1) A 7.6 kg object is at rest on an inclined plane. If the plane makes an angle with the horizontal of 33° what is the normal force acting on the object? **62 N**

2) A 7.6 kg object is pulled up an inclined plane. If the plane makes an angle with the horizontal of 33° and the coefficient of friction is 0.20, what is the force of friction? **12 N**

3) A 16.2 kg object slides down an inclined plane at a constant velocity. If the plane makes an angle of 25°, what is the normal force acting on the object? **144 N**

4) A 445 N box is sliding down a frictionless 25° inclined plane. Find the parallel component of the weight that causes the box to slide **188 N**

5) A 325 N box is sliding down a frictionless 30.0° inclined plane. What is its acceleration? **4.9 m/s²**

6) A 435 N box is sliding down a 40.0° inclined plane. If the acceleration of the box is 0.250 m/s², what is the force of friction acting on the box? **269 N**

7) A student pulls a 125 N object up a 25° incline. If the coefficient of friction is 0.180, what force must the student pull with to move the object at a constant velocity? Assume the applied force is parallel to the ramp (why would that matter?) **73.2 N**

8) Fluffy the cat slides freely down the long porcelain cat slide into the Beverly Hills pet pool. If the incline is 18° and μ = 0.10 determine the time it takes Fluffy to reach the bottom of the 10. m slide. (HINT: find acceleration first, don’t worry about the cat’s mass, it cancels out) **3.1 s**

9) A trucker loses his brakes and hits the bottom of a runoff road (put there to protect against such a situation) at 150 km/h. The runoff road is inclined at 50° and friction against the truck is approximately equal to a sliding coefficient of 0.20. If the runoff road is 100 m long, is it long enough? **Just barely, by 1.0 m**
“Elevator Problems” Worksheet

1. An elevator is moving up at a constant velocity of 2.5 m/s, as illustrated in the diagram below: The man has a mass of 85 kg.
   a. To the right, construct a force diagram for the man.
   b. What force does the floor exert on the man? **833 N**

2. The elevator now accelerates upward at 2.0 m/s².
   a. To the right, construct a force diagram for the man. (same as above)
   b. What force does the floor now exert on the man? **1003 N**

3. Upon reaching the top of the building, the elevator slows down (accelerates downward) at 3.0 m/s².
   a. To the right, construct a force diagram for the man. (same as above)
   b. What force does the floor now exert on the man? **578 N**

4. While descending in the elevator, the cable suddenly breaks. What is the force of the floor on the man? **Zero N**
5. Consider the situation where a person that has a mass of 68 kg is descending in an elevator at a constant velocity of 4.0 m/s. At some time "t", the elevator starts to slow to a stop at the rate of 2.0 m/s².

a. Construct **quantitative** force diagrams (include magnitudes) for the person in the elevator as it descends at (a) constant speed and (b) during its period of acceleration.

\[
\begin{align*}
\text{(a)} & \quad F_N = 666.4 \text{ N} \\
& \quad F_g = 666.4 \text{ N} \\
\text{(b)} & \quad F_N = 802.4 \text{ N} \\
& \quad F_g = 666.4 \text{ N}
\end{align*}
\]

6. If the person in the elevator were standing on a bathroom scale calibrated in Newton’s, what would the scale read while the elevator was:

a. descending at constant speed? **666.4 N**

b. while slowing to a stop? **802.4 N**

7. Explain why the scale reads the values you provided in the previous question. **The scale reads the amount the floor of the elevator is pushing up on the passenger. This value changes as the elevator is accelerating/decelerating in order for the passenger to accelerate/decelerate.**
UNIT V: Worksheet 2

For each of the problems below, you must begin your solution with a force diagram. Some require more than one diagram. Clearly show all your work on each question.

1. A student, standing on a scale in an elevator at rest, sees that his weight is 840 N. As the elevator rises, his weight increases to 1050 N, then returns to normal. When the elevator slows to a stop at the 10th floor, his weight drops to 588 N, and then returns to normal. Determine the acceleration at the beginning and end of the trip.

   **Beginning:** 2.45 m/s$^2$

   **End:** -2.94 m/s$^2$

2. A sign in an elevator states that the maximum occupancy is 20 persons. Suppose that the safety engineers assume the mass of the average rider is 75 kg. The elevator itself has a mass of 500 kg. The cable supporting the elevator can tolerate a maximum force of 30,000 N. What is the greatest acceleration that the elevator’s motor can produce without snapping the cable? 5.2 m/s$^2$
1) A 3.4-kg bucket of water is attached to a 1.0-m rope. The bucket is swung in a circle with the rope at 10.0-m/s.

   a) What is the centripetal force that keeps the bucket moving in its circular path? **340 N**

   b) What provides the centripetal force that keeps the bucket moving in its circular path? **The tension in the rope**

   c) If the rope can hold 400-N of force, what is the maximum speed the bucket can move in its circular path? [Hint: Let the centripetal force be 400-N and solve for the speed.] **10.85 m/s**

2) If the centripetal force on an object is 100-N.

   a) If the speed of the object moving in a circular path triples what will the centripetal force become? **900 N**

   b) If the radius of the circular path is doubled what will the centripetal force become **50 N**

3) Identify the force that provides the centripetal force keeping the object moving in a circular path.

   a) Mar’s satellite Phobos as it orbits Mars. **gravity**

   b) A roller coaster car as it travels through a loop. **The normal force of the track on the cart**

   c) A car travelling through a curve. **Friction between the tires and the road**

   d) Clothes in a washing machine during the spin cycle. **The normal force of the walls of the spinning machine**
4) When you are in a car as it takes a curve too fast. If you are in the back seat without a seat belt, you will slide towards the outside of the curve until you hit the door of the car.

a) Why do you slide to the outside of the curve? You want to maintain the inertial path (a straight line) while the car is changing directions.

b) At what point is a centripetal force applied to you? What supplies this centripetal force & in what direction does it act? Friction between the seat and the passenger. It acts radially inward to the center of the circle.

5) For each find the centripetal force acting on the object in UCM.

a) A 1-kg ball on a 0.25-m string moving at 3-m/s. 36 N

b) A 3-kg ball on a 0.25-m string moving at 1-m/s. 12 N

c) A 0.5-kg ball on a 0.25-m string moving at 6-m/s. 72 N

d) A 1-kg ball on a 0.5-m string moving at 2-m/s. 8 N

e) A 2-kg ball on a 1.0-m string moving at 2-m/s. 8 N

f) A 0.25-kg ball on a 0.25-m string moving at 6-m/s. 36 N

g) Rank each centripetal force calculated for a) through f) in order from smallest to largest. (d) and (e), (b), (a) and (f), (c)