1. **B** $f'(0) = 0$

2. **C** $\int \frac{1}{|3x+5|}\,dx = \frac{1}{3}\ln|3x+5| + C$

3. **D** $v(t) = r'(t) = 1\cdot\vec{i} - \frac{1}{t^2}\vec{j}$
$a(t) = r''(t) = \frac{+2}{t^3}\vec{j} \rightarrow a(1) = 2\vec{j}$

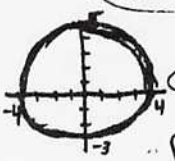
4. **A** $\int_1^4 \sqrt{1+\left(-\frac{3}{2}x^{1/2}\right)^2}\,dx = \int_1^4 \sqrt{1+\frac{9}{4}x}$
$= \frac{2}{3}\cdot\frac{4}{9}\left(1+\frac{9}{4}x\right)^{3/2}\Big|_1^4$

5. **D** Geometric Series

6. **C** $\int x\sec^2 x\,dx = x\tan x - \int \tan x\,dx$
$u = x \quad \int dv = \int \sec^2 x\,dx$
$du = dx \quad v = \tan x$

7. **B** $e^x = 1 + x + \frac{x^2}{2!} + \dots + \frac{x^n}{n!} + \dots$
$e^{-x^2} = 1 + (-x^2) + \frac{(-x^2)^2}{2!} + \dots + \frac{(-x^2)^n}{n!} + \dots$

8. **B** $\int_{-1}^0 \frac{dx}{(x-1)(x-2)(x-3)} = \int_{-1}^0 \frac{1}{2(x-1)} - \frac{1}{x-2} + \frac{1}{2(x-3)}$
$\frac{1}{2}\ln|x-1| - \ln|x-2| + \frac{1}{2}\ln|x-3|\Big|_{-1}^0$
$\left(0 - \ln 2 + \frac{1}{2}\ln 3\right) - \left(\frac{1}{2}\ln 2 - \ln 3 + \frac{1}{2}\ln 4\right)$
$\frac{3}{2}\ln 3 - \frac{3}{2}\ln 2 - \frac{1}{2}\ln 2^2$

9. **D**


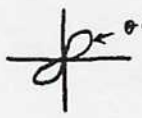
$\frac{1}{2}\cdot 2\int_{-\pi/2}^{\pi/2}(4+\sin\theta)^2\,d\theta$
$\int_{-\pi/2}^{\pi/2} 16 + 8\sin\theta + \sin^2\theta\,d\theta$
$\left(16\theta - 8\cos\theta + \frac{\theta}{2} - \frac{\sin 2\theta}{4\theta}\right)\Big|_{-\pi/2}^{\pi/2}$
$\frac{33\pi}{2}$

10. **D** $\lim_{x\to 0}\frac{1}{x}\left(1-\frac{1}{e^{2x}}\right) = \lim_{x\to 0}\frac{1-e^{-2x}}{x}$
L'Hopital's Rule $\rightarrow \lim_{x\to 0}\frac{2e^{-2x}}{1} = 2$

11. **B** Harmonic Diverges; Alt. Harmonic converges

12. **D** $\int t^3\sin t^2\,dt = \int t^2\cdot t\sin t^2\,dt$
$u = t^2 \quad dv = t\sin t^2\,dt$
$du = 2t\,dt \quad v = -\frac{1}{2}\cos t^2$
$-\frac{1}{2}t^2\cos t^2 + \frac{1}{2}\int 2t\cos t^2\,dt$
$-\frac{1}{2}t^2\cos t^2 + \frac{1}{2}\sin t^2 + C$

13. **D** $\int_{-2}^0 \frac{dx}{x^2+4x+8} = \int_{-2}^0 \frac{dx}{x^2+4x+4+4}$
$= \int_{-2}^0 \frac{dx}{(x+2)^2+4} = \frac{1}{2}\operatorname{Arctan}\frac{(x+2)}{2}\Big|_{-2}^0$
$\frac{1}{2}\operatorname{Arctan} 1 - \frac{1}{2}\operatorname{Arctan} 0$

14. **E**

$\theta\in[0,\pi/2]$ & Double $\quad \frac{1}{2}\int_0^{\pi/2} 4\sin 2\theta\,d\theta$
$-\cos 2\theta\Big|_0^{\pi/2}$
$1+1 =$ **2**

15. **B**

$2\int_0^1 \frac{1}{x^2-1}\,dx$
$2\lim_{a\to 1}\int_0^a \frac{1}{x^2-1}\,dx \rightarrow$
$\frac{1}{2(x-1)} - \frac{1}{2(x+1)}$
$\frac{1}{2}\cdot 2\lim_{a\to 1}\int_0^a \frac{1}{x-1} - \frac{1}{x+1}\,dx$
$\lim_{a\to 1}\left(\ln|x-1| - \ln|x+1|\right)\Big|_0^a$
$\lim_{a\to 1}\ln|a-1| - \ln|a+1| - 0$ (Diverges)
$\ln 2$

16. **C** Converges $\rightarrow$ Alt. Harmonic
Ratio Test $\rightarrow \left|\frac{(-1)^{n+1}}{n+1}\cdot\frac{n}{(-1)^n}\right|$
$\lim_{n\to\infty}\frac{n}{n+1} = 1$ (Inconclusive)

17. **A** $\int_{-\infty}^3 \frac{x}{1-x^2}\,dx \rightarrow -\frac{1}{2}\ln|1-x^2|\Big|_{-\infty}^3$
$\lim_{b\to-\infty} -\frac{1}{2}\ln 3 + \frac{1}{2}\ln|1-b^2|$ Diverges

18. **A** $v(t) = r'(t) = \vec{i} - 3t^2\vec{j}$
$v(0) = \vec{i}$

19. **B** $\lim_{x\to 0^+} x^2\ln x \rightarrow \lim_{x\to 0^+}\frac{\ln x}{x^{-2}}$
L'Hopital's Rule $\lim_{x\to 0^+}\frac{\frac{1}{x}}{\frac{-2}{x^3}} = \lim_{x\to 0^+}\frac{x^2}{-2}$

20. **D** $\lim_{n\to\infty}\frac{n}{5n-1} = \frac{1}{5} \neq 0$
$\therefore$ Diverges

21. **E** $v(t) = r'(t) = t\vec{i} + \sqrt{2}\vec{j} + \frac{1}{t}\vec{k}$

$\text{Speed} = |v(t)| = \sqrt{t^2 + (\sqrt{2})^2 + (\frac{1}{t})^2}$

$@\ t=1 \rightarrow \sqrt{1+2+1} = \boxed{2}$

22. **B** $\int \frac{dx}{(x+2)(x^2+1)} = \int \frac{\frac{1}{5}}{(x+2)} + \frac{\frac{2-x}{5}}{(x^2+1)}\,dx$

$\frac{1}{5}\ln|x+2| + \frac{2}{5}\int \frac{1}{x^2+1}\,dx - \int \frac{x}{5(x^2+1)}\,dx$

$+ \frac{2}{5}\text{Arctan}(x^2+8) -$

$\frac{1}{10}\ln|x^2+1|$

23. **B** $\int \ln x\,dx$

$u = \ln x \quad dv = dx \rightarrow x\ln x - \int x\cdot\frac{1}{x}\,dx$

$du = \frac{1}{x}dx \quad v = x$

$x\ln x - \int dx$

$x\ln x - x + C$

24. **D** $\int_0^{2\pi} \cos 3x \sin 3x\,dx = \int_0^{2\pi} \frac{1}{2}\sin 6x\,dx$

$-\frac{1}{12}\cos 6x\,\Big|_0^{2\pi}$

$-\frac{1}{12} - (-\frac{1}{12}) = 0$

25. **A** See above

$-\frac{1}{12}\cos 6x\,\Big|_0^{\pi/2} \rightarrow \frac{1}{12} + \frac{1}{12} = \frac{1}{6}$

26. **A** $\lim_{n\to\infty} \left|\frac{(n+1)(n+2)\,x^{n+1}}{5^{n+1}} \cdot \frac{5^n}{x^n(n+1)}\right| < 1$

$\left|\frac{x}{5}\right| < 1 \Rightarrow -5 < x < 5$

$x = 5 \rightarrow \sum_{n=1}^{\infty} n(n+1) \rightarrow \text{diverges}$

$x = (-5) \rightarrow \sum_{n=1}^{\infty} n(n+1)(-1)^n \rightarrow \text{diverges}$

27. **D** $\int \frac{x^2+2}{x^2+2x}\,dx = \int \frac{-3}{x+2} + \frac{1}{x} + 1$

Long Div. & Partial Fractions

$-3\ln|x+2| + \ln|x| + x + C$

28. **B** $\int \cos(\ln x)\,dx$

$u = \cos(\ln x) \quad dv = dx$

$du = -\sin(\ln x)\cdot\frac{1}{x} \quad v = x$

$x\cos(\ln x) + \int \sin(\ln x)\,dx$

$u = \sin(\ln x) \quad dv = dx$

$du = \cos(\ln x)\cdot\frac{1}{x} \quad v = x$

$x\cos(\ln x) + x\sin(\ln x) - \int \cos(\ln x)\,dx$

$\frac{2\int \cos(\ln x)\,dx}{2} = \frac{x\cos(\ln x) + x\sin(\ln x)}{2}$

29. **C** $x' = e^t\sin t + e^t\cos t$

$y' = e^t\cos t - e^t\sin t$

$\int_0^{\pi} \sqrt{(e^t\sin t + e^t\cos t)^2 + (e^t\cos t - e^t\sin t)^2}\,dt$

$\sqrt{e^{2t}\sin^2 t + e^{2t}\sin 2t + e^{2t}\cos^2 t + e^{2t}\cos^2 t - e^{2t}\sin 2t + e^{2t}\sin^2 t}$

$\int_0^{\pi} e^t\sqrt{\sin^2 t + \cos^2 t + \sin^2 t + \cos^2 t}\,dt$

$\sqrt{2}\,e^t\,\Big|_0^{\pi} = \sqrt{2}\,e^{\pi} - \sqrt{2}$

30. **D** $f(0) + f'(0)\cdot x + \frac{f''(0)\cdot x^2}{2!} + \ldots$

$f(x) = \sin^{-1}x \qquad 0 + x + 0 + \frac{x^3}{3!} + 0 + \frac{9x^5}{5!}$

$f'(x) = \frac{1}{\sqrt{1-x^2}}$

$f''(x) = x(1-x^2)^{-3/2}$

$f'''(x) = \frac{2x^2+1}{(1-x^2)^{5/2}}$

$f^{IV}(x) = \frac{3x(2x^2+3)}{(1-x^2)^{7/2}}$

$f^{V}(x) = \frac{24x^4 + 72x^2 + 9}{(1-x^2)^{9/2}}$