SUPPLEMENT TO §1.8

RULES OF EXPONENTS

i. $x^a \cdot x^b = x^{a+b}$ (when we multiply like bases raised to powers, we add the powers)

ii. $(x^a)^b = x^{a \cdot b}$ (when we raise a base-with-a-power to a power, we multiply the powers together)

iii. $(xy)^a = x^a y^a$ (we distribute a power over multiplication)

Note that one of the most common mistakes is to confuse rules ***i*** and ***ii***. To avoid this mistake, notice that if there are ***two*** factors with like bases, you should use rule ***i***.

EXAMPLE: Simplify the following expressions using the rules of exponents.

a. $-2t^3 \cdot 4t^5$ **b.** $5\left(v^4\right)^2$ **c.** $4\left(3u\right)^2$ **d.** $x^3 y^2$

Solutions:

a. $-2t^3 \cdot 4t^5 = -8t^3 \cdot t^5$ (combine the numerical coefficients by multiplication)

$= -8t^{3+5}$ (add the two exponents together using rule ***i***)

$= -8t^8$

b. $5\left(v^4\right)^2 = 5 \cdot v^{4 \cdot 2}$ (apply rule ***ii***; note that the power "2" doesn't affect the coefficient "5")

$= 5v^8$

c. $4\left(3u\right)^2 = 4\left(3^2 u^2\right)$ (apply rule ***iii***)

$= 4\left(9u^2\right)$ (simplify)

$= 36u^2$ (combine the numerical coeficients by multiplication; note that we don't distribute 4 to 9 *and* u^2 since $9u^2$ is one term)

d. $x^3 y^2$ cannot be simplified further since the bases are different variables.

EXERCISES:

1. Simplify the following expressions using the rules of exponents.

a. $x^5 \cdot x^6$

b. $7y^7 \cdot 3y^3$

c. $2x^2(3x - 2)$

d. $x^5 + x^5$

e. $5t^3 - 2t^3$

f. $9x^5 - x^5$

g. $\left(x^5\right)^6$

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

i. $x\left(x^2\right)^3$

j. $3(2y)^4$

k. $\left(2x^2\right)^3$

l. $(3x)^2$

2. True or False. If a statement is false, change one side of the equation to make it true.

a. $x^2 + x^3 = x^5$

b. $3^2 \cdot 3^4 = 3^6$

c. $3^2 \cdot 2^3 = 6^5$

d. $x^2x^3 = 2x^5$

e. $\left(5^2\right)^3 = 5^5$

f. $x^3 + x^3 = 2x^3$

ANSWERS TO THE SUPPLEMENT TO §1.8:

1. **a.** $x^5 \cdot x^6 = x^{11}$ **b.** $7y^7 \cdot 3y^3 = 21y^{10}$ **c.** $2x^2(3x - 2) = 6x^3 - 4x^2$

d. $x^5 + x^5 = 2x^5$ **e.** $5t^3 - 2t^3 = 3t^3$ **f.** $9x^5 - x^5 = 8x^5$

g. $\left(x^5\right)^6 = x^{30}$ **h.** $2\left(x^5\right)^3 = 2x^{15}$ **i.** $x\left(x^2\right)^3 = x \cdot x^6 = x^7$

j. $3(2y)^4 = 3\left(16y^4\right) = 48y^4$ **k.** $\left(2x^2\right)^3 = 8x^6$ **l.** $(3x)^2 = 9x^2$

2. **a.** $x^2 + x^3 = x^5$ is *false*.

There is no way to combine $x^2 + x^3$ because they are not like terms. However, if we change the left side to multiplication rather than addition, the statement is true: $x^2 \cdot x^3 = x^5$.

b. $3^2 \cdot 3^4 = 3^6$ is *true*.

c. $3^2 \cdot 2^3 = 6^5$ is *false*.
We can only add the exponents when the bases are the same. We can edit the right side of the equation to make it true: $3^2 \cdot 2^3 = 9 \cdot 8$

d. $x^2x^3 = 2x^5$ is *false.*
We can edit the right side of the equation to make the statement true: $x^2x^3 = x^5$.

e. $\left(5^2\right)^3 = 5^5$ is *false*.

We can edit the right side of the equation to make the statement true: $\left(5^2\right)^3 = 5^6$.

f. $x^3 + x^3 = 2x^3$ is *true*.