Név: ..... osztály:.....

ÉRETTSÉGI VIZSGA • 2023. május 23.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

a 2012-es Nat-ra épülő vizsgakövetelmények szerint

2023. május 23. 8:00

Időtartam: 150 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

OKTATÁSI HIVATAL

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/ ☐

Sources not indicated on the problem sheet can be found in the evaluation guide.

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 draw figures on this problem sheet if necessary.)

1. We raise the temperature of a solid object first by 20 °C, then by 20 K. In which case does the object's temperature change more?

A) In the first case.
B) In the second case.
C) The two temperature changes are equal.

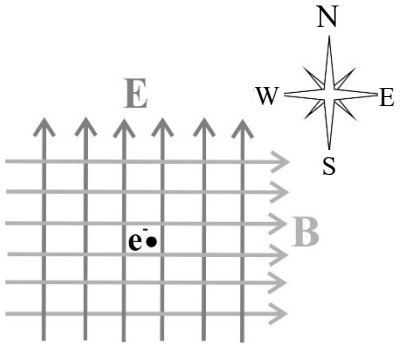
2 points	

2. Two vehicles are driving on the freeway. A lorry with 20 tons mass at a speed of 80 km/h and a sports car with 1.5 tons mass at a speed of 320 km/h. Which of the two vehicles has a greater kinetic energy?

A) The lorry.
B) The sports car.
C) The kinetic energy of the two vehicles are equal.

2 points	

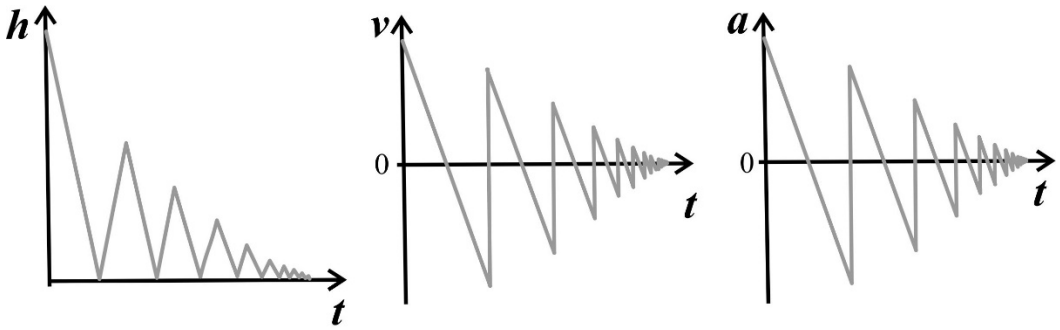
3. In a certain spatial domain, there is homogeneous electric field pointing north and homogeneous magnetic field pointing east. There is an electron fixed inside the domain, which is released at a certain time instant. In which direction will it start moving initially? (The gravitational field can be neglected.)



A) Towards north.
B) Towards south.
C) Towards northeast.
D) Towards southwest.

2 points	

4. An elastic ball is bouncing on the ground. We plotted its height above the ground *h*, its velocity *v* and its acceleration *a* as a function of time. Which of the graphs characterizes its motion correctly?



A) B) C)

A) Graph A).
B) Graph B).
C) Graph C).

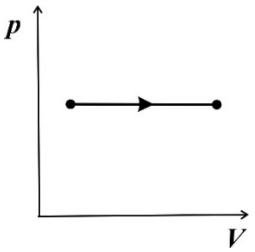
2 points	

5. The phenomenon of diffraction is proof for which property of light?

A) That light propagates as a wave.
B) That light is a transverse wave.
C) That light is an electromagnetic wave.

2 points	

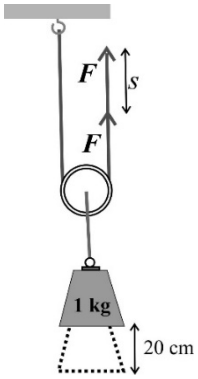
6. An ideal gas undergoes a thermodynamic process, the *p* – *V* graph of the process is shown on the adjacent figure. What can we say about the change that the gas undergoes?



A) The temperature decreased during the process.
B) The temperature remained constant during the process.
C) The temperature increased during the process.
D) The temperature may have either increased or decreased during the process.

2 points	

7. With what *F* force can the 1 kg object be lifted in the setup shown in the figure? What *s* distance will the rope's end move while the object is lifted to a height of 20 cm? (g = 10 m/s^2)



A) F = 10 N, s = 20 cm.
B) F = 10 N, s = 10 cm.
C) F = 5 N, s = 10 cm.
D) F = 5 N, s = 40 cm.

2 points	

8. A bimetallic strip is depicted on the adjacent figure, which is composed of two metal strips with different thermal expansion coefficient, fastened securely to each other. At a temperature of 20 °C, the strip is straight. In which direction will the strip bend when the temperature changes?

A) In the direction of the material with greater thermal expansion coefficient.
B) In the direction of the material with the smaller thermal expansion coefficient.
C) The strip will not bend due to a temperature change.
D) The answer depends on whether the temperature increases or decreases.

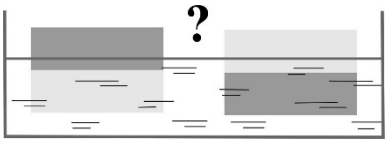
2 points	

9. A man is rowing in a 100 m wide river, perpendicular to the direction of the water-flow with a velocity of 0.5 m/s. In which case will the man reach the opposite shore of the river faster? If the velocity of the river's flow is 0.5 m/s, or if it is 1 m/s?

A) If the river flows with a velocity of 0.5 m/s.
B) If the river flows with a velocity of 1 m/s.
C) The man reaches the opposite shore in equal times in the two cases.
D) The man is able to cross to the opposite shore only if the river flows with 0.5 m/s velocity.

2 points	

10. A rectangular slab is made of two different materials, one of greater density and one of smaller density. The average density of the slab is smaller than that of water. We carefully place the slab into water in two different configurations as shown in the figure. In which case will it be immersed deeper in the water?



A) When the material with greater density is underneath.
B) When the material with smaller density is underneath.
C) It is immersed in the water equally in the two cases.

2 points	

11. A small positive charge is placed exactly halfway between two small, fixed, point-like, negative charges of equal magnitude. The charge will be in equilibrium at this position. We dislocate the positive charge slightly along the line connecting the negative charges. What will happen?

A) The positive charge will return to its original position.
B) The positive charge will not return to its original position, but will collide with the negative charge towards which it was displaced.
C) The question cannot be answered without knowing the magnitudes of the charges.

2 points	

12. Can we create an image of a candle on a screen using a single concave mirror?

A) Yes and this image will certainly be inverted.
B) Yes and this image will certainly be magnified.
C) Yes and this image will certainly be virtual.
D) No, one cannot create an image on screen using a concave mirror.

2 points	

13. We divide a 100 g radioactive sample with homogeneous material distribution into a 40 g and a 60 g part. Can the activity of the two parts be equal?

A) The two activities will be equal in every case, because the half-lives are the same.
B) The two activities can never be equal, because the masses of the two parts are different.
C) The two activities can be the same, but only if the temperatures of the two parts differ by a sufficient amount.

2 points	

14. In what way is Bohr's atomic model a progress compared to Rutherford's atomic model?

A) The concept of the atomic nucleus appears in Bohr's model.
B) Bohr's model explains the structure of the helium nucleus.
C) The line spectrum of hydrogen can be explained using Bohr's model.

2 points	

15. In which direction will charged particles move in the bottom wire of the circuit depicted in the figure? Right or left?

A) Right.
B) Left.
C) It is not possible to decide, it depends on the battery type.

2 points	

16. What causes the numerous shooting stars visible in August?

A) Earth's trajectory crosses the trajectory of a meteor cloud in August. Meteors glow when they enter the atmosphere, these are known as shooting stars.
B) Solar activity is stronger in August, small gaseous balls emitted by the Sun are perceived as shooting stars during the night.
C) In August, Earth crosses a cloud of comets that is located on its trajectory, we perceive the tails of the comets that enter the atmosphere as shooting stars.
D) In August, supernova explosions are more frequent in the Milky Way, it is these explosions that we perceive as shooting stars.

2 points	

17. Can we set electrons in a metallic conductor into motion using a strong magnet?

A) No, because a magnet acts only on magnetic poles, not on electrons.
B) Yes, but only if the material of the conductor can be magnetized.
C) No, because the electric field is shielded by the magnetic field.
D) Yes, by moving the magnet in an appropriate way we can induce current in the metal. ☐

2 points	

18. We throw a tennis ball at a basketball, the mass of the tennis ball is one tenth of the basketball's mass. The tennis ball bounces back from the basketball. On which ball was the force acting due to the collision greater?

A) On the tennis ball.
B) On the basketball.
C) The magnitudes of the two forces are equal. ☐

2 points	

19. What is particle *X* in the following nuclear reaction? ${}_{2}^{4}\mathrm{He} + {}_{4}^{9}\mathrm{Be} \longrightarrow {}_{6}^{12}\mathrm{C} + X$

A) Neutron.
B) Proton.
C) Electron.
D) Alpha particle. ☐

2 points	

20. Approximately what is the age of the Universe according to the Big Bang theory?

A) Approximately 4 billion years.
B) Approximately 14 billion years.
C) Approximately 24 billion years.
D) Approximately 34 billion years. ☐

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 mix 1 liter of 70 °C tea and 0.3 liters of 15 °C rum to make punch.

What will be the temperature of the punch after rapidly mixing the liquids?

(The density of rum is $\rho_{\text{rum}} = 0.8\frac{\text{g}}{\text{cm}^3}$, that of tea is $\rho_{\text{tea}} = 1\frac{\text{g}}{\text{cm}^3}$, the specific heat of rum is $c_{\text{rum}} = 2.6\frac{\text{kJ}}{\text{kg}\cdot°\text{C}}$, that of tea is $c_{\text{tea}} = 4.2\frac{\text{kJ}}{\text{kg}\cdot°\text{C}}$. Heat loss during the mixing is negligible.)

Total
15 points

2. *The Chinese LHAASO observatory (Large High Altitude Air Shower Observatory) investigates the unknown gamma ray sources of the Universe. To date, the observatory recorded over 530 gamma photons with energies over 10^{23} eV. The largest flash among them – the most energetic photon ever observed on Earth – had an energy of $1.4 \cdot 10^{24}$ eV. We know the direction that the signals came from, but the process in which they were created remains unknown. They are presumably created by the collisions of particles, which are accelerated during processes associated with exploding stars or the creation of stars. The most energetic particles in the Large Hadron Collider of CERN have an energy of about 10^{18} eV.*

a) What do we mean by an energy of 1 eV?
b) What is the energy of the most energetic photon ever observed on Earth, expressed in Joules?
c) What can the creation of extreme high-energy gamma photons be attributed to?
d) Under what circumstances, in what process can gamma photons be created on Earth? Name an example.
e) How many times is the energy of the most energetic cosmic photon ever observed on Earth larger than the energy of the most energetic particle created in the Large Hadron Collider?

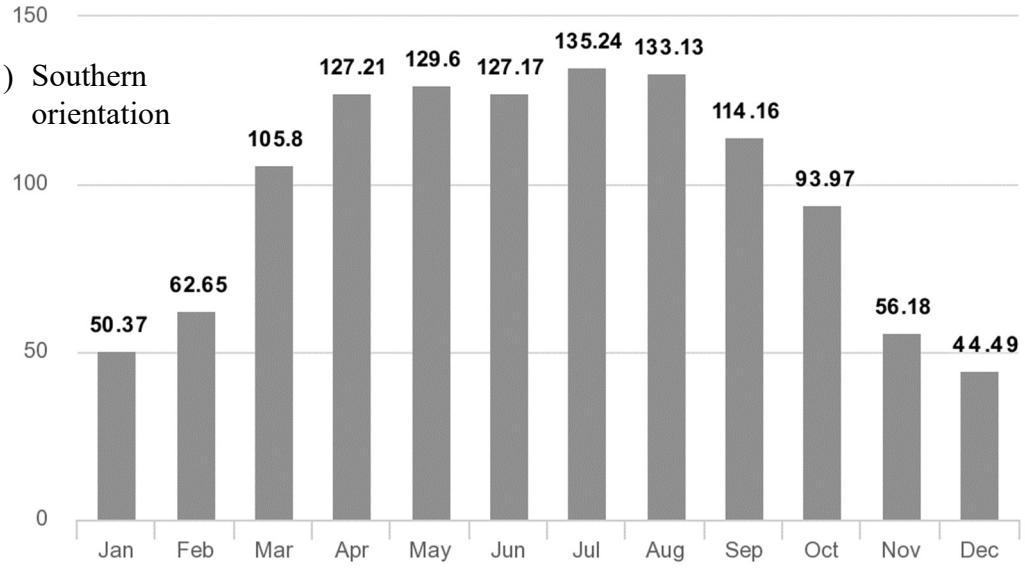
(The elementary charge is $e = 1.6 \cdot 10^{-19}$ C.)

a)	b)	c)	d)	e)	Total
3 points	3 points	3 points	3 points	3 points	15 points

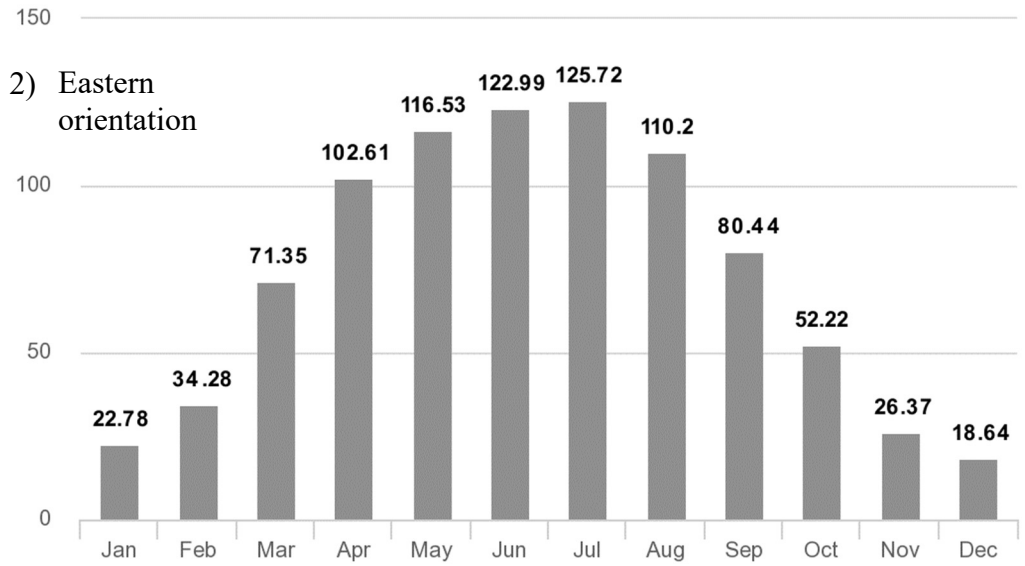
You need to solve only one of the two problems 3/A and 3/B. Indicate your choice on the inside of the front cover.

3/A The graphs below show a monthly breakdown of the annual expected energy yield of a solar panel located in the vicinity of Budapest, in kWh units. The first graph refers to the case when the solar panel is mounted on a roof oriented south and with 45° inclination, while the second graph refers to the case when it is mounted on a roof oriented east and with 45° inclination. The table below contains the total expected energy yield for the two different orientations summed up for the whole year.

1) Southern orientation



2) Eastern orientation

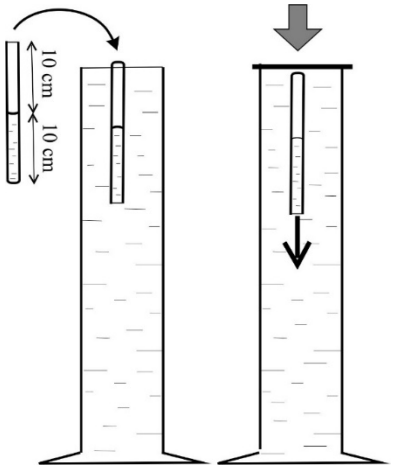


Orientation	S	E
annual yield (kWh)	1180	884

a) What percentage of the annual expected energy yield does a solar panel oriented south give off in each of the seasons?
b) Explain why the expected electric energy yield in the winter season is much smaller than in the summer season. Give two possible reasons.
c) Which of the orientations in the table is more favorable? By what percent is the energy yield of the less favorably oriented solar panel smaller than that of the more favorably oriented panel?
d) Compare the expected energy yield of a solar panel oriented south to the yield of one oriented east in summer and in winter. When is the significance of proper orientation higher?
e) A given home requires 12 solar panels mounted on a roof oriented south and with 45° inclination to cover its annual electric energy consumption. How many panels would the same home require, if its roof was oriented east?

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

3/B In a tall measuring cylinder filled with water, we place a 20 cm test tube, overturned and having air in the top half and water in the bottom half (Cartesius diver). The test tube floats on top of the water, its closed upper end is a bit above the water surface in the measuring cylinder. We seal the top of the measuring cylinder with a rubber sheet and press down on the sheet. If, in the case depicted here, we apply a surplus pressure of 5 kPa, the "diver" will start to sink.



a) What forces act on the test tube floating on top of the water?
b) How does the volume of the air enclosed in the test tube change if we increase the pressure in the system?
c) Why does the diver start to sink if we apply a sufficiently large pressure?
d) If we cease to apply pressure, the diver may rise to the top of the water. Explain the phenomenon.
e) If the cylinder is tall enough, it may happen that the diver will not rise to the top of the water even if the pressure on the rubber sheet ceases. What is the cause of this phenomenon?
f) We fill our diver with oil instead of water. We also replace the water in the cylinder with oil. Do we need to apply a pressure smaller or greater than 5 kPa on the rubber sheet for the diver to start sinking? The density of oil is smaller than the density of water. Justify your answer.

a)	b)	c)	d)	e)	f)	Total
2 points	3 points	3 points	4 points	4 points	4 points	20 points

	score	
	maximum	attained
I. Multiple-choice questions	40	
II. Complex problems	50	
Total score for 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