

**INSTITUTION OF RAILWAY SIGNAL ENGINEERS
2018 EXAMINATION**

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

TIME ALLOWED – 1 1/2 HOURS

ANSWER **THREE** 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

- a) Sketch and label a set of points. Include the arrangement of rails, mechanical fixings and the operating mechanism associated with the points (for example the point machine). Identify and describe the key features that ensure safety. [17 marks]
- b) What tests would you expect to undertake when commissioning a set of points to confirm that the installation has been achieved in a safe manner. [8 marks]

Question 2

Safety needs to be reassessed when a change is made. For any three of the following describe the safety-related characteristics that need to be taken into account when:

- i) A new design of train is introduced on a route
- ii) A track layout is re-signalled
- iii) A new lineside telephone system is installed
- iv) The timetable is changed
- v) There is a change in operating practice
- vi) There is a change in organisational structure
- vii) An area is re-controlled [25 marks]

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Question 3

- a) Briefly describe three methods to mitigate the risks associated with an overlap of sub-standard length. These should include:
- i) one that relies purely on the railway's operating practices;
 - ii) one that relies purely on new or amended trackside equipment; and
 - iii) one that relies on a combination of operating practices, trackside and trainborne equipment. [6 marks]
- b) Identify the main advantages and disadvantages of implementing each method. [9 marks]
- c) Describe how you would determine the most suitable mitigation, explaining the factors that you would take into consideration. [10 marks]

Question 4

Traditionally, many railway administrations have provided lineside telephones at a variety of locations including at every signal. With increased use of cab radio equipment where the driver and signaller can contact each other directly, the need for lineside telephones has reduced.

- a) Propose a risk-based set of rules that could be applied to a major re-signalling scheme to determine the quantity and location of lineside telephones. Describe the risks being controlled and how your rules mitigate these. [20 marks]
- b) How would you agree these rules with affected parties? [5 marks]

Question 5

Many modern signalling installations and trains record real-time data from a variety of sources.

- a) Describe how this data can be used:
- i) to support accident and incident investigation after the event; and
 - ii) proactively to prevent safety-related incidents. [10 marks]
- b) What are the factors that determine the management arrangements for the data? [10 marks]
- c) How would you decide whether it is cost-effective to acquire and process the data? [5 marks]

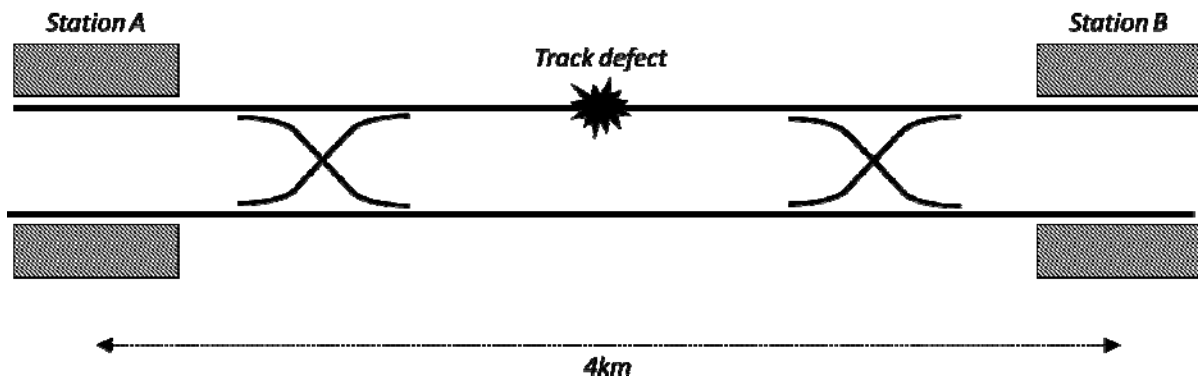
Question 6

- a) A project is remodelling a major station with extensive alterations to the track and signalling. Describe the hazards that might arise and their potential consequences if effective arrangements are not in place for version control of the design. [8 marks]
- b) What processes should you put in place to prevent these hazards arising? [6 marks]
- c) Even with good processes an error is still possible. What controls should you put in place to mitigate the consequences of the error? [6 marks]
- d) What design information should you provide to support the signalling system throughout its whole life? [5 marks]

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Question 7

There is a two-track railway between Station A and Station B. The stations are 4km apart.



During the day a track defect has been found on one line that requires that line to be closed.

- a) Describe a method to continue passenger movements between Station A and Station B:
 - i) if both lines are signalled for bi-directional moves
 - ii) if both lines are only signalled for uni-directional moves, but the points are provided with powered control for engineering purposes. [10 marks]
- b) What risks may be encountered for each of the methods of operation? [5 marks]
- c) What measures can you use to mitigate the risks? [5 marks]
- d) Explain the factors that would affect the mitigations chosen. [5 marks]

Question 8

- a) Why are shunting movements often made under the control of a person on site (shunter), even at locations where the signalling system includes shunt signals? [8 marks]
- b) What precautions can be taken to reduce the probability of error when each of the following means of communication between the shunter and the driver are used:
 - i) Hand signals during daylight
 - ii) Hand signals at night
 - iii) Voice radio [9 marks]
- c) Describe a risk assessment process that the railway operating company could use to identify and mitigate risk arising from the shunting activity. The mitigation can include the use of procedures and/or technology. [8 marks]

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Question 9

A railway engineering organisation is in the process of improving its competence management system.

- a) What should the competence management system include? [10 marks]
- b) A signalling technician has been found to have made an error during testing. Describe a scenario for the error and how it may have been discovered. [5 marks]
- c) What action should be taken as a consequence of the failure? [3 marks]
- d) How should the Competence Management System be used to prevent reoccurrence? [4 marks]
- e) How would you manage the risks arising from staff members that are not yet competent? [3 marks]

Question 10

Your company's Research and Development (R&D) department has produced a new piece of equipment for a safety-critical or safety-related application. They provide equipment for many types of railway projects, but have no detailed knowledge of specific railway applications for their output. This particular device is computer-based, where previously you have always used simple switches and buttons to achieve the same functionality. This device is to be used in your forthcoming commissioning.

- a) As the Project Safety Engineer, list and describe the documentation and safety data that you would expect to be supplied with in order to demonstrate the safety assurance for this application. [10 marks]
- b) Working with the R&D department, what further activities would you expect to have to undertake to confirm that this new piece of equipment will work safely on your particular project? Your answer should include details of the information you would need from your customer to complete this activity. [9 marks]
- c) Describe a process you would follow, after commissioning, to help demonstrate to the customer that the safety requirements have been achieved. [6 marks]

End of paper