Név: ..... osztály:.....

ÉRETTSÉGI VIZSGA • 2010. október 28.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

2010. október 28. 14:00

Az írásbeli vizsga időtartama: 120 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

NEMZETI ERŐFORRÁS MINISZTÉRIUM

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! (Check your answer with calculations if necessary.)

1. A rubber is placed on the turntable of a record player far form the axis of rotation. The rubber rotates with the turntable in a horizontal plane. Which force holds the rubber in circular orbit?

A) The force of gravitation.
B) The normal force.
C) The force of friction.

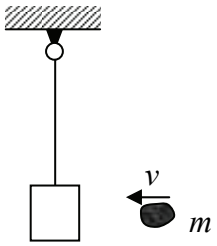
2 points	

2. In which case does a certain gas in an enclosed volume do more work: if its volume is doubled while its pressure is maintained constant, or, if its pressure is doubled while its volume is maintained constant?

A) If its volume is doubled.
B) If its pressure is doubled.
C) The work done by the gas is the same in both cases..

2 points	

3. A massive body is at rest, hanging on a string. Two different projectiles are thrown at the body: an elastic rubber ball and a piece of soft plasticine. The speed of the projectiles is identical, and both velocities are horizontal in direction. Their masses are also identical and much smaller than the mass of the body hanging on the string. In which case does the body on the string swing further out to the side?



A) When the rubber ball is thrown at it.
B) When the piece of plasticine is thrown at it.
C) The swinging of the body is identical in both cases.

2 points	

4. What do we have to remove from a neutral atom in order to obtain an ion?

A) A neutron.
B) An electron.
C) A photon.

2 points	

5. Can the pressure of a gas in a bottle be <u>negative</u> , i.e. such that the gas enclosed in the bottle exerts an inward pulling, 'sucking' force on the bottle wall, not an outward pushing force?

A) No, the particles of an enclosed gas always push the bottle's walls outward.
B) Yes, that is when the bottle walls may indent, or may be crushed if they are not rigid enough.
C) Only if the temperature is below -273ºC.

2 points	

6. The wavelength of light from a blue light-source decreases when it enters a different medium. Which one of its properties changes?

A) Its colour.
B) Its frequency.
C) Its velocity.

2 points	

7. Which electric field is termed homogeneous?

A) In which the magnitude and direction of the force on any charge is the same.
B) In which the magnitude and direction of the force on a given charge is the same everywhere.
C) In which the electric field lines are parallel with each other everywhere.

2 points	

8. A stone is thrown on level ground with an initial speed of 5 m/s. It is first thrown at a low angle, and then it is thrown upward at a steep angle. In which case is the magnitude of its velocity greater when it hits the ground? (Air drag can be neglected.)

A) When it is thrown at a low angle.
B) The speed of the stone when it hits the ground is the same in both cases.
C) When it is thrown upward at a steep angle.

2 points	

9. How can winter cold damage statues made out of stone in public places?

A) Water freezing in the statue's cracks forces the stone apart, thus pieces of stone may break off.
B) Because of the cold environment the statue contracts, so stresses arise in the material which may cause it to break.
C) Cold makes the statue's material rigid and brittle, so if something hits the statue, pieces may break off.

2 points	

10. What is difference between an alpha-particle and the nucleus of a ^{4}He atom?

A) An alpha-particle contains three protons and one neutron, while a ^{4}He nucleus contains two protons and two neutrons.
B) A ^{4}He nucleus contains three protons and one neutron, while an alpha-particle contains two protons and two neutrons.
C) There is no difference between the two particles.

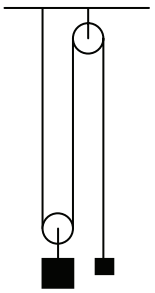
2 points	

11. How much gravitational force does Earth exert on a body of 1 kg mass, located at its center?

A) Infinitely large.
B) 9,81 N.
C) Zero.

2 points	

12. A rope is passed through pulleys and two bodies are hanged on it as shown in the figure. The bodies are then released. We know that the larger body is heavier than the smaller one. What will happen?



A) The larger body pulls the smaller one up.
B) The two bodies will be in equilibrium.
C) It is impossible to determine what will happen using the given information. ☐

2 points

13. When noting the temperature of a gas, we forgot to record which temperature scale we were using. We know that the temperature of the gas was 300 degrees initially, and it then increased by 400 degrees while its volume remained constant. In the meantime, its pressure increased to over twice its initial value. Which temperature scale could we have been using: the Celsius scale or the Kelvin scale?

A) We used the Celsius scale.
B) We used the Kelvin scale.
C) Using the information given, it cannot be determined which scale we were using. ☐

2 points

14. Which apparatus would generally a coil rotating in a magnetic field be a part of?

A) A transformer.
B) A bell.
C) A generator. ☐

2 points

15. A glass drops to the ground and breaks. What kind of interaction held together the pieces of the glass?

A) The electromagnetic interaction.
B) The interaction that gives rise to nuclear forces.
C) The gravitational interaction.

2 points	

16. We are pushing or pulling a small body on level ground with constant speed using a force parallel to the ground. ($\mu \neq 0$) In which case do we need to exert a greater force?

A) When we are pushing the body.
B) When we are pulling the body.
C) The force is equal in both cases.

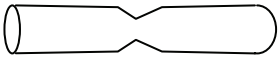
2 points	

17. A long solenoid carries a constant current *I*. In which case does the magnetic induction *B* at the middle of the coil increase the most?

A) When a copper rod is placed in the middle of the solenoid.
B) When an iron rod is placed in the middle of the solenoid.
C) The magnetic induction increases by the same amount in both cases.

2 points	

18. An aluminum wire was pressed with pliers during work. Thus the wire, which was a rod with a uniform cross-section initially, became slightly narrower in the middle. (See the figure.) Did the resistance of the wire change because of this?



A) Yes, the resistance decreased.
B) No, the resistance did not change.
C) Yes, the resistance increased.

2 points	

19. An electron and a proton are moving with identical speed. Which of the two has a greater de Broglie wavelength?

A) The electron has a greater de Broglie wavelength.
B) The two de Broglie wavelengths are identical.
C) The proton has a greater de Broglie wavelength.

2 points	

20. A comet is orbiting the Sun on an elongated elliptical orbit. In which direction does its acceleration point?

A) When the comet is nearing the Sun, its acceleration is parallel to its velocity, when moving away, the comet's acceleration is opposite to it.
B) The acceleration of the comet always points towards the Sun.
C) When the comet is moving away from the Sun, its acceleration is parallel to its velocity, when nearing the Sun, the comet's acceleration is opposite to it.

2 points	

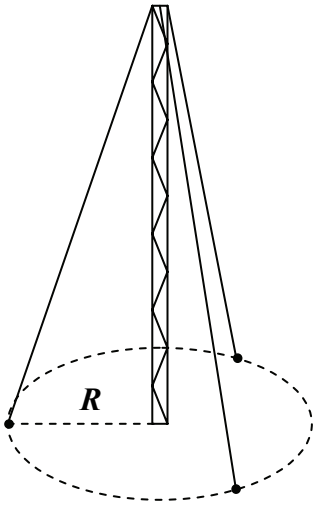
PART TWO

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 50 m tall antenna is secured by strong wire cables at three points. The cables are fixed to the ground at points along a circle of radius R = 20 m, at equal distances from each other.

a) How much downward force do the three cables exert on the antenna altogether, if the tension in each of them is 5000 N?

b) Why is it practical to fix the cables to the ground along a circle at equal distances from each other?



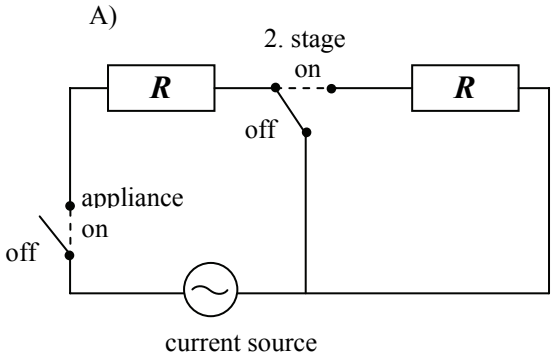
a)	b)	Total
11 points	3 points	14 points

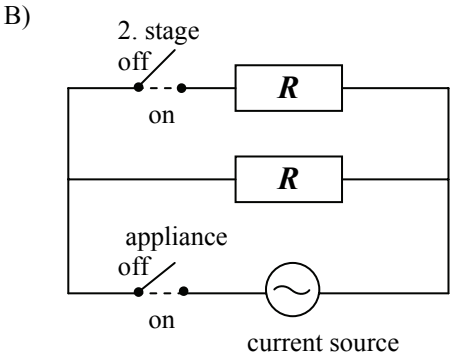
2. An electric heater designed to be used in a 230 V electric network has two stages, consisting of two identical resistors. If the appliance is turned on, but the second stage is turned off, the heating power is 1 kW. If the second stage is also turned on, the total heating power of the appliance is 2 kW.

a) How big is the electric resistance *R* of a single stage?

b) Which of the two circuit diagrams depicts correctly the functioning of the second stage's switch? Justify your answer!

c) What would the heating power of the appliance be after switching on the second stage, if the switch was built to operate as the other (incorrect) circuit diagram depicts it?





a)	b)	c)	Total
6 points	4 points	6 points	16 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 Gliese 581 is the codename given to a star roughly 20 light-years from Earth. Astronomers studying the star discovered that four planets orbit around it. The following table contains the planets' periods of orbit and their distances from the star. It was also determined that two of the planets, Gliese 581c and Gliese 581d may orbit in the "habitable" zone of this solar system, i.e. in the zone where water in a liquid state is possible on the planets' surface.

a) Fill in the missing data in the table.
b) Assume that we are able to determine that water in a liquid state does really exist on the surface of one of the planets. Can we then draw the conclusion, that the average temperature on the planet's surface is certain to be less than 100ºC? Justify your answer.
c) An organization on Earth sent a message of greeting in the direction of Gliese 581 using a large radio antenna in October 2008. What is the earliest possible time after which we can expect an answer to this message?

Codename of planet	Distance (million km)	Period of orbit (days)
Gliese 581a	4,5	3,15
Gliese 581b	6	
Gliese 581c		12,9
Gliese 581d	33	66,8

a)	b)	c)	Total
11 points	5 points	4 points	20 points

3/B The following table contains some isotopes of potassium and their half-life.

a) Fill in the missing data in the table.
b) Which isotopes of potassium are not radioactive?
c) Name a radioactive isotope of potassium which is certainly artificial.
d) What tendency of change can be observed in the half-lives from ^{33}K to ^{54}K? What is the reason for it?
e) What can radioactive isotopes be used for? Name a specific example.
f) Out of 1 mg of ^{46}K isotope how much will have decayed after 7 minutes?

Isotope	Number of protons	Number of neutrons	Half-life
^{33}K			<25 ns
^{35}K			178 ms
^{37}K			1,226 s
^{38}K			7,636 minutes
^{39}K			STABLE
^{40}K			$1{,}248 \cdot 10^{9}$ years
^{41}K			STABLE
^{42}K			12,36 hours
^{44}K			22,13 minutes
^{46}K			105 s
^{48}K			6,8 s
^{50}K			472 ms
^{52}K			105 ms
^{54}K			10 ms

a)	b)	c)	d)	e)	f)	Total
5 points	2 points	2 points	3 points	2 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)

Date: .....

notary (jegyző)

Date: .....