HW (4)
2 pages

Newton's Laws

NAME: _____

Basically, Newton's Laws are intuitive – see that book over there? You'd get a shock if it moved all by itself. You expect things to stay in motion or motionless, unless acted upon by a force.

According to Newton's First Law, an object will only change the way it is accelerating or moving if it is acted on by an unbalanced force, or not cancelled out by an equal force in the opposite direction. This means that objects will remain moving or stationary with the velocity they already have. In the absence of an unbalanced force, an object in motion will maintain its state of motion. This is often called the Law of Inertia. Inertia resists changes in its velocity.

1 **a** Loose objects in a car move forward when the car stops suddenly. That is, they continue to move forward as the car stops. Explain in terms of forces why this happens.

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_____

b Why are seat belts necessary in cars? Include an example of a specific situation in your answer.

_____

_____

2 The aisle in a bus is slippery. Predict the outcomes for a bus that is full of people if the bus:

a starts moving suddenly. _____

_____

b suddenly turns a corner. _____

_____

c accelerates rapidly from a stop sign. _____

_____

Newton's Second Law states that the acceleration of an object is dependent upon the unbalanced force acting on the mass of the object. That is, a large force = large acceleration, a small force = small acceleration. This concept can be expressed as:

acceleration = Force ÷ mass or $a = F \div m$
force = mass × acceleration or $F = ma$

Study the examples shown below.

Example a	Force = mass 10 kg × acceleration 4 ms^{-2} = 40 Newtons
Example b	Acceleration = $\frac{\text{Force 20 Newtons}}{\text{mass 10 kg}}$ = 2 ms^{-2}
Example c	Mass = $\frac{\text{Force 40 Newtons}}{\text{acceleration 4 } ms^{-2}}$ = 10 kg

3 **a** Calculate the missing values to complete the table at the right.

FORCE (N)	MASS (kg)	ACCELERATION (ms^{-2})
100	5	
	4	20
	6	15
20		5
36	6	

b A trolley is acted upon by a force of 60 Newtons and its mass is 15 kilograms. Calculate its acceleration.

_____

c Sue's bike has a mass of 150 kg. If the acceleration of the bike is 10 ms^{-2}, what is the force?

_____

d What is the mass of an object falling with an acceleration of 9.8 ms^{-2} and a force of 833 Newtons?

_____

When you see a car move forwards, look carefully and you will see that the wheels are turning backwards. This is Newton's Third Law of Motion in action.

Formally stated, Newton's Third Law is: *For every action, there is an equal and opposite action.*

This means that in every interaction, there is a pair of forces acting on the two interacting objects. The size of the force on the first object equals the size of the force on the second object, but is in the opposite direction.

4 Identify the action and reaction in each of the following interactions.

a A book resting on a table_____

b A rocket accelerating in space_____

c A ship floating on water_____

d A gun firing a bullet_____

e A person leaning on a fence_____

5 Friction is very important when considering forces. Explain why.

_____

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6 In the space below, draw a picture of a skateboarder travelling down a footpath and colliding with a light pole. Label it to identify the forces that are involved. Then write which of Newton's Laws relates to the collision.