Candidate Name	Centre Number	Candidate Number

WJEC CBAC

GCE A level

1144/01

ELECTRONICS
ET4

P.M. FRIDAY, 28 January 2011

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**6**	
3.	**6**	
4.	**5**	
5.	**7**	
6.	**10**	
7.	**11**	
Total	**50**	

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ADDITIONAL MATERIALS

In addition to this examination paper, you will need a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The total number of marks available for this paper is 50.

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

You are reminded to show all working. Credit is given for correct working even when the final answer given is incorrect.

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INFORMATION FOR THE USE OF CANDIDATES

Preferred Values for resistors

The figures shown below and their decade multiples and sub-multiples are the E24 series of preferred values.

10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91.

Standard Multipliers:

Prefix	Multiplier
T	$\times 10^{12}$
G	$\times 10^{9}$
M	$\times 10^{6}$
k	$\times 10^{3}$

Prefix	Multiplier
m	$\times 10^{-3}$
µ	$\times 10^{-6}$
n	$\times 10^{-9}$
p	$\times 10^{-12}$

Filters

$$f_b = \frac{1}{2\pi RC}$$ Break frequency for high pass and low pass filters

$$X_C = \frac{1}{2\pi fC}$$ Capacitive reactance

$$X_L = 2\pi fL$$ Inductive reactance

$$Z = \sqrt{R^2 + X_C^2}$$ For a series RC circuit

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$ Resonant frequency

$$R_D = \frac{L}{r_L C}$$ Dynamic resistance

$$Q = \frac{2\pi f_0 L}{r_L}$$

$$Q = \frac{f_0}{B}$$

Modulation

$$m = \frac{(V_{max} - V_{min})}{(V_{max} + V_{min})} \times 100\%$$ Depth of modulation

$$\beta = \frac{\Delta f_0}{f_i}$$ Modulation index

$$\text{resolution} = \frac{\text{i/p voltage range}}{2^n}$$ PCM

$$\text{Bandwidth} = 2\left(\Delta f_c + f_{i(max)}\right)$$

$$\text{Bandwidth} = 2(1+\beta)f_i$$

Transmitted FM Bandwidth

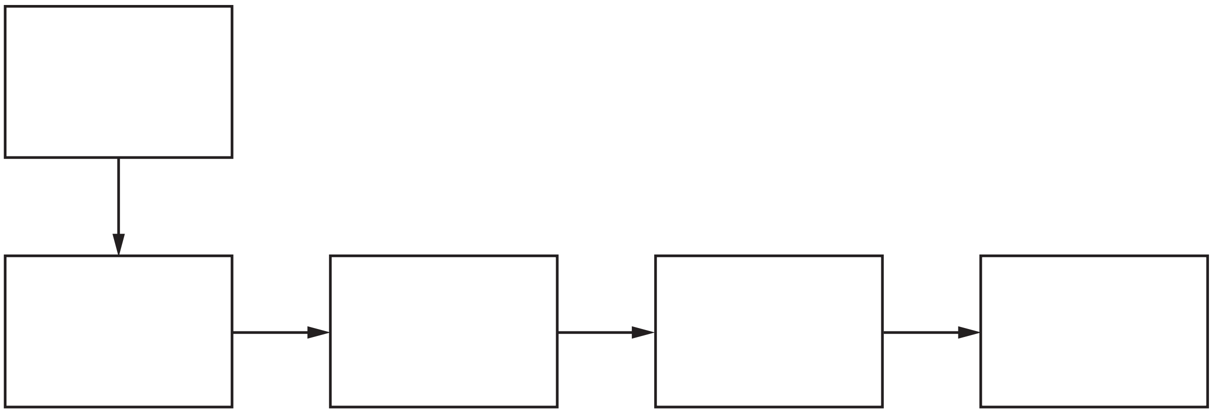
Radio receivers

$$C = \frac{1}{4\pi^2 f_0^2 L}$$

Examiner only

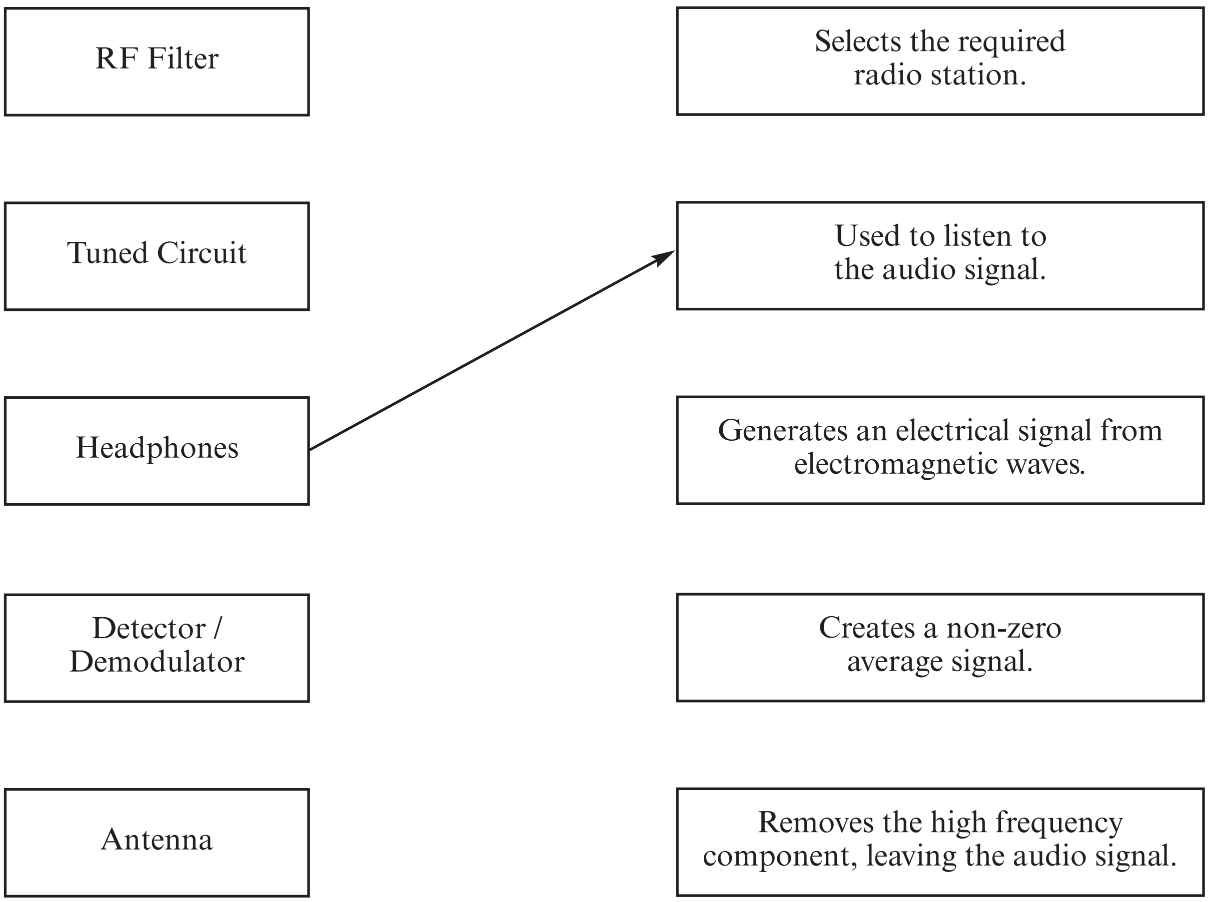
1. *(a)* Complete the following block diagram for the simple radio receiver, using the functional blocks in the list below.

RF Filter, Tuned circuit, Headphones, Detector/Demodulator, Antenna



[2]

(b) Match the part of the simple radio receiver with it's function. One has been done for you.



[3]

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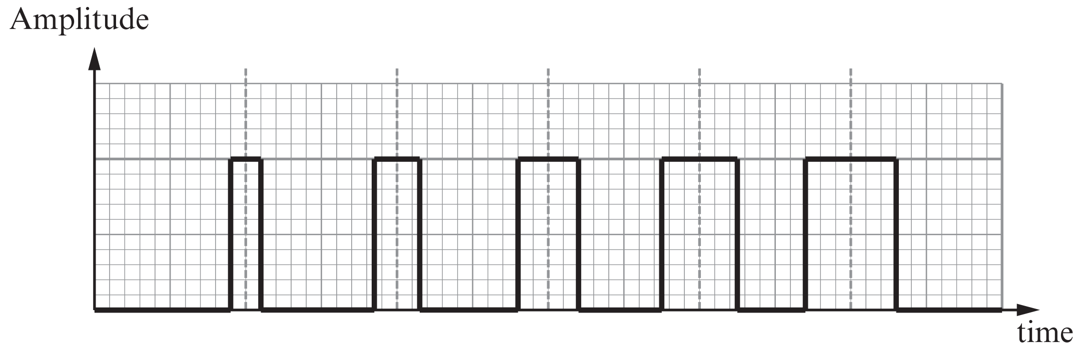
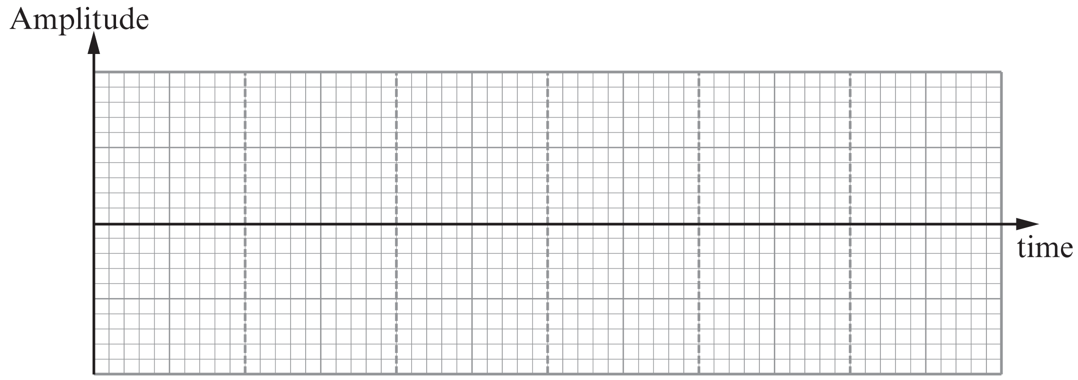
2. The following graphs show different ways in which Pulse Modulation can be used in a communication system. For **each** case:

- state which method is being used: PPM, PWM or PAM;
- sketch the original signal which the Pulse Modulation output represents.

(a) (i) Type of Pulse Modulation used ....



(ii) Draw a possible original signal below



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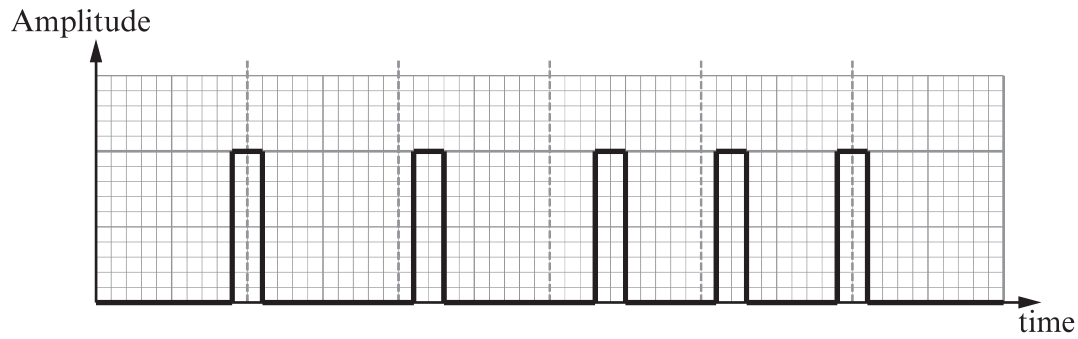
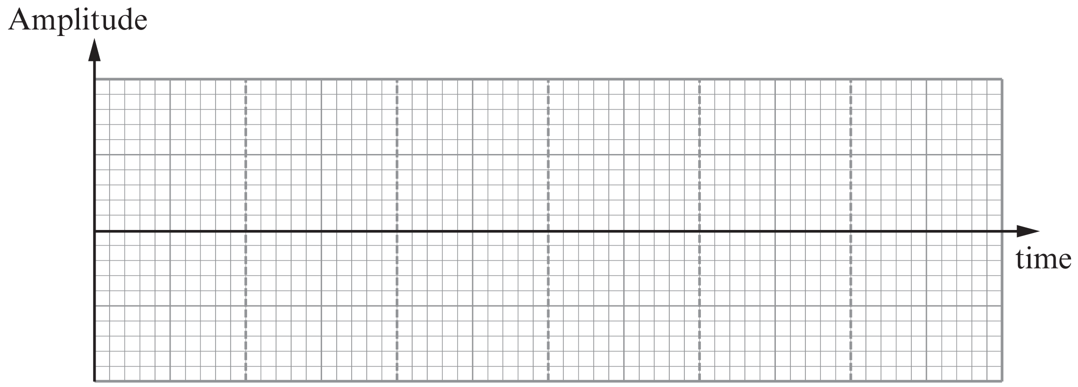
(b) (i) Type of Pulse Modulation used ....



(ii) Draw a possible original signal below



[3]

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3. The ASCII code is an internationally agreed method of coding alphanumeric characters in computer systems.

The following table gives the ASCII code for several numeric characters.

Character	ASCII Code
1	0110001
2	0110010
3	0110011
4	0110100
5	0110101
6	0110110
7	0110111

A computer system uses **even** parity.

(a) Start, stop and parity bits have to be added before a signal can be transmitted.

(i) What is the purpose of the start bit?

....

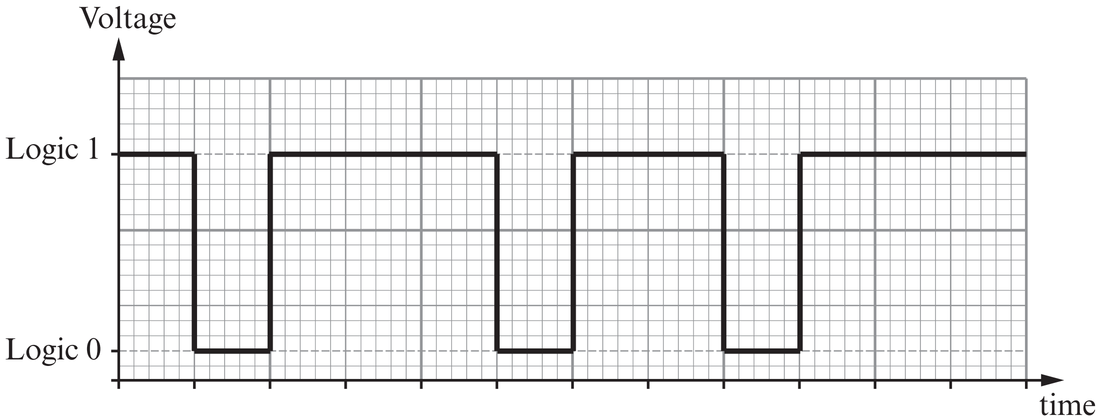
.... [1]

(ii) What is the purpose of the parity bit?

....

.... [1]

(b) The graph shows the signal for a numeric character, received at the end of the transmission link.



(i) Label the start, stop, data and parity bits. [3]

(ii) Using the table above, determine what numeric character has been received.

.... [1]

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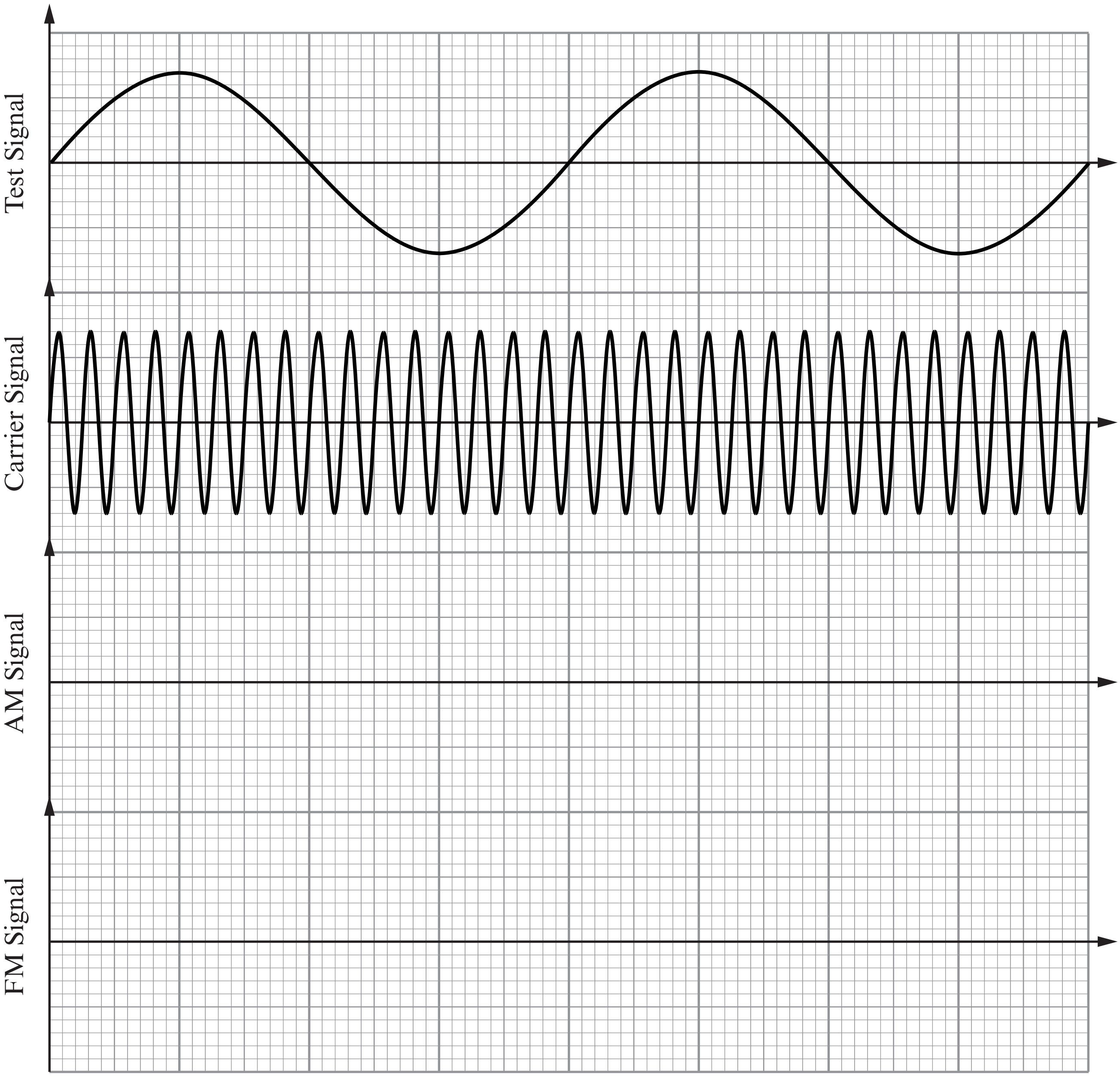
Turn over.

Examiner only

4. *(a)* Two main modulation techniques are used for radio communication across the U.K. These are Amplitude Modulation and Frequency Modulation.

Use the test signal below, and the axes provided to illustrate the effect of these modulation techniques on a high frequency carrier. (Sketch diagrams only are required.)



[2]

Examiner only

(b) A 100 MHz carrier is frequency modulated by an audio signal in the range 100 Hz to 20 kHz. The peak frequency deviation is 60 kHz. Calculate:

(i) the modulation index

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[1]

(ii) the bandwidth of the resulting FM waveform.

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[2]

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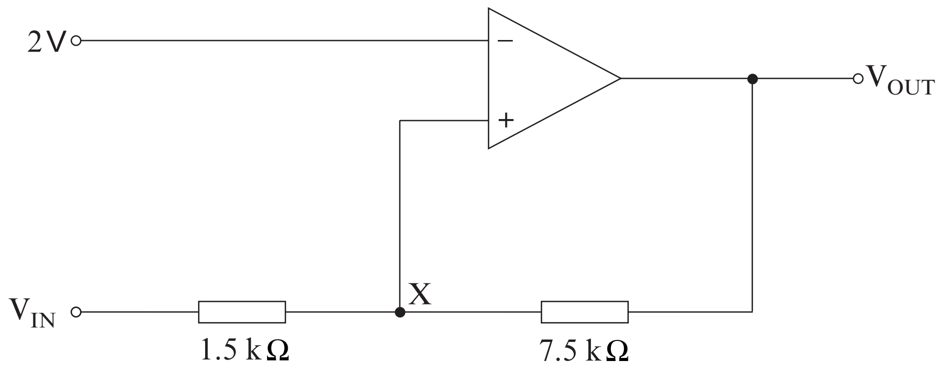
010007

5. *(a)* A Schmitt trigger circuit is shown in the following circuit diagram.



The circuit saturates at ±9V.

(i) Calculate the value of V_{IN} which causes V_{OUT} to change from +9V to –9V.

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[2]

(ii) Calculate the value of V_{IN} which causes V_{OUT} to change from –9V to +9V.

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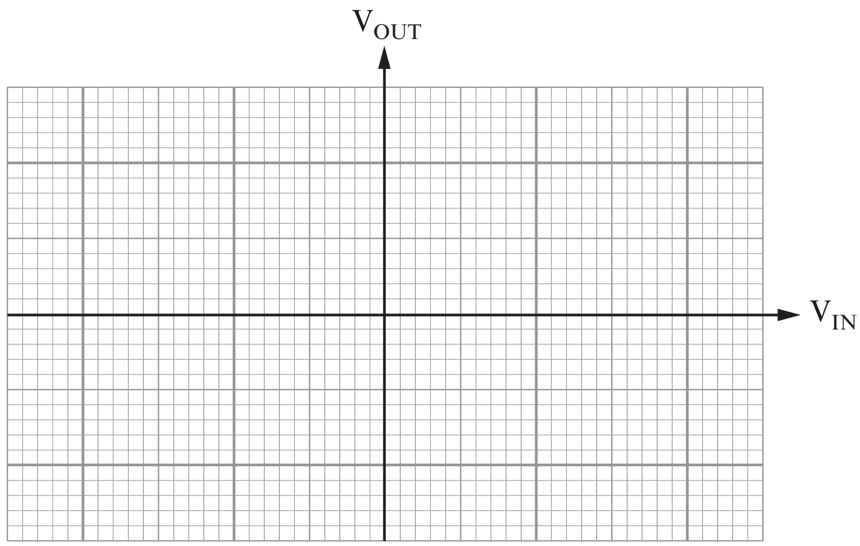
[2]

(b) Draw the characteristic for this Schmitt trigger. **Add appropriate scales to the axes.**



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Examiner only

6. The superheterodyne radio receiver is an advanced radio receiver which has much better *selectivity* and *sensitivity* than the simple radio receiver.

(a) What is meant by the term *selectivity* when applied to a radio receiver?

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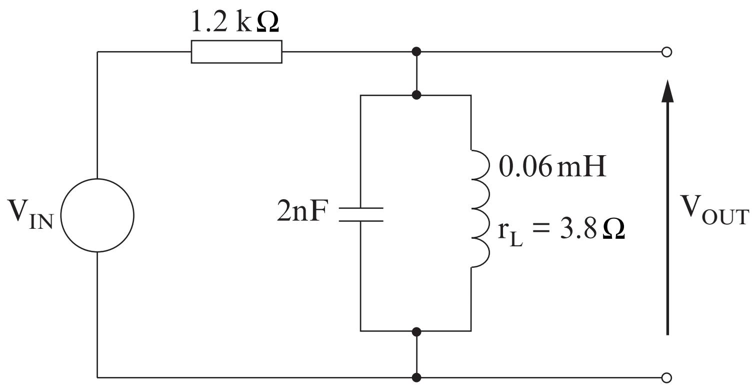
[1]

(b) An engineer is designing an I.F. filter for a Superhet receiver.

The following circuit diagram shows the IF filter connected to a signal generator with V_{IN} set to 10 V. The inductor has a resistance r_L of 3.8 Ω. V_{IN} is kept at 10 V and the frequency increased to give the maximum value of V_{OUT}.



(i) Calculate the frequency at which V_{OUT} is a maximum.

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[2]

Examiner only

(ii) By calculating the Dynamic Resistance R_D of the filter, determine the maximum value of the voltage V_{OUT} with V_{IN} set to 10V.

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[4]

(iii) Determine the bandwidth of this filter.

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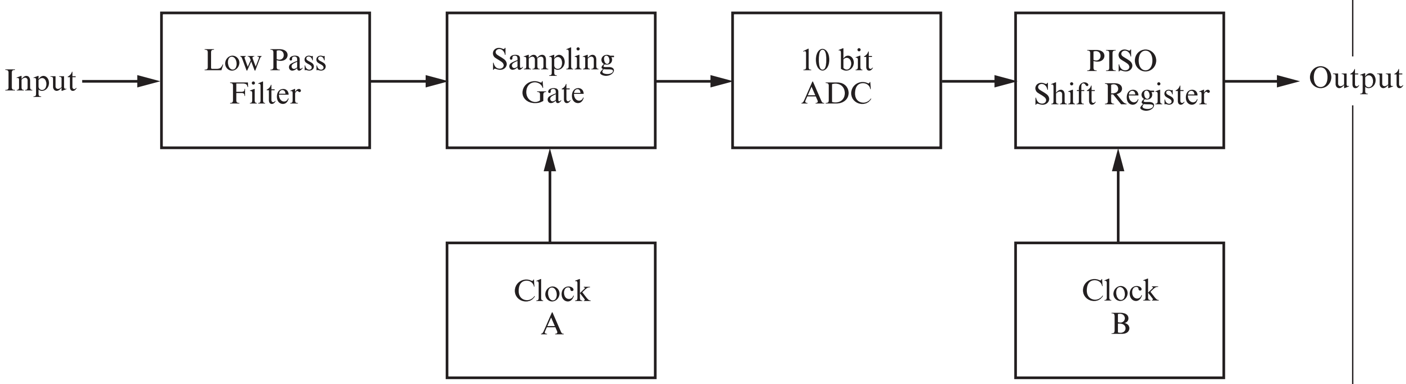
[3]

Examiner only

7. The following block diagram shows a *Pulse Code Modulation* (PCM) Transmitter used in the telephone system, transmitting speech information in the range 100 Hz to 4 kHz.



(a) (i) What is the purpose of the *low pass filter* in the PCM Transmitter?

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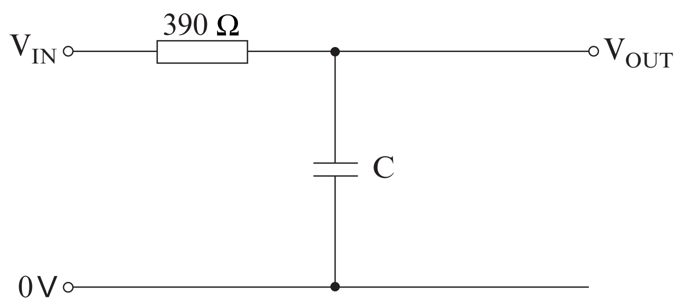
.... [1]

(ii) The following diagram shows a circuit for the low pass filter.



Show by calculation, which capacitor would be the most appropriate to use in this PCM transmitter. Choose from the following capacitors: 47 nF, 100 nF or 470 nF.

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.... **Capacitor Chosen:** .... **nF**
[2]

Examiner only

(b) Suggest a suitable frequency for Clock A for this PCM transmitter. Justify your answer.

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[2]

(c) The *Analogue to Digital Converter* (ADC) for this system has an input voltage range of 0 to 5V. What is the resolution of the system?

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[2]

(d) For this system to work properly Clock B must operate at a higher frequency than Clock A. Explain why this is the case.

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[1]

(e) In the space below draw a block diagram of a suitable PCM Receiver using the following functional blocks.

low pass filter *SIPO clock* *DAC* *SIPO shift register* *Schmitt trigger*

[3]

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