

2019 年 澳門中學物理競賽

Concurso de Física para Alunos do Ensino Secundário de Macau 2019

高級組

Avançada

學生証號碼:

Número do Cartão de Estudante _____

座位編號:

Número do Assento _____

競賽答卷規則及注意事項

1. 使用藍色或黑色圓珠筆答題。若使用鉛筆和其他顏色筆答卷，可被視為白卷處理。
2. 將答題內容填寫在每一題下方框內。若空間不足，可使用每頁背面的方框繼續填寫。若空間再不足，可使用答卷最後補充頁上（第 17 至 18 頁）的方框繼續填寫，但需要標注填寫內容對應的題號。
3. 可以使用計算器，但不可使用具記憶或編程功能的計算器或者其他計算工具。
4. 保持卷面整潔，適當使用草稿紙。卷面不可使用塗改工具。若必要，可用圓珠筆劃去已填下的不適用內容。
5. 本卷有概念題 5 題及計算題 5 題。概念題每題 6 分、計算題每題 14 分。卷面共 100 分。

第一部分：概念題

1. 簡述 LED 呼吸燈（多數使用在手機面板頂部）的工作原理。

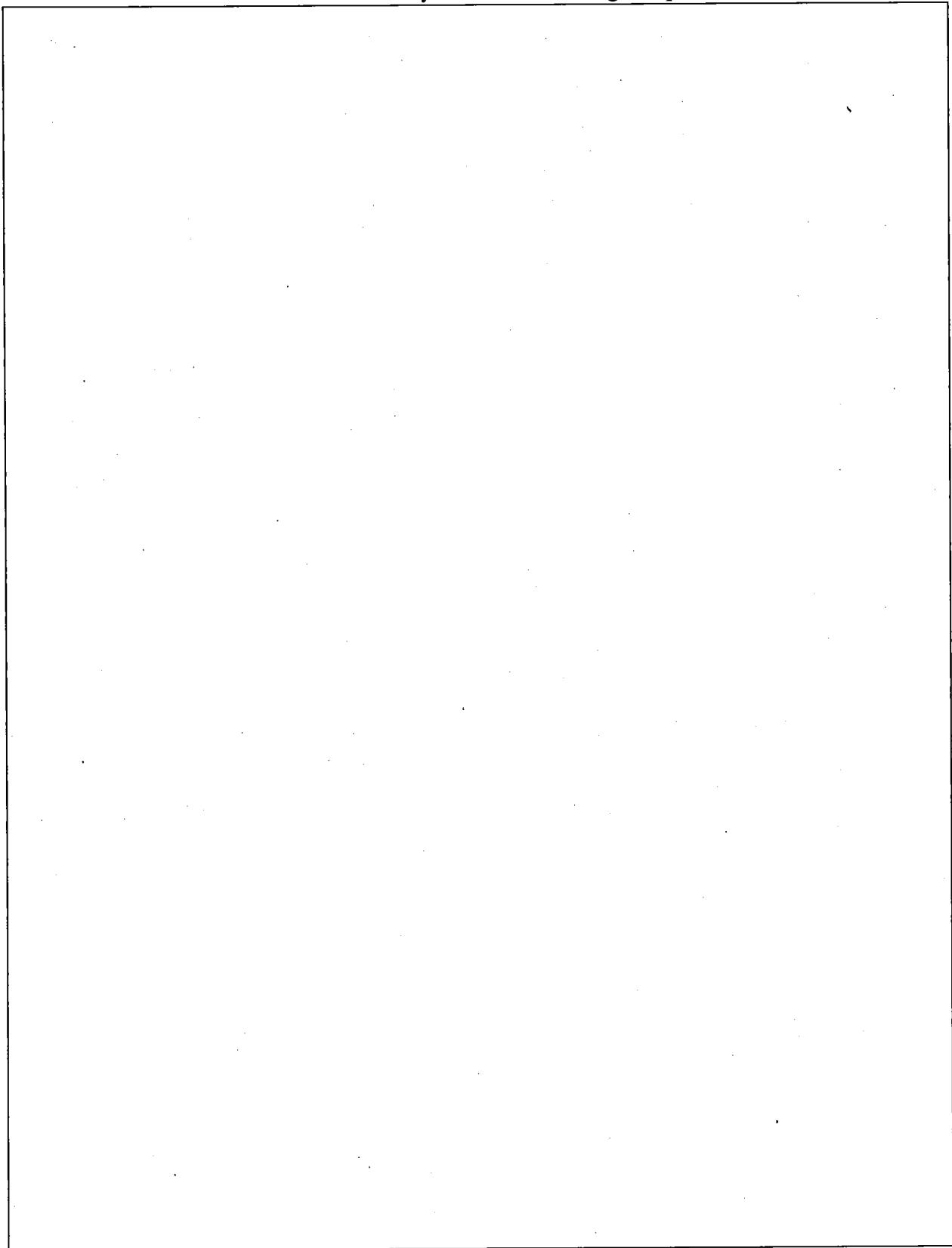
Briefly explain the working principles of a breathing LED light (which is used at the top of a mobile phone front panel).

2. 慣性質量與重力質量之間有區別嗎？若有，怎樣才能區分兩者？請簡述。

Is there a difference between inertial mass and gravitational mass? If there is, how does one differentiate one from the other? Briefly explain.

3. 什麼是霍爾效應？請用簡單文字和圖片描述。

What is Hall effect? Describe briefly in terms of writing and pictures.

A large empty rectangular box with a thin black border, intended for the student to provide a written description and a diagram of the Hall effect.

4. 假設在一導體上連接一交流電流通電。若我們想讓該電流遇到的電阻變得最小，需要考慮哪些因素？

When an AC electric current is let flow in a conductor, what are the factors one has to consider in order to minimize the resistance faced by the current?

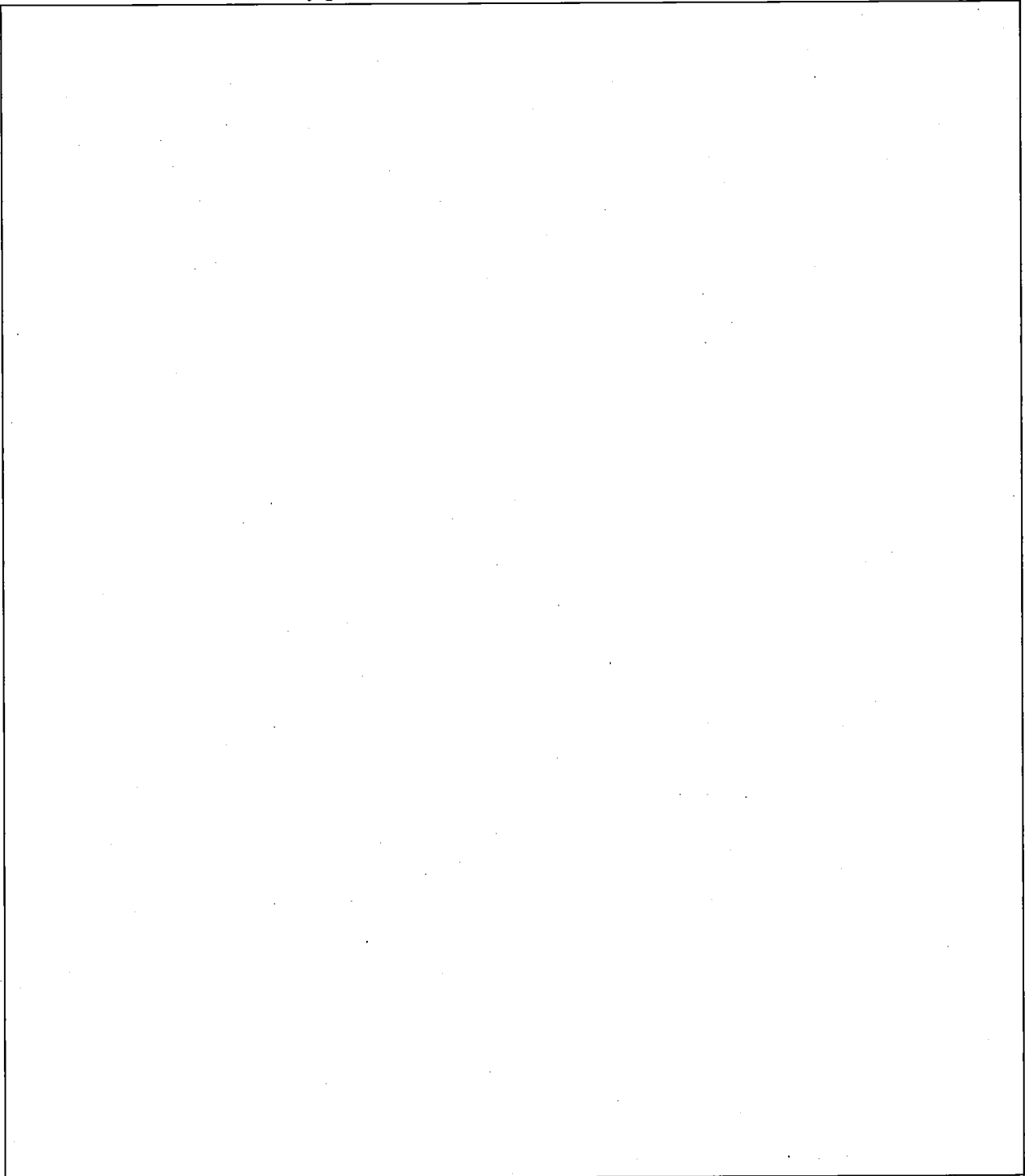
5. 考慮同一斜面上兩個質量相等的物體：一個為輪子形，以滾動形式到達斜面底端；一個為正方體形，以無摩擦滑動形式到達斜面底端。若行走距離相等，則哪個物體會先到達？試解釋為什麼。

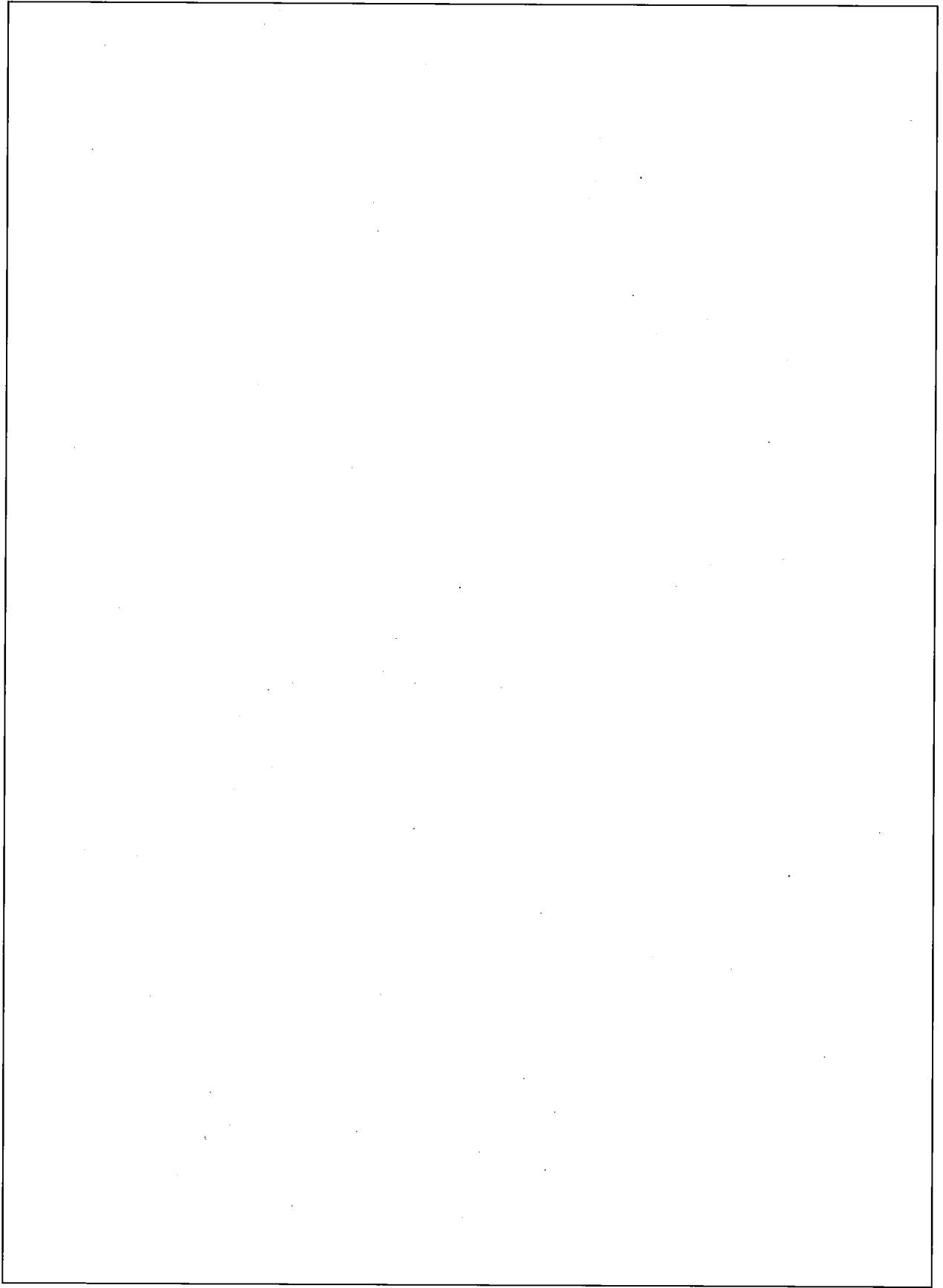
Consider two objects of equal mass on the same slope: one is shaped as a wheel, which rolls down to the bottom of the slope; the other is shaped as a cube, which frictionlessly slides down to the bottom of the slope. If the traveling distance is the same, which object would arrive at the bottom first? Explain why.

第二部分：計算題

1. 設想一個正四面體，其每一棱上均裝有一個 $10\ \Omega$ 的電阻（即電阻兩端連接該棱的兩個頂點）。那麼任意兩個頂點間的等效電阻是多少？

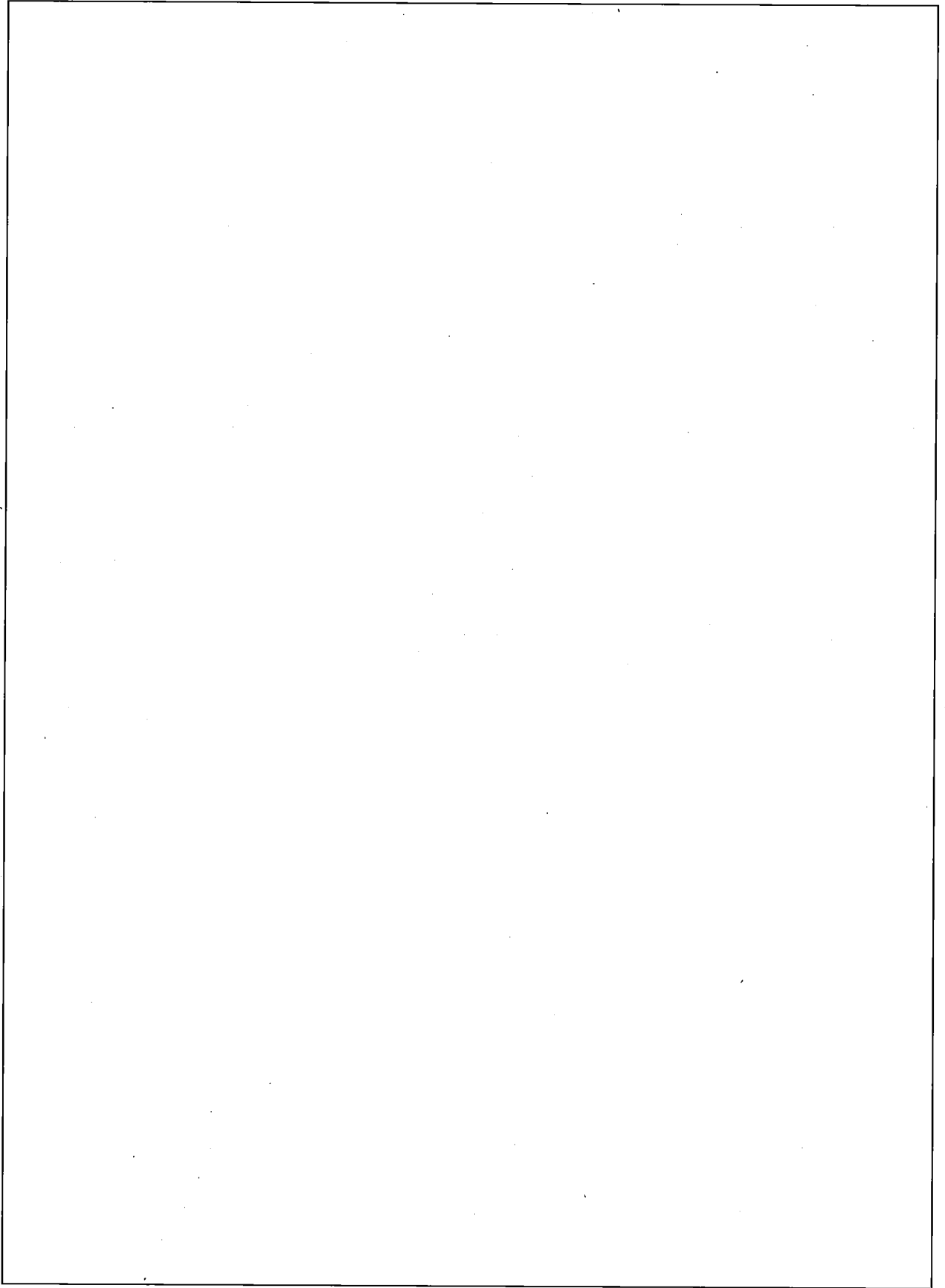
Consider a tetrahedron where each of its edges is installed a resistor of $10\ \Omega$ (i.e. each end of the resistor is connected to one of the two vertices of that edge). What is the equivalent resistance between any pair of its vertices?





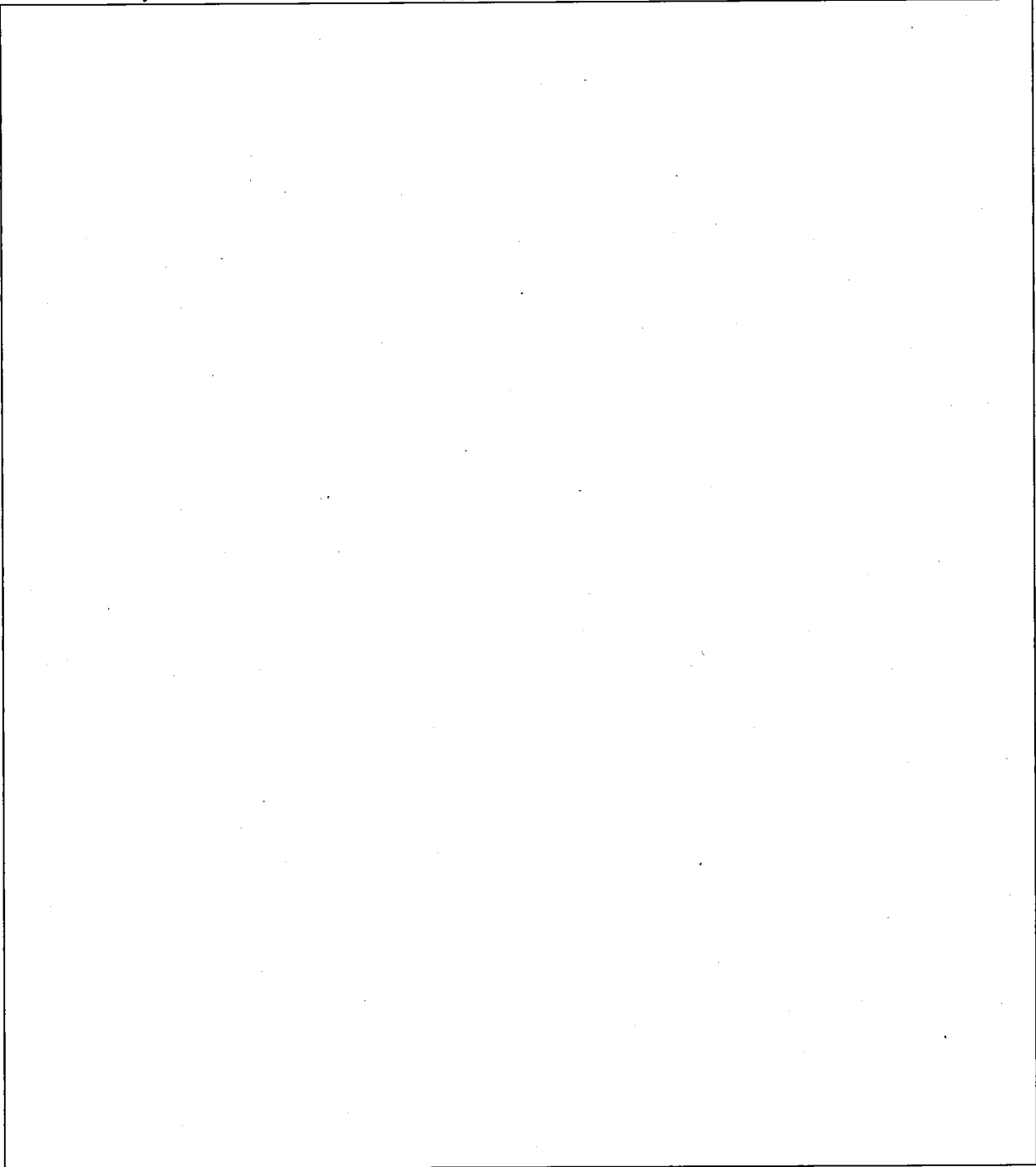
2. 假設地球繞太陽公轉的軌道是圓形以及其週期為 $365\frac{1}{4}$ 天。並假設已知引力常數 G 。我們還需要哪些信息來確定太陽與地球間的距離？若給定這些信息，這個距離的表達式是什麼？

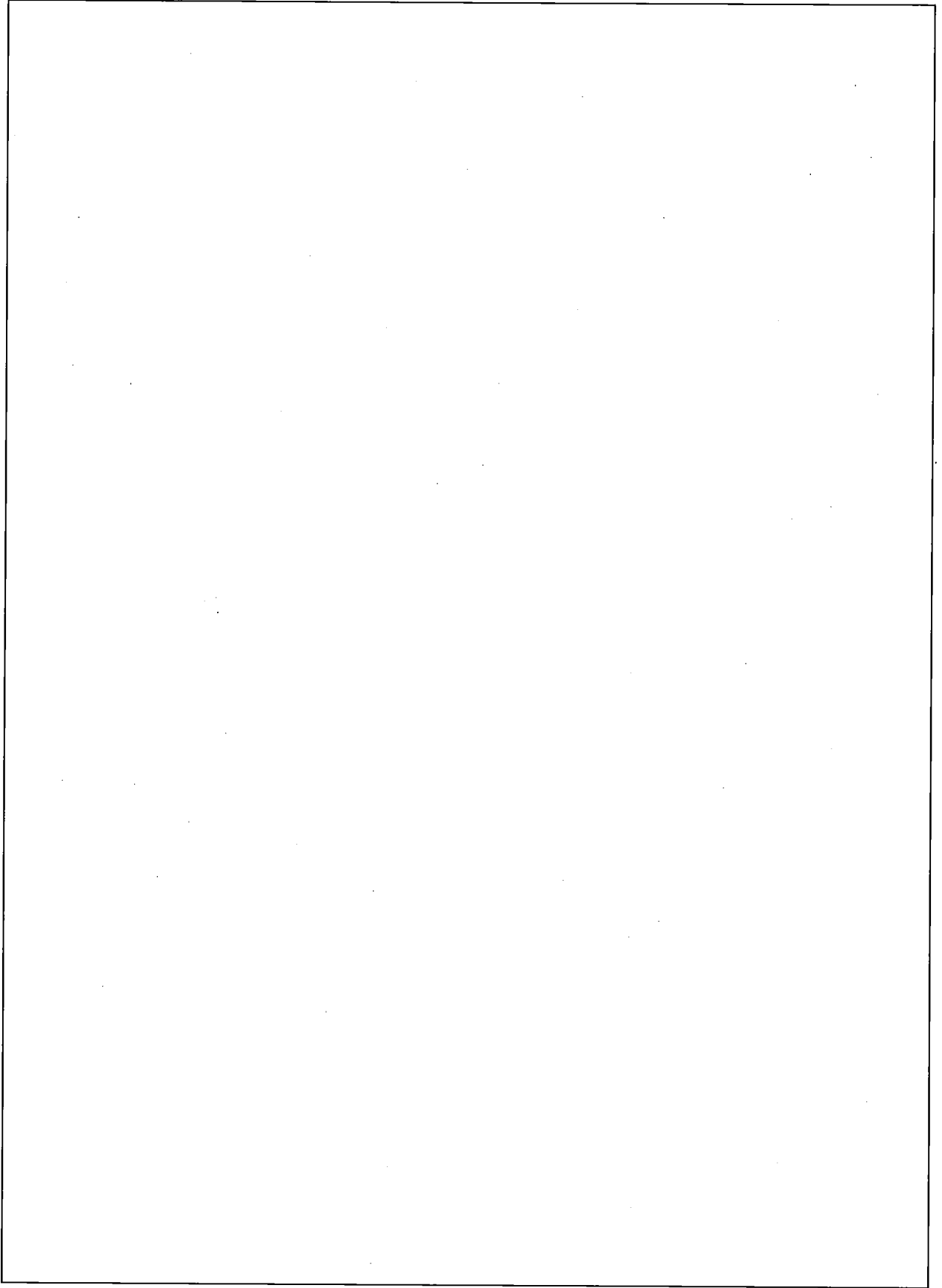
Assume the orbit of the Earth around Sun is circular and its period is $365\frac{1}{4}$ days. Also assume the gravitational constant G is given. What else information do we need to determine the distance between Sun and the Earth? If these information are given, what is the expression of this distance?



3. 使一質量 m 的柱狀磁鐵從靜止下墜 L 米，然後進入一螺旋綫圈內。綫圈內產生的渦電流能夠使磁鐵停止下墜嗎？若可以，磁鐵需在綫圈內行走多遠才能停止？假設綫圈的繞綫密度為 n ，其電綫綫性電阻率為 ρ 。

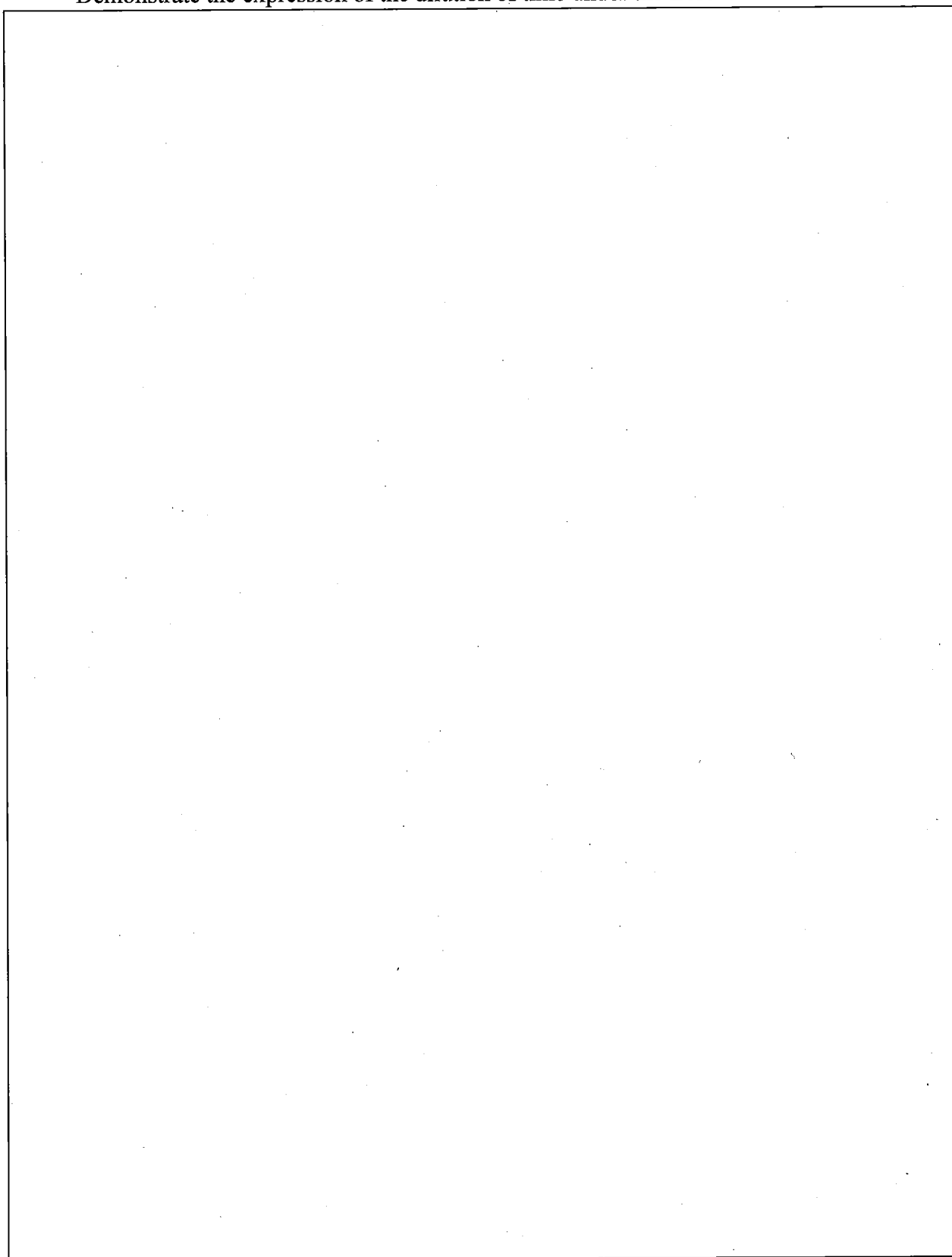
Allow a rod magnet of mass m to drop from rest for L meters and then enter into a solenoid. Will the eddy current produce enough force to stop the dropping? If yes, how long will the rod travel in the solenoid before it stops? Assume the solenoid has winding density n and linear wire resistivity ρ .

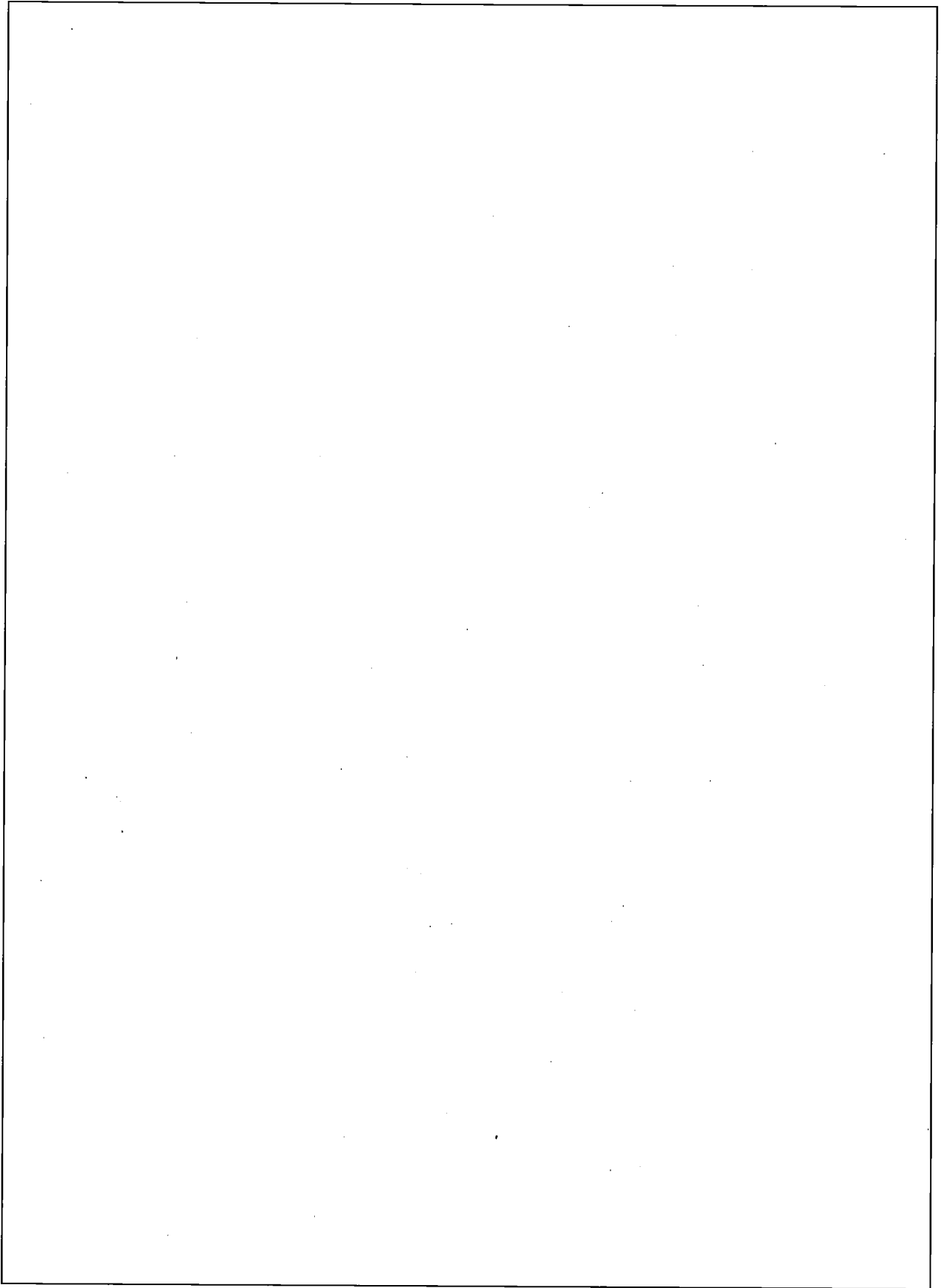




4. 試演算出洛倫茲變換下時間稀釋的表達式。

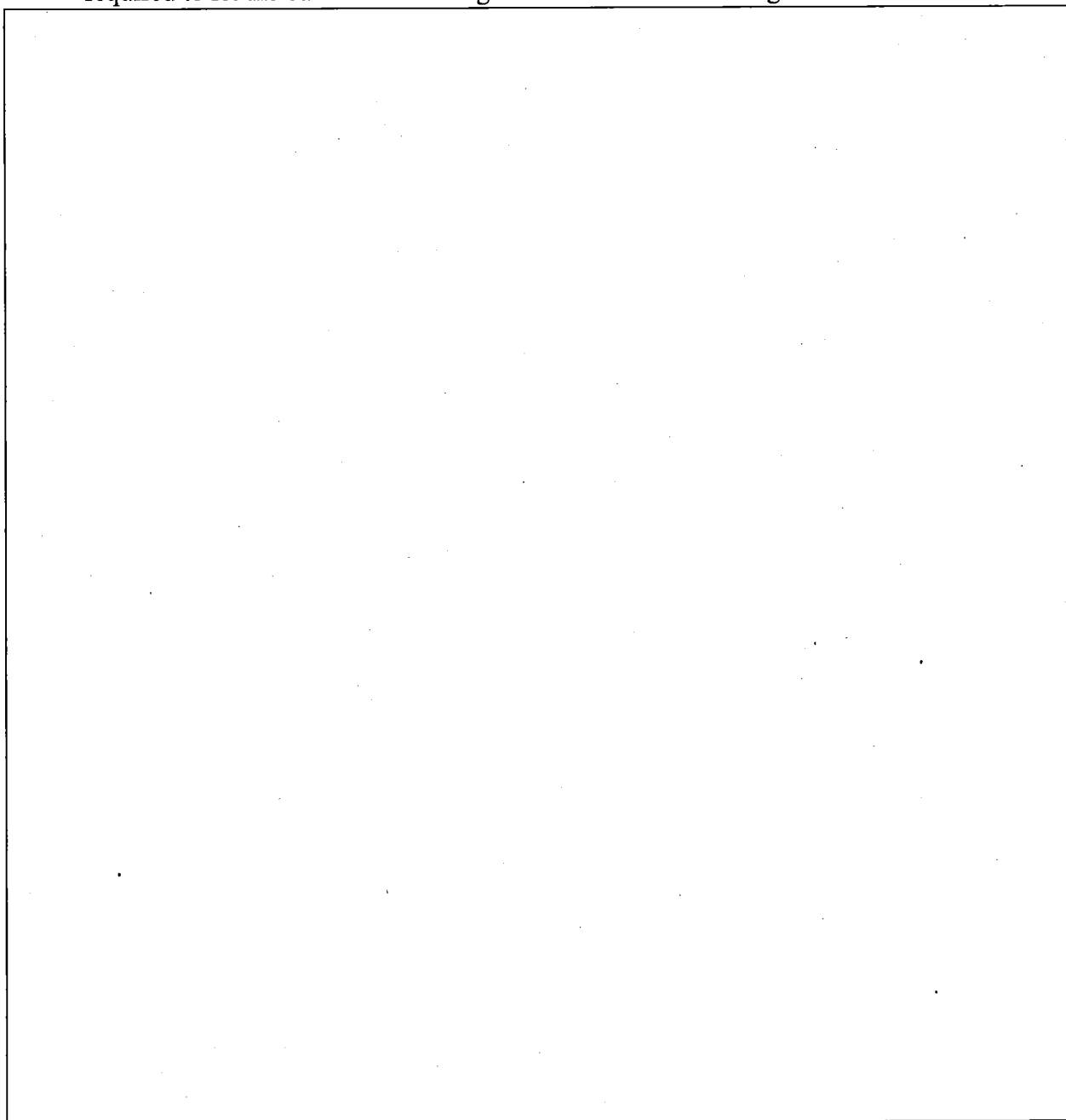
Demonstrate the expression of the dilution of time under the Lorentzian transformation.

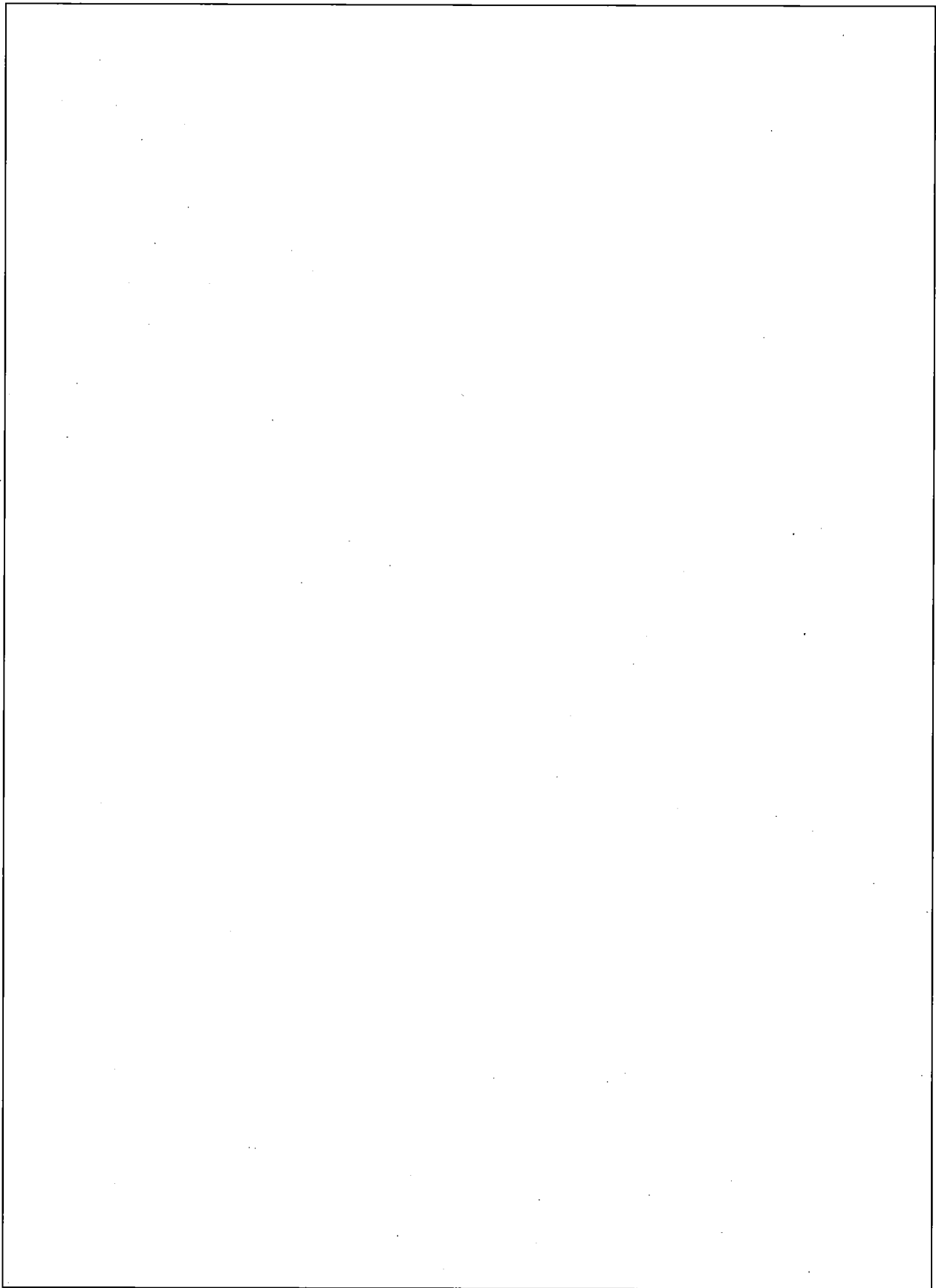




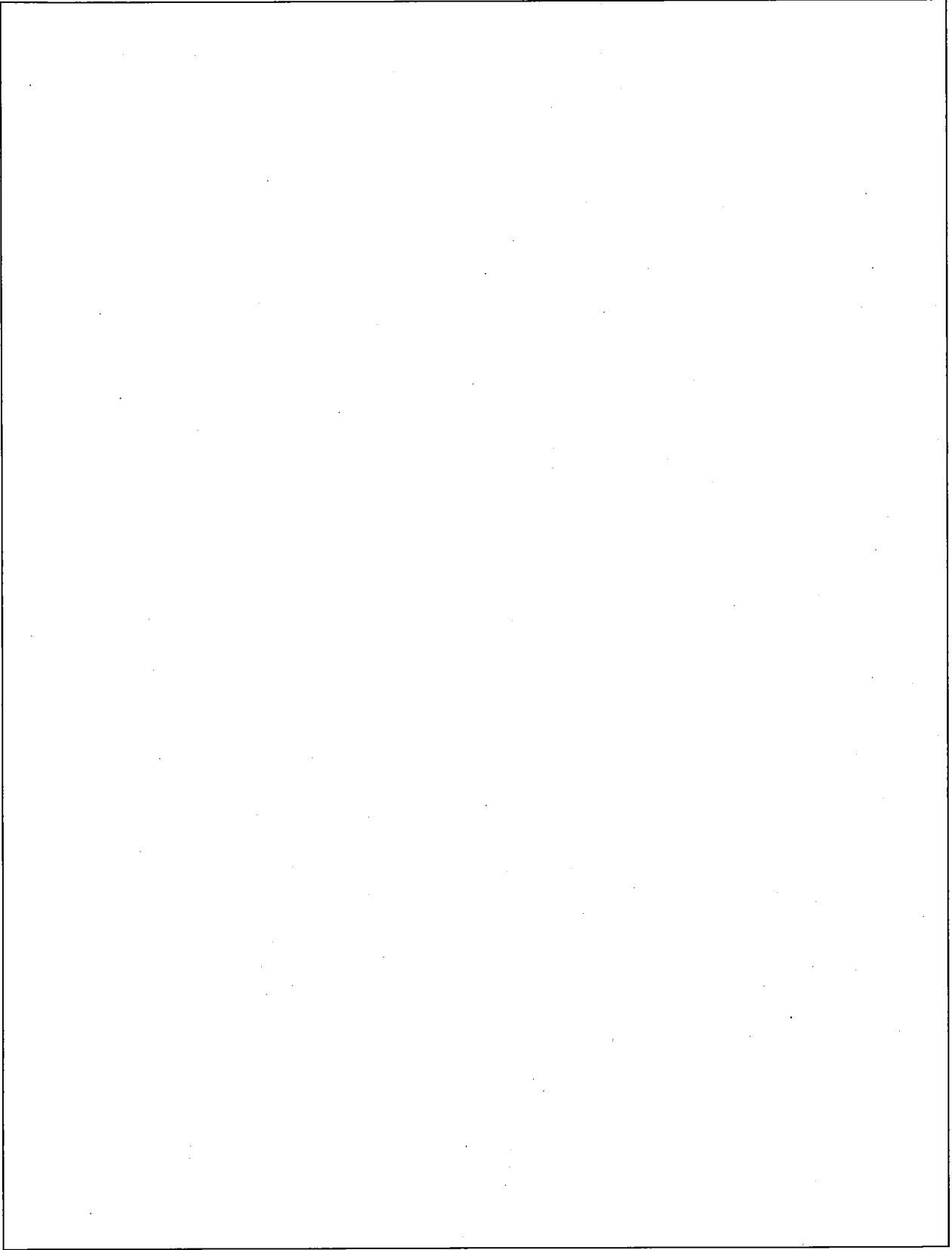
5. 考慮一籃球投射過程。假設籃筐離地 3m 而且直徑為 46cm。一離籃筐中心水平距離 4.6m 的運動員向籃筐投射一 75cm 周長的籃球，而籃球脫離運動員手時離地 2m。若想让籃球在不接觸籃板的條件下穿過籃筐，則最小投射角（即籃球初始速度與地面的夾角）為多少？

Consider the process of a basketball shot. Assume the basketball rim is 3 meters above ground and has a diameter of 46 cm. A player who is 4.6 meters (horizontal distance) away from the center of the rim shoots a basketball of 75 cm in circumference, where the ball is 2 meters above ground when it leaves the hands of the player. What is the minimum shooting angle (i.e. between the initial velocity of the ball and the ground) required to let the ball be shot through the rim without touching the backboard?





補充頁 1



補充頁 2

