

Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE  
General Certificate of Secondary Education



CYD-BWYLLGOR ADDYSG CYMRU  
Tystysgrif Gyffredinol Addysg Uwchradd

294/02

**ELECTRONICS**  
**MODULE TEST E2**  
**HIGHER TIER**

P.M. THURSDAY, 12 January 2006

(45 minutes)

**For Examiner's use only**

<b>Total Mark</b>	
-------------------	--

**ADDITIONAL MATERIALS**

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

**INSTRUCTIONS TO CANDIDATES**

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

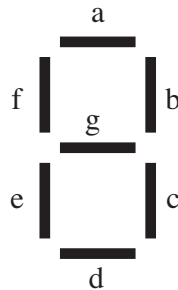
Answer **all** the questions in the spaces provided in this booklet.

**INFORMATION FOR CANDIDATES**

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

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

1. The diagram shows the arrangement of the LEDs in a seven-segment display.



A simple temperature meter uses this display to indicate three temperature levels.

The letter **H** is displayed when the temperature is too hot and the letter **C** displayed when it is too cold.

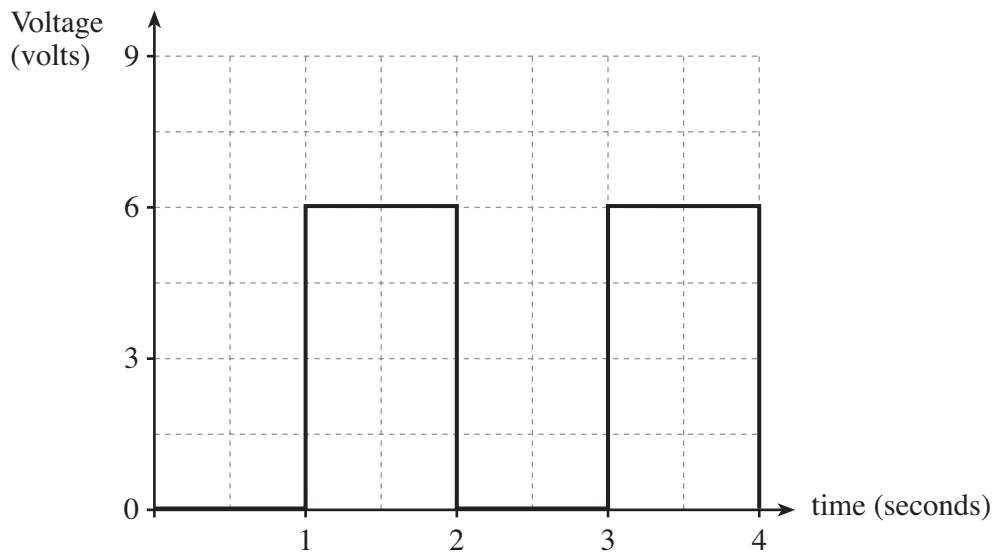
Complete the following table to show:

- which segments are lit when the letter **H** is displayed;
- which segments are lit when the letter **C** is displayed;
- which letter is displayed when segments a to g contain the code **1011011**.

Segment							Letters or Number displayed
a	b	c	d	e	f	g	
0							<b>H</b>
							<b>C</b>
1	0	1	1	0	1	1	

[3]

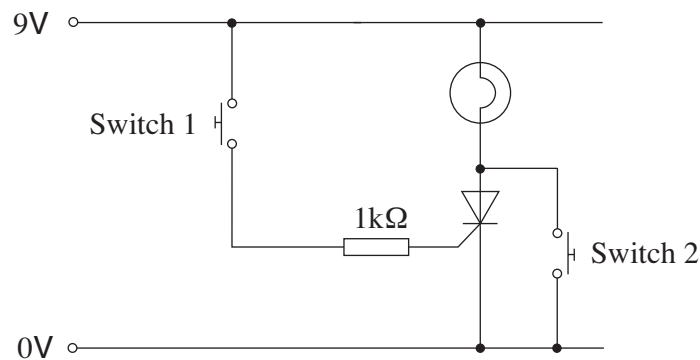
2. An astable circuit produces the output signal shown below.



- (a) What is the amplitude of the signal? .....
- (b) What is the period of the signal? .....
- (c) What is the frequency of the signal .....

[3]

3. The following diagram shows a thyristor circuit.



The switches are operated in the order shown below.  
State whether the bulb is *on* or *off*. The first one is done for you.

- Switch 1 is closed. The bulb is **on**.
- Switch 1 is opened. The bulb is .....
- Switch 2 is closed. The bulb is .....
- Switch 2 is opened. The bulb is .....

[3]

4. The diagram shows a pulse generator and a D-type flip-flop.



(a) The D-type performs a *divide-by-two* action on pulses from the pulse generator. Draw the two connections needed to do this. [1]

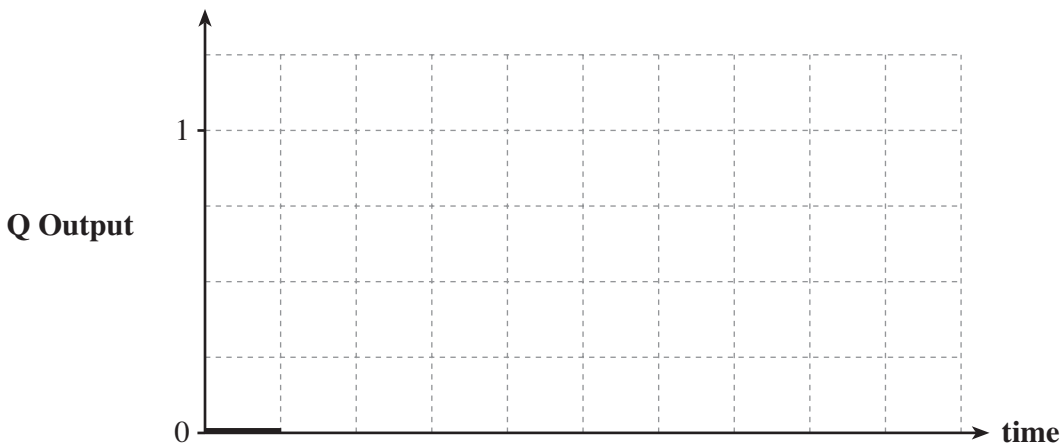
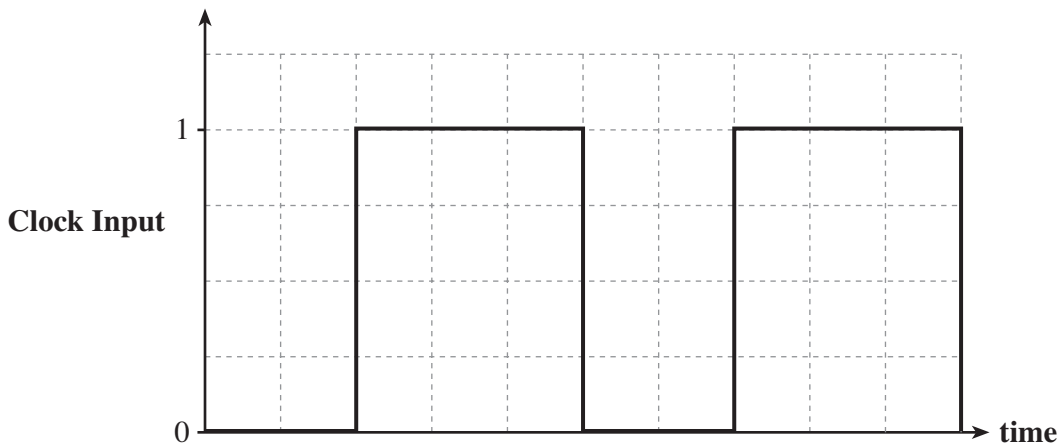
(b) The Pulse Generator frequency is 20Hz.

(i) What is the frequency of the signal at the Q output? .....

(ii) What is the frequency of the signal at the  $\bar{Q}$  output? ..... [2]

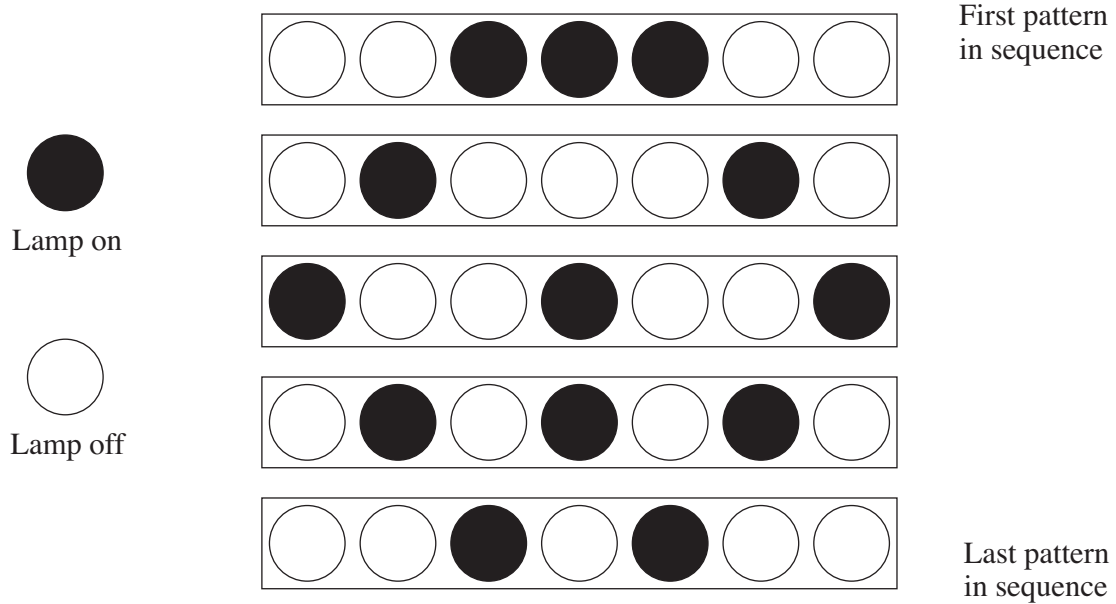
(c) The D-type is *rising-edge* triggered.

Complete the graph to show the signals obtained at the Q output when performing a divide-by-two action on the pulse generator output.



**BLANK PAGE**

5. A disco lighting kit flashes seven lamps on and off in a planned sequence. The diagram shows this sequence.



A memory IC stores the sequence.

- (a) The memory IC has seven data lines and three address lines.

What is the maximum number of sequence steps that can be stored in the IC? ..... [1]

- (b) Complete the table below with the series of binary codes to store the sequence.

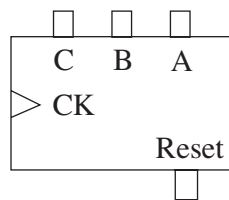
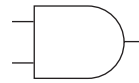
Memory Address	Memory Contents						
	D0	D1	D2	D3	D4	D5	D6
000	0	0	1	1	1	0	0
001							
010							
011							
100							
101	Unused						

[3]

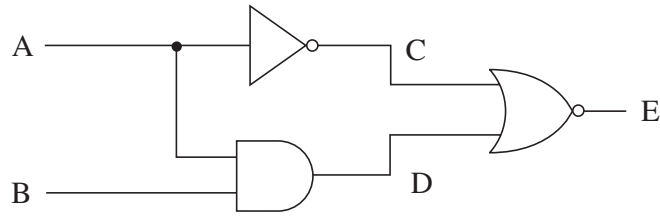
(c) A 3-bit counter is connected to the memory IC. As the counter outputs change, each memory location is accessed in turn. The counter must be reset at the end of the sequence to allow the patterns to repeat.

(i) What is the **binary** memory address of the first unused memory location? ..... [1]

(ii) Complete the diagram below to show how the counter can be reset.  
Bit A of the counter is connected to the least significant bit of the memory address. [3]



6. (a) Complete the truth table for the following logic system.



A	B	C	D	E
0	0			
0	1			
1	0			
1	1			

[3]

- (b) Redraw the system using only NAND gates.

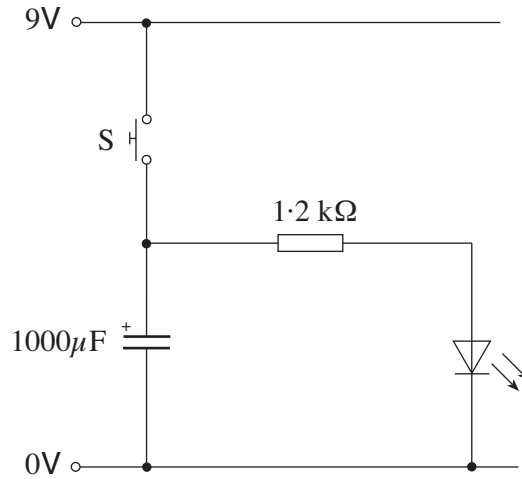
[3]

- (c) Draw a line through any redundant gates.

[2]



7. The circuit diagram shows a simple timer connected to a LED indicator.



(a) Describe what happens to the LED when switch S is:

(i) pressed and held in the closed position;

.....

.....

(ii) and then released.

.....

.....

.....

[2]

(b) Give **one** disadvantage of this simple timer compared with a *555-timer* circuit.

.....

.....

[1]

(c) The period of this simple timer can be estimated using the formula

$$T = \frac{R \times C}{1000} \text{ where } R \text{ is in } k\Omega, C \text{ is in } \mu F \text{ and } T \text{ is in seconds.}$$

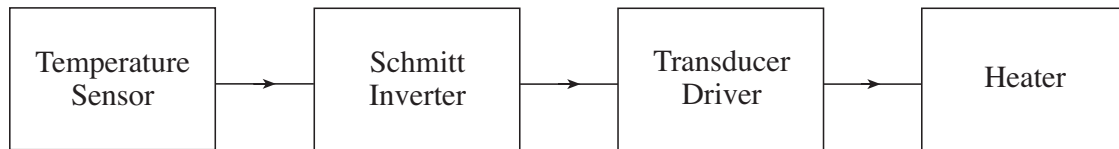
Calculate the period of the simple timer when  $R = 1.2 k\Omega$  and  $C = 1000 \mu F$ .

.....

.....

[1]

8. The block diagram shows a heating system for an aquarium.  
A heater rated at 6V, 3A comes on when the temperature drops too low.



- (a) Explain why a MOSFET is a suitable choice for the Transducer Driver in this system.

.....

.....

[1]

- (b) Here is part of a data sheet for the Schmitt Inverter:

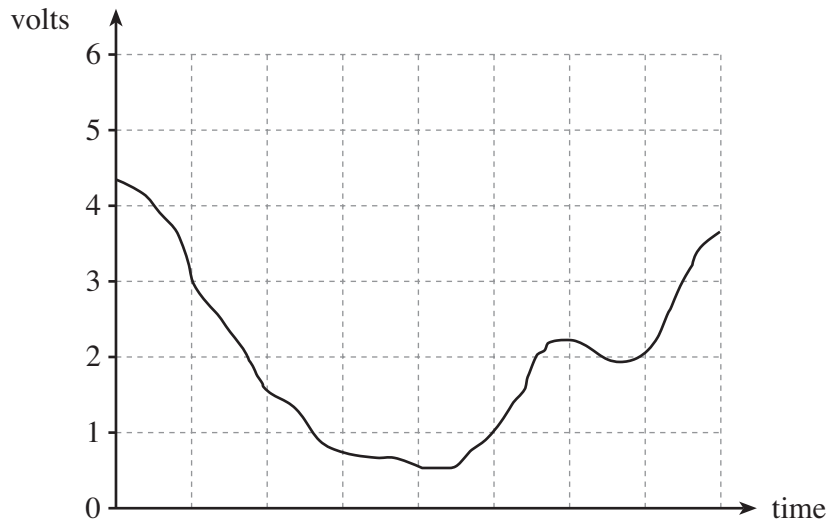
When connected to 6V supply:

- Logic 0 = 0V
- Logic 1 = 6V
- The output changes from logic 1 to logic 0 when a **rising** input voltage reaches 3V
- The output changes from logic 0 to logic 1 when a **falling** input voltage reaches 1V

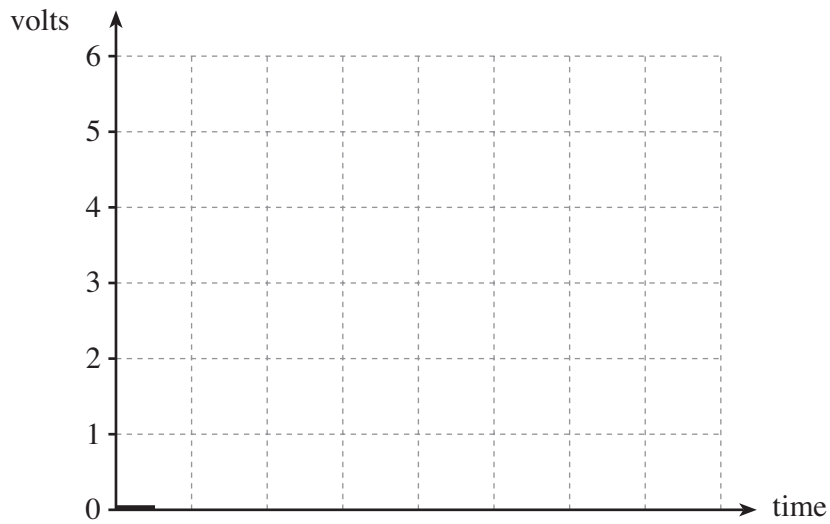
The signal produced by the temperature sensor is shown in **Graph 1**.

Complete **Graph 2** to show the signal obtained at the output of the Schmitt inverter.

**Graph 1**



**Graph 2**



[3]

- (c) The Schmitt Inverter inverts the signal from the temperature sensor. Give another reason for using the Schmitt Inverter in **this** application.

.....

.....

.....

[1]