

2019 年 澳門中學物理競賽

Concurso de Física para Alunos do Ensino Secundário de Macau 2019

初級組

Elementar

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。

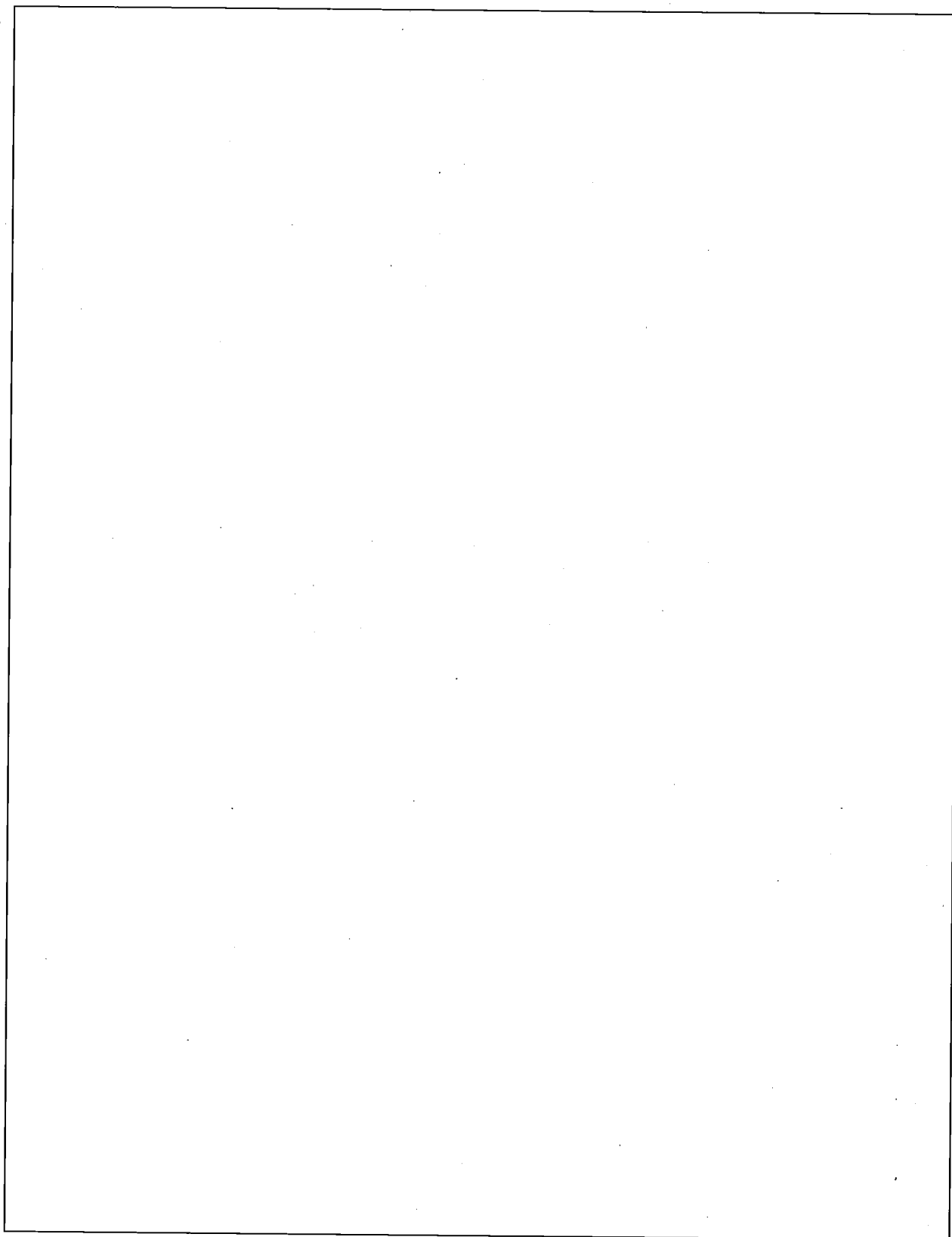
第一部分：概念題

1. 在電學中，電子沿著電線移動的模型是過度簡化及錯誤地表示電流的複雜性質，試解釋。

Explain how the model of electricity as electrons moving along a wire is an oversimplification and it misrepresents the complex nature of an electric current.

2. 太陽系原子模型的主要缺陷是什麼？

What is the main drawback of the solar system model of the atom?



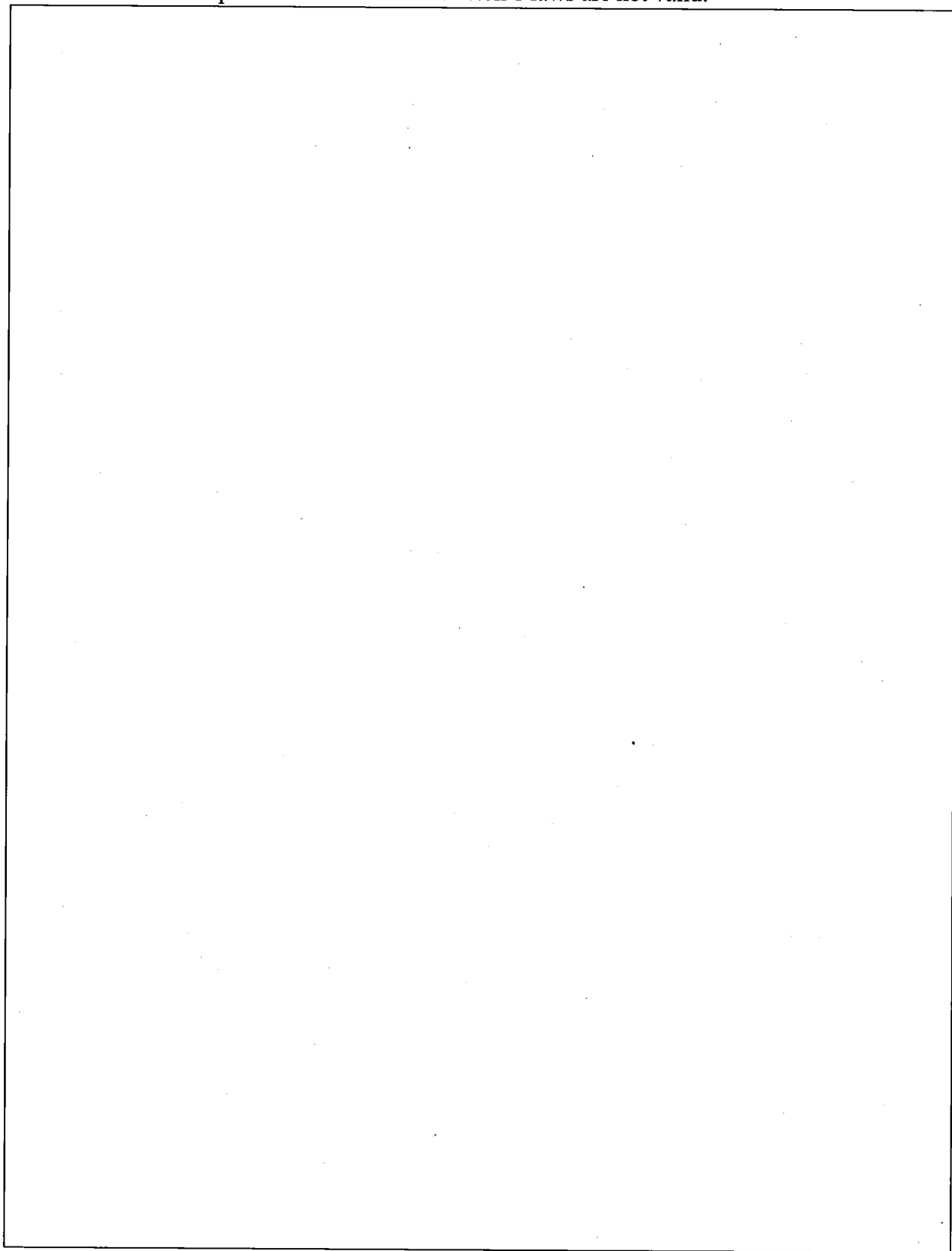
3. 什麼是溫度？什麼是熱量？

What is temperature? What is heat?

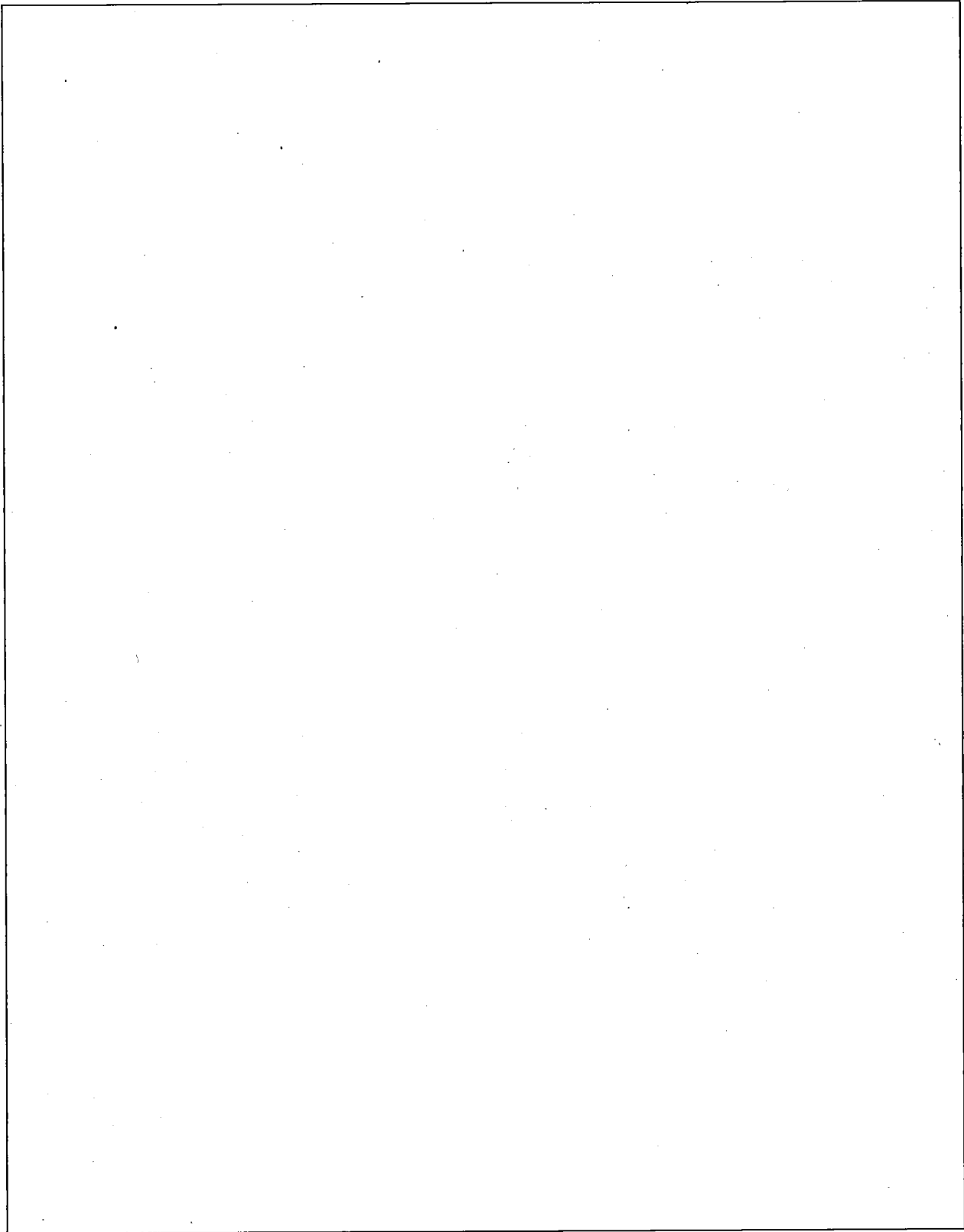
A large empty rectangular box with a thin black border, intended for the student to write their answer to the question above.

4. 試舉出一個牛頓定律為無效的例子。

Give an example for the case when Newton's laws are not valid.



5. 電磁波的範圍從長波到伽馬射線。試討論不同波段的電磁波的相似性和差異性。
The spectrum of electromagnetic (EM) waves ranges from long waves to gamma rays.
Discuss the similarities and differences within the wide range of EM waves.

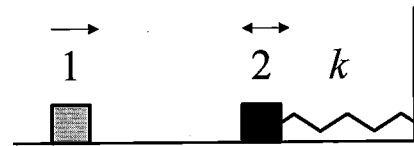


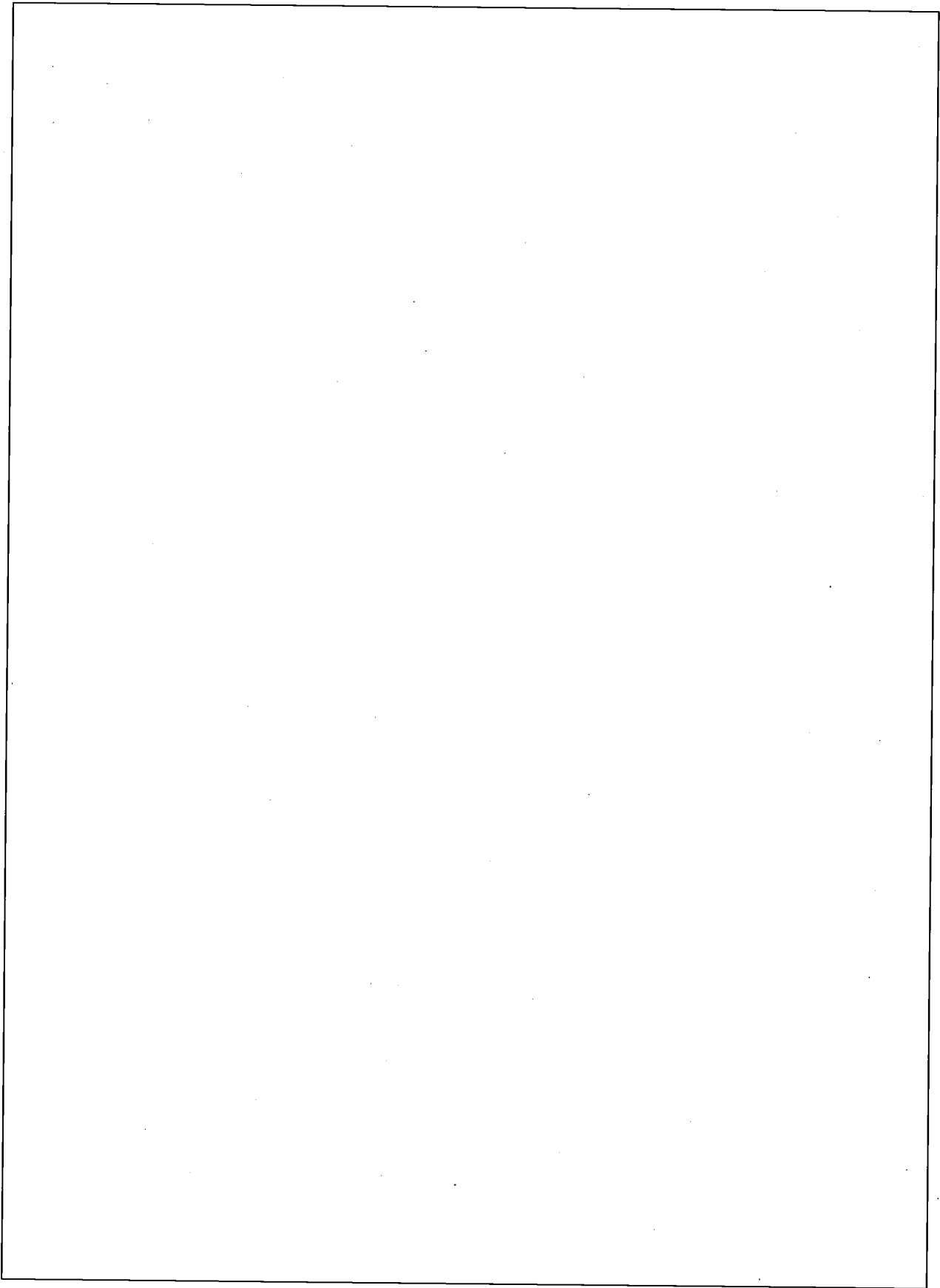
第二部分：計算題

1. 質量為 2.0 kg 的木塊二在彈簧末端作簡諧振動，週期為 15 ms。該木塊的位移方程為： $x = (2 \text{ cm})\cos(\omega t + \pi)$ 。質量為 4.0 kg 的木塊一以 6.0 m/s 的速度滑向木塊二。這兩個木塊在 $t = 10 \text{ ms}$ 時作完全非彈性碰撞（碰撞的時間遠小於振動周期）。碰撞後的速度是多少？它們粘在一起後新的振動週期是多少？

Block 2 of mass 2.0 kg oscillates on the end of a spring in Simple Harmonic Motion with a period of 15 ms. The block's position is given by $x = (2 \text{ cm})\cos(\omega t + \pi)$. Block 1 of mass 4.0 kg slides toward block 2 with velocity of magnitude 6.0 m/s. The two blocks undergo a completely inelastic collision at $t = 10 \text{ ms}$.

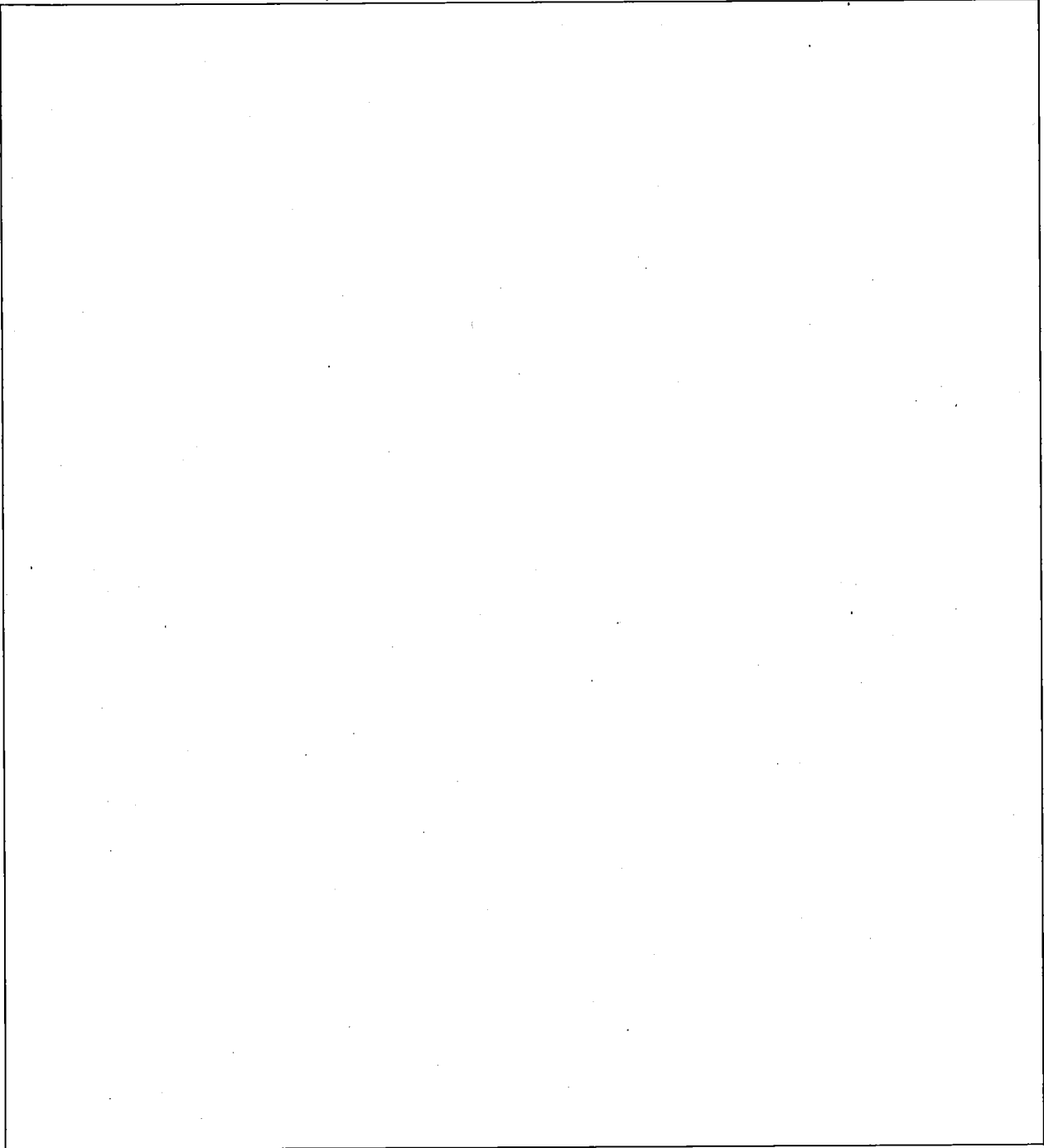
(The duration of the collision is much less than the period of motion.) What is the velocity just after the collision? What is new period for oscillation after they stick together?

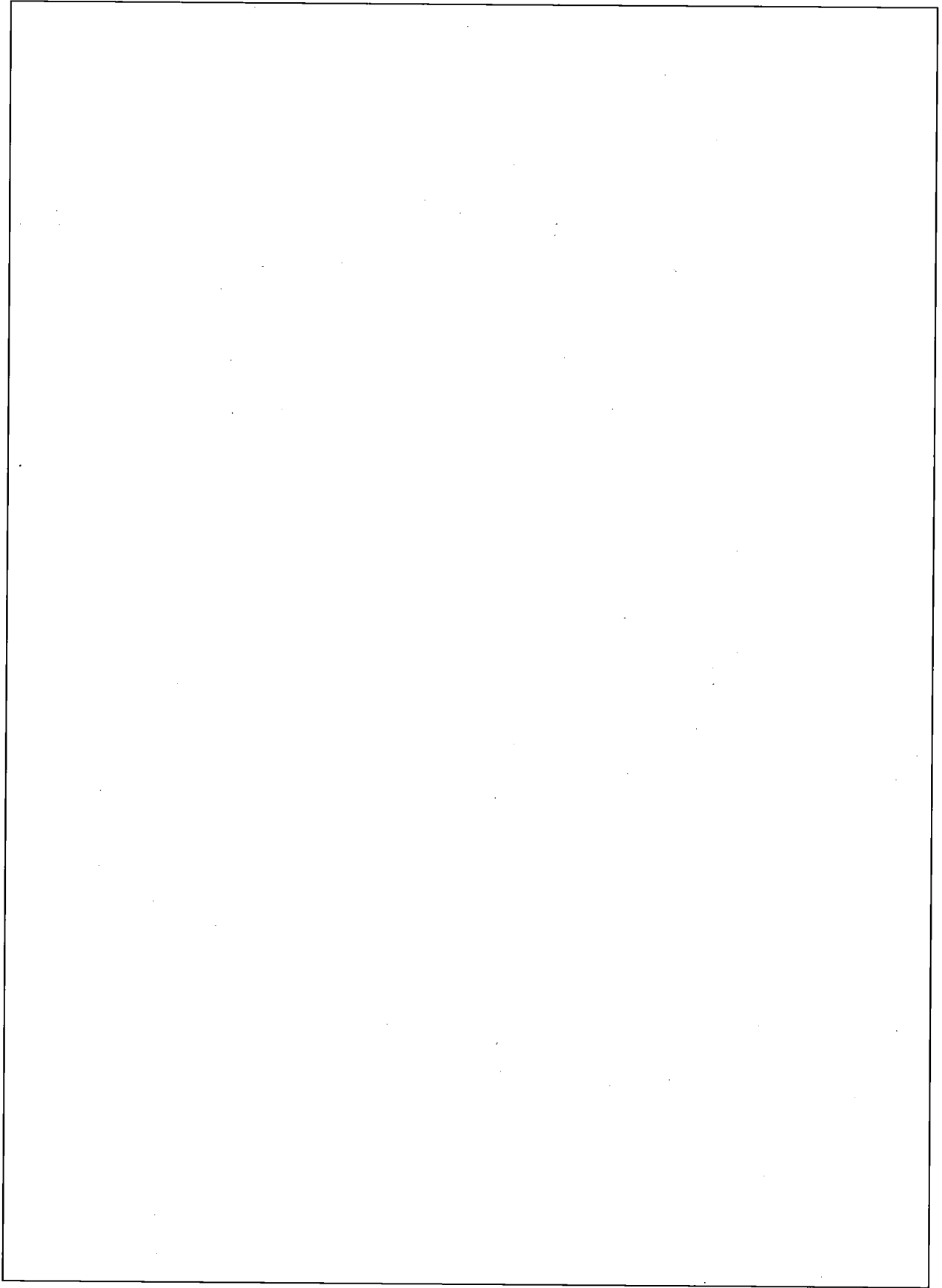




2. (a) 設地球表面的電場強度約為 200 V/m，方向指向地球中心。求所帶的電量。(b) 在離地面 2000 m 處，電場強度降為 10 V/m。方向仍指向地球中心。試計算在離地面 2000 m 以下大氣層裡的平均電荷密度。 $(\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2)$

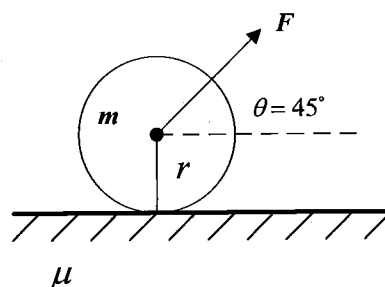
(a) Assume the electric field is 200 V/m near the earth surface ($r \approx$ radius of earth = $6.37 \times 10^6 \text{ m}$) and directs to center of earth. Find the amount of charges. (b) Electric field decreases to 10 V/m if the height is at 2000 m above earth surface. Direction still points to center of earth. Find the charge density of atmosphere below the height of 2000 m. ($\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$)

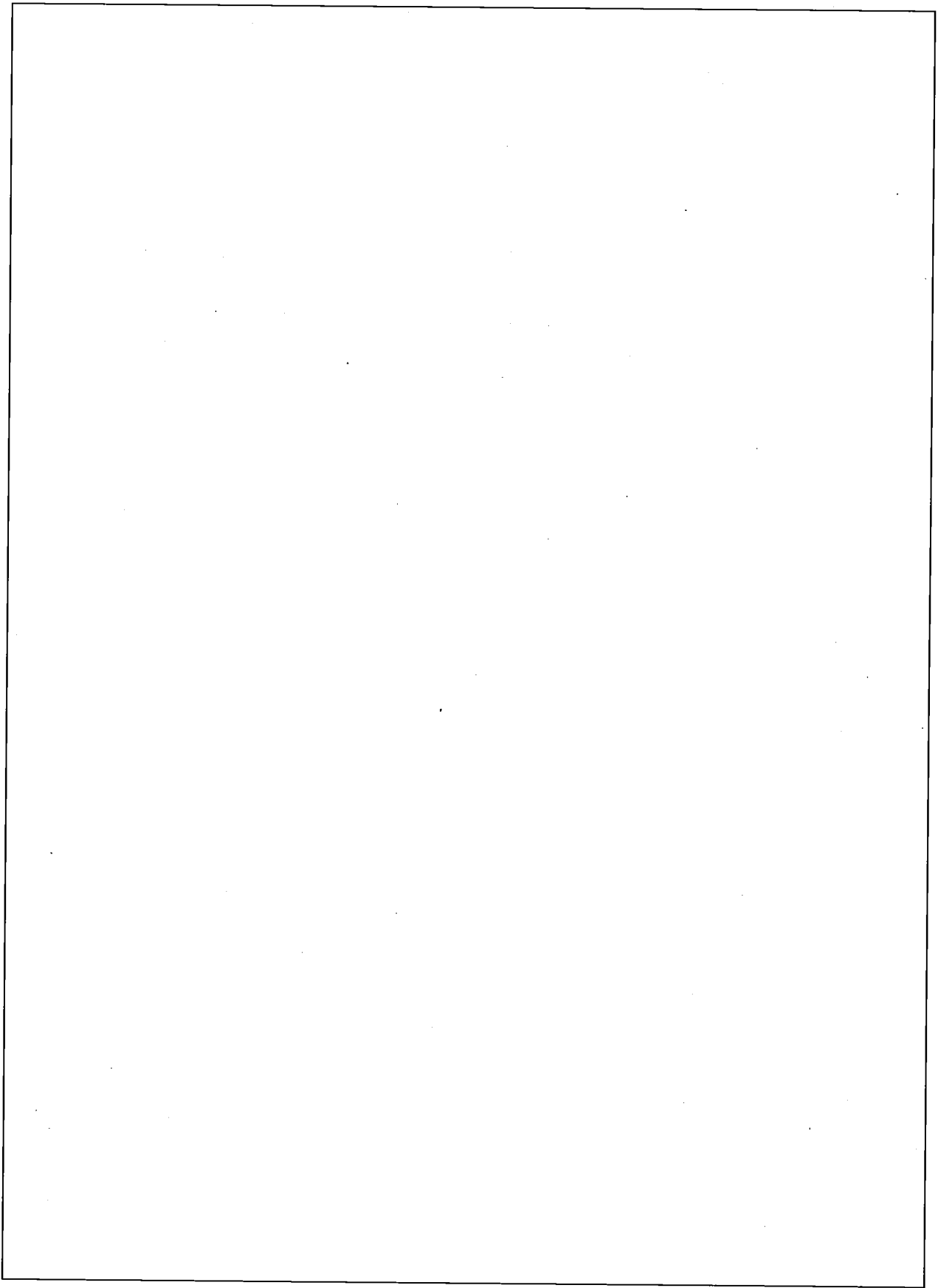




3. 如圖所示，一質量為 m 、半徑為 r 的圓盤沿著水平地板被一個力 \vec{F} 拉動，該力與水平面成角度 $\theta = 45^\circ$ ，圓盤和地板之間的摩擦係數是 μ ，計算 (a) 圓盤的加速度；(b) 圓盤的角加速度和 (c) 滾動而不滑動時的最小摩擦係數 μ 。（圓盤的轉動慣量為 $\frac{1}{2}mr^2$ ）

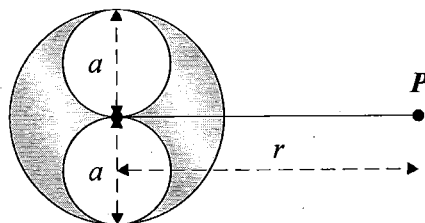
A disk of mass m and radius r is pulled along a horizontal floor by a force \vec{F} that makes an angle $\theta = 45^\circ$ with the horizontal as shown in the figure. The coefficient of friction between the disk and floor is μ . Calculate (a) the acceleration of the disk, (b) the angular acceleration of the disk, and (c) the minimum coefficient of friction μ that is needed to roll without slipping. (moment of inertia of disk is $\frac{1}{2}mr^2$)

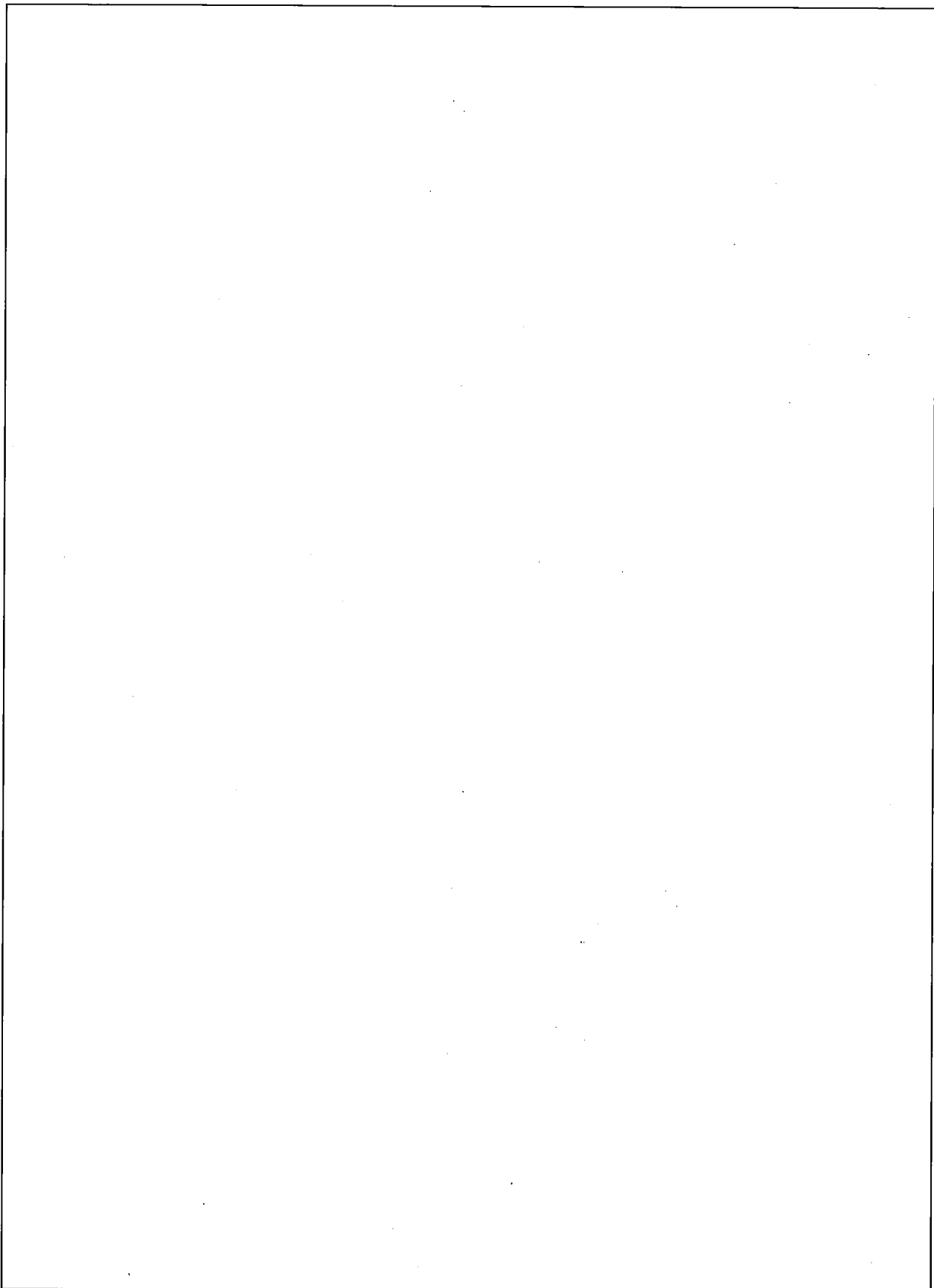




4. 如圖所示，一半徑為 a 的長圓柱形導體在其整個長度上具有兩個直徑為 a 的圓柱形腔。電流 I 的方向為指出頁面；並且通過導體橫截面的電流密度是均勻的。 P 點的磁場強度是多少？ ($\mu_0 = 4\pi \times 10^{-7} \text{ T}\cdot\text{m/A}$)

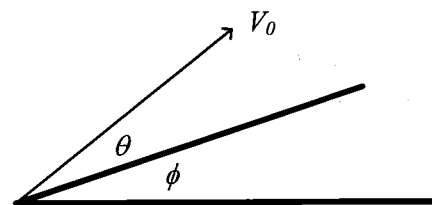
A long cylindrical conductor of radius a has two cylindrical cavities of diameter a through its entire length as shown in figure. A current I is directed out of the page and current density is uniform through a cross section of the conductor. What is the magnitude of the magnetic field at point P ? ($\mu_0 = 4\pi \times 10^{-7} \text{ T}\cdot\text{m/A}$)

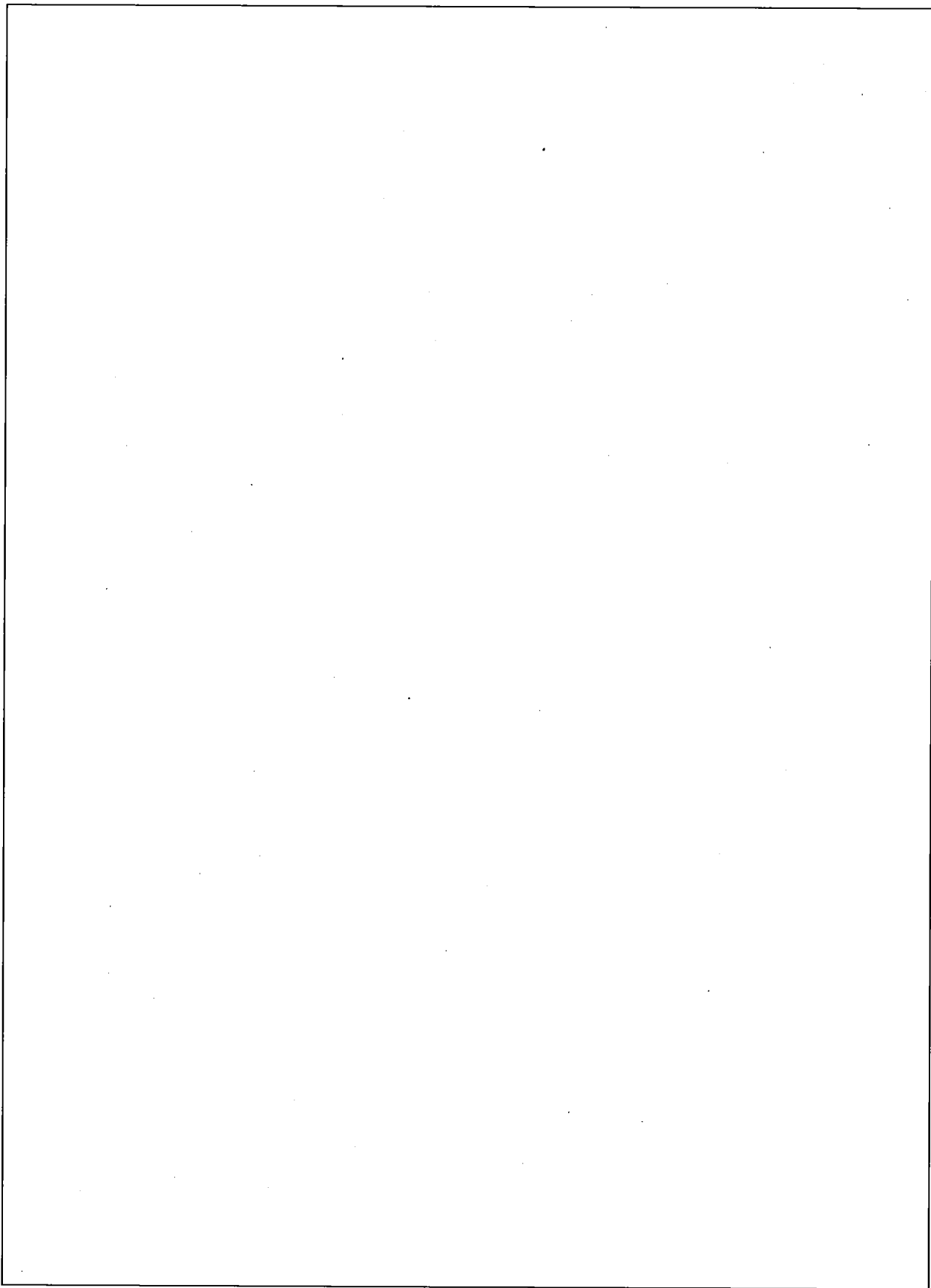




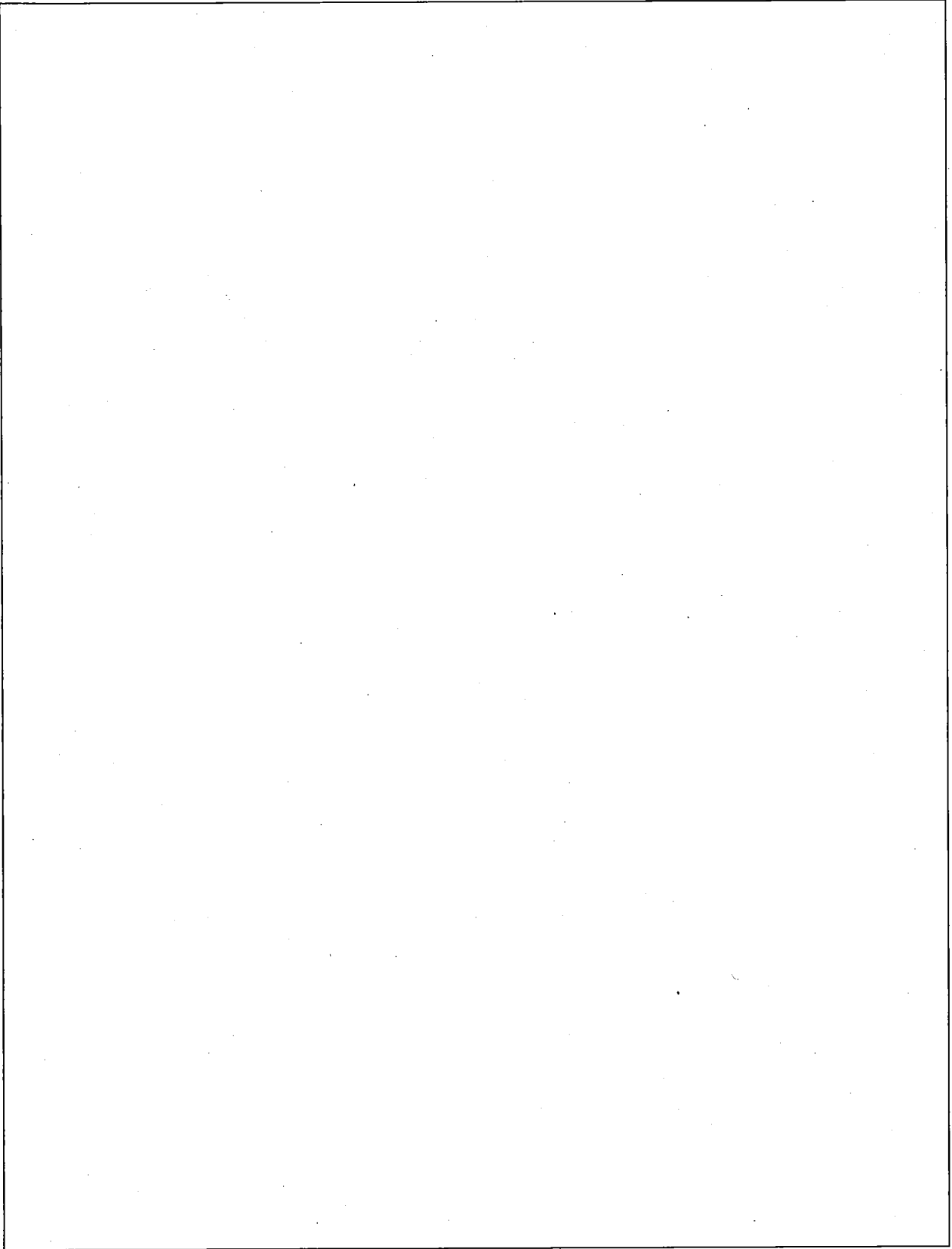
5. (a) 拋射物的初始速度 V_0 ，其相對於水平面成角度 θ ，表明當 $\theta = 45^\circ$ 時，範圍 R 為最大值。(b) 如果表面不是水平的（如圖所示），其具有角度 ϕ 的斜度。用 V_0 、 g 、 ϕ 及 θ ，找出水平位移表示式。

(a) A projectile is thrown with an initial speed V_0 at an angle of θ with respect to a horizontal surface, show that the range R is maximum for $\theta = 45^\circ$. (b) If the surface is not horizontal (see figure) but has a slope of angle ϕ . Find horizontal displacement in terms of V_0 , g , ϕ , θ .





補充頁 1



補充頁 2

