56. Assuming the neutrino has negligible mass, then

$$\Delta m\, c^2 = (\mathbf{m}_{\rm Ti} - \mathbf{m}_{\rm V} - m_e)\, c^2 \ .$$

Now, since Vanadium has 23 electrons (see Appendix F and/or G) and Titanium has 22 electrons, we can add and subtract $22m_e$ to the above expression and obtain

$$\Delta m\, c^2 = (\mathbf{m}_{\rm Ti} + 22m_e - \mathbf{m}_{\rm V} - 23m_e)\, c^2 = (m_{\rm Ti} - m_{\rm V}\,)\, c^2 \ .$$

We note that our final expression for Δmc^2 involves the *atomic* masses, and that this assumes (due to the way they are usually tabulated) the atoms are in the ground states (which is certainly not the case here, as we discuss below). The question now is: do we set $Q = -\Delta mc^2$ as in Sample Problem 43-7? The answer is "no." The atom is left in an excited (high energy) state due to the fact that an electron was captured from the lowest shell (where the absolute value of the energy, E_K, is quite large for large Z – see Eq. 41-25). To a very good approximation, the energy of the K-shell electron in Vanadium is equal to that in Titanium (where there is now a "vacancy" that must be filled by a readjustment of the whole electron cloud), and we write $Q = -\Delta mc^2 - E_K$ so that Eq. 43-27 still holds. Thus,

$$Q = (m_{\rm V} - m_{\rm Ti}\,)\, c^2 - E_K \ .$$