No.: Date:

第二十三章：电流与磁场（2003年－2017年）

选择题

① $B_a = B_b$

$\frac{\mu_0 I_a}{2\pi r_a} = \frac{\mu_0 I_b}{2\pi r_b}$

$\frac{4}{r_a} = \frac{1}{r_b}$

$\frac{4}{a} = \frac{1}{b}$

$\frac{4}{15-b} = \frac{1}{b}$

$4b = 15 + b$

$b = 5\,cm$ ①

$a + b = 15 + 2b$

$a = 15 + b$ ②

把①带入②

$a = 15 + 5$

$= 20\,cm$

C

② $mg = BIl$

$13 \div 1000 \times 9.8 = 0.44 \times I \times 0.62$

$I = 0.467\,A$

D

③ D （电子运动的方向和磁场方向相同）

④ A

⑤ A

⑥ $\frac{B q_n v_n}{B q_\alpha v_\alpha} = \frac{\frac{m_n v_n^2}{r_n}}{\frac{m_\alpha v_\alpha^2}{r_\alpha}}$

$\frac{1}{2} = \frac{m_n}{m_\alpha} \times \frac{v_n}{v_\alpha} \times \frac{r_\alpha}{r_n}$

$\frac{1}{2} = \frac{1}{4} \times \frac{\sqrt{2}}{1} \times \frac{r_\alpha}{r_n}$

$\frac{r_\alpha}{r_n} = \frac{2}{\sqrt{2}}$

$\frac{r_n}{r_\alpha} = \frac{1}{\sqrt{2}}$

A

⑦ B

⑧ A

⑨ $\Phi = BA\cos\theta$

$= 2 \times 0.2 \times 0.1 \times \cos 30$

$= 0.035\,Wb$

B

⑩ $F = Bqv$

$= 2.5 \times 10^{-4} \times e \times \frac{9.1 \times 10^{-25}}{m_e}$

$= 4 \times 10^{-17}\,N$

C

作答题

① (a) $qV = \frac{1}{2}mv^2$

$e \times 1.5 \times 10^3 = \frac{1}{2} m_e \times v^2$

$v = 2.3 \times 10^7\,ms^{-1}$

(b) $v = \frac{s}{t}$

$2.3 \times 10^7 = \frac{0.04}{t}$

$t = 1.74 \times 10^{-9}\,s$

(c) $E = \frac{V}{d}$

$= \frac{50}{0.01}$

$= 5000\,Vm^{-1}$

(d) $E = \frac{F}{q}$

$E = \frac{ma}{q}$

$5000 = \frac{m_e a}{e}$

$a = 8.79 \times 10^{14}\,ms^{-2}$

(f) $F = Bqv$

$ma = Bqv$

$m_e \times 8.79 \times 10^{14} = B e \times 2.3 \times 10^7$

$B = 2.17 \times 10^{-4}\,T$

（方向为垂直纸面向里）

② (a) $\frac{1}{2}mv^2 = qV$

$v = \sqrt{\frac{2qV}{m}}$

$Bqv = \frac{mv^2}{r}$

$Bq = \frac{m}{r}\sqrt{\frac{2qV}{m}}$

$B^2q^2 = \frac{m^2}{r^2} \times \frac{2qV}{m}$

$m = \frac{B^2qr^2}{2V}$

$= \frac{qB^2(\frac{x}{2})^2}{2V}$

$= \frac{qB^2x^2}{8V}$ #

(b) H^+: $m = \frac{qB^2x^2}{8V}$

$1 = \frac{qB^2x^2}{8V}$

$x = \sqrt{\frac{8V}{qB^2}}$

D^+: $m = \frac{qB^2x^2}{8V}$

$2 = \frac{qB^2x^2}{8V}$

$x = \sqrt{\frac{2\times 8V}{qB^2}}$

T^+: $m = \frac{qB^2x^2}{8V}$

$3 = \frac{qB^2x^2}{8V}$

$x = \sqrt{\frac{3\times 8V}{qB^2}}$

$H^+ : D^+ : T^+ = 1 : \sqrt{2} : \sqrt{3}$ #

(c) $m = \frac{qB^2x^2}{8V}$

$\frac{q}{m} = \frac{8V}{B^2x^2}$

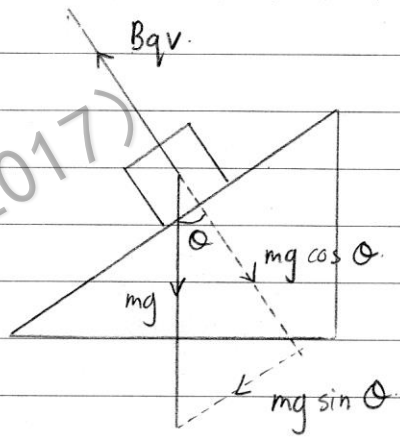
$1.75\times10^{11} = \frac{8\times150}{0.8^2\times x^2}$

$x = 1.035\times10^{-4}\,m$

$r = 1.035\times10^{-4}\,m \div 2$

$= 5.18\times10^{-5}\,m$ #

③



(a) $a = g\sin\theta$ #

(b) 垂直斜面向上。

$Bqv = mg\cos\theta$

$v = \frac{mg\cos\theta}{Bq}$ #

(c) $u = 0$

$a = g\sin\theta$

$s = ?$

$v = \frac{mg\cos\theta}{Bq}$

$v^2 = u^2 + 2as$

$\frac{m^2g^2\cos^2\theta}{B^2q^2} = 0 + 2\times g\sin\theta\, s$

$s = \frac{m^2g}{2B^2q^2} \times \frac{\cos^2\theta}{\sin\theta}$ #

(d) $a = g\sin\theta$

$= 9.8\sin30°$

$= 4.9\ ms^{-2}$ #

$v = \frac{mg\cos\theta}{Bq}$

$= \frac{0.02\times9.8\times\cos30}{4\times1\times10^{-2}}$

$= 4.24\ ms^{-1}$ #

$s = \frac{m^2g}{2B^2q^2} \times \frac{\cos^2\theta}{\sin\theta}$

$= \frac{0.02^2\times9.8}{2\times4^2\times(1\times10^{-2})^2} \times \frac{\cos^230}{\sin30}$

$= 1.84\,m$ #

④ (i) $B = \frac{\mu_0 I}{2\pi r}$

$= \frac{\mu_0 \times 6}{2\pi \times 0.18}$

$= 6.67 \times 10^{-6} T$ #

(ii) $F = BIL$

$= 6.67 \times 10^{-6} \times 3 \times 0.3$

$= 6 \times 10^{-6} N$ #

(ii) $F = Bqv$

$= 0.8 \times 2.5 \times 10^{-6} \times 20$

$= 4 \times 10^{-5} N$ #

(方向与 u 垂直).

⑤, ⑥, ⑦, ⑧ 看后方

⑨ (a) 竖直方向

$u = 20 \sin 60$

$a = -9.8$

$s = 0$

$t = ?$

$s = ut + \frac{1}{2}at^2$

$0 = 20 \sin 60 t + \frac{1}{2} \times -10 t^2$

$t = 3.46 s$ #

(b) $E = \frac{F}{q}$

$E = \frac{ma}{q}$

$16 = \frac{5 \times 10^{-6} a}{2.5 \times 10^{-6}}$

$a = 8 ms^{-2}$

$u = 20 \cos 60$

$a = 8$

$t = 3.46$

$s = ?$

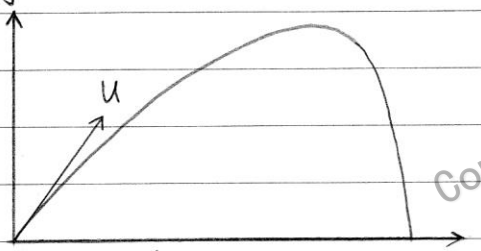
$s = ut + \frac{1}{2}at^2$

$= 20 \cos 60 \times 3.46$

$+ \frac{1}{2} \times 8 \times 3.46^2$

$= 82.5 m$ #

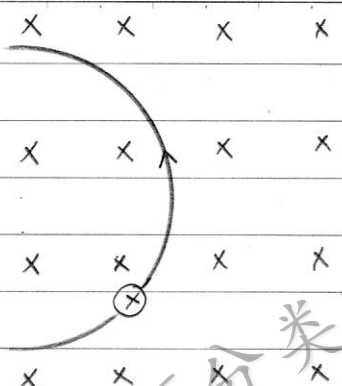
(c)(i)



质点会再通过 x-轴的另一点，因质点所所受净力不与 u 垂直，且向下的分力越来越大，质点不做圆周运动，其可能轨迹如图。

No.: Date:

⑤ (a)



(b) $Bqv = \frac{mv^2}{r}$

$r = \frac{mv}{Bq}$

$= \frac{6.64\times10^{-27}\times5500}{0.001\times2e}$

$= 0.11\ m$ #

(c) 因为洛仑兹力一直垂直作用在粒子上，对粒子没有作功，因此此力没有改变粒子的速率。

(d) $T = \frac{2\pi}{\omega}$

$= \frac{2\pi r}{v}$

$= \frac{2\pi\times0.11}{5500}$

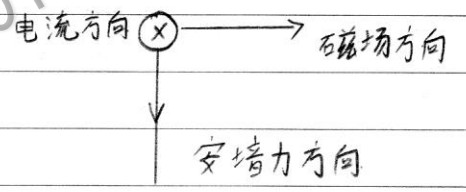
$= 1.3\times10^{-4}\ s$

$t = 1.3\times10^{-4}\div2$

$= 6.5\times10^{-5}\ s$ #

(e) 由于 β 粒子带负电，因此它所受到的洛仑兹力的方向与 α 粒子相反，即 β 粒子是顺时针方向运动，且 β 粒子的质荷比小于 α 粒子的质荷比，造成它的轨道半径也比较小。

⑥ (i) P 极 = S 极



(ii) $F = BIl$

$mg = BIl$

$2.3\div1000\times9.8 = B\times2.6\times0.044$

$B = 0.197\ T$ #

⑦ (i) $F = Bqv$

$qE = Bqv$

$10^6 = 0.5v$

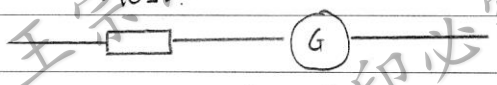
$v = 2\times10^6\ ms^{-1}$ #

(ii) $Bqv = \frac{mv^2}{r}$

$6\times1.6\times10^{-19} = \frac{6.7\times10^{-27}\times2\times10^6}{r}$

$r = 0.014\ m$ #

⑧



$V = I(R+r)$

$2 = 5\times10^{-3}(R+10)$

$R = 390\ \Omega$ (串联).