

Section 1: Simplify Powers (1-20)

$$1. 6^3 \times 6^5$$

$$6^3 \times 6^5$$

$$= 6^{3+5}$$

$$= 6^8 \text{ (Because } A^m \times A^n = A^{m+n})$$

$$2. 10^9 \times 10^1 = 10^{10}$$

$$10^9 \times 10^1$$

$$= 10^{9+1}$$

$$= 10^{10} \text{ (Because } A^m \times A^n = A^{m+n})$$

$$3. y^7 \times y^2 = y^9 \text{ (Because } A^m \times A^n = A^{m+n})$$

$$y^7 \times y^2$$

$$= y^{7+2}$$

$$= y^9 \text{ (Because } A^m \times A^n = A^{m+n})$$

(use small letters
for variables)

$$4 \cdot 2^4 \times 2^{-1}$$

$$2^4 \times 2^{-1}$$

$$= 2^{4+(-1)}$$

$$= 2^{4-1}$$

$$= 2^3 \quad (\text{Because } A^m \times A^{-n} = A^{m+n} = A^{m-n})$$

$$5. (-3)^2 \times (-3)^3$$

$$-3^2 \times -3^3$$

$$-3^{\frac{1}{2}} \times 3^{\frac{1}{3}}$$

$$-\frac{1}{3^2} \times 3^3$$

$$-\frac{1}{3^5}$$

$$= 3^{-5} \quad (\text{Because } \frac{1}{x^n} = x^{-n})$$

$$= a \times a$$

$$= (-3) \times (-3)$$

$$= 9$$

$$a^{-n} = \frac{1}{a^n}; \quad a^{\frac{1}{n}} \neq -a^{\frac{1}{n}}$$

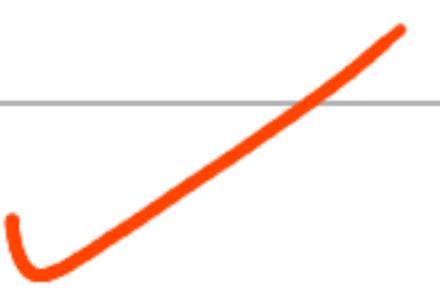
(you can write
 $a^m \times a^n = a^{m+n}$, $m, n \in \mathbb{Z}$
can be true/
-ve)

Don't
remove
brackets!

$$6. \frac{8^7}{8^4}$$

$$\frac{8^7}{8^4} = 8^{7-4}$$

$$= 8^3 \quad (\text{Because } \frac{A^m}{A^n} = A^{m-n})$$



$$7. \frac{x^{10}}{x^3}$$

$$\frac{x^{10}}{x^3} = x^{10-3}$$

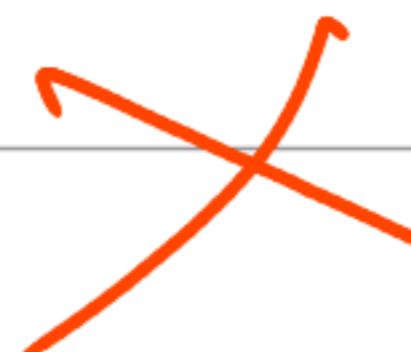
$$= x^7 \quad (\text{Because } \frac{A^m}{A^n} = A^{m-n})$$



$$8. \frac{5^3}{5^5} \quad \times$$

$$\frac{5^3}{5^5} = 5^{3-5}$$

$$\frac{5^2}{5^5}$$



$$= 5^{-2} \quad (\text{Because } \frac{A^m}{A^n} = A^{m-n})$$

$$9. \frac{11^2}{11^0} \quad \times \quad \frac{11^0}{11^2}$$

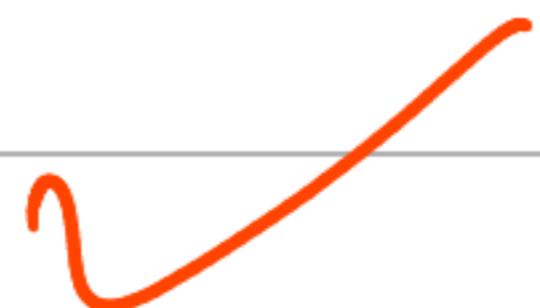
$$\frac{11^2}{11^0}$$
$$= 11^2 - 0$$

$$= 11^2 \text{ (Because } x^0 = 1)$$

$$10. \frac{q^4}{q^4}$$
$$\frac{q^4}{q^4}$$
$$= q^{4-4}$$

$$= q^0$$

$$= 1 \left(\begin{array}{l} 1. \text{ Because } \\ 2. x^0 = 1 \end{array} \right) \quad \frac{A^m}{A^n} = A^{m-n}$$



$$11. (2^3)^5$$

$$= (2^3)^5$$

$$= 2^{3 \times 5}$$

$$= 2^{15} \quad (\text{Because } (x^y)^z = x^{yz}) \quad \checkmark$$

$$\begin{aligned} 12. \quad & (4^{-2})^3 \\ & (4^{-2})^3 \end{aligned}$$

$$= 4^{-2 \times 3}$$

$$= 4^{-6} \quad (\text{Because } (x^y)^z = x^{yz}) \quad \checkmark$$

$$13. \cdot (a^6)^0$$

$$= (a^6)^0$$

$$= a^{6 \times 0}$$

$$= a^0$$

$$= 1 \quad (\text{Because } (x^y)^z = x^{yz}) \quad \checkmark$$

only if $a \neq 0$

$$14. ((-7)^3)^2$$

$$(-7^3)^2$$

$$= \left(\frac{1}{7^3}\right)^2$$

$$= (7^{-3})^2$$

$$= -343^2$$

$$= \frac{1}{54721} \cdot \left(A^{-b} = \frac{1}{A^b}\right)$$

$$\begin{aligned}((-7)^3)^2 &= (-7)^{3 \times 2} \\&= (-7)^6\end{aligned}$$

$$= (-1 \times 7)^6 = (-1)^6 \times 7^6$$

$$= 1 \times 7^6 = 7^6$$

$$15. (10^{1/2})^4$$

$$(10^{1/2})^4$$

$$= 10^{\frac{1}{2} \times 4} = 10^2 = 100$$

$$= (\sqrt[2]{10})^4$$

$$= (\sqrt[4]{10})^4 \quad (\text{Because } A^{\frac{1}{n}} = \sqrt[n]{A}, \text{ and } \sqrt[2]{A} = \sqrt{A})$$

$$16. (3x5)^3$$

$$(3x5)^3$$

$$= 3^3 \times 5^3 \text{ (Because } (A \times B)^n = A^n \times B^n)$$

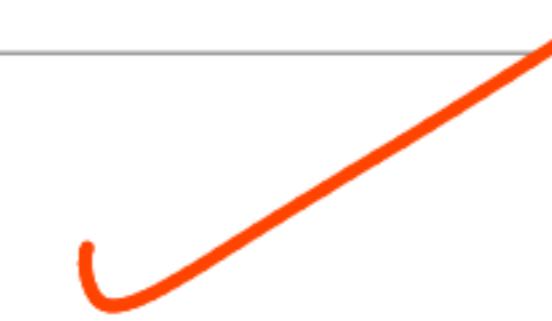


$$17. (4a)^2$$

$$(4a)^2$$

$$= (4 \times a)^2$$

$$= 4^2 \times a^2 \text{ (Because } (A \times B)^n = A^n \times B^n)$$



$$18. (x^2y^3)^4$$

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

$$= (x^2 \times y^3)^4 \text{ (Because } xy \approx x \times y) = (x^2)^4 \times (y^3)^4 \\ = x^8 \times y^{12}$$

$$19. 9^0$$

$$9^0$$

$$= 1 \text{ (Because } x^0 = 1)$$



$$20. 7^{-3}$$

$$7^{-3}$$

$$= \frac{1}{7^3} \text{ (Because } x^{-y} = \frac{1}{x^y})$$



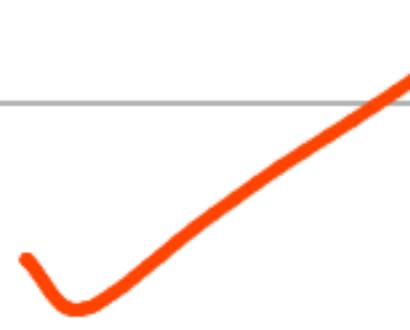
Section 2: Find the actual answer (21-35):

21. 4^3

= $4 \times 4 \times 4$

= 16×4

= 64



22. 1^9

= $1 \times 1 \times 1$

= 1



23. 10^5

= $10 \times 10 \times 10 \times 10 \times 10$

= 100000



$$24. (-2)^4$$

$$= -2^4 \quad \times$$

$$\cancel{= (-2) \times (-2) \times (-2) \times (-2)}$$

$$= 8 \quad \times$$

$$25. \frac{6^5}{6^3}$$

$$= 6^{5-3}$$

$$= 6^2$$

$$\cancel{\geq 3^6} \left(\frac{n^m}{n^n} = n^{m-n} \right)$$

$$(-2)^4 \neq -2^4$$

↓ ↓
 16 -16

$$26. \frac{3^2}{3^4}$$

$$\cancel{\frac{3^2}{3^4}} = \cancel{3^{2-4}} = 3^{-2} = 0.03 \left(\frac{n^m}{n^n} = n^{m-n} \right) \quad \times$$

$$3^{-2} = \frac{1}{3^2} = \frac{1}{9} = 0.\bar{1}$$

$$27. 5^{-2}$$

$$5^{-2}$$

$$= \frac{1}{5^2}$$

$$= \frac{1}{25}$$

$$= 0.04$$

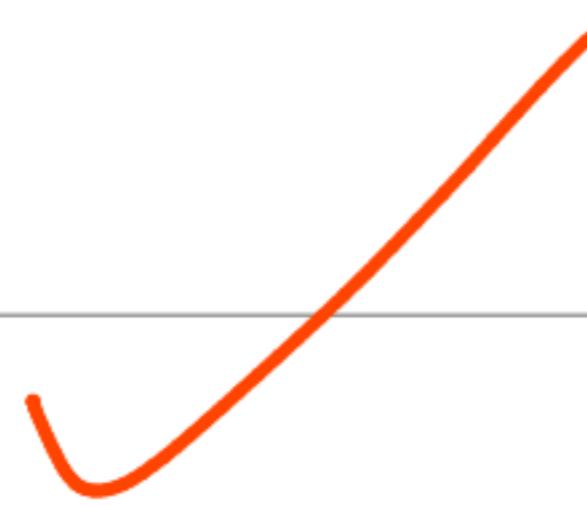


$$28. 2^3 \times 2^1$$

$$2^3 \times 2^1$$

$$= 2^{3+1}$$

$$= 2^4$$



$$= 16 \text{ (Because } A^m \times A^n = A^{m+n})$$

$$29. \sqrt{49}$$

$$\sqrt{49}$$

$$= \sqrt{7 \times 7}$$

$$= 7$$

$$30. \sqrt[3]{27}$$

$$= \sqrt[3]{3 \times 3 \times 3}$$

$$= 3$$

$$31. \sqrt[4]{81}$$

$$\sqrt[4]{81}$$

$$= \sqrt[4]{3 \times 3 \times 3 \times 3}$$

$$= 3$$

$$32. \sqrt{100} + \sqrt[3]{1}$$

$$= \sqrt{10 \times 10} + \sqrt[3]{1 \times 1 \times 1}$$

$$= 10 + 1$$

$$= 11$$

✓

$$33. 4^{\frac{1}{2}}$$

$$4^{\frac{1}{2}}$$

$$= \sqrt[2]{4}$$

$$= \sqrt{4}$$

✓

$$= \sqrt{2 \times 2}$$

$$= 2 \quad (\text{Because } m^{\frac{1}{n}} = \sqrt[n]{m})$$

$$34. \ 8^{\frac{1}{3}}$$

$$8^{\frac{1}{3}}$$

$$= \sqrt[3]{8}$$

$$= \sqrt[3]{2 \times 2 \times 2}$$

$$= 2$$

$$35. 25^{\frac{3}{2}}$$

$$25^{\frac{3}{2}}$$

$$= (25^{\frac{1}{2}})^3$$

$$= (\sqrt{25})^3$$

$$= 5^3$$

$$= 125$$

Section 3: write as a fractional exponent, or radical (36-50):

$$36. \sqrt[3]{s^2}$$

$$\sqrt[3]{s^2} = (s^2)^{\frac{1}{3}} = s^{2/3}$$

$$37. \sqrt{a^7}$$

$$\sqrt{a^7} = (a^7)^{\frac{1}{2}} = a^{7/2}$$

$$38. \sqrt[5]{12}$$

$$\sqrt[5]{12} = 12^{\frac{1}{5}}$$

$$39. \sqrt[4]{x}$$

$$\sqrt[4]{x} = x^{\frac{1}{4}}$$

$$40. \ y^{\frac{1}{5}}$$

$$y^{\frac{1}{5}}$$

$$= \sqrt[5]{5}$$

$$41. \ 10^{\frac{1}{2}}$$

$$10^{\frac{1}{2}}$$

$$= \sqrt{10}$$

$$42. \ 7^{\frac{3}{4}}$$

$$7^{\frac{3}{4}}$$

$$= (7^{\frac{1}{4}})^3$$

$$= (\sqrt[4]{7})^3 = \sqrt[4]{7^3} = \sqrt[4]{343}$$

$$43. \ z^{\frac{5}{3}}$$

$$z^{\frac{5}{3}} = (z^{\frac{1}{3}})^5 = (\sqrt[3]{z})^5$$

$$= z^{5/3} = z^{5 \times \frac{1}{3}} = (z^5)^{\frac{1}{3}} \\ = \sqrt[3]{z^5}$$

$$44. \sqrt[5]{-32}$$

$$\sqrt[5]{-32}$$

$$= \sqrt[5]{-2 \times -2 \times -2 \times -2 \times -2}$$

$$= -2 \quad \checkmark$$

$$45. x^{1/2} x x^{1/2} = x^{\frac{1}{2} + \frac{1}{2}}$$

$$= \sqrt{x} x \sqrt{x} = x^1 = x$$

$$= \sqrt{x \times x} = x$$

$$46. \frac{y^2}{\sqrt{y^2}} = y^{2 - \frac{1}{2}}$$

$$= \frac{y^2}{y^{\frac{1}{2}}} = y^{2 - \frac{1}{2}}$$

$$\begin{aligned} &= y^{2 - \frac{1}{2}} \\ &= y^{\frac{3}{2}} \\ &= \sqrt{y^3} \\ &= \cancel{\sqrt{y}} \cancel{\times 2} \\ &= 4 \end{aligned}$$

$$\sqrt{-16} \neq -2$$

$\sqrt{25} \neq -5$; These are not real numbers!

$$x^2 = -25$$

$$\text{Let } x \geq 0 \Rightarrow x^2 \geq 0$$

$$x < 0 \Rightarrow x^2 > 0$$

So, x can't be \pm Real
(They are imaginary)

$$\sqrt{-25} = 5i, \quad (\text{since } i^2 = -1)$$

$$\sqrt{-25} = \sqrt{25 \times -1}$$

$$= \sqrt{25} \times \sqrt{-1}$$

$$\sqrt{25} = \pm 5 \quad \stackrel{= \pm 5i}{\cancel{= 5}}$$

$$47. \sqrt{\frac{1}{9}} = \sqrt{\frac{1}{3 \times 3}}$$

$$\sqrt{\frac{1}{9}} = \sqrt{\left(\frac{1}{3}\right) \times \left(\frac{1}{3}\right)}$$

$$48. \sqrt[3]{64} = \sqrt[3]{\frac{1}{3}}$$

$$\sqrt[3]{64}$$

$$= \sqrt[3]{4 \times 4 \times 4}$$

$$= 4$$

$$49. \sqrt{121}$$

$$\sqrt{121}$$

$$= \sqrt{11 \times 11}$$

$$= 11$$

$$50. (2^2)^{\frac{1}{2}} = 4^{\frac{1}{2}} = \sqrt{4} = \sqrt{2 \times 2} = 2$$

$$\left| \begin{array}{l} 2 - \frac{1}{2} \\ = \frac{2}{1} \times \frac{2}{2} - \frac{1}{2} \times \frac{1}{1} \\ = \frac{4}{2} - \frac{1}{2} = \frac{3}{2} \end{array} \right.$$

$$\frac{2 \times \frac{1}{2}}{2} = \frac{1}{2} = 2$$

