

1. True or false? For those which are true only if the domain is restricted, give the domain; for those that are false, give the correct equality.

(a)  $\log_b(xy) = (\log_b x)(\log_b y)$

(b)  $\log_b(x + y) = \log_b x + \log_b y$

(c)  $\frac{1}{2} \log_b x = \log_b \sqrt{x}$

(d)  $\log_b \left( \frac{x}{y} \right) = \log_b x + \log_b y$

(e)  $(\log_b x)^r = r \log_b x$

(f)  $y = b^x \Leftrightarrow \log_b y = x$

(g)  $b^{\log_b(\text{Texas})} = \text{Texas}$

2. Solve the following equations for real  $x$  and give the number of solutions you find for each one:

(a)  $\log_x(1 - x) = 2$

(b)  $\log_2 x = \log_4 5 + 3 \log_2 3$

(c)  $\ln x + \ln(x - 2) = 0$

(d)  $\log_5 |x + 3| + \log_5 |x - 3| = 1$

(e)  $\log_5 |x + 1| + \log_5 |x - 1| = 1.$

3. (Page 95 #68) Based on the estimate that there are 10 billion acres of arable land on the Earth, and that each acre can produce enough food to feed 4 people, some demographers believe that the Earth can support a population of no more than 40 billion people. The population of the Earth reached approximately 5 billion in 1986 and 6 billion in 1999. If the population of the Earth is growing according to the formula

$$P(t) = P_0 e^{rt},$$

where  $t$  is the time after the population is  $P_0$  and  $r$  is the growth rate, when will the population reach the theoretical limit of 40 billion?

For differentiable functions  $F$  and  $G$ , the derivative of the product  $F(x)G(x)$  and of the quotient  $F(x)/G(x)$  are given by the product and quotient rules respectively:

$$(F(x)G(x))' = F'(x)G(x) + F(x)G'(x) \quad \text{and} \quad \left(\frac{F(x)}{G(x)}\right)' = \frac{F'(x)G(x) - F(x)G'(x)}{G(x)^2}.$$

4. You are given that  $f$  and  $g$  are differentiable functions and that

$$f(2) = -1, \quad f'(2) = 7, \quad g(2) = 2, \quad g'(2) = 1.$$

(a)  $H(x) = (f(x) + 2)g(x)$ ; use the product rule to find  $H'(2)$ .

(b)  $h(x) = \frac{(f(x) + 2)}{x^2}$ ; use the quotient rule to find  $h'(2)$ .