Technica
CONSULTING SCIENTISTS & ENGINEERS

11 John Street, London, WC1N 2EB
01-242 7893/4

Personnel Evaluation - Technical Staff

WRITTEN TEST

NOTE: This test is designed to evaluate the broad range of skills in technical analysis and written expression that are required in the day-to-day work of a science and engineering consultancy. As far as is practicable, we wish you to work under 'office' conditions rather than 'examination' conditions when taking this test, so please note the following:

(i) if you require guidance or clarification, contact ..... by phoning extension .....

(ii) the time guides are meant to be taken reasonably seriously but not as rigid limits (i.e. - time matters, but if an extra few minutes will see the question completed, you can have them)

(iii) coffee and tea are available at all times.

QUESTION 1 TIME GUIDE : 30 MINUTES

The Manager of your Head Office has asked your advice on the installation of a fire detection system in the main office building, which houses management offices, display showrooms and conference rooms. He has heard that three types of detectors are available: flame detectors, heat detectors and smoke detectors. He has asked you to recommend which type he should evaluate in detail and to mention any specific points he should look out for.

Base your reply on the information below, omitting anything you feel is redundant. Write a memorandum of about 150 - 200 words making a clear recommendation. Do not include any graphs or diagrams.

1. All modern systems connected to a control board through a cable network.
2. Fire starts ⟶ triggers detector ⟶ alarm indicated at control board and (if desired) automatically relayed to local fire service.
3. Smoke detector: reacts to combustion particles formed as fire starts, often before flame can be seen.
4. Heat detector: reacts to rise in temperature. Sets off alarm when temperature near detector reaches predetermined level, commonly 70°C.
5. Flame detector: reacts to varying infra-red light from an open flame. Sets off alarm when hit by varying infra-red light.
6. At control board: both optical and acoustic signals can be given.
   - layout of board can show quickly where alarm has been set off
   - separate fault signal can be set off if fault occurs in cable network
   - mechanism to monitor mains power supply continuously can be installed.
7. Smoke detectors may be triggered by activities that produce much smoke, for example laboratory work, operation of motor trucks in enclosed space or welding. Other detectors therefore desirable in such areas.

Cont'd.....

8. Desirable to install a system that operates even in event of mains supply failure. Require mains supply and battery supply connected in parallel so that system will operate even if mains power supply fails.

9. Development of a fire: early stages - incomplete combustion releases certain particles and gases before open flame and heavy smoke develop and before temperature rises significantly. Smoke detector triggered by these particles and gases.

10. Production of flames visible to an infra-red detector or of temperature rise detectable by ceiling-mounted heat detector set at 70°C requires substantial progress of fire.

11. Smoke-, heat-, and flame-detectors can all be linked into same fire-protection system. Together they can cover varying demands in any building. Installation of any one type does not preclude subsequent installation of other type.

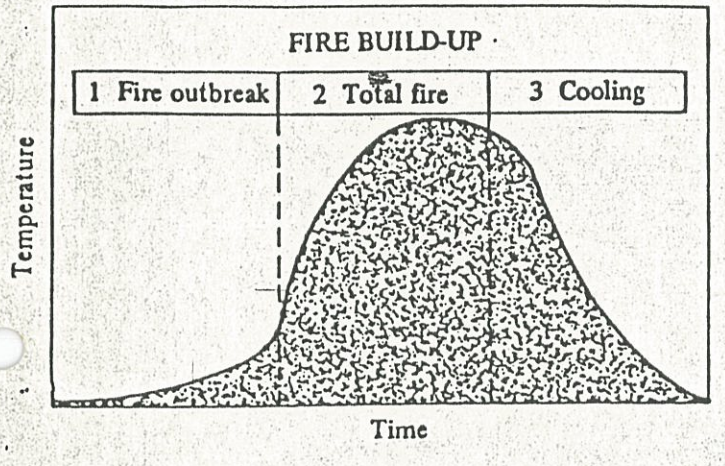


Fig. 1 Characteristic progress of a fire: 1. heating up to out-break of flame; 2. ignition of flame and rapid development of total fire; 3. cooling to smouldering ash.

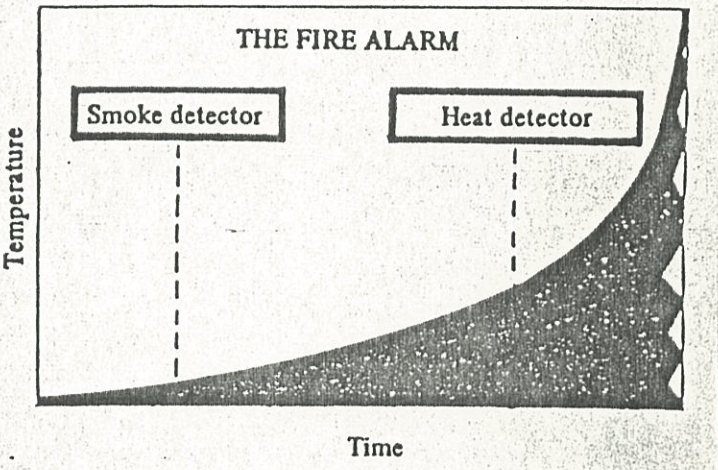


Fig. 2 Alarm set-off points for a smoke detector and a heat detector for a characteristic office fire.

Cont'd.....

QUESTION 2 TIME GUIDE : 15 MINUTES

'Industrialisation is the only hope of the poor. Health, food, education: nothing but the industrial revolution could have spread them right down to the very poor.'

Discuss:-

(a) How far you think this statement ~~was~~ is true ~~in the past~~ at present,

and

(b) How valid you think it is for the future.

REVISED QUESTION

North Sea oil has been of great benefit to the economy of Norway as a whole. It has given the Norwegian economy a great advantage over the other Scandinavian countries.

Discuss :—

(a) as above

(b) as above

Cont'd.....

QUESTION 3 TIME GUIDE : 20 MINUTES

Suppose that a section of chemical plant contains a flammable non-toxic liquefied gas under pressure and well above its normal (atmospheric pressure) boiling point and that, due to some mischance, a complete severance of one of the lengths of pipework in this section occurs.

List (but do not discuss) all the factors you can think of that would affect the magnitude of the harm that could be caused among the local population and the workforce.

Number your list and put the factors in order of significance for:-

(a) the local population

and

(b) the workforce, separately, by listing the factor numbers starting with the most important and ending with the least.

Now suppose that a radio transmitter is built near to the plant and this induces currents in the equipment which could, under certain circumstances, cause sparks. What effect could this have on risks to the local population and to employees? (NOTE: Do not discuss at length. All that is required is a statement of the effects.)

QUESTION 4 TIME GUIDE : 25 MINUTES

NOTE: There is a second part to this question on the next page; allow time for this.

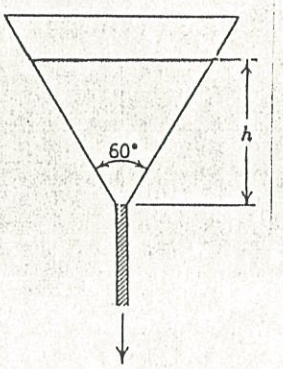
(a) Find, by whatever precise or approximate method you feel is appropriate, the positive value of x which satisfies the equation

$$x = 2 \sin x \qquad (x \text{ in radians}).$$

Your result should be accurate to three significant figures.

Indicate on your worksheet which methods you considered using, and the reasons for your choice.

(b)



A conical funnel whose angle at the outlet is 60° and whose outlet has a cross-sectional area of 0.5 cm^2, contains water. At time t = 0 the outlet is opened and the water flows out. From Torricelli's law, the velocity with which a liquid issues from an orifice is

$$v = 0.6\sqrt{2gh}$$

where g = 980 (cm/sec^2) is the acceleration due to gravity at the surface of the earth and h is the instantaneous height of the liquid above the orifice in cms., and v is measured in cms/sec.

Determine the time when the funnel will become empty, assuming that the initial height of water is h(0) = 10cm.