



THE INSTITUTION OF FIRE ENGINEERS
FOUNDED 1918 • INCORPORATED 1924

PRELIMINARY SYLLABUS

The Preliminary syllabus has been prepared as a series of well defined objectives with the intention that students can acquaint themselves thoroughly with the required subject matter. It is meant to provide a **clear structure** for your study plan.

The guide to the study materials required for this examination is contained in the reading list published on the Institution's website.

The Preliminary examination consists of 120 multiple choice questions which are derived directly from this syllabus.

Fire Engineering Science

1. Mathematics

1. Carry out mathematical processes involving:-
 - a) Measurements of areas and volumes
 - b) Identify and calculate the areas of rectangles, triangles and circles
 - c) Estimate the area of irregular shapes
 - d) Calculate the volumes of rectangular and circular tanks
 - e) Calculate the capacity of hose and pipelines

2. Physical properties of matter

- 2.1 Define and understand the terms:-
 - a) Density
 - b) Vapour density
 - c) Liquids of different density
 - d) Gases of different density
 - e) Matter and energy
 - f) Melting point, boiling point and evaporation

3. Mechanics

- 3.1 Demonstrate an understanding of:-
 - a) Motion
 - b) Momentum and force
 - c) Work, energy and power
 - d) Friction

4. Heat

- 4.1 Define heat and temperature and describe their relationship.
- 4.2 Demonstrate an understanding of how temperature is measured by:-
- a) Liquid thermometers
 - b) The air or gas thermometer
 - c) Using solids to measure temperature
 - d) Thermocouples
 - e) Electrical resistance
 - f) Thermistors
 - g) Comparison by brightness
 - h) Infra red
 - i) Thermometric scales
 - j) The Celsius or Centigrade scale
 - k) The Fahrenheit scale
 - l) The Kelvin scale
- 4.3 Understand the various units of heat:-
- a) The Joule
 - b) The calorie
- 4.4 Demonstrate knowledge of:-
- a) Specific heat
 - b) Change of state and latent heat
 - c) Latent heat of vaporisation
 - d) The effect of change of pressure on the boiling point and latent heat
 - e) Latent heat of fusion
 - f) Cooling by evaporation
- 4.5 Describe the processes of:-
- a) Conduction
 - b) Convection
 - c) Radiation

5. Thermal expansion

- 5.1 Understand the principles involved with:-
- a) The thermal expansion of solids
 - b) The coefficient of linear expansion
 - c) Thermostats
 - d) The coefficient of superficial and cubical expansion of solids
 - e) Thermal expansion of liquids
 - f) Cubical expansion
 - g) The effect of expansion on density
 - h) The expansion of gases
 - i) Temperature, pressure, volume
- 5.2 Define and understand the Gas Laws i.e
- a) Boyle's Law

- b) Charles' Law
- c) The Law of Pressures
- d) The General Gas Law

5.3 Understand the basic principles involved with:-

- a) The liquefaction of gases
- b) Critical temperature and pressure
- c) Liquefied gases in cylinders
- d) Sublimation

6. Hydraulics

6.1 Know the properties of water

6.2 Understand:-

- a) The principle characteristics of pressure
- b) The relationship between pressure and head of water
- c) The loss of pressure due to friction
- d) That energy changes in water streams

7. Chemistry

7.1 Understand basic chemistry including:-

- a) Atoms and molecules
- b) Compounds and mixtures
- c) Basic elements and their symbols
- d) The use of symbols to write formulae
- e) Simple radicals and their symbols
- f) Atomic mass
- g) Molecular mass
- h) Valency
- i) Nomenclature
- j) Simple equations
- k) The triangle of fire (Fire Triangle)
- l) Heat of reaction and calorific values
- m) Flashpoint, firepoint and sustained fires
- n) Ignition
- o) Spontaneous ignition temperatures
- p) Self-heating and spontaneous combustion

7.2 Explain how fires are extinguished by:-

- a) Starvation
- b) Smothering
- c) Cooling

7.3 Explain the action of the following fire extinguishing media/methods, i.e.

- a) Water
- b) Inert gas
- c) Foam
- d) Vaporising liquids
- e) Carbon dioxide and inert gases
- f) Dry chemical powders
- g) Blanketing

h) Beating

8. Electricity

- 8.1 Define the terms:-
- a) Volts
 - b) Ampères
 - c) Ohms
 - d) Watts
 - e) Joules
- 8.2 Define and understand Ohm's Law
- 8.3 Explain the significance of conductors and insulators
- 8.4 Explain the reasons for providing earth connections and other protective devices to electrical circuits

Operations

1. Incident command

- 1.1 The impact of health and safety on the incident ground
- 1.2 Initial stage of incident
- 1.3 Development stage of incident
- 1.4 The closing stage of incident
- 1.5 Definitions relating to incident command
- 1.6 Incident command structure
- 1.7 Lines of command
- 1.8 Span of control
- 1.9 Shared responsibility and authority – roles in the incident command system
- 1.10 Sectorisation of incidents
- 1.11 The use of breathing apparatus at an incident:-
- a) Demonstrate a knowledge of the precautions to be taken when donning Breathing Apparatus
 - b) Demonstrate a knowledge of breathing apparatus entry control procedures
 - c) Know the basic procedural rules to be followed by breathing apparatus wearers
 - d) Describe the principles involved in searching while wearing breathing apparatus
 - e) Know the breathing apparatus line signals

2. Rescue

- 2.1 Understand the basic principles involved in evacuating and searching for casualties

2.2 Understand basic methods of rescue

3. Firefighting

3.1 Demonstrate a basic knowledge of how to tackle:-

- a) Chimney fires
- b) One room fires
- c) Duct fires
- d) Roof fires
- e) Basement and underground fires
- f) High rise building fires

3.2 Understand the advantages and limitations of using hose reels

3.3 Demonstrate the principles of operating with hose lines at any level, including the use of breechings and variable branches

4. Ventilation and salvage

4.1 Understand the value of ventilation

4.2 Know when and how to ventilate, e.g. PPV

4.3 Understand the benefits of damage limitation at an incident

4.4 Demonstrate knowledge of various methods of limiting damage to a building on fire and in neighbouring premises

5. Appliances and equipment

5.1 In relation to pumping appliances:-

- a) Understand the advantages and disadvantages of the various pump mounting positions
- b) Understand the general principles involved in getting pumping appliances to work

5.2 In relation to pumps and primers:-

- a) Describe the three categories of pumps
- b) Describe five types of pumps i.e:-

Force
Lift
Bucket and Plunger
Rotary
Centrifugal

(N.B. a detailed knowledge of pump characteristics is not required)

c) Describe the operation of the following:-

Primers
Pistons
Exhaust gas ejector
Rotary – water ring

- d) Describe how to get a pump to work from a hydrant
- e) Describe how to get a pump to work from open water
- f) Identify and rectify pump faults

- 5.3 In relation to delivery hose:-
- Explain the construction and characteristics of hose
 - Know how to take care of hose
 - Know the causes of damage to hose
- 5.4 In relation to branches and nozzles, understand the design and operation of various hand held branches, controlled and uncontrolled
- 5.5 In relation to ropes and lines:-
- Understand the differences between natural and man made fibre rope
 - Describe the lay of a rope
 - Know the causes of deterioration in rope
- 5.6 In relation to fire extinguishers, demonstrate a knowledge of the method of operation and appropriate use of the following:-
- Water type – gas cartridge
 - Water type – stored pressure
 - Foam type – stored pressure
 - Dry powder type – stored pressure
 - Dry powder type – gas cartridge
 - Carbon dioxide type
- 5.7 In relation to firefighting foams:-
- Describe the classification of foam
 - Describe the properties of foam in relation to its expansion
 - Explain the uses of protein, fluoro chemical and alcohol resistant foam
- 5.8 In relation to foam making equipment:-
- Describe the principles of operation of a low expansion foam branchpipe
 - Explain the principles of operation of a low expansion foam generator
 - Explain the principles of operation of a high expansion foam generator
- 5.9 In relation to Breathing Apparatus:-
- Describe the composition of air before inhalation and after exhalation
 - Describe the circuit flow of Breathing Apparatus
 - Calculate the working duration of Breathing Apparatus
 - Describe the use of a personal line and a guide line for use with Breathing Apparatus
- 5.10 In relation to ladders:-
- Describe the construction of a 10.5 m ladder
 - Describe the construction of a 13.5 m ladder
 - Demonstrate knowledge of pitching and working from 10.5 m and 13.5 m ladders

Fire Safety

1. Elements of construction

- 1.1 Explain the graphical symbols used for fire protection drawings
- 1.2 Outline the use to which the following building materials are put and comment on their behaviour in fire:-
 - a) Timber
 - b) Stone
 - c) Brick
 - d) Cement
 - e) Concrete (reinforced and pre-stressed)
 - f) Metals
 - g) Glass
 - h) Building boards and slabs
 - i) Insulating materials
 - j) Paint
 - k) Plastics
 - l) Insulating boards
- 1.3 Recognise the following elements of structure, state their function and comment on their fire resistance:-
 - a) Columns
 - b) Beams
 - c) Walls
 - d) Floors
 - e) Roofs
 - f) Non-load bearing walls and partitions
 - g) Stairways
 - h) Doors
 - i) Windows
 - j) Roof lights
 - k) Ceilings

2. Fire safety practice

- 2.1 Outline the basic principles of means of escape in case of a fire
- 2.2 Outline the principles of the provision of access for fire appliances to buildings for firefighting purposes
- 2.3 Outline the main causes of fire in the home
- 2.4 Describe two common types of behaviour that lead to fires starting in the home
- 2.5 Describe the two main functions of a domestic smoke alarm
- 2.6 Outline the main points to bear in mind when installing a domestic smoke alarm
- 2.7 Describe the actions to be included in an escape plan for the home
- 2.8 Describe the advice that should be given about tackling a fire in the home and two types of fire

extinguisher that may safely be used

2.9 Outline the advantages of domestic sprinkler systems compared with smoke alarms

3. Fixed installations

3.1 Outline the basic design features, use and operation of the following types of fixed installations:-

- a) Sprinkler systems
- b) Drencher and water spray projector systems
- c) Rising mains
- d) Hose reels
- e) Foam systems
- f) Gas/vapour systems
- g) Dry powder systems