

$$\begin{aligned} \text{TBW} &= 0.724 \text{ L/kg} \times (39.1592145 \text{ kg}) \\ \text{TBW} &= 28.3512713 \text{ L} \end{aligned}$$

7. Convert subject's TBW into subject's apparent volume of distribution (Vd) for alcohol:

$$\text{Apparent Volume of Distribution (Vd)} = \text{TBW}/0.80 \quad [\text{Blood is about 80\% water}]$$

Example:

$$\begin{aligned} \text{Vd} &= \text{TBW}/0.80 \\ \text{Vd} &= 28.3512713 \text{ L}/0.80 \\ \text{Vd} &= 35.43908912 \text{ L} \end{aligned}$$

8. Calculate subject's range of rates of alcohol elimination ($\Delta A/\Delta t = dA/dt$):

$$\text{Alcohol disappearance rate from blood} = \Delta \text{BAC}/\Delta t = d\text{BAC}/dt$$

Population range for rates of $\Delta \text{BAC}/\Delta t$:

$$d\text{BAC}/dt = 0.012 \mid 0.020 \text{ g/dL/hr}$$

Convert Vd from L to dL units: 10 dL = 1.0 L

$$\Delta A/\Delta t = \text{Vd} \times (10 \text{ dL/L}) \times (0.012 \mid 0.020 \text{ g/dL/hr})$$

Example:

$$\begin{aligned} \Delta A/\Delta t &= 35.43908912 \text{ L} \times (10 \text{ dL/L}) \times (0.012 \mid 0.020 \text{ g/dL/hr}) \\ \Delta A/\Delta t &= 354.3908912 \text{ dL} \times (0.012 \mid 0.020 \text{ g/dL/hr}) \\ \Delta A/\Delta t &= 4.252690694 \text{ g/hr} \mid 7.087817824 \text{ g/hr} \end{aligned}$$

9. Calculate time period (Δt) between start of drinking and time of breath alcohol test:

$$\text{Time period } (\Delta t) = (\text{time of breath alcohol test}) - (\text{start of drinking})$$

Example:

$$\begin{aligned} \text{Start of drinking} &= 10:15 \text{ p.m.} \\ \text{End of drinking} &= 12:15 \text{ a.m.} \\ \text{Time of breath alcohol test} &= 1:39 \text{ a.m.} \\ \Delta t &= 1:39 \text{ a.m.} - 10:15 \text{ p.m.} \\ \Delta t &= 3 \text{ hr } 24 \text{ min} \\ \Delta t &= 3.40 \text{ hrs} \end{aligned}$$

10. Calculate the grams of ethanol eliminated (ΔA) between start of drinking and time of breath alcohol test:

$$\Delta A = \Delta A/\Delta t \times \Delta t = dA/dt \times dt$$

Example:

$$\begin{aligned} \Delta t &= 3.40 \text{ hrs} \\ \Delta A/\Delta t &= (4.252690694 \text{ g/hr} \mid 7.087817824 \text{ g/hr}) \\ \Delta A &= 3.40 \text{ hrs} \times (\Delta A/\Delta t) \end{aligned}$$

$$\Delta A = 14.45914836 \mid 24.0985806 \text{ g ethanol}$$

11a. Calculate grams of ethanol consumed (Dose):

$$12 \text{ oz. (= 355 mL) light beer} = 11.3 \text{ g ethanol} \times \# \text{ of light beers} = \# \text{ g ethanol}$$

$$12 \text{ oz. (= 355 mL) regular beer} = 13.6 \text{ g ethanol} \times \# \text{ of reg. beers} = \# \text{ g ethanol}$$

$$\# \text{ mL (29.58 mL/oz.} \times \# \text{ oz.) of 80 proof alcohol}$$

$$(80 \text{ proof} = 40\% \text{ v/v} = 40 \text{ mL/100 mL} \times 0.8 \text{ g/mL})$$

$$= \# \text{ g ethanol (e.g., 6 oz. of 80 proof alcohol} = 177.48 \text{ mL} \times 0.40 \times 0.8 = 56.8 \text{ g ethanol)}$$

11b. Calculate grams of ethanol consumed (Dose):

$$12 \text{ oz. (= 355 mL) light beer} = 11.3 \text{ g ethanol} \times \# \text{ of light beers} = \# \text{ g ethanol}$$

Example:

Subject consumed 2.5 light 12 oz. beers

Dose = 2.5 x light 12 oz. beers

Dose = 2.5 x 11.3 g ethanol

Dose = 28.25 g ethanol

12. Calculate amount (A) of ethanol left in body at the time of the breath alcohol test:

$$A = \text{Dose} - (\Delta A / \Delta t \times \Delta t) = \text{Dose} - \Delta A$$

Example: $A = \text{Dose} - \Delta A$

$$A = 28.25 \text{ g ethanol} - (14.45914836 \mid 24.0985806 \text{ g})$$

$$A_{\text{lower limit}} = 28.25 \text{ g} - 24.0985806 \text{ g} = 4.151419398 \text{ g}$$

$$A_{\text{upper limit}} = 28.25 \text{ g} - 14.45914836 \text{ g} = 13.79085164 \text{ g}$$

$$A = 4.151419398 \mid 13.79085164 \text{ g/ethanol}$$

13. Convert the amount (A) of ethanol left in body at the time of the breath alcohol test into the expected range of blood alcohol concentrations (BAC) at the time of the breath alcohol test:

$$\text{Blood alcohol concentration (BAC)} = A / (V_d \times 10 \text{ dL/L})$$

Example: $V_d = 35.43908912 \text{ L} \times 10 \text{ dL/L}$

$$V_d = 354.3908912 \text{ dL}$$

$$\text{BAC} = (4.151419398 \mid 13.79085164 \text{ g}) / 354.3908912 \text{ dL}$$

$$\text{BAC} = < 0.020 \text{ g/dL} \mid 0.038 \text{ g/dL}$$

14. Convert blood alcohol concentration (BAC) in # g/dL to breath alcohol concentration (BrAC) in # g/210 L:

$$\# \text{ g/dL blood} = \# \text{ g/210 L breath}$$

Example:

$$\begin{aligned} \text{BAC} &= < 0.020 \text{ g/dL} \mid 0.038 \text{ g/dL} \\ \text{BrAC} &= < 0.020 \text{ g/210 L} \mid 0.038 \text{ g/210 L} \end{aligned}$$

15. Using the reported breath alcohol concentration (BrAC), calculate the amount of ethanol left in the subject's body at the time of the breath alcohol test:

$$A = \text{BAC} \times (10 \text{ dL/L} \times V_d)$$

Example: Reported BrAC = 0.100 g/210 L at 1:39 a.m. in this 5' 5", 110 lb. female subject

$$\begin{aligned} \text{BAC} &= 0.100 \text{ g/dL} \\ V_d &= 35.43908912 \text{ L} \times 10 \text{ dL/L} = 354.3908912 \text{ dL} \\ A &= 0.100 \text{ g/dL} \times 354.3908912 \text{ dL} \\ A &= 35.43908912 \text{ g ethanol} \end{aligned}$$

16. Using the reported breath alcohol concentration (BrAC), calculate the amount ethanol consumed (Dose) in order to have the reported breath alcohol concentration at the time of the breath alcohol test:

$$\text{Dose} = A + ((\Delta A / \Delta t) \times \Delta t) = A + \Delta A$$

Example:

$$\begin{aligned} \Delta A &= 14.45914836 \mid 24.0985806 \text{ g ethanol} \quad [\text{Step \#10}] \\ A &= 35.43908912 \text{ g ethanol} \quad [\text{Step \#15}] \\ \text{Dose} &= 35.43908912 \text{ g ethanol} + (14.45914836 \mid 24.0985806 \text{ g}) \\ \text{Dose} &= 49.89823748 \mid 59.53766972 \text{ g ethanol} \end{aligned}$$

17. Convert the apparent Dose needed to achieve the reported the breath alcohol concentration (BrAC) into the corresponding equivalent number of 12 oz. light beers that would have had to be consumed:

$$\text{Consumption} = \text{Dose} / (11.3 \text{ g/light 12 oz. beer})$$

Example: Dose = 49.89823748 | 59.53766972 g

$$\begin{aligned} \text{Consumption} &= \text{Dose} / 11.3 \text{ g/light 12 oz. beer} \\ \text{Consumption} &= 4.4 \mid 5.3 \text{ light 12 oz. beers} \\ &(\text{average} = 4.8 \text{ light 12 oz. beers}) \end{aligned}$$