

LESSON MASTER 2-8

Questions on SPUR Objectives
See pages 152–157 for objectives.

Representations Objective K

1. Use the scatterplot at the right showing the relation between diameter and breaking strength of 3-strand polypropylene rope.

- a. Use a statistics utility to determine the regression equation for each model of the data.

linear model:

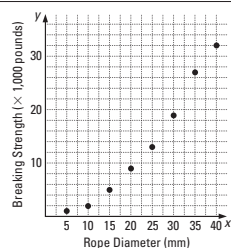
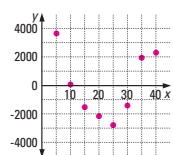
$$y \approx 924x - 7285$$

quadratic model:

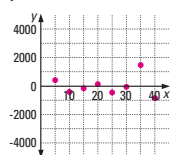
$$y \approx 18.57x^2 + 88.1x - 321.4$$

- b. Plot the residuals for each model in part a.

linear model:



quadratic model:



- c. From the residual plots in part b, which do you believe is a more appropriate model for this data? Justify your answer.

Sample: The quadratic model, since the residuals are much closer to zero and since there appears to be a pattern in the residuals for the linear model

LESSON MASTER 3-1

Questions on SPUR Objectives
See pages 225–229 for objectives.

Vocabulary

1. Explain what is meant by a parent function.

Sample: a function from which other related functions can be derived.

2. Describe the asymptotes and point of discontinuity of the graph of the function $f(x) = \frac{1}{x^2 - 3x - 4}$. Use an automatic grapher if needed.

vertical asymptotes: $x = 4$ and $x = -1$; **horizontal asymptote:** $y = 0$; **points of discontinuity:** $x = 4$ and $x = -1$

Representations Objective J

In 3–5, give an equation of a parent function whose graph has the given features.

3. an asymptote but no points of discontinuity

Samples are given. $y = b^x$

4. points of discontinuity but no asymptotes

$$y = \lfloor x \rfloor$$

$$y = \frac{1}{x} \text{ or } y = \frac{1}{x^2}$$

5. two asymptotes

$$y = x^2$$

6. a. Give an equation for the parent function of a parabola with equation $y = 3(x - 2)^2 + 2$.

- b. Graph $y = 3(x - 2)^2 + 2$ and its parent function on an appropriate viewing window of an automatic grapher. Give the intervals of x - and y -values for your window.

$$-5 \leq x \leq 5, -2 \leq y \leq 15$$

Samples are given.

- c. In the screen at the right, sketch what you see on your window.

- d. Describe the relationship between the two graphs.

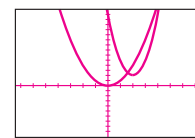
The graph of

$$y = 3(x - 2)^2 + 2 \text{ is}$$

shifted 2 units right and 2 units up from the

graph of its parent

function, $y = x^2$.



$$-5 \leq x \leq 5, -2 \leq y \leq 15, x\text{-scale} = 1, y\text{-scale} = 1$$

LESSON MASTER 3-2

Questions on SPUR Objectives
See pages 225–229 for objectives.

Properties Objective C

1. Let T be the transformation $T: (x, y) \rightarrow (x + 5, y - 6)$. Find an equation for the image of $y = x^3 + \frac{3}{2}$ under T .

$$y = (x - 5)^3 - \frac{9}{2}$$

2. Give an equation for the transformation T which moves each point 9 units down and 3 units to the right.

$$l: (x, y) \rightarrow (x + 3, y - 9)$$

3. What transformation maps the graph of $y = |x|$ onto the graph of $y = |x - 8| + 15$?

$$l: (x, y) \rightarrow (x + 8, y + 15)$$

Properties Objective D

4. What are the zeros and the asymptotes of the graph of $y = \frac{1}{x}$ under the translation $T(x, y) = (x + 3, y - 1)$?

zero at $x = 4$; asymptotes $x = 3$ and $y = -1$

5. True or false. A translation does not change the number of asymptotes of a graph.

True

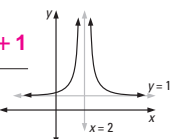
Representations Objective K

6. a. Use the Graph-Translation Theorem to write an equation for the graph at the right. An equation for the parent function is $y = \frac{1}{x^2}$.

$$y = \frac{1}{(x - 2)^2} + 1$$

- b. Use your equation in part a to find the value of the graphed function at $x = 11$.

$$\frac{82}{81}$$



7. Consider the function f given by $f(x) = (x - 5)^3 - 2$.

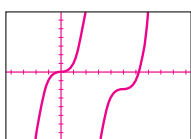
- a. Give an equation for the parent function of f .

$$y = x^3$$

- b. What transformation maps the parent function onto f ?

$$T: (x, y) \rightarrow (x + 5, y + 2)$$

- c. Use an automatic grapher to graph f and its parent function on the same window. Choose an appropriate viewing key features of both graphs. In the screen at the right, sketch what you see on your window.



- d. Identify the x - and y -intercepts of f and its parent function.

$$f: x \approx 6.26; \text{ parent: } x = 0, y = 0$$

$$-2 \leq x \leq 8, x\text{-scale} = 1, -5 \leq y \leq 1, y\text{-scale} = 1$$

LESSON MASTER 3-3

Questions on SPUR Objectives
See pages 225–229 for objectives.

Properties Objective E

1. A data set has a mean of 5 and a standard deviation of 2. Suppose 1,000 is added to each observation. What are the new mean and standard deviation?

$$\text{mean: } 1005$$

$$\text{st. dev.: } 2$$

2. A data set has a median of 35 and a mode of 30. Suppose 15 is added to each observation. What are the new mode and median?

$$\text{mean: } 45$$

$$\text{st. dev.: } 50$$

Uses Objective I

3. A meteorologist takes a number of air-temperature readings and finds that the mean temperature is -24.66°C with a standard deviation of 2.27°C . He then decides to convert all of his measurements from degrees Celsius to degrees Kelvin. To do this, he uses the formula $K = C + 273.15$, where C is the temperature in degrees Celsius and K is the temperature in degrees Kelvin.

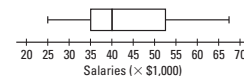
- a. What is the mean air-temperature reading in degrees Kelvin?

$$-297.81^\circ\text{K}$$

- b. What is the standard deviation of air-temperature readings in degrees Kelvin?

$$2.27^\circ\text{K}$$

4. The box plot below displays the annual salaries of employees at Transformation Technologies, Inc., a small biotech company involved in cloning research.



Suppose, due to profit sharing, each employee receives an end-of-year bonus of \$5,000. Which, if any, of the following descriptive statistics will change due to this bonus? If they change, give their new values.

- a. median annual income
b. interquartile range
c. range
d. outliers

$$\text{\$45,000}$$

$$\text{no change}$$

$$\text{no change}$$

$$\text{\$30,000, \$72,000}$$

LESSON MASTER 3-4

Questions on SPUR Objectives
See pages 225–229 for objectives.

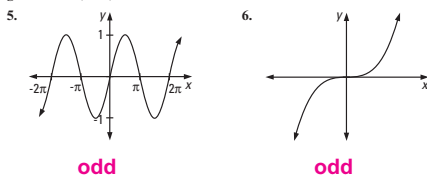
Properties Objective F

In 1–4, decide whether the function with the given equation is even, odd, or neither. Justify your answer algebraically.

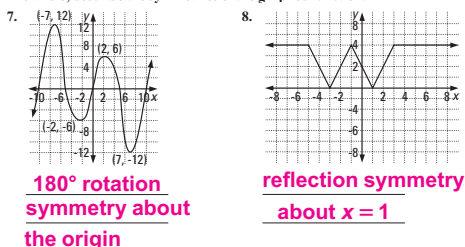
- $s(t) = 8t^7$ **Odd; $8(-t)^7 = -8t^7 = -(8t^7)$**
- $f(x) = 7x^5 - 5x^2$ **Neither; $7(-x)^5 - 5(-x)^2 = -7x^5 - 5x^2$**
- $g(h) = -9h^2 + 5$ **Even; $-9(-h)^2 + 5 = -9h^2 + 5$**
- $v(m) = |7m + 2| - 5$ **Neither; $|7(-m) + 2| - 5 = |-7m + 2| - 5$**

Representations Objective L

In 5 and 6, decide whether the function whose graph is given is even, odd, or neither.



In 7 and 8, describe the symmetries of the graphed function.



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LESSON MASTER 3-5

Questions on SPUR Objectives
See pages 225–229 for objectives.

Properties Objective C

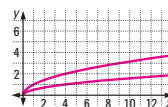
- Find the scale change S which shrinks a graph horizontally with a factor of $\frac{1}{6}$ and stretches it vertically with a factor of 8. **$S: (x, y) \rightarrow (\frac{x}{6}, 8y)$**
- Find an equation for the image of $y = \sqrt{x^2 + 1}$ under the scale change $S: (x, y) \rightarrow (\frac{x}{3}, 3y)$. **$y = 3\sqrt{9x^2 + 1}$**
- Describe two different transformations S_1 and S_2 which map the graph of $y = x^2$ onto the graph of $y = \frac{9}{4}x^2$. **Samples are given.**
 $S_1: (x, y) \rightarrow (\frac{2}{3}x, y)$ **$S_2: (x, y) \rightarrow (x, \frac{9}{4}y)$**
- Multiple choice. Which scale change will map $y = \frac{\pi}{2}x^2$ so that the transformed graph includes the point (1, 1)? **c**
(a) $S(x, y) = (\sqrt{\frac{2}{\pi}}x, \frac{2}{\pi})$ (b) $S(x, y) = (\sqrt{\frac{2}{\pi}}x, y)$
(c) $S(x, y) = (x, \frac{2}{\pi}y)$ (d) $S(x, y) = (x, \frac{\pi}{2}y)$

Properties Objective D

- The graph of an equation has x-intercepts -1.5, 1, and 2, and y-intercept -3. Give the x- and y-intercepts for the image of the graph under the transformation $S: (x, y) \rightarrow (2x, 3y)$. **x-intercepts: -3, 2, 4; y-intercept: -9**
- Describe the points of discontinuity on the image of the graph of $y = [x]$ under the scale change $S: (x, y) \rightarrow (2x, \frac{1}{3}y)$. **integral multiples of 8**
- Suppose the scale change $S: (x, y) \rightarrow (4x, 3y)$ is applied to the graph of $y = \frac{x^2}{9}$. What effect does this transformation have on the graph's asymptotes? **Horizontal asymptote y = 0 is unchanged; vertical asymptotes x = 3 and x = -3 move to x = $\frac{3}{4}$ and x = $-\frac{3}{4}$**

Representations Objective K

- Sketch graphs of $y = \sqrt{x}$ and its image under the transformation $S: (x, y) \rightarrow (\frac{1}{4}x, y)$.



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LESSON MASTER 3-6

Questions on SPUR Objectives
See pages 225–229 for objectives.

Properties Objective E

In 1–4, suppose each element in a data set is multiplied by -7. Describe the effect of this transformation on each measure.

- mean **multiplied by -7**
 - mode **multiplied by -7**
 - median **multiplied by -7**
 - range **multiplied by 7**
5. A data set is rescaled so that its variance is multiplied by 4. What are two possible values for the scale factor?
a = 2 and a = -2

Uses Objective I

- Neil Vestor is trying to decide whether he should purchase stock in an American or a Japanese manufacturing company. He recorded the price of each stock over a 3-week period and computed the mean and standard deviation for each.

	American Company	Japanese Company
Mean stock value	\$39.60	¥6734
Standard deviation	\$ 2.50	¥ 187

To compare the two stocks, Neil rescales his raw data by converting the stock prices in yen to dollars, using the exchange rate \$1 = ¥127. If Neil is trying to minimize his risk by choosing the stock with the least variability, which stock should he buy? Justify your answer.

Sample: the Japanese company, as its standard deviation is $\frac{187}{127} = \$1.47$ so it is less variable than that of the American company.

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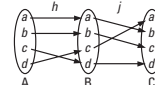
LESSON MASTER 3-7

Questions on SPUR Objectives
See pages 225–229 for objectives.

Skills Objective A

In 1 and 2, let $f(x) = x^2 + 2x + 7$ and $g(x) = 5x - 3$.

- Evaluate each composite.
a. $f(g(1))$ **15** b. $g(f(1))$ **47**
- Find a formula for each composite.
a. $f(g(x))$ **$y = 25x^2 - 20x + 10$** b. $g(g(x))$ **$y = 25x - 18$**
- Let $F = \{(1, 7), (2, 4), (3, 2), (4, 1)\}$ and $G = \{(7, 6), (1, 3), (2, 2), (4, 1)\}$. Find each composite.
a. $F \circ G$ **$\{(1, 2), (2, 4), (4, 7)\}$** b. $G \circ F$ **$\{(1, 6), (2, 1), (3, 2), (4, 3)\}$**
- Consider the functions h mapping A to B and j mapping B to C.



Evaluate each composition.

- a. $h(j(a))$ **b** b. $j(h(b))$ **c** c. $(h \circ j)(d)$ **c**

Properties Objective G

- Let $s(x) = \sqrt{x - 1}$ and $n(x) = x^2 - 2$. Give the domain of each composite.
a. $n \circ s$ **set of all reals > 1** b. $s \circ n$ **set of all reals $> \sqrt{3}$**
- Let $p(t) = \frac{1}{t} - 1$. True or false. The domain of p is the same as the domain of $p \circ p$. Justify your answer.
False; The domain of p is the set of all real numbers except 0; the domain of $p \circ p$ is the set of all real numbers except 0 and 1.

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LESSON MASTER**3-8****Questions on SPUR Objectives**
See pages 225–229 for objectives.**Skills** Objective B

In 1–3, a function is described. a. Give an equation for the inverse of the function. b. State whether the inverse is a function.

1. $y = 3 - 2x$ a. $y = -\frac{1}{2}x + \frac{3}{2}$ b. **a function**

2. $g(x) = \frac{1}{x^2}$ a. $y = \pm \frac{\sqrt{x}}{x}$ b. **not a function**

3. $f = \{(-2.5, 0), (0, -2.5), (1, 3), (3, 1)\}$
a. $f^{-1} = \{(0, -2.5), (-2.5, 0), (3, 1), (1, 3)\}$ b. **a function**

Properties Objective G4. Let $f(x) = \lfloor x \rfloor$ and $g(x) = \lceil x \rceil$. Are functions f and g inverses? Justify your answer.

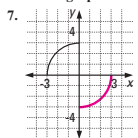
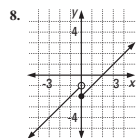
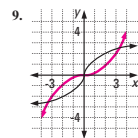
$$f(g(x)) = \lfloor \lceil x \rceil \rfloor; \text{ if } x = 2.5, f(g(2.5)) = 3; \text{ so } f(g(x)) \neq x \text{ and } f \text{ and } g \text{ are not inverses.}$$

5. True or false. If a function is an even function, then its inverse is not a function. **True**6. Suppose f is a function such that for all x , $f(x) = f(x + 2)$. Is the inverse of f a function? Justify your answer.

No; if $x = 0$, then $f(0) = f(2)$ and the line $y = f(0)$ intersects two points on the graph: $(0, f(0))$ and $(2, f(2))$.

Representations Objectives L and M

In 7–9, determine whether the inverse of the graphed function is a function. If the inverse is a function, sketch its graph on the same set of axes.

**a function****not a function****a function**

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LESSON MASTER**3-9****Questions on SPUR Objectives**
See pages 225–229 for objectives.**Properties** Objective H

1. Explain how a z-score is calculated.

The mean is subtracted from the raw score; the difference is divided by the standard deviation.

2. A data set has a mean of 25.6 and a standard deviation of 2.3. Find each for the data set's z-scores.

a. the mean **0**
b. the standard deviation **1**

In 3 and 4, a z-score is given. Explain what it means in terms of the mean and standard deviation of the original data set.

3. $z = 0.75$ **$\frac{3}{4}$ of a standard deviation above the mean**4. $z = -1.25$ **$\frac{5}{4}$ of a standard deviation below the mean****Uses** Objective I

5. The following sets of data show the average number of points scored per game by players on the boys' and girls' basketball teams.

Boys	4.7	0.3	11.6	0.3	3.6	6.2	1.3	1.1
	3.1	7.6	4.0	20.5	0.8	2.5	3.6	
Girls	7.0	2.6	9.8	6.3	5.7	0.8	6.5	8.5
	12.4	7.2	5.3	7.9	9.1	7.6	6.9	

a. Convert the above data for the 15 boys and 15 girls to z-scores. (When calculating z-scores, use the population standard deviation, not the sample standard deviation.)

Boys	-0.1	-0.86	1.33	-0.86	-0.22	0.28	-0.67	-0.71
	-0.32	0.55	-0.14	3.06	-0.77	-0.44	-0.22	
Girls	0.03	-1.61	1.08	-0.23	-0.45	-2.28	-0.15	0.59
	2.05	0.11	-0.60	0.37	0.82	0.26	0	

b. Who did better relative to the rest of the team, the boy who averaged 6.2 points per game or the girl who averaged 7.9 points per game? Justify your answer in terms of z-scores.

the girl; her z-score was 0.37 and boy's was 0.28

6. A student took two tests. On the first, she scored 87 and on the second she scored 80. If the class mean was 80 and the standard deviation was 10 on the first test and the class mean was 72 with a standard deviation of 5 on the second, on which test did she do better compared to the other students?

second test (1st z-score: 0.7; 2nd z-score: 1.6)

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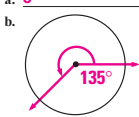
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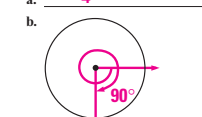
LESSON MASTER**4-1****Questions on SPUR Objectives**
See pages 303–307 for objectives.**Skills** Objective A

In 1 and 2, the measure of a rotation is given. a. Convert the measure to revolutions. b. On the circle draw a central angle showing the given rotation.

1. 225° a. $\frac{5}{8}$, counterclockwise b. $\frac{5\pi}{2}$ radians

3. Give two other degree measures, one positive and one negative, for a rotation of 138° .

$498^\circ, -222^\circ$

4. Give two other radian measures, one positive and one negative, for a rotation of $\frac{4\pi}{3}$.

$\frac{10\pi}{3}, -\frac{2\pi}{3}$

In 5–7, convert to a radian measure without using a calculator.

5. 60° **$\frac{\pi}{3}$** 6. 135° **$\frac{3\pi}{4}$** 7. -210° **$-\frac{7\pi}{6}$**

In 8–10, convert to a degree measure without using a calculator.

8. $\frac{11\pi}{6}$ **330°** 9. $\frac{\pi}{10}$ **-18°** 10. 3.14159 **$\approx 180^\circ$**

In 11–14, use a calculator to convert the given angle measure to the indicated units. Give your answer correct to the nearest thousandth.

11. -42° a. to revolutions **≈ 0.12 , clockwise** b. to radians **≈ -0.733**

12. 19π a. to revolutions ****95, counterclockwise**** b. to degrees ****3420°****

13. 19 a. to revolutions ****≈ 3.02 , counterclockwise**** b. to degrees ****1088.620°****

14. 0.33 revolution clockwise a. to radians ****≈ 2.073 radians**** b. to degrees ****-118.8°****

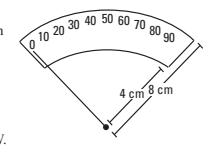
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LESSON MASTER**4-2****Questions on SPUR Objectives**
See pages 303–307 for objectives.**Skills** Objective B1. Find the length of an arc of a circle of radius 8 m if the central angle of the arc is $\frac{5\pi}{3}$. **20π , or ≈ 20.94 , m**2. Find the area of a sector of a circle of diameter 22 in. if the central angle of the sector is 315° . **847π , or ≈ 332.62 in²**3. The arc of a circle of radius 4 cm has a length of $\frac{2\pi}{3}$ cm. Find the measure of the central angle in radians and degrees. **$\frac{\pi}{6}$, 30°** 4. A sector in a circle with central angle $\frac{7\pi}{6}$ has an area of 14π m². Find the exact length of the radius of the circle. **$4\sqrt{3}$ m****Uses** Objective G5. James needs to replace the glass of the speedometer on his old car. If the needle can maximally rotate $\frac{5\pi}{12}$, find the area of the glass that James needs.

10π , or ≈ 31.4 , cm²

6. Austin, TX, and Oklahoma City, OK, have approximately the same longitude, $97^\circ 30' W$. Austin has latitude $30^\circ 16' N$. Oklahoma City has latitude $35^\circ 28' N$. Use 3,960 miles for the radius of the earth to estimate the air distance from Austin to Oklahoma city.

≈ 359 mi

7. Kaitlin watched her son Dizzy ride a horse 22 ft from the center of a merry-go-round. Dizzy completed one revolution in 45 seconds.

a. How far did Dizzy travel in one revolution? **≈ 138 ft**b. How far did Dizzy travel in one minute? **≈ 184 ft**

c. Kaitlin noted that her son started at the easternmost position. If the merry-go-round rotates counterclockwise and the ride lasts 4 minutes, sketch the position of her son when the ride ended.



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