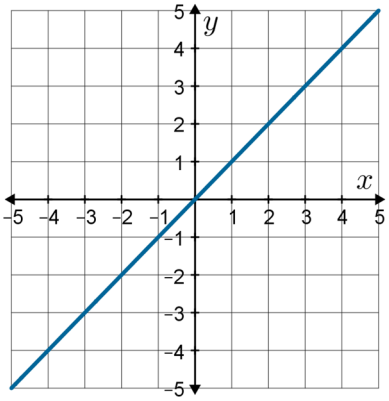
PART A



1) Explain what it means to *translate a line*.

2) Consider the graph of the line $y = x$ on the right.
   a) Sketch the graph of the line after it undergoes a translation up 2 units.
   b) Does translating the line affect its slope?
   c) If the given line is translated down 3 units, what is its new y-intercept?
   d) If the given line is translated up 4 units, what is the equation of the resulting line?

3) The line $y = 3x$ is translated up 7 units. What is the equation of the resulting line?

4) Explain what it means to *reflect a line in the x-axis*.

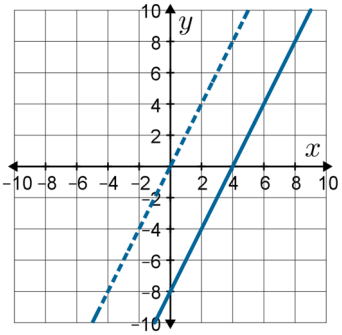
5) Sketch the graph of the line shown above after it undergoes a vertical reflection (in the x-axis).

6) The graph of the line $y = 2x$ undergoes a vertical reflection (in the x-axis).
   a) Sketch the graph of the transformed line.
   b) What is the slope of the transformed line?
   c) What is the equation of the transformed line?

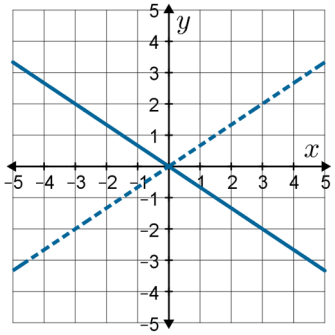
PART B

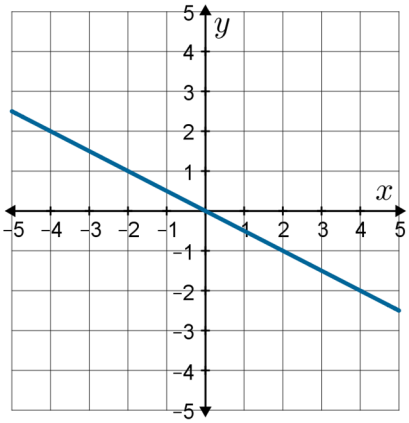
7) In each of the graphs on the right, the dashed line was transformed to give the solid line. State a possible transformation that was applied.

a)



b)





8) The graph of $y = -\frac{1}{2}x$ shown on the left undergoes a translation (shift) up 3 units.
   a) Sketch the graph of the transformed line.
   b) State the equation of the resulting graph.

9) The graph of $y = -\frac{1}{2}x$ shown on the left undergoes a reflection in the x-axis.
   a) Sketch the graph of the transformed line.
   b) State the equation of the resulting graph.

10) In general, how does reflecting a line in the x-axis affect its slope?

11) State the equation of the line $y = -8x$ after it undergoes each of the following transformations.
   a) translation up 14 units
   b) vertical reflection (in the x-axis)
   c) translation down 3.5 units
   d) reflection in the x-axis followed by a translation up 6 units

12) State the vertical transformation(s) that can be applied the graph of $y = \frac{4}{3}x$ to obtain the graph of each of the following lines

   a) $y = \frac{4}{3}x - 17$
   b) $y = -\frac{4}{3}x$
   c) $y = 15 + \frac{4}{3}x$
   d) $y = -\frac{4}{3}x - \frac{2}{3}$

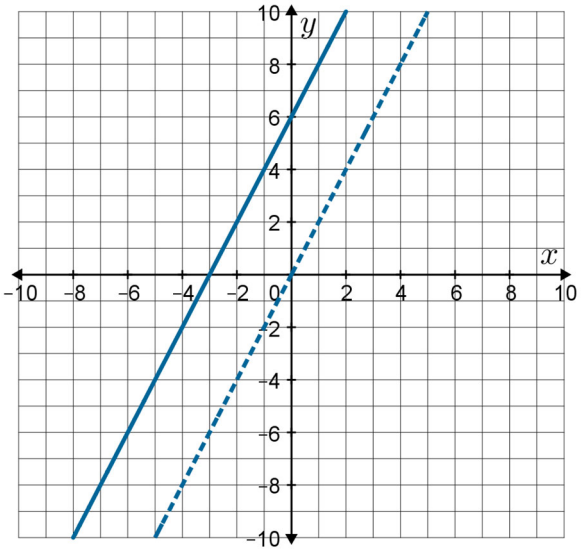
13) A container, which is initially empty, is filled with water at a rate of 53.4 L/min.
   a) Create an equation to model the volume of water in the container (V) after it's been filling for t minutes.
   b) What change to the original situation would result in the graph of the line from part (a) being translated up 87.5 units?

PART C

14) What transformation can be applied to the graph of $y = \frac{5}{6}x + 7$ to get the line $y = \frac{5}{6}x - 4$.

15) Jared is going to apply two transformations to the graph of the line $y = \frac{1}{3}x$. Specifically, the transformations that he'll use are a reflection in the x-axis and a translation up 4 units. Will changing the order in which the transformations are applied give different results? Explain.

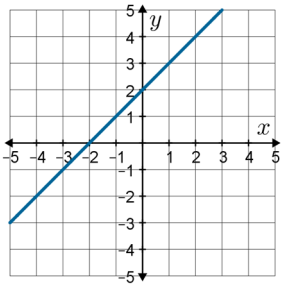
16) In the graph shown below, the dashed line was transformed to give the solid line.
   a) Describe the transformation as a vertical translation.
   b) Describe the transformation as a horizontal translation.
   c) The equation of the solid line can be written as $y = 2x + 6$ or $y = 2(x + 3)$. Show algebraically that these two expressions are the same.
   d) Describe transformation of the line $y = -3x$ to the line $y = -3(x + 4)$ as a horizontal translation and as a vertical translation.
   e) Describe transformation of the line $y = 4x$ to the line $y = 4x - 20$ as a vertical translation and as a horizontal translation.
   f) The graph of $y = \frac{1}{2}x$ is translated right 10 units. Express the equation of the resulting line in $y = mx + b$ form.



17) Prove that for lines with equations of the form $y = ax$, a reflection in the x-axis gives the same result as a reflection in the y-axis.

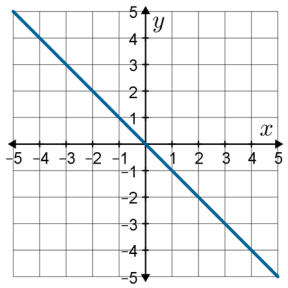
ANSWERS

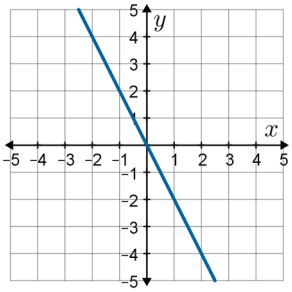
1) To translate a line means to shift the line's position. Every point on the line is moved the same distance in the same direction (up, down, left, right, etc.).

2) a) 

b) no c) -3 d) $y = x + 4$ **3)** $y = 3x + 7$

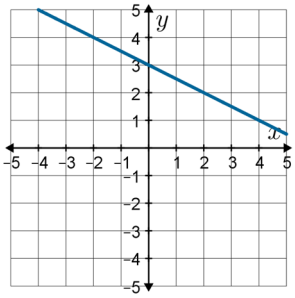
4) To reflect a line in the x-axis means that each point on the line is moved to the opposite side of the x-axis. That is, the sign of each point's y-value is changed to the opposite.

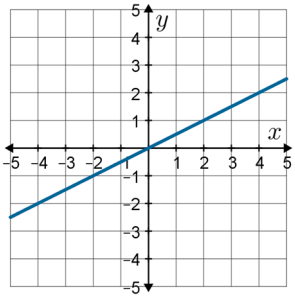
5) 

6) a) 

b) -2 c) $y = -2x$

7) a) vertical translation down 8 units (or right 4 units) b) reflection in the x-axis (or y-axis)

8) a) 

b) $y = -\frac{1}{2}x + 3$ **9)** a) 

b) $y = \frac{1}{2}x$

10) In general, reflecting a line in the x-axis results in a line with the opposite slope. That is, the slope of the reflected line has the opposite sign. (Note: The slopes of horizontal and vertical lines are not affected by a reflection in the x-axis).

11) a) $y = -8x + 14$ b) $y = 8x$ c) $y = -8x - 3.5$ d) $y = 8x + 6$

12) a) translation down 17 units b) reflection in the x-axis

c) translation up 15 units d) reflection in the x-axis and then translation down $\frac{2}{3}$ unit

13) a) $V = 53.4t$ b) The container already contains 87.5 L of water when the filling starts.

14) translation down 11 units

15) Yes. Reflecting first and then translating would give one line. To arrive at the same line by translating first, the axis of reflection would also need to be translated. That is, the translated line would need to be reflected in the line $y = 4$ instead of in the x-axis.

16) a) translation up 6 units b) translation left 3 units c) Using the distributive property, $2(x+3) = 2(x) + 2(3) = 2x + 6$. Therefore, $y = 2x + 6$ and $y = 2(x+3)$ are equivalent.

d) translation left 4 units or translation down 12 units e) translation down 20 units or translation right 5 units f) $y = \frac{1}{2}x - 5$

17) A reflection in the x-axis changes the sign of each point's y-value, giving $-y = ax$. Multiplying both sides of this equation by -1 gives $y = -ax$. A reflection in the y-axis changes the sign of each point's x-value, giving $y = a(-x)$, which simplifies to $y = -ax$. Therefore, each reflection results in the same line, $y = -ax$.