Sample test questions:

Multiple choices: (Only one answer is correct. Please choose the best answer you think.)

1. A rock is suspended under a string; and it accelerates downward. Which one of the following statements concerning the tension in the string is true?

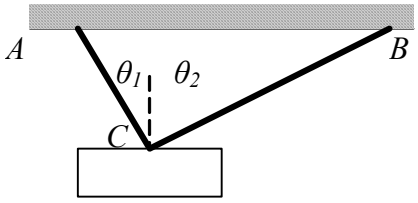
(a) The tension points downward.
(b) The magnitude of the tension is less than the magnitude of the gravity on the rock.
(c) The magnitude of the tension is equal to the magnitude of the gravity on the rock.
(d) The magnitude of the tension is greater than the magnitude of the gravity on the rock.
(e) The tension is independent of the magnitude of the rock's acceleration.

2. A football is kicked at an angle θ with respect to the horizontal. Which one of the following statements best describes the *magnitude of the acceleration* of the football during this event if air resistance is neglected?

(a) The acceleration is zero m/s^2 at all times.
(b) The acceleration is 9.8 m/s^2 at all times.
(c) The acceleration is 9.8 m/s^2 when the football has reached the highest point in its trajectory.
(d) The acceleration is positive as the football rises, and it is negative as the football falls.
(e) The acceleration starts at 9.8 m/s^2 and drops to some constant lower value as the ball approaches the ground.

Comprehensive questions:

An object whose mass is unknown is hung to the wall by two strings, as shown in the graph on the right. The angle between the vertical direction and the left string (from point A to C) is θ_1 = 30.0 degree. The angle between the vertical direction and the right string (from point B to C) is θ_2 = 60.0 degree. The tension in the string AC is 20.0 N. What is the mass of the unknown object? Carefully show your calculation.



Answer: 1. B 2. B

3. 2.36 kg

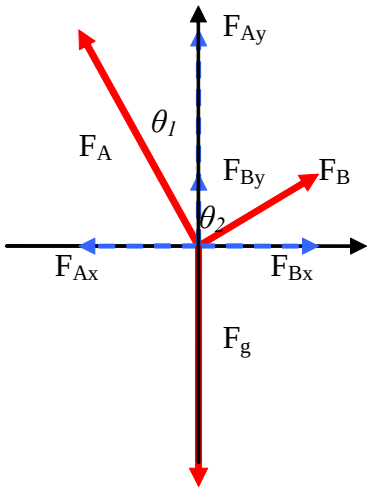
Brief Solution:

1. *From Newton's 2nd Law, the total force on the rock is pointing downward (because the acceleration is downward). Therefore the tension of the string is pointing upward and less than the force of gravity.*

2. *Once the football is off the player's foot, the only force on it is gravity. At all the time, the gravity points straight down. And the only acceleration of the football at all times is the acceleration of gravity, which is 9.8 m/s^2 pointing down. Since the question is asking about the magnitude only, the number is* ***9.8 m/s^2 at all the time****.*

3. *Free-body diagram as shown in right.*

There are three forces on the object. Gravity pointing downward and two tensions pointing to directions along each string, respectively.



We write down the components of all forces:

F_g: F_{gx}=0 N
F_{gy}= -mg (here we use g=+9.8 m/s^2)

F_A: F_{Ax}= -|F_A|sin θ_1
F_{Ay}=+|F_A|cos θ_1 (think why?)

F_B: F_{Bx}=+|F_B|sin θ_2
F_{By}=+|F_B|cos θ_2 (again, why?)

What we know are: |F_A|=20.0 N, g=9.8 m/s^2, θ_1=30.0 degree and θ_2=60.0 degrees
What we don't know are : |F_B|=?? and m=??

Since the object is in rest, Newton's first law tells us that ***the total force is zero.***

$$\sum \vec{F} = 0$$

This can be expressed by two equations:

$$\sum F_x = 0 \text{ and } \sum F_y = 0$$

Which are:

$$\sum F_x = F_{gx} + F_{Ax} + F_{Bx} = 0 - |F_A| \sin\theta_1 + |F_B| \sin\theta_2 = 0$$

$$\sum F_y = F_{gy} + F_{Ay} + F_{By} = -mg + |F_A| \cos\theta_1 + |F_B| \cos\theta_2 = 0$$

Plug in numbers, we have:
-20.0 sin(30.0)+ |F_B|sin(60.0)=0
-9.8m+20.0 cos(30.0)+ |F_B|cos(60.0)=0

Solve the first one we have |F_B|=11.55 N
Plug it in the second equation we have: m=2.36 Kg