

## Forces and Reference Frames

You are a passenger in a car and not wearing your seat belt. Without changing its speed, the car makes a sharp left turn, and you find yourself colliding with the right-hand door. Which of the following is correct?

- 1) Before and after your collision with the door, there is a rightward force pushing you towards the door.
- 2) Before your collision with the door, there is a rightward force pushing you towards the door but it goes away after the collision.
- 3) Starting at the time of your collision, the door exerts a leftward force on you.
- 4) Starting at the time of your collision, you exert a rightward force on the door.
- 5) Both (1) and (3) are correct.
- 6) Both (2) and (3) are correct.
- 7) Both (1) and (4) are correct.
- 8) Both (2) and (4) are correct.
- 9) Both (3) and (4) are correct.
- 10) None of the above are correct. (Hit key "0").

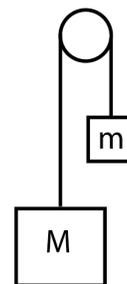
You are standing in an elevator, which was moving upward. While the elevator slows down to stop at a floor.

- 1) The floor still pushes up on you with a force of  $Mg$  and you still push down on the floor with the same force.
- 2) You still push down with a force of  $Mg$  but the floor pushes up with a force larger than  $Mg$  because you are moving upward.
- 3) The floor still pushes upward with a force of  $Mg$  but because you are accelerating downward, you push down with a force smaller than  $Mg$ .
- 4) Both the force you exert and the force the floor exerts are smaller than  $Mg$ .
- 5) Both the force you exert and the force the floor exerts are larger than  $Mg$ .
- 6) None of the above is true.

You are standing in an elevator, which is not moving. You feel the elevator floor pushing up on your feet with a force of  $Mg$ . Now, the elevator accelerates upward.

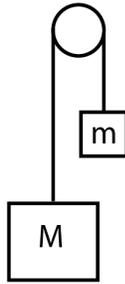
- 1) The floor still pushes up on you with a force of  $Mg$  and you still push down on the floor with the same force.
- 2) You still push down with a force of  $Mg$  but to accelerate you upward, the floor pushes up with a force larger than  $Mg$ .
- 3) The floor still pushes upward with a force of  $Mg$  but because you are accelerating upward, you push down with a force smaller than  $Mg$ .
- 4) Both the force you exert and the force the floor exerts are smaller than  $Mg$ .
- 5) Both the force you exert and the force the floor exerts are larger than  $Mg$ .
- 6) None of the above is true.

A large and small mass ( $M > m$ ) hang from a light string over a light pulley. The masses are not moving because another force is acting on the system. Which is true?



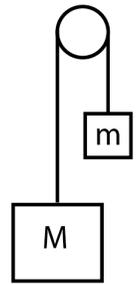
- 1) The extra force is zero (i.e. no extra force is needed).
- 2) The only possibility is a force pushing up on  $M$  with a magnitude of  $Mg$ .
- 3) The only possibility is a force pushing down on  $M$  with a magnitude of  $Mg$ .
- 4) The only possibility is a force pushing up on  $m$  with a magnitude of  $mg$ .
- 5) The only possibility is a force pushing down on  $m$  with a magnitude of  $mg$ .
- 6) More than one of the above are true.
- 7) None of the above are true.

A large and small mass ( $M > m$ ) hang from a light string over a light pulley. The masses are not moving because a force is pushing up on  $M$ . Which is true?



- 1) The tension in the string is  $Mg$  everywhere.
- 2) The tension in the string is  $mg$  everywhere.
- 3) The tension in the string is  $(M+m)g$  everywhere.
- 4) The tension in the string is  $(M-m)g$  everywhere.
- 5) The tension in the string is  $Mg$  on the left and  $mg$  on the right.
- 6) The tension in the string is more than  $Mg$  on the left and  $mg$  on the right.
- 7) None of the above are true.

A large and small mass ( $M > m$ ) hang from a light string over a light pulley. No forces other than gravity and the string are acting on the system so the masses start to accelerate. Which is true?



- 1) The tension in the string is  $Mg$ .
- 2) The tension in the string is  $mg$ .
- 3) The tension in the string is more than  $Mg$ .
- 4) The tension in the string is less than  $Mg$ .
- 5) The tension in the string is more than  $mg$ .
- 6) The tension in the string is less than  $mg$ .
- 7) More than one of the above are true.
- 8) None of the above are true.