1. For each problem, I have listed two different functions that have the given derivative.

(a)
- $y = 3x + 2$
- $y = 3x - 3$

(b)
- $y = x^3 + 5$
- $y = x^3 - 7$

(c)
- $w = 2x^4 - \frac{1}{3}x^3 + \frac{5}{2}x^2 - 10x + 11$
- $w = 2x^4 - \frac{1}{3}x^3 + \frac{5}{2}x^2 - 10x - 13$

(d)
- $h = 4\ln(t) + 17$
- $h = 4\ln(t) - 19$

(e)
- $y = 30e^x + 5x + 23$
- $y = 30e^x + 5x - 29$

(f)
- $q = -50e^{-t} + 31$
- $q = -50e^{-t} - 37$

(g)
- $P = \frac{1}{4}t^4 - \frac{1}{2}t^{-2} + 41$
- $P = \frac{1}{4}t^4 - \frac{1}{2}t^{-2} - 43$

(h)
- $y = \ln(x + 4) + 47$
- $y = \ln(x + 4) - 53$

(i)
- $z = \frac{1}{3}e^{3y} + 59$
- $z = \frac{1}{3}e^{3y} - 61$

(j)
- $v = -100e^{-r} + 67$
- $v = -100e^{-r} - 71$

(k)
- $s = 4e^{t} - 3^{-t} + 73$
- $s = 4e^{t} - 3^{-t} - 79$

(l)
- $P = 2\sqrt{t} + 83$
- $P = 2\sqrt{t} - 89$

(m)
- $P = 2\ln(t) + 3t^{-1} + 97$
- $P = 2\ln(t) + 3t^{-1} - 101$

(n)
- $h = 15e^{2s} + \frac{1}{3}e^{3s} + 103$
- $h = 15e^{2s} + \frac{1}{3}e^{3s} - 107$

(o)
- $P = 100e^{0.05t} + 109$
- $P = 100e^{0.05t} - 113$

(p)
- $y = \frac{1}{2}e^{x^2} + 127$
- $y = \frac{1}{2}e^{x^2} - 131$

(q)
- $y = \left(x^2 + 1\right)^4 + 137$
- $y = \left(x^2 + 1\right)^4 - 139$

(r)
- $y = \frac{8}{3}\left(x^3 + 7\right)^{3/2} + 149$
- $y = \frac{8}{3}\left(x^3 + 7\right)^{3/2} - 151$

(s)
- $y = 6e^{-0.25x^2} + 157$
- $y = 6e^{-0.25x^2} - 163$

2. The indefinite integral represents the most general antiderivative of the integrand and so is an entire family of functions (hence the $+C$).

   (a) $\int 3\,dx \;=\; 3x + C$

   (b) $\int 3x^2\,dx \;=\; x^3 + C$

   (c) $\int \left(8x^3 - x^2 + 5x - 10\right)\,dx \;=\; 2x^4 - \frac{1}{3}x^3 + \frac{5}{2}x^2 - 10x + C$

   (d) $\int \frac{4}{t}\,dx \;=\; 4\ln(t) + C$

   (e) $\int (30e^x + 5)\,dx \;=\; 30e^x + 5x + C$

   (f) $\int 50e^{-t}\,dt \;=\; -50e^{-t} + C$

   (g) $\int \left(t^3 + \frac{1}{t^3}\right)\,dt \;=\; \frac{1}{4}t^4 - \frac{1}{2}t^{-2} + C$

   (h) $\int \frac{1}{x+4}\,dx \;=\; \ln(x+4) + C$

   (i) $\int e^{3y}\,dy \;=\; \frac{1}{3}e^{3y} + C$

(j) $\int \frac{100}{e^r}\, dr \;=\; -100e^{-r} + C$

(k) $\int \left(4e^t + 3e^{-t}\right)\, dt \;=\; 4e^t - 3e^{-t} + C$

(l) $\int \frac{1}{\sqrt{t}}\, dt \;=\; 2\sqrt{t} + C$

(m) $\int \left(\frac{2}{t} - \frac{3}{t^2}\right)\, dt \;=\; 2\ln(t) + 3t^{-1} + C$

(n) $\int \left(30e^{2s} + e^{3s}\right)\, ds \;=\; 15e^{2s} + \frac{1}{3}e^{3s} + C$

(o) $\int 5e^{0.05t}\, dt \;=\; 100e^{0.05t} + C$

(p) $\int xe^{x^2}\, dx \;=\; \frac{1}{2}e^{x^2} + C$

(q) $\int 8x\left(x^2+1\right)^3\, dx \;=\; \left(x^2+1\right)^4 + C$

(r) $\int 12x^2\sqrt{x^3+7}\, dx \;=\; \frac{8}{3}\left(x^3+7\right)^{3/2} + C$

(s) $\int -3xe^{-0.25x^2}\, dx \;=\; 6e^{-0.25x^2} + C$

3. (a) $q = 3.2r + 2.5$

(b) $h = \ln(10) \cdot s + 8$

(c) $q = 30e^{-0.4t}$

(d) $w = 0.3z^2 + 40$

(e) $v = \dfrac{-1}{q - 11}$

(f) $P = \left(\dfrac{t + 2\sqrt{10}}{2}\right)^2$

(g) $y = 2t^3 + 5t + 8$

(h) $w = \sqrt[3]{x^2 - 5x + 8}$

(i) $y = \sqrt[3]{t^2 + 125}$

(j) $y = 4\left(x^2 + 1\right)^5$

(k) $s = \left(\dfrac{5}{3}r + 2\sqrt[3]{4} - \dfrac{50}{3}\right)^{3/5}$

(l) $g = \ln(s - 2) + 4 - \ln(3)$

(m) $r = \sqrt{\ln(v + 3)}$ or $r = -\sqrt{\ln(v + 3)}$

(n) $q = 0.2r^2 + 300$

(o) $h = 400e^{0.1r}$

(p) $P = 500e^{-0.2t}$

(q) $w = 3e^{2t} + 5$

(r) $y = \ln(x + 1)$

(s) $y = -e^{-x} + 1$

(t) $W = 2x^4 + x^3 + 5$

(u) $q = -t^{-1} + 4$

(v) $q = \sqrt[3]{3t + 24}$

(w) $y = \dfrac{-1}{3x^3 - 4}$

(x) $y = 60e^x - 10$

(y) $y = \dfrac{1}{2}x^2 + 10x + 50$

(z) $P = \dfrac{kP_0e^{rt}}{k + P_0(e^{rt} - 1)}$