

Final Problems 2004

1. Misty

Invent and construct a device that would allow the size of a droplet of a mist to be determined using a sound generator.

2. Stubborn Ice

Put a piece of ice (e.g. an ice cube) into a container filled with vegetable oil. Observe its motion and make a quantitative description of its dynamics.

3. Electric Pendulum

Use a thread to suspend a suitable ball between the plates of a capacitor. When the plates are charged the ball will start to oscillate. What does the frequency of the oscillation depend on?

4. Dusty Blot

Describe and explain what you observe when some dry dust (e.g. coffee powder or flour) is poured onto a water surface. Study how it depends on the relevant parameters.

5. Sea-shell

When you put a sea-shell to your ear you can hear 'the sea'. Study the nature and the characteristics of the sound.

6. Seebeck Effect

Two long metal strips are bent into the form of an arc and are joined at both ends. One end is then heated. What are the conditions under which a magnetic needle placed between the strips shows maximum deviation?

7. Coin

Stand a coin on its edge upon a horizontal surface. Gently spin the coin and investigate the resulting motion as it settles.

8. Pebble Skipping

It is possible to throw a flat pebble in such a way that it can bounce across a water surface. What conditions must be satisfied for this phenomenon to occur?

9. Flow

Using a dc source, investigate how the resistance between two metallic wires dipped into a flowing liquid depends upon the speed and direction of the flow.

10. Two Chimneys

Two chimneys stand on a box with one transparent side. Under each chimney there is a candle. A short period after the candles are lit the flame on one side becomes unstable. Examine the case and present your own theory of what is happening.

11. String Telephone

How do the intensity of sound transmitted along a string telephone, and the quality of communication between the transmitter and receiver, depend upon the distance, tension in the line and other parameters? Design an optimum system.

12. Kundt's Tube

In a 'Kundt's Tube' type of experiment the standing waves produced can be made visible using a fine powder. A closer look at the experiment reveals that the regions of powder have a sub-structure. Investigate its nature.

13. Egg White

White light appears red when it is transmitted through a slice of boiled egg white. Investigate and explain this phenomenon. Find other similar examples.

14. Fountain

Construct a fountain with a 1m 'head of water'. Optimise the other parameters of the fountain to gain the maximum jet height by varying the parameters of the tube and the properties of the liquid used.

15. Brazil Nut Effect

When a granular mixture is shaken the larger particles may end up above the smaller ones. Investigate and explain this phenomenon. Under what conditions can the opposite distribution be obtained?

16. Small Fields

Construct a device based upon a compass needle and use your device to measure the Earth's magnetic field.

17. Didgeridoo

The 'didgeridoo' is a simple wind instrument traditionally made by the Australian aborigines from a hollowed-out log. It is, however, a remarkable instrument because of the wide variety of timbres that it produces. Investigate the nature of the sounds that can be produced and how they are formed.