There are 13 problems on this exam. Carefully read and follow all directions. In order to receive credit show all necessary work. No credit will be given for an answer I cannot find or cannot read. All answers should be in simplest form.

In problems 1-3 solve the equation for x using factoring. (5 points each)

1. \(4x^2 - 5x - 6 = 0\)
   \[
   \frac{(4x + 3)(x - 2)}{3x} = 0
   \]
   \[
   -8x
   \]
   \[
   4x + 3 = 0 \quad \text{or} \quad x - 2 = 0
   \]
   \[
   x = -\frac{3}{4} \quad \text{or} \quad x = 2
   \]

2. \((x + 4)(2x - 3) = -5\)
   \[
   2x^2 + 8x - 3x - 12 = -5
   \]
   \[
   2x^2 + 5x - 7 = 0
   \]
   \[
   (2x + 7)(x - 1) = 0
   \]
   \[
   -2x
   \]
   \[
   2x + 7 = 0 \quad \text{or} \quad x - 1 = 0
   \]
   \[
   x = -\frac{7}{2} \quad \text{or} \quad x = 1
   \]

3. \(8x^2 - 6x = 9\)
   \[
   8x^2 - 6x - 9 = 0
   \]
   \[
   (2x - 3)(4x + 3) = 0
   \]
   \[
   -12x
   \]
   \[
   6x
   \]
   \[
   2x - 3 = 0 \quad \text{or} \quad 4x + 3 = 0
   \]
   \[
   x = \frac{3}{2} \quad \text{or} \quad x = -\frac{3}{4}
   \]
4. Solve the following equation by completing the square. All steps must be shown in order to receive credit. (8 points)

\[ x^2 - 8x + 20 = 0 \]

\[
\begin{align*}
x^2 - 8x &= -20 \\
x^2 - 8x + 16 &= -20 + 16 \\
(x - 4)^2 &= -4 \\
x - 4 &= \pm \sqrt{-4} \\
x &= 4 \pm 2i
\end{align*}
\]

5. Completely factor \(8x^3 - y^3\). (6 points)

\[
(2x)^3 - y^3 = (2x - y)((2x)^2 + 2xy + y^2) \\
= (2x - y)(4x^2 + 2xy + y^2)
\]

6. Completely factor \(64x^2 - 36\). (6 points)

\[ 4(16x^2 - 9) = 4(4x-3)(4x+3) \]
7. Simplify each of the following and write your answer in a + bi form. (3 points each)

(a) \(2(3 + 5i) - 3(2 - 4i)\)
\[
\begin{align*}
6 + 10i & \quad -6 + 12i \\
0 & \quad + 22i 
\end{align*}
\]

(b) \((-3 + 2i)(5 - 3i)\)
\[
\begin{align*}
-15 + 9i + 10i - 6i^2 \\
-9 + 19i 
\end{align*}
\]

(c) \(i^{25}\)
\[
i
\]

(d) \(\frac{2 - 3i}{5 + 2i} \cdot \frac{5 - 2i}{5 - 2i} = \frac{10 - 4i - 15i + 6i^2}{29}\)
\[
= \frac{4i}{29} - \frac{19}{29} i
\]

8. (a) To simplify \(\frac{3+4i}{-2-3i}\) by hand we must multiply the numerator and denominator by what complex number? (3 points)
\[-2 + 3i\]

(b) What are the four simplified terms we get when we expand \((2 + 7i)(-2 + 3i)\) by hand? (4 points)
\[-4 + 6i - 14i - 21\]
9. Simplify each of the following expressions involving square roots. (3 points each)

   (a) \[ \sqrt{360} = \sqrt{36 \cdot 10} = 6 \sqrt{10} \]

   (b) \[ \sqrt{-45} = i \sqrt{45} = i \sqrt{9 \cdot 5} = 3i \sqrt{5} \]

   (c) \[ \sqrt{-8} \cdot \sqrt{-18} = i \sqrt{8} \cdot i \sqrt{18} \]

       \[ \begin{align*}
       &= i^2 \sqrt{8 \cdot 18} \\
       &= -1 \sqrt{144} = -12
       \end{align*} \]

10. The longer leg in a right triangle is one inch more than the length of the short leg and the hypotenuse is eleven inches less than twice the length of the short leg. Set up and solve a quadratic equation to determine the length of each side of the triangle. (12 points)

    \[ X \]
    \[ 2X - 11 \]
    \[ X + 1 \]

    \[ X^2 + (X+1)^2 = (2X-11)^2 \]

    \[ X^2 + X^2 + 2X + 1 = 4X^2 - 44X + 120 \]

    \[ 0 = 2X^2 - 46X + 120 \]

    \[ 0 = X^2 - 23X + 60 \]

    \[ 0 = (X - 3)(X - 20) \]

    \[ X - 3 = 0 \text{ or } X - 20 = 0 \]

    \[ X = 3 \text{ or } X = 20 \]

    \[ X + 1 = 21 \text{ or } 2X - 11 = 29 \]
11. Use the quadratic formula to solve each of the following quadratic equations. (5 points each)

(a) \( x^2 - 8x + 25 = 0 \)

\[
X = \frac{8 \pm \sqrt{(8)^2-4.1.25}}{2.1} = \frac{8 \pm \sqrt{-36}}{2} = \frac{8 \pm 6i}{2}
\]

\[X = 4 + 3i, \ 4 - 3i\]

(b) \( 3x^2 - 8x + 2 = 0 \)

\[
X = \frac{8 \pm \sqrt{(-8)^2-4.3.2}}{2.3} = \frac{8 \pm \sqrt{40}}{6} = \frac{8 \pm 2\sqrt{10}}{6}
\]

\[X = \frac{4 \pm \sqrt{10}}{3}\]

12. Calculate the discriminant for each of the following quadratics and indicate by letter whether the zeros of the quadratic are (a) two irrational zeros, (b) two rational zeros, or (c) two nonreal zeros. (5 points each)

3x^2 - 2x + 4

Discriminant: \(-44\) \((-2)^2 - 4.3.4\)

Type of Zeros: \(C\)

2x^2 + 7x + 5

Discriminant: \(9\) \(7^2 - 4.2.5\)

Type of Zeros: \(b\)
13. Use your calculator to find the linear model that best fits the following data. Use $x = 1$ for 1995, $x = 2$ for 1996, and so on. Round the numbers in your answer to four decimal places. (6 points)

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<th>Year</th>
<th>Monthly Rental Cost for a 2-Bedroom Apartment</th>
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<td>1998</td>
<td>$480</td>
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<tr>
<td>1999</td>
<td>$525</td>
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</table>

(a) Linear Model
\[ y = 42x + 317 \]

(b) \( r^2 \)-value = 0.9866