Objective 3 - Construct Direct and Indirect Variation Models

Link to textbook: Direct and Indirect Variation.

Video on Direct Variation

Video on Inverse Variation

Video on Direct and Inverse Variation

Video to provide examples from this homework.

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 4 AUs and it takes Mars about 386.73 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).*

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

$\boxed{PV} = \boxed{RTn}$

Part B. *Assume that the temperature, $30C$, and volume of the gas, 15 liters, remain constant. At 1 atmosphere of pressure, there are 0.06 moles of the gas. Write an equation that describes the pressure on the gas in terms of the amount of the gas.*

$P(n) = \boxed{16.6200000000000} n^{\boxed{1}}$

Part C. *Now assume that the pressure, 1 atmospheres, and volume of the gas, 15 liters, remain constant. At $10C$, there are 0.181 moles of the gas. Write an equation that describes the temperature of the gas in terms of the amount of the gas.*

$T(n) = \boxed{1.80505415162455} n^{\boxed{-1}}$

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 19 mm long, the rate of vibration is 441 cm/s. Write an equation that describes the rate of vibration of a string in terms of the length of the string.*

$r(l) = \boxed{\frac{8379}{10}} l^{\boxed{-1}}$

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 2 ton car traveling at 7 miles per hour has about 8891.45 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.*
