2.26 (a) $\underline{\underline{70.5\ \text{lb}_\text{m}/\text{ft}^3}}$; $\underline{\underline{8.27\times10^{-7}\ \text{in}^2/\text{lb}_\text{f}}}$

(b) $$\rho=(70.5\ \text{lb}_\text{m}/\text{ft}^3)\exp\left[\frac{8.27\times10^{-7}\ \text{in}^2}{\text{lb}_\text{f}}\left|\frac{9\times10^6\ \text{N}}{\text{m}^2}\right|\frac{14.696\ \text{lb}_\text{f}/\text{in}^2}{1.01325\times10^6\ \text{N}/\text{m}^2}\right]$$

$$=\frac{70.57\ \text{lb}_\text{m}}{\text{ft}^3}\left|\frac{35.3145\ \text{ft}^3}{\text{m}^3}\right|\frac{1\ \ \text{m}^3}{10^6\ \text{cm}^3}\left|\frac{1000\ \text{g}}{2.20462\ \text{lb}_\text{m}}\right.=\underline{1.13\ \text{g}/\text{cm}^3}$$

(c) $$\rho\left(\frac{\text{lb}_\text{m}}{\text{ft}^3}\right)=\rho'\frac{\text{g}}{\text{cm}^3}\left|\frac{1\ \text{lb}_\text{m}}{453.593\ \text{g}}\right|\frac{28{,}317\ \text{cm}^3}{1\ \text{ft}^3}=62.43\rho'$$

$$P\left(\frac{\text{lb}_\text{f}}{\text{in}^2}\right)=P'\frac{\text{N}}{\text{m}^2}\left|\frac{0.2248\ \text{lb}_\text{f}}{1\ \text{N}}\right|\frac{1^2\ \ \ \text{m}^2}{39.37^2\ \text{in}^2}=1.45\times10^{-4}P'$$

$$\Rightarrow 62.43\rho'=70.5\exp\left[\left(8.27\times10^{-7}\right)\left(1.45\times10^{-4}P'\right)\right]\Rightarrow \underline{\rho'=1.13\exp\left(1.20\times10^{-10}P'\right)}$$

$$P'=9.00\times10^6\ \text{N}/\text{m}^2\Rightarrow\rho'=1.13\exp[(1.20\times10^{-10})(9.00\times10^6)]=\underline{1.13\ \text{g}/\text{cm}^3}$$

2.30 (b) $\ln y=\ln a+bx\Rightarrow y=ae^{bx}$

$$b=(\ln y_2-\ln y_1)/(x_2-x_1)=(\ln 2-\ln 1)/(1-2)=-0.693$$

$$\ln a=\ln y-bx=\ln 2+0.63(1)\Rightarrow a=4.00\Rightarrow \underline{y=4.00e^{-0.693x}}$$

(c) $\ln y=\ln a+b\ln x\Rightarrow y=ax^b$

$$b=(\ln y_2-\ln y_1)/(\ln x_2-\ln x_1)=(\ln 2-\ln 1)/(\ln 1-\ln 2)=-1$$

$$\ln a=\ln y-b\ln x=\ln 2-(-1)\ln(1)\Rightarrow a=2\Rightarrow \underline{y=2/x}$$

(d) $\ln(xy)=\ln a+b(y/x)\Rightarrow xy=ae^{by/x}\Rightarrow y=(a/x)e^{by/x}$ [can't get $y=f(x)$]

$$b=[\ln(xy)_2-\ln(xy)_1]/[(y/x)_2-(y/x)_1]=(\ln 807.0-\ln 40.2)/(2.0-1.0)=3$$

$$\ln a=\ln(xy)-b(y/x)=\ln 807.0-3\ln(2.0)\Rightarrow a=2\Rightarrow xy=2e^{3y/x}\Rightarrow \underline{\underline{y=(2/x)e^{3y/x}}}$$

(e) $\ln(y^2/x)=\ln a+b\ln(x-2)\Rightarrow y^2/x=a(x-2)^b\Rightarrow y=[ax(x-2)^b]^{1/2}$

$$b=[\ln(y^2/x)_2-\ln(y^2/x)_1]/[\ln(x-2)_2-\ln(x-2)_1]$$

$$=(\ln 807.0-\ln 40.2)/(\ln 2.0-\ln 1.0)=4.33$$

$$\ln a=\ln(y^2/x)-b(x-2)=\ln 807.0-4.33\ln(2.0)\Rightarrow a=40.2$$

$$\Rightarrow y^2/x=40.2(x-2)^{4.33}\Rightarrow \underline{\underline{y=6.34x^{1/2}(x-2)^{2.165}}}$$

2.31 **(b)** Plot y^2 vs. x^3 on rectangular axes. Slope $= m$, Intcpt $= -n$

(c) $\frac{1}{\ln(y-3)} = \frac{1}{b} + \frac{a}{b}\sqrt{x} \Rightarrow$ Plot $\frac{1}{\ln(y-3)}$ vs. $\sqrt{x}$ [rect. axes], slope $= \frac{1}{b}$, intercept $= \frac{a}{b}$

(d) $\frac{1}{(y+1)^2} = a(x-3)^3 \Rightarrow$ Plot $\frac{1}{(y+1)^2}$ vs. $(x-3)^3$ [rect. axes], slope $= a$, intercept $= 0$

OR

$2\ln(y+1) = -\ln a - 3\ln(x-3)$

Plot $\ln(y+1)$ vs. $\ln(x-3)$ [rect.] or $(y+1)$ vs. $(x-3)$ [log]

$\Rightarrow$ slope $= -\frac{3}{2}$, intercept $= -\frac{\ln a}{2}$

(e) $\ln y = a\sqrt{x} + b$

Plot $\ln y$ vs. $\sqrt{x}$ [rect.] or y vs. $\sqrt{x}$ [semilog], slope = a, intercept = b

(f) $\log_{10}(xy) = a(x^2 + y^2) + b$

Plot $\log_{10}(xy)$ vs. $(x^2 + y^2)$ [rect.] $\Rightarrow$ slope = a, intercept = b

(g) $\frac{1}{y} = ax + \frac{b}{x} \Rightarrow \frac{x}{y} = ax^2 + b \Rightarrow$ Plot $\frac{x}{y}$ vs. x^2 [rect.], slope $= a$, intercept $= b$

OR $\frac{1}{y} = ax + \frac{b}{x} \Rightarrow \frac{1}{xy} = a + \frac{b}{x^2} \Rightarrow$ Plot $\frac{1}{xy}$ vs. $\frac{1}{x^2}$ [rect.], slope $= b$, intercept $= a$

Q.4 (a) $C_A = C_{Ae} + (C_{A0} - C_{Ae}) e^{-kt}$

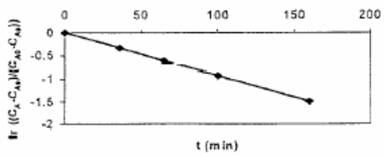
$$C_A - C_{A0} = (C_{A0} - C_{Ae}) e^{-kt}$$

$$\ln (C_A - C_{A0}) = \ln (C_{A0} - C_{Ae}) + \ln e^{-kt}$$

$$\ln (C_A - C_{A0}) - \ln (C_{A0} - C_{Ae}) = -kt \ln e$$

$$\ln \frac{C_A - C_{A0}}{C_{A0} - C_{Ae}} = -kt$$

Yes, because when $\ln[(C_A - C_{Ae})/(C_{A0} - C_{Ae})]$ is plotted vs. t in rectangular coordinates, the plot is a straight line.



one plot either in rectangular coordinates or in semi-log coordinates is enough

Slope = -0.0093 ⇒ $k = 9.3 \times 10^{-3}\ \text{min}^{-1}$

(b) $\text{slope} = -k = \dfrac{\sum x_i y_i}{\sum x_i^2} = \dfrac{S_{xy}}{S_{xx}}$

t (min.)	0	10	50	100	150	200
$\ln\left[\frac{C_A - C_{Ae}}{C_{A0} - C_{Ae}}\right]$	0	−0.101	−0.499	−1.000	−1.500	−1.995
$x_i y_i$	0	−1.01	−24.95	−100.0	−225	−399.0
x_i^2	0	100	2500	10,000	22500	40,000

$$\sum x_i y_i = 0 - 1.01 - 24.95 - 100 - 225 - 399$$
$$= -749.96$$
$$\sum x_i^2 = 100 + 2500 + 10,000 + 22,500 + 40,000$$
$$= 75,100$$
$$\Rightarrow -k = \text{slope} = -\frac{749.96}{75,100} = -0.01\ \text{min}^{-1}$$
$$\Rightarrow \boxed{k = 0.01\ \text{min}^{-1}}$$ (Same as above) Ans

(c) at $t = 1\,\text{hr} = 60\ \text{min}$

$$C_A = 0.1 + (1 - 0.1) e^{-0.01 \times 60} = 0.594\ \text{mol/L}$$

mass concentration of A $= 0.594\ \frac{\text{mol}}{\text{L}} \cdot \frac{20\,\text{g}}{\text{mol}}$

$$= \boxed{11.88\ \text{g/L}}$$ Ans.