

Name:

Date:

1. (a) $\boxed{9}$ (b) $\boxed{4}$ (c) $\boxed{1}$

2. (a) $\sqrt[3]{a} \div \sqrt[5]{a^2} \times (a^{-1})^{\frac{1}{2}} = a^{1/3} \cdot a^{-1/2} \cdot a^{-2/5} = \boxed{a^{-17/30}}$

(b)

$$\begin{aligned} 12^{2x+3} \times 6^{x-5} \times 8^{2x-1} &= (2^2 \cdot 3)^{2x+3} (2 \cdot 3)^{x-5} (2^3)^{2x-1} \\ &= 2^{4x+6} 3^{2x+3} 2^{x-5} 3^{x-5} 2^{6x-3} \\ &= 2^{4x+6+x-5+6x-3} 3^{2x+3+x-5} \\ &= \boxed{2^{11x-2} \cdot 3^{3x-2}} \end{aligned}$$

(c)

$$\begin{aligned} \frac{81^{x+1} - 9^{2x+1}}{3^{x-4} \times 27^{x+2}} &= \frac{(3^4)^{x+1} - (3^2)^{2x+1}}{3^{x-4} \cdot (3^3)^{x+2}} \\ &= \frac{3^{4x+4} - 3^{4x+2}}{3^{x-4} \cdot 3^{3x+6}} \\ &= \frac{3^{4x+2}(3^2 - 1)}{3^{4x+2}} \\ &= 3^2 - 1 = \boxed{8} \end{aligned}$$

3. (a) $\boxed{49}$ (b) $\boxed{4}$ (c) $\boxed{3^6 = 729}$ (d) $\boxed{2^{-12} = \frac{1}{4096}}$ (e) $\boxed{7}$

4. (a) \boxed{a} (b) $\boxed{a^9}$ (c) $\boxed{3a^2}$ (d) $\boxed{\frac{4}{a}}$ (e) $\boxed{a^5 b^6}$ (f) $\boxed{a^{-15}}$

(g) $\sqrt[4]{a^3} \times \sqrt{a} \div \sqrt[3]{a^2} = \frac{a^{3/4} \cdot a^{1/2}}{a^{2/3}} = a^{3/4+1/2-2/3} = \boxed{a^{7/12}}$

(h) $\sqrt[6]{a^{x+2}} \div \sqrt[9]{a^{x+3}} = a^{(x+2)/6} \cdot a^{-(x+3)/9}$. Calculate $\frac{x+2}{6} - \frac{x+3}{9} = \frac{3x+6}{18} - \frac{2x+6}{18} = \frac{3x-2x+6-6}{18} = \frac{x}{18}$. $\boxed{a^{x/18}}$

5. (a)

$$\begin{aligned} 3^{x+4} \times 5^{x+1} \times 15^{2x-1} &= 3^{x+4} 5^{x+1} 3^{2x-1} 5^{2x-1} \\ &= 3^{x+4+2x-1} 5^{x+1+2x-1} \\ &= \boxed{3^{3x+3} \cdot 5^{3x}} \end{aligned}$$

(b)

$$\begin{aligned} 5^{x+7} \times 25^{2x-1} \div 125^{2-x} &= \frac{5^{x+7} 5^{2(2x-1)}}{5^{3(2-x)}} \\ &= \frac{5^{x+7} 5^{4x-2}}{5^{6-3x}} \\ &= 5^{x+7+4x-2-6+3x} \\ &= \boxed{5^{8x-1}} \end{aligned}$$

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(c)

$$\begin{aligned}
 6^{3x+1} \times 8^{x-1} \times 24^{3x-1} &= (2 \cdot 3)^{3x+1} (2^3)^{x-1} (2^3 \cdot 3)^{3x-1} \\
 &= 2^{3x+1} 3^{3x+1} 2^{3x-3} 2^{9x-3} 3^{3x-1} \\
 &= 2^{3x+1+3x-3+9x-3} 3^{3x+1+3x-1} \\
 &= \boxed{2^{15x-5} \cdot 3^{6x}}
 \end{aligned}$$

(d)

$$\begin{aligned}
 2^{x-1} \times 4^{3x-2} \div 32^{2x+1} &= \frac{2^{x-1} \cdot 2^{2(3x-2)}}{2^{5(2x+1)}} \\
 &= \frac{2^{x-1} \cdot 2^{6x-4}}{2^{10x+5}} \\
 &= 2^{x-1+6x-4-10x-5} \\
 &= \boxed{2^{-3x-10}}
 \end{aligned}$$

(e)

$$\begin{aligned}
 6^x \times 12^{2x+2} \div 27^x \times 32^{3x} &= \frac{(2 \cdot 3)^x (2^2 3)^{2x+2} (2^5)^{3x}}{(3^3)^x} \\
 &= \frac{2^x 3^x 2^{4x+4} 3^{2x+2} 2^{15x}}{3^{3x}} \\
 &= 2^{x+4x+4+15x} 3^{x+2x+2-3x} \\
 &= \boxed{3^2 \cdot 2^{20x+4}}
 \end{aligned}$$

(f)

$$\begin{aligned}
 20^{x+3} \times 15^{2x+5} \div 6^{2x-1} &= \frac{(2^2 5)^{x+3} (3 \cdot 5)^{2x+5}}{(2 \cdot 3)^{2x-1}} \\
 &= \frac{2^{2x+6} 3^x 3^3 3^{2x+5} 5^{2x+5}}{2^{2x-1} 3^{2x-1}} \\
 &= 2^{2x+6-2x+1} 3^{2x+5-2x+1} 5^{x+3+2x+5} \\
 &= \boxed{2^7 \cdot 3^6 \cdot 5^{3x+8}}
 \end{aligned}$$