# L3D1

**THE INSTITUTION OF FIRE ENGINEERS**
Founded 1918 • Incorporated 1924

## IFE Level 3 Diploma in Fire Science and Fire Safety

# Unit 1: Fire Engineering Science (A/505/6005)

**Friday 15 March 2019**

**10.30 – 13.30**

## Instructions to Candidates

1.  The time allowed for this examination is **THREE** hours.

2.  Candidates must answer **SIX** questions from the total of **EIGHT** questions set for this examination.

3.  All questions carry equal marks and may be answered in any order.  Candidates should follow the instructions provided in the question when composing their answers.

4.  Candidates should record all of their answers in the answer book provided.

5.  The question paper must be handed in with the answer book.

**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)

**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)

**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)

## 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)

## 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)

## 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)

**[Please turn over]**

**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)

**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)