

PHYSICS 2

SECTION II

Time—1 hour and 30 minutes

4 Questions

**Directions:** Questions 1 and 4 are short free-response questions that require about 20 minutes each to answer and are worth 10 points each. Questions 2 and 3 are long free-response questions that require about 25 minutes each to answer and are worth 12 points each. Show your work for each part in the space provided after that part.

1. (10 points, suggested time 20 minutes)

In each trial of a photoelectric experiment, a scientist uses a device to shine light of a single frequency on two different metals, 1 and 2. The device can emit light with frequency  $f_A$ ,  $f_B$ , or  $f_C$ . Each frequency of light is used to test both metals.

The scientist determines the minimum de Broglie wavelength  $\lambda_e$  of the electrons ejected from the metal in each trial of the experiment. The following table summarizes the results of the experiment. For each trial, the scientist analyzes only the electrons with the minimum de Broglie wavelength.

| Trial | Frequency of Light | Metal Tested | $\lambda_e$ ( $\times 10^{-10}$ m) |
|-------|--------------------|--------------|------------------------------------|
| 1     | $f_A$              | Metal 1      | 6.9                                |
| 2     | $f_A$              | Metal 2      | 9.4                                |
| 3     | $f_B$              | Metal 1      | No electrons ejected               |
| 4     | $f_B$              | Metal 2      | No electrons ejected               |
| 5     | $f_C$              | Metal 1      | 5.3                                |
| 6     | $f_C$              | Metal 2      | 6.3                                |

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Continue your response to **QUESTION 1** on this page.

- (a) In a coherent, paragraph-length response, **indicate** which frequency,  $f_A$ ,  $f_B$ , or  $f_C$ , is greatest and which frequency is least. **Justify** your answer using physics principles.
- (b) **Calculate** the maximum kinetic energy of the electrons ejected from Metal 1 in Trial 1. Assume that the momentum  $p$  of an ejected electron can be described by the classical definition  $p = mv$ .
- (c) **Indicate** whether the work function of Metal 1 is greater than, less than, or equal to the work function of Metal 2. **Justify** your answer by referring to the table of results.

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