Rules of Indices

1. Simplify the following expressions without using a calculator. Leave your answers in index form:

a. $5^2 \times 5^4 = 5^6$ b. $3^5 \times 3^3 = 3^8$ c. $10^8 \times 10^7 = 10^{15}$

d. $2^{12} \times 2^3 = 2^{15}$ e. $a^6 \times a^{-3} = a^3$ f. $f^{21} \times f^{13} = f^{34}$

g. $6^9 \div 6^4 = 6^5$ h. $12^{15} \div 12^2 = 12^{13}$ i. $4^5 \div 4^3 = 4^2$

j. $20^8 \div 20^5 = 20^3$ k. $m^{15} \div m^8 = m^7$ l. $n^4 \div n^2 = n^2$

m. $(4^2)^5 = 4^{10}$ n. $(8^4)^3 = 8^{12}$ o. $(p^{12})^4 = p^{48}$

p. $(30^5)^{10} = 30^{50}$ q. $(13^7)^{11} = 13^{77}$ r. $(t^9)^6 = t^{54}$

2. Simplify the following expressions without using a calculator. Leave your answers in index form:

a. $9^2 \times 9^4 \times 9^3 = 9^9$ b. $3^5 \times 3^6 \div 3^2 = 3^9$ c. $(4^5)^3 \times 4^{10} = 4^{25}$

d. $(d^7 \times d^2)^6 = d^{54}$ e. $(y^{12} \div y^4)^5 = y^{40}$ f. $(k^8 \times k^{21} \div k^7)^2 = k^{44}$

g. $r^{23} \div (r^3)^5 = r^8$ h. $(s^0 \times s^4)^2 \div s^5 = s^3$ i. $p^{18} \times (p^4 \div p^2)^3 = p^{24}$

j. $\dfrac{w^9 \times w^2}{w^5 \times w^3} = w^3$ k. $\dfrac{(g^5 \times g^2)^3}{g^4 \times g^{10}} = g^7$ l. $\left[\dfrac{j^4 \times j^8}{j^9 \div j^2}\right]^3 = j^{15}$

3. Without using a calculator, simplify these expressions to find the missing power:

a. $9^2 \times 3^6 = 3^{\boxed{10}}$ b. $10\,000 \div 10^2 = 10^{\boxed{2}}$ c. $25^2 \times 5^3 = 5^{\boxed{7}}$

d. $64^2 \div 4^3 = 4^{\boxed{3}}$ e. $144 \times 12^5 = 12^{\boxed{7}}$ f. $(3^4)^2 \times 27 = 3^{\boxed{11}}$

g. $4^5 \div 2 = 2^{\boxed{9}}$ h. $11^5 \times 121^2 = 11^{\boxed{9}}$ i. $(16^3 \times 2^4) \div 2^3 = 2^{\boxed{13}}$