① CRITICAL NUMBERS: $\boxed{1,\ 1/e}$

$\boxed{\begin{array}{l} f\left(\frac{1}{e}\right) = \frac{1}{e^2} \text{ IS A REL. MAX.} \\ f(1) = 0 \text{ IS A REL. MIN.} \end{array}}$

f': $+$ on $(0, 1/e)$, $-$ on $(1/e, 1)$, $+$ after 1

② $V = \boxed{\displaystyle\int_{-2}^{4} \pi\left((2x+9)^2 - (x^2+1)^2\right) dx}$

③ $V = \displaystyle\int_0^2 \pi (e^y)^2\, dy = \pi \int_0^2 e^{2y}\, dy = \pi \left[\frac{1}{2} e^{2y}\right]_0^2 = \boxed{\frac{\pi}{2}(e^4 - 1)}$

④ $A = \displaystyle\int_0^{\pi/2} \left(\cos\frac{x}{2} - \sin\frac{x}{2}\right) dx + \int_{\pi/2}^{2\pi} \left(\sin\frac{x}{2} - \cos\frac{x}{2}\right) dx = (2\sqrt{2} - 2) + (2 + 2\sqrt{2}) = \boxed{4\sqrt{2}}$

⑤ $\bar{Y} = \dfrac{1}{5-1} \displaystyle\int_1^5 (x+1)\sqrt{x-1}\, dx = \boxed{\frac{88}{15}}$

⑥ a) $\mu = E(T) = \displaystyle\int_0^3 T \cdot \frac{1}{9} T(4-T)\, dT = \boxed{\frac{7}{4}}$

b) $P(T \geq 1) = \displaystyle\int_1^3 \frac{1}{9} T(4-T)\, dT = \boxed{\frac{22}{27}}$

⑦ a) $\displaystyle\int \frac{\cos 2x}{\sin x}\, dx = \int \frac{1 - 2\sin^2 x}{\sin x}\, dx = \int (\csc x - 2\sin x)\, dx = \boxed{\ln|\csc x - \cot x| + 2\cos x + C}$

b) $\displaystyle\int x \sec^2 x\, dx = \boxed{x \tan x + \ln|\cos x| + C}$ $\quad (u = x,\ dv = \sec^2 x\, dx)$

c) $\displaystyle\int \frac{4x^2 - 2x - 9}{2x^2 - 5x - 3}\, dx = \int \left(2 + \frac{8x - 3}{2x^2 - 5x - 3}\right) dx = \boxed{2x + \ln|2x+1| + 3\ln|x-3| + C}$

d) $\displaystyle\int \frac{4}{6x + 5x^{2/3}}\, dx = \int \frac{4}{x^{2/3}(6x^{1/3} + 5)}\, dx = \boxed{2\ln|6x^{1/3} + 5| + C}$

$(u = 6x^{1/3} + 5,\ du = 2x^{-2/3}\, dx)$

⑧ $\displaystyle\int_0^\infty \frac{1}{x^2 e^{4/x}}\, dx = \int_0^1 \frac{1}{x^2 e^{4/x}}\, dx + \int_1^\infty \frac{1}{x^2 e^{4/x}}\, dx$

$\displaystyle = \lim_{T \to 0^+} \int_T^1 \frac{1}{x^2 e^{4/x}}\, dx + \lim_{T \to \infty} \int_1^T \frac{1}{x^2 e^{4/x}}\, dx$ $\quad \left(\begin{array}{l} u = -4/x \\ du = \frac{4}{x^2}\, dx \end{array}\right)$

$\displaystyle = \lim_{T \to 0^+} \left[\frac{1}{4} e^{-4/x}\right]_T^1 + \lim_{T \to \infty} \left[\frac{1}{4} e^{-4/x}\right]_1^T$

$= \frac{1}{4}(e^{-4} - 0) + \frac{1}{4}(1 - e^{-4}) = \boxed{\frac{1}{4}}$

⑨ a) $T = \boxed{\dfrac{4 \ln .5}{\ln .7} \text{ YEARS}}$

b) $Y(8) = \dfrac{14{,}000}{20{,}000}(14{,}000) = .7(14{,}000) = \boxed{\$9800}$

① a) $\displaystyle\int_0^1 \frac{24x}{(2x^2+1)^3}\,dx = 6\int_1^3 \frac{1}{u^3}\,du = \boxed{\frac{8}{3}}$ b) $\displaystyle\int_0^4 \frac{x+4}{x^2+8x+6}\,dx = \left[\tfrac{1}{2}\ln(x^2+8x+6)\right]_0^4 = \boxed{\ln 3}$

② a) $\displaystyle\int_1^{25} \frac{1}{x+5}\,dx \approx \frac{1}{9}\cdot 6 + \frac{1}{15}\cdot 6 + \frac{1}{21}\cdot 6 + \frac{1}{27}\cdot 6$ (MIDPOINT RULE)

b) $\displaystyle\int_1^{25} \frac{1}{x+5}\,dx \approx \frac{6}{2}\left[\frac{1}{6} + \frac{2}{12} + \frac{2}{18} + \frac{2}{24} + \frac{1}{30}\right]$ (TRAPEZOIDAL RULE)

③ $y = 5\ln(x^2+9) + \tfrac{1}{2}\ln(e^{4x}+7) - \tfrac{1}{3}\ln x - 8\ln(\sin 6x)$, so

$\displaystyle y' = 5\cdot\frac{2x}{x^2+9} + \frac{1}{2}\cdot\frac{4e^{4x}}{e^{4x}+7} - \frac{1}{3}\cdot\frac{1}{x} - 8\cdot\frac{\cos 6x\cdot 6}{\sin 6x}$

④ $\displaystyle A = \int_{-1}^{2} (y+2-y^2)\,dy = \boxed{\frac{9}{2}}$

⑤ a) $\displaystyle\int_1^e x^3 \ln x\,dx = \boxed{\frac{1}{16}(3e^4+1)}$ b) $\displaystyle\int_{\pi/6}^{\pi/4} \frac{\cos 2\theta}{\sin^5 2\theta}\,d\theta = \frac{1}{2}\int_{\sqrt{3}/2}^{1} \frac{1}{u^5}\,du = \boxed{\frac{7}{72}}$ $u = \sin 2\theta$, $du = 2\cos 2\theta\,d\theta$

⑥ $\displaystyle P(T>2) = 1 - P(T\le 2) = 1 - \int_0^2 \frac{1}{3}e^{-T/3}\,dT = \boxed{e^{-2/3}}$

⑦ a) $\displaystyle\int \frac{3e^{2x}}{\sqrt{5e^{2x}+8}}\,dx = \boxed{\frac{3}{5}\sqrt{5e^{2x}+8} + C}$ b) $\displaystyle\int \frac{5x^3-4x+8}{x^3-2x^2}\,dx = \boxed{5x + \frac{4}{x} + 10\ln|x-2| + C}$

⑧ $\displaystyle\int_4^9 \frac{\sqrt{x}}{\sqrt{x}-1}\,dx = 2\int_2^3 \frac{u^2}{u-1}\,du = 2\left[\frac{u^2}{2} + u + \ln(u-1)\right]_2^3 = \boxed{7+2\ln 2}$ ($u=\sqrt{x}$, $x=u^2$, $dx = 2u\,du$)

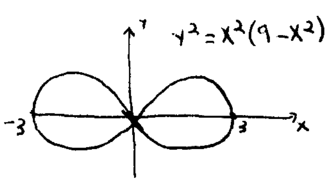
⑨ $P(T) = 100(4)^{T/5}$, so $P(T) = 160$ when $T = \boxed{\dfrac{5\ln 1.6}{\ln 4}\text{ HRS}}$

⑩ a) $\displaystyle\int_{-\infty}^0 x^3 e^{-2x^4}\,dx = \lim_{T\to-\infty}\int_T^0 x^3 e^{-2x^4}\,dx = \boxed{-\frac{1}{8}}$

b) $\displaystyle\int_0^{2\pi/3} \tan x\,dx = \int_0^{\pi/2}\tan x\,dx + \int_{\pi/2}^{2\pi/3}\tan x\,dx$ DIVERGES (SINCE EITHER OF THESE INTEGRALS DIVERGES)

⑪ A) $\displaystyle\int \theta\csc^2\theta\,d\theta = \boxed{-\theta\cot\theta + \ln|\sin\theta| + C}$ B) $\boxed{\frac{3}{13}e^{2x}\sin 3x + \frac{2}{13}e^{2x}\cos 3x + C}$

⑫ a) $\displaystyle\mu = \int_2^6 x f(x)\,dx = \boxed{3}$ b) $\displaystyle V(x) = \int_2^6 x^2 f(x)\,dx - \mu^2 = \boxed{9\ln 3 - 9}$

⑬ 

$\displaystyle A = 4\int_0^3 x\sqrt{9-x^2}\,dx = \boxed{36}$ ($u = 9-x^2$, $du = -2x\,dx$)

⑭ A) $\displaystyle V = \int_{-5}^{5} \pi(f(x))^2\,dx = 2\int_0^5 \pi\left(9\left(1-\frac{x^2}{25}\right)\right)dx = \boxed{60\pi}$

B) $\displaystyle V = \int_0^8 \pi(f(y))^2\,dy = \int_0^8 \pi(\sqrt{2y})^2\,dy = \pi\int_0^8 2y\,dy = \boxed{64\pi}$