Physics 235 Fall 2013: Exam 2
Form #1

You must enter your form number on your scantron to receive your score.

Please Print Your Name:_____

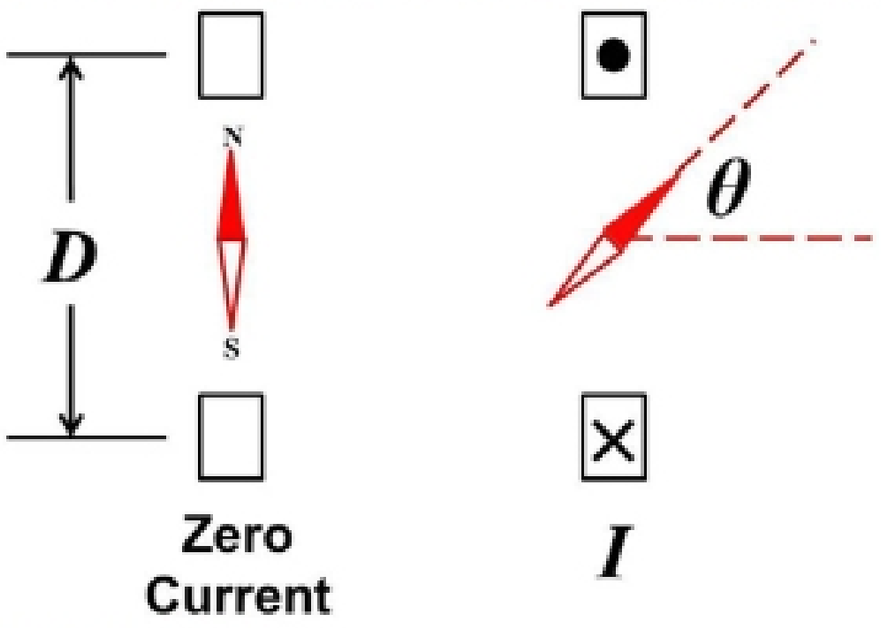
Instructions

1. Fill in your name above
2. Fill in your **name**, **ID number**, and **form number** on your scantron sheet
3. This will be a one hour and 50 minute (110 minute), closed book exam.
4. You may use a calculator, please do not share calculators.
5. The exam includes 20 multiple choice questions which will be machine graded. Each question is worth 5 points. No partial credit will be given.
6. For this exam, you can bring *two* 3×5" index cards with any notes you wish to have. You may use a plastic ruler if you wish. You will also find all the physical constants that you might require listed below.
7. **Please take your exam booklet with you and keep it safe and unaltered.**

Constants you might need:

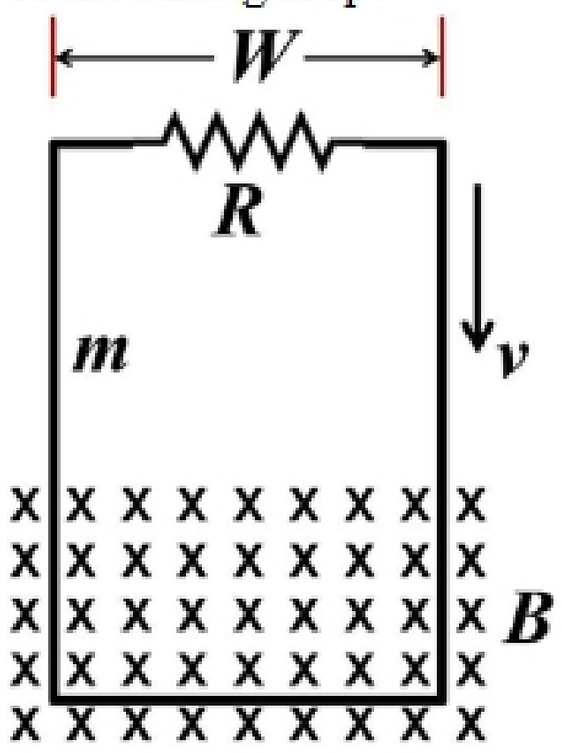
$k = 8.99\times10^{9}\ Nm^2/C^2$
$\varepsilon_0 = 8.85\times10^{-12}\ C^2/Nm^2$
$g = 9.8\ m/s^2$
$\mu_0 = 4\pi\times10^{-7}\ Tm/A$
Mass of the electron: 9.11×10^{-31} kg
Magnitude of the electron charge: 1.6×10^{-19} C
Mass of the proton: 1.67×10^{-27} kg
Atomic Mass Unit (1 AMU): 1.66×10^{-27} kg
1 Gauss = 10^{-4} T
Speed of sound in air = 340 m/s
Threshold of hearing $I_0 = 10^{-12}\ W/m^2$
Speed of light in vacuum = 3.0×10^{8} m/s
$k_B = 1.38\times10^{-23}\ m^2kg/s^2K = 1.38\times10^{-23}$ J/K
$\sigma = 5.7\times10^{-8}\ W/m^2K^4$
0 °C = 273.15 K
1 electron volt (1eV) = 1.6×10^{-19} J
Astronomical Unit (1AU) = 1.5×10^{11} m
1 Light Year = 9.47×10^{15} m
1 Parsec = 3.3 Light Years

1. A compass needle is located at the center of a coil containing $N = 400$ turns of wire with a diameter $D = 10$ cm. The N and S labels the diagram indicate the north and south poles of the compass needle. Initially there is no current in the coil and the compass needle is aligned with the local magnetic field of the Earth, which has a magnitude of 0.50 Gauss. When a current I is established in the coil, the needle rotates to an angle of $\theta = 45°$ with the coil axis and then remains at rest as shown. What is the current I?



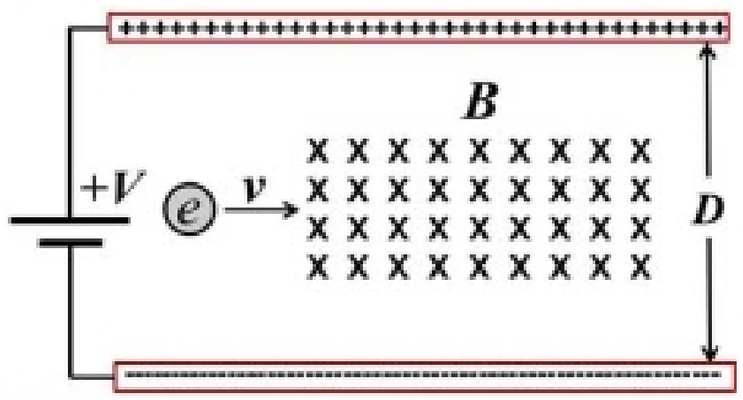
A) 3.62 mA
B) 5.27 mA
C) 9.95 mA
D) 14.33 mA
E) 21.52 mA

2. A loop of wire with a mass $m = 10$ grams and a width $W = 50$ cm is falling into a region of uniform magnetic field with a magnitude $B = 7500$ Gauss. The total resistance of the loop is $R = 0.10\ \Omega$. While it is entering the magnetic field, what is the terminal speed v of the falling loop?



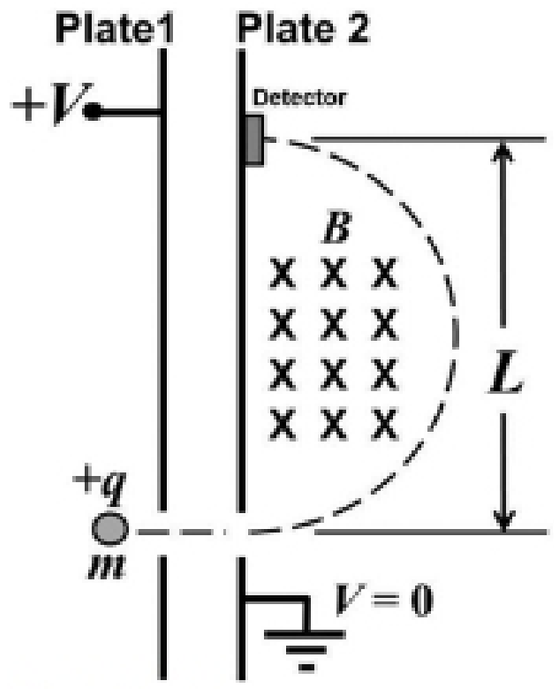
A) 10 cm/s
B) 7 cm/s
C) 5 cm/s
D) 3 cm/s/
E) 1 cm/s

3. Two parallel plates a distance $D = 2.0$ cm apart are maintained at a potential difference $V = 100$ V. A uniform magnetic field B is produced between the plates by coils which are not shown in the figure. The strength of the magnetic field is proportional to the current in the coils: $B = \left[10^{-3}\,\text{T/A}\right] I$. What current is required in the coils so that an electron moving with a speed $v = 5.0\times10^{6}$ m/s will pass through the plates without being deflected?



A) 1 A
B) 2 A
C) 3 A
D) 4 A
E) 5 A

4. For the magnet spectrometer shown, positive ions with charge $+q$, initially at rest, enter the region between two large parallel plates through a narrow slit in Plate 1, cross the region between Plate 1 and Plate 2 and then enter a region of uniform magnetic field of magnitude $B = 0.60$ T through a second narrow slit in Plate 2 as shown. What accelerating voltage V must be applied to Plate 1 so that *singly ionized* sodium ions $^{22}\text{Na}^{+}$ with a mass of 22 AMU strike the detector at a distance $L = 5.0$ cm from the slit in Plate 2? You may neglect any effects due to the presence of the slits in the plates.



A) 86 V
B) 129 V
C) 264 V
D) 312 V
E) 493 V