Ch 4: Newton's 3nd Law of Motion name:

Study Guide H: format: 38 Q; 26 mc/t or F; 2 calculations; 1short answer; 9 action/rxn F pair labeling/drawing; CP: 34Q; 25 mc/t or f; 9 action/rxn F pair labeling/drawing (\*SKIP)

**Vocab**

*Action/reaction F pair interaction Newton's 3rd law*

*Action/reaction F agent simultaneous internal F external F*

*inversely proportional directly proportional*

**Formulae**; (units)

acceleration: **a =F/M**; (m/s2 or 'meters per second per second')

\*be able to derive F or M from this formula as well

**Things you MUST know:**

1. Action/reaction pairs occur simultaneously.
2. \*Be able to calculate **acceleration**/force/mass from a set of givens using the F formula.
3. A student goes to kick an object (ball, tire, clown--you decide)… If objects react equally and oppositely, why does the kicked object (let's choose 'ball') move?
4. I will give you a series of actions and you must identify the proper reaction F agent:
   1. Eg. Julio walking reaction F agent?
   2. How to figure these out:
      * 1. Start with action F agent (Julio) and identify the action F as a phrase (walking: "Julio pushes ground")
        2. Finish with the reaction F as a phrase by reversing action F ("ground pushes Julio")
        3. Select the subject of the reaction F (**ground**)

Try it out here: eg. LaFonda swimming

Action F:

Reaction F:

Reaction F agent:

1. What if I told you that a rocket does not need the ground in order to launch? Would you recoil in abject horror or agree with me? Why should you agree with me (besides the fact that I know a lot more than you)? I know, that was cheeky---just keeping it interesting.
2. Be able to apply the fact that acceleration is inversely proportional to mass (a ~ 1/m) to varying situations (eg. cannon and cannonball, rifle and bullet)
3. Understand internal vs, external forces to be able to apply them (eg. Why can you not move a stalled car by pushing on the steering wheel while seated in the driver's seat? Also, relate this to the horse-cart dilemma).
4. This will come up again & again (& again) in our future: Coach Bowman & Mr. McDougal walk into a physical science classroom and permit Mr. e to stand between them & push each of them with equal F. Which one moves faster? (hint: which one has less inertia?--that's the one)
5. What happens when an object falls to earth? What are the action/rxn F pairs? Are the forces equal & opposite? If so, why does a rock fall noticably (faster) to the earth than the earth falls to the rock?
6. \*Be able to state Newton's 3rd law (include both aspects).
7. Apply Newton's 3rd law to many situations (sim to hw & notes).
8. Two vehicles, one large (truck) and one small (VW) collide:
   1. The impact F is the same for both.
   2. The impact time is the same for both.
   3. The one that experiences the greatest change in v (acceleration/deceleration) is the smaller one. Why?
9. Consider a tug of war. Why is it impossible for one to exert a greater F (tension) on the rope than the other?
10. Finish this sentence, "You can only exert a force on something as great as it \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_."
11. \*Be able to calculate sliding distances of two different sized masses (on ice) pulling on a rope as a combined application of Newton's 2nd & 3rd laws. (Remember, Newton's 3rd law means the F will be the same on each, while Newton's 2nd law says their v (hence their distances) will be inverses of their mass ratios)

Eg. Using a rope 15 m long, two individuals, one 2x as massive as the other, attempt a tug of war on frictionless ice and meet in the middle. How far will the larger person slide?

15m

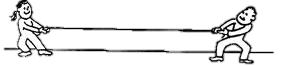
smaller

larger

10m

5m

A: Because Newton's 3rd law requires that the F on each is the same (action/rxn pair), we can remove f from the scenario. Because Newton's 2nd law requires the larger person to move at ½ the v for the same F because of 2x the mass (a = 1/2M), he will travel ½ the d of the smaller individual. Therefore he will travel 5 meters (distance reasoning: x + 2x = 15) while the smaller person will travel 10 meters (2x the d of the larger man).



ESSAYS

No are presented; choose none. (hooray!)

**Newton's Laws (Some more review) Name**

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**Newton's Third Law**

Read from **Lesson 4** of the **Newton's Laws** chapter at **The Physics Classroom**:

**http://www.physicsclassroom.com/Class/newtlaws/u2l4a.html**

**http://www.physicsclassroom.com/Class/newtlaws/u2l4b.html**

**MOP Connection:** Newton's Laws: sublevel 12

A force is a push or pull resulting from an interaction between two objects. Whenever there is a force, there are two objects involved - with both objects pushing (or pulling) on each other in opposite directions. While the direction of the pushes (or pulls) are opposite, the strength or magnitudes are equal.

This is sometimes stated as Newton's Third Law of motion: *for every action there is an equal and opposite reaction*. A force is a push or a pull and it alwaysresults from an interaction between two objects. These forces always come inpairs.

1. For each stated *action force*, identify the *reaction force*.

Bat hits ball.

Man pushes car.

Bus hits bug.

2. Identify by words the action-reaction force pairs in each of the following diagrams.

3. **TRUE** or **FALSE**:

As you sit in your seat in the physics classroom, the Earth pulls down upon your body with a gravitational force; the reaction force is the chair pushing upwards on your body with an equal magnitude.

If False, correct the answer.

4. Shirley Bored sits in her seat in the English classroom. The Earth pulls down on Shirley's body with a gravitational force of 600 N.

Describe the reaction force of the force of gravity acting upon Shirley.

5. Use Newton's third law (law of action-reaction) and Newton's second law (law of acceleration: a =

Fnet/m) to complete the following statements by filling in the blanks.

a. A bullet is loaded in a rifle and the trigger is pulled. The force experienced by the bullet is

\_\_\_\_\_\_\_\_\_\_\_\_ (less than, equal to, greater than) the force experienced by the rifle. The

resulting acceleration of the bullet is \_\_\_\_\_\_\_\_\_\_\_\_ (less than, equal to, greater than) the

resulting acceleration of the rifle.

b. A bug crashes into a high speed bus. The force experienced by the bug is \_\_\_\_\_\_\_\_\_\_\_\_ (less

than, equal to, greater than) the force experienced by the bus. The resulting acceleration of the

bug is \_\_\_\_\_\_\_\_\_\_\_\_ (less than, equal to, greater than) the resulting acceleration of the bus.

c. A massive linebacker collides with a smaller halfback at midfield. The force experienced by the

linebacker is \_\_\_\_\_\_\_\_\_\_\_\_ (less than, equal to, greater than) the force experienced by the

halfback. The resulting acceleration of the linebacker is \_\_\_\_\_\_\_\_\_\_\_\_ (less than, equal to,

greater than) the resulting acceleration of the halfback.

d. The 10-ball collides with the 14-ball on the billiards table (assume equal mass balls). The force

experienced by the 10-ball is \_\_\_\_\_\_\_\_\_\_\_\_ (less than, equal to, greater than) the force

experienced by the 14-ball. The resulting acceleration of the 10-ball is \_\_\_\_\_\_\_\_\_\_\_\_ (less than,

equal to, greater than) the resulting acceleration of the 14-ball.