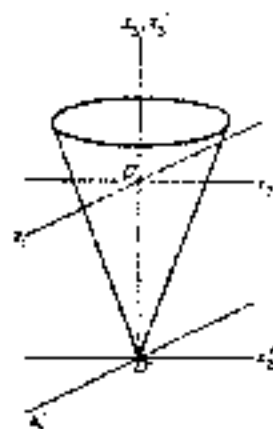
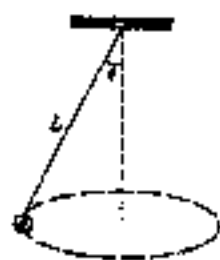


八十五學年度 原子科學系(所) 甲 組碩士班研究生入學考試
 科目 普通物理 科號 4001 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

(There are 20 subquestions in this test. Each get 5 points.)

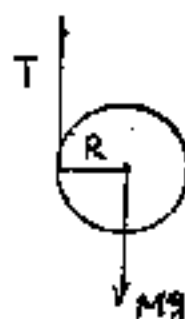
1. A conical pendulum with a bob suspended at the end of a string makes a horizontal circle at a constant speed. The length of the string is 1.2m , and it makes an angle $\pi/6$ with the vertical. What is the velocity?
2. A particle of mass m moves under the action of a central force whose potential is given by $V(r) = kr^3$ ($k > 0$). If the orbit is a circle of radius R , calculate the mechanical energy.
3. A rocket is fired vertically from the earth surface with speed $v_{esc}/9$ where v_{esc} is the speed to escape from the earth gravitation. Estimate the maximum altitude. (use: gravitation constant $g = 9.8\text{m/s}^2$ and earth radius $R_e = 6371\text{ km}$)
4. A proton of energy 4 Mev scatters off a second proton at rest. One proton comes off at an angle $\pi/6$ in the laboratory system. What is its energy?
5. A uniform rope of mass m and length l hangs from a ceiling. Calculate the time required for a transverse wave to travel the length of the rope.
6. A uniform solid cone has mass M , height h , and base radius R .
 - (a) Locate the center of mass (CM).
 - (b) Calculate the principal moments of inertia on CM.



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科目 普通物理 科號 4001 共 3 頁第 2 頁 *請在試卷【答案卷】內作答

7. A solid cylinder of mass M and radius R unwinds on a vertical string.
 (a) Find the speed of the spool after it falls a distance L . (b) If the string is pulled to have the spool spin but not fall, what is the angular acceleration?



8. One mole of an ideal monatomic gas is used as the working substance of a heat engine that operates on the cycle shown. Assume $p_1 = 1 \text{ atm}$, $V_1 = 10 \text{ l}$; $p_2 = 3p_1$, $V_4 = 4V_1$.



- (a) Determine the temperatures on each vertex.
 (b) What is the efficiency of the heat engine?

(use: gas constant $R = 0.082 \text{ atm.l/K.mole} = 1.987 \text{ C/K.mole}$).

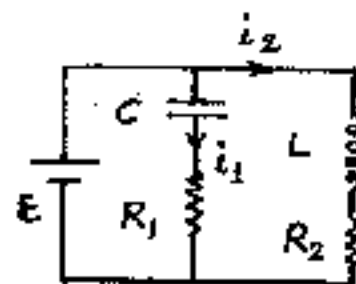
9. The spherical region $a < r < b$ carries volume charge density $\rho = A/r$, with constant A . At the center ($r = 0$) of the enclosed cavity, there is a point charge q . What should the value of A be so that the electric field in the region $a < r < b$ has constant magnitude?
10. Two coaxial cylindrical shells of radii a, b ($a < b$), and length l are kept at constant potential difference V_0 . The region between the two shells is filled with solid dielectrics with dielectric constant κ . If the dielectrics is pulled out from the cylinder with a distance z , calculate the force on the dielectrics (attracting or repelling?).

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11. A point charge q of mass m is accelerated in a cyclotron with a uniform magnetic field B . What is the power supplied by the magnetic field?

12. In the circuit shown, the emf of the generator is $\epsilon = \epsilon_m \sin \omega t$ with constants ϵ_m and ω . What is the maximum current of i_2 ?



13. A spaceship turns on a yellow light with wavelength 560 nm in flight. It travels around the earth in circular orbit with speed $0.6c$. (a) When it passes over, what is the apparent wavelength observed on earth? (b) When it returns to the earth with speed $0.01c$ vertically, what is the measured wavelength on earth? (c : velocity of light)

14. A nonrelativistic particle is moving three times as fast as an electron. The ratio of their de Broglie wavelength (particle to electron) is 1.813×10^{-4} . What can those particles be?

15. According to the Bohr theory of hydrogen, what is the magnetic field on proton due to the circulation of electron?

16. A pion created with a total energy of 1.35×10^5 Mev, at 120 km above sea level travels vertically downward. In its proper frame this pion decays 35 ns after its creation. The rest energy of a pion is 139.6 Mev. Find the altitude where the decay occurs. ($1ns = 10^{-9}sec$).