Name MS A

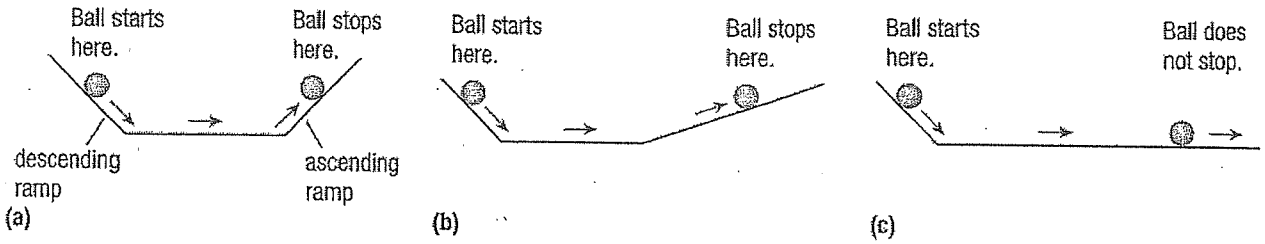
Newton's First Law of Motion

An object in motion will stay

Inertia An object in motion will stay in motion and one at rest will as well unless acted on by an external force

Inertia depends on the mass of an object. The more the mass of an object, the bigger the inertia. The less the mass of an object, the less the inertia.

Galileo's experiment:



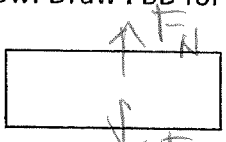
First Law of Motion: If the net external force on an object is zero, the object will remain at rest or continue to move at a constant velocity.

Important implications:

- A **non zero net force** will change the velocity of an object. The velocity can change in magnitude, direction or both
- A net force **is not required** to maintain the velocity of an object.
- **External forces** are required to change the motion of an object. Internal forces have no effect on the motion of an object. (acceleration = 0 m/s^2)

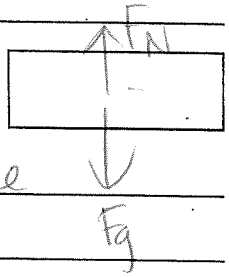
Problem 1: Use Newton's first law of motion to explain each situation below. Draw FBD for each case.

a) Why does a computer sitting on a desk remain at rest?



$F_N = F_g$ No net force $F_{net} = 0$

b) Why does a hockey puck moving across smooth ice move at a constant velocity?

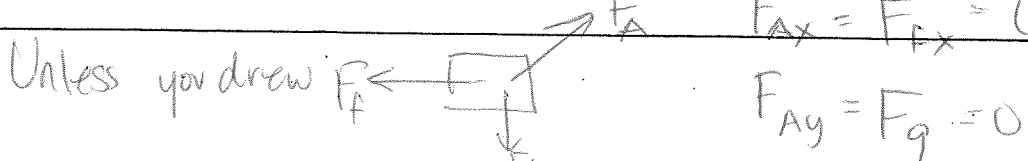


Ice is almost frictionless and no applied force

$F_N = F_g$ ~~Nodar~~ $F_{net} = 0$

c) Why does a wagon pulled across a rough surface by a child move at a constant velocity?

& $F_f = F_A$ No net force



Problem 2: Older cars did not have headrests, but all new cars do. How do headrests help prevent injuries during a rear-end collision? Use Newton's first law to explain your answer. Draw FBD for driver's head.

As a car speeds up, your head (originally moving at speed of car i.e. slower) gets "tipped" backwards. Headrest prevents ~~your~~ ~~it~~ too much backward strain on the neck

3. Explain why it is unsafe to stand when riding a bus or subway without holding onto something.

Because as bus ~~moves~~ accelerates or decelerates or comes to an abrupt stop, you move at the velocity ~~of~~ the bus was previously moving, so you get flung front or back.

4. If you place some plates on top of a smooth tablecloth and pull quickly the tablecloth, predict what could be happening. Explain your reasoning.

The plates may stay stationary (only moving slightly due to some friction from the cloth) due to inertia :)

5. A driver in a car passes over some black ice, which exerts almost no friction on the wheels. Explain why the car cannot slow down when the driver pushes on the brakes.

Because the car wants to remain at its ~~=~~ velocity before it hit the ice and for it to slow down, it needs some friction (an external force)

6. You have some snow stuck on your shovel. Explain how you could apply Newton's first law to get the snow off.

You could push (apply the force) the snow off the shovel.

7. Which has the most inertia a truck, a desk, or a feather? Which has the least inertia? How do you know?

A truck! Because inertia is directly proportional to mass. More mass, more inertia.

8. Skater 1 has a mass of 45 kg and is at rest. Skater 2 has a mass of 50 kg and is moving slowly at a constant velocity of 3.2 m/s [E]. Skater 3 has a mass of 75 kg and is moving quickly at a constant velocity of 9.6 m/s [E]. Which skater experiences the greater net force? Explain your reasoning.

$F=ma$ ✓ can't do this because you are not given acceleration!

$F_1 = 45 \times 0$ $F_2 = (50)(3.2)$ $F_3 = 75$

$= 0$ $= 160$

All are moving at constant velocity and have zero $\vec{a}$. TRICK

9. Explain each statement using inertia or Newton's first law.

a) You should not sit in the back (bed) of a pickup truck when it is moving _____

No seat belts :(

b) It is hard to get a car moving on very slippery ice. Hard to apply a force on a frictional surface

c) You should not put objects on the ledge of a car between the rear windshield and the rear seat. Because they may fall back or forward as you speed up or slow down.

d) During liftoff, astronauts are placed horizontally in the capsule rather than vertically. ___

_____

10. Use Newton's first law to explain why you should slow down when going around a curve on an icy highway. Because then you won't fling out the front (your body wants to keep moving straight)

11. While on the bus, you throw an apple straight up into the air. What will happen if the bus:

a) moves at a constant velocity It will fall back into your hand.

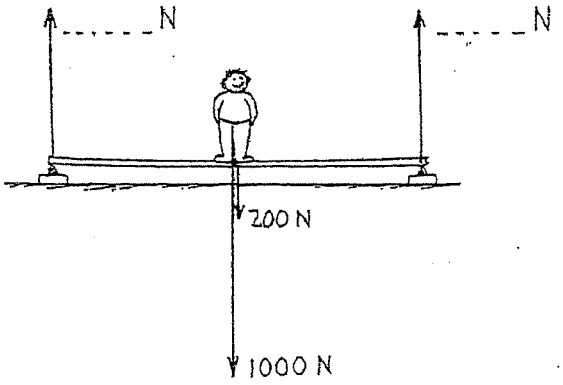
b) slows down the apple will fall behind you.

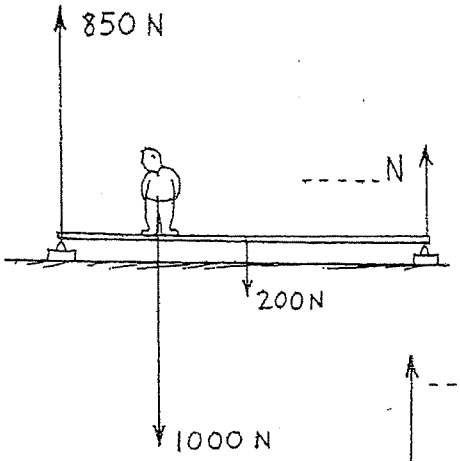
Explain your reasoning by using a diagram.

Chapter 2 Newton's First Law of Motion—Inertia

The Equilibrium Rule: $\Sigma F = 0$

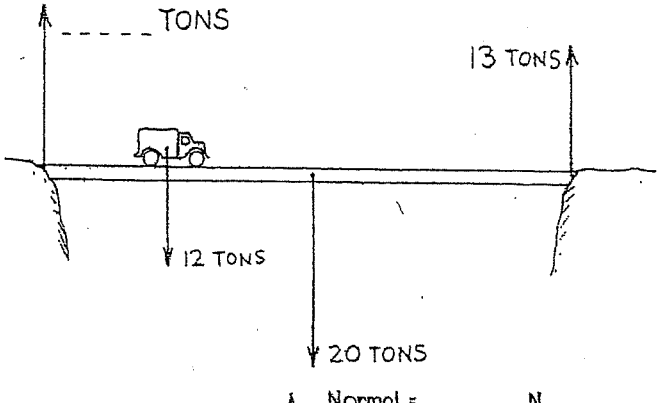
1. Manuel weighs 1000 N and stands in the middle of a board that weighs 200 N. The ends of the board rest on bathroom scales. (We can assume the weight of the board acts at its center.) Fill in the correct weight reading on each scale.



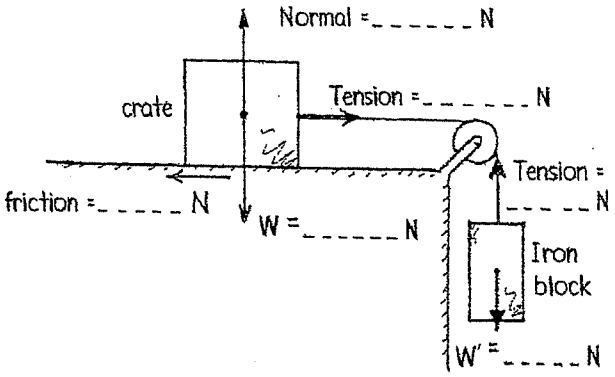


2. When Manuel moves to the left as shown, the scale closest to him reads 850 N. Fill in the weight for the far scale.

3. A 12-ton truck is one-quarter the way across a bridge that weighs 20 tons. A 13-ton force supports the right side of the bridge as shown. How much support force is on the left side?



4. A 1000-N crate resting on a surface is connected to a 500-N block through a frictionless pulley as shown. Friction between the crate and surface is enough to keep the system at rest. The arrows show the forces that act on the crate and the block. Fill in the magnitude of each force.



5. If the crate and block in the preceding question move at constant speed, the tension in the rope

   [is the same] [increases] [decreases].

   The sliding system is then in [static equilibrium] [dynamic equilibrium].