IFE Level 3 Diploma in Fire Safety and Fire Science

Unit 1 – Fire Engineering Science (Zone 2)

Examiner Report – March 2018

Introduction

40% of the candidates achieved a Pass.

Candidates performed best on question 7. Candidates performed least well on questions 2 and 8.

Question 1

a) Define:

i) the volt (2 marks)
ii) the ohm (2 marks)
iii) electric current (2 marks)

b) Explain:
i) how current depends on whether resistances are connected in parallel or in series. (2 marks)
ii) how potential difference depends on whether resistances are connected in parallel or in series. (2 marks)

c) A 4 ohm and a 6 ohm resistance are connected in parallel and then connected in series with a 2 ohm resistance. A current of 2.5 amps is passed through the circuit. Calculate:

i) the current through each resistance. (5 marks)
ii) the potential difference across the circuit. (5 marks)

Examiner Feedback

Candidates often provided basic descriptions in response to part a) rather than definitions.

When responding to part b), many candidates focussed on resistance and Ohm's law and did not answer the question that had been set. Candidates should be aware that:

- Current in series is the same through each component and in parallel is the sum of the currents through each component.
- Potential difference in series is the sum of the currents through each component and in parallel is the same through each component.

The first sub-question of part c) was often omitted although it followed on from part b). Part c)ii) was often well answered and most candidates gained full marks for their calculation.

Question 2

a) Briefly describe the operating principle and uses of thermocouples. (7 marks)
b) Briefly describe the operating principle and uses of thermistors. (7 marks)
c) Describe the operating principles of a rate of rise heat detector using thermistors. (6 marks)

Examiner Feedback

This question was not a popular option for candidates and few candidates provided good responses.

In relation to thermocouples, candidates often referenced only the presence of two different metals; candidates were then confused by bi-metallic strips. Few candidates explained the thermo-electric effect.

Few candidates correctly identified that a thermistor is a type of resistor whose resistance is dependent on temperature, showing a large change in resistance proportional to a small change in temperature. Many candidates again wrote about bi-metallic strips.

Descriptions of bi-metallic strips were again common in responses to part c). However, some candidates were able to attain marks by applying general principles correctly.

Question 3

a) Define:
i) force (2 marks)
ii) moment (2 marks)

b) State and annotate the force equation (Newton's Second Law) and state the SI unit for force. (3 marks)

c) A simple beam, supported at both ends, is 9 metres long. A point load of 2kN is located 3 metres from the right end of the beam and an evenly distributed load of 800N/m is spread along the length of the beam.
i) Draw a diagram showing the loads and support points. (4 marks)
ii) Indicate on the diagram the position of the point where the distributed load can be said to act. (1 mark)
iii) Calculate and check the moments about each support point. (8 marks)

Examiner Feedback

This question was popular with candidates.

Candidates often provided basic descriptions in response to part a) rather than definitions.

Part b) was generally answered well and many candidates attained full marks for this element of the question. The SI unit required was Newton (N); some candidates gave N/M.

The drawings provided in response to part c) were usually good although the distributed load and the point of action were often omitted. The calculations required were often omitted. Where calculations were attempted candidates often used 800N rather than 7.2kN. Only two candidates confirmed the check by matching the loads and the moments.

Question 4

a) Define the following terms:
i) flashpoint (2 marks)
ii) fire point (2 marks)
iii) spontaneous ignition temperature (2 marks)

b) Describe a chemical reaction and briefly explain combustion as a form of a chemical reaction. (8 marks)

c) State the general chemical formulae for:
i) alkanes (1 mark)
ii) alcohols (1 mark)

d) Write a balanced chemical formula for the combustion of Butane in air. (4 marks)

Examiner Feedback

This question was a popular option for candidates.

The definitions provided in response to part a) were often more detailed than the definitions provided in response to other questions. However, many responses still lacked precision eg candidates often referred to "temperature" rather than "lowest temperature".

In responding to part b), candidates often omitted key basic information when describing a chemical reaction. Good responses explained that a chemical reaction is a process in which one or more substances, the reactants, are converted to one or more different substances, the products. Some candidates referred to a triangle of combustion; these candidates failed to appreciate that combustion is a chemical reaction usually including oxygen and usually accompanied by the generation of heat (exothermic) and light in the form of flame.

Candidates sometimes omitted part c). However, those that attempted the question usually attained both of the marks available. Part d) was often answered well.

Question 5

a) Describe the laws which govern the loss of pressure due to friction in pipes and hoses and provide an annotated equation for the derived formula. (6 marks)
b)
i) Calculate the pressure loss due to friction of 300 lpm flowing through 150 metres of:
a. 70 mm hose (2 marks)
b. twinned 70 mm hose (2 marks)

ii) Describe the results and their fireground implications. (4 marks)

c) Describe the effects on pressure, flow rate and nature of the flow of water through a pipe in which the diameter abruptly reduces from its initial value to a smaller value before abruptly increasing again to original value. Include one example of where the effects may be found. (6 marks)

Examiner Feedback

Part a) was usually answered well with most candidates identifying the laws and correct formulae.

Most candidates attained both of the marks available for part b)i)a). However, a surprising number of candidates did not appreciate the implications for twinning hose.

There were few good answers to part c). Many candidates incorrectly identified the pipe as a nozzle and discussed throw.

Question 6

a) Describe the three factors which determine the rise in temperature of a body when heat is added. (6 marks)

b) Define the coefficient of linear expansion and explain the relationship between linear, superficial (area) and cubical thermal expansion. (8 marks)

c) Write down the annotated formula and calculate the increase in volume of a hollow steel box with external dimensions 2m by 1.4m by 1.2m where the following conditions apply: the temperature of the steel has risen from 17^0C to 194^0C; the coefficient of linear expansion of steel is 0.000012. (6 marks)

Examiner Feedback

Part a) was generally answered well although some candidates provided only a list of factors rather than the full rule eg candidates stated only “diameter” whereas the question required “friction loss varies inversely with the diameter”. Marks were not awarded unless all relevant information was provided.

Definitions were often closer to descriptions than definitions. However, the relationship between linear, area and volume and the mathematical relationship was often explained well. Few candidates identified that hollow structures behave the same as solid blocks.

The calculation required by part c) was generally completed well. However, some candidates omitted to annotate the formula.

Question 7

a) A number of breathing apparatus wears last for the following durations in minutes: 59, 65, 61, 62, 53, 55, 60, 70, 64, 56, 58, 58, 62, 62, 68, 65, 56, 59, 68, 61, 67

i) Explain how to identify the mean, median and mode durations. (6 marks)
ii) Calculate the mean and median of the above values. (4 marks)

b) Define the Law of Pressures (Gay-Lussac's Law). (3 marks)

c) Explain the Combined Gas Law and provide an annotated formula for the law. (7 marks)

Examiner Feedback

This was a popular and well answered question. A number of candidates did not understand what is meant by the mode and a common error in relation to median was failure to rank the values.

The definition of the Law of Pressures provided in response to part b) was often good.

Part c) was often answered well. However, candidates sometimes failed to ensure that temperature was identified in Kelvin (K).

Question 8

a) The nucleus of an atom can be represented as:

Where: A = atomic mass, Z = atomic number, X = chemical symbol (as shown on the Periodic Table).

Describe the effect of alpha and beta decay on the nucleus and complete the following generic equations:

Alpha decay 

Beta decay 

(10 marks)

b) Describe gamma decay and explain how gamma decay differs from alpha and beta decay. Include a comparison of the differing ionising potential and penetrating powers in your response. (10 marks)

Examiner Feedback

This question was the least popular option for candidates. Few candidates attained 8 marks or above.

Part a) of the question was often omitted completely. Candidates should be aware that:

- When an alpha particle is emitted from a nucleus the nucleus loses two protons and two neutrons. This means the atomic mass number decreases by 4 and the atomic number decreases by 2. A new element is formed that is two places lower in the Periodic Table than the original element.
- In Beta decay a neutron changes into a proton plus an electron. The proton stays in the nucleus and the electron leaves the atom with high energy, a beta particle. When a beta particle is emitted from the nucleus the nucleus has one more proton and one less neutron. This means the atomic mass number remains unchanged and the atomic number increases by 1 forming a new element.

In responding to part b), candidates often described gamma as the most ionising form; this is incorrect.