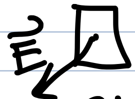
Exam 2 Review Session

#9 (c)

#10 (b) $U = \frac{1}{2} C V^2 = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2} Q V \Rightarrow U$ drops by factor of 4

#11 a



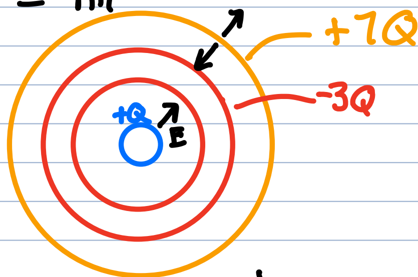
b) $E_x = \frac{2kQ}{dist\sqrt{dist^2 + (\frac{a}{2})^2}} = \frac{2kQ}{\frac{a}{2}\sqrt{(\frac{a}{2})^2 + (\frac{a}{2})^2}} = \frac{4\sqrt{2}\, kQ}{a^2}(-\hat{i})$

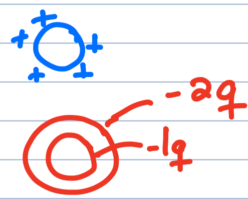
(from the exam: $\frac{kQ}{x\sqrt{x^2+l^2}}$)

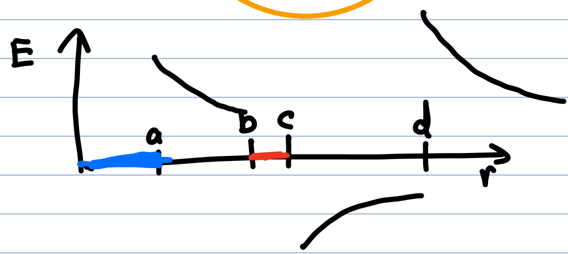
$E_y = \frac{4\sqrt{2}\, kQ}{a^2}(-\hat{j})$ $\quad E_z = 0$

c) = d) = nil

#12







$E(r<a) = 0$

$\vec{E}(a<r<b) = \frac{kQ}{r^2}\hat{r}$

$\vec{E}(b<r<c) = 0$

$\vec{E}(c<r<d) = \frac{-2kQ}{r^2}\hat{r}$

$E(r>d) = \frac{+5kQ}{r^2}\hat{r}$

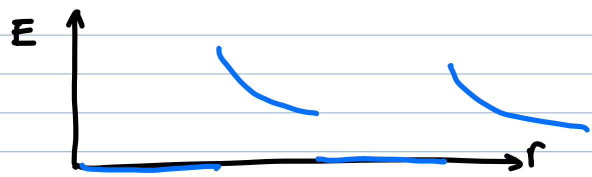
V(r>d) $\quad V_r - V_\infty = \int_r^\infty \vec{E}\cdot d\hat{r} = \int_r^\infty \frac{5kQ}{r^2} dr = \frac{-5kQ}{r}\Big|_r^\infty = 0 + \frac{5kQ}{r}$

$\Rightarrow V(r) = \frac{5kQ}{r} + V_\infty = \frac{5kQ}{r}$

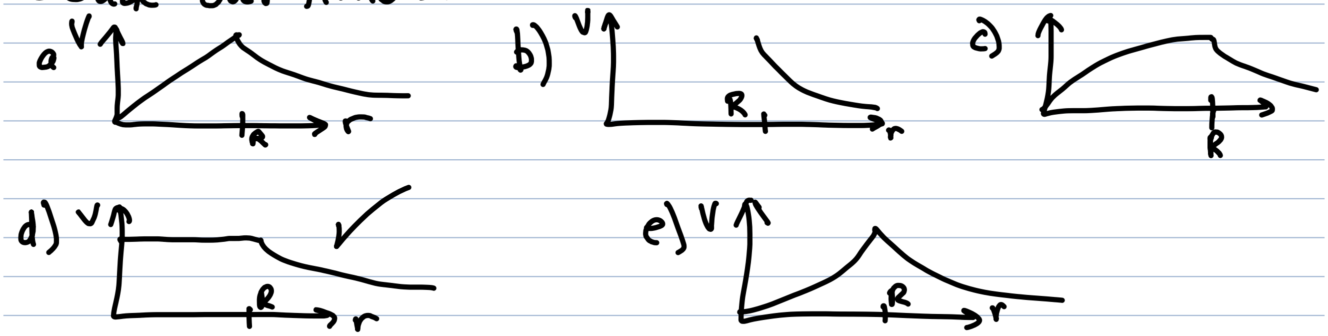
c<r<d $\quad V_r - V_d = \int_r^d \vec{E}\cdot d\hat{r} = -2kQ\int_r^d \frac{dr}{r^2} = \frac{2kQ}{r}\Big|_r^d = \frac{2kQ}{d} - \frac{2kQ}{r}$

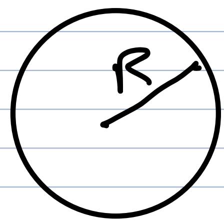
$$\Rightarrow V(r) = \frac{2kQ}{d} - \frac{2kQ}{r} + \frac{5kQ}{d}$$

Bonus fun time



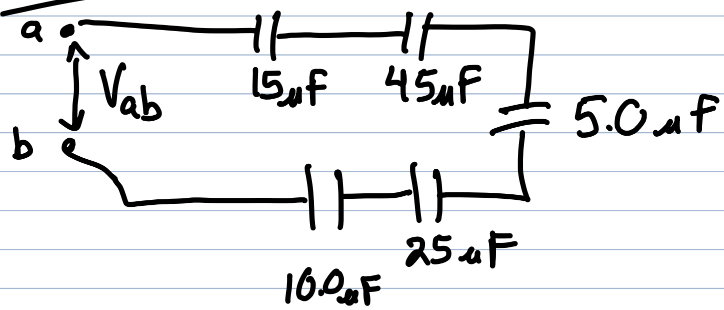
Double over time!!





Solid conducting sphere with a net (positive) charge

Triple overtime



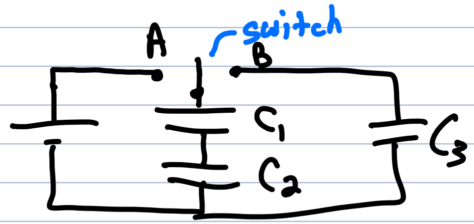
Each capacitor will explode if ΔV across it exceeds 30.0 V. .... the largest V_{ab} could be ...

The 5μF is most susceptible, since $V = \frac{Q}{C}$ ⇒ Shawn: set

$V = 30\,V$ for $5\,\mu F$, then $Q = 150\,\mu C$

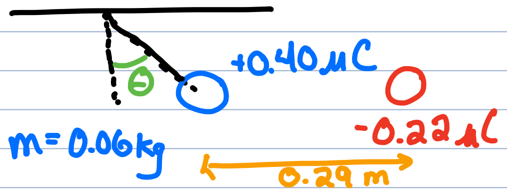
and to calculate V_{ab} use $V_{ab} = \dfrac{Q}{C_{eq}} = \dfrac{150\,\mu C}{\left(\frac{1}{10}+\frac{1}{5}+\frac{1}{45}+\frac{1}{25}+\frac{1}{15}\right)^{-1}}$

$= \boxed{64\,V}$

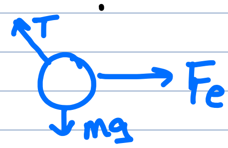


switch initially thrown to A and then to B. the charges are Q_1, Q_2, Q_3 and voltages V_1, V_2, V_3

a) $V_1 = V_2 = V_3$
b) $V_1 + V_2 = V_3$ ←
c) $V_3 = 0$
d) $Q_1 = Q_2 = Q_3$
e) $Q_1 + Q_2 = Q_3$



$\theta = ?$



$\Sigma F_x: \quad F_e = T\sin\theta$

$\Sigma F_y: \quad T\cos\theta = mg \Rightarrow \cos\theta = \dfrac{mg}{T}$

$\rightarrow \sin\theta = \dfrac{k q_1 q_2}{T r^2}$

Divide these $\tan\theta = \dfrac{k q_1 q_2}{r^2 mg}$