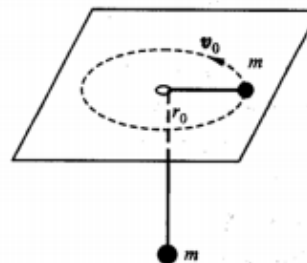


第七次习题课

一. 中心立场问题

1. 郑-习题-5.15

如图 1 所示。在水平的光滑桌面上开有一小孔。一条绳穿过小孔，其两端各系一质量为 m 的物体。开始时，用手握住下面的物体，桌上的物体则以 $v_0 = \frac{3}{2}\sqrt{2gr_0}$ 的速率作半径为 r_0 （即桌上部分的绳长）的匀速圆周运动，然后放手。求以后的运动过程中桌上部分绳索的最大长度和最小长度。



图表 1-习题 1

2. 郑-习题-5.20

质量均为 m 的小球 1、2 用长为 $4a$ 的细线相连，以相同速度 v 沿着与线垂直的方向在光滑水平台面上运动，线处于伸直状态。在运动过程中，线上距离小球 1 为 a 的一点与固定在台面上的一竖直光滑细钉相碰，设在以后的运动过程中两球不相碰。求：

- 1) 小球 1 与钉的最大距离；
- 2) 线中的最小张力。

3. Morin-7.2

A particle moves in a potential $V(r) = -C/(3r^3)$.

- 1) Given L , find the maximum value of the effective potential.
- 2) Let the particle come in from infinity with speed v_0 and impact parameter b . In terms of C , m , and v_0 , what is the largest value of b (call it b_{\max}) for which the particle is captured by the potential? In other words, what is the "cross section" for capture, πb_{\max}^2 , for this potential?

4. Morin-7.5

A particle moves in a $V(r) = \beta r^2$ potential. Following the general strategy in $V(r)$, $r(\theta)$ and conic orbits, show that the particle's path is an ellipse.

5. Morin-7.13

Two masses, m and $2m$, orbit around their CM. If the orbits are circular, they don't intersect. But if they are very elliptical, they do. What is the smallest value of the eccentricity for which they intersect?

6. Morin-7.18

A spaceship travels in a circular orbit around a planet. It applies a sudden thrust and increases its speed by a factor f . If the goal is to change the orbit from a circle to a parabola, what should f be if the thrust points in the tangential direction? Is your answer any different if the thrust points in some other direction? What is the distance of closest approach if the thrust points in the radial direction?

二. 和简谐振动相关的常系数二阶常微分方程求解问题