Név: ..... osztály:.....

ÉRETTSÉGI VIZSGA • 2012. október 29.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

2012. október 29. 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 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 point-like object is moving along a circular orbit of radius *R* with period *T*. How big is its displacement during a time interval of *T*/2?

A) $2R$
B) $R\pi$
C) $2R\pi$

2 points	

2. How does the relative humidity of the air in a room change, if we start to cool it using an air-conditioner?

A) The relative humidity increases.
B) The relative humidity decreases.
C) The relative humidity remains constant.

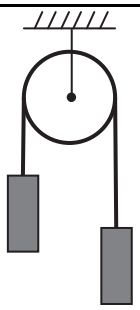
2 points	

3. We load an initially uncharged electroscope with a positive charge. What happens to the plates of the electroscope?

A) The distance between the plates increases, just as if they were loaded with a negative charge.
B) The plates stick firmly together.
C) Nothing happens; the plates of an electroscope can only be loaded with a negative charge.

2 points	

4. We hang two bodies of 1 kg mass onto the ends of a heavy chain weighting 0.5 kg. We place the chain on a pulley that rotates without friction as depicted on the drawing. What happens if we release the system?



A) The lower body accelerates downward, the upper body upward.
B) The upper body accelerates downward, the lower body upward.
C) The system remains motionless.

2 points	

5. What is the difference between electrons emitted as beta radiation and electrons ejected during the photoelectric effect?

A) Electrons emitted as beta radiation originate from the atomic nucleus, so their charge is positive, while the charge of electrons originating from the photoelectric effect is negative.
B) Electrons emitted as beta radiation decay in a short time, while electrons ejected during the photoelectric effect are long-lived.
C) There is no difference at all, every electron is identical.

2 points	

6. Can water boil at room temperature?

A) Yes, if we transfer a sufficient amount of heat to it while warming it slowly.
B) No, it cannot boil, it can only evaporate.
C) Yes, it can boil if the pressure is low enough.

2 points	

7. How can we build a 50 ohm resistance using 100 ohm resistors?

A) By connecting two 100 ohm resistors in series.
B) By connecting two 100 ohm resistors in parallel.
C) It is not possible to build a 50 ohm resistance using 100 ohm resistors.

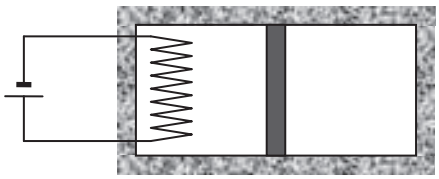
2 points	

8. The landing module of a spacecraft is descending towards the surface of the targeted planet with a constant speed. What can we say about the thrust of the module's rocket engine?

A) The landing module is descending, so the engine's thrust is pointing downward.
B) The landing module moves with a constant speed, so the engine is switched off, there is no thrust.
C) The planet exerts a gravitational pull on the landing module, so the thrust is pointing upward. ☐

2 points	

9. A thermally insulated container is divided by an insulated piston that can move easily. The gases enclosed on the two sides of the piston are equal in quantity and all their properties are identical. We begin to heat the left half of the container with an electric heater. How does the temperature of the gas in the right half of the container change?



A) The temperature increases, because the piston compresses the gas on the right adiabatically.
B) The temperature does not change, because the piston is insulated.
C) The temperature decreases, because according to the law of Gay-Lussac, the temperature is directly proportional to the volume. ☐

2 points	

10. The statements below refer to the iron core of an electromagnet's coil. Which of the statements is true?

A) The coil is a wire wound around an iron core – it is this core that supplies the coil with electric current.
B) The iron core of the coil is a permanent magnet, which stabilizes the magnetic field.
C) A current carrying coil generates a magnetic field even if we replace the iron core with a piece of plastic. ☐

2 points	

11. The kinetic energies of two bodies with different masses are equal (and nonzero). Which of the two has a greater momentum?

A) The one with the smaller mass has greater momentum.
B) The one with the greater mass has greater momentum.
C) The magnitudes of the two bodies' momenta are equal.

2 points	

12. We place a candle in front of a concave spherical mirror, at a distance exceeding the focal length. What can we say about the image of the candle generated by the mirror?

A) The image generated is certainly real because it can be seen with a naked eye.
B) The image generated is certainly real because it can be projected on a screen.
C) The image generated is certainly imaginary, because it is inverted.

2 points	

13. The following statements refer to the electrostatic and gravitational forces acting between two sodium ions (Na^+). Which statement is correct?

A) The directions of the electrostatic and gravitational forces are the same.
B) The magnitude of both forces is inversely proportional to the distance between the ions.
C) The electrostatic force is much greater than the gravitational force.

2 points	

14. A cross-country skier required 3000 J of work to cover a certain distance, while the work done by friction and air drag on him was -2000 J. The speed of the skier has decreased by the end of the distance. What kind of path was the skier moving on?

A) The skier was moving downhill.
B) The skier was moving uphill.
C) The skier was moving horizontally.

2 points	

15. Does 1 kg of powder snow yield more water upon melting completely, or does 1 kg of compacted snow yield more water? (The density of powder snow is 50 kg/m^3, while the density of compacted snow is 400 kg/m^3.)

A) 1 kg of compacted snow yields eight times more water than 1 kg of powder snow.
B) 1 kg of powder snow yields eight times more water than 1 kg of compacted snow.
C) The same amount of water is released in both cases.

2 points	

16. An electron enters a homogeneous electric field with a velocity parallel to the lines of force, pointing in the direction of the electric field. What will be the direction of the electron's acceleration?

A) It will be in the same direction as the electric field, parallel to it.
B) It will be in opposite direction as the electric field, parallel to it.
C) It depends on whether the electric field is generated by positive or negative charges.

2 points	

17. The electron of a hydrogen atom switches from the state with principal quantum number $n = 5$ to the state with principal quantum number $n = 3$. What kind of phenomenon accompanies this transition?

A) The hydrogen atom absorbs a photon.
B) The hydrogen atom emits a photon.
C) The hydrogen atom emits an electron.

2 points	

18. What does an astronaut standing on the Moon, observing the Earth see, when we can observe a total lunar eclipse on Earth?

A) An eclipse of the Sun.
B) An eclipse of the Earth.
C) He does not observe any difference compared to “the usual”.

2 points	

19. Which radiation has a greater wavelength? Infrared radiation or gamma radiation?

A) Infrared rays have a much greater wavelength.
B) Gamma rays have a much greater wavelength.
C) The order of magnitude of their wavelengths is the same; the two wavelength- ranges overlap partially. ☐

2 points	

20. The unit of which quantity is the same as the unit of torque expressed in SI units?

A) The unit of pressure.
B) The unit of energy.
C) The unit of momentum. ☐

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. We wish to operate a 60 W nominal power incandescent light-bulb that we bought overseas, which was designed for a 110 V domestic network. To operate it here using the 230 V network, we use an auxiliary resistor connected in series with the bulb.

What should the resistance of the auxiliary resistor be, so that the voltage on the light-bulb is only 110 V when in operation?

Total
13 points

2. We would like to cook tea in a solar furnace. The furnace consist of a parabolic mirror with a diameter of 1.4 m, which, if turned towards the sun, reflects the sunlight incident on its surface onto an aluminum pot placed in its focal point. The pot has a mass of 0.3 kg and, being painted black, is a very good absorber of radiation. The intensity of sunlight incident perpendicularly on a surface is 750 W/m^2. We can ignore cooling of the pot.

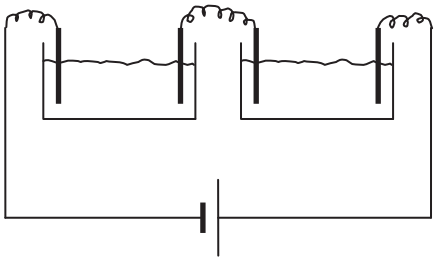
How much time does 1.2 liters of water from a spring require to reach boiling point, if its initial temperature is 15 °C and the efficiency of the furnace is 85%?

The specific heat of water is $4200 \frac{\text{J}}{\text{kg} \cdot ^\circ\text{C}}$, the specific heat of aluminum is $900 \frac{\text{J}}{\text{kg} \cdot ^\circ\text{C}}$.

Total
17 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 We connect two vessels used for electrolysis in series as shown in the drawing and drive electric current through them. One of the vessels contains silver nitrate ($AgNO_3$) solution, while the other one contains aluminum chloride ($AlCl_3$) solution. After a certain time, 108 g of silver and 9 g of aluminum are deposited on the negative electrodes. (We can ignore the role of other ions deposited on the cathode.)



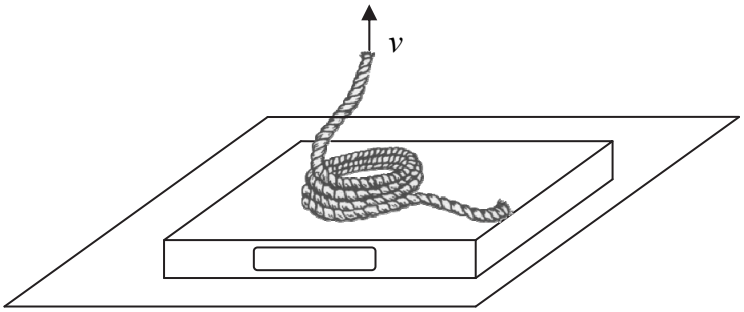
a) Why is metal deposited on the electrodes? Explain the process taking place in the vessels.
b) How can the ratio of the masses of the deposited metals be explained?
c) Does the ratio of the masses of the deposited metals change if we fill one of the vessels with a more concentrated or a less concentrated solution? If yes, in what way? If not, why not?
d) How much time did it take for the 108 g of silver and 9 g of aluminum to deposit if the strength of the current used for electrolysis was 120 A?

The molar mass of aluminum is $27\frac{\text{g}}{\text{mol}}$, the molar mass of silver is $108\frac{\text{g}}{\text{mol}}$.

The charge of an electron is $-1.6\cdot10^{-19}\text{C}$.

a)	b)	c)	d)	Total
3 points	8 points	4 points	5 points	20 points

3/B A heavy bundle of rope lies on a scale, and we start pulling one end of the rope at $t = 0$ s with a constant $v = 0.05$ m/s velocity vertically upward. The table below contains the masses measured by the scale at different times.



t (s)	0	20	40	60	80	100	120	140
m (kg)	6.0	4.8	3.6	2.4	1.2	0	0	0

a) Plot the mass measured by the scale as a function of time and discuss the resulting curve.
b) What is the mass of the whole bundle?
c) How long is the rope?
d) With what force do we have to pull the end of the rope at time $t = 80$ s?
e) How much work did we do during the first 100 seconds, if the kinetic energy of the rope is negligible?

($g = 10 \frac{\text{m}}{\text{s}^2}$, the effects of momentum change are negligible compared to the weight of the rope.)

a)	b)	c)	d)	e)	Total
8 points	2 points	2 points	3 points	5 points	20 points

Attention! 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): .....