**Forensic Science - Arson and Explosives**

1. The Chemistry of Fire

* \_\_\_\_\_\_\_\_\_\_\_\_ – The combination of oxygen with other substances to produce new substances.
* One example is the \_\_\_\_\_\_\_\_\_\_ of methane (natural gas):
* This reaction requires a spark to \_\_\_\_\_\_\_\_\_\_\_.
* \_\_\_\_\_\_\_\_\_\_\_\_ – the rapid combination of oxygen with another substance accompanied by the production of noticeable heat and light.
* \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ – a chemical reaction in which energy is released or given off.
* \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ – the minimum temperature at which a fuel will spontaneously ignite.
* The oxidation of a fuel differs from the oxidation of a substance like \_\_\_\_\_\_ which oxidizes into \_\_\_\_\_\_.
* A fuel will achieve a reaction rate with oxygen \_\_\_\_\_\_\_\_\_\_\_\_\_ to produce a flame only when it is the \_\_\_\_\_\_\_\_\_\_\_ state, for it is only in this state that molecules can \_\_\_\_\_\_\_\_\_\_\_ frequently enough to support a flaming fire.
* How then do liquids and solids burn?
* In a liquid fuel the temperature must be high enough to \_\_\_\_\_\_\_\_\_\_\_\_\_ the fuel.
* Rusting and burning are both oxidation processes. The difference between them is the **\_\_\_\_\_\_ \_\_ \_\_\_\_\_\_\_** at which the reaction takes place.
* \_\_\_\_\_\_ \_\_\_\_\_\_\_ – the minimum temperature at which a liquid fuel will produce enough vapor to burn.
* Once flash point is reached, the fuel can be ignited by some \_\_\_\_\_\_\_\_ \_\_\_\_\_ to start a fire.
* Solids will burn only when exposed to heat that is \_\_\_\_ \_\_\_\_\_\_\_\_\_\_ to decompose the solid into \_\_\_\_\_\_\_\_\_ product.
* \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ - burning at the fuel air interface. Examples are a red-hot charcoal or a burning \_\_\_\_\_\_\_\_\_.
* For most reactions, a 10ºC rise in temperature \_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_ the reaction rate.
* \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ - a fire caused by a natural heat-producing process in the presence of sufficient air and \_\_\_\_.
* Explosives are substances that undergo \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ reactions, with the production of large quantities of \_\_\_\_\_\_. It is this sudden buildup of \_\_\_ \_\_\_\_\_\_\_\_\_\_ that constitutes the nature of an explosion. \_\_\_\_\_\_\_\_\_\_\_ occurs so rapidly that oxygen in the air \_\_\_\_\_\_ participate in the reaction; thus many explosives must have \_\_\_\_\_\_ \_\_\_\_ source of oxygen.
* \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ - a substance that supplies \_\_\_\_\_\_\_\_\_\_ to a chemical reaction.
* The three requirements that must be satisfied if combustion is to be \_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_ are: 1. A \_\_\_\_\_\_ must be present.

2. \_\_\_\_\_\_\_\_\_\_ must be available in sufficient quantity to combine with the fuel.

3. \_\_\_\_\_\_\_ must be applied to initiate the combustion, and generated to \_\_\_\_\_\_\_\_\_ it.

**II. Searching the Fire Scene**

* \_\_\_\_\_\_\_\_\_\_\_\_\_ - any material used to start or sustain a fire. The most common accelerants are combustible \_\_\_\_\_\_\_\_\_\_.
* Because any \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_ that remain after a fire may \_\_\_\_\_\_\_\_\_\_\_ in a few hours or days, a search warrant is not required.
* A search of a fire scene focuses on finding the \_\_\_\_\_\_\_\_.
* Some telltale signs of origin may include “\_\_\_\_\_\_\_\_\_\_”, \_\_\_\_\_\_\_\_\_\_\_\_\_ containers, \_\_\_\_\_\_\_\_\_\_ devices, or \_\_\_\_\_-\_\_\_\_\_\_\_\_ devices.
* Nothing should be moved until \_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_ are taken.

**III.** Collection & Preservation of Arson Evidence

* Two to three \_\_\_\_\_\_\_\_\_ of ash and soot \_\_\_\_\_\_\_ must be collected at the point of origin.
* Should include all \_\_\_\_\_\_\_\_\_\_ materials and all other substances likely to contain \_\_\_\_\_\_\_\_\_\_\_\_ residues. (Wood flooring, rugs, upholstery, and rags.)
* \_\_\_\_, \_\_\_\_\_\_\_ \_\_\_\_\_\_\_ cans with \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_ are good containers. Wide mouthed \_\_\_\_\_\_\_\_ \_\_\_\_ are also useful for packing materials.
* Cans and jars should be filled \_\_\_\_-\_\_\_\_\_ to \_\_\_-\_\_\_\_\_ full, leaving an air space in the container above the debris.
* \_\_\_\_\_\_\_ polyethylene bags are NOT suitable for packing \_\_\_\_\_\_\_\_ because they react with hydrocarbons and permit vapors to be depleted.
* Collect uncontaminated samples of materials from the scene to provide “\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_”.
* If a perpetrator is arrested within a few hours, their \_\_\_\_\_\_\_\_\_ may contain residual traces of accelerant.

**IV. Analysis of Flammable Residues**

* The \_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ is the most sensitive and reliable instrument for detecting and characterizing flammable residues.
* Most arsons are initiated by \_\_\_\_\_\_\_\_\_\_ distillates such as \_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_.
* \_\_\_\_\_\_\_\_\_\_\_\_\_ - any compound consisting of only carbon and hydrogen.

**V. Types of Explosives**

* \_\_\_\_\_\_\_\_\_\_ – a chemical or mechanical action resulting in the rapid expansion of gases.
* The \_\_\_\_\_\_\_ at which explosives decompose varies greatly from one to another and permits their classification as \_\_\_\_\_ and \_\_\_\_ explosives.
* \_\_\_\_ \_\_\_\_\_\_\_\_\_ – explosive with a velocity of detonation less than \_\_\_\_\_\_ meters per second. For example, black powder and smokeless powder.
* In the low explosive the speed is called speed of \_\_\_\_\_\_\_\_\_\_ (burning). This is characterized by a very rapid oxidation producing heat, light and a \_\_\_\_\_\_\_\_ pressure wave.
* \_\_\_\_ \_\_\_\_\_\_\_\_\_\_ – Explosive with a velocity of detonation greater than \_\_\_\_\_ meters per second. For example, dynamite and RDX.
* In the \_\_\_\_ explosive, the speed is called the speed of \_\_\_\_\_\_\_\_\_\_. \_\_\_\_\_\_\_\_\_ – refers to the creation of a \_\_\_\_\_\_\_\_\_ shock wave within the explosive charge.
* This \_\_\_\_\_\_ \_\_\_\_\_\_ causes the chemical bonds of the explosive charge to break apart, leading to the new instantaneous buildup of \_\_\_\_\_ and \_\_\_\_\_\_.
* The most widely used low explosives are \_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_.
* Black powder is a relatively stable mixture of \_\_\_\_\_\_\_\_\_\_\_ or sodium \_\_\_\_\_\_\_\_\_\_, charcoal, and sulfur. Unconfined, it merely \_\_\_\_\_\_. It becomes explosive and lethal when \_\_\_\_\_\_\_\_\_\_\_.
* \_\_\_\_\_ \_\_\_\_\_ usually consist of black powder wrapped in a fabric or plastic casing.
* The safest and most powerful low explosive is \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_.
* \_\_\_\_ explosives are classified into two groups by their \_\_\_\_\_\_\_\_\_\_\_\_.
* **\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_**– a high explosive easily detonated by heat or \_\_\_\_\_\_.
* Usually used to detonate other explosives through a chain reaction and are referred to as **\_\_\_\_\_\_\_\_.**
* Often found in \_\_\_\_\_\_\_\_ \_\_\_\_.
* \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ – are relatively \_\_\_\_\_\_\_\_\_\_ to heat, shock, or friction, and will normally \_\_\_\_\_ rather than detonate if they are ignited in small quantities in the \_\_\_\_\_ \_\_\_.
* Includes dynamite, \_\_\_\_ (trinitrotoluene), \_\_\_\_(pentaerythritol tetranitrate), \_\_\_\_ (cyclotrimethylenetrinitramine)
* Nitroglycerin-based dynamite has been replaced by \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_– based explosives (ANFO). These explosives mix oxygen-rich ammonium nitrate with a \_\_\_\_\_ to form a low-cost and very stable explosive.
* \_\_\_\_\_ is the most popular and powerful of the military explosives. It is often found in the form of a pliable plastic of \_\_\_\_\_\_\_\_ consistency known as \_\_\_\_\_.
* \_\_\_\_\_ is often used in a detonating \_\_\_\_\_ to connect a series of charges so that they will detonate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

**VI. Collection & Analysis of Explosives**

* Most important is collection of samples from the scene containing \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_.