Homework Week 2

113-2 General Physics II

Due before 4:10 PM on March 03, 2025

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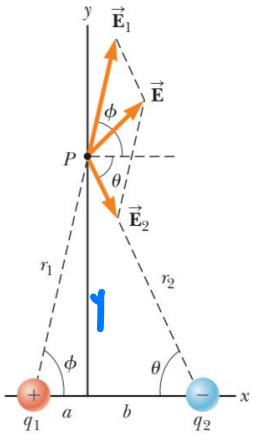
1. [20 points] Please describe your motivations for taking this course or enrolling in the B.S. program in Electrophysics. (Optional) Provide a brief self-introduction, including your major and year of study, or your background. Share your current and future aspirations. (within 200 words, in either English or Chinese)

   此題可留白，無論是否作答都給分，但禁止使用生成式 AI 工具

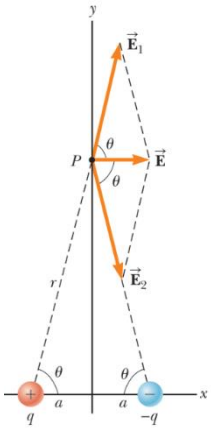
2. [30 points] **Example 22.6**

   Charges q1 and q2 are located on the x axis, at distances a and b, respectively, from the origin as shown in Figure 22.13. (A) Find the components of the net electric field at the point P, which is at position (0, y). [10 points] (B) Evaluate the electric field at point P in the special case that |q1|=|q2| and a=b. [10 points] (C) Find the electric field due to the electric dipole when point P is a distance y>>a from the origin. [10 points]

(A)



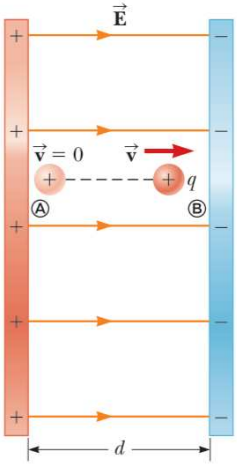
(B)



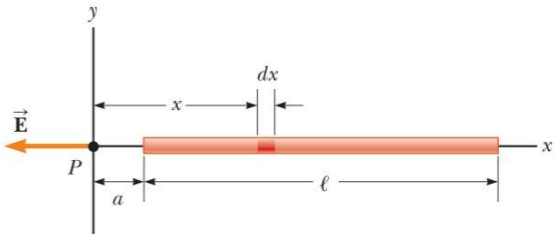
3. [20 points] **Example 22.7**

A uniform electric field **E** is directed along the x axis between parallel plates of charge separated by a distance d as shown in Figure 22.20. A positive point charge q of mass m is released from rest at a point Ⓐ next to the positive plate and accelerates to a point Ⓑ next to the negative plate. (A) Find the speed of the particle at Ⓑ by modeling it as a particle under constant acceleration. [10 points] (B) Find the speed of the particle at Ⓑ by modeling it as a nonisolated system in terms of energy. [10

points]



Example 22.7



Example 23.1

4. [10 points] **Example 23.1**

A rod of length l has a uniform positive charge per unit length λ and a total charge Q. Calculate the electric field at a point P that is located along the long axis of the rod and a distance a from one end (Fig. 23.2).

6. [20 points] 嘗試問一個生活中跟物理有關的問題。比如: 庫侖力的形式與牛頓重力相似，電荷有正負之分，質量有正負之分嗎，有的話會發生什麼事?

有問就給分

勇敢地提出笨的問題，有一天就會問到對的問題

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2. (A)

1°

$$\begin{cases} E_{1x} = \dfrac{kq_1}{a^2+y^2}\dfrac{a}{\sqrt{a^2+y^2}} \\ E_{1y} = \dfrac{kq_1}{a^2+y^2}\dfrac{y}{\sqrt{a^2+y^2}} \end{cases}$$ ✓

$$\begin{cases} E_{2x} = \dfrac{kq_2}{b^2+y^2}\dfrac{b}{\sqrt{b^2+y^2}} \\ E_{2x} = \dfrac{kq_2}{b^2+y^2}\dfrac{y}{\sqrt{b^2+y^2}} \end{cases}$$ ✓

2° $\vec{E} = \vec{E_1} + \vec{E_2}$

$$\begin{cases} E_x = E_{1x} + E_{2x} = \left[\dfrac{aq_1}{(a^2+y^2)^{\frac{3}{2}}} + \dfrac{bq_2}{(b^2+y^2)^{\frac{3}{2}}}\right]k \\ E_y = E_{1y} - E_{2y} = \left[\dfrac{q_1}{(a^2+y^2)^{\frac{3}{2}}} - \dfrac{q_2}{(b^2+y^2)^{\frac{3}{2}}}\right]ky \end{cases}$$ ✓

✓ *

(B)

From (A), substitute $b = a$,

$q_1 = q_2 = q$ into E_x,

we get

$$E = \frac{2aqk}{(a^2+y^2)^{\frac{3}{2}}}$$

✓

(C) From (B), $\frac{1}{(a^2+y^2)^{\frac{3}{2}}} \approx \frac{1}{a^3}$

$y \gg a$

as ~~$a \gg y$~~, we get

$$E = \frac{2aqk}{a^2}$$

是 $y \gg a$

✗

$$\frac{2aqk}{y^3}$$

3. (A)

1' $F = qE = ma \Rightarrow a = \frac{qE}{m}$

2' $v^2 = u^2 + 2aS$

$= 0^2 + 2ad$

$= \frac{2dqE}{m}$

$\Rightarrow v = \sqrt{\frac{2dqE}{m}}$ F

(B) work done → kinetic energy

$W = \Delta E_k$

$$FS = \frac{1}{2}mv^2 - 0$$

$$\Rightarrow (qE)\,d = \frac{1}{2}mv^2$$

$$\Rightarrow v = \sqrt{\frac{2dqE}{m}}$$

E ✓

4.

1° $dE = \frac{1}{4\pi\varepsilon_0}\frac{dq}{r^2}$

$= \frac{1}{4\pi\varepsilon_0}\frac{\lambda dx}{r^2}$ ← $dq = \lambda dx$

2° $E = \frac{1}{4\pi\varepsilon_0}\int_0^l \frac{\lambda dx}{(a+x)^2}$ λ?

$= \frac{\lambda}{4\pi\varepsilon_0}\left[-\frac{1}{a+x}\right]_0^l$

$$= \frac{\lambda}{4\pi\varepsilon_0}\left(\frac{1}{a} - \frac{1}{a+l}\right) \quad \#$$

6. Currents create magnetic fields. Do moving masses create similar effects?