Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE
General Certificate of Education
Advanced

CYD-BWYLLGOR ADDYSG CYMRU
Tystysgrif Addysg Gyffredinol
Uwch

384/01

ELECTRONICS

ET4

P.M. TUESDAY, 13 June 2006

($1\frac{1}{4}$ hours)

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

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

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
	$t = -RC\ 1n\left(1 - \frac{V_c}{V_o}\right)$	For a charging capacitor
	$t = -RC\ 1n\left(\frac{V_c}{V_o}\right)$	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
	$\phi = \tan^{-1}\frac{R}{X_C}$	
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	$t_H = 0{\cdot}7\ (R_A + R_B)C$	
	$t_L = 0{\cdot}7\ R_BC$	
	$f = \frac{1 \cdot 44}{(R_A + 2R_B)C}$	
Schmitt Astable	$f \approx \frac{1}{RC}$	

1. A number of short hand terms and abbreviations are used to describe some of the different systems and processes involved in communications systems.

Give the full version of the following terms.

(a) PCM ....

(b) FSK ....

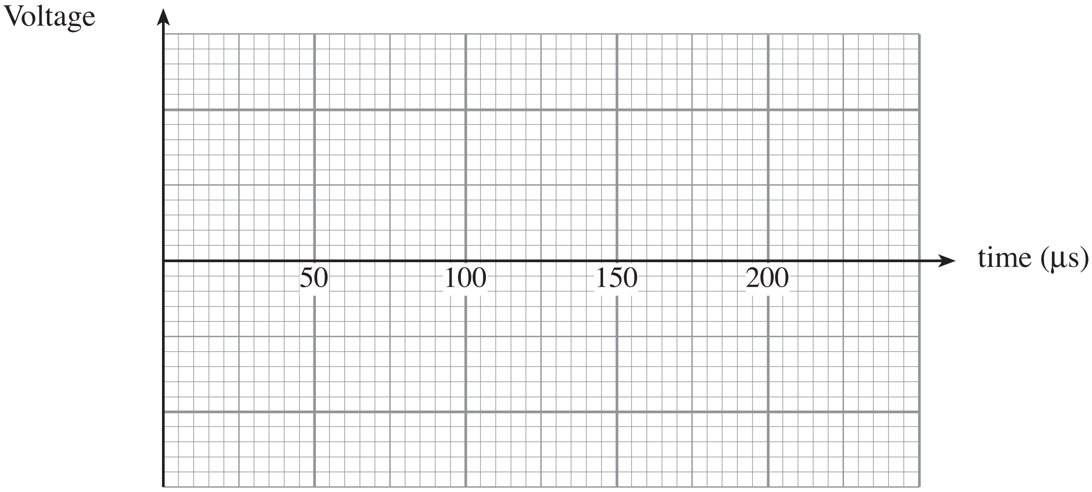
(c) TDM ....

(d) ADC ....

[4]

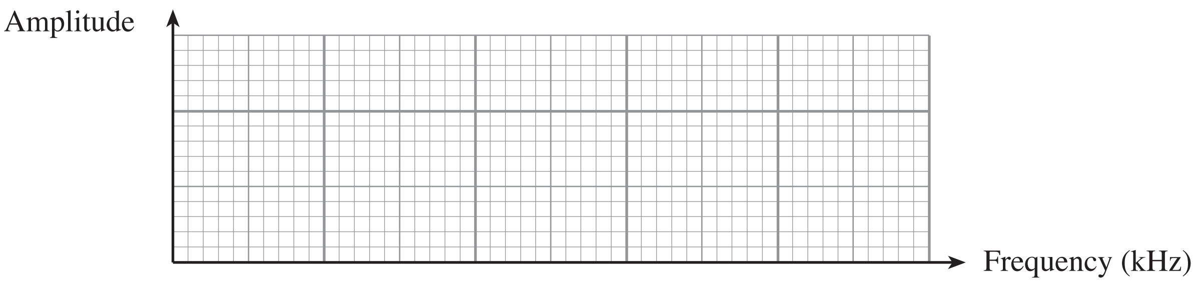
2. A radio station broadcasts for 20 hours each day on a frequency of 100 kHz, using Amplitude Modulation. During the **4 hours** when the radio station is 'off-air' the station transmits its call-sign, a continuous 10 kHz single frequency with a modulation depth of 50%, on the same carrier.

(a) Use the axes provided below to sketch the amplitude modulated envelope of the carrier wave, when transmitting its call-sign.



[3]

(b) Using the axes below sketch the frequency spectrum diagram for the ***amplitude modulated carrier of*** the radio station when transmitting its call-sign. Label all frequencies.



[3]

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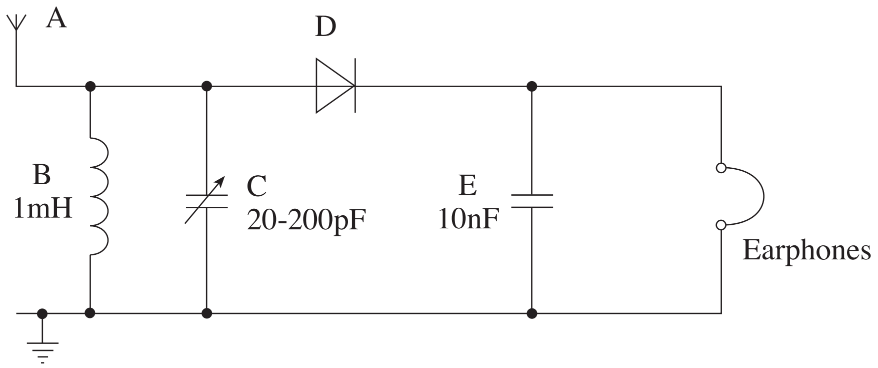
3. The circuit diagram for a simple radio receiver is shown below.



(a) Use the letters A-E to answer the following questions.

(i) Which component(s) modifies the RF signal to give non-zero average audio signal? ....

(ii) Which component(s) separates the audio signal from the RF carrier? ....

(iii) Which component(s) selects the required RF signal? ....

(iv) Which component produces an electrical signal from an electromagnetic wave?

....

[5]

(b) Calculate the highest frequency to which the above receiver can respond.

....

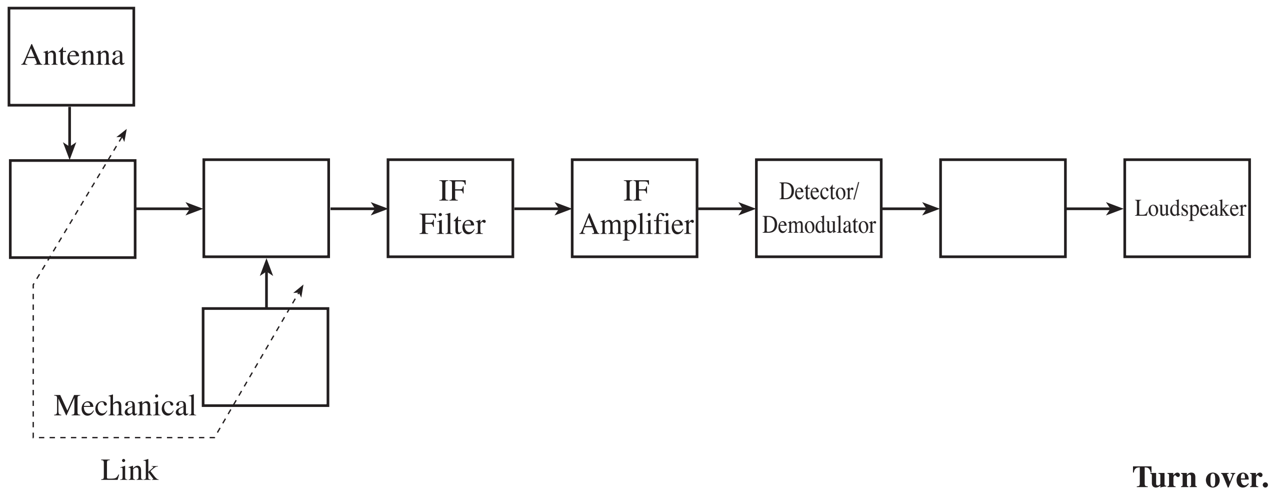
....

....

....

[3]

(c) The superheterodyne radio receiver offers improved selectivity and sensitivity compared to the simple radio receiver. Complete the following block diagram of the superheterodyne 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 number of different characters.

Character	**ASCII Code**
A	1000001
B	1000010
E	1000101
G	1000111

(a) Before transmission of data takes place, a *parity* bit is added to the 7 bit ASCII code. What is the purpose of adding a *parity* bit?

....

....

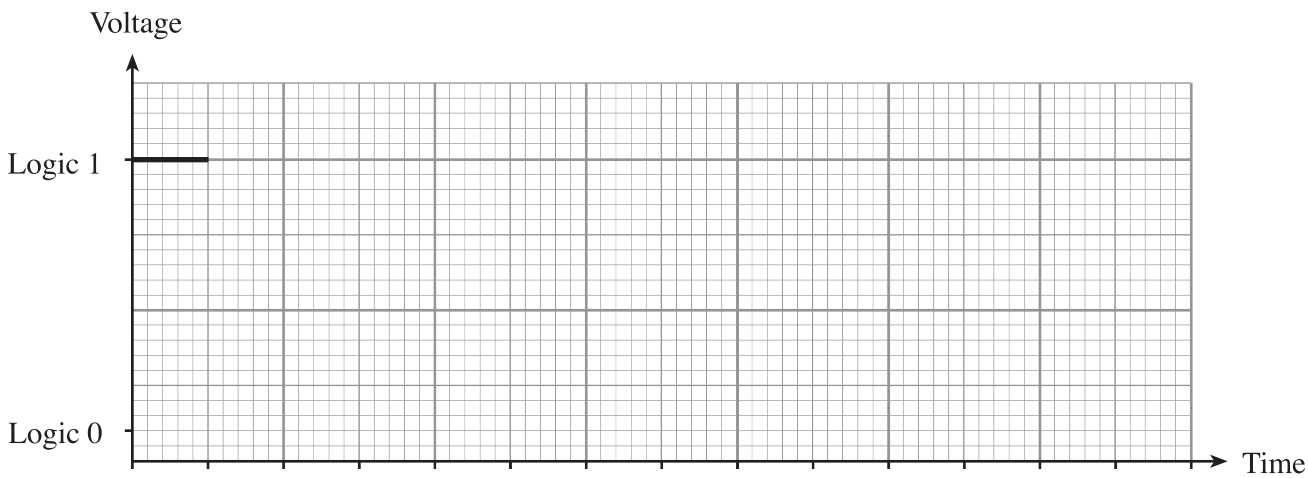
.... [1]

(b) Complete the following to show the logic state of the parity bit if:

(i) Character "E" is transmitted using **odd** parity. Parity Bit = ...

(ii) Character "B" is transmitted using **even** parity. Parity Bit = ... [2]

(c) A computer system uses **even** parity. Start and stop bits have to be added before the signal can be transmitted. Complete the graph to show the signal for the character "G". Label the start, stop and parity bits.



[4]

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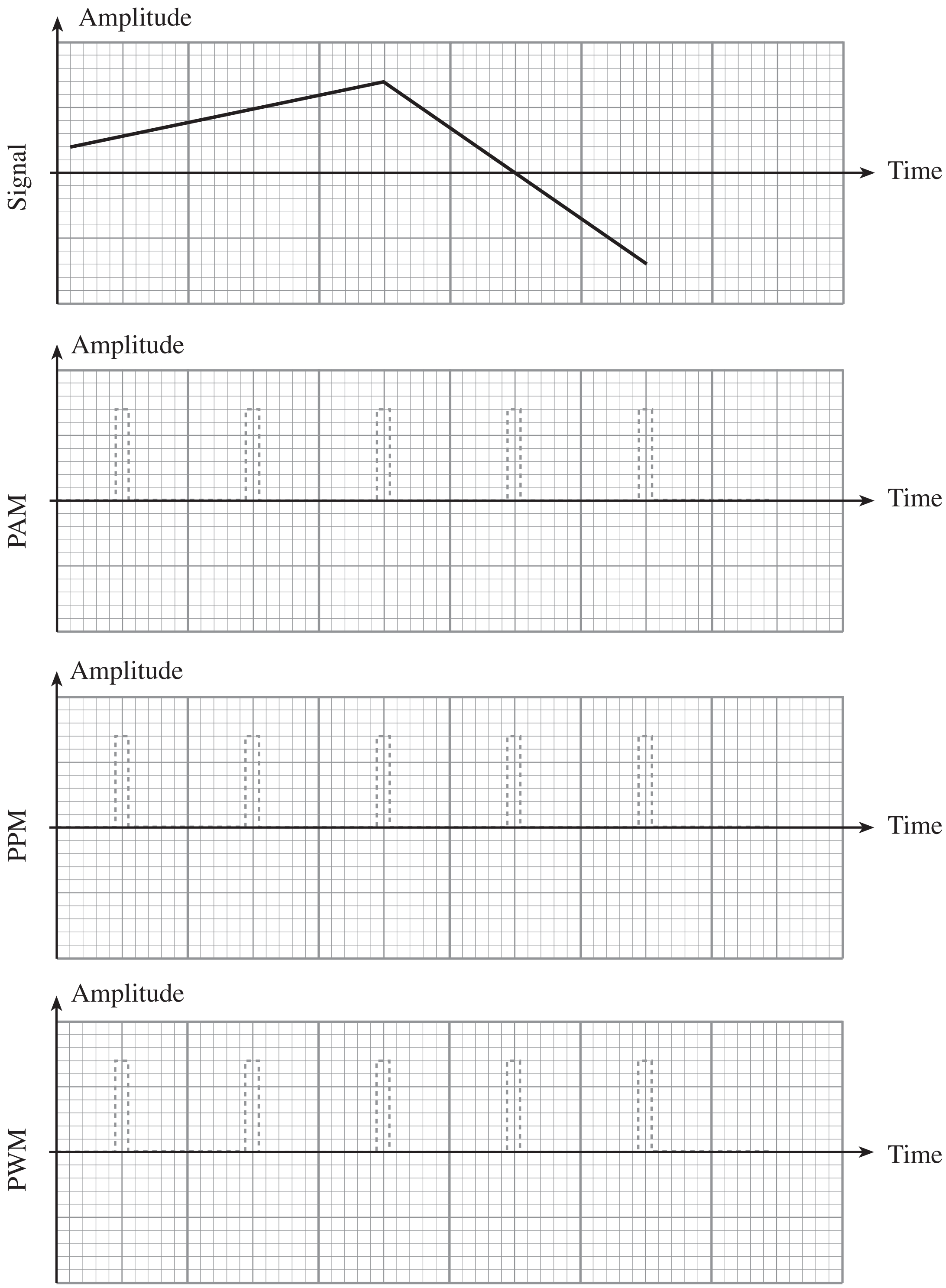
5. Pulse Amplitude Modulation (PAM), Pulse Position Modulation (PPM), and Pulse Width Modulation (PWM) are three methods of transmitting information.

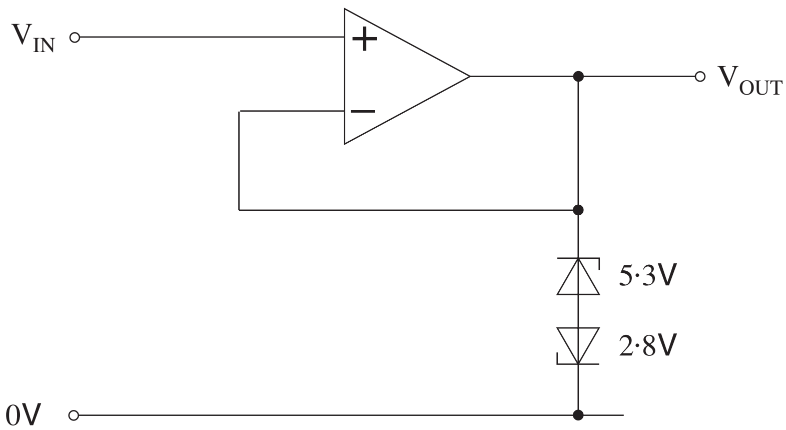
On **each** of the following graphs illustrate what would happen to the unmodulated pulse train (shown dotted) if the signal below was transmitted using

(i) PAM
(ii) PPM
(iii) PWM [6]

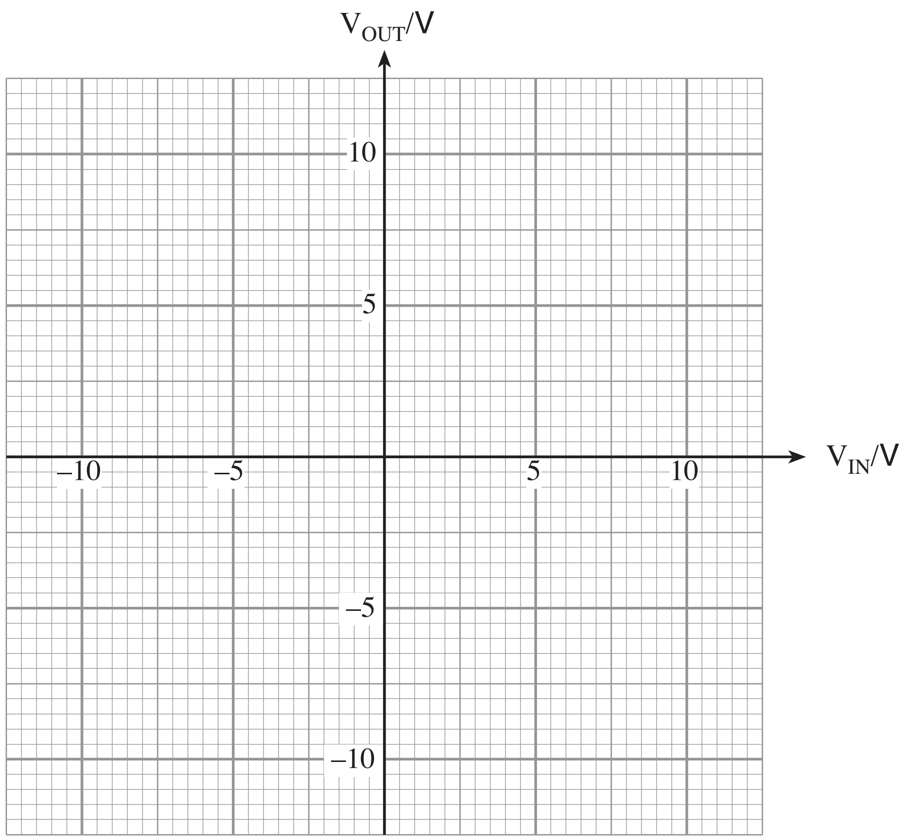


Turn over.

6. *(a)* The following circuit diagram shows how a Schmitt trigger circuit can be made using an operational amplifier and two zener diodes.

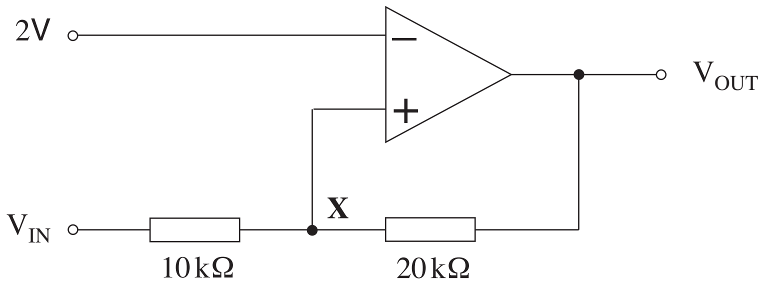


Draw the switching characteristic of the Schmitt trigger when the op-amp is connected to a ±12V power supply using the axes below.



[3]

(b) A **different** Schmitt trigger circuit is shown in the following circuit diagram.



The op-amp saturates at ±12V.

(i) Calculate the volage at **X** when V_{IN} = +3V, and V_{OUT} = +12V.

....

....

....

[2]

(ii) Calculate the value of V_{IN} which causes V_{OUT} to change from +12V to –12V.

....

....

....

[2]

(iii) Calculate the value of V_{IN} which causes V_{OUT} to change from –12V to +12V.

....

....

....

[2]

(c) Identify a situation where a Schmitt trigger would be needed in a communication system and what improvement it would make.

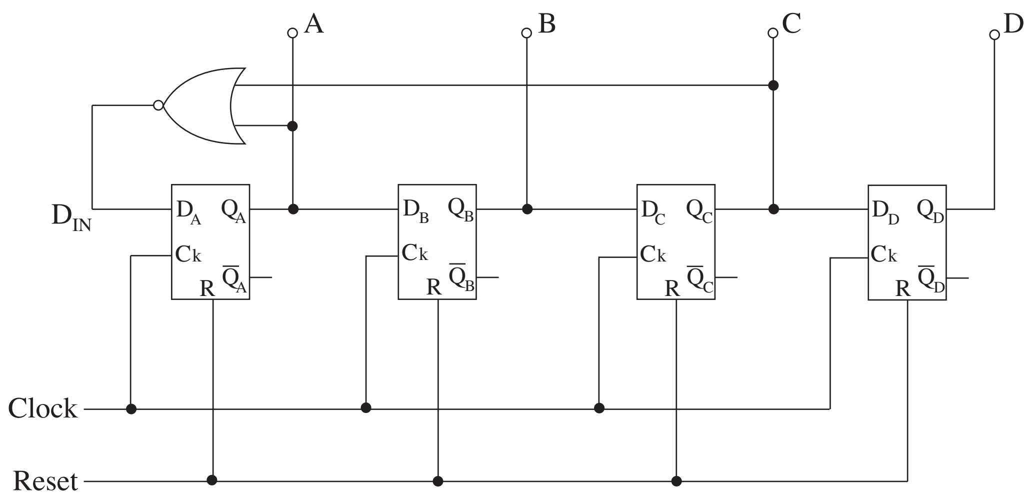
....

....

....

[2]

7. The following circuit diagram shows a serial-in-parallel-out (SIPO) shift register with outputs A and C connected to a NOR gate. The output of the NOR gate is used to generate D_{IN}.



The shift register is momentarily 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				