

Faculty of Engineering Technology

Written Exam	Rail Transport
Teacher	Van Zuilekom, Van Es
Course code	201100013
Date and time	Monday 13-6-2016, 8:45-11:45 hour.
Location	Hall B 2E.
Remarks	Closed book, calculator allowed Formulas and tables are, when necessary, are part of the question. Print in colour

Calculation of the marks for the written exam, C :

$$C = 1 + 9 \cdot \frac{P}{P_{max}}$$

Where P is the sum of points and the maximum number of points is P_{max} .

Available time is 180 minutes. The points per question roughly reflect the time needed for answering the question.

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Question 1 [10 points] Travel time ratio

On a journey from A to B the travel time ratio ($TTratio$) is defined as travel time by public transport ($TT_{publictransport}$) divided by the travel time by car (TT_{car}):

$$TTratio = \frac{TT_{publictransport}}{TT_{car}}$$

Give comment on the following statements:

- a) [3 points] The $TTratio$ is of limited relevance for share of the choice passenger.
- b) [3 points] The $TTratio$ is of limited relevance for share of the captive passenger.
- c) [4 points] The $TTratio$ is of large importance for share of the public transport operator especially in specific situation.

Illustrate the answers with a graph with $TTratio$ on the X-axis and *Share of Public Transport* on the Y-axis.

Question 2 [4 points] Load capacity

There is a big difference in the amount of containers carried by one single train in the United States compared to Europe.

Intermodal goods trains in the United States can carry roughly four to six times the amount of containers of a European intermodal goods train.

- a) [2 points] Give two reasons for the difference in load capacity.
- b) [2 points] Explain why European goods trains can't carry the maximum load of a US intermodal goods train.

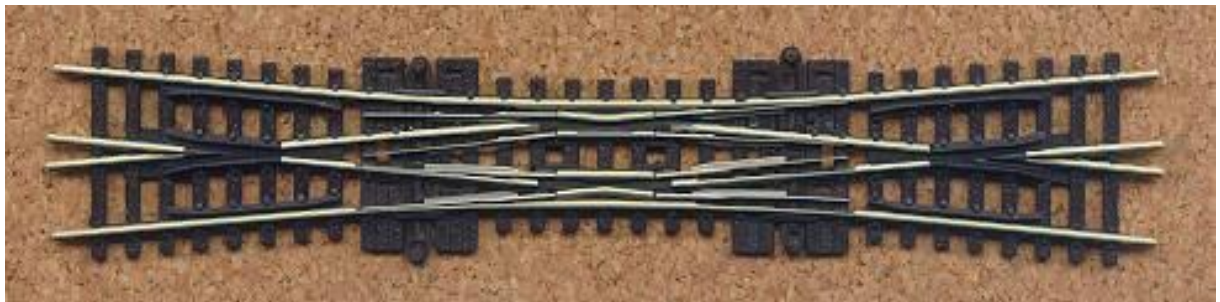
Question 3 [6 points] Rubber versus steel



Some guided transport systems like e.g. Paris metro lines have rubber tyres instead of (full) steel wheels.

Name two advantages and one disadvantage

Question 4 [6 points] Double slip



A Double Slip is a specific type of turn-out.

- [2 points] Describe it's functionality in terms of regular turn-outs and / or crossings.
- [4 points] It has several (dis) advantages. Name two.

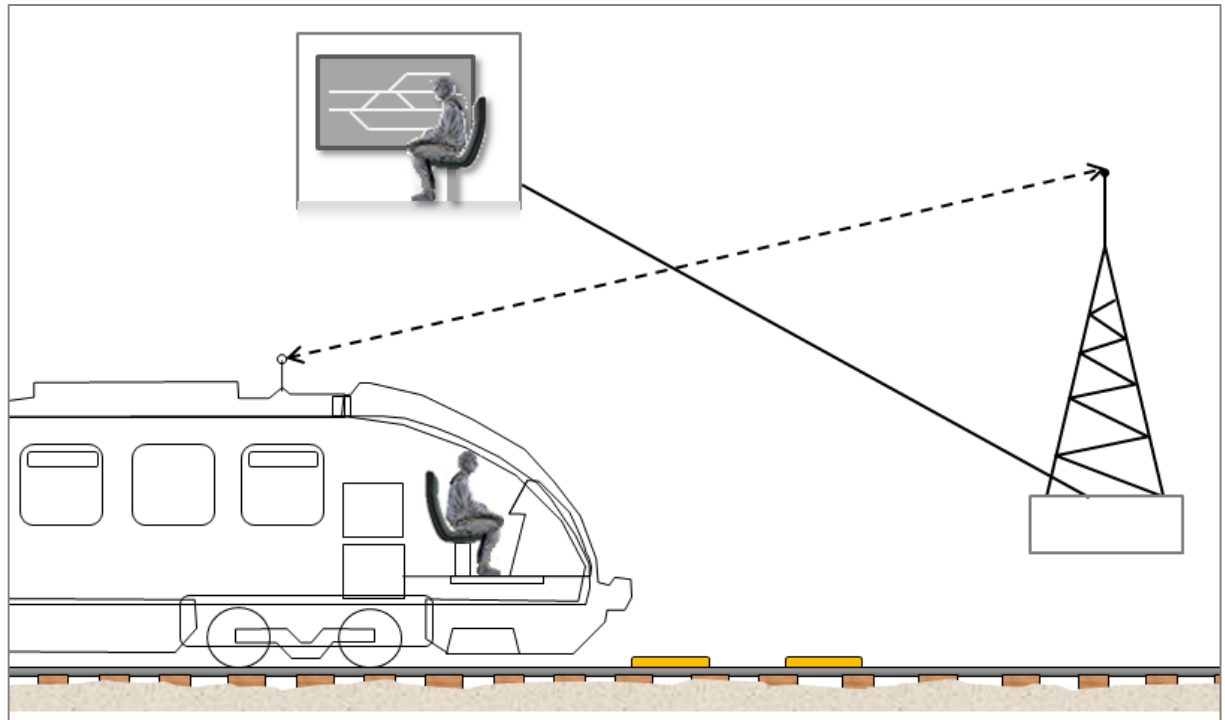
Question 5 [4 points] Subject

The requirements for a train platform are:

- a gradient of less than 1‰ in longitudinal axis and;
- a horizontal curve with a radius of at least 15000 meter.

Explain why.

Question 6 [12 points] ERTMS components



- a) [6 points] Where are the following six components of ERTMS located in the picture above? Use the answering form in the appendix of this exam to answer the question.
1. DMI (Driver Machine Interface)
 2. Eurobalise
 3. GSM-Rail
 4. IXL (interlocking)
 5. RBC (Radio Block Centre)
 6. STM (Specific Transition Module)
- b) [6 points] What is the function of these six ERTMS components (the list in above) within ERTMS-system?

Question 7 [4 points] Signal aspects

Complete the schemes with the missing signal aspects 1, 2, 3 and 4. And, if applicable, add speed indication.

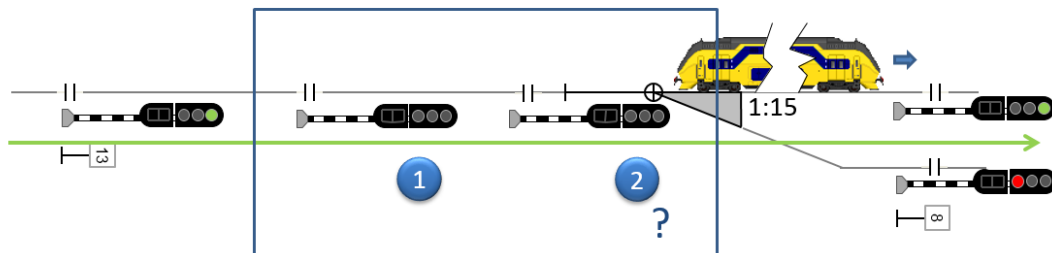
N.B. the distance between two signal posts is always sufficient for the braking curve.

Turnouts / switches

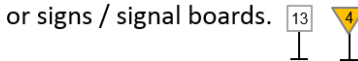
1:9 = Vmax 40 km/h

1:12 = Vmax 60 km/h

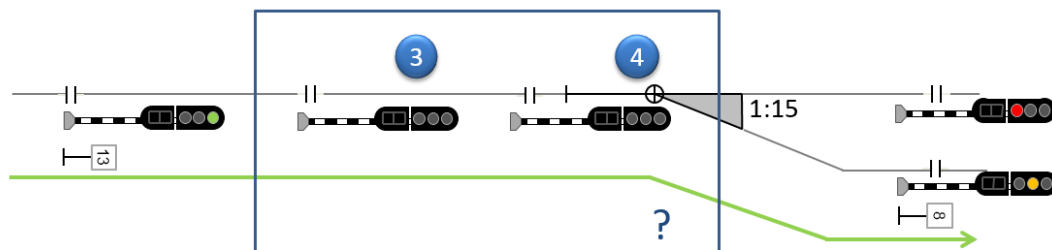
1:15 = Vmax 80 km/h



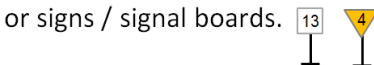
Use R = ● Y = ● G = ●
And - if necessary- add a number / figure; 8, 6, 4
or signs / signal boards.



→ = route



Use R = ● Y = ● G = ●
And - if necessary- add a number / figure; 8, 6, 4
or signs / signal boards.

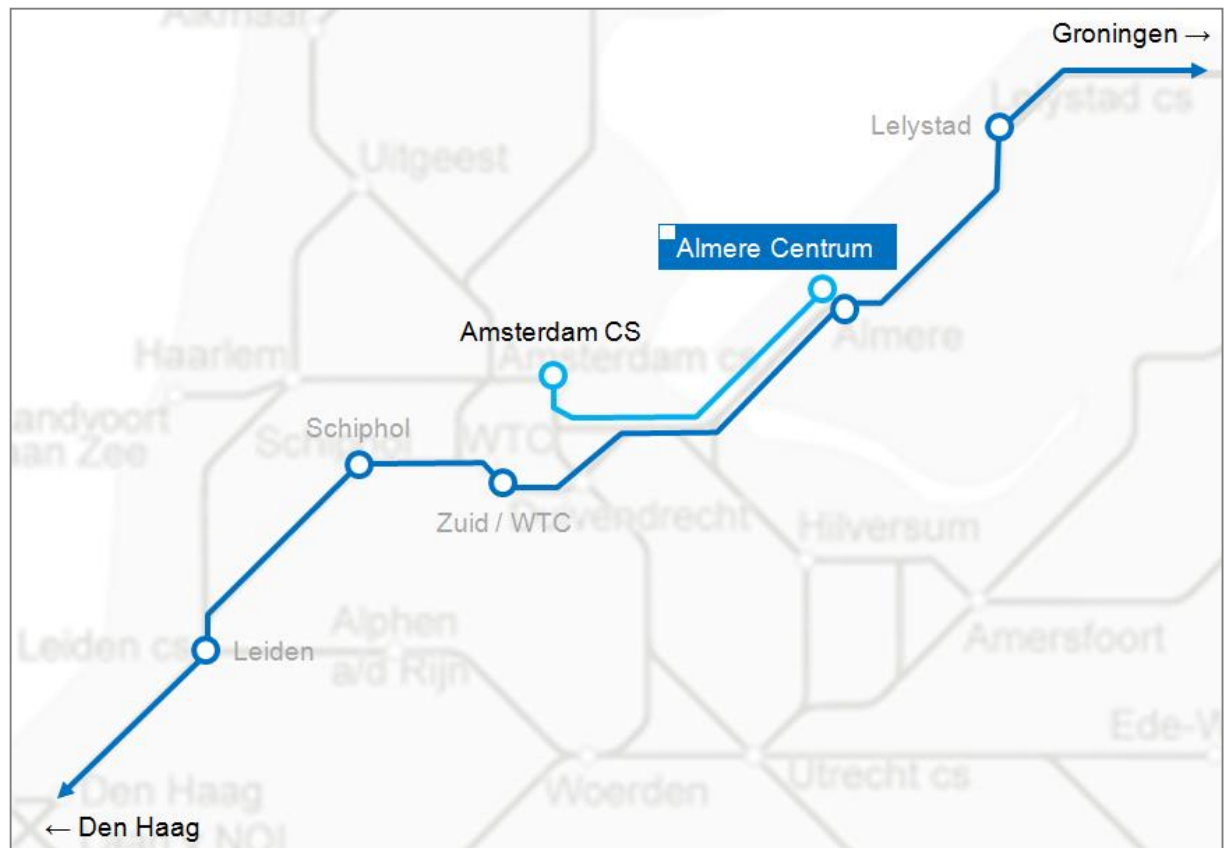


→ = route

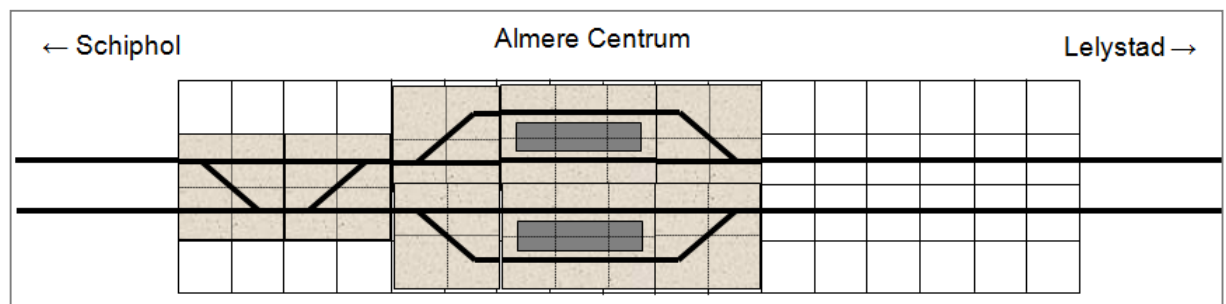
Question 8 [20 points] Almere Centrum

OV SAAL is the name for a program improving the rail based public transport between Schiphol – Amsterdam – Almere and - Lelystad.

In the future plans for the Intercity network there will be an important Southwest – Northeast Intercity line connecting Den Haag and Groningen via Schiphol and Almere Centrum. This line does not call at Amsterdam CS (Central Station).



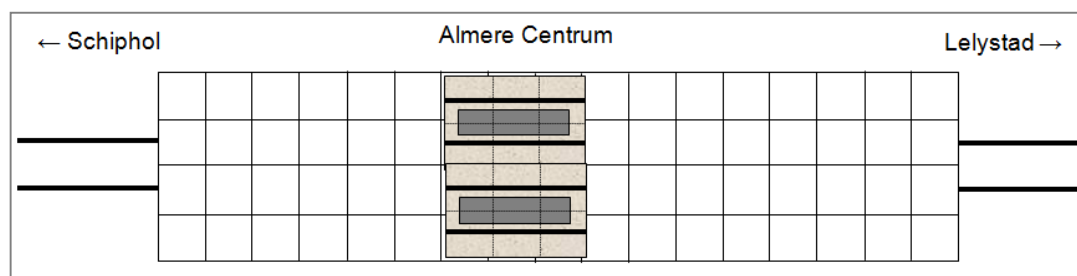
To provide a Intercity connection between Amsterdam CS and Groningen there will be a direct Intercity line between Amsterdam CS and Almere Centrum with a cross platform switch.



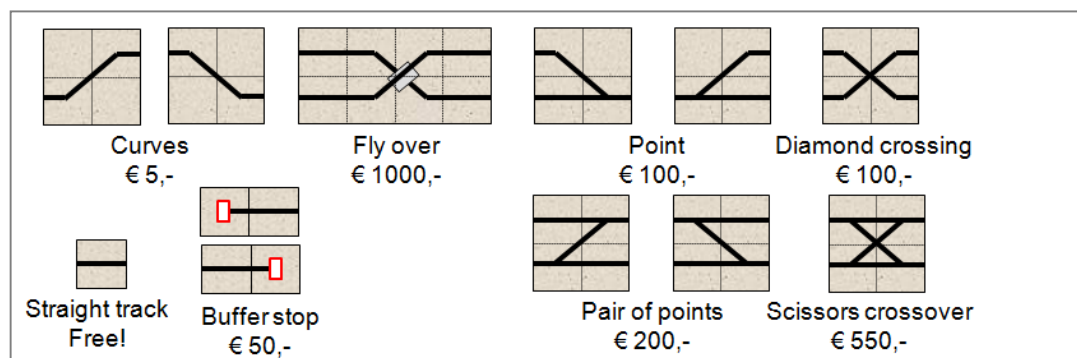
The 2016 station track and platform layout.

It is necessary to rebuild station Almere Centrum. The requirements for the new station layout are:

- A cross platform switch for the direction Amsterdam CS → Almere Centrum → Den Haag vice versa.
- A cross platform switch for the direction Amsterdam CS → Almere Centrum → Groningen vice versa.
- Two platform tracks for the Intercity service Amsterdam CS – Almere Centrum.
- Two tail tracks to ‘park’ Intercity train sets coming from Amsterdam CS outside peak hours.
- Synchronisation:
 - Trains coming from Amsterdam CS and going to one of the two platform tracks at Almere Centrum may not block trains on the route Groningen → Den Haag.
 - Trains going to Amsterdam CS and coming from one from one the two platform tracks at Almere Centrum may not block trains on the route Den Haag → Groningen.
 - Shunting movements between the platform tracks for the Intercity service Amsterdam CS – Almere Centrum and the two tail tracks may not block trains on the route Den Haag → Groningen and Groningen → Den Haag.
- It is not allowed to move the platforms (they remain at the 2016 position).
- Use only standard elements (use as many as you need and rotate or mirror them if necessary).
- Stay inside the chequered pattern.
- Don’t spend more money than necessary.



Available space in 2016 (chequered pattern).



Standard elements.

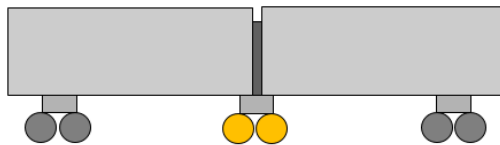
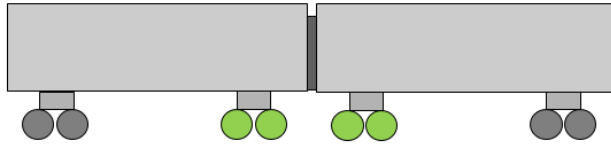
Note: The element “buffer stop” is long enough to park the trains.

Note: for your convenience an answering form for this question is available as an appendix of this exam.

Question 9 [10 points] Axle configuration

Rolling stock can be classified by the axle configuration: (1) fixed axles, (2) non-articulated bogies and (3) articulated bogies.

Non articulated bogie



Articulated bogie

- a) [4 points] Name two advantages of non-articulated bogies.
- b) [6 points] Name three advantages of articulated bogies.

Question 10 [6 points] Traction power supply

One of the main advantages of rail transport is that it is possible to use (permanent) electric power supply without carrying its own energy source / “fuel”.

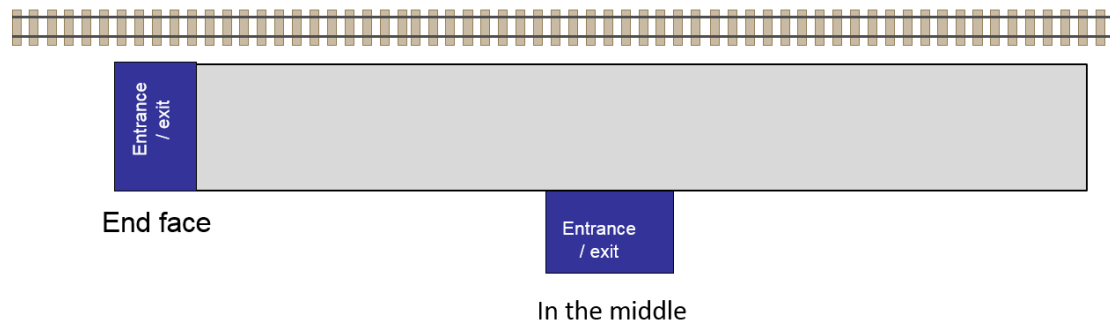
- a) [2 points] Explain why (almost) only rail has this advantage.

There are two systems to transport the electric power to the train:

Overhead contact wires and conductor “third” rail.

- b) [2 points] What is the most common / obviously utilization of the conductor “third” rail power supply system.
- c) [2 points] Name one disadvantage of the conductor “third” rail.

Question 11 [6 points] Single side platform



For a single side platform there are two main solutions for the entrance / exit: at the end face or in the middle.

- a) [4 points] Which of the two is preferred from a railway operator point of view? Explain why.
- b) [2 points] Give one argument for the alternative.

Question 12 [6 points] Fully segregated track

Automated, driverless operation is only possible within the track concept "Fully segregated track".

- a) [2 points] Explain why.
- b) [4 points] Give two disadvantages of the track concept "Fully segregated track".

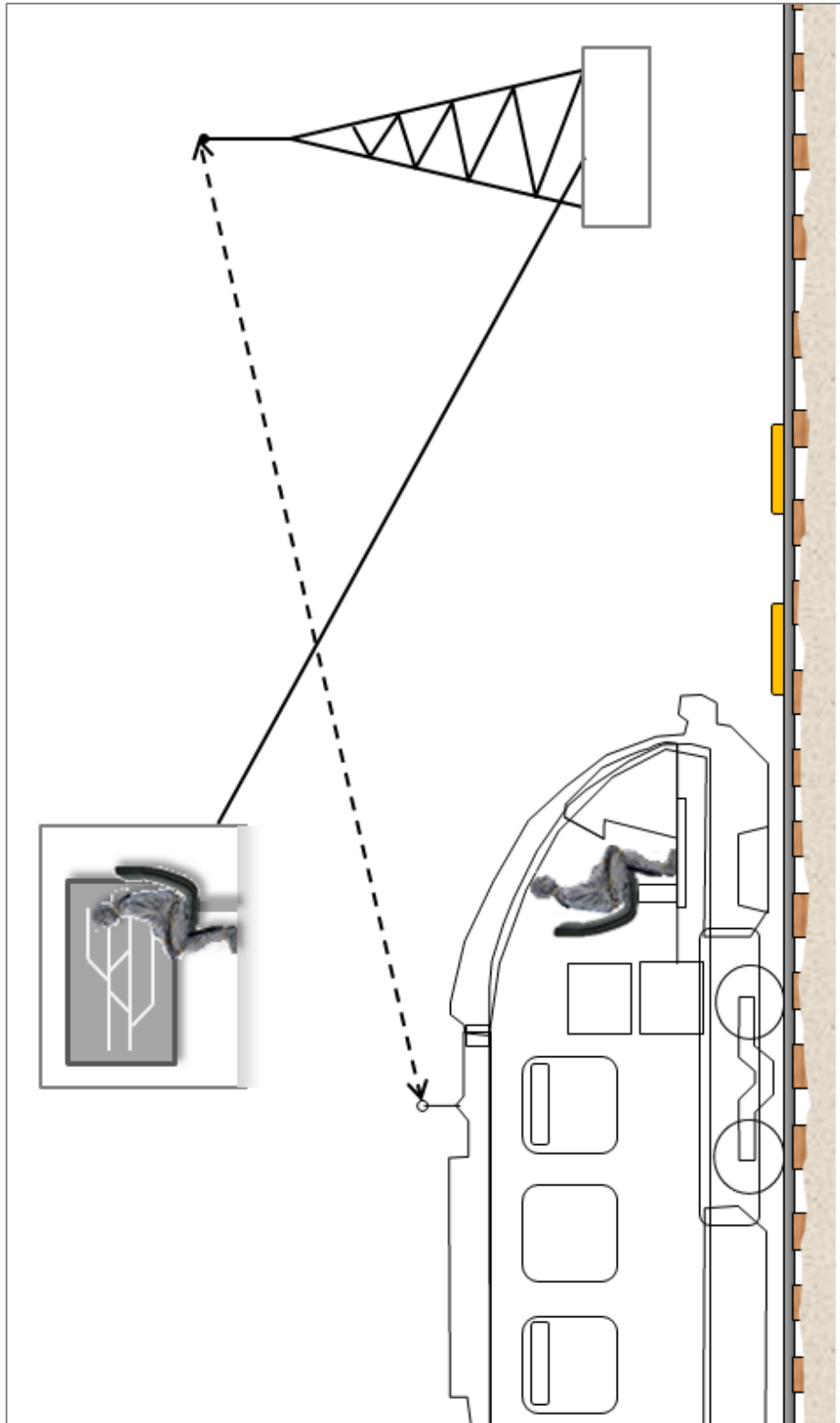
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Appendix 1: Answering form for Question 6

Name: _____

Student number: _____



Appendix 2: Answering form for Question 8

Name: _____

Student number: _____

