IFE Level 3 Diploma in Fire Safety and Fire Science

Unit 1 – Fire Engineering Science

Examiner Report – March 2016

Introduction

Candidates performed well on the paper with 61% of candidates achieving a Pass; this was an improvement on the pass rate of 30% in 2015. It was noted by examiners that many candidates appeared to have prepared well for the examinations. Some candidates achieved very high marks on this paper and 11% of candidates achieved Grade A.

Candidates performed particularly well on questions 1, 4 and 5 where the average mark achieved was 10 or above. Candidates performed least well on question 8.

Question 1

a) Define the following:

i) Boyle's Law (3 marks)
ii) Charles' Law (3 marks)

b)

i) A breathing apparatus cylinder has a pressure of 208 bar and a water volume of 9 litres. Calculate the maximum amount of air in the cylinder at this pressure. Show all formulae and all calculations in your answer. (2 marks)

ii) A breathing apparatus cylinder has a pressure of 198 bar at 23°C. If the pressure in the cylinder rises to 208 bar, calculate the temperature of the air. Give the answer in ^{o}C and show all formulae and all calculations in your answer. (9 marks)

c) Identify three factors that affect the duration of breathing apparatus worn at incidents. (3 marks)

Examiner Feedback

There were many good responses to part a). However, some candidates provided only the formula without supporting descriptions and therefore did not fully answer the question.

In response to part b), many candidates did not include Kelvin temperature conversion and therefore lost several marks in the calculation section.

Few candidates attained full marks for part c). Candidates often incorrectly cited external temperature as a significant factor.

Question 2

a) State five of the principal characteristics of pressure in liquids in open vessels. (5 marks)

b) State and name the SI unit of pressure and name the unit used in practical fire service calculations. Describe the relationship between the two units and explain why the practical unit and not the SI unit is used. (6 marks)

c) What pressure is needed at a pump supplying water at a rate of 925 litres/minute when 7 bar pressure is required at the end of 175 metres of 90 millimetre hose sited 23 metres above the pump outlet? Friction factor = 0.007. Show all formulae and all calculations in your answer. (9 marks)

Examiner Feedback

Those candidates that attempted this question generally performed well.

In response to part a), some candidates failed to recognise that the question referred to "open vessels" and did not take this into account in their response. Those candidates that did recognise the context of open vessels generally attained good marks.

In response to part b), some candidates wrote only about the fire service unit, the bar. The SI unit of pressure is the Pascal which is equal to one newton per square metre, N/m^2.

The calculations required in part c) were generally completed well.

Question 3

a) Define the following:

i) atom (2 marks)
ii) molecule (2 marks)

b) State the name of the substance and the name and the number of atoms of each element that make up the following formulae:

i) H_2SO_3 (2 marks)
ii) Na_2CO_3 (2 marks)

c) Write a balanced chemical equation for the complete combustion of propane in air. (6 marks)

d) From the above equation, if 200 grams of propane is burned, how many grams of water are produced? Molar masses: Propane is 44.10 g/mol. Water is 18.02 g/mol. Show all formulae and all calculations in your answer. (6 marks)

Examiner Feedback

This question was not a popular option for candidates.

Candidates who responded to the question usually provided good definitions in response to part a).

Few candidates identified sulphurous acid as the substance referred to in part b)i).

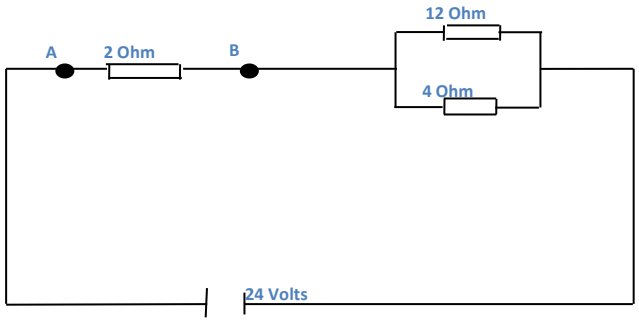
Many candidates successfully balanced the equation required by part c).

Many candidates did not attempt part d).

Question 4

a) *State the different effect on potential difference (voltage) and current in electrical circuits connected in parallel or series. (4 marks)*

b) *For the circuit shown below, calculate (showing all formulae and all calculations) the following:*
   i) The current flowing from the source. (12 marks)
   ii) The voltage drop across AB. (4 marks)



Examiner Feedback

Candidates generally performed well on this question. Many candidates attained high marks for the calculations in part b).

Responses to part a) were often less successful with some candidates providing irrelevant information and others omitting this section of the question completely.

Question 5

a) *Define Newton's three Laws of Motion. (6 marks)*

b) *A steel beam 18 metres long at equilibrium resting on a central fulcrum point has four loads acting on it. Two are on one side: 1.8 kN which is acting 5 metres from the fulcrum and 2.2 kN which is acting 3.5 metres from the fulcrum. On the other side of the fulcrum a load of 0.5 kN is acting 0.5 metres from the end of the beam and an unknown load is acting 3 metres from the end of the beam.*

   i) Draw a diagram to illustrate these loads. (6 marks)
   ii) Calculate (showing all formulae used and all calculations) the unknown load. (5 marks)
   ii) The load at 5 metres from the fulcrum is increased to 2.6 kN. What load needs to be added at the point 3 metres from the opposite end to balance this increase? Show all formulae and all calculations used. (3 marks)

Examiner Feedback

Some candidates provided correct definitions in response to part a). However, many candidates only quoted the Third Law and some made errors in the definition that they gave.

Part b) was answered well by most candidates. Candidates generally presented clear diagrams and set out calculations clearly and correctly. However, some candidates placed the 0.5kN load wrongly and this impacted on subsequent calculations.

Question 6

In relation to radiation:

a) Define the following terms:
- *i) half life (2 marks)*
- *ii) radioactive decay (2 marks)*
- *iii) isotope (2 marks)*
- *iv) ionising radiation (2 marks)*

b) Describe two types of radioactive particle. (6 marks)

c) Explain three ways in which personnel can be protected from the effects of radiation. (6 marks)

Examiner Feedback

This question was a popular option for candidates.

The definitions provided in response to part a) were often poor and there were many inaccuracies. Candidates often failed to provide a full definition and this meant that they could achieve only half of the marks available.

In response to part b), the descriptions provided of alpha and beta particles often lacked depth and this limited the marks that could be achieved. Some candidates incorrectly identified gamma particles – gamma rays are not particles.

Most candidates correctly identified three safety measures in response to part c) although the points were not always fully explained as required by the question.

Question 7

a) Describe how an ionisation smoke detector works. (5 marks)

b) Draw a diagram of an ionisation detector in the fire condition indicating the main parts. (5 marks)

c) In relation to heat detectors, describe a bi-metallic strip and how it can work to raise an alarm. (3 marks)

d) Explain, with the aid of diagram(s), the operating principles of a bi-metallic strip 'rate of rise heat detector' indicating the main parts. (7 marks)

Examiner Feedback

In response to part a), many candidates incorrectly stated that radiation was being detected. Good answers to part a) provided an explanation of the way in which ionisation of the air and smoke affect the flow of electricity.

Responses to part d) were often poor with many candidates providing a further description of bi-metallic strips rather than addressing the rate of rise.

Question 8

a) Define the following terms:

i) Monomer (2 marks)
ii) polymer (2 marks)
iii) thermosetting plastics (2 marks)
iv) thermoplastics (2 marks)

b) Explain the difference between addition and condensation polymerisation and give an example of a polymer from each process. (8 marks)

c) Describe the main fire hazards with regard to plastics. (4 marks)

Examiner Feedback

This was one of the least popular choices of question for candidates. Those candidates that did attempt the question often attained only low marks.

Definitions provided in response to part a) were often limited or inaccurate and therefore most candidates attained fewer than half of the marks available.

In response to part b) few candidates were able to describe the polymerization processes.

Part c) was often answered well and candidates often attained good marks for this section of their response to the question.

Question 9

a) Explain, with the aid of a diagram, the design and operating principles of a siphon. (10 marks)

b) The theoretical lift of water due to atmospheric pressure is approximately 10 metres. Describe the practical factors which reduce this. (10 marks)

Examiner Feedback

Good responses to part a) demonstrated understanding of the role of gravity in a siphon. Less successful responses failed to describe a siphon and instead provided descriptions of nozzle or extinguisher operation.

Responses to part b) often failed to demonstrate understanding of the practical factors at work. Candidates often appeared confused by entry loss and temperature impact.

Question 10

Write down the chemical formulae and describe the properties and significant hazards of the following substances:

a) Sodium (5 marks)
b) Ammonia (5 marks)
c) Phosgene (5 marks)
d) Sulphuric acid (5 marks)

Examiner Feedback

This question was the least popular option for candidates.

Many of the candidates that attempted the question were able to identify at least one property and one hazard for each substance. Some candidates appeared to apply a scattergun approach and incorrectly assumed that all substances were flammable and toxic.