1) $|3x+5| = \begin{cases} -3\left(x+\frac{3}{5}\right), x < \frac{-3}{5} \\ 3\left(x+\frac{3}{5}\right), x \geq \frac{-3}{5} \end{cases} \therefore \int_{-5}^{1} |3x+5| dx = \int_{-5}^{\frac{-5}{3}} \left(-3\left(x+\frac{5}{3}\right)\right) dx + \int_{\frac{-5}{3}}^{1} \left(3\left(x+\frac{5}{3}\right)\right) dx = \frac{82}{3}$ B

2) $0=\sqrt{\ln x} \therefore x = e^0 = 1 \Rightarrow$ Disc Method: $\pi \int_1^e \left(\sqrt{\ln x}\right)^2 dx = \pi$ B

3) $\int x\sqrt{4x+3}dx$ u=4x+3 $\therefore$ x=$\frac{u-3}{4} \Rightarrow dx = \frac{du}{4} \Rightarrow \int\left(\frac{u-3}{4}\right)\sqrt{u}\left(\frac{du}{4}\right) = = \frac{(4x+3)^{5/2}}{40} - \frac{(4x+3)^{3/2}}{8} + C$ A

4) n=5 $\therefore \frac{1-0}{5} = \frac{1}{5} \Rightarrow \frac{1}{5}\left(0^2+4\right) + \frac{1}{5}\left(\left(\frac{1}{5}\right)^2+4\right) + \frac{1}{5}\left(\left(\frac{2}{5}\right)^2+4\right) + \frac{1}{5}\left(\left(\frac{3}{5}\right)^2+4\right) + \frac{1}{5}\left(\left(\frac{4}{5}\right)^2+4\right) = \frac{106}{25}$ D

5) $-x^2+3x+5 = x^2-6x+12$ at $x = \left\{1, \frac{7}{2}\right\} \Rightarrow$ Area= $\int_1^{\frac{7}{2}} \left(\left(-x^2+3x+5\right) - \left(x^2-6x+12\right)\right)dx = \frac{125}{24}$ A

6) y=C$e^{kt} \Rightarrow$ k=$\frac{1}{4{,}510{,}000{,}000} \ln\frac{1}{2} \Rightarrow .85 = e^{kt} \Rightarrow \ln .85 = kt \therefore t = \frac{\ln .85}{\ln k} \approx 1{,}057{,}438{,}294$ C

7) $\int \frac{\tan x}{\cos^2 x} dx \Rightarrow u = \tan x$ & $du = \sec^2 x dx \Rightarrow \frac{1}{\cos^2 x} = \sec^2 x \Rightarrow \int u du = \frac{u^2}{2} + C \therefore \frac{\tan^2 x}{2} + C$ B

8) C

9) $\int \frac{3+x}{x^2+9}dx = \int \frac{x}{x^2+9}dx + \int \frac{3}{x^2+9}dx \Rightarrow \frac{1}{2}\int \frac{2x}{x^2+9}dx + \int \frac{3}{x^2+9}dx = \frac{1}{2}\ln\left|x^2+9\right| + \frac{1}{3}\arctan\left(\frac{x}{3}\right) + C$ E

10) $\int_{-5}^{7} f(x)dx = -\left(\int_{-3}^{-5} f(x)dx = 4\right) + \int_{-3}^{4} f(x)dx = 7 + -\left(\int_{7}^{4} f(x)dx = 3\right)$=-4+7-3=0 D

11) Using the shell method, $2\pi \int_0^a (a-x)\left(x^{\frac{2}{3}}\right)dx = 2\pi \int_0^a ax^{\frac{2}{3}} - x^{\frac{5}{3}} dx = \frac{9a^{\frac{8}{3}}\pi}{20}$ D

12) $\frac{dy}{dt} = k(y-30) \Rightarrow \int \frac{1}{y-30}dy = \int kdt \Rightarrow \ln|y-30| = kt + C \Rightarrow y-30 = e^{kt} + C \Rightarrow y = 30 + Ce^{kt} \Rightarrow$ When y=45, t=0, so solve for C. $45 = 30 + Ce^{k(0)}$ $\therefore$ C=15$\Rightarrow$Solve for k. $\Rightarrow 41.5 = 30 + 15e^{20k} \Rightarrow$ k≈-.01328516
$\Rightarrow y = 30 + 15e^{-.01328516(45)} \Rightarrow$ y=38.3°C C

13) f(x)=$\frac{d}{dx}\left[\frac{2e^x - e^x}{e^{2x}}\right] = \frac{d}{dx}\left[e^{-x}\right] = -e^{-x}$ A

14) $\frac{1}{\frac{\pi}{3} - 0} \int_0^{\frac{\pi}{3}} \sin x \cos x dx = \frac{9}{8\pi}$ E

15) $\int_0^6 e^{2x}dx \approx \frac{6-0}{3\times 6}\left(e^{2(0)} + 4e^{2(1)} + 2e^{2(2)} + 4e^{2(3)} + 2e^{2(4)} + 4e^{2(5)} + e^{2(6)}\right) \approx 86192.01$ B

16) $\lim_{n\to\infty} \sum_{i=1}^{n} 3\left(-2+\frac{5i}{n}\right)^2\left(\frac{5}{n}\right) \Rightarrow \Delta x = \frac{b-a}{n} \Rightarrow c_1 = a + i\Delta x = -2 + \frac{5i}{n} \Rightarrow$ b-(-2)=5$\Rightarrow$ b=3 $\int_{-2}^{3} 3x^2 dx$ B

17) $\int \frac{x^3+6x^2-9x+9}{x-3}dx = \int x^2+9x+18+\frac{63}{x-3}dx = \frac{x^3}{3}+\frac{9x^2}{2}+18x+63\ln(x-3)$ +C D

18) y'=6x²y⇒ y'/y=6x² $\Rightarrow \int \frac{y}{y'} = \int 6x^2 dx \Rightarrow y = Ce^{2x^3} \Rightarrow e = Ce^2 \Rightarrow y = \frac{e^{2x^3}}{e}$ A

19) $\int_0^{\sqrt{2}} \left(10-x^2\right)^2 - \left(10-(4-x^2)\right)^2 dx = \frac{128\pi\sqrt{2}}{3}$ C

20) $\int_0^1 \sqrt{1+(y')^2}\,dx = \int_0^1 \sqrt{1+\left(\frac{d}{dx}\left(4x^2-6x+3\right)\right)^2}\,dx = \int_0^1 \sqrt{64x^2-96x+37}\,dx$ C

21) (x^2+y^2) and 8xy are homogeneous of degree 2, so let y=vx. By substitution, $(x^2+y^2)dx = 8xydy =$ $(x^2+v^2x^2)dx = 8x^2v(vdx+xdv)$ Simplifying, and canceling an x^2 term yields : $\frac{dx}{x} = \frac{8vdv}{\left(1-7v^2\right)}$. Integrating both sides, and then removing the natural logs yields: $Cx^6 = \left(x^2-7y^2\right)^4$ C

22) The ellipse is defined by the equation $\frac{x^2}{9}+\frac{y^2}{16} = 25 \Rightarrow y = \pm\frac{4\sqrt{225-x^2}}{3}$. Using the upper equation, and multiplying by 2, the expression for the volume of the shape is $\int_{-15}^{15} \frac{\sqrt{3}}{4}\left(\frac{2\times 4\sqrt{225-x^2}}{3}\right)^2 dx = 8000\sqrt{3}$ B

23) $\int \frac{x}{\sqrt{3x^2+9}}dx = \frac{\sqrt{3x^2+9}}{3}+C$ A

24) $\int_0^6 (6x-x^2)dx \approx \frac{6}{2\times 4}\left(0+2\left(6\times 1.5+1.5^2\right)+2\left(6\times 3+3^2\right)+2\left(6\times 4.5+4.5^2\right)+\left(6\times 6+6^2\right)\right) \approx 33.75$ B

25) Integrate by parts $\int \arctan x dx$ = x arctan x- $\int \frac{x}{x^2+1}dx = x\arctan x - \frac{\ln\left(x^2+1\right)}{2}+C$ D

26) Area of surface= $2\pi\int_a^b r(x)\sqrt{1+(y')^2}\,dx = 2\pi\int_1^2 x\sqrt{1+4x^2}\,dx$ C

27) 11-x²=2x+3⇒ x= -4 & 2⇒ Area= $\int_{-4}^{2} \left(11-x^2\right)-\left(2x+3\right)dx = 36$ ⇒x-component= $\frac{1}{36}\int_{-4}^{2} x\left[\left(11-x^2\right)-\left(2x+3\right)\right]dx$

y-component= $\frac{1}{36}\int_{-4}^{2}\left(\left[\left(11-x^2\right)-\left(2x+3\right)\right]\left[\frac{\left(11-x^2\right)+\left(2x+3\right)}{2}\right]\right)dx$ ∴Centroid= (-1, $\frac{23}{5}$) D

28) $\int \frac{\cos\alpha\csc^2\alpha}{\sqrt{\sin\alpha}}d\alpha = \int \frac{\frac{\cos\alpha}{\sin^2\alpha}}{\sqrt{\sin\alpha}}d\alpha = \int \frac{\cos\alpha}{\left(\sin\alpha\right)^{5/2}}d\alpha = \frac{-2}{3\left(\sin\alpha\right)^{3/2}}+C$ E

29) r=3cos(2θ)=0 at θ= -π/4 & π/4⇒ $\int_{-\pi/4}^{\pi/4} \frac{1}{2}\left(3\cos 2\theta\right)^2 d\theta = \frac{9\pi}{8}$ A

30) Acceleration=32 ⇒ Velocity= $\int 32dt = 32t$ +C where C=0⇒Position= $\int 32tdt = 16t^2 + C_2$, where $C_2 = 0$ .16(6)²=576ft. C