Electrostatics Evaluation Solutions

p. 137 C DE BG AF

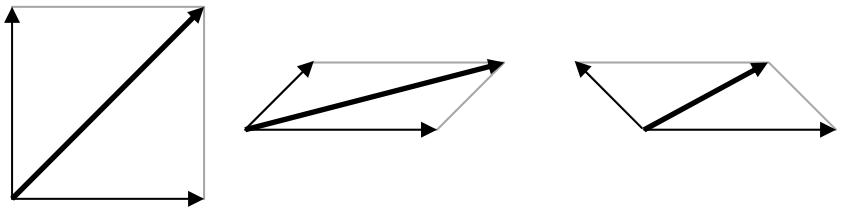
$F_E = kQq/r^2$ add as vectors. Some points are twice as far away as other points.

p. 138 D C A F E B

Similar to the last one. Charges are at 1, 2, and 3 units distance from P. Charges then have forces or relative size 1, 1/4 and 1/9. (If you want to deal with whole numbers, use 36, 9, and 4 by multiplying everything by the same factor – the common denominator of 1/4 and 1/9.)

p. 139 AEFG BC DH

New twist: vector addition in 2D. Otherwise, the same concept applies as the last 2 tasks. Note that points on a diagonal are $\sqrt{2}$ times as far away, so forces are 1/2 as large. The three different setups are drawn to-scale below (largest to smallest)



p. 147 BE CD AF

All spheres start with no charge. The rods do not transfer charge to the spheres, all charge results from induction – the induced movement of charge without contact. C and D are the same distance from the source of charge, so neither acquired a net charge. The AB ad EF pairs have the same separation of charge because of parallel arrangements. But the signs are opposite because of the oppositely charged rod. Sphere A attains a negative charge and B is left with an equal positive charge.

p. 151 All same

Same charge, same field ➔ same force

p. 155 BF ADE C

Electric field for a capacitor is $\Delta V/d$. $F_E = qE$

p. 156 A EH C I B FG D

Charge redistributes until the charge on both spheres is the same (since they are the same size). This is related to equalizing electrical potential.

p. 158 AB C D E F

Field lines point from high to low potential. Field lines are perpendicular to equipots.(This is not the field of a single charge. While referencing to the direction of field lines from a single positive charge is useful for determining the first key idea, it is not a sufficient explanation.)

p. 159 AB C D E F

Field strength weakens as field lines spread out.

p. 160 G DH ACE BF
High potential near +, low potential near -. “Downhill” is a negative ΔV, “uphill” is positive ΔV. Call each lateral step a ΔV of +/-1. Up and down are along the equipots (which are perpendicular to the field lines) so $\Delta V = 0$ for any vertical part of the shift.

p. 164 C AB DE F
Electric field points from high to low electrical potential.

p. 166 F DE AB C
Potential energy is low for negative charges where potential is high. (A uniform electric field can be created in a positive plate capacitor. In this case, potential energy for a negative charge is highest near the negative plate.)

p. 169 EF AB CD
Half-way across a potential difference is half the potential in a capacitor where E is constant. Negative charges have positive PE when at a negative potential.