

## Part I: Multiple Choice. Choose the correct answer.

1. Given  $4^x = 9$ , which best approximates  $x$ ?  $\log 4^x = \log 9$   
 $4^{1.58} = 8.9$  or  $\frac{x \log 4 = \log 9}{\log 4} = \frac{\log 9}{\log 4}$   
 (A) 0.35  
 (B) 1.17  
 (C) 1.58  
 (D) 2.25  
 $x = 1.58$
2. Solve:  $2^x + 1 = 4$   $2^x = 4 - 1$   
 (A) 0.176  
 (B) 0.631  
 (C) 1.500  
 (D) 1.585  $2^{1.585} = 3.00007$
3. Evaluate:  $\log_7 13$ .  $= \frac{\log 13}{\log 7}$   
 (A) 0.76  
 (B) 1.19  
 (C) 1.32  
 (D) 1.86  $= 1.32$
4. Evaluate:  $\log_4 10$ .  $= \frac{\log 10}{\log 4}$   
 (A) 0.60  
 (B) 1.66  
 (C) 1.78  
 (D) 2.50  $= 1.66$
5. Given  $5^x = 12$ , which best approximates  $x$ ? Another method:  
 (A) 0.65  
 (B) 1.23  
 (C) 1.46  
 (D) 1.54  $\log_5 12 = x$   
 $\frac{\log 12}{\log 5} = x$   
 $x = 1.54$

6. Given  $2(7)^x = 40$ , which best approximates  $x$ ?

- (A) 0.46
- (B) 0.65
- (C) 1.54
- (D) 1.90

$$\frac{2(7)^x}{2} = \frac{40}{2}$$
$$7^x = 20$$

$$\log 7^x = \log 20$$
$$x \log 7 = \log 20$$
$$x = \frac{\log 20}{\log 7}$$
$$x = 1.54$$

7. Given  $7^x = 14$ , which best approximates  $x$ ?

- (A) 1.15
- (B) 1.36
- (C) 2
- (D) 7

$$\log 7^x = \log 14$$
$$x \log 7 = \log 14$$
$$x = \frac{\log 14}{\log 7}$$
$$x = 1.36$$

8. Given  $8^x = 15$ , which best approximates  $x$ ?

- (A) 0.27
- (B) 0.77
- (C) 1.22
- (D) 1.30

$$\log 8^x = \log 15$$
$$x \log 8 = \log 15$$
$$x = \frac{\log 15}{\log 8}$$
$$x = 1.30$$

9. Given  $2(5)^x = 30$ , what is the approximate value of  $x$ ?

- (A) 0.5
- (B) 1.5
- (C) 1.7
- (D) 3.0

$$\frac{2(5)^x}{2} = \frac{30}{2}$$
$$5^x = 15$$

$$\log 5^x = \log 15$$
$$x \log 5 = \log 15$$
$$x = \frac{\log 15}{\log 5}$$
$$x = 1.7$$

10. Solve:  $3^{x+1} = 5$ .

- (A)  $\frac{\log 3}{\log 5} - 1$
- (B)  $\frac{\log 3}{\log 5} + 1$
- (C)  $\frac{\log 5}{\log 3} - 1$
- (D)  $\frac{\log 5}{\log 3} + 1$

$$\log 3^{x+1} = \log 5$$
$$\frac{(x+1) \log 3}{\log 3} = \frac{\log 5}{\log 3}$$
$$x+1 = \frac{\log 5}{\log 3}$$
$$x = \frac{\log 5}{\log 3} - 1$$

11. Given  $7^x + 5 = 25$ , what is the approximate value of  $x$ ?

- (A) 0.83  
(B) 1.30  
(C) 1.54  
(D) 1.75
- $7^x = 25 - 5$        $x = \frac{\log 20}{\log 7}$   
 $7^x = 20$   
 $\log_7 20 = x$        $x = 1.54$

**Part II: Constructed Response. Answer each question in the space provided. Show all workings.**

12. Solve for  $x$ :

(A)  $6^{x-6} = 3^{x+1}$

$$\log_6 (x-6) = \log_3 (x+1)$$

$$(x-6)\log 6 = (x+1)\log 3$$

$$x\log 6 - 6\log 6 = x\log 3 + \log 3$$

$$x\log 6 - x\log 3 = \log 3 + 6\log 6$$

$$x(\log 6 - \log 3) = \log 3 + 6\log 6$$

(B)  $10^{x+1} = 5^{x-1}$

$$\begin{array}{r} 0.3010x = 5.1460 \\ \hline 0.3010 \quad 0.3010 \\ \hline x = 17.1 \end{array}$$

$$(C) 2^{2x-1} = 5^{x+1}$$

$$(D) 3^{x+1} = 5^{x-1}$$

$$(E) 2^{x+3} = 3^{2x-1}$$

(F)  $2^{x+1} - 3^{x-1} = 0$

13. What annual interest rate (compounded annually) is necessary for \$8 500 to grow to \$9 000 in 3 years?

$$A = P(1+i)^n$$

$$\frac{9000}{8500} = \frac{8500(1+i)^3}{8500}$$

$$1.0588 = (1+i)^3$$

$$\sqrt[3]{1.0588} = \sqrt[3]{(1+i)^3}$$

$$\rightarrow 1.019 = 1+i$$

$$1.019 - 1 = i$$

$$i = 0.019$$

or  
1.9%

14. An investment broker promises to give you an 18% return on your money. If you invest \$850, and your investment is compounded annually, how many years will it take for your investment to be worth \$7310?

$$P = 850$$

$$A = 7310$$

$$i = 0.18 = 0.18$$

$$n = ?$$

$$\frac{7310}{850} = \frac{850(1.18)^n}{850}$$

$$8.6 = 1.18^n$$

$$\log 8.6 = \log 1.18^n$$

$$\log 8.6 = n \log 1.18$$

$$n = \frac{\log 8.6}{\log 1.18}$$

$$n = \frac{13}{1} = 13 \text{ years}$$

15. An element has a half-life of 120 years. If its initial mass is 42 grams, algebraically determine how long it will take to decrease to 5 grams.

Change of base method.

$$\frac{5}{42} = \frac{42}{42} \left(\frac{1}{2}\right)^{\frac{t}{120}}$$

$$0.119 = 0.5^{-\frac{t}{120}}$$

$$\log_{0.5} 0.119 = \frac{t}{120}$$

$$\frac{t}{120} = \frac{\log 0.119}{\log 0.5}$$

$$\frac{t}{120} = 3.07$$

$$t = 3.07 \times 120 = 369 \text{ years}$$

16. Suppose there are 25 coyotes in one area of NL right now. If this population is known to triple every 4 years, how long will it take for the population to reach 258 animals?

$$\frac{258}{25} = \frac{25}{25} (3)^{\frac{t}{4}} \rightarrow \frac{t}{4} = \frac{\log 10.32}{\log 3}$$

$$10.32 = 3^{\frac{t}{4}}$$

$$\log_3 10.32 = \frac{t}{4}$$

$$\frac{t}{4} = 2.12$$

$$t = 2.12 \times 4 = 8.5 \text{ years}$$

17. The half-life of a certain drug in the bloodstream is 6 days. If a patient is given 480 mg, algebraically determine how long it will take for the amount of drug in the patient's body to reduce to 15 mg.

18. Technetium-99, a radioactive isotope used in nuclear medicine, has a half-life of 6 hours. Set up an equation, and use it to determine how long it would take for 500 micrograms of Technetium-99 to reduce to 100 micrograms.

19. If the number of daisies in a field increases by 30% every 2 years, how long will it take for a population of 20 daisies to grow to 600 daisies?

20. Tom bought a car for \$14 000. The value of the car depreciates at a rate of 21% every two years. Write an equation that models the value of the car over time and use it to determine the approximate value of the car after five years.

21. A radioactive isotope has a half-life of 125 years. How long does it take for an initial amount of 200 mg to decay to 120 mg?

22. A laboratory assistant decided to observe the reproductive properties of a new strain of bacteria. The assistant started observing a population of 300 bacteria and noted that the bacteria population doubled every 5 minutes. Write a function to model this situation and use it to determine the time it will take for the population to reach 18 000 bacteria.