1.

a) $\sqrt{121} = \pm 11$

(b) $\sqrt{\frac{1}{9}} = \frac{\sqrt{1}}{\sqrt{9}} = \pm\frac{1}{3}$

(c) $\sqrt{\frac{16}{49}} = \frac{\sqrt{16}}{\sqrt{49}} = \pm\frac{4}{7}$

d) $\sqrt{0.01} = \sqrt{\frac{1}{100}}$

$= \frac{\sqrt{1}}{\sqrt{100}}$

$= \pm\frac{1}{10}$

(e) $\sqrt[3]{8} = 2$

2. a) $\sqrt{3} \times \sqrt{5} = \sqrt{15}$

(b) $\sqrt{3} \times \sqrt{7} = \sqrt{21}$

(c) $\frac{\sqrt{p}}{\sqrt{q}} = \sqrt{\frac{p}{q}} = \frac{\sqrt{pq}}{q}$

d) $\frac{1}{2\sqrt{q}} = \frac{\sqrt{q}}{2q}$

(e) $\frac{3\sqrt{a}}{\sqrt{2b}} = \frac{3\sqrt{2ab}}{2b}$

3. a) $\sqrt{8} = \sqrt{4}\sqrt{2}$

$= 2\sqrt{2}$

(b) $\sqrt{12} = \sqrt{4}\sqrt{3}$

$= 2\sqrt{3}$

(c) $3\sqrt{2} = \sqrt{9}\sqrt{2}$

$= \sqrt{18}$

d) $\sqrt{50} = \sqrt{25}\sqrt{2}$

$= 5\sqrt{2}$

(e) $4\sqrt{5} = \sqrt{16}\sqrt{5}$

$= \sqrt{80}$

(f) $3\sqrt{8} = \sqrt{9}\sqrt{8}$

$= \sqrt{72}$

g) $\sqrt{1210} = \sqrt{121}\sqrt{10}$

$= 11\sqrt{10}$

(h) $6\sqrt{6} = \sqrt{36}\sqrt{6}$

$= \sqrt{216}$

(i) $\sqrt{72} = \sqrt{36}\sqrt{2}$

$= 6\sqrt{2}$

i) $14\sqrt{2} = \sqrt{196}\sqrt{2}$

$= \sqrt{392}$

Have assumed positive solutions.

4. a) $\sqrt{18} + \sqrt{32}$

$= \sqrt{9}\sqrt{2} + \sqrt{16}\sqrt{2}$

$= 3\sqrt{2} + 4\sqrt{2}$

$= 7\sqrt{2}$

(b) $\sqrt{48} - \sqrt{27}$

$= \sqrt{16}\sqrt{3} - \sqrt{9}\sqrt{3}$

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

$= \sqrt{3}$

(c) $2\sqrt{8} + \sqrt{72}$

$= 2(\sqrt{4}\sqrt{2}) + \sqrt{36}\sqrt{2}$

$= 2(2\sqrt{2}) + 6\sqrt{2}$

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

$= 10\sqrt{2}$

4. d) $\sqrt{360} - 2\sqrt{40}$

$= \sqrt{36}\sqrt{10} - 2(\sqrt{4}\sqrt{10})$

$= 6\sqrt{10} - 2(2\sqrt{10})$

$= 6\sqrt{10} - 4\sqrt{10}$

$= \underline{\underline{2\sqrt{10}}}$

e) $2\sqrt{5} - \sqrt{45} + 3\sqrt{20}$

$= 2\sqrt{5} - \sqrt{9}\sqrt{5} + 3(\sqrt{4}\sqrt{5})$

$= 2\sqrt{5} - 3\sqrt{5} + 3(2\sqrt{5})$

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

$= \underline{\underline{5\sqrt{5}}}$

f) $\sqrt{24} + \sqrt{150} - 2\sqrt{96}$

$= \sqrt{4}\sqrt{6} + \sqrt{25}\sqrt{6} - 2(\sqrt{16}\sqrt{6})$

$= 2\sqrt{6} + 5\sqrt{6} - 2(4\sqrt{6})$

$= 2\sqrt{6} + 5\sqrt{6} - 8\sqrt{6}$

$= \underline{\underline{-\sqrt{6}}}$

5. a) $3(2 + \sqrt{8})$

$= \underline{\underline{6 + 3\sqrt{3}}}$

(b) $4 - \sqrt{3} - 2(1 - \sqrt{3})$

$= 4 - \sqrt{3} - 2 + 2\sqrt{3}$

$= \underline{\underline{2 + \sqrt{3}}}$

(c) $(\sqrt{5} + 2)^2$

$= (\sqrt{5} + 2)(\sqrt{5} + 2)$

$= 5 + 2\sqrt{5} + 2\sqrt{5} + 4$

$= \underline{\underline{9 + 4\sqrt{5}}}$

d) $(1 + \sqrt{2})(3 - 2\sqrt{2})$

$= 3 - 2\sqrt{2} + 3\sqrt{2} - 2(\sqrt{2})(\sqrt{2})$

$= 3 + \sqrt{2} - 4$

$= \underline{\underline{\sqrt{2} - 1}}$

e) $\sqrt{\frac{1}{2}} + \sqrt{\frac{1}{4}} + \sqrt{\frac{1}{8}}$

$= \frac{1}{\sqrt{2}} + \frac{1}{2} + \frac{1}{2\sqrt{2}}$

$= \frac{\sqrt{2}}{2} + \frac{1}{2} + \frac{\sqrt{2}}{4}$

$= \frac{2\sqrt{2}}{4} + \frac{2}{4} + \frac{\sqrt{2}}{4}$

$= \frac{2\sqrt{2} + 2 + \sqrt{2}}{4}$

$= \underline{\underline{\frac{2 + 3\sqrt{2}}{4}}}$

5. f) $(3\sqrt{3}+1)(2-5\sqrt{3})$

$= 6\sqrt{3} + (5\sqrt{3})(3\sqrt{3}) + 2 - 5\sqrt{3}$

$= 6\sqrt{3} - 5\sqrt{3} + 2 + (15)(\sqrt{3})(\sqrt{3})$

$= \sqrt{3} + 2 + (15)(3)$

$= \sqrt{3} + 2 + 45$

$= \underline{\sqrt{3} + 47}$

g) $(5\sqrt{5}-4)^2$

$= (5\sqrt{5}-4)(5\sqrt{5}-4)$

$= (5\sqrt{5})(5\sqrt{5}) - 20\sqrt{5} - 20\sqrt{5} + 16$

$= (25)(5) - 40\sqrt{5} + 16$

$= 125 - 40\sqrt{5} + 16$

$= \underline{141 - 40\sqrt{5}}$

h) $(3-\sqrt{8})(4+\sqrt{2})$

$= 12 + 3\sqrt{2} - 4\sqrt{8} - (\sqrt{8})(\sqrt{2})$

$= 12 + 3\sqrt{2} - 4(2\sqrt{2}) - \sqrt{16}$

$= 12 + 3\sqrt{2} - 8\sqrt{2} - 4$

$= \underline{8 - 5\sqrt{2}}$

6 a) $\frac{1}{\sqrt{5}} = \underline{\frac{\sqrt{5}}{5}}$

b) $\frac{2}{\sqrt{3}} = \underline{\frac{2\sqrt{3}}{3}}$

c) $\frac{14}{\sqrt{7}} = \underline{\frac{14\sqrt{7}}{7}}$

d) $\frac{3\sqrt{2}}{\sqrt{3}} = \frac{3\sqrt{2}\sqrt{3}}{3}$

$= \underline{\sqrt{6}}$

e) $\frac{1}{2\sqrt{2}} = \frac{\sqrt{2}}{2\sqrt{2}\sqrt{2}}$

$= \frac{\sqrt{2}}{(2)(2)}$

$= \underline{\frac{\sqrt{2}}{4}}$

f) $\frac{-7}{2\sqrt{7}} = \frac{-7\sqrt{7}}{2\sqrt{7}\sqrt{7}}$

$= \frac{-7\sqrt{7}}{(2)(7)}$

$= \frac{-7\sqrt{7}}{14} = \underline{\frac{-\sqrt{7}}{2}}$

g) $\frac{9}{4\sqrt{6}} = \frac{9\sqrt{6}}{(4)(\sqrt{6})(\sqrt{6})}$

$= \frac{9\sqrt{6}}{(4)(6)}$

$= \frac{9\sqrt{6}}{24}$

$= \underline{\frac{3\sqrt{6}}{8}}$

h) $\frac{1}{\sqrt{2}+1} = \frac{1}{\sqrt{2}+1} \times \frac{(\sqrt{2}-1)}{(\sqrt{2}-1)}$

$= \frac{\sqrt{2}-1}{(\sqrt{2}+1)(\sqrt{2}-1)}$

$= \frac{\sqrt{2}-1}{2-1}$

$= \frac{\sqrt{2}-1}{-1}$

$= \underline{1-\sqrt{2}}$

6. i) $\frac{1}{3-\sqrt{5}} = \frac{1}{3-\sqrt{5}} \times \frac{3+\sqrt{5}}{3+\sqrt{5}}$

$= \frac{3+\sqrt{5}}{(3-\sqrt{5})(3+\sqrt{5})}$

$= \frac{3+\sqrt{5}}{9+3\sqrt{5}-3\sqrt{5}-5}$

$= \frac{3+\sqrt{5}}{4}$

(j) $\frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} = \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}-\sqrt{2}} \times \frac{\sqrt{3}+\sqrt{2}}{\sqrt{3}+\sqrt{2}}$

$= \frac{(\sqrt{3}+\sqrt{2})(\sqrt{3}+\sqrt{2})}{(\sqrt{3}-\sqrt{2})(\sqrt{3}+\sqrt{2})}$

$= \frac{3+\sqrt{3}\sqrt{2}+\sqrt{2}\sqrt{3}+2}{3-2}$

$= \frac{5+2\sqrt{6}}{1}$

$= 5+2\sqrt{6}$

k) $\frac{\sqrt{5}+1}{\sqrt{5}-\sqrt{3}} = \frac{\sqrt{5}+1}{\sqrt{5}-\sqrt{3}} \times \frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}+\sqrt{3}}$

$= \frac{(\sqrt{5}+1)(\sqrt{5}+\sqrt{3})}{(\sqrt{5}-\sqrt{3})(\sqrt{5}+\sqrt{3})}$

$= \frac{5+\sqrt{5}\sqrt{3}+\sqrt{5}+\sqrt{3}}{5-3}$

$= \frac{5+\sqrt{15}+\sqrt{5}+\sqrt{3}}{2}$

(l) $\frac{2\sqrt{2}-\sqrt{3}}{\sqrt{3}+\sqrt{2}} = \frac{2\sqrt{2}-\sqrt{3}}{\sqrt{3}+\sqrt{2}} \times \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}-\sqrt{2}}$

$= \frac{(2\sqrt{2}-\sqrt{3})(\sqrt{3}-\sqrt{2})}{(\sqrt{3}+\sqrt{2})(\sqrt{3}-\sqrt{2})}$

$= \frac{2\sqrt{6}-(2\sqrt{2})(\sqrt{2})-3+\sqrt{6}}{3-2}$

$= \frac{3\sqrt{6}-4-3}{1}$

$= 3\sqrt{6}-7$

m) $\frac{\sqrt{6}+\sqrt{3}}{\sqrt{6}-\sqrt{3}} = \frac{\sqrt{6}+\sqrt{3}}{\sqrt{6}-\sqrt{3}} \times \frac{\sqrt{6}+\sqrt{3}}{\sqrt{6}+\sqrt{3}}$

$= \frac{(\sqrt{6}+\sqrt{3})(\sqrt{6}+\sqrt{3})}{(\sqrt{6}-\sqrt{3})(\sqrt{6}+\sqrt{3})}$

$= \frac{6+\sqrt{18}+\sqrt{18}+3}{6-3}$

$= \frac{9+2\sqrt{18}}{3}$

$= \frac{9+(2)(\sqrt{9}\sqrt{2})}{3}$

$= \frac{9+(2)(3\sqrt{2})}{3}$

$= \frac{9+6\sqrt{2}}{3} = 3+2\sqrt{2}$

(n) $\frac{\sqrt{10}+2\sqrt{5}}{\sqrt{10}+\sqrt{5}} = \frac{\sqrt{10}+2\sqrt{5}}{\sqrt{10}+\sqrt{5}} \times \frac{\sqrt{10}-\sqrt{5}}{\sqrt{10}-\sqrt{5}}$

$= \frac{(\sqrt{10}+2\sqrt{5})(\sqrt{10}-\sqrt{5})}{10-5}$

$= \frac{10-\sqrt{50}+2\sqrt{50}-(2)(5)}{5}$

$= \frac{10+\sqrt{50}-10}{5}$

$= \frac{\sqrt{25}\sqrt{2}}{5}$

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

$= \sqrt{2}$