Problem A: Evaluate the logs in each column without a calculator.

Column A	Column B	Column C
$\log_3 81$ $\log_2 64$ $\log_6 36$ $\log 1000$ $\ln e$	$\log_3 \frac{1}{9}$ $\log_{49} 7$ $\ln e^7$ $\log_5 125$ $\log_5 \sqrt{5}$	$\log_4 \frac{1}{64}$ $\log_2 \frac{1}{2}$ $\log_9 9^6$ $\log_\pi 1$ $\log_{\frac{1}{2}} \left(\frac{1}{32}\right)$
Sum of Column A: _____	Sum of Column B: _____	Sum of Column C: _____

Your final answer is the 4-digit code made by writing the three sums next to each other.

Problem B:

$$\log \frac{9x^7y}{x^2y^4} = A \log 3 + B \log x + C \log y$$

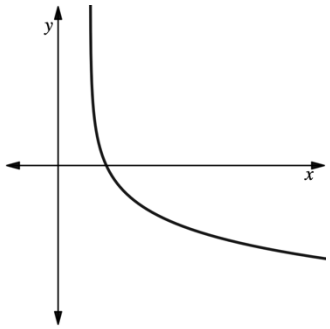
Find $A + B + C$.

Problem C:

A 2020 Ford Escape is valued at $24,885 and loses about 14% of its value each year, on average. After how many years will the car be worth half its original amount? Round your answer to the nearest hundredth to get your next clue!

Problem D:

1. Which of the following logarithmic equations could represent the function shown below?



A) $y = -3\log_2(x-2)$

B) $y = 3\log_2(x-2)$

C) $y = -3\log_2(x+2)$

D) $y = 3\log_2(x+2)$

2. The equation $y = \log_b(x-h)+k$ would pass through the point

A) $(1,0)$
B) $(b,1)$
C) (h,k)
D) $(h+1,k)$

3. Which of the following logarithmic functions has a vertical asymptote at $x = -3$?

I. $y = \log_4(x-3)$
II. $y = \log_4(-x-3)$
III. $y = -\log_2(x+3)$

A) II only B) I and III only C) II and III only D) I, II, and III

4. Find the inverse function of $y = \frac{1}{3}\cdot e^{2x}$

A) $y = \frac{1}{2}\ln(3x)$

B) $y = \frac{3}{e^{2x}}$

C) $y = \frac{3}{2}\ln x$

D) $y = \ln 6x$

Your final answer is the 4-letter code made by the answers to the 4 multiple choice questions!

Problem E:

A logarithmic function of the form $y = a\log_5 x + k$ passes through the points $(5,4)$ and $(25,11)$.

Find the value of $3a + k$.

Problem F:

A population of 320 bacteria grows continuously at a rate of 4.2% each day. Let $T(b)$ represent the number of days until the population has *b* bacteria. Find $T(1500)$ to the nearest thousandth.

Problem G:

a. Solve $\log_7(3x + 1) = 3$.
b. Solve $\log_8(5x^2) = \log_2(4x)$.

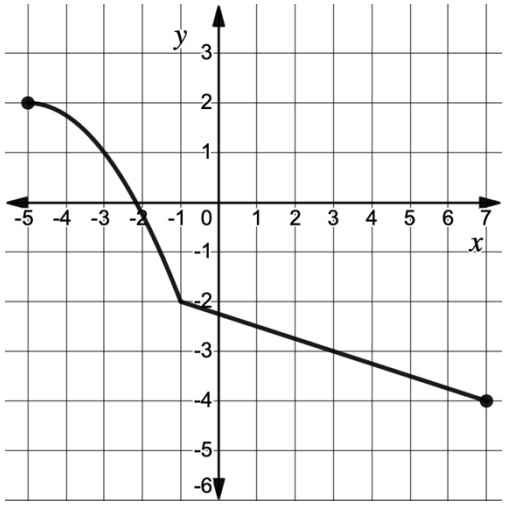
Your final answer is the sum of your solutions to parts a and b.

Problem H:

The complete graph of a function f is shown.

a. Find $f^{-1}(-3)$.

b. f^{-1} is defined on the interval $[c, d]$. Find the values of c and d.



Problem I:

Let $f(x) = 4^x$, $g(x) = 7x - 9$, and $h(x) = \ln x$. Which of the following compositions would produce a linear function?

A) $g\big(h(x)\big)$
B) $h\big(f(x)\big)$
C) $f\big(h(x)\big)$
D) $f\big(g(x)\big)$

Problem J: Let $[a, b]$, $[c, d]$, and $[e, f]$ represent equal sized intervals in the domain of a logarithmic function $g(x) = \log_k x$ where $k > 1$ and $a < b < 1 < c < d < e < f$. Which of the following statements is true about the average rates of change on the intervals $[a, b]$, $[c, d]$, and $[e, f]$?

A) The average rate of change on $[a, b]$ is negative but the average rates of change on $[c, d]$, and $[e, f]$ are positive.
B) The average rate of change on $[a, b]$ is greater than the average rate of change on $[c, d]$, which is greater than the average rate of change on $[e, f]$.
C) The average rate of change on $[a, b]$ is less than the average rate of change on $[c, d]$, which is less than the average rate of change on $[e, f]$.
D) The average rates of change on $[a, b]$, $[c, d]$, and $[e, f]$ are equal because the intervals are of equal length.

Problem K: Selected values of a function f are given in the table.

x	6	12	24	48	96	192
$f(x)$	14	17	20	23	26	29

Which of the following statements is true about g, the inverse function of f?

A) g is logarithmic because the inputs of g change additively as the outputs of g change multiplicatively.
B) g is exponential because the inputs of g change multiplicatively as the outputs of g change additively.
C) g is logarithmic because the inputs of g change multiplicatively as the outputs of g change additively.
D) g is exponential because the inputs of g change additively as the outputs of g change multiplicatively.