

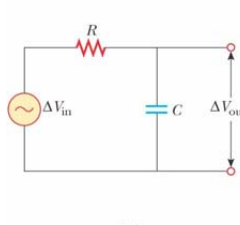
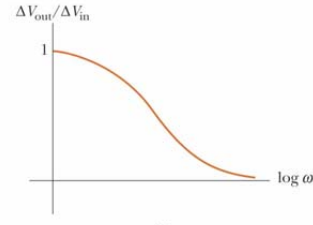


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**General Physics II, Final 2**  
PHYS10400, Class year 102  
06-19-2014

SN: \_\_\_\_\_, Name: \_\_\_\_\_

**Problems (5 Problems, total 100%)**

- Brewster Angle:** (20%) Consider an interface separated by two different media with indexes of refraction  $n_1$  (upper medium) and  $n_2$  (lower medium). A light incident in medium 1 with incidence angle  $\theta_1$ , refracted in medium 2 with refraction angle  $\theta_2$  in medium. (a) At what condition can we observe a Brewster angle? (b) Draw the diagram, (c) Derive the relation of Brewster angle with the indexes of refraction of these two media. (d) If medium 1 is air with index of refraction  $n_1=1$ , what is the best method to determine the index refraction of medium?
- Diffraction Grating:** (20%) For a diffraction grating of  $N$  ruling, with grating spacing  $d$ , incident with light of wavelength  $\lambda$ . What is the half width angle  $\theta_{HW}$  in terms of the parameters given? If the grating is placed at a distance of  $D$  away from the screen (or detector), what is the distance between the center maximum and the first minimum?
- Yang's Interference:** (20%) In a double-slit experiment, the wavelength  $\lambda$  of the light source is 405 nm, the slit separation  $d$  is 19.44  $\mu\text{m}$ , and the slit width  $a$  is 4.050  $\mu\text{m}$ . Consider the interference of the light from the two slits and also the diffraction of the light through each slit. (a) How many bright interference fringes are within the central peak of the diffraction envelope? (10%) (b) How many bright fringes are within either of the first side peaks of the diffraction envelope? (4%) (c) Draw the interference plus the diffraction fringes for the center peak and the two side peaks next to the center peak (6%).
- Low pass filter:** (20 %) Consider the filter circuit shown in the figure below. (a) Show that the ratio of the output voltage to the input voltage is (5 pts)
 
$$\frac{\Delta V_{\text{out}}}{\Delta V_{\text{in}}} = \frac{1/\omega C}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}}$$


 (b) What value does this ratio approach as the frequency decreases toward zero? (5 pts) (c) What value does this ratio approach as the frequency increases without limit? (5 pts) (d) At what frequency is the ratio equal to one half? (5 pts)
- AC Circuit:** (20%) Suppose a simple circuit with a resistor  $R$ , powered by an AC source of  $\Delta V_R = \Delta V_{\text{max}} \sin \omega t$ . What is the rate the energy is delivered to the resistor?