

Problems for the 12th International Young Physicists Tournament¹ (1998–1999)

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1. Rotation

A long rod, partially and vertically immersed in a liquid, rotates about its axis. For some liquids this will cause an upward motion of the liquid on the rod and for other liquids a downward motion. Explain this phenomenon and determine the essential parameters on which it depends.

2. Ionic motor

An electrolyte (an aqueous solution of CuSO_4 , NaCl ...) in a shallow tray is made to rotate in the field of a permanent magnet (a small „pill“ placed under the tray). The electric field is applied from a 1.5 V battery in such a way that one electrode is in the form of a conducting ring immersed in the electrolyte – the other is a tip of a wire placed vertically in the centre of the ring. Study the phenomenon and find possible relations between the variables.

3. Magic motor

Construct a DC motor without a commutator, using a battery, a permanent magnet and a coil. Explain how it functions.

4. Soap film

Explain the appearance and development of colours in a soap film, arranged in different geometries.

5. Dropped paper

If a rectangular piece of paper is dropped from a height of a couple of meters, it will rotate around its long axis whilst sliding down at a certain angle. How does this angle depend on various parameters?

6. Singing glass

When rubbing the rim of a glass containing a liquid a tone can be heard. The same happens if the glass is immersed in a liquid. How does the pitch of the tone depend on different parameters?

7. Heated needle

A needle hangs on a thin wire. When approached by a magnet the needle will be attracted. When heated the needle it will return to its original position. After a while

¹ Zájemci o bližší informace je mohou získat na adrese RNDr. Zdeněk Kluíber, CSc., Gymnázium Christiana Dopplera, Zborovská 45, 150 00 Praha 5

the needle will be attracted again. Investigate this phenomenon, describe the characteristics and determine the relevant parameters.

8. Energy converter

A body of mass 1 kg falls from a height of 1 m. Convert as much as possible of the released potential energy into electric energy and use that to charge a capacitor of 100 μF .

9. Air dryer

During 4 minutes collect as much water as possible from the air in the room. The mass of the equipment must not exceed 1 kg. The water should be collected in a glass test tube, provided by the jury.

10. Charged balloon

An air-filled balloon rubbed with wool or dry paper may stick to the ceiling and stay there. Investigate this phenomenon and measure the charge distribution on the surface of the balloon.

11. Billiard

Before a snooker game starts, 15 balls form an equilateral triangle on the table. Under what conditions will the impact of the white ball (16th ball) produce the largest disorder of the balls?

12. Flour craters

If you drop a small object in flour, the impact will produce a surface structure which looks like moon crater. What information about the object can be deduced from the crater?

13. Gas flow

Measure the speed distribution of the gas flow in and around the flame of a candle. What conclusions can be drawn from the measurements?

14. Wheat waves

The wind blowing through a wheat field creates waves. Describe the mechanism of wave formation and discuss the parameters which determine the wavelength.

15. Bright spots

Bright spots can be seen on dew drops if you look at them from different angles. Discuss this phenomenon in terms of the number of spots, their location and angle of observation.

16. Liquid diode

Make an electrochemical diode and investigate its properties, in particular the frequency dependence.

17. Sound from water

When you heat water in a kettle you hear a sound from the kettle before the water starts to boil. Investigate and explain this phenomenon.

OBSAH

Obsah	1
Společná část	
Vážení čtenáři!	3
Grygar: Mým nepolepšitelným novinářům!	4
Rojko, Caletka: Demonstrace vybočování	5
Havel: Analytické vyjádření hysterézní smyčky	9
Erhart: Měření na ručkových elektrických přístrojích	12
Höfer: Když struny zní	17
Havel: Elektrokapilární jev	24
Prokšová: Fyzikální zákony z pohledu kočičího mazlíčka	25
Prokšová: Nanotechnologie zítřka – umělé molekulární stroje	27
Rauner: Mystifikace tisíciletí odhalena!	29
Bláha: Energie a člověk	30
Eckertová: „Svět krystalů“ – nová videokazeta řady „Cesty k vědě“	32
Kepka: Novinky firmy DIDAKTIK	33
Randa: 150 nositelů Nobelovy ceny za fyziku VII	34
Část pro ZŠ	
<i>Fyzikální olympiáda</i>	
Volf: ARCHIMÉDIÁDA 2000 – kategorie G fyzikální olympiády	37
<i>Obecná část</i>	
Rojko: Střídavý proud	40
Kučera: Lidské oko v číslech	43
Randa: Grafy pohybu na ZŠ netradičně	47
Křenová: Červená Karkulka I	49
Šmídová: Červená Karkulka II	50
Sauer: Neskutečný příběh Barona Prášila	52
Randa: Astronomické novinky 14	53
Část pro SŠ	
<i>Fyzikální olympiáda</i>	
Randa: Revoluční pohon lokomotiv (B1)	61
Randa: Bez odporu na odpory (B3)	68
Havel: Úloha o elektrolýze vody (B4)	70
Mazanec: Let balónu (B5)	72
Výsledky FO 1999/00 kategorie A v regionech	76
Kluiber: Středoškolská odborná činnost v oboru fyzika	78
Kluiber: Turnaj mladých fyziků ve školním roce 1998–1999	79
<i>Obecná část</i>	
Musilová: Postrecenze učebnice „Fyzika pro gymnázia – Mechanika“	80
Lacina: Postrecenze učebnice „Fyzika pro gymnázia – Molekulová fyzika a termika“	85

Verze ZŠ obsahuje strany 1–60; verze SŠ strany 1–36 a 61–88

číslo

2

VI.

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