SME M1
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Practice Problems

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Sketch your graphs freehand. Don't use a ruler unless it's absolutely necessary. Use blank (no lines) paper if you have it. We are not trying to produce perfect graphs: we just want graphs that contain the essential ideas about a curve. Don't include details that are not important.

Make sure that you do the following:

- Plot the axes and label them.
- Label all the important features (lines, curves, points of intersection, etc.)
- Label and explain graph operations (shift, rotate, etc.)
- Give equations for your curves, and for each operation step.

1 Constant curves and points

1. On the same pair of axes, plot $y = 1$, $y = 5$ and $y = -3$.

2. Plot $x = -2$, $x = -1$ and $x = 5$ on the same axes.

3. Plot the point $P(1, 3)$ and show the constant lines. Give an interpretation of the symbol $(1, 3)$ in English.

4. Plot the point $Q(-3, -2)$ and give an interpretation in English. Show all important features of this graph, including the constant curves, axes, labels etc.

2 Shift operations

5. Start with $y = 5$ and plot $y = 5 + 1$ by doing a shift operation.

6. Start with $y = -2$ and do a shift operatio to get the graph of $y = -2 - 4 = -6$.

7. Do a shift on $x = a$, $a > 0$, to get the graph of $x = a - 2$.

8. Do a shift on $x = -a$, $a > 0$ to get the graph of $x = -a + 1$.

9. Start with $y = a$, $a > 0$, and do a LHS shift to get the graph of $y + 1 = a$.

10. Start with $x = -3$ and do a LHS shift to get the graph of $x - 4 = -3$.

11. Begin with $y = 5$ do a LHS shift and a RHS shift to get the graph of $y + 1 = 5 + 1$. Show both shift operations in your drawing.

12. Begin with $x = -5$. Do two shift operations: a LHS shift and a RHS shift to get $x + 2 = 5 - 1$. Show both operations in your graph drawing.

3 Stretch and shrink

13. Start with $y = 5$ and $x = 5$. Do stretch operations by multiplying the right-hand sides by 2. Label the operations. Show what they do.

14. Start with $y = -6$ and $x = -6$. Draw them on the same axes. Do shrink operations by multiplying the right-hand sides by $1/3$. Label the operations and show what they do.

15. Reflect $x = 2$ and $y = -2$ by multiplying the left-hand-side by -1. Show the effects of the operations on your graph.

16. Fill in the table. Start with curve $y = a$ where a is a positive, $a > 0$. How can we get the desired result?

Curve	Operations on $y = a$
$y + 1 = a$	
$y = 2a - 1$	Stretch by 2, then shift down by 1.
$y = 2(a + 1)$	
$y = (2a + 5)/3$	

17. Start with $y = a$. How can we get the desired curve? What operations must we do?

Curve	Operations on $y = a$
$\frac{y}{3} - 1 = a$	Stretch by 3 then shift up by 1.
$y + 2 = a$	
$3y - 1 = a$	
$\frac{1}{2}y - 2 = a$	

18. Start with curve $x = a$ where a is a positive. How can we get the desired result? Fill in the table.

Curve	Operations on $x = a$
$x + 1 = a$	
$x = 2a - 1$	
$x = 2(a + 1)$	Shift right by 1, then stretch by 2.
$x = \frac{2a+1}{3}$	

19. Start with curve $x = a$ where a is a positive. How can we get the desired result? Fill in the table.

Curve	Operations on $x = a$
$x + 2 = a$	
$3x - 1 = a$	
$\frac{1}{2}x - 2 = a$	
$2(x + 1) = a$	Shift left by 1, then shrink to 1/2.

4 Reflection

20. For $a > 0$, plot $y = a$, $x = a$ and their reflections $y = -a$, $x = -a$.

21. For positive constant a, plot $y = -4a$ by doing operations. Start with $y = a$. First do a stretch by 4, then do a reflection.

22. Let $a > 0$. Plot $x = -(a + 1)$. Start with $x = a$, do a shift, then a reflection. Label everything and show the effect of the operations.

23. Plot $y = -(a - 1)/2$ by doing three operations: shift, shrink, reflect. Start with the basic curve $y = a$, with positive a.

24. Start with $x = 5$. Plot $-2(x + 1) = 5$ by doing three operations: shift, shrink and then reflect.

5 Rotations

25. Start with $y = 5$. Do a reflection. Then rotate by 90°. Then reflect. Then rotate by -90°. Draw all the steps and show the result. Label everything. Don't forget to label the axes and the operations that you are doing.

26. Start with $x = -5$. Do a -90° rotation. Then do a reflection. Then do a 90° rotation. Draw all steps and label everything.

27. Start with $y = 1$. Do a shift up by 1. Reflect. Stretch by 2. Rotate by 90°. What do you get? Show all the steps and label everything.

6 Curves $y = x$ and $y = x^2$

Use the special square technique to help you draw $y = x$ and $y = x^2$.

28. Start with $y = x$. Rotate by 90°. Reflect. Rotate by -90°. What do you get?

29. Plot $y = (2x + 1)/2$. Start with $y = x$. Do a stretch. Then shift. Then a shrink. What do you get? Label everything. Show the operations.

30. Plot $y = 3(x + 1)$. Start with $y = x$. Do a shift, then a stretch.

31. Plot $y = -(x^2 + 2)$. Start with $y = x$. Do a shift, then reflect.

32. Plot $y = -x^2/2$. Start with the parabola $y = x^2$. Do a shrink and then a reflect. Show all the steps and label everything.

33. Plot $y = -2x^2 + 1$. Start with $y = x^2$. Do a stretch. Then a reflect. Finally do a shift. Show all the steps. Label everything and show the operations that you are doing.