

Section 1: simplify powers (1-20)

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

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

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

(use small letters
for variables)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$= 3^{-5} \text{ (because } \frac{1}{x^m} = x^{-m} \text{)}$$

$$a^2$$

$$= a \times a$$

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

$$= 9$$

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

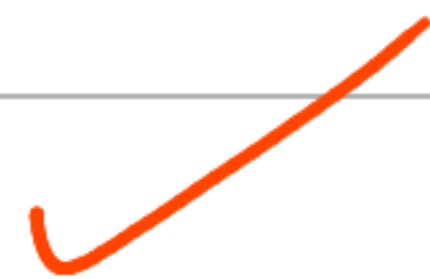
Don't
remove
brackets!

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

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

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

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

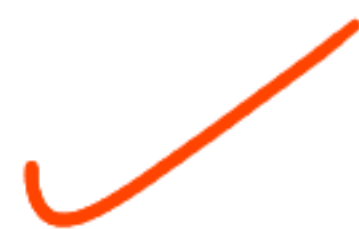


$$7. \frac{x^{10}}{x^3}$$

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

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

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



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

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

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

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

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



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

~~$$\frac{11^0}{11^2}$$~~

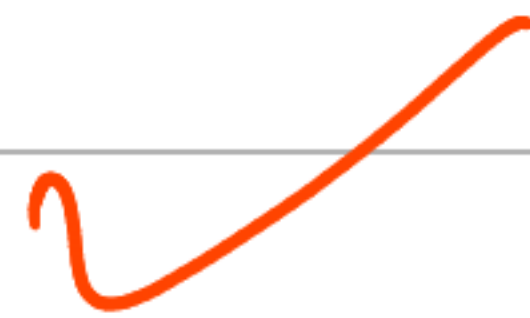
$$= 11^2 - 0$$

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

$$10. \frac{9^4}{9^4}$$

$$= 9^4 - 4$$

$$= 9^0$$



$$= 1 \text{ (1. because } \frac{A^m}{A^n} = A^{m-n} \text{)} \\ \text{2. } x^0 = 1$$

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

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

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

$$= 2^{19} \text{ (Because } (x^y)^z = x^{y \times z} \text{)} \quad \checkmark$$

$$12. (4^{-2})^3$$
$$(4^{-2})^3$$

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

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

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

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

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

$$= a^0$$

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

only if $a \neq 0$

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

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

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

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

$$= -343^2$$

X

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

$$= (-7)^6$$

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

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

$$= \frac{1}{54721} \left(A^{-6} = \frac{1}{A^6} \right)$$

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

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

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

$$= 10^2 = 100$$

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

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

16. $(3 \times 5)^3$

$$(3 \times 5)^3$$

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

17. $(4a)^2$

$$(4a)^2$$

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

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

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

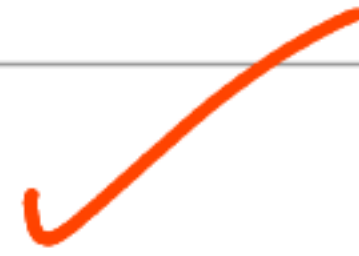
$$(x^2 y^3)^4$$

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

$$19. 9^0$$

$$9^0$$

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



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

$$7^{-3}$$

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



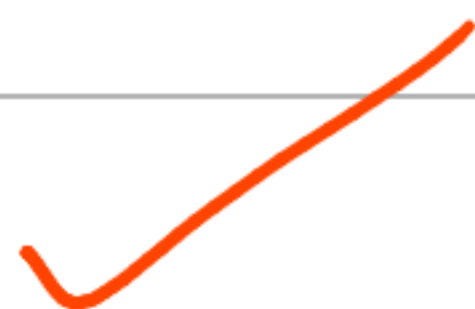
Section 2: Find the actual answer (21-35):

$$21. 4^3$$

$$= 4 \times 4 \times 4$$

$$= 16 \times 4$$

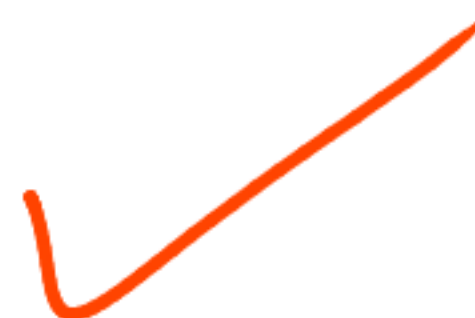
$$= 64$$



$$22. 1^9$$

$$= 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1$$

$$= 1$$



$$23. 10^5$$

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

$$= 100000$$



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

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

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

$$= 8 \quad \times$$

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

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

$$= 6^2$$

$$= 36 \quad \left(\frac{n^m}{n^x} = n^{m-n} \right)$$

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

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

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

$$\downarrow$$

$$16$$

$$\downarrow$$

$$-16$$

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

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

$$5^{-2}$$

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

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

$$= 0.04$$

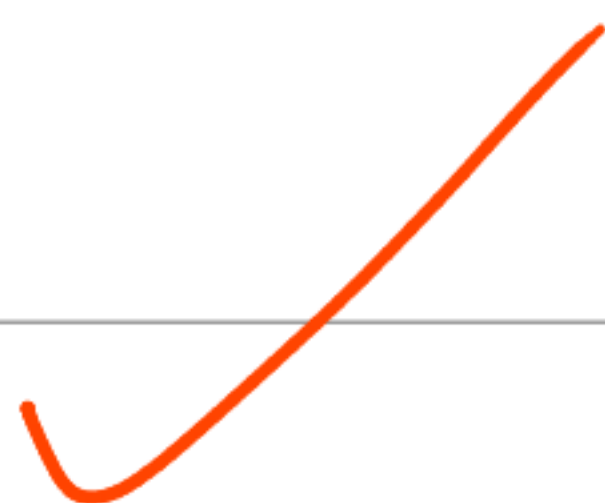


$$28. 2^3 \times 2^1$$

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

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

$$= 2^4$$



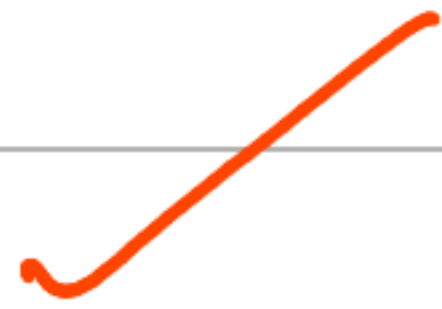
$$= 16 \text{ (Because } A^m \times A^n = A^{m+n} \text{)}$$

$$29. \sqrt{49}$$

$$\sqrt{49}$$

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

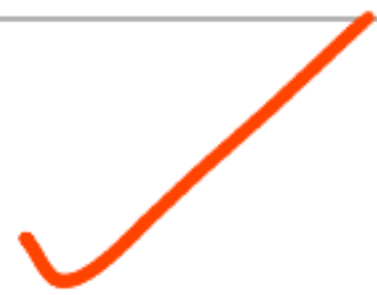
$$= 7$$



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

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

$$= 3$$



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



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

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

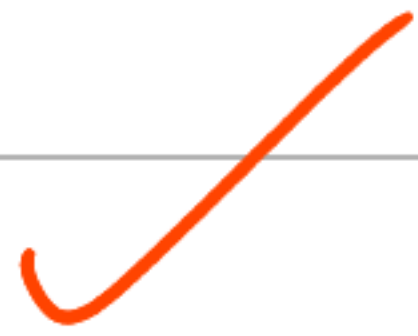
$$= 3$$

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

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

$$= 10 + 1$$

$$= 11$$

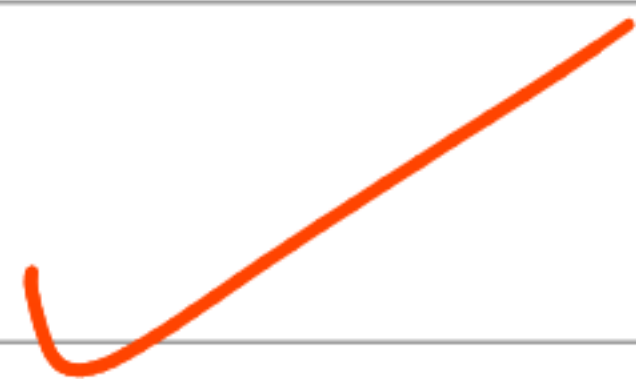


$$33. 4^{\frac{1}{2}}$$

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

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

$$= \sqrt{4}$$



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

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

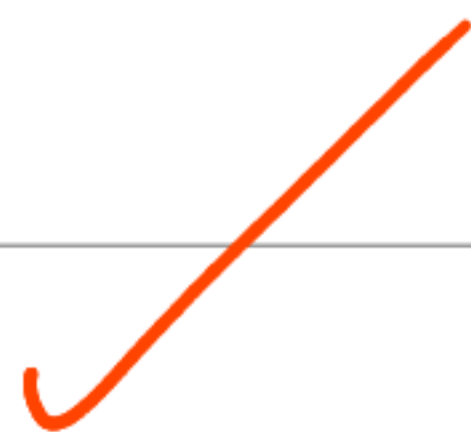
$$34. 8^{\frac{1}{3}}$$

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

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

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

$$= 2$$



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

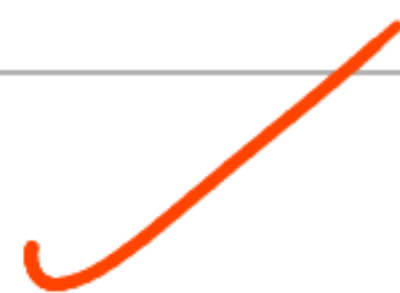
$$25^{\frac{3}{2}}$$

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

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

$$= 5^3$$

$$= 125$$



Section 3: write as a fractional exponent, or radical (36-507:

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. $\sqrt[4]{x}$

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

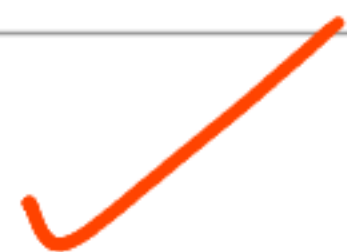
$$= x^{\frac{1}{4}}$$



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

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

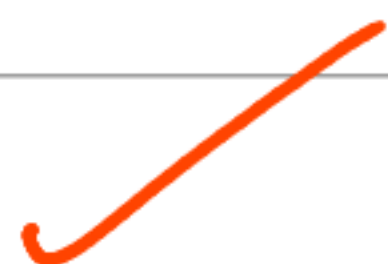
$$= \sqrt[5]{y}$$



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

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

$$= \sqrt{10}$$



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

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

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

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

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

$$= \sqrt[4]{343}$$

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

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

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

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

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

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

$$= -2$$

$$45. x^{1/2} \times x^{1/2}$$

$$= x^{1/2 + 1/2}$$

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

$$= x^1 = x$$

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

$$46. y^2$$

$$\frac{y^2}{y^{1/2}}$$

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

$$= y$$

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

$$= y^{\frac{4}{2} - \frac{1}{2}} = y^{3/2}$$

$$= \sqrt{y^3}$$

$$= \frac{y \times y}{\sqrt{y}}$$

$$= 1 \times 2$$

$$= 4$$

$$\sqrt[4]{-16} \neq -2$$

$\sqrt{-25} \neq -5$; 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)

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

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

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

$$= \pm 5i$$

$$\sqrt{25} = \pm 5$$

$$47. \sqrt{\frac{1}{9}}$$

$$= \sqrt{\frac{1}{3 \times 3}}$$

$$\sqrt{\frac{1}{9}}$$

$$= \sqrt{0.111}$$

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

$$= \frac{1}{3}$$

$$48. \sqrt[3]{64}$$

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

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

$$= 4$$

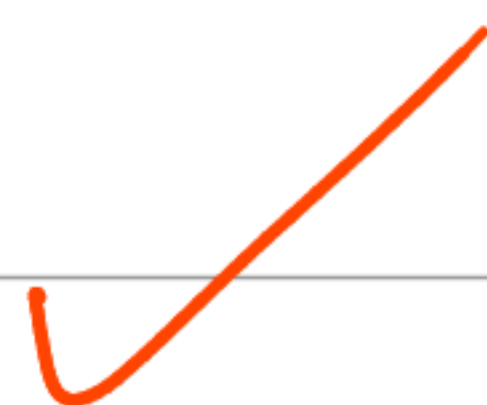


$$49. \sqrt{121}$$

$$\sqrt{121}$$

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

$$= 11$$



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



$$\underline{\underline{2 - \frac{1}{2}}}$$

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

$$= 2 \frac{4}{2} - \frac{1}{2} = \frac{3}{2}$$

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

