RECOGNISING ACHIEVEMENT

Oxford Cambridge and RSA Examinations

General Certificate of Secondary Education

PHYSICS

1982/4

PAPER 4

HIGHER TIER

Specimen Paper 2003

Candidates answer on the question paper.

Additional materials:

Pencil, Ruler (cm, mm)

TIME 45 minutes

Candidate Name	Centre Number	Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer all the questions.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

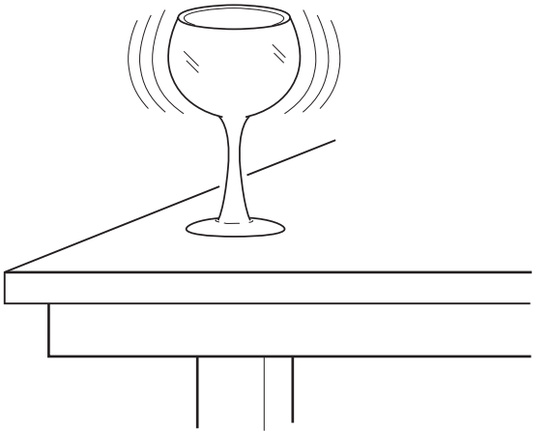
INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is 50.
- *You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.*

Question number	For examiner's use only
1	
2	
3	
4	
5	
6	
7	
TOTAL	

1 This question is about sounds from loudspeakers.

(a) Sounds of a particular pitch makes an empty wine glass vibrate strongly.
Sounds of other pitches do not affect the glass noticeably.



(i) What is this effect called?

_____ [1]

(ii) Why does this happen?

_____ [1]

(b) A bigger glass does not vibrate strongly.
State and explain how this bigger glass can be made to vibrate strongly.

_____

_____

_____ [2]

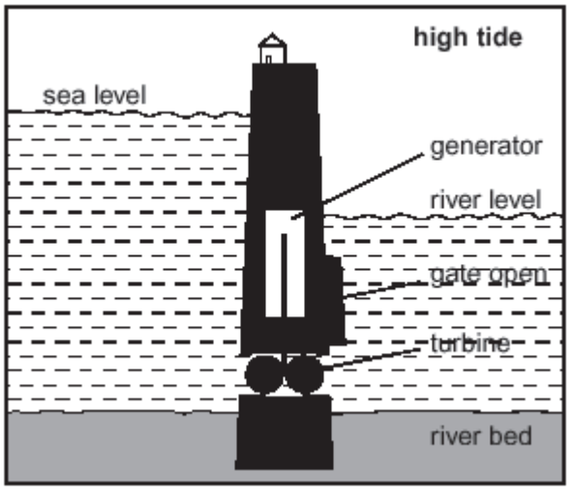
[Total: 4]

For Examiner's Use

2 This question is about generating electricity.

A dam has been built across a river where it meets the sea.

The diagram shows the water levels around the dam at high tide.



The dam contains a tidal power station. Tides are a renewable source of energy.

You are a scientist who wants to use more renewable energy.

Suggest how you would persuade people to want more renewable energy sources used.

You will be given credit for the correct use of technical terms and for the correct use of spelling, punctuation and grammer.

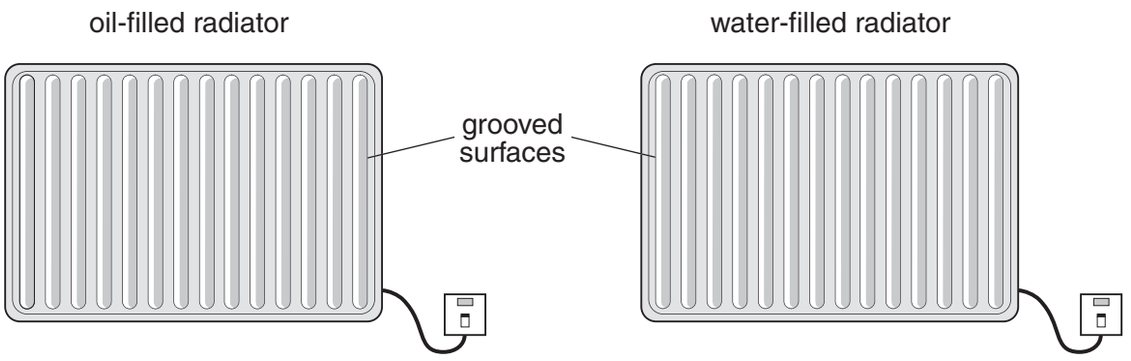
[4]

[Total: 4]

For Examiner's Use

3 A room contains two electrically heated radiators.

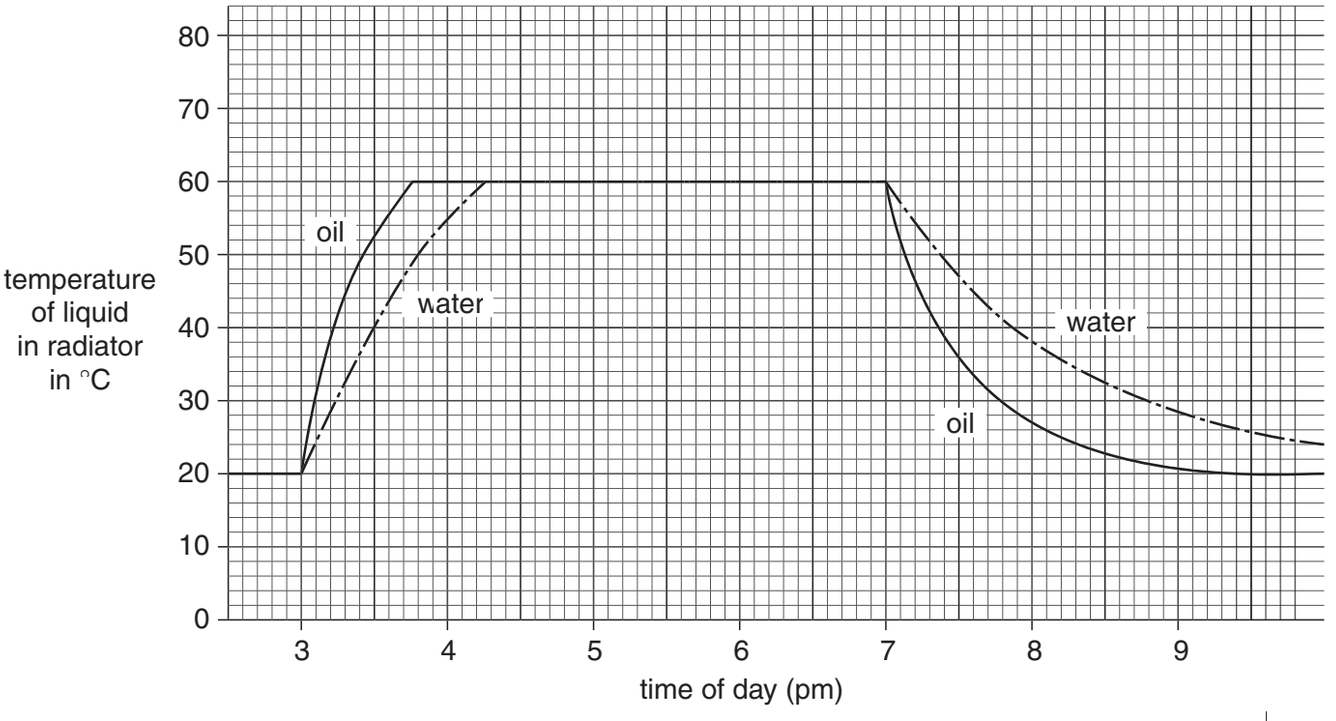
The radiators are exactly the same but contain different liquids.



This radiator contains 10 kg of oil.

The oil has a specific heat capacity of 2000 J/kg°C (or J/kgK)

This radiator contains 10 kg of a water-based liquid.
The water has a specific heat capacity of 4000 J/kg°C (or J/kgK)



(a) The radiators are switched on at the mains at 3 pm and left on for 4 hours.

The graph shows how the temperature of the liquid in each radiator changes.

(i) How long does it take the oil-filled radiators to reach 60 °C?

_____ minutes [1]

(ii) The oil-filled radiator heats up faster than the water-filled radiator.

What is the **biggest** difference between the temperatures of the two radiators during the heating-up time?

_____ °C [1]

(b) Calculate the energy that needs to be transferred to raise the temperature of the water in the radiator by 20 °C.

The specific heat capacity of the water is 4000 J/kg°C.

Use the equation below. You **must** show how you work out your answer.

energy transfer = mass × specific heat capacity × temperature change

energy transfer = _____ unit _____ [2]

(c) The amount of energy needed to raise the temperature of the water-filled steel radiator is actually **more** than the correct answer to **(b)**.
Suggest why.

_____

_____ [1]

(d) A student writes this.

> The oil gives out more heat energy than the water between 7 and 8 o'clock because the slope of the line for the oil is steeper.

Discuss whether the student is correct.
Use your ideas about specific heat capacity and the rate of energy transfer.

_____

_____

_____

_____

_____

_____ [3]

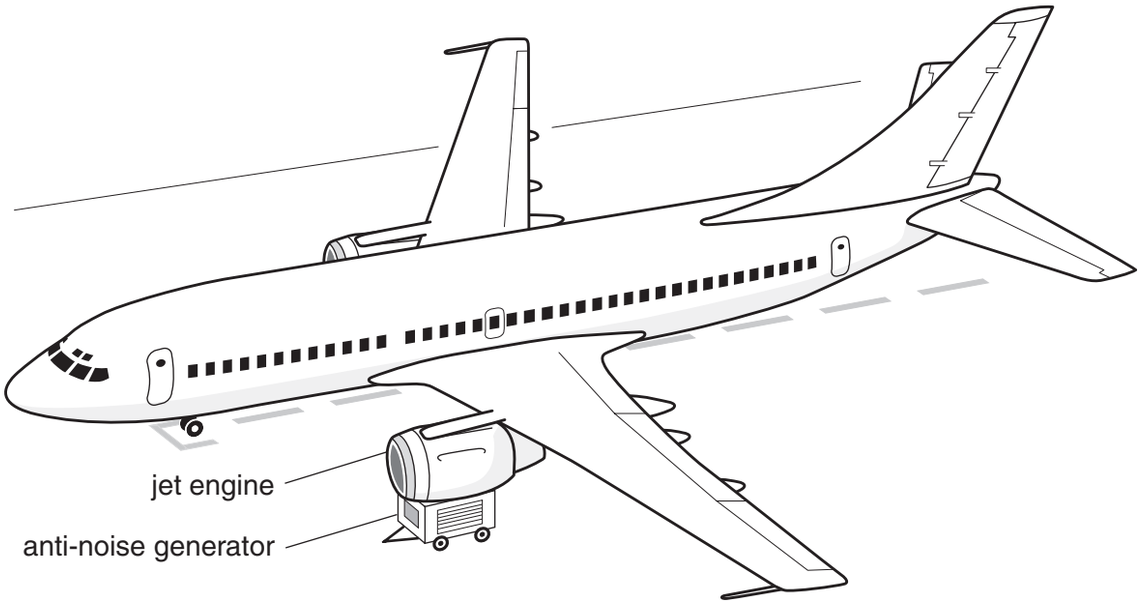
[Total: 8]

4 At Heathrow Airport in London, tests are being done to reduce the noise made by aircraft waiting on the runway. This is achieved by the process of destructive interference.

Anti-noise generators are placed on the ground under the jet engines.

The sound produced by the engines is analysed.

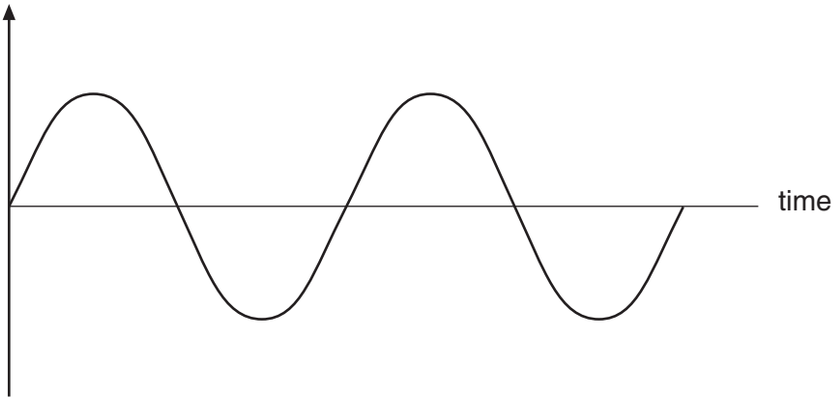
The frequency of the loudest sound is selected.



(a) The diagram below represents the waveform of the selected frequency produced by the jet engine.

The sound output of the anti-noise generator is adjusted so that it **cancels out** the noise of this frequency.

Draw on the diagram the wave produced by the anti-noise generator.

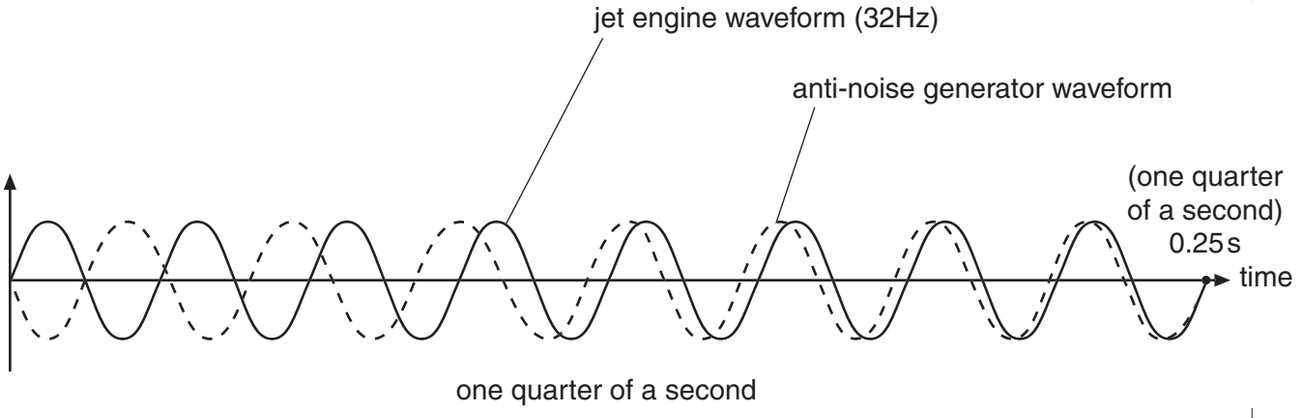


[2]

For Examiner's Use

(b) The frequency of the anti-noise generator changes slightly.

The diagram below represents the waveform produced by the jet engine and the generator.



The two waveforms combine.

Describe what you would hear over the next second.

You will be given credit for the correct use of technical terms and for the correct use of spelling, punctuation and grammer.

_____

_____

_____

_____

_____

_____ [4]

[Total: 6]

[Turn over

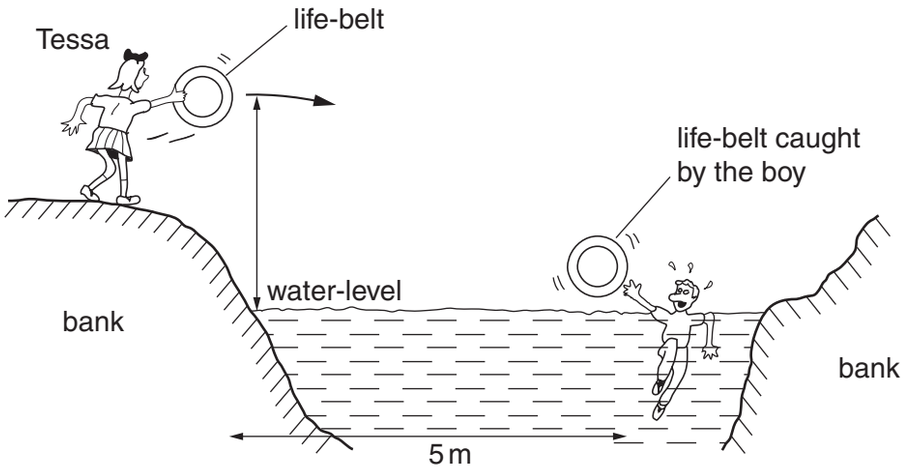
For Examiner's Use

5 Tessa walks around a pond and sees a boy who has fallen in the water.

She throws a 2 kg life-belt and aims to hit the water near the boy.

(a) The diagram below shows part of the path that the life-belt takes from leaving her hand to the boy who catches it.

Finish the diagram to show the path the life-belt takes.



[1]

(b) The life-belt is moving horizontally at the instant she releases it.

(i) Calculate the time taken for the life-belt to drop 2.5 m.

Use the equation below and show how you work out your answer.
(Assume that the acceleration due to gravity is 10 m/s^2.)

$$\mathbf{s = ut + \frac{1}{2}\,at^2}$$

answer = _____ [2]

(ii) Now show that the horizontal velocity with which the life-belt needs to leave her hand to just reach the boy is approximately 7 m/s.

[2]

(c) The boy catches the life-belt.

This causes him to move away from the bank where Tessa is. (To the right of the diagram).

(i) Use your ideas about momentum to explain why this happens.

_____

_____

_____ [2]

(ii) Calculate the momentum of the life-belt when it has a velocity of 7m/s.

Use the equation below and show how you work out your answer.

momentum = mass × velocity

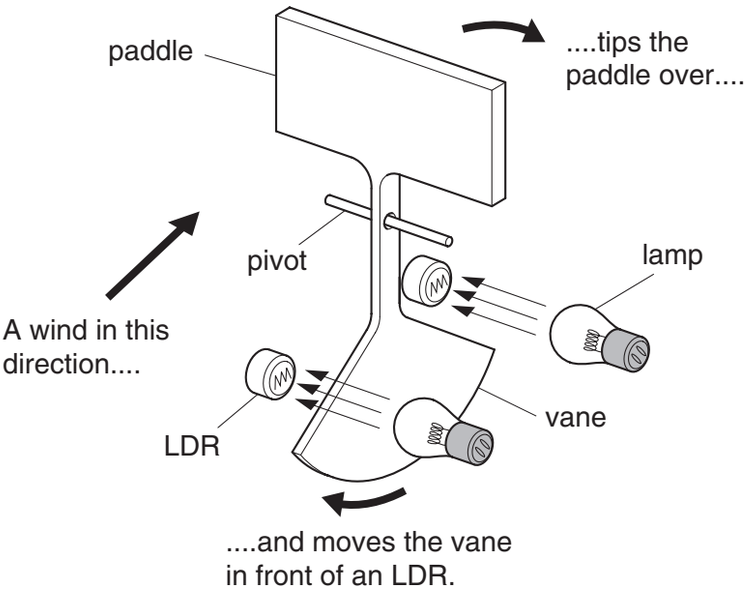
momentum = _____ kgm/s [2]

(iii) The boy has a mass of 26 kg and is not moving when he catches the life-belt. Calculate the common velocity of the boy and the life-belt.

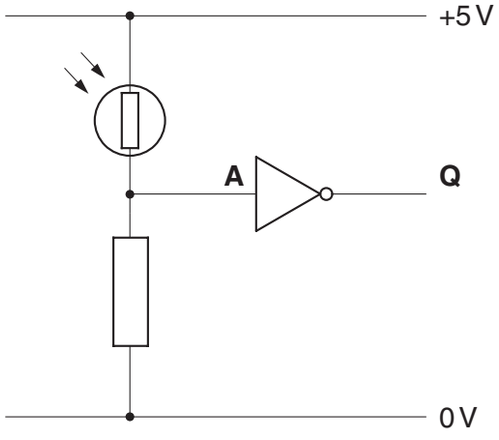
velocity = _____ m/s [2]

[Total: 11]

6 It is dangerous for aircraft to take off or land when there is a strong wind across the runway.



The lamps shine light onto the LDRs. Any cross wind pushes the vane between the lamp and one of the LDRs. Here is the circuit for **one** of the LDRs.

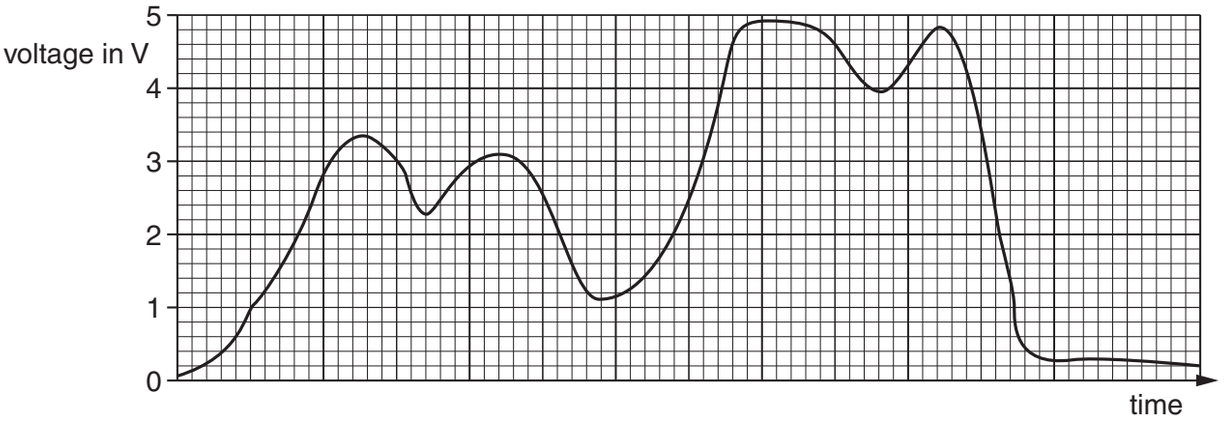


(a) Use the words **HIGH** or **LOW** to complete the sentences.

When there is no wind, there is lots of light on the LDR. It has a _____ resistance and the voltage at **A** is _____ .

In strong wind, there is no light on the LDR. So it has a _____ resistance and the voltage at **A** is _____ . [2]

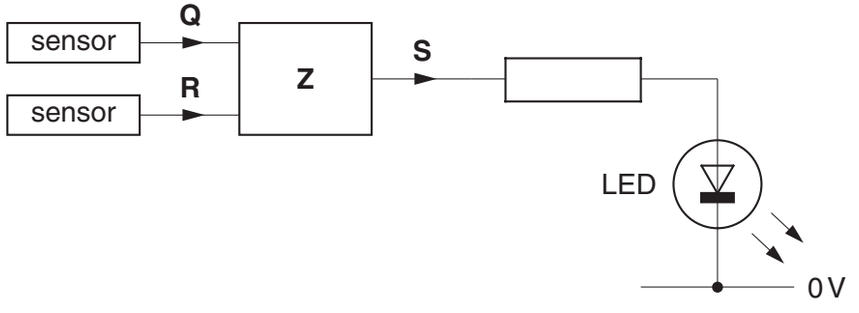
(b) The graph shows how the voltage at **A** changes during a day.



voltage at **A**	voltage at **Q**
less than 2.0 V	4.5 V
more than 2.0 V	0.5 V

On the **graph** show how the voltage at **Q** changes during the day. Use the data in the table. [3]

(c) A logic gate **Z** combines the signals from the two sensors.



The LED must glow if the cross wind is dangerous. The output from each sensor is LOW when there is no wind.

(i) Complete the table.

R	**Q**	**S**
LOW	LOW	
LOW	HIGH	
HIGH	LOW	
HIGH	HIGH	HIGH

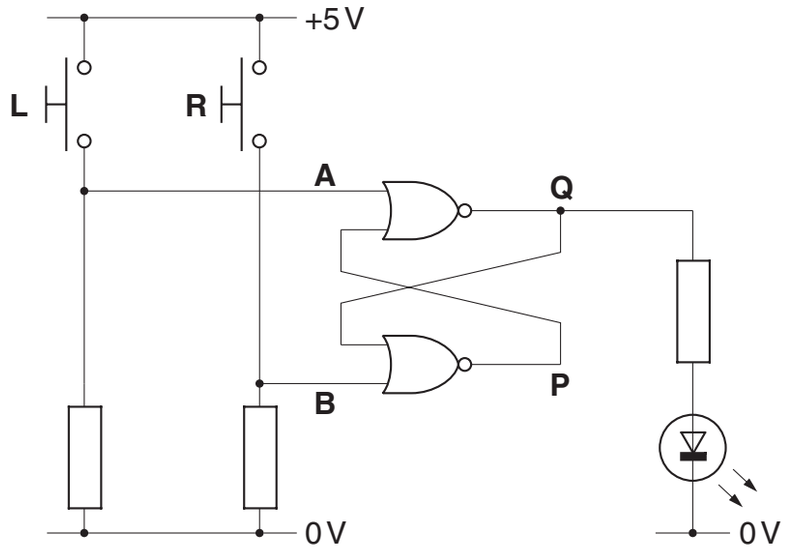
[2]

(ii) Name the logic gate **Z**. _____ [1]

[Total: 8]

For Examiner's Use

7 Bobby constructs this circuit. He tells Joy that it has a memory. She wants to find out what this means.



(a) Complete the truth table for **one** NOR gate.

A	P	Q

[2]

(b) Joy starts off by pressing the switch labelled **R**.

(i) Explain why **B** goes HIGH when she presses switch **R**.

_____

_____ [1]

(ii) State and explain what happens to **Q** and **P** when she presses switch **R**.

_____

_____

_____

_____

_____

_____ [4]

(c) To her surprise, the LED remains on when she stops pressing **R**. This is because the circuit has a memory.

Explain why the LED remains on.

_____

_____

_____

_____ [2]

[Total: 9]

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