CHAPTER 4.5

Exponential and Logarithmic Equations

Multiple-Choice Old Exam Questions

53 questions • 5 topics • options A–E • two questions per page

Topic 1 | Exponential Equations with Different Bases

Solving exponential equations by matching bases or by taking logarithms • Questions 1–14

Q **1**

The sum of all solutions of the equation $(8)^{x} = \left(\sqrt{2}\right)^{2x+4}$ is

A) -1

B) 3

C) -2

D) 1

E) 2

Q **2**

If $\left(\sqrt[4]{3}\right)^{8x+12} = (e)^{3x\ln 3}$, then $x =$

A) 3

B) 4

C) -2

D) $\frac{3}{2}$

E) $\frac{5}{2}$

Q
3

If the solution of the equation $2^{3x-2} = 5^{x+1}$ is $x = \frac{\ln a + \ln b}{\ln c - \ln b}$, then $a + b + c =$

A) 17

B) 13

C) 11

D) 15

E) 19

Q
4

If $6^{x+1} = 4^{2x-1}$, then $x =$

A) $\frac{\log 24}{\log\left(\frac{8}{3}\right)}$

B) $\frac{\log 24}{\log\left(\frac{3}{8}\right)}$

C) $\frac{\log\left(\frac{3}{2}\right)}{\log\left(\frac{8}{3}\right)}$

D) $\frac{\log 8}{\log\left(\frac{1}{2}\right)}$

E) $\frac{\log 8}{\log\left(\frac{3}{8}\right)}$

Q
5

If $5^x = (3)(4^{1-x})$, then $x =$

A) $\frac{\ln 12}{\ln 20}$

B) $\ln\left(\frac{3}{5}\right)$

C) $\frac{\ln 3}{\ln 5}$

D) $\frac{\ln 6}{\ln 10}$

E) $\frac{\ln 5}{\ln 3}$

Q
6

If $2^{x+1} = 3^{2x-1}$, then $x =$

A) $\log_{9/2} 6$

B) $\log_{9/2} 5$

C) $\log_{3/2} 6$

D) $\log 6$

E) $\log_6 5$

Q
7

If the line $y = \frac{26}{27}$ intersects the graph of $y = -3^{x-2} + 1$ at the point (x_1, y_1), then $x_1 + y_1 =$

A) $\frac{28}{27}$

B) $-\frac{5}{27}$

C) $-\frac{23}{27}$

D) $-\frac{7}{27}$

E) $-\frac{1}{27}$

Q
8

The solution set of $\left(\sqrt{2}\right)^{12x-8} = 4\left(\frac{1}{2}\right)^{5x+7}$

A) contains exactly one negative rational number.

B) contains exactly one negative irrational number.

C) contains exactly one positive irrational number.

D) contains exactly one positive rational number.

E) is the empty set.

Q
9

The sum of all solutions of the equation $125^{-3} = \left(\frac{1}{5}\right)^{|x+2|}$ is

A) -4

B) 1

C) 5

D) -5

E) 4

Q
10

If $x = a$ is the solution of the equation $125^{x} + 5^{3x+1} = 12$, then $3a =$

A) 3

B) $\log_5 2$

C) $\log_5 3$

D) 0

E) 2

Q
11

If $e^{k-1} = \left(\frac{1}{e^4}\right)^{k+1}$, then $k =$

A) $-\frac{3}{5}$

B) $\frac{1}{5}$

C) $\frac{1}{2}$

D) -2

E) $\frac{1}{3}$

Q
12

The sum of all the solution(s) of $2(3^{2x-6}) - 4 = 8$ is

A) $3 + \log_3 \sqrt{6}$

B) $6 + \log_3 6$

C) $3 + \log_3 36$

D) $6 - \log_3 \sqrt{6}$

E) $6 - \log_3 \sqrt{3}$

Q
13

If $\log_3(1) = -3 + \left(\frac{1}{3}\right)^{x+2}$, then $3x + 1 =$

A) -8

B) -2

C) 0

D) 3

E) 10

Q
14

The sum of all solution(s) of the equation $\left(\sqrt[3]{4}\right)^{-|x-1|} = \left(\frac{1}{8}\right)^2$ is

A) 2

B) 8

C) 10

D) 18

E) 4

Topic 2 | Quadratic-Type and Hyperbolic Exponential Equations

Equations that become quadratic after a substitution such as u=2^x or u=e^x • Questions 15–28

Q **15**

The solution set of the equation $9^x - 2(3)^{x+1} = 27$ consists of

A) one positive real number only

B) two negative real numbers

C) one negative real number only

D) one positive and one negative real number

E) two positive real numbers

Q **16**

The sum of all the solution(s) of the equation $2(4^{1-x}) - 3(2^{1-x}) = -1$ is

A) $\log_2 6$

B) 3

C) -3

D) 1

E) $\log_2 3$

Q
17

If $\frac{8^x+8^{-x}}{8^x-8^{-x}} = 3$, then $x =$

A) $\frac{1}{6}$

B) $\ln 6$

C) $\ln 2$

D) 1

E) -1

Q
18

The sum of the solutions of the equation $2^x - (6)2^{-x} - 1 = 0$ is

A) -1

B) $\log_3(2)$

C) $\ln 3$

D) $\log_2(3)$

E) $\ln\sqrt{3}$

Q
19

The sum of all the solutions of the equation $2 \cdot 3^{x} - 21 \cdot 3^{-x} + 1 = 0$ is

A) 1

B) 3

C) $-\frac{1}{2}$

D) $\frac{9}{2}$

E) $\frac{1}{2}$

Q
20

The sum of all solution(s) of the equation $e^{x} - 12e^{-x} - 1 = 0$ is

A) $\ln 4$

B) $\ln 12$

C) $\ln 3$

D) $1 + \ln 2$

E) $-\ln 12$

Q
21

If the solution of the equation $2^{2x+1} = 7(2^x) + 4$ is $x = A$, then $2A - 1 =$

A) $\frac{1}{2}$

B) 3

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

D) 0

E) 4

Q
22

The solution set of the equation $4^x - 2^x - 12 = 0$ consists of

A) one positive integer only.

B) one positive integer and one negative integer.

C) two positive integers.

D) two negative integers.

E) one negative integer only.

Q
23

The sum of all the solution(s) of the equation $4^x - 2^{x+3} + 12 = 0$ is

A) $\log_2 12$

B) $\log_2 6$

C) 7

D) $\log_2 8$

E) 1

Q
24

The sum of the solutions of the equation $2e^{2x} - 13e^x = 15$ is:

A) $\ln \frac{15}{2}$

B) $\ln \frac{17}{2}$

C) $\ln \frac{13}{2}$

D) $\ln \frac{3}{10}$

E) $\ln \frac{7}{2}$

Q
25

If $6e^{x} - 15e^{-x} + 1 = 0$, then $e^{2x} =$

A) $\frac{25}{9}$

B) $\frac{1}{4}$

C) $\frac{9}{4}$

D) $\frac{25}{4}$

E) $\frac{9}{25}$

Q
26

The sum of all solutions of the equation $2e^{x} + 6e^{-x} = 7$ is

A) $\ln 3$

B) $\ln 2$

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

D) $\ln \frac{3}{2}$

E) $\ln \frac{7}{2}$

Q
27

If the solution of the equation $\frac{7^x+7^{-x}}{7^x-7^{-x}} = 2$ is $x = \log_b \sqrt{a}$, then $a \cdot b =$

A) 21

B) 34

C) 14

D) 9

E) 24

Q
28

The sum of all the solution(s) of $e^x - 6e^{-x} = -1$ is

A) $\ln 2$

B) $\ln 3$

C) $-\ln 6$

D) 1

E) 2

Topic 3 | Solving for a Variable

Solving an exponential or logarithmic formula for one variable in terms of the others • Questions 29–32

Q **29**

If $\log 2 = t$, then solving the equation $2^{x+3} = 5^x$ in terms of t, we get $x =$

A) $\frac{3t}{1-2t}$

B) $\frac{2t}{1-3t}$

C) $\frac{1-3t}{2t}$

D) $\frac{3t}{1+2t}$

E) $\frac{1+2t}{3t}$

Q **30**

If $y = A + B(1 - e^{-cx})$, then $x =$

A) $-\frac{1}{c}\ln\left(\frac{B-y+A}{B}\right)$

B) $-\frac{1}{c}\ln\left(\frac{B+y+A}{B}\right)$

C) $-\frac{1}{c}\ln\left(\frac{B-y-A}{B}\right)$

D) $-\frac{1}{c}\ln\left(\frac{B-y+A}{A}\right)$

E) $-\frac{1}{c}\ln\left(\frac{B+y-A}{A}\right)$

Q
31

If $y = \log(x+1) - \log\ x$, then $x =$

A) $\frac{1}{10^y - 1}$

B) $\frac{1}{10^y + 1}$

C) $10^y + 1$

D) $10^y - 1$

E) $\frac{1}{e^y - 1}$

Q
32

If $\log_2 y = x$, then $\left(\frac{1}{8}\right)^{1-x} =$

A) $\frac{y^3}{8}$

B) $\frac{y^3}{2}$

C) $\frac{y}{8}$

D) $8y$

E) $8y^3$

Topic 4 | Logarithmic Equations: Solution Sets

Describing the solutions of a logarithmic equation after checking the domain • Questions 33–38

Q **33**

The solution set of the equation $\log_3(x-2) = 1 + \log_{1/3}(x+2)$ consists of

A) two rational solutions.

B) two solutions, one rational and one irrational.

C) one irrational solution only.

D) two irrational solutions of different signs.

E) only one integer.

Q **34**

The solution set of the equation $\ln(4x-2) - \ln e^{\ln 4} = -\ln(x-2)$ contains

A) only one positive rational number.

B) only one negative rational number.

C) one negative and one positive rational number.

D) two positive rational numbers.

E) no real solution.

Q
35

The equation $\ln e^{\ln x^2} - \ln(4 - x) = \ln 2$ has

A) one negative and one positive real solution.

B) only one positive real solution.

C) only one negative real solution.

D) two negative real solutions.

E) no real solution.

Q
36

The solution set of the equation $\sqrt{\log_2 x} = -\log_2 \sqrt{x}$ contains

A) one positive integer only.

B) one positive and one negative integer.

C) no real numbers.

D) two positive integers.

E) one negative integer only.

Q
37

The solution set of the equation $\log_4(x+2) - 2\log_{1/16}(x-1) = 1$ consists of

A) one positive integer only.

B) one negative integer only.

C) one positive irrational number only.

D) two integers whose sum is -1.

E) one negative irrational number only.

Q
38

The equation $\log_9(5-x) + \log_3\sqrt{6-x} = \frac{1}{\log_{12} 9}$ has

A) only one positive real solution.

B) only one negative real solution.

C) two positive real solutions.

D) two negative real solutions.

E) no real solution.

Topic 5 | Logarithmic Equations: Sums, Products and Values

Solving logarithmic equations, rejecting extraneous solutions, and computing the requested value • Questions 39–53

Q **39**

The sum of all the solution(s) of the equation $\ln(2x^2 - 4x + 1) = 2\ln(1 - x)$ is

A) 1

B) 2

C) -1

D) 0

E) -2

Q **40**

The sum of all the solution(s) of $\log(x + 2) = 1 + \log_{0.1}(x - 1)$ is

A) -1

B) 1

C) 0

D) -3

E) 3

Q
41

The sum of the solutions of the equation $\log_2(x-1) = 2 - \log_2(x+1)$ is

A) 0

B) 5

C) $\sqrt{5}$

D) $-\sqrt{5}$

E) -5

Q
42

If $x = k$ is the solution of $\log_3(\log_4(x-36)) = 1$, then $\log\ k =$

A) 6

B) -1

C) 3

D) 2

E) 1

Q
43

If the graph of $f(x) = \log_5(x - 20)$ intersects the graph of $g(x) = \log_5\left(\frac{1}{x}\right) + 3$ at the point (a, b), then $a + b =$

A) 26

B) 25

C) 28

D) 21

E) 29

Q
44

The sum of all the solutions of the equation $\frac{1}{2}\ln(3x + 8) = \frac{1}{2}\ln(2x + 2) + \frac{1}{4}\log_{\sqrt{e}}(x - 2)$ is

A) 4

B) $\frac{5}{2}$

C) 3

D) $\frac{1}{2}$

E) 5

Q
45

The sum of all solutions of the equation $(\log_2(x+3))^2 = 4\log_2(x+3)$ is

A) 11

B) 6

C) 13

D) 5

E) 4

Q
46

The product of the solution(s) of the equation $\log_7(x-1) - \log_{1/7}(x+1) = 2\log_{\sqrt{7}} 1 + \log_7(2x-1)$ is

A) 2

B) 0

C) 3

D) 4

E) 6

Q
47

The sum of all solution(s) of the equation $\log_2 \sqrt[3]{x+5} + \log_8(3x-1) = 2$ is

A) 3

B) 14

C) 11

D) 10

E) -6

Q
48

The sum of all solution(s) of the equation $\log_2 \sqrt{x-2} + \log_4(x-4) = \frac{1}{2}(3+\log_2 3)$ is:

A) 8

B) 6

C) 11

D) 10

E) -6

Q
49

The sum of all the solution(s) of the equation $\log_{x^2+2x} 27 = 3$ is

A) -2

B) -4

C) -3

D) 4

E) 1

Q
50

The sum of all the solution(s) of the equation $\log(5x) - \log_{0.1}(x-1) = 2$ is

A) 5

B) -4

C) 4

D) 1

E) 9

Q
51

If $(\log_4 5)(\log_{25} 2x) = 1$, then $x =$

A) 8

B) 6

C) 4

D) 2

E) 10

Q
52

The sum of all the solution(s) of the equation $\log_{\sqrt{5}}(x) + \log_5(x^2 - 3) + \log_{1/5} 4 = 0$ is

A) 2

B) 4

C) 0

D) 3

E) 6

Q
53

The sum of all the solution(s) of the equation $\log_{4x}(16) + \log_{x/2}(16) = 2$ is

A) $\frac{33}{2}$

B) $\frac{9}{2}$

C) $\frac{31}{2}$

D) 16

E) 15

Answer Key

"Original" shows the question number in the source worksheet.

Q	Original	Ans.	Value
1	3	D	1
2	4	A	3
3	6	A	17
4	10	A	$\frac{\log 24}{\log\left(\frac{8}{3}\right)}$
5	12	A	$\frac{\ln 12}{\ln 20}$
6	16	A	$\log_{9/2} 6$
7	21	E	$-\frac{1}{27}$
8	22	A	contains exactly one negative rational number.
9	26	A	-4
10	27	B	$\log_5 2$
11	28	A	$-\frac{3}{5}$
12	29	A	$3 + \log_3 \sqrt{6}$
13	51	A	-8
14	53	A	2
15	1	A	one positive real number only
16	2	B	3
17	5	A	$\frac{1}{6}$
18	7	D	$\log_2(3)$
19	8	A	1
20	9	A	$\ln 4$
21	13	B	3
22	14	A	one positive integer only.
23	15	A	$\log_2 12$
24	17	A	$\ln\frac{15}{2}$
25	18	C	$\frac{9}{4}$
26	20	A	$\ln 3$
27	24	A	21
28	30	A	$\ln 2$
29	11	A	$\frac{3t}{1-2t}$
30	23	A	$-\frac{1}{c}\ln\left(\frac{B-y+A}{B}\right)$
31	36	A	$\frac{1}{10^y - 1}$
32	52	A	$\frac{y^3}{8}$

Q	Original	Ans.	Value
33	31	**C**	one irrational solution only.
34	32	**A**	only one positive rational number.
35	33	**A**	one negative and one positive real solution.
36	35	**A**	one positive integer only.
37	40	**A**	one positive integer only.
38	55	**A**	only one positive real solution.
39	34	**D**	0
40	37	**E**	3
41	38	**C**	$\sqrt{5}$
42	39	**D**	2
43	41	**A**	26
44	42	**A**	4
45	43	**A**	11
46	44	**A**	2
47	45	**A**	3
48	46	**A**	8
49	47	**A**	-2
50	48	**A**	5
51	49	**A**	8
52	50	**A**	2
53	54	**A**	$\frac{33}{2}$