IFE Level 4 Certificate in Fire Safety and Fire Science

Unit 6 – Fire Investigation

Examiner Report – March 2019

Introduction

Only 26 candidates sat this examination. Unfortunately, only two candidates passed the examination.

Candidates generally performed best on questions 1 and 2. However, the average mark attained for all questions was under eight. Candidates performed least well on questions 3 and 7.

The main reason why candidates failed the examination is that they did not demonstrate understanding of the science that underpins fire and therefore fire investigation. Candidates were usually able to identify one or two basic points in their responses but they then failed to provide the technical detail needed to secure further marks. Fire Investigators need to have a thorough comprehension of the factors that affect the way that fire behaves in different contexts as they need to be able to analyse all relevant information to produce conclusions based on evidence and fire science.

Question 1

a) Interviews with witnesses form an important part of any fire investigation. State and explain four factors that can affect the quality of evidence provided by lay witnesses. (4 marks)

b) The witness testimony of first responders will contain information not available from anyone else. State six questions that can be asked of first responders and explain why the information is valuable to the investigator. (12 marks)

c) Explain what is meant by the Cognitive Interviewing method. (4 marks)

Examiner Feedback

This question was a popular option for candidates and many candidates scored their highest mark for the response to this question.

Part a) was often answered well with candidates appearing to be familiar with factors such as interviewees being traumatised, excited or obstructive or the person carrying out the interview lacking experience.

In responding to part b), candidates often identified at least a few relevant questions but sometimes they failed to explain why the information was valuable.

Part c) was the least well answered part of the question. Candidates should be aware that this method of interviewing was developed to eliminate the risk of suggestive questioning and witnesses being led into making incorrect statements or confessions. The method is often used by counsellors and members of the psychiatric profession and is designed to get witnesses to give their information in a natural manner without threat or coercion. The interviewer uses open questions and only prompts/asks for clarification.

Question 2

a) Glass is a material that is commonly used in the built environment. Describe the evidence that would indicate that normal window glass (i.e. not reinforced or toughened) has been broken by:
i) impact (8 marks)
ii) non-uniform heating (8 marks)

b) Toughened glass breaks in a different way to normal glass. Describe the limitations related to toughened glass when trying to determine how it was broken. (4 marks)

Examiner Feedback

Some candidates provided detailed responses to this question and were clearly familiar with this common material and its behaviour – one candidate scored 17 of the 20 marks available, another scored 12 and several others secured 7 or 8 marks. Unfortunately, several candidates scored four or fewer marks for their response to this question.

Question 3

a) Discuss the likelihood of a motor vehicle's fuel tank, containing petrol/gasoline, exploding when involved in a fire. (17 marks)

b) Some vehicles are being fitted with Liquefied Petroleum gas fuel systems. Describe the main fire risks relating to these systems. (3 marks)

Examiner Feedback

This question was a popular option for candidates but was generally answered poorly. Many candidates scored fewer than four marks for their response to question. This was largely due to the lack of detail provided in responses.

In responding to part a), candidates were required to explore the properties and behaviour of a common flammable liquid in a common context. However, few candidates provided sufficient detail to secure more than a few marks. Examples of points that could have been made include the following:

- The flammable/explosive range of petrol/gasoline is between 1.4% and 7.6% when mixed with air
- The petrol vapour and air mixture within a fuel tank will be well in excess of its upper flammable/explosive limit

- Petrol vapour is heavier than air and it tends to fill a fuel tank to the top, excluding the ingress of air
- Fire will not normally invade the interior of a fuel tank, but will burn at an opening where enough air is present
- If a petrol/gasoline vapour and air mixture is ignited at an open filler neck it will burn with a steady torch like flame, approximately 30cm in length
- Pressure built up by vaporising fuel can split a tank or blow a filler cap off,
- Polymeric tanks can crack, melt or burn through during a fire
- Any sudden release of fuel may give the impression that a fuel tank has exploded

In relation to part b), candidates could have identified the following:

- Even a small leak can result in a fire or an explosion
- Lack of maintenance or poorly fitted systems can lead to leaks
- Poor filling practices can result in explosive vapour mixtures in or around the vehicle

Question 4

A number of indicators that have been traditionally linked to fires involving ignitable liquids have been shown to be unreliable. Identify ten of these indicators and explain in detail the facts relating to how they can be unreliable as an indicator of fire involving a flammable liquid. (20 Marks)

Examiner Feedback

This was the least popular question on the examination. It was anticipated that this would have been a straightforward question for fire investigators who need to be familiar with fires of this type but few candidates scored more than a handful of marks for their responses.

Examples of indicators and the facts relating to how they are unreliable as indicators of fire involving a flammable liquid follow:

Indicator	Reasons why this is not a reliable indicator of the involvement of a flammable liquid
Evidence of an abnormally fast rate of fire spread	• Fires are rarely seen from the time of ignition so the actual rate of development is rarely known. • Modern furnishings will support an energetic fast-growing fire
Evidence of abnormally high temperatures	• Flammable liquid fires have the same flame temperatures as wood-fuelled fires. • Higher temperatures can be produced by the combustion of synthetic materials without any flammable liquids being present
Crazing of glass	• Crazing of glass is produced when glass is heated and then rapidly cooled, usually during suppression activities. • A rapid build-up of heat will often produce shattering of glass
Floor to ceiling heat damage	• If the temperature of the hot gas layer within a compartment exceeds 600^0C the radiant heat flux is sufficient to char and ignite all exposed fuel. • Due to the large surface area of the gas layer, protected areas under furniture may also ignite

• Irregular damage to floors and floor coverings	• Turbulent, high heat fluxes encountered in post flashover compartments and also areas around ventilation openings can cause irregular burn patterns to floor coverings. • Drop down etc can cause irregular floor patterns even in the absence of flashover

Question 5

a) Hot objects and surfaces provide a viable source of ignition. However, it is not a simple matter of noting the temperature of the surface or mass and comparing it to the fuel's auto-ignition temperature. Detail the factors that influence a fuel's ability to be ignited by a hot surface or object. (6 marks)

b) Static electricity is also a viable ignition source. Discuss in detail the phenomenon of static electricity and its ability to initiate fires. (14 marks)

Examiner Feedback

Although some candidates attained good scores (the highest mark attained being 12) for this question, there were also many poorer responses.

As with other questions, responses generally lacked sufficient detail to score more than a few marks. Candidates often demonstrated some understanding of static electricity in response to part b). However, many failed to demonstrate understanding of the ways in which a fuel can be ignited by a hot surface or object when responding to part a). In responding to part a), candidates should have been aware that the transfer of heat can depend on issues such as the:

- nature and contour of the surface
- roughness of the surface
- cleanliness of the surface
- nature of the contact
- length of the contact time
- orientation of the hot surface in relation to the fuel
- physical state of the fuel
- existing temperature of the fuel

Question 6

With regards to explosions, describe in detail the difference between a detonation and a deflagration. Explain in your answer the mechanism and effects that can be expected from each. (20 marks)

Examiner Feedback

As with other questions, a few candidates demonstrated good understanding of the topic (with one candidate attaining 15 of the marks available) whilst many others secured fewer than five marks. In order to obtain higher marks, candidates needed to be able to explain the mechanisms in detail. Unfortunately, few candidates appeared to have sufficient understanding to provide more than a few basic points.

Question 7

a) 'Entrainment effects' occur when a fire draws in cooler air from its surroundings. A special case of this phenomenon is called the 'trench effect'. Describe in detail this phenomenon. (15 marks).

b) Entrainment also affects plume development. Describe the effect entrainment has on a fire's plume if the fire is located against a non-combustible wall. (5 marks)

Examiner Feedback

This question was answered poorly with few candidates having an understanding of entrainment and its effects.

As with other questions, the underpinning scientific understanding is critical in explaining what happens and how it happens. Unfortunately, many candidates did not demonstrate the level of understanding required.

Question 8

Wood is a common fuel burned in structural and outdoor fires. Thus, its properties as a fuel regarding its behaviour during a fire must be understood by the fire investigator. Discuss in detail these properties and how they relate to ignition and combustion. (20 marks)

Examiner Feedback

Wood is a common material that is frequently encountered by fire investigators. It was therefore anticipated that all candidates would find this question straightforward. Unfortunately, few candidates appeared to have more than a basic grasp of the way that this material behaves in a fire.

Examples of points that would have secured marks include the following:

- Chief component is vegetable in origin/cellulose but it also contains hemicellulose, lignin, water, resins and salts (max of two marks for any of these)
- Wood can be altered by manufacturing processes
- Thermal conductivity of wood various with its orientation and its permeability to air which are both higher in the direction of the grain as opposed to across it
- Heat must penetrate the wood surface to initiate pyrolysis and charring
- The production of volatile oils and resins is also faster along the grain than across it
- Wood discolours and chars relatively quickly at temps above 200^{o}C but prolonged heating above 85^{o}c will have the same effect
- As wood chars it darkens so its ability to absorb heat increases - so, its temp increases faster after charring has started
- This means wood does not have a fixed ignition temperature – this varies with the rate and manner that heat is applied to it

- Other variables that effect ignitability include moisture content, size and thickness of the sample, orientation, Oxygen concentrations, duration of heat exposure and species of wood
- Surface applications such as paint and varnish affect ignitability and combustion

Date issued: September 2019