編號： 199　系所：民航研究所甲組　　科目：普通物理

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Problem 1. In civil aviation, it is necessary to determine if the airplane is balanced for each flight. To make the airplane balance, it is necessary to know how the center of gravity (c.g.) shifts after cargos are loaded. As shown in Fig. 1, the airplane frame originally weighs W with

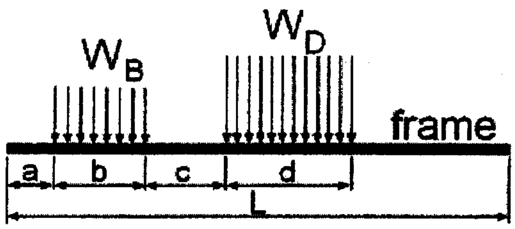

Figure 1: Cargo distribution diagram.

its c.g. located at the center of the frame. Two cargos with weights W_B and W_D are evenly loaded (with constant distributed weight) over the lengths b and d, respectively, as shown in the figure. Determine the new c.g. position in terms of the given parameters a, b, c, d, L, W_B, W_D, and W. (15%)

Problem 2. City A (located at 120°E longitude) has its local time 16 hours ahead of City B(located at 120°W longitude). An airplane departured from city A at 11:30 p.m., 22 January 2007, local time. It flied eastward and took 11 hours to arrive at city B. What is the local time at city B when the airplane arrived? Conversely, if the airplane departured from city B at 9:00 p.m., 30 January 2007, local time, and flied westward for 13 hours to arrive at city A, what is the local time at city A when the airplane arrived? (15%)

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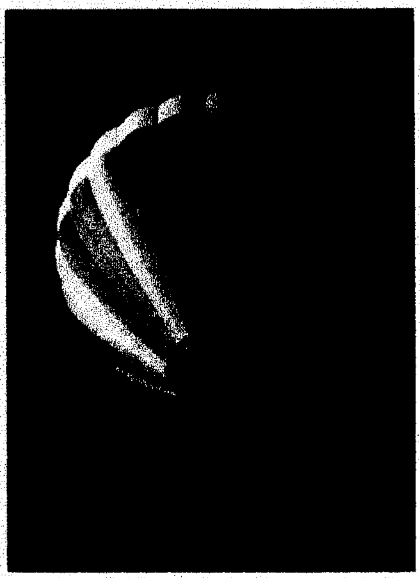
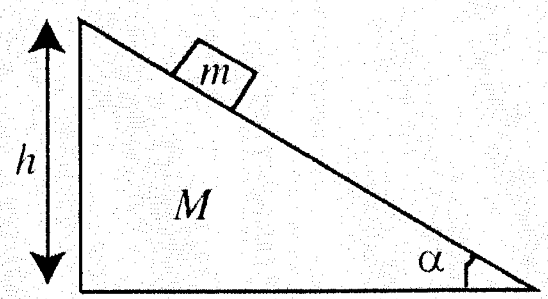
Problem 3 A hot air balloon has a structural mass of 50 kg, and the payload mass is 10 kg. The mass of the air inside the balloon depends on the temperature and pressure. For this problem, assume that the pressure is the same as the standard ambient pressure for the given geometric altitude, h. Assume the balloon is spherical with radius of 10 m, and neglect the volume of the payload.
Determine the temperature of the "hot" air such that the balloon is neutrally buoyant at a geometric altitude of 10 km. (20%)
NOTE: The pressure and density at H= 10 km. The values we need are $P = 2.6500\times10^4\, N/m^2$ and $\rho = 4.1351\times10^{-1}$ kg/m^3. We also need to know that R = 287 J/(kg K).



Problem 4 A block of mass m slides on a frictionless inclined wedged-plane of mass M. The plane has height h, makes an angle α with the horizontal (see sketch), and rests on a flat, frictionless surface. The small block can slide down the plane, and the plane can slide along the surface.
If the small block starts at the top of the plane, how long will it take to reach the bottom? (15%)



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5. Two blocks of mass **m** and **2m** sit on a smooth surface. Mass **A** is initially at rest and mass **B** is initially moving to the right at speed $\mathbf{V_0}$. Mass **B** collides with a wall with coefficient of restitution **e** = 0.5. Mass **B** then collides with mass **A** with coefficient of restitution **e** = 0 (completely inelastic). You can do all work assuming motion in one direction in an inertial reference frame.

(a) Find the velocity of both blocks after mass **B** collides with the wall. Is linear momentum conserved in this collision?

(b) Find the velocity of both blocks after mass **B** collides with mass **A**. Is linear momentum conserved in this collision?

(c) What is fundamentally different about a mass collision with a wall (first collision) and a mass colliding with another mass (second collision)?

(35%)