Unit 9 Lesson 1 – Radical Word Problems and Systems of Equations

I. Radical Word Problems

1. The speed of a wave during a tsunami can be calculated with the formula $s = \sqrt{9.81d}$ where s represents speed in meters per second, d represents the depth of the water in meters where the disturbance (for example an earthquake) takes place, and 9.81 m/s² is the acceleration due to gravity.

speed → depth

a. Write an equation to find the depth of the water where the disturbance took place. (get D by itself)

$s^2 = (\sqrt{9.81d})^2$

$s^2 = 9.81d$ ✓ Divide by 9.81 $d = s^2/9.81$

b. If the speed of the wave is 150 m/s, what is the depth of the water where the disturbance took place.

$d = \frac{(150)^2}{9.81} = \frac{22500}{9.81} = 2293.57$ about 2293.6 meters

2. Police measure the lengths of skid marks to determine the initial speed of a vehicle before the breaks were applied. Many variables, such as type of road surface and weather conditions, play an important role in determining speed. The formula used to determine the initial speed is $S = 5.5\sqrt{D \cdot f}$ where S is the speed in miles per hour, D is the average length of the skid marks in feet, and f is a constant called the "drag factor". drag factor

speed length of mark

a. At a particular scene, assume it is known that the road surface has a drag factor of 0.7. If the average length of the skid marks is 60 feet, estimate the initial speed of the car when the brakes were applied.

$S = 5.5\sqrt{(60)(.7)} = 35.6$ mph

b. Solve the formula for D.

$(S/5.5)^2 = (\sqrt{D \cdot f})^2$

$S^2/30.25 = D \cdot f$ ✓ $D = \frac{S^2}{30.25f}$

c. If you traveled on this road at a speed of 65 mph and slammed on your brakes, how long would your skid marks be?

$D = \frac{(65)^2}{(30.25)(.7)} = 199.52$ feet

3. The length s of one edge of a cube is given by $s = \sqrt{\frac{A}{6}}$, where A represents the cube's surface area.

length surface area

a. Rewrite the equation to determine surface area.

$s^2 = \frac{A}{6}$

Multiply by 6 ✓ $6 \cdot s^2 = A$

b. Use your equation from part a to find the surface area if the edge length is 9 cm.

$A = 6(9)^2 = 486\text{cm}^2$

4. The time t in seconds it takes for a pendulum of a clock to complete a full swing is approximated by the equation $t = 2\sqrt{\frac{L}{3.3}}$, where L is the length of the pendulum in feet.

time → length

a. If the pendulum of a clock completes a full swing in 3 seconds what is the **length** of the pendulum? Solve the equation for the indicated variable then use your new eqaution to help you answer the question.

$\left(\frac{t}{2}\right)^2 = \left(\sqrt{\frac{L}{3.3}}\right)^2 \Rightarrow \frac{t^2}{4} = \frac{L}{3.3} \Rightarrow$ mult by 3.3 $\Rightarrow \frac{3.3t^2}{4} = L$ ✓ $\frac{3.3(3)^2}{4} = L$

$L = 7.425$ feet

b. How long is a pendulum if each swing takes 1 second?

$L = \frac{3.3(1)^2}{4} = .825$ feet

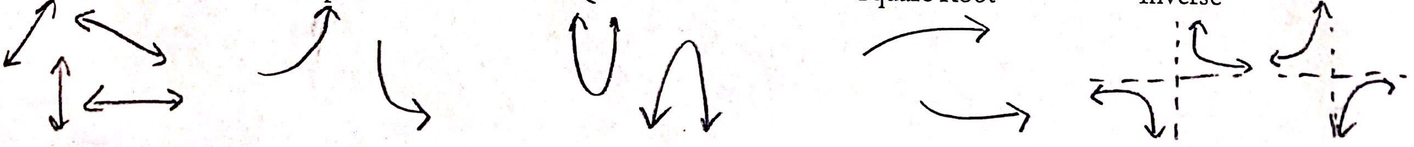
II. Systems involving Radicals

System of Equations: Two or more linear equations graphed in the same coordinate plane.

Solution to a System of Equations: any point shared by all the lines in the system.

Your Function Toolbox includes the following functions:

Linear Exponential Quadratic Square Root Inverse



Examples: (2.903, 5.429)

5. $\begin{cases} y = \sqrt{x+5} \\ y = -1 \end{cases}$ SR L

ϕ

6. $\begin{cases} f(x) = \sqrt{x-3} \\ g(x) = -\sqrt{x}+7 \end{cases}$ SR SR

(13.796, 3.286)

7. $\begin{cases} h(x) = \sqrt{x+1} \\ p(x) = (x-8)^2 \end{cases}$

(6.353, 2.712)

(9.813, 3.288)

8. $\begin{cases} y = \frac{4}{x-2} + 1 \\ y = x^2 - 3 \end{cases}$

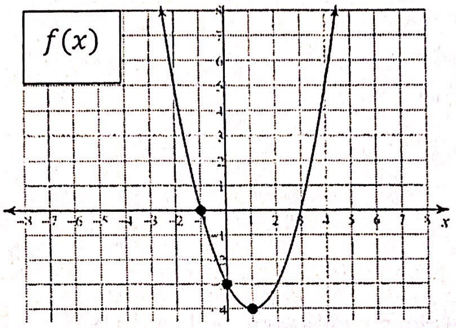
(−1.709, −.078)

(0.806, −2.35)

9. Graph the function $I = \frac{1}{5}\sqrt{P}$, which gives the current I in amperes for a certain current with P watts of power. When will the current exceed 2 amperes? When the power is more than 100 watts.

III. Comparing Functions

10. **Multiple Choice**: Kelly compared the y – intercept of the graph of $f(x)$ shown below to the y-intercept of the function $g(x) = 2\sqrt{x+4} - 8$. What is the difference when the y-intercept of $f(x)$ is subtracted from the y-intercept of $g(x)$?



A. 1   B. −1   C. −7   D. 7

y-int of f(x) = −3

y-int of g(x) = −4

g(x) − f(x) = −4 − (−3) = −1

11. **Multiple Choice:** Which function in question #10 above has the smallest minimum value and by how much? (1 point)

A. $f(x)$ and 4 units

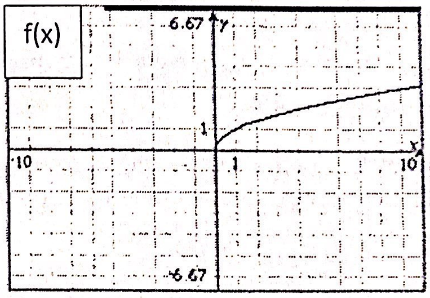
B. $g(x)$ and 4 units

C. $f(x)$ and 9 units

D. $f(x)$ and $g(x)$ have the same minimum value

12. **Multiple Choice**: Compare the rate of change for d(x) to the rate of change for f(x).

Meredith runs at a constant rate of 6 miles per hour when she runs on her treadmill. The distance d(x) that she runs is a function of the time she runs (x).



A. Initially the rate of change for f(x) is greater than d(x) but then d(x) is greater than f(x)

B. Initially the rate of change for d(x) is greater than f(x) but then f(x) is greater than d(x)

C. The rate of change for f(x) equals the rate of change for g(x)

D. There is not enough information to determine the rate of change for d(x) or f(x)

13. Two functions are shown below. What is the y-value when $f(x) = g(x)$?

2.18

$$\begin{cases} f(x) = \dfrac{1}{4(x-3)} + 2 \\ g(x) = \sqrt{x-3} + 1 \end{cases}$$