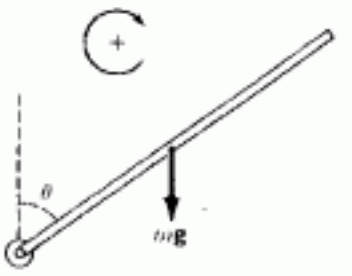
國　立　清　華　大　學　命　題　紙

九十三學年度 物理-天文 系（所） ＿＿＿＿ 組碩士班入學考試

科目 普通物理 科號 0402 0501 共 2 頁第 1 頁 *請在試卷【答案卷】內作答

注意: 1. 請按題目順序作答。
2. 填充題不需要寫計算過程。

甲. 填充題(每空格 3 分，依號碼順序填寫在試卷上)

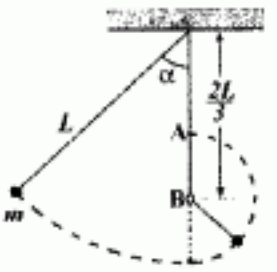


1. A uniform rod of length L and mass M is pivoted freely at one end. (a)What is the angular acceleration of the rod when it is at angle θ to the vertical? **(1)** . (b)What is the tangential linear acceleration of the free end when the rod is horizontal? **(2)** . The moment of inertia of a rod about one end is $1/3ML^2$.
2. An iceberg with a density of 920 kg/m^3 floats on an ocean of density 1025 kg/m^3. What fraction of its volume is submerged? **(3)** .
3. A traveling harmonic wave function is $y = 0.006\ sin[\pi(0.01x - 4t + 0.02)]$, where x and y are in meter and t in second. The period is **(4)** sec. The wave velocity is **(5)** m/s.
4. A mole of an ideal gas undergoes a reversible isothermal expansion from V to 2V. The change in entropy of the universe is **(6)** . Suppose the same expansion takes place as an adiabatic free expansion, the change in entropy of the universe is **(7)** .
5. 10 公分的銅棒與同粗細的 30 公分鋁棒頭尾接在一起，在銅棒的另一端爲 80℃，鋁棒的另一端爲 20℃，則銅鋁接觸點的溫度是 **(8)** 。設銅與鋁的熱導率分別爲 400 及 240 W/m.K。
6. 從投手的觀點看，當他投出向下旋轉的快速球，在進入打擊區時，球會比沒有旋轉時的路徑向 **(9)** 偏移。
7. 靜止的電子 (質量 m_e，電荷 e) 經一電壓爲 $V = m_ec^2/e$ 的電極加速後，在相對論效應不可忽略的情況下，該電子的 de Broglie 波長爲 **(10)** 。
8. 在雙狹縫干涉實驗中，在中央繞射主極大中，可以觀察到 7 條干涉條紋。則在第一個次極大的繞射中有 **(11)** 條干涉條紋。
9. 光纖的是由一折射率較高 (n = 1.3) 的柱狀結構被折射率較低 (n' = 1.2) 的材質包覆著，如右圖。若設空氣的折射率爲 1，最大入射角θ爲 **(12)** 。(提示：內部能夠有全反射時，光纖才能進行光的傳遞) 。

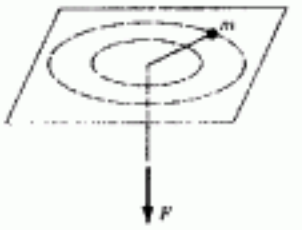
10. 已知一電磁波的電場爲 E，則磁場 B = **(13)** ，用以表示該電磁波的平均強度 (average intensity) 的向量 Poynting vector S_{av} = **(14)** 。

乙. 計算題

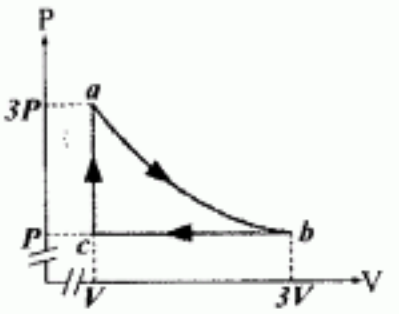
1. [5%, 5%] A pendulum bob has its motion interrupted by a peg at point B vertically beneath the support at a distance $2L/3$, as shown in right figure. (a) What is the tension in the rope at point A if the bob is released from a horizontal position? (b) If the pendulum is released at the angle α to the vertical such that the tension of rope at point A vanishes, what is the value of cos α?



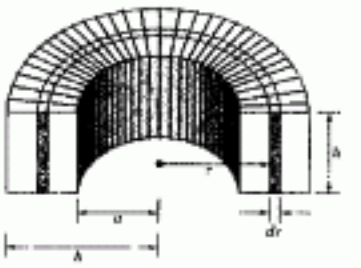
2. [4%, 4%, 3%] The right figure shows a particle of mass m moving in a circle with the centripetal force provided by a rope that passes through a hole in the table. The initial angular momentum is L_0. The force is changed in such a way that the radius of the motion decreases from r_1 to r_2. (a) How does the force vary as a function of r? (b) Calculate the work done by the force in changing the radius. (c) What is the change in kinetic energy of the particle?



3. [6%, 4%, 4%] If n moles of ideal monatomic gas (C_v = 3R/2) are taken around the cycle of the right figure, where $a \rightarrow b$ is an isothermal process at T. Find the answers of the following questions in terms of P and V. (a) The heat (indicate whether it is adsorbed or rejected) in each segment Q_{ab}, Q_{bc}, and Q_{ca}. (b) The work done per cycle. (c) The efficiency.



4. [6%, 6%] 環形電感的結構如右圖示。(a) 請計算該電感的電感值 (b) 若繞製該電感的電線每單位長度有線電阻值λ，請計算該電感的時間常數(time constant)。



5. [7%, 4%] 一非導體球半徑爲 R，球殼上有均勻分布的表面電荷密度σ。該球以角速度ω自旋，並置於一大小爲 B 的磁場中，該磁場方向垂直於自旋角速度的方向。請問(a)該球的磁偶極大小爲何？(b)該球所受力矩大小。