Name_____ Block _____ Date _____

Ch 5 Newton's 2nd Law: Force and Acceleration

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Objectives:

State the relationship between acceleration and net force. Know the SI units and the other units.(5.1)
State the relationship between acceleration and mass. Know the SI units and the other units(5.2)
State Newton's 2nd Law of Motion and explain it using a "numeric" example. (5.3)
Describe the effect of friction on stationary and on moving objects. (5.4)
Distinguish between force and pressure. Know their SI & other units of measurement.(5.5)
Using the metric system, convert mass given in grams to kilograms and vice a versa. (4.6)

Vocabulary:

air resistance	pressure	Newton's 2nd Law	pascal
inversely	fluid	free-body diagram	rolling friction
static friction	fluid friction	kinetic/ sliding friction	

	symbol	**SI unit**	**other unit(s)**
force	F	N newton	kg m s^2
acceleration	a	m/s^2	
friction	f	N newton	kg m /s^2
pressure	P	Pa pascal	N/ m2
area	A	m2	

Formulas:

$a = \frac{F}{m}$ $F = ma$ $w = mg$ $F_f = \mu F_n$ $A = \pi r^2$ $P = \frac{F}{A}$

Newton's 1st law covered objects at rest or moving at a constant velocity (Equilibrium)

Newton's 2nd law covers objects that are changing their motion ..... objects that are accelerating

acceleration is the change in velocity per time $a = \frac{\Delta v}{t}$

5.1 Force Causes Acceleration

apply a force to object at rest.....it velocity changes.....therefore, it has accelerated

if remove that force then object will continue its motion at a constant velocity

if add force again....it's velocity will change again....and it is accelerating

5.1 Force Causes Acceleration

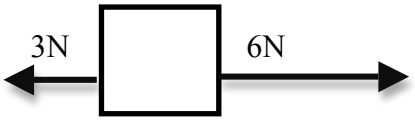
acceleration depends on the net force.....to increase the acceleration of an object you must increase the net force acting on it.....double the force.....double the acceleration

object's acceleration is directly proportional to the net force acting on it (not = to each other)

acceleration ~ net force if net force increases.....so does acceleration

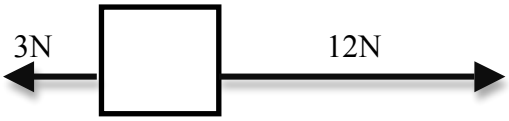
? The acceleration of a ball with a net force of 2N is 6 m/s2. If the net force is doubled then what is the resulting acceleration? Draw free body diagrams to help solve.

? The acceleration of a box being pushed across a room with a net force of 3N is 6 m/ s2. What is the resulting acceleration if the net force is tripled?



Fnet = _____

a = 6 m/ s2

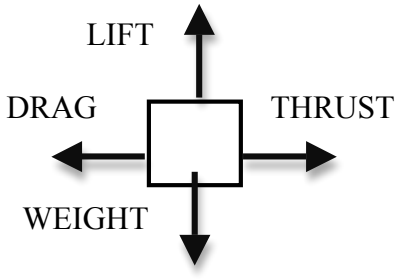


Fnet = _____

a = _____

? A pilot announces that the plane is flying at a constant 900 km/ h and the thrust of the engines is a constant 80,000 N. What is the acceleration of the airplane?

? what is the combined force of air resistance that acts on the plane's outside surface?



acceleration depends on the mass being pushed

the same force applied to twice as much mass results in only half the acceleration

for a given force, the acceleration produce is inversely proportional to the mass

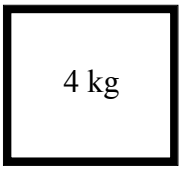
inversely- When two values change in opposite directions, so that if one is doubled the other is reduced to one half.

as mass increases.....acceleration decreases

$$\text{acceleration} \sim \frac{1}{\text{mass}}$$

? A bucket has a mass of 2 kg and has an acceleration of 4 m/ s2. If 2 kg of stones are added to the bucket, then what is it's new acceleration?

a = 4 m/ s2



a = _____

5.3 Newton's Second Law

The acceleration produced by a net force on a body is directly proportional to the magnitude of the net force, is in the same direction as the net force, & is inversely proportional to the mass of the body.

Newton's 2nd law equation $\text{acceleration} = \frac{\text{net force}}{\text{mass}}$

$$a = \frac{F}{m}$$

if both the net force & mass are doubled: _____

acceleration depends on net force on object & also depends on the mass of object

friction= force that acts to resist motion (or attempted motion)

F_f depends on 1. Area of surfaces in

2. Types of materials in contact (irregularities in the surfaces)

use coefficient of friction to describe relationship b/w 2 materials in contact

Coefficient of Friction - μ , ratio of force of sliding friction to normal force

high μ .....high Ff and object does not slide easily

low μ .....low Ff and object slides easily

(oils and lubricants strive for a low μ)

Ff = μFn μ ~ Ff

? A boy weighs 420N steps in a puddle on the floor. The coefficient of friction between the boy and the wet floor is 0.04. What is the force of friction between the boy and the slippery floor?

fig. 5.5 rubber tire and metal barrier have _____ μ therefore _____ friction force

tire and concrete barrier have a _____r μ therefore _____ friction force:_____ acc

barrier is wider on bottom...rubber tire hits barrier before metal part of car

fluid- anything that flows (liquid or gas)

fluid friction- resistant force of gas or liquid on a n object that passes through

ex. **air resistance**- friction or drag that acts on something moving through air

constant velocity.....only if F_f Fapp F_{net} = N a = m/s^2

static friction- the resistance force that must be overcome to start an object in motion

kinetic or sliding friction- the resistance force between two surfaces already in motion

rolling friction- the resistance force between a surface and a rolling object

force- a push or a pull (measured in Newtons)

pressure- the amount of force per unit of area symbol - P SI Unit - Pascal (Pa)

$$\text{pressure} = \frac{\text{force}}{\text{area of application}} \qquad \frac{N}{m^2} = \text{Pascal}$$

$P = F / A$

area unit is squared = length (m) x width (m) = m^2

circle area = $A = \pi r^2$ radius= m $r^2 = m^2$

fig 5.7 The force exerted by an object onto a surface is independent of which side of the object is on the surface. The upright book exerts the same force, but greater pressure, against the supporting surface.

$P = F / A$ $P \sim F$

$P \sim 1 / A$

the smaller the area supporting a given forece, the greater the pressure on that surface

eg: sharpened knives exert more force over less area

? a. What happens to the pressure you exert on the floor when you stand on 1 foot compared to when you were standing on 2 feet?

b. What happens to the force you exert on the floor when you stand on 1 foot compared to when you were standing on 2 feet?

Pressure Problems

1. Avery comes home from school and puts his books down on the kitchen table. The books have a combined mass of 2.5 kg. The area of contact is 0.19m by 0.24m. What pressure do the books apply on the table?

2. Mrs. Peck walks next to Mrs. Gaglio on the football field. Both teachers have a mass of 60 kg. Mrs. Peck is wearing spike heels that have an area of 0.40 cm^2 while Mrs. G is wearing wide heels with an area of 6.0 cm^2.

a. Calculate how much pressure each teacher will apply on the ground.

b. What could Mrs. Peck do, while she walks, to help her sink less into the ground?

3. A full coffee mug has a mass of 0.6 kg and a n empty mug has a mass of 0.3 kg.
a) Which mug, the full one or the empty one, applies a greater pressure on the table?

b) If the full mug has a diameter of 0.08m, what is the pressure it exerts on the table?

4. What force must you exert on a ball point pen in order to apply a pressure of 0.067 N/mm^2 on a piece of paper, if the ball of the pen has a surface area of 3 mm^2 touching the paper?