Multiple choice: Each question is worth 5 points.
1. You are enrolled in a class that meets at 8:00 AM every weekday. The subject of this course is:
   - A. philosophy
   - B. psychology
   - C. physics
   - D. phlebotomy
   - E. philology
   - F. none of these

2. A ball is thrown straight up into the air in one-dimensional motion. At the top of its path, which of the following is/are correct?
   - A. The velocity is a maximum.
   - B. The velocity is zero.
   - C. The acceleration is zero.
   - D. The acceleration changes.
   - E. Both B & C.
   - F. Both B & D.

3. Imagine a projectile that is launched into the air. Which of the following variables for the projectile is most directly related to the time the projectile spends in the air?
   - A. The maximum range (x) of the projectile.
   - B. The maximum height (y) of the projectile.
   - C. The angle of the projectile's launch.
   - D. The initial speed of the projectile.
   - E. The mass of the projectile.
   - F. 42

4. An elevator is moving downward, but coming to a stop. You are standing on a scale inside the elevator. While this event is occurring, the scale reads
   - A. exactly your normal weight.
   - B. less than your normal weight.
   - C. more than your normal weight.
   - D. More information is needed to answer this question.
   - E. Less information is needed to answer this question. ☺
   - F. 42

5. For an object to be in equilibrium, which of the following must be true?
   - A. Any velocity must equal zero.
   - B. All forces must balance, so the net force is zero.
   - C. All torques (clockwise and counter-clockwise) must balance.
   - D. A and B are both correct.
   - E. B and C are both correct.
   - F. A, B, and C are all correct.

6. With each step that you take as you walk in the forward direction, which of the following occur?
   - A. The Earth pushes you forward.
   - B. The Earth pushes you backward.
   - C. You push the Earth forward.
   - D. You push the Earth backward.
   - E. A and D are both correct.
   - F. B and C are both correct.
Situation #1 - Fun with mutants (35 points total):

A. [15 points] In your genetics course (ZOOI 8740) you create a new dinosaur, composed of three masses: one at the tip of its tail, one in its tummy/torso, and one in its head (as shown). Given the information shown in the diagram for the various masses and dimensions of the dinosaur, what is the length, \( l \), of the dinosaur's neck?

\[
\begin{align*}
\text{below torques:} \\
T_{cw} &= M_{H} \frac{(3.00 \, \text{m})}{\cos 20^\circ} \\
\lambda &= \frac{M_{T} (3.00 \, \text{m})}{M_{H} \cos 20^\circ} \\
\lambda &= \frac{80 \, \text{kg} (3.00 \, \text{m})}{100 \, \text{kg} \cos 20^\circ} \\
\lambda &= 2.55 \, \text{m}
\end{align*}
\]

B. [20 points] You are pulling your 20.0 kg cat across a surface with a tether, as shown, at a constant rate of 1.45 m/s. If the coefficient of static friction for this surface is 0.25, and the coefficient of kinetic friction is 0.0500, what is the tension in the tether?

\[
\begin{align*}
\text{f} &= \mu_{k} N \\
T \sin \theta &= f \\
T \cos \theta - f &= M_{G} x \\
T_{x} &= f = \mu_{k} N \\
T \sin \theta &= \mu_{k} N \\
\sum_{x} &= T \sin \theta = \frac{T_{f}}{\mu_{k}} \\
\sum_{x} &= T \cos \theta - f = M_{G} x \\
T \tan \theta &= f \\
T \tan \theta &= \frac{T_{f}}{\mu_{k}} \\
\sum_{x} &= T \sin \theta = \frac{T_{f}}{\mu_{k}} \\
\sum_{x} &= T \cos \theta - f = M_{G} x \\
\sum_{x} &= T \tan \theta = f \\
\sum_{x} &= T \sin \theta = \frac{T_{f}}{\mu_{k}} \\
\sum_{x} &= T \cos \theta - f = M_{G} x \\
\sum_{x} &= T \tan \theta = f
\end{align*}
\]

\[
T = \frac{M_{G} g}{\sin \theta + \frac{\cos \theta}{\mu_{k}}} \\
T = \frac{(20 \, \text{kg}) (9.8 \, \text{m/s}^2)}{\sin 15^\circ + \frac{\cos 15^\circ}{0.0500}} \\
T = 10.0 \, \text{N}
\]
Situation #2 - Fun with a bicycle (35 points total):

A. [10 points] On your bicycle, you can achieve constant accelerations of 2.00 m/s². At this acceleration, how long does it take you to achieve a forward velocity of 13.0 m/s?

Assuming starting from rest:

\[ v = u + at \]

\[ t = \frac{v - u}{a} = \frac{13 \frac{\text{m}}{\text{s}}}{2.00 \frac{\text{m}}{\text{s}^2}} = 6.50 \text{ s} \]


B. [5 points] Your speedometer measures your velocity in miles per hour. Once you are moving at a rate of 13.0 m/s, what does your speedometer read?

\[ 13.0 \frac{\text{m}}{\text{s}} \left( \frac{3600 \text{ s}}{1 \text{ hr}} \right) \left( \frac{1.0 \frac{\text{mi}}{1000 \text{ km}}} \right) \left( \frac{1.609 \text{ km}}{1 \text{ mi}} \right) = 29.1 \frac{\text{mi}}{\text{hr}} \]

C. [20 points] This same bicyclist is able to launch himself at an initial velocity of 13.0 m/s at an angle of 10.0° degrees above the horizontal from the top of the science building, 20.0 m above the ground. When our hero reaches the ground, how far from the building is he?

\[ \vec{A} = \begin{bmatrix} X_0 \cr 0 \end{bmatrix} \quad \vec{u} = \begin{bmatrix} V_{0x} \cr V_{0y} \end{bmatrix} \quad \vec{v} = \begin{bmatrix} V_x \cr V_y \end{bmatrix} \]

\[ V_y = V_{0y} - gt \]

\[ V_y = \left( V_{0y} \cos 10° \right)t \]

\[ V_y = 13 \frac{\text{m}}{\text{s}} \left( \cos 10° \right) \]

\[ x = \frac{29.0 \text{ m}}{2.26 \text{ s}} \quad \text{or} \quad 28.9 \text{ m} \]

(depending on round off of t)