EF 157 Module 2 Review
<table>
<thead>
<tr>
<th>FBD/KD</th>
<th>Down an Incline</th>
<th>Rockin and Movin</th>
<th>Round and Round we go</th>
<th>TA’s Choice</th>
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Question:

Two cars are rolling down the same hill. They are perfectly identical except that one is 25% heavier than the other. Which will have a higher terminal speed?
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the one with the greater weight
Question:
A bicycle makes a turn with a radius of 200 ft while decreasing in speed at a rate of 1 ft/s\(^2\). If the bicycle’s instantaneous speed is 20 ft/s, what is its acceleration?

\[
\begin{align*}
A) & \ (2\hat{e}_t - 1\hat{e}_n) \text{m/s}^2 \\
B) & \ (-2\hat{e}_t + 1\hat{e}_n) \text{m/s}^2 \\
C) & \ (1\hat{e}_t - 2\hat{e}_n) \text{m/s}^2 \\
D) & \ (-1\hat{e}_t + 2\hat{e}_n) \text{m/s}^2
\end{align*}
\]

Answer!!!
Question:
A bicycle makes a turn with a radius of 200 ft while decreasing in speed at a rate of 1 ft/s². If the bicycle’s instantaneous speed is 20 ft/s, what is its acceleration?

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Question:
Which FBD is correct for a ball moving in projectile motion as shown?

Answer!!!
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### Question:
You enter an elevator with a scale on the floor. The scale says you are the heaviest when the elevator ______.

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<th>accelerating up</th>
<th>moves up at a constant speed</th>
<th>accelerates down</th>
<th>moves down at a constant speed</th>
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**Answer!!!**
You enter an elevator with a scale on the floor. The scale says you are the heaviest when the elevator _____.

**Answer:**
- is stationary
- accelerating up
- moves up at a constant speed
- accelerates down
- moves down at a constant speed
Question:
A child places a bathroom scale into the elevator and stand on it. When the elevator is stationary the scale reads 56 lb. What will the scale read when the elevator is accelerating up at 3.5ft/s²?
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Answer!!!
62 lbs
Question:
In the figure at right, $F$ is parallel to the slope and the 68.0 lb force is horizontal.
Determine the magnitude of the force $F$ that would cause the 185 lb block to slide up the smooth slope (36.0° above horizontal) with an acceleration of 12.6 ft/s².

Answer!!!
Question:

In the figure at right, \( \mathbf{F} \) is parallel to the slope and the 68.0 lb force is horizontal. Determine the magnitude of the force \( \mathbf{F} \) that would cause the 185 lb block to slide up the smooth slope (36.0° above horizontal) with an acceleration of 12.6 ft/s\(^2\).

126 lbs
Question:
An airplane flies in a loop of radius 150 m. The speed of the airplane is not constant. The pilot’s weight is 710N. At the top of the loop, the pilot just begins to lose contact with the seat and he “feels weightless.” What is the speed of the airplane at this point?

Answer!!!
Question:
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38 m/s²
Question:

A giant spherical ball (diameter = 4.6 m, mass = 120 kg) fell out of an airplane. Assuming a Coefficient of Drag of $C_D = 0.55$, the density of the air to be $\rho = 1.2 \text{ kg/m}^3$, and a Quadratic Drag Force Model, determine the acceleration of the ball when its velocity = 8.5 m/s.

Answer!!!
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\[ F_D = \frac{1}{2} \rho A C_D v^2 \]

\[ \Sigma F = F_g - F_D = ma \]

\[ M g - \frac{1}{2} \rho A C_D v^2 = ma \]

\[
\begin{align*}
6.5 \text{ m/s}^2
\end{align*}
\]

Return to Board
Question:
A flatbed truck is transporting a 260 kg crate. While traveling in a straight line at a constant speed of 19 m/s, the crate is not sliding on the bed. The coefficients of friction between the crate and the bed of a truck are $\mu_s = 0.27$ and $\mu_k = 0.21$. If the truck were to *decelerate at a constant rate*, what would be the *maximum deceleration* if the box does not slip on the bed?

Answer!!!
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$2.7 \text{ m/s}^2$
Question:

Draw a correct Free-Body Diagram and KD for the man doing the pull up. Assume Equilibrium.
Question:
Draw a correct Free-Body Diagram and KD for the man doing the pull-up. Assume Equilibrium.
Question:

In order to throw a football in the real world, what direction/s should the force be applied for it be properly thrown?

A) Only in the y-direction
B) Only in the x-direction
C) Both in the x and y directions
D) Neither
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A) Only in the y-direction
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C) Both in the x and y directions
D) Neither
Question:
Two strings of negligible mass and 1.0 m in length are attached to a vertical support 1.0 m apart, and a mass of 5.0 kg at the end of the two strings and rotates about the support at a constant speed. Both strings are taut so that they and the vertical support form an equilateral triangle.
If the tension in the upper string is measured to be 150 N, determine the **Tension in the lower string**.

Answer!!!
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\[
\sum F_n = T_H \cos \theta + T_L \cos \theta = m a_n \\
\sum F_k = -T_H \sin \theta + T_L \sin \theta + mg = 0
\]

52 N
Question:

**True or False**

As you are driving around a curve, the reason you are pushed to towards the outside is because of an active centrifugal force.
Question:

**True or False**

As you are driving around a curve, the reason you are pushed to towards the outside is because of an active centrifugal force.

*False*
Question:
At the moment shown, a 1,850 kg truck is travelling due east on a 175 m radius semi-circular curve with a constant speed of 63.0 km/hr. A wind is blowing towards the west with a speed of 15.0 km/hr. The drag force on the truck can be modelled by the quadratic model by $F_D = 2.39v^2$ where $F_D$ is in Newtons and $v$ is in m/s.

At this moment, determine the magnitude of the total friction force exerted on the truck assuming the tires do not slip.

Answer!!!
Question:

At this moment, determine the **magnitude of the total friction force** exerted on the truck assuming the tires do not slip.

\[ F_t \]

\[ F_D \]

\[ F_n \]

\[ m \dot{a}_n \]

\[ \hat{n} \]

\[ \hat{t} \]

\[ \text{3430 N} \]
Question:

The EF 157 class decided to determine the terminal velocity of a Hot Wheels car which has a mass of 72 g. Assume the wheels are frictionless. The class set up a ramp at an angle of $22^\circ$ with the horizontal. Determine its \textit{initial acceleration}.
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The EF 157 class decided to determine the terminal velocity of a Hot Wheels car which has a mass of 72 g. Assume the wheels are frictionless. The class set up a ramp at an angle of 22° with the horizontal. Determine its initial acceleration.

3.7 m/s²
Question:

James Bond, weighing 82 kg including his parachute, falls with the parachute open at a constant speed of 8.5 m/s toward Earth. The density of air is 1.3 kg/m³ and the drag coefficient $C_D = 0.72$. Determine the area of his parachute.

$$F_D = \frac{1}{2} \rho A C_D v^2$$

Answer!!!
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$F_D = \frac{1}{2} \rho A C_D v^2$

24 m²
Question:

A coffee cup lid (m = 52 g) is laying stationary on a 11° incline when the wind begins to blow parallel to and down the slope with a speed of wind. The coefficients of friction between the lid and the ground are $\mu_s = 0.29$ and $\mu_k = 0.25$. The force the wind exerts on the lid follows the linear model as $F_{\text{wind}} = (16 \text{ g/s})V_{\text{wind}}$ where $F_{\text{wind}}$ is in mN(1g•m/s²) and wind is in m/s. Determine the minimum $V_{\text{wind}}$ that will cause the lid to slide down the slope.

Answer!!!
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3 m/s
Question:
A window washer applies a scrub brush (W = 12.0 N) on a vertical window at the angle shown. If the maximum force $F$ that can be applied without the brush moving is 18.5 N, what is the value of $\mu_s$?
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Question:
The lift force that acts on an airplane acts in a direction that is normal to the plane of the wings. Why do airplanes bank as they turn? Explain. You may use words, diagrams, and equations to explain your answer.

Answer!!!
Question:
The lift force that acts on an airplane acts in a direction that is normal to the plane of the wings. Why do airplanes bank as they turn? Explain. You may use words, diagrams, and equations to explain your answer.

In order to turn, some force must act towards the center of curvature. By banking, some component of the lift will act, in the normal direction, towards the center of curvature.
Question:
In kinematics, we know that in order to change the speed of something there needs to be an acceleration. In kinetics, we now know that the acceleration must come from a force. What must the force be in order to change the speed of this truck from \textit{0mph to 60mph in 8.0 secs}?
You can ignore any counteracting friction or drag forces.
Assume 3 SigFigs.

Answer!!!

$W_{\text{truck}} = 6,500 \text{ lbs}$
Question:

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\[ F = 2220 \text{ lbs} \]
Question:

**True or False**

The total acceleration of the block system on a frictional surface can be determined by dividing the applied force $F$ by the summation of the blocks’ masses.
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**False**
Question:

If the man weighs 185 lbs determine the weight of the block if the block does not move and $\mu_s = 0.750$.
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\[
W = 151 \text{ lbs}
\]

\[
\Sigma F_y = N - W \cos \theta = 0
\]
\[
\Sigma F_x = F_f + W \sin \theta - T = 0
\]

\[
W = \frac{T}{\mu \cos \theta + \sin \theta}
\]
Question:
What angle $\theta$ will the block start to move down the hill if $\mu_s = 0.50$?
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What angle \( \theta \) will the block start to move down the hill if \( \mu_s = 0.50 \)?

\[ \Sigma F_y = N - W \cos \theta = 0 \]
\[ \Sigma F_x = -F_f + W \sin \theta = 0 \]

\[ N = W \cos \theta \]
\[ W \sin \theta = \mu N \]
\[ W \sin \theta = \mu W \cos \theta \]
\[ \theta = \tan^{-1}(\mu) \]

\( \theta = 26.6^\circ \)
Question:
The vols are kicking a short field goal. If our kicker kicks it and the $y$-component of the initial acceleration is 2.0 m/s$^2$, what was the magnitude of the force he initially applied? Let $m_{\text{football}}=0.6 \text{ kg}$ and $\theta_{\text{kick}}=60^\circ$. (hint: remember gravity)
Question:
The vols are kicking a short field goal. If our kicker kicks it and it initially accelerates at 2.0 m/s² in the y-direction. What was the magnitude of the force he initially applied if the \( m_{\text{football}} = 0.6 \text{ kg} \) and \( \theta_{\text{kick}} = 60^\circ \).
(hint: remember gravity)

\[ F = 8.2 \text{ N} \]
Question:

An acrobat has a weight of 123 lb and is sitting on a chair which is perched on top of a pole as shown. A mechanical drive rotates the pole clockwise such that the acrobat follows a circular path with a radius $\rho = 23.4$ ft. When $\theta = 34.5^\circ$, the acrobat has a speed of 12.3 ft/s and his speed is decreasing at a rate of 3.45 ft/s$^2$. The bottom of the seat is normal to the pole and the back of the seat is normal to the direction of travel. At this moment, determine the magnitude of the normal force that the bottom of the seat exerts on the acrobat.

Answer!!!
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$F = 76.7$ lbs