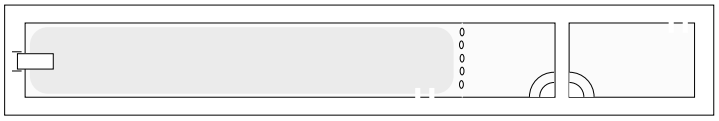
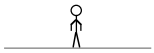
PhyzSpringboard: Centrifugal Weight Loss



TRUE WEIGHT AND APPARENT WEIGHT

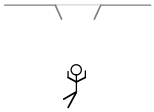
1. Show the forces acting on the little dude while he stands on the ground.



2. Which is greater, the downward _____ force or the upward

_____ force?

3. Suppose the ground beneath the little dude could not support him and he fell downward. Which of the forces above—if any—would continue to act and which—if any—would no longer act?



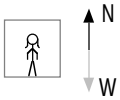
4. While falling, little dude would feel weightless. Is he truly weightless?

5. A distinction is made between apparent weight and true weight. The **true weight** of a body is the gravitational force the Earth (or other nearby planet-like object) exerts on the body. The **apparent weight** of a body is the compression (normal force) between the body and the Earth (or other nearby planet-like body).

What is the apparent weight of the little dude while he is in freefall?

APPARENT WEIGHT IN AN ELEVATOR

6. Consider the little dudette in the elevator. Which—if either—is greater: her true weight or her apparent weight when... (justify each answer)



a. the elevator is at rest?

b. the elevator moves upward with increasing speed?

c. the elevator moves upward with constant speed?

d. the elevator moves upward with decreasing speed?

e. the elevator moves downward with increasing speed?

f. the elevator moves downward with constant speed?

g. the elevator moves downward with decreasing speed?

7. For each case in which one force is greater than the other, Draw a vector representing the net force $\sum \mathbf{F}$ and a vector representing the acceleration **a.**

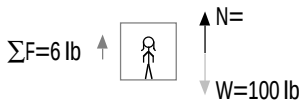
8. a. How does the direction of the net force on the dudette compare to the direction of her acceleration?

b. If the mass of the dudette is *m* and the acceleration of the elevator is *a*,

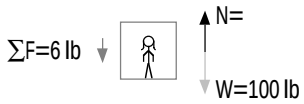
i. what is the net force on the dudette?

ii. by how much do her true weight and her apparent weight (normal force) differ?

c. i. Suppose she weighs 100 lb and needs a net force of 6 lb to accelerate her upward. What is her apparent weight during this acceleration?

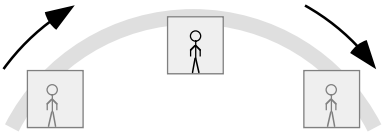


i. Suppose she weighs 100 lb and needs a net force of 6 lb to accelerate her downward. What is her apparent weight during this acceleration?



OVER THE TOP ON THE FERRIS WHEEL

9. Consider a little dude standing in a ferris wheel cabin as shown.



a. Draw the forces acting on him.

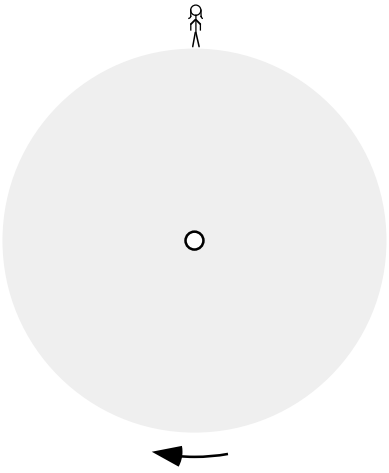
b. Which force is greater: weight or normal? (If one is greater, draw a vector representing th net force, $\sum$**F.)**

c. Explain the reason(s) for your answer to part 9.b.

d. Suppose the little dude weighs 100 lb and he needs a net force of 6 lb to maintain circular motion. What is his apparent weight?

AROUND THE WORLD

10. Consider a little dudette standing on the equator of the rotating Earth. (Diagram not to scale.)



a. In our view from above the North Pole, draw the forces acting on her.

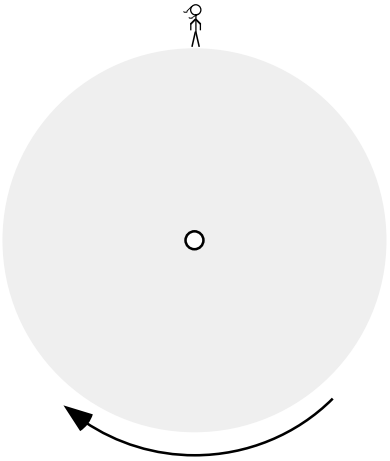
b. Which force is greater: weight or normal? (If one is greater, draw a vector representing th net force, $\sum$**F.)**

c. Explain the reason(s) for your answer to part 10.b.

d. Suppose the little dudette weighs 100 lb and she needs a net force of 6 lb to maintain circular motion. What is her apparent weight?

11. Suppose the rotational speed of the Earth were to increase.

a. What would happen to the size of the net force needed to keep the dudette in her circular motion around the world?



b. Would her true weight increase, decrease, or remain the same?

c. Would her apparent weight (normal force) increase, decrease, or remain the same?

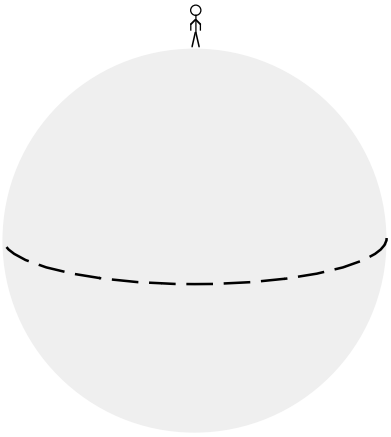
d. Suppose the little dudette weighs 100 lb and she needs a net force of 60 lb to maintain circular motion. What is her apparent weight?

12. Suppose the rotational speed of the Earth were to increase further so that the dudette needs 100 lb of net force acting on her to stay in circular motion. What would the dudette's apparent weight be?

13. What would happen if the rotational speed of the Earth were to increase even further so that the dudette needs 101 lb of net force acting on her to stay in circular motion?

14. Consider a little dude standing at the North Pole.

a. Draw the forces acting on him.



b. Which force is greater: weight or normal? (If one is greater, draw a vector representing th net force, $\sum$**F.)**

c. Explain the reason(s) for your answer to part 14.b.

d. What would happen to the dude's apparent weight (normal force) if the Earth's rotational speed were to increase?

15. a. What is the true shape of the Earth? (Draw and label it to the right.)

b. What happens to the distance between the center of the Earth and a body that travels from the North Pole to the equator?

c. What happens to the true weight (gravitational force) of a body that moves away from the center of the Earth?

d. What happens to the true weight of a body that travels from the North Pole to the equator?