Candidate Name	Centre Number	Candidate Number
		0

GCE A level

1144/01

ELECTRONICS
ET4

A.M. WEDNESDAY, 8 June 2011

1 hour

For Examiner's Use Only		
Question	Maximum Mark	Mark Awarded
1.	3	
2.	8	
3.	6	
4.	9	
5.	8	
6.	4	
7.	6	
8.	6	
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 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

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

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

$X_L = 2\pi fL$ Inductive reactance

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

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

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

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

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

Modulation

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

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

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

$\left.\begin{array}{l}\text{Bandwidth} = 2(\Delta f_c + f_i) \\ \text{Bandwidth} = 2(1 + \beta) f_i\end{array}\right\}$ Transmitted FM Bandwidth

Radio receivers

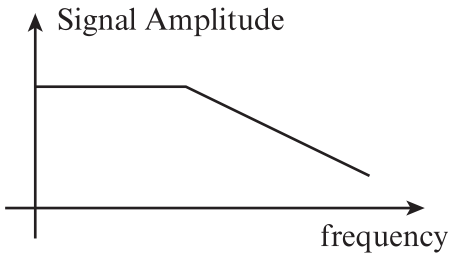
$C = \dfrac{1}{4\pi^2 f_0^2 L}$

Examiner only

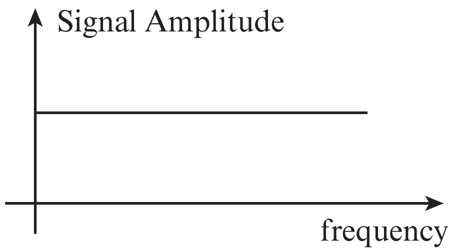
1. Communications systems use a number of different types of filters.

Match the name of the filter to its characteristic by drawing a line between them.

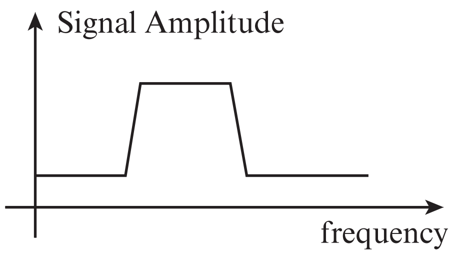
Name of Filter | Filter Characteristic



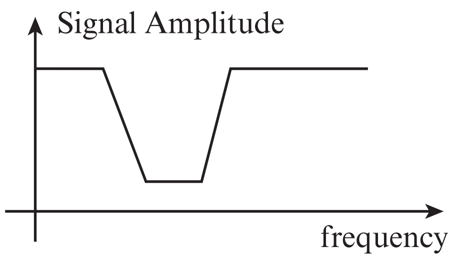
High Pass Filter.

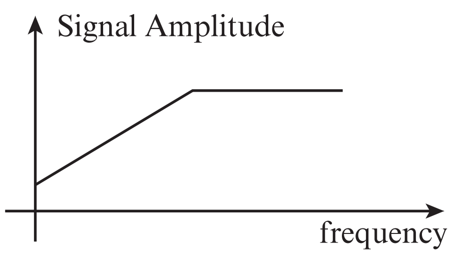


Low Pass Filter.



Band Pass Filter.





[3]

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2. *(a)* The following table contains some statements about FM transmissions. Complete the table by writing True or False after each statement.

Statement	**True / False**
The modulators and demodulators for FM are more complex than for AM.	
The FM bandwidth needed for a given information baseband is greater than that required for AM.	
In an FM signal with a modulation index β=3, the amplitude of the carrier is smaller than the sideband signals.	
All communication systems pick up noise. This has the effect of significantly downgrading the signal quality in the FM receiver.	

[4]

(b) In national radio broadcasts using FM, the frequency deviation of the carrier, Δf_c is chosen to be 75 kHz. The audio information baseband is the range 20 Hz to 15 kHz.

(i) Calculate the modulation index, β, for the transmission.

....

....

[2]

(ii) Calculate the broadcast bandwidth of the signal.

....

....

[2]

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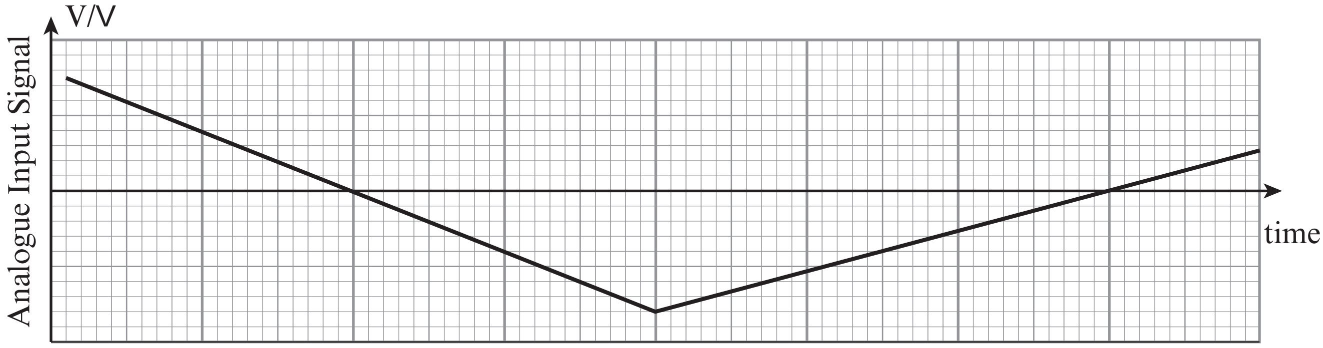
3. Pulse Amplitude Modulation (PAM), Pulse Position Modulation (PPM), and Pulse Width Modulation (PWM) are three methods of modulating information.

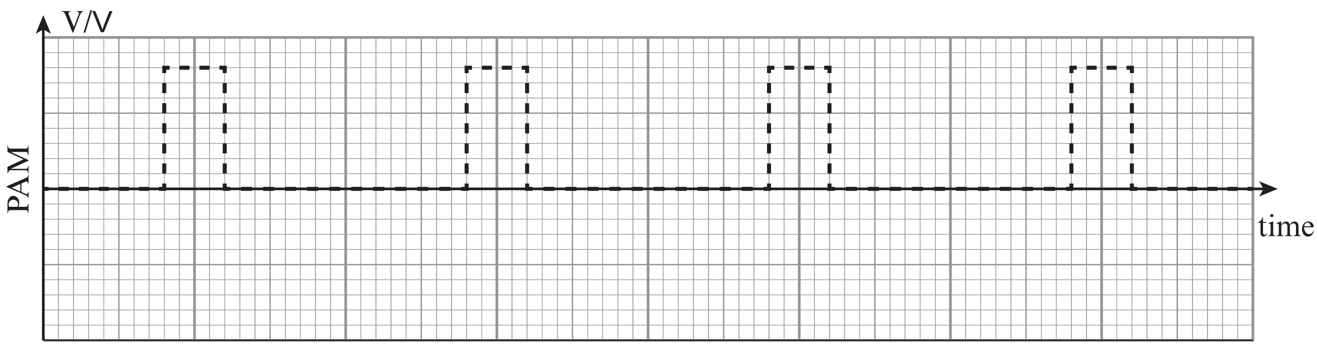
On each of the following graphs, illustrate what would happen to the unmodulated clock pulse train (shown dotted) if the signal below was transmitted using:

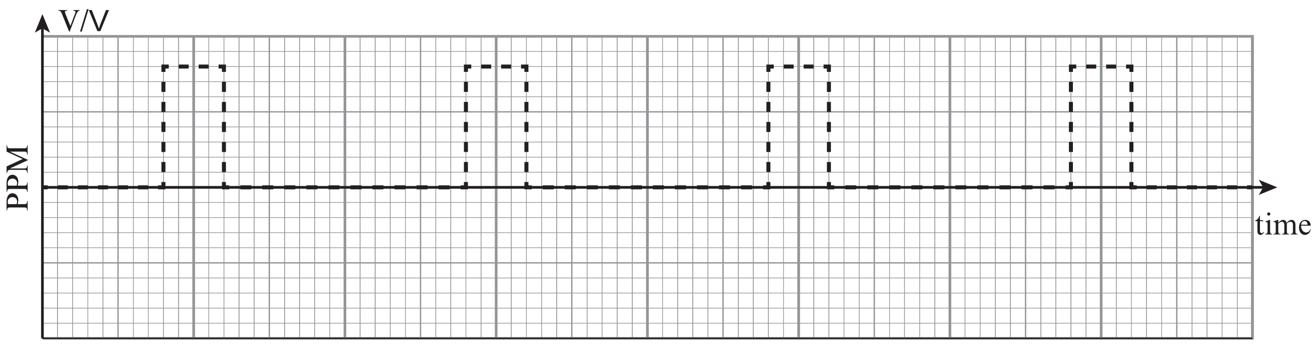
(i) PAM

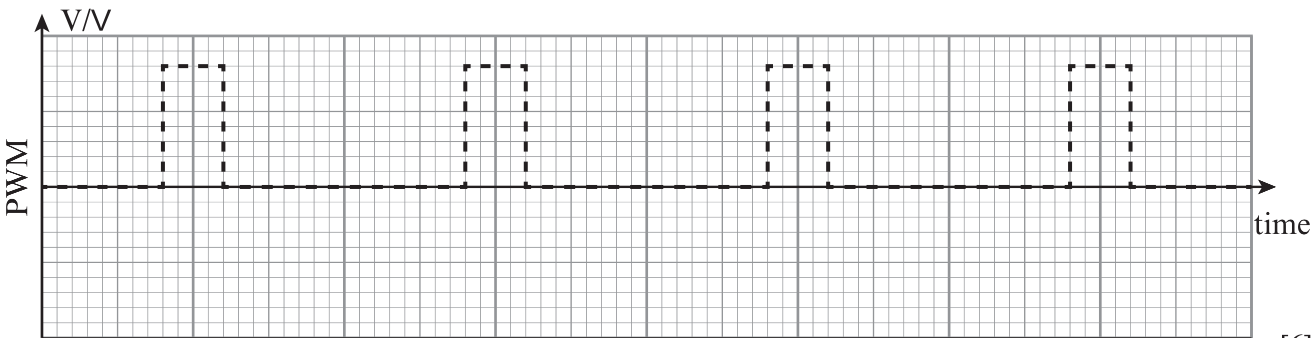
(ii) PPM

(iii) PWM









[6]

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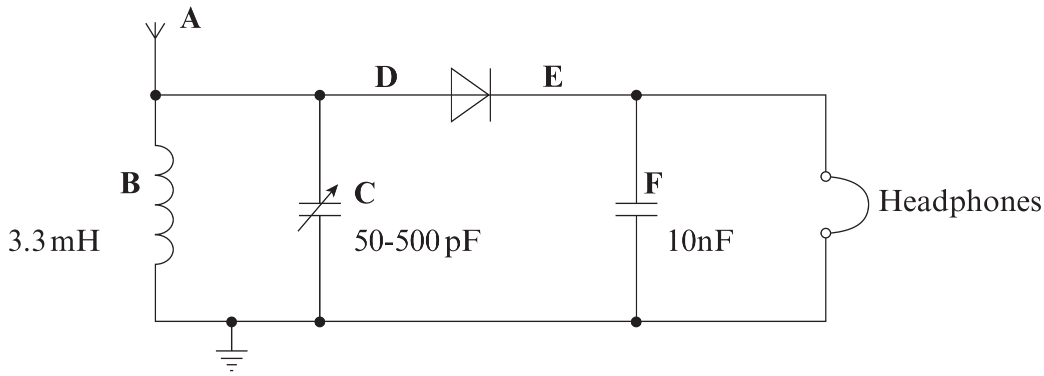
4. The circuit diagram for a simple radio receiver is shown below.



(a) (i) What is the purpose of component **A**?

....

....

.... [1]

(ii) What is the name of component **C**?

.... [1]

(iii) What is the purpose of component **F**?

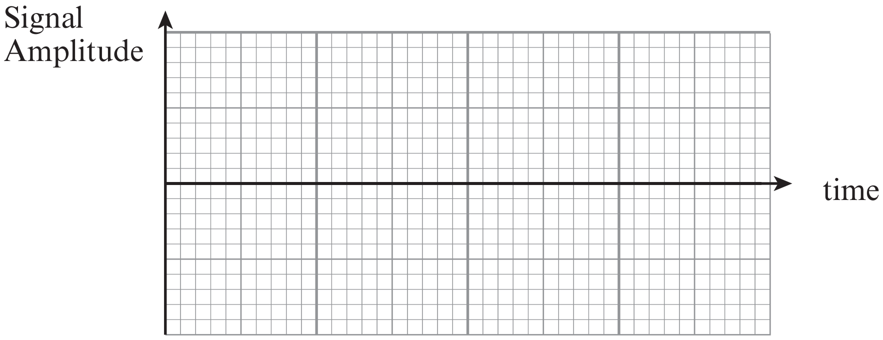
....

....

.... [1]

Examiner only

(b) (i) The receiver is tuned to a radio station. Sketch on the axes below a typical signal you would expect to see at point **D** on the axes below.



[1]

(ii) Sketch the signal you would expect to see at point **E** on the axes below.

[1]

(c) (i) Calculate the frequency range to which the receiver can be tuned.

....

....

....

....

[3]

(ii) Hence or otherwise determine if this radio circuit would be suitable for an England cricket supporter to listen to Test Match Special on Radio 4 Long Wave, transmitting at a frequency of 198 kHz.

....

....

....

....

[1]

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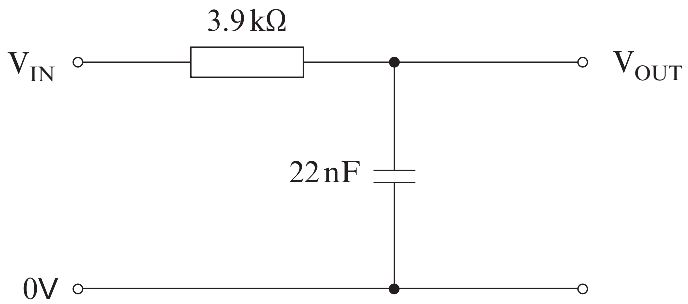
5. The following circuit is to be used as a filter.



(a) What is the name of this type of filter? .... [1]

(b) Calculate the reactance of the capacitor at 100 Hz.

....

....

.... [2]

(c) Estimate the reactance of the capacitor at 10 kHz.

.... [1]

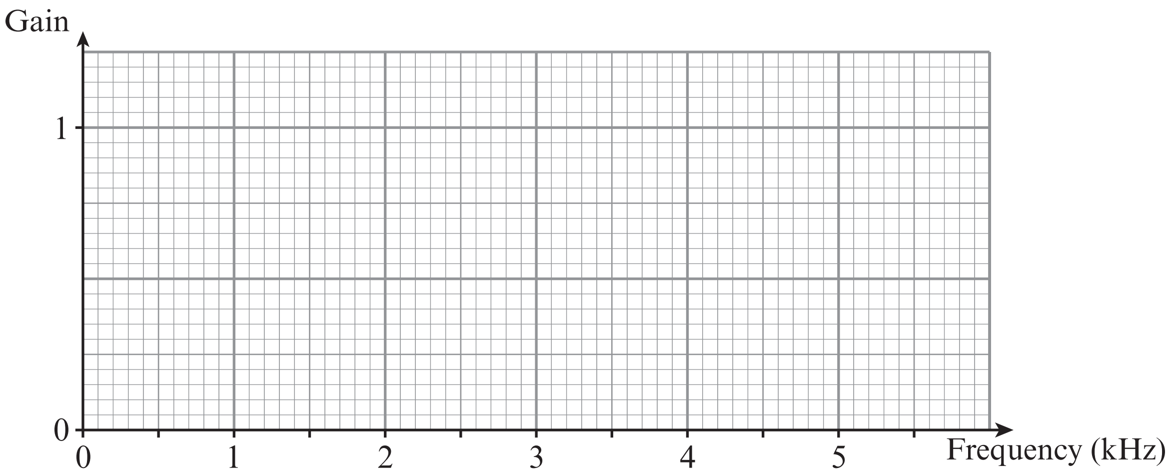
(d) Calculate the break frequency for this filter.

....

....

.... [2]

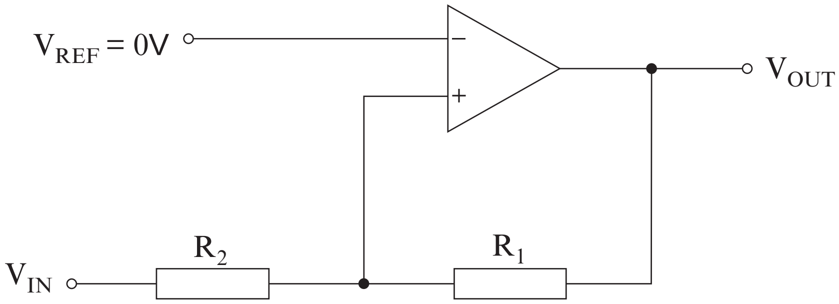
(e) Draw the characteristic of this filter.



[2]

Examiner only

6. A non-inverting Schmitt trigger is required to have saturation values of ±10 V, and switching thresholds of ±4 V.



(a) Explain why the switching thresholds for this circuit are symmetrical about zero volts.

....

.... [1]

(b) Determine the values of R_1 and R_2.

....

....

....

....

....

....

....

....

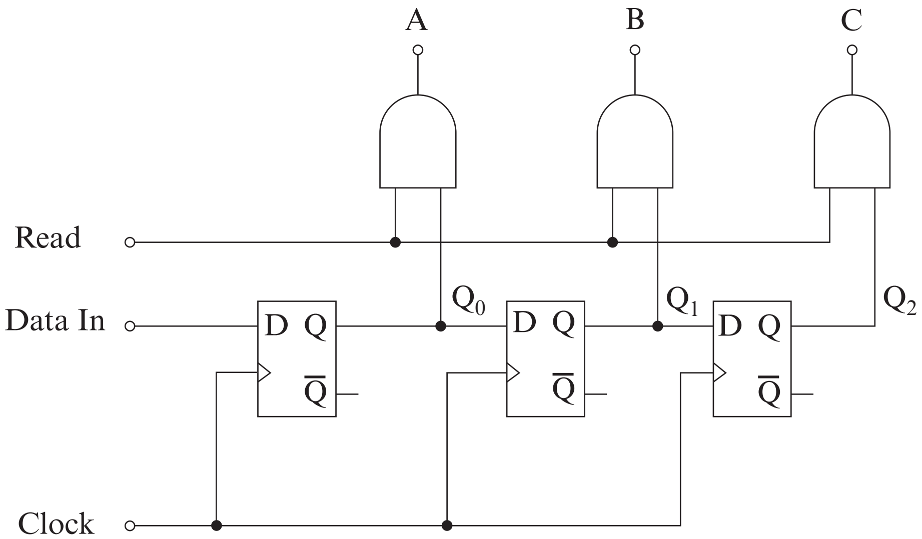
....

R_1 = ... R_2 = ...

[3]

Examiner only

7. The following diagram shows a 3-bit Serial-In-Parallel-Out shift register. It is made from *rising-edge-triggered* D-Type flip flops. Initially **all** inputs and outputs are at Logic 0.



Complete the graphs opposite to show the outputs Q_0-Q_2, and A-C in response to the given 'Clock', 'Data In' and 'Read' signals.

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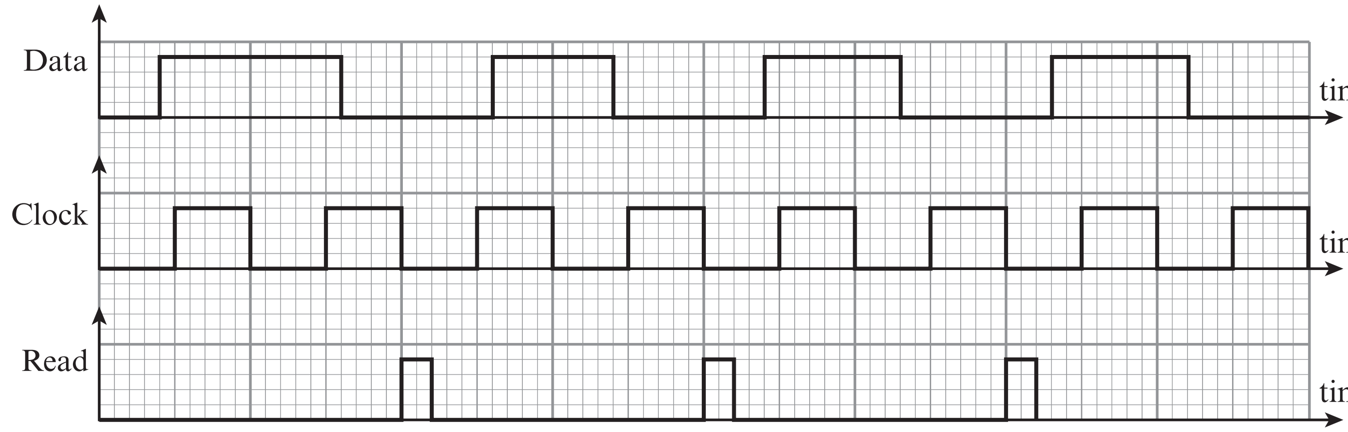

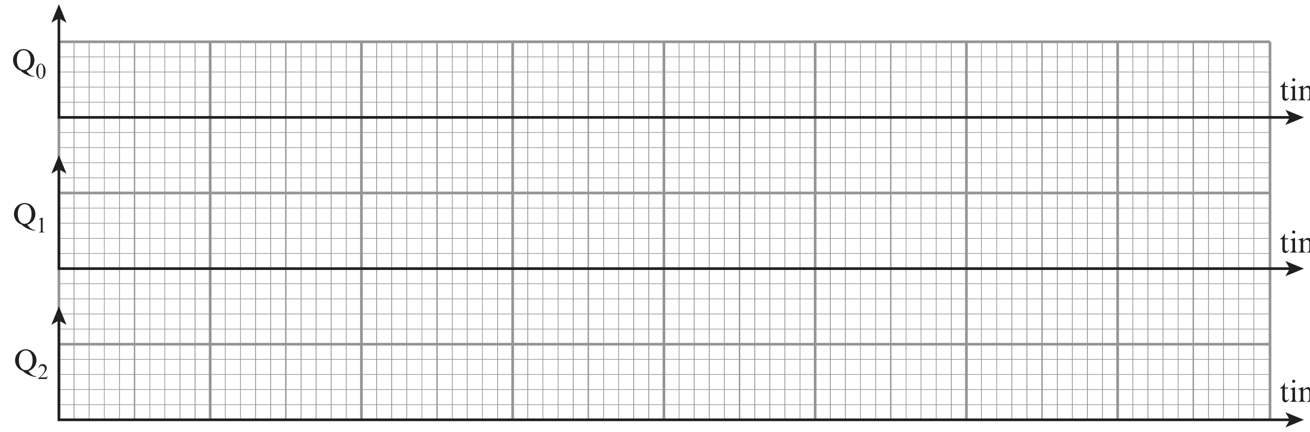

[6]

Turn over.

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8. A good-quality transmission system uses a four-bit parity system, with the parity bits assigned to the data bits in accordance with the following table.

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	P_3	P_2	P_1	P_0
				x	x	x	x				x
x	x	x	x							x	
		x	x			x	x		x		
	x	x			x	x		x			

(a) The following data is to be transmitted along a transmission line.

D_7							D_0
1	1	1	0	1	1	0	1

Determine the values of the parity bits P_3 - P_0 that should be transmitted after this data for an **odd-parity** system.

P_3 = ... P_2 = ... P_1 = ... P_0 = ... [2]

(b) The following data and parity bits are received from a transmission line of a system using **even** parity.

D_7							D_0	P_3			P_0
1	1	0	1	0	1	0	1	0	1	1	1

There is a **single** error in the received data.

(i) Which parity bits fail the parity test? .... [1]

(ii) Determine where the error is located and therefore write down the correct version of the received data.

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0	P_3	P_2	P_1	P_0
								0	**1**	**1**	**1**

[1]

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(c) The following data and parity bits are received from a transmission line of a system using **even** parity.

D_7							D_0	P_3			P_0
1	1	0	1	1	1	0	0	0	1	0	0

There is a **single** error in the received data.

In this case the received data **cannot** be reconstructed with any certainty. Use the information provided in the received data to explain why this is the case.

....

....

....

....

....

....

....

....

[2]

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