MODULE D - VENTILATOR CALCULATIONS
CALCULATING TOTAL CYCLE TIME, T_I, T_E, I:E RATIOS, and f

1. Given an inspiratory time of 1.2 seconds and an expiratory time of 3 seconds, calculate the I:E ratio and the respiratory rate.

$$\boldsymbol{IT} + \boldsymbol{ET} = \boldsymbol{TCT}\ 1.2 + 3 = 4.2\ \text{sec}$$

$$\text{f} = \frac{60}{\text{TCT}} = \frac{\mathbf{60}}{\mathbf{4.2}} = \mathbf{14.3} \cong \mathbf{14}\ \text{breaths/min}$$

$$\text{I:E} = 1.2 : 3 = \frac{1.2}{3} = \frac{\mathbf{1}}{\chi} = \mathbf{1.2}\chi = \mathbf{3,}\ \chi = 2.5, 1 : 2.5$$

2. Given an inspiratory time of 0.8 seconds and an expiratory time of 1.5 seconds, calculate the I:E ratio and the respiratory rate.

$$\boldsymbol{IT} + \boldsymbol{ET} = \boldsymbol{TCT}\ 0.8 + 1\mathbf{.5} = 2\mathbf{.3}\ \text{sec}$$

$$\text{f} = \frac{60}{\text{TCT}} = \frac{\mathbf{60}}{\mathbf{2.3}} = \mathbf{26.1} \cong \mathbf{26}\ \text{breaths/min}$$

$$\text{I:E} = 0.8 : 1.5 = \frac{0.8}{1.5} = \frac{\mathbf{1}}{\chi} = \mathbf{0.8}\chi = \mathbf{1.5,}\ \chi = 1\mathbf{.9}, 1 : 1.9$$

3. Given an inspiratory time of 1.0 seconds and an expiratory time of 1.75 seconds, calculate the I:E ratio and the respiratory rate.

$$\boldsymbol{IT} + \boldsymbol{ET} = \boldsymbol{TCT}\ 1.0 + 1\mathbf{.75} = 2\mathbf{.75}\ \text{sec}$$

$$\text{f} = \frac{60}{\text{TCT}} = \frac{\mathbf{60}}{\mathbf{2.75}} = \mathbf{21.8} \cong \mathbf{22}\ \text{breaths/min}$$

$$\text{I:E} = 1.0 : 1.75 = \frac{1.0}{1.75} = \frac{\mathbf{1}}{\chi} = \mathbf{1}\chi = \mathbf{1.75,}\ \chi = 1\mathbf{.75}, 1 : 1.75$$

4. Given a f of 40/minute and a I:E ratio of 1:2, calculate the inspiratory and expiratory times.

$$\boldsymbol{TCT} = \frac{\mathbf{60}}{\boldsymbol{f}} = \frac{\mathbf{60}}{\mathbf{40}} = \mathbf{1.5}\ \text{sec}$$

$$\text{IT} = \frac{\text{TCT}}{\text{I} + \text{E}} = \frac{\mathbf{1.5}\ \text{sec}}{1 + 2} = \frac{\mathbf{1.5}}{\mathbf{3}} = \mathbf{0.5}\ \text{sec}$$

$$\text{ET} = \text{TCT} - \text{IT} = 1.5\ \text{sec} - 0.5\ \text{sec} = 1.0$$

5. A newborn is being ventilated on a time-cycled, pressure limited ventilator. The ventilatory parameters are as follows:

   Rate: 40/minute Peak Pressure: 32 cm H_2O
   PEEP: 5 cm H_2O Inspiratory Time: 0.4 seconds

   What is the I:E ratio?

$$\boldsymbol{TCT} = \frac{\mathbf{60}}{\boldsymbol{f}} = \frac{\mathbf{60}}{\mathbf{40}} = \mathbf{1.5}\ \text{sec}$$
$$\text{ET} = \text{TCT} - \text{IT} = 1.5\ \text{sec} - 0.4\ \text{sec} = 1.1\ \text{sec}$$
$$\text{I:E} = 0.4 : 1.1 = \frac{0.4}{1.1} = \frac{\mathbf{1}}{\chi} = \mathbf{0.4}\chi = \mathbf{1.1},\ \chi = 2\mathbf{.75}, 1 : 2.75$$

6. The RCP receives an order to initiate mechanical ventilation at a rate of 45 breaths/minute and an I:E ratio of 1:2. Which of the following inspiratory times would achieve the specified ratio?

   a. 0.54
   b. 0.48
   c. 0.44
   d. 0.40
   e. 0.20

$$\boldsymbol{TCT} = \frac{\mathbf{60}}{\boldsymbol{f}} = \frac{\mathbf{60}}{\mathbf{45}} = \mathbf{1.}\overline{\mathbf{3}}\ \text{sec}$$
$$\text{IT} = \frac{\text{TCT}}{\text{I} + \text{E}} = \frac{\mathbf{1.}\overline{\mathbf{3}}\ \text{sec}}{1 + 2} = \frac{\mathbf{1.}\overline{\mathbf{3}}}{\mathbf{3}} = \mathbf{0.}\overline{\mathbf{4}}\ \text{sec}$$

7. The doctor orders a f of 50/minute and an I:E ratio of 1:1.5. Calculate the T_I and T_E.

$$\boldsymbol{TCT} = \frac{\mathbf{60}}{\boldsymbol{f}} = \frac{\mathbf{60}}{\mathbf{50}} = \mathbf{1.2}\ \text{sec}$$
$$\text{IT} = \frac{\text{TCT}}{\text{I} + \text{E}} = \frac{\mathbf{1.2}\ \text{sec}}{1 + \mathbf{1.5}} = \frac{\mathbf{1.2}}{\mathbf{2.5}} = \mathbf{0.48}\ \text{sec}$$
$$\text{ET} = \text{TCT} - \text{IT} = 1.2 - 0.48 = .72\ \text{sec}$$

8. The doctor orders a f of 60/minute and an I:E ratio of 1:1. Calculate the T_I and T_E.

$$\boldsymbol{TCT} = \frac{\mathbf{60}}{\boldsymbol{f}} = \frac{\mathbf{60}}{\mathbf{60}} = \mathbf{1.0}\ \text{sec}$$
$$\text{IT} = \frac{\text{TCT}}{\text{I} + \text{E}} = \frac{\mathbf{1}\ \text{sec}}{1 + 1} = \frac{\mathbf{1}}{\mathbf{2}} = \mathbf{0.5}\ \text{sec}$$
$$\text{ET} = \text{TCT} - \text{IT} = 1 - 0.5 = .5\ \text{sec}$$

9. The doctor orders a f of 30/minute and an I:E ratio of 1:3. Calculate the T_I and T_E.

$$\boldsymbol{TCT} = \frac{\mathbf{60}}{\boldsymbol{f}} = \frac{\mathbf{60}}{\mathbf{30}} = \mathbf{2.0}\ \text{sec}$$
$$\text{IT} = \frac{\text{TCT}}{\text{I} + \text{E}} = \frac{\mathbf{2}\ \text{sec}}{1 + \mathbf{3}} = \frac{\mathbf{2}}{\mathbf{4}} = \mathbf{0.5}\ \text{sec}$$
$$\text{ET} = \text{TCT} - \text{IT} = 2 - 0.5 = \mathbf{1.5}\ \text{sec}$$

10. The doctor orders a f of 35/minute and an inspiratory time of 0.75 seconds. What is the I:E ratio?

$$TCT = \frac{60}{f} = \frac{60}{35} = 1.7\ \text{sec}$$
$$\text{ET} = \text{TCT} - \text{IT} = 1.7\ \text{sec} - 0.75\ \text{sec} = 0.95\ \text{sec}$$
$$\text{I:E} = 0.75 : 0.95 = \frac{0.75}{0.95} = \frac{1}{\chi} = 0.75\chi = 0.95,\ \chi = 1.27, 1 : 1.27$$

11. The doctor orders a f of 40/minute and an inspiratory time of 0.6 seconds. What is the I:E ratio?

$$\boldsymbol{TCT} = \frac{\mathbf{60}}{\boldsymbol{f}} = \frac{\mathbf{60}}{\mathbf{40}} = \mathbf{1.5}\ \text{sec}$$

$$\text{ET} = \text{TCT} - \text{IT} = 1.5\ \text{sec} - 0.6\ \text{sec} = 0.9\ \text{sec}$$

$$\text{I} : \text{E} = 0.6 : 0.9 = \frac{0.6}{0.9} = \frac{\mathbf{1}}{\chi} = \mathbf{0.6}\chi = \mathbf{0.9,}\ \chi = \mathbf{1.5}, 1 : 1.5$$