HW 3.4.1: Applications of Function Patterns

Use your knowledge of function patterns to answer the questions below. At this point in the year, you have the skills to determine the regression function for linear and exponential without using a calculator. However, if the function modeled is quadratic, power, or logarithmic, a calculator is needed.

Linear: $y = ax + b$ Quadratic: $y = ax^2 + bx + c$

Power: $y = a \cdot x^b$ Exponential: $y = a \cdot b^x$ Logarithm: $y = a + b \ln x$

1. A house is bought in an up and coming Texas neighborhood. The table below shows the value of the house, $V(t)$, after owning the house for t years.

t in years	$V(t)$ value of house
2	\$150,000
4	\$225,000
6	\$337,500
8	\$506,250

a. Determine the price of the home after 12 years.

b. Use the function properties that you learned previously to make a conjecture as to the type of function that models the given data. What type of function models this pattern?

c. Why can't you use the pattern to find $V(15)$?

d. Find a particular equation for $V(t)$ and verify that all of the $V(t)$ values in the given table satisfy the equation. (Leave your equation exact.)

e. Evaluate $V(15)$.

f. In what year will the house be worth 5 million dollars? Give both, the exact (without calculator) and approximate (with calculator) answers.

2. A Cessna airplane is taking off on a runway. You start recording the velocity as a function of time slightly after it has started. Below is a table of your results.

t, time in seconds	$V(t)$ in miles per hour
3	80
6	160
9	206.8
12	240

   a. Determine the velocity of the plane after 48 seconds.

   b. Use the function properties that you learned previously to make a conjecture as to the type of function that models the given data. What type of function models this pattern?

   c. Why can't you use the pattern to find $V(20)$?

   d. Find a particular equation for $V(t)$ and verify that all of the $V(t)$ values in the given table satisfy the equation.

   e. Evaluate $V(t)$.

   f. How long will it take the plane to reach 700 mph? Give both, the exact (without calculator) and approximate (with calculator) answers.

3. Below is a table relating altitude, h, and atmospheric pressure $P(h)$.

Altitude above sea level (km)	Atmospheric Pressure (kPa)
2	80
4	64
6	51.2
8	40.96

   a. Determine the atmospheric pressure at 10 km above sea level.

   b. Use the function properties that you learned previously to make a conjecture as to the type of function that models the given data. What type of function models this pattern?

c. Why can't you use the pattern to find $P(5)$?

d. Find a particular equation for $P(h)$ and verify that all of the $P(h)$ values in the given table satisfy the equation. (Leave your equation exact.)

e. Evaluate $P(5)$.

f. At what altitude will the atmospheric pressure reach 25 kPa? Give both, the exact (without calculator) and approximate (with calculator) answers.

4. Below is a table relating speed of a vehicle, s, and its stopping distance, $d(s)$.

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Speed (mph)	Stopping Distance (ft)
10	14.6
20	39.9
30	75.2
40	120.5
50	175.8

a. Determine the stopping distance at 70 mph.

b. Use the function properties that you learned previously to make a conjecture as to the type of function that models the given data. What type of function models this pattern?

c. Why can't you use the pattern to find $d(25)$?

d. Find a particular equation for $d(s)$ and verify that all of the $d(s)$ values in the given table satisfy the equation.

e. Evaluate $d(25)$.

f. At what speed will the stopping distance be 100ft? Give both, the exact (without calculator) and approximate (with calculator) answers.

Selected answers:

1.
a) $1,139,062.50
b) Exponential: Add-Product
c) The input is not a multiple of 2.

d.) $V(t) = 100{,}000\left(\frac{3}{2}\right)^{\frac{t}{2}}$

e.) $2,092,591.43

f.) $t = \dfrac{2\log 50}{\log\left(\frac{3}{2}\right)}$; 19.296 years

3.
a.) 32.768 kPa
b.) Exponential: Add-Product
c.) The input is not a multiple of 2.

d.) $P(h) = 100\left(\frac{4}{5}\right)^{\frac{h}{2}}$

e.) 57.243 kPa

f.) $h = \dfrac{2\log\left(\frac{1}{4}\right)}{\log\left(\frac{4}{5}\right)}$; 12.425 km