p. 285: 1-4, 7-15, 17-19, 21-22

1. $f(x)=x^3-x^2+3 \Rightarrow f'(x)=3x^2-2x$, so $f(-2)=-9$ and $f'(-2)=16$.
   Thus, $L(x)=f(-2)+f'(-2)(x-(-2)) = -9+16(x+2)=16x+23$.

2. $f(x)=\sin x \Rightarrow f'(x)=\cos x$, so $f\left(\frac{\pi}{6}\right)=\frac{1}{2}$ and $f'\left(\frac{\pi}{6}\right)=\frac{1}{2}\sqrt{3}$.
   Thus, $L(x)=f\left(\frac{\pi}{6}\right)+f'\left(\frac{\pi}{6}\right)\left(x-\frac{\pi}{6}\right)=\frac{1}{2}+\frac{\sqrt{3}}{2}\left(x-\frac{\pi}{6}\right)=\frac{\sqrt{3}}{2}+\frac{1}{2}-\frac{\sqrt{3}}{12}\pi$.

3. $f(x)=\sqrt{x} \Rightarrow f'(x)=\frac{1}{2}x^{-1/2}\frac{1}{2\sqrt{x}}$, so $f(4)=2$ and $f'(4)=\frac{1}{4}$.
   Thus, $L(x)=f(4)+f'(4)(x-4)=2+\frac{1}{4}(x-4)=2+\frac{1}{4}x-1=\frac{1}{4}x+1$.

4. $f(x)=2^x \Rightarrow f'(x)=2^x\ln 2$, so $f(0)=1$ and $f'(0)=\ln 2$.
   Thus, $L(x)=f(0)+f'(0)(x-0)=1+\ln 2x$.

7. $f(x)=\ln(x+1) \Rightarrow f'(x)=\frac{1}{x+1}$, so $f(0)=0$ and $f'(0)=1$.
   Therefore, $L(x)=f(0)+f'(0)(x-0)=0+1(x)=x$.

8. $f(x)=(1+x)^{-3} \Rightarrow f'(x)=-3(1+x)^{-4}$, so $f(0)=1$ and $f'(0)=-3$.
   Therefore, $L(x)=f(0)+f'(0)(x-0)=1-3x$.

9. $f(x)=\sqrt[4]{1+2x} \Rightarrow f'(x)=\frac{1}{4}(1+2x)^{-3/4}(2)=\frac{1}{2}(1+2x)^{-3/4}$, so $f(0)=1$ and $f'(0)=\frac{1}{2}$.
   Thus $L(x)=f(0)+f'(0)(x-0)=1+\frac{1}{2}x$.

10. $f(x)=e^x\cos x \Rightarrow f'(x)=e^x(-\sin x)+(\cos x)e^x=e^x(\cos x-\sin x)$, so $f(0)=1$ and $f'(0)=1$.
    Thus $L(x)=f(0)+f'(0)(x-0)=$

11. To estimate $(1.999)^4$ we'll find the linearization of $f(x)=x^4$ at $a=2$. Since $f'(x)=4x^3$, $f(2)=16$, and $f'(x)=32$, we have $L(x)=16+32(x-2)$. Thus, $x^4\approx 16+32(x-2)$. when x is near 2, so $(1.999)^4\approx 16+32(1.999-2)=160-0.032=15.986$.

12. $y=f(x)=\frac{1}{x} \Rightarrow dy=\frac{-1}{x^2}dx$. When $x=4$ and $dx=0.002$, $dy=-\frac{1}{16}(0.002)=-\frac{1}{8000}$, so

    $$\frac{1}{4.002}=f(4.002)\approx f(4)+dy=\frac{1}{4}-\frac{1}{8000}-\frac{1999}{8000}=0.249875.$$

13. $y=f(x)=\sqrt[3]{x} \Rightarrow dy=\frac{1}{3}x^{-2/3}dx$. When $x=1000$ and $dx=1$, $dy=\frac{1}{3}(1000)^{-2/3}(1)=\frac{1}{300}$, so

    $$\sqrt[3]{1001}=f(1001)\approx f(1000)+dy=10+\frac{1}{300}=10.00\overline{3}\approx 10.003.$$

14. $y=f(x)=\sqrt{x} \Rightarrow dy=\frac{1}{2\sqrt{x}}dx$. When $x=100$ and $dx=0.5$, $dy=\frac{1}{2}\cdot\frac{1}{2\sqrt{100}}=\frac{1}{40}$, so

    $$\sqrt{100.5}=f(100.5)\approx f(100)+dy=10+\frac{1}{40}=10.025.$$

15. $y = f(x) = e^x \Rightarrow dy = e^x dx$. When $x = 0$ and $dx = 0.1$, $dy = e^0(0.1) = 0.1$, so
$e^{0.1} = f(0.1) \approx f(0) + dy = 1 + 0.1 = 1.1$.

17. $f(x) = xe^x \Rightarrow f'(x) = xe^x + e^x = e^x(x+1)$, so $f(0) = 0$ and $f'(0) = e^0(0+1) = 1$.
Thus, $L(x) = f(0) + f'(0)(x-0) = 0 + 1(x) = x$ which is choice (**A**).

18. $y = f(x) = \sqrt{x+1} \Rightarrow dy = \dfrac{1}{2\sqrt{x+1}}dx$. When $x = 3$ and $dx = 0.2$, $dy = \dfrac{0.2}{2\sqrt{3+1}} = \dfrac{0.2}{4} = 0.05$, so
$\sqrt{4.2} = f(0.2) \approx f(3) + dy = 2 + 0.05 = 2.05$. This is choice (**D**).

19. $f(x) = \sqrt[3]{40x^2 - 17} \Rightarrow f'(x) = \dfrac{80x}{3\sqrt[3]{40x^2-17}}$, so $f(3) = 7$ and $f'(3) = \dfrac{80}{49}$.

Thus, the slope of $L(x)$ is (**B**) $\dfrac{80}{49}$.

21. (a) The graph shows that $f'(1) = 2$, so
$L(x) = f(1) + f'(1)(x-1) = 5 + 2(x-1) = 2x + 3$.
$f(0.9) \approx L(0.9) = 4.8$ and $f(1.1) \approx L(1.1) = 5.2$.
(b) From the graph, we see that is positive and decreasing. This means that the slopes of the tangent lines are positive, but the tangents are becoming less steep. So the tangent lines lie *above* the curve. Thus the estimates in part (a) are too large.

22. (a) $g(2) = -4$ and since $g'(x) = \sqrt{x^2+5}$, it follows that $g'(2) = 3$. So,
$L(x) = g(2) + g'(2)\cdot(x-2) = -4 + 3(x-2) = 3x - 10$. Thus, $g(1.95) \approx L(1.95) = -4.15$ and
$g(2.05) \approx L(2.05) = -3.85$.
(b) Since the slope, $g'(x)$, increases as x goes from 1.95 to 2.05, the linearization $L(x)$ must lie below the curve on this interval. Thus, these estimates are too small.