INVESTIGATING GAS LAWS WORKSHEET - SCH 3U

Review: Convert the following.

30.0°C = K

55°F = °C = K

255 cm^3 = L

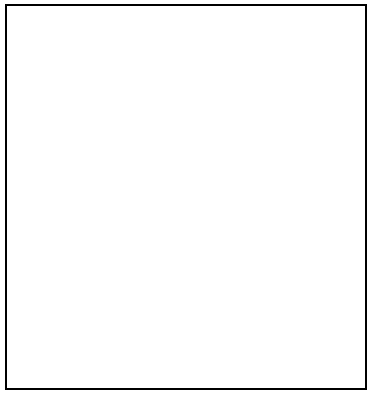
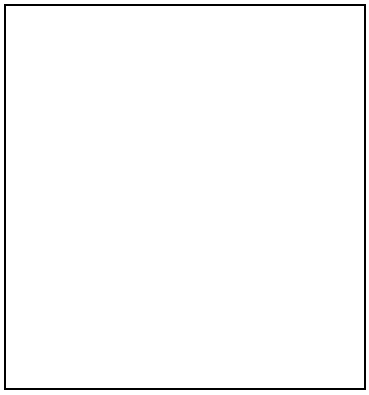
5500 mL = m^3

799 mm Hg = kPa

155 kPa = lb/in^2

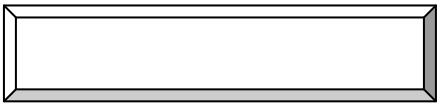
(1) BOYLE'S LAW – *The Relationship between Pressure and Volume*

V	P

V  V 

P 1/P

Use the graphs above to derive the equation and state Boyle's law.

Final "working" Equation for Boyle's law 

Using a large syringe with a cap, remove the plunger and place a mini-marshmallow inside. Replace the plunger.

Predict what will happen to the marshmallow when you push on the plunger and the volume in the syringe is reduced.

_____
_____

Try it. What did you see? Explain.

_____
_____

Remove the cap from the syringe and push on the plunger until it is almost in contact with the marshmallow. Replace the cap, ensuring a good seal.

Predict what will happen to the marshmallow when you pull back on the plunger and the volume in the syringe is increased.

_____
_____

Try it. What did you see? Explain.

_____
_____

An online tool to explore gas relationships is available at http://phet.colorado.edu/en/simulation/gas-properties.

Set the temperature to constant in the parameters box. Select the ruler function from the tools options. Pump the handle a couple of times to put some gas into the chamber. Adjust the size of the container to make it as large as possible and record the pressure. What will happen to the pressure if the container size is halved?

_____
_____

Test this and record the pressure. _____

Now reduce the size of the container by half again. Record the pressure. _____

What do you notice happens in order to keep the temperature constant? (Keep this in mind for the next part of the lesson.) _____
_____

Reset the simulation. This time continue to pump in more gas without adjusting the volume. What eventually has to happen? _____
_____

Word Problems:

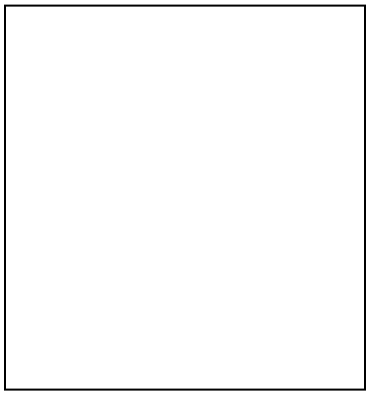
1.0 L of a gas at standard temperature and pressure is compressed to 473 mL.
What is the new pressure of the gas?

Atmospheric pressure on the peak of Mt. Everest can be as low as 150 mm Hg, which is why climbers need to bring oxygen tanks for the last part of the climb. If the climbers carry 10.0 litre tanks with an internal gas pressure of 3.04×10^4 mm Hg, what will be the volume of the gas when it is released from the tanks?

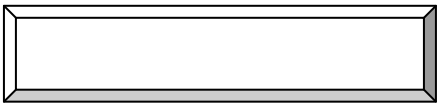
(2) CHARLES'S LAW – *The Relationship between Volume and Temperature*

V	T

V



Use the graph above to derive the equation and state Charles's law.

Final “working” Equation for Charles’s law 

Press on a ping pong ball to place a small dent in it. Then place the ball in a beaker of water. Heat the beaker on a hotplate until the water boils. What do you observe happening to the ball?

_____

_____

Return to the simulation website http://phet.colorado.edu/en/simulation/gas-properties . Reset the simulation if necessary. Set the pressure to constant. Add 50 particles of light species gas into the chamber. What do you predict will happen to the volume of gas if the temperature is reduced by half? _____

_____

Cool the gas down to test your prediction. Now increase the temperature in increments of 25 K, what happens to the volume of the gas? _____

_____

What do you notice about the behaviour of the gas particles? Explain.

_____

Now change the constant parameters setting to none. What do you expect will happen to the temperature if the volume of the container is reduced by half?

_____

Test your prediction. Now make the container as large as possible. What happens to the temperature? _____

Word Problems:

The temperature inside my refrigerator is about 4.0^0 Celsius. If I place a balloon in my fridge that initially has a temperature of 22.0^0 C and a volume of 0.50 litres, what will be the volume of the balloon when it is fully cooled by my refrigerator?

I have made a thermometer which measures temperature by the compressing and expanding of gas in a piston. I have measured that at 100^0 C the volume of the piston is 20 L. What is the temperature outside if the piston has a volume of 15 L? What would be appropriate clothing for the weather?

(3) GAY-LUSSAC'S LAW – *The Relationship between Pressure and Temperature*

P	T

P

Use the graph above to derive the equation and state Gay-Lussac's law.

Final "working" Equation for Gay-Lussac's law

Carefully observe the pop can demonstration. Describe what happens to the can.

_____

Can this be explained using Gay-Lussac's law? _____

Is Gay-Lussacs law the only law represented in this demonstration?

_____

Return to the simulation website http://phet.colorado.edu/en/simulation/gas-properties . Reset the simulation if necessary. Set the volume parameter to constant. Pump a small amount of gas into the container. Record the temperature and pressure.

_____

What do you predict will happen to the pressure if you cool the gas by half?

_____

Test your prediction. Now cool the gas as much as possible. Describe what occurs._____

Now return the temperature of the gas back to its initial setting. Predict what will happen if you double the temperature. _____

_____

Test your prediction. Now continue to add heat. Describe what happens.

_____

Why does this occur?_____

When you put air in the tires of your car, the recommended pressures in the owner's manual are for cold pressure, explain what this means and why it is important.

_____

_____

Word Problems:

The temperature of a sample of gas in a steel container at 30.0 kPa is increased from -100.0 °C to 1.00×10^3 °C. What is the final pressure inside the tank?

If a gas in a closed container is pressurized from 15.0 atmospheres to 16.0 atmospheres and its original temperature was 25.0 °C, what would the final temperature of the gas be?