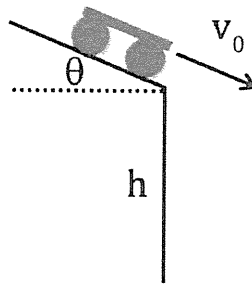


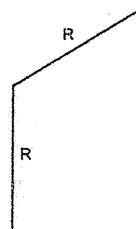
※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (10%) Please estimate the period of a low-altitude reconnaissance satellite. Ignore the effects of air resistance, the mean radius of the Earth is 6400 km, and the centripetal acceleration is close to $g = 10 \text{ m/s}^2$.

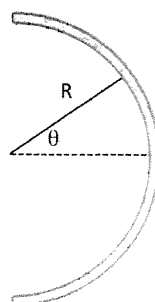
2. (10%) A car goes out of control and slides off a steep embankment of height h at θ to the horizontal. It lands in a ditch at a distance R from the base. Find the speed at which the car left the slope.



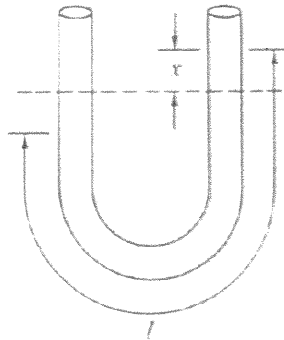
3. (10%) Find the CM of the shape in the following Figure with a uniform area density σ [kg/m^2].



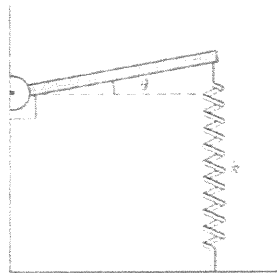
4. (10%) A thin semi-circular ring of radius R has a nonuniform linear charge density given by $\lambda(\theta) = \lambda_0 \sin\theta$. What is the field strength at the center? (Hint: the length of a small element on the ring is $Rd\theta$ and $2\sin\theta\cos\theta = \sin 2\theta$ and $\sin^2\theta = (1 - \cos 2\theta)/2$.)



5. (10+5%) Water fills a length of a U tube, as in Figure. The water is slightly displaced and then allowed to move freely. (a) Show that the liquid executes simple harmonic motion. (b) What is the period?



6. (15%) A uniform rod of mass M and length L is pivoted about a vertical axis at one end and attached to a horizontal spring whose constant is k (see Figure). Show that for small angular displacements from the equilibrium position (indicated by the dashed line) the oscillations are simple harmonic. What is the period? The moment of inertia of the rod is $I = (ML^2)/3$.



7. (7+8%) Find the change in entropy for n moles of an ideal monatomic gas in the following processes: (a) the temperature change from T_1 to T_2 at constant pressure. (b) the pressure changes from P_1 to P_2 at constant volume.

8. (5+5+5%) (a) Please write down the Lorentz transformation from coordinates (x, t) to (x', t') where frame S' moves at $+v$ along the x axis of frame S .
 (b) Please write down the γ factor.
 (c) Please write down the mass-energy relation in special relativity, and its meaning.