

**Section 1.1b – Practice Questions****Emerging Level Questions**

1. Multiply. Leave answers in exponential form, positive exponents only

a)  $2^3 \cdot 2^4$   
 $2^{3+4}$   
 $2^7$

b)  $3^5 \cdot 3^7$   
 $3^{12}$

c)  $4^{-3} \cdot 4^2$   
 $4^{-1} = \frac{1}{4}$

d)  $5^0 \cdot 5^3$   
 $5^3$

e)  $a^2 \cdot a^3 \cdot a^{-5}$   
 $a$

f)  $y^{-3} \cdot y^2 \cdot y$   
 $y^0 = 1$

g)  $8^0 \cdot 8^1 \cdot 8^2$   
 $8^3$

h)  $\left(\frac{2}{3}\right)^3 \cdot \left(\frac{2}{3}\right)^4$   
 $\left(\frac{2}{3}\right)^7$

i)  $(-3)^4 \cdot (-3)^3 \cdot -3^2$   
 $3^4 \cdot -3^3 \cdot -3^2$   
 $3^4 \cdot \cancel{(-1)3^3} \cdot \cancel{(-1)3^2}$   
 $3^9$

j)  $(-\frac{1}{2})^5 \cdot (-\frac{1}{2})^{-3} \cdot (-\frac{1}{2})^6$   
 $(-\frac{1}{2})^8$  or  $(\frac{1}{2})^8$

2. Divide. Leave answers in exponential form, positive exponents only

a)  $\frac{5^6}{5^3}$   
 $5^{6-3}$   
 $5^3$

b)  $\frac{4^8}{4^4}$   
 $4^4$

c)  $\frac{2^8}{2^2}$   
 $2^6$

d)  $\frac{3^9}{3^3}$   
 $3^6$

e)  $\frac{t^6}{t^2}$   
 $t^4$

f)  $\frac{x^6}{x^6}$   
 $x^0 = 1$

g)  $\frac{(-6)^4}{(-6)^{-3}}$   
 $(-6)^7$  or  $-6^7$

h)  $\frac{(-9)^{-3}}{(-9)^{-6}}$   
 $(-9)^3$  or  $-9^3$

i)  $\frac{(-2x)^3}{(-2x)^{-4}}$   
 $(-2x)^7$

j)  $\frac{z^{-2}}{z^{-6}}$   
 $z^4$

3. Simplify. Express without brackets or negative exponents.

a)  $(2^4)^2$   
 $2^{4 \cdot 2} = 2^8$

b)  $(5^3)^{-2}$   
 $5^{-6} = \frac{1}{5^6}$

c)  $(3^{-4})^{-2}$   
 $3^8$

d)  $(-3x^{-2})^0$   
 $1$

e)  $(2x)^3$   
 $2^3 x^3 = 8x^3$

f)  $(3x^{-4})^2$   
 $3^2 x^{-8} = 9x^{-8}$  or  $\frac{9}{x^8}$

g)  $(2a^{-4})^3$   
 $2^3 a^{-12}$  or  $\frac{8}{a^{12}}$

h)  $(3x^4y^{-2})^4$   
 $3^4 x^{16} y^{-8}$  or  $\frac{81x^{16}}{y^8}$

i)  $(-4a^{-3}b^{-2})^2$   
 $(-4)^2 a^{-6} b^{-4}$   
 $\frac{16}{a^6 b^4}$

j)  $(-2^{-3}x^{-2}y)^3$   
 $-2^{-9} x^{-6} y^3 \rightarrow (-1)2^{-9} x^{-6} y^3$   
 $\rightarrow \frac{-y^3}{2^9 x^6} = \frac{-y^3}{512x^6}$

**Proficient Level Questions**

4. Simplify. Express without brackets or negative exponents.

a)  $\frac{3^4 \cdot 3^7}{3^5} = \frac{3^{11}}{3^5} = \boxed{3^6}$

b)  $\frac{2^5}{2^4 \cdot 2^3} = \frac{2^5}{2^7} = \boxed{\frac{1}{2^2}}$

c)  $\frac{4^{-3} \cdot 4^1}{4^{-1}} = \frac{4^{-2}}{4^{-1}} = 4^{-1} = \boxed{\frac{1}{4}}$

d)  $\frac{5^4 \cdot 5^{-2}}{5^3 \cdot 5^{-1}} = \frac{5^2}{5^2} = \boxed{1}$

e)  $\frac{7^0 \cdot 7^{-3}}{7^2 \cdot 7^{-2}} = \frac{7^{-3}}{7^0} = \boxed{\frac{1}{7^3}}$

f)  $\frac{11^2 \cdot 11^3}{11^{-1}} = \frac{11^5}{11^{-1}} = \boxed{11^6}$

g)  $\frac{3(x^3)^2}{x^{-2}} = \frac{3x^6}{x^{-2}} = \boxed{3x^8}$

h)  $\frac{(3x^2)^{-3}}{x^3} = \frac{3^{-3} x^{-6}}{x^3} = \frac{1}{3^3 x^9} = \boxed{\frac{1}{27x^9}}$

i)  $\frac{(2a^2b^{-4}c^{-5})^3}{2^2}$

$$\frac{8a^6b^{-12}c^{-15}}{4} = \boxed{\frac{2a^6}{b^{12}c^{15}}}$$

j)  $\left(\frac{2a^2}{3b^4}\right)^{-3}$

$$\left(\frac{3b^4}{2a^2}\right)^3 = \boxed{\frac{27b^{12}}{8a^6}}$$

5. Solve.

a)  $3^2$

$$\boxed{9}$$

b)  $3^{-2}$

$$\frac{1}{3^2} = \boxed{\frac{1}{9}}$$

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

$$\boxed{\frac{1}{9}}$$

d)  $\left(\frac{1}{3}\right)^{-2}$

$$\left(\frac{3}{1}\right)^2 = \boxed{9}$$

e)  $-3^2$

$$-(3)^2 = \boxed{-9}$$

f)  $(-3)^2$

$$\boxed{9}$$

g)  $-(-\frac{1}{3})^2$

$$-\left(\frac{1}{9}\right) = \boxed{-\frac{1}{9}}$$

h)  $\left(-\frac{1}{3}\right)^2$

$$\boxed{\frac{1}{9}}$$

i)  $(-\frac{1}{3})^{-2}$   
 $(-\frac{3}{1})^2 = \boxed{9}$

j)  $-(-\frac{1}{3})^{-2}$   
 $-(-\frac{3}{1})^2 \rightarrow -(9) = \boxed{-9}$

k)  $-2^3$   
 $-(2)^3 = \boxed{-8}$

l)  $-(-2)^3$   
 $-(8) = \boxed{-8}$

**Extending Level Questions**

6. Simplify. Express without brackets or negative exponents.

a)  $\frac{(2a^2b^3)^{-2}(4ab^{-1})^3}{(a^3b)^{-4}}$

$$\frac{(a^3b)^4 (4ab^{-1})^3}{(2a^2b^3)^2}$$

$$\frac{a^{12}b^4 4^3a^3b^{-3}}{2^2a^4b^6}$$

$$\frac{4^3a^{15}b^4}{2^2a^4b^9}$$

$$\boxed{\frac{16a^{11}}{b^5}}$$

b)  $\frac{(x^5y^2)^{-2}(x^2y^{-2})^3}{x^{-1}y^{-2}}$

$$\frac{(x^2y^{-2})^3}{(x^5y^2)^2 x^{-1}y^{-2}}$$

$$\frac{x^6y^{-6}}{x^{10}y^4 x^{-1}y^{-2}}$$

$$\frac{x^6x^1y^2}{x^{10}y^4y^6}$$

$$\frac{x^7y^2}{x^{10}y^{10}} \rightarrow \boxed{\frac{1}{x^3y^8}}$$

c)  $\frac{(5m^{-1}n^2)^2(2m^{-2}n^{-3})^3}{(2m^3n^2)^{-1}}$

$$2m^3n^2 (5m^{-1}n^2)^2 (2m^{-2}n^{-3})^3$$

$$2m^3n^2 5^2 m^{-2} n^4 2^3 m^{-6} n^{-9}$$

$$\frac{5^2 \cdot 2^4 m^3 n^6}{m^8 n^9} \rightarrow \boxed{\frac{400}{m^5 n^3}}$$

d)  $\frac{(3a^{-2}b^3)^2(3a^{-1}b^{-4})^{-1}}{(3a^2b^{-2})^{-3}}$

$$\frac{(3a^{-2}b^3)^2 (3a^2b^{-2})^3}{(3a^{-1}b^{-4})^1}$$

$$\frac{3^2 a^{-4} b^6 3^3 a^6 b^{-6}}{3a^{-1} b^{-4}}$$

$$\frac{3^5 a^2 b^0}{3 a^4 b^6} \rightarrow \boxed{81 a^3 b^4}$$

e)  $\frac{(3^{-1}x^{-2}y)^{-1}(5x^2y^4)^{-2}}{(4x^{-2}y^{-3})^2}$

$$\frac{(3^{-1}x^{-2}y)^{-1} (5x^2y^4)^{-2}}{(4x^{-2}y^{-3})^2}$$

$$\frac{3^{-1}x^{-2}y 5^2 x^4 y^8 4^2 x^{-4} y^{-6}}{3 x^6 y^6}$$

$$\frac{5^2 \cdot 4^2 y^9 x^4}{3 x^2}$$

$$\boxed{\frac{400 y^3}{3 x^2}}$$

f)  $\frac{(3^{-1}a^{-1}b^{-2})^{-2}(4a^{-3}b^4)^{-2}}{(3a^{-3}b^{-4})^2}$

$$\frac{(3^{-1}a^{-1}b^{-2})^{-2} (4a^{-3}b^4)^{-2}}{(3a^{-3}b^{-4})^2}$$

$$\frac{3^{-2} a^{-2} b^{-4} 4^2 a^{-6} b^8 3^2 a^{-6} b^{-8}}{3^2 a^{-6} b^{-8}}$$

$$\frac{4^2 \cdot 3^2 b^{-6}}{3^2 a^{-6} b^{-8}}$$

$$\boxed{\frac{a^{14} b^4}{16}}$$

g)  $\left(\frac{4^{-2}x^2y^{-3}}{x^{-2}y}\right)^3 \left(\frac{8^{-1}x^{-3}y}{x^3y^{-1}}\right)^{-2}$

$$\left(\frac{4^{-2}x^2y^{-3}}{x^{-2}y}\right)^3 \left(\frac{x^3y^{-1}}{8^{-1}x^{-3}y}\right)^2$$

$$\frac{4^{-6}x^6y^{-9}}{x^{-6}y^3} \cdot \frac{x^6y^{-2}}{8^{-2}x^{-6}y^2}$$

$$\frac{8^2 x^{24}}{4^6 y^{16}} = \boxed{\frac{x^{24}}{64 y^{16}}}$$

h)  $\left(\frac{9ab^{-1}}{8a^{-2}b^2}\right)^{-2} \left(\frac{3a^{-2}b^2}{2a^2b^{-1}}\right)^3$

$$\left(\frac{8a^{-2}b^2}{9ab^{-1}}\right)^2 \left(\frac{3a^{-2}b^2}{2a^2b^{-1}}\right)^3$$

$$\frac{8^2 a^{-4} b^4}{9^2 a^2 b^{-2}} \cdot \frac{3^3 a^{-6} b^6}{2^3 a^6 b^3}$$

$$\frac{8^2 \cdot 3^3 b^{15}}{9^2 \cdot 2^3 a^{18}} = \boxed{\frac{8 b^{15}}{3 a^{18}}}$$

i)  $\frac{(2x^{-1}y^2)(4x^2y^{-3})^{-2}}{(12x^2y^2)}$

$$\frac{(2x^{-1}y^2)}{(4x^2y^{-3})^2 (12x^2y^2)}$$

$$\frac{2x^{-1}y^2}{4^2 x^4 y^{-6} 12x^2 y^2}$$

$$\frac{2 y^8}{4^2 \cdot 12 x^7 y^2} = \boxed{\frac{y^6}{96 x^7}}$$

j)  $\left[\frac{(5x^{-3}y^4)^{-2}(6x^2y^{-5})^{-2}}{15x^2y^{-4}}\right]^{-2}$

$$\left[\frac{5^{-2}x^{-6}y^{-8} \cdot 6^2x^{-4}y^{-10}}{15x^2y^{-4}}\right]^{-2}$$

$$\left[\frac{5^{-2}x^{-8}y^{-13}}{15x^2y^{-4}}\right]^{-2} \rightarrow \left[\frac{5^{-2} \cdot 6^2 x^6 y^{-9}}{15}\right]^{-2}$$

$$\frac{5^4 \cdot 6^{-2} x^{-12} y^{18}}{15^{-2}} \rightarrow \frac{5^4 \cdot 15^2 y^{18}}{6^2 x^{12}}$$

$$\frac{5^4 \cdot 15 \cdot 15 y^{18}}{6 \cdot 6 x^{12}} \rightarrow \frac{5^4 \cdot 5 \cdot 5 y^{18}}{2 \cdot 2 x^{12}} = \boxed{\frac{15625 y^{18}}{4 x^{12}}}$$



**Proficient Level Questions**

7. Solve.

a)  $16^{\frac{3}{4}}$   
 $\sqrt[4]{16^3} \rightarrow 2^3 = \boxed{8}$

b)  $16^{\frac{3}{4}}$   
 $\frac{1}{16^{\frac{3}{4}}} \rightarrow \frac{1}{\sqrt[4]{16^3}} \rightarrow \boxed{\frac{1}{8}}$

c)  $8^{\frac{2}{3}}$   
 $\sqrt[3]{8^2} \rightarrow 2^2 = \boxed{4}$

d)  $8^{\frac{2}{3}}$   
 $\frac{1}{8^{\frac{2}{3}}} \rightarrow \boxed{\frac{1}{4}}$

e)  $27^{\frac{4}{3}}$   
 $\sqrt[3]{27^4} \rightarrow 3^4 = \boxed{81}$

f)  $27^{\frac{4}{3}}$   
 $\frac{1}{27^{\frac{4}{3}}} \rightarrow \frac{1}{\sqrt[3]{27^4}} \rightarrow \frac{1}{3^4} = \boxed{\frac{1}{81}}$

g)  $-16^{\frac{5}{4}}$   
 stays out  $\sqrt[4]{16^5} \rightarrow -2^5 = \boxed{-32}$

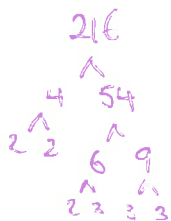
h)  $-16^{\frac{5}{4}}$   
 $\frac{-1}{\sqrt[4]{16^5}} = \frac{-1}{2^5} = \boxed{\frac{-1}{32}}$

i)  $-32^{\frac{4}{5}}$   
 $-\sqrt[5]{32^4} = -2^4 \rightarrow \boxed{-16}$

j)  $-32^{\frac{4}{5}}$   
 $\frac{-1}{\sqrt[5]{32^4}} \rightarrow \frac{-1}{2^4} = \boxed{\frac{-1}{16}}$

k)  $216^{\frac{2}{3}}$   
 $\sqrt[3]{216^2} \rightarrow 6^2 = \boxed{36}$

l)  $216^{\frac{2}{3}}$   
 $\frac{1}{\sqrt[3]{216^2}} = \frac{1}{6^2} = \boxed{\frac{1}{36}}$



m)  $-125^{\frac{4}{3}}$   
 $-\sqrt[3]{125^4}$   
 $-5^4 = \boxed{-625}$

n)  $-125^{-\frac{4}{3}}$   
 $\frac{-1}{\sqrt[3]{125^4}} = \frac{-1}{5^4} = \boxed{\frac{-1}{625}}$

o)  $64^{\frac{7}{6}}$   
 $\sqrt[6]{64^7} \rightarrow 2^7$   
 $\boxed{128}$

p)  $64^{-\frac{7}{6}}$   
 $\sqrt[6]{\frac{1}{64^7}} \rightarrow \frac{1}{2^7} = \boxed{\frac{1}{128}}$

q)  $-49^{\frac{3}{2}}$   
 $-\sqrt{49^3} \rightarrow -7^3$   
 $\boxed{-343}$

r)  $-49^{-\frac{3}{2}}$   
 $\frac{-1}{\sqrt{49^3}} \rightarrow \frac{-1}{7^3} \rightarrow \boxed{\frac{-1}{343}}$

s)  $128^{\frac{5}{7}}$   
 $\sqrt[7]{128^5} \rightarrow 2^5 = \boxed{32}$

t)  $128^{-\frac{5}{7}}$   
 $\sqrt[7]{\frac{1}{128^5}} \rightarrow \frac{1}{2^5} = \boxed{\frac{1}{32}}$

u)  $-243^{\frac{6}{5}}$   
 $-\sqrt[5]{243^6} \rightarrow -3^6$   
 $\boxed{-729}$

v)  $-243^{-\frac{6}{5}}$   
 $\frac{-1}{\sqrt[5]{243^6}} \rightarrow \frac{-1}{3^6} \rightarrow \boxed{\frac{-1}{729}}$

w)  $81^{\frac{5}{4}}$   
 $\sqrt[4]{81^5} \rightarrow 3^5$   
 $\boxed{243}$

x)  $81^{-\frac{5}{4}}$   
 $\sqrt[4]{\frac{1}{81^5}} \rightarrow \frac{1}{3^5} \rightarrow \boxed{\frac{1}{243}}$

8. Simplify. Leave answer with positive exponents.

a)  $2^{\frac{1}{4}} \cdot 2^{\frac{5}{4}}$   
 $2^{\frac{6}{4}} \rightarrow 2^{\frac{3}{2}}$

b)  $3^{\frac{2}{3}} \cdot 3^{\frac{7}{3}}$   
 $3^{\frac{9}{3}} = 3^3$

c)  $4^{\frac{1}{4}} \cdot 4^{-\frac{3}{4}}$   
 $4^{-\frac{2}{4}} \rightarrow 4^{-\frac{1}{2}}$   
 $\frac{1}{4^{\frac{1}{2}}} = \frac{1}{2}$

d)  $5^{-\frac{2}{3}} \cdot 5^{-\frac{1}{3}}$   
 $5^{-\frac{3}{3}} \rightarrow 5^{-1} \rightarrow \frac{1}{5}$

e)  $\frac{6^{\frac{3}{4}}}{6^{\frac{5}{4}}}$   
 $6^{-\frac{2}{4}} \rightarrow 6^{-\frac{1}{2}} = \frac{1}{6^{\frac{1}{2}}}$

f)  $\frac{7^{\frac{2}{5}}}{7^{-\frac{1}{5}}}$   
 $7^{\frac{3}{5}}$

g)  $\frac{8^{\frac{2}{7}} \cdot 8^{\frac{4}{7}}}{8^{\frac{3}{7}}}$   
 $\frac{8^{\frac{2}{7}}}{8^{-\frac{3}{7}}} = 8^{\frac{5}{7}} = (2^3)^{\frac{5}{7}} = 2^{\frac{15}{7}}$

h)  $\frac{9^{\frac{3}{5}}}{9^{\frac{2}{5}} \cdot 9^{-\frac{4}{5}}}$   
 $9^{\frac{5}{5}} \rightarrow 9$

i)  $a^{\frac{3}{4}} \cdot a^{\frac{5}{4}}$   
 $a^{\frac{8}{4}} = a^2$

j)  $b^{\frac{5}{6}} \cdot b^{-\frac{1}{3}}$   
 $b^{\frac{5}{6}} \cdot b^{-\frac{2}{6}}$   
 $b^{\frac{3}{6}} = b^{\frac{1}{2}}$

k)  $\frac{c^{\frac{2}{3}}}{c^{\frac{5}{6}}}$

$$\frac{c^{\frac{4}{6}}}{c^{\frac{5}{6}}} \rightarrow c^{-\frac{1}{6}} = \boxed{\frac{1}{c^{\frac{1}{6}}}}$$

l)  $\frac{d^{\frac{1}{3}}}{d^{-\frac{1}{2}}}$

$$\frac{d^{\frac{2}{6}}}{d^{-\frac{3}{6}}} \rightarrow \boxed{d^{\frac{5}{6}}}$$

m)  $\left(\frac{9}{4}\right)^{\frac{3}{2}}$

$$\frac{9^{\frac{3}{2}}}{4^{\frac{3}{2}}} \rightarrow \frac{\sqrt[3]{9^3}}{\sqrt[3]{4^3}} = \frac{3^3}{2^3} = \boxed{\frac{27}{8}}$$

n)  $\left(\frac{9}{4}\right)^{-\frac{3}{2}}$

$\frac{2^3}{3^3} = \boxed{\frac{8}{27}}$

Flip the fraction and change exponent from neg to pos

o)  $\left(\frac{81}{16}\right)^{\frac{3}{4}}$

$$\frac{\sqrt[4]{81^3}}{\sqrt[4]{16^3}} \rightarrow \frac{3^3}{2^3} \rightarrow \boxed{\frac{27}{8}}$$

p)  $\left(\frac{81}{16}\right)^{-\frac{3}{4}}$

$$\left(\frac{16}{81}\right)^{\frac{3}{4}} \rightarrow \frac{\sqrt[4]{16^3}}{\sqrt[4]{81^3}} \rightarrow \frac{2^3}{3^3} = \boxed{\frac{8}{27}}$$

q)  $(a^3 b^4)^{\frac{2}{3}}$

$$a^2 b^{\frac{8}{3}}$$

$$\boxed{a^{\frac{2}{1}} b^{\frac{8}{3}}}$$

r)  $(x^4 y^{\frac{1}{2}})^{\frac{4}{3}}$

$$x^{\frac{16}{3}} y^{\frac{2}{3}}$$

$$\boxed{x^{\frac{16}{3}} y^{\frac{2}{3}}}$$

s)  $(a^{\frac{2}{3}} b^{\frac{5}{6}} c^{\frac{1}{2}})^{\frac{6}{7}}$

$$a^{\frac{12}{21}} b^{\frac{30}{42}} c^{\frac{6}{14}}$$

$$\boxed{a^{\frac{4}{7}} b^{\frac{5}{7}} c^{\frac{3}{7}}}$$

t)  $(x^{\frac{4}{3}} y^{\frac{3}{4}} z^{\frac{5}{2}})^{\frac{12}{5}}$

$$\frac{1}{x^{\frac{48}{5}} y^{\frac{9}{5}} z^{\frac{30}{5}}}$$

$$\rightarrow \boxed{\frac{1}{x^{\frac{16}{5}} y^{\frac{3}{5}} z^6}}$$

9. Simplify each radical. Assume the variables are positive.

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

Annotations: "Root" with an arrow pointing to the 4th root symbol, "Power" with an arrow pointing to the 1/4 exponent, "Flower" with an arrow pointing to the 2 inside the parentheses.

$$(2^2)^{1/4} = 2^{2/4} = 2^{1/2} = \boxed{\sqrt{2}}$$

b)  $8^{6/3} = 8^2 = \boxed{64}$

c)  $\sqrt[3]{16^3}$

$$(2^4)^{3/3} = 2^{12/3} = 2^4 = 16$$

$$= 2^{2 \cdot 2} = 2^2 \cdot 2^2 = \boxed{2\sqrt{2}}$$

d)  $27^{2/3} = (3^3)^{2/3} = 3^2 = \boxed{9}$

e)  $9^{3/12} = 9^{1/4} = (3^2)^{1/4} = 3^{1/2} = \boxed{\sqrt{3}}$

f)  $4^{2/4} = 4^{1/2} = (2^2)^{1/2} = 2^1 = \boxed{2}$

g)  $\sqrt[4]{a^2} = a^{2/4} = a^{1/2} = \boxed{\sqrt{a}}$

h)  $b^{3/9} = b^{1/3} = \boxed{b^{1/3}}$

10. Simplify.

a)  $\sqrt{2} \cdot \sqrt[3]{2}$

$$2^{1/2} \cdot 2^{1/3} = 2^{3/6} \cdot 2^{2/6} = 2^{5/6} = \sqrt[6]{2^5} = \boxed{\sqrt[6]{32}}$$

b)  $\sqrt{3} \cdot \sqrt[4]{3}$

$$3^{1/2} \cdot 3^{1/4} = 3^{2/4} \cdot 3^{1/4} = 3^{3/4} \rightarrow \sqrt[4]{3^3} = \boxed{\sqrt[4]{27}}$$

$$\begin{aligned}
 \text{c) } & \sqrt[3]{2} \cdot \sqrt[4]{2} \\
 & 2^{\frac{1}{3}} \cdot 2^{\frac{1}{4}} \\
 & 2^{\frac{4}{12}} \cdot 2^{\frac{3}{12}} = 2^{\frac{7}{12}} \\
 & \sqrt[12]{2^7} = \sqrt[12]{128}
 \end{aligned}$$

$$\begin{aligned}
 \text{d) } & \frac{\sqrt[3]{4}}{\sqrt[4]{4}} \\
 & \frac{4^{\frac{1}{3}}}{4^{\frac{1}{4}}} = \frac{4^{\frac{4}{12}}}{4^{\frac{3}{12}}} = 4^{\frac{1}{12}} \\
 & (2^2)^{\frac{1}{12}} = 2^{\frac{1}{6}} \\
 & \boxed{\sqrt[6]{2}}
 \end{aligned}$$

**Extending Level Questions**

$$\begin{aligned}
 \text{e) } & \frac{\sqrt{27}}{\sqrt[3]{9}} \\
 & \frac{27^{\frac{1}{2}}}{9^{\frac{1}{3}}} = \frac{(3^3)^{\frac{1}{2}}}{(3^2)^{\frac{1}{3}}} = \frac{3^{\frac{3}{2}}}{3^{\frac{2}{3}}} \\
 & \frac{3^{\frac{9}{6}}}{3^{\frac{4}{6}}} = 3^{\frac{5}{6}} = \sqrt[6]{3^5} \\
 & = \boxed{\sqrt[6]{243}}
 \end{aligned}$$

$$\begin{aligned}
 \text{f) } & \frac{\sqrt[3]{16}}{\sqrt[4]{8}} \\
 & \frac{16^{\frac{1}{3}}}{8^{\frac{1}{4}}} = \frac{(2^4)^{\frac{1}{3}}}{(2^3)^{\frac{1}{4}}} = \frac{2^{\frac{4}{3}}}{2^{\frac{3}{4}}} \\
 & \frac{2^{\frac{16}{12}}}{2^{\frac{9}{12}}} = 2^{\frac{7}{12}} = \sqrt[12]{2^7} \\
 & \boxed{\sqrt[12]{128}}
 \end{aligned}$$

$$\begin{aligned}
 \text{g) } & \frac{(\frac{1}{2})^x \cdot 8^x}{4^x} \\
 & \frac{(2^{-1})^x \cdot (2^3)^x}{(2^2)^x} = \frac{2^{-x} \cdot 2^{3x}}{2^{2x}} \\
 & \frac{2^{2x}}{2^{2x}} = \boxed{1}
 \end{aligned}$$

$$\begin{aligned}
 \text{h) } & \frac{3^x \cdot 27^x}{9^x} \\
 & \frac{3^x \cdot (3^3)^x}{(3^2)^x} = \frac{3^x \cdot 3^{3x}}{3^{2x}} = \frac{3^{4x}}{3^{2x}} \\
 & \downarrow \\
 & 3^{2x} = (3^2)^x \\
 & \downarrow \\
 & \boxed{9^x}
 \end{aligned}$$

$$i) \frac{\left(\frac{1}{3}\right)^x \cdot 81^x}{27^x}$$

$$\frac{3^{-x} \cdot (3^4)^x}{(3^3)^x} = \frac{3^{-x} \cdot 3^{4x}}{3^{3x}}$$

$$\frac{3^{3x}}{3^{3x}} = \boxed{1}$$

$$j) \frac{5^{-x} \cdot 125^{2x}}{25^{3x}}$$

$$\frac{5^{-x} \cdot (5^3)^{2x}}{(5^2)^{3x}} = \frac{5^{-x} \cdot 5^{6x}}{5^{6x}}$$

$$\frac{5^{5x}}{5^{6x}} = 5^{-x} = \boxed{\frac{1}{5^x}}$$