ÉRETTSÉGI VIZSGA ● 2014. május 19.

FIZIKA
ANGOL NYELVEN

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA

2014. május 19. 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 exam 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. **Two small carts are placed on a level surface with a small explosive charge between them. The charge is detonated and the explosion pushes the two carts apart. Which conservation theorem applies to the motion of the carts?**
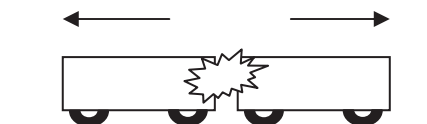
    A) The conservation of mechanical energy and the conservation of momentum.
    B) Only the conservation of mechanical energy.
    C) Only the conservation of momentum.

    2 points

2. **A beam of light crosses the boundary from air to water. Which one of its properties <u>does not</u> change during refraction?**

    A) Its speed.
    B) Its frequency.
    C) Its wavelength.

    2 points

3. **Which of the following scientists is the one that showed, that the colours of the rainbow can be merged to yield white light?**

    A) Newton
    B) Kepler
    C) Galilei

    2 points

4. **We would like to simulate a free-fall experiment performed on the Moon using a film made here on Earth. We therefore record the experiment here on Earth. What should we do with the recording, so that it looks as if we performed the experiment on the Moon?**

A) We should slow down the film, because objects on the Moon take longer to fall from the same height.

B) We should speed up the film, because gravity is smaller on the Moon than on Earth.

C) The speed of the film should remain unchanged, because gravitational attraction is always proportional to acceleration, on the Earth as well as on the Moon.

2 points

5. **In what kind of process can a ^{14}C nucleus be converted to a ^{14}N nucleus?**

A) Through alpha-decay.

B) Through beta-decay.

C) With the help of gamma radiation.

2 points

6. **We heat some noble gas enclosed in a container. As a consequence, the gas exerts an increasing pressure on the walls of the container. Which of the following statements is the correct explanation for the increase in pressure?**

A) The magnitude of the momentum of atoms in the container increased.

B) The average potential energy of atoms in the container increased.

C) The average volume of the atoms increased due to heating.

2 points

7. **Two resistors of different resistance are connected in parallel. What can we say about their equivalent resistance?**

A) The value of the equivalent resistance is closer to the smaller of the two resistances.

B) The value of the equivalent resistance is closer to the greater of the two resistances.

C) The value of the equivalent resistance is the arithmetic mean of the two resistances.

2 points

8. **What kind of orbit does the Halley comet follow around the Sun?**

   A) A circular orbit.
   B) An elliptic orbit.
   C) A parabolic orbit.

2 points

9. **We would like to carry a broom horizontally by balancing it on our shoulder. Where should we support the broom with our shoulder?**

   A) Somewhere between the end and the center of the broomstick.
   B) Exactly at the center of the broomstick
   C) Somewhere between the center of the broomstick and the bristle.

2 points

10. **Two ions of equal charge, but different mass are placed in homogeneous electric field with zero initial velocity. They accelerate along the same path. Which one of the two will leave the electric field with greater velocity? (The force of gravity acting on the ions is negligible!)**

   A) The ion with the greater mass will acquire greater velocity.
   B) The ion with the smaller mass will acquire greater velocity.
   C) Their velocities will be equal because their charges are equal.

2 points

11. **We place two identical bodies on a disc spinning in the horizontal plane as shown in the figure. The bodies are spinning together with the disc. Which of the two bodies has greater force acting on it due to friction?**
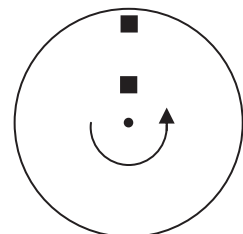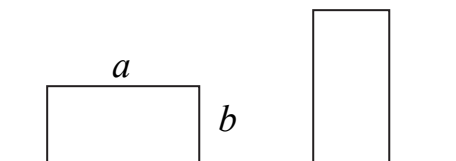
   A) The body that is farther from the axis of rotation.
   B) The body that is closer to the axis of rotation.
   C) The friction forces acting on the two bodies are equal.

2 points

12. **A rectangular body of mass *m* = 1 kg is lying on a level surface on its longer, *a* = 20 cm long side. How much does the potential energy of the body change, if it is raised to stand on its shorter, *b* = 10 cm long side?**

   A) 1 J
   B) 0.5 J
   C) It depends on where we define the reference point for potential energy.

2 points	

13. **What is the ratio of neutrons to protons in a $^{4}_{2}He$ nucleus?**

   A) 1
   B) 2
   C) 4

2 points	

**14.** **A ball is first thrown vertically upward from a height of 20 m above the ground with an initial velocity of 10 m/s. Then it is thrown vertically downward from the same position 20 m above the ground, again with an initial velocity of 10 m/s. In which of these two cases will its velocity be greater when it reaches the ground?**

   A) In the first case.
   B) In the second case.
   C) The velocity in question will be equal in these two cases.

2 points	

15. The cork in a bottle of wine fits tightly, sealing the content in an airtight manner. Which of the following figures depicts correctly the change of state that the air enclosed above the wine goes through as the cork is pulled out of the bottle?
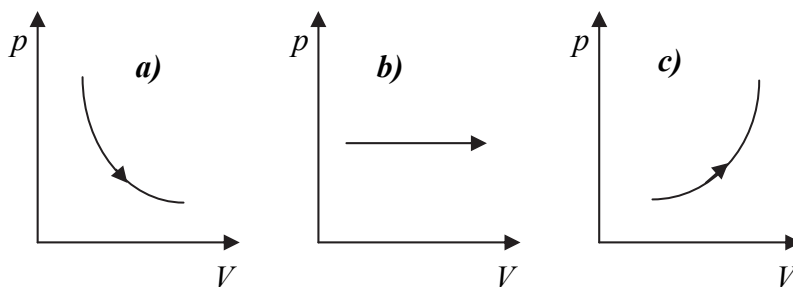
- **A)** Figure a).
- **B)** Figure b).
- **C)** Figure c).

2 points

16. What happens during the photoelectric effect?

- **A)** Electrons hitting a metal plate cause flashes of light to be emitted.
- **B)** Photons hitting a metal plate are converted to protons.
- **C)** Photons hitting a metal plate cause electrons to be emitted.

2 points

17. A child descends a slide in a playground. (We consider the slide to be a simple inclined plane.) Which of the following factors determines the speed with which the child arrives to the end of the slide?

- **A)** The child's mass.
- **B)** The frictional coefficient between the child and the slide.
- **C)** The child's mass and the frictional coefficient between the child and the slide.
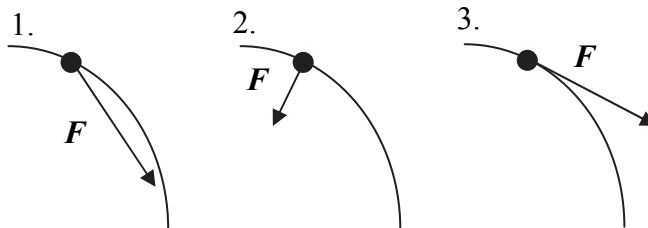
2 points

18. We pour 30 liters of 20 °C water into 20 liters of 30 °C water. What will be the temperature of the water after it has been well mixed? (Heat loss is negligible.)

- **A)** Less than 25 °C.
- **B)** Precisely 25 °C.
- **C)** More than 25 °C.

2 points

19. **An electron is placed in a static electric field, whose electric field lines are depicted by the curves in the figures (inhomogeneous electric field). Which of the figures depicts correctly the direction of the force acting on the electron?**

1. 2. 3.

A) Figure 1.
B) Figure 2.
C) Figure 3.

2 points	

20. **How far should we place the object from a converging lens, so that no sharp image is formed (neither real, nor virtual)?**

A) To a distance greater than twice the focal length.
B) To a distance between twice the focal length and the focal length.
**C)** Exactly to the focal point.

2 points	

SECOND PART

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 60 kg athlete is moving with a velocity of 7.2 km/h, when a shopping cart weighing 10 kg is pushed <u>towards him</u> with a velocity of 10.8 km/h. As the cart approaches, the athlete jumps up into the air and lands in the cart. (While jumping up in the air, he maintains his horizontal velocity.)**

　　a)　In which direction and with what speed will the cart and the athlete move together?
　　b)　How much did the kinetic energy of the athlete and the kinetic energy of the cart change?
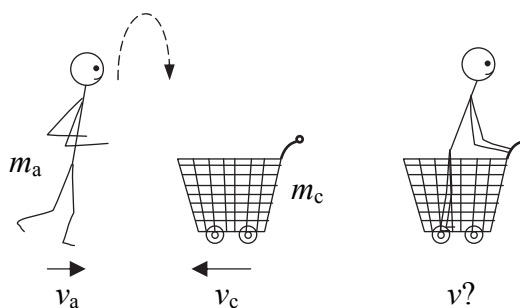
a)	b)	Total
7 points	8 points	15 points

2.   A gas confined in a container reaches two different final states starting from the same initial state, in two different processes. We know that during the first (number 1.) process, the heat absorbed by the gas is $Q_1 = 900$ J.

$p_0 = 2 \cdot 10^5 \, \text{Pa}$, $V_0 = 2 \, \text{dm}^3$, $V_2 = 5 \, \text{dm}^3$

a) How much did the internal energy of the gas change during the first and the second process?
b) How much heat did the gas absorb during the second process?
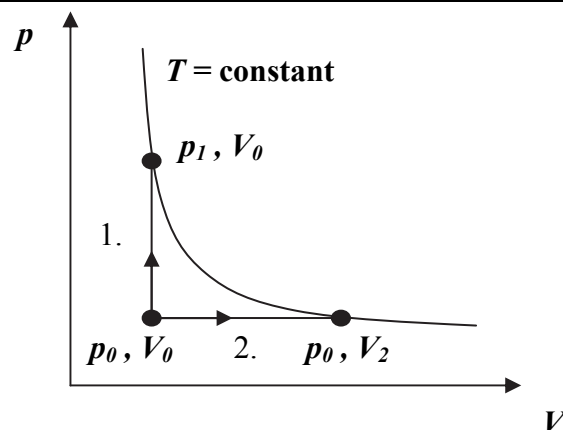
	a)	b)	Total
	7 points	**8 points**	**15 points**

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 **We attach a strong, disc-shaped magnet to the positive terminal of a battery, with a long steel screw sandwiched between the magnet and the battery. (The screw sticks to the magnet precisely at the center of the disc. The end of the screw attaches to the battery because it is strongly magnetized.) We attach a copper wire to the negative terminal of the battery and we touch the end of the wire gently to the edge of the magnet. We observe that the magnet and the screw begin to rotate quickly.**

  a) Provide an interpretation of the phenomenon! What is the explanation for the rotation?

 b) What kind of a change will take place if the terminals of the battery are reversed?
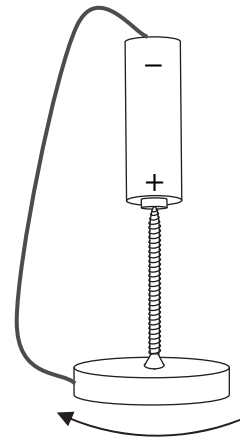
a)	b)	Total
17 points	3 points	20 points

3/B **We would like to construct a slide-projector using a lens. To this end, we first examine the imaging of the lens with several different objects. The following table contains the distance of the image from the lens (k) for several values of the object distance (t), as well as the inverse of these quantities.**

t (m)	0,25	0,33	0,50	1,00
k (m)	0,91	0,55	0,31	0,26
$1/t$ (1/m)	4,00	3,00	2,00	1,00
$1/k$ (1/m)	1,10	1,82	3,23	3,85

a) Plot the inverse of the image distance as a function of the inverse of the object distance! Fit the plotted data with a straight line! Where does the line intersect the axis of the graph? What is the physical meaning of these intersections? What is the focal length of the lens?

b) Mark the point on the graph where the object distance is equal to the image distance. Where is the image located in this case? What is the size and nature of the image?

c) In the room the screen is at a distance of $e = 4.5$ m from the lens of the projector. How far is the slide from the lens, when the image is sharp and clear?

slide

d

e

screen
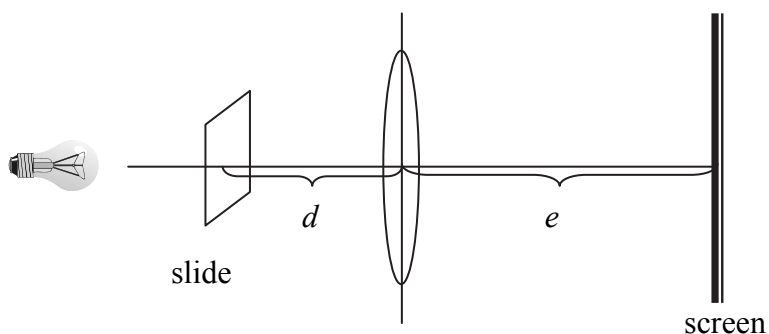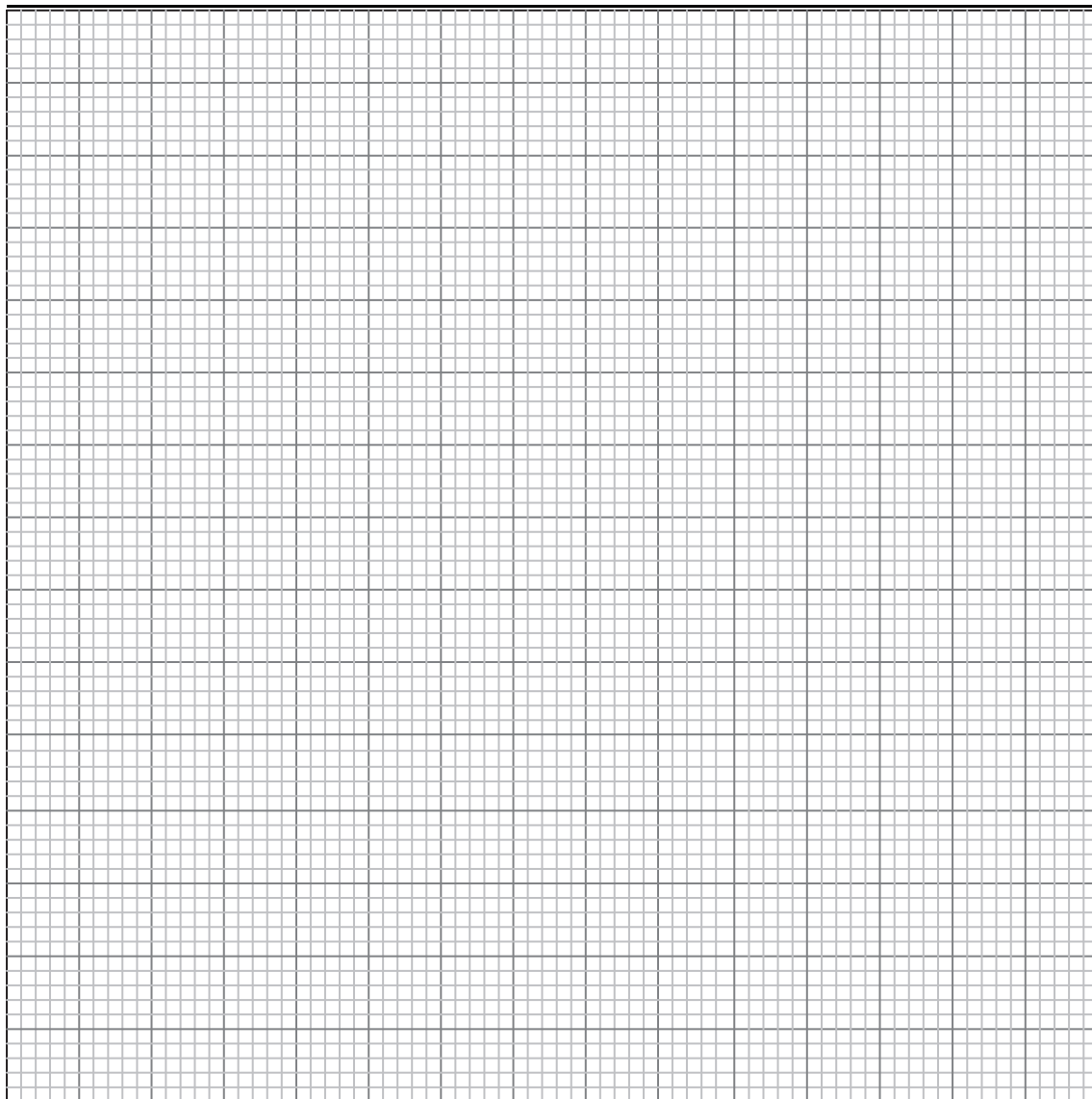
a)	b)	c)	Total
10 points	6 points	4 points	20 points

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 in the written part of the examination	**90**	

_____

examiner

Date: ....

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	elért pontszám egész számra kerekítve/ score rounded to **integer**	programba beírt egész pontszám/ **integer** score entered in program
I. Multiple choice questions (Feleletválasztós kérdéssor)		
II. Complex problems (Összetett feladatok)		

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examiner (javító tanár)   notary (Jegyző)

Date (Dátum): ....   Date (Dátum): ....