Surds

1. Which of the following is rational?

   A. $\sqrt{12^3}$
   B. $\sqrt{4} \times \sqrt{3}$
   C. $\sqrt{8} \div \sqrt{2}$
   D. $\sqrt{8} + \sqrt{8}$
   E. $\sqrt{3} - \sqrt{2}$

   [1972-CE-MATHS B1-2]

2. $\dfrac{\sqrt{3}-1}{\sqrt{3}+1} - \dfrac{\sqrt{3}+1}{\sqrt{3}-1} =$

   A. $-2\sqrt{3}$.
   B. $-\dfrac{1}{2}\sqrt{3}$.
   C. $\dfrac{1}{2}\sqrt{3}$.
   D. $2\sqrt{3}$.
   E. 4.

   [1977-CE-MATHS 2-5]

3. One of the following expressions is different in value from the other four. Which one is it?

   A. $.0234\sqrt{43200}$
   B. $.234\sqrt{432}$
   C. $2.34\sqrt{4.32}$
   D. $23.4\sqrt{.432}$
   E. $234\sqrt{.000432}$

   [SP-CE-MATHS 2-36]

4. $\sqrt{4+4x^2} - \sqrt{1+x^2} =$

   A. $1 + x$.
   B. $\sqrt{1+x^2}$.
   C. $3\sqrt{1+x^2}$.
   D. $\sqrt{3+3x^2}$.
   E. $\sqrt{3} + \sqrt{3}x$.

   [SP-CE-MATHS 2-10]

5. If $(\sqrt{3}-\sqrt{2})x = 1$, then $x =$

   A. $\sqrt{3} + \sqrt{2}$.
   B. $\dfrac{1}{\sqrt{3}+\sqrt{2}}$.
   C. $\dfrac{1}{\sqrt{3}} + \dfrac{1}{\sqrt{2}}$.
   D. $\dfrac{1}{\sqrt{3}} - \dfrac{1}{\sqrt{2}}$.
   E. $\dfrac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$.

   [1984-CE-MATHS 2-6]

6. If $x + \dfrac{1}{x} = 1 + \sqrt{2}$, then $x^2 + \dfrac{1}{x^2} =$

   A. 1.
   B. 3.
   C. $1 + 2\sqrt{2}$.
   D. $2 + 2\sqrt{2}$.
   E. $3 + 2\sqrt{2}$.

   [1987-CE-MATHS 2-6]

7. If $x = \sqrt{a+1} - \sqrt{a}$, where $a > 0$, then $x + \dfrac{1}{x} =$

   A. 2.
   B. $2\sqrt{a}$.
   C. $2\sqrt{a+1}$.
   D. $2\sqrt{a+1} - \sqrt{a}$.
   E. $2(\sqrt{a+1} + \sqrt{a})$.

   [1989-CE-MATHS 2-43]

8. $\dfrac{1}{1+\sqrt{2}} + \dfrac{1}{\sqrt{2}+\sqrt{3}} + \dfrac{1}{\sqrt{3}+\sqrt{4}} + \dfrac{1}{\sqrt{4}+\sqrt{5}} =$

   A. $\dfrac{1}{1-\sqrt{5}}$.
   B. $\dfrac{1}{\sqrt{5}-1}$.
   C. $1 + \sqrt{5}$.
   D. $1 - \sqrt{5}$.
   E. $-1 + \sqrt{5}$.

   [1990-CE-MATHS 2-33]

9. If $(\sqrt{3}+1)\sqrt{x} = 2$, then $x =$

   A. $2 - \sqrt{3}$.
   B. $\sqrt{3} - 1$.
   C. 1.
   D. $2(2 - \sqrt{3})$.
   E. $4 - \sqrt{3}$.

   [1991-CE-MATHS 2-33]

10. $\dfrac{\sqrt{5}+1}{\sqrt{5}-1} - \dfrac{\sqrt{5}-1}{\sqrt{5}+1} =$

    A. 0.
    B. $\dfrac{1}{2}$.
    C. 3.
    D. $\sqrt{5}$.
    E. $\dfrac{1}{2} + \sqrt{5}$.

    [1992-CE-MATHS 2-4]

11. Simplify $\frac{\sqrt{b}}{\sqrt{a}-\sqrt{b}}+\frac{\sqrt{a}}{\sqrt{a}+\sqrt{b}}$.

A. $\frac{1}{\sqrt{a}-\sqrt{b}}$

B. $\frac{a+2\sqrt{ab}-b}{a-b}$

C. $\frac{\sqrt{b}+\sqrt{a}}{2\sqrt{a}}$

D. $\frac{b+2\sqrt{ab}-a}{a-b}$

E. $\frac{a+b}{a-b}$

[1993-CE-MATHS 2-4]

12. If $a=\sqrt{3}+\sqrt{2}$, then $a-\frac{1}{a}=$

A. 0.

B. $2\sqrt{2}$.

C. $2\sqrt{3}$.

D. $\sqrt{3}-\sqrt{2}$.

E. $\frac{2\sqrt{3}}{3}+\frac{\sqrt{2}}{2}$.

[1994-CE-MATHS 2-4]

13. $\frac{1}{2+\sqrt{6}}-\frac{1}{2-\sqrt{6}}=$

A. $-\sqrt{6}$.

B. $-\frac{\sqrt{6}}{2}$.

C. 0.

D. $\frac{\sqrt{6}}{2}$.

E. $\sqrt{6}$.

[1995-CE-MATHS 2-5]

14. If $(\frac{\sqrt{3}}{3}-\frac{1}{2})x=1$, then $x=$

A. $-\frac{\sqrt{3}}{3}+\frac{1}{2}$.

B. $\frac{\sqrt{3}}{3}+\frac{1}{2}$.

C. $-4\sqrt{3}-6$.

D. $4\sqrt{3}-6$.

E. $4\sqrt{3}+6$.

[1996-CE-MATHS 2-39]

15. $\frac{1}{\sqrt{2}-1}-\frac{1}{\sqrt{3}-\sqrt{2}}=$

A. $-1+\sqrt{3}$.

B. $1-\sqrt{3}$.

C. $-1+2\sqrt{2}-\sqrt{3}$.

D. $1-2\sqrt{2}+\sqrt{3}$.

E. $1+2\sqrt{2}-\sqrt{3}$.

[1997-CE-MATHS 2-29]

16. If $(\frac{\sqrt{5}}{2}+1)x=\sqrt{2}$, then $x=$

A. $2\sqrt{10}-2$.

B. $2\sqrt{10}-4\sqrt{2}$.

C. $2\sqrt{10}+4\sqrt{2}$.

D. $\frac{\sqrt{10}-1}{2}$.

E. $\frac{2\sqrt{10}-4\sqrt{2}}{3}$.

[2000-CE-MATHS 2-40]

17. If $(x+1)(\sqrt{3}-1)=4$, then $x=$

A. $2\sqrt{3}-3$.

B. $2\sqrt{3}+1$.

C. $2\sqrt{3}+2$.

D. $\frac{4\sqrt{3}-1}{2}$.

[2002-CE-MATHS 2-39]

18. $\sqrt{25a}-\sqrt{4a}=$

A. $3\sqrt{a}$.

B. $7\sqrt{a}$.

C. $21\sqrt{a}$.

D. $\sqrt{21a}$.

[2004-CE-MATHS 2-4]

19. If n is a positive integer, then $\frac{1}{1+2\sqrt{n}}-\frac{1}{1-2\sqrt{n}}=$

A. $\frac{4\sqrt{n}}{1-4n}$.

B. $\frac{-4\sqrt{n}}{1+4n}$.

C. $\frac{4\sqrt{n}}{4n+1}$.

D. $\frac{4\sqrt{n}}{4n-1}$.

[2005-CE-MATHS 2-37]

20. If $a > 0$, then $\frac{3\sqrt{a}}{2} - \frac{a}{\sqrt{4a}} =$

A. 1.
B. $\frac{\sqrt{a}}{2}$.
C. $\sqrt{a}$.
D. $2\sqrt{a}$.

[2007-CE-MATHS 2-37]

21. If $a > 0$, then $\sqrt{49a} - \sqrt{25a} =$

A. $2\sqrt{a}$.
B. $12\sqrt{a}$.
C. $\sqrt{24a}$.
D. $\sqrt{74a}$.

[2008-CE-MATHS 2-39]

Basic Concepts

1. If a and b are greater than 1, which of the following statements is/are true?

   (1) $\sqrt{a+b} = \sqrt{a} + \sqrt{b}$
   (2) $(a^{-1} + b^{-1})^{-1} = a + b$
   (3) $a^2b^3 = (ab)^6$

   A. (1) only
   B. (2) only
   C. (3) only
   D. (1) and (2) only
   E. None of them

   [1992-CE-MATHS 2-9]

Simplification of Indices

2. Which of the following is identical to $\dfrac{\left(\frac{p}{q}\right)^{-\frac{1}{3}}\left(\frac{q}{p}\right)^{2}}{p^{-\frac{2}{3}}q^{\frac{2}{3}}}$?

   A. $\left(\frac{p}{q}\right)^{\frac{7}{3}}$
   B. $(pq)^2$
   C. $\left(\frac{q}{p}\right)^{\frac{5}{3}}$
   D. $\left(\frac{p}{q}\right)^{\frac{2}{3}}$
   E. 1

   [1972-CE-MATHS B1-15]

3. $32^{-\frac{2}{5}} =$

   A. -2.
   B. $\frac{1}{2}$.
   C. $-\frac{1}{4}$.
   D. $\frac{1}{4}$.
   E. 4.

   [1974-CE-MATHS A1-1]

4. $\dfrac{(a-b)^{\frac{1}{2}}}{b^{\frac{1}{2}}} =$

   A. $(ab - b^2)^{\frac{1}{2}}$.
   B. $\left(\frac{a}{b} - 1\right)^{\frac{1}{2}}$.
   C. $\left(\frac{a}{b}\right)^{\frac{1}{2}} - 1$.
   D. $-b^{\frac{1}{2}}(a-b)^{\frac{1}{2}}$.
   E. $b^2(a-b)^{\frac{1}{2}}$.

   [1977-CE-MATHS 2-13]

5. $\left(\frac{27}{64}\right)^{-\frac{2}{3}} =$

   A. $\frac{3}{4}$.
   B. $\frac{4}{3}$.
   C. $\frac{9}{16}$.
   D. $\frac{16}{9}$.
   E. $-\frac{9}{16}$.

   [SP-CE-MATHS A2-36]

6. $\dfrac{3^{n+2}}{9^n} =$

   A. 3^2.
   B. 3^{2n}.
   C. 3^{2-n}.
   D. 3^{n-2}.
   E. 3^{3n+2}.

   [SP-CE-MATHS A2-37]

7. $\dfrac{(x^{n+1})^2}{x^{2n-1}} =$

   A. x^2.
   B. x^3.
   C. x^4.
   D. x^{3-n}.
   E. x^{n-3}.

   [1978-CE-MATHS 2-6]

8. $(3^{a+b})^2 =$

   A. 3^{a+b+2}.
   B. $3^{a^2+b^2}$.
   C. $3^{(a+b)^2}$.
   D. 3^{2a+2b}.
   E. $9^{a^2+b^2}$.

   [1978-CE-MATHS A2-45]

9. $125^a \cdot 5^b =$

   A. 625^{a+b}.
   B. 625^{ab}.
   C. 125^{a+3b}.
   D. 5^{a+3b}.
   E. 5^{3a+b}.

   [1980-CE-MATHS 2-2]

10. $\dfrac{5^{n+2} - 35(5^{n-1})}{18(5^{n+1})} =$

A. $\dfrac{1}{18}$.
B. $\dfrac{1}{15}$.
C. $\dfrac{1}{5}$.
D. 5.
E. 5^n.

[1980-CE-MATHS 2-8]

11. $\dfrac{(a^2b^{-3})^2}{a^{-2}b} =$

A. a^2b^{-7}.
B. a^2b^{-5}.
C. a^6b^{-2}.
D. a^6b^{-6}.
E. a^6b^{-7}.

[1981-CE-MATHS 2-1]

12. $(2^x)^x =$

A. $2^{(x^x)}$.
B. $2^x \cdot x^x$.
C. $2x^x$.
D. 2^{2x}.
E. $2^{(x^2)}$.

[1981-CE-MATHS 2-4]

13. $\dfrac{8^{2x} \cdot 4^{3x}}{2^x \cdot 16^{2x}} =$

A. 2^{3x}.
B. 2^{2x}.
C. 2^x.
D. 8.
E. 1.

[1982-CE-MATHS 2-2]

14. $(x^2y^{-1}) \div (x^{\frac{1}{2}}y^{-1})^2 =$

A. xy.
B. xy^{-1}.
C. xy^{-3}.
D. $x^2y^{\frac{1}{2}}$.
E. $x^{-\frac{1}{2}}y^{-2}$.

[1983-CE-MATHS 2-4]

15. $(2^{n+1})^2 \times (2^{-2n-1}) \div 4^n =$

A. 1.
B. 2^{2n-1}.
C. 2^{n^2+2n}.
D. 2^{n^2-2n}.
E. 2^{-2n+1}.

[1984-CE-MATHS 2-3]

16. $\dfrac{2^{n+4} - 2(2^n)}{2(2^{n+3})} =$

A. $\dfrac{7}{8}$.
B. $\dfrac{7}{4}$.
C. $1 - 2^{n+1}$.
D. $2^{n+4} - \dfrac{1}{8}$.
E. 2^{n+1}.

[1988-CE-MATHS 2-1]

17. $3^{n-1} \times 3^{n+1} =$

A. 3^{n^2-1}.
B. 9^{n^2-1}.
C. 3^{2n}.
D. 6^{2n}.
E. 9^{2n}.

[1989-CE-MATHS 2-1]

18. $\sqrt{\dfrac{x}{\sqrt{x}}} =$

A. $x^{\frac{3}{4}}$.
B. $x^{\frac{1}{4}}$.
C. $x^{\frac{1}{2}}$.
D. $x^{-\frac{1}{4}}$.
E. $x^{-\frac{3}{4}}$.

[1989-CE-MATHS 2-3]

19. $(a^{2n})^3 =$

A. a^{6n}.
B. a^{8n}.
C. a^{2n^3}.
D. a^{6n^3}.
E. a^{8n^3}.

[1990-CE-MATHS 2-1]

20. $(a^{2a})(3a^{4a}) =$

A. $3a^{6a}$.
B. $(3a)^{6a}$.
C. $3a^{8a}$.
D. $4a^{6a}$.
E. $(3^{4a})(a^{6a})$.

[1991-CE-MATHS 2-1]

21. Simplify $\dfrac{\overbrace{n \times n \times \ldots \times n}^{n \text{ times}}}{\underbrace{n + n + \ldots + n}_{n \text{ times}}}$.

A. n^{n-2}
B. $n^{\frac{n}{2}}$
C. $n - 2$
D. $\dfrac{n}{2}$
E. 1

[1992-CE-MATHS 2-8]

22. $(3^x)^2 =$

A. $3^{(x^2)}$.
B. 3^{x+2}.
C. 3^{2x}.
D. 6^x.
E. 9^{2x}.

[1994-CE-MATHS 2-33]

23. Simplify $\left(\dfrac{a^6}{b^{12}}\right)^{-\frac{2}{3}}$.

A. $\dfrac{b^8}{a^4}$
B. $\dfrac{b^{18}}{a^9}$
C. $\dfrac{a^4}{b^8}$
D. $\dfrac{a^9}{b^{18}}$
E. $\dfrac{1}{a^4b^{12}}$

[1995-CE-MATHS 2-4]

24. $\dfrac{27^x}{3^y} =$

A. $\dfrac{9x}{y}$.
B. $9^{\frac{x}{y}}$.
C. 9^{x-y}.
D. $3^{\frac{3x}{y}}$.
E. 3^{3x-y}.

[1996-CE-MATHS 2-2]

25. $\dfrac{(2^m)^2}{8^m} =$

A. $\dfrac{2}{3}$.
B. 2^{-m}.
C. 2^m.
D. 2^{m^2-3m}.
E. 2^{2m^2-3m}.

[1998-CE-MATHS 2-7]

26. $\dfrac{(a^3b^{-1})^{-2}}{(a^{-1}b^2)^4} =$

A. $\dfrac{1}{ab^3}$.
B. $\dfrac{1}{a^2b^3}$.
C. $\dfrac{1}{a^2b^6}$.
D. $\dfrac{1}{a^2b^9}$.
E. $\dfrac{a^4}{b^6}$.

[2000-CE-MATHS 2-3]

27. $\dfrac{a^{n-2} + a^{n-1}}{a^{n-2}} =$

A. a^{n-1}.
B. $a^{n-2}(1 + a)$.
C. $1 + a^{n-1}$.
D. $1 + \dfrac{1}{a}$.
E. $1 + a$.

[2001-CE-MATHS 2-10]

28. $2^x \cdot 8^y =$

A. 2^{x+3y}.
B. 2^{3xy}.
C. 16^{x+y}.
D. 16^{xy}.

[2002-CE-MATHS 2-3]

29. $3^x \cdot 9^y =$

A. 3^{x+2y}.
B. 3^{x+3y}.
C. 27^{x+y}.
D. 27^{xy}.

[2003-CE-MATHS 2-4]

30. $\dfrac{2^{2n} \cdot 9^n}{3^n} =$

A. 6^{2n}.
B. 6^{3n}.
C. 12^n.
D. 12^{2n}.

[2004-CE-MATHS 2-1]

31. $a \cdot a(a + a) =$

A. a^4.
B. $2a^3$.
C. $a^3 + a$.
D. $3a^2 + a$.

[2005-CE-MATHS 2-1]

32. $(2x)^3 \cdot x^3 =$

A. $6x^6$.
B. $8x^6$.
C. $6x^9$.
D. $8x^9$.

[2006-CE-MATHS 2-1]

33. If n is a positive integer, then $3^{2n} \cdot 4^n =$

A. 6^{2n}.
B. 6^{3n}.
C. 12^{2n}.
D. 12^{3n}.

[2007-CE-MATHS 2-1]

34. $\left(\frac{1}{2}\right)^{888} (-2)^{887} =$

A. -2.
B. -0.5.
C. 0.
D. 0.5.

[2008-CE-MATHS 2-1]

35. $2^n \cdot 3^n =$

A. 5^n.
B. 6^n.
C. 8^n.
D. 9^n.

[2009-CE-MATHS 2-1]

36. $\left(\frac{1}{9}\right)^{500} (3^{500})^3 =$

A. 0.
B. 3^{500}.
C. 6^{500}.
D. 18^{500}.

[2010-CE-MATHS 2-2]

37. If a and b are positive numbers, then $\frac{1}{\sqrt{a^3}} \div \frac{\sqrt{b}}{a} =$

A. $\frac{\sqrt{b}}{ab}$.
B. $\frac{\sqrt{ab}}{b}$.
C. $\frac{\sqrt{ab}}{ab}$.
D. $\frac{\sqrt{a^3b}}{b}$.

[2010-CE-MATHS 2-39]

38. $5^{334}\left(\frac{-1}{5}\right)^{333} =$

A. -5.
B. -0.2.
C. 0.
D. 5.

[2011-CE-MATHS 2-1]

Equations with Indices

39. If $25^x = 125$, then $x =$

A. $\frac{5}{2}$.
B. $\frac{2}{5}$.
C. 5.
D. $\frac{3}{2}$.
E. $\frac{2}{3}$.

[SP-CE-MATHS 2-2]

40. If $9^{2x} = 27$, then $x =$

A. $\frac{3}{2}$.
B. $\frac{1}{3}$.
C. $\frac{2}{3}$.
D. $\frac{4}{3}$.
E. $\frac{3}{4}$.

[1978-CE-MATHS 2-5]

41. If $10^{2y} = 25$, then $10^{-y} =$

A. $\frac{1}{5}$.
B. $-\frac{1}{5}$.
C. $\frac{1}{25}$.
D. $-\frac{1}{25}$.
E. $\frac{1}{125}$.

[1979-CE-MATHS 2-23]

42. If $(10^x)^y = (2^z)(5^z)$, then which of the following must be true?

A. $xy = z$
B. $xy = 2z$
C. $xy = z^2$
D. $x^y = z$
E. $x^y = 2z$

[1986-CE-MATHS 2-29]

43. If $3^{2k+1} = 3^{2k} + 6$, then $k =$

A. $-\frac{1}{4}$.
B. $-\frac{1}{2}$.
C. $\frac{1}{4}$.
D. $\frac{1}{2}$.
E. 3.

[1987-CE-MATHS 2-7]

44. If $9^{x+2} = 36$, then $3^x =$

A. $\frac{2}{3}$.
B. $\frac{4}{3}$.
C. 2.
D. $\sqrt{6}$.
E. 9.

[1993-CE-MATHS 2-34]

45. If $5^a = 2^b = 10^c$ and a, b, c are non-zero, then $\frac{c}{a} + \frac{c}{b} =$

A. $\frac{7}{10}$.
B. 1.
C. 7.
D. $\log 7$.
E. $\frac{1}{\log 2} + \frac{1}{\log 5}$.

[1995-CE-MATHS 2-38]

46. If $2^x \cdot 8^x = 64$, then $x =$

A. $\frac{3}{2}$.
B. $\frac{3}{4}$.
C. $\frac{6}{5}$.
D. 2.
E. 4.

[1997-CE-MATHS 2-2]

47. If $4^x = a$, then $16^x =$

A. $4a$.
B. a^2.
C. a^4.
D. 2^a.
E. 4^a.

[1999-CE-MATHS 2-4]

HKDSE Problems

48. $(3a)^2 \cdot a^3 =$

A. $3a^5$.
B. $6a^6$.
C. $9a^5$.
D. $9a^6$.

[SP-DSE-MATHS 2-1]

49. $\frac{(2x^4)^3}{2x^5} =$

A. $3x^2$.
B. $3x^7$.
C. $4x^7$.
D. $4x^{59}$.

[2012-DSE-MATHS 2-1]

50. $(27 \cdot 9^{n+1})^3 =$

A. 3^{6n+12}.
B. 3^{6n+15}.
C. 3^{9n+12}.
D. 6^{9n+18}.

[2013-DSE-MATHS 2-1]

51. $(2n^3)^{-5} =$

A. $\frac{1}{32n^2}$.
B. $\frac{1}{32n^{15}}$.
C. $\frac{1}{10n^{125}}$.
D. $\frac{1}{10n^{243}}$.

[2014-DSE-MATHS 2-1]

52. $\frac{(3y^6)^4}{3y^2} =$

A. $4y^5$.
B. $4y^8$.
C. $27y^{12}$.
D. $27y^{22}$.

[2015-DSE-MATHS 2-2]

53. $8^{222} \cdot 5^{666} =$

A. 10^{666}.
B. 10^{888}.
C. 40^{666}.
D. 40^{888}.

[2016-DSE-MATHS 2-1]

54. $\left(\frac{1}{9^{555}}\right) 3^{444} =$

A. 0.
B. $\frac{1}{3^{111}}$.
C. $\frac{1}{3^{222}}$.
D. $\frac{1}{3^{666}}$.

[2017-DSE-MATHS 2-2]

55. $\frac{8^{2n+1}}{4^{2n+1}} =$

A. 1
B. 2
C. 2^n
D. 2^{-n}

[2018-DSE-MATHS 2-1]

56. $\frac{(6x^7)^2}{4x^5} =$

A. $3x^4$
B. $9x^4$
C. $3x^9$
D. $9x^9$

[2019-DSE-MATHS 2-2]

57. $\frac{6x}{(3x^{-5})^{-2}} =$

A. $54x^3$
B. $\frac{2x^3}{3}$
C. $\frac{54}{x^9}$
D. $\frac{2}{3x^9}$

[2020-DSE-MATHS 2-1]

Basic Concepts

1. If a and b are positive numbers, which of the following is/are true?

   (1) $\log_{10}(a+b) = \log_{10} a + \log_{10} b$

   (2) $\log_{10} \frac{a}{b} = \log_{10} a - \log_{10} b$

   (3) $\frac{\log_{10} a}{\log_{10} b} = \frac{a}{b}$

   A. (1) only
   B. (2) only
   C. (3) only
   D. (1) and (2) only
   E. (1), (2) and (3)

   [1983-CE-MATHS 2-36]

2. If $\log x^2 + \log y^2 = \log z^2$, where x, y and z are positive numbers, which of the following must be true?

   (1) $x^2 + y^2 = z^2$
   (2) $\log x + \log y = \log z$
   (3) $x^2 y^2 = z^2$

   A. (1) only
   B. (2) only
   C. (3) only
   D. (1) and (2) only
   E. (2) and (3) only

   [1986-CE-MATHS 2-33]

3. If $\log a > 0$ and $\log b < 0$, which of the following is/are true?

   (1) $\log \frac{a}{b} > 0$

   (2) $\log b^2 > 0$

   (3) $\log \frac{1}{a} > 0$

   A. (1) only
   B. (2) only
   C. (3) only
   D. (1) and (2) only
   E. (2) and (3) only

   [1988-CE-MATHS 2-35]

Logarithmic Expressions

4. $10^{\log_{10} b} =$

   A. $(\log_{10} b)^2$.
   B. $\log_{10}(\log_{10} b)$.
   C. $\log_{10} b$.
   D. b.
   E. $10 \log_{10} b$.

   [1974-CE-MATHS A1-16]

5. If $3^x = 8$, then $x =$

   A. $\frac{8}{3}$.
   B. $\frac{\log 8}{3}$.
   C. $\log \frac{8}{3}$.
   D. $\log 5$.
   E. $\frac{\log 8}{\log 3}$.

   [1977-CE-MATHS 2-15]

6. If $\log a = 0.0490$, then $\log \frac{1}{a} =$

   A. $\frac{1}{0.0490}$.
   B. -0.9510.
   C. -1.9510.
   D. -0.0490.
   E. -1.0490.

   [SP-CE-MATHS 2-12*]

7. $\log_{10}(0.1) =$

   A. -2.
   B. -1.
   C. 0.
   D. 1.
   E. 2.

   [SP-CE-MATHS A2-38]

8. If $\log a = 0.5678$, then $\log \sqrt{a} =$

   A. $\sqrt{0.5678}$.
   B. $0.5678 \div 2$.
   C. $0.5678 - 2$.
   D. $2 - 0.5678$.
   E. 2.5678.

   [1978-CE-MATHS 2-2]

9. What is $\frac{\log_{10} 5}{\log_{10} 3}$ equal to?

   A. $\frac{5}{3}$
   B. $\log_{10}(5-3)$
   C. $\log_{10} 5 - \log_{10} 3$
   D. $\log_{10}(\frac{5}{3})$
   E. None of the above

   [1979-CE-MATHS 2-14]

10. If $n = 10^a$, then $\log_{10} n =$

    A. 10^a.
    B. 10^n.
    C. n^a.
    D. a^n.
    E. a.

    [1980-CE-MATHS 2-4]

11. If $\log_{10} x + \log_{10} 4 = \log_{10} (x + 4)$, what is the value of x?

A. 0
B. 1
C. $\frac{4}{3}$
D. 4
E. x may be any positive number

[1981-CE-MATHS 2-8]

12. $\log_{10} (x^{\log_{10} x}) =$

A. $(\log_{10} x)^2$.
B. $\log_{10} (x^2)$.
C. $x \log_{10} x$.
D. $\log_{10} (\log_{10} x)$.
E. 10^{-2}.

[1982-CE-MATHS 2-30]

13. $\log_{10} (a^2 - b^2) =$

A. $\frac{\log_{10} a}{\log_{10} b}$.
B. $2 \log_{10} (a - b)$.
C. $2 \log_{10} a - 2 \log_{10} b$.
D. $\log_{10} (a + b) + \log_{10} (a - b)$.
E. $(\log_{10} a + \log_{10} b)(\log_{10} a - \log_{10} b)$.

[1985-CE-MATHS 2-8]

14. $\log_4 2\sqrt{2} =$

A. $\frac{3}{8}$.
B. $\frac{3}{4}$.
C. $\frac{1}{4}$.
D. $2^{\frac{3}{4}}$.
E. $2^{\frac{3}{8}}$.

[1989-CE-MATHS 2-42]

15. If $2 = 10^p$, $3 = 10^q$, express $\log \frac{1}{6}$ in terms of p and q.

A. $-p - q$
B. $\frac{1}{pq}$
C. $\frac{1}{p + q}$
D. pq
E. $p + q$

[1990-CE-MATHS 2-5]

16. If $\log x : \log y = m : n$, then $x =$

A. $\frac{my}{n}$.
B. $(m - n)y$.
C. $m - n + y$.
D. $y^{\frac{m}{n}}$.
E. $\frac{m \log y}{n}$.

[1991-CE-MATHS 2-34]

17. If $\log_{10} b = 1 + \frac{1}{2} \log_{10} a$, then $b =$

A. $10\sqrt{a}$.
B. $10 + \sqrt{a}$.
C. $5a$.
D. $\frac{a}{2}$.
E. $1 + \frac{a}{2}$.

[1992-CE-MATHS 2-5]

18. If $\log (p + q) = \log p + \log q$, then

A. $p = q = 1$.
B. $p = \frac{q}{q - 1}$.
C. $p = \frac{q}{q + 1}$.
D. $p = \frac{q + 1}{q}$.
E. $p = \frac{q - 1}{q}$.

[1993-CE-MATHS 2-8]

19. If $\log 2 = a$ and $\log 9 = b$, then $\log 12 =$

A. $2a + \frac{b}{3}$.
B. $2a + \frac{b}{2}$.
C. $\frac{2}{3}a + \frac{2}{3}b$.
D. $a^2 + b^{\frac{1}{2}}$.
E. $a^2 b^{\frac{1}{2}}$.

[1994-CE-MATHS 2-34]

20. Let $x > y > 0$. If $\log (x + y) = a$ and $\log (x - y) = b$, then $\log \sqrt{x^2 - y^2} =$

A. $\frac{a + b}{2}$.
B. $\frac{ab}{2}$.
C. $\sqrt{a + b}$.
D. $\sqrt{ab}$.
E. $\sqrt{a} + \sqrt{b}$.

[1996-CE-MATHS 2-38]

21. If $\log(x+a) = 2$, then $x =$

A. $2 - a$.
B. $100 - a$.
C. $\frac{100}{a}$.
D. $2 - \log a$.
E. $100 - \log a$.

[1997-CE-MATHS 2-5]

22. Suppose $\log_{10} 2 = a$ and $\log_{10} 3 = b$. Express $\log_{10} 15$ in terms of a and b.

A. $-a + b + 1$
B. $-a + 10b$
C. $a + 2b$
D. $(a+b)b$
E. $\frac{10b}{a}$

[1998-CE-MATHS 2-40]

23. If $\frac{1}{2}\log y = 1 + \log x$, then

A. $y = \sqrt{10x}$.
B. $y = 100 + x^2$.
C. $y = (10+x)^2$.
D. $y = 10x^2$.
E. $y = 100x^2$.

[1999-CE-MATHS 2-39]

24. If $\log(x-a) = 3$, then $x =$

A. 3^{3+a}.
B. a^3.
C. $1000a$.
D. $1000 + a$.
E. $30 + a$.

[2000-CE-MATHS 2-38]

25. If $\log x^2 = (\log x)^2$, then $x =$

A. 1.
B. 10.
C. 100.
D. 1 or 10.
E. 1 or 100.

[2001-CE-MATHS 2-37]

26. If $\log x^2 = \log 3x + 1$, then $x =$

A. 2.
B. 5.
C. 30.
D. 0 or 30.

[2002-CE-MATHS 2-40]

27. If $10^{a+b} = c$, then $b =$

A. $\log c - a$.
B. $a - \log c$.
C. $\frac{c}{10} - a$.
D. $c - 10^a$.

[2003-CE-MATHS 2-40]

28. If $5 = 10^a$ and $7 = 10^b$, then $\log \frac{7}{50} =$

A. $b - a - 1$.
B. $b - a + 1$.
C. $\frac{b}{a}$.
D. $\frac{b}{a+1}$.

[2004-CE-MATHS 2-39]

29. If a and b are positive integers, then $\log(a^b b^a) =$

A. $ab \log(ab)$.
B. $ab (\log a)(\log b)$.
C. $(a+b)\log(a+b)$.
D. $b \log a + a \log b$.

[2005-CE-MATHS 2-39]

30. Let a and b be positive numbers. If $\log \frac{a}{10} = 2\log b$, then $a =$

A. $10b^2$.
B. $20b$.
C. $b^2 + 10$.
D. $2b + 10$.

[2006-CE-MATHS 2-38]

Application of Logarithm

31. Which of the following is the greatest?

A. 500^{3000}
B. 2000^{2500}
C. 2500^{2000}
D. 3000^{500}

[2007-CE-MATHS 2-39]

32. Which of the following is the best estimate of 1234^{3235}?

A. 10^{4000}
B. 10^{5000}
C. 10^{10000}
D. 10^{20000}

[2009-CE-MATHS 2-38]

33. Which of the following is the least?

A. 1234^{1811}
B. 2345^{1711}
C. 3456^{1511}
D. 7890^{1411}

[2011-CE-MATHS 2-39]

HKDSE Problems

34. Let $b > 1$. If $a = \log_{12} b$, then $\frac{1}{a} =$

A. $\log_b \frac{1}{12}$.
B. $\log_b 12$.
C. $\log_{12} \frac{1}{b}$.
D. $\frac{1}{\log_b 12}$.

[PP-DSE-MATHS 2-36]

35. If $x - \log y = x^2 - \log y^2 - 10 = 2$, then $y =$

A. 100.
B. 2 or -4.
C. $\frac{1}{100}$ or 10 000.
D. $\frac{1}{10\,000}$ or 100.

[2013-DSE-MATHS 2-34]

36. Which of the following is the greatest?

A. 124^{241}
B. 241^{214}
C. 412^{142}
D. 421^{124}

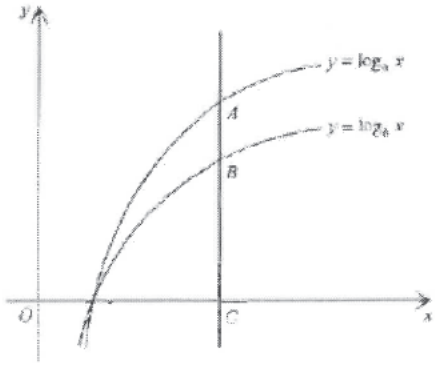
[2014-DSE-MATHS 2-33]

37. If $\begin{cases} \log_9 y = x - 3 \\ 2(\log_9 y)^2 = 4 - x \end{cases}$, then $y =$

A. -1 or $\frac{1}{2}$.
B. 1 or $\frac{1}{3}$.
C. 2 or $\frac{7}{2}$.
D. 3 or $\frac{1}{9}$.

[2017-DSE-MATHS 2-34]

38. The figure shows the graph of $y = \log_a x$ and the graph of $y = \log_b x$ on the same rectangular coordinate system, where a and b are positive constant. If a vertical line cuts the graph of $y = \log_a x$, the graph of $y = \log_b x$ and the x-axis at the points A, B and C respectively, which of the following is/are true?



I. $a > 1$
II. $a > b$
III. $\frac{AB}{BC} = \log_a \frac{b}{a}$

A. I only
B. II only
C. I and III only
D. II and III only

[2018-DSE-MATHS 2-32]

39. If $\frac{3}{3\log x - 2} + 7 = \frac{2}{2\log x + 1}$, then $\log \frac{1}{x} =$

A. -3 or 2
B. -2 or 3
C. $-\frac{1}{3}$ or $\frac{1}{2}$
D. $-\frac{1}{2}$ or $\frac{1}{3}$

[2019-DSE-MATHS 2-32]

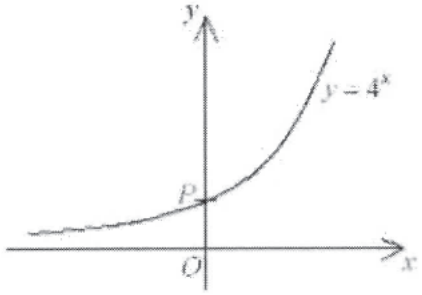
40. If the roots of the equation $(\log_\pi x)^2 - 10\log_\pi x + 24 = \log_\pi x$ are α and β, then $\alpha\beta =$

A. π^{10}
B. π^{11}
C. $\log_\pi 10$
D. $\log_\pi 11$

[2020-DSE-MATHS 2-32]

Exponential Graphs

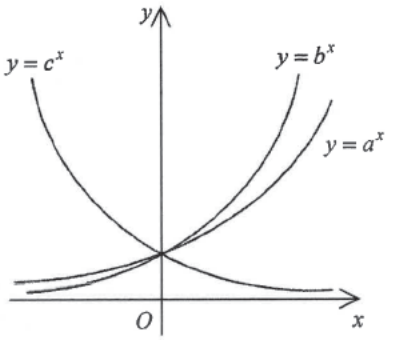
1. The figure shows the graph of $y = 4^x$. The coordinates of P are



A. $(1, 0)$.
B. $(0, 1)$.
C. $(4, 0)$.
D. $(0, 4)$.

[2006-CE-MATHS 2-37]

2.



The figure shows the graph of $y = a^x$, the graph of $y = b^x$ and the graph of $y = c^x$ on the same rectangular coordinate system, where a, b and c are positive constants. Which of the following must be true?

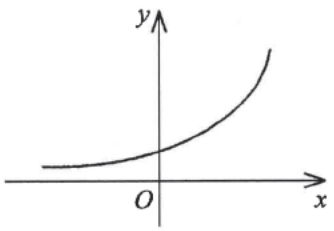
(1) $a > b$
(2) $b > c$
(3) $a > 1$
(4) $c > 1$

A. (1) and (3) only
B. (1) and (4) only
C. (2) and (3) only
D. (2) and (4) only

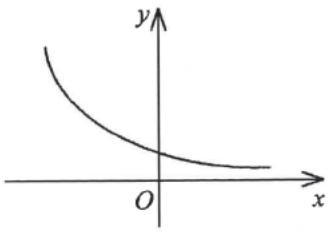
[2008-CE-MATHS 2-38]

3. Which of the following may represent the graph of $y = -3^{-x}$?

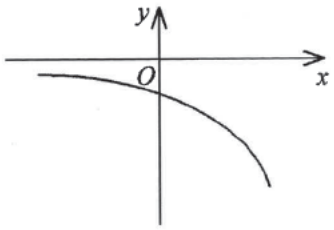
A.



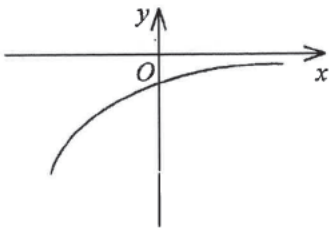
B.



C.

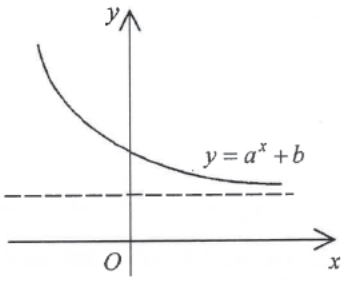


D.



[2009-CE-MATHS 2-39]

4.

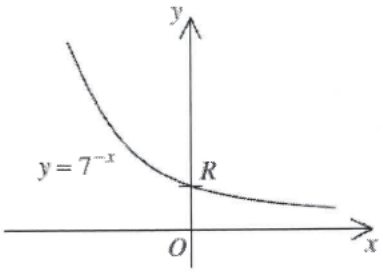


The figure shows the graph of $y = a^x + b$, where a and b are constants. Which of the following must be true?

A. $0 < a < 1$ and $b > 0$
B. $0 < a < 1$ and $b < 0$
C. $a > 1$ and $b > 0$
D. $a > 1$ and $b < 0$

[2010-CE-MATHS 2-38]

5. The figure shows the graph of $y = 7^{-x}$. The coordinates of R are

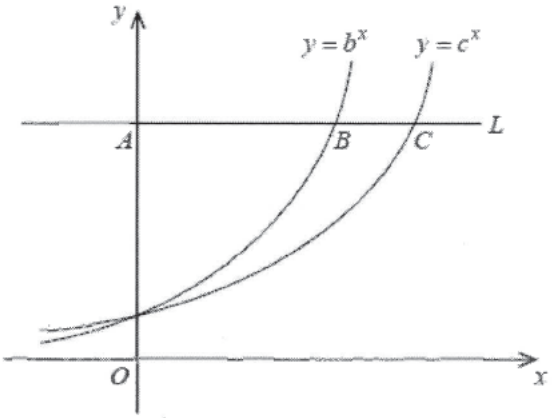


A. $(1, 0)$.
B. $(0, 1)$.
C. $(7, 0)$.
D. $(0, 7)$.

[2011-CE-MATHS 2-38]

HKDSE Problems

6. The figure shows the graph of $y = b^x$ and the graph of $y = c^x$ on the same rectangular coordinate system, where b and c are positive constants. If a horizontal line L cuts the y-axis, the graph of $y = b^x$ and the graph of $y = c^x$ at A, B and C respectively, which of the following are true?

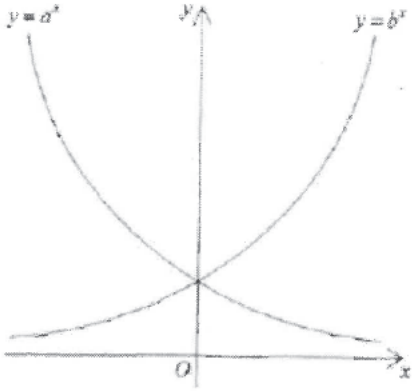


(1) $b < c$
(2) $bc > 1$
(3) $\frac{AB}{AC} = \log_b c$

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

[2014-DSE-MATHS 2-32]

7. The figure shows the graph of $y = a^x$ and the graph of $y = b^x$ on the same rectangular coordinate system, where a and b are positive constants. If the graph of $y = a^x$ is the reflection image of the graph of $y = b^x$ with respect to the y-axis, which of the following are true?



I. $a < 1$
II. $b > 1$
III. $ab = 1$

A. I and II only
B. I and III only
C. II and III only
D. I, II and III only

[2020-DSE-MATHS 2-33]