1. $\int (-7x^2 + 6x + 3)\, dx = -\frac{7}{3}x^3 + 3x^2 + 3x + C.$

2. $\int (-13x^2 + 10x + 9)\, dx = -\frac{13}{3}x^3 + 5x^2 + 9x + C.$

3. $\int (2x^{-1} + \frac{1}{x^5})\, dx = 2\ln x - \frac{1}{4}x^{-4} + C.$

4. $\int (10\sin x - 9\cos x - 8)\, dx = -10\cos x - 9\sin x - 8x + C.$

5. $\int (3e^x - \frac{5}{x} + \frac{12}{x^4})\, dx = 3e^x - 5\ln x - 4x^{-3} + C.$

6.

$$\begin{aligned}\int_{-2}^{1} \big(15x^2 - 4x - 10\big)\, dx &= \Big[5x^3 - 2x^2 - 10x\Big]_{-2}^{1} \\ &= \big(5\times 1^3 - 2\times 1^2 - 10\times 1\big) - \Big(5\times(-2)^3 - 2\times(-2)^2 - 10\times(-2)\Big) \\ &= 5 - 2 - 10 - (-40 - 8 + 20) \\ &= -7 - (-28) \\ &= 21\end{aligned}$$

7.

$$\begin{aligned}\int_{-3}^{-2} \big(6x^2 - 4x - 9\big)\, dx &= \Big[2x^3 - 2x^2 - 9x\Big]_{-3}^{-2} \\ &= \Big(2\times(-2)^3 - 2\times(-2)^2 - 9\times(-2)\Big) - \Big(2\times(-3)^3 - 2\times(-3)^2 - 9\times(-3)\Big) \\ &= -16 - 8 + 18 - (-54 - 18 + 27) \\ &= -6 - (-45) \\ &= 39\end{aligned}$$

8.

$$\begin{aligned}\int_{-2}^{-1} \big(3x^2 - 4x + 10\big)\, dx &= \Big[x^3 - 2x^2 + 10x\Big]_{-2}^{-1} \\ &= \Big((-1)^3 - 2\times(-1)^2 + 10\times(-1)\Big) - \Big((-2)^3 - 2\times(-2)^2 + 10\times(-2)\Big) \\ &= -1 - 2 - 10 - (-8 - 8 - 20) \\ &= -13 - (-36) \\ &= 23\end{aligned}$$

9.

$$\begin{aligned}\int_{-1}^{1} (-4x + 9)\, dx &= \Big[-2x^2 + 9x\Big]_{-1}^{1} \\ &= \big(-2\times 1^2 + 9\times 1\big) - \Big(-2\times(-1)^2 + 9\times(-1)\Big) \\ &= -2 + 9 - (-2 - 9) \\ &= 7 - (-11) \\ &= 18\end{aligned}$$

10.

$$\int_{-1}^{2} \left(-6x^2 + 2x\right) dx = \left[-2x^3 + x^2\right]_{-1}^{2}$$
$$= \left(-2 \times 2^3 + 2^2\right) - \left(-2 \times (-1)^3 + (-1)^2\right)$$
$$= -16 + 4 - (2 + 1)$$
$$= -12 - 3$$
$$= -15$$

11. The area under the curve $y = x^2 + 2x + 4$ from $x = 1$ to $x = 3$ is

$$\int_{1}^{3} \left(x^2 + 2x + 4\right) dx = \left[\frac{1}{3}x^3 + x^2 + 4x\right]_{1}^{3}$$
$$= \left(\frac{1}{3} \times 27 + 9 + 12\right) - \left(\frac{1}{3} \times 1 + 1 + 4\right)$$
$$= 30 - 5\frac{1}{3}$$
$$= 24\frac{2}{3}$$

12. Determine the area under the curve $y = e^{-x} + 2$ from $x = -3$ to $x = 1$ is

$$\int_{-3}^{1} \left(e^{-x} + 2\right) dx = \left[-e^{-x} + 2x\right]_{1}^{-3}$$
$$= \left(-e^3 - 6\right) - \left(-e^{-1} + 2\right)$$
$$= -e^3 - 6 + e^{-1} - 2$$
$$= -e^3 + e^{-1} - 8$$
$$= -e^3 + \frac{1}{e} - 8$$

13. **(a)** Fixed: \$175, variable \$10 per echidna.

(b) $c(x) = 175 + 10x$

(c) $r(x) = (50 - x)x = 50x - x^2$

(d) $p(x) = 50x - x^2 - (175 + 10x) = -x^2 + 40x - 175$

(e) Breaks even when profit equals 0, so when $-x^2 + 40x - 175 = 0$ or $x^2 - 40x + 175 = 0$. $(x - 5)(x - 35) = 0$ so $x = 5$ or 35. So Egbert breaks even if he sells 5 or 35 echidnas.

(f) $p'(x) = -2x + 40$. Solve $p'(x) = 0 \Rightarrow -2x + 40 = 0 \Rightarrow x = 20$. $p'(x) = -2$ which is negative so it's a maximum. The maximum profit is $-(20^2) + 40 \times 20 - 175 =$\$225.

(g) If the fixed costs were doubled, this would have NO impact on the optimal level of echidna production as the fixed costs disappear when you differentiate. The overall profit will be less but not the optimal level.