# MATH 151 — Exponential & Logarithmic Functions

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**Learning Objectives**

- Evaluate and expand/condense logarithms using product, quotient, and power rules
- Solve exponential and logarithmic equations
- Apply the change of base formula
- Model exponential growth, decay, and compound interest

*Always check for extraneous solutions in log equations — arguments must be positive. For exponential equations without common bases, take ln of both sides.*

**1. Evaluate the logarithm.**

$$\log_2 32$$

Answer: ________________________________

**2. Expand using logarithm properties.**

$$\log_b\left(\frac{x^3\sqrt{y}}{z^2}\right)$$

Answer: ________________________________

**3. Condense into a single logarithm.**

$$2\ln x + \ln(x+1) - \ln 5$$

Answer: ________________________________

**4. Solve the exponential equation.**

$$3^{x+1} = 81$$

Answer: ________________________________

**5. Solve the exponential equation using logarithms.**

$$5^x = 20$$

Answer: ________________________________

**6. Solve the logarithmic equation.**

$$\log_3(2x-1) = 4$$

Answer: ________________________________



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**7. Solve.**

$$\ln(x+3) + \ln(x-2) = \ln 14$$

Answer: ____________________________________

**8. Use the change of base formula to evaluate.**

$$\log_7 50$$

Answer: ____________________________________

**9. Compound interest: $5000 invested at 4% compounded continuously. Find the amount after 10 years.**

$$A = Pe^{rt}, \quad P = 5000,\ r = 0.04,\ t = 10$$

Answer: ____________________________________

**10. A population starts at 1000 and doubles every 5 years. Write the exponential model and find the population after 15 years.**

$$P(t) = 1000 \cdot 2^{t/5}$$

Answer: ____________________________________

*Problems 2–3: expand vs condense — students confuse these directions. Problem 7 (log equation): extraneous root x=–5 must be rejected. Problems 9–10: applied context.*

## Solutions

**1.** Evaluate the logarithm.

$\log_2 32$

→ *log■32 = x means 2^x = 32 = 2■.*
→ *Answer: 5.*

**Answer:** $5$

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**2.** Expand using logarithm properties.

$\log_b\left(\frac{x^3\sqrt{y}}{z^2}\right)$

→ *log(A/B)=log A–log B. log(AB)=log A+log B. log(A■)=n log A.*
→ *= log x³ + log y^(1/2) – log z² = 3 log x + ½ log y – 2 log z.*

**Answer:** $3\log_b x + \frac{1}{2}\log_b y - 2\log_b z$

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**3.** Condense into a single logarithm.

$2\ln x + \ln(x+1) - \ln 5$

→ *2 ln x = ln x². Combine using product/quotient rules.*
→ *ln x² + ln(x+1) – ln 5 = ln[x²(x+1)/5].*

**Answer:** $\ln\left(\frac{x^2(x+1)}{5}\right)$

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**4.** Solve the exponential equation.

$3^{x+1} = 81$

→ *81=3■. 3^(x+1)=3■ → x+1=4 → x=3.*

**Answer:** $x = 3$

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**5.** Solve the exponential equation using logarithms.

$5^x = 20$

→ *Take ln of both sides: x ln5 = ln20.*
→ *x = ln20/ln5 = log■20 ≈ 1.861.*

**Answer:** $x = \frac{\ln 20}{\ln 5} \approx 1.861$

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**6.** Solve the logarithmic equation.

$$\log_3(2x-1) = 4$$

→ *Convert to exponential: 3■=2x–1.*
→ $81=2x-1 \rightarrow 2x=82 \rightarrow x=41$.

**Answer:** $x = 41$

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**7.** Solve.

$$\ln(x+3) + \ln(x-2) = \ln 14$$

→ $\ln[(x+3)(x-2)]=\ln 14 \rightarrow (x+3)(x-2)=14$.
→ $x^2+x-6=14 \rightarrow x^2+x-20=0 \rightarrow (x+5)(x-4)=0$.
→ *x=4 (reject x=–5 since x–2=–7<0 makes ln undefined).*

**Answer:** $x = 4$

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**8.** Use the change of base formula to evaluate.

$$\log_7 50$$

→ *Change of base: log■50 = ln50/ln7 = log10(50)/log10(7).*
→ $\approx 3.912/1.946 \approx 2.012$.

**Answer:** $\dfrac{\ln 50}{\ln 7} \approx 2.012$

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**9.** Compound interest: $5000 invested at 4% compounded continuously. Find the amount after 10 years.

$$A = Pe^{rt}, \quad P=5000, \ r=0.04, \ t=10$$

→ *A = 5000·e^(0.04·10) = 5000·e^0.4.*
→ *e^0.4 ≈ 1.4918. A ≈ 5000·1.4918 ≈ $7459.*

**Answer:** $A = 5000e^{0.4} \approx \$7459$

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**10.** A population starts at 1000 and doubles every 5 years. Write the exponential model and find the population after 15 years.

$$P(t) = 1000 \cdot 2^{t/5}$$

→ *Doubling time 5 yrs → P(t)=1000·2^(t/5).*
→ $P(15)=1000\cdot 2^{(15/5)}=1000\cdot 2^3=1000\cdot 8=8000$.

**Answer:** $P(15) = 1000 \cdot 2^3 = 8000$