Név: ..... osztály:.....

ÉRETTSÉGI VIZSGA • 2019. május 20.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

2019. május 20. 8:00

Időtartam: 150 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

EMBERI ERŐFORRÁSOK MINISZTÉRIUMA

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 make drawings on the exam sheet if necessary.)

1. There are physical quantities listed in two columns in the adjacent table. Which of the columns contains only vector quantities?

1.	2.
force	acceleration
velocity	kinetic energy
pressure	displacement

A) Only column 1.
B) Only column 2.
C) Both columns.
D) Neither one of the columns.

2 points	

2. Two bodies compose a system that is isolated from its environment in every possible way. There is only thermal interaction between the bodies. Which body transfers some of its energy to the other?

A) The one with the higher temperature.
B) The one with the higher internal energy.
C) The one with the higher heat capacity.

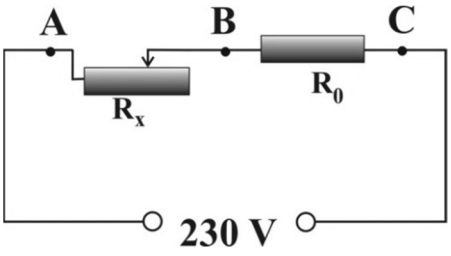
2 points	

3. Which of the phenomena below is able to explain the high temperature of stars?

A) The fission of atomic nuclei.
B) Alpha radiation from radioactive atomic nuclei.
C) The fusion of atomic nuclei.
D) The slow chemical burning of stellar material.

2 points	

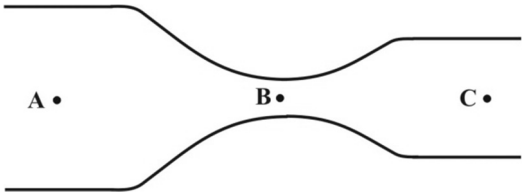
4. In the circuit shown on the figure a resistor with constant resistance R_0 and a resistor with variable resistance R_x are connected in series to a generator supplying constant voltage. How does the voltage U_{AB} measured between points A and B, and the voltage U_{BC} measured between points B and C change if the resistance of R_x is increased?



A) U_{AB} increases, U_{BC} decreases.
B) U_{AB} increases, U_{BC} increases.
C) U_{AB} decreases, U_{BC} increases.
D) U_{AB} decreases, U_{BC} decreases.

2 points	

5. The tube with a circular cross section seen on the figure first narrows strongly and then expands again a little. We observe the stationary, laminar flow of water in the tube. What can we say about the velocities v_A, v_B, and v_C of the water at points A, B and C?



A) $v_A < v_B < v_C$
B) $v_A < v_C < v_B$
C) $v_A > v_C > v_B$
D) $v_A = v_B = v_C$

2 points	

6. Mobile phones radiate signals in the form of radio waves. What can we say about the wavelength of these waves?

A) The wavelength of the signal emitted by mobile phones is approximately the same as that of X-rays.
B) The wavelength of the signal emitted by mobile phones is approximately the same as that of UV radiation.
C) The wavelength of the signal emitted by mobile phones is approximately the same as that of microwaves.

2 points	

7. A bicycle track follows a vertical loop. The adjacent multiple exposure photo depicts a cyclist going along the track. At which point is the force exerted by the wall on the bicycle the smallest?

A) At the lowest point of the loop.
B) At the highest point of the loop.
C) At the side of the loop where the bicycle is in a vertical position.

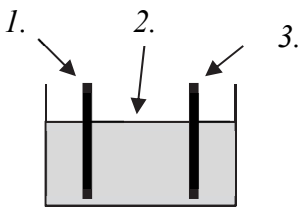
2 points	

8. We would like to raise the power output of a nuclear power plant. To this end, the neutron multiplication factor is raised above 1 for a short time with the help of the control rods. How does this influence the half-lives of radioactive materials inside the reactor?

A) The half-lives of radioactive materials in the reactor increase.
B) The half-lives of radioactive materials in the reactor decrease.
C) The half-lives of radioactive materials in the reactor do not change.

2 points	

9. The adjacent figure depicts metal plates immersed in a tub filled with a liquid. What materials could the numbers on the figure stand for if the depicted arrangement functions as a galvanic cell?



A) 1. copper plate, 2. salt solution, 3. zinc plate.
B) 1. copper plate, 2. salt solution, 3. copper plate.
C) 1. zinc plate, 2. distilled water, 3. copper plate.
D) 1. zinc plate, 2. distilled water, 3. zinc plate.

2 points	

10. The two pictures depict a sealed, unopened bag of crisps with protective gas (nitrogen gas) packing on an airplane just before takeoff and later during the trip at an altitude of 10 000 meters. What can we say about the pressure inside the cabin based on the pictures?

Before take-off **At an altitude of 10 000 m**

A) The pressure was higher before takeoff than during the trip.
B) The pressure was smaller before takeoff than during the trip.
C) Because the altitude above sea level changes during the takeoff and the trip, we cannot obtain any information on the pressure from the pictures. ☐

2 points	

11. Which of the following relationships is valid between the displacement x and acceleration a of a point-like body that is undergoing harmonic oscillation?

A) $a \sim x$
B) $a \sim \mathrm{tg}\,(x)$
C) $a \sim \sin(x)$
D) $a \sim \cos(x)$ ☐

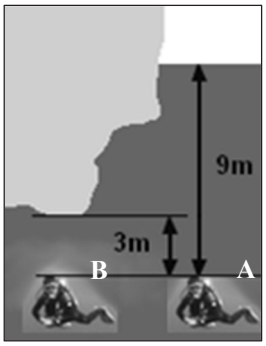
2 points	

12. According to Flora, the force exerted on a point-like, charged body that is shot into a homogeneous electric field perpendicular to the lines of force is constant in magnitude. According to Fruzsina, when a point-like, charged body is shot into a homogeneous magnetic field perpendicular to the magnetic field lines, the force acting on it is constant in magnitude. Which one of them is right?

A) Only Flora.
B) Only Fruzsina.
C) Both of them.
D) Neither one of them. ☐

2 points	

13. A diver dives to a depth of 9 meters below the water surface to the point marked with "A", then swims under an overhanging cliff to the position marked with "B". The cliff here is only 3 meters above the diver. What will the hydro-static pressure at point "B" underneath the cliff be compared to the pressure experienced at point "A" that is at an identical depth but outside the cave?



A) The pressure will be greater than at point "A", because beside the weight of the water, the weight of the rock will also increase the pressure.
B) The pressure will be precisely equal to that at point "A".
C) The pressure will be smaller than at point "A", because the diver will experience the weight of only a 3 m water column underneath the cliff. ☐

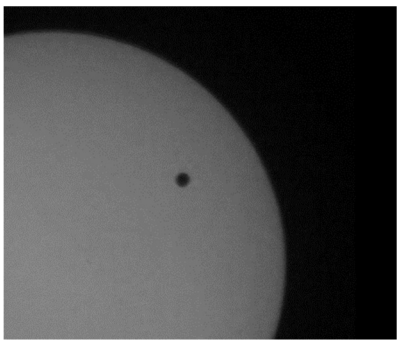
2 points	

14. To evaluate the heat insulation of buildings, a heat camera is used nowadays to make images of the house. How is the picture made, what does the heat camera image?

A) In reality, the camera measures the air temperature in the immediate vicinity of the house, that is what is draw on the image.
B) The heat camera functions much the same way as a normal camera, only it images radiation in the infra-red domain instead of visible light.
C) The heat camera does not detect electromagnetic waves, but infra-sound waves that are emitted by the structure of the house during thermal expansion. ☐

2 points	

15. The adjacent picture depicts the Sun and a planet and was taken through a terrestrial telescope. Which of the named planets <u>could not possibly be</u> on the picture?



A) Mercury.
B) Venus.
C) Mars. ☐

2 points	

16. Which physical unit of the ones listed below <u>is not</u> a unit of energy?

A) keV
B) MJ
C) kWh
D) mAh

2 points	

17. We would like to create an upright, diminished image in a room with an optical device. With which one can we accomplish this?

A) Concave mirror.
B) Concave lens.
C) Convex lens.

2 points	

18. If we drop a solid steel ball from a tall house simultaneously with a styrofoam ball of precisely equal diameter, the former reaches the ground sooner. Which statement is correct?

A) The steel ball reaches the ground sooner because its gravitational acceleration is greater than that of the styrofoam ball.
B) The steel ball reaches the ground sooner because the styrofoam ball is affected by air drag, while the steel ball is not.
C) The steel ball reaches the ground sooner because it is also attracted by Earth's magnetic field.
D) The steel ball reaches the ground sooner because the air drag acting on it slows it less.

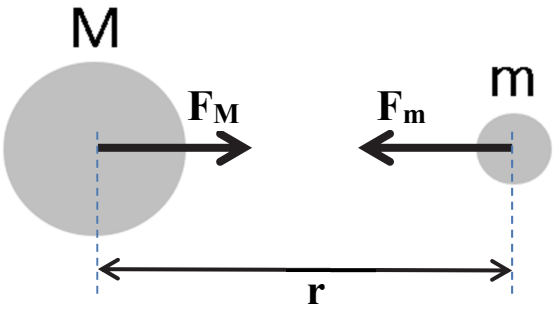
2 points	

19. In the following nuclear reaction a carbon nucleus and an unknown $^{A}_{Z}X$ particle is created: $^{4}_{2}He + ^{9}_{4}Be \rightarrow ^{12}_{6}C + ^{A}_{Z}X$. What is the unknown particle $^{A}_{Z}X$?

A) A proton.
B) A neutron.
C) An electron.
D) An α-particle.

2 points	

20. The centers of mass of two bodies with masses *m* and *M* are at a distance *r* from each other. The forces acting on them due to their mutual gravitational attraction are F_m and F_M. How will the gravitational forces acting on them change, if the mass *M* is doubled?



A) The force F_M does not change, the force F_m is doubled.
B) The force F_M is doubled, the force F_m does not change.
C) The forces F_M and F_m are both doubled.
D) The forces F_M and F_m are both increased by a factor of four.

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. There is an amount of 3 dl soft drink in a glass which was unfortunately heated by the Sun to 25 °C. We pour it in a well-insulated glass and put 0 °C ice into it in order to cool it down to a temperature pleasant for drinking. We seal the glass and wait for thermal equilibrium to set in.

a) How much ice do we need to put in the glass for the soft drink to cool to 10 °C?
b) At least how much ice would have been necessary to cool the mixture to 0 °C straight away?

(The specific heat and density of the soft drink can be taken to be the same as that of water, which are $c = 4183 \ \frac{\mathrm{J}}{\mathrm{kg} \cdot \mathrm{K}}$, and $\rho = 1 \ \frac{\mathrm{kg}}{\mathrm{l}}$. The heat of fusion of ice is $L = 334 \ \frac{\mathrm{kJ}}{\mathrm{kg}}$.)

a)	b)	Total
10 points	5 points	15 points

2. Listening to music on the road

Anyone can hear that a car makes different sounds when driving on different types of road surfaces with an appropriate speed. On a smooth road, it is silent as if gliding along. Upon reaching a road with an uneven surface, it starts vibrating softly instead of the previous smooth glide. This is precisely what clever specialists utilized when they devised parallel grooves and ridges on the road surface in a transverse direction. These generate vibrations in the car passing over them. The vibration of the chassis in turn gives rise to a sound in the air inside the cabin. The pitch of the sound depends on the distance of the ridges from each other and the speed of the car.

According to plans, one section of road 67 (that is the road between Balatonszemes and Szigetvár) will be covered with such a musical tarmac which will play the song “On road 67” by the band Republic. The picture depicts an already existing musical road in Japan.

Image source: http://www.gitarpengeto.hu/zenei-utazasi-ajanlat/dalol-az-aszfalt-ut-japanban/

a) Let us imagine that a car is passing on the road on the picture from left to right over the ridges that are closest to us. (All four of its wheels are passing over the ridges that are closest.) How does the pitch of the sound change when it reaches the section with a more dense set of ridges? Justify your answer.
b) How is the sound pitch affected by the speed of the car passing over the grooves? Justify your answer.
c) What should the distance between the grooves be in order to hear a 250 Hz sound inside a car going at 90 km/h?

a)	b)	c)	Total
5 points	5 points	5 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 A few data out of the technical specification sheet of a Bugatti Veyron:

Mass:	1888 kg	
Maximum speed:	408.3 km/h	
Engine power:	1001 LE (736 kW)	
Acceleration:	0–100 km/h	2.5 s
	0–200 km/h	7.3 s
	0–300 km/h	16.7 s
	0–400 km/h	55 s

Source: https://hu.wikipedia.org/wiki/Bugatti_Veyron

Source: https://en.wikipedia.org/wiki/Bugatti_Veyron

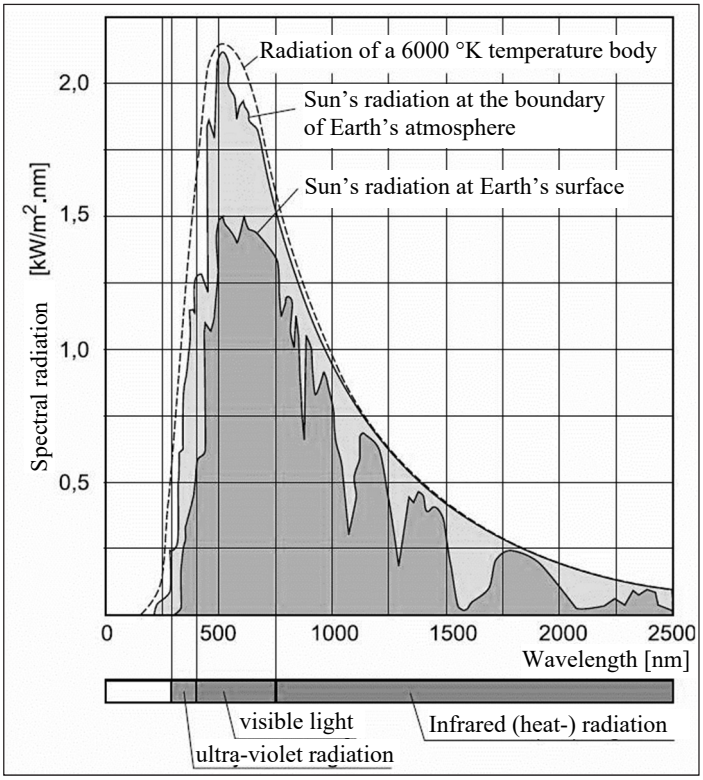
a) Determine the average acceleration of the car and the average net force accelerating the car in the speed ranges 0-100 km/h, 100-200 km/h, 200-300 km/h and 300-400 km/h. Determine the values of the kinetic energy change for each of the ranges as well. Enter your results in the table below.
b) Determine and write down in the table the average power of the engine used for acceleration at each section.
c) At which section did the engine have to overcome the smallest air drag? Justify your answer.

section	average acceleration (m/s^2)	average net force (N)	change of kinetic energy (kJ)	average useful power (kW)
0–100 km/h				
100–200 km/h				
200–300 km/h				
300–400 km/h				

a)	b)	c)	Total
8 points	8 points	4 points	20 points

3/B Would planet Earth have no atmosphere at all, its average surface temperature would be about -18 °C instead of 14 °C. Water vapor, carbon dioxide and other "greenhouse gases" (e.g. methane) in the atmosphere that are largely transparent to electromagnetic radiation in the visible range but absorb considerably in the infrared domain, play a major role in determining the surface temperature. (The physical unit on the vertical axis expresses the energy of the radiation per unit area and for a unit time.)

Source: http://www.hol-napinvest.hu/site/napelemekrol



a) How does the energy produced by the Sun reach Earth? How does a planet give energy off to its surroundings?
b) What is the difference between the wavelengths of the radiation emitted by a "cooler" red star and a "hotter" blue star?
c) What happens to visible radiation from the Sun that reaches the boundary of Earth's atmosphere? How does it interact with the atmosphere? What happens to most of the radiation reaching Earth's surface? How does this influence the physical state of the surface?
d) It can be seen on the figure that the atmosphere does not let part of the infrared radiation through. What happens to the Earth's radiation in the infrared domain radiated out towards space? What are those atmospheric gases called which do not let infrared radiation emitted by Earth pass through?
e) How and in what way can human activity influence the average temperature of Earth's atmosphere by the carbon dioxide emitted into the atmosphere?

a)	b)	c)	d)	e)	Total
4 points	2 points	6 points	4 points	4 points	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

---

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

dátum dátum

javító tanár jegyző