

Topical Worksheet : Indices

Secondary 3 Mathematics

BASIC

1. Evaluate the following without using a calculator.

(a) $(4^5 + 7^9)^0$

(b) $6^8 \times 6^7 \div 6^{13}$

(c) $2^{15} \times 2^5 \div (4)^8$

(d) $(3^2)^2$

(e) $(5^0 + 5^1) \times 5^2$

(f) $(2^3)^2 + (2^3 \times 2^2)$

(g) $9^{\frac{1}{2}} + 9^2 + 9^{-1}$

(h) $27^{\frac{2}{3}}$

2. Evaluate the following without using a calculator.

(a) $16^{10} \times 16^{-8} \div \sqrt{16}$

(b) $5^{\frac{5}{2}} \times 5^2 \div 5^{\frac{3}{2}}$

(c) $25^{\frac{3}{2}}$

(d) $(\sqrt{64})^{\frac{2}{3}}$

(e) $2^{-1} - 2^{-2} + 2^{-3}$

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

(g) $(-3)^2 + 3^{-2}$

(h) $\left(8^{\frac{2}{3}}\right)^{-2}$

3. Simplify the following and express your answers with positive indices.

(a) $(3x^4)^2$

(b) $5x^3 \times 3x^2$

(c) $24y^3 \div 8y^2$

(d) $(3x^5)^0$

(e) $\left(a^{\frac{2}{3}}\right)^6$

(f) $\left(\frac{z^8}{z^2}\right)^{\frac{1}{3}}$

(g) w^{-4}

(h) $(c^4)^{-2}$

4. Simplify the following and express your answers with positive indices.

(a) $15x^3y \div 3xy^4$

(b) $(p^2)^{-1} \times (q^3)^2$

(c) $\sqrt[3]{27s^6t^9}$

(d) $(3x^3y^2)^2 \times x^2y^4$

(e) $(2a^4b^{-3})^2(a^{-1}b)^5$

(f) $\frac{(n^2)^2}{m^6 \times n^7}$

(g) $\frac{6p^4 \times 7q^3}{14q^6 \times 3p^2}$

(h) $\left(\frac{x^4}{9y^6}\right)^{\frac{1}{2}}$

5. Solve the following equations.

(a) $6^x = 1$

(b) $3^x = 27$

(c) $2^x = \frac{1}{16}$

(d) $4^x = 2^{15}$

(e) $5^x = 25^{-8}$

(f) $\sqrt{7^x} = 49$

6. Solve the following equation.

(a) $3^{4x} = 9^{12}$

(b) $6^{2-x} = 36^4$

(c) $5^2 \times 5^{2x} = 5^2$

(d) $2^x \div 32 = 2^{-x}$

(e) $\sqrt[x]{7^2} = 7^6$

(f) $4^x - 1 = 0$

7. Express each of the following in standard form correct to 3 significant figures.

(a) 3245

(b) 6 782 450

(c) $0.034\ 63 \times 10^7$

(d) $279\ 825 \div 10^2$

(e) 0.006 752

(f) 0.000 046 4

(g) $0.034\ 63 \times 10^{-5}$

(h) $4295 \div 10^{-8}$

8. Express each of the following as an integer or a decimal.

(a) 2.556×10^4

(b) 1.245×10^6

(c) 3.774×10^2

(d) $0.024\ 5 \times 10^7$

(e) 6.583×10^{-3}

(f) 5.378×10^{-5}

(g) 145.8×10^{-6}

(h) 0.034×10^{-1}

9. Evaluate the following without using a calculator and express your answers in standard form.

(a) $(3.2 \times 10^2) \times (2.4 \times 10^7)$

(b) $(5.5 \times 10^{-6}) \times (4.8 \times 10^3)$

(c) $(7.6 \times 10^7) \div (1.9 \times 10^4)$

(d) $(2.5 \times 10^5) \div (5 \times 10^{-1})$

(e) $2.4 \times 10^6 + 3.6 \times 10^5$

(f) $2.1 \times 10^6 - 7.2 \times 10^4$

(g) $3.35 \times 10^{-3} - 4.46 \times 10^{-4}$

(h) $8.5 \times 10^{-4} + 2.1 \times 10^{-2}$

10. Given that $x = 7.5 \times 10^2$ and $y = 2.5 \times 10^{-2}$, find the value of each of the following in standard form correct to 3 significant figures.

(a) xy

(b) x^3y^4

(c) $\frac{x}{y}$

(d) $\frac{x^5}{y^2}$

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

(f) $y^{-2} - x$

INTERMEDIATE

11. Evaluate the following without using a calculator.

(a) $(-2)^{3r+1} + 2(-2)^{3r}$

(b) $\sqrt[3]{-27} \times \left(-\frac{3}{2}\right)^{-1} + 9^{\frac{3}{2}}$

(c) $8^{\frac{4}{3}} + \left(1\frac{9}{16}\right)^{-\frac{1}{2}} - 5^0$

(d) $27^{\frac{2}{3}} \times \left(\frac{32^2}{2^2 \times 4^3}\right) - (-3)^2$

12. Solve the following equations.

(a) $5^{x-1} - 25^{x+4} = 0$

(b) $3^{\frac{2}{3}} = 9x^{\frac{2}{3}}$

(c) $2^{2x+1} \times 8^{-x} = 4^{-1}$

(d) $2^x = \frac{32}{\frac{3x}{4^2}}$

(e) $\sqrt[3]{5^{2(x-4)}} = \left(\frac{1}{25}\right)^x$

13. Simplify the following and express your answers with positive indices.

(a) $\frac{2^4q^{-2}}{3r} \div \left(\frac{2}{3qr^2}\right)^3$

(b) $\frac{(x+\sqrt{x})(x-\sqrt{x})}{(\sqrt{x})^8 - x^2}$

(c) $\frac{(yw)^{-4}}{y^2}$

(d) $(-2p^3q^{-2})^4(-p^{-2}q^2)^3$

$$(e) \frac{(-x)^2 y^{-\frac{2}{5}}}{4x} \div \frac{x^{-3}}{8y^{-\frac{3}{5}}}$$

14. (a) Find the positive value of x if $(20)(4x)^{-2} = \frac{1}{5}$.

(b) Show that $2^{2m+3} + 4^m$ is a multiple of 3 for all positive values of m .

15. (a) Solve for w if $4(3^w) = 9^2 + 9^{\frac{w}{2}} - 2(3^{w+1})$.

(b)(i) Show that the expression $\left(\frac{(w^2)^{(-m+1)}\sqrt{w}}{3\sqrt{w-4m}}\right)^2$ does not depend on m .

(ii) Hence, evaluate $\left(\frac{(w^2)^{(-m+1)}\sqrt{w}}{3\sqrt{w-4m}}\right)^2$ when w is 6.

16. (a) Simplify $\sqrt[4]{m\left(\sqrt[3]{m(\sqrt{m})}\right)}$ expressing your answer in positive index notation.

(b) Hence, evaluate y^4 if $y = \sqrt[4]{m\left(\sqrt[3]{m(\sqrt{m})}\right)}$ and $m = 100$.

17. (a) Simplify $(-3a)^2 + (-3a)^{-2} \times (-3a^{-2})$.

(b) Solve for x if $5x^{-\frac{3}{2}} = 320$.

18. Evaluate the following without using a calculator.

(a) $\left(\frac{100}{81}\right)^{-\frac{1}{2}} \div \left(\frac{3^{-2}}{5}\right)^{-1}$

(b) $\sqrt{2.25} + \left(\frac{8}{125}\right)^{-\frac{2}{3}}$

19. The speed of sound is estimated to be 1188km /h. The maximum speed of a fighter jet is 3.5 times the speed of sound.

(a) Find the maximum speed of the fighter jet. Give your answer in standard form.

(b) Convert the maximum speed of the fighter jet to m/s. Give your answer in standard form.

20. The equatorial radius of the Earth is 6370km. Calculate, the distance in km, that an orbiting satellite will cover when it travels 100 rounds around the equator at an altitude of 180km. Give your answer in standard form correct to 3 significant figures.

Answers:

1. (a) 1 (b) 36 (c) 16 (d) 81
 (e) 150 (f) 96 (g) $84\frac{1}{9}$ (h) 9
2. (a) 64 (b) 125 (c) 125 (d) 4
 (e) $\frac{3}{8}$ (f) $3\frac{3}{8}$ (g) $9\frac{1}{9}$ (h) $\frac{1}{16}$
3. (a) $9x^8$ (b) $15x^5$ (c) $3y$ (d) 1
 (e) a^4 (f) z^2 (g) $\frac{1}{w^4}$ (h) $\frac{1}{c^8}$
4. (a) $\frac{5x^2}{y^3}$ (b) $\frac{q^6}{p^2}$ (c) $3s^2t^3$ (d) 1
 (e) $\frac{4a^3}{b}$ (f) $\frac{1}{m^6n^3}$ (g) $\frac{p^2}{q^3}$ (h) $\frac{x^2}{3y^3}$
5. (a) $x = 0$ (b) $x = 3$ (c) $x = -4$
 (d) $x = 7\frac{1}{2}$ (e) $x = -16$ (f) $x = 4$
6. (a) $x = 6$ (b) $x = -6$ (c) $x = 0$
 (d) $x = 2\frac{1}{2}$ (e) $x = \frac{1}{3}$ (f) $x = 0$
7. (a) 3.25×10^3 (b) 6.78×10^6 (c) 3.46×10^5
 (d) 2.80×10^3 (e) 6.75×10^{-3} (f) 4.64×10^{-5}
 (g) 3.46×10^{-7} (h) 4.30×10^{11}
8. (a) 25 260 (b) 1 245 000 (c) 377.4
 (d) 245 000 (e) 0.006 583 (f) 0.000 053 78
 (g) 0.000 145 8 (h) 0.0034
9. (a) 7.68×10^9 (b) 2.64×10^{-2} (c) 4×10^3
 (d) 5×10^5 (e) 2.76×10^6 (f) 2.028×10^6
 (g) 2.904×10^{-3} (h) 2.185×10^{-2}
10. (a) 1.88×10^1 (b) 1.65×10^2 (c) 3.00×10^4
 (d) 3.80×10^{17} (e) 4.60×10^3 (f) 8.50×10^2
11. (a) 0 (b) 29 (c) $15\frac{4}{5}$ (d) 27
12. (a) $x = -9$ (b) $x = \frac{1}{9}$ (c) $x = 3$
 (d) $x = 1\frac{1}{4}$
13. (a) $18qr^5$ (b) $\frac{1}{x(x+1)}$ (c) $\frac{1}{w^4y^6}$
 (d) $-\frac{16p^6}{q^2}$ (e) $\frac{2x^4}{y}$
14. (a) $2\frac{1}{2}$
15. (a) $w = 2$ (b)(ii) 864
16. (a) $m^{\frac{3}{8}}$ (b) 1000
17. (a) $9a^2 - \frac{1}{3a^4}$ (b) $\frac{1}{16}$
18. (a) $\frac{1}{50}$ (b) 7.75
19. (a) 4.158×10^3 km/h (b) 1.155×10^3 m/s
20. 4.12×10^6 km