Matt Katz

Newton's Laws

Newton's First Law

- AKA law of ineria
- A body will have zero acceleration if no forces act on it
 - An object in motion stays in a straight path of motion unless acted upon by an external force
 - An object at rest stays at rest unless acted upon by an external force
- Formulated by Gallileo
 - Rolled objects along horizontal surfaces and realized that the smoother the

surface, the smaller the deceleration

- · Concluded that with the absence of friction an object can stay in motion forever
 - No force necessary to maintain motion
 - Contrary to Aristotle's belief that force is necessary to maintain motion
- Inertial Reference Frame- anywhere where Newton's first law is satisfied
 - e.g. surface of the earth
- Mass is proportional to the inertia of a body

Newton's Second Law

- Acceleration is in the direction of the resultant force (sigma F)
- The magnitude of the resultant force equals the product of mass times acceleration
- Sigma is sum of

- Sum of the forces in x direction=mass times acceleration in x direction
- Sum of the forces in y direction=mass times acceleration in y direction
- Acceleration= sigma F divided by mass

Newton's Third Law

- For each force there is an equal and opposite force
 - · Forces result from mutual interaction of bodies
 - ----> always occur in pairs
 - They are always equal to each other and opposite in direction
- Utilized in locomotion
 - e.g. walking- your feet apply force on the ground and an equal and opposite force

is applied by the ground on you, accelerating you

Forces

- · force laws relate to the force on a body to the body's surroundings
- Fundemental forces
 - Gravitational- that occurring between the earth and a body on or near its csurface
 - Electromagnetic- Force of static electricity for example
 - act between particles having electric charge
 - Nuclear-
 - strong interaction stability of atomic nucleus
 - and week interaction beta decay
- Derived forces

- Tension tautness of something sustaining force
- Spring force- force exerted by a stretched spring

Problems:

- 1) On Earth, a scale shows that you weigh 585 N.
- A) what is your mass?
- B) What would the scale read on the moon (g=1.60 m/s^2)?
- 2) Use the results from the previous problem to answer these questions about a scale in an elevator on Earth. What force would the scale exert when
- A) the elevator moves up at a constant speed?
- B) It slows at 2.0 m/s² while moving upward?
- C) It speeds up at 2.0 m/s^2 while moving downward?
- D) It moves downward at a constant speed?
- E) It slows to a stop at a constant magnitude of acceleration?
- 3) A box exerts a 36-N horizontal force as he pulls a 52 N sled across a cement sidewalk at a constant speed. What is the coefficient of kinetic friction between the sidewalk and the metal sled runners? Ignore air resistance.

4) Suppose the sled runs on packed snow. The coefficient of friction is now only 0.12. If

a person weighing 650 N sits on the sled, what force is needed to pull the sled across

the snow at constant speed?

5) Calculate the force you exert as you stand on the floor (1 lb = 0.454 kg). Is the force

the same as if you lie on the floor?

6) Which law states that an object in motion will stay in motion and an object at rest will

stay at rest unless acted upon by an outside force?

A) Newtons First Law

B) Newtons Second Law

- C) Newtons Third Law
- 7) Which of Newton's laws states that for every action there is an equal and opposite

reaction?

- A) First
- B) Second
- C) Third

8) What is the difference between static and kinetic?

A) Static is moving and kinetic is not moving

- B) Kinetic is moving and static is not moving
- C) There is no difference

9) What is inertia?

A) An object's resistance to changeB) An object's velocityC) Ori

10) Mass times what equals force?

A) Acceleration

- B) Velocity
- C) Mass

Answers:

1) A) Scale reads 585 N. Since there is no acceleration your force equals the downward force of gravity.

Mass = force of gravity divided by gravity = 59.7 kg.

B) On the moon the scale would read 95.5 N.

```
2)
```

A) mass = 75 kg

B) F scale= m(g+a)= 5.9 x 10^2 N

C) F scale= m(g+a)= 5.9 x 10^2 N

D) F scale= 7.4 x 10^2 N

E) Depends on the magnitude of the acceleration

Since the speed is constant, the friction force equals the force exerted by the boy, 36 N.

Ff= mue k times Fn

Mue kinetic= Ff/Fn= 36 N/52 N= 0.69

4) applied force=friction force

.12 x (52 + 650)= 84 N

5) F= mg= .454 x 9.80= 4.45 N/lb

Same force as if you lie on floor

6) A

- 7) C
- 8) B
- 9) A

10) A