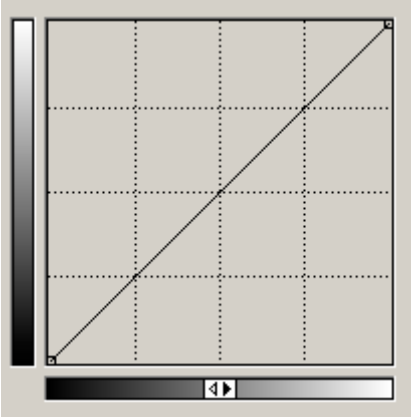
Supplement to Chapter 3 of *The Science of Digital Media* – Digital Image Processing

Worksheet – Digital Imaging > Curves and Gamma Levels[1]

Before completing this worksheet, you should view the on-line interactive tutorial "Curves and Gamma Levels." This tutorial can be accessed at the website for *The Science of Digital Media*.

1. Using the following graph of a linear transform function as a guide, draw the curves that would result from the following transform functions on the set of axes provided. Each function is expressed in the form $p_1 = p_2^{\gamma}$, where the gamma level γ is given as an exponent. Below each graph, explain what this transform function would do to the image.

   A. $p_1 = p_2^2$
   (gamma level of 2)



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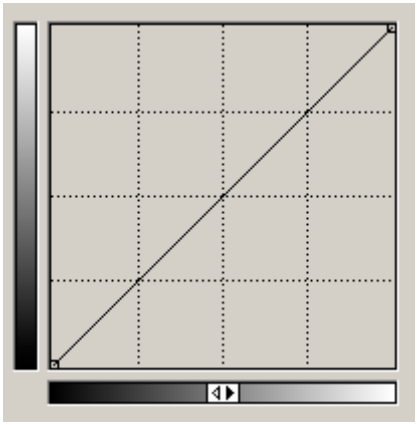
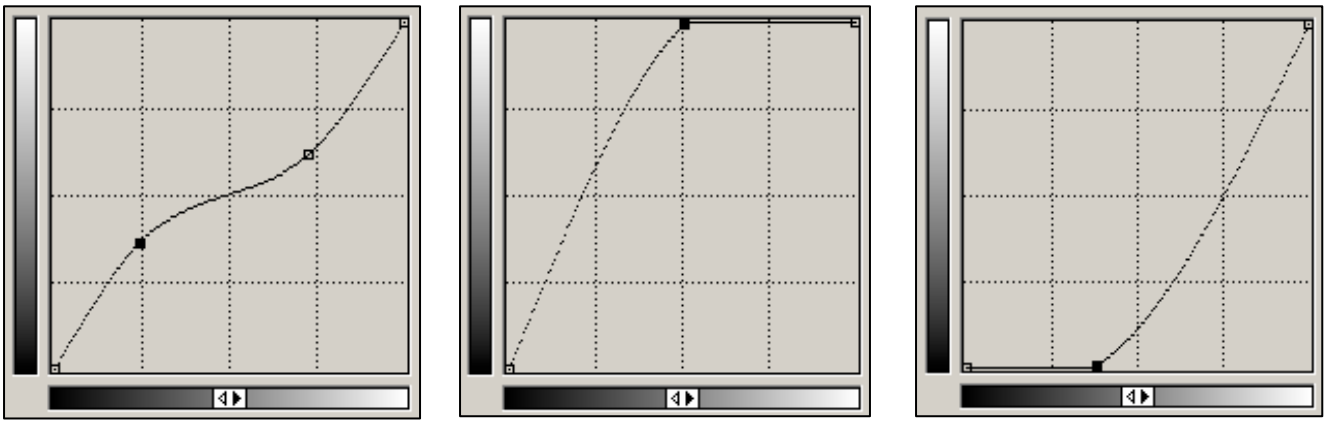
B. $p_1 = p_2^{0.5}$
(gamma level of 0.5)



2. Below are two versions of the same grayscale image. The one on the right had a transform function applied to it. From the three curves shown below the images, circle the one that would produce the image on the right when applied to the image on the left. Explain your choice.



3. Suppose that a transform function *T* is applied to a 24-bit RGB image, with the following outputs for the specified inputs:

T(100) = 150	*T(150) = 175*
T(200) = 210	*T(250) = 255*

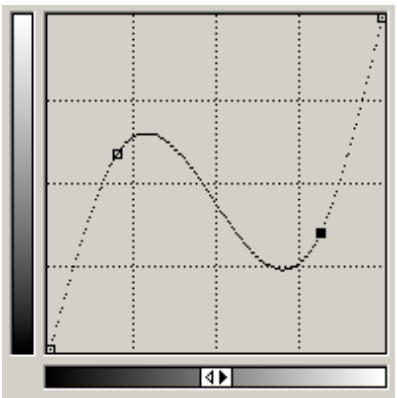
Recall that this notation means that, for example, a pixel value of 100 in the red, green, or blue component of the RGB image is mapped to 150. For the following pixels, give what the resulting pixel would be after the transform function has been applied to the image.

	Red	Green	Blue
Pixel 1	100	150	250
Pixel 2	150	150	200
Pixel 3	250	100	100

Pixel 1: Pixel 2: Pixel 3:

Now explain why it is best to modify the three color channels (red, green, and blue) separately – with a different transform function *T* – rather than with the same transform function as you have done above. Use your knowledge of how the human eye perceives color.

4. You have learned that the S-curve can be used to maximize contrast in an image by making dark pixels darker and light pixels lighter. Below are the graphs of the transform functions for two modifications of the S-curve. Using what you know about curves and their effect on images, describe what each of these would do to a grayscale image in comparison to the S-curve.

A. 

B.