MAT 121-G81-G83 Writing Project #2 Spring, 2021

Graphing Functions by Transforming Basic Functions Name____________________

FORMATTING: This is semi-formal writing, here. You don't have to type it out, but you do need to be very clear. For the formatting guidelines, please see Writing Project #1. They're the same for tests and (face-to-face) homework, except on Tests and Writing Projects, don't waste time writing out the question details, because they come WITH (the cover sheet).

If you can't send a nice, clear PDF and attach it to an e-mail, then either slide it under my door on Greeley Campus EDBH 134K or mail it to me at that address:

> #3 has been revised. (-1, -1) should be (-1, 1).
>
> I'm also making a video for the $x^{2/3}$ basic function for #3. It's a standard function for the future, but you won't find it in your Pearson.

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DEADLINE for Early-Bird 10% Bonus is FRIDAY, February 19th. Otherwise, just make sure you e-mail or get it postmarked no later than Thursday, February 25th, for full credit, without bonus.

Main Resources: Chapter 2 Videos (and notes) and Writing Project 2 Videos (and notes).

You only need to use one of the following methods. I will demonstrate both on the solutions. I'm partial to Method 2, because you get the shape and size, before you shift left/right or up/down. It's also how we attack graphing in trigonometry and calculus (amplitude and period before phase).

Method 1: (See Problem #1 on which the following is based.) **0.** $f(x)=\dfrac{1}{x^2}$;

1. $3f(x)=\dfrac{3}{x^2}$; **2.** $3f(x-15)=\dfrac{3}{(x-15)^2}$; **3.** $3f(5x-15)=\dfrac{3}{(5x-15)^2}$; **4.** $3f(5x-15)-6=g(x)$

1. $(x,y)\mapsto(x,3y)$ **2.** $(x,y)\mapsto(x+15,y)$ **3.** $(x,y)\mapsto\left(\dfrac{1}{5}x,y\right)$ **4.** $(x,y)\mapsto(x,y-6)$

1. vertical stretch by factor of 3; **2**. Right 15 (delay); **3**. Horizontal shrink by factor of 1/5; **4**. Down 6.

Method 2:

0. $f(x)=\dfrac{1}{x^2}$; **1.** $3f(x)=\dfrac{3}{x^2}$; **2.** $3f(5x)=\dfrac{3}{(5x)^2}$; **3.** $3f(5(x-3))=\dfrac{3}{(5(x-3))^2}$; **4.** $3f(5(x-3)-6=g(x)$

1. $(x,y)\mapsto(x,3y)$ **2.** $(x,y)\mapsto\left(\dfrac{1}{5}x,y\right)$ **3.** $(x,y)\mapsto(x+3,y)$ **4**. $(x,y)\mapsto(x,y-6)$

1. vertical stretch by factor of 3; **2**. Horizontal shrink by factor of 1/5; **3**. Right 3; **4**. Down 6.

I prefer Method 2, because it's just better, for later (Trig, Calculus, Analysis in general), but beginners like Method 1, more, even though it puts a ceiling on their later understanding, which I don't like. In #1, by factoring out the 5 inside, you can SEE where the center of the action is, immediately. (Vertical asymptote: $x = 3$).

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Graph the function $g(x)$ by transforming the graph of a basic function, $f(x)$.

1. $g(x)=\dfrac{3}{(5x-15)^2}-6$ (Use $(-1,1)$ and $(1,1)$ as the two points in the 1st graph. (Graph **0.**)
2. $g(x)=\dfrac{-5}{(2x+14)}+3$ (Use $(-1,-1)$ and $(1,1)$ as the 2 points in the 1st graph. (Graph **0.**)
3. $g(x)=2(3x-12)^{2/3}-5$ (Use $(-1,1)$, $(0,0)$ and $(1,1)$ as the 3 points in the 1st graph. (Graph **0.**)

This is now fixed.

4. $g(x)=-3\sqrt{4x+20}+7$ Pick 2 points to start with in Graph **0**. I suggest (1, 1) and (4, 2)
5. $g(x)=4\sqrt[5]{3x+12}-7$ Pick 3 points to start with in Graph **0**. I suggest (-1, -1), (0, 0) and (1, 1)
6. $g(x)=3(3x-6)^4-2$ Pick 3 points to start with in Graph **0**. I suggest (-1, 1), (0, 0) and (1, 1)

We treat lines and parabolas a little differently. They come up so often – plus the completing-the-square trick – we sidestep the whole $f(bx)$ issue and just work with $g(x)=a(x-h)^2+k$ and $g(x)=m(x-h)+k=m(x-x_1)+y_1$.

7. $g(x)=-4(x+3)+5$ Pick 3 points for Graph **0.** and (of course) track where they go under transformations.
8. $g(x)=-5(x+3)^2+2$ Pick 3 points for Graph **0.** and (of course) track where they go under transformations.

I expect you to complete the square to re-write these, just like the bonus problems in Test 1 (and tests to come).

9. $g(x)=x^2-4x-10$ Pick 3 points for Graph **0.** ...

10. $g(x)=7x^2-11x+5$ Pick 3 points for Graph **0.** ...

One reason I stress point-slope form is that $y=m(x-h)+k$ corresponds to: $y=m(x-x_1)+y_1$.

The "cheat" for completing the square: $g(x)=ax^2+bx+c=a(x-h)^2+k=a\left(x-\dfrac{-b}{2a}\right)^2+g\left(-\dfrac{b}{2a}\right)$

I think it's fine to use the "cheat" for a backup/check, but you really want to master the *process*. They're much easier to remember, long-term than trying to memorize the $\dfrac{-b}{2a}$ thing, and how it fits in the formula. The moves are demonstrated over and over again in videos. Practice them. Own them. By the time you get to calculus, you want this technique to be quick-twitch, muscle memory, because your teacher will take it for granted that you *know* it and are *quick* at it.