# INSTITUTION OF RAILWAY SIGNAL ENGINEERS 2010 EXAMINATION

## MODULE 3 - SIGNALLING PRINCIPLES

## TIME ALLOWED - 1 1/2 HOURS

#### EITHER ANSWER ALL OF PART A AND ONE QUESTION FROM PART B OR ANSWER THREE QUESTIONS FROM PART B.

## 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

#### Please read carefully these notes applicable to Part A:

If your control table entries include numbered 'standard' notes, then **you** must show the examiner that **you** know the meaning of the numbers you have used, a reference to where you found them is not sufficient.

Control table entries involving time are more likely to get marks if the value is reasonably close than if it is entered as just 't'. You will not lose marks for a difference of a few seconds but you should show that you know the difference between 5 seconds and 30.

You are not required to include a drawn/checked/issued and date box.

If your interlocking is part electric/electronic and part mechanical, the locking for both should be shown.

You are not required to include a drawn/checked/issued and date box

Tell us which railway's practice you have followed and state any assumptions you make.

#### PART A

Using the attached **layout 3**;

1. Give the full Interlocking and Controls for the following signalled routes:

473B (M), 488B (M, W and C), 468C (S)

2. Give the full interlocking and controls for the following points:

137 and 148

[50 marks]

## PART B

#### ALL QUESTIONS IN THIS PART CARRY EQUAL MARKS

#### Question 1

A signalling system based on UK mainline practice uses aspects of Green, Double Yellow, Single Yellow and Red.

Explain any rules which you would expect to apply relating to the absolute and relative separations of the signals with relation to the minimum stopping distance of the different types of train using the route. [9 marks]

In a particular situation, it is required to bring a train closer to an occupied station such that potentially the yellow to red distance will be relatively short compared to the minimum stopping distance. Discuss the risks of uneven signal spacing or an additional (or closing up) signal at significantly less than normal signal spacing, proposing any special controls which could be applied for this situation. [8 marks]

Discuss the risks of drivers receiving repeated cautionary aspects on a regular basis and any considerations when designing aspect sequences with repeated cautionary aspects.

[8 marks]

#### **Question 2**

A railway operates an urban and inter-urban rail service utilising lineside signals at speeds up to 100MPH (160km/h). It is proposed to replace the current 144m long trains with trains of 184m length.

Identify three issues of infrastructure compatibility which need to be considered. [3 marks]

At stations, the stopping positions are going to be closer to the existing signals. The administration is considering moving the signals or extending the platforms in the rear. Describe the advantages, disadvantages and commercial implications of the two options. [10 marks]

At two locations it is not possible to relocate the signal or extend the platform, requiring the train to stop approximately 1.5m from the signal. Describe two possible solutions to enable the train driver to be fully aware of the signal aspect taking account of modern multiple unit design features such as restricted visibility. (Novel, practical solutions will achieve extra credit).

[12 marks]

## Question 3

Describe briefly, with the aid of diagrams, two methods of signalling control of a single line between two different signalling control centres or signal boxes. [9 marks]

Describe the advantages and disadvantages of each method in the following areas:-

- Integrity of the signalling system,
- The quantity of trackside equipment and communications,
- Management of failures,
- Operational flexibility.

[16 marks]

#### **Question 4**

Different railway administrations utilise "distance to go", "route based" or "speed" signalling, sometimes in combination.

Briefly describe how one of the above styles is implemented. [7 marks]

Identify the information a driver requires from any signalling system in order to correctly manage the train. [6 marks]

Describe how each style of signalling provides the required information to the driver including the potential for errors by the signaller or driver to be managed. [12 marks]

#### **Question 5**

A double track commuter line is to have its rush hour train frequency increased to the extent that ATO will be required to run a regular service with platforms that are only just long enough for the rush hour trains. Off peak services are shorter, less frequent and use a range of train types. Describe an ATP/ATO system suitable for the peak, and without ATO, for the off peak services. [25 marks]

#### Question 6

Describe a system for detecting and reacting to SPADs [Signals Passed at Danger] which is resilient to legitimate moves, rapid in response, and only affects train movements in the immediate vicinity of the SPAD. [25 marks]

## **Question 7**

Two double track main lines share a junction. There are at least four ways of laying out the junction as shown below:



i) Traditional double junction with plain diamond

Discuss the risks, possible control mitigations, and criteria for selecting both the layout and controls, which may include additional point work. [25 marks]

#### **Question 8**

Describe the features and method of operation of a staff protection system suitable for use where a number of staff are required independently to work on a train occupying either of a pair of tracks between platforms (as shown in the diagram below) during the 20 minute intervals between services.



#### **Question 9**

Discuss what weather and other factors can affect the performance of trains operating with a fixed or moving block ATP system. Discuss how these factors may be safely fed into the system on a daily basis. [25 marks]

#### **Question 10**

Draw an aspect sequence chart for all signals, routes and classes of route shown on the diagram on the next page. Include with your aspect sequence chart an explanation of any assumptions or controls you have included. [25 marks]

#### **Diagram for Question 10**



End Of Paper.