(Hw) DQ of $f(x) = 3x^2 + 2x + 1$

$$DQ = \frac{f(a+h) - f(a)}{h} = \frac{3(a+h)^2 + 2(a+h) + 1 - 3a^2 - 2a - 1}{h}$$

$$= \frac{3(a^2 + 2ah + h^2) + 2a + 2h + 1 - 3a^2 - 2a - 1}{h}$$

$$= \frac{3a^2 + 6ah + 3h^2 + 2a + 2h + 1 - 3a^2 - 2a - 1}{h}$$

$$= \frac{h[6a + 3h + 2]}{h} = \boxed{6a + 3h + 2}$$

$(h \neq 0)$

(1) Simplify $(3x^5)^3 (2x^7)^2$

$27 x^{15} \cdot 4 x^{14}$

$\boxed{108 x^{29}}$

(2) $\sqrt{54 x y^4} = \sqrt{54}\sqrt{x}\sqrt{y^4} = \sqrt{9 \cdot 6}\sqrt{x}\, y^2$

$= 3y^2\sqrt{6x}$ $\quad \boxed{x \geq 0}$

(3) $2\sqrt{50} + 12\sqrt{8}$

$2\sqrt{25 \cdot 2} + 12\sqrt{4 \cdot 2} = 2 \cdot 5\sqrt{2} + 12 \cdot 2\sqrt{2}$

$= 10\sqrt{2} + 24\sqrt{2} = \boxed{34\sqrt{2}}$

(4) $5\sqrt{10x^2} - \sqrt{90x^2}$

$5\sqrt{10}\sqrt{x^2} - \sqrt{9\cdot 10}\sqrt{x^2}$

$5\sqrt{10}|x| - 3\sqrt{10}|x| = \boxed{2|x|\sqrt{10}}$

$\sqrt{x^2} = |x|$ $\quad x^2 = 1$, $x = \pm 1$

$\sqrt{x^2} = \sqrt{1}$; $x^2 = 1$; $x^2 - 1 = 0$

$(x-1)(x+1) = 0$

Zero product property.

$|x| = 1$ ✓

$x = 1$ or $x = -1$

$x - 1 = 0$ or $x + 1 = 0$

$\boxed{x = 1}$ or $\boxed{x = -1}$

(5) $8\sqrt[3]{27x} - \frac{1}{2}\sqrt[3]{64x}$

$8 \cdot 3\sqrt[3]{x} - \frac{1}{2} \cdot 4\sqrt[3]{x}$

$= 24\sqrt[3]{x} - 2\sqrt[3]{x} = \boxed{22\sqrt[3]{x}}$

$\sqrt[3]{-8} = -2$

$\sqrt[n]{x}$ → $x \geq 0$ if n is even

$\sqrt[n]{x^m} = x^{\frac{m}{n}}$

(6) Solve for x

$X^2 = X$

"Safe mode"

$X^2 - X = 0$

$X(X-1) = 0$

Zero product property.

$X = 0$ or $X - 1 = 0$

$\boxed{X=0}$ or $\boxed{X=1}$ ✓

$X^2 \cdot \frac{1}{X} = X \cdot \frac{1}{X}$ $\quad X \neq 0$ ✓

$\boxed{X=1}$