1.4 Radical Operations

Reducing radicals:

1) Factor tree
2) Circle groups of index
3) Circled groups come out, everything else stays in
   - multiply everything outside radical & everything inside

1) Simplify

a) $\sqrt{63}$

$63 = 9 \cdot 7$, $9 = 3 \cdot 3$

$\boxed{3\sqrt{7}}$

b) $3\sqrt{112}$

$112 = 2 \cdot 56$, $56 = 2 \cdot 28$, $28 = 4 \cdot 7$, $4 = 2 \cdot 2$

$3 \cdot 2 \cdot 2\sqrt{7}$

$\boxed{12\sqrt{7}}$

c) $\sqrt[3]{108}$

$108 = 2 \cdot 54$, $54 = 2 \cdot 27$, $27 = 9 \cdot 3$, $9 = 3 \cdot 3$

$\boxed{3\sqrt[3]{4}}$

* if you have a negative with an odd index, it <u>always</u> comes out

ex: $\sqrt[3]{-32} = -\sqrt[3]{32} = \boxed{-2\sqrt[3]{4}}$

32: $8 \cdot 4$, $8 = 2 \cdot 2 \cdot 2$, $4 = 2 \cdot 2$

* the kind of root you're taking

2) a] $\sqrt{12x^3}$

$12 = 4 \cdot 3$, $4 = 2 \cdot 2$; $x^3 = x \cdot x \cdot x$

$\boxed{2|x|\sqrt{3x}}$

Absolute value signs:

1) Real number
2) Even <u>index</u> *
3) Odd amount of variable comes out

b] $\sqrt{24x^4y^2}$

$24 = 4 \cdot 6$, $4 = 2 \cdot 2$, $6 = 2 \cdot 3$; $x^4 = x \cdot x \cdot x \cdot x$; $y^2 = y \cdot y$

$2xxy\sqrt{2 \cdot 3}$

$\boxed{2x^2|y|\sqrt{6}}$

Adding/subtracting radicals

- reduce all radicals first
- combine like terms – add coefficients of like radicals

3) a) $\sqrt{8} + 4\sqrt{2}$

4 2

2 2

$2\sqrt{2} + 4\sqrt{2} = \boxed{6\sqrt{2}}$

b) $-2\sqrt{5} + 6\sqrt{3} - 2\sqrt{20} - \sqrt{12}$

4 5 4 3

2 2 2 2

$-2 \cdot 2\sqrt{5}$

$-2\sqrt{5} + 6\sqrt{3} - 4\sqrt{5} - 2\sqrt{3}$

$\boxed{-6\sqrt{5} + 4\sqrt{3}}$

Multiplying radicals

- when roots have same index, you can multiply the insides & combine under same root

4) a) $\sqrt{10} \cdot \sqrt{15} = \sqrt{150}$

$10 = 2 \cdot 5$, $15 = 5 \cdot 3$

$150 = 10 \cdot 15$; $10 = 2 \cdot 5$, $15 = 5 \cdot 3$

$\boxed{5\sqrt{6}}$

Dividing radicals

- rationalize denominator – no roots in bottom
- if no add/sub in denominator, multiply top & bottom by root of denominator

5) a) $\frac{5}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}}$

$\sqrt{2} \cdot \sqrt{2} = \sqrt{4} = 2$

$= \boxed{\frac{5\sqrt{2}}{2}}$

b) $\frac{2}{6\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}}$

• If there is add/sub in denominator, multiply top & bottom by <u>conjugate</u> – switch sign between terms of binomial
(2 terms)

c) $\frac{3}{4+\sqrt{2}} \cdot \frac{4-\sqrt{2}}{4-\sqrt{2}} = \boxed{\frac{12-3\sqrt{2}}{14}}$

$3(4-\sqrt{2}) = 12-3\sqrt{2}$

$(4+\sqrt{2})(4-\sqrt{2}) =$

$16 - \cancel{4\sqrt{2}} \cancel{+4\sqrt{2}} - 2$

$16-2 = 14$

* $\sqrt{2} \cdot -\sqrt{2}$
$= -\sqrt{4} = -2$

HW

21) $\frac{5}{3-4\sqrt{3}} \cdot \frac{3+4\sqrt{3}}{3+4\sqrt{3}}$

* can't have negative in bottom

$= \frac{15+20\sqrt{3}}{-39}$

$(3-4\sqrt{3})(3+4\sqrt{3})$

switch all signs

$9 - 48 = -39$

$\boxed{\frac{-15-20\sqrt{3}}{39}}$

$-4\sqrt{3} \cdot 4\sqrt{3}$

$-16\sqrt{9}$

$-16 \cdot 3 = -48$