

1. Biot-Savart 定律描述當某一小段導線 $d\vec{s}$ 上有電流 i 通過時，與 $d\vec{s}$ 距離

\vec{r} 處的磁場 $d\vec{B}$ 之大小與方向。其關係式為：
$$d\vec{B} = \frac{\mu_0 i}{4\pi} \cdot \frac{d\vec{s} \times \vec{r}}{r^3}。$$

- (1) 請詳細敘述上述關係式中的 $d\vec{s}$ 與 \vec{r} 兩向量之方向如何定義。
- (2) 如圖一所示，電流 i 通過一無限長的導線，請利用 Biot-Savart 定律計算 P 點之磁場大小與方向。(10%)

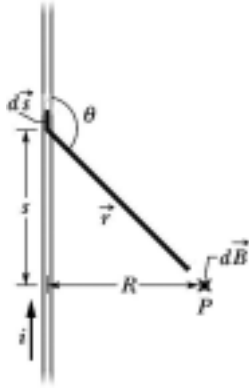


圖 1

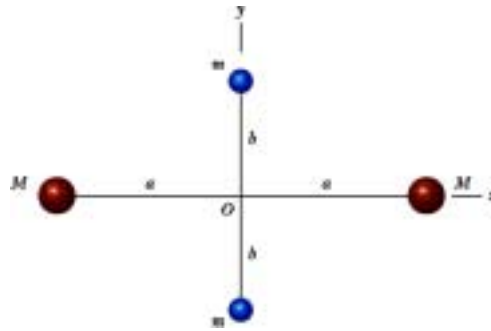


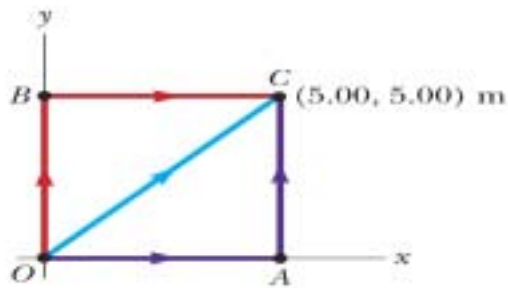
圖 2

2. 如圖二所示，假設由四個小球構成的系統被固定在 xy 平面上， z 軸垂直 xy 平面的質量不計。
 - (a) 如果系統的轉動軸為 y 軸，角速率為 ω ，請問系統的轉動慣量 I_y 為多少？轉動動能為多少？
 - (b) 如果系統的轉動軸為 z 軸，角速率為 ω ，請問系統的轉動慣量 I_z 為多少？轉動動能為多少？
 - (c) 請畫圖說明什麼是「平行軸」定理(parallel axis theorem)？ ($I = I_{com} + Mh^2$)

如果現在這個四個小球的系統以一個垂直 xy 平面、並通過 $(x, y) = (\sqrt{7}a, \sqrt{3}b)$ 的軸心轉動。請問此時系統的轉動慣量為多少？(20%)

3. When a certain spring is stretched beyond its proportional limit, the restoring force of the spring satisfies the equation $F = -kx + \beta x^3$, If $k = 10.0 \text{ N/m}$ and $\beta = 100 \text{ N/m}^3$, calculate the work done by this force when the spring is stretched 0.100m. (10%)
4. 一作用力 $\vec{F} = (2y\hat{i} + x^2\hat{j})\text{N}$ 作用於質點沿 X-Y 平面移動，這裡 X 和 Y 是以米 (m) 為單位，計算作用力沿以下路徑由原點到座標 $x = 5.00\text{m}$ 和 $y = 5.00\text{m}$ ，

(a) OAC (b) OBC (c) OC, 並分析 \vec{F} 是否為保守力, 解釋之(20%).



5. (a) Find the capacitance for a solid conducting sphere of radius R . (Hint: the second conductor can be considered as being located at infinity.) (b) Find the capacitance of the earth, which is a good conductor and of radius 6.38×10^6 m, from the previous result.(20%)
6. A solenoid is designed to produce a magnetic field of $0.19T$ at its center. Its radius is $3.00cm$, length is 80.0 cm, and the wire can carry a maximum current of $10.0A$. (a) What is the minimum number of turns per unit length the solenoid must have? (b) What total length of wire is required?(20%)