6. $\int \left(\sqrt{x^3} + \sqrt[3]{x^2}\right) dx = \int (x^{3/2} + x^{2/3})\, dx = \dfrac{x^{5/2}}{5/2} + \dfrac{x^{5/3}}{5/3} + C = \frac{2}{5}x^{5/2} + \frac{3}{5}x^{5/3} + C$

12. $\int \left(x^2 + 1 + \dfrac{1}{x^2+1}\right) dx = \dfrac{x^3}{3} + x + \tan^{-1} x + C$

17. $\int (1 + \tan^2 \alpha)\, d\alpha = \int \sec^2 \alpha\, d\alpha = \tan \alpha + C$

42. $\int_1^2 \dfrac{(x-1)^3}{x^2}\, dx = \int_1^2 \dfrac{x^3 - 3x^2 + 3x - 1}{x^2}\, dx = \int_1^2 \left(x - 3 + \dfrac{3}{x} - \dfrac{1}{x^2}\right) dx = \left[\frac{1}{2}x^2 - 3x + 3\ln|x| + \dfrac{1}{x}\right]_1^2$

$= \left(2 - 6 + 3\ln 2 + \frac{1}{2}\right) - \left(\frac{1}{2} - 3 + 0 + 1\right) = 3\ln 2 - 2$

49. $A = \int_0^2 (2y - y^2)\, dy = \left[y^2 - \frac{1}{3}y^3\right]_0^2 = \left(4 - \frac{8}{3}\right) - 0 = \frac{4}{3}$

60. (a) Displacement $= \int_1^6 (t^2 - 2t - 8)\, dt = \left[\frac{1}{3}t^3 - t^2 - 8t\right]_1^6 = (72 - 36 - 48) - \left(\frac{1}{3} - 1 - 8\right) = -\frac{10}{3}$ m

(b) Distance traveled $= \int_1^6 |t^2 - 2t - 8|\, dt = \int_1^6 |(t-4)(t+2)|\, dt$

$= \int_1^4 (-t^2 + 2t + 8)\, dt + \int_4^6 (t^2 - 2t - 8)\, dt = \left[-\frac{1}{3}t^3 + t^2 + 8t\right]_1^4 + \left[\frac{1}{3}t^3 - t^2 - 8t\right]_4^6$

$= \left(-\frac{64}{3} + 16 + 32\right) - \left(-\frac{1}{3} + 1 + 8\right) + (72 - 36 - 48) - \left(\frac{64}{3} - 16 - 32\right) = \frac{98}{3}$ m

32. Let $u = \ln x$. Then $du = (1/x)\, dx$, so $\int \dfrac{\sin(\ln x)}{x}\, dx = \int \sin u\, du = -\cos u + C = -\cos(\ln x) + C$.

44. Let $u = x^2$. Then $du = 2x\, dx$, so $\int \dfrac{x}{1+x^4}\, dx = \int \dfrac{\frac{1}{2}\, du}{1+u^2} = \frac{1}{2}\tan^{-1} u + C = \frac{1}{2}\tan^{-1}(x^2) + C$.

68. Let $u = 1 + 2x$, so $x = \frac{1}{2}(u-1)$ and $du = 2\, dx$. When $x = 0$, $u = 1$; when $x = 4$, $u = 9$. Thus,

$\int_0^4 \dfrac{x\, dx}{\sqrt{1+2x}} = \int_1^9 \dfrac{\frac{1}{2}(u-1)}{\sqrt{u}} \dfrac{du}{2} = \frac{1}{4}\int_1^9 (u^{1/2} - u^{-1/2})\, du = \frac{1}{4}\left[\frac{2}{3}u^{3/2} - 2u^{1/2}\right]_1^9 = \frac{1}{4} \cdot \frac{2}{3}\left[u^{3/2} - 3u^{1/2}\right]_1^9$

$= \frac{1}{6}[(27 - 9) - (1 - 3)] = \frac{20}{6} = \frac{10}{3}$

86. Let $u = x^2$. Then $du = 2x\, dx$, so $\int_0^3 x f(x^2)\, dx = \int_0^9 f(u)\left(\frac{1}{2}\, du\right) = \frac{1}{2}\int_0^9 f(u)\, du = \frac{1}{2}(4) = 2$.