1. A
2. D
3. A
4. A
5. D
6. C
7. B
8. A
9. B
10. A
11. B
12. C
13. C
14. C
15. D
16. C
17. C
18. B
19. D
20. C
21. A
22. B
23. C
24. B
25. B
26. A
27. D
28. D
29. C
30. E

1. A The indefinite integral is commonly known as $\arctan(x)+C$. Since $\arctan(x)+\text{arccot}(x)=\frac{\pi}{2}$, we let $\arctan(x)=\frac{\pi}{2}-\text{arccot}(x)$ to get that we can also write the answer in a different way: $\arctan(x)+C=-\text{arccot}(x)+\frac{\pi}{2}+C=$ $-\text{arccot}(x)+C(A)$ since the C just represents some constant, which remains a constant even if $\frac{\pi}{2}$ is added to it. OR we write the integral as $-\int\frac{-1}{1+x^2}dx=$ $-\text{arccot}(x)+C$.

2. D We use integration by parts, putting the $arctan(x)$ on the "derivative side" and the $\frac{1}{x^3}$ on the "integration side." $\int_1^\infty\frac{\arctan(x)}{x^3}dx=\frac{-\arctan(x)}{2x^2}\Big|_1^\infty+\frac{1}{2}\int_1^\infty\frac{1}{x^2(1+x^2)}dx=\frac{\pi}{8}+\frac{1}{2}\int_1^\infty\frac{1}{x^2}-\frac{1}{x^2+1}dx=\frac{\pi}{8}+\frac{1}{2}\left(-\frac{1}{x}\Big|_1^\infty\right)-\frac{1}{2}\left(\arctan(x)\Big|_1^\infty\right)=\frac{\pi}{8}+\frac{1}{2}-\left(\frac{\pi}{4}-\frac{\pi}{8}\right)=\frac{1}{2}(D)$

3. A Let $x=\sin(u)\rightarrow dx=\cos(u)\,du$.
$\int_0^{\frac{\sqrt{2}}{2}}\frac{x^2}{\sqrt{1-x^2}}dx=\int_0^{\frac{\pi}{4}}\frac{\sin^2(u)}{\cos(u)}\cos(u)\,du=\int_0^{\frac{\pi}{4}}\sin^2(u)du=\int_0^{\frac{\pi}{4}}\frac{1}{2}du-\int_0^{\frac{\pi}{4}}\frac{1}{2}\cos(2u)\,du=$ $\frac{\pi}{8}-\left(\frac{1}{4}\sin(2u)\Big|_0^{\frac{\pi}{4}}\right)=\frac{\pi}{8}-\frac{1}{4}$. So $K=8, H=4$, and $K+H=12(A)$

4. A Let $9-x^2=u\rightarrow -2xdx=du$.
Then $\int_0^3 x\sqrt{9-x^2}dx=\int_9^0-\frac{1}{2}\sqrt{u}du=\int_0^9\frac{1}{2}\sqrt{u}du=\frac{1}{3}u^{\frac{3}{2}}\Big|_0^9=9(A)$

5. D Let $4-x^2=u\rightarrow -2xdx=du$.
Then $\int_0^4 x^3\sqrt{4-x^2}dx=\int_4^0-\frac{1}{2}x^2\sqrt{u}du=\int_0^4\frac{1}{2}(4-u)\sqrt{u}du=\int_0^4 2\sqrt{u}du-\int_0^4\frac{1}{2}u^{\frac{3}{2}}du=\frac{4}{3}u^{\frac{3}{2}}\Big|_0^4-\frac{1}{5}u^{\frac{5}{2}}\Big|_0^4=\frac{32}{3}-\frac{32}{5}=\frac{64}{15}(A)$

6. C Using shell method, the volume should be
$2\pi\int_0^1(x)(2x^3+2x)dx=2\pi\int_0^1 2x^4+2x^2dx=\frac{32\pi}{15}(C)$ after computation.

7. B Rotating around the y-axis, we use shell method to get a volume of $2\pi\int_0^a x\sqrt{x}dx=\frac{4\pi}{5}a^{\frac{5}{2}}$ and rotating around the x-axis, we use disk method to get a volume of $\pi\int_0^a xdx=\frac{\pi}{2}a^2$. These volumes are equal, so we have $\frac{4\pi}{5}a^{\frac{5}{2}}=\frac{\pi}{2}a^2\rightarrow$ $\sqrt{a}=\frac{5}{8}\rightarrow a=\frac{25}{64}$. Note that $a=0$ doesn't work because we have the $a>0$ condition. Then $m=25, n=64$, and $m+n=89(B)$

8. A We will use the property that $\tan^2(x)=\sec^2(x)-1$.

$\int_0^{\frac{\pi}{3}} \tan^4(x)dx = \int_0^{\frac{\pi}{3}} \tan^2(x)(\sec^2(x)-1)\,dx = \int_0^{\frac{\pi}{3}} \tan^2(x)\sec^2(x)dx - \int_0^{\frac{\pi}{3}} \tan^2(x)dx = \frac{1}{3}\tan^3(x)\Big|_0^{\frac{\pi}{3}} - \int_0^{\frac{\pi}{3}}(\sec^2(x)-1)dx = \sqrt{3} - \int_0^{\frac{\pi}{3}}\sec^2(x)dx + \int_0^{\frac{\pi}{3}} 1dx = \sqrt{3} - \tan(x)\Big|_0^{\frac{\pi}{3}} + x\Big|_0^{\frac{\pi}{3}} = \sqrt{3}-\sqrt{3}+\frac{\pi}{3} = \frac{\pi}{3}(A)$

9. B Let $u = ix \rightarrow du = idx$. Then

$A = i\int_{\ln(2)}^{\ln(3)} \tan(ix)\,dx = \int_{i\ln(2)}^{i\ln(3)} \tan(u)\,du = \ln(sec(u))\Big|_{i\ln(2)}^{i\ln(3)} = \ln\big(sec(i\ln(3))\big) - \ln\big(sec(i\ln(2))\big)$. Using $\cos(x) = \frac{e^{ix}+e^{-ix}}{2} \rightarrow \sec(x) = \frac{2}{e^{ix}+e^{-ix}}$, $\sec\big(i\ln(3)\big) = \frac{3}{5}$ and $\sec\big(i\ln(2)\big) = \frac{4}{5}$ to get $\ln A = \ln\left(\frac{3}{5}\right) - \ln\left(\frac{4}{5}\right) = \ln\left(\frac{3}{4}\right)$

$\rightarrow A = \frac{3}{4}$, so $m = 3$, $n = 4$, and $m + n = 7(B)$

10. A Let $x = 2\tan(u) \rightarrow dx = 2\sec^2(u)du$. So

$\int_{\frac{2}{\sqrt{3}}}^{\infty} \frac{\sqrt{4+x^2}}{x^4}dx = \frac{1}{4}\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \frac{\sec^3(u)}{\tan^4(u)}du = \frac{1}{4}\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \frac{cos(u)}{sin^4(u)}du$. Letting $w = \sin(u) \rightarrow dw = \cos(u)\,du$, $\frac{1}{4}\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \frac{cos(u)}{\sin^4(u)}du = \frac{1}{4}\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \frac{\cos(u)}{\sin^4(u)}du = \frac{1}{4}\int_{\frac{1}{2}}^{1} \frac{1}{w^4}dw = -\frac{1}{12}(\frac{1}{w^3}\Big|_{\frac{1}{2}}^{1}) = \frac{7}{12}$ after computation. So $m = 7$ and $n = 12$ and $m + n = 19(A)$

11. B We can split up the integral into two smaller integrals.
This leads to $\ln A = \int_0^{\ln(5)} \frac{e^x-1}{e^x+1}dx = \int_0^{\ln(5)} 1dx + \int_0^{\ln(5)} -\frac{2}{e^x+1}dx = \ln(5) + 2\int_0^{\ln(5)} -\frac{e^{-x}}{1+e^{-x}}dx = \ln(5) + 2(\ln(1+e^{-x})\Big|_0^{\ln(5)}) = \ln(5) + 2\left(\ln\left(\frac{6}{5}\right) - \ln(2)\right) = \ln(5) + \ln\left(\frac{36}{25}\right) - \ln(4) = \ln\left(\frac{9}{5}\right)$. So $\ln A = \ln\left(\frac{9}{5}\right) \rightarrow A = \frac{9}{5}$. So $m = 9, n = 5$, and $m + n = 14(B)$

12. C We can multiply top and bottom by $\sec^2(x)$ and let $u = \tan(x) \rightarrow du = \sec^2(x)dx$. $\int_0^{\frac{\pi}{2}} \frac{1}{9\sin^2(x)+4\cos^2(x)}dx = \int_0^{\frac{\pi}{2}} \frac{\sec^2(x)}{9\tan^2(x)+4}dx = \int_0^{\infty} \frac{1}{9u^2+4}du = \frac{1}{9}\int_0^{\infty} \frac{1}{u^2+\left(\frac{2}{3}\right)^2}du = \frac{1}{6}\arctan\left(\frac{3}{2}u\right)\Big|_0^{\infty} = \frac{1}{6}\left(\frac{\pi}{2}\right) = \frac{\pi}{12}(C)$. A useful tool is that $\int \frac{1}{x^2+a^2}dx = \frac{1}{a}\arctan\left(\frac{x}{a}\right) + C$.

13. C We can write $\sin(x)+\cos(x)$ into one trigonometric function by writing $\sin(x) + \cos(x) = \sqrt{2}\left(\cos\left(\frac{\pi}{4}\right)\cos(x) + \sin\left(\frac{\pi}{4}\right)\sin(x)\right) = \sqrt{2}\cos\left(x-\frac{\pi}{4}\right)$. Then $\int_0^{\frac{\pi}{2}} \frac{1}{\sin(x)+\cos(x)}dx = \frac{\sqrt{2}}{2}\int_0^{\frac{\pi}{2}} \sec\left(x-\frac{\pi}{4}\right)dx = \frac{\sqrt{2}}{2}\ln\left(sec\left(x-\frac{\pi}{4}\right) + tan\left(x-\frac{\pi}{4}\right)\right)\Big|_0^{\frac{\pi}{2}} =$

$\frac{\sqrt{2}}{2}\ln\left(\frac{\sqrt{2}+1}{\sqrt{2}-1}\right) = \frac{\sqrt{2}}{2}\ln\left(\left(\sqrt{2}+1\right)^2\right) = \sqrt{2}\ln\left(1+\sqrt{2}\right)(C)$. We used the fact that $\int \sec(x)\,dx = \ln(sec(x) + tan(x)) + C$.

14. C We let $x = f(u) \rightarrow dx = f'(u) = d(2u^3 + 2u + 4) = (6u^2 + 2)du$. So $\int_8^{24} \frac{1}{g^2(x)} dx = \int_1^2 \frac{1}{u^2}(6u^2+2)du = \int_1^2 \left(6 + \frac{2}{u^2}\right) du = \left(6u - \frac{2}{u}\right)\Big|_1^2 = 7(C)$. Since $g(x)$ is the inverse of $f(x)$, $g(f(u)) = u$. Also, the bounds are $u = 1$ and $u = 2$ because $f(1) = 8$ and $f(2) = 24$.

15. D Using the tool in the beginning of the test, we can factor the expression: $x^2 + 90x + 2024 = (x+44)(x+46)$. Then let $u = x + 45 \rightarrow dx = du$ so $\int_{-51}^{-39}(x+44)(x+46)dx = \int_{-6}^{6}(u-1)(u+1)du = \int_{-6}^{6}(u^2-1)\,du = \frac{1}{3}u^3 - u\Big|_{-6}^{6} = 132(D)$ after computation.

16. C Turning the sum into an integral,

$$\lim_{n\to\infty} \sum_{i=0}^{n} \frac{1}{\sqrt{i^2+3n^2}} = \lim_{n\to\infty} \sum_{i=0}^{n} \frac{1}{n}\left(\frac{1}{\sqrt{\left(\frac{i}{n}\right)^2+3}}\right) = \int_0^1 \frac{1}{\sqrt{x^2+3}}dx.$$ Letting

$x = \sqrt{3}\tan(u) \rightarrow dx = \sqrt{3}\sec^2(u)du$, $\int_0^1 \frac{1}{\sqrt{x^2+3}}dx = \int_0^{\frac{\pi}{6}} \frac{1}{\sqrt{3}\sec(u)}\sqrt{3}\sec^2(u)du = \int_0^{\frac{\pi}{6}} \sec(u)\,du = \ln(sec(u) + tan(u))\Big|_0^{\frac{\pi}{6}} = \ln\left(\sqrt{3}\right) = \frac{1}{2}\ln(3)\,(C)$. We used the fact that $\int \sec(x)\,dx = \ln(sec(x) + tan(x)) + C$.

17. C For the sake of practice, let's solve for $\int_0^k \lfloor x \rfloor + \{x\} dx$ in terms of k and then plug in $k = 12$. $\int_0^k \lfloor x \rfloor + \sqrt{\{x\}}\,dx = \sum_{a=0}^{k-1} \int_a^{a+1} \lfloor x \rfloor + \sqrt{\{x\}}\,dx$ after splitting the integral into multiple smaller integrals. Treating a as a positive integer constant, we let $x = a + y \rightarrow dx = dy$, so $\sum_{a=0}^{k-1} \int_a^{a+1} \lfloor x \rfloor + \sqrt{\{x\}}\,dx = \sum_{a=0}^{k-1} \int_0^1 \lfloor a+y \rfloor + \sqrt{\{a+y\}}\,dy = \sum_{a=0}^{k-1} \int_0^1 a + \sqrt{y}\,dy$. $\lfloor a+y \rfloor = a$ because y only ranges from 0 to 1 and $\{a+y\} = y$ because a is an integer and y ranges from 0 to 1 (Our variable of integration is y, and the bounds are from 0 to 1, so y only ranges from 0 to 1). $\sum_{a=0}^{k-1} \int_0^1 (a + \sqrt{y})\,dy = \sum_{a=0}^{k-1}\left(ay + \frac{2}{3}y\sqrt{y}\Big|_0^1\right) = \sum_{a=0}^{k-1}\left(a + \frac{2}{3}\right) = \sum_{a=0}^{k-1} a + \sum_{a=0}^{k-1} \frac{2}{3} = \frac{(k-1)k}{2} + \frac{2}{3}k = \frac{k^2}{2} + \frac{k}{6}$. At $k = 12$, our answer is $\frac{12^2}{2} + \frac{12}{6} = 74(C)$.

18. B We let $x = e^u$ and then do integration by parts: $x = e^u \rightarrow dx = e^u du$, so $\int_1^e \frac{\ln(x)}{x^2}dx = \int_0^1 ue^{-2u}(e^u du) = \int_0^1 ue^{-u}du = -ue^{-u}\Big|_0^1 - \int_0^1 -e^{-u}du = -\frac{1}{e} - \left(e^{-u}\Big|_0^1\right) = -\frac{1}{e} - \left(\frac{1}{e} - 1\right) = 1 - \frac{2}{e} = \frac{e-2}{e}(B)$

19. D Letting $x = \frac{1}{u} \rightarrow dx = -\frac{1}{u^2}du$,

$\int_0^1 \frac{1}{(1+x^2)\sqrt{1-x^2}}dx = \int_\infty^1 -\frac{1}{u^2\left(1+\frac{1}{u^2}\right)\sqrt{1-\frac{1}{u^2}}}du = \int_1^\infty \frac{u}{(u^2+1)\sqrt{u^2-1}}du$. Now we let $u^2 = w \to 2udu = dw$ to get $\int_1^\infty \frac{u}{(u^2+1)\sqrt{u^2-1}}du = \frac{1}{2}\int_1^\infty \frac{1}{(w+1)\sqrt{w-1}}dw$. We let $\sqrt{w-1} = z \to w = z^2+1 \to dw = 2zdz$ to get $\frac{1}{2}\int_1^\infty \frac{1}{(w+1)\sqrt{w-1}}dw = \frac{1}{2}\int_0^\infty \frac{2z}{(z^2+1)z}dz = \int_0^\infty \frac{1}{z^2+2}dz = \int_0^\infty \frac{1}{z^2+(\sqrt{2})^2}dz = \frac{\sqrt{2}}{2}\arctan\left(\frac{z}{\sqrt{2}}\right)\Big|_0^\infty = \frac{\pi\sqrt{2}}{4}(D)$. A useful tool is that $\int \frac{1}{x^2+a^2}dx = \frac{1}{a}\arctan\left(\frac{x}{a}\right) + C$.

20. C To solve this integral we can use the famous Weierstrass substitution. Using trig properties and manipulations, we get that as a result of $\tan\left(\frac{x}{2}\right) = u$, the following properties are true: $\cos(x) = \frac{1-u^2}{1+u^2}$, $\sin(x) = \frac{2u}{1+u^2}$ and $dx = \frac{2}{1+u^2}$. Using Weierstrass, $\int_0^{\frac{\pi}{2}} \frac{1+\sin(x)}{1+\cos(x)}dx = \int_0^1 \frac{1+\frac{2u}{1+u^2}}{1+\frac{1-u^2}{1+u^2}}\left(\frac{2}{1+u^2}du\right) = \int_0^1 \frac{\frac{u^2+2u+1}{1+u^2}}{\frac{2}{1+u^2}}\left(\frac{2}{1+u^2}du\right) = \int_0^1 \frac{u^2+2u+1}{u^2+1}du$. Notice that we were able to cancel out a $\frac{2}{1+u^2}$. Then $\int_0^1 \frac{u^2+2u+1}{u^2+1}du = \int_0^1\left(1+\frac{2u}{u^2+1}\right)du = \int_0^1 1du + \int_0^1 \frac{2u}{1+u^2}du = (u+\ln(u^2+1))\Big|_0^1 = 1+\ln(2)\,(C)$

21. A We can use the factoring rule that $x^3+y^3 = (x+y)(x^2-xy+y^2)$ to simplify this integral. $\int_0^{\frac{\pi}{2}} \sin^3(x)+\cos^3(x)dx = \int_0^{\frac{\pi}{2}}(\sin(x)+\cos(x))(\sin^2(x) - \sin(x)\cos(x)+\cos^2(x))dx = \int_0^{\frac{\pi}{2}}(\sin(x)+\cos(x))(1-\sin(x)\cos(x))dx = \int_0^{\frac{\pi}{2}}\sin(x)\,dx - \int_0^{\frac{\pi}{2}}\sin^2(x)\cos(x)\,dx + \int_0^{\frac{\pi}{2}}\cos(x)\,dx - \int_0^{\frac{\pi}{2}}\sin(x)\cos^2(x)dx = -\cos(x)\Big|_0^{\frac{\pi}{2}} - \frac{1}{3}\sin^3(x)\Big|_0^{\frac{\pi}{2}} + \sin(x)\Big|_0^{\frac{\pi}{2}} + \frac{1}{3}\cos^3(x)\Big|_0^{\frac{\pi}{2}} = 1-\frac{1}{3}+1-\frac{1}{3} = \frac{4}{3}(A)$

22. B Once we write $f(a)$ in terms of a, we can obtain two telescoping series: $f(a) = \int_0^1 x^a(1-x)^2dx = \int_0^1 x^a dx - \int_0^1 2x^{a+1}dx + \int_0^1 x^{a+2}dx = \frac{1}{a+1} - \frac{2}{a+2} + \frac{1}{a+3} = \left(\frac{1}{a+1}-\frac{1}{a+2}\right) - \left(\frac{1}{a+2}-\frac{1}{a+3}\right)$. $S = \sum_{a=1}^\infty f(a) = \sum_{a=1}^\infty\left(\frac{1}{a+1}-\frac{1}{a+2}\right) - \left(\frac{1}{a+2}-\frac{1}{a+3}\right) = \sum_{a=1}^\infty\left(\frac{1}{a+1}-\frac{1}{a+2}\right) - \sum_{a=1}^\infty\left(\frac{1}{a+2}-\frac{1}{a+3}\right) = \frac{1}{2}-\frac{1}{3} = \frac{1}{6}$ since both series are telescoping series where $\sum_{a=1}^\infty\left(\frac{1}{a+1}-\frac{1}{a+2}\right) = \frac{1}{2}$ and $\sum_{a=1}^\infty\left(\frac{1}{a+2}-\frac{1}{a+3}\right) = \frac{1}{3}$. Then $S = \frac{1}{6}$, $m = 1, n = 6$, and $m+n = 7(B)$

23. C Let's solve for $f'(x)$ first then use an equation with $g'(x)$ in it. $f(x) = \int_3^x \frac{1}{\sqrt{t+1}}dt \to f'(x) = \frac{1}{\sqrt{x+1}}$. Since $g(x)$ is the inverse of $f(x)$, $f\big(g(x)\big) = x \to f'\big(g(x)\big)g'(x) = 1$. Letting $x = 86$, $f'\big(g(86)\big)g'(86) = 1$. $f(x) = 2\sqrt{t+1}\Big|_3^x = 2\sqrt{x+1}-4$. $g(86)$ is the value of x that satisfies $f(x) = 86 \to$

$2\sqrt{x+1}-4=86 \to x=2024$, so $g(86)=2024$. $f'\big(g(86)\big)g'(86)=1 \to$ $f'(2024)g'(86)=1 \to \frac{1}{\sqrt{2024+1}}g'(86)=1 \to \frac{1}{45}g'(86)=1 \to g'(86)=$ $45(C)$

24. B The 2nd degree Maclaurin approximation for $f(x)$ is, in general, $f(0)+f'(0)x+\frac{f''(0)}{2}x^2$. So let's solve for $f(x), f'(x)$, and $f''(x)$ while treating k as a constant and then plug in $x=0$. $f(x)=\cos^k(x) \to f'(x)=-kcos^{k-1}(x)\sin(x) \to$ $f''(x)=k(k-1)\sin^2(x)\cos^{k-2}(x)-kcos^k(x)$. $f(0)=1, f'(0)=0, f''(0)=-k$, so the 2nd degree Maclaurin approximation for $f(x)$ is $1-\frac{k}{2}x^2$. We have $\int_0^1 x^k dx=\int_0^1 1-\frac{k}{2}x^2dx \to \frac{1}{k+1}=1-\frac{k}{6} \to 6=6k+6-k(k+1) \to k^2-5k=0 \to k=0$ or 5. But k is a positive integer, so $k=$ $5(B)$

25. B The midpoint approximation of the integral with $n=2$ has rectangles centered at $x=\frac{\pi}{4}$ and $x=\frac{3\pi}{4}$: $M(k)=\frac{\pi}{2}(\sin^{2k}\left(\frac{\pi}{4}\right)+\sin^{2k}\left(\frac{3\pi}{4}\right))=\frac{\pi}{2}\left(\frac{1}{2^k}+\frac{1}{2^k}\right)=\pi\left(\frac{1}{2^k}\right)$. So $\sum_{k=0}^{\infty}\pi\left(\frac{1}{2^k}\right)=\pi\sum_{k=0}^{\infty}\frac{1}{2^k}=$ $2\pi(B)$

26. A The integrand can be recognized as the derivative of arcsecant. $\int_2^7 \frac{1}{x\sqrt{x^2-1}}dx=\operatorname{arcsec} x\,|_2^7=\operatorname{arcsec} 7-\operatorname{arcsec} 2$. When $\sec\theta=7$, $\tan\theta=4\sqrt{3}$, and when $\sec\phi=2$, $\tan\phi=\sqrt{3}$. By the tangent addition formula, $\tan(\theta-\phi)=\frac{4\sqrt{3}-\sqrt{3}}{1+4\sqrt{3}\cdot\sqrt{3}}=\frac{3\sqrt{3}}{13}$. So $r=3$, $s=3$, $t=13$, and $r+s+t=$ $19(A)$.

27. D Because $f(x)$ is odd, $\int_{-a}^{a}f(x)dx=0$ so $\int_2^6 f(x)dx=4$, $\int_6^{11}f(x)dx=3$, and $\int_1^{11}f(x)dx=5$. $\int_2^{11}f(x)dx=\int_2^6 f(x)dx+\int_6^{11}f(x)dx=4+3=7$. $\int_1^2 f(x)dx=\int_1^{11}f(x)dx-\int_2^{11}f(x)dx=5-7=-2$. $\int_{-2}^{-1}f(x)dx=-\int_1^2 f(x)dx=$ $2(D)$.

28. D We use partial fractions.

$\frac{2x+1}{x^3+x^2}=\frac{2x+1}{x^2(x+1)}=\frac{A}{x}+\frac{B}{x^2}+\frac{C}{x+1}=\frac{Ax(x+1)+B(x+1)+Cx^2}{x^2(x+1)}$. Comparing coefficients, we get that $A=1, B=1, C=-1$. So $\int_1^2\frac{2x+1}{x^3+x^2}dx=\int_1^2(\frac{1}{x}+\frac{1}{x^2}-\frac{1}{x+1})dx=\int_1^2\frac{1}{x}dx+\int_1^2\frac{1}{x^2}dx-\int_1^2\frac{1}{x+1}dx=\ln(2)+\frac{1}{2}-\ln\left(\frac{3}{2}\right)=$ $\ln\left(\frac{4}{3}\right)+\frac{1}{2}(D)$

29. C This region ranges from $x=0$ to $x=1$. The formula for the x-coordinate of the centroid is $\frac{\int_a^b xf(x)dx}{\int_a^b f(x)dx}=\frac{\int_0^1(-2x^4-2x^2+4x)dx}{\int_0^1(-2x^3-2x+4)dx}=\frac{\frac{14}{15}}{\frac{5}{2}}=\frac{28}{75}$. So $m=28$ and $n=75$ makes $m+n=$ $103(C)$

30. E No answer choice has a constant of integration, so the answer is E. For practice, $\int xcos(x)dx=xsin(x)-\int\sin(x)\,dx=$ $xsin(x)+\cos(x)+C(E)$