

Name: \_\_\_\_\_ Period: \_\_\_\_ Date: \_\_\_\_\_ EN: \_\_\_\_\_  
UNDERSTANDING CAR CRASHES- ITS BASIC PHYSICS

Newton's 1<sup>st</sup> law: Inertia

1. Why did the dummy fall off the truck? Explain *The dummy was at rest, it has INERTIA, and wants to stay at rest even when the truck moves.*
2. Why is it important to wear a seat belt and have an air bag? *The seat belt allows the passenger to decelerate with the car increasing the time the force is delivered.*

Newton's 2<sup>nd</sup> law:  $F=ma$

3. The force  $F$  is what is needed to move the mass  $m$  with an acceleration  $a$ .
4. Or, acceleration is the rate at which velocity changes.
5. Newton actually talked about changing momentum with an impulse .

The equation for impulse is  $Ft = m\Delta v$

Momentum and Impulse

6. What changes an object's momentum? Mass or velocity
7. How is the impulse changed for the two eggs? The wall applies large  $F$  in short time , while the sheet small force over a long time .
8. Fighter pilots feel as much as 9 g's during maneuvers, astronauts as many as 11. How many g's does a belted driver feel with a 1 ft crumple zone? 30 With a 2 ft crumple zone? 15  
This is because the time the force acts is doubled.
9. What are some other ways to increase crash time? Air bags, seat belts

Collisions

10. What is remembered or saved in the collision of the metal balls?

This is called the Law of Conservation of Momentum .

11. What happens when two cars moving with equal mass and speed collide head on (an inelastic collision)? Inelastic means they stick together; the whole unit stops moving
12. This would feel the same as a single car colliding into a wall or rigid barrier.
13. In an inelastic collision between a light and heavy car, which would be better off? The heavy car

Energy - the ability to do work

14. What kind of Energy is important in car crashes? Kinetic energy

This is the Energy of moving objects.

15. When is the PE = KE of the pendulum? Halfway through the swing

16. On what two things does KE depend? Mass and velocity .

The formula is:  $KE = \frac{1}{2} mv^2$  .

Which of these two is more critical in a car crash? velocity

17. To reduce KE requires a decelerating force applied over a distance . This is WORK!  $W = Fd$   
and  $F = ma$

Crash Worthiness

18. In a good design, the safety cage will not crush, while the front end or the crumple zone will collapse (bend) buckle during the crash .

19. The previous design is good for front-end crashes but another important issue is the side impact crash. The only crush space is the width of the door, the padding and now some cars have side air bags .