

IFE Level 3 Diploma in Fire Science and Fire Safety

Unit 7 – Fire Investigation

Examiner Report – March 2020

Introduction

Candidates generally performed well with 56% of those who sat the examination attaining a Pass.

Candidates performed best on question 8 where the average mark attained was 12; they also performed well on questions 4, 7, 1 and 5. Candidates performed least well on questions 2 and 6.

Candidates often demonstrated a good theoretical knowledge and were familiar with key definitions. However, many were unable to support their knowledge by explanations and understanding of issues.

Question 1

You are called to investigate a fire involving an extension lead which is supplying an electric heater. The circuit supplying the extension lead is protected by a 16a miniature circuit breaker and the nominal voltage is 230v AC. The measured resistance of the electric heater's element is 17.63 ohms.

a) *Using the correct formulas and showing all working out, calculate:*

- i) *how much current the heater would draw when in use (correct to 2 decimal places). (4 marks)*
- ii) *the power rating of the element. (4 marks)*

b) *State the possibility of this fire being caused by an overload of the extension lead and describe the evidence you would expect to find to support this. (12 marks)*

Examiner Feedback

Part a) of this question was well answered with most candidates achieving full marks by demonstrating a good theoretical knowledge of both Ohms law and the Power Law. The correct answer to part ai) was $I = 13.05$ amps; the correct answer to part aii) was $P = 3000$ w or 3kW.

Unfortunately, part b) was less well answered. Few candidates appeared to understand how the overloading of electrical cables can be an ignition source and of the evidence that would support this hypothesis.

Candidates could have achieved higher marks for part b) if they had included more detail with regards to:

- the size and current carrying capacity of the cable
- the effects of temperature and the insulation effects around the cable
- incorrectly designed electrical circuits
- thermal damage along the entire length or sleeving of the cable
- the examination of circuit protection devices

Further information is available in the IFE publication- *A Guide to Fire Investigation*, chapters 8 and 9.

Question 2

With regards to scene examination and excavation techniques, explain the following terms:

- a) *Layering* (4 marks)
- b) *search zone* (4 marks)
- c) *Reconstruction* (6 marks)
- d) *radius of error* (6 marks)

Examiner Feedback

This question was the least popular option for candidates and those candidates that did attempt the question usually secured only a low mark; the average score for this question was 4 marks.

The question centred on terminology that should be clearly understood by the Fire Investigator. However, few candidates appeared to understand the concepts. Most candidates submitted scripts which contained only generic statements and very little specific detail. Candidates should be aware of the following:

Layering occurs where items or materials collapse or are displaced on top of existing materials during a fire which then protects the items or material in the layer below. Examination of each layer will give an indication of the sequence of events during the fire's development. The layers are not always completely distinct and will depend upon the materials present and their original positions. Layers may also be disturbed by firefighting actions.

Search Zones are implemented when compartments are examined sequentially. Geometry will dictate the best method for zoning. Typically, compartments can be divided into two, three or four zones. The Common Approach Path can be treated as a single zone and horizontal surfaces should be treated as sub-zones in their own right. Zoning large complex investigations helps to prevent cross-contamination.

Reconstruction refers to the replacement of furnishings into their original positions within a compartment in order to re-check all fire patterns and indicators against the available evidence to either confirm the hypothesis or prompt reappraisal/review. Reconstruction should be ideally take place in the room itself. If it is done outside, the area must be cleaned and inspected first and be marked out using exact dimensions of the room involved.

The Radius of Error is a term used in relation to the certainty of the point of the fire's origin or ignition. The smaller the radius of error, the greater the level of certainty. The exact point of ignition is often difficult to identify with precision. In establishing a radius of error, it will be necessary to conduct a methodical examination of the surrounding fire damaged area. Investigators need to be aware that items may have been moved during firefighting operations or displaced during the fire so should not focus entirely on the point of suspected origin.

Further information on this topic can be found in the IFE publication – *A Guide to Fire Investigation*, Chapter 14, pages 147-151 and Chapter 11, pages 104-105.

Question 3

Define and explain the characteristics of the following three explosive events:

- a) *deflagration* (6 marks)
- b) *detonation* (10 marks)
- c) *mechanical* (4 marks)

Examiner Feedback

Most candidates demonstrated a good understanding of the characteristics of a Mechanical Explosion and correctly identified the speed of reactions between a Deflagration and a Detonation. However, few were able to go beyond basic knowledge and demonstrate in-depth understanding of the chemistry and development of both a Deflagration and Detonation.

When responding to part a) candidates could have attained additional marks if they had provided information on the stoichiometry of a Deflagration along with an explanation of how the pressure increases with the propagation of an accelerating flame front. They could also have referred to the effects that containment or confinement has on the overall combustion process and effects of pressure.

In responding to part b), it was common for candidates to omit the following from their responses: the chemical process of a Detonation, the characteristics and brisance of an explosive material and how a shockwave following a detonation would propagate.

In responding to part c) candidates often failed to explain that a Mechanical explosion is the containment failure of a vessel by an increase in internal pressure generally caused by a combination of external heating and a failure of safety devices and relief valves. Good responses included explanations of the combined gas laws.

Further information on this topic is available in the IFE publication - *A Guide to Fire Investigation*, chapter 20, pages 218-221.

Question 4

- a) *Define the term “accelerant”.* (4 marks)
- b) *State the two primary groups of flammable/ignitable liquids used as accelerants and list the properties that make them both efficient first fuels.* (6 marks)
- c) *Explain what is meant by:*
- i) *flammability / explosive limits*
 - ii) *stoichiometric mixtures* (10 marks)

Examiner Feedback

This question was a popular option for candidates and most of the candidates who attempted the question secured a mark of 8 or above.

Nearly all candidates answered parts a) and b) of this question well; however, responses to part c) were less well answered.

Candidates should be aware that Flammability or the Explosive Limits refer to the range of ignitable concentrations of any vapour with air (usually given as percentages by volume). Most candidates seemed to understand the concept of LEL and UEL (or lean and rich mixtures); however, few candidates articulated an understanding of the dangers of substances with a wide flammability range. Nearly all candidates failed to appreciate the effects that an increase in ventilation would have on the UEL and that substances ignited at the mid to upper end of their ignitable range would do so explosively.

Candidates should also note that a Stoichiometric mixture is the most efficient combustible concentration with air that produces very little waste of fuel and the greatest heat release rate. The ignition of an “over the Stoichiometric mix” will result in unburnt fuel whilst the ignition of an “under the Stoichiometric mix” will not provide the greatest heat release.

Further information is available in the IFE publication - *A Guide to Fire Investigation*, chapter 5, pages 24-27.

Question 5

With regard to the investigation of vehicle fires:

- a) *state the potential ignition sources that may be the cause of an accidental vehicle fire.* (10 marks)

b) *describe the circumstances that may lead you to suspect that a vehicle has been set on fire deliberately.* (10 marks)

Examiner Feedback

This was the most popular question on the examination paper and many candidates provided good responses.

In response to part a) of the question, many candidates correctly identified potential ignition sources within a vehicle to be:

- exhaust systems and catalytic converters,
- turbo charge units,
- alternators/dynamo/ignition coils and starter motors,
- engine management systems,
- battery and electrical faults, auxiliary heaters
- poor maintenance
- careless disposal of smoking materials,
- friction from overheating pulleys, brakes and tyres.

Some candidates incorrectly described fuel loading such as grease, oil, leaking fuel lines and hydraulic fluid as ignition sources.

When responding to part b) of the question, most candidates failed to include sufficient detail as to the circumstances that would lead a Fire Investigator to suspect that a vehicle fire was deliberate or incendiary in nature. This failing prevented candidates from achieving the higher marks available.

Further information is available in the IFE publication- *A Guide to Fire Investigation*, chapter 18, pages 193-196.

Question 6

Fire scenes are inherently dangerous environments for the fire investigator. The degree of risk posed will depend on the amount of damage caused by the fire and the presence of any hazardous materials.

a) *Explain how the dusts present after a fire are a major hazard to the fire investigator and state how they can be controlled.* (6 marks)

b) *Detail and describe the main hazardous dusts that may be present at a fire scene.* (14 marks)

Examiner Feedback

This question was an unpopular option. Those candidates that did respond often attained only low marks – the average mark for the question was 4.5.

When responding to part a), most candidates concentrated on the levels of PPE required and failed to take into account the additional control measures that should be considered. Marks were awarded where candidates recognised that dusts present both a health risk and also a possible fire hazard and as such should be accounted for in their site risk assessments. Adequate control measures should then be put in place such as monitoring equipment, damping down, ventilation, decontamination, tool cleaning etc.

In responding to part b), few candidates recognised that the main hazardous dusts that could be encountered in a fire investigation, are; Asbestos, Silica, Metal compounds, Dioxins, Carcinogens and Biological spores.

Further information is available in the IFE publication- *A Guide to Fire Investigation*, chapter 3, pages 13-18 and chapter 17, page 171.

Question 7

You are called to investigate a building fire. Describe the information that you would gather from the fire brigade crews in attendance at the fire. (20 marks)

Examiner Feedback

Those candidates that secured high marks for this question supported their responses by providing full descriptions of the information they would require. Responses with little or no detail/explanation attracted fewer marks.

Examples of the types of points that would have secured marks follows:

- Risk Assessment - covering safety issues, structural stability, utilities, bio hazards etc.
- Flames – whether they were visible or not, which aperture, colour, turbulence and pressure.
- Smoke – whether visible or not, from where, colour, pressure or volume driven
- Security of building – the state of windows and doors, signs of forced entry, access difficulties
- Weather – identification of local conditions that may affect ventilation
- Actions by fire crews – access points, forced or not, tools used, access routes, media used, aerial appliance/monitors used what was moved, ventilation activities, what windows were opened.
- Obvious damage – where the main area of burning appears to be
- Utilities – whether or not isolated
- Fixed Installations – fire alarms present and were they sounding or not, suppression systems present and actuating or not, any evidence to suggest tampering
- Occupancy – numbers, actions, where, injuries and fatalities
- Witnesses present and why what was said.
- Anything suspicious or out of the ordinary- eg build-up of combustible material, property removed, state of dress of occupants, trailers, unusual smells, containers etc.

Further information is available in the IFE publication – *A Guide to Fire Investigation*, appendix IV, page 263.

Question 8

- a) *“ELBOWS” is an acronym that relates to the established rules for the taking of contemporaneous notes at the scene of an investigation. Outline the rules as defined by the ELBOWS acronym. (8 marks)*
- b) *State the information that should be included when producing diagrams/sketches and explain how diagrams/sketches can be an invaluable part of recording a fire scene. (8 marks)*
- c) *State the methods other than contemporaneous notes and diagrams/sketches that are available for recording a fire scene. (4 marks)*

Examiner Feedback

This was an unpopular option for candidates. However, those that did attempt it performed well and all who attempted it achieved a mark of 8 or above.

Most candidates achieved full marks for part a) and correctly identified the rules for each of the elements of ELBOWS to be:

- E – Erasures: No erasures of entries, words or lines.
- L - Lines Missed: There must be NO blank lines. Any blanks should be struck through with a single stroke.
- B - Blank Spaces: As for lines missed, strike through with a single stroke.
- O - Overwriting: Do NOT overwrite anything, strike through the mistake, initial it and continue.
- W -Written in ink: All entries must be written in indelible ink.
- S - Spare Pages: Strike through the page with a diagonal stroke and write “Omitted in error” across the page.

Candidates often provided only a few basic points in response to b) and many omitted to include the required explanation. This meant that few candidates achieved many of the marks available.

Part c) was a straightforward question and candidates often performed well on this element of the questions. Methods that could be used in recording a fire scene include: photographs, video footage, voice recording, IPADS/Tablets, DRONE footage, Thermal Image Cameras and annotated maps and plans supplied from occupiers.

Further information is available in the IFE publication- *A Guide to Fire Investigation*, chapter 16, pages 159 - 165.

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