

國立中央大學103學年度碩士班考試入學試題卷

所別：地球科學學系地球物理碩士班 不分組(一般生) 科目：普通物理學 共 1 頁 第 1 頁
地球科學學系地球物理碩士班 不分組(在職生)

本科考試禁用計算器

*請在試卷答案卷(卡)內作答

(一) Energy in simple harmonic motion (共40分)

1. 一質量不計垂直地表彈簧下端懸掛著一具有質量的物質做簡諧運動，請畫圖解釋其位能、彈性能、動能和總力學能變化(請自行假設必要參數並詳細說明其意義)。(20分)
2. 一枚硬幣置於活塞頂面，此活塞以頻率 f 及振幅 A 作鉛直方向的簡諧運動。若振幅固定，頻率由小變大，則當頻率等於多少時，在活塞最高點處，該枚硬幣會與活塞失去接觸？(20分)

(二) Rotation and gravitational law (共 30 分)

1. What is centripetal force? What are its sources and how to calculate its amplitude? (15 分)
2. (a) The fastest possible rate of rotation of a planet is that for which the gravitational force on material at the equator barely provides the centripetal force needed for rotation, why? (5分)
(b) Show that the corresponding shortest period of rotation, T , is given by $T = \left(\frac{3\pi}{G\rho}\right)^{\frac{1}{2}}$, where ρ is the density of the planet, assumed to be constant throughout the planet. (10分)

(三) Drag force at very low speeds (共30分)

At low speeds (especially in liquids rather than gases), the drag force is proportional to the speed rather than its square, i.e., $F = -C_1rv$, where C_1 is a constant, r is the radius and v is the velocity. At time $t = 0$, a small ball of mass m is projected into a liquid so that it initially has a horizontal velocity of u in the $+x$ direction. The initial speed in the vertical direction (y) is zero. The gravitational acceleration is g .

- (a) Write down the differential equations of motion in the x and y direction. (10分)
- (b) What is the horizontal component of the ball's velocity at time t ? (5分)
- (c) What is the vertical component of the ball's velocity at time t ? (5分)
- (d) After how many seconds is the vertical speed 99% of its maximum value? (5分)
- (e) Answer the questions under b) and c) for the limiting case that t becomes infinitely large. (5分)

參考用