

# Calculus by Schlieper and Tiemeyer

## Answers to Selected Problems

### SECTION 1.1

9) 1, 2, d.n.e, 2, 0, d.n.e	19) 1	29) 64	39) $\frac{1}{4}$
11) 9	21) 0	31) 0	41) 0
13) 0	23) 7	33) $-1$	43) 9
15) 3	25) $\frac{\pi^2+3\pi+5}{5\pi^2-2\pi-3}$	35) $-2$	45) 9
17) 3	27) $\frac{1}{2}$	37) $-\frac{7}{8}$	47) $-\frac{1}{9}$

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### SECTION 1.2

7) $\infty, \infty$	13) $-\infty$	19) $\infty$
9) 1, 0, .5, .5	15) $\infty$	21) $\frac{1}{3}$
11) d.n.e, d.n.e	17) $\infty$	23) $-\infty$

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### SECTION 1.3

19) Y, N	25) $(-\infty, -\sqrt{6}] \cup [\sqrt{6}, \infty)$	31) $(-\infty, 0]$
21) Y, N	27) $(-\infty, \infty)$	
23) $(-\infty, -2] \cup [2, \infty)$	29) $(0, \infty)$	

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## SECTION 2.1

- 9) 2,  $y = 2x$       11) 4,  $y = 4x - 4$       13)  $-\frac{1}{4}$ ,  $y = -\frac{1}{4}x - 1$       19) b.  $F^\circ/\text{ml}$
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## SECTION 2.2

- 15)  $y' = 2x$       17)  $s'(t) = -\frac{1}{t\sqrt{t}}$       19)  $f'(x) = \frac{3}{2\sqrt{3x-1}}$       21)  $s'(t) = -\frac{1}{(t-5)^2}$
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## SECTION 2.3

- 5) increasing and concave down, greater than  $-3$ , less than  $1.5$   
6) 1, 1, 9, estimates vary  
7) graphs vary
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## SECTION 2.4

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|---|---|
| 5) $f'(x) = 14x - 5$                    | 15) $g'(x) = -2\sin(x)$ , $g''(x) = -2\cos(x)$ ,<br>$g'''(x) = 2\sin(x)$ , $g^{(4)}(x) = 2\sin(x)$                                  |
| 7) $m'(t) = 45t^4 - \frac{3}{8}t^2 + 3$ | 17) $p'(\theta) = 4\theta^3 - 3\theta^2$ , $p''(\theta) = 12\theta^2 - 6\theta$ ,<br>$p'''(\theta) = 24\theta - 6$ , $p^{(4)} = 24$ |
| 9) $f'(r) = 6e^r$                       | 19) $f'(x) = f''(x) = f'''(x) = f^{(4)}(x) = 0$   |
| 11) $p'(s) = s^3 + s^2 + s + 1$         | 21) $y = x + 4$   |
| 13) $g'(t) = 6 + 18t$                   | 23) $y = \sqrt{2}x - \frac{\sqrt{2}}{4}\pi - \sqrt{2}$  |
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## SECTION 2.5

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|--|---|
| 9) $g'(x) = \frac{1}{2}$                             | 25) $f'(x) = xe^x(x \sec^2(x) + (x+2) \tan(x))$ |
| 11) $f'(t) = 1$                                      | 27) $y = 2s + 2$                                |
| 13) $f'(x) = x \cos(x) - \sin(x)$                    | 29) $y = 4$                                     |
| 15) $f'(x) = \frac{x-7}{2x^{3/2}}$                   | 31) $x = \frac{3}{2}$                           |
| 17) $h'(t) = -\csc^2(t) - e^t$                       | 33) none  |
| 19) $f'(x) = 7, x \neq 0, \frac{-3 \pm \sqrt{6}}{4}$ | 35) $f''(x) = 2 \cos(x) - x \sin(x)$            |
| 21) $f'(x) = \frac{1+3 \cos(x)}{(\cos(x)+3)^2}$      | 37) $f''(x) = \csc(x)(\csc^2(x) + \cot^2(x))$   |
| 23) $g'(t) = 4t^2 e^t(t+3) - \cos(2t)$               | 41) a. $r'(-2) = 5, r'(0) = 1$                  |
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## SECTION 2.6 (update #15 and #17 after corrections to original problems)

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|--|--|
| 7) $f'(t) = 15(3t-2)^4$                                  | 19) $m'(w) = \frac{3^w \ln(3) - (3^w+1) \ln(2)}{2^w}$                  |
| 9) $h'(t) = (6t+1)e^{3t^2+t-1}$                          | 21) $f'(x) = 5x^2 \cos(5x) + 2x \sin(5x)$                              |
| 11) $f'(x) = -3 \sin(3x)$                                | 23) $g'(x) = e^{5x^2} (10x \cos(\frac{1}{x}) + \frac{\sin(1/x)}{x^2})$ |
| 13) $h'(t) = 8 \sin^3(2t) \cos(2t)$                      | 25) $y = 15x - 14$   |
| 15) $f'(x) = 0$ ( $f'(x) = 4^x \ln(4)$ if $f(x) = 4^x$ ) | 27) $y = -5ex - 4e$  |
| 17) $g'(t) = 0$  | 29) $V'(1) = 7\pi \frac{ft^3}{ft}$                                     |
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## SECTION 2.7

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|---|---|
| 3) $f'(x) = \frac{1}{3\sqrt[3]{x^2}}$                     | 13) $y' = -\frac{2 \tan(y)}{x \sec^2(y)}$ |
| 5) $g'(t) = \sqrt{t} \cos(t) + \frac{\sin(t)}{2\sqrt{t}}$ | 15) $y' = \frac{1}{2(y+1)}$               |
| 7) $y' = -\frac{4x^3}{2y+1}$                              | 19) a. $x = 1$                            |
| 9) $y' = \frac{\sin(x)}{\cos(y)}$                         | 21) a. $y = -x + 1$                       |
| 11) $y' = 10, x \neq 0$                                   | 28) $y = -x + \pi$                        |
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## SECTION 2.8

- |   |   |
|---|---|
| 15) $h'(t) = \frac{2}{\sqrt{1-4t^2}}$                                   | 23) $f'(x) = -\frac{1}{\sqrt{1-x^2}}$   |
| 17) $g'(x) = \frac{2}{1+4x^2}$  | 25) $f'(x) = \frac{1}{2 \arctan(x) + 3 \arcsin(x) + 5} \left( \frac{2}{1+x^2} + \frac{3}{\sqrt{1-x^2}} \right)$ |
| 19) $g'(t) = -\frac{\sin(t)}{\sqrt{1-t^2}} + \cos(t) \arccos(t)$        | 29) $y = (1 - 2 \ln(2))x + 1 + 2 \ln(2)$  |
| 21) $h'(x) = \frac{\arccos(x) + \arcsin(x)}{\sqrt{1-x^2} \arccos^2(x)}$ | 35) $y = \sqrt{2}x - 1 + \frac{\pi}{4}$   |
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### SECTION 3.1

All answers have been rounded to give approximate, not exact, values.

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|---------------------|------------------|--------------------|
| 3) a. 0.795775 cm/s | b. 0.007958 cm/s | c. 0.000080 cm/s   |
| 7) a. 0.0726 rad/s  | b. 3.6667 rad/s  | c. 7.3333 rad/s    |
| 9) a. -30.59 ft/min | b. -36.06 ft/min | c. -301.496 ft/min |
| 11) a. 105 ft       | b. 17.45 ft/min  |                    |
| 13) a. 80 ft        | b. 1.715 ft/s    | c. not possible    |
| 15) -0.24 rad/s     |                  | d. 34.162 ft       |
| 17) 1.28 ft/s       |                  |                    |
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### SECTION 3.2

Use graphing calculators or computer graphics to confirm answers.

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### SECTION 3.3

- 7) A - absolute min; C - absolute max, local max; B, D, E - none of the above  
9) absolute max = 3, absolute min = -134.5  
11) absolute max =  $\frac{16}{3\sqrt{3}}$ , absolute min = 0  
13) absolute max =  $\frac{5}{6}$ , absolute min = 0  
15) absolute max =  $\frac{\sqrt{2}e^{3\pi/4}}{2}$ , absolute min = 0  
17) absolute max =  $\frac{4}{27}$ , absolute min =  $\sqrt[3]{4} - 2$   
19) a. absolute max at  $x = a$ , absolute min at  $x = b$   
20) a. absolute max = 3, absolute min = -3
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### SECTION 3.4

- |   |                                      |
|---|--------------------------------------|
| 3) 2500   | 13) none, cost $\approx \$4,308,132$ |
| 5) $20\sqrt{5}$   | 15) about 12.95 ft                   |
| 7) $1/4$  | 17) 1.52 cubic feet                  |
| 9) $r = \sqrt[3]{\frac{355}{2\pi}} \approx 3.837$ cm, $h \approx 7.6744$ cm | 19) about 172 ft                     |
| 11) $w = 4\sqrt{3}$ in, $h = 4\sqrt{6}$ in                                  |                                      |
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### SECTION 3.5

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|---------------------------------|--|
| 3) any $c$ in $(-1, 1)$         | 11) $c = 0$                                |
| 5) cannot apply Rolle's Theorem | 13) $c = \frac{3}{\sqrt{2}}$               |
| 7) cannot apply Rolle's Theorem | 15) $c = \frac{4}{\ln(5)}$                 |
| 8) $c = \frac{\pi}{2}$          | 17) $c = -\frac{2}{3}$                     |
| 9) cannot apply Rolle's Theorem | 19) $c = \pm \frac{\sqrt{\pi^2 - 4}}{\pi}$ |
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### SECTION 3.6

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|--|---|
| 7) $2.05^2 \approx 4.2$                    | 21) $dy = -\frac{16}{x^5} dx$                               |
| 9) $\sqrt{16.5} \approx 4.03125$           | 23) $dy = \frac{1}{x} dx$                                   |
| 11) $\sin(3) \approx \pi - 3 \approx .14$  | 25) $dy = -\sin(\sin(x)) \cos(x) dx$                        |
| 17) $dy = (7x^6 - 5x^4) dx$                | 29) propagated error $\approx \pm 48$ sq. in.               |
| 19) $dy = 2(2x + \sin(x))(2 + \cos(x)) dx$ | 31) $l \approx 297.7$ ft, prop. error $\approx \pm 62.3$ ft |
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### SECTION 3.7

- |                   |              |       |           |
|-------------------|--------------|-------|-----------|
| 9) $-5/3$         | 23) 0        | 33) 0 | 43) 1     |
| 11) $-\sqrt{2}/2$ | 25) $-2$     | 35) e | 45) 1     |
| 17) $1/2$         | 27) 0        | 37) 1 | 47) $1/2$ |
| 19) 0             | 29) 0        | 39) 1 | 49) 1     |
| 21) $\infty$      | 31) $\infty$ | 41) 0 | 51) 3     |
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### SECTION 4.1

- |                        |                  |                      |                                  |
|------------------------|------------------|----------------------|----------------------------------|
| 1) a. 12 miles, 1 hr   | b. 1 mile, north | c. 40 miles, 0 miles |                                  |
| 3) a. $1/2 + \pi/4$ ft | b. $-2$ ft       | c. $[2, 5]$          | d. $[0, 2]$ and $[5, 7]$         |
| 5) a. 2 ft/s           | b. 2 ft          | c. 1.5 ft            |                                  |
| 7) a. 64 ft/s          | b. 64 ft         | c. 2 s               | d. $2 + \sqrt{7} \approx 4.65$ s |
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### SECTION 4.2

- |                              |                           |  |
|------------------------------|---------------------------|--|
| 5) 29                        | 15) $\sum_{i=0}^4 (-e)^i$ | 29) $L_5 \approx 8.144$                        |
| 7) 0                         | 17) 1045                  | 31) $R_4 = \frac{496}{315}$                    |
| 9) 3                         | 19) 2050                  | 37) a. $R_n = -\frac{1}{12} + \frac{1}{12n^2}$ |
| 11) 6                        | 21) 2870                  | 39) a. $f(x) = x^2 + 1$ on $[1, 3]$            |
| 13) $\sum_{i=0}^8 (i^2 - 1)$ | 27) $M_5 = \frac{59}{8}$  | 41) a. answers vary                            |
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### SECTION 4.3

- |                       |                      |           |            |
|-----------------------|----------------------|-----------|------------|
| 5) a. 3               | b. 4                 | c. 3      | d. 0       |
| 7) a. 4               | b. 2                 | c. 4      | d. 2       |
| 9) a. $\pi$           | b. $\pi$             | c. $2\pi$ | d. $10\pi$ |
| 11) a. $4/\pi$        | b. $-4/\pi$          | c. 0      | d. $2/\pi$ |
| 13) a. $40/3$         | b. $26/3$            | c. $8/3$  | d. $38/3$  |
| 15) 5                 |                      |           |            |
| 17) $a = -2, b = 7$   | is one possible pair |           |            |
| 19) 2                 |                      |           |            |
| 21) $a = -18, b = 11$ | is one possible pair |           |            |
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### SECTION 4.4

- |                                   |   |
|-----------------------------------|---|
| 4) $F'(x) = \frac{3x^2+1}{x^3+x}$ | 6) $F'(x) = 2x^3 + 3x - 2$                          |
| 7) $F'(x) = -3x^{11}$             | 7) $F'(x) = e^x \sin(e^x) - \frac{\sin(\ln(x))}{x}$ |
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## SECTION 4.5

- |                              |                                      |                      |
|------------------------------|--------------------------------------|----------------------|
| 11) $x^9/9 + C$              | 31) $f(x) = \tan(x) + 4$             | 51) $\ln(2)$         |
| 13) $t + C$                  | 33) $f(x) = \frac{5}{2}x^2 + 7x + 3$ | 53) $3/8$            |
| 15) $-\frac{1}{3t} + C$      | 35) $f(x) = 5e^x - 2x$               | 55) $1/3$            |
| 17) $2\sqrt{x} + C$          | 37) ask instructor                   | 57) $1/101$          |
| 19) $-\cos(\theta) + C$      | 39) 20                               | 59) 15               |
| 21) $\frac{3^t}{\ln(3)} + C$ | 41) 0                                | 61) $2 - 2/\sqrt{3}$ |
| 23) $\frac{(2t+3)^3}{6} + C$ | 43) 1                                | 65) 400 ft           |
| 25) $\frac{1}{6}x^6 + C$     | 45) $\frac{24}{5\ln(5)}$             | 67) $-1$ ft          |
| 27) $tx + C$                 | 47) $e^3 - e$                        | 69) $-64$ ft/s       |
| 29) $f(x) = 5e^x + 5$        | 49) 4                                | 71) $2$ ft/s         |
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## SECTION 4.6

- |   |   |
|---|---|
| 3) $\frac{1}{8}(x^3 - 5)^8 + C$                       | 39) $3 \arcsin(x/3) + C$                            |
| 5) $\frac{1}{18}(x^2 + 1)^9 + C$                      | 41) $\frac{2}{3} \operatorname{arcsec}(x/3) + C$    |
| 7) $\frac{1}{2} \ln  2x + 7  + C$                     | 43) $\frac{1}{2} \arcsin(x^2) + C$                  |
| 9) $\frac{2}{3}(x + 3)^{3/2} - 6\sqrt{x + 3} + C$     | 45) $2 \arcsin(\frac{x-3}{4}) + C$                  |
| 11) $2e^{\sqrt{x}} + C$                               | 47) $\arctan(\frac{x+3}{8}) + C$                    |
| 13) $-\frac{1}{2}(\frac{1}{x} + 1)^2 + C$             | 49) $\frac{1}{45}(5x^3 + 5x^2 + 2)^2 + C$           |
| 15) $\frac{1}{3} \sin^3(x) + C$                       | 51) $-\frac{1}{3} \cot(x^3 + 1) + C$                |
| 17) $-\tan(4 - x) + C$                                | 53) $\ln  x - 5  + C$                               |
| 19) $\frac{1}{3} \tan^3(x) + C$                       | 55) $\frac{3x^2 - 10x}{2} + \ln  x^2 + 3x + 5  + C$ |
| 21) $\tan(x) - x + C$                                 | 57) $3 \ln  3x^2 + 9x + 7  + C$                     |
| 23) $\frac{1}{3}e^{x^3} + C$                          | 59) $\frac{1}{18} \arctan(x^2/9) + C$               |
| 25) $x - e^{-x} + C$                                  | 61) $\operatorname{arcsec}(2x) + C$                 |
| 27) $\frac{3^{3x}}{3\ln(3)} + C$                      | 69) $\arctan(\sin(x)) + C$                          |
| 29) $\frac{1}{3} \ln^3(x) + C$                        | 71) $3\sqrt{x^2 - 2x - 6} + C$                      |
| 31) $\frac{1}{2} \ln  \ln(x^2)  + C$                  | 73) $-\ln(2)$                                       |
| 33) $\frac{x^3}{3} + \frac{x^2}{2} + x + \ln  x  + C$ | 75) $2/3$   |
| 35) $\frac{x^2}{2} + 5x + 10 \ln  x - 3  + C$         | 77) $(1 - e)/2$                                     |
| 37) $\frac{1}{3} \ln  x^3 + 3x^2 + 3x  + C$           | 79) $\pi/2$   |
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## SECTION 4.7

- |            |                         |                             |                         |
|------------|-------------------------|-----------------------------|-------------------------|
| 1) $2/\pi$ | 7) $4/\pi$              | 13) $\frac{45}{4} - \ln(8)$ | 19) $2\sqrt{3} + \pi/3$ |
| 3) 2       | 9) $c = \pm 2/\sqrt{3}$ | 15) $27/2$                  | 21) $64/3$              |
| 5) 16      | 11) $c = 64/9$          | 17) $9/2$                   | 23) 187.2 lb            |
-