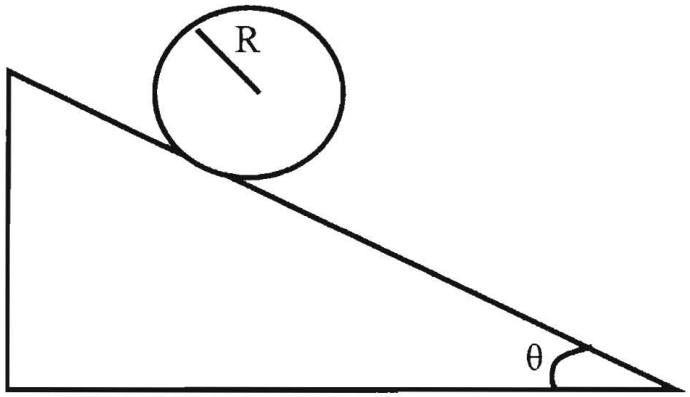
※ 考生請注意：本試題 ☑可 ☐不可 使用計算機

1. **A disk of radius R and mass M is released from a slope as is shown in figure below. The slope makes an angle θ with the horizontal surface. And the length of the slope is L. (a)When the disk rolls without slipping down the slope what is the velocity of the center of the mass when it reaches the bottom? (10%) (b)What is the maximum θ that the disk could roll down the slope without slipping? (10%) The rotational inertial with respect to a line passing through the center of the disk is $1/2MR^2$. The coefficient of static friction between the disk and the slope is μ_s.**



2. **A satellite of mass m is in a circular Earth orbit a height h above the surface of Earth. Let M and R be the mass and radius of the Earth and G is the gravitational constant. What is the period T of the satellite in terms of M, m, h, and G? (20%)**

3. **Two long, straight, parallel wires are shown in cross section as shown in figure below. Each wire carries the same current I, flow in opposite sense. Let x locate a point in the plane containing the axes of the wires. Determine the magnetic field as a function of x for the following cases:**
   (a). $0<x<a$ (5%)
   (b). $a<x<D-a$ (5%)
   (c). $D-a<x<D$ (5%)

(背面仍有題目，請繼續作答)

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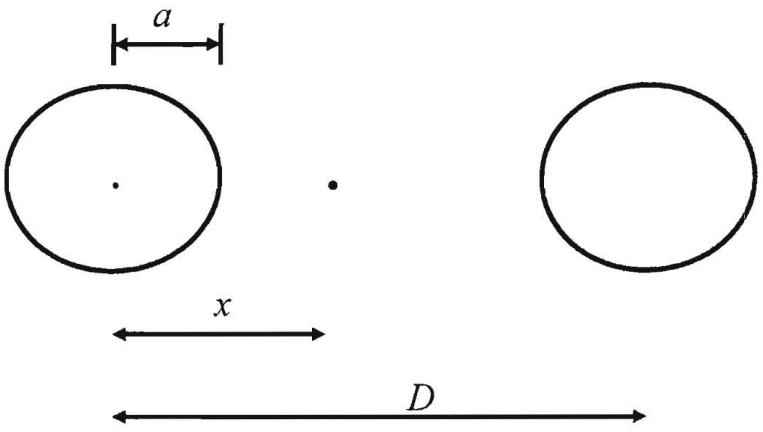

4. **A spaceship turns on a yellow light with wavelength 560nm in flight. It travels around the earth in circular orbit with speed parameter v/c=0.5, where v is this spaceship's speed and c is light speed.**
   (a). When it passes over, what is the measured frequency on earth? (10%)
   (b). When it returns to the earth with speed parameter 0.5 vertically, what is the measured frequency? (10%)

5. **(a). Find mean speed $\bar{v}$ from Maxwell distribution for the speed** $f(\upsilon)=4\pi\left(\frac{m}{2\pi kT}\right)^{3/2}\upsilon^2\exp\left(-\frac{m\upsilon^2}{2kT}\right)$ **, where T is temperature, m is the mass of a particle, v is speed of a particle and k is Boltzmann constant. (10%)**

   (b). From Maxwell distribution for the speed, find the average kinetic energy of a particle $\overline{\varepsilon_k}$.

   (Hint: $\overline{\varepsilon_k}=\frac{\int_0^\infty \varepsilon_k f(\upsilon)d\upsilon}{\int_0^\infty f(\upsilon)d\upsilon}$ **, and** $\int_{-\infty}^{\infty}e^{-\alpha x^2}dx=\sqrt{\frac{\pi}{a}}$ **) (10%)**

   (c). From (b), find the specific heat capacity at constant volume C_v and specific heat capacity at constant pressure C_p for a single atomic molecular system. (5%)