Objective 3 - Construct Direct and Indirect Variation Models

Link to textbook: Direct and Indirect Variation.

You can print out these notes to follow along with the video below and keep notes to organize your thoughts.

YouTube link: `https://www.youtube.com/watch?v=dCjOPvlpIl8`

Now that we've seen how to recognize whether when we would use direct and inverse variation equations, we'll practice creating the equations. **After you complete the questions in this objective, try to describe the general process to constructing direct and inverse variation equations.**

Question 1 *Kepler's Third Law: The square of the time, T, required for a planet to orbit the Sun is directly proportional to the cube of the mean distance, a, that the planet is from the Sun.*

Part A. *Write the equation that describes time T (years) in terms of the mean distance, a (AUs). Use k for your constant.*

$T(a) = \boxed{k}a^{\boxed{3/2}}$

Part B. *Assume that Mars' mean distance from the Sun is 7 AUs and it takes Mars about 895.29 months to orbit the Sun. Write the equation that describes time T (years) in terms of the mean distance, a (AUs).*

$T(a) = \boxed{0.408163265306122\,\pi^2}a^{\boxed{3/2}}$

Feedback(`attempt`): ***Part A.*** *Remember: if you initially had c as a constant and took it's square root, this is **still** a constant. So we can rebrand it as k.*

Part B. *Check your units!*

Question 2 *Ideal Gas Law: The product of pressure, P (atmospheres), and volume, V (liters), of a gas is directly proportional to the product of the amount of substance, n (moles), and temperature, T (Celsius).*

Part A. *Write the equation that describes the Ideal Gas Law. Use R for your constant.*

Learning outcomes:
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$\boxed{PV} = \boxed{RTn}$

Part B. *Assume that the temperature, $20C$, and volume of the gas, 8 liters, remain constant. At 1 atmosphere of pressure, there are 0.048 moles of the gas. Write an equation that describes the pressure on the gas in terms of the amount of the gas.*

$P(n) = \boxed{20.7750000000000}n^{\boxed{1}}$

Part C. *Now assume that the pressure, 1 atmospheres, and volume of the gas, 8 liters, remain constant. At $10C$, there are 0.096 moles of the gas. Write an equation that describes the temperature of the gas in terms of the amount of the gas.*

$T(n) = \boxed{0.962695547533093}n^{\boxed{-1}}$

Question 3 *The rate of vibration of a string under constant tension, r cm/s, varies inversely with the length of the string, l cm. When the string is 12 mm long, the rate of vibration is 365 cm/s. Write an equation that describes the rate of vibration of a string in terms of the length of the string.*

$r(l) = \boxed{438}l^{\boxed{-1}}$

Hint: *Check your units!*

Question 4 *The kinetic energy K (J) of a moving object varies jointly with its mass m (kg) and the square of its velocity v (m/s). A 1 ton car traveling at 6 miles per hour has about 3266.25 Joules of kinetic energy. Write an equation that describes the amount of kinetic energy, K in terms of mass m and velocity v.*

$K = \boxed{1/2}m^{\boxed{1}}v^{\boxed{2}}$

Feedback(`attempt`): *On the exam, you would **not** be expected to know the conversions like tons to kg - these will be given on a problem-by-problem basis.*
