Multiple choice questions. Circle the correct answer. No work need be shown and no partial credit will be given.

1. (5pts) The positive charge in the figure below is moving to the right and experiences a vertical (upward) magnetic force. In which direction is the magnetic field?

(a) to the right
(b) to the left
(c) upward
(d) out of the page
(e) into the page

2. (5pts) Alpha particles (with charge $+2e$ and mass $m = 6.68 \times 10^{-27}$ kg) are accelerated in a cyclotron to a final orbit of radius $r = 0.7$ m. The magnetic field of the cyclotron is $B = 0.90$ T. The period of the circular motion for the alpha particles is closest to

(a) $0.15 \mu s$
(b) $0.22 \mu s$
(c) $0.29 \mu s$
(d) $0.36 \mu s$
(e) $0.44 \mu s$

3. (5pts) A coil is connected to a battery as shown in the figure. A bar magnet is suspended with its north pole just above the center of the coil. What will happen to the bar magnet just after the switch $S$ is closed?

(a) it will be pulled toward the coil
(b) it will be pushed away from the coil
(c) it will be pushed out of the paper
(d) it will be pushed into the paper
(e) nothing will happen
4. (5pts) A solenoid of length 13cm consists of a wire wrapped tightly around a wooden core. The magnetic field strength is 3.0 T inside the solenoid. If the solenoid is stretched to 26cm by applying a force to it, what does the magnetic field become?

(a) 1.5 T
(b) 6.0 T
(c) 19 T
(d) 3.0 T
(e) 8.0 T

5. (5pts) In the figure below a bar is in contact with a pair of parallel rails and is in motion with velocity v. A uniform magnetic field is present. The induced current through the resistor R is

(a) zero
(b) from a to b
(c) from b to a

On the following problems show all your work. Partial credit will be given if earned.

6. (20pts) In the circuit of the figure, the capacitors are all initially uncharged and the battery has no internal resistance. After the switch S is closed

(a) find the maximal charge on each capacitor
(b) the maximal potential difference across each capacitor
(c) the maximal reading of the ammeter A
(d) time constant of the circuit
7. (20pts) When a certain inductor carries a current I, it stores 3.0 mJ of magnetic energy. How much current (in terms of I) would it have to carry to store 9.0 mJ of energy?
8. (10pts) In the circuit shown in the figure below, $S_1$ has been closed for a long enough time so that the current reads a steady 3.50 A. Suddenly, $S_2$ is closed and $S_1$ is opened at the same instant.

(a) what is the maximal charge the capacitor will receive?
(b) what is the current in the inductor at this time?

9. (15pts) A solenoid is centered inside another. The outer solenoid has a length of 50.0 cm and contains 6750 coils, while the coaxial inner solenoid is 3.0 cm long, 0.120 cm in diameter and contains 15 coils. The current in the outer solenoid is changing at 37.5 A/s

a) what is the mutual inductance of these solenoids?

b) find the emf induced in the inner solenoid.

10. (10pts) If, in a velocity selector using perpendicular electric and magnetic fields, a magnetic field $B$ is required so that charges with speed $v$ emerge undeflected, what field (in terms of $B$) is needed for charges with speed $2v$ to emerge undeflected?