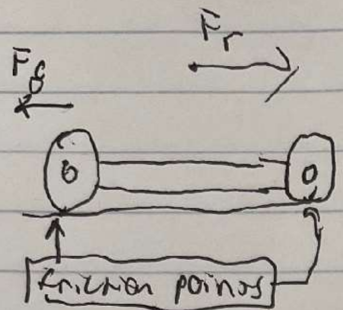

24 CRAYOLA COLORED PENCILS


24

- What type of energy did your car start with? Explain how you know
    - The car started with potential spring energy as the rubber band is a type of spring, and when we wound up the rubber band, we were putting the rubber band in tension.
- What type of energy when your car was traveling at the maximum velocity it would have?
    - The type of energy the car had when it was traveling at its maximum velocity would be kinetic energy as all the potential energy stored in the rubber band has been converted into kinetic energy to propel the car.
- What are possible ways your car lost energy?
    - The possible ways the car could lose energy was not all of the potential energy in the rubber band being completely converted into kinetic energy, friction between the axel and the box, friction between the wheels and the ground, along with some slippage causing some energy to be lost.

Provide an example of how each of the following topics applies to your car:

- Forces & Newton's 2nd Law
    - This applies because we could find how much force the rubber band applied to the car over distance using the formula $\sum F = ma$.
- Kinematics in one Dimension
    - We could use kinematics to determine the velocity of the car along the path it traveled.
- Impulse and momentum
    - Using impulse and momentum, we could find out how much momentum the car had at its maximum velocity, along with finding out the impulse of the force applied to the car by the rubber band.
- Work, Energy & Energy Conservation
    - We could utilize the equations from energy conservation to determine how much potential energy the car started with when the rubber band was would, and how efficiently the car converted potential spring energy into kinetic energy.
- Newton's 2nd Law for Rotation & Torque
    - Utilizing the equations for Newton's 2nd Law for Rotation & Torque, we could find out how fast the wheels are rotating, and from that we could also determine how much force the rubber band exerted for it to go at that speed.
- Rotational Kinematics
    - Using rotational kinematics, we could determine the efficiency of the translation from the rubber band into the drive shaft.



$$KE_f = \underbrace{KE_I}_{0} + PE_I$$

$$KE_f = 0 + PE_I$$

$$KE_f \; \cancel{\;} =$$

$$\cancel{\tfrac{1}{2}m}v^2 = PE_I$$

$$\cancel{\tfrac{1}{2}m}v^2 = \frac{1}{2}k\Delta x^2 + F_f$$

$$\frac{1}{2}mv^2 = \frac{1}{2}k\Delta x^2 + F_f$$

$$mv^2 = k\Delta x^2 + 2F_f$$

$$v^2 = \frac{k\Delta x^2 + 2F_f}{m}$$

$$v = \sqrt{\frac{k\Delta x^2 + 2F_f}{m}}$$

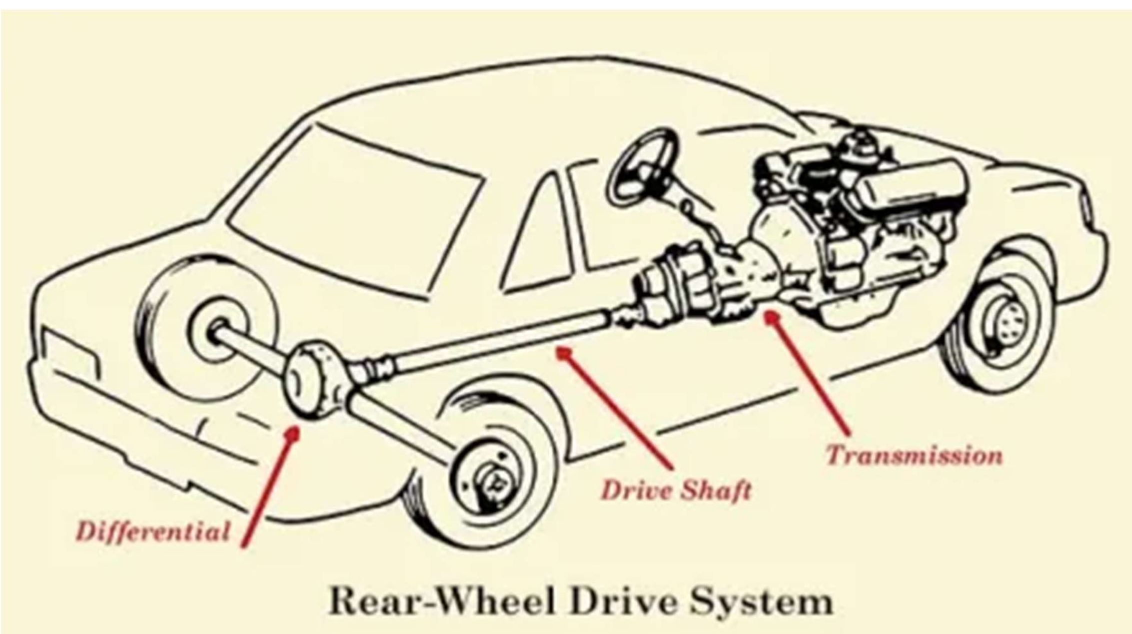
List the topic names that could be related the items below and list the equations for each other the topics

- Car moving forward/backward in a straight line
  - All of the 1D kinematic equations like $x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$
  - $F_f = \mu N$
- Tires spinning
  - $v_{tangent} = r\omega$
  - $\Delta\theta = \omega_0 t + \frac{1}{2}\alpha t^2$
  - $\mathrm{KE}_{\mathrm{rot}} = \frac{1}{2}I\omega^2$
- All factors that affect how the car moves
  - Same as the above ones
  - $F_{spr} = k\Delta L$
  - $u_s = \frac{1}{2}kx^2$
  - $F_x = -kx$
- If the car didn't travel straight and started to curve
  - If we think about the car from a top down view, so that side to side motion is the x-axis, and forward and back is y-axis
    - We can use the kinematic equations to calculate the x and y components of velocity and acceleration.

Do some research online and explain how a real life car that you drive

Write a brief summary on how the car functions

There are two main fuel sources for cars, gasoline and electricity. Gasoline cars, and more specifically the engine, functions by mixing gasoline and outside air in a pre-determined ratio, then ignited. This occurs in the engine cylinders, and the linear motion of the piston moving up and down the cylinder is converted into rotational motion by the crank, crank shaft, and pull rods. Electric cars use motors to directly drive the wheels most of the time, though there are some that use gearboxes to allow for the car to go even faster. From now, we will only discuss gasoline powered engines, called internal combustion engines, as electric cars are much simpler. Using a gearbox A.K.A the transmission, the engine spins the main drive shaft which runs to either two or four tires. In rear-wheel drive cars, a differential takes the rotational energy delivered from the drive shaft, and powers two gears the spin independently of each other for each of the wheels.



In our rubber band car, we skip all of the complicated gearing and simply used a rubber band that pulled on a level on the back axle, taking the restoring force from the rubber band and using it to spin the axle.