5.2

1 a) $2\sqrt{5}(7\sqrt{3}) = 14\sqrt{15}$

b) $-\sqrt{32}(7\sqrt{2}) = -7\sqrt{64}$
$= -7 \cdot 8$
$= -56$

c) $2\sqrt[4]{48}\sqrt[4]{5}$
$2\sqrt[4]{240}$
$2\sqrt[4]{16}\sqrt[4]{15}$
$2 \cdot 2\sqrt[4]{15}$
$4\sqrt[4]{15}$

d) $4\sqrt{19x}\sqrt{2x^2} = 4\sqrt{38x^3}$
$= 4\sqrt{x^2}\sqrt{38x}$
$= 4x\sqrt{38x}$

e) $\sqrt[3]{54y^7}\sqrt[3]{6y^4}$
$\sqrt[3]{27y^6}\sqrt[3]{2y}\ \sqrt[3]{y^3}\sqrt[3]{6y}$
$3y^2\sqrt[3]{2y}\ y\sqrt[3]{6y}$
$3y^3\sqrt[3]{12y^2}$

f) $\sqrt{6t} \cdot 3t^2 \cdot \sqrt{\frac{t}{4}}$
$\sqrt{6t} \cdot \frac{1}{2}\sqrt{t} \cdot 3t^2$
$\frac{1}{2}\sqrt{6t^2} \cdot 3t^2$
$\frac{1}{2} + \sqrt{6} \cdot 3t^2$
$\frac{3}{2} + \sqrt[3]{6}$

2. a) $3\sqrt{11} - 4\sqrt{77}$

b) $-14\sqrt{10} - 3\sqrt{12} + \sqrt{26}$
$-14\sqrt{10} - 3\sqrt{4}\sqrt{3} + \sqrt{26}$
$-14\sqrt{10} - 6\sqrt{3} + \sqrt{26}$

c) $2\sqrt{y^2} + \sqrt{y}$
$2y + \sqrt{y}$

d) $z^2\sqrt{36} - 5z^2\sqrt{3} + 2z\sqrt{3}$
$6z^2 - 5\sqrt{3}z^2 + 2z\sqrt{3}$

3 a) $-3\sqrt{2} + 12 + 9\sqrt{2}$
$6\sqrt{2} + 12$

b) $-7 - 14\sqrt{6} + 5\sqrt{6} + 8$
$1 - 9\sqrt{6}$

c) $4\sqrt{15j} + 32\sqrt{5} - 3\sqrt{15j} + \sqrt{5}$
$\sqrt{15j} + 33\sqrt{5}$

d) $3 - 12\sqrt[3]{4k} - 2\sqrt[3]{32k}$
$3 - 12\sqrt[3]{4k} - 2\sqrt[3]{8}\sqrt[3]{4k}$
$3 - 12\sqrt[3]{4k} - 2 \cdot 2\sqrt[3]{4k}$
$3 - 12\sqrt[3]{4k} - 4\sqrt[3]{4k}$
$3 - 16\sqrt[3]{4k}$

4 a) $8\sqrt{14} - 24\sqrt{7} + 2\sqrt{2} - 6$

b) $16 - 81\sqrt{25}$
$16 - 81(5)$
$16 - 405$
-389

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4c) $\sqrt{9} - \sqrt{45} + 2\sqrt{45} - 2\sqrt{225}$

$3 + \sqrt{45} - 2(15)$

$3 + \sqrt{9}\sqrt{5} - 30$

$3\sqrt{5} - 27$

d) $36\sqrt[3]{4} + 16\sqrt{169} - 48\sqrt{13}\sqrt[3]{2}$

$36\sqrt[3]{4} + 16(13) - 48\sqrt{13}\sqrt[3]{2}$

$36\sqrt[3]{4} + 208 - 48\sqrt{13}\sqrt[3]{2}$

e) $-2\sqrt{12} + 3\sqrt{30} - \sqrt{6} + 4\sqrt{2} - 6\sqrt{5} + 2$

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

$-4\sqrt{3} + 3\sqrt{30} - \sqrt{6} + 4\sqrt{2} - 6\sqrt{5} + 2$

5a) $15\sqrt{2c^2} - 90\sqrt{c} + 2\sqrt{2c} - 12$

$15c\sqrt{2} - 90\sqrt{c} + 2\sqrt{2c} - 12$ $\quad c \geq 0$

b) $2 + 7\sqrt{5x} - 20\sqrt{8x^3} - 70\sqrt{40x^4}$

$2 + 7\sqrt{5x} - 20\sqrt{4x^2}\sqrt{2x} - 70\sqrt{4x^4}\sqrt{10}$

$2 + 7\sqrt{5x} - 40x\sqrt{2x} - 140x^2\sqrt{10}$ $\quad x \geq 0$

c) $81\sqrt{4m^2} + 16\sqrt{36m^2} - 72\sqrt{12m^2}$

$162m + 96m - 72m\sqrt{4}\sqrt{3}$

$258m - 144m\sqrt{3}$ $\quad m \geq 0$

d) $20r\sqrt[3]{6r^2} + 30r\sqrt[3]{12r} - 8\sqrt[3]{24r^3} - 12\sqrt[3]{48r^2}$

$-8\sqrt[3]{8r^3}\sqrt[3]{3} - 12\sqrt[3]{8}\sqrt[3]{6r^2}$

$20r\sqrt[3]{6r^2} + 30r\sqrt[3]{12r} - 16r\sqrt[3]{3} - 24\sqrt[3]{6r^2}$ $\quad$ no restrictions.

6 a) $\sqrt{8} = \sqrt{4}\sqrt{2} = 2\sqrt{2}$

b) $\frac{-\sqrt{4}}{2} = \frac{-2}{2} = -1$

c) $3\sqrt{2}$

d) $3\sqrt{\frac{45}{7}m^2}$

$\frac{3m\sqrt{45}}{\sqrt{7}}$

$\frac{3m\sqrt{315}}{7}$

$\frac{3}{7}m\sqrt{9}\sqrt{35}$ $\quad \frac{9}{7}m\sqrt{35}$

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7a $\dfrac{9\sqrt{144p^4}\sqrt{3p} - 7\sqrt{9p^4}\sqrt{3p}}{\sqrt{p^4}\sqrt{33}} \rightarrow \dfrac{108p^2\sqrt{3p} - 21p^2\sqrt{3p}}{p^2\sqrt{33}}$

$\dfrac{87p^2\sqrt{3p}}{p^2\sqrt{33}} \rightarrow \dfrac{87\sqrt{3p}}{\sqrt{33}} \rightarrow \dfrac{87\sqrt{p}}{\sqrt{11}} \rightarrow \dfrac{87\sqrt{11p}}{11}$

b) $\dfrac{6\sqrt[3]{v^6}\sqrt[3]{4v}}{\sqrt[3]{14v}} \quad \dfrac{6v^2\sqrt[3]{4v}}{\sqrt[3]{14v}} = 6v^2\sqrt[3]{\frac{2}{7}} \quad \dfrac{6v^2\sqrt[3]{2}}{\sqrt[3]{7}} \left(\dfrac{\sqrt[3]{7\cdot7}}{\sqrt[3]{7\cdot7}}\right)$

$\dfrac{6v^2\sqrt[3]{98}}{7}$

8a) $\dfrac{20\sqrt{10}}{10} = 2\sqrt{10}$ b) $-\dfrac{\sqrt{7m(21)}}{7m} = -\dfrac{\sqrt{147m}}{7m} = -\dfrac{\sqrt{49}\sqrt{3m}}{7m}$

$= -\dfrac{7\sqrt{3m}}{7m} = -\dfrac{\sqrt{3m}}{m}$

c) $-\frac{2}{3}\dfrac{\sqrt{5}}{\sqrt{12u}} = \dfrac{-2\sqrt{5}}{3\sqrt{4}\sqrt{3u}} = -\dfrac{2\sqrt{5}}{6\sqrt{3u}} = -\dfrac{\sqrt{5}}{3\sqrt{3u}} = \dfrac{-\sqrt{15u}}{9u}$

d) $20\sqrt[3]{\frac{6t}{5}} = 20\dfrac{\sqrt[3]{6t}}{\sqrt[3]{5}} = 20\dfrac{\sqrt[3]{6t\cdot5\cdot5}}{\sqrt[3]{5\cdot5\cdot5}} = \dfrac{20\sqrt[3]{150t}}{5} = 4\sqrt[3]{150t}$

9a) $(2\sqrt{3}+1)(2\sqrt{3}-1) = 4(3) - 1 = 11$

b) $(7-\sqrt{11})(7+\sqrt{11}) = 49 - 11 = 38$

c) $(8\sqrt{z} - 3\sqrt{7})(8\sqrt{z}+3\sqrt{7}) = 64z - 63$

d) $(19\sqrt{h} + 4\sqrt{2h})(19\sqrt{h} - 4\sqrt{2h}) = 361h - 16(2h)$

$361h - 32h$

$329h$

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10a) $\frac{5}{2-\sqrt{3}}\left(\frac{2+\sqrt{3}}{2+\sqrt{3}}\right) = \frac{10+5\sqrt{3}}{4-3} = 10+5\sqrt{3}$

b) $\frac{7\sqrt{2}}{\sqrt{6}+8}\left(\frac{\sqrt{6}-8}{\sqrt{6}-8}\right) = \frac{7\sqrt{12}-56\sqrt{2}}{6-64} = \frac{7\sqrt{4}\sqrt{3}-56\sqrt{2}}{-58}$

$\frac{14\sqrt{3}-56\sqrt{2}}{-58} = \frac{28\sqrt{2}-7\sqrt{3}}{29}$

c) $\frac{-\sqrt{7}}{\sqrt{5}-2\sqrt{2}}\left(\frac{\sqrt{5}+2\sqrt{2}}{\sqrt{5}+2\sqrt{2}}\right) = \frac{-\sqrt{35}-2\sqrt{14}}{5-8} = \frac{\sqrt{35}+2\sqrt{14}}{3}$

d) $\frac{\sqrt{3}+\sqrt{13}}{\sqrt{3}-\sqrt{13}}\left(\frac{\sqrt{3}+\sqrt{13}}{\sqrt{3}+\sqrt{13}}\right) = \frac{3+13+2\sqrt{39}}{3-13} = \frac{16+2\sqrt{39}}{-10} = \frac{-8-\sqrt{39}}{5}$

11a) $\frac{4r}{\sqrt{6}r+9}\left(\frac{\sqrt{6}r-9}{\sqrt{6}r-9}\right) = \frac{4\sqrt{6}r^2-36r}{6r^2-81}$

b) $\frac{18}{\sqrt{8}} = \frac{18}{\sqrt{4}\sqrt{2}} = \frac{18}{2\sqrt{2}} = \frac{9}{\sqrt{2}} = \frac{9\sqrt{2}}{2}$

c) $\frac{8}{4-\sqrt{6t}}\left(\frac{4+\sqrt{6t}}{4+\sqrt{6t}}\right) = \frac{32+8\sqrt{6t}}{16-6t} = \frac{16+4\sqrt{6t}}{8-3t}$

d) $\frac{5\sqrt{3y}}{\sqrt{10}+2}\left(\frac{\sqrt{10}-2}{\sqrt{10}-2}\right) = \frac{5\sqrt{30y}-10\sqrt{3y}}{10-4}$ $\frac{5\sqrt{30y}-10\sqrt{3y}}{6}$

12. $c^2+7c\sqrt{3}c+c^2\sqrt{c}+7c\sqrt{3c^2}$
$c^2+7c\sqrt{3}c+c^2\sqrt{c}+7c^2\sqrt{3}$

13 $\frac{4}{3-2\sqrt{2}}\left(\frac{3+2\sqrt{2}}{3+2\sqrt{2}}\right) = \frac{12+8\sqrt{2}}{9-8} = 12+8\sqrt{2}$ fixed.

14 $\frac{2}{\sqrt{5}-1}\left(\frac{\sqrt{5}+1}{\sqrt{5}+1}\right) = \frac{2\sqrt{5}+2}{5-4} = \frac{2\sqrt{5}+2}{4} = \frac{\sqrt{5}+1}{2}$

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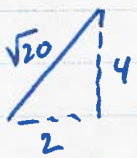
15 a) $T = 2\pi\sqrt{\frac{L}{10}}$ $\quad \frac{2\pi\sqrt{L}}{\sqrt{10}}$ $\quad \frac{2\pi\sqrt{10L}}{10}$ $\quad \frac{\pi\sqrt{10L}}{5}$

b) one cycle: $\frac{\pi\sqrt{10\cdot 27}}{5}$ $\quad \frac{3\pi\sqrt{30}}{5}$ $\quad \therefore$ 3 cycles $\frac{9\pi\sqrt{30}}{5}$

~ 31 seconds

16. 

perimeter $\sqrt{20} + \sqrt{20} + 4$

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

$4\sqrt{5} + 4$ units

$u^2 = 9245$ $\quad u = \sqrt{9245}$

$= \sqrt{1849}\sqrt{5}$

$= 43\sqrt{5}$

$\therefore$ perimeter $(4\sqrt{5}+4)(43\sqrt{5})$

$172\sqrt{25} + 172\sqrt{5}$

$860 + 172\sqrt{5}$ m

17. $\left(\frac{1+\sqrt{5}}{2-\sqrt{3}}\right)\left(\frac{1-\sqrt{5}}{2-\sqrt{3}}\right) = \frac{1-5}{4+3-4\sqrt{3}} = \frac{-4}{7-4\sqrt{3}}\left(\frac{7+4\sqrt{3}}{7+4\sqrt{3}}\right)$

$\frac{-28-16\sqrt{3}}{49-48}$ $\qquad -28-16\sqrt{3}$

18 a) 

$x^3 = 192$

$x = \sqrt[3]{192}$

$x = \sqrt[3]{64}\sqrt[3]{3}$

$x = 4\sqrt[3]{3}$ mm

$V = \frac{1}{4} \therefore V = 48$

b) $x^3 = 48$

$x = \sqrt[3]{48}$

$x = \sqrt[3]{8}\sqrt[3]{6}$

$x = 2\sqrt[3]{6}$

c) $4\sqrt[3]{3} : 2\sqrt[3]{6}$

$2\sqrt[3]{3} : \sqrt[3]{6}$

19 a) $3 - 5x \geq 0$

$-5x \geq -3$

$x \leq 3/5$

b) $\sqrt{}$ of negatives, division by zero

c) any without variables $\sqrt{1234}$

any with odd roots $\sqrt[3]{x}$

any with even roots, even powers $\sqrt[4]{x^2y^4}$

20. $\frac{2c - c\sqrt{25}}{\sqrt{3}}$ $\frac{2\sqrt{3}c - \sqrt{75}c}{3}$ $\frac{2\sqrt{3}c - 5\sqrt{3}c}{3}$ $\frac{-3\sqrt{3}c}{3}$

$\therefore -\sqrt{3}c$

21. $A(\text{face}) = \frac{1}{2} 5\sqrt{7}(3\sqrt{2})$

$V = \frac{1}{2} 5\sqrt{7}(3\sqrt{2})(7\sqrt{14})$

$V = \frac{1}{2} 105\sqrt{14 \cdot 14}$

$V = \frac{1}{2} 105 \cdot 14$

$V = 105 \cdot 7$ $735\,cm^3$

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