Név: ..... osztály:.....

ÉRETTSÉGI VIZSGA • 2013. május 16.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

2013. május 16. 8:00

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 is correct for each of the following questions. Write the corresponding letter in the white square on the right! (Check your answer with calculations if necessary.)

1. At what temperature does water boil?

A) The boiling point for water is always 100 °C.
B) The boiling point of water depends on the external temperature.
C) The boiling point of water depends on the external pressure.

2 points	

2. We point a spring gun vertically upward. If we compress the spring of the gun's ejection mechanism by 5 cm, the gun shoots the projectile to a height of 3 meters. How high does the projectile go if we compress the spring by 10 cm? (Assume the spring to be ideal and air drag to be negligible.)

A) 6 meters high.
B) 9 meters high.
C) 12 meters high.

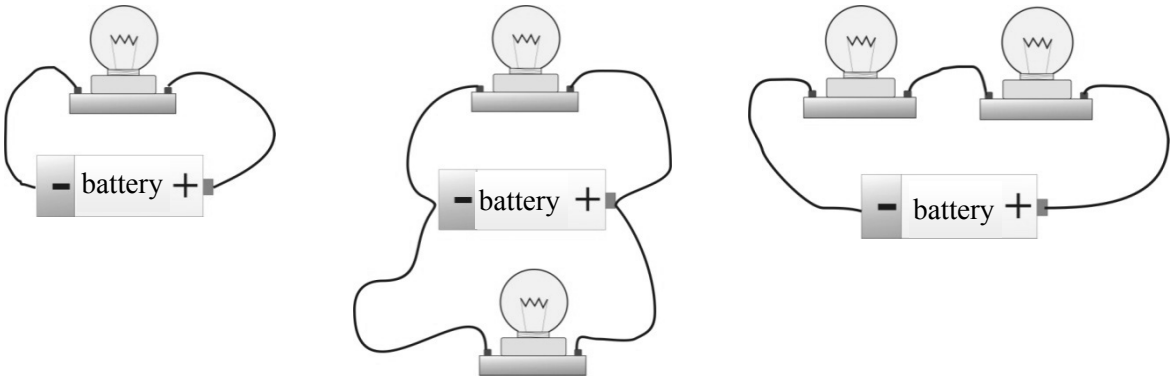
2 points	

3. White light is incident upon a prism, which decomposes it into the colours of the rainbow. What is the cause for this phenomenon?

A) Diffraction.
B) Dispersion.
C) Dissipation.

2 points	

4. We prepare three circuits shown below using identical incandescent lamps and identical, ideal batteries with negligible internal resistance. Which circuit provides the highest light intensity?

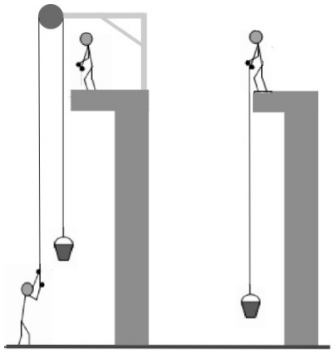


I. **II.** **III.**

A) Circuit I.
B) Circuit II.
C) Circuit III.

2 points	

5. A bucket of water is raised to a height of 8 meters at a construction site in two different ways as depicted on the figure. In which case is the work done greater?



A) When the water is raised from below using a fixed pulley.
B) When the water is raised from above with a rope.
C) The work done is the same in both cases.

2 points	

6. The statements below refer to the frequency of a sound wave propagating in air under standard conditions. Which one is correct?

A) The greater is the frequency of a sound wave, the smaller is its speed of propagation.
B) The greater is the frequency of a sound wave, the greater is its amplitude.
C) The greater is the frequency of a sound wave, the shorter is its wavelength. ☐

2 points	

7. Can the principal and orbital quantum numbers of two electrons within an atom be the same?

A) No they cannot, this is disallowed by the Pauli exclusion principle.
B) Yes they can, but only if the atom is not in its ground state.
C) Yes they can, irrespective of whether the atom is in its ground or excited state. ☐

2 points	

8. What is the root-mean-square voltage between the two connections of a two pin electrical socket when nothing is connected to the socket?

A) 0 V
B) 230 V
C) $230 \cdot \sqrt{2}$ V ☐

2 points	

9. There is some sort of gas in a container sealed with a piston. How can we raise its temperature?

A) Only by heating it.
B) Only by doing work on it.
C) Both by heating it and by doing work on it. ☐

2 points	

10. Which one is greater? The mass of an alpha particle, or the combined mass of two free neutrons and two free protons?

A) The mass of the alpha particle is greater.
B) The two masses are precisely equal.
C) The combined mass of two free neutrons and two free protons is greater.

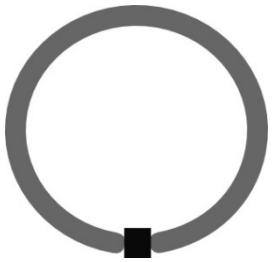
2 points	

11. What do astronomers mean by a constellation?

A) Groups of stars which are in physical connection with each other.
B) Certain areas of the celestial sphere which only appear distinct and are helpful for orientation in the sky.
C) An aggregation of galaxies and galaxy clusters which are located near each other in space and which, due to their great mass, have an influence on terrestrial life.

2 points	

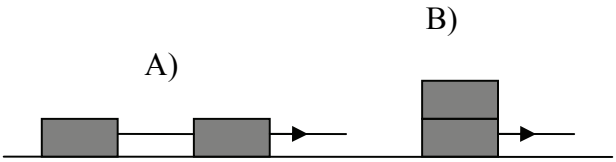
12. There is a small gap in the iron ring depicted in the figure. We squeeze a cube into the gap, which is made of an alloy whose thermal expansion coefficient is much smaller than that of iron. We begin to heat the ring. What happens to the small cube?



A) The gap expands, so the cube drops out.
B) The gap shrinks, so the cube is jammed tighter and may even become deformed.
C) The size of the gap does not change, so nothing happens to the cube.

2 points	

13. We would like to pull two identical 100 kg chests simultaneously with a rope on level ground. We pull the chests using a horizontal force with constant velocity in two different ways, as depicted in the figure. The coefficient of friction between the ground and the chests and also between the two chests is considerable. In which case do we need a smaller force for moving the chests with constant velocity?



A) In case A), because in this case we are only pulling one of the chests, the other chest is being pulled by the first one.
B) In case B), because in this case a friction force is exerted by the ground upon only one of the chests.
C) We have to pull the chests with same force in both cases.

2 points	

14. What is the value of the electric field strength inside a charged metal sphere?

A) The electric field strength inside the sphere is zero.
B) The electric field strength inside the sphere depends on the magnitude of the charge and the distance from the center of the sphere.
C) The electrical field strength inside the sphere is the same as its value on the surface.

2 points	

15. Where is our Solar System located within our galaxy?

A) In the arm of our Galaxy, on the part close to the Galactic Center.
B) At about the middle of the arm of our Galaxy.
C) In the outer half of the arm of our Galaxy.

2 points	

16. Direct current is flowing through the primary coil of a transformer designed to transform 50 Hz alternating current. What sort of voltage is generated in the secondary coil?

A) There is no voltage generated in the secondary coil.
B) Direct voltage.
C) 50 Hz alternating voltage.

2 points	

17. During nuclear fusion, two deuterium nuclei fuse to form a ^{3}He isotope. What other particle is created in the process?

A) A neutron.
B) An alpha particle.
C) An electron.

2 points	

18. What is the SI unit of pressure expressed in base units?

A) $\frac{kg}{m \cdot s^2}$
B) $\frac{kg \cdot s}{m^2}$
C) $\frac{kg \cdot m}{s^2}$

2 points	

19. Which one of the types of electromagnetic radiation below contains the most energetic photons?

A) Infrared radiation.
B) Microwave radiation.
C) UHF radiation (Ultra high frequency radio waves).

2 points	

20. Can an oarsman reach the opposite bank of the river, if his rowing speed (the speed he attains by rowing in still water) is less than the speed that the river's water is flowing with?

A) No, he cannot.
B) Yes he can, but only if he rows in a direction perpendicular to the river bank.
C) Yes he can reach the opposite bank by rowing in numerous different directions.

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. The needle of a sewing machine undergoes harmonic oscillatory motion along a vertical line. The distance between the highest and lowest points of its motion is 4 cm. The machine makes 24 stitches in 9 seconds.

a) What is the greatest speed of the needle and what is its highest acceleration?
b) Let us assume that the thread winds down from a reel with a diameter of 1 cm, rotating slowly. How many rotations does the reel make in one minute, if a single stitch requires 4 mm of thread?

(The needle of the sewing machine makes one stitch during a full period of oscillation.)

a)	b)	Total
8 points	7 points	15 points

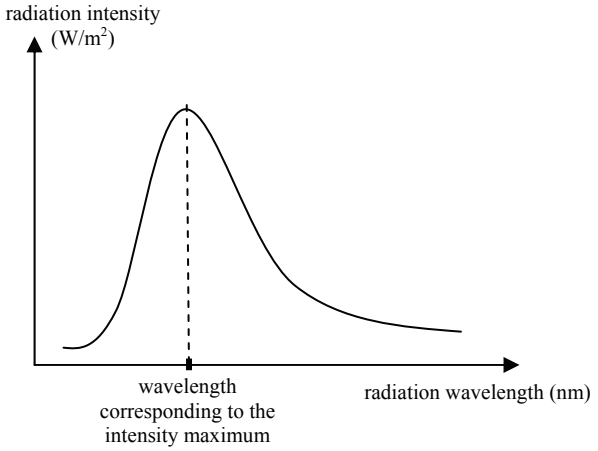
2. A 78 kg ice slab breaks off from a glacier of temperature 0 °C, and is floating in the water of a fjord whose temperature is also 0 °C. During the daylight hours, the Sun shines on the part of the ice above the water with an average power of 400 W/m^2. Approximately how many days does it take for half of the slab to melt, if the area of its surface above the water is 0.5 m^2 all along the process, the ice absorbs 25 % of the incident radiation and the sun shines about 12 hours each day.

(The sky is bright all along during the process, the air temperature is assumed to be 0 °C. The latent heat of fusion for ice is 334 $\frac{\text{kJ}}{\text{kg}}$.)

Total
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 According to observations, the hot surface of stars emits radiation in a wide region of the electromagnetic spectrum - the so-called thermal radiation. The intensity of the radiation depends on its wavelength as shown by the adjacent figure.



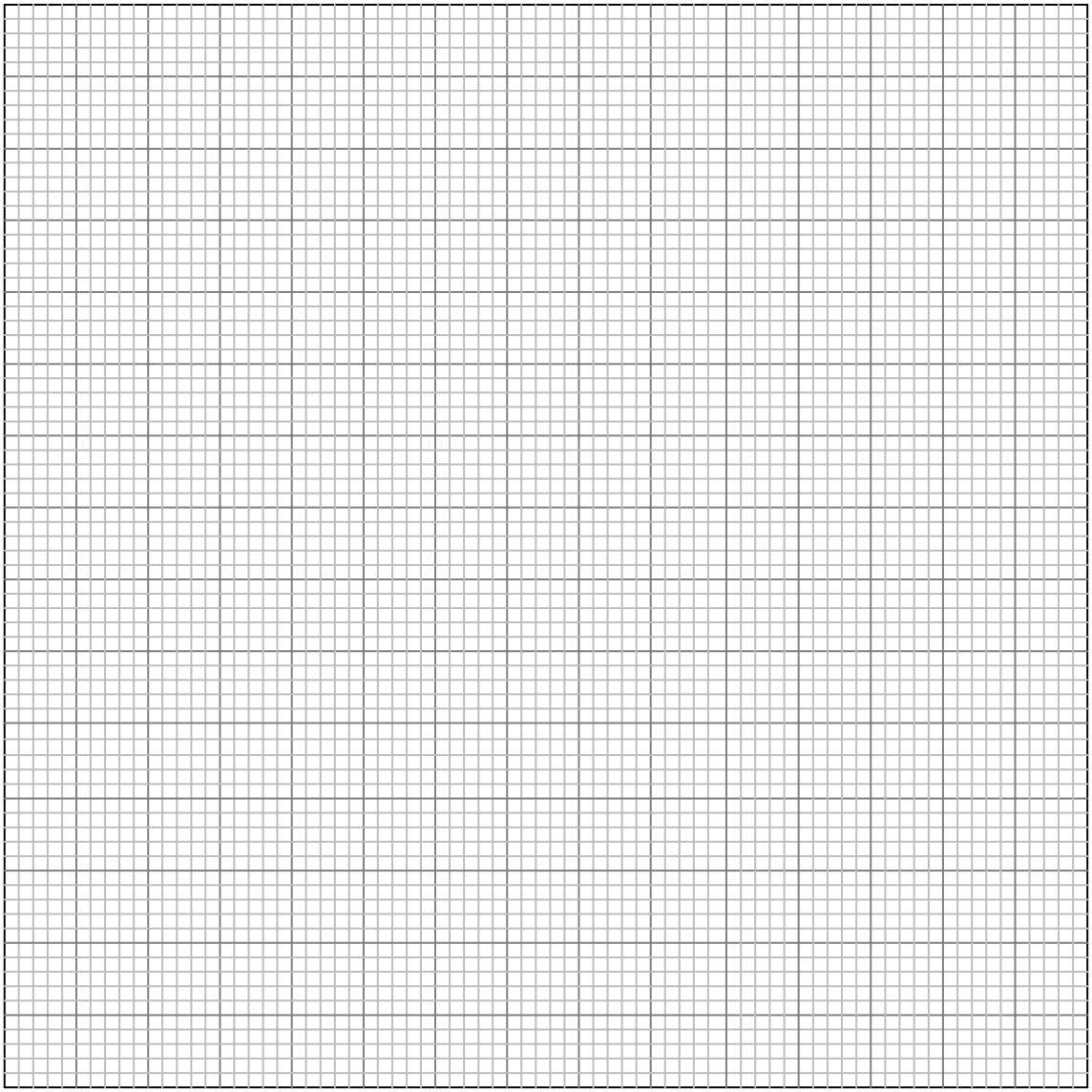
According to Wien's displacement law, there is a close relationship between the temperature of a star's surface and the wavelength at which the intensity of the emitted thermal radiation is maximal. The table below contains the surface temperature of a few stars, along with the wavelength that belongs to the intensity maximum of the thermal radiation that the star emits.

a) Plot the temperature data ($T_{surface}$) in the table as a function of the wavelength (λ_{max}) that belongs to the intensity maximum on a graph.
   Using the points, sketch the $T_{surface}$–λ_{max} curve that characterizes the stars.
b) Using the curve, estimate the surface temperature of the Sun, knowing that the intensity maximum of its radiation is at a wavelength of $\lambda_{max} = 5 \cdot 10^{-7}$ m.
c) Which of the stars radiate with maximal intensity in the ultraviolet region?
d) Which of the stars listed here look red to our eyes?

Name of the star	Surface temperature (K)	λ_{max} (10^{-7} m)
Achernar	15000	1.9
Arcturus	4300	6.7
Betelgeuse	3500	8.3
Deneb	8500	3.4
Proxima Centauri	3000	9.7
Rigel	11000	2.6
Sirius	9900	2.9
Spica	22400	1.3

Spectrum of visible light

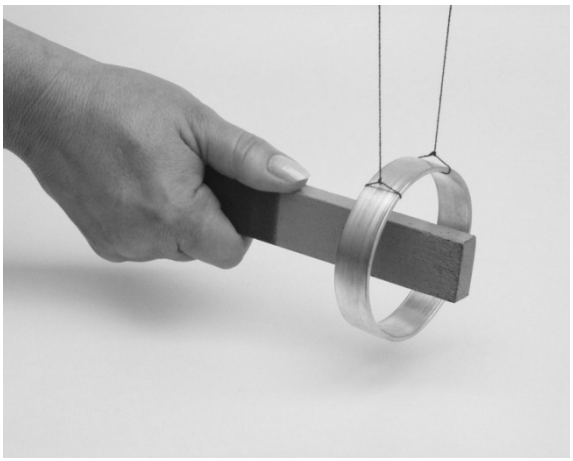
violet	380–450 nm
blue	450–495 nm
green	495–570 nm
yellow	570–590 nm
orange	590–620 nm
red	620–780 nm



a)	b)	c)	d)	Total
6 points	7 points	3 points	4 points	20 points

3/B

We push a bar magnet into a copper ring suspended as shown in the photograph. When we push the south pole of the magnet into the ring, the ring moves in the same direction as the magnet. We hold the magnet still until the motion of the ring ceases. We then pull the magnet out and observe that the ring starts moving again. The direction of its motion is opposite to the previous one, it follows the motion of the magnet.



How can this phenomenon be explained? Why does the ring move?
How can the direction of the copper ring's motion be explained?
In what equilibrium position will the ring come to rest when we push the magnet into the ring and wait for the ring to stop moving?
What happens if we repeat the experiment with the magnet reversed, moving the north pole in the ring?

Total
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): .....