12E

1) $(X + 4)(X - 2) = 0$
$X = -4 \quad X = 2$

2) $X - 6X + 8 = 0$
$(X - 4)(X - 2) = 0$
$X = 4,\ 2$

3) $(2X - 1)(X - 7) = 0$
$X = 1/2,\ 7$

4) $3X^2 + 4X - 7 = 0$
$(3X + 7)(X - 1) = 0$
$3X + 7 = 0; \quad X - 1 = 0$
$3X = -7 \quad X = 1$
$X = -7/3$

5) $X^2 + 5X - 2 = 0$
$$\frac{-5 \pm \sqrt{5^2 - 4(1)(-2)}}{2(1)} = \frac{-5 \pm \sqrt{33}}{2}$$

6) $(X + 5)(X - 3) = 0$
$X = -5,\ 3$

7) $\frac{4X^2}{4} + \frac{28X}{4} + ____$
$X^2 + 7X + \frac{49}{4}$
You might want to leave it in this reduced form if you were going on to solve the equation.
or, $4X^2 + 28X + 49$

8) $\frac{9X^2}{9} - \frac{36X}{9} + ____$
$X^2 - 4X + 4$
or, $9X^2 - 36X + 36$

9) $60X$

10) $198X$

11) $(X + 7)(X - 2) = 0$
$X = -7,\ 2$

12) $(-7)^2 + 5(-7) - 14 = 0$,
$49 - 35 - 14 = 0$
$(2)^2 + 5(2) - 14 = 0$
$4 + 10 - 14 = 0$

13) $(2X)^5 + 5(2X)^4 + 10(2X)^3 + 10(2X)^2 + 5(2X) + 1$
$32X^5 + 80X^4 + 80X^3 + 40X^2 + 10X + 1$

14) $\frac{5 \cdot 4}{1 \cdot 2}(1/3\ X)^3(2)^2 = 10(1/27)X^3(4) =$
$40/27\ X^3$

15) $X^3 + 3X^2(-3/5) + 3X(-3/5)^2 + (-3/5)^3 =$
$X^3 - 9/5\ X^2 + 27/25\ X - 27/125$

16) $(2X + 1)$

17) $\frac{(10 + i)i}{(5i)i} = \frac{10i - 1}{-5}$

18) $\frac{(10)(5 + \sqrt{8})}{(5 - \sqrt{8})(5 + \sqrt{8})}$
$\frac{50 + 10\sqrt{8}}{25 - 8} = \frac{50 + 10\sqrt{4}\sqrt{2}}{17} =$
$\frac{50 + 20\sqrt{2}}{17}$

19) $\frac{(2 + 3\sqrt{6})(1 + \sqrt{6})}{(1 - \sqrt{6})(1 + \sqrt{6})} =$
$\frac{2 + 2\sqrt{6} + 3\sqrt{6} + 18}{1 - 6} =$
$\frac{20 + 5\sqrt{6}}{-5} = -4 - \sqrt{6}$

20) $\frac{(6 - \sqrt{2})(10\sqrt{3} + 8)}{(10\sqrt{3} - 8)(10\sqrt{3} + 8)} =$
$\frac{60\sqrt{3} + 48 - 10\sqrt{6} - 8\sqrt{2}}{100(3) - 64} =$
$\frac{30\sqrt{3} + 24 - 5\sqrt{6} - 4\sqrt{2}}{118}$

13A

1) $6^2 - 4(1)(9) = 0$
real, rational, equal (double root)
$(X + 3)(X + 3) = 0$
$X = -3$

2) $7^2 - 4(2)(3) = 25$
real, rational, unequal
$(2X + 1)(X + 3) = 0$
$2X + 1 = 0 \quad X + 3 = 0$
$X = -1/2 \quad X = -3$

3) $-2X^2 + 3X + 6 = 0$
$(3)^2 - 4(-2)(6) = 57$
real, irrational, unequal
$$\frac{-3 \pm \sqrt{57}}{2(-2)} = \frac{-3 \pm \sqrt{57}}{-4}$$

4) $(-2)^2 - 4(3)(5) = -56$
imaginary
$$\frac{-(-2) \pm \sqrt{-56}}{2(3)} = \frac{2 \pm 2i\sqrt{14}}{6} = \frac{1 \pm i\sqrt{14}}{3}$$

5) $7X^2 - 3X - 20 = 0$
$(-3)^2 - 4(7)(-20) = 569$
real, irrational, unequal
$$\frac{-(-3) \pm \sqrt{569}}{2(7)} = \frac{3 \pm \sqrt{569}}{14}$$

13B

1) $2R^2 + 5R - 3 = 0$
$5^2 - 4(2)(-3) = 49$
real, rational, unequal
$(2R - 1)(R + 3) = 0$
$2R - 1 = 0 \quad R + 3 = 0$
$R = 1/2 \quad R = -3$

2) $X^2 + 8X + 16 = 0$
$8^2 - 4(1)(16) = 0$
real, rational, equal (double roots)
$(X + 4)(X + 4) = 0$
$X = -4$

3) $6Y^2 + 7Y + 11 = 0$
$7^2 - 4(6)(11) = -215$
imaginary
$$\frac{-7 \pm \sqrt{-215}}{2(6)} = \frac{-7 \pm i\sqrt{215}}{12}$$

4) $4X^2 + 5X + 1 = 0$
$5^2 - 4(4)(1) = 9$
real, rational, unequal
$(4X + 1)(X + 1) = 0$
$4X + 1 = 0 \quad X + 1 = 0$
$X = -1/4 \quad X = -1$

5) $(-5)^2 - 4(6)(-3) = 97$
real, irrational, unequal
$$\frac{-(-5) \pm \sqrt{97}}{2(6)} = \frac{5 \pm \sqrt{97}}{12}$$

13C

1) $(+3)^2 - 4(1)(1) = 5$
real, irrational, unequal

2) $X = \dfrac{-3 \pm \sqrt{5}}{2}$

3) $X^2 + 4X + 49 = 0$
$4^2 - (4)(1)49 = 16 - 196 = -180$ imaginary

4) $X = \dfrac{-4 \pm \sqrt{-180}}{2} = \dfrac{-4 \pm 6i\sqrt{5}}{2} = -2 \pm 3i\sqrt{5}$

5) $(-5)^2 - 4(1)(-9) = 25 + 36 = 61$
real, irrational, unequal

6) $X = \dfrac{-(-5) \pm \sqrt{61}}{2} = \dfrac{5 \pm \sqrt{61}}{2}$

7) $(11)^2 - 4(2)(12) = 121 - 96 = 25$
real, rational, unequal

8) $(2X + 3)(X + 4) = 0 \qquad X = -3/2, -4$

9) $\dfrac{-(-8) \pm \sqrt{(-8)^2 - 4 \cdot 1 \cdot 8}}{2 \cdot 1} = \dfrac{8 \pm \sqrt{32}}{2} =$

$\dfrac{8 \pm 4\sqrt{2}}{2} = 4 \pm 2\sqrt{2}$

10) $\dfrac{-7 \pm \sqrt{7^2 - 4 \cdot 1 \cdot 12}}{2} = \dfrac{-7 \pm \sqrt{1}}{2} =$

$\dfrac{-7 + 1}{2}, \quad \dfrac{-7 - 1}{2} = (-3, -4)$

11) $X^2 - 7X = -1$
$X^2 - 7X + 49/4 = -4/4 + 49/4$
$(X - 7/2)^2 = 45/4$
$\sqrt{(X - 7/2)^2} = \sqrt{45/4}$
$X - 7/2 = \pm \dfrac{3\sqrt{5}}{2}$
$X = \dfrac{7}{2} \pm \dfrac{3\sqrt{5}}{2}$

12) $\left(\dfrac{7}{2} + \dfrac{3\sqrt{5}}{2}\right)^2 - 7\left(\dfrac{7}{2} + \dfrac{3\sqrt{5}}{2}\right) + 1 = 0$

$\dfrac{49}{4} + \cancel{\dfrac{21\sqrt{5}}{2}} + \dfrac{45}{4} - \dfrac{49}{2} - \cancel{\dfrac{21\sqrt{5}}{2}} + \dfrac{4}{4} = 0$

Other value of X works as well.

13) $(1/2\ X)^6 + 6(1/2\ X)^5(3) + 15(1/2\ X)^4(3)^2 +$
$20(1/2\ X)^3(3)^3 + 15(1/2\ X)^2(3)^4 +$
$6(1/2\ X)(3)^5 + 3^6 =$
$1/64\ X^6 + 9/16\ X^5 + 135/16\ X^4 + 135/2\ X^3 +$
$1215/4\ X^2 + 729X + 729$

14) $\dfrac{4 \cdot 3 \cdot 2}{1 \cdot 2 \cdot 3}(4X)^1(-1)^3 = -16X$

15) $(1/4\ X)^3 + 3(1/4\ X)^2(1/5) +$
$3(1/4\ X)(1/5)^2 + (1/5)^3 =$

$1/64\ X^3 + 3/80\ X^2 + 3/100\ X + 1/125$

16) $(X - 5)$

17) $\left(\dfrac{4 - 3\sqrt{5}}{2}\right)\left(\dfrac{4 + 3\sqrt{5}}{2}\right) =$

$\dfrac{16 - 9 \cdot 5}{4} = \dfrac{16 - 45}{4} = \dfrac{-29}{4}$

18) $\dfrac{2 + \frac{1}{4}}{2 - \frac{1}{4}} = \dfrac{9}{4} \div \dfrac{7}{4} =$

$\dfrac{9}{\cancel{4}} \times \dfrac{\cancel{4}}{7} = \dfrac{9}{7}$

19) $\left[\dfrac{X}{5} - \dfrac{7}{2} - \dfrac{X}{6} = 0\right] 30 =$

$6X - 105 - 5X = 0$
$X = 105$

20) $X^2 - A^2i^2 = X^2 + A^2$

13D

1) $(-2)^2 - 4(1)(-3) = 4 + 12 = 16$
real, rational, unequal

2) $(X - 3)(X + 1) = 0 \qquad X = 3, -1$

3) $(-2)^2 - 4(1)(5) = 4 - 20 = -16$
imaginary

4) $X = \dfrac{2 \pm \sqrt{-16}}{2} = \dfrac{2 \pm 4i}{2} = 1 \pm 2i$

5) $(-20)^2 - 4(4)(25) = 400 - 400 = 0$
real, rational, equal (double root)

6) $(2X - 5)(2X - 5) = 0 \qquad X = 5/2, 5/2$

7) $(-2)^2 - 4(2)(5) = 4 - 40 = -36$
imaginary

8) $X = \dfrac{-(-2) \pm \sqrt{-36}}{2(2)} = \dfrac{2 \pm 6i}{4} = \dfrac{1 \pm 3i}{2}$

9) $3X^2 + 6X + 2 = 0$

$\dfrac{-6 \pm \sqrt{6^2 - 4(3)(2)}}{2(3)} = \dfrac{-6 \pm \sqrt{12}}{6} =$

$\dfrac{-6 \pm 2\sqrt{3}}{6} = \dfrac{-3 \pm \sqrt{3}}{3}$

10) $\dfrac{-2 \pm \sqrt{2^2 - 4(7)(1)}}{2(7)} = \dfrac{-2 \pm \sqrt{-24}}{14} =$

$\dfrac{-2 \pm 2i\sqrt{6}}{14} = \dfrac{-1 \pm i\sqrt{6}}{7}$

11) $X^2 - 6X = 2$
$X^2 - 6X + 9 = 2 + 9$
$(X - 3)^2 = 11$
$\sqrt{(X - 3)^2} = \sqrt{11}$
$X - 3 = \pm\sqrt{11}$
$X = 3 \pm \sqrt{11}$

12) $(3 - \sqrt{11})^2 - 6(3 - \sqrt{11}) - 2 = 0$
$9 \cancel{- 6\sqrt{11}} + 11 - 18 \cancel{+ 6\sqrt{11}} - 2 = 0$

$(3 + \sqrt{11})^2 - 6(3 + \sqrt{11}) - 2 = 0$
$9 \cancel{+ 6\sqrt{11}} + 11 - 18 \cancel{- 6\sqrt{11}} - 2 = 0$

13) $X^4 + 4X^3A + 6X^2A^2 + 4XA^3 + A^4$

14) $\dfrac{6}{1}(4X)^5(-1)^1 = (-6)(1024X^5) = -6144X^5$

15) $X^3 + 3X^2(-2/9) + 3(X)(-2/9)^2 + (-2/9)^3 =$
$X^3 - 2/3\ X^2 + 4/27\ X - 8/729$

16) $(3X + 1)$

17) $\left(\dfrac{7 + 2\sqrt{X}}{6}\right)\left(\dfrac{7 - 2\sqrt{X}}{6}\right) =$

$\dfrac{49 - 4X}{36}$

18) $\dfrac{\frac{X^2}{X} - \frac{1}{X}}{3 + \frac{1}{3}} = \dfrac{\frac{X^2 - 1}{X} \cdot \frac{3}{10}}{\frac{\cancel{10}}{\cancel{3}} \cdot \frac{\cancel{3}}{\cancel{10}}} =$

$\dfrac{3X^2 - 3}{10X}$

19) $\dfrac{4X + 1}{3} - \dfrac{(3)1}{(3)} = \dfrac{(5)X}{(5)} + \dfrac{3X - 8}{5}$

$\left[\dfrac{4X - 2}{3} = \dfrac{8X - 8}{5}\right] 15 =$

$20X - 10 = 24X - 24$
$14 = 4X$
$X = 7/2$

20) $4X^2 - 9i^2 = 4X^2 + 9$

13E

1) $(7)^2 - 4(3)(2) = 49 - 24 = 25$
real, rational, unequal

2) $(3X + 1)(X + 2) = 0 \quad X = -1/3,\ -2$

3) $(-5)^2 - 4(2)(4) = 25 - 32 = -7$
imaginary

4) $X = \dfrac{-(-5) \pm \sqrt{-7}}{2(2)} = \dfrac{5 \pm i\sqrt{7}}{4}$

5) $(-2)^2 - 4(4)(9) = 4 - 144 = -140$
imaginary

6) $X = \dfrac{-(-2) \pm \sqrt{-140}}{2(4)} = \dfrac{2 \pm 2i\sqrt{35}}{8} = \dfrac{1 \pm i\sqrt{35}}{4}$

7) $(-4)^2 - 4(2)(-7) = 16 + 56 = 72$
real, irrational, unequal

8) $X = \dfrac{-(-4) \pm \sqrt{72}}{2(2)} = \dfrac{4 \pm 6\sqrt{2}}{4} = \dfrac{2 \pm 3\sqrt{2}}{2}$

9) $2X^2 + 6X - 3 = 0$

$\dfrac{-6 \pm \sqrt{6^2 - 4(2)(-3)}}{2(2)} = \dfrac{-6 \pm \sqrt{60}}{4} =$

$\dfrac{-6 \pm 2\sqrt{15}}{4} = \dfrac{-3 \pm \sqrt{15}}{2}$

10) $5X^2 - 8X + 4 = 0$

$\dfrac{-(-8) \pm \sqrt{(-8)^2 - 4(5)(4)}}{2(5)} = \dfrac{8 \pm \sqrt{-16}}{10} =$

$\dfrac{8 \pm 4i}{10} = \dfrac{4 \pm 2i}{5}$

11) $[3X^2 + 8X - 3 = 0] \div 3$

$X^2 + 8/3\ X + 16/9 = 1 + 16/9$

$\sqrt{(X + 4/3)^2} = \sqrt{25/9}$

$X + 4/3 = \pm 5/3$

$X = -4/3 \pm 5/3 \quad X = -3,\ 1/3$

12) $3(1/3)^2 + 8(1/3) - 3 = 0$
$1/3 + 8/3 - 9/3 = 0$

$3(-3)^2 + 8(-3) - 3 = 0$
$27 + (-24) - 3 = 0$

13) $X^5 + 5X^4(2A) + 10X^3(2A)^2 + 10X^2(2A)^3 + 5X(2A)^4 + (2A)^5 =$

$X^5 + 10X^4A + 40X^3A^2 + 80X^2A^3 + 80XA^4 + 32A^5$

14) $\dfrac{6 \cdot 5 \cdot 4 \cdot 3 \cdot 2}{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5} X^1(-4)^5 = 6X(-1{,}024) = -6{,}144X$

15) $(2A)^3 + 3(2X)^2(-A) + 3(2X)(-A)^2 + (-A)^3 =$
$8X^3 - 12X^2A + 6XA^2 - A^3$

16) $(2X + 3Y)$

17) $\left(\dfrac{10 - \sqrt{AX}}{4}\right)\left(\dfrac{10 + \sqrt{AX}}{4}\right) =$

$\dfrac{100 - AX}{16}$

18) $\dfrac{\dfrac{2X^2(X^2)}{X^2} - \dfrac{1}{X^2}}{\dfrac{4}{X}} = \dfrac{\dfrac{2X^4 - 1}{X^{\cancel{2}}} \cdot \dfrac{\cancel{X}}{4}}{\dfrac{\cancel{4}}{\cancel{X}} \cdot \dfrac{\cancel{X}}{\cancel{4}}} =$

$\dfrac{2X^4 - 1}{4X}$

19) $\left[X + 3 - \dfrac{6X - 5}{2} = \dfrac{2X - 7}{6}\right] 6 =$

$6X + 18 - 18X + 15 = 2X - 7$

$-12X + 33 = 2X - 7$

$40 = 14X \qquad X = 20/7$

20) $A^2 - B^2i^2 = A^2 + B^2$

14A

1) $45.00 - 33.75 = \$11.25$ saved

$WP \times 45 = 11.25$

$WP = \dfrac{11.25}{45} = .25$ or 25%

2) $25.00 - 15.00 = \$10.00$ profit

$WP \times 15 = 10$

$WP = \dfrac{10}{15} = \dfrac{2}{3} = 67\%$

3) $25.00 - 15.00 = \$10.00$ profit

$WP \times 25 = 10$

$WP = \dfrac{10}{25} = \dfrac{2}{5} = 40\%$

4) $.28 \times 32 = 8.96$

$32.00 + 8.96 = \$40.96$

5) $2{,}500 = P + 15\%(P)$

$2{,}500 = P(1 + .15)$

$\dfrac{2{,}500}{1.15} = \dfrac{P(1.15)}{(1.15)} = \$2174$

6) $.55 \times 195 = 107.25$

$195 - 107.25 = \$87.75$

7) $32.45 = P + .06(P)$

$32.45 = P(1 + .06)$

$\dfrac{32.45}{1.06} = \dfrac{P(1.06)}{(1.06)} = \$30.61$

8) $.054 \times 45.50 = 2.46$

$.15 \times 45.50 = 6.83$

$45.50 + 2.46 + 6.83 = \$54.79$

9) $Si = 28,\ O = 16;\ SiO_2 = 28 + 2(16) = 60$

$\dfrac{Si}{SiO_2} = \dfrac{28}{60} = 47\%$

10) $\dfrac{O_2}{SiO_2} = \dfrac{32}{60} = 53\%$

11) $Fe = 56,\ O = 16;\ Fe_2O_3 = 2(56) + 3(16) = 160$

$\dfrac{Fe_2}{Fe_2O_3} = \dfrac{112}{160} = 70\%$

12) $\dfrac{O_3}{Fe_2O_3} = \dfrac{48}{160} = 30\%$