Fluid dynamics of fire

Science

The paper " Fluid Dynamics of Fire" is a delightful example of an assignment on science.

Area of a circle = πr2 = 5. 76R2 = 5. 76/π = 1. 83 = r = 1. 35The critical diameter is 1. 35 + 1. 35 = 3. 0 mQuestion 2Lower flammability limits of mixtures of combustible gases can be calculated using Le Chatelier's mixing rule for combustible volumeLm = 100/(x1/L1 + x2/L2 + ... xn/Ln) % (vol)Where: Lm = upper/lower flammability limit of gas mixtureLi = upper/lower flammability limit of component iXi = concentration of component i in gas mixtureMixed fuel is composed by methane (volume percent is 0. 35), carbon monoxide (0. 35) and hydrogen (0. 30)Lm = 100/ (35/4. 4 + 35/12 + 30/4) = 100/ (7. 95 + 2. 92 + 7. 5) = 18. 37 is the lower flammable limit of the concentration. Question 3Question 4Infrared thermal radiation = 1015Hz, BBC radio 92. 8 MHzBBC = 92. 8 x 1000 = 92800HzSpeed of sound = 344m/sThe wavelength of the thermal radiation = speed of sound in the air/frequency= 344/ 1015= 0. 339mThe wavelength of the BBC radio = 344/92800= 0. 004mThe wavelength of thermal radiation is larger than that of the BBC radio. This indicates that the higher the frequency the smaller the wavelength. Question 5Question 6Question 7Question 8The Stefan-Boltzmann Law can be expressed asE = 0. 85q = ε σ T4 AWhereε = emissivity of the objectAnd 5. 6703 10-8 W/m2K4 is the Stefan-Boltzmann Law constantQ= 0. 85 x 5. 6703 10-8 = 4. 82 x 108 W/m2Question 9

- IUPAC nomenclature

The formal naming of haloalkanes should follow IUPAC nomenclature, which puts the halogen as a prefix to the alkane. For example, ethane with bromine becomes bromoethane, methane with four chlorine groups becomes carbon tetrachloride. However, many of these compounds have already an established trivial name, which is endorsed by the IUPAC nomenclature, for example, chloroform (trichloromethane) and methylene chloride (dichloromethane). For unambiguity, this article follows the systematic naming scheme throughout. CFCs have greatly contributed to the depletion of the ozone and this led to their phase out at a given time. The compounds also enhance the greenhouse effect because of high concentrations. Low concentrations of the compounds lead to an increase in their effects in line with their mass. Question 10Chemical reaction rates of temperatures at three temperatures – 300, 600 and 1200 K. The activation energy is 110 kJ/moleEach reaction rate coefficient k has a temperature dependency, which is usually given by the Arrhenius equation: Ea is the activation energy and R is the gas constant. Since at temperature T the molecules have energies given by a Boltzmann distribution, one can expect the number of collisions with energy greater than Ea to be proportional to. A is the pre-exponential factor or frequency factor. The values for A and Ea are dependent on the reaction. There are also more complex equations possible, which describe the temperature dependence of other rate constants which do not follow this pattern. Particles can only react when they collide. If you heat a substance, the particles move faster and so collide more frequently. That will speed up the rate of reaction. That seems a fairly straightforward explanation until you look at the numbers! It turns out that the frequency of two-particle collisions in gases is proportional to the square root of the kelvin temperature. If you increase the temperature from 293 K to 303 K (20°C to 30°C), you will increase the collision frequency by a factor of: That's an increase of 1. 7% for a 10° rise. The rate of reaction will probably have doubled for that increase in temperature - in other words, an increase of about 100%. The effect of increasing collision frequency on the rate of the reaction is very minor. The important effect is quite different. SummaryIncreasing the temperature increases reaction rates because of the disproportionately large increase in the number of high energy collisions. It is only these collisions (possessing at least the activation energy for the reaction) which results in a reaction.