1. In your own words, define the following terms. Include the conceptual definition, equation(s) and unit(s):
	1. Momentum

***Momentum is similar to inertia in motion;*** $p=m∙v$***; the units are*** $kg^{m}/\_{s} or N∙s$***.***

* 1. Impulse

***Impulse is a force applied over a time interval;*** $I=F∆t=∆p$***; the units are*** $kg^{m}/\_{s} or N∙s $***.***

* 1. Conservation of Momentum

***The momentum of a system before an event is equal to momentum afterward. The units are*** $kg^{m}/\_{s} or N∙s$***.***

$$p\_{before}=p'\_{after}$$

* 1. Kinetic Energy

***Energy due to motion;*** $E\_{K}=\frac{1}{2}mv^{2}$***; the units are Joules ( J )***.

* 1. Potential Energy

***Energy due to position/location;*** $E\_{P}=mgh$***; the units are Joules ( J )***.

* 1. Mechanical Energy

***Energy due to motion or location of a physical body;*** $ME=E\_{K}+E\_{P}$***; the units are Joules ( J )***.

* 1. Conservation of Energy

***Mechanical energy of a system remains constant before and after an event; the units are Joules ( J )***.

$$E\_{K1}+E\_{P1}=E'\_{K2}+E'\_{P2}$$

* 1. Work

***Work is defined as the transfer of energy through motion. Its equation is*** $W=F∙d∙\cos(θ)$ ***and the units are N∙m or Joules ( J )***.

* 1. Work-Energy Theorem

***Work is directly related to a change in kinetic energy. This is called the work-kinetic energy theorem. The equation for this is*** $W=∆E\_{K}=E\_{K2}-E\_{K1}$ ***and the units are N∙m or Joules ( J )***.

* 1. Power

***Power is defined as the rate at which work is done. Its equation is*** $P=\frac{W}{t}$ ***and the units are*** $^{J}/\_{s}$ ***or Watts (W)***.

1. Compare and contrast elastic and inelastic collisions. Make sure that you discuss what quantities are conserved in these types of collisions!

***An elastic collision is one in which objects bounce off each other undamaged; momentum and kinetic energy are conserved. An inelastic collision is one in which objects bounce off and each is damaged OR objects collide and stick together; momentum is conserved, but kinetic energy is NOT conserved.***

1. What are the relationships between the following quantities (i.e. – inverse, directly proportional, etc.)?
	1. Momentum and Velocity

***Directly:*** $p α v$

* 1. Impulse and Time

***Directly:*** $I α ∆t$

* 1. Force and Time

***Inversely:*** $F α \frac{1}{∆t}$

* 1. Impulse and Δ Momentum

***Directly*:** $I α ∆p$

* 1. Kinetic and Potential Energy

***Inversely:*** $E\_{K} α \frac{1}{E\_{P}}$

* 1. Kinetic Energy and Velocity

***Squared*:** $E\_{K} α v^{2}$

* 1. Potential Energy and Height

***Directly*:** $E\_{P} α h$

* 1. Work and Force

***Directly*:** $W α F$

* 1. Work and Δ Kinetic Energy

***Directly*:** $W α ∆E\_{K}$

* 1. Power and Work

***Directly*:** $W α P$

* 1. Power and Time

***Inversely:*** $P α \frac{1}{t}$

1. If you fire a bullet from a pistol and a revolver with a longer barrel, which will have greater velocity when it leaves the barrel? Why?

***Because the force stays the same and the time it is applied over increases, the impulse increases. Since impulse is directly proportional to change in velocity, this means it will have a greater velocity.***

1. You are having a water balloon fight with your friends. Why are your water balloons more likely to break if you hit a friend who is not prepared versus letting them catch it?

***A friend who catches the balloon will most likely move their hand with the motion of the balloon, thus increasing the time over which the balloon comes to rest. This means that the force experienced by the balloon has a smaller magnitude and is less likely to break.***

1. Which is more damaging: running into a solid wall or colliding head on (with the same speed from the wall) with an identical car moving at the same speed? Why?

***They are both equally damaging! Think about the Myth Busters clip: Newton’s 3rd law means that they are both experiencing the same force!***

1. Two skiers are moving toward each other and collide. If the come to rest at the point of impact, what do we know about their motion before the collision?

***They had equal and opposite momentums before the collision. We know this because the total momentum after their collision is 0, so it must have been 0 before! (Since we don’t know their masses, we cannot say their velocities were equal and opposite. We need more information for that).***

1. When we talk about work, we are looking at a force causing motion. What forces are doing work in the following situations? ***These forces must be causing the motion and in the same direction as the displacement!***
	1. A box is pushed 5 meters across the floor

***The applied push force***

* 1. A sky-diver falls 100 meters towards the Earth

***The force due to gravity***

* 1. An elevator is lifted 20 meters upward

***The of tension in the cable***

1. Why is it important for work to depend on displacement versus distance? What do we know about work as a result?

***Displacement is a vector! As a result, work is independent of the path taken! All that matters is the starting and ending points!***

1. Two boats of unequal mass travel across the bay at the same speed and in the same direction. If the water exerts the same frictional force on the boats, how will their stopping distances compare?

***The boat with more mass will have a longer stopping distance. This is due to the work-kinetic energy theorem. More mass means more kinetic energy and thus more work. If work is greater and force is the same, the distance must be longer.***

1. Basketball A and B each have a mass of 3.0 kg and are moving at 4.0 $^{m}/\_{s}$.
	1. What is Basketball A’s momentum? Basketball B?

$$p\_{A}=p\_{B}=mv=(3.0 kg)(4.0 ^{m}/\_{s})$$

$$$$

* 1. If A and B are moving in the same direction, what is the momentum of the system? What if they move in opposite directions?

$$p\_{total}=p\_{A}+p\_{B}=12 kg^{m}/\_{s}+12 kg^{m}/\_{s}=$$

$$p\_{total}=p\_{A}+-p\_{B}=12 kg^{m}/\_{s}-12 kg^{m}/\_{s}=$$

1. A roller coaster cart starts at the bottom of a hill with some speed. At some point while moving up the hill, the cart has a potential energy of 80.0 J and a kinetic energy of 20.0 J.
	1. When the cart is at the top of a hill and at rest, what is its potential energy?

$$ME=constant=E\_{K}+E\_{P}=80.0 J+20.0 J=100. J$$

***At the top of the hill, velocity is 0 so kinetic energy is 0 J:***

$$$$

* 1. What was the initial speed of the cart at the bottom of the hill if it has a mass of 85.0 kg?

***At the bottom of the hill, height is 0 m so potential energy is 0 J:***

$$E\_{P}=100. J=\frac{1}{2}mv^{2}$$

$$v=\sqrt{\frac{2E\_{K}}{m}}=\sqrt{\frac{2(100 J)}{(85 kg)}}$$

$$$$

1. An ice skater is at rest on the ice when she catches a prop that her partner threw to her. If the skater has a mass of 55 kg, the prop is 7.0 kg, and it was initially moving towards her at 18 $^{m}/\_{s}$, how fast will the skater with the prop be moving after she catches the prop?

$$p\_{before}=p\_{after}↝m\_{1}v\_{1}+m\_{2}v\_{2}=\left(m\_{1}+m\_{2}\right) v '$$

$$0+\left(7.0 kg\right)\left(18 ^{m}/\_{s}\right)=\left(55 kg+7.0 kg\right)v '$$

$$126 kg^{m}/\_{s}=\left(62 kg\right)v '$$

$$$$

1. What is the work done by a 35 N force exerted at an angle of 25° to push a box of tools 15 m?

$$W=F∙d∙cos\left(θ\right)=\left(35 N\right)\left(15 m\right)cos\left(25°\right)$$

$$$$

1. What is the power supplied by a constant 75 N force if the object has an average speed of 12 $^{m}/\_{s}$?

$$P=\frac{W}{t}=\frac{F∙d}{t}=F∙v=(75 N)(12 ^{m}/\_{s}) $$

$$$$