1.
   a. A number is rational if and only if it can be expressed as the quotient of two integers.
   b. Function f(x) is greater than function g(x) for all values of x bounded by and including zero and one.

2. Odd numbers

3. Linear: g(2) = 0.9 ➔ 2A = 0.9 ➔ A = 0.9/2 = 0.45
   a. g(5) = 0.45*5 = **2.25**
   b. g(-1.5) = 0.45*-1.5 = **-0.675**

4. No, L must be affine to result in a non-zero value.

5.
   a. 2-norm: $\begin{pmatrix} 1 \\ -2 \\ 3 \end{pmatrix} = \sqrt{1^2 + (-2)^2 + 3^2} = \sqrt{14}$
   b. 2-norm: $\begin{pmatrix} 2 \\ a \\ 0 \end{pmatrix} = \sqrt{2^2 + a^2 + 0^2} = \sqrt{4 + a^2}$
   c. 2-norm: $\begin{pmatrix} 1 \\ -1 \\ 1 \end{pmatrix} = \sqrt{1^2 + (-1)^2 + 1^2} = \sqrt{3}$

	0-norm	1-norm	2-norm	∞-norm
5a	3	6	$\sqrt{14}$	3
5b	2 (when a ≠ 0) 1 (when a = 0)	2 + abs(a)	$\sqrt{4 + a^2}$	2 (or a if a > 2)
5c	3	3	$\sqrt{3}$	1

6.

a. $\begin{pmatrix} 0 \\ 3\theta \\ \theta \end{pmatrix} \rightarrow (1)^2 = \left(\sqrt{0^2 + (3\theta)^2 + \theta^2}\right)^2 \rightarrow 1 = 9\theta^2 + \theta^2 \rightarrow \frac{1}{10} = \theta^2 \rightarrow \boldsymbol{\theta = \frac{1}{\sqrt{10}}}$

b. $\begin{pmatrix} 2\cos(\theta) \\ 0 \\ 1 \end{pmatrix} \rightarrow 1^2 = \left(\sqrt{4\cos(\theta)^2 + 0 + 1}\right)^2 \rightarrow 0 = \cos(\theta) \rightarrow \boldsymbol{\theta = \frac{\pi}{2}\ or \frac{(2n+1)\pi}{2}}$

c. $\begin{pmatrix} \cos(\theta) \\ 0 \\ \sin(\theta) \end{pmatrix} \rightarrow 1^2 = \left(\sqrt{\cos^2(\theta) + 0 + \sin^2(\theta)}\right)^2 \rightarrow 1 = \cos^2(\theta) + \sin^2(\theta) \rightarrow \boldsymbol{\theta = \mathbb{R}}$

7. $\begin{pmatrix} 3 \\ -2 \\ 1 \end{pmatrix} \cdot \begin{pmatrix} 2 \\ -5 \\ 4 \end{pmatrix} = \sqrt{9+4+1}\sqrt{4+25+16}\cos(\theta) \rightarrow 6 + 10 + 4 = 3\sqrt{70}\cos(\theta) \rightarrow \frac{20}{3\sqrt{70}} = \cos(\theta) \rightarrow \boldsymbol{\theta = 0.649\ radians\ or\ 37.2\ degrees}$

8. $\begin{pmatrix} -3 \\ a \\ 1 \end{pmatrix} \cdot \begin{pmatrix} -1 \\ 5 \\ 2 \end{pmatrix} = 0 \rightarrow 3 + 5a + 2 = 0 \rightarrow 5a = -5 \rightarrow \boldsymbol{a = -1}$

9. Yes: $\frac{\boldsymbol{a \cdot b}}{\|\boldsymbol{a}\|\|\boldsymbol{b}\|} = 0 \rightarrow \frac{\boldsymbol{2a \cdot (-1)b}}{\|\boldsymbol{2a}\|\|\boldsymbol{(-1)b}\|} = \frac{\boldsymbol{2(-1)a \cdot b}}{|2||-1|\|\boldsymbol{a}\|\|\boldsymbol{b}\|} = (-1)\frac{\boldsymbol{a \cdot b}}{\|\boldsymbol{a}\|\|\boldsymbol{b}\|} = 0 \rightarrow \frac{\boldsymbol{a \cdot b}}{\|\boldsymbol{a}\|\|\boldsymbol{b}\|} = 0$

10. **Machine Problem**

Download the files `bioe210_test_suite.m` and `lasso_data.mat` from the course website. Both files need to be placed in the same directory, as `bioe210_test_suite.m` loads data from `lasso_data.mat`. Check the extensions on the files; some browsers change the names upon download (to .exe, for example). If so, try another browser or adjust your browser's MIME settings.

Run the file `bioe210_test_suite.m` and turn in the output.

For full credit, there should be no errors when you run the script. If the script completes without errors, you have installed all the Matlab toolboxes you will need for the course. (Note that there may be warnings that some functions "will be removed in a future release". This is not a problem. We are using the old names for functions to allow compatibility with previous Matlab releases.)

```
Command Window

Optimal solution found.


ans =

   45.1546
   -0.0082
    0.1969


ans =

         0
    1.4534
         0
   -2.3954
         0


linx =

    0.6667
    1.3333
```

```
Command Window

quadx =

    0.6667
    1.3333


species =

  2×1 cell array

    {'virginica' }
    {'versicolor'}


ans =

   36.8218   29.6073  -12.9818   23.7147   -0.5532


ans =

   -0.0170   -0.0161   -0.0171   -0.0191   -0.0200

>>
```