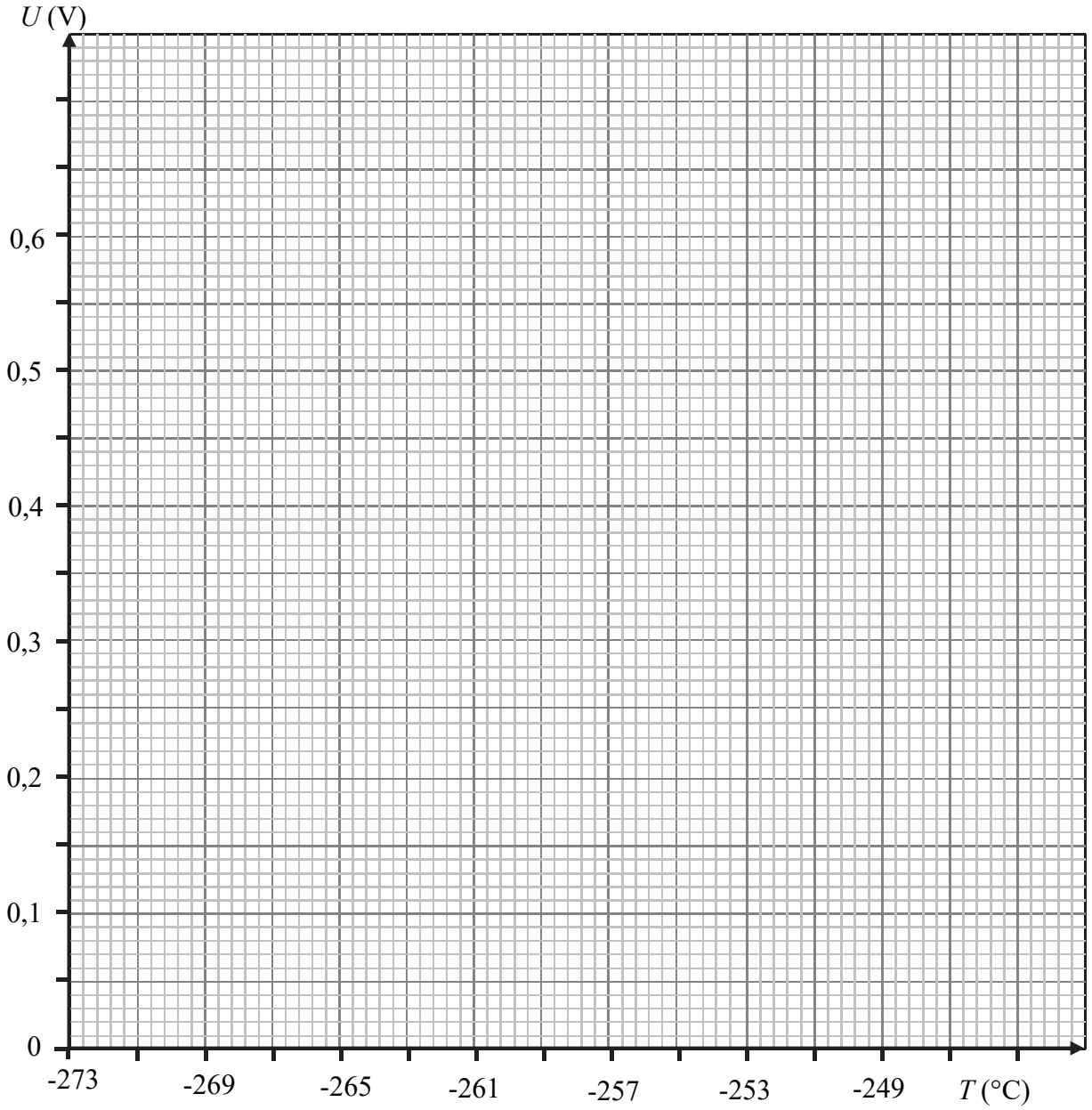
| a) | b) | c) | Total |
|---|---|---|---|
| 8 points | 3 points | 4 points | 15 points |
| | | | |

*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 The conductivity of metals at low temperatures was investigated in an experiment. First, a wire made of material "A" was inserted in a circuit and using a current of 1 A, the voltage on it was measured at different temperatures. The experiment was then repeated with a wire made of material "B". The table below contains the data from the measurements.**

| $T$ (ºC) | −273 | −269 | −268 | −264 | −260 | −256 | −252 | −248 |
|---|---|---|---|---|---|---|---|---|
| $U_A$ (V) | 0.28 | 0.29 | 0.30 | 0.34 | 0.38 | 0.42 | 0.46 | 0.50 |
| $U_B$ (V) | 0 | 0 | 0.12 | 0.20 | 0.28 | 0.36 | 0.44 | 0.52 |

a) Plot the data in the table on a graph.
b) Which of the two wires has a greater resistance at a temperature of –260 °C? What is the value of this resistance?
c) At approximately what temperature will the resistances of the two wires be equal?
d) The resistance of which wire exhibits unusual behavior at low temperatures? What is the essence of this special behavior?




| a) | b) | c) | d) | Total |
|---|---|---|---|---|
| 8 points | 4 points | 4 points | 4 points | 20 points |
| | | | | |

**3/B We would like to consume our drink using a straw. When we use a straw, we seal our mouth airtight from the outside and enlarge the cavity within using our tongue and soft palate. In this manner, we can decrease the pressure in our mouths to 70 % of the external atmospheric pressure.**

How and why does the drink get into our mouth through the straw when we do this?
Why is it a problem if there is a small hole in the side of the straw when using it?
What is the greatest length of straw that we can use successfully to suck water into our mouths in a vertical position if the external pressure is $10^5$ Pa? The density of water is 1000 kg/m$^3$.
How does this length change if we use the straw to suck some alcoholic drink with smaller density than water into our mouths? How does it change for a sweet drink with greater density than water?
How does the maximum length of the straw that we can use successfully change when we are using it on a very high mountain?

| Total |
| --- |
| 20 points |
| |

## To be filled out by the examiner evaluating the paper!

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

date examiner

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

dátum dátum

javító tanár jegyző