

Key

PHYS SPRINGBOARD:
CENTRIFUGAL WEIGHT LOSS



TRUE WEIGHT AND APPARENT WEIGHT

- Show the forces acting on the little dude while he stands on the ground.
- Which is greater, the downward gravitational weight or force or the upward Normal force?
- 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? stay - Gravity
- While falling, little dude would feel weightless. Is he truly weightless? Go away - Normal
Feel weightless
- 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?

0

APPARENT WEIGHT IN AN ELEVATOR

- Consider the little dude 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? Same

b. the elevator moves upward with increasing speed? Apparent

c. the elevator moves upward with constant speed? Same

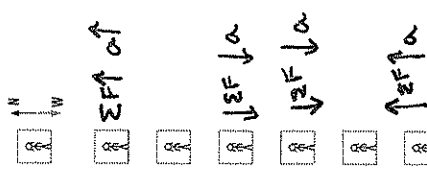
d. the elevator moves upward with decreasing speed? True

e. the elevator moves downward with increasing speed? True

f. the elevator moves downward with constant speed? Same

g. the elevator moves downward with decreasing speed? Apparent

- For each case in which one force is greater than the other, Draw a vector representing the net force ΣF and a vector representing the acceleration a.



- How does the direction of the net force on the dudette compare to the direction of her acceleration? Same

- If the mass of the dudette is m and the acceleration of the elevator is $\Sigma F = ma$

a. i. what is the net force on the dudette? $F_N - F_g = ma$

ii. By how much do her true weight and her apparent weight (normal force) differ? $F_N - mg = ma$

$\Sigma F = F_N - mg = ma$

$F_N - mg = ma$

- 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? $F_N - 100 = 6$

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$F_N = 106 \text{ lbs}$

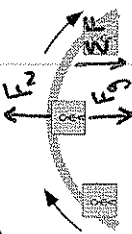
$F_N - 100 = -6$

$F_N = 94 \text{ lbs}$

means Down

OVER THE TOP ON THE FERRIS WHEEL

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



- Draw the forces acting on him.
- Which force is greater: weight or normal? (If one is greater, draw a vector representing th net force, ΣF)

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

Net acceleration is towards the center (centripetal)

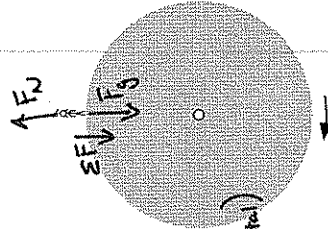
- Suppose the little dude weighs 100 lb and he needs a net force of 6 lb to maintain circular motion. What is his apparent weight?

$F_N - F_g = ma \rightarrow F_N - 100 = 6$

AROUND THE WORLD

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

- In our view from above the North Pole, draw the forces acting on her.
- Which force is greater: weight or normal? (If one is greater, draw a vector representing th net force, ΣF)



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

Net force to center of earth (Centripetal)

- 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?

$F_N - 100 = -6$

$F_N = 94 \text{ lbs}$

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 dudetete in her circular motion around the world?

Increases

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

remain the same?

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

$F_N - 100 = -60$

$F_N = 40 \text{ lbs}$

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

$F_N - 100 = -100$

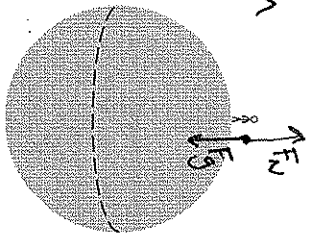


12. Suppose the rotational speed of the Earth were to increase further so that the dudetete needs 100 lb of net force acting on her to stay in circular motion. What would the dudetete's apparent weight be?

Fall off the earth

13. What would happen if the rotational speed of the Earth were to increase even further so that the dudetete needs 100 lb of net force acting on her to stay in circular motion?

14. Consider a little dudetete standing at the North Pole.
 a. Draw the forces acting on him.



Same

b. Which force is greater: weight or normal? (If one is greater, draw a vector representing th net force, ΣF)

Not moving in a circle

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

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

Nothing



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

Oblong/egg

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

* exaggerated drawing

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

Increases

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

Decreases