

Educational Supplement

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This supplement to the September 2000 issue contains the report on the 2000 Membership and Graduateship examinations by the Chairman of the Examinations Committee, John M. Cowie FIFireE who has been assisted in this task by Mark Fisher, who compiled the individual examiners' reports

This supplement contains the questions set in the 2000 Graduate-ship and Member examination papers. The comments made by the markers of individual questions have again been published.

In order to further assist future examination candidates, markers this year were asked to include guidance about the way the answers should have been attempted as well as relevant points to illustrate comments made. I hope this slight change from previous years' format will further benefit those studying for examinations in 2001, and give some indication to tutors where the majority of students' strengths and weaknesses occur.

Each year, the Examinations Sub-Committee considers the value or otherwise of continuing to produce marker comments in addition to a copy of each question set in each of the 14 papers (106 questions in total). Each year there are one or two individual requests for further changes to the format of the supplement.

Some years ago, the then Chairman of the Education Committee, controversially suggested the supplement appeared to serve no useful purpose, other than releasing a copy of the question papers for public knowledge and sought comments to support the abolishing of markers comments. At the time, many members responded requesting retention of, in their words "useful observations from experienced examination markers".

As we are now five years on and reviewing all examinations, syllabi and Institution qualifications, I feel it is appropriate to again seek views, comments and observations about the value of this supplement. A final decision will be made at the end of this year by the Committee to further review or cease production of the comment section from this supplement.

Those wishing to respond are asked to consider the following aspects of the examination process:

- Markers comments.
- Supplement layout.
- Examination issues generally.
- The date of examinations (2nd Thursday & Friday in March annually)
- Study material (books, journals etc.).
- IFE Journal information for students/examination candidates.

Responses should be marked 'Examination Supplement Comments' and arrive at IFE Headquarters, 148 Upper New Walk, Leicester LE1 7QB, England, not later than Friday 15th December 2000.

John M Cowie FIFireE
Chairman Education Committee

REPORT ON IFE EXAMINATIONS 2000 Membership Examinations

Paper 1 - Fire Engineering Science

Question 1.1: 3600 litres of water flows in a horizontal 90 millimetre pipe in 4 minutes. The pressure on entry is 7 bar. a) at what pressure will the water emerge through a 25 millimetre nozzle? and b) Explain why the actual pressure would be lower than that calculated.

$$\begin{aligned} (\text{Density of water} &= 1000 \text{ kg/m}^3) \\ (g &= 9.8 \text{ m/s}^2) \end{aligned}$$

This type of question, which requires the use of Bernoulli's Theorem to attain an accurate answer, appears to be becoming a more acceptable choice for candidates. This year, 21 candidates attained either 19 or 20 marks, whilst others who failed to grasp Bernoulli's concept floundered at the first hurdle. A minority of candidates struggled through the calculation using either the wrong formulae, or a mixture of several incorrect formulae and a failure to produce a structured answer. With regard to Bernoulli's Theorem, the message is simple: if you don't understand the principle, leave well alone and move on.

Question 1.2: a) Define the essential differences between a Premixed flame and Diffusion flame, referring in your answer to Limits of Flammability; and b) Describe this in relation to the terms 'Flashpoint' and 'Firepoint'.

A very popular question with the majority of candidates achieving a pass. There were some excellent scripts received, demonstrating an in depth knowledge of the subject matter. Good descriptions of premixed and diffusion flames, along with definitions of flashpoint, gave candidates a pass.

Question 1.3: Explain the physical and chemical mechanisms of terminating the process of combustion.

Having read the question it should have been apparent to candidates that what was required here was the need to explain both the physical and chemical mechanisms that terminate the process of combustion.

With regard to the physical methods of ending combustion - ie triangle of fire, cooling, smothering and starvation, excellent answers were received, and the maximum marks for this part of the question were often attained. However, explaining the chemical mechanisms which terminate the process of combustion was where the majority of candidates lost marks. Some failed to attempt this part of the question altogether, whilst others who did attempt an answer were clearly confused with this process and had difficulty reproducing a chain reaction diagram.

Question 1.4: Explain the operating principles of thermocouples and thermistors and discuss their use and effectiveness as detection devices.

It was disappointing that, at membership level, what should have been an easy question requiring explanations of the operating principles of thermocouples and thermistors together with their use and effectiveness as detection systems, attracted such a very poor standard of answer. Very few candidates achieved a pass for this question and the most common mistake made was to confuse a thermocouple with a bi-metallic strip; and coupled with the absence of any answer regarding a thermistor, it can only be assumed that the majority of this year's candidates had no idea what a thermistor is.

Question 1.5: a) Define the terms 'earthing' and 'bonding' as used in electrical situations; and b) Describe in detail the essential features of an earth fault loop and the methods by which it may be a source of ignition.

The question required two definitions and simple answers. If candidates included the following list regarding earth fault loops they would have been awarded six points:

1. The earth conductor from the point of fault;
2. The consumer's earth terminal;
3. A metallic return path (eg cable sheath) where available or through the ground as an alternative return path;
4. The path through the earth neutral point of the transformer winding line conductor back to the point of fault;

This question however did not attract high marks at all, and candidates missed the opportunity to include diagrams in their answers which could have attracted higher marks and saved them a great deal of writing.

Question 1.6: Explain the nature, properties, industrial processes and hazards associated with the use of plastics.

This question was split into four areas associated with the use of plastics – nature, properties, industrial processes and hazards. Each area attracted similar marks.

The question was relatively well answered, and many scripts demonstrated a good depth of knowledge regarding the chemistry of plastics. Although most candidates were familiar with the hazards and properties of plastics, some demonstrated a lack of knowledge regarding the nature and processes associated with the subject.

Question 1.7: a) Discuss the main ingredients which are used in the manufacture of paints and varnishes; and b) Discuss the hazards associated with their use.

This question posed a problem in producing a structured answer. If candidates were to have logically followed the requirement of the question and not deviated (ie included exhaustive scripts detailing firefighting methods which gained them no marks), they could have allowed themselves to concentrate on relevant detail. Very few scripts mentioned resins or mediums, or that varnishes were similar to paints but excluded pigment.

As already mentioned, this was a difficult question and the scores were low - the highest mark being 13. The following passage could have in itself gained the candidate 5 marks:

"Resins or mediums : these are usually carbon based materials or oils which are flammable, burn well, produce intense heat - thick black smoke and toxic products - eg polyvinyl chloride produces hydrogen chloride"

Question 1.8: It has been stated that "The fire resistance of an element of construction is a measure of its ability to withstand the effects of fire in one or more ways". Describe the tests which may be used to confirm this.

At member level it was expected that this could have been an opportunity to score high marks. However, this was not the case. Numerous candidates' depth of knowledge regarding fire tests, and their subsequent results in respect of the elements of construction, proved inadequate, and omission of the test curve diagram lost them further marks.

Additional study of the elements of construction is required if candidates are to better prepare themselves for future examinations.

Question 1.9: Discuss the toxicity, the precautions to be taken during handling and storage, and the reaction with firefighting media of the following chemicals; (i) Cadmium; (ii) Hydrogen Cyanide; (iii) Arsenic

The majority of candidates demonstrated, by their answers - which tended to be structured and follow a logical sequence - that they had read and understood the question.

The depth of knowledge however on occasion failed to meet the demands of the question, and candidates commonly offered answers which only included one or two of the stated chemicals and, again, failed to give sufficient detail to justify awarding high marks.

The model answer for Cadmium chemical formulae Cd, is as follows:

Toxicity: A silvery white metal. The metal fumes and dust are very poisonous (similar to arsenic and mercury) although the effects may not be felt for some time.

Handling and Storage: Care in handling: in the form of a dust it will ignite when exposed to flame.

Firefighting: BA sets need to be worn and dry sand used (not water or any form of liquid or gas extinguisher).

Question 1.10: A fire compartment has been built according to the following data and is to be fitted with a sprinkler system. Calculate the number of sprinkler heads required.

Mass of material (timber equivalent) = 2675 kg

Calorific value of timber = 17.6 MJ/kg

Specific heat capacity of water = 4.2 kJ/kg·K

Latent heat of evaporation of water = 2260 kJ/kg

Initial temperature of water = 20°C

Final temperature of water = 70°C

Assume 10% of water is evaporated during the application

Time for application of water = 4 minutes

Flow rate per sprinkler head = 500 litre/minute

This question proved to be an unpopular one with the exception of 15 candidates who each scored 18 or more marks. The majority of candidates scores were very low and failed to achieve a pass. From the information provided in the question, the candidate should calculate:

1. Total heat produced by a fire in the compartment

2. Using the variable *m* to equal the mass of water required, the total heat the water will remove is equal to

Heat to raise the temperature from 20°C to 70°C + Heat to raise the temperature from 20°C to 100°C + Heat required to vapourise 10% of the water

3. Total heat produced = heat water will remove

4. This leads to the mass (and hence volume) of the water required

Number of heads required = $\frac{\text{Total quantity of water required}}{\text{Flow rate of sprinkler head}}$

Paper 2 - Fire Safety

Question 2.1: Compare the legislative systems of regulatory enforcement with that of relying upon self-compliance, listing the advantages and disadvantages of each.

This question clearly lent itself to list answers. Although most candidates demonstrated a knowledge of the subject, it was often the case that candidates failed to be clear enough in their descriptions of what was an advantage or disadvantage. The question also asked for a comparison between the systems of regulatory enforcement, and that which relies on self compliance. The majority of candidates failed to offer a good comparison and therefore missed the opportunity to score higher marks.

Question 2.2: Outline the fire precautionary measures that would be necessary for a large capacity sports stadium. State in particular the requirements to ensure the safety of those occupying extensive seating areas.

The first part of the question was generally well answered. However, the second was not - and few candidates attempted this part. The model answer for the second part attracted 10 marks and for future reference is:

The basic design principles for seating are:

1. Sufficient exits in suitable locations;
2. Exits are required to be of an adequate height and width;
3. Limited travel distances;
4. Entry control for spectators;
5. Exits to be clearly identified.

Question 2.3: Discuss the fire precautionary measures that are necessary to maintain an acceptable degree of fire safety in an

enclosed shopping mall in which a large shop unit is undergoing complete refurbishment, whilst still open to the public.

30 candidates attempted this question. Unfortunately the highest mark was 10. Candidates did not approach the question logically by differentiating between the two scenarios of either leaving the sprinklers on or turning them off. The latter of course would require:

1. Separation of unit from shopping mall;
2. 1 hour fire resistance;
3. Monitor the effect of surface spread of flame, especially with regard to the materials adjacent to the mall;
4. Floor to soffit separation;
5. Limit combustible materials;
6. Do not reduce the mall width.

If candidates included this list in their model answer they would have attracted the 10 marks on offer.

Question 2.4: *People react in a variety of ways to fire. Discuss the following in relation to fires in domestic property: (i) the range of reactions that may occur; (ii) the factors that influence these reactions; and (iii) the possible consequence of the various reactions*

Some very good scripts were received, and marks were awarded to candidates who clearly divided their answers into the three categories requested in the question.

Many candidates were either confused regarding the requirements of the question and therefore mixed and matched their answer; some candidates just drafted a list of responses to the three sections and didn't discuss each issue as requested in the question.

Candidates are therefore reminded to read and, more importantly, to understand the question and its requirements. Of further importance is the need to carry out the necessary pre-examination study in order that candidates can produce confident, structured answers.

Question 2.5: *Describe in detail an appropriate maintenance schedule for the fire alarm and emergency lighting systems of a large hospital.*

A simple explanation of the daily, weekly, monthly, quarterly, six monthly and annual testing regimes would have resulted in a satisfactory answer to the question. Candidates who attempted this unpopular question and responded with a logical approach achieved good marks. However, some failed to demonstrate an in-depth knowledge of the subject matter.

Question 2.6: *Discuss the firefighting facilities provided for the use of firefighters, which are necessary in a commercial building with a height of excess of 20 metres.*

35 candidates chose to answer this question, and unfortunately 17 of those failed to score higher than 6 marks. Relying on practical experience and personal knowledge was not enough to fulfil the requirements of the question.

Answers should have included the following points:

1. Provision of operable vents;
2. Lift to be provided with additional provision for firefighting use;
3. Smoke control provision either natural or pressurised;
4. Number of shafts - ie 1 shaft for 900 m²;
4. Plans for Fire Service use.

This list is not exhaustive, but is intended to offer the candidate a flavour of what was required.

Question 2.7: *Discuss the structural fire precautions that would be necessary to secure the safety of the occupants of residential quarters situated on the upper floors of a large city centre complex, which includes, on its lower floors, shopping and commercial premises.*

Candidates failed to read and understand the requirements of this question and many attempted to answer offering only general fire precautionary arrangements.

The question was clear on the direction that answers should have followed and additional marks were awarded to those who included items such as the separation of the residential property from the

commercial use, separate and dedicated means of escape and protection of services. Within these arrangements other marks were available for further detail provided.

Question 2.8: *Discuss the fire safety recommendations you would make for the construction of a library and records centre. The building would be in two parts; one offering public access, and the other offering extensive racked storage for valuable archive material.*

What an opportunity! The question was clear and made reference to a building consisting of both a library and record centre. Candidates should have immediately offered separation of the two different uses. What construction materials were used, surface spread etc.

Now consider the records store. The occupier requires to maintain these records, so let's include a suitable fixed extinguishing system. Sprinklers only = 1 mark; but the inclusion of a carbon dioxide system would have attracted another mark. With the inclusion of a fire alarm system (to include automatic fire detection, portable firefighting equipment, provision of salvage plans, means of escape and we have now not only achieve a pass mark but we would have equally scored the highest mark achievable.

Paper 3 - Fire Protection Technology

Question 3.1: *Transmission delay in fire alarm systems may, in certain circumstances, be used to reduce the instances of false alarms of fire. a) Outline the normal sequence of events following operation of a fire alarm where a transmission delay unit has been fitted; and b) Describe any restrictions that should be applied to these systems.*

The first part of this question was rarely attempted by candidates which demonstrates an inadequate level of knowledge towards this subject, the recommended answer for this part of the question included

1. Activation of the fire alarm system by a manual call point would sound the alarm, and transmit the alarm to the remote manned centre without any delay.
2. Unless a prior arrangement exists, the call to the fire brigade on remote manned centre may be delayed for up to two minutes if an automatic detector indicates the alarm.
3. Subject to agreement by interested parties, a further delay not exceeding five minutes may be initiated by a manual operation at the control equipment, indicating that an investigation is in progress.
4. If during a delay period a fire is discovered, either operation of the control panel or call point will cause the transmission of the alarm and sound the fire alarm.
5. If the alarm is proved to be false, then the internal alarm can be silenced, a message made of any indication of the origin of the alarm, and the system reset. Resetting the system should inhibit the transmission of the alarm unless the system again goes into the alarm state.

Question 3.2: *A developer is planning a large shopping centre with numerous malls and has asked for guidance on the value of sprinkler protection. Draft your comments to include specific reference to the likely interaction between sprinklers and other proposed fire protection measures.*

Only one candidate failed to attempt this question. However, it was disappointing that, for those who did attempt it, higher marks could have been achieved if they mentioned the interaction between sprinklers and the fire precautionary measures which was already asked for in the question. A greater understanding of the subject would have allowed candidates more confidence to structure an answer based on their own opinions, quoting relevant reference material and not restricting their answer to the standard paragraph approach adopted possibly by their own fire authority.

Question 3.3: *Radiation detectors are suitable for certain kinds of risks. Discuss.*

The recommended answer for this question was divided into two areas. Firstly the question asked candidates if they were aware of both infra-red and ultra violet type radiation detectors and asked for further discussion on where best to locate each type of detector relevant to the environment that it was going to protect.

Secondly, with regards to the potential for false alarms, candidates should have discussed the vulnerability of each type of detector and the design features that can be utilised to prevent them. This was quite a popular question, and excellent scripts were required. These included detailed explanations of both types of detector, their inherent qualities and limitations; the inclusion of accurate diagrams also allowed some candidates to demonstrate these principles.

One area where some candidates did lose valuable marks was by not discussing why false alarms may be generated. Candidates are reminded that bibliography for this question is contained in the Manual of Firemanship book 9.

Question 3.4: *Discuss the requirements of a sprinkler system designed for life safety.*

Congratulations to the candidates who scored 18 marks for this question, they followed the model answer outlined in the Manual of Firemanship book 9. Pages 8-10 and included within their answer the following points.

1. The system should be a wet type.
2. No zone shall extend to an area of a building under separate ownership.
3. All practical steps shall be taken to ensure continuity and reliability of water supplies.

Some overseas candidates, in particular, unfortunately confused sprinkler protection for life safety with the provision of domestic sprinkler system. Half of the candidates failed to score above 5, which shows that a greater degree of understanding of the subject is clearly required.

Question 3.5: *'Mass Transport' is a broad term given to the physical movement of the atmosphere in a fire. It is by this phenomenon that some detectors are designed to operate. Discuss the principle of 'Mass Transport' and the various characteristics of this phenomenon used in the design of detection systems.*

This question should have allowed candidates the opportunity for a high score, since the subject of Mass Transport is well documented. Candidates appeared unaware of its concept and limitations. A brief description of mass transport that included the physical mechanism in which smoke and heat detectors respond, and the fact that the operation of flame detectors relies on radiation, connected to the limitation of height of the ceiling or gas level where the fire occurs would have awarded candidates sufficient marks to achieve a pass mark. As it was, the question was poorly answered with the majority of candidates answers relying on common sense.

Question 3.6: *Discuss the types of smoke detectors that can be used in ductwork, and the problems associated with detection systems that are installed.*

The recommended answer consisted of the following areas.

1. Beam detector.
2. Ionisation Duct Detector.
3. Optical Duct Detector.
4. Air Sampling System.
5. Problems relating to dust protection.

There was an absence of detail in candidates' answers. Tips include: Try looking at wider issues when discussing points; use diagrams; look at the cost of systems; consider the positioning of detectors avoiding areas of turbulence and places where smoke could be diluted (e.g. junctions of duct etc).

Question 3.7: *Automatic fire detection circuits may be considered broadly as being of either open or closed circuit configuration. Compare the two types of system.*

A popular question, well answered by the majority of candidates, some achieving excellent marks.

The subject of open and closed circuit configurations for fire alarm systems was well understood, and candidates gained marks for well executed diagrams which aided their discussion of the systems but also the comparison between the two.

Question 3.8: *Intumescent materials contribute significantly to the protection of buildings and people in the event of fire. Discuss the essential properties for an effective intumescent material.*

Few marks were achieved by the majority who clearly had little knowledge of intumescent materials. Three candidates, however, demonstrated a wider knowledge of this subject and achieved excellent marks.

Paper 4 - Building Construction

Question 4.1: *Describe in detail, the collapse sequence of a steel portal frame building involved in fire.*

This was a relatively popular question that asked for a detailed description of the collapse of a steel portal frame building. Many candidates directed their answers to include the qualities of steel when used in building construction, although this was not required, this line of answer could have led into the areas that were covered in the recommended answer i.e. expansion of rafters, deflection of the eaves.

Marks were awarded to candidates who described the formation of hinges, axial thrusts, torsion instability and, last, cantilever forces.

Question 4.2: *Discuss the propagation and spread of flame characteristics of materials used in the construction of large tented structures.*

Many candidates were familiar with the materials used in tent construction but not so aware of how they behaved in a fire situation. To have gained additional marks, candidates should have mentioned issues such as the effects of linings, debris and internal contents, and safe distances between tents and marquees.

Question 4.3: *Detail the main objectives of passive fire protection in buildings, and comment on the methods by which these objectives can be achieved.*

This question again illustrates that candidates must double check the requirements of the question before attempting the answer. This was apparent when candidates lost valuable marks detailing active fire protection rather than passive fire protection measures. Despite this confusion, some candidates did submit very good scripts. The main objectives of passive fire protection in buildings contained within the model answer are as follows:-

1. To prevent the start of fire
2. To slow down the growth rate of fire
3. To delay the creation of untenable conditions
4. To prevent the unrestricted spread of fire
5. To avoid structural failure

Marks were also awarded for detailing national standards on fire resistance, heat release and restricted spread of fire.

Question 4.4: *Discuss in detail the limitations of using concrete as a means of protecting steel used in the construction of a building.*

It was disappointing that although this question was very popular with candidates, only a handful achieved a pass mark. Many candidates failed to gain marks detailing the properties of steel or the spalling effects of concrete. Candidates did, however, achieve marks for including the high weight ratios, the amount of work involved in installing concrete and the associated increase in foundation costs due to the additional weight imposed on the structure.

Lastly, further marks were gained when candidates effectively discussed other forms of lightweight encasing.

Question 4.5: *Large insulated sandwich and cladding panels (LISPs) used in building construction have caused concern with their behaviour in fire. Classify the types of panels in use and comment in detail on their behaviour in fire.*

Candidates were not prepared for this unpopular question. Five marks were available for the following list of types of panels available:-

1. Polystyrene
2. Polyurethane
3. Polyisocyanate
4. Phenolic foams
5. Mineral fibre

Candidates lost the opportunity of gaining marks by failing to discuss the areas of core melting and creating voids, delamination and the possibility of fire spread through the panel core. Home students who applied their practical knowledge gained from site inspections and reading relevant articles referring to sandwich panels should have scored better – be prepared, read *Fire Safety of Sandwich Panels*, Summary Report No 76, 1997, J Harwood and B Hume.

Question 4.6: Describe in detail the considerations that should be taken when designing a smoke ventilation system.

This was a very popular question for both the Home and Overseas candidates; and the majority of candidates achieved a pass. Two excellent scripts were received, gaining those candidates a mark of 18 and 17. Well done. It is pleasing to see that worldwide students not only have an excellent understanding of smoke travel, but of the associated elements of smoke plumes, entrained air, buoyancy and smoke reservoirs. Some candidates, however, did lose time describing AFD and sprinkler systems, which indicates they probably did not read and understand the requirements of the question.

Question 4.7: Discuss the concept of risk assessment in relation to the structure of a building.

With regard to fire, the principles of risk assessments still remain in their infancy, which probably explains why this relatively easy question was not popular with candidates.

Many scripts discussed the concept and process of risk assessment in detail; but candidates were not asked to comment on these points. The question was specific in its requirements and looked for a discussion of risk assessment in relation to the structure of a building, no as some suggested, a risk assessment based around life safety.

Let us now in hindsight look at the question again and visualise the following items taken from the recommended answer

1. **Through the wall** - as a result of failure of integrity and insulation
2. **Within a void** - fire prevention into a void and unrestricted access into the next enclosure
3. **Via windows** - spread to upper floors via the failure of a window
4. **Within a façade** - fire spread behind and within a façade

The bibliography for this question is Dr G Cook "When are sandwich panels safe in a fire" Institution of Fire Engineers Journal Vol 59, No 198, January 1999.

Question 4.8: Discuss the implications of a roof being an element of structure.

The question was trying to direct candidates down the road of discussing what areas would need to be addressed if the roof became an element of structure.

Examples of this could be if the roof were to be used as a podium, either for pedestrian or vehicular circulation, or possible to support roof based equipment.

With floor areas becoming a premium in modern buildings, roof spaces are changing from their designed use to accommodate restaurants, gymnasia, swimming pools or other services that the public or workers have access to.

Paper 5 - Management and Administration

Question 5.1: Discuss the benefits of a comprehensive press and public relations policy.

It was apparent that all candidates appreciated the important role that the press and public relations play in the modern Fire Service and that this relationship needs to be developed. Some candidates limited their answers to specific issues that focussed around operational incidents, and marks were awarded for this approach. If the candidate had looked more at the wider issues – including developing a media strategy within the organisation and discussing the benefits of implementing the strategy – higher marks would have been achieved.

Question 5.2: Discuss the concept and implications of an equal opportunities policy within an organisation.

This was a wide ranging question which attracted a large number of different approaches, many of which attracted respectable marks. Most candidates addressed the implication of an equal opportunity, but discussion on the concepts involved was sparse. Concepts which when discussed would secure marks included: economic, social and legal pressures on an organisation, an understanding of equality and fairness, and recognition that every individual is different.

Candidates are to be mindful to address both parts of the question to secure high marks.

Question 5.3: Describe the characteristics of an organisation committed to the development of Total Quality Management.

This question was generally well answered with a number of candidates achieving high marks. The candidates that felt confident with this question through a regime of pre-examination study submitted excellent scripts and dealt with the answer by dividing it into parts, as examples:-

1. Customer focus;
2. Processes;
3. Role of staff; and
4. Leadership

And using their knowledge had the ability to expand on their points to include

1. Meeting customers' needs, dealing with dissatisfied customers and improving ways to meet these needs.
2. Process, planning and control, improving using comparative data, benchmarking, problem solving methods.
3. Staff skills and development, encouraging ideas and ownership and treating fairly.
4. Co-ordinating, valuing and motivating, developing the right culture.

Question 5.4: Discuss in detail the different types of management structure, defining the relative advantages of each.

This question proved unpopular with candidates, the low response would suggest that the question looked too difficult. The three management structures that required discussing were those of:-

1. Functional management structure.
2. Product, division/customer/market structure and
3. Matrix organisation.

Having discussed these three systems, the candidates were then asked to define the advantages of each; for matrix organisations these are as follows.

1. Decision making is decentralised to a level where information is processed properly and relevant knowledge is applied.
2. An extensive communications network helps process large amounts of information.
3. When decisions are delegated to appropriate levels, higher management levels are not overloaded with operational decisions.
4. Resource utilisation is efficient because key resources are shared across several important projects or products at the same time.
5. Employers learn the collaborative skills needed to function in an environment characterised by frequent meetings and more informal interactions.
6. Dual career ladders are elaborated as more career options become available on both sides of the organisation.

Question 5.5: "Customer Care is important for a service organisation". Analyse this statement.

This was a popular question with the majority of candidates noting the importance of good customer care, and displaying the ability to demonstrate their knowledge of good and bad practices. The outline answer consists of the following five points.

1. Meeting customer needs.
2. Makes service organisations take account of special nature of services.
3. Customer care enables organisations to provide what customers want.

4. Customer care focuses attention on important issues.
5. Customer care brings benefits to an organisation.

Candidates would have achieved high marks if these points had been discussed in detail.

Question 5.6: *Discuss in detail the benefits of Critical Incident Stress Debriefing.*

All candidates who attempted this question demonstrated through their scripts a high level of awareness of the principles and strategies of critical incident stress debriefing. Many candidates offered good examples of practical help and assistance that they or their colleagues had offered within their own organisations.

It was therefore reassuring that the article concerning this subject that was recently published in the Fire Engineers Journal had been read and understood by so many professional fire engineers.

Question 5.7: *Define the principle elements of competence based training and assessment.*

The bibliography for this question was intended to be primarily an article in the January 1999 issue of the Fire Engineers Journal, but articles that focus on training for competence can normally be found within any modern management journal. However, that aside, this question offered candidates an opportunity to score well on what is a topical subject; but candidates appeared not to have read and understood the requirements of the question, as many saw this as an opportunity to explain their own understanding of competency based training. Within submitted scripts, elements that would have benefited from more attention were the policy statement and the strategy on how to effectively achieve it. Recording systems again were often omitted from answers – this was worth three marks.

Candidates must ensure they answer the points within the question, it is often the case that candidates waste time describing irrelevant information and gain no marks in the process.

Question 5.8: *Discuss the essential features of an occupational health and safety programme.*

Read the question, sit back and think about it, consider the wider issues. Formulate – either in your mind or on scrap paper – a structured response and the salient points; then and only then put pen to paper. Candidates who chose this question too often directed their answers down narrow channels.

The essential elements of a good answer were

1. Analysis of performance, problems and hazards.
2. Development of policies, organisation procedures and training systems.
3. Implementation of policies.
4. Evaluation with feedback to further improve performance.

Paper 6 - Fire Service Operations

Question 6.1: *Discuss the concepts of 'dynamic risk assessment' in relation to Fire Service operations.*

This proved a popular question, and virtually all candidates demonstrated that they had grasped the principles of dynamic risk assessment.

Considering the up take of this question, and that the majority achieved a pass mark, it was apparent that Dynamic Risk Assessment was well understood and practiced and equally that the authors of the two documents above were successful in reaching the target audience.

Question 6.2: *Discuss the use of post incident debriefs as a means for improving operational performance.*

This was the most popular question of this paper and it was disappointing that, although most candidates appeared to understand the principles involved, because of lack of detail in their answers only a few achieved high marks. 12 marks were available for discussing the purpose of a post incident debrief, and a further 8 marks were available for discussing the benefits of carrying out post incident debriefs. The benefits include the following points taken from the outline answer.

1. Opportunity to validate good practices and procedures.
2. Opportunity to observe limitations in equipment.
3. Allows observation of firefighters competency.
4. Provides support/encouragement for individuals and team welfare.

Question 6.3: *Discuss the factors to be considered in determining operational firefighting tactics at an incident in a tunnel.*

At first glance, for the operational candidates this question possibly looked easy. Many candidates submitted scripts that should have answered the question comprehensively; but because their answer had been based on personal experience rather than incident command strategies, they lost valuable marks. This is clearly an example of a question where it is not appropriate to rely on what you know and understand, even if within your organisation you are deemed a specialist. You must prepare yourself properly for the examination in hand. Some of the points to be discussed from the recommended answer are as follows.

1. Nature of fire
2. Consideration of siting of appliances and equipment.
3. Appropriate and safe deployment of personnel.

Question 6.4: *With particular reference to fireground operations, discuss reasons for adopting trunk radio systems rather than non-trunked alternatives.*

For the majority who sat this paper, this question appeared to be complex and technical in nature and so only the brave few attempted it. Yet this is far from the truth. Candidates must therefore have been poorly prepared for this type of question. With regard to the advantages of trunked systems, I have included below the five points referring to trunked systems from the model answers that if properly covered would have gained 10 marks.

1. Greater flexibility.
2. Permits dynamic configuration of talk groups.
3. Allows prioritisation of transmission depending on message status.
4. Increased radio channel frequency.
5. Increased utilisation of data of tele services (e.g. telemetry image transfer etc).

Question 6.5: *Discuss the use of specialist equipment over conventional Fire Service equipment at fires involving large oil storage tanks.*

This was a popular question, and some candidates achieved excellent marks. The candidates who achieved comfortable pass marks usually submitted scripts that discussed the limitations of the Fire Service equipment, the range of specialist equipment available, and further discussed the advantages and disadvantages of each.

Other candidates could have improved their marks by discussing advantages and disadvantages rather than just listing equipment.

Question 6.6: a) *Describe the general arrangements for the storage of chemicals on bulk chemical carriers; and b) Outline the relevant operational considerations when dealing with a fire involving a bulk chemical carrier whilst in port.*

This question was already divided into two parts which attracted equal marks.

Part B was favoured by the majority of candidates who probably had an operational view point, but generally if you were to adopt a common sense approach towards both parts A and B you would have covered the majority of points and probably improved your overall mark.

Let's consider a bulk chemical carrier, carrying concentrated acid alongside a shipment of drinking water. What would we look for.

1. Separation between cargoes of chemicals.
2. For collision and other purposes, the chemical tanks should be away from the sides and bottom of the vessel.
3. Pumping and piping systems need to be separated.
4. Ventilation system for each chemical storage area should be separated.
5. Specially controlled atmosphere maybe required.

If you included these points in your answer you could have achieved 10 marks.

Question 6.7: Detail the factors to be considered prior to introducing a new item of equipment into operational service.

As you can imagine this question was very popular. It could be understood and applied to every walk of life, for you would consider similar points. Those who did consider the following points would have scored high marks and comfortably passed this question as many did.

1. Intended use of equipment.
2. Assessment of the functionality of the equipment.
3. Assessment of the Health and Safety considerations
4. Assessment of the training requirements prior to and following the introduction of the equipment.

Question 6.8: The introduction of an incident command system at an incident involves the application of an appropriate tactical mode for firefighting. Describe in detail these tactical modes, giving appropriate examples to illustrate your answer.

This question offered the candidates the chance to score very high marks, the subject matter is current and has developed greatly over recent years. The question required a description of the three tactical modes: offensive, defensive and transitional – and an example of each.

A few candidates failed to score sufficient marks to achieve a pass as they probably focussed on their own command and control system, which bears little resemblance to the generally accepted and wider approach.

Paper 7 - Aero Fire Studies

Question 7.1: Discuss the main considerations and actions to be taken when attending aircraft engine fires.

This was a popular question, with the majority of candidates not only achieving a pass, but also demonstrating a broad knowledge of general aviation firefighting, with regard in particular to engine fires.

High marks were awarded to answers that were logical and methodical in approach, and covered both piston and turbine engines commonly found mounted integrally into wings, rear mounted, or which take the role of the auxiliary power unit (APU) with their associated method of extinguishment. The bibliography for this question was *Airports and Aircraft Fire Protection*, published by the IFF, pages 85-88 (second edition, pages 104-106).

Question 7.2: Detail the main considerations of an airport authority when producing a plan and emergency orders to cope with an aircraft emergency.

A few candidates who attempted this question were conversant with this topic and scored extremely high marks. Their answers included extensive detail into the following areas:-

- (a) Grid maps - that illustrate the ease of location, flight paths, airport plus 10ftms, and provision of maps on emergency vehicles.
- (b) Updating emergency plans - Airports to maintain plans current, practice plans at regular intervals and discuss fully any potential changes.
- (c) Emergency exercises - Invite all external support agencies for full scale exercise every two years.
- (d) Rendezvous - Standby points and staging areas
- (e) Pre-arrangement for other interested organisations - Plan for media, crowd and traffic control. Also catering facilities and security of the accident site.

Candidates who only submitted a list of the above points lost valuable marks.

Question 7.3: Detail the general construction features of Groups 1, 2 and 3 hangars with particular emphasis on hangar separation.

This proved the least popular question, and was answered in two distinct ways. Those firstly who had studied the bibliography produced some remarkable comprehensive answers and attracted high marks. Others appeared to tackle the question using basic fire safety knowledge and were not able to answer in detail.

Marks were awarded to candidates who were able to differentiate between classes and groups of hangars. Also, high marks were awarded to candidates who demonstrated a clear understanding of the details of separation between hangars and clusters of hangars.

Question 7.4: Describe in detail the points to consider when rescuing aircrew from military aircraft.

Within the subject of aviation this question crops up on a regular basis. Candidates appeared to understand this and the majority who scored excellent pass marks had read and understood the bibliography associated with this question.

The three areas that attracted the highest marks were:-

1. Description of the method of operating the MDC
2. Description of the method for making ejection seats safe.
3. Description of the method of releasing the air crew from PEC and of lifting aircrew clear of the cockpit.

Question 7.5: Describe the classes and divisions covering the carriage of dangerous goods by air as defined by ICAO and IATA.

The definition of dangerous goods associated with aviation is any article or substance, which is capable of posing significant risk to health, safety or property when carried.

There are nine separate classes which include the following:-

1. Explosives
2. Gases
3. Flammable liquids
4. Flammable solids

Two candidates submitted faultless answers and achieved the full 20 marks. This was indeed a popular question, and in the main was attempted by candidates who were confident through being properly prepared.

Question 7.6: Describe in relationship to aircraft fires: (i) the concept of critical area; (ii) the way in which the critical area is used to calculate the amount of water required for foam production to control a fire; (iii) other factors, which affect the quantity of water needed to extinguish the fire.

Marks awarded for this question were almost equal throughout the scale, with no real peaks or troughs.

It is therefore clear to see that some candidates attempted this question, probably in desperation hoping to achieve a few marks; while at the other end of the scale, those who had prepared meticulously and approached the question methodically scored extremely high marks. In the middle were those who probably had studied hard but on the day failed to apply themselves to the question and left valuable details out of their answer. Candidates commonly lost marks in part (b) of the question by failing to remember the formula and not explaining what each symbol of the formula represented. The formula and description is as follows:-

$$Q^1 = F^{0.5} \times R \times t$$

- | | |
|-----------|--|
| Q^1 | the amount of water to control the critical area |
| $F^{0.5}$ | the size of the practical critical area |
| R | the rate of application |
| t | the time of application |

Question 7.7: Detail the normal precautions which should be implemented when fuelling passenger aircraft.

Pages 90 and 91 (second edition pages 152-154) of *Airports and Aircraft Fire Protection* gives a list of 20 precautions that should be adopted when refuelling passenger aircraft, and 1 mark was available for each.

This was a popular question and in the main was answered well, which demonstrated a sound knowledge; however, a minority of scripts failed to achieve a pass, with answers based on experience rather than specific knowledge.

Question 7.8: Explain and justify the topics you would choose to incorporate into a training programme for firefighters on the subject of operational tactics for extinguishing aircraft fires at airports.

This was a popular question, but despite exhaustive lists and explanations, candidates failed to achieve a score higher than 13.

The manner in which the question was answered illustrated that candidates appeared to have adopted a logical sequence, but many candidates failed to add sufficient detail to attract top marks. This simple statement taken from the recommended answer attracted in itself four marks: 'Cause of fire, aircraft familiarisation, and practical use of equipment and search and rescue techniques.'

Paper 8 - Fire Investigation

Question 8.1: Discuss electric lighting as a source of ignition.

Most candidates presented their answers in a discussion style as requested, with many experienced fire investigation officers supporting their answers quoting case histories. Other marks were also available to candidates who understood the subject well enough to use diagrams.

Marks were lost by some candidates who concentrated on describing how electric lights work rather than discussing their role as a source of ignition. Again, marks were not awarded to scripts that described various electrical fires that were unconnected with lighting.

Candidates are therefore reminded to concentrate and direct their answers in the direction that the question requires, support answers with facts, e.g. temperature of different types of lighting, use diagrams, especially when they appear in the bibliography.

Question 8.2: Discuss the potential errors that could be made by investigators of fatal fires.

Few candidates demonstrated evidence of having read the associated bibliography for this question, but instead relied on their own experience of previous fatal fire investigations. Whilst exploring that avenue, candidates appeared to lose sight of the questions requirements. i.e. discuss the potential errors made by investigators. The marks were available, and many snapped them up by the inclusion of the following points that form part of the recommended answer. It must be stressed again, candidates must read the question and realise what is being asked for.

1. Destruction of evidence
2. The strict adherence to fire investigation theory
3. Failure to examine bodies closely
4. Failure to carry out a full investigation

Question 8.3: 'Smokers' Materials' are a frequent cause of fire. Discuss.

Unusually, even the recommended answer for this question consists of three reproduced pages from Kirk's Fire Investigation 4th Edition, and therefore the scope was there for candidates to achieve excellent marks, and to their credit many candidates did score well.

Marks were generally lost by candidates who overstated the ease with which cigarettes can start fires, and by restricting their answers primarily to cigarettes and omitting any reference to other smoking materials, matches, lighters etc. Candidates gained marks by quoting facts, i.e. cigarettes, temperatures and reasons how smouldering fires can develop to ignition.

Question 8.4: Define the term 'spalling', and describe the mechanical forces which cause this effect.

Most candidates who attempted this question demonstrated a basic understanding of the phenomena 'Spalling', but failed to include sufficient detail to achieve high marks.

Marks were also commonly lost by candidates who restricted their discussion of spalling to plaster, forgetting that a description of spalling to concrete and masonry had also been given in the bibliography associated with this question.

Question 8.5: Describe six common incendiary devices and explain how they might be deployed.

This proved to be an unpopular question, and only approximately 50% achieved a pass mark.

Valuable points were lost by using generic terms such as timing devices, flammable materials etc. The question required detailed description and not description formatted in general terms. It was apparent that generally candidates need to fully prepare themselves in this area prior to next years examination.

Question 8.6: Explain how photography should be used to help document the fire scene.

This was the most popular question of this paper, congratulations to the six candidates who achieved 18 marks and over. Most candidates comfortably achieved passes in this question, submitting detailed scripts; others did not fare so well, their knowledge of this subject was not comprehensive, and where detail was required it was sadly not provided.

For those who will be re-sitting this paper next year, the bibliography for this question is Cook and Ide's 'Principles of Fire Investigation'.

Question 8.7: Discuss the problems associated with using the criminal term 'Arson'.

This again was a popular question which disappointingly only attracted average marks from candidates who appeared to answer the questions relying on their own experiences rather than the information given in the recommended answer.

Candidates also commonly lost valuable marks by only discussing the signs of arson and forgetting fire setting.

Question 8.8: Discuss in detail the following terms: (i) Deflagration; (ii) Endothermic & exothermic; (iii) Pyrolysis; (iv) Stoichiometry

This question was divided into four parts, which each attracted five marks. The question was popular and well answered by the majority who attempted it.

The question was straightforward, unambiguous and required short answers for each definition.

1. **Deflagration** - A very rapid oxidation with the evolution of heat and light, and the generation of a low energy pressure wave that can accomplish damage. The reaction proceeds between fuel elements at sub-sonic speed.
2. **Endothermic and Exothermic**
Endothermic - absorbing heat during a chemical reaction
Exothermic - generation of heat during a chemical reaction.
3. **Pyrolysis** - The chemical decomposition of substances through the action of heat in the absence of oxygen.
4. **Stoichiometry** - balance of chemical reactants and products.

Bibliography: Kirk's Fire Investigation, pages 481 +

Paper 9 - Marine Fire Studies

Question 9.1: Describe the problems associated with movement of firefighting equipment and personnel in ships lying offshore.

This question asked for a description of the problems associated with movement of personnel and equipment. Therefore, if candidates had read this and understood the requirements of the question, valuable marks would not have been lost by restricting answers to lists.

Points were gained by approaching the question in a structured manner and including a description of the following:-

1. Boarding precautions
2. Adequate training
3. Pre-planning
4. Use of helicopters

Candidates are therefore reminded to read and understand the requirements of the question before attempting to answer it.

Question 9.2: Outline the SOLAS provisions for means of escape from accommodation, machinery and cargo spaces.

This question asked the candidate to outline the SOLAS provisions - in the main this was adhered to. Most submitted scripts formatted in a logical manner, and many candidates demonstrated a good understanding of the subject and had obviously prepared well.

For those candidates who diverted their concentration away from the provisions of SOLAS and included provision of automatic fire detection or sprinklers, no marks were awarded.

Answers should have been confined to travel distances, levels of protection, alternative structural provision and number of exits.

Question 9.3: a) Define the term 'Metacentric height'; b) Show with the aid of a diagram: (i) An unladen ship with a positive metacentric height; (ii) The effect of placing a heavy cargo, centrally low in the hull; (iii) The effect of placing a heavy cargo, centrally on the upper deck; and c) Explain in detail how these effects have a direct bearing on the ship's equilibrium.

This was a popular question and some excellent scripts were received scoring very high marks.

Candidates had clearly researched the subject and to their credit submitted well presented, logical scripts including clear diagrams with additional explanations.

Uncommonly, some candidates did lose marks by confusing metacentre and the centre of buoyancy.

Question 9.4: Discuss the problems associated with fires on board insulated ships.

Many of the scripts received were usually incomplete which gives the impression that the question was unpopular and answered last in the desperate attempt to gain the odd mark or two.

Candidates were obviously ill prepared to confidently attempt the question, and candidates should take the opportunity to review the bibliography associated with this question.

Question 9.5: When pre-planning for a major marine incident: a) Describe who should be involved in the process; and b) Discuss in detail the features of such a plan.

With few exceptions this question was answered well, and many candidates achieved a comfortable pass.

Candidates presented their answer in a logical format including detail of the following points:

1. Committee constitution
2. Pre determined attendances
3. Access/Assembly
4. Manpower
5. Water supplies
6. Special resources/Special risks
7. Offshore consideration

Question 9.6: a) Discuss the use of CO₂ as part of a ship's fixed installation; and b) Calculate the quantity of CO₂ required in a fixed system, for a hold of 1200 cubic metres.

70% of candidates achieved a pass for this question. Generally the scripts were of a good standard and discussed such points as characteristics, advantages/disadvantages, concentration requirements etc. It was disappointing that candidates still do not understand when a question requires a discussion, submitting a list will not suffice and marks will be lost.

Part (b) of the question required a formula and answer – 6 marks were available for this and generally these marks were lost because candidates, for whatever reason, could not reproduce the formula on the day.

Question 9.7: Describe the action required in military naval routines to assist the local fire services in firefighting and controlling an incident.

Candidates who scored 14+ clearly understood the requirements of the question and submitted in some cases excellent scripts describing such points as access, alternative access, action prior to the arrival of the local Fire Service etc.

Candidates who scored 7 - 10, by the nature of their answer, clearly had studied the subject but not in any great depth. Many candidates in this group attained a pass mark.

Candidates who scored between 1 and 4 marks found the question a struggle; they obviously had not prepared properly for this subject although may have briefly scanned the study material.

Prospective candidates should include this topic in their pre-examination preparation.

Question 9.8: Describe how counter-flooding can be an effective method of damage control when dealing with a fire aboard a ship.

Although all candidates managed to describe the principles of counter flooding, only 15% did so with sufficient detail in their answers to attract a pass mark.

Marks were gained by outlining the purpose and use of counter flooding and, more importantly, the precautions to be observed prior to counter flooding.

Poor preparation is blamed for the low marks achieved by candidates for this question.

Paper 11 - Disaster Planning and Emergency Management

Question 11.1: Define the term 'Major Incident' in the context of the emergency services and discuss the merits of contingency planning.

This proved to be a popular question and some candidates submitted excellent scripts. Some candidates unfortunately drifted away from the requirements of the question and gave detailed descriptions of major incident sites. Candidates were awarded marks for presenting clear structured answers that concentrated on the subject matter.

Question 11.2: Discuss the role of the Emergency Planning Officer before, during and after a major civil disaster.

Candidates demonstrated a sound understanding of the role adopted by the Emergency Planning Officer at the various stages of the incident. Valuable time was lost by many candidates who over elaborated on the merits of employing an EPO and how the EPO would support the wider role of the Local Authority.

Question 11.3: Discuss the main principles of adopting an 'integrated approach' to emergency management in preparation for a major disaster.

Candidates generally had not prepared themselves for the question which was reflected in the low take up and the respective low marks. Good marks were awarded to the minority of candidates who gave examples of partnership schemes related to integrated emergency arrangements.

Overall this was a disappointing performance for candidates at Membership level and additional preparation is required prior to next year's examination.

Question 11.4: a) Discuss in detail the merits of training in relation to emergency management; and b) Outline the main planning objectives and the various methods of rehearsal.

This was a popular question that gave candidates the opportunity to reflect on the importance of training as an integral feature of planning to mitigate the effects of a major disaster. The question was generally well answered although many candidates had difficulty in highlighting the main planning objectives.

Many candidates also submitted over elaborate views of the roles of the emergency services in dealing with disasters when the question clearly focused on the training aspect.

Candidates are reminded to read the question fully and take time to construct an answer that is clear, precise and follows a logical path.

Question 11.5: Command and control of a major incident can operate at strategic, tactical and operational levels, often referred to as gold, silver and bronze. Describe the roles and functions of the emergency services at each tier of command.

Command and control at a major incident is commonly rehearsed by the emergency services and should be seen as a bread and butter question that should have realised high marks. Unfortunately, there appeared to be a lack of a detailed understanding of the subject by candidates who attempted to pad their answers by including the same information in all three areas of gold, silver and bronze.

At member level, the expectation is that candidates will understand and can anticipate the different activities of each command level and their importance.

Question 11.6: *The effective exercise of command, control and co-ordination of action at major incidents is dependent upon the provision of effective inter-agency communications. Discuss in detail the problems that can arise when using communications equipment.*

A very poorly answered question which reflected the high number of candidates failing to achieve good marks. Candidates who understood what was required gave a good overview of the inter agency issues and the practical problems which impede effective communications.

Most candidates demonstrated a good understanding of problems relating to radio interference, siting of vehicles and different communication media, but at that point the information train stopped. Candidates need to reflect at member level the need to demonstrate a broader application of the organisation and technical issues which impact on major incidents.

Question 11.7: *The pattern of media reporting falls into a number of distinct phases following a civil disaster. Detail these phases and discuss ways in which media presence can be positive.*

The proved to be a very popular question and generally was well answered; some candidates in fact submitted near perfect scripts. The more positive approach to the answer was one in two parts as specified in the question.

Without exception candidates attempted to discuss the positive benefits of media reporting, although poor answers in both parts usually contained an absence of detail, or detail that was repeated throughout the question.

For those candidates who may have to resit the paper again next year it is important to remind them to:-

1. Read the question carefully
2. Set out a clear structured answer
3. Avoid duplication of information
4. At membership level you must be able to demonstrate a sound understanding of the important points and be able to articulate these precisely in the answer.

Question 11.8: *a) Explain in detail why the identification of victims is important following an incident with mass fatalities; and b) Outline the methods that are available to carry out this task.*

Although 11.8 was the last question in this paper, it still attracted a large number of attempts, which in the main were well answered – and some candidates achieved very high marks. The question was split into two areas: the importance of victim identification was the more popular part of this question, and answers included points such as:-

1. Legal reasons
2. Social and religious
3. Investigative

Additional marks were awarded for more detailed accounts of how victims are identified e.g. through the Home and Away teams in forensic odontology.

Candidates are again reminded to present answers clearly and answer all the points of the question.

Graduateship Examination

Paper 1 - Fire Safety

Question 1.1: *a) Explain the following terms: i) Decking; ii) Pre-stressed concrete; and iii) Curtain walling; and b) Describe the risks presented by each to the firefighter, in the case of fire.*

A straightforward question taken from the Manual of Firemanship book No 5 and the "Fire Technology of Building Construction" published in the IFE Journal. Disappointingly, two thirds of attempts failed to achieve a pass mark. The majority of candidates were not familiar with the terms of decking and curtain walling, and because this was a two part question which contained elements of decking and curtain walling in each, a lot of points were therefore lost. On a positive note, the majority of candidates displayed an excellent knowledge of the third term "pre stressed concrete".

Question 1.2: *With regard to the characteristics of building materials, define the following terms: a) Ignitability; b) Combustibility; c) Fire propagation; d) Surface spread of flame; e) Potential for smoke obscuration; and f) Fire resistance.*

With the exception of fire propagation and fire resistance that had a model answer consisting of three lines, the other terms requiring definition had only a one line answer; therefore candidates who expanded their answers (some up to four pages) wasted a great deal of time. Some candidates appeared confused and included definitions of fire point, flash point and spontaneous combustion which attracted no extra marks.

A liberal interpretation of terms was all that was required.

Question 1.3: *List and describe the factors that cause smoke movement within a building.*

242 candidates attempted this popular question, but unfortunately many failed to understand what was being asked of them. The key word in the question was that of cause – "what factors cause smoke movement within a building". Equal marks were awarded to each of the following points and their explanations:-

1. The buoyancy of the rising smoke plume.
2. The stack effect.
3. Direction and velocity of the prevailing wind.
4. Mechanical air movement system.

Question 1.4: *Explain the principle of operation of a beam detector*

There were some excellent answers to this standard question. This also presented the candidate the opportunity to include clear diagrams that would gain additional marks. At the other end of the scale, the majority of candidates' performance was disappointing. Candidates lost marks confusing beam detectors with either ionising or obscuration type detectors.

Many candidates also concentrated on how smoke affected fire beam but failed to mention the effect of heat and systems that included retro reflectors.

Question 1.5: *In order to comply with fire precaution legislation, fire safety training should be given to all employees. Briefly describe the subject headings which need to be covered during such training.*

This proved a very popular question for both home and overseas candidates. The opportunity to gain good marks was achieved by those who concentrated on the following areas:-

1. What to do on discovery of a fire.
2. On hearing the fire alarm.
3. How to summon the fire brigade.

The bibliography associated with this question was LPC Volume No 5 *Fire Risk Management in the Workplace*, which was obviously well read by the majority of candidates.

Question 1.6: *Many large fires occur within industrial/commercial buildings where contractors have been engaged in activities which involve hot work, e.g. welding, cutting etc. Detail the measures that management can introduce to control and reduce the risk of fire occurring when such activities are taking place.*

Strangely, a popular question that was poorly answered. The

majority of marks for this question were below 10. When you consider the regularity of this type of question and the fact that it does occur frequently as an actual cause of fire world-wide, it was disappointing that the basics of

1. Tar boilers.
2. Other work/risk activities underway in the same environment.
3. Safe removal of residues.
4. Consideration of alternative repair methods.
5. Gas cylinders.

were rarely included in candidates answers. Candidates did however show a good grasp of the removal or covering of combustible materials, provision of fire extinguishers and provision of trained staff to maintain an active fire watch. Candidates wasted time discussing means of escape, provision of sprinklers/automatic fire alarms which were not relevant to the question.

Question 1.7: *When determining a fire evacuation plan for a place of work, describe the particular points to be borne in mind when preparing such a plan.*

This question proved popular for candidates who followed two distinctive routes to their answer. The first, which was the correct style of answer, described the main points of an evacuation plan, and the second which lost marks and wasted valuable time was to describe means of escape issues such as building construction, travel distances etc.

Question 1.8: *Discuss the responsibilities and duties of attendants at smaller premises being used for public entertainment.*

Generally this question was poorly answered, however, candidates did display a good knowledge of the broad areas of maintaining safe conditions and the control of areas within the premise.

Chapter 12 of the *Guide to Fire Precautions in Existing Places of Entertainment and the Like Premises* also details other responsibilities and duties of attendants like:-

1. Accountability for the number, age and any disabilities of the audience.
2. That attendants remain on duty at all times that members of the public are within the premises
3. Attendants should be readily identifiable at all times

which for the majority of candidates were omitted, losing them valuable marks.

Question 1.9: *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 operate; b) The possible causes or dangers of ignition in respect of each type of lighting.*

Only 92 candidates attempted this question and many failed to achieve a pass mark. Marks were lost generally throughout the question, and in particular marks were lost when attempting to describe the causes and dangers of ignitability of each type of lighting.

Preparation for this question should have included recent Journal articles and reading materials including "Principles of Fire Investigation".

Question 1.10: *During the course of carrying out a fire investigation, several apparent signs of fire may be evident. This could be due to the results of the stages of fire development and spread rather than suspecting arson. List and briefly describe the factors that could lead to the impression of a multi-seated fire.*

Approximately one third of candidates achieved a pass mark. The majority however lost marks because they only covered half of the question.

Candidates need to apply the basic principles of convection, conduction, radiation and other like effects of ventilation high fire loading, gas and vapours, secondary electrical and firefighting, when answering this question.

Paper 2 - Operations

Question 2.1: *Accurate information is essential for the fire officer who is considering the correct response to a ship fire where the ship is located off-shore. Detail the information required prior to the initial response.*

This was a popular question with some candidates achieving high marks. Marks were gained when aspects of firefighting were mentioned, but some candidates submitted extensive answers relating to rescues which was not required. Further study into "stability and free board" should be undertaken when preparing for future examinations.

Question 2.2: *Detail the different power tools carried by fire brigades, describing in your answer the tasks for which they can be used and the means by which power can be supplied.*

To the home candidates this should have been a "bread and butter" type question. Although some excellent scripts were submitted, more often than not candidates settled for just listing the different power tools; they didn't follow the instructions in the question and explain which tasks can be used for each tool and by which means of power can be supplied. A few candidates lost marks for using the manufacturer's name instead of the general term for a specific power tool.

Question 2.3: *Prepare an action plan that includes points to be considered by the fire officer who is faced with an unignited leakage of liquefied petroleum gas from a bulk storage vessel located in a populated area.*

319 candidates chose this question, and disappointingly the highest awarded mark was only 16 – achieved by one individual. Having compared the various answers for this question, the marker was in no doubt that had candidates read and understood the question, there should have been no misunderstanding regarding the definition of vessel being that of a container, and not a ship. Also that this was a "static" bulk storage vessel and not a transportable container.

One other common failing from candidates was their confusion between the terms "up wind" and "down wind".

Question 2.4: *a) Detail a water distribution system which is typically found in towns and cities that can be used for firefighting purposes; and; b) Discuss the importance of standardising the system in liaison with the local water company.*

As expected part A of this question was well answered. The majority of candidates achieved excellent marks for identifying:-

1. Trunk mains
2. Secondary mains
3. Service mains
4. Services reservoirs
5. Booster pumps

With regard to part B, many candidates digressed away from water distribution and concentrated on lengthy discussion regarding hydrants and sprinklers. Others unfortunately channelled their answers toward Fire Service operations.

The digression away from distribution towards hydrants, sprinklers and Fire Service operation may have been due possibly to the candidates lack of detailed knowledge, or as with other questions, failure to understand the question.

Question 2.5: *Compare the characteristics of typical fire appliances used at civil and military aerodromes with conventional fire appliances.*

This question, was generally poorly answered. For those candidates who mentioned characteristics such as four wheel drive, large capacity tanks, high output pumps etc., they usually failed to expand on their answers and lost valuable marks. Candidates should follow a sequence of: What is the appliance? What does it carry? How do you project the extinguishing media onto the aircraft?

Question 2.6: *a) List the different agencies that you would expect to be included in discussions on the management of environmental pollution; and b) Explain the points that should be included in any operational procedure note.*

Candidates achieved good marks for part A of this question, but with regard to part B marks were commonly lost by failing to consider the wider implications of dealing with environmental pollution incidents. Instead, candidates preferred to draw from their own experiences of attending smaller roadside spillages, possibly easily dealt with by a bag of absorbent granules.

Decontamination procedures were also in the main poorly detailed and references to global environmental issues were also not asked for.

Question 2.7: *To enable the fire authority to deal successfully with a major disaster it is essential that some degree of pre-planning is carried out. Discuss the considerations that need to be implemented for control and communication as part of any pre-planning.*

The bibliography for this question was the Manual of Firemanship, Book 12, Part 1, Chapter 4. It was clear to the marker that adequate time was not allocated to researching this topic.

A few good scripts were received which gained good marks for covering the subject matter from the highest level down to the actions at the sharp end. Many candidates elaborated on the types of incident that would require pre-planning which lost them valuable time and no marks.

Question 2.8: *A number of different fire fighting systems, both fixed and portable, are available for use on oil tanker ships. Briefly explain each of these systems.*

This question was not popular amongst candidates, and for those that selected this question, only a few gained good marks. The question asked for a brief explanation of each of systems, and therefore the candidates who restricted their answer to a list of systems lost the majority of marks that were available.

Some excellent diagrams were produced, but unfortunately their explanations proved to be sketchy.

Question 2.9: *Pre-planned emergency arrangements for incidents at oil refineries should include the provision of relief crews and, where personnel are likely to be detained for lengthy periods, some form of emergency feeding. List the other emergency arrangements that should be included in the pre-planning.*

This question was specific in its demands. It required a list, yet many candidates provided full explanations or even the basis of a discussion paper. Yet again too many candidates lost marks concentrating their efforts towards personnel issues.

On a positive note, good marks were awarded for structured answers that started at arriving at the scene and leading to the point at which the incident was left.

The model answer for this question can be found in the Manual of Firemanship, book 6B.

Question 2.10: *Discuss the problems associated with fighting a serious fire in a very large single storey retail store that is un-compartmented and unsprinklered.*

32 candidates attempted this popular question, some gained excellent marks, especially those that included in their answer:

1. The rapid collapse of the building was usually around 30 minutes, despite the structural elements having a 60 minute resistance.
2. The speed and development of the growth of the fire.
3. The dangers associated with search and rescue for casualties trapped or missing in this type of premise.

Candidates should be reminded that when a question asks for a discussion, a debate considering advantages and disadvantages should be produced, and not just a list answer concerning the subject – this was where some candidates lost marks.

Paper 3 - Fire Engineering Science

Question 3.1: *The resistance of a conductor of length l and cross sectional area A of a material with a resistivity of ρ , is given by the formula*

$$R = \frac{\rho l}{A}$$

a) If the cross sectional area is 5 mm^2 and $r = 2.45 \times 10^{-8} \text{ ohm metre}$, plot a graph to show the increase of resistance with length; b) How long would the specimen be to have a resistance of 6 ohm; c) Determine the cross sectional area of a 6 ohm specimen when the length is limited to 1 metre.

This was a popular question with approximately $\frac{1}{3}$ of candidates gaining a pass. The question required the use of a graph to illustrate the increase of resistance as the length of the cable was increased.

Candidates who laid out a table of length and resistance, plotting the results on to a graph gained marks. Some candidates failed to answer part two and obviously lost marks. Candidates who used the information obtained from their calculations to work out the cross sectional area of a 1 metre length of cable with a 6 Ohm resistance, gained marks.

Candidates should be mindful to show all working and not rely on calculators; marks cannot be given in the event of a calculation error if the marker has no information to work from.

Question 3.2: *a) Define Stress, Strain and Hooke's law; and b) A section of timber $175 \text{ mm} \times 75 \text{ mm} \times 75 \text{ mm}$ is compressed 2 mm by a force acting at right angles to the longer side. If the Modulus of Elasticity (E value) is 9.6 kN/mm^2 , calculate the size of the force exerted.*

This was not a popular question, and few candidates gained a pass. Candidates who defined stress, strain and Young's modulus gained marks. The candidates who did this, and in addition, substituted the information given in the question for the formula gained extra marks.

It was pleasing to note that one of the 33 candidates who chose this question gained full marks, well done.

Question 3.3: *An empty 60 litre petrol tank has a mass of 10 kg. a) What will be its mass when filled with a fuel of density $720 \text{ kg/cubic metre}$; and b) If the tank and contents are then raised to a height of 25 metre in 15 seconds by a pump with a 5 kW rating, calculate the efficiency of the pump. ($g = 9.8 \text{ m/s}^2$)*

25 out of the 236 who chose this question achieved full marks, submitting model answers. Below them was a void of knowledge candidates were obviously poorly prepared and did not understand the question.

Three common mistakes which lost candidates marks were:-

1. confusion over which formula to use
2. not including the original mass of the tank
3. misunderstanding of efficiency of the pump, which should have been expressed as:-

$$\frac{\text{Power Output} \times 100}{\text{Power Input}}$$

It should be remembered that answers that are neatly presented and follow a logical sequence usually result in less errors.

Question 3.4: *A battery supplies a current of 0.5 amp through a 2 ohm coil but when connected in a different circuit, a current of 0.2 amp through a 7 ohm coil. Calculate the voltage and internal resistance of the battery.*

Approximately 15% of candidates achieved full marks for this question, whereas the majority failed to achieve 25% of the available marks.

Although candidates were familiar with Ohms Law, they lost marks because they did not understand what internal resistance represented.

The voltages and the internal resistance of the battery are the common features in each of the circuits, and by comparing one with the other, the internal resistance, and therefore the voltage, may be derived. The internal resistance of the battery forms a resistance in series with the rest of the circuit.

Question 3.5: *a) Define Boyle's Law, Charles Law and the General Gas Law; and b) A thick walled steel cylinder used for storing compressed air is fitted with a safety valve which opens at a pressure of $1 \times 10^6 \text{ N/m}^2$. It contains air at 17°C and $0.8 \times 10^6 \text{ N/m}^2$. At what temperature will the valve open?*

This was a very popular question, generally well answered with a number of candidates gaining full marks.

In connection with the Kelvin scale of temperature, candidates who failed to practically apply the formula lost marks. Candidates are reminded that to define Boyle's, Charles and the General Gas laws is a common question in both the IFE and the Fire Services Statutory examinations, and the three definitions need to be accurately memorised to obtain the marks available.

Question 3.6: a) Explain what is meant by "radioactive decay"; and b) If you are given three radioactive sources each emitting a different kind of radiation, what evidence or experiment could you use to identify the radiation from each source?

Generally the first part of the question was well answered; however, for the majority of candidates, extra marks could have been obtained if their answers were more specific regarding the process of radioactive decay, in particular to the action that takes place within the nucleus during the decay process.

With regard to the second part of the question, it was apparent that the majority of candidates were aware of at least one of the two methods that could be used to identify what type of radiation was emanating from each of the three given sources.

The first method involves passing emissions between the opposite poles of a magnet causing the particles to deviate, dependent of their inherent charge.

The second method would involve shielding the emissions using various barriers.

Question 3.7: a) If the formula of n-heptene is C_7H_{14} , calculate the quantity of carbon dioxide produced from 15 kg; and b) If 4 m^3 of n-heptene were burnt and the carbon dioxide produced subsequently released into a room measuring $10\text{ m} \times 5\text{ m} \times 3\text{ m}$, what percentage concentration of the air (by volume) would it produce; (Atomic masses: C = 12 O = 16 H = 1)

Only 108 candidates attempted this question and the majority of those unfortunately failed to obtain a pass mark.

For the candidates who were successful however, excellent scripts were received. These answers were presented in a logical sequence showing all workings at each stage of the answer.

If candidates who rely on calculators do not show their workings, in the event of an error it is impossible to award marks as the marker cannot trace the mistake. Thus, the importance of showing all workings cannot be overemphasised, even if the candidate cannot complete the question - due possibly to the stress associated in participating in an examination, or the absence of prior study.

Question 3.8: a) Define "hydrocarbons" and illustrate their structure by giving three named examples from the alkane series; and b) Explain the hazards associated with hydrocarbons and their relationship to other groups of chemicals.

Part one of this question was generally well answered and accompanied by neat accurate diagrams. The structures of propane C_3H_8 , Butane C_4H_{10} and methane CH_4 were most commonly described, however, many candidates appeared to have misread the question and failed to list the hazards associated with hydrocarbons, which are:

- flammable
- burns with excessive smoke
- intense heat during combustion
- toxic products of combustion

Many candidates also failed to recognise the differences and relationships between organic and inorganic chemicals, and that organic chemicals are divided into two groups; aliphatic and aromatic compounds.

Question 3.9: a) State Newton's Laws of motion; and b) The valve of a cylinder containing 12 kg of compressed gas is opened and the cylinder empties in 90 seconds. If the gas issues from the exit nozzle with an average velocity of 25 m/s, find the force exerted on the cylinder and the total momentum of the gas.

A pleasing number of candidates were well versed with Newton's Law and applied its principles accurately gaining full marks. Others

however, appeared to have lacked the knowledge that should have been gained through thorough pre-examination study, and restricted their answer to Newton's Third Law in the hope this would be adequate to gain a pass mark. For those candidates, minimum marks were awarded.

Question 3.10: A car of mass 1000 kg travelling at 72 km/hr is brought to rest by applying the brakes. Assuming that the kinetic energy of the car becomes transferred to internal energy in four steel brake drums of equal mass, find the rise in temperature of the drums if their total mass is 20 kg, the specific heat capacity of steel is 450 J/kg °C and the work done is equal on all drums.

139 candidates chose this question, 52 of those submitted excellent scripts that achieved full marks, congratulations!

This being the last question on this paper may explain why other candidates appeared to rush their answer, and by doing so made silly mistakes like failing to convert Km/hr to m/sec before using formula $\frac{1}{2}mv^2$ to ascertain kinetic energy. Others simply lost marks by the careless positioning of the decimal point, either in the workings or in the final answer.

Paper 4 - Management & Administration

Question 4.1: a) Outline McGregor's "Theory Y" in relationship to motivation; b) Expand this theory and compare "Theory Y" management behaviour in relation to the whole organisation.

The concept of theory 'Y' was clearly well understood by most candidates who achieved excellent marks. With regard to the second part of the question, some candidates gained excellent marks for submitting scripts that took an overview of not only McGregor's assumptions that promoted a user friendly environment within the organisation, but importantly linked that with Maslow's higher level needs that are the prime motivators at work according to Herzberg.

A few candidates however, appeared confused with the issues of motivation and responsibility against those of ambition and promotion, which suggests this subject is not yet fully understood.

Question 4.2: Discuss those aspects that must be considered before a counselling interview can be undertaken.

This was a basic management question that offered the opportunity for candidates to gain very good marks. The question required more than a list of generalities and candidates lost marks by not elaborating on issues such as a suitable room should be provided. Other candidates failed to understand the purpose of a counselling interview and didn't discuss:

- Is the counsellor competent?
- Is the counsellor able to set aside his/her own morality and prejudices to establish rapport.

Other areas of consideration are:-

- The gaining of sufficient personnel information
- Confidentiality
- Time allocation

All of these points carried with them either 2 or 3 marks, candidates are therefore advised that this is a common question and further study in this area should be undertaken.

Question 4.3: a) Describe the procedural items required for a meeting; and b) Detail the responsibilities of the chairperson.

For the majority of candidates with experience of committee work this question should have been a gift, yet disappointingly the highest mark achieved was 11.

Candidates should be mindful of the procedural items that are adopted at union meetings, station commanders meetings, parent/teacher association meetings, etc.

- Quorum
- Agenda
- Apologies for absence
- Minutes of the meeting
- Minutes accepted as true and correct record etc.

Candidates generally confused procedural items with that of chairperson's responsibilities, and again inaccurate scripts failed to gain valuable marks.

This subject is important for personnel development no matter what area of expertise you practice, and therefore it is an area that requires additional study.

Question 4.4: *a) Briefly describe five teaching methods which may be used in a classroom session; and b) Discuss how each could be used when giving a theory session.*

Unfortunately this question generally appeared to be misunderstood, with candidates being confused between what was asked for, a description of five teaching methods, and not that of teaching aids. Those who chose the latter again lost further marks in the second part of the question when they discussed how their teaching aids could be used.

Some candidates however, did achieve good marks by fulfilling the requirements of the question without repeating the same information in both parts.

Candidates are advised to carefully read the question, understand what is required, and formulate a structured answer.

Question 4.5: *a) Define the terms in relationship to Fire Service managers: (i) Command; (ii) Leadership; (iii) Management; and b) Briefly describe how these concepts interlink.*

This question generally suited the home candidates who provided a much clearer definition of the terms and their concepts of interlinking. Most overseas candidates, however, still received good marks by providing scripts based on local practice where a clear understanding of their concepts were demonstrated.

A valuable tool used by many candidates to support their answers to the second part of the question was a diagram. Candidates did not however, gain marks for the submission of detailed line management structures.

Question 4.6: *Outline the possible barriers to effective communication between individuals, which may hinder effective communication within organisations.*

The model answer consists of ten points for consideration, each attracting two marks. Examples of these are:-

1. Lack of clarity of message
2. Mistaken meanings
3. Intference

The requirements of the question were clear. The direction candidates should have taken was to discuss the barriers to effective communication, and in fairness many candidates did, but many strayed away and produced answers that detailed transmitters, receivers, radio procedures, inherent difficulties of the 2.2.4 duty system, currently being adopted by the Rome Fire Service candidates.

The examination marker has mentioned that home candidates generally based their answers on a common sense approach, whereas overseas candidates, due to the content of their answers, were better prepared for this question.

Question 4.7: *Describe the features of a performance appraisal procedure to enable management of an organisation to make best use of human resources.*

This was not a popular question but performance appraisals are an important aspect in many of modern management systems, i.e., performance management and investors in people (home candidates

only), and therefore it was envisaged that a better understanding of this concept would have been apparent in the fire engineering workforce.

Performance appraisals are generally about focusing on the individual, recognising his/her strengths or weaknesses, reviewing performance and agreeing a specific plan that identifies training targets for future development.

Question 4.8: *During an interview for promotion, the panel ask you to describe what you feel is the role of a supervisor. Briefly describe the points you would include in your answer.*

This was a very popular question and generally was well answered by both home and overseas candidates alike. The model answer consisted of 11 points to consider, such as:-

1. To organise and plan the work of the group in the short term.
2. To set standards of work and discipline.
3. To ensure effective training of workers.

Some candidates did however misinterpret the question and directed the answers along the lines of the qualities of a supervisor and not that of the role of the supervisor.

Question 4.9: *Efficient decision making processes are essential for long term strategic planning. Describe six simple steps, which could help to prevent a manager from jumping to conclusions.*

The question required a step by step rational, and was recently featured in the March 1999 edition of The Fire Engineers Journal on page 11.

The standard of candidates scripts varied greatly, some received were of an excellent standard, whereas other candidates failed to have carried out the necessary prior study in this area and failed to achieve a pass.

When attempting to answer a question of this nature candidates must adopt a systematic approach and provide a structured response, responding to the conception of the identity of the problem leading through the many stages to the review and evolution of whatever development plan was adopted.

Those candidates that did adopt this style of answer did attract the majority of passes for this question.

Question 4.10: *The study of group dynamics by Balbin identified eight roles, which could be adopted by group members. Briefly describe the roles.*

Two out of the ten candidates who attempted this very unpopular question, had obviously read and understood the article regarding the subject in the March 1996 edition of the Fire Engineers Journal. They must have undertaken an extensive course of preparation prior to sitting the exam, and therefore these two candidates achieved the full mark of 20. I offer you my congratulations.

At the other end of the scale, four candidates chose this question without any knowledge of the subject matter in the hope that extensive explanation of irrelevant issues would achieve valuable marks. Wrong, but you will be better prepared next year.

The model answer to this question consisted of:-

1. The chairman
 2. The shaper
 3. The fixer
 4. The resource investigator
- etc...

Intermediate Examination

Question 1: In relation to building construction, briefly explain the term 'sacrificial timber'.

The term sacrificial timber was well understood by the home candidates. The overseas candidates did appear to struggle with the term, and some relied on guesswork.

Question 2: Briefly outline the factors which affect the fire resistance of a concrete column.

The model answer for this question was:

1. Applied load
2. Type and strength of concrete
3. Dimension of the column
4. Method of reinforcement, and
5. Resistance to collapse

If candidates approached this question logically, they would have included these points, some candidates did become confused between the fire resistance of a column and causes of collapse.

Question 3: What types of automatic fire detection systems can be installed into buildings?

Most candidates achieved a pass mark for this question although only a few achieved full marks. Smoke, heat and flame detection systems were familiar to most candidates although only a few commented on air sampling systems.

Question 4: Briefly describe the principle of operation of a centrifugal pump

The pump impeller imparts a high velocity to the water, the pump casing transforms most of the velocity energy into pressure energy. This was the model answer.

A simple, but for a few, a searching question which allowed candidates to demonstrate their lack or depth of knowledge of the subject.

Question 5: Within the context of incident Command, briefly describe the term 'near miss'.

The term 'near miss' should have been fully understood by engineers working in the Fire Service but disappointingly there were a number of candidates who appeared to resort to guesswork in order to answer the question. I must remind candidates that command and

control type questions appear through all levels of the Institution of Fire Engineers examining process and therefore be prepared and read the associated bibliography.

Question 6: List the basic S.I. units and symbols for the following: a) force; b) velocity; c) energy.

The majority of candidates achieved a pass for the question stating the following definition:

1. Force = Newton (N)
2. Velocity = Metre per second (m/s)
3. Energy = Joule (J)

Question 7: Transpose the formula $L = \frac{2}{3} d^2 \sqrt{P}$ in terms of P

For most of the candidates to transpose this formulae proved difficult. The correct answer expressing the formulae for P was:

$$P = \left(\frac{3L}{2d^2} \right)^2$$

Question 8: In relation to chemistry, define the words 'compound' and 'mixture'

This question was well received and demonstrated an excellent basic knowledge of chemistry definition.

Question 9: List four key elements of an effective management system.

1. Policy
2. Organisation
3. Planning
4. Audit and Review of Performance

These were the four definitions taken from the model answer and proved to be a good test of management theory. Some overseas candidates used different terminology, and allowances were made for those differences.

Question 10: With regard to health & safety, what is a 'near miss'?

"A near miss is an unplanned and undesired event that could have resulted in harm or loss"
Generally this was a well understood term but only four candidates achieved full marks.

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Control and Communications - the New Examination

by W.C. Cox, MEd, BSc, CEng, MInstE, FIFireE and C. Norman, CEng, MICE, MInstrctE

For many years the Examination Committee of the Institution has been conscious that one part of the fire industry, namely the control and communications sector has not been catered for in its examinations system. In order to address that issue, the committee has been working with the Control and Communications special interest group to develop a suitable system.

The syllabuses have been produced and were published in the May issue of the Fire Engineers Journal. An explanation of the content and approach was given and comments invited. At that stage, no comments were received and work continued to produce a pilot examination.

This was held in May – at two centres in the UK and one in Northern Ireland – with a small group of volunteers, and it is very pleasing to be able to report the complete success of that venture.

The volunteers achieved the success they had hoped. The comments they made – immediately after sitting the paper and before the results were announced – were extremely favourable and particularly valuable as an indication of the way to proceed.

The net result is that the Control and Communications paper will be introduced into the normal round of international examinations to be held in March 2001, whilst the syllabus will be incorporated into the syllabus review process for the examinations to be held in 2003.

It is however worth repeating here that this paper is the alternative to the Fire Service Operations paper, and as such is the first option to be allowed in the Graduate examination. The three other papers (Science, Fire Safety and Management) must still be passed and the normal rules for membership must still be satisfied for a candidate to be given the Graduate membership. It is also the case that this Control and Communications paper will NOT be acceptable for the reciprocal Station Officers examination.

Using such a small and select band of volunteers limits the value of any examiners comments, and for that reason they are not included here, but the question paper used is reproduced below together with an indication of the answer and the reading list which was provided to the volunteers.

Graduateship Examination Control and Communications Pilot Examination

Held on Friday, May 19, 2000; 10.00 - 13.00

1. Explain the term pre determined attendance (PDA), as applied to mobilising Fire Service resources. Describe the difference between dynamic PDAs, i.e. those derived when the location of the resource is displayed in the control room or a map and the traditional approach based on the location of the resources' home station. List the advantages of dynamic PDAs.
2. Describe the constituent elements of a typical fire brigade wide area main radio scheme, utilising hill top sites linked to a control centre.
Explain the various methods used to link the hill top sites and the control centre.
3. Describe the facilities provided to:
 - a) firefighters; and b) control staff
 that may be provided by the use of vehicle fitted personnel computers and data transmitted to control room computer equipment.
4. Explain the term modulation.
Describe the methods used to modulate radio signals, used in Fire Service equipment.

5. Desk top computers are often linked together in a network. List the types of networks used for such links.
Discuss the advantages and the disadvantages of networking computers.
6. Describe the following terms when applied to sound: Loudness, Pitch, Noise
Briefly describe how the human ear detects sound indicating its range of response in terms of frequency and loudness.
7. Describe the two types of waves, including the terms frequency, speed, amplitude and wave length.
List the types of electromagnetic waves, their approximate frequency, their uses and their source.
List the types of radio waves, used in communications and broadcasting.
8. Describe the methods by which calls from the public and other sources are passed to Fire Service control rooms.
9. Briefly describe the functions carried out by a Fire Service control centre.
10. Describe the British Telecom emergency call handling system, including the BT operator call-handling procedure in passing an emergency call to an emergency authority.

Reading List

Please note that only some sections of the books listed will cover the syllabus. Students should reconcile the syllabus with the contents of the books listed.

Halliday, Resnick & Krane. *Basic Physics*. Volume 2 (4th edition). John Wiley & Sons.
 Avison, J. *The World of Physics*. Nelson.
 Gottfried. *Biology Today*. Mosley.
 Johnson, K. *GCSE Physics For You*. Hutchinson.
 Longman Revision Guides. *GCSE/Key Stage 4 Science*. Longman.
 Green, D.C. *Radio System Technology*. Longman.
 Kepits & Marx. *RDS The Radio Data System*. Artech House Pubs.
 Smith, M.S. *Introduction to Antennas*. McMillan
 Scroggie, M.C. *Foundations of Wireless & Electronics*. Newnes
 Rappaport, T.S. *Cellular Radio & Personal Communications*. IEEE
 Pellica, B. *Satellite Based Cellular Communications*. McGraw Hill
 Schweber. *Electronics Communications Systems*. Prentice Hall Int.
 Mazden. *Telecommunications Transmission Principles*. Pocal Pocket Guides
The Radio Amateur's Handbook. ARRL
Guide to EMC. RSGB
Microwave Handbook. RSGB
VHF/UHF Handbook. RSGB
Radio Communication Handbook. RSGB
Fire Service Manual Vol. 1: Physics & Chemistry. HMSO
Fire Service Manual Vol. 1: Communications & Mobilising. HMSO
Fire Service Manual Volume 2: Electricity. HMSO
 IFE Journal
 BAFCO Journal
 Mobile Communications

Pilot Examination May 2000 - Results

Alan Crawford	(N. Ireland)	Pass: Grade C
Robin Bigger	(N. Ireland)	Pass: Grade D
Christine Ferris	(Norfolk)	Pass: Grade B
John Linden	(Norfolk)	Pass: Grade B
Emma Coombs	(W Sussex)	Pass: Grade B