

# 2020 年 CUPT 竞赛题目

## 1. Invent Yourself 自己创造

Design an instrument for measuring current using its heating effect. What are the accuracy, precision and limits of the method?

设计一种利用热效应测量电流的仪器。该方法的准确性、精确度和局限性是什么？

## 2. Inconspicuous Bottle “隐形”的瓶子

Put a lit candle behind a bottle. If you blow on the bottle from the opposite side, the candle may go out, as if the bottle was not there at all. Explain the phenomenon.

把点燃的蜡烛放在瓶子后面。如果你从对面吹瓶子，蜡烛可能会熄灭，就好像瓶子根本不在那里一样。解释这一现象。

## 3. Swinging Sound Tube 转动的声管

A Sound Tube is a toy, consisting of a corrugated plastic tube, that you can spin around to produce sounds. Study the characteristics of the sounds produced by such toys, and how they are affected by the relevant parameters.

声音管是一种玩具，由波纹塑料管组成，你可以旋转它来发出声音。研究这些玩具发出的声音的特征，以及它们如何受到相关参数的影响。

## 4. Singing Ferrite 唱歌的铁氧化物

Insert a ferrite rod into a coil fed from a signal generator. At some frequencies the rod begins to produce a sound. Investigate the phenomenon.

将铁氧化物插入由信号发生器供电的线圈中。在某些频率下，杆开始发出声音。研究这一现象。

## 5. Sweet Mirage 甜蜜的海市蜃楼

Fata Morgana is the name given to a particular form of mirage. A similar effect can be produced by shining a laser through a fluid with a refractive index gradient. Investigate the phenomenon.

Fata Morgana 是海市蜃楼的一种特殊形式。用激光照射具有折射率梯度的液体也可以产生类似的效果。研究这一现象。

## 6. Saxon Bowl 撒克逊人的碗

A bowl with a hole in its base will sink when placed in water. The Saxons used this device for timing purposes. Investigate the parameters that determine the time of sinking.

一个底部有洞的碗放在水中会下沉。撒克逊人使用这个装置来计时。研究决定下沉时间的参数。

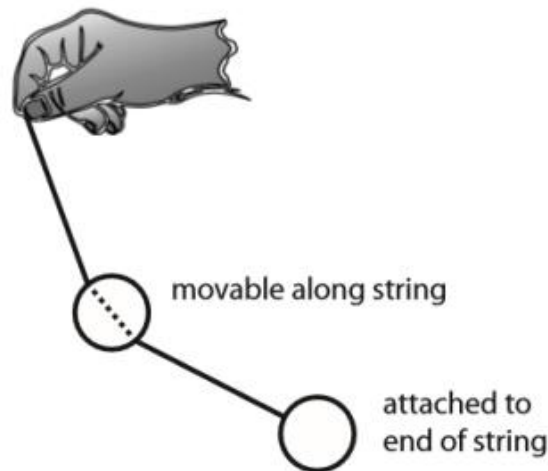
## 7. Balls on a String 绳上的球

Put a string through a ball with a hole in it such that the ball can move freely along the string.

When you move the free end periodically, you can observe complex movements of the two

balls. Investigate the phenomenon.

用一根绳子穿过带孔的球，使得球可以在绳上自由移动。在绳的另一端连接另一个球。



当你周期性地移动绳的自由端时，你可以观察到两个球之间的复杂运动。研究这一现象。

### 8. Soap Membrane Filter 肥皂膜过滤器

A heavy particle may fall through a horizontal soap film without rupturing it. However, a light particle may not penetrate the film and may remain on its surface. Investigate the properties of such a membrane filter.

一个重粒子可以穿过水平的肥皂沫而不使其破裂。然而，一个轻粒子可能穿不透薄膜，并可能停留在它的表面。研究这种薄膜过滤器的性能。

### 9. Magnetic Levitation 磁悬浮

Under certain circumstances, the “flea” of a magnetic stirrer can rise up and levitate stably in a viscous fluid during stirring. Investigate the origins of the dynamic stabilization of the “flea” and how it depends on the relevant parameters.

在一定条件下，磁力搅拌器的“磁子”在搅拌过程中可以在粘性流体中稳定地上升和悬浮。研究“磁子”动态稳定的原因及其如何依赖于相关参数。

### 10. Conducting Lines 导电回路

A line drawn with a pencil on paper can be electrically conducting. Investigate the characteristics of the conducting line.

用铅笔在纸上画的线可以导电。研究导电回路的特性。

### 11. Drifting Speckles 漂流斑点

Shine a laser beam onto a dark surface. A granular pattern can be seen inside the spot. When the pattern is observed by a camera or the eye, that is moving slowly, the pattern seems to drift relative to the surface. Explain the phenomenon and investigate how the drift depends on relevant parameters.

用激光束照射黑暗的表面。在斑点内部可以看到颗粒状的图案。当用相机或眼睛观察到这种缓慢移动的图案时，它看起来正在相对于表面漂浮。解释这一现象，并研究这种漂浮现象如何依赖于相关参数。

### 12. Polygon Vortex 多边形涡

A stationary cylindrical vessel containing a rotating plate near the bottle surface is partially filled with liquid. Under certain conditions, the shape of the liquid surface becomes polygon-like. Explain this phenomenon and investigate the dependence on the relevant parameters.

一个静止的圆柱形容器，包含一个靠近底部表面的部分填充液体的旋转板。在一定条件下，液体表面的形状会变成多边形。解释这一现象，并研究其对相关参数的依赖关系。

### **13. Friction Oscillator 摩擦振子**

A massive object is placed onto two identical parallel horizontal cylinders. The two cylinders each rotate with the same angular velocity, but in opposite directions. Investigate how the motion of the object on the cylinders depends on the relevant parameters.

一个大质量物体被放置在两个相同的平行水平圆柱体上。两个圆柱体以相同的角速度旋转，但方向相反。研究物体在圆柱体上的运动如何依赖于相关参数。

### **14. Falling Tower 下降的塔**

Identical discs are stacked one on top of another to form a freestanding tower. The bottom discs can be removed by applying a sudden horizontal force such that the rest of the tower will drop down onto the surface and the tower remains standing. Investigate the phenomenon and determine the conditions that allow the tower to remain standing.

相同的圆盘，一个叠在另一个上面，形成一个独立的塔。底部的圆盘可以通过施加一个突然的水平力而撤出，使塔身的其余部分掉到表面上，而塔身保持直立状态。研究这一现象，并确定让塔身保持屹立的条件。

### **15. Pepper Pot 胡椒罐**

If you take a salt or pepper pot and just shake it, the contents will pour out relatively slowly. However, if an object is rubbed along the bottom of the pot, then the rate of pouring can increase dramatically. Explain this phenomenon and investigate how the rate depends on the relevant parameters.

如果你拿一个盐或者胡椒粉罐，摇一摇，里面的东西就会慢慢倒出来。然而，如果一个物体沿着罐底摩擦，那么倒出的速度会急剧增加。解释这一现象，并研究速率如何依赖于相关参数。

### **16. Nitinol Engine 镍钛合金发动机**

Place a nitinol wire loop around two pulleys with their axes located at some distance from each other. If one of the pulleys is immersed into hot water, the wire tends to straighten, causing a rotation of the pulleys. Investigate the properties of such an engine.

将镍钛合金线圈绕在两个滑轮上，使它们的轴彼此保持一定距离。如果其中一个滑轮浸入热水中，电线就会变直，导致滑轮旋转。研究这种发动机的性能。

### **17. Playing Card 扑克牌**

A standard playing card can travel a very long distance provided that spin is imparted as it is thrown. Investigate the parameters that affect the distance and the trajectory.

一张标准的扑克牌在它被旋转着抛出时，它可以运动很长的一段距离。研究影响距离和轨迹的参数。