Homework Week 13

113-2 General Physics II

Due before 4:10 PM on May 19, 2025

Name 110033056 資科四 徐宏宇

勇敢地提出

笨的問題，　　有一天就會

問到對的問題

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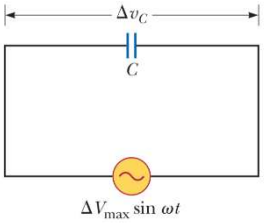
1. [15 points] **Example 33.1 Displacement Current in a Capacitor**

A sinusoidally varying voltage is applied across a capacitor. The capacitance is $C = 8.00\,\mu F$, the frequency of the applied voltage is $f = 3.00\,kHz$, and the voltage amplitude is $\Delta V_{max} = 30.0\,V$. Find the displacement current in the capacitor.



2. [15 points] **Maxwell's Equations and Lorentz Force Law**

Write down the Maxwell's Equations and the Lorentz Force Law.

3. [5 points] Express the speed of light c in μ_0 and ϵ_0.

4. [15 points] **Example 33.3 Fields on the Page**

Estimate the maximum magnitudes of the electric and magnetic fields of the light that is incident on this page because of the visible light coming from your 60 W incandescent desk lamp. Treat the lightbulb as a point source of electromagnetic radiation that is 5% efficient at transforming energy coming in by electrical transmission to energy leaving by visible light (95% energy to thermal conduction and invisible radiation). The distance between the lamp and this page is 0.3 m.
Constant: μ_0

5. [15 points] **Example 33.5**

When giving presentations, many people use a laser pointer to direct the attention of the audience to information on a screen. If a 3.0-mW pointer creates a spot on a screen that is 2.0 mm in diameter, determine the radiation pressure on a screen that reflects 70% of the light that strikes it. The power 3.0 mW is a time-averaged value.

6. [5 points] According to our course schedule, what topics will be covered in the next lecture? _____.

7. [30 points] (A) 嘗試問一個生活中跟物理有關的問題。[10 points]
(B)列出關鍵字 (用物理思維，把大問題拆解成小問題) 。[10 points]
(C) Google 關鍵字 or 查閱維基有無文章（注意維基不見得正確）。[10points]
螢幕截圖/照相，或是附上出處，線上繳交（如前面手寫，可分開繳交）。

有問就給分，鼓勵同學多方閱讀，自己整理資訊。

範例問題: 如果我們追上一道光，看到什麼景象?
1949 Einstein's "Autobiographical Notes"

截止後，已繳交需要解答的寄信助教: 110104035@nccu.edu.tw

1. $i_d = \frac{dq}{dt}$ $\quad C = \frac{q}{\Delta V}$

$= \frac{dC\Delta V}{dt}$ $\quad \Rightarrow q = C\Delta V$

$= \frac{dC(\Delta V_{max}\sin(\omega t))}{dt}$

$= C\omega\Delta V_{max}\cancel{\sin}\cos\omega t$

$= 2\pi f C \Delta V_{max} \sin(2\pi f t)$

$= 2\pi(3\times10^3)(8\times10^{-6})(30)\sin(2\pi(3\times10^3)t)$

$= 4.52\sin(1.88\times10^4 t)$

2.

Gauss's Law: $\oint \vec{E}\cdot d\vec{A} = \frac{q_{in}}{\varepsilon_0}$

Gauss's Law in Magnetism: $\oint \vec{B}\cdot d\vec{A} = 0$

Faraday's Law: $\oint \vec{E}\cdot d\vec{s} = -\frac{d\Phi_B}{dt}$

Ampere-Maxwell Law: $\oint \vec{B}\cdot d\vec{s} = \mu_0 I +$ ✓ $\mu_0\varepsilon_0\frac{d\Phi_E}{dt}$

Lorentz Force Law: $F = q\vec{E} + q\vec{v}\times\vec{B}$

3. $$C = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$$ ✓

4. $$\text{Intensity} = \frac{P_{avg}}{4\pi r^2} = \frac{E_{max}^2}{2\mu_0 c}$$

$$E_{max} = \sqrt{\frac{\mu_0 c P_{avg}}{2\pi r^2}}$$

$$= \sqrt{\frac{(4\pi \times 10^{-7})(3\times 10^8)(60 \times 5\%)}{2\pi (0.3)^2}}$$

$$= 45 \ (V/m)$$ ✓

$$B_{max} = E_{max} / C$$

$$= 45 / (3\times 10^8)$$

$$= 1.5 \times 10^{-7} \ (T)$$ ✓

5. a) $$S_{avg} = \frac{(\text{Power})_{avg}}{A} = \frac{3\times 10^{-3}}{\pi\left(\frac{2\times 10^{-3}}{2}\right)^2}$$

$$= 955 \ (W/m^2)$$ ✓

2° Pressure $_{avg} = (1+f)\frac{S_{avg}}{c}$

$= (1+0.7)\frac{955}{3\times10^8}$

$= 5.4\times10^{-6}\ (N/m^2)$ #

6. the nature of light and the laws of geometric optics

7. (A) Why do microwave ovens use microwaves instead of other types of EM waves to cook food?

(B) microwave, EM waves, induction heating

(C)

Microwave

83 languages

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From Wikipedia, the free encyclopedia

This article is about the electromagnetic wave. For the cooking appliance, see Microwave oven. For other uses, see Microwaves (disambiguation).

Microwave is a form of electromagnetic radiation with wavelengths shorter than other radio waves but longer than infrared waves. Its wavelength ranges from about one meter to one millimeter, corresponding to frequencies between 300 MHz and 300 GHz, broadly construed.[1][2]:3[3][4][5][6][*excessive citations*] A more common definition in radio-frequency engineering is the range between 1 and 100 GHz (wavelengths between 30 cm and 3 mm),[2]:3 or between 1 and 3000 GHz (30 cm and 0.1 mm).[7][8] The prefix *micro-* in *microwave* is not meant to suggest a wavelength in the micrometer range; rather, it indicates that microwaves are small (having shorter wavelengths), compared to the radio waves used in prior radio technology.

The boundaries between far infrared, terahertz radiation, microwaves, and ultra-high-frequency (UHF) are fairly arbitrary and are used variously between different fields of study. In all cases, microwaves include the entire super high frequency (SHF) band (3 to 30 GHz, or 10 to 1 cm) at minimum. A broader definition includes UHF and extremely high frequency (EHF) (millimeter wave; 30 to 300 GHz) bands as well.

Frequencies in the microwave range are often referred to by their IEEE radar band designations: S, C, X, K_u, K, or K_a band, or by similar NATO or EU designations.

Microwaves travel by line-of-sight; unlike lower frequency radio waves, they do not diffract around hills, follow the Earth's surface as ground waves, or reflect from the

A telecommunications tower with a variety of dish antennas for microwave relay links on Frazier Peak, Ventura County, California. The apertures of the dishes are covered by plastic sheets (radomes) to keep out moisture.