

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	



General Certificate of Education  
Advanced Level Examination  
June 2013

# Electronics

# ELEC5

## Unit 5 Communications Systems

Wednesday 12 June 2013 9.00 am to 10.30 am

**For this paper you must have:**

- a pencil and ruler
- a calculator
- a Data sheet (enclosed).

**Time allowed**

- 1 hour 30 minutes

**Instructions**

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

**Information**

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.



J U N 1 3 E L E C 5 0 1

Answer **all** questions in the spaces provided.

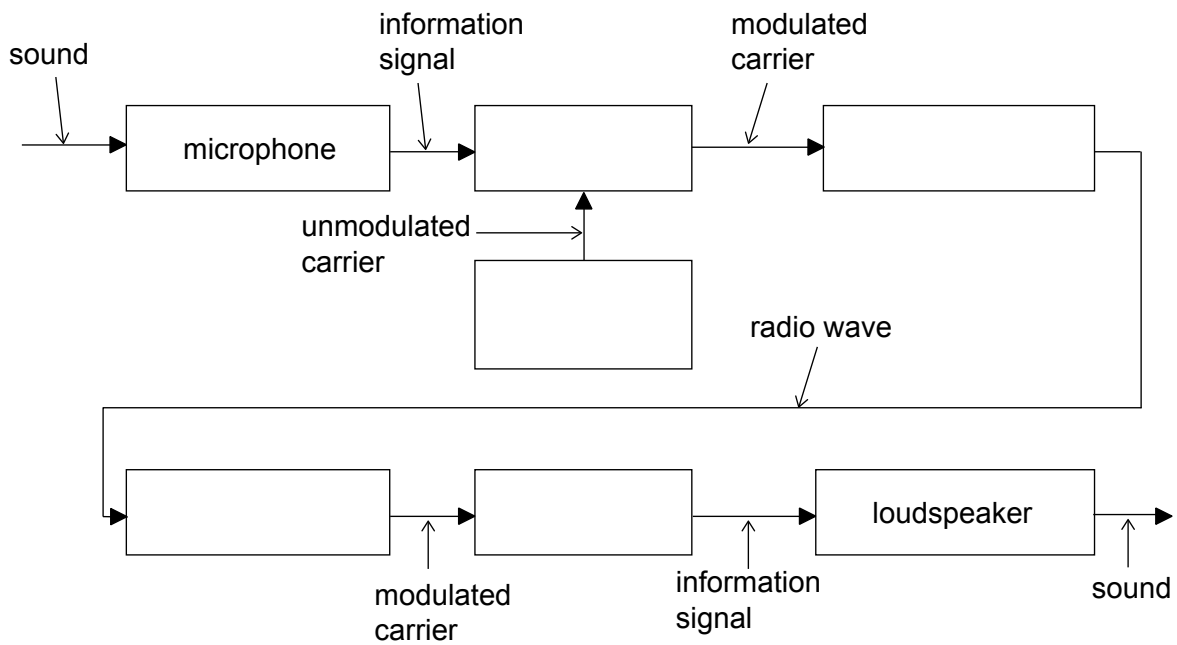
**1 (a)** Name **three** different types of medium that a modulated carrier signal could travel through.

- 1 .....
- 2 .....
- 3 .....

(3 marks)

**1 (b)** A block diagram of a radio communication system is shown below. The signals between subsystems are shown.

Label the blank boxes.

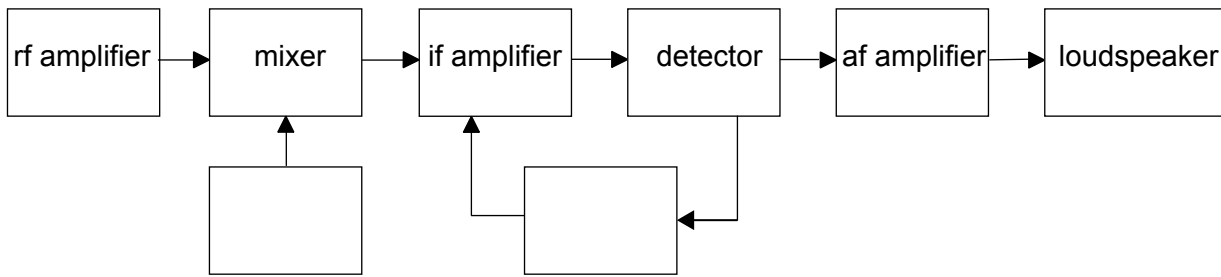


(5 marks)

8
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2 A system diagram of a superheterodyne radio receiver is shown below.



2 (a) Complete the diagram by adding the names of the unlabelled blocks.

(2 marks)

2 (b) Explain the function and differences between each of the **three** amplifiers in the diagram above.

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(6 marks)

2 (c) (i) The radio receiver receives a signal on 101.4 MHz.

The local oscillator frequency at this time is 112.1 MHz.

Calculate the frequency at which the if amplifier operates.

.....

(1 mark)

2 (c) (ii) Calculate the image, or second channel, frequency.

.....

.....

(2 marks)

Turn over ▶



**3** Marine VHF radio is installed on all large ships and most seagoing small boats providing a number of channels for communication. It can be used for calling rescue services, communicating with other ships and stations on the shore. It operates in the frequency range 156 MHz–158 MHz.

**3 (a)** State the meaning of the term VHF.

.....  
(1 mark)

**3 (b)** *Frequency modulation* is used.

**3 (b) (i)** Explain the meaning of the term frequency modulation.

.....  
.....  
(2 marks)

**3 (b) (ii)** State an advantage of frequency modulation, compared with amplitude modulation.

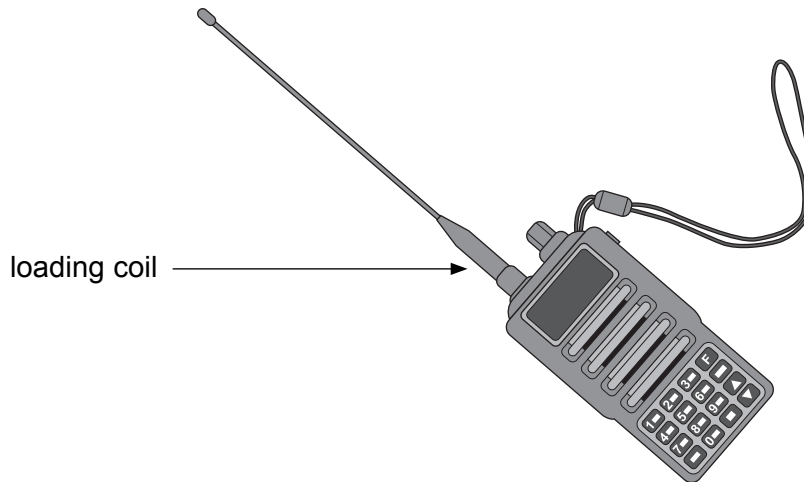
.....  
(1 mark)

**3 (c)** One of the operating frequencies is 156.300 MHz. Calculate the optimum length of a half-wave dipole aerial for use at this frequency.

.....  
.....  
.....  
(3 marks)



- 3 (d) In practice, the aerial on a hand-held radio is unlikely to be this length. A 'loading coil' is included in the radio to change the impedance of the aerial system.



State why the impedance of the aerial system needs to be changed.

.....  
 .....  
 (1 mark)

- 3 (e) Some of the channels are allocated only a **single frequency** and are **half-duplex**. Explain how two-way communication can take place over such a channel.

.....  
 .....  
 (2 marks)

- 3 (f) Explain why it is necessary to allocate two frequencies to a channel to enable full-duplex communication.

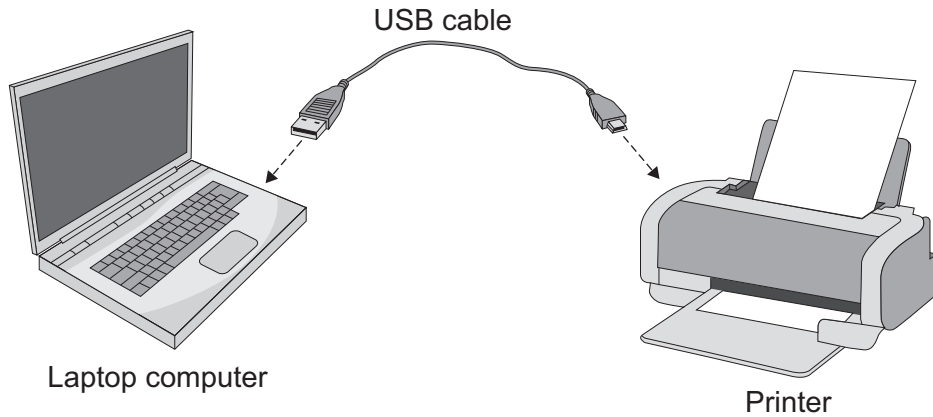
.....  
 .....  
 (2 marks)

- 3 (g) The spacing between allocated frequencies has been reduced from 50 kHz to 25 kHz. Explain how this change affects the signal that can be transmitted.

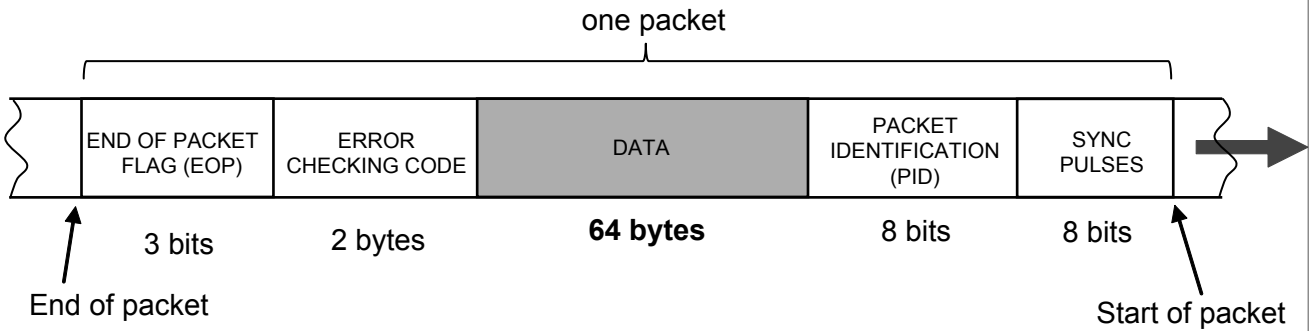
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 (1 mark)



4 Computer peripherals are usually connected to the computer via the USB (Universal Serial Bus) port. An example is shown in the picture below.



USB 2.0 is a high-speed, half-duplex, serial data connection operating at up to 480 Mbps.  
 The data is sent in packets. A possible packet is shown in the simplified diagram below, which also shows the size of each part.



4 (a) What do the terms **serial data** and **half-duplex** mean?

serial data .....

.....

half-duplex .....

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(3 marks)

4 (b) (i) By referring to the diagram above, calculate how many bits there are in this USB packet.

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(2 marks)



**4 (b) (ii)** Calculate how long it takes to send this packet via USB, if the USB is operating at its maximum speed.

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(2 marks)

**4 (c)** A memory stick is plugged into the USB port of a laptop computer in order to copy onto it some items from the hard disk. Three items are copied. One item is a folder containing pictures, and its size is 1.45 GB. The other two items are documents, of sizes 13.5 MB and 800 KB.

**4 (c) (i)** Calculate how many packets will need to be sent if every packet is as shown in the diagram.

.....  
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(3 marks)

**4 (c) (ii)** Calculate how long it will take to transfer all the items to the memory stick.

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(1 mark)

**4 (d)** State an alternative way in which information can be sent between a peripheral and a computer, and give an advantage of using this method instead of a USB link.

.....  
.....

(2 marks)

**4 (e)** In a USB link, the data signal is carried by a twisted pair cable. Explain the advantage of using a twisted pair.

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(2 marks)

15

Turn over ▶



**5** A student finds that there is too much high frequency noise (hiss) on the audio frequency signal from a radio receiver he has constructed.

**5 (a)** What type of filter is required to pass the wanted signal and reduce the noise?

.....  
(1 mark)

**5 (b)** Draw the circuit diagram of a passive filter that would improve the quality of the signal. Label the input and the output.

(4 marks)

**5 (c)** The components he chooses have values of 10kΩ and 10 nF. Calculate the breakpoint frequency of this filter.

.....  
.....  
.....  
(3 marks)

**5 (d)** State with a reason whether this would be suitable for a full range audio frequency signal.

.....  
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(2 marks)

10





**6** In answering this question, credit will be given for the correct use of the relevant technical terms.

**6 (a)** Given that there is only a limited number of channels available to use for communication, describe how a mobile phone is connected to the mobile telephone network and how the network is organised to cope with large numbers of users.

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*(5 marks)*

**6 (b)** Describe the difference in function between a repeater and a regenerator, and state the type of signal that each processes.

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*(4 marks)*

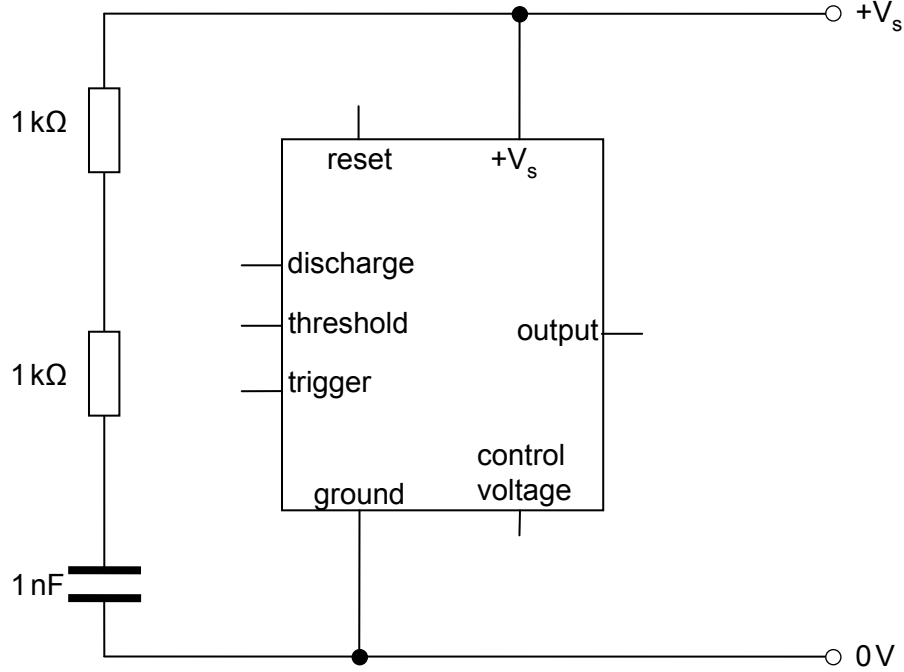
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**Turn over ▶**



7 A 555 IC is used as an astable to generate pulses for a fibre optic communication system.

7 (a) Complete the circuit diagram to show how the IC is connected as an astable.



(5 marks)

7 (b) Calculate the time high ( $t_H$ ) and time low ( $t_L$ ) for the output signal for this circuit.

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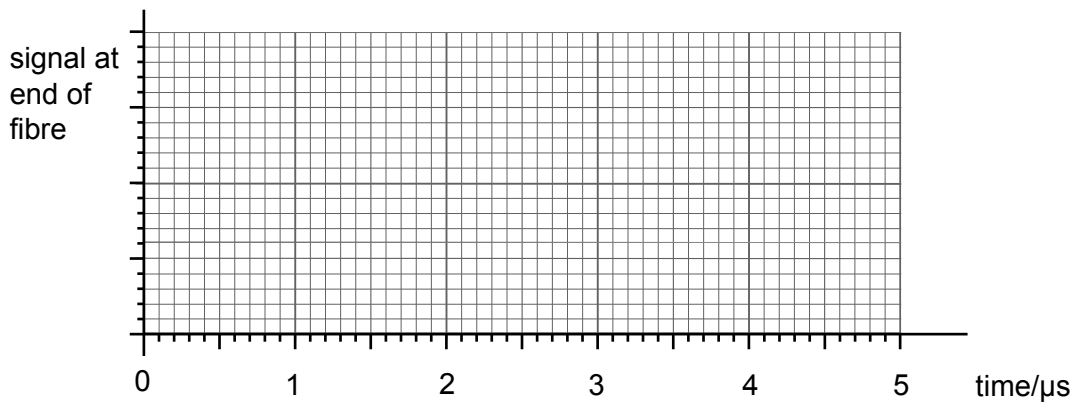
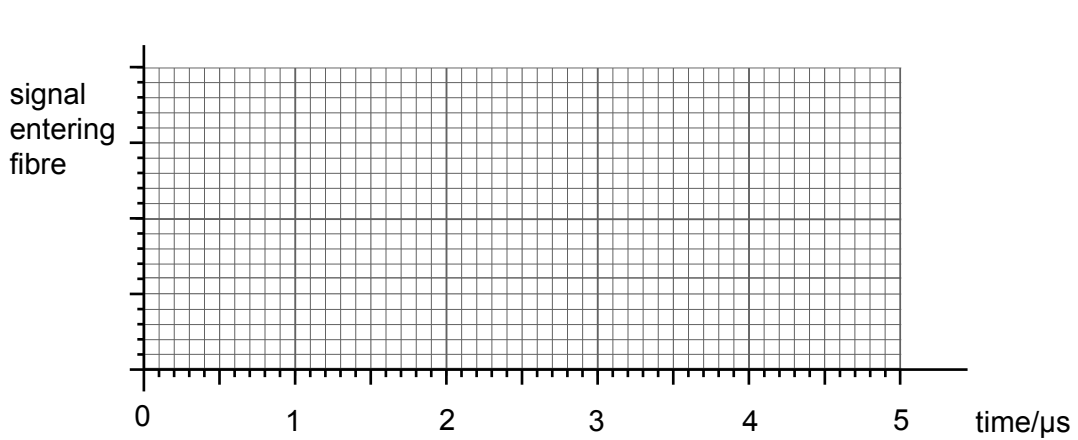
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(3 marks)



- 7 (c) The output of the 555 astable is converted to an optical signal to send down a long optical fibre. On the upper axes sketch the intensity of the signal as it enters the fibre. On the lower axes, sketch the intensity of the signal received at the end of the fibre.



(4 marks)

- 7 (d) State the causes responsible for **two** differences between the input signal and the signal at the end of the fibre.

.....

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(2 marks)

END OF QUESTIONS



**Turn over for the next question**

**DO NOT WRITE ON THIS PAGE  
ANSWER IN THE SPACES PROVIDED**

