Név: ..... osztály:.....

ÉRETTSÉGI VIZSGA • 2016. május 17.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

2016. május 17. 8:00

Az írásbeli vizsga időtartama: 120 perc

Pótlapok száma	
Tisztázati	
Piszkozati	

EMBERI ERŐFORRÁSOK
MINISZTÉRIUMA

Important information

The time available for the solution of the problems is 120 minutes.
Read the instructions for the problems carefully and use your time wisely.
You may solve the problems in arbitrary order.
Resources you may use: 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

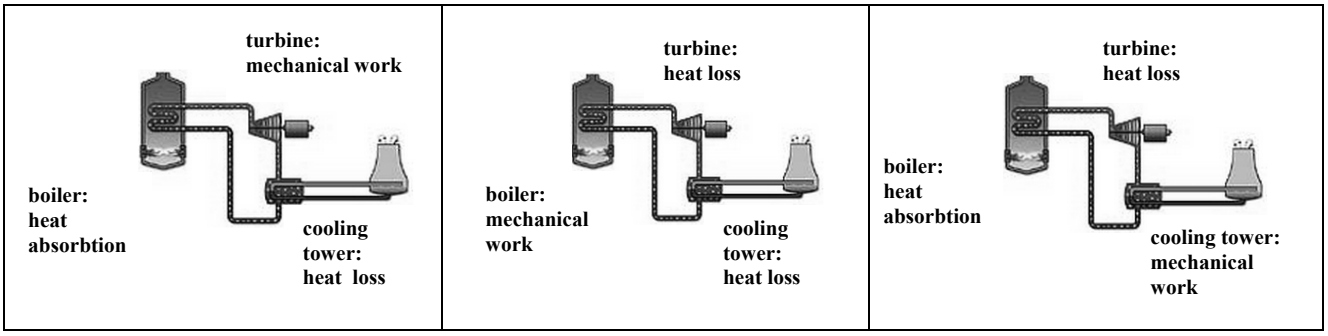
Precisely one of the possible solutions for each of the following questions is correct. Write the corresponding letter in the white square on the right! (Check your answer with calculations if necessary.)

1. A person whose mass is 70 kg is standing on a scale in an elevator. At a certain instant he observes that the weight that the scale displays is 77 kg. In which direction is the elevator moving at this instant?

A) Upwards.
B) Downwards.
C) It may move in either direction.

2 points	

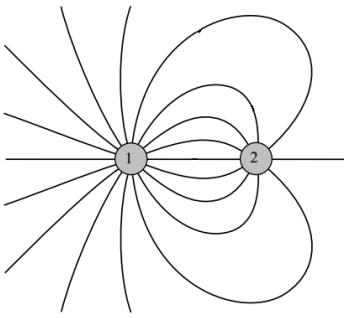
2. Which of the three figures describes the energy exchange in a thermal power plant correctly?



A) The one on the left.
B) The one in the middle.
C) The one on the right.

2 points	

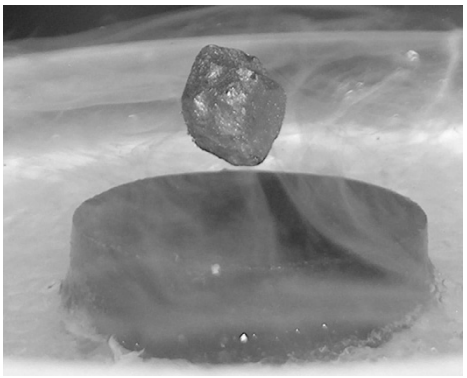
3. The adjacent figure displays two electric charges and field lines that illustrate their electric field. What can we state about the signs of the charges?



A) The signs of the two charges are identical.
B) The signs of the charges are different.
C) It is not possible to decide using the adjacent figure.

2 points	

4. A tiny magnet is hovering motionlessly above a superconducting material. Why is it, that the downward directed gravitational force and the upward directed magnetic force acting on the magnet <u>cannot</u> be an action-reaction force pair?



A) Because the two forces are not equal in magnitude.
B) Because the lines of action of the two forces do not overlap.
C) Because the two forces are acting on the same body.

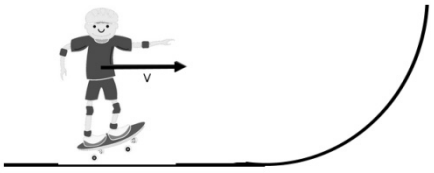
2 points	

5. Nuclear fusion takes place inside the stars, the statements below refer to this process. Which of the statements is true?

A) Nuclear fusion occurs only at a very high temperature, which is present in the interior of stars.
B) The mass of stars constantly increases due to the mass gain occurring during nuclear fusion.
C) Nuclear fusion can only be realized with elements heavier than uranium, which can only be created in the interior of stars.

2 points	

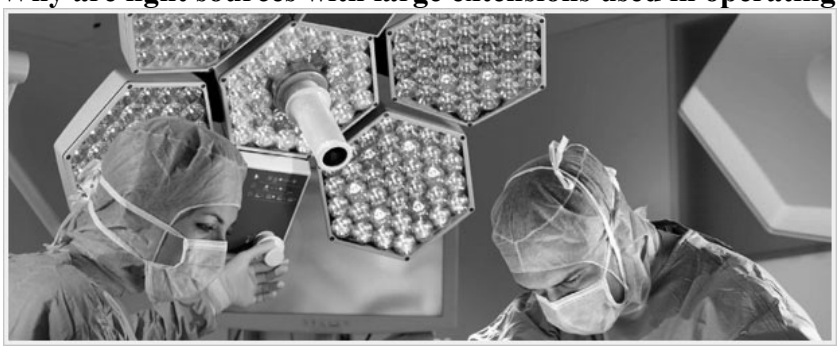
6. A skateboarder rolls towards a ramp on level ground with constant speed. He rolls up the ramp and back down again. Friction forces and drag may be neglected during his motion. What can we say about the momentum and mechanical energy of the skateboarder during this motion?



A) His momentum is constant during this motion.
B) His mechanical energy is constant during this motion.
C) Both quantities are constant during this motion.

2 points	

7. Why are light sources with large extensions used in operating rooms?



A) So that the light can disinfect the entire area of operation everywhere.
B) So that a lot of light can be focused onto a single point of the operational area.
C) So that no point of the operational area is completely in shadow.

2 points	

8. During a summer evening, while the atmosphere containing water vapor cooled down, its relative humidity increased from 40% to 80%. How did the mass of water contained in 1 m^3 of air change?

A) The mass of water doubled as well.
B) The mass of water did not change.
C) The mass of water reduced to half its original a value.

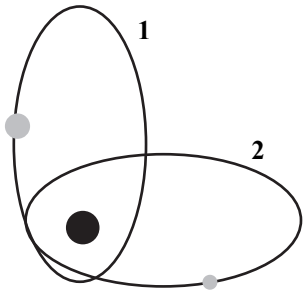
2 points	

9. What do we mean when we say that a certain material is radioactive?

A) That the atomic nuclei of the material transform spontaneously, emitting radiation.
B) That the atomic nuclei of the material are isotopes.
C) That each atomic nucleus of the material emits radiation continuously for the duration of the so-called half-life.

2 points	

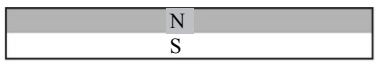
10. Two comets with different masses orbit a star. The shapes and dimensions of their orbits are identical, only the spatial locations of the orbits are different. The mass of comet 1. is greater than that of comet 2. Which of the two bodies has a greater orbital period?



A) The two orbital periods are the same.
B) The body with a smaller mass has a greater orbital period.
C) The body with a larger mass has a greater orbital period.

2 points	

11. A bar magnet broke into two pieces as shown on the figure. We tried to fit together the two pieces along the fracture line, but found that they repel each other strongly.
How were the poles of the original bar magnet located?

A) 

B) 

A) As shown in figure A).
B) As shown in figure B).
C) We could not have found a strong repelling force in either of the cases because the magnet would then split up easily by itself.

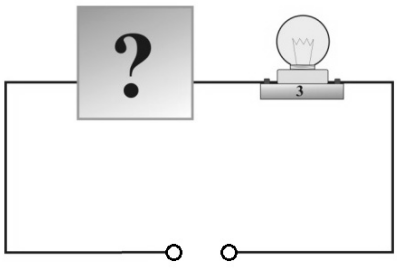
2 points	

12. An α-, a β- and a γ-particle are traversing a homogeneous electric field. Which one of them will have the smallest acceleration?

A) The γ-particle.
B) The β-particle.
C) The α-particle.

2 points	

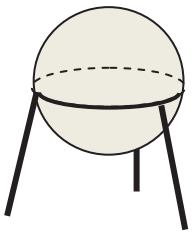
13. We connect an incandescent light-bulb in series with an unknown circuit element as shown in the figure. If we connect the circuit to DC voltage the light-bulb does not light up, whereas if we connect the circuit to AC voltage, it does. What can the unknown circuit element be?



A) A capacitor.
B) A variable resistance resistor.
C) A coil.

2 points	

14. We place a metal ball onto the ring of an iron tripod as shown in the figure. The ball is just slightly too big to pass through the ring. We heat up both bodies to the same temperature. Will the ball pass through the ring because of the heating?



A) The ball will certainly not pass through the ring because it expands as it is heated.
B) The ball will certainly not pass through, because the diameter of the ball increases by the same amount as that of the ring as it is heated.
C) The ball may pass through if it is made of a material different from the ring and it expands less as it is heated.

2 points	

15. We construct a 2 m high wall using identical, solid bricks. In which case is the pressure on the concrete foundation of the wall greater: if the wall is a single brick in thickness , or if it is two bricks thick?

A) If it is one brick in thickness.
B) If it is two bricks in thickness.
C) The pressure on the concrete foundation is the same in both cases. ☐

2 points

16. The pressure of an enclosed ideal gas doubles in a process during which its volume decreases to 2/3 its initial value. Which statement is true?

A) This is not possible, because according to Boyle's law, the product of the pressure and the volume is constant.
B) This is only possible if some of the gas escaped during the process.
C) If the quantity of the gas did not change, its temperature must have increased. ☐

2 points

17. It is full moon. How is Earth visible from the Moon at this time?

A) Viewed from the Moon, we can see a "full earth", i.e. the face of the Earth looking at the Moon is entirely illuminated.
B) Half of the face of the Earth visible from the Moon is illuminated.
C) Viewed from the Moon we can see a "new earth", i.e. the face of the Earth looking a the Moon is essentially in darkness. ☐

2 points

18. Approximately what is the molar mass of heavy water (^2H_2O)?

A) Approximately 18 g/mol.
B) Approximately 20 g/mol.
C) Approximately 36 g/mol. ☐

2 points

19. The generally used derived unit of the electric potential is the volt. How can we express 1 volt with SI base units?

A) $1\,\mathrm{V} = 1\,\frac{\mathrm{A}\cdot\mathrm{s}}{\mathrm{kg}\cdot\mathrm{m}}$

B) $1\,\mathrm{V} = 1\,\frac{\mathrm{kg}\cdot\mathrm{m}^2}{\mathrm{A}\cdot\mathrm{s}^3}$

C) $1\,\mathrm{V} = 1\,\frac{\mathrm{kg}}{\mathrm{A}\cdot\mathrm{s}^2}$

2 points	

20. The position – time graph of a body is depicted. When was the magnitude of the body's speed the greatest?

A) During the time interval between $t = 2$ s and $t = 3.5$ s.

B) At the instant $t = 4$ s.

C) During the time interval between $t = 7$ s and $t = 10$ s.

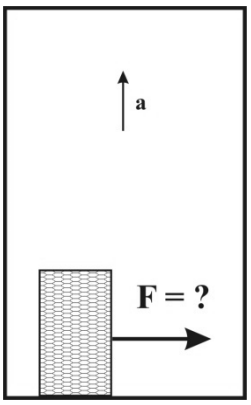
2 points	

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 are standing in an elevator and are trying to pull our suitcase on the floor when the elevator starts moving upwards with an acceleration of 1.5 m/s^2 . How great is the horizontal force that we have to exert on the suitcase in order to move it, if its mass is 24 kg and the coefficient of static friction between the floor of the elevator and the suitcase is 0.5?

$g = 9.8 \frac{\text{m}}{\text{s}^2}$



Total
15 points

2. All four wheels of a modern car are slowed by disc brakes. Disc brakes transform the kinetic energy of the car to heat using the friction between the disc and the brake pads. The mass of a car with passengers is 1.2 tons, while the mass of each disc brake is 9 kg (this is the mass of the disc and the pads pressed against it together). While breaking on the motorway, the brakes heated up by 60 °C until the car came to a full stop. Did the car go faster than the 130 km/h speed limit if the specific heat of the material the brakes are made of is $c = 400 \frac{\text{J}}{\text{kg} \cdot \text{°C}}$?

(Let us assume that the braking force on each wheel was the same. Because the braking lasted only a short time, we may neglect heat loss to the environment during braking.)

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 We compared the quality of two AA sized batteries in an experiment. During the investigation, we placed the batteries in a circuit that ensured that the current flowing through the battery (the load current) had a constant magnitude of 1 A at all times. The output voltage that we measured between the electrodes of the batteries was noted down at certain time intervals. The data is contained in the following tables:

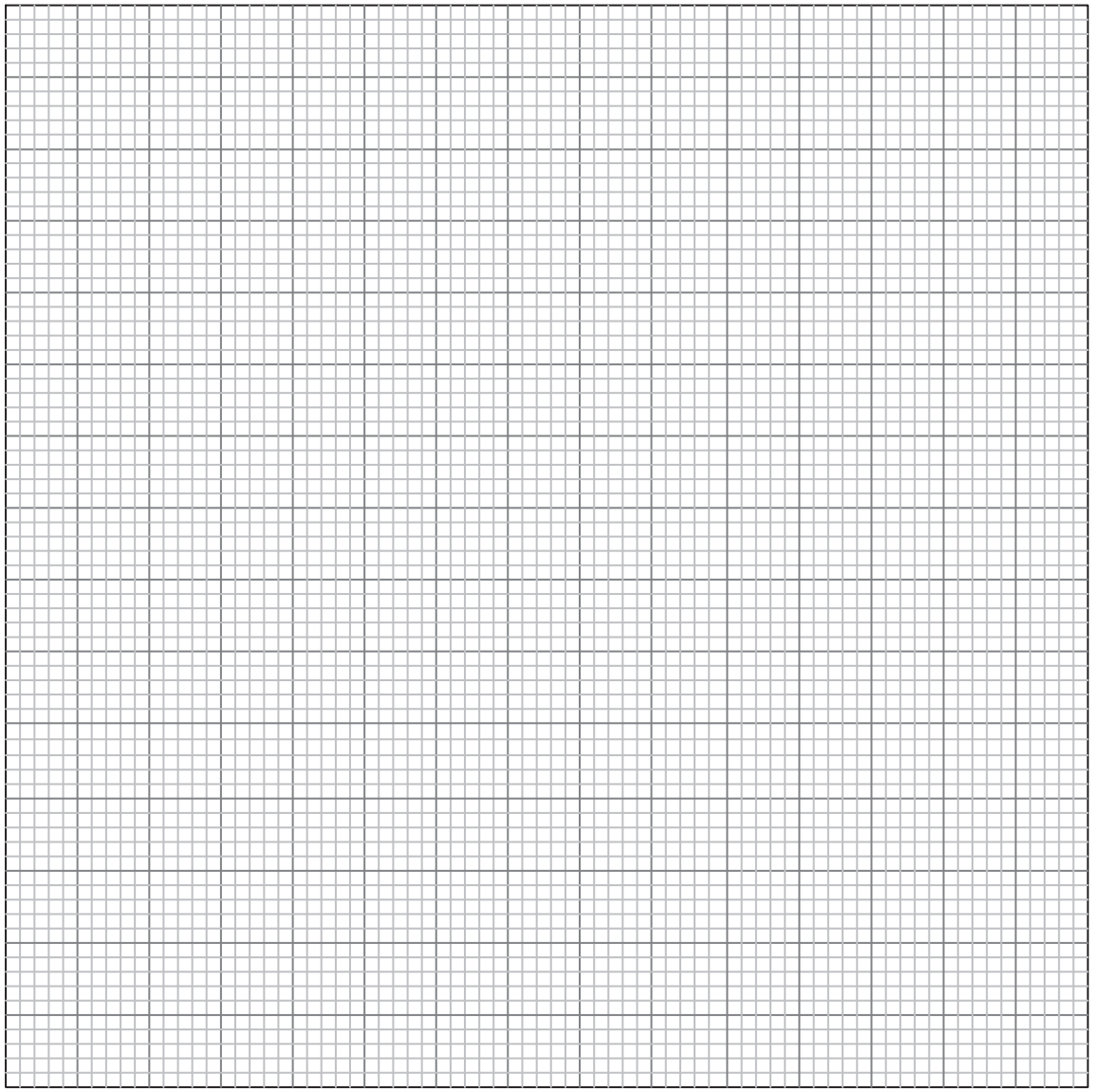
Non-rechargeable alkaline battery, nominal voltage 1.5 V:

t (h)	0	0.1	0.2	0.4	0.6	0.8	1.0	1.2	1.3	1.4	1.5
U (V)	1.45	1.25	1.18	1.1	1.03	0.95	0.85	0.75	0.65	0.4	0.0

Rechargeable NiMH (nickel-metal hydride) battery, nominal voltage 1.2 V:

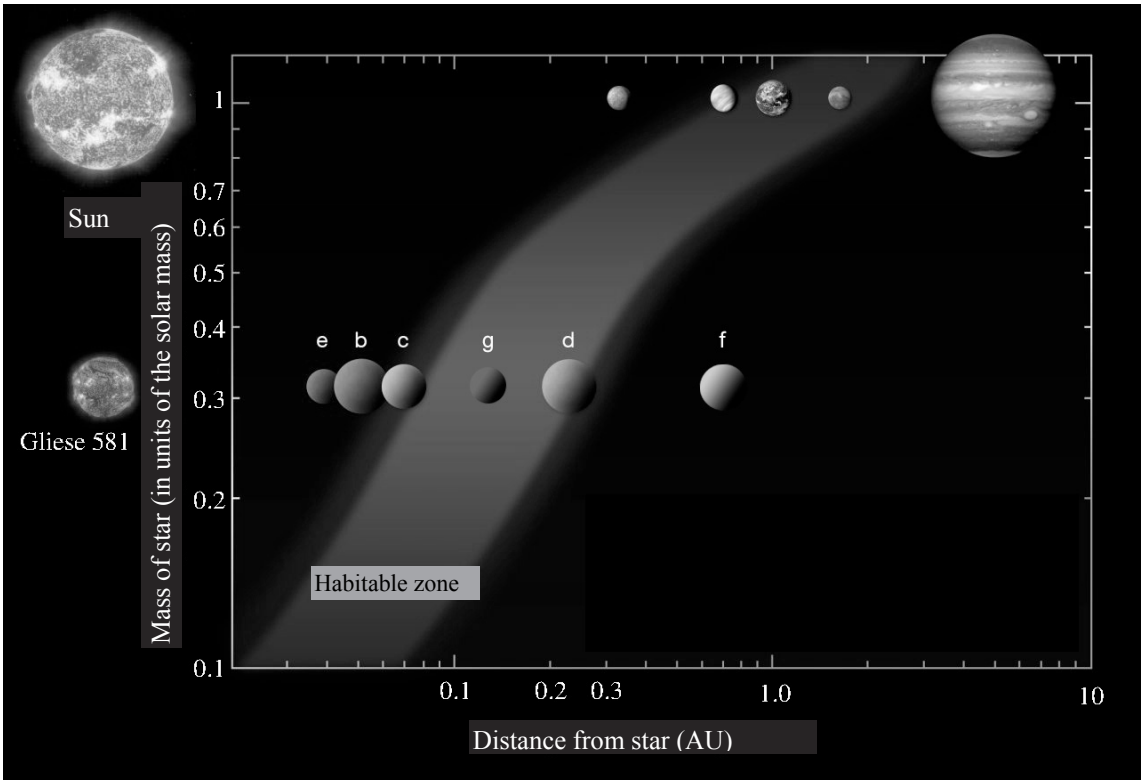
t (h)	0	0.2	0.6	1.0	1.4	1.6	1.8	1.9	2.0	2.1	2.2
U (V)	1.25	1.2	1.19	1.18	1.16	1.15	1.1	0.93	0.75	0.4	0.0

a) Plot the voltage data as a function of time.
b) Which battery has a greater nominal voltage? Which battery has a greater output voltage at the start of the experiment and which one at $t = 0.4$ h?
c) Which battery operates the circuit for a longer time? Estimate the overall quantity of electric charge provided by each battery during the experiment in units of Ah.
d) Taking two identical torches, we insert the fully charged NiMH battery in one and a brand new alkaline battery just like the one we performed the experiment with into the other. The light of which torch will be more constant during the lifetime of the battery?



a)	b)	c)	d)	Total
8 points	3points	7 points	2 points	20 points

3/B „Habitable zone" is the name given by astronomers to a region around stars, where, should a planet orbit the star within this region, liquid water is possible on its surface. (Naturally, whether there actually is water on the planet surface and in which phase, depends also on a great number of other factors as well.) On the adjacent figure, a light region depicts the approximate location and extension of the habitable zone depending on the mass of the star. The distance from the star is shown on the horizontal axis, while the mass of the star is shown on the vertical one. (The scale on the axis is not linear but logarithmic.) Also shown on the figure are two stars: the Sun and the Gliese 581. This latter is a so-called red dwarf star about 22 light years from us. A few planets orbiting around these stars are also shown in the figure, drawn at the distance they are located from their star. (The sizes of the spheres depicting the planets are not proportional to the distances from their stars, they only depict the relative sizes of the planets.)



Answer the following questions using the figure.

a) Which planets can be found in the habitable zone of the Sun? Name one that is definitely too close and one that is definitely too far.
b) Which planets can be found in the habitable zone of Gliese 581? Name one (using the corresponding letter on the figure) that is definitely too close and one that is definitely too far.
c) Which of the two stars has its habitable zone closer to the star? What can the reason be?
d) Compare the orbital period of Venus and the "f" planet of Gliese 581. Which planet's orbital period is greater? Justify your answer in text, without detailed calculations, only using data obtained from the figure. (Let us assume that the orbits of both planets are circular.)

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!

	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: .....