

ÉRETTSÉGI VIZSGA • 2022. május 17.

FIZIKA
ANGOL NYELVEN
KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

a 2012-es Nat-ra épülő vizsgakövetelmények szerint

2022. május 17. 8:00

Időtartam: 150 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

EMBERI ERŐFORRÁSOK MINISZTERIUMA

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.

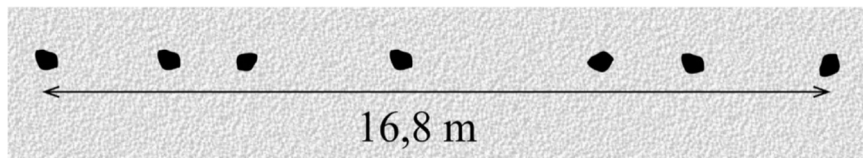
Please indicate here which of the two problems 3/A and 3/B you have chosen (that is, which one you would like evaluated):

3/ ☐

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 make drawings on the exam sheet if necessary.)

1. A boy walked along the street with a bucket of paint that was dripping paint. A drop of paint fell every two seconds, leaving stains on the pavement. What was the average speed of the boy, while the paint left stains on the pavement as depicted by the picture?



- A) 1,2 m/s.
B) 1,4 m/s.
C) 2 m/s.

☐

2 points	
----------	--

2. Optic fibers can be used to guide light along a curved trajectory instead of a straight line. Which phenomenon is utilized for the operation of the optic fiber?

- A) The diffraction of light.
B) The total internal reflection of light.
C) The polarization of light.

☐

2 points	
----------	--

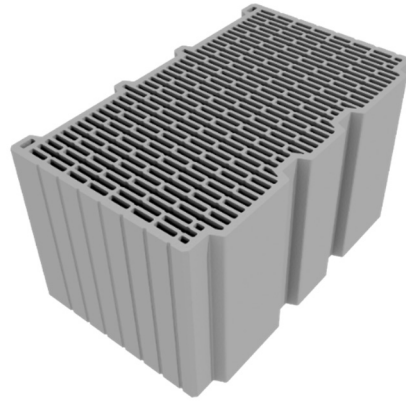
3. Which of the instruments below can be used to generate direct current?

- A) A galvanic cell, a solar cell.
B) A galvanic cell, a transformer.
C) A solar cell, a transformer.

☐

2 points	
----------	--

4. Bricks used in modern construction most often have a hollow structure as the heat engineering properties of buildings made of them are much better. Why could hollow structure bricks be better than solid bricks?

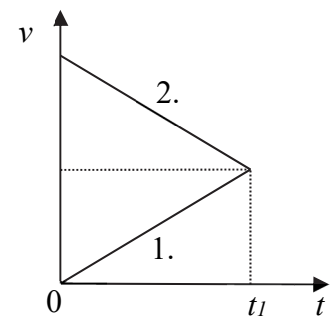


- A) Because bricks with a hollow structure are better conductors of heat.
B) Because bricks with a hollow structure radiate heat better.
C) Because bricks with a hollow structure have better heat convection.
D) Because bricks with a hollow structure are better insulators of heat.

☐

2 points

5. The adjacent v - t graph depicts the varying speed of two bodies moving along a straight line from a time $t = 0$ to t_1 . At time t_1 their speeds are equal. Which body covered a greater distance during the time interval between $t = 0$ and t_1 ?



- A) The body denoted with number 1.
B) The body denoted with number 2.
C) The distances covered by the two bodies are equal.
D) It is not possible to determine this from the graph.

☐

2 points

6. In which radioactive decay process does the mass number of the decaying nucleus decrease?

- A) Only in alpha-decay.
B) Only in beta-decay.
C) Only in gamma-decay.
D) Both alpha- and beta-decay processes have this property.

☐

2 points

7. The adjacent photograph was taken from the gondola of a hot-air balloon. Which of the shadows on the ground in the picture is cast by the balloon from which the picture was taken?



- A) Shadow 1.
B) Shadow 2.
C) It cannot be determined from the photograph.

☐

2 points	
----------	--

8. The half-life of a certain quantity of radioactive isotope is 2 years. If we have half this quantity of the same type of isotope, what will its half-life be?

- A) 1 year.
B) 2 years.
C) 4 years.

☐

2 points	
----------	--

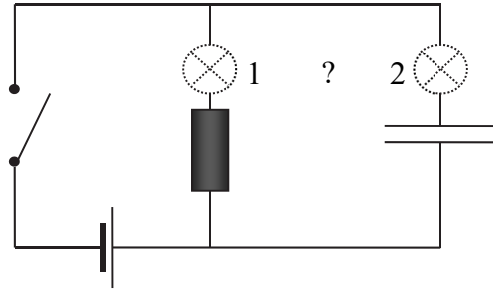
9. A stone is thrown vertically upward with a certain initial speed. It ascends, halts at the top of its trajectory and falls back to the ground. During which phase of its movement does the force of gravity do work on it?

- A) Only during the ascending phase when its speed decreases.
B) Only when it is falling back and accelerating.
C) Both during the ascending phase and during the descending phase.
D) No work is done, not even for a moment as the speed with which it reaches the ground is the same as the initial one.

☐

2 points	
----------	--

10. We connect a resistor and a capacitor in parallel in a direct current circuit. We then connect a light-bulb at one of the two numbered locations. Where should we connect the light-bulb if we want it to shine permanently after the current is turned on?



- A) We can connect it only at location 1.
B) We can connect it only at location 2.
C) We may connect it at any one of the locations, both are suitable.

☐

2 points

11. During summer, very high (dangerously high) temperatures may develop in the cabins of cars parked in the sun. Which of the following factors is the prime cause of the heating of the cabin?

- A) The engine of the car remains hot for a long time after stopping in summer, that is what heats the cabin.
B) The Sun heats up the road surface a great deal, so if a car is stopped and parked in the sun, the hot road surface below heats the cabin above it.
C) Sunlight entering the cabin through the windows heats the inside of the cabin a great deal and the heat is trapped by the greenhouse effect.
D) Humidity increases a great deal in the enclosed space and water condensing at various places gives off a lot of heat.

☐

2 points

12. The circuit breaker of a domestic 230 V electric circuit disengages if a current larger than 15 A is detected, interrupting the current. We would like to operate the following appliances in this circuit: a 2000 W hair-dryer and a 3000 W water heater. Which appliance can be switched on without the circuit breaker disengaging?

- A) Only the hair dryer on its own.
B) Either appliance may be switched on, but only one at a time.
C) We may switch both appliances on together, the circuit breaker will not disengage.
D) Neither one, if any of the appliances is turned on, the circuit breaker disengages.

☐

2 points

13. In 1962, a railway car broke loose when reversing, broke through the glass wall of Western Railway Station and came to rest on the boulevard. Which force was greater? The force exerted by the car on the glass wall or the force exerted by the glass wall on the car?



- A) The glass wall exerted a greater force on the car than the car on the glass wall.
B) The car exerted a greater force on the glass wall than the glass wall on the car.
C) The two forces were equal in magnitude.
D) The question cannot be decided without performing precise measurements.

☐

2 points

14. We release a proton, then an electron in a homogeneous electric field without initial velocity. Which particle will move with a greater magnitude of acceleration?

- A) The proton, because its charge is positive.
B) The electron, because its mass is smaller.
C) The magnitude of acceleration for the two particles will be equal, because the magnitude of their charges are identical.

☐

2 points

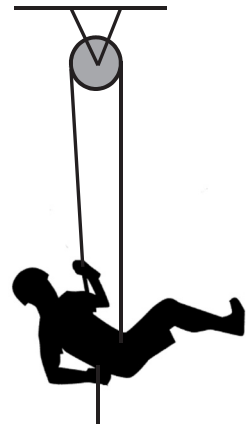
15. A body is just floating inside water whose temperature is $4\text{ }^{\circ}\text{C}$. What happens to the body if the temperature of the water is lowered slowly to $0\text{ }^{\circ}\text{C}$? (The body's thermal expansion is negligible.)

- A) The body sinks to the bottom of the vessel.
B) The body will rise to the water surface.
C) The body will first sink, then rise.
D) The body will first rise, then sink.

☐

2 points

16. The mountain climber on the adjacent drawing has a weight G and is wearing a so-called harness. The rope tied to him at his waist passes through a pulley above and he tries to lift himself by pulling strongly on the rope. Approximately what force does he need to exert in order to lift himself?



- A) Approximately G .
B) Approximately $G/2$.
C) He cannot pull himself up this way, this is just like trying to lift himself by his own hair.

☐

2 points

17. Objects at the International Space Station are in a state of weightlessness. What is the explanation for weightlessness? Which statement is false?

- A) The space station is far from Earth, so gravity is no longer effective there.
B) The centripetal acceleration of the space station is, in effect the same as its gravitational acceleration.
C) The space station and all objects within are in a free-fall towards the center of the Earth.

☐

2 points

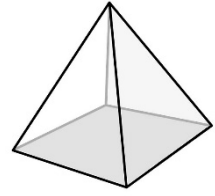
18. An atom emits a photon, while one of its electrons makes a transition to an inner orbit. Can the atom then absorb a photon of the same frequency?

- A) Yes and the electron will make a transition to an outer orbit.
B) No, because the absorption energy is greater than the emission energy.
C) Yes, but only in vacuum because a material medium will change the frequency of the emitted photon.

☐

2 points

19. A pyramid made of homogeneous material is standing on a horizontal table top. Its height is $h = 40$ cm, its mass $m = 2$ kg. What can we state about the potential energy of the pyramid with respect to the table surface?



- A) $E_h > m \cdot g \cdot h / 2$
B) $E_h = m \cdot g \cdot h / 2$
C) $E_h < m \cdot g \cdot h / 2$



2 points	
----------	--

20. The moon (or moons) of which planet can be seen from Earth by the naked eye?

- A) Only Earth's own Moon.
B) That of Earth and that of Mars.
C) That of Earth and that of Saturn.



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 would like to project the picture of a 18 mm x 24 mm diapositive onto a screen to obtain a 45 cm x 60 cm picture using a converging lens.

- a) What is the image magnification?
- b) Where should we place the screen if the distance between the lens and the film is 3 cm?
- c) What is the diopter of the lens we should use?

a)	b)	c)	Total
4 points	4 points	6 points	14 points

2. Lightning and thunder

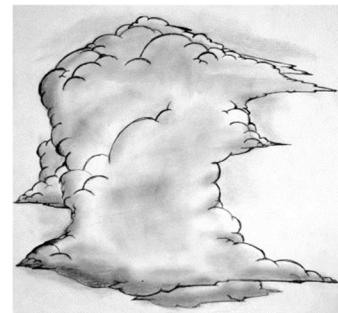
The type of lightning that is most frequent is an electric discharge that may occur inside a cloud, between clouds or between a cloud and the ground. The precise mechanism by which it is generated is not fully known, but there is agreement that the occurrence of lightning is caused by the friction and breakup of water droplets and ice crystals inside clouds, which leads to charge separation within the cloud.



Positive charges will accumulate at the upper half of clouds, while negative charges will build up at the lower. Charge separation gives rise to an electric field, whose magnitude is proportional to the quantity of separated charges. The electric field exerts a repulsive force on the negative charges in the ground close to the surface so they move deeper into the ground (static charge separation) and the surface will become positively charged. The discharge is initiated by the formation of a channel between the cloud and the ground that contains ionized gas and thus has a very small resistance. The electric discharge will flow along this channel. The main discharge has a current of approximately 30 kA and carries about 15 C charge and 500 MJ of energy. The gas suddenly heated in the channel emits strong light and expands in an explosive manner, initiating a shock wave in the air which we perceive as thunder.

(based on Wikipedia. Image source: <https://www.pexels.com>)

- Using the figure given, depict the location of the charges inside the cloud and inside the ground surface. Furthermore, depict the direction of the electric field inside the cloud and between the cloud and the ground surface!
- Why do we hear the thunder much later than seeing the lightning?
- Approximately what is the average duration of a lightning discharge?



a)	b)	c)	Total
5 points	5 points	6 points	16 points

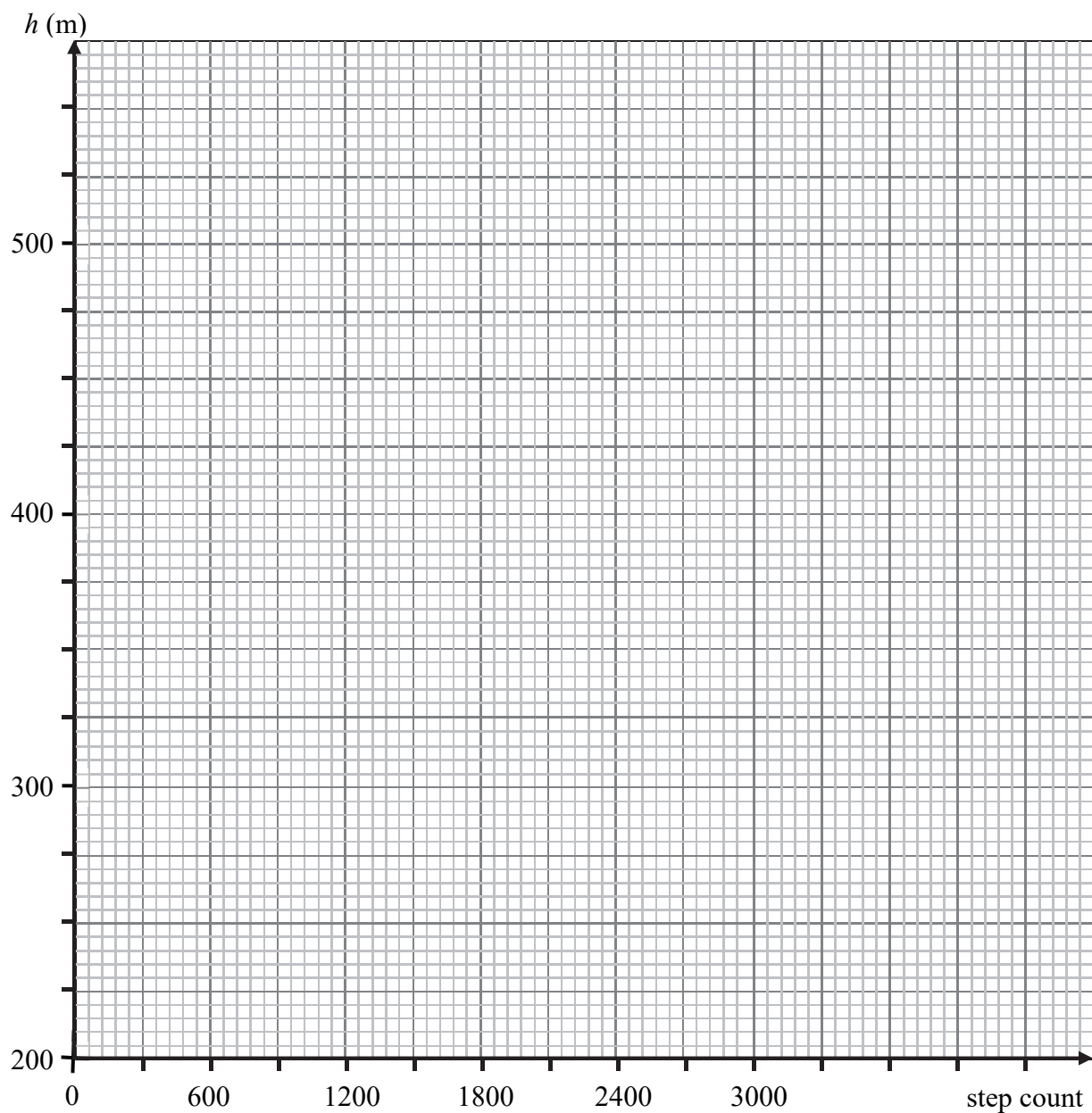
You need to solve only one of the two problems 3/A and 3/B. Indicate your choice on the inside of the front cover.

3/A During a short mountain hike, the hiker recorded his altitude above sea level while counting his footsteps with a mobile phone application. After the hike he summarized the data in the following table:

altitude above sea level (m)	213	256	311	355	358	352	394	446	487	523
number of steps since the start	0	354	715	1372	2098	2868	3498	3933	4238	4504

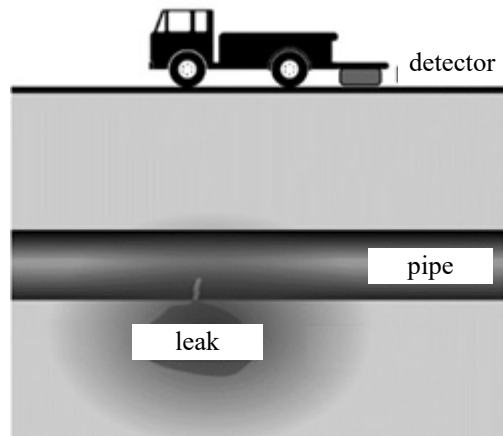
The route to the summit consisted of two even, steady climbs and an approximately horizontal section between them. The average length of the hiker's steps was 55 cm on the climbs and 70 cm on the horizontal section.

- Plot the altitude as a function of the number of steps.
- Fit straight lines on the appropriate sections of the graph and determine, using the given information, the approximate step counts at which the horizontal section started and ended.
- Approximately what distance did the hiker cover until he reached the summit?



a)	b)	c)	Total
6 points	8 points	6 points	20 points

3/B Faults in underground pipelines (e.g. oil, gas or heating pipes) can lead to cracks and leaks. To find such a leak, a radioactive isotope (tracer substance) is mixed with the fluid being transported in the pipe. Mobile radiation detectors moving above ground can then locate the place where radioactivity is accumulated in the ground. This is where the crack is, where the pipe should be unearthed and fixed



- Explain why it is sensible to use isotopes with a relatively short half-life for mixing with the fluid being transported in order to find cracks.
- Should we mix an alpha, a beta or a gamma emitter with the fluid being transported in pipes deep underground if we want the radiation to be measurable above ground? Why?
- How does the activity measured by the detector change if we double the amount of isotope mixed with the fluid? How much longer will the time available for the search be (the time during which the radiation is measurable above the ground at the leak)? Justify your answer.
- The Iodine 131 isotope is a beta emitter. Write down the reaction equation and name the decay product.

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

To be filled out by the examiner evaluating the paper!

	score	
	maximum	attained
I. Multiple-choice questions	40	
II. Complex problems	50	
Total score of the written exam	90	

date

examiner

	pontszáma egész számra kerekítve	
	elért	programba beírt
I. Feleletválasztós kérdéssor		
II. Összetett feladatok		

dátum

dátum

javító tanár

jegyző