Answers to Problems from section 2.8:

4. and 7. Graphs omitted here. To be discussed in Monday Lecture, July 6th.

32. f is not differentiable at $x = 0$, because there is a discontinuity there, and at $x = 3$, because the graph has a vertical tangent there.

37. $a = f,\ \ b = f',\ \ c = f''$. We can see this because where a has a horizontal tangent, $b = 0$, and where b has a horizontal tangent, $c = 0$. We can immediately see that c can be neither f nor f', since at the points where c has a horizontal tangent, neither a nor b is equal to 0.

Answers to Problems from section 2.9:

2. (a) $f'(x) > 0$ and f is increasing on (0,1) and (3,5). $f'(x) < 0$ and f is decreasing on (1,3) and (5,6).

(b) f has local maxima at $x = 1$ and $x = 5$, and it has a local minimum at $x = 3$.

8. (a) If the position function is increasing, then the particle is moving toward the right. This occurs on t-intervals (0,2) and (4,6). If the function is decreasing, then the particle is moving toward the left – that is, on (2,4).

(b) The acceleration is the second derivative and is positive where the curve is concave upward. This occurs on (3,6). The acceleration is negative where the curve is concave downward – that is, on (0,3).

21. (a) Since e^{-x^2} is positive for all x, $f'(x) = xe^{-x^2}$ is positive where $x > 0$ and negative where $x < 0$. Thus, f is increasing on (0, ∞) and decreasing on (∞, 0).

(b) Since f changes from decreasing to increasing at $x = 0$, f has a minimum value there.

23. (a) f is increasing on $\left(-\infty, -\sqrt{\frac{1}{3}}\right)$ and on $\left(\sqrt{\frac{1}{3}}, \infty\right)$. f is decreasing

on $\left(-\sqrt{\frac{1}{3}}, \sqrt{\frac{1}{3}}\right)$.

25. b is the antiderivative of f. For small x, f is negative, so the graph of its antiderivative must be decreasing. But both a and c are increasing for small x, so only b can be f's antiderivative. Also f is positive where b is increasing, which supports our conclusion.

Answers to Problems from section 3.1:

17. 0.

19. $\frac{3}{2}\sqrt{x} + \frac{2}{\sqrt{x}} - \frac{3}{2x\sqrt{x}}$

22. $ae^v - \frac{b}{v^2} - \frac{2c}{v^3}$

23. $-\frac{10A}{y^{11}} + Be^y$

24. $\frac{2}{3\sqrt[3]{t}} + 3\sqrt{t}$

25. Tangent Line: $y = 2x + 2$. Normal Line: $y = -\frac{1}{2}x + 2$.

38. $G''(r) = \frac{1}{4}\, r^{-3/2} - \frac{2}{9}\, r^{-5/3}$.

47. $m = y' = 18x^2 + 5$, but $x^2 \geq 0$ for all x, so $m \geq 5$ for all x.

Answers to Problems from section 3.2:

5. $\frac{e^x(x-2)}{x^3}$.

9. $5 + 14y^{-2} + 9y^{-4}$.

10. $3 + 3e^t - \frac{3}{2}\sqrt{t} - \sqrt{t}e^t - e^t/(2\sqrt{t})$.

15. $2v - v^{-1/2}$.

16. $\frac{5}{2}\, w^{3/2} + \frac{1}{2}\, cw^{1/2} e^{w}(2w+3)$.

20. $\frac{ad-bc}{(cx+d)^2}$.

21. Tangent Line: $y = 2x$. Normal Line: $y = -\frac{1}{2}x$.

30. $g^{(n)}(x) = \frac{(x-n)(-1)^n}{e^x}$

45. (a) $(fgh)' = [(fg)h]' = (fg)'h + (fg)h' = (f'g + fg')h + fgh' = f'gh + fg'h + fgh'$

(b) Putting $f = g = h$ in part (a), we have $\frac{d}{dx}[f(x)]^3 = (fff)' = f'ff + ff'f + fff' = 3fff' = 3[f(x)]^2 f'(x)$.

(c) $\frac{d}{dx}(e^{3x}) = \frac{d}{dx}(e^x)^3 = 3(e^x)^2 e^x = 3e^{2x}e^x = 3e^{3x}$.

Answers to Problems from section 3.3:

8. (a) Maximum height is 100 ft.

27. 16 ft/s and -16 ft/s.

Answers to Problems from section 3.4:

5. $\sec\theta(\sec^2\theta + \tan^2\theta) = \sec\theta(1 + 2\tan^2\theta) = \sec\theta(2\sec^2\theta - 1)$

8. $\frac{x\cos x}{(x+\cos x)^2}$

13. $-\csc x \cot x$

14. $\sec x \tan x$

15. $-\csc^2 x$

18. $y = x + 1$.

31. (a) $a(t) = -8\sin t$

(b) The mass at time $t = \dfrac{2\pi}{3}$ has position $4\sqrt{3}$, velocity -4 and acceleration $-4\sqrt{3}$. It is moving to the left and it is speeding up.

36. $-35\sin x - x\cos x$.

Answers to Problems from section 3.5:

10. $\dfrac{\sec^2 t}{3\sqrt[3]{(1+\tan t)^2}}$

12. $-3\sin x\cos^2 x$

19. $e^{x\cos x}(\cos x - x\sin x)$

21. $\dfrac{1}{(z-1)^{1/2}(z+1)^{3/2}}$

31. $\cos\left(\tan\sqrt{\sin x}\right)\left(\sec^2\sqrt{\sin x}\right)\left(\dfrac{1}{2\sqrt{\sin x}}\right)(\cos x)$

32. $\dfrac{1}{2}\left(x+\sqrt{x+\sqrt{x}}\right)^{-1/2}[1+\dfrac{1}{2}\,(x+\sqrt{x})^{-1/2}(1+\dfrac{1}{2}\,x^{-1/2})]$

34. $e^{e^x}\cdot e^x(1+e^x)$

36. $y = x$.

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70. $y = \dfrac{1}{2}\,x + \dfrac{1}{2}$

71. $y = -\dfrac{2}{e}\,x + 2$