1(i) $\sqrt{441} = 21$ (ii) $3\sqrt{289} = 3 \times 17 = 51$

(iii) $2\sqrt{1024} = 64$ (iv) $\sqrt{\frac{1}{4}} = \frac{1}{2}$

(v) $\sqrt{\frac{9}{16}} = \frac{3}{4}$ (vi) $\sqrt{\frac{100}{121}} = \frac{10}{11}$

(vii) $\sqrt{6\frac{1}{4}} = \sqrt{\frac{25}{4}} = \frac{5}{2} = 2\frac{1}{2}$

(viii) $\sqrt{5\frac{4}{9}} = 2\frac{1}{3}$ (ix) $\sqrt{0 \cdot 0004} = 0 \cdot 02$

(x) $\sqrt{0 \cdot 0625} = 0 \cdot 25$

2(i) $\sqrt{28} = \sqrt{4}\sqrt{7} = 2\sqrt{7}$

(ii) $\sqrt{18} = \sqrt{9}\sqrt{2} = 3\sqrt{2}$

(iii) $\sqrt{200} = \sqrt{100}\sqrt{2} = 10\sqrt{2}$

(iv) $\sqrt{108} = \sqrt{36}\sqrt{3} = 6\sqrt{3}$

(v) $\sqrt{98} = \sqrt{49}\sqrt{2} = 7\sqrt{2}$

(vi) $\sqrt{75} = \sqrt{25}\sqrt{3} = 5\sqrt{3}$

(vii) $\sqrt{300} = \sqrt{100}\sqrt{3} = 10\sqrt{3}$

(viii) $\sqrt{27} = \sqrt{9}\sqrt{3} = 3\sqrt{3}$

(ix) $\sqrt{40} = \sqrt{4}\sqrt{10} = 2\sqrt{10}$

(x) $\sqrt{32} = \sqrt{16}\sqrt{2} = 4\sqrt{2}$

3(i)

$$\sqrt{40} + \sqrt{90} = \sqrt{4}\sqrt{10} + \sqrt{9}\sqrt{10}$$
$$= 2\sqrt{10} + 3\sqrt{10} = 5\sqrt{10}$$

(ii)

$$\sqrt{28} + \sqrt{63} = \sqrt{4}\sqrt{7} + \sqrt{9}\sqrt{7}$$
$$= 2\sqrt{7} + 3\sqrt{7} = 5\sqrt{7}$$

(iii)

$$\sqrt{500}+\sqrt{125}-\sqrt{5}=\sqrt{100}\sqrt{5}+\sqrt{25}\sqrt{5}-\sqrt{5}$$
$$=10\sqrt{5}+5\sqrt{5}-\sqrt{5}=14\sqrt{5}$$

(iv)

$$\sqrt{24}+\sqrt{54}-4\sqrt{6}=\sqrt{4}\sqrt{6}+\sqrt{9}\sqrt{6}-4\sqrt{6}$$
$$=2\sqrt{6}+3\sqrt{6}-4\sqrt{6}=\sqrt{6}$$

(v)

$$\sqrt{75}-\sqrt{27}=\sqrt{25}\sqrt{3}-\sqrt{9}\sqrt{3}$$
$$=5\sqrt{3}-3\sqrt{3}=2\sqrt{3}$$

4.

$$5\sqrt{6}-\sqrt{150}+2\sqrt{24}=5\sqrt{6}-\sqrt{25}\sqrt{6}+2\sqrt{4}\sqrt{6}$$
$$=5\sqrt{6}-5\sqrt{6}+4\sqrt{6}=4\sqrt{6}$$

5.(i) $\frac{6}{\sqrt{2}}\frac{\sqrt{2}}{\sqrt{2}}=\frac{6\sqrt{2}}{2}=3\sqrt{2}$

(ii) $\frac{7}{\sqrt{7}}\frac{\sqrt{7}}{\sqrt{7}}=\frac{7\sqrt{7}}{7}=\sqrt{7}$

(iii) $\frac{1}{\sqrt{2}}\frac{\sqrt{2}}{\sqrt{2}}=\frac{\sqrt{2}}{2}$

(iv) $\frac{3}{\sqrt{5}}\frac{\sqrt{5}}{\sqrt{5}}=\frac{3\sqrt{5}}{5}$

(v)

$$\frac{1}{\left(\sqrt{5}-2\right)}\frac{\left(\sqrt{5}+2\right)}{\left(\sqrt{5}+2\right)}=\frac{\left(\sqrt{5}+2\right)}{\left(\sqrt{5}\right)^2-2^2}$$
$$=\frac{\sqrt{5}+2}{5-4}=\sqrt{5}+2$$

(vi)

$$\frac{1}{\left(3+\sqrt{3}\right)}\frac{\left(3-\sqrt{3}\right)}{\left(3-\sqrt{3}\right)}=\frac{3-\sqrt{3}}{3^2-\left(\sqrt{3}\right)^2}$$
$$=\frac{3-\sqrt{3}}{9-3}=\frac{3-\sqrt{3}}{6}$$

(vii)

$$\frac{5\sqrt{2}}{\left(\sqrt{2}-1\right)}\frac{\left(\sqrt{2}+1\right)}{\left(\sqrt{2}+1\right)}=\frac{5\sqrt{2}\sqrt{2}+5\sqrt{2}}{\left(\sqrt{2}\right)^2-1}$$

$$=\frac{10+5\sqrt{2}}{2-1}=10+5\sqrt{2}$$

(viii)

$$\frac{\left(2-\sqrt{3}\right)}{\left(5-\sqrt{3}\right)}\frac{\left(5+\sqrt{3}\right)}{\left(5+\sqrt{3}\right)}=\frac{2\left(5+\sqrt{3}\right)-\sqrt{3}\left(5+\sqrt{3}\right)}{5^2-\left(\sqrt{3}\right)^2}$$

$$=\frac{10+2\sqrt{3}-5\sqrt{3}-3}{25-3}$$

$$=\frac{7-3\sqrt{3}}{25-3}=\frac{13-3\sqrt{3}}{22}$$

(ix)

$$\frac{1}{\left(\sqrt{3}-\sqrt{2}\right)}\frac{\left(\sqrt{3}+\sqrt{2}\right)}{\left(\sqrt{3}+\sqrt{2}\right)}=\frac{\sqrt{3}+\sqrt{2}}{\left(\sqrt{3}\right)^2-\left(\sqrt{2}\right)^2}$$

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

(x)

$$\frac{\left(\sqrt{3}-7\right)}{\left(\sqrt{3}+7\right)}\frac{\left(\sqrt{3}-7\right)}{\left(\sqrt{3}-7\right)}=\frac{\sqrt{3}\left(\sqrt{3}-7\right)-7\left(\sqrt{3}-7\right)}{\left(\sqrt{3}\right)^2-7^2}$$

$$=\frac{3-7\sqrt{3}-7\sqrt{3}+49}{3-49}$$

$$=\frac{52-14\sqrt{3}}{-46}=\frac{7\sqrt{3}-26}{23}$$

(Divide above and below by -2)

6.

$$\frac{1}{a}=\frac{1}{\left(\sqrt{10}-3\right)}\frac{\left(\sqrt{10}+3\right)}{\left(\sqrt{10}+3\right)}$$

$$=\frac{\sqrt{10}+3}{\left(\sqrt{10}\right)^2-3^2}=\frac{\sqrt{10}+3}{10-9}$$

$$=\sqrt{10}+3$$

$$a+6=\sqrt{10}-3+6=\sqrt{10}+3$$

$$=\frac{1}{a}$$

7.

$$\frac{11\left(\sqrt{2}-1\right)+2}{2\left(\sqrt{2}-1\right)+1}=\frac{11\sqrt{2}-11+2}{2\sqrt{2}-2+1}$$

$$=\frac{\left(11\sqrt{2}-9\right)}{\left(2\sqrt{2}-1\right)}\frac{\left(2\sqrt{2}+1\right)}{\left(2\sqrt{2}+1\right)}$$

$$=\frac{11\sqrt{2}\left(2\sqrt{2}+1\right)-9\left(2\sqrt{2}+1\right)}{\left(2\sqrt{2}\right)^2-1^2}$$

$$=\frac{22\sqrt{2}\sqrt{2}+11\sqrt{2}-18\sqrt{2}-9}{\left(2\sqrt{2}\right)\left(2\sqrt{2}\right)-1}$$

$$=\frac{22\times 2-7\sqrt{2}-9}{8-1}=\frac{35-7\sqrt{2}}{7}$$

$=5-\sqrt{2}$ (Divide above and below by 7)

8(i)

$$\left\{\begin{matrix}ax^2+bx+c=0\\x^2-4x-2=0\end{matrix}\right\}\quad a=1,\ b=-4,\ c=-2$$

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}=\frac{-(-4)\pm\sqrt{(-4)^2-4(1)(-2)}}{2(1)}$$

$$x=\frac{4\pm\sqrt{24}}{2}=\frac{4\pm\sqrt{4}\sqrt{6}}{2}=\frac{4\pm 2\sqrt{6}}{2}=2\pm\sqrt{6}$$

(ii)

$$\left\{\begin{matrix}ax^2+bx+c=0\\x^2-6x+4=0\end{matrix}\right\}\quad a=1,\ b=-6,\ c=4$$

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}=\frac{-(-6)\pm\sqrt{(-6)^2-4(1)(4)}}{2(1)}$$

$$x=\frac{6\pm\sqrt{20}}{2}=\frac{6\pm\sqrt{4}\sqrt{5}}{2}=\frac{6\pm 2\sqrt{5}}{2}=3\pm\sqrt{5}$$

(iii)

$$\left.\begin{matrix} ax^2+bx+c=0 \\ x^2+2x-1=0 \end{matrix}\right\} \quad a=1,\ b=2,\ c=-1$$

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}=\frac{-2\pm\sqrt{2^2-4(1)(-1)}}{2(1)}$$

$$x=\frac{-2\pm\sqrt{8}}{2}=\frac{-2\pm\sqrt{4}\sqrt{2}}{2}=\frac{-2\pm2\sqrt{2}}{2}=-1\pm\sqrt{2}$$

(iv)

$$\left.\begin{matrix} ax^2+bx+c=0 \\ x^2-8x+9=0 \end{matrix}\right\} \quad a=1,\ b=-8,\ c=9$$

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}=\frac{-(-8)\pm\sqrt{(-8)^2-4(1)(9)}}{2(1)}$$

$$x=\frac{8\pm\sqrt{28}}{2}=\frac{8\pm\sqrt{4}\sqrt{7}}{2}=\frac{8\pm2\sqrt{7}}{2}=4\pm\sqrt{7}$$

9.

$$3\frac{\sqrt{2}}{\sqrt{3}}\frac{\sqrt{3}}{\sqrt{3}}-\frac{\sqrt{3}}{\sqrt{2}}\frac{\sqrt{2}}{\sqrt{2}}+\sqrt{24}$$

$$=\frac{3\sqrt{6}}{3}-\frac{\sqrt{6}}{2}+\sqrt{4}\sqrt{6}$$

$$=\left(1-\frac{1}{2}+2\right)\sqrt{6}=\frac{5\sqrt{6}}{2}$$

10.

$$\frac{\sqrt{2}}{\sqrt{5}}\frac{\sqrt{5}}{\sqrt{5}}+\frac{\sqrt{5}}{\sqrt{2}}\frac{\sqrt{2}}{\sqrt{2}}=\frac{\sqrt{10}}{5}+\frac{\sqrt{10}}{2}$$

$$=\left(\frac{1}{5}+\frac{1}{2}\right)\sqrt{10}=\frac{7\sqrt{10}}{10}$$