always, show all your work and circle your final answer. All numeric values are good to 3 significant figures.

- potentially useful info:
  - $k = 8.99 \times 10^9 N \cdot m^2 / C^2$
  - $e = 1.60 \times 10^{-19} C$
  - $E = -\frac{\Delta V}{\Delta s}$
  - $\Delta U = q \Delta V$
  - $V = \frac{kq}{r}$
  - $C = \frac{Q}{V}$
  - $C = \frac{\varepsilon_0 A}{d}$
  - $U = \frac{1}{2} QV$
  - $K = \frac{1}{2} mv^2$

1. [3 pts.] You are able to measure and draw lines of equipotential on a piece of paper. The lines of electric field will be

| A. only parallel to the equipotential lines. | B. only perpendicular to the equipotential lines. | C. neither perpendicular nor parallel to the equipotential lines. | D. sometimes perpendicular and sometimes parallel to the equipotential lines. | E. 42 |

2. [3 pts.] The potential (or voltage) for a point in space will be proportional to a charge’s


3. [3 pts.] A parallel-plate capacitor is connected to a battery that maintains a constant potential difference $V$ between the plates. If the plates are pulled farther apart from one another, the energy stored in the capacitor will

| A. remain constant. | B. decrease. | C. increase. | E. There is no way to predict for sure. |

4. [3 pts.] The electric potential is known to be constant on a given surface. What is known about the electric field in this same surface?

| A. The electric field has some value that is constant. | B. The electric field has a constant value of 0 N/C. | C. The electric field is changing throughout this surface. | D. Two neutral (non-charged) conducting spheres | E. None of these. |

5. [5 pts.] An electron of charge $-e$ is initially moving at a speed of $2.00 \times 10^5$ m/s. What potential difference is required to bring this electron to rest? (Note: The mass of an electron is $9.11 \times 10^{-31}$ kg.)

\[ V = \frac{1}{2} m v_i^2 = q \Delta V \]

\[ \Delta V = \frac{m v_i^2}{2q} = \frac{(9.11 \times 10^{-31} \text{kg})(2 \times 10^5 \text{m/s})^2}{2(-1.6 \times 10^{-19} \text{C})} \]

\[ \Delta V = -0.114 \text{ V} \]

6. [2 pts.] As this electron is slowing down, is the potential, $V$, increasing or decreasing? (Circle one.)

This is counterintuitive, but because it’s a NEGATIVE charge, it increases only as $V$ decreases. $U = qV$