Surname	Centre Number	Candidate Number
Other Names		

GCE A level

1144/01

ELECTRONICS – ET4

A.M. FRIDAY, 25 January 2013

1 hour

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

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

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

$$\text{Bandwidth} = 2(\Delta f_c + f_i)$$ Transmitted FM Bandwidth

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

Radio receivers

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

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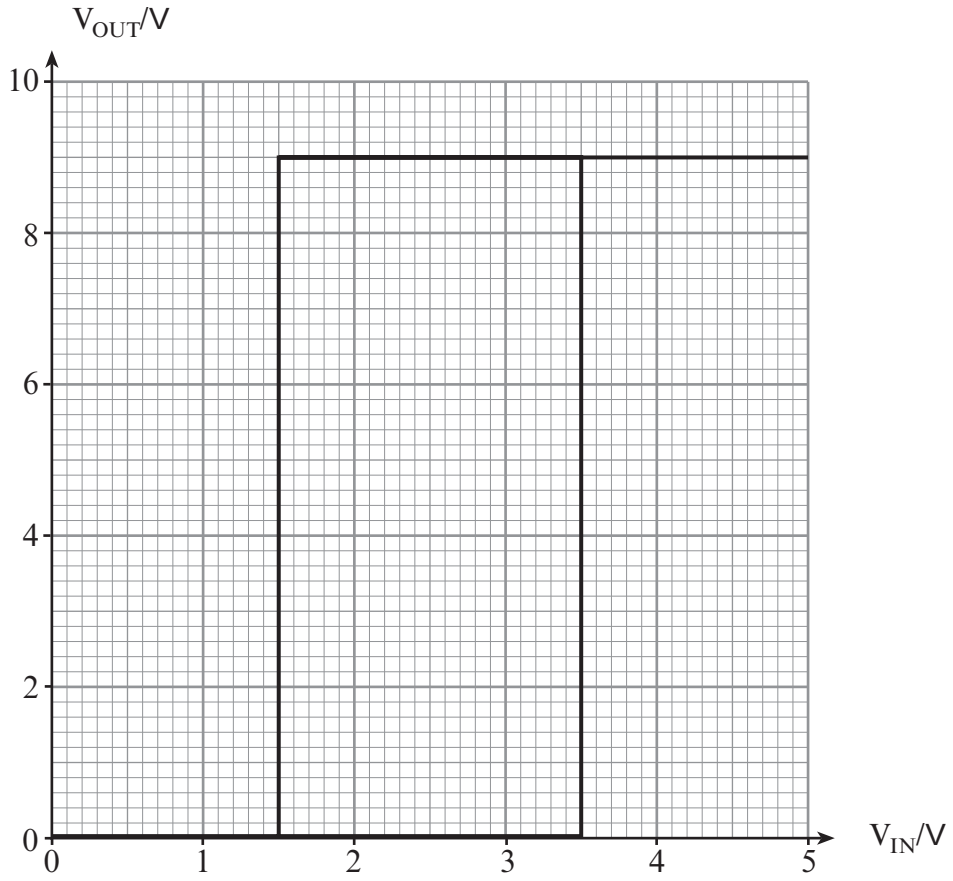
Turn over.

Examiner only

1. A Schmitt trigger circuit has the following characteristic.



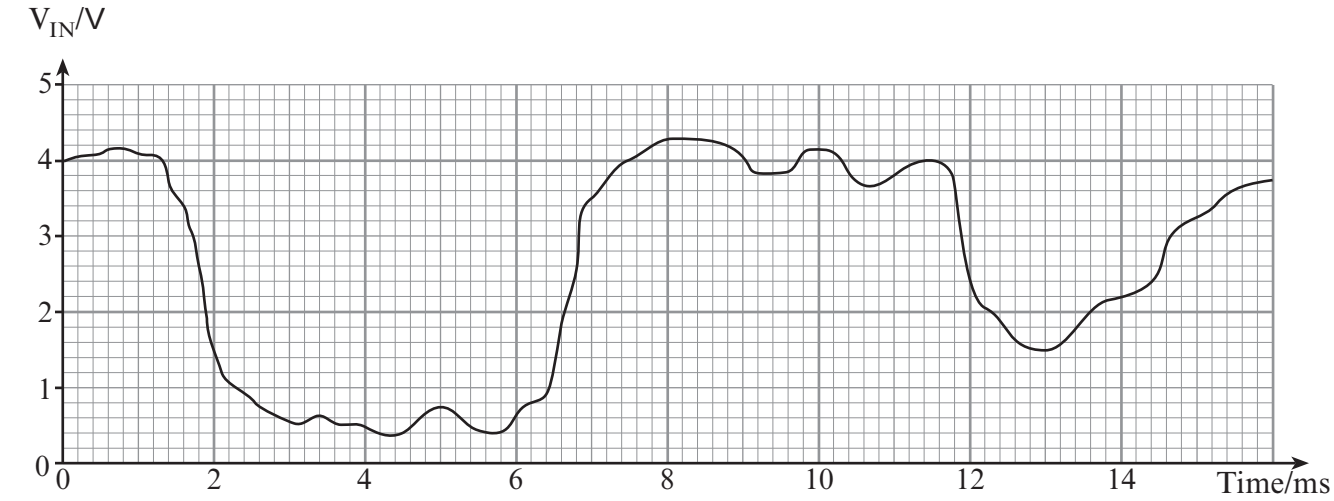
(a) (i) What type of Schmitt trigger has this characteristic? .....
[1]

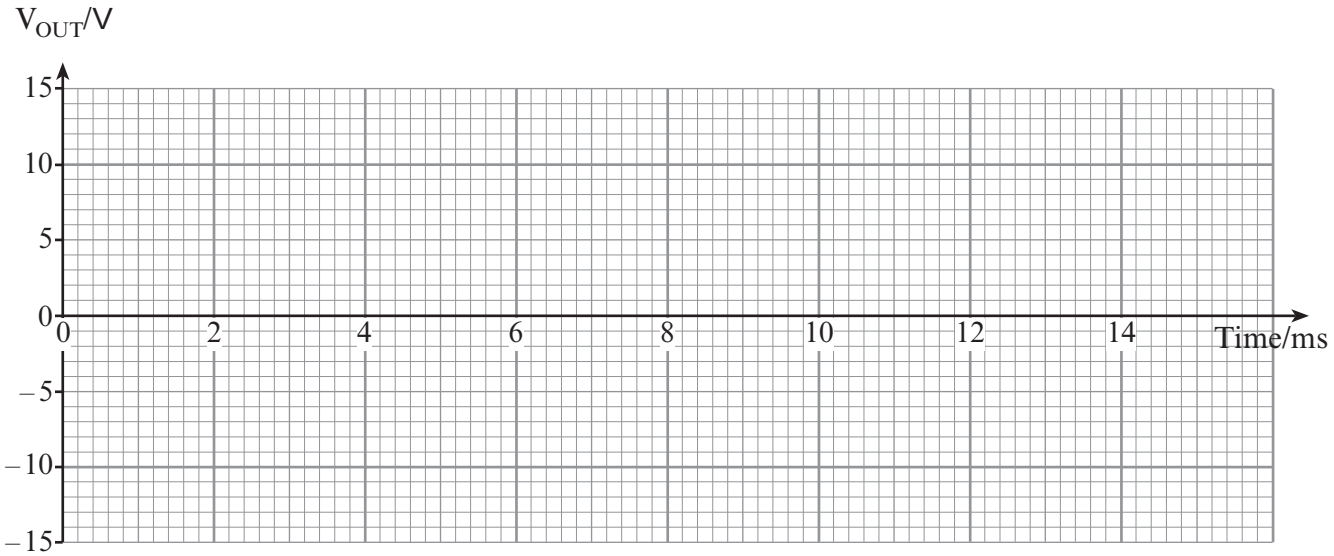
(ii) What are the switching thresholds for this Schmitt trigger?

..... and ..... [1]

Examiner only

(b) Draw the output for this Schmitt trigger when the following analogue signal is applied to the input. [3]





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2. The following diagrams show two carrier waves modulated by two different sinusoidal modulating signals.

Diagram A

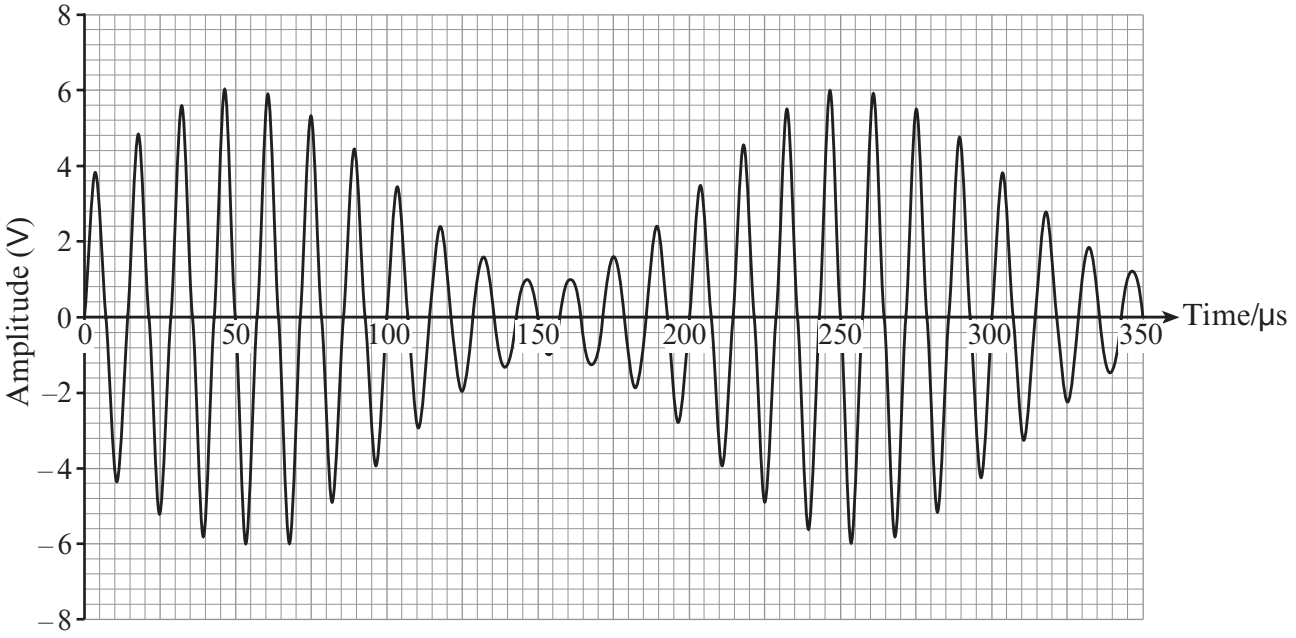
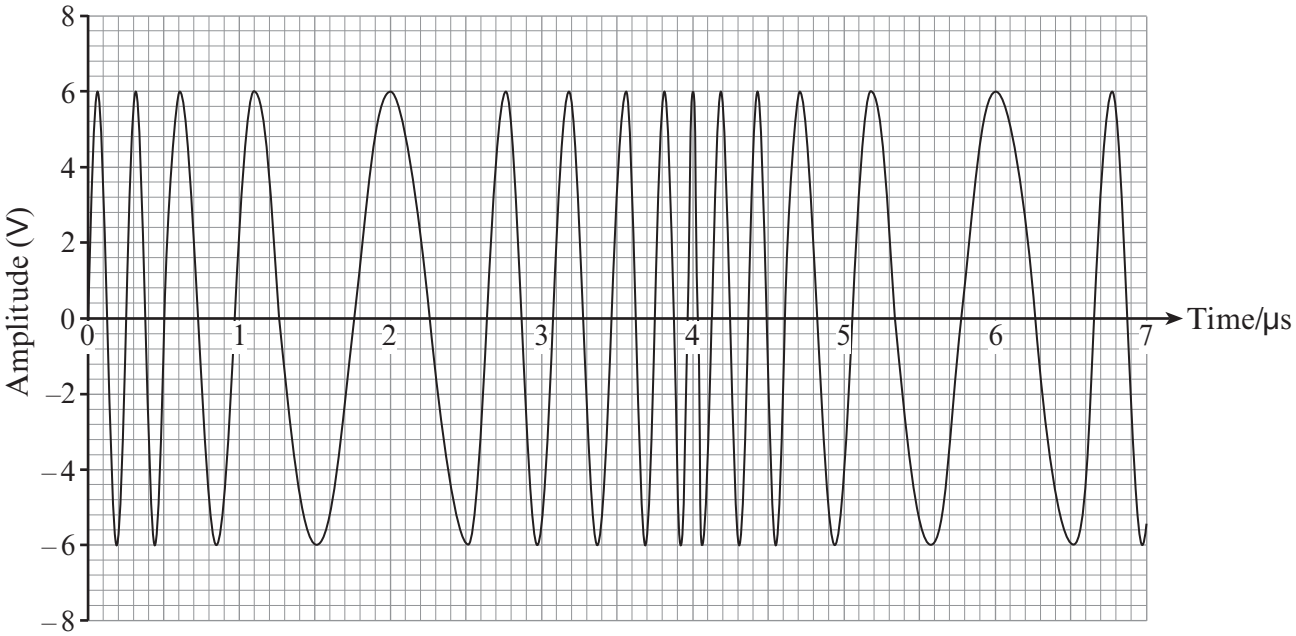


Diagram B



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(a) Name the type of modulation that has been used to produce the signals shown in Diagram **A** and Diagram **B**.

Diagram **A:** .....

Diagram **B:** ..... [1]

(b) For Diagram **A**, determine:

(i) the carrier frequency;

.....

.....

(ii) the frequency of the sinusoidal modulating signal used to modulate the carrier;

.....

.....

(iii) the depth of modulation.

.....

.....

[3]

(c) For Diagram **B**, determine:

(i) the carrier frequency;

.....

.....

(ii) the frequency of the sinusoidal modulating signal used to modulate the carrier.

.....

.....

[2]

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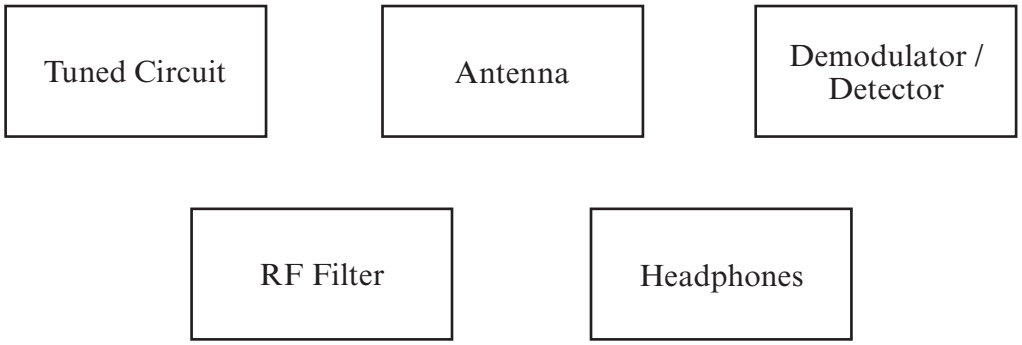
3. The simple radio receiver is made from five functional blocks. The blocks are shown below.



(a) In the space below draw a block diagram to show how these blocks are connected to make a simple radio receiver.

[1]

(b) State **two** limitations of the simple radio receiver.

1. .....

.....

2. .....

.....

[2]

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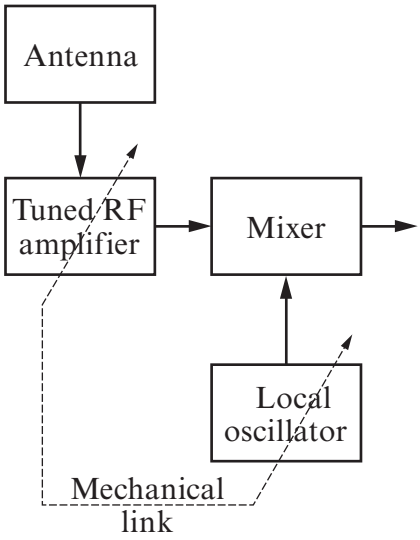
(c) The superheterodyne radio receiver offers considerable improvement compared with the simple radio receiver. The front end of the superheterodyne radio receiver is shown below.



(i) The tuned RF amplifier has been tuned to a frequency of 1.8 MHz. The local oscillator output is measured at 2.27 MHz. What **four** frequency signals will be present at the output of the mixer?

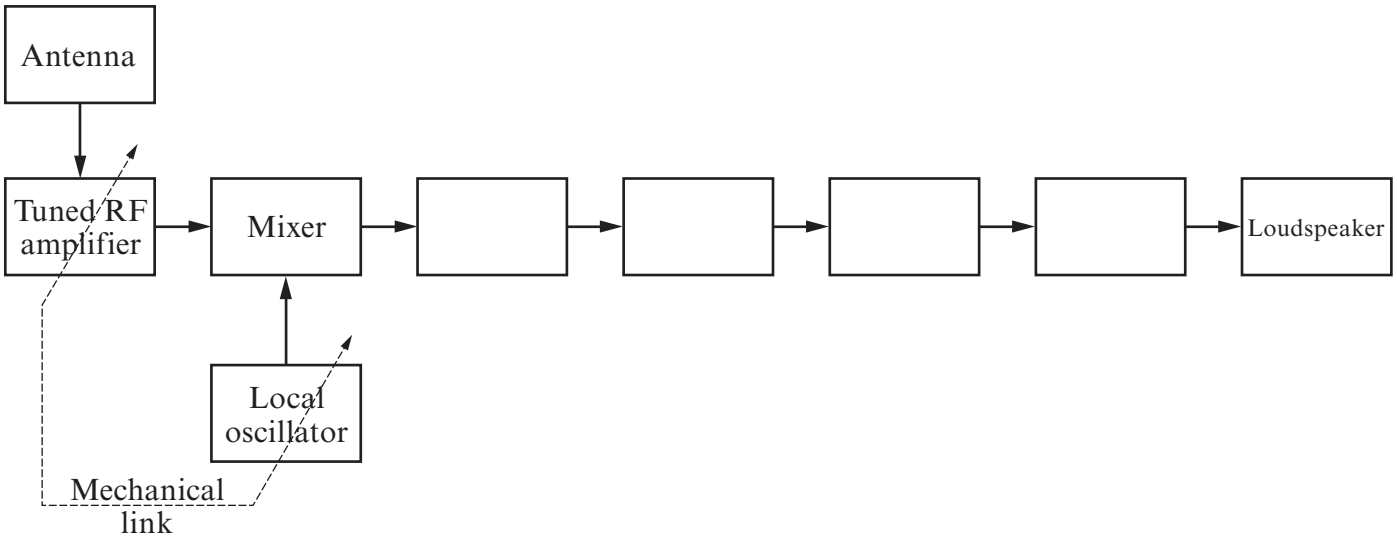
.....

.....

[2]

(ii) Which of these frequencies is the intermediate frequency? ..... [1]

(iii) Complete the following block diagram of the full superheterodyne radio receiver.



[4]

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

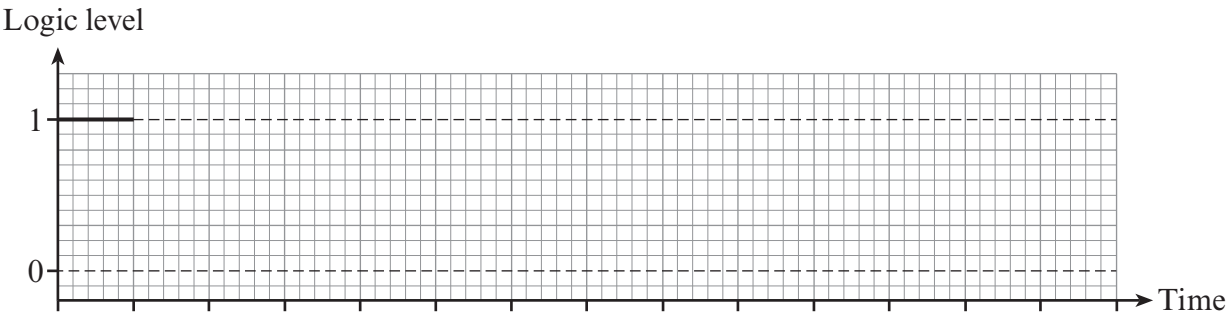
The following table gives the ASCII code for a selection of different characters.

Character	ASCII Code
a	0110001
b	0110010
c	0110011
d	0110100
e	0110101

(a) A computer system uses **odd** parity. Start, stop and parity bits have to be added before the signal can be transmitted.

Which character(s) in the table will have a parity bit set at logic 0? ..... [1]

(b) Complete the graph below to show the signal that would be transmitted for the transmission of character "c". **Label** the start, stop and parity bits.



[3]

(c) The single parity bit system has a significant weakness compared with multiple bit parity systems. Describe this weakness.

.....

.....

.....

.....

[1]

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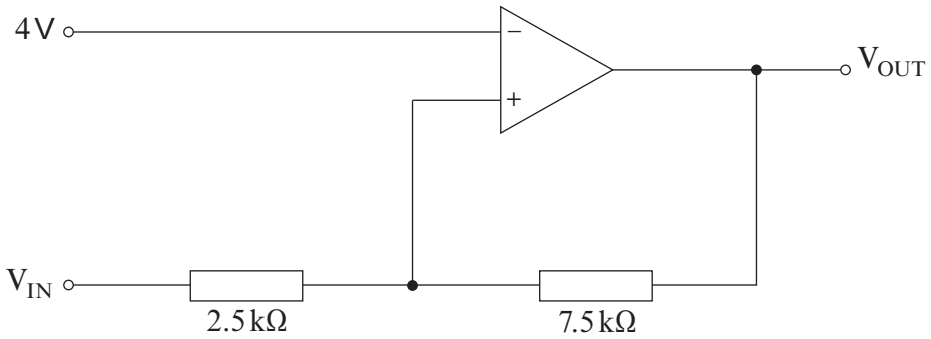
5. A Schmitt trigger circuit is shown in the following diagram.



The op-amp saturates at ±10 V.

(a) Calculate the value of V_{IN} which causes V_{OUT} to change from +10 V to –10 V.

.....

.....

.....

.....

.....

.....

[2]

(b) Calculate the value of V_{IN} which causes V_{OUT} to change from –10 V to +10 V.

.....

.....

.....

.....

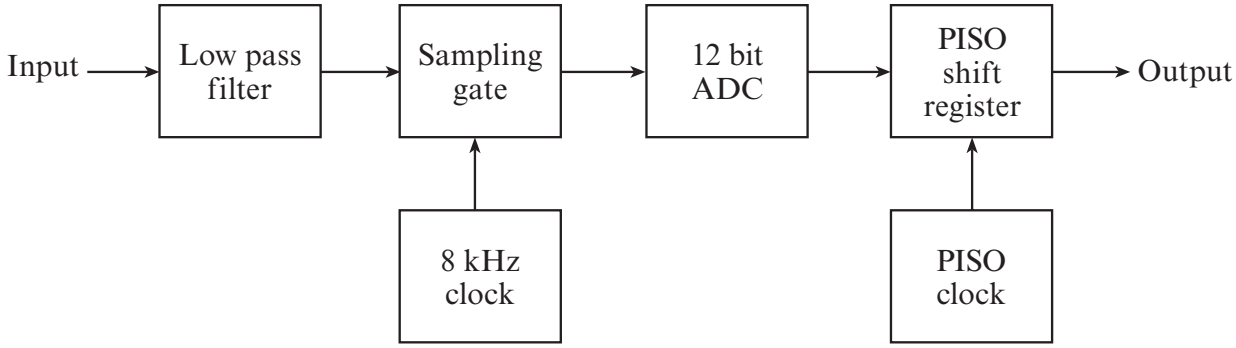
.....

.....

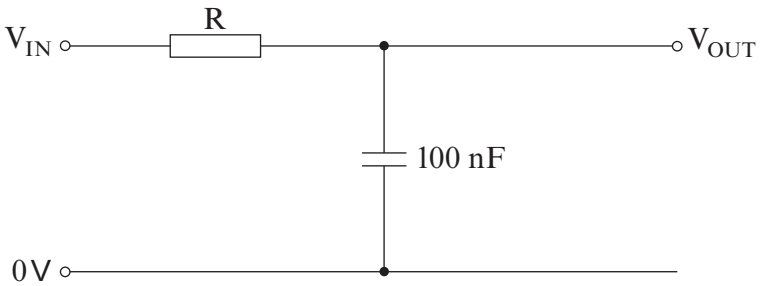
[2]

Examiner only

6. 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 3.8 kHz.



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



Determine the ideal value of the resistor required for the low pass filter.

.....

.....

.....

.....

.....

[3]

(b) What is the minimum frequency for the PISO clock for this PCM transmitter? Justify your answer.

Minimum frequency = ...

Reason: .....

.....

.....

.....

[2]

Examiner only

(c) The 12-bit Analogue to Digital Converter (ADC) has an input voltage range of 0 to 9 V. What is the resolution of the system?

.....

.....

.....

.....

[2]

(d) Draw a block diagram of a suitable PCM receiver using the following functional blocks.

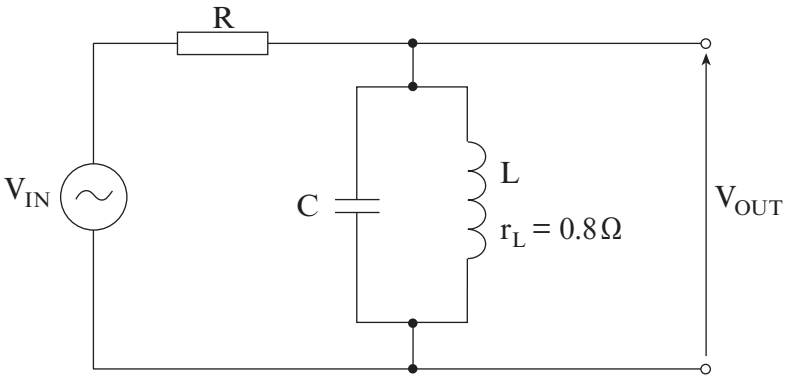
low pass filter *SIPO clock* *DAC* *SIPO shift register* *Schmitt trigger*

[3]

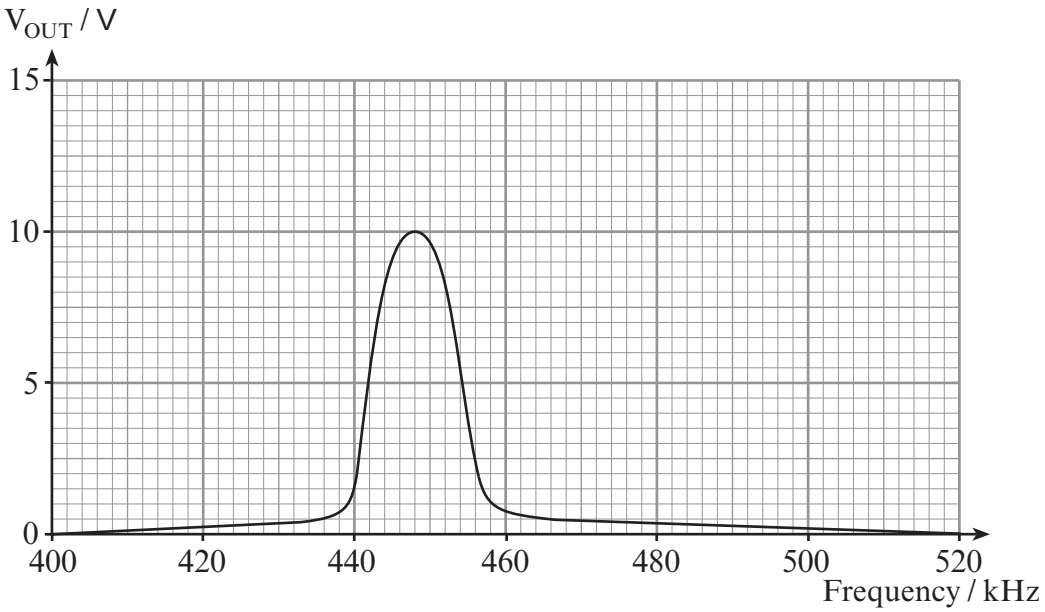
Turn over.

Examiner only

7. A student has built an intermediate frequency filter for a superheterodyne receiver. The circuit is as shown below. The inductor resistance r_L is 0.8 Ω. The circuit is tested with a signal generator which is set to provide a constant amplitude of 12 V.



The following graph shows the characteristic required for the filter.



(a) Use the graph to determine:

(i) the resonant frequency required,

.....

[1]

(ii) the bandwidth required.

.....

[2]

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(b) Use your answers from *(a)* to show by calculation that the Q factor of the filter is approximately 45.

.....

.....

.....

[1]

(c) Use your answers from parts *(a)* and *(b)* to calculate the ideal value of the inductor.

.....

.....

.....

[1]

(d) Show by calculation that the value of C required to achieve the required resonant frequency for this filter is approximately 10 nF.

.....

.....

.....

.....

[2]

(e) (i) Calculate the dynamic resistance for this filter.

.....

.....

.....

.....

[1]

(ii) Hence, determine the value of R.

.....

.....

.....

.....

[2]

THERE ARE NO MORE QUESTIONS IN THIS EXAMINATION.

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