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Chapter 4 Test

1. Simplify the following expressions. Write your answers using only positive exponents.

a) $a^2 \times a^4$ **b)** $b^3 \div b^{-2}$

c) $(4x^{-3})^{-2}$ **d)** $\left(\frac{a^5}{b^2}\right)^{-3}$

e) $(2ab^3)^4$ **f)** $(6x^{-2})(-5x^{-4})$

g) $\frac{48k^{-3}}{8k^{-1}}$

2. Evaluate each of the following expressions, without the use of a calculator. Where appropriate, express your answer as a fraction.

a) $(3 \times 4^5)^0$ **b)** 3^{-2}

c) $\left(\frac{4}{5}\right)^3$ **d)** $16^{\frac{3}{4}}$

e) $27^{-\frac{1}{3}}$

3. Simplify the following expressions.

a) $a^{\frac{1}{2}} \times a^{\frac{1}{3}}$ **b)** $\left(9a^6\right)^{\frac{1}{2}}$ **c)** $\frac{54w^{\frac{3}{2}}}{9w^{-\frac{1}{4}}}$

4. Use a calculator to evaluate the following expressions. Where appropriate, express your answer to two decimal places.

a) $200 \times (1.015)^{20}$ **b)** $144^{\frac{3}{4}}$

c) $(-3)^{-2}$ **d)** $\sqrt[3]{(-5)^4}$

5. Explain the difference between $(-5)^2$ and -5^2.

6. a) Express $100^{\frac{3}{4}}$ as a radical.

b) Express $\sqrt[3]{(-64)^5}$ as a power with a rational exponent.

7. Describe the values of x for which the following statement is true: $\sqrt{x^2} = x$.

8. A formula for the volume of a sphere is $V = \frac{4}{3}\pi r^3$. Determine the radius of a sphere with a volume of 200 cm^3. Express your answer to the nearest tenth of a centimetre.

9. For the graph defined by $y = 3^x$

a) state the domain

b) state the range

c) state the y-intercept

d) explain why the graph has no x-intercepts

10. For the graphs defined by $y = 2^x$, $y = 5^x$, and $y = 10^x$

a) state how they are alike

b) state how they are different

11. Describe how to use a graphing calculator to solve $2^x = 25$.

12. a) Write an equation relating the amount, A, of a \$100 initial investment that grows at a rate of 1% per month for n months.

b) What will the investment be worth after 24 months?

c) How long, to the nearest month, will it take for the investment to double in value?

13. Explain why $y = \left(\frac{1}{2}\right)^x$ and $y = 2^{-x}$ represent the same graph.

14. For functions of the form $f(x) = a^x$, state which values of a will result in each of the following types of graph.

a) a graph that represents an increasing function

b) a graph that represents a decreasing function

c) a graph that cannot be defined

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15. The value of a house was $200 000 when it was built at the end of 2009. It is expected to increase in value at a rate of 4% per year.
a) Write an equation using V for the value of the home and n for its age.
b) Use a graphing calculator to determine the value of the house when it is 30 years old.

16. Due to a day of frost, 10% of a colony of beetles died. There were initially 2000 beetles in the colony.
a) Write an equation for the number of beetles, n, after d days of frost.
b) Use a graphing calculator to determine how many days of frost it will take for only 20% of the beetles to remain.

17. The following table shows the value of a motorcycle n years after it was purchased.

Year	Value ($)
1	15 000.00
2	10 500.00
3	7 350.00
4	5 145.00
5	3 601.50

a) State the percentage by which the motorcycle is losing value each year.
b) Determine the value of the bike when it was new.
c) Write an exponential function relating the value, V, to the age, n.
d) Determine the value of the motorcycle when it is 10 years old.
e) Use a graphing calculator to determine how old the motorcycle will be when it is worth $1000. Express your answer to the nearest tenth of a year.

18. Solve the following equations.
a) $2^x = 64$
b) $3^x = \frac{1}{81}$
c) $64^x = 16^{x+3}$

19. a) Solve $2^{x+3} = 4^{x-1}$.
b) Describe how the point of intersection of the graphs defined by $y = 2^{x+3}$ and $y = 4^{x-1}$ is related to the equation in part a).

20. a) Write $\log 1000 = 3$ in exponential form.
b) Write $2^x = 128$ in logarithmic form.

21. Evaluate without using a calculator.
a) $\log_3 81$
b) $\log 0.01$
c) $\log_5 5^{1/2}$
d) $\log_2 0.25$
e) $\log_a \sqrt[3]{a^2}$

22. Explain why $\log_a 1 = 0$ when $a > 0$.

23. a) Describe how points from the graph defined by $y = 2^x$ can be used to graph $y = \log_2 x$.
b) How are the domain and range of $y = 2^x$ related to the domain and range of $y = \log_2 x$?

24. a) Without using a calculator, evaluate $\log_4 64$.
b) Use a calculator to evaluate $\frac{\log 64}{\log 4}$.
c) Use your results from parts a) and b) and a calculator to evaluate $\log_5 40$ to one decimal place.

25. The number of bacteria in a culture doubles every hour. It is estimated there were 500 bacteria at noon on Monday.
a) Write an exponential equation relating the number of bacteria, n, and the number of hours, h, since noon Monday.
b) Later, there are 20 000 bacteria. Using this information, rewrite the equation in logarithmic form.
c) Use the method from #24c) to determine when there will be 20 000 bacteria. Express your answer to the nearest minute.

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