

科目：普通物理

系所組：物理學系

1. Considering a solid sphere with a mass of M rolling without slipping after being released from rest at the top of the incline, as shown in Fig. 1, determine the translational speed of the center of mass, v_{CM} , when it reaches the bottom of the incline. The moment of inertia I_{CM} about its axis of rotation is $0.4 MR^2$. (20 points)
2. A solid that has a latent heat of fusion L_f melts at a temperature T_m . Calculate the change in entropy of this substance when a mass m of the substance melts. (20 points)
3. Two identical loudspeakers placed 3.00 m apart are driven by the same oscillator, as shown in Fig. 2. A listener is originally at point O , located 8.00 m from the center of the line connecting the two speakers. The listener then moves to point P , which is a perpendicular distance 0.350 m from O , and she experiences the first minimum in sound intensity. Assuming a speed of sound of 343 m/s in air, determine the frequency of the oscillator. (20 points)
4. A rod of length L (Fig. 3) lies along the x axis with its left end at the origin. It has a nonuniform linear charge density $\lambda = \alpha x$, where α is a positive constant. Calculate the electric potential at B , which lies on the perpendicular bisector of the rod, a distance b above the x axis.
(hint: $\int \frac{dx}{\sqrt{x^2+a^2}} = \ln|x+\sqrt{x^2+a^2}|+c$, 20 points)
5. The conducting bar illustrated in Fig. 4 moves on two frictionless, parallel rails in the presence of a uniform magnetic field directed into the page. The bar has mass m , and its length l . The bar is given an initial velocity \vec{v}_i to the right and is released at $t = 0$. Find the velocity of the bar as a function of time. (20 points)

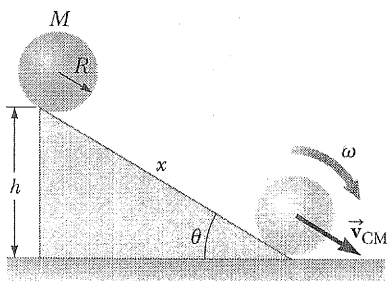


Fig. 1

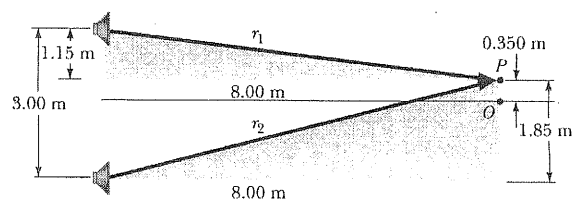


Fig. 2

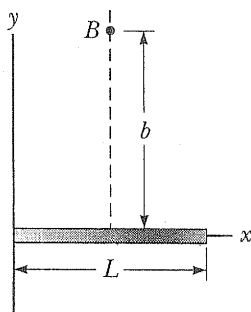


Fig. 3

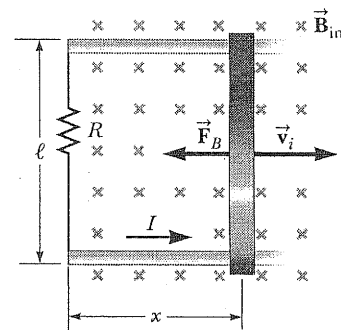


Fig. 4

※ 注意：1. 考生須在「彌封答案卷」上作答。

2. 本試題紙空白部份可當稿紙使用。

3. 考生於作答時可否使用計算機、法典、字典或其他資料或工具，以簡章之規定為準。