

NAME _____
PER _____

DATE _____
Newton's Laws of Motion

I. Newton's First Law

Inertia: tendency of an object to resist _____.

An object will keep moving at a constant speed, unless an _____ force acts on it.

OR:

If all the _____ in a direction are balanced, then the object doesn't change _____.

(Bodies in motion stay in motion, bodies at rest stay at rest)

REMEMBER: Having NO forces means they are _____.

An object at _____ has a constant speed of _____.

EXAMPLES: Tape at rest on table, 2 people pushing on a chair, coin on a card, tablecloth, throwing a ball, a car going 55 MPH on cruise control (gas vs friction).

II. Newton's Second Law, $F=ma$

If the forces in a direction are _____, the object will change _____.
(_____).

Force (n) = Mass (kg) times Acceleration (m/s²)

Force = mass * change in speed / time

The force needed to change speed is proportional to the _____, also, the larger the mass, the _____ the _____.

(note: the first law is a special case of the second law, $f=ma$ with the force and the acceleration both zero)

EXAMPLES: A heavy ball and a light one, stopping a car like SUPERMAN, catching a baseball, car mileage, fruit being crushed.

III. Newton's Third Law, Action/Reaction

When an object exerts a force on another, it exerts the same force back.

$F(1)=F(2)$.

EXAMPLES: book on table, pulling string, 2 scales, bat/ball, rifle, you on chair, car crash, skates, balloon)

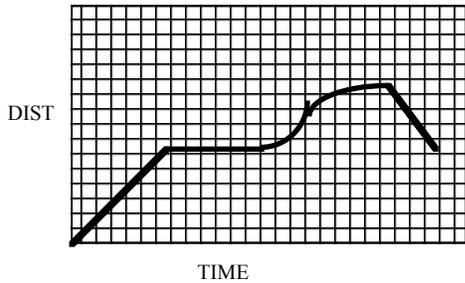
FOR YOU TO ANSWER:

Find two examples of each of Newton's Laws. These can be from TV, sports, play, etc... About 3-4 sentences each. Example: My cat was sliding across the waxed kitchen floor with a mouse in his mouth. When he ran into the basket on the floor, the mouse popped out and went flying. This is an example of inertia, because the cat was going at a constant speed (no friction force) until stopped by the force, while the mouse wasn't, so it kept going at a constant speed.

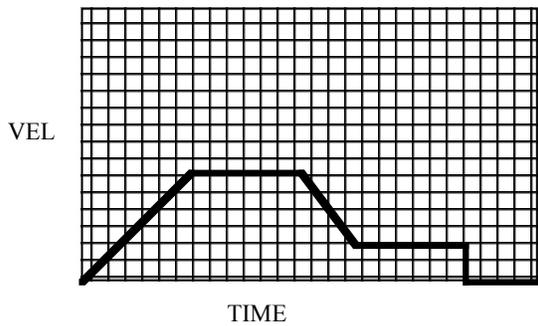
NAME _____ DATE _____ PERIOD _____

NEWTON'S LAWS I

WHAT PARTS OF A DISTANCE TIME GRAPH SHOW NEWTON'S FIRST OR SECOND LAW? LABEL EACH PART:



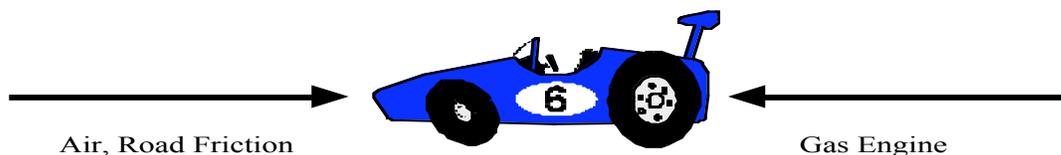
WHAT PARTS OF A SPEED TIME GRAPH SHOW NEWTON'S FIRST OR SECOND LAW? LABEL EACH PART:



An older incorrect theory of motion stated that an object's motion would continue only as long as there was a force applied to the object. Some science fiction movies would even show rockets traveling through space with their engines roaring to keep the rocket moving at a constant speed. How does this old theory disagree with Newton's First Law of Motion? Why do you think people had that theory?



Is it true that the car below will stop? Why or why not?



NAME _____ DATE _____ PERIOD _____ NEWTON'S LAWS I

Write a 1, 2, or 3 next to each occurrence listed to show which of Newton's Laws applies best., For H and I sketch a distance and speed-time graph.

- A. A Book lying undisturbed on a table.
- B. A comet passing Jupiter is accelerated by Jupiter's great gravity.
- C. A rocket soars skyward as the engine fires come out.
- D. A baseball hits the catcher's mitt when the batter misses.
- E. A hockey player' stick bounces backwards when he hits the puck.
- F. A car does not move until the engine is started and put in gear.
- G. A chair with wheels moves back when the person pushes on the desk.
- H. A falling object accelerates as it falls towards the earth.

- I. An object thrown up in the air eventually falls back down.

- J. An open air balloon flies around the room.
- K. A dresser doesn't move when pushed.
- L. a gust of wind blows an arrow in flight off target.
- M. A bowling ball is deflected as it strikes the pins.
- N. A diving fighter pilot gains speed.
- O. An airliner lifting off the runway during takeoff.
- P. A jet flying level at a constant 2000 km/hr.
- Q. A tennis ball is smushed as it contacts and bounces off the racket.

NAME _____

DATE _____ PERIOD _____

NEWTON'S LAWS II

NEWTON'S LAWS IN MOTION

Coach Rogers had 6 positions to fill on his football team. In order to be considered for a particular position the players has to meet certain physical criteria.



LINE: Stops other players. requires great strength in a short distance

BACK: Runs with football. Requires speed and agility.

END: May block as a lineman or act as a pass receiver. Requires a balance of both speed and strength.

Coach Jones had physical data from each player, their weight and their time and final speed in the 36 meter dash. Use your knowledge of Newton's Laws to assign each the players to the position for which they are best suited.

MASS(on Earth) in kg = Weight in Newtons divided by 9.8 m/s².

Acceleration in m/s² = Change in velocity divided by time.

Force in Newtons = Mass in kg times Acceleration in m/s²

1. Calculate the Mass, Acceleration, at Force at finish line for each player.

PLAYER	WEIGHT (N)	MASS (kg)	SPEED at Finish (meters per sec)	TIME (sec)	ACCELERATION (m/s ²)	FORCE
(Newtons)						
ALLEN	833 N		16 m/s	4.5 s		
TERRY	735 N		16.4 m/s	4.4 s		
FRANK	911 N		15 m/s	4.8 s		
DAVE	823 N		15.3 m/s	4.7 s		
BOB	1000 N		14.7 m/s	4.9 s		
CARLOS	931 N		15.7 m/s	4.6 s		

2. Select two players for each position. Assign each player to a position. Explain your selections in terms of Newton's Laws.

POSITION	PLAYER	REASONING
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Line 1

Line 2

Back 1

back 2

End 1

End 2

3. Assuming that their acceleration remained the same, how many kilograms would Dave have to gain to exert the same force at the finish line as Allen?

$$\text{Force (Allen)} = \text{Mass (new)} \times \text{Acceleration (Dave)}$$

$$\text{mass} = \text{Force divided by Acceleration}$$

4. Coach Rogers particularly needed a fullback who not only had speed, but would be difficult for opposing players to bring down. Which of the six players did he choose? Explain the physical principals that governed his choice.

5. Suppose that Bob, who you know has a mass of 102 kg, has a force of 306 Newtons at the finish line, and hits Terry, who is standing still, head on for exactly one second. How fast would Terry, with a mass of 75 kg, move backwards?

$$\text{Force} = \text{Mass} \times (\text{Change in Speed} / \text{Time})$$

$$\text{Change in Speed} = \text{Force} \times \text{Time} / \text{Mass}$$