Help Sheet on Net Force & Acceleration (Newton's 2nd Law of Motion)

Now that you have completed the worksheet, take a look at the explanation below. Hopefully, you will not be surprised that the acceleration is always in the direction of the net force (thus the 2nd and 3rd column always agree)! This is in agreement Newton's 2nd Law of Motion.

The acceleration CAN be in the direction opposite to the motion, such as in cases 3 and 6. This simply means the object is slowing down.

In the analysis of the falling baseball, you will see that the force diagram, net force, and acceleration do not change while the ball is going up, at the peak, and on the way back down. This is often surprising, but it is a reflection of what happens. We can think about what happens during each of these stages and it is because of the downward net force and downward acceleration:

Stage 6: The ball is moving upward, but slowing down because of gravity. If the force of the hand were still acting on the ball (equal or bigger to the force of gravity), then the ball would not slow down and it would just keep going up and up forever (e.g. a rocket).

Stage 7: The ball is at the peak and for an instant the velocity is zero. If gravity did not act on the ball at this point, there would be no forces acting on the ball and it would stay there indefinitely. We know that does not happen! That's because gravity acts even on objects that are not moving.

Stage 8: The ball is moving downward. Its speed is increasing because of gravity.

The answers to the worksheet are filled in on the next two pages.

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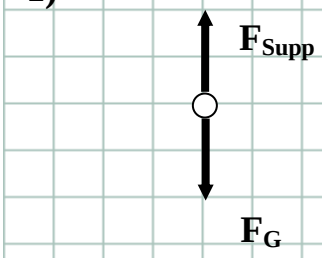
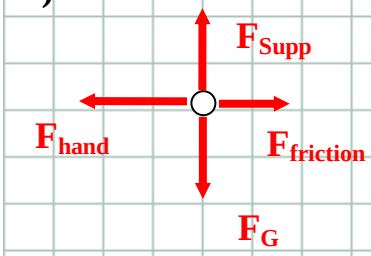
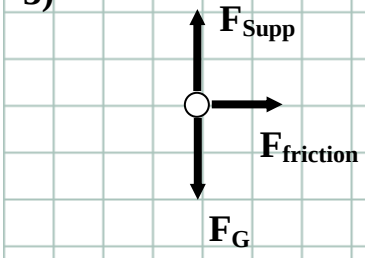
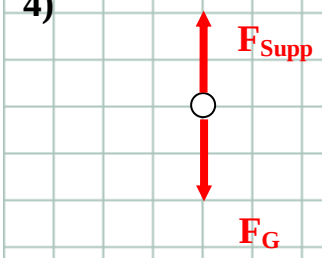
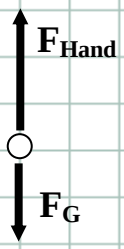
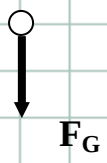
Fill in the missing parts of the following table that describe the motion of a book pushed across a table, then slows to a stop without running into anything. Remember, that Newton's 2nd Law says the acceleration is equal to the net force divided by the mass. However, also remember that the acceleration is always in the same direction as the net force.

Force Diagram	Net Force	Acceleration (left, right, or zero)?	Describe the object's motion
1) 	$F_{net} = 0$	Zero	Book is stationary
2) 	⇐	Left	Moving to the left, speeding up
3) 	⇒	Right	Book is moving to the left, but accelerating to the right- that just means it is slowing down
4) 	$F_{net} = 0$	Zero	Book is stationary

Fill in the missing parts of the following table that describe the motion of a ball thrown vertically (straight up)- assume air resistance is negligible. Remember, that Newton's 2nd Law says the acceleration is equal to the net force divided by the mass. However, also remember that the acceleration is always in the same direction as the net force.

Force Diagram	Net Force	Acceleration (up, down, or zero)?	Describe the object's motion
5) While hand is pushing up 		**Up**	Ball is moving upward at increasing speed
6) Part way up 		Down	Ball is moving upward, but slowing down
7) At peak 		**Down**	Ball is stopped for an instant; F_G still acts even though ball is stationary
8) On the way back down 		**Down**	Ball is moving downward at increasing speed