Homework Problem Set Sample Solutions

1. **The National Agricultural Statistics Service (NASS) is an agency within the USDA that collects and analyzes data covering virtually every aspect of agriculture in the United States. The following table contains information on the amount (in tons) of the following vegetables produced in the U.S. from 1988–1994 for processing into canned, frozen, and packaged foods: lima beans, snap beans, beets, cabbage, sweet corn, cucumbers, green peas, spinach, and tomatoes.**

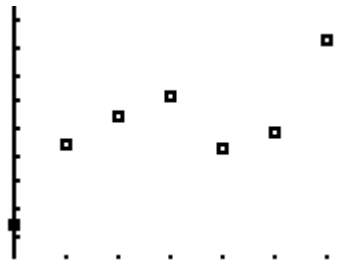
Vegetable Production by Year

Year	Vegetable Production (tons)
1988	11,393,320
1989	14,450,860
1990	15,444,970
1991	16,151,030
1992	14,236,320
1993	14,904,750
1994	18,313,150

Source: NASS Statistics of Vegetables and Melons, 1995, Table 191.
http://www.nass.usda.gov/Publications/Ag_Statistics/1995-1996/agr95_4.pdf

a. **Plot the data using a graphing utility. Then sketch the graph in the space below.**

Think back to the work you did in Lesson 2.



b. **Determine if the data display the characteristics of an odd- or even-degree polynomial function.**

Looking at the end behavior, the data show the characteristics of an odd-degree polynomial function.

c. **List two possible reasons the data might have such a shape.**

Possible responses: Bad weather in 1992 and 1993; shifts in demand for fresh foods vs. processed.

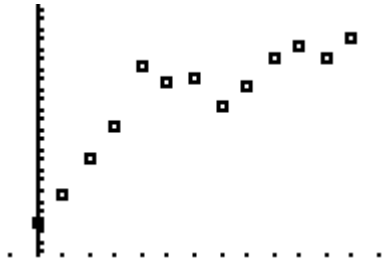
2. The U.S. Energy Information Administration (EIA) is responsible for collecting and analyzing information about energy production and use in the United States and for informing policy makers and the public about issues of energy, the economy, and the environment. The following table contains data from the EIA about natural gas consumption from 1950–2010, measured in millions of cubic feet.

U.S. Natural Gas Consumption by Year

Year	U.S. natural gas total consumption (millions of cubic feet)
1950	5.77
1955	8.69
1960	11.97
1965	15.28
1970	21.14
1975	19.54
1980	19.88
1985	17.28
1990	19.17
1995	22.21
2000	23.33
2005	22.01
2010	24.09

Source: U.S. Energy Information Administration. http://www.eia.gov/dnav/ng/hist/n9140us2a.htm

A. Plot the data using a graphing utility. Then sketch the graph in the space below.



B. Determine if the data display the characteristics of an odd- or even-degree polynomial function.

Looking at the end behavior, the data show the characteristics of an odd-degree polynomial function.

C. List two possible reasons the data might have such a shape.

Possible responses: changes in supply, new sources and technology created new supplies, weather may impact usage.

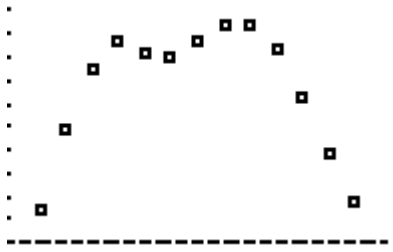
3. **The Center for Transportation Analysis (CTA) studies all aspects of transportation in the United States, from energy and environmental concerns to safety and security challenges. A 1997 study compiled the following data of the fuel economy in miles per gallon (mpg) of a car or light truck at various speeds measured in miles per hour (mph). The data are compiled in the table below.**

Fuel Economy by Speed

Speed (mph)	Fuel Economy (mpg)
15	24.4
20	27.9
25	30.5
30	31.7
35	31.2
40	31.0
45	31.6
50	32.4
55	32.4
60	31.4
65	29.2
70	26.8
75	24.8

Source: Transportation Energy Data Book, Table 4.28.
http://cta.ornl.gov/data/chapter4.shtml

a. **Plot the data using a graphing utility. Which variable is the independent variable? Then sketch the graph in the space below.**



Speed is the independent variable.

b. **This data can be modeled by a polynomial function. Determine if the function that models the data would have an even or odd degree.**

It seems we could model this data by an even-degree polynomial function.

c. **Is the leading coefficient of the polynomial that can be used to model this data positive or negative?**

The leading coefficient would be negative since the end behavior of this function is to approach negative infinity on both sides.

d. **List two possible reasons the data might have the shape that it does.**

Possible responses: Fuel economy improves up to a certain speed, but then wind resistance at higher speeds reduces fuel economy; the increased gas needed to go higher speeds reduces fuel economy.

4. For each problem below, determine if the function is even, odd or neither. Be sure to show your work.

A. $f(x)=4x^3-2x$

$$\begin{aligned} f(x) &= 4x^3-2x \\ f(-x) &= 4(-x)^3-2(-x) \\ &= -4x^3+2x \\ &= -\left(4x^3-2x\right) \\ &= -f(x) \end{aligned}$$

Therefore $f(x)$ is an odd function.

B. $g(x)=5x^3-7x^2+2$

$$\begin{aligned} g(x) &= 5x^3-7x^2+2 \\ g(-x) &= 5(-x)^3-7(-x)^2+2 \\ &= -5x^3-7x^2+2 \\ g(-x) &\neq -g(x) \neq g(x) \end{aligned}$$

Therefore $g(x)$ is not an even nor an odd function.

C. $h(x)=-x^4+6x^2+9$

$$\begin{aligned} h(x) &= -x^4+6x^2+9 \\ h(-x) &= -(-x)^4+6(-x)^2+9 \\ &= -x^4+6x^2+9 \\ &= h(x) \end{aligned}$$

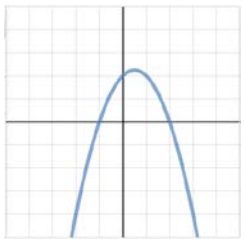
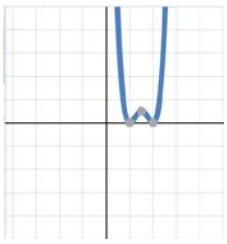
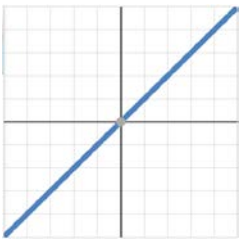
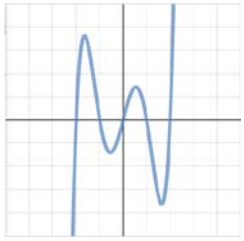
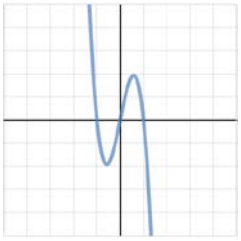
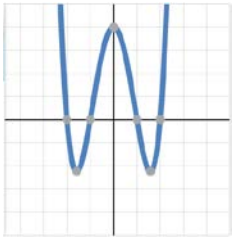
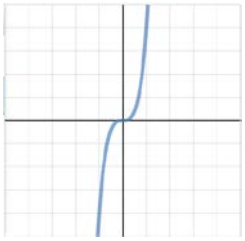
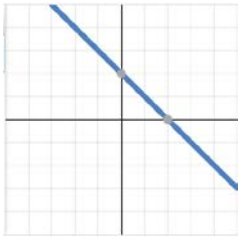
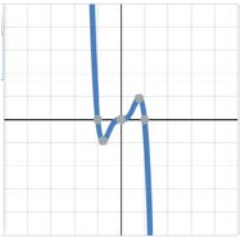
Therefore $h(x)$ is an even function.

D. $j(x)=3x^2+x$

$$\begin{aligned} j(x) &= 3x^2+x \\ j(-x) &= 3(-x)^2+(-x) \\ &= 3x^2-x \\ j(-x) &\neq -j(x) \neq j(x) \end{aligned}$$

Therefore $j(x)$ is not an even nor an odd function.

5. In Exercises 7 and 9, you looked at the symmetry of the graphs. Even functions are symmetry over the *y*-axis, while odd functions are symmetry about the origin (rotational symmetry). Use this idea to determine which of the following functions are even, odd or neither.

A.  Neither	B.  Neither	C.  Odd
D.  Odd	E.  Odd	F.  Even
G.  Odd	H.  Neither	I.  Odd