IFE Level 3 Diploma in Fire Safety and Fire Science

Unit 1 – Fire Engineering Science (Zone 1)

Examiner Report – March 2017

Introduction

Candidates that sat this version of the paper performed well with 46% of the candidates achieving a Pass.

Candidates generally performed well on questions 1, 2, 3 and 7. Candidates performed least well on question 5.

Question 1

a) Describe the three primary sub-atomic particles. (5 marks)

b) Define the following terms:
- *i) half-life*
- *ii) radioisotope*
- *iii) ionising radiation*

(6 marks)

c) Use the following data with a suitable graphical method to determine the half-life of the element shown. Clearly mark the first half-life on your graph. (9 marks)

Time	*0*	*15*	*30*	*45*	*60*	*75*	*90*	*105*	*120*	*135*	*150*
Disintegrations	*556*	*438*	*357*	*291*	*230*	*180*	*150*	*128*	*100*	*88*	*80*

Examiner Feedback

Candidates generally performed well on this question, with many candidates able to attain a high proportion of the marks available for part c).

In response to part a), the majority of candidates correctly identified and described protons, electrons and neutrons.

Part b) was the least well answered part of the question. Whilst candidates often managed to describe half-life correctly, there were many errors in descriptions of radioisotope and ionising radiation.

Part c) was generally answered well. Most candidates were able to plot the points using an appropriate scale and employ correct axis labelling. Some candidates lost marks for either failing to identify the first half-life correctly or for failing to identify it at all.

Question 2

a) Define the following terms and give the SI units for each:
- *i) work*
- *ii) force*
- *iii) momentum*
- *iv) mass*
- *v) weight* *(10 marks)*

b) A car travels from rest to a point 200m away at a constant acceleration for 10s. What is the rate of acceleration and final velocity of the car? (4 marks)

c) The car continues to travel at this speed for another 300m. How long does it take to travel this distance? (2 marks)

d) The car then decelerates at a constant speed of 10m/s. How long does it take the car to reach a complete stop and how far does it travel in this time? (4 marks)

Examiner Feedback

Part a) was usually answered well. The majority of candidates attempting this question achieved most of their marks for their response to part a).

Although some candidates were able to determine the rate of acceleration in response to part b), few correctly identified the final velocity of the car as v=40ms$^{-1.}$

Responses to parts c) and d) were often incorrect. The answer to part c) was that the time take was 7.5s. The answers to part d) were t=4s and 3=80m.

Question 3

a) Explain the term 'Jet Reaction'. (2 marks)

b) When water leaves a nozzle, the maximum theoretical height of the water jet would be:

$$H = \frac{V^2}{2g}$$

However, in practice the jet will not achieve this height. Explain the factors that affect the practical height of the jet. (4 marks)

c) A pump is 85% efficient and is driven by an engine of 112 Kw brake power.

- *i) What water power is the pump capable of developing? (3 marks)*
- *ii) When 5500 litres of water per minute are being taken from the pump, what is the pressure in bar at which the pump is operating? (4 marks)*

iii) The pump is delivering 5500 litres per minute through 2 lines of 150mm hose of 12 lengths each terminating in a monitor of identical nozzle size. The monitors are 8 metres above the water level. What nozzle size will be required at each monitor to deliver this quantity of water?

N.B. Assume friction losses in each line are 0.2 bar per length. Take the pressure value as calculated in part cii). (7 marks)

Examiner Feedback

Candidates who were able to complete the calculations required in part c) generally attained high marks for the question.

Some candidates attempted only parts a) and b) and omitted part c) completely.

Question 4

a) Explain the three factors which determine the rise in temperature of an object to which a source of heat is applied. (6 marks)

b) Explain the three methods of heat transfer. (6 marks)

c) Briefly describe the electro-magnetic spectrum. (4 marks)

d) With the aid of a diagram, describe the inverse square law with regards to the spectrum. (4 marks)

Examiner Feedback

Few candidates achieved full marks for their response to part a). The three factors that were required in response to part a) were the amount of heat supplied, the mass of the receiving object and the specific heat capacity of the object. Some candidates correctly identified the three factors but few candidates followed the instruction in the question to "explain" the three factors. Candidates who omitted to provide the explanation required were unable to obtain more than half of the marks available.

In response to part b), candidates were often able to list the methods correctly. However, candidates again failed to attain all of the marks available as they often omitted to explain the methods in sufficient detail.

There were many good responses to part c) with many candidates demonstrating some understanding of the electro-magnetic spectrum.

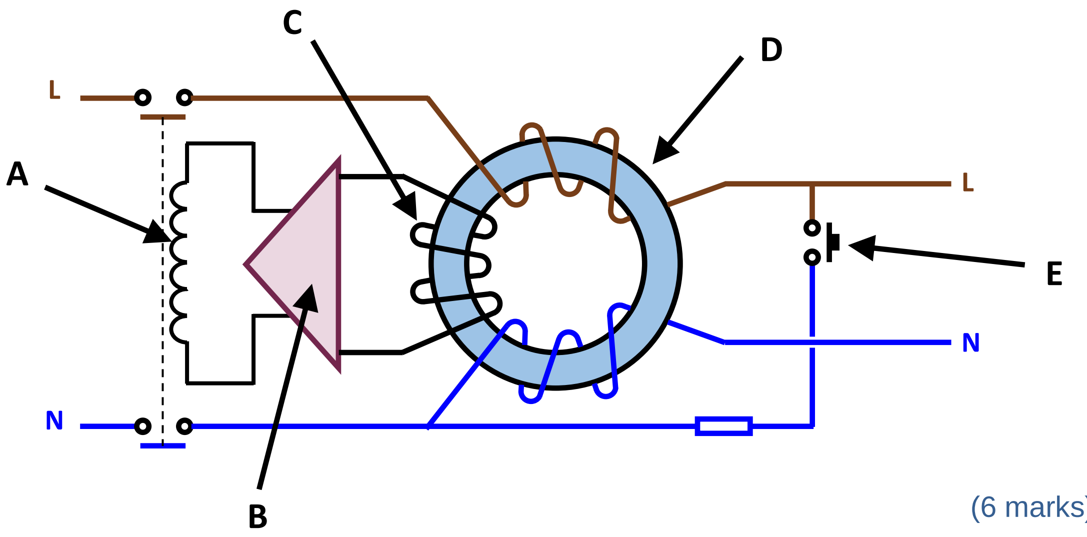
Part d) was usually answered poorly and few candidates achieved high marks for their response to this element of the question.

<u>Question 5</u>

a) *Explain what is meant by 'power' in an electrical circuit and annotate the formula for calculating power, including the units for each term. (3 marks)*

b) *Explain what is meant by 'resistance' in an electrical circuit. (3 marks)*

c) *The diagram below illustrates the operating mechanism of a circuit protective device. State the type of circuit protective device and state the components shown in the diagram labelled A, B, C, D and E. (Answers should be written in your answer book.)*



(6 marks)

d) *A two core copper cable is 65m long. At the far end there is a heater which draws 60 amps and the terminal voltage at the load is 230 volts. The maximum voltage available at the supply end of the cable is 237 volts.*

   i) *What is the maximum practical resistance of the cable? (3 marks)*

   ii) *What is the smallest cross sectional area of copper which can be used? The resistivity of copper is 1.6 x 10^{-8} ohm metre. Express your answer in square millimetres. (5 marks)*

Examiner Feedback

This question was not a popular option for candidates. Those candidates that attempted the question often attained only low marks.

In response to part a), candidates often failed to explain what is meant by power in sufficient detail to attain the mark available. There were also errors in setting out the formula Power (Watts) = Current (amps) X Voltage (volts).

When responding to part b), most candidates provided only a limited explanation of resistance and therefore failed to attract more than one or two of the marks available.

Few candidates identified more than a few of the components labelled. The components were: A – trip coil, B- amplifier, C- search coil, D – current transformer, E – test button.

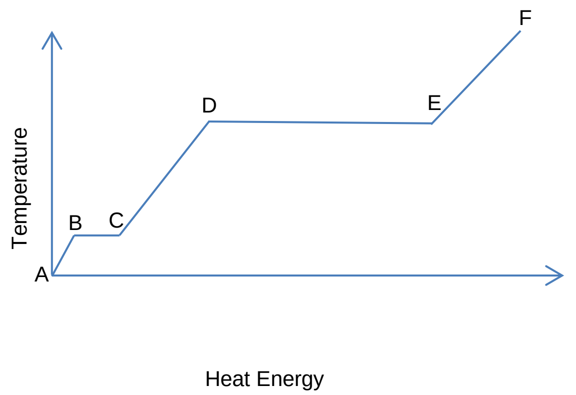
Part d) was often omitted completely. Where it was attempted, there were few correct responses.

Question 6

a) Define:
- *i) absolute zero*
- *ii) specific heat capacity*
- *iii) latent heat*
- *iv) thermal capacity of a body*
- *v) linear expansion*

(10 marks)

b) Below is a simplified state change diagram for water.



Briefly explain what is happening at the following points shown on the diagram above:
- *i) between A and B*
- *ii) between B and C*
- *iii) between C and D*
- *iv) between D and E*
- *v) between E and F*

(10 marks)

Examiner Feedback

Candidates often provided only brief definitions in response to part a). There were ten marks available for this element of the question but few candidates attained more than half of the marks. Candidates should be aware that marks are awarded for relevant points and therefore if two marks are available for a definition, this means that at least two relevant points are required in responses.

In response to part b), candidates were usually able to identify what was happening at each point but responses generally omitted to provide any explanation. This meant that few candidates attained more than half marks. For example, candidates usually identified that at point A, the water was in a solid state and the temperature was increasing but they then failed to explain that the rise in temperature is dictated by the specific heat capacity of ice (which is 2.03 kj/kg^{0}C).

Question 7

a) Define the term 'compound' and give an example of a compound. (2 marks)

b) Describe the relationship between the number of electrons in the outer shell of an atom and the valency. (6 marks)

c) Write a balanced equation for the combustion of propane in air. (4 marks)

d) Calculate the mass of carbon dioxide produced by the complete combustion of 22kg of propane. (8 marks)

Examiner Feedback

This question was the least popular option for candidates but those candidates that opted to attempt this question generally performed well.

Candidates often demonstrated basic understanding of chemistry in responding to parts a) and b). Parts c) and d), which required application of understanding were generally less well answered.

Question 8

a) Describe the operating principles of an obscuration-type optical detector. (4 marks)

b) One type of an obscuration-type optical detector is a linear beam detector. Describe the operating principles of a linear beam detector. (4 marks)

c) Excluding the two detectors mentioned in parts a) and b), state a type of detector that can be used to detect each of the products stated below. Describe one advantage and one disadvantage of each detector stated.

i) Smoke

ii) Heat

iii) Radiation (flame)

iv) Combustion gases

(12 marks)

Examiner Feedback

Candidates often demonstrated only limited understanding with most candidates identifying only one or two relevant points for each section of the question.

In response to part c), many candidates were unable to provide examples of a relevant type of detector for all of the products set out in the question. Where candidates did provide an example, they often ignored the requirement to present an advantage **and** a disadvantage for each type of detector stated. Candidates usually identified correctly a type of detector that could be used to detect the products of smoke (eg ionization detector, optical detector) and of heat (eg fixed temperature, rate of rise, linear detector). However, candidates were less successful in identifying detectors to identify the products of radiation (eg infrared and ultra-violet detectors) and combustion gases (eg carbon monoxide detectors).