Assignment:

Section 2.4, Part 1 (pages 96–97): Exercises 1, 3, 4, 5. **Section 2.4, Part 2** (pages 97–98): Exercises 6abdf, 7ac, 9. **Section 2.4, Part 3** (page 98): Exercises 10, 11, 13. **Section 2.5, Part 1** (pages 107–109): Exercises 1acehijor, 2bdfhk, 4, 6, 7. **Section 2.5, Part 3** (page 112): Exercise 16abd.

Section 2.4, Part 1

1. (a) $\frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx} = 5 \cdot (-7) = -35.$

(d) $\frac{dy}{dx} = \frac{dy}{du}\frac{du}{dx} = \ln(10)10^u \cdot 2x = 2\ln(10)x10^{x^2}.$

3. $A = \ell^2$, so $\frac{dA}{dt} = \frac{dA}{d\ell}\frac{d\ell}{dt} = 2\ell\frac{d\ell}{dt}$, and we're told that $d\ell/dt = -2$ ft/day. So $\frac{dA}{dt} = 2\ell(-2) = -4\ell$ ft^2/day. Now we know that the iceberg starts at 100 feet per side, so at the outset, $\frac{dA}{dt} = -4(100) = -400$ ft^2/day. After 5 days, the iceberg is down to 90 feet per side. So after five days, $\frac{dA}{dt} = -4(90) = -360$ ft^2/day.

4. $V = \ell^3$, so $\frac{dV}{dt} = \frac{dV}{d\ell}\frac{d\ell}{dt} = 3\ell^2\frac{d\ell}{dt}$, and we're told that $d\ell/dt = -2$ ft/day. So $\frac{dV}{dt} = 3\ell^2(-2) = -6\ell^2$ ft^3/day. So at the outset, $\frac{dV}{dt} = -6(100)^2 = -60{,}000$ ft^3/day; after five days, $\frac{dV}{dt} = -6(90)^2 = -48{,}600$ ft^3/day.

Section 2.4, Part 2

6. (a) $F'(x) = 5(9x + 6x^3)^4 \cdot (9 + 18x^2)$.

(f) $\text{wombat}'(x) = \ln(5)5^{1/x} \cdot \frac{-1}{x^2} = \frac{-\ln(5)5^{1/x}}{x^2}$.

7. (a) $\text{dog}'(w) = 2(\sin(w^3+1))^1 \cdot \frac{d}{dw}[\sin(w^3+1)] = 2\sin(w^3+1)\cos(w^3+1) \cdot \frac{d}{dw}[w^3+1] = 2\sin(w^3+1)\cos(w^3+1) \cdot 3w^2 = 6w^2\sin(w^3+1)\cos(w^3+1)$.

(c)

$$\begin{aligned} R'(x) &= 3 + 3(x^2 + (7x^3+5)^2)^2 \frac{d}{dx}[x^2 + (7x^3+5)^2] \\ &= 3 + 3(x^2 + (7x^3+5)^2)^2 \left(2x + 2(7x^3+5)^1 \frac{d}{dx}[7x^3+5]\right) \\ &= 3 + 3(x^2 + (7x^3+5)^2)^2 \left(2x + 2(7x^3+5)(21x^2)\right). \end{aligned}$$

Section 2.4, Part 3

10. $h'(x) = 6(f(x))^5 \cdot f'(x)$, so $h'(93) = 6(f(93))^5 \cdot f'(93) = 6 \cdot 2^5 \cdot (-4) = -768$.

Section 2.5, Part 1

1.

(a) $15x^4 - 20x$

(c) $14u^6 + \dfrac{9}{u^4} + \dfrac{1}{2\sqrt{u}}$

(e) $.5\cos(x) + \dfrac{1}{3}x^{-2/3}$

(i) $\dfrac{x^2\cos(x) - 2x\sin(x)}{x^4} = \dfrac{x\cos(x) - 2\sin(x)}{x^3}$

(j) $\ln(3)x^2 3^x + 2x3^x$

(o) $\cos\left(4^x\cos(x)\right)\left(\ln(4)4^x\cos(x) - 4^x\sin(x)\right)$

(p) $\dfrac{-5\ln(64)t^{1/3}64^{\cos(t)}\sin(t) - \frac{5}{3}t^{-2/3}64^{\cos(t)}}{25t^{2/3}}$

2.

(b) $\dfrac{d}{dt}[5f(t) - 2g(t)] = 5f'(t) - 2g'(t)$; evaluate at t=2: $5f'(2) - 2g'(2) = 5\cdot 2 - 2\cdot(-1) = 12$.

(d) $\dfrac{d}{dt}\left[\dfrac{f(t)}{g(t)}\right] = \dfrac{g(t)f'(t) - f(t)g'(t)}{g^2(t)}$; evaluate at $t = 2$: $\dfrac{g(2)f'(2) - f(2)g'(2)}{g^2(2)} = \dfrac{11}{16}$.

(f) $\dfrac{d}{dt}\left[\sqrt{g(t)}\right] = \dfrac{g'(t)}{2\sqrt{g(t)}}$; evaluate at $t = 2$: $\dfrac{-1}{2\sqrt{4}} = -\dfrac{1}{4}$.

7. Let $P(t)$ represent the population over time, $C(t)$ represent the per capita yearly expenditure for energy, and $E(t)$ represent the total yearly energy expenditure. Then,

$$E(t) = P(t) \cdot C(t) \tag{1}$$
$$E'(t) = P'(t) \cdot C(t) + P(t) \cdot C'(t) \tag{2}$$

Using equation 1, we see that the current energy expenditure is

$$E = (15{,}000{,}000)(1{,}000) = \$15{,}000{,}000{,}000.$$

Then using equation 2, we see that the energy expenditure is growing at a rate of

$$E' = (10{,}000)(1{,}000) + (15{,}000{,}000)(8) = 130{,}000{,}000$$

dollars per year.

Section 2.5, Part 3

16. (a) $f''(x) = 24x - 14$. (b) $f''(t) = 9\ln^2(2)2^{3t-2}$. (d) $f''(x) = 2\cos(x) - x^2\cos(x) - 4x\sin(x)$.