

IFE Level 3 Diploma in Fire Safety and Fire Science

Unit 1 – Fire Engineering Science

Examiner Report – March 2019

Introduction

33% of the candidates that sat this paper achieved a Pass. Those candidates that achieved a Pass usually secured either a D grade or a C grade; however, four candidates secured an A grade and five secured a B grade.

Candidates generally performed best on questions 2 and 8. Candidates performed least well on questions 1 and 4.

Question 1

- a) *Within an electrical installation, describe where and why a residual current device (RCD) is used. (5 marks)*
- b) *Explain the operating principles of a residual current device. (6 marks)*
- c) *Describe, including a simple diagram, the operation of a step down transformer. (9 marks)*

Examiner Feedback

Responses to part a) were generally good although very few candidates identified that an RCD can be used as a portable plug-in unit into a standard socket outlet protecting portable equipment.

Part b) was not answered well with few candidates demonstrating understanding of the operating principles of a residual current device. Points which would have secured marks include the following:

- An RCD monitors the residual current and switches off the circuit in milliseconds if it rises to a pre-set level
- Inside the RCD there are live and neutral conductors wound around a toroidal iron core in such a way that they induce a balanced neutral magnetic field.
- There is also a permanent magnet which holds a spring-loaded switch in place.
- Any loss of current to earth causes an imbalance between the live and neutral conductors passing within the RCD unit and this induces a magnetic field within the toroid
- which in turn interferes with the field generated by the permanent magnet and allows the spring to open the switch.
- RCD unit itself does not require any connection to Earth.

Part c) was generally well answered and many candidates achieved full marks for this part of the question. However, a significant number of candidates described distribution networks in

detail showing transformer steps; this did not answer the question so no marks could be awarded.

Question 2

a) *Define and explain the following terms:*

- i) *friction (3 marks)*
- ii) *velocity (3 marks)*

b) *State Newton's Third Law of Motion and state the SI units for force and velocity. (4 marks)*

c) *A light aircraft of mass 1200 kg starts from rest and accelerates along a straight horizontal runway. The aircraft engine produces a constant thrust of 3400 N. A constant frictional force of 400 N acts on the aircraft. The aircraft takes off when it reaches a speed of 35 ms⁻¹. Calculate the distance travelled by the aircraft from its starting point until it takes off. Explain the steps taken and show all calculations in full. (10 marks)*

Examiner Feedback

Performance on this question varied dramatically, largely due to the fact that some candidates were able to score full marks on part c) whereas others struggled with this element of the question and scored few, if any, marks.

Part a) was often answered well and most candidates were able to achieve some/all of the marks available.

In responding to part b), most candidates were able to state the Third Law of Motion ie for every action, there is an equal and opposite reaction. Some candidates failed to identify the correct SI units ie for Force the SI unit is Newton (N) and for Velocity the SI Unit is ms⁻¹

Part c) could have been calculated in a number of ways. Some candidates omitted this question completely and others made errors in calculation. The correct answer is that the aircraft travels 245 m from its starting point until it takes off. Candidates who identified the correct response were able to secure all of the marks available.

Question 3

a) *Explain the term 'radioactivity'. (8 marks)*

b) *Explain the difference between ionising and non-ionising radiation and give one example of each type of radiation. (4 marks)*

c) *Describe the principles by which people can be protected from harm from ionising radiation. (8 marks)*

Examiner Feedback

This question was often answered well but, as with other questions, some candidates omitted sections of the question in their response. Some candidates provided only brief responses as

they failed to appreciate that the number of marks shown on the question paper is an indication as to the number of points required in answers in order to attain full marks.

In response to part a), some candidates wrote at length about types of radiation without actually explaining what is meant by radiation. Candidates should be aware that:

- Radiation is the phenomenon by which unstable isotopes of some atoms break down to form a more stable isotope of a different atom.
- They do this by expelling a small amount of matter from the nucleus of the unstable atom.
- Although there are several ways in which this can occur, by far the most dominant are by alpha emissions or by beta emissions.
- Shortly after an alpha or beta emission has occurred it is usually, but not always, followed by a gamma emission.
- Radioactive materials continue to undergo this process until all the original unstable atoms have changed into the new stable atoms at which point the radioactive material ceases to exist.

In response to part b), gamma was often identified as non-ionising radiation which is incorrect.

Part c) was generally answered well and candidates who scored well on this question usually did so as a result of their response to this part of the question.

Question 4

a) In terms of chemistry:

- i) define a base (2 marks)*
- ii) describe the general properties of bases (4 marks)*
- iii) explain the difference between a base and an alkali (1 mark)*

b) Write a balanced chemical equation for the reaction of Lithium Oxide and water. (3 marks)

c) Explain the difference between organic and inorganic acids and name one example of each also giving its chemical formula. (8 marks)

d) Briefly explain the difference between weak and strong acids. (2 marks)

Examiner Feedback

When responding to part a), few candidates demonstrated understanding of bases. Candidates should be aware that a base is a substance that neutralises acids; it is a hydrogen receiver or electron pair donor

Part b) was generally well answered although some candidates struggled with only one product. The correct answer was: $\text{Li}_2\text{O} + \text{H}_2\text{O} \rightarrow 2 \text{LiOH}$

Most candidates scored well in part c) with most able to demonstrate good understanding and provide correct examples.

In response to part d), few candidates correctly identified the difference between strong and weak acids. Candidate should be aware that strong acid is completely (100%) ionised whereas a weak acid is partially (less than 100%) ionised.

Question 5

- a) *Describe atmospheric pressure, including its measurement, and explain the importance of atmospheric pressure when pumping from open water. (12 marks)*
- b) *A simple Vernon-Morris flowmeter has a water level in an open manometer of 0.4 m. Calculate the flowrate assuming a pipe diameter of 57mm. (5 marks)*
- c) *Calculate the potential energy of 19,200 litres of water in a tank 38 metres above its outlet. (3 marks)*

Examiner Feedback

Part a) was often poorly answered with many candidates failing to consider altitude variation or meteorological conditions or adequately explaining pump priming.

There were many errors in the calculations required by parts a) and b).

Question 6

- a) *Radiation within the electromagnetic spectrum travels as a wave form. Describe three characteristics of a wave form. (6 marks)*
- b) *Describe the seven regions of the electromagnetic spectrum. (14 marks)*

Examiner Feedback

Part a) was often answered poorly or else omitted entirely. Candidates could have identified and described any three of the following characteristics: amplitude, wavelength, frequency, period and velocity.

Part b) was occasionally answered very well and some candidates achieved full marks. Most candidates were able to identify the parts of the spectrum but detail and description were sometimes lacking which meant that candidates could attain only half of the marks available.

Question 7

- a) *A study of fire detector usage in non-domestic property identifies that 38% are optical smoke, 34% are ionisation smoke, 12% are heat, 8% are air sampling, 6% are beam and 2% are other. State the most appropriate graphical model for displaying this type of information and explain why this is the case. Include a rough sketch to illustrate your points. (Note: an accurate graphical model of the data is not required.) (9 marks)*
- b) *In the context of heat detectors, explain the term thermal lag and its implications for choosing and siting the detectors. (7 marks)*
- c) *Describe a bi metallic strip and explain how it works within a heat detector. (4 marks)*

Examiner Feedback

In response to part a), many candidates correctly identified a pie chart as the most appropriate format; credit was also given where candidates suggested a bar chart. Few candidates could fully explain or justify their choice of format so this limited the marks that could be attained.

In responding to part b), few candidates demonstrated understanding of thermal lag. Points that could have secured marks included:

- Heat detectors are dependent for their operation on heat being transferred from the surrounding air to the detector itself.
- As the air will heat more quickly than the detector, the operating element in the detector will usually be at a slightly lower temperature than the surrounding air.
- This difference in temperature is referred to as 'thermal lag' and could in some circumstances delay a detector's response.
- The extent of the delay will depend on a number of factors and this needs to be taken into account when siting the device ie:
 - the surface area of the detector
 - the volume of air passing the device
 - the speed of air passing the device.

Candidates generally achieved good marks for part c).

Question 8

- a) *Identify the class of hydrocarbons of which benzene is the simplest member and describe benzene in detail including a diagram of its structure. (10 marks)*
- b) *Write a balanced chemical equation for the complete combustion of benzene with oxygen. (4 marks)*
- c) *Using the equation provided in response to part b), calculate the following: if 250g of benzene is completely burned, how many grams of water are produced? Molar masses: Benzene is 78.11 g/mol; water is 18.02 g/mol. (6 marks)*

Examiner Feedback

Most candidates secured at least some of the marks available for part a). However, candidates rarely considered factors such as being toxic and a carcinogen or the fact that benzene has a distinct and sweet odour.

Part b) was generally answered well and many candidates secured full marks for their response.

Part c) was often omitted. The correct answer to this calculation was: 172.99 g water.

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