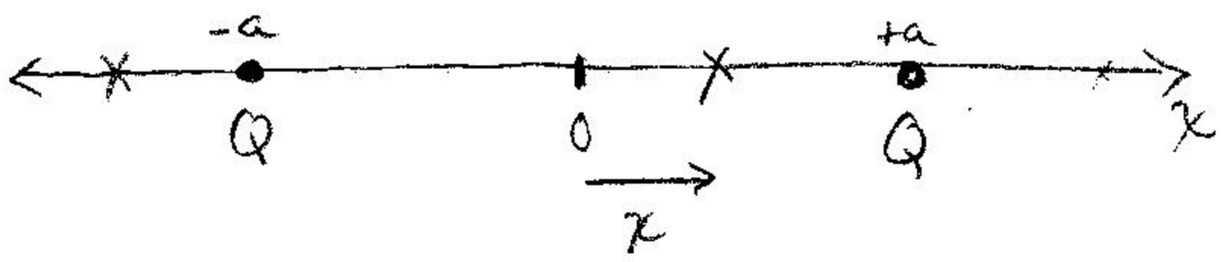
23-3 GIVEN: UNIFORM POTENTIAL

FIND: $\vec{E}$

$$\vec{E} = -\vec{\nabla} V = -\vec{\nabla}(\text{CONSTANT}) = 0$$

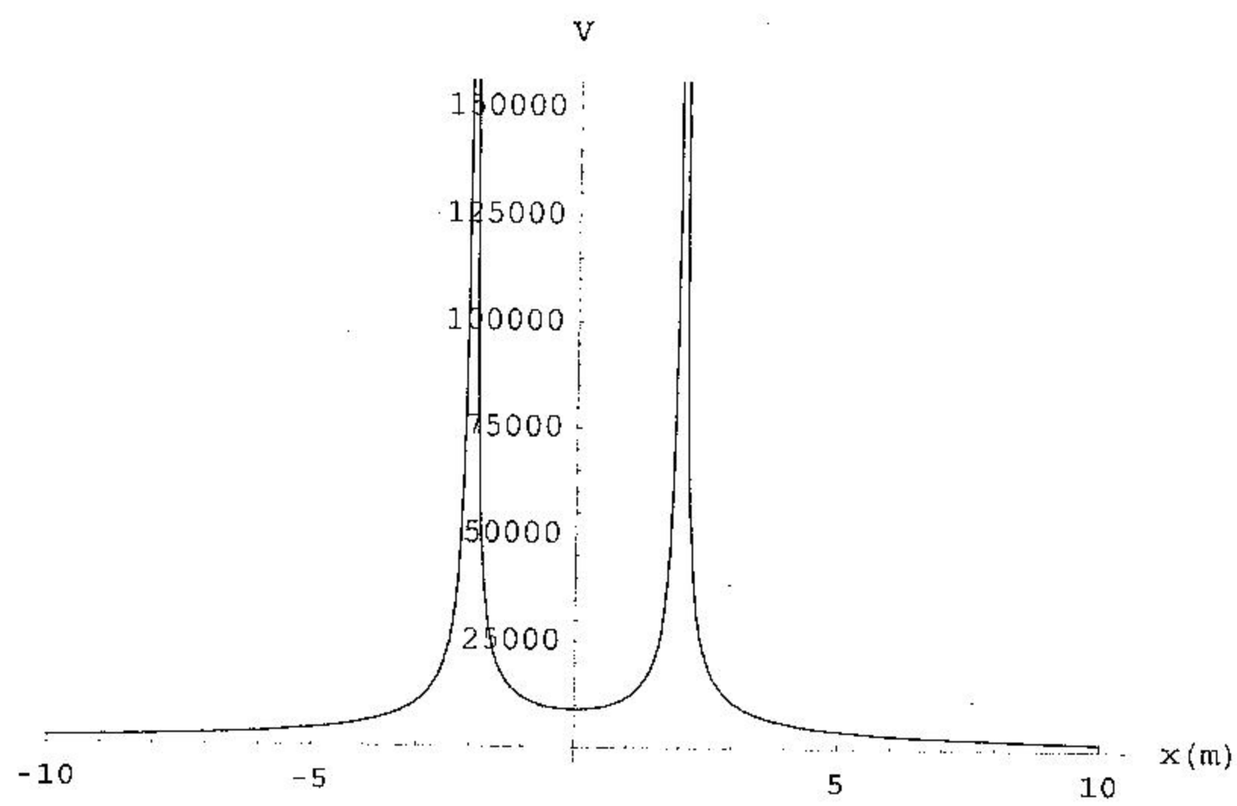
23-31 GIVEN: $+Q$ AT $x = -a$, $+Q$ AT $x = +a$ (ON x-AXIS)

FIND: $V(x)$, SKETCH $V(x)$



$-a < x < a$ $$V(x) = \frac{kQ}{a-x} + \frac{kQ}{a+x} = \frac{kQ\left[a + \cancel{x} + (a - \cancel{x})\right]}{(a-x)(a+x)} = \frac{2kQa}{a^2 - x^2}$$

$a < x$ $$V(x) = \frac{kQ}{x-a} + \frac{kQ}{x+a} = \frac{kQ\left[x + \cancel{a} + (x - \cancel{a})\right]}{(x-a)(x+a)} = \frac{2kQx}{x^2 - a^2}$$

$x < -a$ $$V(x) = \frac{kQ}{-(x+a)} + \frac{kQ}{-(x-a)} = \frac{-kQ\left[x - \cancel{a} + (x + \cancel{a})\right]}{(x+a)(x-a)} = \frac{-2kQx}{x^2 - a^2}$$

OR $$V(x) = \left|\frac{kQ}{a-x}\right| + \left|\frac{kQ}{a+x}\right|$$