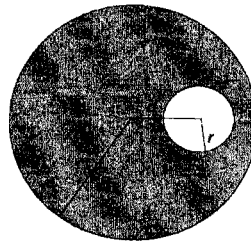


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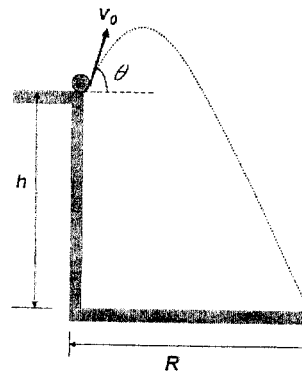
The following may be useful.

Electron's charge $e=1.60 \times 10^{-19}$ [C]	Permittivity constant $\epsilon_0=8.85 \times 10^{-12}$ [C ² /N·m ²]	Universal gas constant $R=8.31$ [J/mol·K]
Boltzmann's constant $k=1.38 \times 10^{-23}$ [J/K]	Gravitational constant $G=6.67 \times 10^{-11}$ [N·m ² /kg ²]	Planck's constant $h=6.63 \times 10^{-34}$ [J·s]
Stefan-Boltzmann constant $\sigma=5.67 \times 10^{-8}$ [W/m ² ·K ⁴]	$\log 2 = 0.30$	$\log 3 = 0.48$

1. A uniform sphere of radius R has a spherical hole of radius r removed. The center of the hole is at a distance of d from the center of the original sphere, as seen in the figure below. Find the center of mass relative to the center of the sphere. (10%)



2. Assuming the same sphere in the last question, as shown in the figure above, is made of nonconducting material and has a total charge Q uniformly distributed throughout its volume. (a) Compute the magnitude and direction of the field within the cavity. (b) Show that the electric field within the cavity is uniform. (10%)
3. A rocket is fired with an initial speed v_0 at an angle θ above the horizon from a point at height h , as shown below. Calculate the horizontal range R for the rocket to hit the ground. (10%)

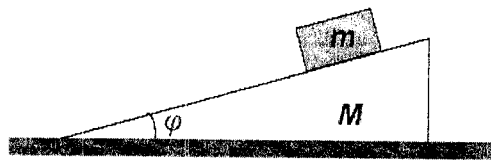


4. For communication we need a satellite that appears fixed in the sky. Find the radius of its orbit. Express your answer in meters. The gravitational constant $G=6.67 \times 10^{-11}$ N·m²/kg² and the earth's mass $M_E=6 \times 10^{24}$ kg. (10%)

注意：背面有試題

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5. A wedge of mass M , whose faces form an angle φ with each other, lies on a smooth horizontal table, as shown below. A block of mass m is placed on the wedge and is allowed to slide down. What is the acceleration of the wedge along the table before the block reaches the table? Neglect all friction. (10%)



6. The position of a particle moving along the x axis is given by
$$x = 0.9 \sin(24t + 0.3) \text{ [m]}$$
where t is in seconds. (a) What are the amplitude and period of the motion?
(b) Determine the position, velocity, and acceleration at $t = 0.5$ s. (10%)
7. (a) Calculate the change in entropy when one mole of an ideal gas expands freely to double its original volume. (b) What is the entropy change when one mole each of two different noninteracting ideal gases, starting with equal volumes and temperatures, are mixed? (10%)
8. A liquid has its density varying linearly with depth, being $\rho = \rho_0$ at the surface and $\rho = 2\rho_0$ at depth of D . Now place a small sphere of density $2\rho_0$ at depth $D/2$ and release it from rest. Find the equation of the oscillation motion of the sphere. Neglect the damping force of the liquid. (10%)
9. A 40-m/s wind blows past a roof with dimensions 10 m \times 15 m. Assuming that the air under the roof is at rest, what is the net force on the roof? (10%)
10. A coating of MgF_2 (refractive index $n=1.38$) on glass ($n=1.6$) is 8.3×10^{-5} cm thick. If white light is incident normally, which visible wavelengths are missing in the reflected light? (10%)