Free Body Diagrams I

NAME:

The first step in solving problems involving Newton's Laws is to draw a diagram of the situation.

Common forces that may be present:

 F_g or w – Force of gravity (weight) F_T or T – Force of tension (force in a string or a cable) F_N or N – Normal force (support force of the ground on an object) F_f or f – Force of friction F_{drag} – Air resistance F_{lift} – Lift force of the propellers or wings of an airplane F_a – Force applied to an object by some random force in a problem

Part 1: Finding the Net Force.

For each of the following situations, sketch the direction of the net force. If there is no net force, simply say " $\Sigma F = 0$ ". Unless otherwise stated, the motions are to the right. 1. A car driving to the right at constant speed.

- 2. A car driving to the right and speeding up.
- 3. A car driving to the left and slowing down.
- 4. A car driving up a straight hill at constant speed.
- 5. A car driving up a straight hill and slowing down.
- 6. A car driving in a circle at constant speed.
- 7. A helicopter hovering in the air.
- 8. A plane climbing at constant speed.
- 9. A plane climbing and speeding up.
- 10. An elevator going up at constant speed.

Part II: Identifying the individual forces.

For each of the situations below, draw all the individual force vectors, and then give the net force, like previously. Do not ignore air resistance or other forms of friction. If forces are of equal magnitude, draw them the same length. If not otherwise stated, assume motion is to the right.

1. A person standing still in the hallway.

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- 2. A car traveling down the highway at constant speed.
- 3. A car traveling down the highway at increasing speed.
- 4. A person standing in an elevator that is not moving. (Focus on person.)
- 5. A toy wagon being pulled to the left at an increasing velocity.
- 6. A bicycle coasting and slowing down.
- 7. An airplane flying at constant velocity.
- 8. An airplane flying with increasing speed.
- 9. A person riding an elevator up at constant velocity.
- 10. A helicopter hovering in the air.

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11. A person riding an elevator traveling up at an increasing speed.

- 12. A car traveling down the road with a constant acceleration.
- 13. A helicopter coming down at constant speed.
- 14. A person traveling up in an elevator, but with a decreasing velocity.
- 15. A box sitting at rest on hill.

16. A box with an initial velocity up a hill, but slowing down. Include friction.

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