Instructions:

- Put name and section on your exam.
- Put seating label on your equation sheet.
- Do not open the test until you are told to do so.
- Write your final answers in the boxes provided.
- If you finish with less than 5 minutes remaining, please stay seated until the exam is over.
- Stop work immediately when time is over.
- Turn in your equation sheet with your examination.
- Pass exams to the aisle; stay seated until all exams are collected.

Guidelines:

- Assume 3 significant figures for all given numbers unless otherwise stated.
- Show all of your work – no work, no credit.
- Include units for all answers.
- Include directions for all vectors.

<table>
<thead>
<tr>
<th>T/Th Recitations</th>
<th>111 Front</th>
<th>111 Back</th>
<th>Est 209</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:10</td>
<td>S1a Jason</td>
<td>S1b Jordan</td>
<td>S1c Kevin</td>
</tr>
<tr>
<td>9:40</td>
<td>S2a Jason</td>
<td>S2b Jordan</td>
<td>S2c Kevin</td>
</tr>
<tr>
<td>11:10</td>
<td>S3a Jason</td>
<td>S3b Jordan</td>
<td>S3c Kevin</td>
</tr>
<tr>
<td>12:40</td>
<td>S4a Katherine</td>
<td>S4b Ally</td>
<td>S4c Josh</td>
</tr>
<tr>
<td>2:10</td>
<td>S5a Katherine</td>
<td>S5b Ally</td>
<td>S5c Josh</td>
</tr>
<tr>
<td>3:40</td>
<td>S6a Katherine</td>
<td>S6b Ally</td>
<td>S6c Josh</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M/W Recitations</th>
<th>Est 209</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:40</td>
<td>S7c Daniel</td>
</tr>
<tr>
<td>2:10</td>
<td>S8c Daniel</td>
</tr>
<tr>
<td>3:40</td>
<td>S8c Daniel</td>
</tr>
</tbody>
</table>
1. (3 pts)
UT soccer player Allie Sirna drops a soccer ball from the top of the stands. Use
positive as upward with the ground as the origin. Circle the correct relationships
for the instant before the ball hits the ground.

<table>
<thead>
<tr>
<th>Position &gt; 0</th>
<th>Position = 0</th>
<th>Position &lt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity &gt; 0</td>
<td>Velocity = 0</td>
<td>Velocity &lt; 0</td>
</tr>
<tr>
<td>Acceleration &gt; 0</td>
<td>Acceleration = 0</td>
<td>Acceleration &lt; 0</td>
</tr>
</tbody>
</table>

2. (3 pts)
An object has a negative velocity and positive acceleration. Circle the correct
statement.

- The object’s speed is decreasing
- The object’s speed is not changing
- The object’s speed is increasing
- None of the above

3. (3 pts)
Circle the correct equation based on the vector diagram.

- $a = u + c + b$
- $a = b - c - u$
- $a = c - u - b$
- $a = -u - c - b$

4. (3 pts)
Circle the correct equation for the x-component of this vector.

- $18 \sin(25) \text{ ft}$
- $18 \cos(25) \text{ ft}$
- $18 \tan(25) \text{ ft}$

- $-18 \sin(25) \text{ ft}$
- $-18 \cos(25) \text{ ft}$
- $-18 \tan(25) \text{ ft}$
5. (9 pts)
Justin Worley runs backward 15 yards in 6 seconds, forward 4 yards in 4 seconds, and then backward 20 yd in 12 seconds. Determine his average speed and velocity. (Use forward as positive)

\[
\begin{align*}
\text{Speed} &= \frac{15 \text{ yd}}{6 \text{ sec}} = 2.5 \text{ yd/sec} \\
\text{Velocity} &= \frac{4 \text{ yd}}{4 \text{ sec}} = 1 \text{ yd/sec}
\end{align*}
\]

\[
\text{vel} = \frac{\Delta s}{\Delta t} = \frac{-15 + 4 - 20}{6 + 4 + 12} = -1.41 \text{ yd/sec}
\]

6. (9 pts)
The area of a basketball court is 437 square meters. One Martin is equivalent to 1800 in\(^2\). Determine the volume of a 1:12 scale model of the stadium in Martins.

\[
\begin{align*}
\text{Area} &= 437 \text{ m}^2 \left( \frac{100 \text{ cm}}{\text{m}} \right)^2 \left( \frac{\text{in}}{2.54 \text{ cm}} \right)^2 \left( \frac{\text{Martins}}{1800 \text{ in}^2} \right) \left( \frac{1}{12} \right)^2 \\
&= 2.61 \text{ Martins}
\end{align*}
\]
7. (14 pts)  
Determine the angle of the vector (degrees CCW from +x) of the vector \( \vec{A} - \vec{B} + \vec{C} \).

\[ \vec{A} = (-2i + 5j) \text{ ft} \]
\[ \vec{B} = (1 - 4i) \text{ ft} \]
\[ \vec{C} = (-3j) \text{ ft} \]

\[
\begin{array}{c|c}
A & -2 + 5^j \\
B & -1 + 4^j \\
C & 0 - 3^j \\
\hline
\text{Resultant} & -3 + 6^j \\
\end{array}
\]

\[
\theta = \tan^{-1} \left( \frac{6}{3} \right) = 63.4^\circ \\
\alpha = 180 - \theta = 116.6^\circ
\]

8. (14 pts)  
A boat heads 75 m at 15° south of east, then turns and heads 60 m at 22° east of north. How far and in what direction does the boat go to get back to where it started?

[Diagram showing vector addition with calculations for 102 m at 21° S of W]

\[
D^2 = 75^2 + 60^2 - 2(75)(60) \cos(75 + 22) \\
D = 101.6 \text{ m}
\]

\[
\sin \alpha = \frac{\sin(75 + 22)}{75} \\
\alpha = 47^\circ \\
\theta = 90 - 22 - \alpha \\
\theta = 21^\circ
\]
9. (14 pts)
A bug starts crawling at location \((8i - 3j)\ mm\) with a velocity of \((-2i + 5j)\ mm/s\) and is subjected to a constant acceleration of \((4i - 7j)\ mm/s^2\). Determine the bug's position (using \(i, j\) notation) when it is at its minimum x position.

\[
(7.5\hat{i} - 1.38\hat{j})\ mm
\]

\[
\begin{align*}
\text{min } x & \quad v_x = 0 \\
v_x &= v_{x0} + a_x t \\
0 &= -2 + 4(t) \\
t &= \frac{1}{2} \text{ sec}
\end{align*}
\]

\[
x = x_0 + v_{x0} t + \frac{1}{2} a_x t^2 \\
= 8 + (-2)(\frac{1}{2}) + \frac{1}{2}(4)(\frac{1}{2})^2 \\
= 7.5
\]

\[
y = y_0 + v_{y0} t + \frac{1}{2} a_y t^2 \\
= -3 + 5(\frac{1}{2}) + \frac{1}{2}(-7)(\frac{1}{2})^2 \\
= -1.375
\]

10. (14 pts)
A car starts from rest, accelerates at a constant rate of \(4.2\ m/s^2\) for \(4.0\) seconds, travels \(60\) meters at a constant velocity, and then slows to a stop a constant rate of \(11\ m/s^2\). What is the total distance travelled?

\[
106\ m
\]

\[
\begin{align*}
v_2 &= v_1 + a t \\
&= 0 + 4.2(4) \\
&= 16.8 \ m/s
\end{align*}
\]

\[
\begin{align*}
s_2 &= s_1 + v_1 t + \frac{1}{2} a t^2 \\
&= 0 + 0(4) + \frac{1}{2}(4.2)(4)^2 \\
&= 33.6 \ m
\end{align*}
\]

\[
\begin{align*}
v_3 &= v_2 + \frac{v_4^2 - v_3^2}{2a} \\
&= 33.6 + \frac{0 - 16.8^2}{2(-11)} \\
&= 106.4\ m
\end{align*}
\]
11. (14 pts)
A student standing on a bridge throws a tennis ball upwards. The ball is in the air 3.2 seconds before it hits the ground 20 feet below the bridge. How long (time) did it take the ball to get to its maximum height above the ground?

\[ t = 3.2 \text{ sec} \]

Use final \( t \) to find \( v_0 \)

\[ y = y_0 + v_{y0} t + \frac{1}{2} a_y t^2 \]

\[ 0 = 20 + v_{y0}(3.2) + \frac{1}{2}(-32.2)(3.2)^2 \]

\[ v_{y0} = 45.27 \text{ ft/s} \]

Use \( v_y = 0 \) at max height

\[ v_y = v_{y0} + a_y t_{top} \]

\[ 0 = 45.27 + (-32.2) t_{top} \]

\[ t_{top} = 1.41 \text{ sec} \]