Year 11 Mathematics Advanced

Topic: Exponential and Logarithmic Functions (2 of 4)
Review Questions: Logarithmic functions and laws
Term 3, 2026

How to use this review set

These are real past-paper questions, grouped by question pattern. The grey label on each question shows where it is from and its marks.

- The questions are grouped by the pattern that keeps coming up in exams, a few of each in a row, running from the plainer patterns into the harder ones near the end. Work through them and you will meet every type an exam can throw at you.
- This set **is your diagnostic**. Working through it shows you exactly which patterns are solid and which need work. Attempt every question properly in your own book, and go back to your notes to help you work through tough questions if needed.
- Every question you get wrong, need help with or struggle with goes in your **Mistakes Log**, which you should be working on daily to get you exam-ready.

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7. Change of base and applications

Logarithmic laws and expressions

1. Evaluating logarithms

Q1 Pymble 2022 Prelim Q13 · **1 mark**

Evaluate $\log_3 27$.

Q2 Girraween 2022 Trial Q32 · **1 mark**

Evaluate $\ln 3$ correct to three significant figures.

Q3 Cherrybrook Tech 2021 Prelim Q3 · **1 mark**

What is the value of $\log_7 \dfrac{1}{49}$?

(A) -7

(B) -2

(C) 2

(D) 7

Q4 Baulkham Hills 2021 Prelim Q3 · **1 mark**

What is the value of $\log_4\left(\dfrac{1}{16}\right)$?

(A) 2

(B) 4

(C) -2

(D) -4

Q5 Moriah 2021 Prelim Q10(a) · **1 mark**

Evaluate $\log_4(2)$.

Q6 Sydney Grammar 2021 Prelim Q9(a) · **1 mark**

Evaluate $\log_2 16$.

2. Simplifying expressions using the logarithmic laws

Q7 North Sydney Boys 2022 Trial Q1 · **1 mark**

$2\log_{10}(x) - \log_{10}(3x)$ is equal to

(A) $\log_{10}\left(\frac{x}{3}\right)$

(B) $\log_{10}(x^2 - 3x)$

(C) $\frac{2\log_{10}(x)}{\log_{10}(3x)}$

(D) $-\log_{10}(x)$

Q8 Hurlstone 2023 Trial Q13 · **2 marks**

Simplify $\ln 60 + \ln e^2 - \ln 15$.

Q9 Hurlstone 2021 Prelim Q28 · **1 mark**

Which of these single logarithms is equivalent to $2\log_a x - 5\log_a y + 3\log_a z$?

(A) $\log_a\left(\frac{x^2z^3}{y^5}\right)$

(B) $-30\log_a(xyz)$

(C) $-\log_a(x^2y^5z^3)$

(D) $\log_a\left(\frac{x^2y^5}{z^3}\right)$

Q10 Normanhurst Boys 2021 Trial Q4 · **1 mark**

Which of the following is $e^{2\log_e x}$ equal to?

(A) $\sqrt{x}$

(B) x^2

(C) $2x$

(D) e^{2x}

Q11 Fort St 2022 Prelim Q11(a) · **2 marks**

Simplify, using the log laws,

$$2\log_2 25 - \log_2 16 - \log_2 20.$$

Q12 Ascham 2023 Trial Q12(a) · **2 marks**

Evaluate the following expression.

(a) $\log_2 4x + \log_2 8x - 2\log_2 x$

Q13 Barker 2022 Trial Q7 · **1 mark**

Which of the following is equal to $\dfrac{\ln 8^x + 3\ln 3^x}{2\ln 3 + \ln 8 - \ln 2}$?

(A) x

(B) $\dfrac{3x}{2}$

(C) $3x$

(D) $6x$

3. Expressing a logarithm in terms of given logarithms

Q14 Cherrybrook Tech 2022 Prelim Q13(a) · **1 mark**

Given that $\log_a b = 2.75$ and $\log_a c = 0.25$, find the value of:

(a) $\log_a\left(\dfrac{b}{c}\right)$

Q15 Barker 2024 Trial Q11 · **2 marks**

If $\log p = a$ and $\log q = b$, express $\log(pq^2)$ in terms of a and b.

Q16 Girraween 2022 Prelim Q11(c)(i) · **1 mark**

Given that $\log_a 4 = 1.5$ and $\log_a 5 = 1.7$, find:

(i) $\log_a 1.25$

Q17 Barker 2024 Prelim Q3 · **1 mark**

Given that $\log_a 4 = 0.420$ and $\log_a 5 = 0.488$. What is the value of $\log_a 100$?

(A) 0.410

(B) 0.664

(C) 1.396

(D) 2.908

Q18 Gosford 2024 Prelim Q19 · **2 marks**

Given that $x = \log_a 3$ and $y = \log_a 7$, write an expression for $\log_a \dfrac{27}{7}$ in terms of x and y.

Q19 Hornsby Girls 2022 Prelim Q13(a) · **3 marks**

If $a = \log_{10} x$, $b = \log_{10} y$ and $c = \log_{10} z$, express the following in terms of a, b and c.

(a) $\log_{10}\left(\dfrac{x^2\sqrt{y}}{z}\right)$

Q20 Hurlstone 2024 Prelim Q27 · **2 marks**

If $\log_3 2 = a$ and $\log_3 13 = b$, express $\log_3 52$ in terms of a and b.

Solving logarithmic equations

4. Basic logarithmic equations

Q21 Normanhurst Boys 2024 Trial Q1 · **1 mark**

What is the solution to the equation $\log_3(2x - 5) = 2$?

(A) $x = 1$

(B) $x = \dfrac{13}{2}$

(C) $x = \dfrac{11}{2}$

(D) $x = 7$

Q22 Baulkham Hills 2023 Prelim Q11 · **2 marks**

Solve the equation $\log_{10}(3x + 1) = 2$.

Q23 Hurlstone 2024 Trial Q12 · **2 marks**

Solve the equation

$$\log_e(x + 2) = \log_e(2x).$$

Q24 Kambala 2024 Prelim Q16(a) · **2 marks**

Solve the equation $\log_2(x + 20) = 5$.

Q25 Loreto Kirribilli 2022 Prelim Q17(b) · **2 marks**

Solve the equation below. Give your answer in exact form.

$$\log_e(x) - 1 = 1.$$

Q26 Blacktown Boys 2022 Prelim Q17(a) · **2 marks**

Solve the following equation to find the exact value of x.

$$\log_5(7x + 1) - \log_5(x - 1) = 2.$$

Q27 Manly 2024 Trial Q15 · **2 marks**

Solve $\log_2(x+3) - \log_2 x = 1$.

5. Logarithmic equations reducing to a quadratic

Q28 Gosford 2020 Trial Q14 · **3 marks**

Solve $2\log x = \log(5x+6)$.

Q29 SCEGGS 2022 Prelim Q25 · **3 marks**

Solve the equation $\log_{10} x + \log_{10}(x-3) = \log_{10} 18$.

Q30 St George Girls 2023 Trial Q20 · **3 marks**

Solve $2\ln x = \ln(2x+3)$.

Q31 Sydney Tech 2023 Trial Q17 · **2 marks**

Solve $\ln(7x-12) = 2\ln x$.

Q32 North Sydney Girls 2023 Prelim Q26 · **3 marks**

Solve $\log_{10}(x-3) + \log_{10}(x+2) = \log_{10} 6$.

Q33 North Sydney Boys 2024 Prelim Q22 · **3 marks**

Solve the equation $\log_2(x+4) + \log_2(x-2) = 4$.

Q34 Sydney Tech 2024 Trial Q17 · **2 marks**

Solve $\ln x - \dfrac{3}{\ln x} = 2$ giving your answers in exact form.

Q35 James Ruse 2023 Trial Q26 · **2 marks**

Solve $\ln x - \dfrac{6}{\ln x} = 5$.

Q36 Abbotsleigh 2024 Prelim Q30 · **3 marks**

Solve the equation

$$\log_2 x - \frac{3}{\log_2 x} = 2.$$

6. Making a variable the subject (inverse form)

Q37 Hornsby Girls 2020 Trial Q32(a) · **1 mark**

Consider the relation $y = \ln(x + r)$, where $r > 1$.

Show that $x = e^y - r$.

Q38 St George Girls 2020 Trial Q6 · **1 mark**

$y = \log_a x^{-3}$ is equivalent to:

(A) $x = a^{\frac{y}{3}}$

(B) $x = a^{-\frac{y}{3}}$

(C) $x = a^{3y}$

(D) $x = a^{-3y}$

Q39 Loreto Kirribilli 2022 Prelim Q9 · **1 mark**

If $y = \dfrac{e^x}{e^x + 1}$, which of the following is correct?

(A) $x = \ln\left(\dfrac{1-y}{y}\right)$

(B) $x = \ln\left(\dfrac{y}{1-y}\right)$

(C) $x = \ln\left(\dfrac{y}{1+y}\right)$

(D) $x = \ln\left(\dfrac{1+y}{y}\right)$

Q40 Shore 2023 Prelim Q8 · **1 mark**

If $y = \dfrac{e^x}{2 - e^x}$, which of the following is correct?

(A) $x = \ln\left(\dfrac{2y}{1 + y}\right)$

(B) $x = \ln\left(\dfrac{1 + y}{2y}\right)$

(C) $x = \ln\left(\dfrac{2y}{1 - y}\right)$

(D) $x = \ln\left(\dfrac{1 - y}{2y}\right)$

Q41 Abbotsleigh 2024 Prelim Q9 · **1 mark**

If $x = \log_e(1 + y) - \log_e(1 - y)$, where $-1 < y < 1$, which of the following is correct?

(A) $y = \dfrac{1}{2}e^x$

(B) $y = \dfrac{x - 1}{x + 1}$

(C) $y = \dfrac{e^x - 1}{e^x + 1}$

(D) $y = \dfrac{e^x - e^{-x}}{e^x + e^{-x}}$

Change of base and applications

7. Change of base and applications

Q42 Danebank 2020 Trial Q19(a) · 1 mark

Show that

$$\log_x 2 = \frac{1}{\log_2 x}.$$

Q43 North Sydney Boys 2024 Prelim Q1 · 1 mark

What is the value of x such that $\log_x 2 = \frac{1}{2}$?

(A) $\sqrt{2}$

(B) 2

(C) 4

(D) $2\sqrt{2}$

Q44 Cherrybrook Tech 2022 Prelim Q13(b) · 1 mark

Given that $\log_a b = 2.75$ and $\log_a c = 0.25$, find the value of

$$\log_c b.$$

Q45 North Sydney Girls 2022 Prelim Q27(a) · 1 mark

The Richter scale is used to rate the magnitude (M) of an earthquake based on the amount of energy (E) released by the earthquake, measured in Joules. They are related by the equation

$$\log_{10}(E) = a + 1.5M,$$

where a is a real constant.

The San Francisco earthquake in 1906 registered 8.2 on the Richter scale and released 5.011×10^{16} Joules of energy.

Use this information to determine the value of a, correct to 1 decimal place.

Q46 Killara 2021 Trial Q29(a) · **1 mark**

Show that

$$\log_a b = \frac{1}{\log_b a}.$$

Q47 Caringbah 2020 Trial Q21(b) · **2 marks**

Solve the equation

$$\log_2 x = 4 \log_x 2.$$

Q48 Hurlstone 2023 Prelim Q15(e)(i) · **2 marks**

The magnitude of an earthquake is measured on the logarithmic scale known as the Richter scale. If an earthquake has intensity I, its magnitude $M(I)$ is defined as

$$M(I) = \log_{10}\left(\frac{I}{I_0}\right),$$

where I_0 is a minimum level of intensity used for comparisons.

In 1989 in Newcastle, Australia an earthquake measured 5.9 on the Richter scale and resulted in destruction and the loss of life. In February 2023, an earthquake of magnitude 7.8 devastated the country of Turkey.

How many times more intense was the earthquake in Turkey than the one in Newcastle, Australia?

Q49 Sydney Girls 2023 Trial Q35 · **3 marks**

Find the exact value of x given

$$\log_3 x = \log_x \sqrt[9]{3}.$$

Q50 James Ruse 2022 Trial Q35 · **3 marks**

Solve

$$2 \log_2 x - 9 \log_x 2 = 3.$$

Q51 North Sydney Boys 2024 Prelim Q20 · **3 marks**

The observed brightness of a star can be measured by its energy flux and can be transformed by a logarithmic scale to be more easily measured by an apparent stellar magnitude. It is defined to be

$$m = -\sqrt[5]{100}\,\log\left(\frac{f}{f_V}\right),$$

where m is the magnitude, f is the energy flux of the star and f_V is the reference energy flux.

The star Betelgeuse has a magnitude of 0.45 while the star Deneb has a magnitude of 1.26.

Which star is brighter and by how much brighter is it?