



Institution of Fire Engineers 2005 Examination Markers Report

This document contains the report on the 2005 Membership examinations by the Chair of the Examinations Committee, W C Cox, who was assisted in this task by comments from the individual markers.

It is my pleasure as Chair of the Examinations Committee to present the report for the Institution's Membership examinations held in March 2005. In so doing I hope that the comments made will help to prepare future candidates for their attempts at the Institution's examinations.

These comments are not intended to be a definitive answer for I do not believe there is such a thing as a "model answer". There could be many variations in detail from different countries around the world and each one answer needs to be, and is, considered on its merits.

The comments do then contain details of "suggested answers" but they do not represent a full or complete answer and are only intended as a guide for students studying for these examinations. Similarly any comments that are made are general to the question as a whole and should not be read in the context of any one individual script.

Every year the comment is made by examiners and markers that candidates "do not read the question". So it is particularly disappointing for markers to receive very lengthy answers that gain no marks for going in the wrong direction, or for containing details which are not relevant in the context of the question. The examiners are looking to see that the candidate understands the topic being asked. A script that contains references to something not relevant to the answer will not be awarded any marks and in fact it only serves to illustrate a lack of understanding by the candidate. Marks cannot be gained by presenting an answer to the question that you would like to see instead of the one that is actually asked. Equally it is also impossible to gain marks if nothing is written.

Two of the biggest failings from candidates and those that lose them the most marks are:

- ? A lack of detail and explanation. At this level of examination an answer should be about two pages of explanation, anything less is probably too little and cannot illustrate the depth of understanding required.
- ? Vague and general statements. Candidates cannot expect the markers to either interpret answers or to fill in the blanks by adding detail to vague or general statements. Nor is it the task of the marker to try to interpret any answer to make sense of it.

It is pleasing to report however, that the number of better scripts is increasing and that the quality of answers is improving.

Finally I must record my thanks to the markers, the question setters, IFE staff and all who gave their time and energy to making the whole process possible

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Chair – Examinations Committee**

Member Examinations

Paper 1 - Fire Engineering Science

Question 1: *By reference to Bernoulli's equation describe both the Venturi effect and the type of pump which makes use of this principle.*

This was a poorly answered question with many candidates failing to state Bernoulli's equation correctly. This was mainly due to the confusion between velocity and pressure. Very poor diagrams were presented and there was a failure by the candidates to recognise that a gas or a liquid could be employed as the operating medium or propellant. Some candidates spent time making up unnecessary examples of calculations.

The question was asking candidates to show their understanding of the practical application of the Bernoulli equation to the Venturi effect and to show how this was used to good effect in the Ejector pump. The basic idea is that the Bernoulli equation describes how the pressure in a fluid changes as the velocity changes. By altering the diameter of a tube, the velocity of the fluid is altered and so too the pressure on the fluid. That principle is used in the ejector pump. The pressure at the throat is decreased causing a partial vacuum which entrains fluid from outside of the throat into the pump.

Question 2: *a) Describe the meaning of a balanced chemical reaction.
b) Explain in detail the meaning of a stoichiometric mixture and describe how the necessary fuel/air mixture is achieved in practice.*

This was a poorly answered question with very few candidates receiving a pass mark. There seemed to be a general failure to understand the question with some confusion over the meaning of a "balanced chemical reaction". Many answers included unnecessary calculations and showed little knowledge of a stoichiometric mixture or what that means.

Again the idea of the question was to allow the candidates the opportunity to show they understood the theory and how it applied in practice.

A "balanced" chemical equation is shown when the same number of atoms of each element is maintained throughout the reaction. The number of molecules may change. The proportions of the reactants in this balanced state are known as the stoichiometric mixture. In the combustion process the flame is at its hottest temperature when this is achieved. Altering the proportions of air and fuel means the mixture will reach a stage where it will not burn. The carburettor in the engine of a car is designed to mix the fuel/air in the correct ratio.

Question 3 *Describe the use, construction, fire resistance and testing of Fire Rated Partitions.*

This seemed to be an example of candidates not studying widely enough during their preparation. The answer to this fairly straightforward question was readily available by reading the recent copies of the IFE Journal.

Many candidates failed to identify all uses of the fire rated partitions and little mention was made of protected shafts, stairs and escape routes. Little knowledge was shown of the construction and the methods of fixing materials and very few candidates referred to insulation ratings. Testing was not explained in depth (although some candidates were aware of BS476 Part 22) and too few candidates explained any system or that insurance companies often require a building to have standards beyond those specified by Building Regulations. Overall a set of disappointing answers where good marks should have been achieved.

Question 4: *Outline and discuss the different types of smoke detectors.*

Many candidates identified the main categories and produced diagrams. Little knowledge was shown regarding the method by which voltage is used to indicate smoke density in the ionisation detector or that the use of this detector is declining rapidly because of a move away from the use of radioactive sources.

Optical scatter and beam detectors were not explained in the correct detail. Elaborate diagrams are not really necessary and a brief description of each would have gained good marks.

Students need to understand that for this paper it is more important to show an understanding of the science involved and not just the workings of the detector.

Few candidates mentioned aspirating smoke detectors and video smoke detection both of which were discussed in the IFE Journal.

Question 5: *Outline the use, manufacture, hazards and medical effects of LPG gases.*

The LPG gases have been in use for some considerable time so candidates should have a good understanding of this subject. It was pleasing to report that this appeared to be the case with scripts showing a good general knowledge. However they needed to have studied the subject in greater depth to gain high marks.

The use of propane as a refrigerant or as a substitute for acetylene in flame cutting and welding was only mentioned by a few.

The majority of candidates failed to mention that LPG becomes flammable when mixed with air in a concentration within the flammable range (by volume) and medical effects were not described in detail.

The basic information needed to answer this question was easily found in the Manuals of Firemanship.

Question 6: *Describe the two different types of electrical spark which may be generated by an electrical circuit.*

This, perhaps not surprisingly, was very poorly answered although the few candidates that had studied the subject gained a reasonable pass mark.

The two types referred to are Capacitive and Inductive sparks. The former is a single discharge, like a thin bright thread, the latter results from the collapse of a magnetic field. The energies associated with both are different and calculated from the capacity of the condenser and the voltage (capacitive spark) and the inductance and current (inductive spark). This difference was only known by a few and incorrect formulae were mainly stated. The knowledge of, and values derived from using these, can be used in designing intrinsically safe and flameproofed equipment.

The basic information regarding these can be found in the IFE publication "Chemistry and Combustion" by Wharry and Hirst.

Question 7: *The figure shown below is a plot of heat release rate (HRR) against time for a mattress fire in a bedroom with an open door.*

Diagram to be added

- Write a sentence to describe the fire behaviour during each of the time intervals A, B and C and give an approximate value of X.
- Sketch the heat release rate curve above and add another curve to show how you would expect the fire to behave if both the door and a large window were open when the fire started.
- Sketch the curve again and add another curve to show how you would expect the fire to behave if it was started using an accelerant.

This was very poorly answered with only a few candidates achieving a pass mark or showing any understanding of this part of Fire Dynamics.

The stages of the fire are typically:

- Initial growth (slow, medium, fast or ultra fast)
- Steady state (ventilation controlled)
- Decay phase (fuel exhaustion or extinguishing activities)

Most candidates gave a poor explanation of these stages and were unable to describe that the plateau region B would be due to ventilation control. Thus the introduction of more air would mean the growth section would continue to a higher level but the plateau would be shorter as the fuel was exhausted faster. Some candidates were able to show on the graph the effect of the accelerant, which would cause the initial growth period to be shortened, and the graph to become steeper.

Question 8 *Calculate the total fire load and fire load density for a room furnished to domestic standards which is 3 x 4 x 3 metres high and containing:*

60 kg of Nylon/Polyester carpet (calorific value 22 MJ/kg)

85 kg of polyurethane furniture (calorific value 35.2 MJ/kg)

25 kg of wooden fittings (calorific value 17.6 MJ/kg)

Hence explain the use of Law's Law to calculate the time of the fire resistance required.

Many candidates answering the first part of this question correctly gained good marks.

The total fire load was calculated as 4752 MJ and the Fire Load Density as 396 MJ Un fortunately the majority were not able to explain Law's Law or to show how it could be used to calculate the fire resistance. Using the example given for a total fire load of 4752 MJ and assuming 1 square metre of window area the fire resistance can be calculated as 35 minutes. Dougal Drysdale gives a good explanation of this in Introduction to Fire Dynamics.

Paper 2 - Fire Safety

Question 1: *Healthcare staff in hospitals need to learn about and practice basic fire actions, including special needs for particular locations. Discuss in detail those actions.*

This was a very popular question with some good answers. However many candidates missed a lot of marks by not thinking widely enough and mentioning:

The function of fire/smoke doors and the need to keep exits clear of obstructions

The recognition of fire hazards

Special procedures and problems associated with Intensive Care Units, Operating Theatres etc

Instructions for dealing with the safe control and isolation of services such as gas, electricity, ventilation.

Medical gases, including oxygen, which may need to be controlled during a fire

Question 2: *Discuss the problems associated with the positioning of smoke detectors within buildings.*

Whilst this proved to be a popular question the quality of the answers was very poor. Too many candidates concentrated on descriptions of the different types of smoke detectors and the methods of reducing the number of false alarms. The question was not asking for this and was specifically aimed at the **problems associated with the positioning** of smoke detectors. The answers should have been under the broad headings:

- Air movement
- Heat Inversion
- Voids
- Walls, beams and galleries
- Corridors, staircases and shafts
- Sloping ceilings and roofs
- Ducts

Question 3 *Describe in detail the precautions and purpose of a 'Hot Work' permit that can be introduced to minimise the risks when outside contractors are on the premises.*

This topic seemed to be well understood by the majority of the candidates who answered it and they obtained good marks as a result. The main points that were missed related to:

- The "Hot work" permit being a contract between the client and contractor
- The effect the work could have on the fire provisions including the possible need to isolate the fire detectors
- The need for temporary electrical installations to comply with the wiring regulations
- The fact that temporary heaters should be in a fixed position and removed when not required

Question 4: *Compare legislative systems of regulatory enforcement with that of relying upon self-compliance, listing the advantages and disadvantages of each.*

This was not a popular, albeit topical for the UK, question, however there were some good answers and the majority obtained a pass mark. This has been well covered in the IFE journal and the answer should have pointed to the major features of each, for example

Regulatory enforcement

- Inspectors visit premises to identify violations
- The onus is upon the enforcing authority
- It is usually very prescriptive
- The risk may be ignored until advised by the authority
- It is dependent on workloads and numbers of inspectors

Self-compliance

- Responsible persons undertake their own risk assessment
- It is dynamic and ongoing
- Different levels of standards may be used
- Onus of responsibility for compliance has shifted to the responsible person
- Inspecting officers will carry out more of a policing role

Question 5: *People react in a variety of ways to fire.*

- a) *Outline the behavioural stages of evacuation; and*
- b) *Discuss the following in relation to a fire in a shop having a restaurant area on the first floor;*
 - 1) *The range of reactions that may occur*
 - 2) *The factors that influence these reactions, and*
 - 3) *The possible consequences of the various actions.*

This was a very disappointing response to what should have been a very simple question. Too many scripts discussed "fire spread", "panic", "stampedes", "jumping out of windows"

The behavioural steps are:

- ? Interpret - Ignore/Investigate
- ? Prepare - Instruct/Explore/Withdraw
- ? Act - Evacuation/Flight/Warn/Wait

The range of reactions include

- ? ambiguity and misinterpretation of cues
- ? scepticism as to whether the alarm is a test or false
- ? individuals leaving by their route of entry

The factors include:

- ? the size of the building
- ? the reaction of the person
- ? the reaction of others
- ? familiarity
- ? gender, age and sex

The possible consequences are:

- ? delay in reaction
- ? staff may have difficulty in getting customers to leave
- ? individuals act inappropriately but rarely panic

If candidates really thought about their own reactions and used their own experiences a lot of the marks missed could have been gained.

Question 6: *The owner of a local factory, which has had two small fires of deliberate ignition, has asked for your advice on the action to be taken to prevent or deter any further arson attempts. Outline the advice that you would give.*

The subject of arson and preventative measures has been covered in the IFE journal in different guises many times. If candidates thought the question through and considered how they would protect their own property, the majority would have gained higher marks.

Options such as “moving the factory” or “building higher roofs” are not viable or sound advice to offer.

Candidates gained good marks where they considered giving advice under the following headings:

- ? Deter unauthorised entry to the site/premises
- ? Prevent unauthorised entry into buildings
- ? Reduce opportunities for potential arsonists
- ? Reduce scope for potential fire damage
- ? Carry out end of day checks

Question 7: a) *Briefly outline the general design principals of a radio based automatic fire detection system including the safeguards and survey that needs to be undertaken prior to installation; and*
b) *Detail the advantages and disadvantages of this type of system.*

Surprisingly this was not a popular question and the standards of some of the answers suggests that candidates have not studied the syllabus. The design principles were quoted quite well. The safeguards are built into the system to prevent interference by outside radio signals. The survey is undertaken to ensure that is so and to confirm the strength of the signal.

Advantages include:

- ? Quick to install
- ? Risk of wiring damage eliminated
- ? Location of detectors flexible etc

Disadvantages include:

- ? Temporary screening may occur
- ? Initial cost is relatively high
- ? Frequency of tests can seriously reduce the fire alarm sounder battery life, etc

Question 8: *Define ‘Travel Distance’ as used in means of escape codes of practice and discuss the factors that influence the selection of travel distances suitable for the assumed occupancy of the building*

Those candidates that gave the formulae for exit widths and number of exits etc wasted valuable time and effort.

No-one outlined the 4 stages of travel, namely

- ? Escape from the room of origin
- ? Escape from the compartment
- ? Escape from the floor of origin to ground level
- ? Escape at ground level

But most identified the influencing factors which all under the headings of

- ? Occupancy
- ? Nature of the route
- ? Risk
- ? Compensating engineering features

Paper 5 - Human Resource Management

Question 1: *How would you seek to achieve control of occupational health and hygiene problems within your organisation?*

Occupational health remains a topical aspect of life generally and as might be expected produced some good answers to this question. The answer is generally accepted as involving a discussion of

- ? Analysis – of performance, problems and potential hazards
- ? Development - of policies, organisation procedures and training systems
- ? Implementation – of the programme by training, inspections, investigations and audits
- ? Evaluation – of information and reports

Further thought by some candidates would have resulted in even better marks.

Question 2: *Identify your organisation’s internal and external customers and describe how various quality systems can aid customer satisfaction.*

The terms of the question seemed to have deterred candidates from answering it. Those that did so gave answers that lacked depth. Internal customers are colleagues within a single organisation or across organisations. External customers are the final recipient of a service or the purchaser of goods.

The answer therefore required

- ? an outline of methods to maintain good relations within a firm or organisation to satisfy internal customers and
- ? to maintain a good quality assurance system to satisfy external customers.

Those that expanded upon and explained the points in some detail gained good marks.

Question 3: *You are tasked with conducting a recruitment interview, how would you ensure that all arrangements run smoothly and that the choice of candidate is based on an objective assessment?*

This should have been a straightforward question to most candidates and most answers demonstrated personal experience of the subject. The arrangements are fairly well known and follow the steps

- ? Informing the candidate – date, time, place etc
- ? Arrival – sitting area and greeting
- ? Interviewing panel – briefed on the programme
- ? Interview room – no distractions, booked, no psychological barriers etc
- ? Follow up – candidates informed

Ensure the interviewing panel are briefed on the job and the procedures and that any form of prejudiced behaviour or judgements are eliminated.

Question 4: *The strategy of an organisation is a high level vision, what methods can an organisation use to turn the strategy into a work plan, which achieves result and enables all employees to contribute?*

Once the strategy of an organisation has been identified it is used as the basis for the business plan for the organisation. Such plans can be used to identify the objectives of the departments and used to develop unit or department plans which will identify

- ? Standards of performance
- ? Resources available
- ? Data to be used to monitor performance
- ? New skill requirements
- etc

Implementing such plans is very dependent on the quality of leadership so it is important that managers have the skills to involve employees, develop a culture of improvement, trust and working together and of motivating staff.

Although there were some good answers along the lines outlined above too many tended to stray into the more mundane matters of the unit plan and so lost the thread of what was required.

Question 5: *Identify the problems which poorly performing employees can cause and describe the actions a Manager can take to encourage the employee to improve their performance.*

All of the candidates that answered this question achieved a pass mark although no one achieved a very high mark. Most answers reflected the fact that the candidates had found themselves with a working colleague who could be described as a poorly performing employee.

The five basic steps to handle performance problems are

- ? Identify and agree the problem
- ? Establish the reasons for the shortfall
- ? Decide and agree on the action required
- ? Resource the action
- ? Monitor and provide the feedback

All of the scripts were able to outline the steps involved but few could give sufficient detail for each step to gain the higher marks.

Question 6: *Discuss the information required by Managers before important strategic decisions are made.*

This was one of the most unpopular questions on the paper. Strategic decisions are normally required to be made by high level managers in an organisation but it was pleasing to read answers given which illustrated a level of understanding from lower level managers.

To gain high marks the candidates needed to submit scripts showing they appreciated that a strategic plan is about making decisions on an organisations long term future, goals and actions. This means

- ? Identifying the customers
- ? The customers requirements
- ? The purpose of the organisation
- ? The financial situation
- ? Strengths and weaknesses
- etc

Once the plan is in place then the manager will require information relating to operation, performance and resources for example.

Question 7: *Discuss the importance of team work to the smooth running of an organisation.*

The majority of candidates must themselves be members of a team in their working time. The excellent results that come from proper team work was not lost on candidates and naturally produced answers which echoed their involvement. Very high marks were not achieved, however, and this is probably due to a lack of detailed answers.

The benefits are many and some can be listed

- ? Leads to smooth running
- ? An organisation can pool resources and respond quickly to new opportunities
- ? Increase job satisfaction
- ? Can lead to healthy competition between teams
- ? Fire service operational response is dependent on effective teams, etc

Question 8: *As a Supervisor, what factors would you take into account when determining an individuals training and development needs?*

Again this question provided answers which showed an understanding of the subject and yet lacked sufficient detail to gain very high marks. Training and development of staff is an important aspect of a career and this resulted in much thought behind the answers presented.

The overall aim is to see that the organisation has the quality of people it needs to attain its goals for improving performance and growth.

Employee development then involves

- ? Learning
- ? Education
- ? Development
- ? Training

Candidates needed to define the meaning of each and the differences between them, and to illustrate how they could be used by the manager.

Paper 6 - Fire Service Operations

Question 1: *Discuss in detail the theory and use of Positive Pressure Ventilation equipment in firefighting operations.*

This is a topical subject with the Fire Service at the present time which makes the wide variation in the standard of answers disappointing. Several attempts were far too short and did not cover the requirements in sufficient depth. Surprisingly a number of candidates did not refer to the pressure differentials in their answer.

Several scripts covered the provision of "pressurised staircases" in considerable depth but gained no marks. Candidates should have included a definition of forced ventilation and the factors to be considered such as:

- ? Tactical options (defensive or offensive)
- ? Location and quality of inlet vent
- ? Issues affecting efficiency (eg wind, size and design of the fan, sizes of inlet and outlet vents, size of the compartment and temperature of the compartment gases)

Question 2: *Discuss the need for an Incident Command Structure.*

The difference in the scripts presented was clear; those who had studied the subject gained good marks whilst those who relied on experience missed out.

The main purpose of the subject – to assist Officers in Charge/Incident Commanders in decision making and to encourage effective communication and delegation – was missing.

Some of the main factors to consider are

- ? Dynamic risk assessment
- ? Structured support
- ? Describing tasks and performance
- ? Consistent methodology and terminology for operational command

Each of which needed to be expanded upon and explained.

Question 3: *Discuss the considerations and control measures required to limit environmental pollution as a result of firefighting operations.*

Despite being topical this was not a particularly popular question. Candidates often concentrated on the pollution of water courses, giving good information, but failing to consider the effects of airborne pollution on surrounding areas and the public.

Marks were lost due to a failure to discuss

- ? Avoidance of routes of contamination
- ? Use of monitoring equipment
- ? Seeking specialist advice
- ? Establishing a decontamination zone

Question 4: *Discuss the factors to be considered when planning for firefighting operations in highly secure storage premises.*

The discussion in any answer presented needed to centre around the broad factors:

- ? Assessment of the hazards
- ? Prevention measures to be adopted
- ? Preparation of plans to respond
- ? Response , initial response including other agencies
- ? Recovery, a return to normality

Few candidates attempted the question and the overall response was poor. Areas not considered included the preparation of procedures following an assessment of the likely hazards. No mention was made of the need to consider ways of preventing fires or emergencies or to reduce their severity and effect.

Question 5 *Discuss the impact on firefighting operations of sandwich panel construction in buildings.*

Candidates who attempted this question clearly had not studied the subject and as a result the marks awarded were low. This topic has been the subject of articles in the IFE journal so the study material is available to all members.

The factors that candidates should have discussed included:

- ? A description of sandwich panel construction
- ? Features of buildings containing such features (eg building size and a lack of fixed protection)
- ? Behaviour in a fire (eg speed of development, potential for hidden spread, delamination and collapse of panels, quantity and toxicity of smoke and fumes)
- ? Issues regarding firefighting operations (eg advance planning, dynamic risk assessment, health and safety, building entry and withdrawal of personnel and environmental protection)

Question 6 *Describe in detail the hazards for firefighters relating to an incident involving aircraft constructed of Man-Made Mineral Fibres (MMMMF).*

This question required a detailed knowledge of this form of construction so that the hazards and the awareness of the hazards during firefighting operations could be discussed.

The suggested answer identified the hazards, such as lightweight high tensile fibres, capable of absorbing post-crash fire products which are likely to be in a friable, easily liberated form.

Most candidates were aware of the fact that the potential for "needle stick" injuries and traumatic dermatitis needed to be addressed and that when the material was decomposing toxic isocyanates may be released. Failure to refer to the need for breathing apparatus and chemical protection suits lost valuable marks. Likewise many failed to mention any possible environmental pollution.

Question 7: *Discuss the major considerations when determining operational procedures at an incident involving biological hazards.*

A suggested answer would need to discuss the need for pre-planning (nature and extent of the hazard and contact arrangements) as well as the operational considerations such as

- ? Personal protection
- ? Use of firefighting water
- ? Presence of animals
- ? Airborne pollution
- ? Cordons/restricted areas
- ? Casualties
- ? Containment
- ? Decontamination

Several good scripts were submitted from candidates who had clearly studied this subject. Marks were lost by a number of candidates who did not consider the possible presence of animals who may have been infected, the potential for airborne pollution or the need to deal with casualties.

Question 8: *Discuss the factors to be taken into consideration when carrying out rescues from quarries.*

The standard of response to this question varied markedly. Whilst most attempts included reference to safety of personnel, marks were lost by not providing a more in-depth answer.

Measures to prevent fire service personnel falling were often missed as was reference to the type of equipment that might be required.

A suggested answer should have considered factors such as

- ? Casualty location and extent of the injuries
- ? Measures to prevent personnel falling and provisions for their recovery.
- ? "Safe" working procedures (Equipment, nature of the work, site and prevailing conditions and actual use of equipment).

Paper 7 - Aero Fire Studies

Question 1: *Explain the concept of "Zones of Control" when dealing with an incident involving civil aircraft.*

This was a very popular question with candidates who did appreciate that they should be divided into the accident site, the casualty clearing site and the ambulance loading zones. A brief description of the restrictions in personnel and positioning of each was also needed although many candidates missed the fact that the zoning system is a "progressive measure of control".

Candidates also missed the opportunity for gaining easy marks by the use of a simple diagram. This could have been used to illustrate the positioning of and relationship between the zones much more easily than it can be with words.

Question 2: *Discuss the techniques and fire-fighting tactics to be applied for the following:*

- a) *Locating the incident*
- b) *Approaching the incident*
- c) *Fire-fighting procedures*

Although this was a popular question it was poorly answered with too many candidates failing to mention many of the points. The most commonly missed being for example:

- a) *Locating the incident:*
On or off the airport? Last known location? Any other messages? Visibility procedures? Other specialised equipment, vehicles or manpower? Any visible signs of fire, smoke etc.? Any other hazards involved cars, trains, boats or buildings etc?
- b) *Approaching the incident*
Upwind, up slope? Consider other weather conditions?. Approach slowly, do not drive through smoke unless absolutely necessary
- c) *Fire-fighting Procedures*
Check aircraft structure or wreckage, intact or not, and for the presence of survivors, ensure enough resources are in place to deal with incident, availability of water supplies

A few words of explanation with each of the points also illustrates the candidate's understanding.

Question 3: *What is the importance of response times and the possible solutions to reducing them?*

Although this was a very popular question with candidates a majority failed to mention some obvious points relating to the response times such as:

“To improve survivability times for occupants and to maintain the fuselage integrity”

Possible solutions could have included:
Rockets filled with extinguishing media
Faster appliances
Better use of technology
And remote controlled appliances

Overall this was a disappointing response.

Question 4 *Discuss the provision of fixed fire protection systems found in civil aircraft.*

This was a straightforward question that should have rewarded candidates with easy marks but surprisingly this was not a popular question. Many candidates failed to mention fire detection and suppression systems, the use of media such as BCF, BTM, Freon or nitrogen gases and the discharge rate but instead concentrated upon cabin crew training and hand extinguishers. Very few candidates mentioned the proposed use of the water spray suppression systems. Overall a very poorly answered question.

Question 5: *Describe the use, construction features and classifications of aircraft hangers.*

This was a well answered and popular question with many candidates who demonstrated a good working knowledge of hangar classifications and structural fire protection. The question was essentially asking candidates to describe the 3 groups of buildings:

Group 1: Entrance doors to have a height of 8.5
Single fire area of size 3175m^2

Group 2: Entrance doors to have a door height of 8.5m or less
Single fire area between $465\text{m}^2 - 3175\text{m}^2$

Group 3: Entrance door height of 8.5m or less
Single fire area of between $465\text{m}^2 - 2790\text{m}^2$

and to describe their construction features. Groups 1 and 2 having the same features whilst Group 3 is separate with different features.

Question 6: *Discuss in detail the fire fighting procedures to be adopted when dealing with aircraft engine fires.*

Candidates showed varying degrees of knowledge for dealing with this question. It appeared to be the case that many had failed to read the question which asked for the candidate to “discuss in detail the fire fighting procedures”. Many candidates then failed to mention areas such as:

- ? The engine configurations: Embedded, Piston, jet, helicopter, etc.
- ? The problems associated height of some engines.
- ? Be aware of running fuel fires

? Contact the captain on discreet frequency 121.6

? Use onboard engine fire suppression systems on fires first, if the fire is outside the combustion chamber but within the engine nacelle.

What should have been a rewarding question for those who had read the material actually produced some very poor answers.

Question 7: *Explain the formula used to calculate the quantity of water required for foam production to control the practical critical area and identify the variables which can affect it.*

This question produced some very good answers and candidates demonstrated a very good working knowledge of the requirements.

The formula being referred to is expressed as:

$$Q = Q_1 + Q_2$$

Where:

Q = The total amount of water required

Q_1 = The water for control of the fire within the practical critical area

Q_2 = the water required after control has been established and is needed for such factors as the maintenance of control and/or the extinguishment of the remaining fire. And further explanation was required to explain the meaning of Q_1 and Q_2 and the variables. Some candidates wasted valuable time by describing the theoretical and practical area concepts which were not asked for.

Question 8: *Describe the components that make up a modern day aircraft's undercarriage and discuss the fire-fighting action to take for an undercarriage assembly on fire.*

This was not a popular question with the candidates who missed the opportunity to score well by failing to mention fire fighting actions in detail. Many however did demonstrate their knowledge of the component parts of an undercarriage.

The answer should have included details such as:

For undercarriages:

May have different configurations (bogies)

Parts of the undercarriage (Shock struts, Retracting mechanisms, Wheels and fusible plugs (operate at 177°C), Brake assemblies, Tyres, Hydraulic pipes, both rigid and flexible)

Water activated floatation devices

Undercarriages may include skids or wheels or both on helicopters

Fire-fighting Actions:

Approach with extreme caution

Approach from front or rear or both (keep away from the hub disintegration zone)

Be aware of the possibility of undercarriage collapse

Be aware of the possibility of exploding parts of the wheel or wheel rims and brake assemblies

Be aware of the possibility of escaping fluids at very high pressures from damaged rigid or flexible hydraulic pipes.

Paper 8 - Fire Investigation

Question 1: *People who set fires invariably use flammable liquids to accelerate the burning. Discuss in detail how this might affect the fire scene.*

Every candidate attempted this question but it was not well answered. Many seemed to rely on basic knowledge which was not good enough. Some of the points expected include:

- ? It may deplete the oxygen in the room and self extinguish
- ? Amateurs nearly always use more than necessary
- ? Flammable liquids on absorbent material allows some fuel to escape combustion
- ? Accelerant poured directly onto a floor enters cracks, holes and joints and burns in a characteristic manner.

Question 2: *Produce a comprehensive list of the agencies and professionals who may well be involved in some way with the investigation of a fatal fire of deliberate origin. Brief details of their respective roles should be included.*

This was a popular question which was easy marks if you knew the definitions. Many candidates did not appear to know the answers although in numerous cases the answers were there but hidden away in the "brief description" of roles. Some answers were not that brief and some candidates omitted to include them.

The usual list of Coroner, Police, Scenes of Crime Officers, Police photographer, Forensic Scientists and Odontologists (Dentists) were included but not many thought to include Forensic Pathologists or even Doctors, police surgeons or medical officers depending on whatever they are referred to in your country. Toxicologists and Anthropologists were not mentioned by anyone.

Question 3: *Explain in detail how on-scene Firefighters can contribute to the successful investigation of fires.*

Not surprisingly this was a well answered question and candidates scored very highly.

Many answers could rely on their own experiences and think about the information that only they could supply, such as:

- ? Had the premises been secure at the time of arrival?
- ? What had been the apparent location of the seat (or seats) of the fire?
- ? Had there been any abnormalities (in the behaviour of the fire or witnesses)?
- ? Any unusual odours?
- ? Entry paths blocked? Windows open?
- ? Weather conditions?
- ? What was said by occupiers, neighbours, passers-by?

Question 4: *Explain the following terms:*

- ii) Annealing
- iii) Backdraft (Back draught)
- iv) BLEVE
- v) Brisance
- vi) Pyrolysis
- vii) Combustible
- viii) DNA
- ix) Auto-ignition
- x) Forensic
- xi) Petrol bomb

This was a very well answered question where candidates scored very high marks. This should not be surprising since all of the definitions are well documented. The one exception was "Forensic" which all candidates, except one, described as meaning "science" or "laboratory work" but was accurately described only once as "pertaining to courts of law"

Question 5: *Fires are occasionally associated with the use of night light candles sometimes known as tea lights. Discuss.*

This was not a popular question and only two candidates scored highly. Many confused "night light candles" and "tea lights" with ordinary candles and answered accordingly. Few marks were gained by doing this.

Nightlight candles or tea lights consist of a wax candle within a thin aluminium case. When it is lit the wax becomes liquid and the light will burn with a small steady flame for approximately 4 – 6 hours. They are commonly used to keep food warm or for decoration or as vaporisers with scented oils. As their use has increased so has the number of fires they cause, in particular by placing them on top of a plastic television or other combustible item. But the candle holder will get very hot in use or a larger flame can occur by the formation of a secondary wick from debris being dropped into the wax.

Question 6 *The examination of fire damaged vehicles present the fire investigator with a number of specific hazards. Describe in detail each of these hazards and how they may be injurious.*

The answer to this question should have included:

- ? Gas filled suspension components which are susceptible to explosive failure
- ? Fuels and lubricants which can cause dermatitis
- ? Synthetic polymers containing fluorine. At high temperatures they can decompose producing hydrogen fluoride which in turn will dissolve in the moisture in the respiratory tract to produce hydrofluoric acid.
- ? Air bags operated by small explosive charges
- ? Electric shock and acid burn risks
- ? LPG tanks can be found in or under vehicles usually at the rear.
- ? Tyres weakened by heat could fail and reduce vehicle height.

This was not a popular question although some who made educated attempts easily achieved high marks.

Question 7: *Describe in detail the ideal conditions and minimum time frame for a discarded, lighted cigarette to cause flame to evolve from upholstered soft furnishings. Give two other examples of where flaming fires may also begin from the same source.*

Generally this was a poorly answered question which is surprising given the number of these types of fires over the years. Clearly the candidates knew little of the basic science of how cigarettes can cause smouldering combustion in furnishings and how this moves to flaming conditions.

The main point is that a lighted cigarette will only occasionally set fire to dry fuel on which it rests while uncovered. If the cigarette is covered by only a single layer of cloth, the insulating effect prevents radiation and temperatures up to of 100°C higher can result. The minimum time span is generally considered to be about 22 minutes but this is variable depending on the materials and the extent and location of contact with the cigarette. Fires will also begin from the same source if the materials in contact are also insulators eg sawdust, waste paper, crisp packets etc.

Question 8: *Write a training instruction paper for your organisation on the utilisation of all forms of photography for fire investigation purposes, including in your answer the forensic applications.*

A really disappointing result for this question which allowed the candidate opportunity for thought and imagination. Very few candidates grasped this. Many ignored the request for a “training instruction paper” and wrote an essay type answer.

- ? For general photography the instruction should have included the information:
- ? Generally use colour film and in-house processing
- ? Wait until the building is cool
- ? Daylight produces the best results
- ? Black debris is difficult and oblique lighting will raise the contrast
- ? Accurate records of what pictures are and the stages of evacuation should be photographed
- ? Any significant object should be shown in-situ

The use of video is a valuable tool and should be included although many answers failed to include this or a discussion of the use of modern digital cameras.

Graduate Examinations

Paper 1 - Fire Safety

Question 1: *Outline the purpose and requirements of compartment walls and floors.*

Compartment walls and floors are necessary to sub-divide a building into units/cells to stop the spread of fire. Most candidates understood the purpose but then many went on to describe the construction details of walls and floors instead of a simple common sense explanation of what is required to make sure a compartment is “fire tight”.

Details of the construction was not asked for and gained few marks. The answer should have included details of the fact that the compartment should be a complete barrier to fire, have appropriate fire resistance, be constructed from materials of limited combustibility, run the full height of the building and be “fire stopped where they meet.

Question 2 *List and briefly discuss points for consideration for the siting of portable fire fighting equipment.*

This was a good basic question which attracted a wide spread of marks but overall a disappointing result. If candidates had just remembered the simple words/phrases that make up the answer and built upon them, they would have gained a pass. These simple words and phrases were:

- ? Siting and placement
- ? Distance
- ? Height of fixing
- ? Area to cover
- ? Number of floors
- ? Types of extinguishers
- ? Exposure to weather
- ? Vandal and thief proof
- ? Additional and extra extinguishers
- ? Risk covered

Question 3: *The most common form of domestic/commercial lighting is by either incandescent bulbs or fluorescent tubes. Briefly describe:*

- a) *How each of these lighting systems operates.*
- b) *The possible cause or dangers of ignition in respect of each type of lighting*

This was not a popular question. The operation of each lighting system was not well known, especially what the systems (that is, the tubes and bulbs) contain by way of materials. The bulb is normally a tungsten filament in an inert gas (eg Argon). Whilst the filament is raised to white heat temperature the glass envelope operates at temperatures between 100°C - 300°C. The fluorescent tube is filled with mercury vapour and the tube is coated with a mixture of compounds which glow in ultra-violet light. The danger of ignition with the bulb comes from the heat generated and the breakage of the bulb with the filament continuing to glow for a few seconds. With tubes little heat is produced but the chokes/starters can overheat.

Question 4: a) *Detail the principle controlling valves found on a wet pipe sprinkler system; and*
b) *Outline the purpose of the three pressure gauges on a wet pipe system.*

This was not a very popular question but easy marks were gained by those candidates who chose to illustrate their answers with a clear and well labelled diagram.

A common mistake by a number of candidates was to describe operational procedures when attending a sprinklered building. Candidates need to be aware that this is a Fire Safety paper and direct their answers accordingly. Other candidates chose to explain the whole of the operating system of a sprinkler installation whilst yet others described in great detail the workings of the internal "clack valve".

A simple list and explanation of a stop valve on each source of supply, a non-return valve, a main stop valve and a test and drain valve would have gained a pass mark. Part b could have been covered in an explanation of the gauges above and below the main stop valve together with the towns main /water main supply.

Question 5: *Escape is generally considered in four distinctive stages:*

- a) *Define these stages, and*
- b) *Explain is meant by the term phased evacuation and identify which of the above stages it involves?*

Many candidates did not have any idea of the four stages of escape:

- From the room of origin
- From the compartment or storey
- From the floor of origin, and
- Escape at ground level

but instead concentrated upon the definition of means of escape. Some managed to get to the answer in a round about way and were rewarded for their efforts.

In part (b) only a handful of candidates mentioned it was relevant to fire alarms and predominantly involving stages 1 and 2. This part of the question was looking for candidates to explain a "zoning" system which allows the alarm in one part to operate so that evacuation can take place whilst other parts are put on alert or are silent.

Question 6: a) *Describe the objective of a pressurised system,*
b) *Outline the two basic requirements when designing a pressurisation system; and*
c) *Draw a labelled sketch illustrating leakage paths of a pressurised system*

This was not a popular question and several of those who answered it did so in terms of ventilation systems so the results were quite poor. The objective is of course to achieve an excess pressure in the escape route in order to prevent the entry of smoke and toxic gases. The requirements that follow are the pressure to be used and the leakage paths.

The final part of the question asked for a labelled sketch illustrating these paths and this carried about half of the marks to be awarded.

Question 7: *Define the term 'Atria' and outline the systems that may be used for managing smoke control.*

A poorly answered and unpopular question. An "Atria" is a space within a building which passes through one or more structural floors. The control systems that manage smoke in Atria include Clearance, Smoke control, Exhaust and Air pressure differential systems. Some candidates described variations on these and were awarded marks accordingly.

A simple knowledge of Atria and smoke movement and control is a start to understanding the basic principles and concepts behind fire engineering by design in buildings.

Question 8: *Detail the advantages and disadvantages of Radio-based automatic fire detection systems.*

This question attracted good marks for those candidates who were able to use their knowledge of radio-based systems and transfer this to a fire detection system. In other words the main advantages and disadvantages are generic and can be adopted for Automatic Fire Detection systems. The main confusion was that some candidates interpreted the question as a radio based system “connected” to the local fire station.

The main advantages included

- Ease of installation
- Can be used in unusual buildings
- No wiring or protective cable is needed
- Extra zones are easily added, and the system is flexible

The disadvantages are

- High set-up costs
- Possible radio screening and interference
- A significant delay in fault signalling, and
- The frequency of testing and fire drills can reduce battery life.

Question 9 *Briefly describe how dry powders extinguish Class ‘BC’ fires and explain why mixing and cross contamination of different types of dry powder should be avoided when recharging dry powder extinguishers.*

Only a small percentage of candidates who attempted this question obtained a pass mark. A number of candidates for example, described class B and C type fires and mentioned the different types of dry powder extinguishers on the market. At this level of the examination it should be expected that students taking this paper would have a better understanding of the underlying principles upon which the dry powder extinguisher works. Some of the points that should have been covered include the facts that:

- ? The power interferes with the chemical chain reactions
- ? They are only surface treatment agents and do nothing to penetrate or cool the fire.
- ? A small percentage of the powder decomposes becoming catalytically active and destroying the free radicals
- ? Re-ignition is always a possibility

Some candidates also failed to realise that different powders may react together producing water and Carbon Dioxide. The former would cause “caking” of the powder whilst the latter would lead to a dangerous pressure rise.

Question 10: *The manager of a residential care home has asked for advice on the action to be taken by staff on discovery of a fire and/or hearing the fire alarm. Briefly outline the considerations & advice that should be offered.*

This was a popular question which offered candidates the potential to gain easy marks. However a failure to read the question resulted in

25% of the candidates losing marks by concentrating on detailed training programmes when the question referred to briefly outlining considerations and advice. This advice should be in the three areas of

Discovery of the Fire

Raise the alarm, Remove any residents at risk and ensure the brigade is called.

On hearing the alarm

Stop what you are doing, ensure the residents or other potential hazards are made safe, respond to the alarm control panel and send persons to the zone showing on the panel.

Once staff have reported the alarm can be silenced but not re-set

Role of the persons sent to check the zone

Check for signs of fire, remove any residents and ensure all areas have been inspected.

It is not normal practice to evacuate residents to outside the premises and in some cases, where there is no immediate risk, it may be best to leave a resident in the room.

Paper 2A - Fire Service Operations

Question 1: *Briefly describe the types of lighting that are available for use by the fire service on the incident ground and list their essential requirements.*

About half of the candidates found this to be a question where they could gain a pass mark. A description of torches, searchlights, floodlights, halogen lights and fluorescent lights would have gained sufficient marks for a pass. Some candidates spent too much time on areas like blue flashing lights and natural daylight. The essential requirements should include:

Robust design, weight, working temperatures, quality of light, Intrinsic safety, battery performance and maintenance aspects.

All of which would have attracted additional marks.

Question 2: *Discuss the problems associated with fire fighting on board a ‘container’ ship.*

This question allowed those who attempted it to gain good marks but candidates should remember that the important points that gain marks are those that are specific to the situation outlined. The more specific problems with container ships include:

- ? Access to the fire
- ? Problems in moving containers or if they are moved, it is time consuming and the ship stability may be affected
- ? Ventilation is difficult
- ? Guide rails may distort
- ? Containers may be fitted with refrigeration units
- ? Holds may be insulated
- ? Initial access to the ship may be difficult

Some candidates took the wrong track and mentioned fires in engine rooms; accommodation etc. which was not asked for and so failed to attract any marks.

Question 3: *Describe the factors that have to be considered when conducting fire-fighting operations at an incident involving a large number of vehicle tyres located on open ground.*

A lot of candidates mentioned general fire fighting techniques which could have been any incident. For example, direction of the wind, command, communications, access to the fire. As in the previous question, the examiner would like to see that the candidate understands the specific hazards of that type of fire and hence the factors to be considered such as:

- ? Rubber will become liquid at certain temperatures and will flow leading to possible contamination of equipment
- ? Drains could become blocked
- ? Flammable vapours, which could explode, may be given off
- ? Dense black toxic smoke will be given off
- ? Hard hitting, high velocity jets need to be used

All of these points, with an explanation, would have gained good marks.

Question 4: *Detail the points that should be taken into account when dealing with a fire involving radioactive materials.*

This was a relatively well answered question and seemed to be well understood by the majority of candidates who in this instance did concentrate upon the hazards specific to this type of incident. Candidates gained marks by detailing such points as:

- ? The minimum of personnel to be used
- ? Use of shielding
- ? Use of a contamination zone
- ? Control of water
- ? Decontamination procedures
- ? Use of spray to minimise disturbance
- ? Minimum disturbance of damaged containers
- ? Seek specialist advice

Question 5: *Detail the safety procedures to be adopted when dealing with the rescue of persons from underground sewer systems.*

This was a relatively straightforward type of question which was generally well answered and gave candidates the opportunity for some good easy marks.

The essential issue here is speed with little time to measure for gases or check the weather. One of the main concerns mentioned should have been the possible presence of "sewer gas" (a mixture of methane and hydrogen sulphide) which is both highly toxic and flammable. But other points that should have been covered include the concern for the collapse of old sewers, the use of a surface worker to advise, the flow of water which may move unconscious people, the use of appropriate harnesses and possible resuscitation.

Question 6 *Describe the possible advantages that "assisted pump controls" might offer if provided as an additional feature to the conventional manual control systems on a fire service pump.*

This question attracted very few attempts by candidates. Many who gave detailed descriptions of pump controls and instructions on how operators have to "set them up" did not achieve good marks. Yet the following points, which would have gained marks were not included in a number of scripts:

- ? The requirement for the operator to set the initial parameters for the pump
- ? The provision of a facility to warn the operator should the pump exceed the chosen parameters and possibly leading problems, and
- ? A failure to identify the enhancement of safety to firefighters.

The advantages are that it does enable the operator to set up the pump conditions and to carry out other tasks, whilst the assisted control monitors the pump parameters and quickly controls fluctuations in pressure thereby reducing damage to equipment.

Question 7: *Describe the essential features of a typical fire appliance for use at civil aerodromes and airports.*

Many candidates gained marks due to being aware of the need for:

- ? good performance (acceleration and braking)
- ? a cross country capability
- ? must comply with Civil Aviation Authority guidance material specifications, and
- ? the need for large capacity water and foam tanks

However a large number of candidates failed to mention the need:

- ? for a large fire fighting capability
- ? to be able to produce steam whilst on the move
- ? to have set attendance times with as little as two minutes to any part of the airport

The need to provide high discharge rates and throw (to 80 metres) was also missed by many.

Question 8: a) Briefly describe the forced ventilation techniques known as:

- i) Positive Pressure Ventilation
 - ii) Negative Pressure Ventilation and
- b) List the main advantages and the disadvantages of forced ventilation.

This was a popular question with candidates as one would expect with what is still a topical subject. Interestingly most candidates gained good marks under part (a) of the question, giving good descriptions of the techniques. Part (b) however was poor by comparison.

Positive pressure is achieved by forcing air into the building, which will increase the pressure, whilst negative pressure extracts the smoke and hot gases reducing the pressure inside. This is achieved by the use of a fan or water spray. The advantages are that the objectives are achieved more rapidly, it reduces the need for vertical ventilation, and it is less susceptible to erratic wind conditions and is more controllable. The disadvantages are that the mechanical device takes time to set up, it can increase the intensity of a fire and large compartments require a very large or several small fans.

Detailed descriptions of the methods and reasons for ventilating an area or building was not what the question asked for and did not gain many marks and neither did any reference to the use of pressurisation of staircases.

Question 9: Explain the three methods of applying water for the suppression of fire.

The quality of scripts for this straightforward question was disappointing. Detailed descriptions of sprinkler systems and even portable extinguishers were not required for the answer and so did not gain many marks.

The failure to mention:

- ? How water spray when converted to steam also smothers the fire, and
- ? the application of water at ceiling level in "pulse form" to mitigate the possibility of "backdraft"

also lost marks.

The question was looking for the candidates to explain the methods under the three headings:

- ? Direct Application; involving the use of a jet and is useful on growing fires
- ? Indirect application; in the form of a spray or fog to produce steam
- ? Three dimensional offensive water fog; used in a pulse or brief burst to counter the gaseous phase of combustion at ceiling level for reasons given above and to complement direct/indirect methods of attack.

Question 10: Describe the principles of good practice and techniques that should be observed by personnel when lifting and lowering heavy objects on the incident ground.

This question proved popular with candidates and a number of good scripts were produced. Most candidates, and those who gave examples gained additional marks, knew the basic principles associated with lifting heavy objects.

The question required a description of the techniques and good practice that should be applied, which meant that statements such as "the correct technique should be used" did not gain any marks. There were a number of points that were missed and these include:

- ? Not overexerting oneself and taking rests when appropriate
- ? Ensuring good grip
- ? Keeping the load close to the body
- ? Avoiding any twisting of the body, and
- ? Not blocking ones vision

The failure to pick up marks in the above areas probably reflects the difference between the candidates who had studied the appropriate bibliography and those who relied on practical experience.

Paper 2C - Aero Fire Studies

Question 1: Outline the types, their uses and possible toxic gases being given off from the materials commonly used in aircraft interiors.

This was not a popular question however candidates could have picked up easy marks by thinking logically. Easy marks could have been gained by mentioning for example, wool, silk, nylon, rubber, ABS (Acrylo-Nitril-Butadiene Styrene), PVC (Polyvinyl Chloride), Polyester, Polystyrene, Acrylics and many modern materials. These are used in glazing, carpets, mouldings, seats, panelling, trims, luggage lockers and wiring systems.

The toxic gases produced are much more complicated than just Carbon Monoxide and Carbon Dioxide and may include Hydrogen Cyanide, Ammonia, Sulphur Dioxide, Hydrogen Chloride, Nitrogen Dioxide and many more depending what material burns.

Those candidates who read the relevant material gained the appropriate pass mark.

Question 2 *Detail the subject matter required for:*

- a) *The basic training*
- b) *Aircraft familiarisation*

of all rescue and fire-fighting personnel

This was a very popular question and almost all candidates obtained a pass mark because they read and understood the question. Many could perhaps rely on personal experience and produce many of the points required which include:

Basic Training

Aircraft Rescue and Firefighting techniques, Causes of Fire, Extinguishing agents, Use and maintenance of equipment, Airfield topography, Aircraft familiarisation, and Search and rescue procedures

Aircraft Familiarisation

Emergency exit and normal door operation, seating configuration, Aircraft construction, break-in points, Aircraft engines and fire suppression systems.

Question 3: *Composite materials used in the construction of modern aircraft present a number of hazards to fire-fighters. List their locations and identify specific hazards.*

It seemed that the half of the candidates who failed to gain a pass mark for this question did so because they failed to read the question. Many of these mentioned the materials of aircraft construction such as aluminium alloys, magnesium etc which was not required. The composite materials are used in floor panels, engine covers (nacelles), ailerons, flaps and tail plane elevators etc. Their specific hazards relate to the release of toxic gases, they are difficult to cut, they produce needle sharp splinters and fibres which are virtually undetectable to the naked eye or X-rays and of course airborne particles.

Question 4 a) *What are the main causes of passenger cabin fires*
b) *What fire-fighting action should be employed to deal with such fires*

Candidates demonstrated a very high level of knowledge of the main causes of cabin fire and rightly listed such things as:

Electrical faults, prohibited materials within the baggage area, careless disposal of smoking materials, Arson, Hijacking or terrorism or from external fires breaking through the fuselage.

Many candidates lost easy marks in the second part of the question by producing answers which

were too vague and lacking in detail. Answers should have included the facts that:

A fast response from the airport fire service and cabin staff is essential with the immediate evacuation of the passengers being top priority, breathing apparatus to be worn and teams should keep as low as possible on entry, consider multiple entry points and keep a constant check on the aircraft structure.

Question 5 *Summarise the theoretical benefits of foaming a runway for an emergency landing and outline the factors the Officer in Charge would need to consider.*

This proved to be quite a popular question and candidates did demonstrate the theoretical benefits of foaming runways lead to reductions in aircraft damage, friction and spark production, fuel spill and deceleration forces.

Marks were lost in this question by failing to consider the actions of the officer in charge and to outline the factors such as time to foam the runway, equipment available, weather conditions, wind, rain, low visibility and the type of emergency.

Question 6: *List the responsible parties that should have access to emergency airport maps and provide the details to be included and description of its use.*

This was a well answered and popular question with candidates demonstrating a good knowledge of the responsible parties that should have access to the airport maps, like Police, The Local Authority Fire Service, each Airport Fire Service vehicle, Ambulances, Air Traffic Control, Local Hospitals and any other emergency service or information centre that may need to be involved.

There was a good understanding of what airport maps are and most candidates identified the information required such as crash gates/access roads, Runways, Taxiways, Airside roads, water supplies etc. But many lost marks by failing to mention the scale of the map, a compass "north" bearing, and that each square represents 1 kilometre.

Question 7: a) *Explain the three basic designs of airport terminal buildings and their layout*
b) *Describe the fire precautions measures that are used to protect terminal buildings*

This was not a popular question although some candidates demonstrated a very high degree of competence in this area. Some lost marks by not stating the 3 basic designs which were Centralised, De-Centralised and Unit formation.

The fire precaution measures are explained in terms of the Building Design (compartmentation, construction methods and materials), means of escape, water supplies, fire detection systems, automatic sprinklers, smoke extraction and of course trained staff.

Question 8: *Describe in detail the following personal protective equipment used by airport fire-fighters in respect of:*

- a) *Entry Suits*
- b) *Proximity Suits*

The majority of candidates who attempted this unpopular question failed to get the marks required for a pass. Many could identify the equipment for an entry suit in terms of helmet, gloves, coat and trousers and boots, and that it should have an outer coating of aluminised material. Breathing apparatus is usually used with the suit. But many failed to mention this was primarily used by rescue teams of military aircraft. A proximity suit consists of similar equipment to protect from radiated heat and direct flame contact. So it must be waterproof, non-combustible, electrically resistant and have impact resistance to sharp objects. But many candidates failed to mention that it must be tear resistant, thermally insulated, may be lined, must be lightweight and comfortable to wear.

Question 9: *Describe in detail the use, provision and detailed contents of Rendezvous points (RVP) and list the factors that would need to be constantly monitored by crews detailed for watching /observation duties.*

This was a popular but poorly answered question. Many marks were lost because candidates failed to read the question and only answered one part of it.

A Rendezvous point is a pre-determined reference point where responding emergency services can meet and await further instructions. They are positioned strategically around the airfield to help reduce the response times and as such form a part of the emergency plan. But they must not interfere with normal airport operations or navigational equipment. They need to be equipped with maps, radios, telephones, high visibility jackets and an escort for guiding emergency services.

There needs to be constant observation of the apron and runways from an elevated position. Binoculars are used for improved vision and there must be a means of alerting the crews. The attendants need to be aware of weather conditions, refuelling, airfield maintenance, obstructions and changes of runway.

Question 10: *Describe in detail the requirement, types and locations of airport water supplies*

This should have been a straightforward question for candidates and although it was popular it was poorly answered.

The requirement is for a primary (usually a ring main) and secondary (can be natural rivers, lakes, ponds, seas etc) water supplies whilst an additional supply should be readily available. (Local Authority Fire Service, Airport hydrant system, mobile water carriers). The water hydrants must be placed in high risk areas such as runways and terminal buildings, there must be high level storage tanks, clear access for easy location and all supplies must be distinctly marked. The locations must be indicated on the airport grid maps or any other relevant document.

Paper 3 - Fire Engineering Science

Question 1: *The relationship between velocity and discharge through a hose is given by the equation:*

$$L = \frac{vd^2}{20}$$

Construct a graph to illustrate this for values of v between 0 and 10 m/s. From your graph read the value of:

The velocity when the discharge is 1200 litres/min

The discharge when the velocity is 15m/s

This was a two-part question requiring the candidate to firstly use any selected values of velocity between 0 and 10 metres per second to calculate the discharge (L). For example a velocity of 4 metres/second using the formula stated would give a discharge of 980 litres/minute. This calculation needed to be carried out for at least five different values of the velocity.

The second part of the question then required candidates to plot the values of the discharge on a graph against the relevant velocity. If constructed properly this would lead to a straight line graph. Using this graph the final part of the question can be accomplished by reading the values directly from the line drawn.

The results were generally poor with few candidates successfully plotting the correct calculations on the graph.

Question 2: *In a collapsed building scenario a beam has fallen in such a way that it is supporting others which are imposing loads upon it in the following way.*

A load of 90 kg at 1.5 m from one end

A load of 150 kg at 3 m from the same end

And a further load of 120 kg at 6 m also from the same end.

If the beam has a mass of 15 kg /metre and is 7 m long what **force** will be required to lift the beam using a jack at the far end of the beam?

This was a straightforward question for those candidates who were familiar with the Principle of Moments. It is clear from some of the answers that many were not.

The basic idea is that the turning moment is the product of the force and the perpendicular distance to the fulcrum or pivot point. For example for the 90 kilogram mass this would be 90×1.5 (135 kgm). This calculation needs to be carried out for each mass in turn. When added together they give the total moment on the beam. Dividing this by the length of the beam gives the force required to lift it. (238.9 kilogram or 2343.9 Newtons). As is usually the case, many marks were lost by candidates failing to show the steps involved in their calculations. This is essential to show that the candidate understands the problem.

Question 3: A rectangular tank measuring 4 x 3 x 2 metres, full of water is fed by a cylinder 7 metre high and 4m diameter. It is required to feed a 45 mm branch at a pressure of 7 bar. How long will the water last?

This was a popular question that was well answered with most candidates obtaining a pass mark.

The solution required candidates to calculate the capacity of both tanks (24000 litres and 87976 litres) add them together (111976 litres) and divide by the calculated rate of flow through the hose (3571.8 litres/min) to obtain the time taken to empty both tanks, a time of approximately 31 minutes.

Question 4 Define the meaning of the terms used in Radioactivity:

Half life, Radioactive decay, Radioactive particles, Radioisotope, Isotope

This question involving very simple definitions, should be an opportunity for candidates to gather at least a pass mark. To many it should be the opportunity to gain very good marks. However although it was a popular question it was not answered as well as it should have been, the main reasons being:

- ? Many do not make the differences between definitions clear. In this instance many were not clear on the difference between and isotope and a radioisotope and described both as radioactive with one being man-made. The main difference is that not all isotopes are radioactive.

- ? The best way to show a full understanding when quoting a definition is to quote an example. Many did not do.

The result was the loss of very simple marks.

Question 5: An aluminium tube contains a silica centre, which is 20 mm diameter. The silica expands and contracts with the temperature changes to control the flow of liquid in the tube. At 0°C there is an exact fit and no liquid flows. Calculate the area of the gap between Aluminium and Silica at 100°C.

Coefficient of Linear expansion of Aluminium = 0.000 026/ K

Coefficient of Linear expansion of Silica = 0.000 008/ K

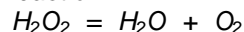
A large proportion of the candidates attempted this question but unfortunately many failed to obtain a pass mark.

The question required the candidate to calculate the area expansion of both the aluminium and the silica. Since both have the same area at 0°C (314.2 square millimetres), it follows that the area expansion at 100°C is 1.63 mm² for the aluminium and 0.50 mm² for the silica. The main mistake in this calculation is to forget that the linear coefficient must be multiplied by 2 for an area calculation. The difference between the two represents the area of the gap at 100°C (1.13 mm²). Far too many candidates failed to show their full method of working out the problem (including the formula used) and as a result marks were lost.

Candidates need to note that where they make a calculation error marks are awarded for those elements that are correct. Obviously this is not possible if the information is not provided.

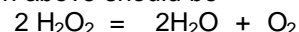
Question 6: Describe what is meant by a "balanced chemical reaction".

Hydrogen peroxide produces oxygen according to the chemical reaction



If the oxygen produced from 6m³ of hydrogen Peroxide are introduced into a room measuring 4 x 2 x 2 metre what will be the % concentration of oxygen?

Many candidates explained the first part of the question well and correctly stated that it was when both sides of the equation contained the same numbers of atoms of each element. (The number of molecules are usually, in a combustion reaction, different). For example when balanced the equation above should be



This shows that for every 2 cubic metres of H₂O₂ used only 1 cubic metre of oxygen is produced. If 6 cubic metres of H₂O₂ are used then 3 cubic metres of oxygen are produced. Few answers calculated that oxygen.

However if the room has a volume of 16m^3 it will already contain approximately 20% as oxygen. Thus the total amount of oxygen is now 6.2 cubic metres or 38.75% concentration.

Many answers failed to add the oxygen already in the room to calculate the total percentage.

Question 7: *Outline the principles of the fire “tetrahedron” and the inhibition of combustion chains involving a free radical mechanism.*

This was not a popular choice for candidates but was generally well answered. Most were aware of the tetrahedron and how fire can be extinguished by the removal of heat, fuel and oxygen or air. The “fourth” arm is the chemical chain reaction involving the free radicals and it was good to see that many candidates were able to explain how the chain reaction affects fire and how, by removal of the free radicals, a fire can be extinguished.

Question 8: *In a transformer fire the mass of the metal is 65 kg and the cooling oil it contains is 45 kg. 25 kg of lubricating fluid is burning and supplying heat at the rate of 1100 KJ /kg. Assuming all of the fluid burns calculate the maximum temperature rise the transformer casing will achieve.*

$$\text{Sp Ht of cooling oil} = 1680 \text{ J/kg}^\circ\text{C}$$

$$\text{Sp Ht of metal} = 460 \text{ J/kg}^\circ\text{C}$$

Although this question was not popular with candidates a high proportion of those who attempted it gained high marks and a very significant proportion gained full marks.

The answer required a calculation to find the heat being supplied by the burning fluid (27500 kilojoules). This heat is being absorbed by the transformer metal and oil. These obviously do not change state so the calculation for each involves the formula:

$$\text{Heat absorbed} = mc? (\text{metal}) + mc? (\text{oil})$$

This gives a value of 105.5? KJ which is equal to the heat produced by the burning fluid and will give a temperature rise in the transformer of 260.6?C.

Question 9: *State the laws of pressure
If a pump is supplying water at a rate of 1100 litres/min and 7 bar pressure is required at the end of 200 metre of 90 mm hose, what pressure is needed at the pump?*

$$\text{Friction factor} = 0.007$$

Although this question, in two parts, was popular, few candidates completed the first part satisfactorily. It required a brief description of the basic rules but many candidates either failed to answer this correctly or quoted the laws of friction loss. An understanding of the basic rules and elements is essential as a foundation the knowledge required at the higher levels of these examinations and others.

It was good to see that many candidates were able to carry out the simple calculation in the second part of the question and determine that the pressure at the pump is simply the branch pressure (7 bar) plus the calculated friction loss (2.58 bar), a total of 9.58 bar.

Question 10: *State the combined gas Law.
If a cylinder full of air (volume 2 litre at 0°C) and a pressure of 200 bar is being used at atmospheric pressure and a temperature of 120°C, at a rate of 4 litre /min, how long will the air last?
State two factors which will affect the calculations.*

This question proved to be popular with candidates who presented a high proportion of good answers. The majority were able to quote the combined gas law but it should be remembered that it is necessary to explain what the symbols mean to obtain full marks. From that many were able to calculate that the volume of the air at the higher temperature had a volume of 575.8 litres and would therefore last a total of approximately 143 minutes.

The final marks were awarded to those candidates who were able to identify two factors such as the temperature of the atmosphere, the expansion of the cylinder leading to a lowering of pressure or a change in the rate of use as the factors which will affect the calculations.

Paper 4 - Human Resource Management

Question 1: *List the benefits and disadvantages of implementing word-processing systems in an organisation’s offices.*

This was generally very well answered. Most candidates answered the benefits side of the question better than the disadvantages and consequently picked up most of their marks from this section. Such benefits include improved productivity, improved quality and consistency of output, increased job satisfaction, ease of editing, ease of document recall and staff savings (usually among copy typists).

The disadvantages are that they inevitably require changes, staff need training, it can lead to redundancies, it may reduce the scope for certain jobs and it may lead to eye-strain.

It was noticeable that some candidates had clearly studied the subject whilst others were obviously calling on their own experience and weren’t thinking widely enough.

Question 2: *Describe a procedure for reporting, recording and monitoring of accidents to personnel in a large organisation.*

This question was reasonably well answered with some candidates who had studied the subject gaining some very good marks. However a large number were obviously relying on their own work experience and this is often not enough to pass a Graduate examination.

The question was asking candidates to explain the key points of the process for reporting accidents as well as the subsequent investigation. For the former there should be an accident report book, with copies, to ensure uniformity of reporting and gathering of information. Guidance notes to help complete the report and central recording of all accident reports. For the latter, the accident investigation, mention should be made of contributory negligence, remedial action and comments by the supervisor/investigating officer.

A few candidates did not read the question and detailed procedures for dealing with accidents. This was not required.

Question 3: a) *Explain the major steps in a decision making process; and*
b) *Briefly describe key considerations in each step.*

This question was well answered by most candidates and it was clear that the subject had been studied and there was a clear understanding of the issues involved. Most answers were well thought out and laid out in a logical manner however some candidates did not read the question and merely repeated their answer in both parts of the question.

The first part of the question asked candidates to list the major steps which are:

Define the problem, Collect the relevant data, Develop alternative solutions, Assess the consequences, Select the optimum solution and Measure the results.

The second part of the question required the candidates to develop each heading and to explain how each step is to be accomplished. For example, Defining the problem is carried out by asking the right questions of the right people and isolating the crucial issues from the subsidiary ones so as to not confuse the issue.

Question 4: *Discuss the statement:*
“A manager can be flexible in his choice of leadership style in order to be effective.”

This question required a discussion and to answer it well the candidate must have read about Management theory and studied the subject well. Otherwise their answer would have been based on personal experience which is rarely enough to pass.

Marks were gained for a candidate's knowledge of different styles of leadership but the points to be considered are:

- ? There is no “one best way” of arriving at an optimum style and the most practical approach is to aim for the “best fit” between the leader and the situation.
- ? The situation usually comprises the following variables:
 - Requirements of the task
 - Needs of the team
 - Needs of the individuals
 - Relations between the leader and the team
 - Authority granted to the leader
- and the power of the leader
- ? Meeting these demands requires the leader to select an appropriate style from a range of styles.

Most answers were poorly laid out and some candidates need to learn how to logically construct answers to avoid wasting time and effort during the examinations.

Question 5: (i) *Identify the essential features of:*
a) *an ideal disciplinary procedure*
b) *an ideal grievance procedure.*
(ii) *Evaluate the role of each in an industrial conflict*

The majority of marks were awarded for the first part of the question so this should have been a good opportunity for many candidates to gain good marks. However the majority of candidates appear to have relied on their own personal experience and on local discipline and grievance procedures.

The answer is probably best presented as a series of bullet points. So for example:

An ideal disciplinary procedure
Should be written down and made known
Specify to whom it applies
Capable of dealing swiftly with matters
Indicate what is meant by misconduct
Specify who has the authority
Ensure every case is fully investigated
Ensure employees are informed of the reasons

An ideal grievance procedure.
Should recognise the right of every employee
Aim to provide a speedy settlement
Provide time limits, etc

The second part of the question required some thought before answering but the aim of each is to minimise conflict by being fair and just to the employee.

Question 6: *Summarise the process of developing budgets in conjunction with the plan of an organisation.*

This was not a well answered question as too many candidates wasted time and effort describing in detail the intricacies of various budgeting methods and tools. This was not asked for. Where candidates did concentrate on “developing” budgets reasonable marks were obtained.

The answer should have related to the fact that the budget should be prepared against the backdrop of the wider organisational plan. That they are a means to an end which is the achievement of the organisation’s business or service objectives. This should require:

Budget Planning	Overall business plan Quantitative forecast Financial budgets Budgets agreed
Budget Control	Actual results recorded Compared to budget targets Corrective action taken

Where candidates are asked to summarise they should concentrate on the key points. Long well argued essays are not appropriate and attract few marks.

Question 7: *Identify the various methods, which can be used when collecting information for a training needs analysis.*

This was answered by a reasonable number of candidates but with varying results. Too many wasted time and effort by describing and defining Training Needs Analysis whilst others sought to gain marks by giving unasked for information about the systems approach to training. The emphasis was about collecting the information which can be classified under the headings:

- ? Analysing recorded data, Analysing questionnaires, Interviewing managers,
- ? Observing job performance, Monitoring the results of group discussions, and
- ? Analysing self-recording diaries etc.

This allows the managers to draw a comprehensive picture of the areas of current and future requirements.

Question 8: *Detail the points of good practice to be considered when delegating tasks or powers to subordinates.*

The answer to this should have contained the following points:

- Clear objectives and outcomes are set
- Standards of performance are established
- Appropriate authority is granted
- Resources are allocated
- Reporting/Monitoring arrangements are made
- Support/guidance is given

The task is completed according to agreed standards

Most candidates achieved a reasonable mark from this popular question and there were a few excellent scripts which achieved maximum marks. As is all too often the case however many candidates failed to read the question correctly. Scripts giving lengthy descriptions of the advantages and disadvantages of delegation, or the attributes that should be looked for when selecting someone to delegate to, attracted few marks.

Question 9: *Briefly discuss the most important barriers to communication within an organisation.*

This was a popular question which on the whole was quite well answered. The question asked candidates to “briefly discuss” so the answers expected should have included a paragraph of explanation with the following headings:

- Individual bias and selectivity
- Status differences
- Fear and other emotional overtones
- Lack of trust
- Verbal difficulties
- Information overload
- Inadequate machinery for communication

Those who provided just one word lists without any further explanation lost marks.

Question 10: *Describe the Seven Point Plan, which is used as a framework for the preparation of a person specification in a selection process and comment on its usefulness.*

This was the least popular question on the paper with very few attempts. However for those who had read and understood the required material some very high marks were achieved. Most candidates were able to describe the plan and to outline the personal attributes namely:

- Physical make-up
- Attainments
- General intelligence
- Specialised aptitudes
- Interests
- Disposition (Character or personality), and
- Domestic and personal circumstances

but it was only those who went on to “comment on its usefulness” who achieved the very high marks. In this case it ensures that at least the right sort of questions are being asked about that person’s suitability. It is not intended to be a tightly drawn measuring device but it can provide a useful frame of reference for those seeking to describe a candidate.

2006 IFE EXAMINATION DETAILS

The Rules, Regulations and syllabuses, together with examination application forms can be downloaded from the IFE website at www.ife.org.uk.

TIMETABLE

Membership Examination Thursday, 9 March 2006

am Paper 1 (Fire Engineering Science)
pm Paper 4 (Building Construction)*
Paper 6 (Fire Service Operations)
Paper 7 (Aero Fire Studies)
Paper 8 (Fire Investigation)
Paper 9 (Marine Fire Studies)*
Paper 10(Petrochemical Fire Studies)*
Paper 11(Civil Emergency and Disaster Management)*

Friday, 10 March 2006

am Paper 5 (Human Resource Management)
pm Paper 2 (Fire Safety)

*These papers whilst still included in the options list, will only be offered in 2006 subject to there being sufficient demand. Candidates considering entering any of these four papers are therefore, advised to nominate an alternative paper from the other three optional papers. An advice will be sent should any of these papers be withdrawn as soon as possible after the closing date.

Note: Papers 1, 2 and 5 are compulsory papers in this examination. Candidates require one optional paper. It is not necessary to sit four papers in the same year. Individual papers may be attempted. All papers being taken should be entered on the application form, ensuring that the subject paper and paper number agree and are clearly indicated. Candidates are expected to answer six questions from eight on all papers which are each of three hours duration.

Graduate Examination Thursday, 9 March 2006

am Paper 1 (Fire Safety)
pm Paper 2a (Operations)
Paper 2c (Aero Fire Studies)

Candidates who pass paper 2c together with papers 1, 3 and 4 will **NOT** be entitled to claim under the reciprocal arrangement.

Friday, 10 March 2006

am Paper 3 (Fire Engineering Science)
pm Paper 4 (Human Resource Management)

Candidates are expected to answer six questions from ten on all papers which are each of three hours duration.

It is not necessary to sit all four papers in the same year. Individual papers may be attempted but passes in all four sections are required to apply for Graduateship membership.

Those UK candidates wishing to claim reciprocity with the Statutory Station Officers' exams should ensure that the Sub Officers Exams have been passed prior to completing the Graduateship Examinations and must sit paper 1a – Operations.

Intermediate and Preliminary Examinations Thursday, 9 March 2006

am Preliminary
Intermediate Paper 1
pm Intermediate Paper 2

EXAMINATION FEES 2006

The examination fees for 2005 are as follows:
Preliminary/Intermediate£32 per paper
Graduateship/Membership.....£32 per paper*

(* where all four papers are taken in the same year the fee will be reduced to £105)

The closing date for the receipt of applications from candidates outside the UK is 31 October 2005 and 30 November 2005 for the UK and Republic of Ireland candidates.

It is incumbent upon all Branch Secretaries and individuals to ensure that applications, together with payment of the correct fees, are sent well in advance of the closing dates mentioned above. This is particularly important for candidates living outside of the United Kingdom in countries where exchange control operates and official approval is required for the remittance of funds.

Candidates are reminded that they must be current members of the Institution, that is to say, they must have renewed their membership for the membership year 2005 when applying, also the subscriptions due 1 January 2006 must have been received prior to sitting the examinations.

Applications received without payment will NOT be accepted. Applications received after the closing dates mentioned above will NOT be accepted.

*Application forms must be fully completed and legible to avoid errors and delay. Preferred examination centres should be stated although the Institution **cannot guarantee** that requests for preferred centres will be met.*

Acknowledgement of applications to sit examinations will be issued following the final closing date for examinations bookings. Candidates requiring confirmation prior to that should request a receipt for payment