1st and 2nd Laws of Motion
Practice (ANSWER KEY)

Define Force__A push or a pull._____

Define Mass____The amount of Matter (stuff) an object has._____

Define Acceleration___How fast an object speeds up._____

Unit guide:

Mass is measured in kilograms (kg).

Acceleration is measured in meters per second squared (m/s^2).

Force is measured in Newtons (N). Newtons are equal to kilograms over meters per second squared ($\frac{kg\ m}{s^2}$)

Section 1: Car Trip

Phenomena: Han cannot push his car.

> Han is traveling to Tatooine to visit his friend Luke. Han's car is full of all the things he will need for a fun trip. While on the way Han forgets to fill up his car with gas and runs out of gas a few miles outside the nearest town. Han gets out to push, but no matter how hard he pushes the car, the car will not move.

Use the scenario and the terms defined above to help answer questions 1-3.

1. Explain why Han cannot move the car?
   Han cannot apply enough force to get the large mass of the car into motion.

2. There is no one around to help Han push, what can he do to get his car moving?
   He could reduce the mass of the car by taking some things out of the car.

3. Ben, another traveler, stops and helps Han push the car to the gas station. Why were Han and Ben able to get the car moving when Han was unable to do so on his own?
   Together Han and Ben were able to produce enough force to move the car.

Chewbacca and Yoda are on swings at a playground. Chewbacca has a mass of 125 kg and Yoda has a mass of 30 kg.

Use the scenario and the terms defined above to help answer questions 4-5

4. If Chewbacca and Yoda are pushed with the same amount of force what will be the result?

   Yoda will accelerate more than Chewbacca.

5. If Chewbacca and Yoda have the same amount of acceleration who was pushed with the least amount of force? Yoda

Section 2: Calculation

(You may use a calculator but still **SHOW YOUR WORK**).
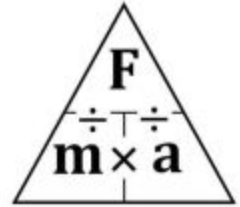
Rey is pulling Fin in a wagon. The combined mass of Fin and the wagon is 84 kg.

6. How much force would Rey need to use to pull Fin at $3 \, m/s^2$?

   F=ma so F = (84)(3) therefore F = 252 N

   The amount of force Rey needs to produce is 252 N.

7. If Rey is pulling Fin 144 N of force what is the acceleration of the wagon?

   a=F/m so a = (144/84) therefore a = 1.71 m/s^2

   The acceleration of the wagon is 1.71 m/s^2 .

8. Without Fin in the wagon, Rey pulls the wagon with 160 N of force at an acceleration of 15 m/s^2 , what is the mass of wagon without Fin?

   m=F/a so m = (160/15) therefore m = 10.67 kg.

   The mass of the wagon without Fin is 10.67 kg.

Anakin wants to build the fastest spaceship ever.

9. The engine Anakin built for his spaceship can power the ship with 14500 N of force. How much mass must his ship have if needs to to accelerate at 55 m/s^2 ?

   m=F/a so m = (14500/55) therefore m = 263.64 kg.

   Anakin's shipps needs to be 263.64 kg.

10. After completing his ship Anakin realizes his ship only has a mass of 200 kg. If his engines creates 14500 N of force, how fast can his ship accelerate?

    a=F/m so a = (14500/200) therefore a = 72 m/s^2 .

    Anakin's ship can accelerate at 72 m/s^2 .