



## Center for Academic Resources in Engineering (CARE) Peer Exam Review Session

Phys 212 — University Physics: Electricity and Magnetism

### Midterm 3 Worksheet

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*The problems in this review are designed to help prepare you for your upcoming exam. Questions pertain to material covered in the course and are intended to reflect the topics likely to appear in the exam. Keep in mind that this worksheet was created by CARE tutors, and while it is thorough, it is not comprehensive. In addition to exam review sessions, CARE also hosts regularly scheduled tutoring hours.*

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Tutors are available to answer questions, review problems, and help you feel prepared for your exam during these times:

Session 1: Apr 22, 5-6:30pm Alex and Charlie      Session 2: Apr 25, 2-3:30pm Javi and Rutvi

Can't make it to a session? Here's our schedule by course:

<https://care.engineering.illinois.edu/tutoring-resources/tutoring-schedule-by-course/>

Solutions will be available on our website after the last review session that we host, as well as posted in the zoom chat 30 minutes prior to the end of the session

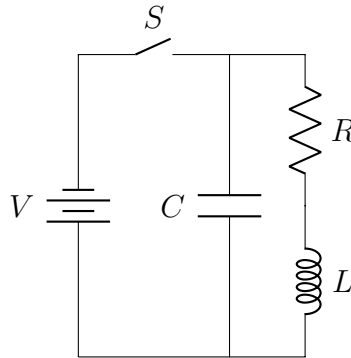
Step-by-step login for exam review session:

1. Log into [Queue @ Illinois](#)
2. Click "New Question"
3. Add your NetID and Name
4. Press "Add to Queue"
5. Join the zoom link in the staff message

**Please do not log into the zoom call without adding yourself to the queue**

Good luck with your exam!

Questions 1 - 4 refer to the following diagram



A circuit is composed of a battery with voltage  $V = 10\text{ V}$ , one resistor  $R = 75\ \Omega$ , a capacitor  $C = 20\text{ pF}$ , an inductor  $L = 20\text{ mH}$  and a switch  $S$ . The switch has been open for a long time; at  $t = 0$ , it is closed.

1. What is the voltage across the capacitor after the switch has been closed for a long time?
  - a)  $10\text{ V}$
  - b)  $0\text{ V}$
  - c)  $15\text{ V}$
  - d)  $7.5\text{ V}$
  
2. What is the charge across the capacitor at this time?
  - a)  $20\text{ pC}$
  - b)  $0\text{ C}$
  - c)  $0.2\text{ nC}$
  - d)  $2\text{ nC}$

3. What is the voltage across  $R$  after the switch has been closed for a long time?
- a) 7.5 V
  - b) 10 V
  - c) 0 V
  - d) 5 V
4. If the switch is now reopened after a long period of time, what will the initial current going through  $R$  be?
- a) 0.133 A
  - b) 0 A
  - c) 0.5 A
  - d) 0.167 A

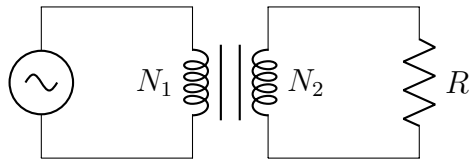
*Questions 5 - 8 refer to the following situation*

The electric field for a plane electromagnetic wave in a vacuum is given by

$$\vec{E} = 2100 \sin(\omega t + 0.8y) \hat{x}$$

5. What is the frequency of the wave?
6. What is the magnitude of the magnetic field?
7. What is the direction of the poynting vector?
- a)  $\hat{y}$
  - b)  $-\hat{y}$
  - c)  $-\hat{z}$
  - d)  $\hat{z}$
8. What is the direction of  $\vec{B}$ ?
- a)  $\hat{y}$
  - b)  $-\hat{y}$
  - c)  $-\hat{z}$
  - d)  $\boxed{\hat{z}}$

Questions 9 - 10 refer to the following diagram



An ideal transformer has  $N_1 = 100$  turns in the primary coil and  $N_2 = 10$  turns in the secondary coil. An RMS voltage of  $V = 120$  V 60Hz AC voltage is connected to the primary coil. A resistor with resistance  $R = 20 \Omega$  is connected to the secondary coil as shown in the figure

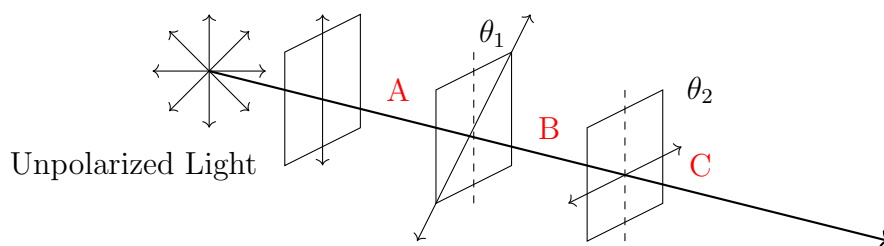
9. What is the average voltage across the resistor?

- a) 120 V
- b) 1200 V
- c) 12 V
- d) 24 V

10. What is the average power in the resistor?

- a) 0 W
- b) 14.4 W
- c) 0.6 W
- d) 7.2 W

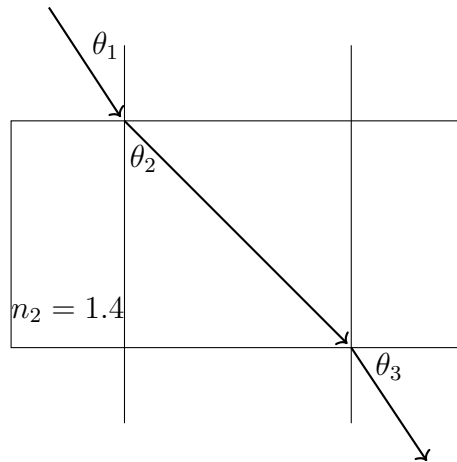
Question 11 - 14 refer to the following diagram



A beam of unpolarized light of intensity  $I_0$  passes through a series of ideal polarizing filters with their transmission axis turned to various angles, as shown in the figure ( $\theta_1 = 75^\circ$  and  $\theta_2 = 90^\circ$ , both relative to the vertical)

11. What is the light intensity (in terms of  $I_0$ ) in regions A, B and C?
12. If we remove the middle filter, what will be the intensity at point C?
13. If the second filter was rotated  $15^\circ$  clockwise, what would the light intensity be at point C?
14. How far should the first filter be rotated in order to maximize the intensity of light at point C?

Questions 15 - 17 refer to the following diagram



A light ray is incident from the air ( $n_1 = 1$ ) into a glass with index of refraction  $n_2 = 1.4$  at angle  $\theta_1$ . The angle between the normal and the refracted ray is  $\theta_2 = 45^\circ$ .

15. What is the value of  $\theta_1$ ?

16. What is the value of  $\theta_3$ ?

17. If  $n_2$  were to decrease but stay above the index of refraction of air and we fix  $\theta_2$  to be  $45^\circ$ , how would the values of  $\theta_1$  and  $\theta_3$  be affected?
- a) Decrease  $\theta_1$ , increase  $\theta_3$
  - b) Decrease  $\theta_1$ , decrease  $\theta_3$
  - c) Increase  $\theta_1$ , increase  $\theta_3$
  - d) Increase  $\theta_1$ , decrease  $\theta_3$