TOPIC 12

Indices

1. Evaluate

(a) $9^1 + 9^0$,

Answer (a) ..... [1]

(b) $\left(\frac{1}{9}\right)^{\frac{1}{2}}$.

Answer (b) ..... [1]

[June/2010/P12/Q4]

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2. (a) Evaluate $4^0 + 4^1$.

Answer (a) ..... [1]

(b) Evaluate $\left(\frac{1}{4}\right)^{-2}$.

Answer (b) ..... [1]

[Nov/2010/P11/Q4]

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3. (a) Evaluate $5^0 - 5^{-1}$.

Answer (a) ..... [1]

(b) Simplify $\left(5x^3\right)^2$.

Answer (b) ..... [1]

(c) Simplify $\left(\frac{16}{n^{16}}\right)^{\frac{1}{2}}$.

Answer (c) ..... [1]

[Nov/2010/P12/Q10]

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4. Evaluate

(a) $8^{\frac{2}{3}}$,

Answer ..... [1]

(b) $\left(\frac{1}{6}\right)^{-2}$.

Answer ..... [1]

[June/2011/P11/Q6]

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5. (a) Evaluate $\left(\frac{1}{4}\right)^{-2}$.

Answer ..... [1]

(b) Evaluate $64^{\frac{2}{3}}$.

Answer ..... [1]

(c) Simplify $\left(\frac{4x^2y^9}{x^4y}\right)^{\frac{1}{2}}$.

Answer ..... [2]

[June/2011/P12/Q21]

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6. (a) Simplify $(3a^4)^2$.

Answer ..... [1]

(b) Evaluate $\left(\frac{1}{4}\right)^{-2}$.

Answer ..... [1]

(c) Given that $x^3 = 27^0$, find x.

Answer x = ... [1]

(d) Evaluate $\frac{12^{\frac{1}{2}}}{3^{\frac{3}{2}}}$.

Answer ..... [1]

[Nov/2011/P11/Q18]

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7. (a) Evaluate $4^0 - 4^{-2}$.

Answer ..... [1]

(b) Simplify $(2x^2)^3$.

Answer ..... [1]

[Nov/2011/P12/Q7]

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8. (a) Write 8^3 in the form 2^k.

Answer ..... [1]

(b) Evaluate $\dfrac{9\times 2^{12} - 3\times 2^{10}}{3\times 2^8}$.

Answer ..... [2]

[June/2012/P11/Q15]

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9. (a) Find the value of

(i) $\sqrt{121}$,

Answer ..... [1]

(ii) $\sqrt[3]{-27}$.

Answer ..... [1]

(b) Write the following numbers in order of size, starting with the smallest.

$$2^3 \quad 3^2 \quad 4^0 \quad 5^{-1}$$

Answer .... [1]
smallest

(c) Evaluate $16^{\frac{3}{2}}$.

Answer ..... [1]

[June/2012/P12/Q18]

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10. (a) Evaluate

(i) $5^1 + 5^0$,

Answer ..... [1]

(ii) $\left(\frac{4}{3}\right)^{-2}$.

Answer ..... [1]

(b) Simplify $\left(2x^2\right)^3$.

Answer ..... [1]

[Nov/2012/P11/Q14]

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11. (a) Find the value of a when $3^a \div 3^4 = 3^2$.

Answer a = ... [1]

(b) Find the value of b when $8^b = 2$.

Answer b = ... [1]

[Nov/2012/P12/Q11]

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12. (a) Evaluate

(i) $5^0 + 5^2$,

Answer ..... [1]

(ii) $36^{\frac{1}{2}}$,

Answer ..... [1]

(iii) $(2^{\frac{2}{3}})^6$.

Answer ..... [1]

(b) $\left(\frac{1}{3}\right)^k = 9$

Find the value of k.

Answer k = ... [1]

[June/2013/P11/Q20]

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13. (a) Evaluate 4^{-2}.

Answer ..... [1]

(b) Simplify $\left(\frac{9xy^6}{x^3y^2}\right)^{\frac{1}{2}}$.

Answer ..... [2]

[June/2013/P12/Q16]

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14. Giving each answer as a fraction in its lowest terms, evaluate

(a) $\frac{3\times(2)^3}{6\times9}$,

Answer ..... [1]

(b) $\left(\frac{3^2}{2}\right)^{-2}$.

Answer ..... [1]

[Nov/2013/P11/Q8]

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15. (a) Evaluate $\left(\frac{5}{3}\right)^{-2}$.

Answer ..... [1]

(b) Simplify $\left(\frac{9}{t^6}\right)^{\frac{1}{2}}$.

Answer ..... [1]

(c) Simplify $\frac{2x^3y}{6xy^2}$.

Answer ..... [1]

[Nov/2013/P12/Q12]

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16. (a) Evaluate

(i) $\sqrt[3]{216}$,

Answer ..... [1]

(ii) $16^{\frac{1}{2}} - 16^{0}$.

Answer ..... [1]

(b) Simplify $\left(\frac{3a^2b}{12ab^4}\right)^{-2}$.

Answer ..... [2]

[June/2014/P12/Q19]

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17. (a) Find n when $3^3 \times 3 \times 3^5 = 3^n$.

Answer n = ... [1]

(b) Find the value of $32^{\frac{3}{5}}$.

Answer ..... [1]

(c) Find the value of $\left(\frac{1}{5}\right)^{-2}$.

Answer ..... [1]

[Nov/2014/P11/Q8]

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18. (a) Simplify $p^2(p^3 - 3p^{-2})$.

Answer ..... [2]

(b) Simplify $(27x^6)^{\frac{1}{3}}$.

Answer ..... [2]

[Nov/2014/P12/Q17]

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19. Given that $6^x = 9$, write down the value of

(a) 6^{-x},

Answer ..... [1]

(b) $6^{\frac{x}{2}}$,

Answer ..... [1]

(c) $6^0 + 6^x$.

Answer ..... [1]

[June/2015/P11/Q12]

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20. (a) Evaluate

(i) $2^0 + 2^3$,

Answer ..... [1]

(ii) $\left(\frac{1}{9}\right)^{\frac{1}{2}}$.

Answer ..... [1]

(b) Simplify $(4x^2)^{-2}$.

Answer ..... [1]

[June/2015/P12/Q16]

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21. (a) Evaluate $9^{-\frac{1}{2}}$.

Answer ..... [1]

(b) Evaluate $10^3 - 10^0$.

Answer ..... [1]

(c) Solve $x^{\frac{3}{2}} = 8$.

Answer $x =$ ..... [1]

[Nov/2015/P11/Q14]

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22. (a) Evaluate $\left(\frac{3}{2}\right)^0$.

Answer ..... [1]

(b) Evaluate $\left(\frac{3}{2}\right)^{-1}$.

Answer ..... [1]

(c) Simplify $(9x^3)^2$.

Answer ..... [1]

[Nov/2015/P12/Q11]

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23. Simplify

(a) $\frac{5x^7y}{15x^3y^4}$,

Answer ..... [1]

(b) $\left(\frac{4t^2}{v^4}\right)^{-\frac{1}{2}}$.

Answer .....[1]

[June/2016/P12/Q11]

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24. (a) Evaluate $2^3 - 2^0$.

Answer ..... [1]

(b) Simplify $\frac{12xy}{9x^2}$.

Answer ..... [1]

[Nov/2016/P11/Q8]

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25. (a) Evaluate $3^2 + 3^1 + 3^0$.

Answer ..... [1]

(b) Evaluate $\left(\frac{4}{3}\right)^{-2}$.

Answer ..... [1]

(c) Simplify $(16y^6)^{\frac{1}{2}}$.

Answer ..... [1]

[Nov/2016/P12/Q16]

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26. (a) Evaluate

(i) 3^{-2},

Answer ..... [1]

(ii) $125^{\frac{2}{3}}$.

Answer ..... [1]

(b) Simplify $\left(\frac{2a^2b^5}{18a^4b}\right)^{\frac{1}{2}}$.

Answer ..... [2]

[June/2017/P11/Q18]

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27. Find the value of k in each of the following.

(i) $\sqrt{27} = 3^k$

Answer k = ... [1]

(ii) $\left(\frac{1}{4}\right)^{-3} = 2^k$

Answer k = ... [1]

[June/2017/P12/Q20(b)]

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28. (a) Evaluate $9^2 - 9^0$.

Answer ..... [1]

(b) Evaluate $9^{-\frac{1}{2}}$.

Answer ..... [1]

[Nov/2017/P11/Q2]

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29. $a^x = 5$

(a) Find a^{2x}.

Answer ..... [1]

(b) Find a^{-x}.

Answer ..... [1]

[Nov/2017/P12/Q12]

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30. (a) Evaluate $3^3 - 3^0$.

Answer ..... [1]

(b) Simplify completely $\left(\frac{9a^3b^3}{16ba^5}\right)^{\frac{1}{2}}$.

Answer ..... [2]

[June/2018/P11/Q16]

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31. (a) Evaluate $\left(\frac{1}{3}\right)^0 - \left(\frac{1}{3}\right)^2$.

Answer ..... [1]

(b) Simplify $\left(\frac{27}{x^6}\right)^{-\frac{1}{3}}$.

Answer ..... [2]

[Nov/2018/P11/Q14]

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32. (a) Evaluate $9^1 + 9^0$.

Answer ..... [1]

(b) Find n, where $4^n = 2^{n-1}$.

Answer n = ... [2]

[Nov/2018/P12/Q21]

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33. (a) Evaluate.

(i) $36^{\frac{1}{2}}$

..... [1]

(ii) 5^{-2}

..... [1]

(b) $2^2 \times 8^{\frac{5}{3}} = 2^k$

Find the value of k.

k = ... [2]

[June/2019/P11/Q6]

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34. Simplify.

$$\left(\frac{9x^7y}{x^5y^9}\right)^{-\frac{1}{2}}$$

..... [2]

[June/2019/P12/Q20]

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35. (a) Evaluate $3^{-2} \times 3^4$.

..... [1]

(b) Evaluate $3 - 3^0$.

..... [1]

(c) Simplify $y^{\frac{1}{2}} \times 4y^{\frac{1}{4}}$.

..... [1]

[Nov/2019/P11/Q12]

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36. Simplify.

(a) $\left(2x^2\right)^0$

..... [1]

(b) $\left(3x^3\right)^2$

..... [1]

(c) $\left(\frac{8}{x^3}\right)^{-\frac{1}{3}}$

..... [2]

[Nov/2019/P12/Q13]

ANSWERS

Topic 12 - Indices

1. **(a)** $9^1+9^0=9+1=10$

(b) $\left(\frac{1}{9}\right)^{\frac{1}{2}}=\left[\left(\frac{1}{3}\right)^2\right]^{\frac{1}{2}}=\frac{1}{3}$

2. **(a)** $4^0+4^1=1+4=5$

(b) $\left(\frac{1}{4}\right)^{-2}=4^2=16$

3. **(a)** $5^0-5^{-1}=1-\frac{1}{5}=\frac{4}{5}$

(b) $\left(5x^3\right)^2=25x^6$

(c) $\left(\frac{16}{n^{16}}\right)^{\frac{1}{2}}=\left(\left(\frac{4}{n^8}\right)^2\right)^{\frac{1}{2}}=\frac{4}{n^8}$

4. **(a)** $8^{\frac{2}{3}}=(2^3)^{\frac{2}{3}}=4$

(b) $\left(\frac{1}{6}\right)^{-2}=6^2=36$

5. **(a)** $\left(\frac{1}{4}\right)^{-2}=\left(\frac{4}{1}\right)^2=16$

(b) $64^{\frac{2}{3}}=\left(4^3\right)^{\frac{2}{3}}=16$

(c) $\left(\frac{4x^2y^9}{x^4y}\right)^{\frac{1}{2}}$

$=\left(\frac{4y^8}{x^2}\right)^{\frac{1}{2}}=\frac{4^{\frac{1}{2}}\,y^{8\times\frac{1}{2}}}{x^{2\times\frac{1}{2}}}=\frac{2y^4}{x}$

6. **(a)** $(3a^4)^2=9a^8$

(b) $\left(\frac{1}{4}\right)^{-2}=\left(\frac{4}{1}\right)^2=16$

(c) $x^3=27^0 \Rightarrow x^3=1 \Rightarrow x=1$

(d) $\frac{12^{\frac{1}{2}}}{3^{\frac{3}{2}}}=\left(\frac{12}{27}\right)^{\frac{1}{2}}=\left(\frac{4}{9}\right)^{\frac{1}{2}}=\frac{2}{3}$

7. **(a)** $4^0-4^{-2}=1-\frac{1}{4^2}=\frac{15}{16}$

(b) $(2x^2)^3=2^3x^6=8x^6$

8. **(a)** $8^3=(2^3)^3=(2)^9$

(b) $\frac{3^2\times2^{12}-3\times2^{10}}{3\times2^8}$

$=\frac{3\times2^{10}(3\times2^2-1)}{3\times2^8}=2^2(12-1)=44$

9. **(a)** **(i)** $\sqrt{121}=\sqrt{11^2}=11$

(ii) $\sqrt[3]{-27}=\left((-3)^3\right)^{\frac{1}{3}}=-3$

(b) $2^3 \quad 3^2 \quad 4^0 \quad 5^{-1}$

$=8 \quad 9 \quad 1 \quad \frac{1}{5}$

$\therefore \quad 5^{-1} \quad 4^0 \quad 2^3 \quad 3^2$

(c) $16^{\frac{3}{2}}=(4^2)^{\frac{3}{2}}=(4)^3=64$

10. **(a)** **(i)** $5^1+5^0=5+1=6$

(ii) $\left(\frac{4}{3}\right)^{-2}=\left(\frac{3}{4}\right)^2=\frac{9}{16}$

(b) $\left(2x^2\right)^3=8x^6$

11. **(a)** $3^a\div3^4=3^2 \Rightarrow 3^a=3^2\times3^4$

$\therefore \quad a=2+4=6$

(b) $8^b=2 \Rightarrow (2)^{3b}=(2)^1$

$\therefore \quad 3b=1 \Rightarrow b=\frac{1}{3}$

12. **(a)** **(i)** $5^0+5^2=1+25=26$

(ii) $36^{\frac{1}{2}}=6$

(iii) $(2^{\frac{2}{3}})^6=2^4=16$

(b) $\left(\frac{1}{3}\right)^k=9 \Rightarrow (3)^{-k}=3^2 \qquad \therefore k=-2$

13. **(a)** $4^{-2}=\frac{1}{4^2}=\frac{1}{16}$

(b) $\left(\frac{9xy^6}{x^3y^2}\right)^{\frac{1}{2}}=\left(\frac{9y^4}{x^2}\right)^{\frac{1}{2}}=\frac{3y^2}{x}$

14. **(a)** $\frac{3\times(2)^3}{6\times9}=\frac{3\times(2)^3}{2\times3\times3^2}=\frac{4}{9}$

(b) $\left(\frac{3^2}{2}\right)^{-2}=\left(\frac{2}{9}\right)^2=\frac{4}{81}$

15. **(a)** $\left(\frac{5}{3}\right)^{-2}=\left(\frac{3}{5}\right)^2=\frac{9}{25}$

(b) $\left(\frac{9}{t^6}\right)^{\frac{1}{2}}=\left(\frac{(3)^2}{(t^3)^2}\right)^{\frac{1}{2}}=\frac{3}{t^3}$

(c) $\frac{2x^3y}{6xy^2}=\frac{x^2}{3y}$

16. **(a)** **(i)** $\sqrt[3]{216}=(6^3)^{\frac{1}{3}}=6$

(ii) $16^{\frac{1}{2}}-16^0=4-1=3$

(b) $\left(\frac{3a^2b}{12ab^4}\right)^{-2}=\left(\frac{a}{4b^3}\right)^{-2}=\left(\frac{4b^3}{a}\right)^2=\frac{16b^6}{a^2}$

17. **(a)** $3^3\times3\times3^5=3^n$

$\Rightarrow n=3+1+5=9$

(b) $32^{\frac{3}{5}}=(2^5)^{\frac{3}{5}}=2^3=8$

(c) $\left(\frac{1}{5}\right)^{-2}=5^2=25$

18. **(a)** $p^2(p^3-3p^{-2})=p^5-3$

(b) $(27x^6)^{\frac{1}{3}}=\left[(3x^2)^3\right]^{\frac{1}{3}}=3x^2$

19. **(a)** $6^{-x}=\frac{1}{6^x}=\frac{1}{9}$

(b) $6^{\frac{x}{2}}=(6^x)^{\frac{1}{2}}=(9)^{\frac{1}{2}}=\pm3$

(c) $6^0+6^x=1+9=10$

20. **(a)** **(i)** $2^0+2^3=1+8=9$

(ii) $\left(\frac{1}{9}\right)^{\frac{1}{2}}=\frac{1}{3}$

(b) $(4x^2)^{-2}=\left(\frac{1}{4x^2}\right)^2=\frac{1}{16x^4}$

21. **(a)** $9^{-\frac{1}{2}}=(3^2)^{-\frac{1}{2}}=\frac{1}{3}$

(b) $10^3-10^0=1000-1=999$

(c) $x^{\frac{3}{2}}=8$

$\Rightarrow (x^{\frac{3}{2}})^2=(8)^2 \Rightarrow x^3=64 \Rightarrow x=4$

22. **(a)** $\left(\frac{3}{2}\right)^0=1$

(b) $\left(\frac{3}{2}\right)^{-1}=\frac{2}{3}$

(c) $(9x^3)^2=81x^6$

23. **(a)** $\frac{5x^7y}{15x^3y^4}=\frac{x^4}{3y^3}$

(b) $\left(\frac{4t^2}{v^4}\right)^{-\frac{1}{2}}=\left(\frac{v^4}{4t^2}\right)^{\frac{1}{2}}=\frac{v^2}{2t}$

24. **(a)** $2^3-2^0=8-1=7$

(b) $\frac{12xy}{9x^2}=\frac{4y}{3x}$

25. **(a)** $3^2+3^1+3^0=9+3+1=13$

(b) $\left(\frac{4}{3}\right)^{-2}=\left(\frac{3}{4}\right)^2=\frac{9}{16}$

(c) $(16y^6)^{\frac{1}{2}}=(4^2)^{\frac{1}{2}}\,(y^6)^{\frac{1}{2}}=4y^3$

26. **(a)** **(i)** $3^{-2}=\frac{1}{9}$

(ii) $125^{\frac{2}{3}}=(5^3)^{\frac{2}{3}}=25$

(b) $\left(\frac{2a^2b^5}{18a^4b}\right)^{\frac{1}{2}}=\left(\frac{b^4}{9a^2}\right)^{\frac{1}{2}}=\frac{b^2}{3a}$

27. **(i)** $\sqrt{27}=3^k \Rightarrow \left(3^3\right)^{\frac{1}{2}}=3^k \Rightarrow k=\frac{3}{2}$

(ii) $\left(\frac{1}{4}\right)^{-3}=2^k$

$\Rightarrow (4)^3=2^k \Rightarrow (2^2)^3=2^k \Rightarrow k=6$

28. **(a)** $9^2 - 9^0 = 81 - 1 = 80$

(b) $9^{-\frac{1}{2}} = \left(\frac{1}{9}\right)^{\frac{1}{2}} = \pm\frac{1}{3}$

29. **(a)** $a^x = 5$

$\Rightarrow a^{2x} = 5^2 \Rightarrow a^{2x} = 25$

(b) $a^x = 5 \Rightarrow a^{-x} = 5^{-1} \Rightarrow a^{-x} = \frac{1}{5}$

30. **(a)** $3^3 - 3^0 = 27 - 1 = 26$

(b) $\left(\frac{9a^3b^3}{16ba^5}\right)^{\frac{1}{2}} = \left(\frac{9b^2}{16a^2}\right)^{\frac{1}{2}} = \frac{3b}{4a}$

31. **(a)** $\left(\frac{1}{3}\right)^0 - \left(\frac{1}{3}\right)^2 = 1 - \frac{1}{9} = \frac{8}{9}$

(b) $\left(\frac{27}{x^6}\right)^{-\frac{1}{3}} = \left(\frac{x^6}{27}\right)^{\frac{1}{3}} = \frac{x^2}{3}$

32. **(a)** $9^1 + 9^0 = 9 + 1 = 10$

(b) $4^n = 2^{n-1} \Rightarrow 2^{2n} = 2^{n-1}$

$\therefore\ 2n = n - 1 \Rightarrow n = -1$

33. **(a)** **(i)** $36^{\frac{1}{2}} = 6$ **(ii)** $5^{-2} = \frac{1}{25}$

(b) $2^2 \times 8^{\frac{5}{3}} = 2^k \Rightarrow 2^2 \times (2^3)^{\frac{5}{3}} = 2^k$

$\therefore\ k = 5 + 2 = 7$

34. $\left(\frac{9x^7y}{x^5y^9}\right)^{-\frac{1}{2}}$

$= \left(\frac{x^5y^9}{9x^7y}\right)^{\frac{1}{2}} = \left(\frac{y^8}{9x^2}\right)^{\frac{1}{2}} = \frac{y^4}{3x}$

35. **(a)** $3^{-2} \times 3^4 = 3^2 = 9$

(b) $3 - 3^0 = 2$

(c) $y^{\frac{1}{2}} \times 4y^{\frac{1}{4}} = 4y^{\frac{3}{4}}$

36. **(a)** $(2x^2)^0 = 1$

(b) $\left(3x^3\right)^2 = 9x^6$

(c) $\left(\frac{8}{x^3}\right)^{-\frac{1}{3}} = \left(\frac{x^3}{8}\right)^{\frac{1}{3}} = \frac{x}{2}$