

Question #1

a.) $(x^3 - 2x^2 + 2x - 5) \div (x+1)$

$$\begin{array}{r} x^2 - 3x + 5 \\ x+1 \overline{) x^3 - 2x^2 + 2x - 5} \\ \underline{-(x^3 + x^2)} \\ -3x^2 + 2x - 5 \\ \underline{-(-3x^2 - 3x)} \\ 5x - 5 \\ \underline{-(5x + 5)} \\ -10 \end{array}$$

$$\boxed{x^2 - 3x + 5 - \frac{10}{x+1}}$$

b.) $(3x^4 + 2x^3 - 11x^2 - 2x + 5) \div (x^2 + 1)$

$$\begin{array}{r} 3x^2 + 2x - 5 \\ x^2 + 0x + 1 \overline{) 3x^4 + 2x^3 - 11x^2 - 2x + 5} \\ \underline{-(3x^4 + 0x^3 - 6x^2)} \\ 2x^3 - 5x^2 - 2x + 5 \\ \underline{-(2x^3 + 0x^2 - 4x)} \\ -5x^2 + 4x + 5 \\ \underline{-(-5x^2 + 0x + 10)} \\ 4x - 5 \end{array}$$

$$\boxed{3x^2 + 2x - 5 + \frac{4x - 5}{x^2 + 1}}$$

Question #2

b.) $\frac{1}{x} + \frac{1}{y}$
 $\frac{1}{x^2} - \frac{1}{y^2}$

LCD = x^2y^2

$$\frac{x^2y^2 \left(\frac{1}{x} + \frac{1}{y} \right)}{x^2y^2 \left(\frac{1}{x^2} - \frac{1}{y^2} \right)}$$

$$\frac{x^2y^2 \left(\frac{1}{x} \right) + x^2y^2 \left(\frac{1}{y} \right)}{x^2y^2 \left(\frac{1}{x^2} \right) - x^2y^2 \left(\frac{1}{y^2} \right)}$$

$$\frac{xy^2 + x^2y}{y^2 - x^2}$$

$$\frac{xy(y+x)}{(y-x)(y+x)} = \boxed{\frac{xy}{y-x}}$$

Question #2

a.) $\frac{4}{x^2-1} - \frac{3}{x+1}$

$\frac{5}{x^2-1} - \frac{2}{x-1}$

$\frac{4}{(x+1)(x-1)} - \frac{3}{x+1}$ LCD = (x+1)(x-1)

$\frac{5}{(x+1)(x-1)} - \frac{2}{x-1}$

$(x+1)(x-1) \left[\frac{4}{(x+1)(x-1)} - \frac{3}{x+1} \right]$

$(x+1)(x-1) \left[\frac{5}{(x+1)(x-1)} - \frac{2}{x-1} \right]$

$\left(\frac{4}{(x+1)(x-1)} \right) (x+1)(x-1) - \left(\frac{3}{x+1} \right) (x+1)(x-1)$

$\left(\frac{5}{(x+1)(x-1)} \right) (x+1)(x-1) - \left(\frac{2}{x-1} \right) (x+1)(x-1)$

$\frac{4-3(x-1)}{5-2(x+1)}$

$\frac{4-3x+3}{5-2x-2}$

$\frac{4-3x+3}{5-2x-2} = \frac{1-3x}{3-2x}$

Question #3

a.) $\frac{x-2}{2x} + 1 = \frac{x+1}{x}$

LCD = 2x RVC: x ≠ 0

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

$x-2+2x = 2(x+1)$

$3x-2 = 2x+2$

$3x-2x = 2+2$

$x = 4$

b.) $\frac{x+2}{x+10} = \frac{x-3}{x+4}$ RVC: x = -10, -4

LCD = (x+10)(x+4)

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

$(x+2)(x+4) = (x-3)(x+10)$

$x^2+6x+8 = x^2+7x-30$

$0 = x^2+7x-30 - x^2-6x-8$

$0 = x-38$

$38 = x$

c.) $\frac{8}{x^2-9} + \frac{4}{x+3} = \frac{2}{x-3}$ RVC: x ≠ 3, -3

$\left(\frac{8}{(x+3)(x-3)} \right) (x+3)(x-3) + \left(\frac{4}{x+3} \right) (x+3)(x-3) = \left(\frac{2}{x-3} \right) (x+3)(x-3)$

$8+4(x-3) = 2(x+3)$

$8+4x-12 = 2x+6$

$4x-4 = 2x+6$

$4x-2x = 6+4$

$2x = 10$

$x = 5$

Question #3 continued

d.) $\frac{1}{x-2} + \frac{1}{x+2} = \frac{4}{x^2-4}$
 $(x+2)(x-2)$ R.V.: $x \neq 2, -2$

LCD = $(x+2)(x-2)$

$\left(\frac{1}{x-2}\right)(x+2)(x-2) + \left(\frac{1}{x+2}\right)(x+2)(x-2) = \left(\frac{4}{(x+2)(x-2)}\right)(x+2)(x-2)$

$x+2 + x-2 = 4$

$2x = 4$

$x = 2 =$ Restricted value

No solution

e.) $\frac{2x-1}{x^2+2x-8} + \frac{2}{x+4} = \frac{1}{x-2}$
 $(x+4)(x-2)$ R.V. $x \neq -4, 2$

LCD = $(x+4)(x-2)$

$\left(\frac{2x-1}{(x+4)(x-2)}\right)(x+4)(x-2) + \left(\frac{2}{x+4}\right)(x+4)(x-2) = \left(\frac{1}{x-2}\right)(x+4)(x-2)$

$2x-1 + 2(x-2) = x+4$

$2x-1 + 2x-4 = x+4$

$4x-5 = x+4$

$4x-x = 4+5$

$3x = 9$

$x = 3$

Question #11

a.) $5\sqrt{12} + 16\sqrt{27}$
 $5(2\sqrt{3}) + 16(3\sqrt{3})$
 $10\sqrt{3} + 48\sqrt{3}$
 $58\sqrt{3}$

b.) $\sqrt{5a} + 2\sqrt{45a^3}$
 $\sqrt{5a} + 2(3a\sqrt{5a})$
 $\sqrt{5a} + 6a\sqrt{5a}$
 $(1+6a)\sqrt{5a}$

c.) $\sqrt{10} \cdot \sqrt{5} = \sqrt{50} = \boxed{5\sqrt{2}}$

e.) $\frac{\sqrt{40x^9}}{\sqrt{8x}} = \sqrt{\frac{40x^9}{8x}} = \sqrt{5x^8} = \boxed{4\sqrt{5x}}$

d.) $\sqrt{5a^7} \cdot \sqrt{15a^3} = \sqrt{75a^{10}} = \boxed{5a^5\sqrt{3}}$

f.) $(2\sqrt{5}-\sqrt{7})(3\sqrt{5}+4\sqrt{7})$

$6\sqrt{25} + 8\sqrt{35} - 3\sqrt{35} - 4\sqrt{49}$

$6 \cdot 5 + 5\sqrt{35} - 4 \cdot 7$

$30 + 5\sqrt{35} - 28$

$2 + 5\sqrt{35}$

Question #4

rate x time = distance

upstream	$b-3$	t	4
downstream	$b+3$	t	10

$(b-3)t = 4$

$(b+3)t = 10$

$t = \frac{4}{b-3} \rightarrow t = \frac{10}{b+3}$

$\frac{4}{b-3} = \frac{10}{b+3}$

$4(b+3) = 10(b-3)$

$4b+12 = 10b-30$

$12+30 = 10b-4b$

$\frac{42}{6} = \frac{6b}{6}$

$b = 7$

The speed of the boat is 7 mph

Question #5

rate x time = distance

bicycle	b	t	15
motorcycle	b+30	t	40

$$bt = 15 \quad (b+30)t = 40$$

$$t = \frac{15}{b} \quad t = \frac{40}{b+30}$$

$$\frac{15}{b} = \frac{40}{b+30}$$

$$15(b+30) = 40b$$

$$15b + 300 = 40b$$

$$300 = 40b - 15b$$

$$300 = 25b$$

$$b = 12$$

The bicycle's speed is 12 mph and the motorcycle's speed is 32 mph.

Question #6

upstream	$8-c$	t	9
downstream	$8+c$	t	15

$$(8-c)t = 9 \quad (8+c)t = 15$$

$$t = \frac{9}{8-c} \quad t = \frac{15}{8+c}$$

$$\frac{9}{8-c} = \frac{15}{8+c}$$

$$9(8+c) = 15(8-c)$$

$$72 + 9c = 120 - 15c$$

$$9c + 15c = 120 - 72$$

$$24c = 48$$

$$c = 2$$

The current is 2 mph

Question #7

	rate	x time	= job
3 hrs 1st pipe	$\frac{1}{3}$	t	$\frac{1}{3}t$
6 hrs 2nd pipe	$\frac{1}{6}$	t	$\frac{1}{6}t$

$$\frac{1}{3}t + \frac{1}{6}t = 1 \quad \text{LCD} = 6$$

$$(\frac{1}{3}t)6 + (\frac{1}{6}t)6 = 1(6)$$

$$2t + t = 6$$

$$3t = 6$$

$$t = 2$$

It takes 2 hours

Question #8

	rate	x time	= job
x+5 Low	$\frac{1}{x+5}$	b	$\frac{b}{x+5}$
x Bad	$\frac{1}{x}$	b	$\frac{b}{x}$

$$\frac{b}{x+5} + \frac{b}{x} = 1 \quad \text{LCD} = x(x+5)$$

$$\left(\frac{b}{x+5}\right)x(x+5) + \left(\frac{b}{x}\right)x(x+5) = 1x(x+5)$$

$$bx + b(x+5) = x(x+5)$$

$$bx + bx + 30 = x^2 + 5x$$

$$12x + 30 = x^2 + 5x$$

$$0 = x^2 + 5x - 12x - 30$$

$$0 = x^2 - 7x - 30$$

$$0 = (x-10)(x+3)$$

$$x-10=0$$

$$x=10$$

$$\text{or } x+3=0$$

$$x=-3$$

cannot apply

Question #11

a.) $5\sqrt{12} + 16\sqrt{27}$
 $5\sqrt{4}\sqrt{3} + 16\sqrt{9}\sqrt{3}$
 $5 \cdot 2\sqrt{3} + 16 \cdot 3\sqrt{3}$
 $10\sqrt{3} + 48\sqrt{3}$
 $58\sqrt{3}$

b.) $\sqrt{5a} + 2\sqrt{45a^3}$
 $\sqrt{5a} + 2\sqrt{9\sqrt{a^2}\sqrt{5a}}$
 $\sqrt{5a} + 2 \cdot 3a\sqrt{5a}$
 $\sqrt{5a} + 6a\sqrt{5a}$
 $(1+6a)\sqrt{5a}$

c.) $\sqrt{10}\sqrt{5}$
 $\sqrt{50}$
 $\sqrt{25}\sqrt{2}$
 $5\sqrt{2}$

d.) $\sqrt{5a^7}\sqrt{15a^3}$
 $\sqrt{75a^{10}}$
 $\sqrt{25}\sqrt{a^{10}}\sqrt{3}$
 $5a^5\sqrt{3}$

e.) $\sqrt{40xy^3}$
 $\sqrt{8x}$
 $\sqrt{5y^3}$
 $y\sqrt{5y}$

f.) $(2\sqrt{5}-\sqrt{7})(3\sqrt{5}+4\sqrt{7})$
 $6\sqrt{25} + 8\sqrt{35} - 3\sqrt{35} - 4\sqrt{49}$
 $6 \cdot 5 + 5\sqrt{35} - 4 \cdot 7$
 $30 + 5\sqrt{35} - 28$
 $2 + 5\sqrt{35}$

Question #12

a.) $\frac{4\sqrt{5}\sqrt{2}}{3\sqrt{2}\sqrt{2}}$
 $\frac{4\sqrt{10}}{3 \cdot 2}$
 $\frac{4\sqrt{10}}{6}$
 $\frac{2\sqrt{10}}{3}$

b.) $\frac{12}{\sqrt{72}}$
 $\frac{12}{\sqrt{36}\sqrt{2}}$
 $\frac{12}{6\sqrt{2}}$
 $\frac{2}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}}$
 $\frac{2\sqrt{2}}{2} = \sqrt{2}$

c.) $\frac{\sqrt{12}}{\sqrt{3}-1} \cdot \frac{\sqrt{3}+1}{\sqrt{3}+1}$
 $\frac{\sqrt{36} + \sqrt{12}}{3-1}$
 $\frac{6 + 2\sqrt{3}}{2}$
 $3 + \sqrt{3}$

d.) $\frac{5}{\sqrt[3]{9}} \cdot \frac{\sqrt[3]{3}}{\sqrt[3]{3}}$
 $\frac{5\sqrt[3]{3}}{3}$

e.) $\frac{7}{\sqrt{8}} \cdot \frac{\sqrt{4}}{\sqrt{4}}$
 $\frac{7\sqrt{4}}{2}$

f.) $\frac{3-\sqrt{2}}{5+\sqrt{6}} \cdot \frac{5-\sqrt{6}}{5-\sqrt{6}}$
 $\frac{15-3\sqrt{6}-5\sqrt{2}+\sqrt{12}}{25-6}$
 $\frac{15-3\sqrt{6}-5\sqrt{2}+2\sqrt{3}}{19}$

Question #13

a.) $\sqrt{m}-5=0$
 $\sqrt{m}=5$
 $(\sqrt{m})^2=(5)^2$
 $m=25$

check:
 $\sqrt{25}-5=0$
 $5-5=0$
 $0=0 \checkmark$
 $m=25$

b.) $\sqrt{5m+4}=3\sqrt{m}$
 $(\sqrt{5m+4})^2=(3\sqrt{m})^2$
 $5m+4=9m$
 $4=9m-5m$
 $4=4m$
 $m=1$

check
 $\sqrt{5(1)+4}=3\sqrt{1}$
 $\sqrt{9}=3 \cdot 1$
 $3=3 \checkmark$
 $m=1$

c.) $\sqrt{4y+1}=y-1$
 $(\sqrt{4y+1})^2=(y-1)^2$
 $4y+1=y^2-2y+1$
 $0=y^2-2y+1-4y-1$
 $0=y^2-6y$
 $0=y(y-6)$
 $y=0$ or $y-6=0$
 $y=6$

check $y=0$
 $\sqrt{4(0)+1}=0-1$
 $\sqrt{1}=-1$
 $1 \neq -1 \times$

check $y=6$
 $\sqrt{4(6)+1}=6-1$
 $\sqrt{25}=5$
 $5=5 \checkmark$

$y=6$

d.) $\sqrt[3]{x+5}=2$
 $(\sqrt[3]{x+5})^3=(2)^3$
 $x+5=8$
 $x=3$

check
 $\sqrt[3]{3+5}=2$
 $\sqrt[3]{8}=2$
 $2=2 \checkmark$

$x=3$

e.) $\sqrt{5t+3}=2$
 $(\sqrt{5t+3})^2=(2)^2$
 $5t+3=4$
 $5t=4-3$
 $5t=1$
 $t=1/5$

check:
 $\sqrt{5(\frac{1}{5})+3}=2$
 $\sqrt{1+3}=2$
 $\sqrt{4}=2$
 $2=2 \checkmark$

$t=1/5$

Question #3 continued

f.) $x = 2\sqrt{x-1}$
 $(x)^2 = (2\sqrt{x-1})^2$
 $x^2 = 4(x-1)$
 $x^2 = 4x - 4$
 $x^2 - 4x + 4 = 0$
 $(x-2)(x-2) = 0$
 $x-2 = 0$
 $x = 2$

check:

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

$x = 2$

g.) $\sqrt{3-x+x^2} = x-2$
 $(\sqrt{3-x+x^2})^2 = (x-2)^2$
 $3-x+x^2 = x^2-4x+4$
 $3-x+x^2-x^2+4x-4 = 0$
 $3x-1 = 0$
 $3x = 1$
 $x = 1/3$

check:

$\sqrt{3 - \frac{1}{3} + (\frac{1}{3})^2} = \frac{1}{3} - 2$
 $-5/3$

$\sqrt{\text{cannot be negative}}$

No solution

h.) $2 + \sqrt{12-2x} = x$
 $\sqrt{12-2x} = x-2$
 $(\sqrt{12-2x})^2 = (x-2)^2$
 $12-2x = x^2-4x+4$
 $0 = x^2-4x+4+2x-12$
 $0 = x^2-2x-8$
 $0 = (x-4)(x+2)$

$x-4 = 0$ or $x+2 = 0$
 $x = 4$ or $x = -2$

check $x = 4$

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

check $x = -2$

$2 + \sqrt{12-2(-2)} = -2$
 $2 + \sqrt{12+4} = -2$
 $2 + \sqrt{16} = -2$
 $2 + 4 = -2$
 $6 \neq -2$

$x = 4$

Question #14

a.) $(9-3i)-(2+4i)$
 $(9-3i)+(-2-4i)$
 $7-7i$

b.) $(2-i)(3+4i)$
 $6+8i-3i-4i^2$
 $6+5i-4(-1)$
 $6+5i+4$
 $10+5i$

c.) $\sqrt{10} \cdot \sqrt{-4}$
 $4i \cdot 2i$
 $8i^2$
 -8

d.) i^{2437}
 $4 | 2437$
 $609 \text{ r } 1$
 $(i^4)^{609} i = i$

e.) $\frac{4}{2+3i} \cdot \frac{2-3i}{2-3i}$
 $\frac{8-12i}{4-9i^2}$
 $\frac{8-12i}{4+9}$
 $\frac{8-12i}{13}$
 $\frac{8}{13} - \frac{12}{13}i$

Question #15

a.) $(y+3)^2 = 64$
 $\sqrt{(y+3)^2} = \sqrt{64}$
 $|y+3| = 8$
 $y+3 = 8$ or $y+3 = -8$
 $y = 5$ or $y = -11$

b.) $(4x+3)^2 = 24$
 $\sqrt{(4x+3)^2} = \sqrt{24}$
 $|4x+3| = 2\sqrt{6}$
 $4x+3 = \pm 2\sqrt{6}$
 $4x = \frac{-3 \pm 2\sqrt{6}}{4}$
 $x = \frac{-3 \pm \sqrt{6}}{2}$

Question #6

a.) completing the square:
 $x^2 + 6x = 7$
 $x^2 + 6x + 9 = 7 + 9$
 $\frac{6}{2} \rightarrow (3)^2$
 $(x+3)^2 = 16$
 $\sqrt{(x+3)^2} = \sqrt{16}$
 $x+3 = \pm 4$
 $x+3 = 4$ or $x+3 = -4$
 $x = 1$ or $x = -7$

quadratic formula:

$x^2 + 6x - 7 = 0$
 $a = 1, b = 6, c = -7$
 $x = \frac{-6 \pm \sqrt{16^2 - 4(1)(-7)}}{2(1)}$
 $x = \frac{-6 \pm \sqrt{36 + 28}}{2}$
 $x = \frac{-6 \pm \sqrt{64}}{2}$
 $x = \frac{-6 \pm 8}{2}$
 $x = \frac{-6+8}{2}$ or $x = \frac{-6-8}{2}$
 $x = \frac{2}{2}$ or $x = \frac{-14}{2}$
 $x = 1$ or $x = -7$

Question #16 continued

b) $4x^2 + 8x + 3 = 0$

completing the square

$$\frac{4x^2 + 8x + 3}{4} = \frac{0}{4}$$

$$x^2 + 2x + \frac{3}{4} = 0$$

$$x^2 + 2x + 1 = -\frac{3}{4} + 1$$

$$\downarrow \quad \uparrow$$

$$\frac{2}{2} \rightarrow (1)^2$$

$$(x+1)^2 = \frac{1}{4}$$

$$\sqrt{(x+1)^2} = \sqrt{\frac{1}{4}}$$

$$x+1 = \pm \frac{1}{2}$$

$$x+1 = \frac{1}{2} \text{ OR } x+1 = -\frac{1}{2}$$

$$x = \frac{1}{2} - 1 \text{ OR } x = -\frac{1}{2} - 1$$

$$\boxed{x = -\frac{1}{2} \text{ OR } x = -\frac{3}{2}}$$

quadratic formula

$$4x^2 + 8x + 3 = 0$$

$$a=4, b=8, c=3$$

$$x = \frac{-8 \pm \sqrt{(8)^2 - 4(4)(3)}}{2(4)}$$

$$x = \frac{-8 \pm \sqrt{64 - 48}}{8}$$

$$x = \frac{-8 \pm \sqrt{16}}{8}$$

$$x = \frac{-8 \pm 4}{8}$$

$$x = \frac{-8+4}{8} \text{ OR } x = \frac{-8-4}{8}$$

$$x = -\frac{4}{8} \text{ OR } x = -\frac{12}{8}$$

$$\boxed{x = -\frac{1}{2} \text{ OR } x = -\frac{3}{2}}$$

c) $x^4 - 5x^2 + 4 = 0$

substitution question

$$u = x^2$$

$$(x^2)^2 - 5x^2 + 4 = 0$$

$$u^2 - 5u + 4 = 0$$

$$(u-4)(u-1) = 0$$

$$(x^2-4)(x^2-1) = 0$$

$$(x+2)(x-2)(x+1)(x-1) = 0$$

$$\boxed{x = -2, 2, -1, 1}$$

d) $x^2 = -12x + 13$

completing the square

$$x^2 + 12x = 13$$

$$\downarrow$$

$$\frac{12}{2} \rightarrow (6)^2$$

$$(x+6)^2 = 49$$

$$\sqrt{(x+6)^2} = \sqrt{49}$$

$$x+6 = \pm 7$$

$$x+6 = 7 \text{ OR } x+6 = -7$$

$$\boxed{x = 1 \text{ OR } x = -13}$$

quadratic formula

$$x^2 + 12x - 13 = 0$$

$$a=1, b=12, c=-13$$

$$x = \frac{-12 \pm \sqrt{(12)^2 - 4(1)(-13)}}{2(1)}$$

$$x = \frac{-12 \pm \sqrt{144 + 52}}{2}$$

$$x = \frac{-12 \pm \sqrt{196}}{2}$$

$$x = \frac{-12 \pm 14}{2}$$

$$x = \frac{-12+14}{2} \text{ OR } x = \frac{-12-14}{2}$$

$$x = \frac{2}{2} \text{ OR } x = \frac{-26}{2}$$

$$\boxed{x = 1 \text{ OR } x = -13}$$

e) $x^2 - 4x + 4 = 0$

completing the square

$$x^2 - 4x + 4 = -4 + 4$$

$$\downarrow$$

$$-\frac{4}{2} \rightarrow (-2)^2$$

$$(x-4)^2 = 0$$

$$\sqrt{(x-4)^2} = \sqrt{0}$$

$$x-4 = 0$$

$$\boxed{x = 4}$$

quadratic formula

$$x^2 - 4x + 4 = 0$$

$$a=1, b=-4, c=4$$

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

$$x = \frac{4 \pm \sqrt{16 - 16}}{2}$$

$$x = \frac{4 \pm 0}{2}$$

$$x = \frac{4}{2} = 2$$

$$\boxed{x = 2}$$

f) $6x^2 + 6x = 0$

completing the square

$$6x^2 + 6x = 0$$

$$x^2 + x + \frac{1}{4} = 0 + \frac{1}{4}$$

$$\downarrow$$

$$\frac{1}{2} \rightarrow (\frac{1}{2})^2$$

$$(x + \frac{1}{2})^2 = \frac{1}{4}$$

$$\sqrt{(x + \frac{1}{2})^2} = \sqrt{\frac{1}{4}}$$

$$x + \frac{1}{2} = \pm \frac{1}{2}$$

$$x + \frac{1}{2} = \frac{1}{2} \text{ OR } x + \frac{1}{2} = -\frac{1}{2}$$

$$\boxed{x = 0 \text{ OR } x = -1}$$

quadratic formula

$$6x^2 + 6x = 0$$

$$a=6, b=6, c=0$$

$$x = \frac{-6 \pm \sqrt{(6)^2 - 4(6)(0)}}{2(6)}$$

$$x = \frac{-6 \pm \sqrt{36}}{12}$$

$$x = \frac{-6 \pm 6}{12}$$

$$x = \frac{-6+6}{12} \text{ OR } x = \frac{-6-6}{12}$$

$$x = 0 \text{ OR } x = -1$$

f) $2x^2 + 12x = -5$

completing the square

$$2x^2 + 12x = -\frac{5}{2}$$

$$x^2 + 6x + 9 = -\frac{5}{2} + 9$$

$$\downarrow \quad \uparrow$$

$$\frac{6}{2} \rightarrow (3)^2$$

$$(x+3)^2 = \frac{13}{2}$$

$$\sqrt{(x+3)^2} = \sqrt{\frac{13}{2}}$$

$$x+3 = \pm \frac{\sqrt{13}}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}}$$

$$x+3 = \pm \frac{\sqrt{26}}{2}$$

$$\boxed{x = -3 \pm \frac{\sqrt{26}}{2}}$$

quadratic formula

$$2x^2 + 12x + 5 = 0$$

$$a=2, b=12, c=5$$

$$x = \frac{-12 \pm \sqrt{(12)^2 - 4(2)(5)}}{2(2)}$$

$$x = \frac{-12 \pm \sqrt{144 - 40}}{4}$$

$$x = \frac{-12 \pm \sqrt{104}}{4}$$

$$x = \frac{-12 \pm 2\sqrt{26}}{4}$$

$$x = \frac{-12}{4} \pm \frac{2\sqrt{26}}{4}$$

$$\boxed{x = -3 \pm \frac{\sqrt{26}}{2}}$$

Question #16 continued

h) $2x^2 + x + 5 = 0$
 completing the square
 $\frac{2x^2 + x + 5}{2} = 0$
 $x^2 + \frac{1}{2}x + \frac{5}{2} = -\frac{5}{2} + \frac{1}{16}$
 $\frac{1}{2}x \rightarrow (\frac{1}{4})^2$
 $(x + \frac{1}{4})^2 = -\frac{39}{16}$
 $\sqrt{(x + \frac{1}{4})^2} = \sqrt{-\frac{39}{16}}$
 $x + \frac{1}{4} = \pm \frac{\lambda \sqrt{39}}{4}$
 $x = -\frac{1}{4} \pm \frac{\lambda \sqrt{39}}{4}$

quadratic formula
 $2x^2 + x + 5 = 0$
 $a=2, b=1, c=5$
 $x = \frac{-1 \pm \sqrt{1^2 - 4(2)(5)}}{2(2)}$
 $x = \frac{-1 \pm \sqrt{1-40}}{4}$
 $x = \frac{-1 \pm \sqrt{-39}}{4}$
 $x = \frac{-1 \pm \lambda \sqrt{39}}{4}$

i) $(x+3)(x+2) = 15$
 $x^2 + 5x + 6 = 15$
 $x^2 + 5x - 9 = 0$
 completing the square
 $x^2 + 5x + \frac{25}{4} = 9 + \frac{25}{4}$
 $(x + \frac{5}{2})^2 = \frac{61}{4}$
 $\sqrt{(x + \frac{5}{2})^2} = \sqrt{\frac{61}{4}}$
 $x + \frac{5}{2} = \pm \frac{\sqrt{61}}{2}$
 $x = \frac{-5 \pm \sqrt{61}}{2}$

quadratic formula
 $x^2 + 5x - 9 = 0$
 $a=1, b=5, c=-9$
 $x = \frac{-5 \pm \sqrt{5^2 - 4(1)(-9)}}{2(1)}$
 $x = \frac{-5 \pm \sqrt{25+36}}{2}$
 $x = \frac{-5 \pm \sqrt{61}}{2}$

j) $x^2 - 2x + 2 = 0$
 completing the square
 $x^2 - 2x + 1 = -2 + 1$
 $(x-1)^2 = -1$
 $\sqrt{(x-1)^2} = \sqrt{-1}$
 $x-1 = \pm i$
 $x = 1 \pm i$

quadratic formula
 $x^2 - 2x + 2 = 0$
 $a=1, b=-2, c=2$
 $x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(2)}}{2(1)}$
 $x = \frac{2 \pm \sqrt{4-8}}{2}$
 $x = \frac{2 \pm \sqrt{-4}}{2}$
 $x = \frac{2 \pm 2i}{2}$
 $x = 1 \pm i$

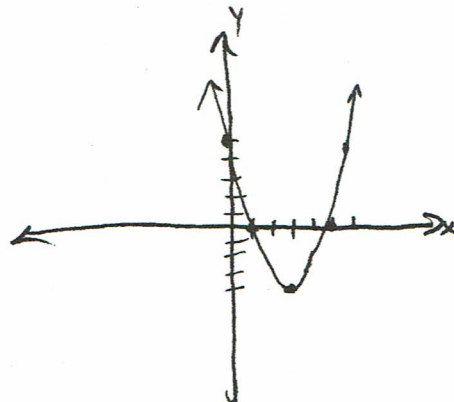
k) $6y^2 + 2y + 1 = 0$
 completing the square
 $\frac{6y^2 + 2y + 1}{6} = 0$
 $y^2 + \frac{1}{3}y + \frac{1}{6} = 0$
 $y^2 + \frac{1}{3}y + \frac{1}{36} = -\frac{1}{6} + \frac{1}{36}$
 $(y + \frac{1}{6})^2 = -\frac{5}{36}$
 $\sqrt{(y + \frac{1}{6})^2} = \sqrt{-\frac{5}{36}}$

quadratic formula
 $6y^2 + 2y + 1 = 0$
 $a=6, b=2, c=1$
 $y = \frac{-2 \pm \sqrt{2^2 - 4(6)(1)}}{2(6)}$
 $y = \frac{-2 \pm \sqrt{4-24}}{12}$
 $y = \frac{-2 \pm \sqrt{-20}}{12}$
 $y = \frac{-2 \pm 2i\sqrt{5}}{12}$
 $y = \frac{-2 \pm 2i\sqrt{5}}{12}$
 $y = -\frac{1}{6} \pm \frac{i\sqrt{5}}{6}$

Question #17

a) $f(x) = (x-3)^2 - 4$
 vertex (3, -4)
 axis of symmetry $x=3$
 y-intercept $y = (0-3)^2 - 4$
 $y = (-3)^2 - 4$
 $y = 9 - 4$
 $y = 5$
 symmetric point (6, 5)

x-intercept
 $(x-3)^2 - 4 = 0$
 $(x-3)^2 = 4$
 $\sqrt{(x-3)^2} = \sqrt{4}$
 $x-3 = \pm 2$
 $x-3 = 2$ or $x-3 = -2$
 $x = 5$ or $x = 1$
 (5, 0) (1, 0)



Questions #17 continued

b) $f(x) = x^2 - 6x + 9$

vertex:

$$x = -\frac{b}{2a}$$

$$x = -\frac{-6}{2(1)} = \frac{6}{2} = 3$$

$$y = (3)^2 - 6(3) + 9$$

$$y = 9 - 18 + 9 = 0$$

$$(3, 0)$$

axis of symmetry

$$x = 3$$

y-intercept

$$y = (0)^2 - 6(0) + 9$$

$$y = 9$$

$$(0, 9)$$

Symmetric point

$$(6, 9)$$

x-intercept

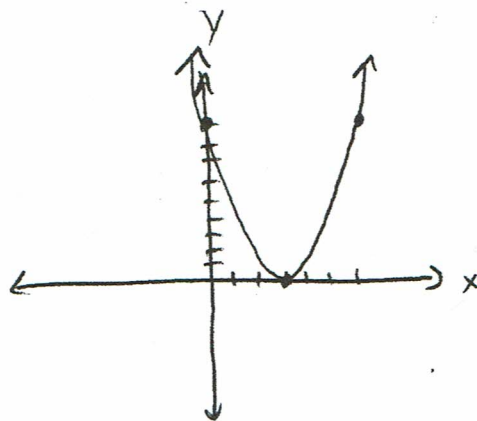
$$x^2 - 6x + 9 = 0$$

$$(x-3)^2 = 0$$

$$x-3 = 0$$

$$x = 3$$

$$(3, 0)$$



c) $f(x) = 2x^2 - x + 2$

vertex

$$x = -\frac{b}{2a}$$

$$x = -\frac{-1}{2(2)} = \frac{1}{4}$$

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

$$y = 2\left(\frac{1}{16}\right) - \frac{1}{4} + 2$$

$$y = \frac{1}{8} - \frac{1}{4} + 2$$

$$y = \frac{1-2+16}{8} = \frac{15}{8}$$

$$\left(\frac{1}{4}, \frac{15}{8}\right)$$

y-intercept

$$y = 2(0)^2 - 0 + 2$$

$$y = 2$$

$$(0, 2)$$

symmetric point

$$\left(\frac{1}{2}, 2\right)$$

x-intercept

$$2x^2 - x + 2 = 0$$

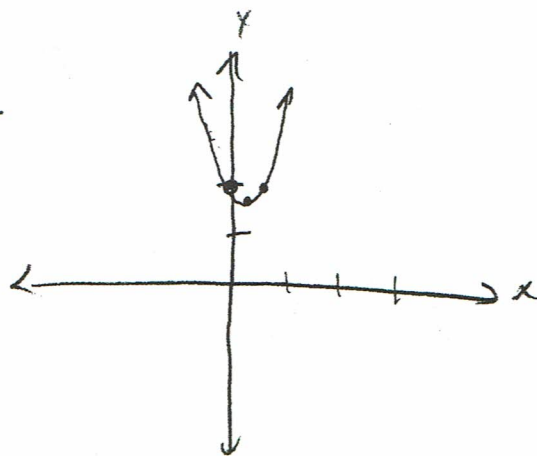
$$x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(2)(2)}}{2(2)}$$

$$x = \frac{1 \pm \sqrt{1-16}}{4}$$

$$x = \frac{1 \pm \sqrt{-15}}{4}$$

$$x = \frac{1 \pm i\sqrt{15}}{4}$$

No x-intercepts



axis of symmetry

$$x = \frac{1}{4}$$

d) $f(x) = 2x^2 + 5x + 3$

vertex

$$x = -\frac{b}{2a}$$

$$x = -\frac{5}{2(2)} = -\frac{5}{4}$$

$$y = 2\left(-\frac{5}{4}\right)^2 + 5\left(-\frac{5}{4}\right) + 3$$

$$y = 2\left(\frac{25}{16}\right) - \frac{25}{4} + 3$$

$$y = \frac{25}{8} - \frac{25}{4} + 3$$

$$y = \frac{25-50+24}{8} = -\frac{1}{8}$$

$$\left(-\frac{5}{4}, -\frac{1}{8}\right)$$

axis of symmetry

$$x = -\frac{5}{4}$$

y-intercept

$$y = 2(0)^2 + 5(0) + 3$$

$$y = 3$$

$$(0, 3)$$

symmetric point

$$\left(-\frac{5}{2}, 3\right)$$

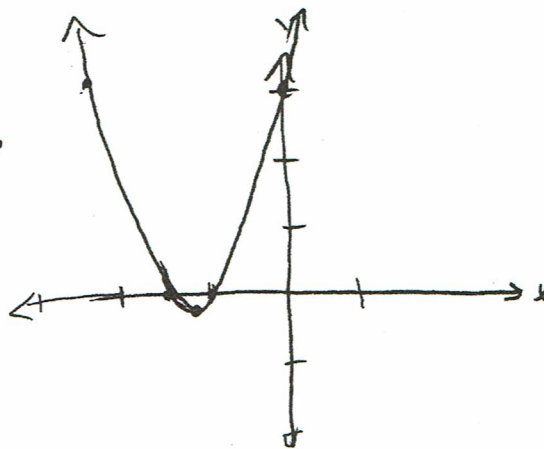
x-intercept

$$2x^2 + 5x + 3 = 0$$

$$(2x+3)(x+1) = 0$$

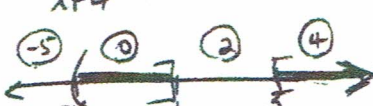
$$x = -\frac{3}{2}, -1$$

$$\left(-\frac{3}{2}, 0\right) (-1, 0)$$



Question #18

a.) $\frac{(x-3)(x-1)}{x+4} \geq 0$



$\frac{(-)}{(-)} \quad \frac{(-)}{(+)} \quad \frac{(-)}{(+)} \quad \frac{(+)}{(+)}$


- + - +

$[-4, 1] \cup [3, \infty)$

b.) $x^2 + 4x < 12$

$x^2 + 4x - 12 < 0$

$(x+6)(x-2) < 0$




$\frac{(-)}{(-)} \quad \frac{(+)}{(-)} \quad \frac{(+)}{(+)}$

+ - +

$(-6, 2)$

c.) $(x-4)(x+2)(x-1) < 0$

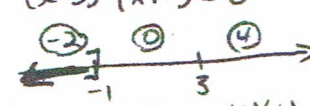


$\frac{(-)}{(-)} \quad \frac{(-)}{(+)} \quad \frac{(-)}{(+)} \quad \frac{(+)}{(+)}$

- + - +

$(-\infty, -2) \cup (1, 4)$

d.) $(x-3)^2(x+1) \leq 0$

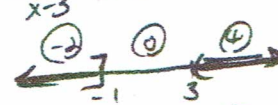


$\frac{(+)}{(-)} \quad \frac{(+)}{(+)} \quad \frac{(+)}{(+)}$

- + +

$(-\infty, -1]$

e.) $\frac{x+1}{x-3} \geq 0$



$\frac{(+)}{(-)} \quad \frac{(+)}{(+)} \quad \frac{(+)}{(+)}$

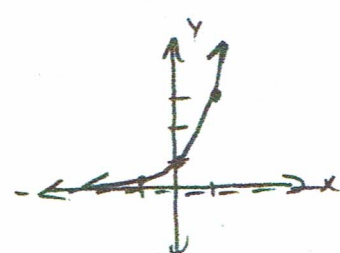
+ - +

$(-\infty, -1] \cup (3, \infty)$

Question #21

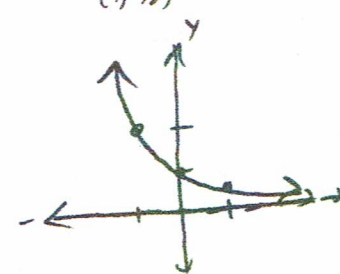
a.) $f(x) = 3^x$

$(-1, 1/3)$
 $(0, 1)$
 $(1, 3)$



b.) $f(x) = (\frac{1}{2})^x$

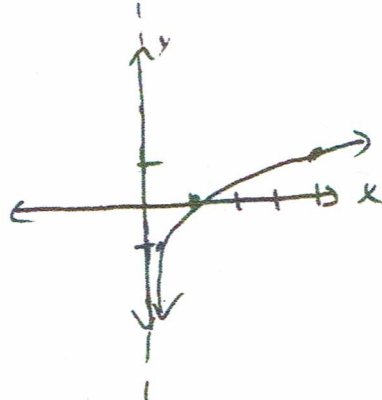
$(-1, 2)$
 $(0, 1)$
 $(1, 1/2)$



c.) $f(x) = \log_4 x$

$4^x \quad \log_4 x$

$(-1, 1/4) \quad (1/4, -1)$
 $(0, 1) \quad (1, 0)$
 $(1, 4) \quad (4, 1)$



2, 1, d and 2, 1, 2 not on team #3

Question #22

a.) $\log_5 25 = 2$

b.) $\log_2 \frac{1}{8} = -3$

c.) $\log_7 \sqrt{7} = \frac{1}{2}$

d.) $\log_5 5 = 1$

e.) $\log_6 1 = 0$

f.) $\log_4 4^6 = 6$

g.) $8^{\log_8 19} = 19$

h.) $\log_2 64 = 6$

i.) $\log_{49} 7 = \frac{1}{2}$

Question #19

a.) $f(x) = x^5 + 2$

$y = x^5 + 2$

$x = y^5 + 2$

$x - 2 = y^5$

$\sqrt[5]{x-2} = \sqrt[5]{y^5}$

$y = \sqrt[5]{x-2}$

$f^{-1}(x) = \sqrt[5]{x-2}$

b.) $f(x) = 4x - 3$

$y = 4x - 3$

$x = 4y - 3$

$x + 3 = 4y$

$\frac{x+3}{4} = y$

$f^{-1}(x) = \frac{x+3}{4}$

c.) $f(x) = \frac{2}{x-3}$

$y = \frac{2}{x-3}$

$x = \frac{2}{y-3}$

$x(y-3) = 2$

$xy - 3x = 2$

$xy = 2 + 3x$

$y = \frac{2+3x}{x}$

$f^{-1}(x) = \frac{2+3x}{x}$

d.) $f(x) = \frac{1}{x}$

$y = \frac{1}{x}$

$x = \frac{1}{y}$

$xy = 1$

$y = \frac{1}{x} \quad f^{-1}(x) = \frac{1}{x}$

Question #20

a.) $(f \circ g)(2)$

$= f(g(2)) \quad g(x) = -4(x) + 5$

$= f(-3) \quad = -8 + 5 = -3$

$= (-3)^4 - 3(-3) + 2$

$= 9 + 9 + 2 = 20$

b.) $(g \circ f)(x)$

$= g(f(x))$

$= g(x^2 - 3x + 2)$

$= -4(x^2 - 3x + 2) + 5$

$= -4x^2 + 12x - 8 + 5$

c.) $(h \circ k)(6)$

$= h(k(6)) \quad k(x) = \sqrt{6+x}$

$= h(3) \quad = \sqrt{9} = 3$

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

$= \frac{6-3}{12+5} = \frac{3}{17}$

Question #9

a.) $\sqrt{36} = 6$

b.) $-\sqrt{49} = -7$

c.) $\sqrt{-25} = -5i$

d.) $\sqrt[3]{27} = 3$

e.) $\sqrt[3]{-64} = -4$

f.) $\sqrt{x^2} = |x|$

g.) $\sqrt[3]{x^3} = x$

h.) $\sqrt{(x-3)^2} = |x-3|$

i.) $\sqrt{x^2 + 8x + 16} = \sqrt{(x+4)^2} = |x+4|$

j.) $\sqrt[4]{x^4} = |x|$

k.) $\sqrt[4]{16} = 2$

l.) $\sqrt[4]{-16}$ not real.

c.) $(x^{4/7})^{5/8} = x^{20/56} = x^{5/14}$

g.) $\sqrt{x^2} = |x|$

h.) $\sqrt[3]{x^3} = x$

i.) $\sqrt[9]{x^9} = x^{9/9} = x^1 = x$

j.) $\sqrt[4]{x^{12}y^8} = x^{12/4}y^{8/4} = x^3y^2$

k.) $\sqrt[3]{27x^2y^3} = 3x^{2/3}y^{3/3} = 3x^{2/3}y$

l.) $\sqrt[8]{x^2} = x^{2/8} = x^{1/4} = \sqrt[4]{x}$

m.) $\sqrt[4]{x^2y^6} = x^{2/4}y^{6/4} = x^{1/2}y^{3/2} = x^{1/2}y^{1/2}$

Question #10

a.) $81^{1/2} = \sqrt{81} = 9$

b.) $27^{2/3} = (\sqrt[3]{27})^2 = 3^2 = 9$

c.) $16^{-3/4} = \frac{1}{16^{3/4}} = \frac{1}{(\sqrt[4]{16})^3} = \frac{1}{2^3} = \frac{1}{8}$

d.) $x^{2/5} \cdot x^{3/5} = x^{2/5+3/5} = x^{5/5} = x^1 = x$

e.) $\frac{x^{4/5}}{x^{2/5}} = x^{4/5-2/5} = x^{2/5}$

$= y\sqrt{xy}$

n.) $\sqrt{56} = \sqrt{4 \cdot 14} = 2\sqrt{14}$

o.) $\sqrt{72x^5y^8z^2} = \sqrt{36} \sqrt{2} x^{5/2} y^{8/2} z^{2/2} = 6\sqrt{2} x^{2\frac{1}{2}} y^4 z^1 = 6x^2y^4z\sqrt{2}$

p.) $\sqrt[3]{48x^{16}y^{25}} = \sqrt[3]{8} \sqrt[3]{6} x^{16/3} y^{25/3} = 2\sqrt[3]{6} x^{5\frac{1}{3}} y^{8\frac{2}{3}}$

$2x^5y^9\sqrt[3]{6xy^2}$