

**INSTITUTION OF RAILWAY SIGNAL ENGINEERS  
2009 EXAMINATION**

**MODULE 1 - SAFETY OF RAILWAY SIGNALLING AND  
COMMUNICATIONS**

**TIME ALLOWED - 1 HOUR**

ANSWER **TWO** QUESTIONS, ALL QUESTIONS CARRY EQUAL MARKS

WRITE ON ONE SIDE OF THE PAPER ONLY, AND NUMBER EACH SHEET THAT YOU  
USE CONSECUTIVELY

COMMENCE YOUR ANSWER TO EACH QUESTION ON A NEW SHEET OF PAPER

ANSWER SHEETS WILL BE PHOTOCOPIED – PLEASE USE ONLY BLACK INK

**Question 1**

During a station refurbishment project, a temporary wall is to be erected on the platform to allow building work to take place whilst trains are running. The station will remain open.

The temporary wall will affect the existing signalling and telecommunications systems in a number of ways:

- i) Visibility of the station starting signal and access to the associated Signal Post Telephone (SPT) will be restricted.
- ii) For several hours each day, when building work is taking place, maintenance access to a number of signalling and telecommunications equipment cases will be impossible.
- iii) Access to various devices (e.g. Train Ready To Start Plungers, Right Away Plungers and Emergency Stop Plungers) and passenger 'Help Points' (e.g. information systems and fire alarms) will be impossible.

Describe a range of measures which should be considered in order to address items i), ii) and iii) and to ensure the safe and efficient operation of the railway. [9 marks]

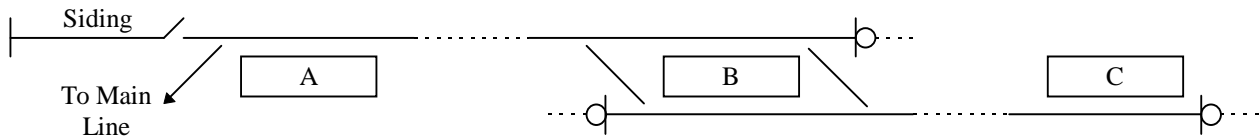
Describe a generic process which will allow you to determine the preferred solution in each case. [10 marks]

How should the safety of your preferred solutions be documented? [6 marks]

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## Question 2

A single-track branch line serves stations 'A', 'B' and 'C', as follows:



...○ denotes a friction arrestor.

Journey times: 'A-B' 11 minutes, 'B-C' 7 minutes.  
Minimum platform dwell times: 'Reversing' 5 minutes, 'straight through' 1 minute.  
Timetabled recovery time: 10%

The connection to the Main Line is only used for empty trains and may be ignored.

Two trains are normally used to provide a service of a train every 30 minutes in each direction, passing at 'B'. The signalling at 'B' has a separate local interlocking which is controlled remotely from a control centre at 'A'. Only one train can occupy either of the sections 'A-B' or 'B-C' at any given time.

Describe two degraded methods of operation which may be appropriate in the event of a complete failure of the control system data link between 'A' and 'B'.

- Method 1 should assume that there is a local control panel available at 'B'.
- Method 2 should assume that no local control panels are provided.

Your answer should identify any risks inherent in each proposed method of operation, and describe any mitigating measures which are necessary. [25 marks]

## Question 3

You are required to design a system to monitor and analyse safety failures of all operational signalling or telecommunications equipment. What would the specification for the system need to include? [17 marks]

How would you implement the system across a large railway network? [8 marks]

Paper continued on next page

#### **Question 4**

A railway is equipped with colour light signalling and a secure radio system.

Describe three different methods which could be provided for a signaller to stop a train in an emergency. Include in your description the manner in which the control is applied by the signaller, the manner in which the control is received by the driver, the effectiveness of the control and the impact on the operation of unaffected parts of the railway. [15 marks]

How is the signaller's training and competence affected if there are different methods of stopping trains in an emergency? How may the signaller's competency be maintained? [5 marks]

How can the design of the secure radio system influence the effectiveness of the control and the impact on the operation of the unaffected parts of the railway? [5 marks]

#### **Question 5**

A major resignalling or renewal of a major operational telecommunications system is being planned.

Explain the major stages in the project lifecycle. [7 marks]

Describe how safety can be assured through each of these major stages. Include in your response:

- A definition of risk
- An explanation of quantitative risk assessment and qualitative risk assessment
- How cost benefit analysis can be used [12 marks]

How can the project management assure that the original project requirements can be met? [6 marks]

#### **Question 6**

Discuss how legislation, standards and good practice contribute to the safety of the railway system. [25 marks]

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### Question 7

On a multiple-aspect signalled line, a train has entered an occupied section which is not permissively worked. The train driver claims that the protecting signal was showing a proceed aspect.

- a) What immediate action should be taken? [5 marks]
- b) Describe five possible causes for this scenario. [10 marks]
- c) Describe a procedure to manage the investigation of this scenario with reference to one or more of your five possible causes. Your procedure should address the actions and authority necessary if a failure of the equipment is identified and similarly if a failure of the equipment is not identified. [10 marks]

### Question 8

A two track railway is 100km long with multiple aspect signalling in the normal direction of travel. Signals are spaced approximately every kilometre and the line is equipped with automatic train protection. The line is fitted with double cross-overs at 10km intervals permitting running moves from the normal running line to the other line in the wrong-direction and back again.

Each line is signalled for reverse direction moves but signals are only provided to protect the cross-over points; these signals are provided with distant signals. No train protection system is provided for the reverse direction movement nor is there any suppression of the right direction train protection.

- a) Sketch this arrangement for a representative 15km section of the railway. [4 marks]
- b) Carry out a risk assessment of all aspects of the operation including maintenance and the operation of infrequent wrong direction movements. [16 marks]
- c) Briefly identify possible mitigations for the risks that you identify. [5 marks]

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