Human Physiology

The Heart

1. For the average person at rest, the heart pumps blood at a rate of about 5 L/min. Therefore, the volume, \( V \) litres, pumped over a period of time, \( t \) minutes, is given by the equation \( V = 5t \).

   a) Let \( V = y \) and \( t = x \), complete a table of values, and graph the equation. Use the same scale on each axis.

   b) Which quadrant did you use? Explain.

2. For top athletes in competition, the heart can pump blood at 30 L/min, so \( V = 30t \).

   a) Let \( V = y \) and \( t = x \), and graph this equation on the same axes as the graph from question 1.

   b) For points with the same non-zero \( x \)-coordinate, how do the \( y \)-coordinates compare for the two graphs?

   c) Do the two graphs have any points in common?

3. a) Interchange the \( x \)- and \( y \)-coordinates in the table from question 1, so that a point \((x, y)\) becomes the point \((y, x)\). Graph the resulting coordinates on the same axes as the graph from question 1.

   b) Describe what the graph with the interchanged coordinates represents.

4. a) Graph the line \( y = x \) on the same set of axes you used in question 3.

   b) Reflect the graph from question 1 in the line \( y = x \). How does the result compare with the graph from question 3?

Breathing

5. At rest, the average person breathes about 12 times per minute.

   a) Write an equation that expresses the number of breaths in terms of the time, in minutes.

   b) Graph the equation.

6. Use the graph from question 5 to graph an equation that expresses the time, in minutes, in terms of the number of breaths. Explain your reasoning.
Review of Prerequisite Skills

If you need help with any of the skills named in purple below, refer to Appendix A.

1. Translations Find the image of the point $(-3, -2)$ under each translation.
   a) 4 units upward  
   b) 6 units downward  
   c) 3 units to the left  
   d) 5 units to the right  
   e) 2 units downward and 4 units to the right  
   f) 8 units upward and 9 units to the left  
   g) 7 units downward and 10 units to the left  
   h) 12 units upward and 11 units to the right

2. Translations Name the translation that transforms the first point onto the second.
   a) $(7, 0)$ onto $(-5, 0)$
   b) $(3, 4)$ onto $(3, 12)$
   c) $(8, -2)$ onto $(0, -3)$
   d) $(-1, -3)$ onto $(-7, -8)$
   e) $(-6, 12)$ onto $(5, -9)$
   f) $(-11, 3)$ onto $(-4, -16)$

3. Translations Draw $\triangle ABC$ with vertices $A(1, 3)$, $B(-2, -1)$, and $C(4, -3)$ on grid paper. Find the coordinates of the image of $\triangle ABC$ after
   a) a translation of 3 units downward and 4 units to the left  
   b) a translation of 2 units upward and 3 units to the right  
   c) a translation of 4 units downward and 5 units to the right

4. Reflections Draw $\triangle ABC$ with vertices $A(-2, 4)$, $B(-4, 1)$, and $C(5, -2)$ on grid paper. Find the coordinates of the image of $\triangle ABC$ after
   a) a reflection in the $x$-axis  
   b) a reflection in the $y$-axis  
   c) a reflection in the $x$-axis followed by a reflection in the $y$-axis.

5. Stretches and shrinks Describe the stretch or shrink that transforms the function $y = x^2$ onto each of the following functions.
   a) $y = 3x^2$  
   b) $y = \frac{1}{3}x^2$

6. Reflections Describe the reflection that transforms the function $y = 2x^2$ onto the function $y = -2x^2$.

7. Translations Describe the translation that transforms the function $y = x^2$ onto
   a) $y = x^2 + 3$  
   b) $y = x^2 - 7$  
   c) $y = (x - 4)^2$  
   d) $y = (x + 6)^2$  
   e) $y = (x + 3)^2 - 8$  
   f) $y = (x - 7)^2 + 2$

8. Graphing quadratic functions Sketch each parabola. State the direction of the opening, the coordinates of the vertex, the equation of the axis of symmetry, the domain and range, and the maximum or minimum value.
   a) $y = x^2 - 4$  
   b) $y = -2x^2 + 5$  
   c) $y = (x - 2)^2 + 3$  
   d) $y = -(x + 3)^2 - 5$

9. Translations a) Translate the graph of $y = x$ upward by 1 unit.
   b) Translate the graph of $y = x$ to the left by 1 unit.
   c) Compare the results from parts a) and b).
   d) Translate the graph of $y = x^2$ upward by 1 unit.
   e) Translate the graph of $y = x^2$ to the left by 1 unit.
   f) Compare the results from parts d) and e).
   g) Explain any differences in your answers to parts c) and f).