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In order to continue enjoying our site, we ask that you confirm your identity as a human. Thank you very much for your cooperation. The SI unit for energy is the joule(1). The joule has been given the symbol J(2) Most common energy unit conversion is between joules (J) and kilojoules (kJ): There are 1000 J in 1 kJ so $1000\text{ J} = 1\text{ kJ}$ How to convert initial unit to final unit initial unit conversion final unit joules (J) $\times 1000 =$ kilojoules (kJ) kilojoules (kJ) $\times 1000 =$ joules (J) The calorie(3) is a non SI unit of measurement for energy(4). 1 calorie ≈ 4.18 joules(5) 1 cal ≈ 4.18 J How to convert initial unit to final unit initial unit conversion final unit calories (cal) $\times 4.18 =$ joules (J) joules (J) $\div 4.18 =$ calories (cal) Please do not block ads on this website. No ads = no money for us = no free stuff for you! SI and Metric Units of Energy The SI unit of energy is the joule (J). 1 J is actually quite a small amount of energy. We need only 4.18 J of energy to increase the temperature of 1 gram of liquid water by 1°C(6) If you want to boil 500 g of water to make a cup of tea, you will need $500 \times 4.18 = 2090$ J of energy just to increase its temperature by 1°C. If the temperature of the water you put in the kettle is 25°C you need to raise the temperature by 75°C to get it to the boiling point of water at 100°C.(7) The amount of energy to do this will be $75 \times 2090\text{ J} = 156,750\text{ J}$ The energy involved in most of the chemical reactions you will meet in your chemistry course is of the order of thousands of joules of energy per gram of reactant. The prefix "kilo" is used to refer to a multiplication by 1000 This means that 1 kilojoule = $1000 \times 1\text{ joules} = 1000\text{ joules}$ The prefix "kilo" is given the symbol k, so 1 kilojoule = 1 kJ $1000\text{ J} = 1\text{ kJ}$ If divide both sides of this equation by 1000 we can find out how many kilojoules are in 1 J: $1000\text{ J} \div 1000 = 1\text{ kJ} \div 1000\text{ J} = 0.001\text{ kJ} = 1 \times 10^{-3}\text{ kJ}$ So, if it takes 156,750 J of energy to raise the temperature of water in my kettle to its boiling point, this is equivalent to: $156,750 \times 1\text{ J} = 156,750 \times 10^{-3}\text{ kJ} = 156.75\text{ kJ}$ Chemists commonly use kilojoules (kJ) as the unit of measurement when talking about the energy involved in chemical reactions in the laboratory. But, if you are using chemical reactions like the burning of coal, or nuclear fission reactions, to generate electricity in a power station, you need to use a much, much, bigger unit of energy like megajoules (MJ) or gigajoules (GJ) to express the total amount of energy being produced. 1 megajoule is 1 million joules: 1 MJ = 1,000,000 J = 10^6 J 1 gigajoule is 1 billion joules: 1 GJ = 1,000,000,000 J = 10^9 J The table below lists the common metric prefixes, symbols, and their multiplication factor given in scientific notation: larger -- -- -- -- -- smaller factors 1012 109 106 103 102 101 10-1 10-2 10-3 10-6 10-9 10-12 10-15 10-18 prefix tera giga mega kilo hecto deca deci centi milli micro nano pico femto atto symbol T G M k h da d c m µ n p f a Using this table we find that: 1 kilojoule (1 kJ) = 103 joules (1000 J) 1 joule (1 J) = 1 ÷ 103 kilojoules = 0.001 kJ 1 millijoule (1 mJ) = 10-3 joules (0.001 J) 1 joule (1 J) = 1 ÷ 10-3 millijoules = 1,000 mJ 1 microjoule (1 µJ) = 10-6 joules (0.000001 J) 1 joule (1 J) = 1 ÷ 10-6 microjoules = 106 µJ Do you know this? Join AUS-e-TUTE! Play the game now! The most likely conversions you will have to make during your chemistry course will be between joules (J) and kilojoules (kJ) To convert kilojoules (kJ) to joules (J): multiply the number of kilojoules (kJ) by 1000 to give an energy value in units of joules (J) energy (J) = energy (kJ) $\times 1000$ To convert joules (J) to kilojoules (kJ): divide the number of joules (J) by 1000 to give an energy value in kilojoules (kJ) energy (kJ) = energy (J) $\div 1000$ Do you understand this? Join AUS-e-TUTE! Take the test now! Worked Examples of Converting Joules to Kilojoules, and, Kilojoules to Joules Question 1: Convert 1 kilojoule to joules Solution: From the table above we see that kilo = 103 = 1,000 1 kJ = 103 J = 1,000 J 1 kilojoule = 1,000 joules Question 2: Convert 2.5 kJ to joules Solution: From the table above we see that kilo = 103 = 1,000 1 kJ = 1,000 J Multiply both sides of equation by 2.5: $2.5 \times 1\text{ kJ} = 2.5 \times 1,000\text{ J}$ $2.5\text{ kJ} = 2,500\text{ J}$ Which we can express in scientific notation as: $2,500\text{ J} = 2.5 \times 10^3\text{ J}$ Question 3: Convert 5 millijoules to joules Solution: From the table above we see that milli = 10-3 1 mJ = 10-3 J Multiply both sides of the equation by 5: $5 \times 1\text{ mJ} = 5 \times 10^{-3}\text{ J} = 0.005\text{ J}$ 5 mJ = 0.005 J Question 4: Convert 250 J to kilojoules Solution: From the table above we see that: 103 J = 1 kJ Divide both sides of the equation by 1000 to find the number of kilojoules in 1 joule: $103\text{ J} \div 103 = 1\text{ kJ} \div 103\text{ J} = 10^{-3}\text{ kJ} = 0.001\text{ kJ}$ Multiply both sides of the equation by 250: $250 \times 1\text{ J} = 250 \times 0.001\text{ kJ}$ $250\text{ J} = 0.250\text{ kJ}$ Question 5: Convert 25 µJ to kilojoules Solution: From the table above we see that µ = 10-6 1 µJ = 10-6 J Multiply both sides of this equation by 25 to determine the number of joules in 25 µJ : $25 \times 1\text{ µJ} = 25 \times 10^{-6}\text{ J}$ $25\text{ µJ} = 2.5 \times 10^{-5}\text{ J}$ Convert $2.5 \times 10^{-5}\text{ J}$ to kilojoules: From the table above we see that: 1 kJ = 103 J Divide both sides of this equation by 103: $1\text{ kJ} \div 103 = 1\text{ J} \div 103$ $10^{-3}\text{ kJ} = 1\text{ J}$ Multiply both sides of the equation by 2.5×10^{-5} to find the number of kJ in $2.5 \times 10^{-5}\text{ J}$ (2.5×10^{-5}) $\times 10^{-3}\text{ kJ} = (2.5 \times 10^{-5}) \times 1\text{ J}$ $2.5 \times 10^{-8}\text{ kJ} = 2.5 \times 10^{-5}\text{ J}$ State the answer to the question: 25 µJ = $2.5 \times 10^{-8}\text{ kJ}$ Quick Question Question 1. Convert 0.343 kJ to J A calorie is non-metric unit of energy. It is a larger measure of energy than the SI unit of energy, joule. 1 calorie = 4.18 joules 1 kilocalorie = 4.18 kilojoules 1 kilocalorie = $1000 \times 4.18\text{ joules} = 4180\text{ joules}$ 1 joule = 1 calorie $\div 4.18 = 0.239\text{ calories}$ 1 kilojoule = 1 kilocalorie $\div 4.18 = 0.239\text{ kilocalories}$ 1 kilojoule = $1000 \times 0.239\text{ calories} = 239\text{ calories}$ The most likley conversions you will need to make are between joules (J) and calories (cal) To convert energy in calories (cal) to energy in joules (J): multiply the energy in calories (cal) by 4.18 to give an energy value in joules (J) energy (J) = 4.18 \times energy (cal) To convert energy in joules (J) to energy in calories (cal): divide the energy in joules (J) by 4.18 to give an energy value in calories (cal) energy (cal) = energy (J) $\div 4.18$ Alternative method to convert energy in joules (J) to energy in calories (cal) multiply the energy in joules (J) by 0.239 (since $1 \div 4.18 = 0.239$) to give energy in calories (cal) energy (cal) = energy (J) $\times 0.239$ Can you apply this? Join AUS-e-TUTE! Take the exam now! Question 1: Convert 100 calories to joules Solution: 1 calorie = 4.18 joules multiply both sides of the equation by 100: $100 \times 1\text{ calorie} = 100 \times 4.18\text{ J}$ $100\text{ cal} = 418\text{ J}$ Question 2: Convert 12.0 kilocalories to kilojoules Solution: 1 kilocalorie = 4.18 kilojoules multiply both sides of the equation by 12.0 $12.0 \times 1\text{ kilocalorie} = 12.0 \times 4.18\text{ kJ}$ $12.0\text{ kcal} = 50.2\text{ kJ}$ Question 3: Convert 150 kilocalories to joules Solution: Calculate the number of kilojoules in 150 kilocalories: 1 kilocalorie = 4.18 kilojoules multiply both sides of the equation by 150 $150 \times 1\text{ kilocalorie} = 150 \times 4.18\text{ kJ}$ $150\text{ kcal} = 627\text{ kJ}$ Calculate the number of joules in 627 kJ 1 kilojoule = 1000 joules multiply both sides of the equation by 627 $627 \times 1\text{ kJ} = 627 \times 1000\text{ J}$ $627\text{ kJ} = 627,000\text{ J}$ Write the answer to the question: 150 kcal = 627,000 J Question 4: Convert 10 joules to calories Solution: 1 joule = 0.239 calories multiply both sides of the equation by 10 $10 \times 1\text{ J} = 10 \times 0.239\text{ cal}$ $10\text{ J} = 2.39\text{ cal}$ Question 5: Convert 1.2 kilojoules to kilocalories Solution: 1 kilojoule = 0.239 kilocalories multiply both sides of the equation by 1.2 $1.2 \times 1\text{ kJ} = 1.2 \times 0.239\text{ kcal}$ $1.2\text{ kJ} = 0.287\text{ kcal}$ Question 6: Convert 1500 joules to kilocalories Solution: Calculate the number of calories in 1500 joules 1 joule = 0.239 calories multiply both sides of the equation by 1500 $1500 \times 1\text{ J} = 1500 \times 0.239\text{ cal}$ $1500\text{ J} = 359\text{ calories}$ Calculate the number of kilocalories in 359 calories 1000 calories = 1 kilocalorie Divide both sides of the equation by 1000 $1000\text{ calories} \div 1000 = 1\text{ kilocalorie} \div 1000$ $1\text{ calorie} = 0.001\text{ kilocalories}$ multiply both sides of the equation by 359 $359 \times 1\text{ calorie} = 359 \times 0.001\text{ kilocalories}$ $359\text{ calories} = 0.359\text{ kilocalories}$ Write your answer to the question: 1500 J = 0.359 kcal Quick Question Question 1. Convert 12.5 J to cal (1) The Ninth International Conference on Weights and Measures (1948) recommended the use of the joule (volt coulomb) as the unit of heat. The joule is a derived SI unit for the measurement of energy. The SI base unit for the measurement of energy is kg.m² s⁻² 1 J = 1 kg.m² s⁻² (2) The joule is named after the English physicist James Prescott Joule. (3) The calorie, from the Latin calor meaning heat, was first defined by Nicolas Clément in 1824 as a unit of heat. (4) Other units for measuring energy are: erg (1 J = 10⁷ ergs) British Thermal Units, BTU (1 J = 9.48 $\times 10^{-4}$ BTU) electronvolts, eV (1 J = 6.24 $\times 10^{18}$ eV) kilowatt hours, kWh (1 J = 2.78 $\times 10^{-7}$ kWh) (5) National Bureau of Standards defined a calorie as equal to exactly 4.1840 J You will find this approximated to 1 cal = 4.18 J, even 1 cal = 4.2 J, when used in schools. Note that this will effect the number of significant figures that you will be able to use in your calculations. (6) The calorie, another unit of energy was defined as the amount of energy required to raise the temperature of 1 gram of liquid water at 1 atmosphere pressure by 1 °C. 1 calorie = 4.18 joules So it requires 4.18 joules of energy to raise the temperature of 1 gram of liquid water at 1 atmosphere pressure by 1 °C. For more information about this, go to the Heat Capacity Tutorial. (7) This only the amount of energy required to raise the temperature to 100°C. If you want to boil the water you need to supply even more energy, but that energy will be used to break the intermolecular forces between the water molecules in the liquid, the energy will not be used to raise the temperature of the water any further. Go to the tutorial on Latent Heat to find out more.

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