Candidate Name	Centre Number	Candidate Number
		2

WJEC CBAC

GCE A level

384/01

ELECTRONICS – ET4

P.M. TUESDAY, 10 June 2008

1 ¼ hours

For Examiner's use only.	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

ADDITIONAL MATERIALS

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

INSTRUCTIONS TO CANDIDATES

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 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.

Your attention is drawn to the Information for the Use of Candidates on pages 2 and 3 of this paper.

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.

RC networks	$V_C = V_O (1 - e^{-t/RC})$	for a charging capacitor
	$V_C = V_O e^{-t/RC}$	for a discharging capacitor
	$t = -RC \ln\left(1 - \frac{V_c}{V_o}\right)$	for a charging capacitor
	$t = -RC \ln\left(\frac{V_c}{V_o}\right)$	for a discharging capacitor
Alternating Voltages	$V_o = V_{rms}\sqrt{2}$	
	$X_C = \frac{1}{2\pi fC}$	Capacitive reactance
	$X_L = 2\pi fL$	Inductive reactance
	$f_0 = \frac{1}{2\pi\sqrt{LC}}$	Resonant frequency
	$f_{co} = \frac{1}{2\pi RC}$	Cut-off frequency for high pass and low pass filters
	$\phi = \tan^{-1}\frac{R}{X_C}$	Phase shift between V_S and V_c.
Silicon Diode	$V_F \approx 0{\cdot}7V$	
Bipolar Transistor	$h_{FE} = \frac{I_C}{I_B}$	Current gain
	$V_{BE} \approx 0{\cdot}7V$	in the on state
MOSFETs	$I_D = g_M V_{GS}$	

Operational amplifier

$$G = -\frac{R_F}{R_{IN}}$$ Inverting amplifier

$$G = 1 + \frac{R_F}{R_1}$$ Non-inverting amplifier

$$V_{OUT} = -R_F\left(\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right)$$ Summing amplifier

$$\text{Slew Rate} = \frac{\Delta V_{OUT}}{\Delta t}$$ Slew rate

$$V_{OUT} = V_{DIFF}\left(\frac{R_F}{R_1}\right)$$ Difference amplifier

$$V_L \approx V_Z\left(1 + \frac{R_F}{R_1}\right)$$ Stabilised power supply

Power Amplifier

$$P_{MAX} = \frac{V_S^2}{8R_L}$$ where V_S is rail-to-rail voltage

555 Monostable

$$T = 1{\cdot}1\ RC$$

555 Astable

$$t_H = 0{\cdot}7\ (R_A + R_B)C$$

$$t_L = 0{\cdot}7\ R_B C$$

$$f = \frac{1 \cdot 44}{(R_A + 2R_B)C}$$

Schmitt Astable

$$f \approx \frac{1}{RC}$$

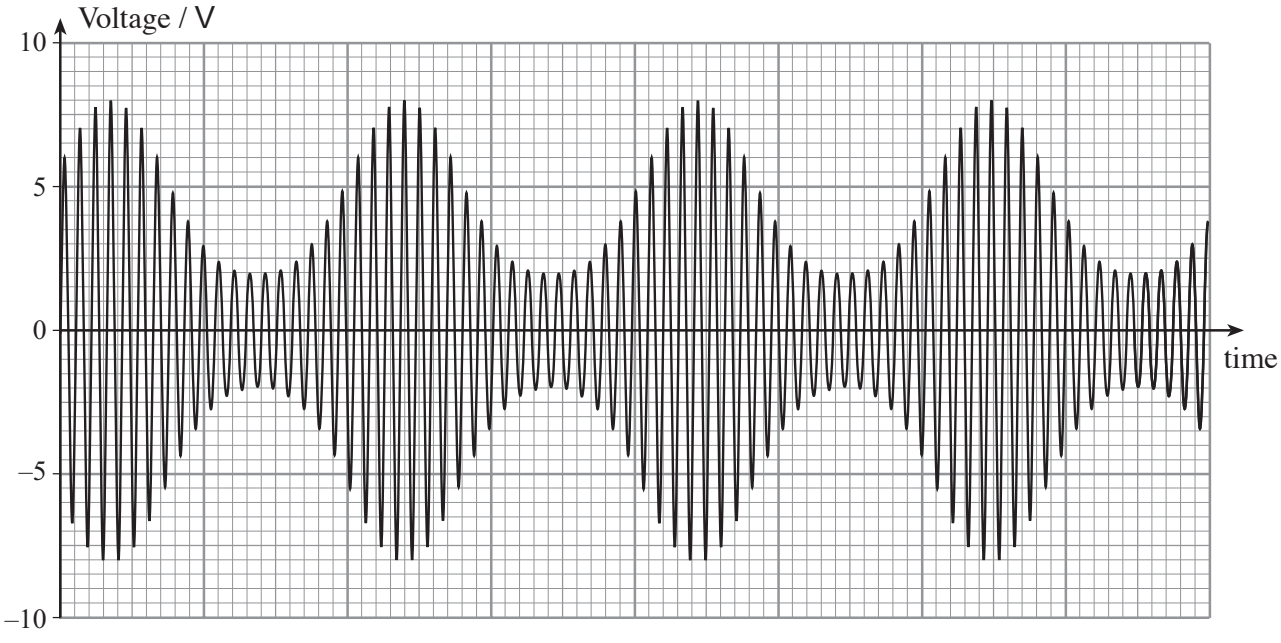
Turn over.

1. The following words / phrases are frequently used when talking about communication systems. Match the correct word / phrase to the descriptions in the table below: [5]

modulation noise carrier multiplexer distortion demodulation demultiplexer time division multiplexing frequency division multiplexing

Correct word / phrase	Description
	A device for directing a number of signal channels into a single transmission link.
	This is needed to allow an audio signal to be transmitted through free space over a long distance.
	A communication method which uses a number of frequency channels to transmit signals simultaneously through a transmission link.
	The process of retrieving an audio signal after it has been transmitted through free space over a long distance.
	Non-random errors introduced into an electronic signal by the components of a circuit.

2. The following graph shows the broadcast signal from a radio station.



(a) What type of modulation has been used for this radio broadcast? [1]

.....

(b) Calculate the depth of modulation for this broadcast signal. [2]

.....

.....

3. Computer networks use the TCP/IP protocol to pass information around the network.

(a) The following IP address exists in *dotted decimal notation*.

200 . 202 . 93 . 103

Dotted decimal notation is a shorthand way of writing a binary address. Complete the binary address below to give the full address that this shorthand form represents.

– – – – – – – – . – – – – – – – – . – – – – – – – – . 0 1 1 0 0 1 1 1

[2]

(b) The following IP address cannot exist, even though it has the same format as the address given in part *(a)*.

234 . 124 . 265 . 23

Explain why this address is invalid.

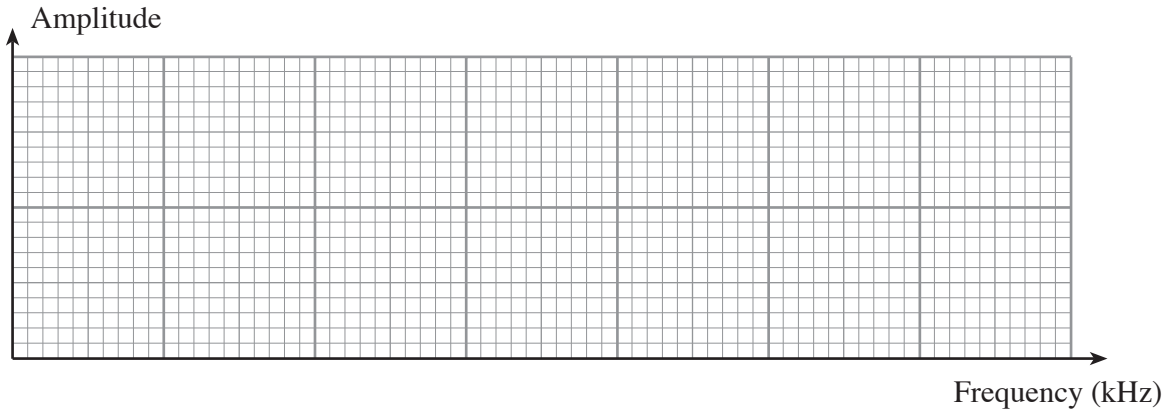
.....

.....

.....

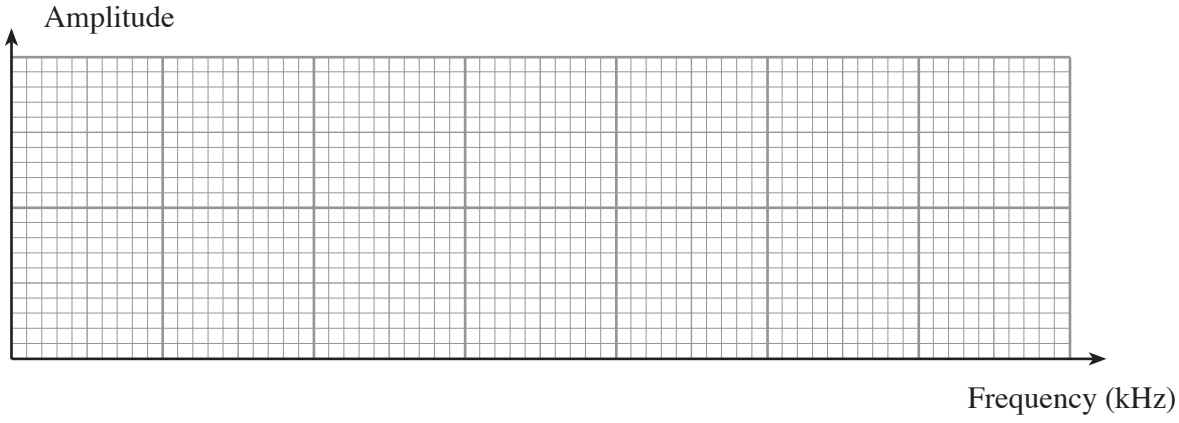
[1]

4. *(a)* A 15 kHz sinusoidal wave is amplitude modulated onto a 150 kHz carrier wave. On the axes below, draw the frequency spectrum of the transmitted wave. Label all significant frequencies. [3]



(b) The 15 kHz sinusoidal wave is now replaced with an audio signal containing frequencies in the range of 300 Hz - 15 kHz. The carrier signal frequency is not changed.

(i) On the axes below, draw the frequency spectrum of the transmitted wave. Label all significant frequencies. [1]



(ii) What is the broadcast bandwidth of the signal ? [1]

.....

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

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

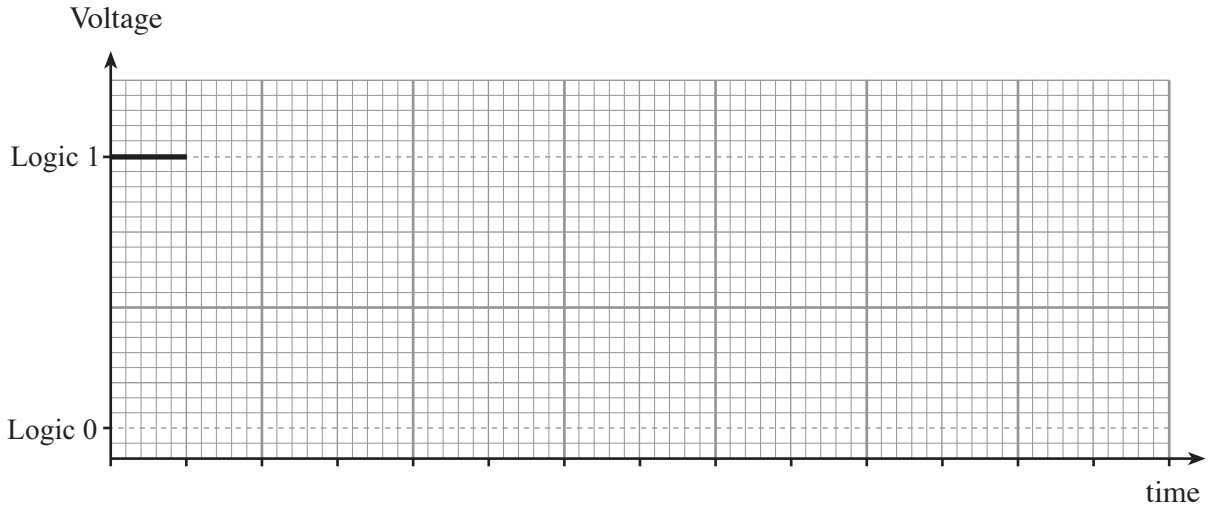
Character	ASCII Code
K	1001011
p	1110000
R	1010010
u	1110101

(a) Complete the following to show the logic state of the parity bit if: [2]

(i) character "K" is transmitted using **odd** parity; Parity Bit = ...

(ii) character "u" is transmitted using **even** parity. Parity Bit = ...

(b) A transmission system uses **odd** parity. Start and stop bits are added before the signal is transmitted. Complete the following graph to show the waveform of the transmitted signal when the character "R" is transmitted. [4]



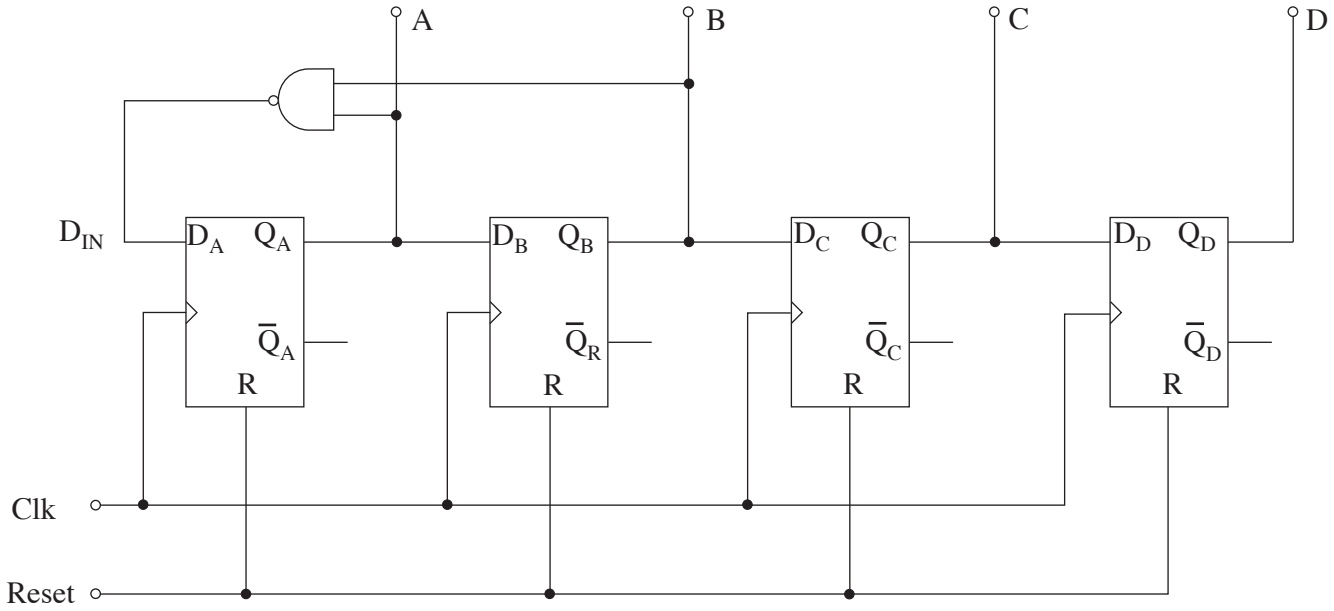
(c) Explain the purpose of the *parity* bit. [1]

.....

.....

.....

6. The following circuit diagram shows a Serial-In-Parallel-Out (SIPO) shift register with outputs A and B connected to a NAND gate. The output of the NAND gate is used to generate D_{IN}.



The shift register is reset so that outputs A, B, C, and D are logic 0. Complete the following table to give the state of the output after the given number of clock pulses have been applied. [4]

	A	**B**	**C**	**D**
After reset applied	0	0	0	0
After 1 clock pulse				
After 2 clock pulses				
After 3 clock pulses				
After 4 clock pulses				

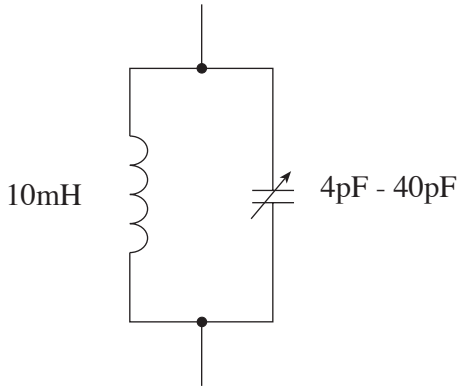
Turn over.

7. Here is a block diagram of a simple radio receiver.

(a) Name the component used as the detector in the simple radio receiver. [1]

.....

(b) The circuit diagram of the ***Tuned circuit*** is shown below. The radio receiver is tuned to receive Radio Five Live which transmits on a carrier frequency of 693 kHZ.



(i) Calculate the reactance of the inductor at 693 kHz. Give the unit. [2]

.....

.....

.....

(ii) What is the reactance of the variable capacitor at 693 kHz? [1]

.....

(iii) Calculate the value of the variable capacitor when tuned to receive Radio Five Live, at 693 kHz. [2]

.....

.....

.....

(iv) Radio Five Live also broadcasts on 909 kHz. Show by calculation whether this tuned circuit can be adjusted to receive Radio Five Live at 909 kHz. [2]

.....

.....

.....

.....

(c) The simple radio receiver suffers from *poor selectivity* and *poor sensitivity*. What is meant by the terms poor selectivity and poor sensitivity?

Poor selectivity means .....

.....

.....

Poor sensitivity means .....

.....

.....

[2]

(d) The superheterodyne receiver offers improved selectivity and sensitivity compared with the simple radio receiver.

(i) Name the section of the superheterodyne radio receiver which improves the *selectivity* of the receiver. [1]

.....

(ii) Name the section of the superheterodyne radio receiver which improves the *sensitivity* of the receiver. [1]

.....

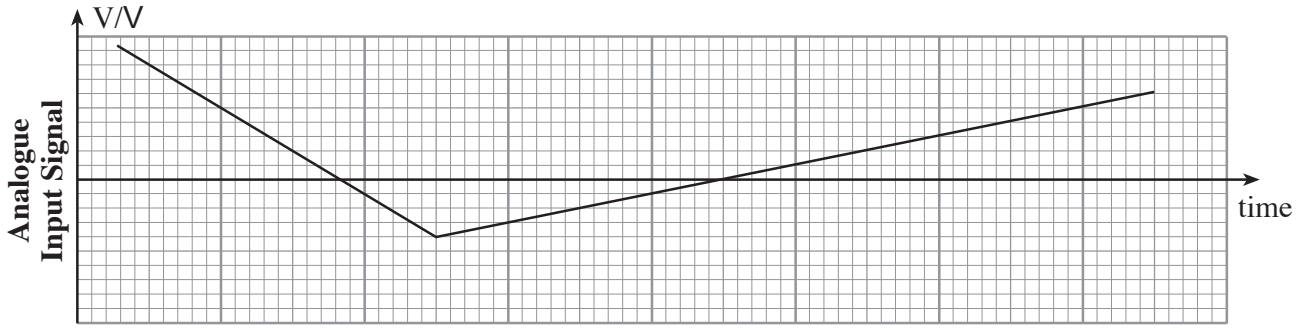
Examiner only

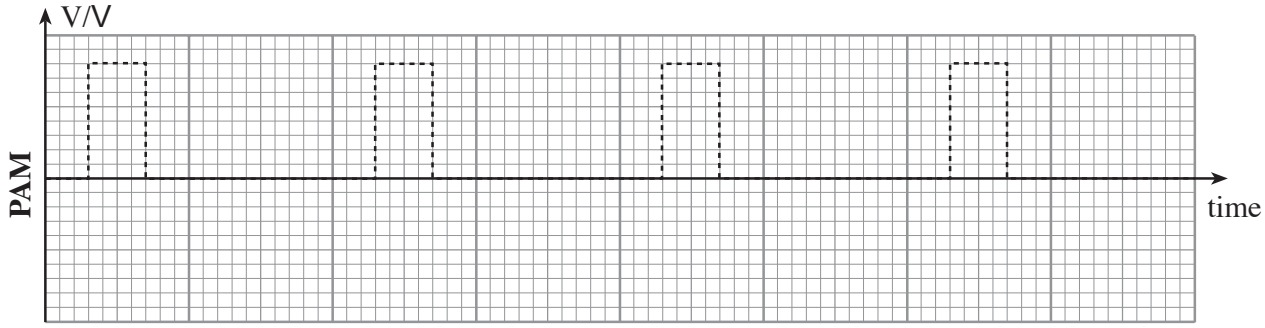
8. Pulse Amplitude Modulation, Pulse Position Modulation, and Pulse Width Modulation are three methods of modulating information.

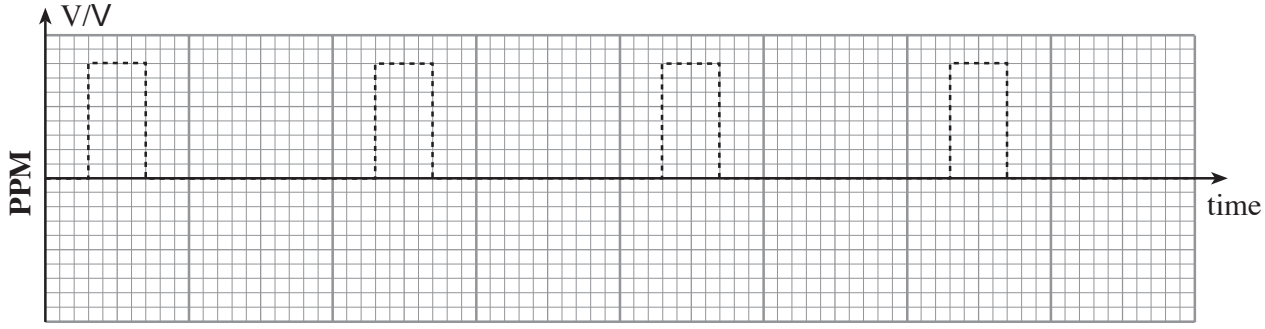
(a) On **each** of the following graphs illustrate what would happen to the unmodulated clock pulse train (shown dotted) if the signal below was transmitted using

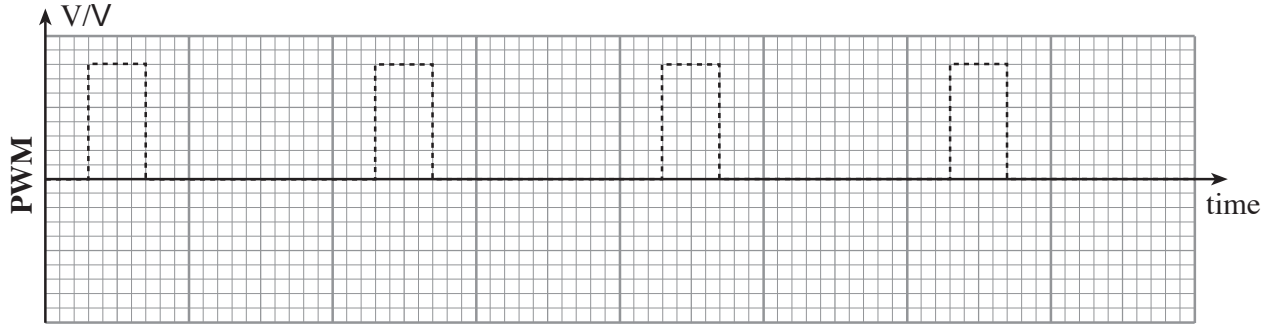
(i) PAM
(ii) PPM
(iii) PWM

[6]

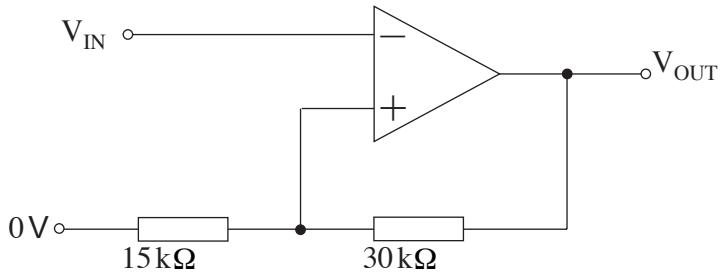








9. The following circuit diagram shows an op-amp connected as a Schmitt trigger. The op-amp saturates at +12 V and -12 V.



(a) Is this an *inverting* Schmitt trigger or *non-inverting* Schmitt trigger ? [1]

.....

(b) Calculate the value of V_{IN} that causes V_{OUT} to change from -12 V to +12 V. [2]

.....

.....

.....

.....

(c) What is the value of V_{IN} that causes V_{OUT} to change from +12 V to -12 V ? [1]

.....

(d) Give a use for a Schmitt trigger circuit in a digital communication system.

.....

.....
[1]

Examiner only

FOR USE ONLY IF YOU HAVE MADE SUBSTANTIAL DELETIONS IN PARTS OF YOUR ANSWERS OR NEED MORE SPACE TO COMPLETE THEM. BE SURE TO INDICATE THE QUESTIONS CONCERNED.