1. $f(x) = 3^x = e^{x\ln 3}$ $\quad f'(x) = \ln 3 e^{x\ln 3} = 3^x \ln 3$ **C**

2. Domain of $\sqrt{x^2+2x-3} = \sqrt{(x+3)(x-1)}$: $(-\infty,-3]\cup[1,\infty)$
   Domain of $\ln(x-1)$: $(1,\infty)$ Common domain: $(1,\infty)$
   Range on domain: $(-\infty,\infty)$ **D**

3. $x = y^{2/3} = 8^{2/3} = 4$
   $2y\dfrac{dy}{dx} = 3x^2 \Rightarrow \dfrac{dy}{dx} = \dfrac{3x^2}{2y} \Rightarrow \left.\dfrac{dy}{dx}\right|^{(x,y)=(4,8)} = 3$ **B**

4. $\dfrac{1}{2-0}\displaystyle\int_0^2 3^x\,dx = \dfrac{1}{2}\left.\dfrac{3^x}{\ln 3}\right|_0^2 = \dfrac{8}{2\ln 3} \approx 3.6$ **E**

5. $V = \displaystyle\int_1^3 2\pi(x+1)(x+1)dx = 2\pi\int_1^3 (x+1)^2\,dx = 2\pi\left.\frac{(x+1)^3}{3}\right|_1^3 = \frac{112\pi}{3}$ **D**

6. $\dfrac{x^2-2x+1}{\cos x}$ is continuous at $x=0$, so $\displaystyle\lim_{x\to 0}\frac{x^2-2x+1}{\cos x} = \left.\frac{x^2-2x+1}{\cos x}\right|_{x=0} = 1$ **C**

7. $f'(x) = \dfrac{3}{5\sqrt{1-(x/5)^2}} \Rightarrow f'(4) = 1$ **D**

8. $\dfrac{dy}{dx} = 2^x\ln 2 + \cos x$ $\quad y\big|_{x=3} = 8+\sin 3$ $\quad \left.\dfrac{dy}{dx}\right|_{x=3} = 8\ln 2 + \cos 3$

   $y - y_1 = m(x-x_1) \Rightarrow y-(8+\sin 3) = (8\ln 2+\cos 3)(x-3)$
   $y(0) = (8+\sin 3) - 3(8\ln 2 + \cos 3) \approx -5.5$ **A**

9. $Perimeter = 2(height) + width = 2h + w = 60 \Rightarrow w = 60-2h$
   $A = w\cdot h = (60-2h)h \Rightarrow \dfrac{dA}{dh} = 60-4h$
   Extrema: $\dfrac{dA}{dh} = 0 = 60-4h \Rightarrow h = 15 \Rightarrow A = 450$ **C**

10. $f'(x) = (2x)(\ln 3)3^{x^2+1}$ $\quad f'(-1) = -18\ln 3$ **E**

11. $f'(x) = -4x^3$ $\quad f'(0) = 0$
    $f''(x) = -12x^2$ $\quad f''(0) = 0$ Test is inconclusive for $f''(0) = 0$. **D**

12. Let $x = 2\sin\theta \quad \Rightarrow dx = 2\cos\theta d\theta \quad x = 0 \Rightarrow \theta = 0 \quad x = \sqrt{2} \Rightarrow \theta = \pi/4$

$$\int_0^{\sqrt{2}} \sqrt{4-x^2}\,dx = \int_0^{\pi/4} \sqrt{4-4\sin^2\theta}\,2\cos\theta d\theta = 4\int_0^{\pi/4} \sqrt{\cos^2\theta}\cos\theta d\theta = 4\int_0^{\pi/4} \cos^2\theta d\theta$$

$$... = 2\int_0^{\pi/4} [1+\cos 2\theta] d\theta = 2\left[\theta + \frac{\sin 2\theta}{2}\right]_0^{\pi/4} = \frac{\pi}{2} + 1 \qquad \textbf{B}$$

13. $\dfrac{f(\pi) - f(-\pi)}{\pi - (-\pi)} = \dfrac{\frac{1}{4+\pi} - \frac{1}{4-\pi}}{2\pi} = \dfrac{1}{\pi^2 - 16}$ **B**

14. $3(1 - \log_{(\pi/2)}(\pi/2)) = 0 \qquad \cos(\pi/2) = 0 \qquad \Rightarrow$ L'Hospital

$$\lim_{x\to\frac{\pi}{2}} \frac{3(1-\log_{(\pi/2)} x)}{\cos x} = 3\lim_{x\to\frac{\pi}{2}} \frac{-1/x\ln(\pi/2)}{-\sin x} = \frac{3}{\sin(\pi/2)\cdot\pi/2\cdot\ln(\pi/2)} \approx 4.23 \qquad \textbf{D}$$

15. $Area = \dfrac{1}{2}\displaystyle\int_\alpha^\beta [r(\theta)]^2\,d\theta = \dfrac{1}{2}\int_0^{2\pi} [1+\cos\theta]^2\,d\theta = \dfrac{1}{2}\int_0^{2\pi} [1 + 2\cos\theta + \cos^2\theta] d\theta =$

$$... = \frac{1}{2}\int_0^{2\pi}\left[1 + 2\cos\theta + \frac{1+\cos 2\theta}{2}\right] d\theta = \frac{1}{2}\left[\theta + 2\sin\theta + \frac{\theta}{2} + \frac{\sin 2\theta}{4}\right]_0^{2\pi} = \frac{3\pi}{2} \qquad \textbf{B}$$

16. $I \approx \dfrac{1}{2}\dfrac{2}{4}\left[f(0) + 2f(.5) + 2f(1) + 2f(1.5) + f(2)\right]$

$$= \frac{1}{4}\left[0 + 2(.125) + 2(1) + 2(3.375) + 8\right] \approx 4.3 \qquad \textbf{C}$$

17. $(a,b) \Rightarrow b = 2a - 1 \Rightarrow a + b = 3a - 1$

$y = 5 - x^3 \qquad y(3) = -22$

$\dfrac{dy}{dx} = -3x^2 \qquad \left.\dfrac{dy}{dx}\right|_{x=3} = -27 \qquad m_\perp = -\dfrac{1}{dy/dx} = \dfrac{1}{27}$

$y + 22 = \dfrac{1}{27}(x-3) \qquad y = 2x - 1 \qquad \Rightarrow 2a - 1 = \dfrac{1}{27}(a-3) - 22 \Rightarrow a \approx -10.7457$

$a + b = 3a - 1 = 3(-10.7457...) - 1 \approx -33.3$ **A**

18. $f'(x) = 2\sin(2x+5)\cos(2x+5)(2) = 4\sin(2x+5)\cos(2x+5)$ **D**

19. $\displaystyle\int (2x^3 + e^{2x})dx = 2\frac{x^4}{4} + \frac{e^{2x}}{2} + C = \frac{x^4 + e^{2x}}{2} + C$ **A**

20. $f'(x) = \dfrac{-2x}{2\sqrt{4-x^2}}$ $4 - x^2 > 0 \Rightarrow -2 < x < 2$ **A**

21. Only highest order terms play a role approaching infinity: $\lim\limits_{x\to\infty} \dfrac{8x^2}{2x^2} = 4$ **B**

22. $V = s^3$ $\dfrac{dV}{ds} = 3s^2$ $dV = 3s^2 ds$ $dV = 3(2)^2(.05) = .60$ **B**

23. $V = \int_1^3 (x^2)^2\,dx = \int_1^3 x^4\,dx = \left.\dfrac{x^5}{5}\right|_1^3 = \dfrac{242}{5}$ **D**

24. $f'(x) = \dfrac{\ln x \cdot e^x - e^x \cdot 1/x}{(\ln x)^2} = \dfrac{e^x(x\ln x - 1)}{x(\ln x)^2}$ **C**

25. $\dfrac{d}{dx}\int_a^{x^2} \sqrt{t}\cos t\,dt = 2x\left(\sqrt{x^2}\cos x^2\right) = 2x^2\cos x^2 \Rightarrow \left[2x^2\cos x^2\right]_{x=\sqrt{\pi}} = -2\pi$ **A**

26. $\int\left(x + x^{-1}\right)dx = \dfrac{x^2}{2} + \ln|x| + C$ **A**

27. $x = \int_0^2 \left(t^3 + \cos t\right)dt = \left.\dfrac{t^4}{4} + \sin t\right|_0^2 \approx 4.9$ **E**

28. $f(x) = |x| = \begin{cases} x & x \ge 0 \\ -x & x < 0 \end{cases}$ $f'(x) = \begin{cases} 1 & x \ge 0 \\ -1 & x < 0 \end{cases}$
$\lim\limits_{x\to 0^-} f'(x) = -1$ **A**

29. $x^2 + x + 6\big|_{x=2} = 12$ $x - 2\big|_{x=2} = 0$ $\dfrac{12}{0} \to \infty$ (does not exist) **D**

30. $f(x) = 2x^2 - 5x - 3$ $f'(x) = 4x - 5$ $f'(2) = 3$ **A**