國立交通大學八十九學年度碩士班入學考試試題

科目名稱：普通物理(213)　　考試日期：89 年 4 月 22 日 第 2 節

系所班別：材料科學與工程學系　　組別：乙組　　第 1 頁，共 3 頁

＊作答前，請先核對試題、答案卷（試卷）與准考證上之所組別與考試科目是否相符!!

Problem #1 (15%)

A rocket is launched from rest and moves in a straight line at 70.0° above the horizontal with an acceleration of 46.0 $\mathrm{m/sec^2}$. After 30.0 sec of the linear powered flight, the engines shut off and the rocket follows a parabolic path back to earth (see Fig. 1). Assume that the free-fall acceleration is 9.8 $\mathrm{m/sec^2}$ throughout and that effects of the air can be ignored.

(a) Find the time of flight from launch to impact.

(b) What is the maximum altitude reached?

(c) What is the distance from launchpad to impact point?

Problem #2 (17%)

A pendulum mounted in a cart has period T when the cart is stationary and on a horizontal plane. How is the period affected if the cart is on a plane inclined at angle θ with the horizontal (see Fig. 2) while

(a) stationary,

(b) moving down the plane with constant speed,

(c) moving up the plane with constant speed,

(d) moving up the plane with constant acceleration up the plane,

(e) moving down the plane with constant acceleration up the plane,

(f) moving down the plane with constant acceleration $a < g\sin\theta$ down the plane,

(g) moving down the plane with constant acceleration $a = g\sin\theta$ down the plane.

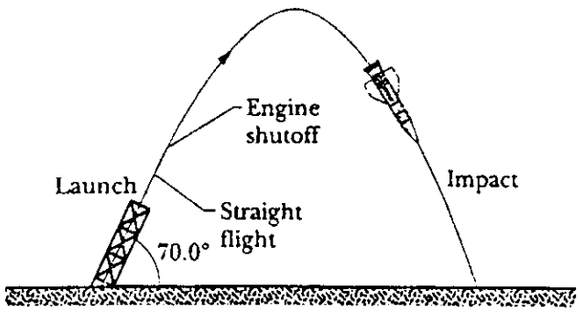

Fig. 1

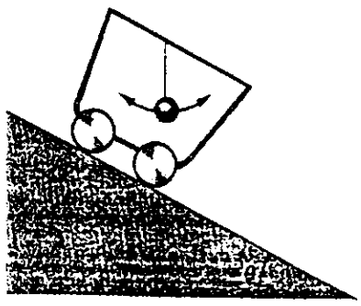

Fig. 2

Problem #3

A permanent magnet, having a moment of inertia I relative to a vertical axis about which it is pivoted and a magnetic dipole moment μ. is placed in a magnetic field of flux density **B**.

(a) Show that when the dipole moment is brought slightly out of the alignment with the magnetic field lines and is released, the dipole undergoes angular simple harmonic motion. (4%)

(b) Show that the period oscillation is given by $2\pi\sqrt{\frac{I}{\mu B}}$. (4%)

Problem #4

A pure inductor having an inductance of 2.0 H is connected across the terminals of a 60-Hz ac voltage source, the *rms* voltage being 115 V. Find

(a) The inductive reactance X_L, (3%)

(b) The *rms* current, (3%)

(c) The maximum power delivered by the inductor, and (3%)

(d) The maximum energy stored in the inductor. (3%)

Problem #5

Find the current through a series *RLC* circuit across the applied alternating emf. Must one increase or decrease the frequency of the applied emf, to bring the circuit to resonance? (8%)

Problem #6

The light from the star Aldebaran shows a Doppler shift corresponding to a maximum recession speed of 84 km/sec when the earth is at one point in its orbit about the sun. Six months later its light shows a shift corresponding to a recession speed of 24 km/sec. Aldebaran is very close the plane of the earth's orbit about the sun and has a constant radial velocity with respect to the sun. From the information given here,

(a) Find the orbit speed of the earth about the sun, and (4%)

(b) Find the redial velocity of Aldebaran relative to the sun. (4%)

Problem #7

(a) State the Fermat's Principle. (5%)

(b) Derive the law of refraction by using the Fermat's principle. (5%)

Problem #8

Calculate the momentum and De Broglie wavelength of an electron with kinetic energy of 10 eV. (*Note*: Electron rest mass $m_e = 9.11\times10^{-31}$ kg, Planck constant $h = 6.63\times10^{-34}$ Joule·sec, speed of light $c = 3\times10^{8}\ \mathrm{m/sec}$.) (6%)

Problem #9

The radius of curvature of the convex surface of a plano-convex lens is 1.50 m. The lens is placed on a plane glass with the convex side down, and illuminated from above with the light of wavelength 5000Å. Determine the separation of the 2nd and 3rd bright rings of the interference pattern. (8%)

Problem 10

(a) Currently the light source in the pick-up head of optical disk drivers is either red- or yellow/green-light laser. Explain the recording density of optical disks (*e.g.*, DVD disks) may be increased by replacing the light source with blue-light laser. (4%)

(b) State at least one plausible method (other than that described in (*a*)) which may increase the recording density of optical media. Justify your answer. (4%)