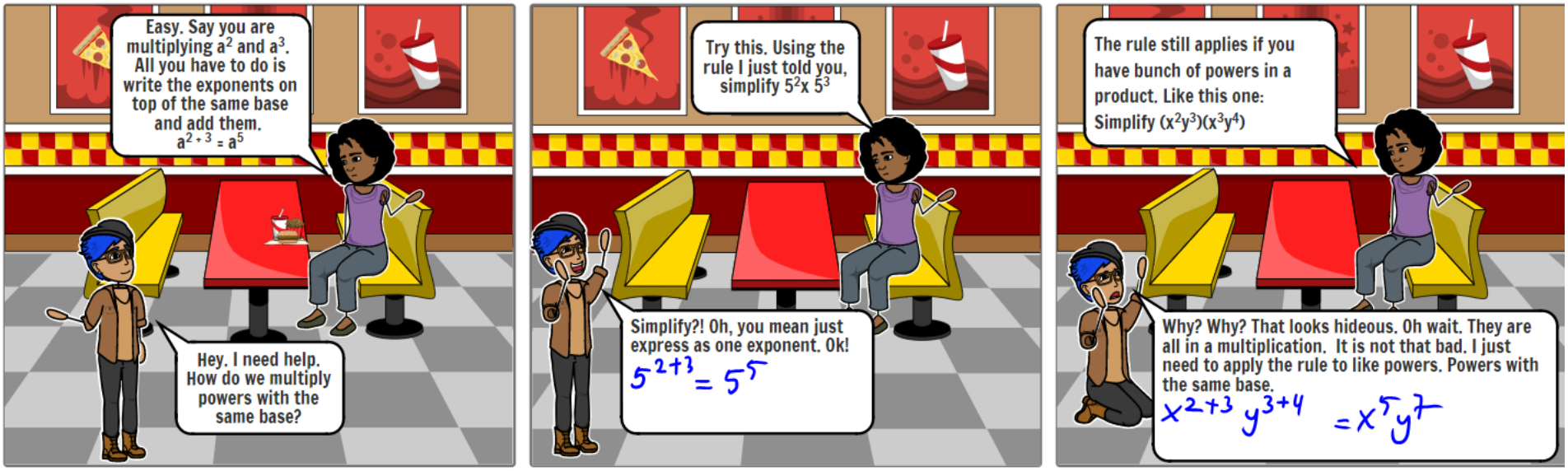
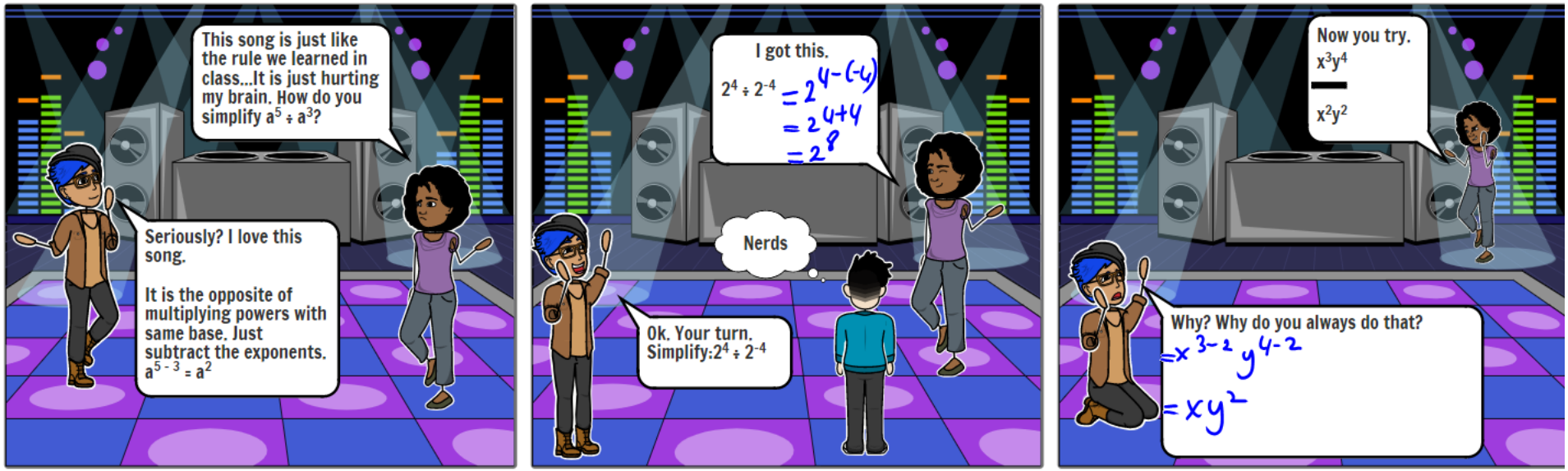
1) MULTIPLYING POWERS WITH THE SAME BASE



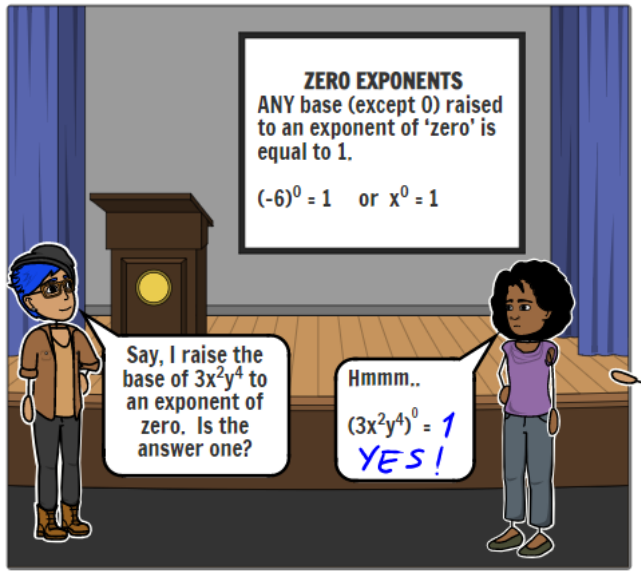
$5^5 \times 5^4 = 5^{5+4} = 5^9$	$(x^3)(x^4) = x^{3+4} = x^7$	$(2x^2yz)(3x^2y^5z^3) = 6 \cdot x^{2+2}y^{1+5}z^{1+3} = 6x^4y^6z^4$

2) DIVIDING POWERS WITH THE SAME BASE



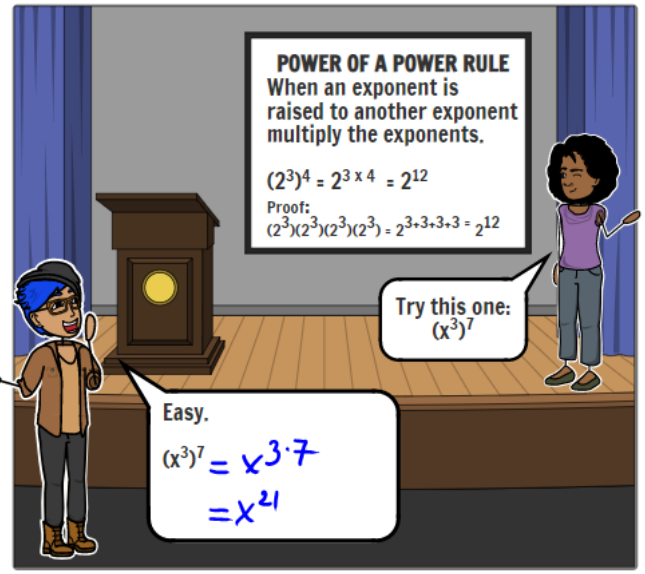
$(-6)^{10} \div (-6)^{-2} = (-6)^{10-(-2)} = (-6)^{10+2} = (-6)^{12}$	$\frac{x^4}{x^2} = x^{4-2} = x^2$	$\frac{x^3y^4}{xy^3} = x^{3-1}y^{4-3} = x^2y$

3) ZERO EXPONENT



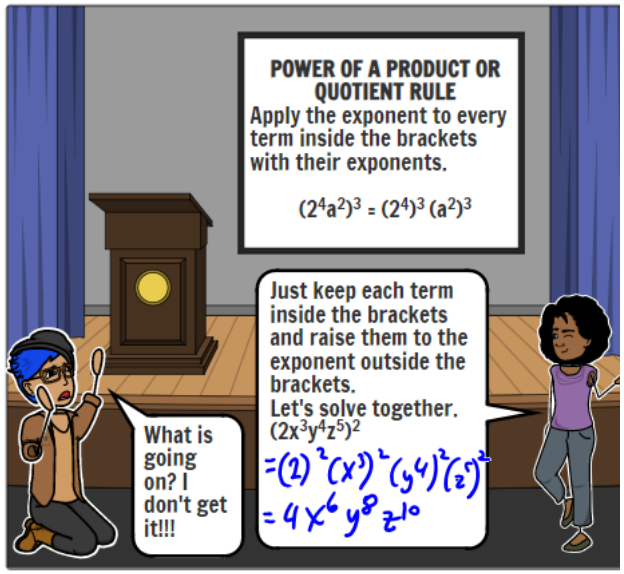
$$\left(-3x^4\right)^3 = (-3)^3(x^4)^3$$
$$= -27x^{4\cdot 3} = -27x^{12}$$

4) POWER OF A POWER



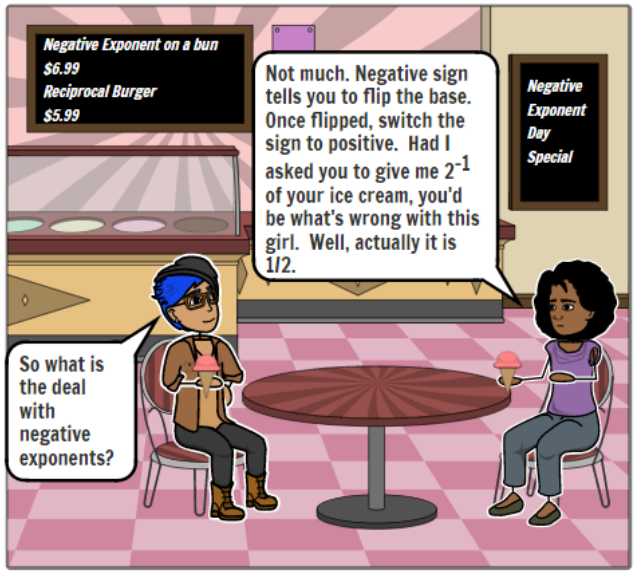
$$\left(\frac{x^2}{y}\right)^3 = \left[\frac{(x^2)^3}{(y)^3}\right] = \frac{x^6}{y^3}$$

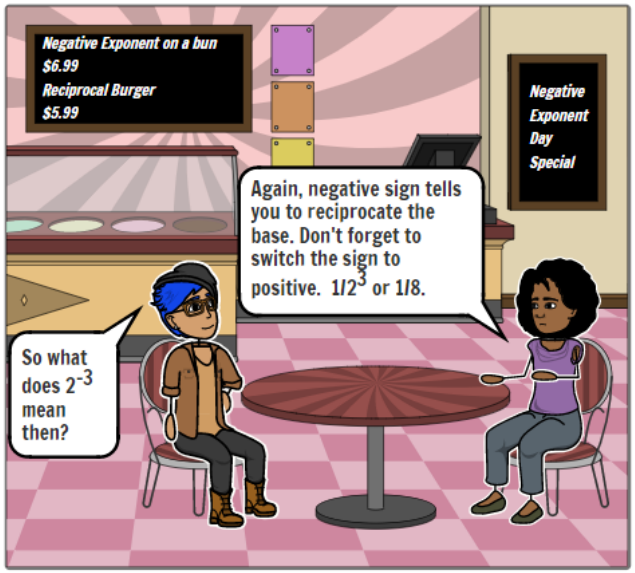
5) POWER OF A PRODUCT OR QUOTIENT



$$\left(\frac{4y^5}{6x^2}\right)^2 = \frac{4^2(y^5)^2}{6^2(x^2)^2} = \frac{16y^{5\cdot 2}}{36x^{2\cdot 2}} = \frac{4y^{10}}{9x^4}$$

6) NEGATIVE EXPONENT





SUMMARY OF EXPONENT RULES

1) MULTIPLICATION RULE	$x^m \times x^n = x^{m+n}$
2) DIVISION RULE	$\frac{x^m}{x^n} = x^{m-n}$
3) ZERO EXPONENT RULE	$x^0 = 1$
4) POWER OF A POWER RULE	$(x^m)^n = x^{m\times n}$
5) POWER OF A PRODUCT / QUOTIENT RULE	$(xy)^m = x^m y^m$ $\quad (\frac{x}{y})^m = \frac{x^m}{x^m}$
6) NEGATIVE EXPONENT RULE	$x^{-m} = \frac{1}{x^m}$ $\quad \frac{1}{x^{-m}} = x^m$ $\quad \left(\frac{x}{y}\right)^{-n} = \left(\frac{y}{x}\right)^n$

EXPONENTS PRACTICE

Simplify:

1. $3 \cdot 4^3 = 3 \cdot 4^3$
2. $4x^3 \cdot 2x^3 = 8 \cdot x^{3+3} = 8x^6$
3. $x^5 \cdot x^3 = x^{5+3} = x^8$
4. $2x^3 \cdot 2x^2 = 4x^{3+2} = 4x^5$
5. $\frac{6^5}{6^3} = 6^{5-3} = 6^2$
6. $\frac{x^4}{x^7} = x^{4-7} = x^{-3} = 1/x^3$
7. $8^0 = 1$
8. $-(9x)^0 = -1$
9. $(y^4)^3 = y^{4\cdot 3} = y^{12}$
10. $(x^2y)^4 = (x^2)^4(y)^4 = x^8y^4$
11. $\frac{6x^7}{2x^4} = 3x^{7-4} = 3x^3$
12. $\frac{8x^5}{4x^2} = 2x^{5-2} = 2x^3$
13. $(2cd^4)^2(cd)^5 = 2^2c^2(d^4)^2c^5d^5$ (d^8) $= 4c^7d^{13}$
14. $(2fg^4)^4(fg)^6$ (g^{16}) $= 2^4f^4(g^4)^4f^6g^6$ $= 16f^{10}g^{22}$
15. $\frac{x^5y^6}{xy^2} = x^{5-1}y^{6-2} = x^4y^4$
16. $\frac{x^2y^5}{xy^4} = x^{2-1}y^{5-4} = xy$
17. $\left(\frac{4x^5y}{16xy^4}\right)^3 = \left(\frac{1}{4}x^4y^{-3}\right)^3 = \frac{1}{4^3}(x^4)^3(y^{-3})^3 = \frac{1}{64}x^{12}y^{-9}$
18. $\left(\frac{5x^3y}{20xy^5}\right)^4 = \left(\frac{1}{4}x^2y^{-4}\right)^3 = \frac{1}{64}x^6y^{-12}$
19. $y^{-7} = 1/y^7$
20. $7^{-2} = 1/7^2$
21. $\frac{1}{x^{-5}} = x^5$
22. $\frac{1}{2^{-4}} = 2^4$
23. $x^5 \cdot x^{-1} = x^{5+(-1)} = x^4$
24. $x^{-6} = 1/x^6$
25. $x^9 \cdot x^{-7} = x^{9+-7} = x^2$
26. $(j^{-13})(j^4)(j^6)$
$= j^{-13+4+6}$
$= j^{-3}$ or $1/j^3$
27. $\frac{x^{-1}}{x^{-8}} = x^{-1-(-8)} = x^7$
28. $\frac{52x^6}{13x^{-7}} = 4x^{6-(-7)} = 4x^{13}$
29. $f^{-3}(f^2)(f^{-3}) = f^{-3+2+-3}$
$= f^{-4}$
30. $\frac{x^{-4}}{x^{-9}} = x^{-4-(-9)}$
$= x^5$
31. $\frac{24x^6}{12x^{-8}} = 2x^{6-(-8)} = 2x^{14}$
32. $\frac{3x^2y^{-3}}{12x^6y^3} = \frac{1}{4}x^{2-6}y^{-3-3}$
$\frac{1}{4}x^{-4}y^{-6}$
33. $(2x^3y^{-3})^{-2}$
34. $\frac{2x^4y^{-4}}{8x^7y^3}$
35. $(4x^4y^{-4})^3$
36. $5x^2y(2x^4y^{-3})$
37. $\left(\frac{-7a^2b^3c^0}{3a^3b^4c^3}\right)^{-4}$
38. $\left(\frac{-2a^3b^2c^0}{3a^2b^3c^7}\right)^{-2}$

COMPLETE: page 362 #1 – 3 (bef), 4 bce, 5 (bdfh), 6, 7b, 8ac, 10, 13

33) $(2x^3y^{-3})^{-2} = (2)^{-2}(x^3)^{-2}(y^{-3})^{-2}$

$= 2^{1\cdot -2}x^{3\cdot -2}y^{-3\cdot -2}$

$= 2^{-2}x^{-6}y^{6}$

$= \frac{1}{4}\cdot\frac{1}{x^6}\cdot y^6$

OR

$= \frac{y^6}{4x^6}$

34) $\frac{2x^4y^{-4}}{8x^7y^3} = \frac{1}{4}x^{4-7}y^{-4-3}$

$= \frac{1}{4}x^{-3}y^{-7}$ OR $\frac{1}{4}\cdot\frac{1}{x^3}\cdot\frac{1}{y^7} = \frac{1}{4x^3y^7}$

35) $(4x^4y^{-4})^3 = (4)^3(x^4)^3(y^{-4})^3$

$= 4^3x^{4\cdot 3}y^{-4\cdot 3}$

$= 64x^{12}y^{-12}$

36) $5x^2y(2x^4y^{-3}) = 5\cdot 2\cdot x^2\cdot x^4\cdot y\cdot y^{-3}$

$= 10x^{2+4}\cdot y^{1+(-3)}$

$= 10x^6y^{-2}$

37) $\left(\frac{-7a^3b^2c^0}{3a^2b^3c^7}\right)^{-4} \xrightarrow[\text{inside ( )}]{\text{simplify}} = \left(\frac{-7}{3}a^{3-2}b^{2-3}c^{0-7}\right)^{-4}$

$= \left(\frac{-7}{3}ab^{-1}c^{-7}\right)^{-4}$ now use product rule

$= \left(\frac{-7}{3}\right)^{-4}(a)^{-4}(b^{-1})^{-4}(c^{-7})^{-4}$

$= \frac{(-3)^4}{7^4}\cdot a^{-4}b^4c^{28}$

$= \frac{81}{2401}a^{-4}b^4c^{28}$