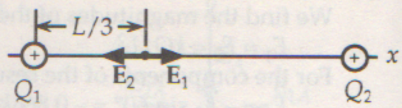
37. For the electric field to be zero, the individual fields must have opposite directions, so the two charges must have the same sign. For the net field to be zero, the magnitudes of the individual fields must be equal:



$E = kQ_1/r_1^2 = kQ_2/r_2^2$, or $Q_1/(\frac{1}{3}L)^2 = Q_2/(\frac{2}{3}L)^2$,

which gives $\boxed{Q_2 = 4Q_1.}$

38. (*a*) We find the acceleration produced by the electric field:

$F = qE = ma;$

$(1.60 \times 10^{-19}\ \text{C})(1.85 \times 10^4\ \text{N/C}) = (9.11 \times 10^{-31}\ \text{kg})a$, which gives $a = 3.24 \times 10^{15}\ \text{m/s}^2$.

Because the field is constant, the acceleration is constant, so we find the speed from

$v^2 = v_0^2 + 2ax = 0 + 2(3.24 \times 10^{15}\ \text{m/s}^2)(0.0120\ \text{m})$, which gives $v = \boxed{8.83 \times 10^6\ \text{m/s.}}$

(*b*) For the ratio of the two forces, we have

$mg/qE = (9.11 \times 10^{-31}\ \text{kg})(9.80\ \text{m/s}^2)/(1.60 \times 10^{-19}\ \text{C})(1.85 \times 10^4\ \text{N/C}) = 3.0 \times 10^{-15}$.

Thus $mg \ll qE$.

39. (*a*) The acceleration of the electron, and thus the force produced by the electric field, must be opposite its velocity. Because the electron has a negative charge, the direction of the electric field will be opposite that of the force, so the direction of the electric field is

$\boxed{\text{in the direction of the velocity, to the right.}}$

(*b*) Because the field is constant, the acceleration is constant, so we find the required acceleration from

$v^2 = v_0^2 + 2ax;$

$0 = [0.01(3.0 \times 10^8\ \text{m/s})]^2 + 2a(0.050\ \text{m})$, which gives $a = -9.00 \times 10^{13}\ \text{m/s}^2$.

We find the electric field from

$F = qE = ma;$

$(1.60 \times 10^{-19}\ \text{C})E = (9.11 \times 10^{-31}\ \text{kg})(9.00 \times 10^{13}\ \text{m/s}^2)$, which gives $E = \boxed{5.1 \times 10^2\ \text{N/C.}}$