A. Electric charges of the opposite sign
   1. Exert no force on each other
   2. Attract each other
   3. Repel each other
   4. Repel and attract each other
   5. Repel and attract each other depending on the magnitude of the charges

B. A free positive charge released in an electric field will
   1. Remain at rest
   2. Accelerate in the direction opposite to the electric field
   3. Accelerate in the direction perpendicular to the electric field
   4. Accelerate in the same direction as the electric field
   5. Accelerate in a circular path

C. If a negative charge is released in a uniform electric field, it will move
   1. In the direction of the electric field
   2. From high potential to low potential
   3. From low potential to high potential
   4. In a direction perpendicular to the electric field
   5. In circular motion

D. A positive charge is moved from one point to another point along an equipotential surface. The work required to move the charge:
   1. Is positive
   2. Is negative
   3. Is zero
   4. Depend on the sign of the potential
   5. Depends on the magnitude of the potential

E. When capacitors are connected in series, they have the same
   1. Charge
   2. Voltage
   3. Dielectric
   4. Surface area
   5. Separation

F. When capacitors are connected in parallel, they have the same
   1. Charge
   2. Voltage
   3. Dielectric
   4. Surface area
   5. Separation
Three point charges have equal magnitudes and are located on the same line. The separation between A and B is the same as that between B and C. One of the charges is negative and two are positive, as the drawing shows.

Consider the net electrostatic force that each charge experiences due to the other two charges.

(i) Rank the magnitude of the net electrical forces acting on the charges A, B, and C in descending order (greatest first).

   \[ \text{B} \quad \text{C} \quad \text{A} \]

(ii) State the direction of the net force acting on each charge. Use **up**, **down**, **left**, or **right**. State **zero** if the net force is zero.

   Charge A _left_   Charge B _right_   Charge C _left_

An electrocardiogram (EKG) monitors the electrical activity of the heart by measuring the electric potential differences between different points of the body. One set-up for an EKG uses three wires that are fixed to the body at points A, B, and C. Suppose at one instant the electric field inside the patient's body is uniform and points as shown in the diagram. At this same instant, the potential difference between points A and B is measured to be 2.4 mV.

1. Which point (A, B, or C) has the lowest potential? _B_

2. What is the magnitude of the electric field on the body at this instant?

   \[ \Delta V_{AB} = E \cdot d_{AB} \quad \text{d}_{AB} = \text{distance between points A \\& B} \]

   \[ \Rightarrow E = \frac{\Delta V_{AB}}{d_{AB}} = \frac{2.4 \times 10^{-3} \text{ V}}{0.40 \text{ m}} = 6.0 \times 10^{-3} \text{ N/C} \]

2. What is the potential difference between points C and B (\(V_B - V_C\))?

   \[ V_B - V_C = -E \cdot d_{BC} \cdot \cos \theta \]

   \[ V_B - V_C = -\left(6 \times 10^{-3} \text{ N/C}\right)\left(0.53 \text{ m}\right) \cos 80^\circ \]

   \[ V_B - V_C = -5.57 \times 10^{-4} \text{ V} \]
A small 2.0-g plastic ball that has a charge \( q \) of 2 C is suspended by a long string that has a length \( L \) of 1.5 m in a uniform electric field, as shown below. If the ball is in equilibrium when the string makes a 9.0° angle with the vertical as indicated by \( \theta \), what is the electric field strength? [SHOW YOUR WORK!]

**Force diagram:**

**Electric force**
\[ F_E = qE \]
\( q \): charge of the ball

**Sum forces:**
\[ \sum F_x = qE - T \sin \theta \]
\[ \sum F_y = T \cos \theta - mg \]

**System is in equilibrium** \( \Rightarrow \sum \vec{F} = 0 \)
\[ \sum F_x = 0 \Rightarrow T \sin \theta = qE \]
\[ \sum F_y = 0 \Rightarrow T \cos \theta = mg \]

**Solve:**
\[ \frac{T \sin \theta}{T \cos \theta} = \frac{qE}{mg} \Rightarrow \tan \theta = \frac{qE}{mg} \]
\[ E = \frac{mg \cdot \tan \theta}{q} = \frac{(0.002 \text{ kg})(9.8 \text{ m/s}^2) \tan(9^\circ)}{2 \text{ C}} \]

\[ E = 0.00155 \text{ N/C} \]