Only a few more details on a few selected problems are provided for this problem set. Most information can be found by simple application of the power rule, so the normal solution set should be adequate.

2. The derivative is a straight application of the power rule.

$$\begin{aligned} g(x) &= 3x^2 - 3x + 4 - 2x^{-3} \\ g'(x) &= 2(3x) - 3 - (-3)2x^{-4} = 6x - 3 + 6x^{-4} \end{aligned}$$

3. Begin by writing $h(t)$ in powers of t.

$$\begin{aligned} h(t) &= t^3 - 5t + \frac{1}{2} - t^{-2} \\ h'(t) &= 3t^2 - 5 - (-2)t^{-3} = 3t^2 - 5 + 2t^{-3} \end{aligned}$$

6. Begin by writing $q(w)$ in powers of w.

$$\begin{aligned} q(w) &= 3w^{-0.4} + 2.1w^5 - 2w^{-1/2} \\ q'(w) &= 3(-0.4)w^{-1.4} + 2.1(5)w^4 - 2(-\frac{1}{2})w^{-3/2} = -1.2w^{-1.4} + 10.5w^4 + w^{-\frac{3}{2}} \end{aligned}$$

8. Begin by writing $g(x)$ in powers of x.

$$\begin{aligned} g(x) &= A - Bx^{-3} + Cx{-1/2} - Dx^4 \\ g'(x) &= 3Bx^{-4} - (\frac{C}{2})x^{-\frac{3}{2}} - 4Dx^3 \end{aligned}$$

10. a. Since $N = 3A^{\frac{1}{3}}$, the derivative is

$$N'(A) = 3(\frac{1}{3})A^{-\frac{2}{3}} = A^{-\frac{2}{3}}.$$

For the three different areas, $N'(64) = 64^{-\frac{2}{3}} = \frac{1}{4^2} = \frac{1}{16}$, $N'(125) = 125^{-\frac{2}{3}} = \frac{1}{5^2} = \frac{1}{25}$, and $N'(1000) = 1000^{-\frac{2}{3}} = \frac{1}{10^2} = \frac{1}{100}$.

12. a. The velocity is $v(t) = h'(t) = 32 - 32t$. The maximum height occurs when $v(t) = 0$, $v(t) = 32 - 32t = 0$ implies $t = 1$. Thus, $h(1) = 144$ ft is the maximum height of the ball. At $t = 2$ and $t = 4$, the velocity is $v(2) = 32 - 32(2) = -32$ ft/sec and $v(4) = 32 - 32(4) = -96$ ft/sec, respectively.

13. a. Since $h(t) = -16t^2 + v_0 t + 12$, the velocity is $v(t) = h'(t) = -32t + v_0$ by the power rule.

b. The velocity is zero when $-32t_m + v_0 = 0$ or $t_m = v_0/32$.

c. Substituting $t_m = v_0/32$ into the equation for the height of the cat gives

$$h(v_0/32) = -16\left(\frac{v_0}{32}\right)^2 + v_0\left(\frac{v_0}{32}\right) + 12 = 16,$$

which gives

$$-\frac{v_0^2}{64} + \frac{v_0^2}{32} = 4 \qquad \text{or} \qquad \frac{v_0^2}{64} = 4.$$

Thus, the initial velocity needs to be $v_0 = 16$ ft/sec, so $v(t) = -32t + 16$. The velocity at $t = 1$ sec is $v(1) = -32(1) + 16 = -16$ ft/sec.

d. With this information, when the cat hits the ground, $h(t) = -16t^2 + 16t + 12 = -4(4t^2 - 4t - 3) = -4(2t - 3)(2t + 1) = 0$. It follows that either $t = \frac{3}{2}$ or $-\frac{1}{2}$ with the latter not being appropriate. Thus, the cat hits the ground at $t = \frac{3}{2}$ sec with a velocity of $v(1.5) = -32(1.5) + 16 = -32$ ft/sec.