Here the index q refers to a quark flavor (*i.e.*, u, d, s, c, b, or t), and

$$A_q = \left(-q_q + g_{Lq}\, g_{Le}\, \frac{Q^2}{Q^2+M_Z^2}\right)^2 + \left(-q_q + g_{Rq}\, g_{Re}\, \frac{Q^2}{Q^2+M_Z^2}\right)^2, \tag{24.5}$$

$$B_q = \left(-q_q + g_{Rq}\, g_{Le}\, \frac{Q^2}{Q^2+M_Z^2}\right)^2 + \left(-q_q + g_{Lq}\, g_{Re}\, \frac{Q^2}{Q^2+M_Z^2}\right)^2. \tag{24.6}$$

Here q_q is the charge of flavor q. For a left-handed electron, $g_{Re} = 0$ and $g_{Le} = (-1/2 + \sin^2\theta_W)/(\sin\theta_W \cos\theta_W)$, while for a right-handed one, $g_{Le} = 0$ and $g_{Re} = (\sin^2\theta_W)/(\sin\theta_W\cos\theta_W)$. For the quarks, $g_{Lq} = (T_3 - q_q \sin^2\theta_W)/(\sin\theta_W\cos\theta_W)$, and $g_{Rq} = (-q_q\sin^2\theta_W) / (\sin\theta_W\cos\theta_W)$.

For neutral-current *neutrino* (*antineutrino*) *scattering*, the same formula applies with g_{Le} replaced by $g_{L\nu} = 1/(2\sin\theta_W\cos\theta_W)$ ($g_{L\overline{\nu}} = 0$) and g_{Re} replaced by $g_{R\nu} = 0$ [$g_{R\overline{\nu}} = -1/(2\sin\theta_W\cos\theta_W)$].

In the case of the *charged-current processes* $e_L^- p \to \nu X$ and $\overline{\nu} p \to e^+ X$, Eq. (24.3) applies with

$$F_2 = 2xF_1 = 2x\Big[f_u(x,Q^2) + f_c(x,Q^2) + f_t(x,Q^2) + f_{\overline{d}}(x,Q^2) + f_{\overline{s}}(x,Q^2) + f_{\overline{b}}(x,Q^2)\Big], \tag{24.7}$$

$$F_3 = 2\Big[f_u(x,Q^2) + f_c(x,Q^2) + f_t(x,Q^2) - f_{\overline{d}}(x,Q^2) - f_{\overline{s}}(x,Q^2) - f_{\overline{b}}(x,Q^2)\Big]. \tag{24.8}$$

For the process $\nu p \to e^- X$:

$$F_2 = 2xF_1 = 2x\Big[f_d(x,Q^2) + f_s(x,Q^2) + f_b(x,Q^2) + f_{\overline{u}}(x,Q^2) + f_{\overline{c}}(x,Q^2) + f_{\overline{t}}(x,Q^2)\Big], \tag{24.9}$$

$$F_3 = 2\Big[f_d(x,Q^2) + f_s(x,Q^2) + f_b(x,Q^2) - f_{\overline{u}}(x,Q^2) - f_{\overline{c}}(x,Q^2) - f_{\overline{t}}(x,Q^2)\Big]. \tag{24.10}$$