50 multiple-choice questions

Question 1 (Level 1) — *Evaluate a power*
Evaluate 2^5.

(A) 32

(B) 10

(C) 25

(D) 64

Question 2 (Level 1) — *Index law — multiplication*
Simplify $3^2 \times 3^4$.

(A) 3^6

(B) 3^8

(C) 9^6

(D) 3^2

Question 3 (Level 1) — *Index law — division*
Simplify $\frac{5^7}{5^3}$.

(A) 5^4

(B) 5^{10}

(C) 1^4

(D) 5^{21}

Question 4 (Level 1) — *Zero exponent*
Evaluate 7^0.

(A) 1

(B) 0

(C) 7

(D) Undefined

Question 5 (Level 1) — *Power of a power*
Simplify $(2^3)^2$.

(A) 64

(B) 12

(C) 32

(D) 36

Question 6 (Level 1) — *Negative exponent*
Evaluate 2^{-3}.

(A) $\frac{1}{8}$

(B) -8

(C) -6

(D) $\frac{1}{6}$

Question 7 (Level 1) — *Y-intercept of exponential*
What is the y-intercept of $y = 3^x$?

(A) $(0,1)$

(B) $(0,3)$

(C) $(0,0)$

(D) $(1,0)$

Question 8 (Level 1) — *Evaluate a fractional base*
Evaluate $\left(\frac{1}{2}\right)^3$.

(A) $\frac{1}{8}$

(B) $\frac{3}{2}$

(C) $\frac{1}{6}$

(D) $\frac{3}{8}$

Question 9 (Level 1) — *Identify exponential growth*
Which function represents exponential growth?

(A) $y = 2 \times 3^x$

(B) $y = 3x + 2$

(C) $y = x^3$

(D) $y = 2 \times 0.5^x$

Question 10 (Level 1) — *Express as a power of 2*
Write 16 as a power of 2.

(A) 2^4

(B) 2^3

(C) 2^5

(D) 4^2

Question 11 (Level 2) — *Simplify with multiple index laws*
Simplify $\frac{2^5 \times 2^3}{2^4}$.

(A) 16

(B) 8

(C) 32

(D) 4

Question 12 (Level 2) — *Fractional exponent*
Evaluate $27^{\frac{1}{3}}$.

(A) 3

(B) 9

(C) $\frac{27}{3}$

(D) $\frac{1}{3}$

Question 13 (Level 2) — *Solve simple exponential equation*
Solve $2^x = 16$.

(A) $x = 4$

(B) $x = 8$

(C) $x = 3$

(D) $x = 5$

Question 14 (Level 2) — *Asymptote of basic exponential*
What is the horizontal asymptote of $y = 5^x$?

(A) $y = 0$

(B) $y = 1$

(C) $y = 5$

(D) $x = 0$

Question 15 (Level 2) — *Evaluate combined fractional exponent*
Evaluate $8^{\frac{2}{3}}$.

(A) 4

(B) $\frac{16}{3}$

(C) 6

(D) 2

Question 16 (Level 2) — *Simple exponential decay table*
A population halves each year from an initial value of 800. What is the population after 3 years?

(A) 100

(B) 200

(C) 400

(D) 50

Question 17 (Level 2) — *Simplify algebraic indices*
Simplify $\frac{x^5 \cdot x^{-2}}{x^2}$.

(A) x

(B) x^5

(C) x^3

(D) $\frac{1}{x}$

Question 18 (Level 2) — *Graph recognition*
Which of the following is the graph of $y = 2^{-x}$?

(A) Decreasing curve through $(0,1)$ with asymptote $y = 0$

(B) Increasing curve through $(0,1)$ with asymptote $y = 0$

(C) Decreasing curve through $(0,-1)$ with asymptote $y = 0$

(D) Decreasing straight line through $(0,1)$

Question 19 (Level 2) — *Solve with equal bases*
Solve $3^{2x} = 81$.

(A) $x = 2$

(B) $x = 4$

(C) $x = 40.5$

(D) $x = \frac{4}{3}$

Question 20 (Level 2) — *Compound growth*
An investment of $1000 grows by 10% per year. What is it worth after 2 years?

(A) $1210

(B) $1200

(C) $1100

(D) $1331

Question 21 (Level 3) — *Solve requiring common base*
Solve $4^x = 8$.

(A) $x = \frac{3}{2}$

(B) $x = 2$

(C) $x = \frac{2}{3}$

(D) $x = 3$

Question 22 (Level 3) — *Transformed exponential asymptote*
What is the horizontal asymptote of $y = 2^x + 3$?

(A) $y = 3$

(B) $y = 0$

(C) $y = 2$

(D) $y = -3$

Question 23 (Level 3) — *Simplify with negative and fractional indices*
Simplify $\frac{(2x)^3 \cdot x^{-1}}{4x^2}$.

(A) 2

(B) $2x$

(C) 4

(D) $\frac{2}{x}$

Question 24 (Level 3) — *Growth and decay model*
A substance decays according to $A = 500 \times 0.8^t$ where t is in hours. What percentage of the substance has decayed after 1 hour?

(A) 20%

(B) 80%

(C) 10%

(D) 50%

Question 25 (Level 3) — *Y-intercept of transformed exponential*
Find the y-intercept of $y = 3 \times 2^{x-1} - 4$.

(A) $-\frac{5}{2}$

(B) -1

(C) $\frac{3}{2}$

(D) -4

Question 26 (Level 3) — *Solve with fractional base*
Solve $\left(\frac{1}{3}\right)^x = 27$.

(A) $x = -3$

(B) $x = 3$

(C) $x = -\frac{1}{3}$

(D) $x = 9$

Question 27 (Level 3) — *X-intercept of exponential*
Find the x-intercept of $y = 2^x - 8$.

(A) $(3, 0)$

(B) $(8, 0)$

(C) $(0, -8)$

(D) $(2, 0)$

Question 28 (Level 3) — *Scientific notation*
Express 0.00045 in scientific notation.

(A) 4.5×10^{-4}

(B) 45×10^{-5}

(C) 4.5×10^{-3}

(D) 0.45×10^{-3}

Question 29 (Level 3) — *Doubling time*
A population doubles every 5 years. If it starts at 1000, what is the population after 15 years?

(A) 8000

(B) 3000

(C) 4000

(D) 6000

Question 30 (Level 3) — *Simplify surds as indices*
Write $\sqrt{x} \cdot \sqrt[3]{x}$ as a single power of x.

(A) $x^{\frac{5}{6}}$

(B) $x^{\frac{1}{6}}$

(C) $x^{\frac{2}{3}}$

(D) $x^{\frac{1}{5}}$

Question 31 (Level 4) — *Solve using logarithms*
Solve $5^x = 20$, giving your answer correct to 3 decimal places.

(A) $x \approx 1.861$

(B) $x \approx 4.000$

(C) $x \approx 2.861$

(D) $x \approx 1.431$

Question 32 (Level 4) — *Graph transformation*
The graph of $y = 2^x$ is transformed to $y = -2^{x+1} + 3$. State the asymptote and whether the graph is increasing or decreasing.

(A) Asymptote $y = 3$, decreasing

(B) Asymptote $y = 3$, increasing

(C) Asymptote $y = -3$, decreasing

(D) Asymptote $y = 1$, decreasing

Question 33 (Level 4) — *Exponential equation with substitution*
Solve $4^x - 6 \cdot 2^x + 8 = 0$.

(A) $x = 1$ or $x = 2$

(B) $x = 2$ or $x = 4$

(C) $x = \log_2 6$ or $x = 3$

(D) $x = 0$ or $x = 3$

Question 34 (Level 4) — *Half-life calculation*
A radioactive substance has a half-life of 10 years. If the initial amount is 200 g, how much remains after 30 years?

(A) 25 g

(B) 50 g

(C) 100 g

(D) 12.5 g

Question 35 (Level 4) — *Range of transformed exponential*
Find the range of $f(x) = -3 \times 2^x + 5$.

(A) $(-\infty, 5)$

(B) $(5, \infty)$

(C) $(-\infty, -3)$

(D) $(-3, 5)$

Question 36 (Level 4) — *Continuous growth model*
A population grows according to $P(t) = 500e^{0.03t}$ where t is years. Find the population after 10 years (to the nearest whole number).

(A) 675

(B) 650

(C) 515

(D) 750

Question 37 (Level 4) — *Solve exponential inequality*
Solve $3^{x-1} > 27$.

(A) $x > 4$

(B) $x > 3$

(C) $x > 28$

(D) $x < 4$

Question 38 (Level 4) — *Matching exponential to equation*
An exponential function passes through $(0, 2)$ and $(3, 54)$. Find its equation in the form $y = a \cdot b^x$.

(A) $y = 2 \cdot 3^x$

(B) $y = 3 \cdot 2^x$

(C) $y = 54 \cdot 3^x$

(D) $y = 2 \cdot 27^x$

Question 39 (Level 4) — *Inverse of exponential*
Find the inverse function of $f(x) = 3^x + 1$.

(A) $f^{-1}(x) = \log_3(x-1)$

(B) $f^{-1}(x) = \log_3(x) - 1$

(C) $f^{-1}(x) = 3^{x-1}$

(D) $f^{-1}(x) = \log_3(x+1)$

Question 40 (Level 4) — *Percentage growth rate*
Rewrite $y = 200 \times 1.05^t$ in the form $y = 200e^{kt}$ and find k correct to 4 decimal places.

(A) $k \approx 0.0488$

(B) $k \approx 0.0500$

(C) $k \approx 0.1000$

(D) $k \approx 1.0500$

Question 41 (Level 5) — *Solve simultaneous exponential equations*
Solve the system: $2^x \cdot 4^y = 32$ and $2^x \cdot 2^{-y} = 4$.

(A) $x = 3, y = 1$

(B) $x = 5, y = 0$

(C) $x = 1, y = 2$

(D) $x = 4, y = \frac{1}{2}$

Question 42 (Level 5) — *Exponential with quadratic substitution*
Solve $9^x - 4 \cdot 3^x + 3 = 0$.

(A) $x = 0$ or $x = 1$

(B) $x = 1$ or $x = 3$

(C) $x = \log_3 4$ only

(D) $x = -1$ or $x = 1$

Question 43 (Level 5) — *Newton's Law of Cooling*
A cup of coffee cools according to $T(t) = 20 + 60e^{-0.1t}$ (T in řC, t in minutes). How long until the temperature is 50řC?

(A) $t = 10\ln 2 \approx 6.93$ min

(B) $t = \frac{\ln 2}{10} \approx 0.069$ min

(C) $t = 5\ln 2 \approx 3.47$ min

(D) $t = 10$ min

Question 44 (Level 5) — *Tangent to exponential curve*
Find the equation of the tangent to $y = e^{2x}$ at $x = 0$.

(A) $y = 2x + 1$

(B) $y = x + 1$

(C) $y = 2x$

(D) $y = e^2 x + 1$

Question 45 (Level 5) — *Area under exponential*
Find $\int_0^1 e^{3x}\,dx$.

(A) $\frac{e^3 - 1}{3}$

(B) $\frac{e^3}{3}$

(C) $e^3 - 1$

(D) $3e^3 - 3$

Question 46 (Level 5) — *Compound interest with continuous compounding*
How long does it take for an investment to triple with continuous compounding at 5% per annum?

(A) $t = 20 \ln 3 \approx 21.97$ years

(B) $t = \frac{3}{0.05} = 60$ years

(C) $t = \frac{\ln 3}{5} \approx 0.22$ years

(D) $t = \frac{3 \ln 2}{0.05} \approx 41.59$ years

Question 47 (Level 5) — *Exponential function with two transformations*
The graph of $y = e^x$ undergoes a dilation by factor 2 from the x-axis, then a reflection in the x-axis, then a translation of 4 units up. Write the equation of the resulting graph.

(A) $y = -2e^x + 4$

(B) $y = 2e^{-x} + 4$

(C) $y = -2e^{x+4}$

(D) $y = -2e^x - 4$

Question 48 (Level 5) — *Solve*
Find all solutions of $e^{2x} - 5e^x + 6 = 0$.

(A) $x = \ln 2$ or $x = \ln 3$

(B) $x = 2$ or $x = 3$

(C) $x = \ln 5$ or $x = \ln 6$

(D) $x = e^2$ or $x = e^3$

Question 49 (Level 5) — *Stationary point of*
Find the coordinates of the stationary point of $y = xe^{-x}$.

(A) $\left(1, \frac{1}{e}\right)$

(B) $(0, 0)$

(C) $(-1, -e)$

(D) $(1, e)$

Question 50 (Level 5) — *Logistic growth*
A population follows $P(t) = \frac{1000}{1+9e^{-0.2t}}$. What is the limiting population as $t \to \infty$?

(A) 1000

(B) 100

(C) 9000

(D) ∞

Solutions

Q1: (A)
$2^5 = 32$.

Q2: (A)
$3^2 \times 3^4 = 3^{2+4} = 3^6$.

Q3: (A)
$\frac{5^7}{5^3} = 5^{7-3} = 5^4$.

Q4: (A)
$7^0 = 1$.

Q5: (A)
$(2^3)^2 = 2^{3 \times 2} = 2^6 = 64$.

Q6: (A)
$2^{-3} = \frac{1}{2^3} = \frac{1}{8}$.

Q7: (A)
When $x = 0$: $y = 3^0 = 1$. The y-intercept is $(0, 1)$.

Q8: (A)
$\left(\frac{1}{2}\right)^3 = \frac{1}{8}$.

Q9: (A)
$y = 2 \times 3^x$ has base $3 > 1$, so it is exponential growth.

Q10: (A)
$16 = 2^4$.

Q11: (A)
$\frac{2^5 \times 2^3}{2^4} = \frac{2^8}{2^4} = 2^4 = 16$.

Q12: (A)
$27^{\frac{1}{3}} = \sqrt[3]{27} = 3$.

Q13: (A)
$2^x = 2^4$, so $x = 4$.

Q14: (A)
As $x \to -\infty$, $5^x \to 0$. The asymptote is $y = 0$.

Q15: (A)
$8^{\frac{2}{3}} = (\sqrt[3]{8})^2 = 2^2 = 4$.

Q16: (A)
$P = 800 \times \left(\frac{1}{2}\right)^3 = 800 \times \frac{1}{8} = 100$.

Q17: (A)
$\frac{x^{5+(-2)}}{x^2} = \frac{x^3}{x^2} = x^1 = x$.

Q18: (A)
$y = 2^{-x}$ is a reflection of $y = 2^x$ in the y-axis — decreasing, passing through $(0, 1)$, with asymptote $y = 0$.

Q19: (A)
$3^{2x} = 3^4$, so $2x = 4$, $x = 2$.

Q20: (A)
$A = 1000 \times 1.1^2 = 1000 \times 1.21 = \$1210$.

Q21: (A)
$(2^2)^x = 2^3 \Rightarrow 2^{2x} = 2^3 \Rightarrow 2x = 3 \Rightarrow x = \frac{3}{2}$.

Q22: (A)
The asymptote of $y = 2^x$ is $y = 0$. Shifting up by 3 gives asymptote $y = 3$.

Q23: (A)
$\frac{8x^3 \cdot x^{-1}}{4x^2} = \frac{8x^2}{4x^2} = 2$.

Q24: (A)
After 1 hour: $A = 400$. Decayed: $500 - 400 = 100$. Percentage: $\frac{100}{500} \times 100 = 20\%$.

Q25: (A)
$y = 3 \times \frac{1}{2} - 4 = \frac{3}{2} - 4 = -\frac{5}{2}$.

Q26: (A)
$(3^{-1})^x = 3^3 \Rightarrow 3^{-x} = 3^3 \Rightarrow -x = 3 \Rightarrow x = -3$.

Q27: (A)
$2^x = 8 = 2^3$, so $x = 3$. The x-intercept is $(3, 0)$.

Q28: (A)
$0.00045 = 4.5 \times 10^{-4}$.

Q29: (A)
After 15 years: $1000 \times 2^3 = 1000 \times 8 = 8000$.

Q30: (A)
$x^{\frac{1}{2}} \cdot x^{\frac{1}{3}} = x^{\frac{1}{2} + \frac{1}{3}} = x^{\frac{5}{6}}$.

Q31: (A)
$x = \frac{\log 20}{\log 5} = \frac{1.3010}{0.6990} \approx 1.861$.

Q32: (A)
Asymptote: $y = 3$. The reflection makes the graph decreasing (as the original 2^x was increasing).

Q33: (A)
Let $u = 2^x$: $u^2 - 6u + 8 = (u-2)(u-4) = 0$. $u = 2 \Rightarrow 2^x = 2 \Rightarrow x = 1$. $u = 4 \Rightarrow 2^x = 4 \Rightarrow x = 2$.

Q34: (A)
$A = 200 \times \left(\frac{1}{2}\right)^3 = 200 \times \frac{1}{8} = 25$ g.

Q35: (A)
Since $2^x > 0$: $-3 \times 2^x \in (-\infty, 0)$, so $f(x) \in (-\infty, 5)$. Range: $(-\infty, 5)$.

Q36: (A)
$P(10) = 500 \times e^{0.3} = 500 \times 1.3499 \approx 675$.

Q37: (A)
$3^{x-1} > 3^3 \Rightarrow x - 1 > 3 \Rightarrow x > 4$.

Q38: (A)
$a = 2$. $2b^3 = 54 \Rightarrow b^3 = 27 \Rightarrow b = 3$. Equation: $y = 2 \cdot 3^x$.

Q39: (A)
$x = 3^y + 1 \Rightarrow 3^y = x - 1 \Rightarrow y = \log_3(x - 1)$. So $f^{-1}(x) = \log_3(x - 1)$.

Q40: (A)
$1.05^t = e^{t \ln 1.05}$, so $k = \ln 1.05 \approx 0.0488$.

Q41: (A)
$x + 2y = 5$ (1) and $x - y = 2$ (2). Subtracting: $3y = 3$, $y = 1$, $x = 3$.

Q42: (A)
$u^2 - 4u + 3 = (u-1)(u-3) = 0$. $u = 1 \Rightarrow 3^x = 1 \Rightarrow x = 0$. $u = 3 \Rightarrow 3^x = 3 \Rightarrow x = 1$.

Q43: (A)
$30 = 60e^{-0.1t} \Rightarrow e^{-0.1t} = 0.5 \Rightarrow -0.1t = \ln 0.5 \Rightarrow t = \frac{-\ln 0.5}{0.1} = 10 \ln 2 \approx 6.93$ minutes.

Q44: (A)
At $x = 0$: $y = e^0 = 1$, $y' = 2e^0 = 2$. Tangent: $y - 1 = 2(x - 0)$, i.e. $y = 2x + 1$.

Q45: (A)
$\int_0^1 e^{3x} \, dx = \left[\frac{1}{3} e^{3x}\right]_0^1 = \frac{1}{3} e^3 - \frac{1}{3} = \frac{e^3 - 1}{3}$.

Q46: (A)
$e^{0.05t} = 3 \Rightarrow 0.05t = \ln 3 \Rightarrow t = \frac{\ln 3}{0.05} = 20 \ln 3 \approx 21.97$ years.

Q47: (A)

After all transformations: $y = -2e^x + 4$.

Q48: (A)

$(u-2)(u-3) = 0$. $u = 2 \Rightarrow x = \ln 2$. $u = 3 \Rightarrow x = \ln 3$.

Q49: (A)

$y' = e^{-x}(1-x) = 0$. Since $e^{-x} > 0$, $x = 1$. $y = 1 \cdot e^{-1} = \frac{1}{e}$. Stationary point: $\left(1, \frac{1}{e}\right)$.

Q50: (A)

As $t \to \infty$: $P \to \frac{1000}{1+0} = 1000$.