1. (15 pts) A tennis ball is thrown off a cliff at an angle of 30° from the horizontal. The tennis ball hits the ground 3.0 seconds later at a horizontal distance of 200 ft from where it was thrown. How high was the cliff?

2. (15 pts) A helicopter can fly 185 km/hr in still air. The helicopter heads due south. After 2 hours of flying, the helicopter is over a point on the ground that is 270 km at 40° east of south from where it started. Determine the wind velocity (magnitude and direction) (a clearly labeled velocity vector diagram is required for full credit)

3. (15 pts) A 0.05 m radius disc is spinning at 120 rpm. The disk is brought to rest in 20 seconds. Determine the magnitude of the total acceleration of a particle on the edge of the disc just as it starts to slow down.

4. (15 pts) An 11 kg mass rests on a frictionless surface. Three forces act on the mass, parallel to the surface, and the mass accelerates as shown. Determine the magnitude of the acceleration.
5. (15 pts) A 4000 pound concrete block is sitting on a 3000 pound flat bed truck. Determine the maximum tractive force of the truck so the concrete block does not start sliding. \( \mu_s = 0.40 \) \( \mu_f = 0.30 \) (Two FBD=KD required)

Concrete Block

<table>
<thead>
<tr>
<th>Static Friction</th>
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<tbody>
<tr>
<td>Tractive Force</td>
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</table>

6. (15 pts) A 2500 pound car is going around a 10° banked 300 ft radius curve. The speed of the car is a constant 90 ft/sec. Determine the magnitude of the friction force on the car and state whether the friction force is up or down the bank. Assume the car is not sliding. \( \mu_s = 0.30 \) (FBD=KD required)

\[
\begin{align*}
a_n &= \frac{v^2}{r} = \frac{90^2}{300} = 27 \text{ ft/s}^2 \\
F &= \mu_s N \\
F &= 1630 \text{ lb} \\
F + W \sin \theta = m a_n \cos \theta \\
F = 2500 \text{ lb} \sin(10°) = 2500 \text{ lb} \left( \frac{21}{2} \right) \cos 10° \\
F &= 1630 \text{ lb} \\
F = 1630 \text{ lb} \\
F \cos 10° + N \sin 10° = \frac{2500 \text{ lb}}{32.2} (\cos 10°) \\
N &= 2826 \text{ lb}
\end{align*}
\]

7. (10 pts) Indicate T(true) or F(false) for each statement

An object is moving in UNIFORM circular motion:
- \( T \) It is moving at a constant speed
- \( T \) Its acceleration vector always points to the center of the curvature of the path.
- \( F \) Its total acceleration is zero
- \( F \) Its velocity vector always points in the direction of motion
- \( T \) It is moving at a constant angular acceleration

The friction force \( F \) between an object and its support surface: (\( N \) is normal force, \( W \) is weight)
- \( F \) If stationary, \( F \) is always \( \mu_s N \)
- \( F \) If sliding, \( F \) is always opposite the direction of motion.
- \( F \) If impending motion, \( F \) is always \( \mu_s N \)
- \( T \) \( N \) is always equal to \( W \)
- \( F \) If sliding, \( F \) is always \( \mu_s N \)