Név: ..... osztály:.....

ÉRETTSÉGI VIZSGA • 2022. október 27.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

a 2012-es Nat-ra épülő vizsgakövetelmények szerint

2022. október 27. 14:00

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

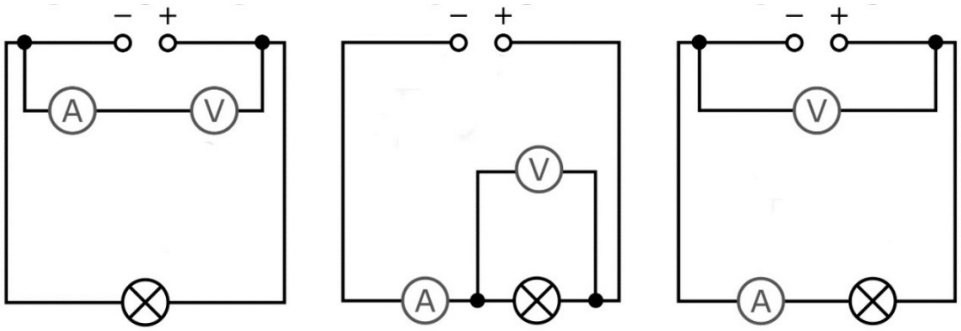
Precisely one of the possible solutions for each of the following questions is correct. Write the corresponding letter in the white square on the right. (You may write calculations or draw figures on this problem sheet if necessary.)

1. A cyclist was riding for 1.2 hours. What can we state about the cyclist's average speed if we know the largest and the smallest speed attained during the motion?

A) The average speed is the arithmetic mean of the largest and smallest speeds attained during the journey.
B) The average speed will be closer to the smallest speed, than to the largest.
C) The average speed will be closer to the largest speed, than to the smallest.
D) It is impossible to decide which of the above statements is true without more precise knowledge of the motion.

2 points	

2. In which of the circuits below will the lamp <u>not</u> light up?



A) In the circuit on the left.
B) In the middle circuit.
C) In the circuit on the right.
D) The lamp will light up in all three circuits.

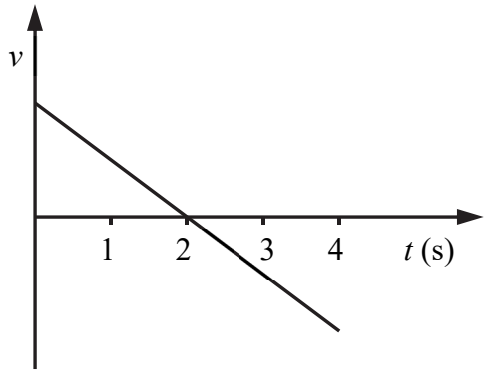
2 points	

3. We perform experiments with an ideal gas enclosed with a piston. Can we realize a process during which the volume of the gas changes, while its pressure and temperature remain constant?

A) No, because in thermodynamic processes of an enclosed gas $\frac{pV}{T}$ remains constant.
B) Yes, the isothermal-isobaric process is just so.
C) Yes, if T < 0 K, one can realize such a process.

2 points	

4. The velocity-time graph of a body moving along a straight line can be seen on the figure. At which time instant will the body be the farthest from its initial position (the position occupied at *t* = 0 s)?



A) $t = 0$ s.
B) $t = 2$ s.
C) $t = 4$ s.

2 points	

5. A firm is buying a corn grinder machine and has a choice of two models. The first one has an efficiency of 60 % and consumes 210 kW electric power from the grid. The second one has an efficiency of 70 % and consumes 180 kW electric power from the grid. Both machines grind the same amount of corn during an hour. Which statement is true?

A) The useful power of the two machines are equal, and the second one is more economic to operate.
B) The useful power of the first machine is greater, but the second one is more economic to operate.
C) The useful power of the second machine is greater, but the first one is more economic to operate.

2 points	

6. The rear wheel of a tractor has a diameter 1.2 times greater than its front wheel. Which statement is true? If the tractor moves with constant speed (with wheels rotating without slipping), …

A) … the rotation frequency of the rear wheel is 1.2 times that of the front wheel.
B) … the angular velocity of the rear wheel is 1.2 times that of the front wheel.
C) … the period of rotation of the rear wheel is 1.2 times that of the front wheel.
D) Neither of the above statements is true.

2 points	

7. We are caught by a thunderstorm while walking in a meadow. Which of the actions below is most dangerous?

A) We take refuge in a tin hut.
B) We put on our raincoat and start running.
C) We hold our pointed umbrella with a metallic shaft above our head.

2 points	

8. The eye disorder of a lady is corrected by a pair of +4 diopter glasses. What sort of eye disorder has been corrected by the glasses for the lady?

A) Her far-sightedness.
B) Her short-sightedness.
C) Both her short-sightedness and her far-sightedness may be corrected by these glasses.

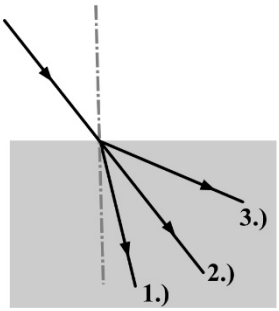
2 points	

9. When did the Sun exert a greater gravitational attraction force on the Moon? At the time of the 2012 May 20 solar eclipse, or at the time of the 2022 May 15 total lunar eclipse?

A) At the time of the solar eclipse.
B) At the time of the lunar eclipse.
C) The gravitational attraction forces were precisely equal.

2 points	

10. A light ray propagates in air and is incident upon the planar face of a glass slab. How does it propagate further?



A) As shown by arrow 1.).
B) As shown by arrow 2.).
C) As shown by arrow 3.).

2 points	

11. A parachutist is descending towards the ground with parachute open and at a constant speed. Which of the statements below is true at this stage of the parachutist's motion?

A) The kinetic energy of the parachutist increases, its potential energy remains constant.
B) The kinetic energy of the parachutist remains constant, its potential energy decreases.
C) The kinetic energy of the parachutist increases, its potential energy decreases.

2 points	

12. A small charged particle performs uniform motion along a straight line in vacuum. How does its motion change, when it enters a spatial domain with homogeneous magnetic field present?

A) The particle deviates from its previous straight course.
B) The particle continues with its uniform motion along a straight line.
C) The question cannot be decided, it depends on the direction of the magnetic field.

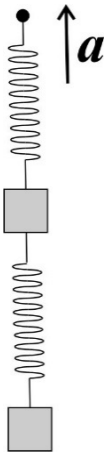
2 points	

13. Where does natural background radiation originate?

A) It comes from the rocks that form Earth's crust.
B) It comes directly from space.
C) Both of the above sources contribute.

2 points	

14. We hang two identical, weightless springs and two identical bodies below each other as depicted on the figure. We examine this system in an elevator that is accelerating upward. Which of the springs stretches more when the bodies are already at rest with respect to the elevator?



A) The lower spring.
B) The upper spring.
C) The two springs will be stretched equally.
D) The question cannot be decided without knowing the precise value of the acceleration.

2 points	

15. During an experiment, the absolute value of the temperature of some material measured in degrees Celsius and in degrees Kelvin were equal. What was the temperature of the material?

A) 0 K
B) 136.5 K
C) 0 °C
D) 136.5 °C

2 points	

16. The half-life of a radioactive isotope is 10 minutes, its activity in the course of a measurement is 20 Bq. What was its activity 20 minutes before the measurement?

A) 5 Bq.
B) 10 Bq.
C) 40 Bq.
D) 80 Bq.

2 points	

17. The helicopter 'Ingenuity', carried by the mars rover 'Perseverance' made several successful flights above the surface of Mars recently. Why was a similar device not used during the exploration of the Moon's surface?

A) Because surface gravity on Mars is smaller than on the Moon, so it is much easier to fly there than above the Moon's surface.
B) Because the surface of the Moon is smooth and solid, so a moon rover can drive easily and fast, whereas the surface of Mars is dusty and rocky, where it is difficult to drive a vehicle with wheels.
C) Because the Moon has no atmosphere, so a helicopter cannot fly there, whereas Mars does have an atmosphere.

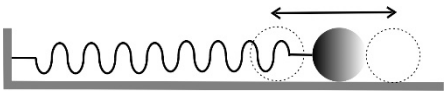
2 points	

18. For the material composing the cathode of a photocell, we know the smallest frequency that can be used to eject electrons from the cathode. What does this frequency tell us?

A) The work function characterizing the cathode.
B) The average kinetic energy of the ejected electrons.
C) The current of the photocell.

2 points	

19. A body is fastened to a spring that can push and pull and undergoes harmonic oscillatory motion on a frictionless, level table as depicted in the figure. At which position is the energy stored in the spring greater during the oscillation? When the body is its left turning point, or when it is at its right turning point?



A) When it is at the left turning point, where the spring is compressed.
B) When it is at the right turning point, where the spring is stretched.
C) The energy stored in the spring is the same in the two positions.
D) The question cannot be decided without precise data.

2 points	

20. Approximately what is the pressure at the bottom of a 2 m deep pool, if the atmospheric pressure is 10^5 Pa?

A) Approximately 10^5 Pa.
B) Approximately $1.2 \cdot 10^5$ Pa
C) Approximately $2 \cdot 10^5$ Pa
D) Approximately $3 \cdot 10^5$ Pa

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 cube with edge length a = 30 cm and density ρ = 600 kg/m^3 is placed in a deep tub of water.

a) Determine to what depth is the cube submerged in the water.

b) What is the mass of the lead weight that we should place on the top of the cube if we want the cube to be submerged precisely to its top?

(ρ_{water} = 1000 kg/m^3, g = 9.81 m/s^2)

a)	b)	Total
7 points	7 points	14 points

2. Measuring the speed of light

The first successful measurement of the speed of light was performed by the Danish astronomer Olaf Römer (1644-1710), using the following procedure. He started his observations, when Earth was precisely between Jupiter and the Sun. He first measured the orbital period of Io, a moon of Jupiter, by observing the two consecutive times when Io appeared after being hidden behind Jupiter. Io is the innermost of the four great moons of Jupiter (Galilean moons). Then he waited for half a year. During this time, Io orbited 103 times around Jupiter, Earth moved to the opposing side of the Sun and Jupiter's movement along its orbit was not substantial. From the orbital period determined by his initial measurement, Römer calculated the time when Io should emerge from Jupiter's shadow after orbiting 103 times, but found that the appearance from behind Jupiter was 1200 s late compared to the calculated time. He deduced, that the reason for the delay is that Earth moved farther from Jupiter. Therefore the light from Io had to travel a greater distance to the Earth and thus to Römer's eyes in the second case than during the initial measurement and it needed 1200 s for that.

a) Complete the sketch below. Draw Earth's position on it during the first and the second measurement of Olaf Römer. Indicate which position corresponds to which measurement.

b) Estimate the value of the orbital period of Io measured by Römer based on the data in the text.

c) What value do we obtain for the speed of light in the measurement above, if we take the distance between Earth and the Sun to be 150 000 000 km approximately?

d) What can we say about the orbital periods of the other three Galilean moons compared to that of Io based on the text above? Justify your answer.

a)	b)	c)	d)	Total
4 points	4 points	4 points	4 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 We investigate changes in the volume of air enclosed in a cylinder by a piston that can move without friction, as a function of temperature. The initial volume of the enclosed air was 535 cm^3 at a temperature of 20 °C. We could measure the volume with an accuracy of 5 cm^3. The measured values are in the table below:

T (°C)	20	30	40	50	60	70	80	90	100
V (cm^3)	535	555	570	590	610	625	645	665	680

a) Plot the data on a graph.

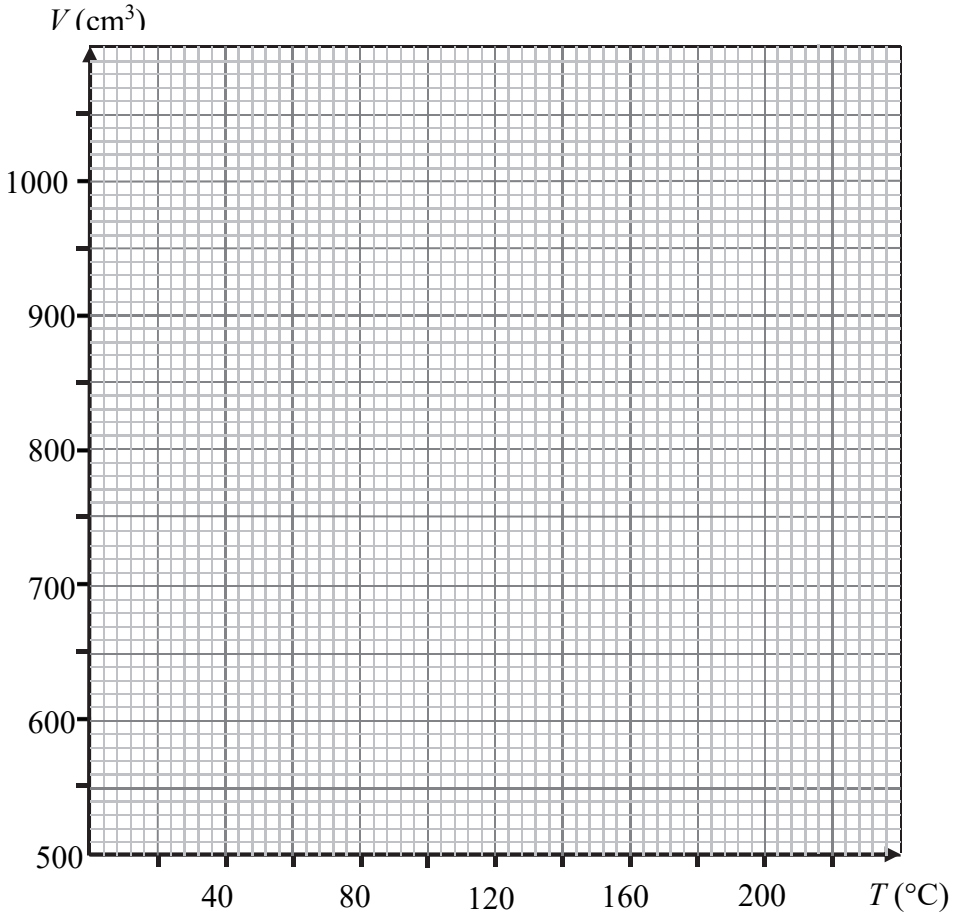
b) What is the nature of the relation between the data?

c) What would the volume of the air be at 0 °C?

d) What would the volume of the air be at 200 °C?

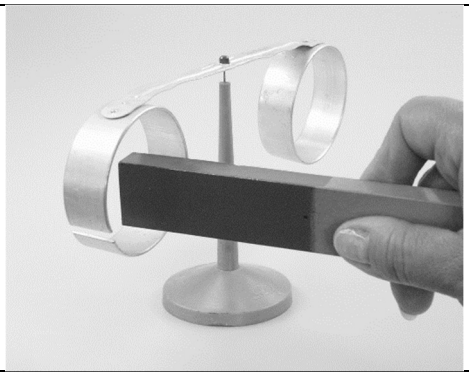
e) At what temperature would the volume of the air become zero, if the gas would not condense, would not freeze and the relationship between the volume and temperature of the gas remained identical to the one exhibited by the data in the table even for lower temperatures?

f) What is the significance of the temperature determined in question e) and what is the related temperature scale?



a)	b)	c)	d)	e)	f)	Total
5 points	2 points	2 points	2 points	5 points	4 points	20 points

3/B A device used to demonstrate Lenz's law is composed of two light aluminum rings placed on a stand. One ring is closed (continuous), while the other is open (broken). The pair of rings can rotate easily around the axis of the device. During the experiment, we would like to push a bar magnet through the rings. We find that if we want to push the magnet through the closed ring, the device rotates in the direction of motion of the magnet. If we try to push the magnet through the open ring, we do not observe any rotation.



Explain why the closed ring rotates when the bar magnet gets closer. What force acts on the ring and why? Does the direction of rotation change if we near the magnet to the closed ring with the other pole? Why does the phenomenon not take place when we near the magnet to the open ring?

Total
20 points

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