GCSE

298/01

ELECTRONICS
TERMINAL EXAMINATION
FOUNDATION TIER

A.M. TUESDAY, 10 June 2008

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

For Examiner's use only	
Total Mark	

ADDITIONAL MATERIALS

In addition to this question 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** questions.

Write **all** the 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.

INFORMATION SHEET

This information may be of use in answering the questions.

1. Resistor Colour Codes

BLACK	0	GREEN	5
BROWN	1	BLUE	6
RED	2	VIOLET	7
ORANGE	3	GREY	8
YELLOW	4	WHITE	9

The fourth band colour gives the tolerance as follows:
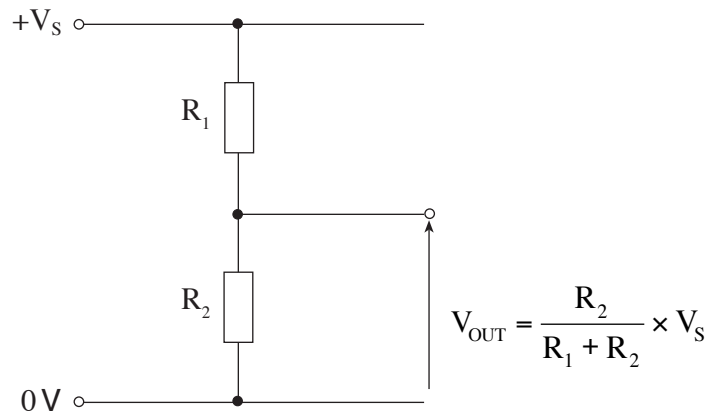
GOLD ± 5%

SILVER ± 10%

2. Preferred Values for Resistors

> **E 12 SERIES OF PREFERRED VALUES**
> **10; 12; 15; 18; 22; 27; 33; 39; 47; 56; 68; 82 and multiples thereafter**

3. Resistance $= \dfrac{\text{voltage}}{\text{current}}$; $R = \dfrac{V}{I}$.

4. Effective resistance, R, of two resistors R_1 and R_2 **in series** is given by $R = R_1 + R_2$.

5. Voltage Divider

$$V_{OUT} = \frac{R_2}{R_1 + R_2} \times V_S$$

6. Power = voltage × current; P = VI

7. LED The forward voltage drop across a LED is 2 V.

8. Transistors

The forward voltage drop across the base emitter junction is 0·7 V.

9. Amplifiers

Voltage gain $\quad A = \dfrac{V_{OUT}}{V_{IN}}$

Non-inverting amplifier: $\quad A = 1 + \dfrac{R_F}{R_1}$.

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

1. Here is a list of four mechanical switches.

    push   *reed*   *tilt*   *toggle*

    Choose the most appropriate switch from the list for the following jobs.

    (a)   To be used with a magnet to sense when a door is open.

    Answer ....

    (b)   To be used for a switch to warn the driver of a crane that it is in danger of toppling over.

    Answer ....   [2]

2. Four bulbs A, B, C and D are working at the following currents and voltages.

Bulb	Current (A)	Voltage (V)
A	0·1	12
B	0·2	9
C	0·2	6
D	0·3	12

    (a)   Which bulb uses the **most** power ?   .... [1]

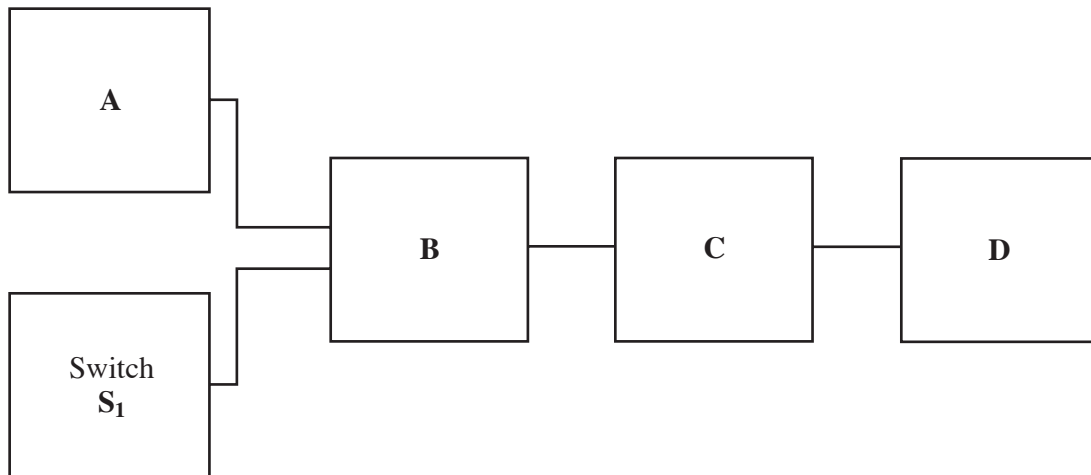   *(b)*   Use the formula in the information sheet on page 2 to calculate the power used by bulb **D**.
                                                                                          [2]

    ....

    ....

Turn over.

3. Here is a system to warn someone that their freezer is too warm.

The output should only come on when switch S_1 is pressed (high) and the output of block **A** is high.

(a) In each of the following tables place a tick ✓ next to the correct answer:

(i) Which one of the following is the **best** sub-system to use as block **A**? [1]

Light sensing unit	
Temperature sensing unit	
Pressure sensing unit	

(ii) Which one of the following is the **best** sub-system to use as block **B**? [1]

AND gate	
OR gate	
Time delay	

(iii)   Which one of the following is the **best** sub-system to use as block **C**?   [1]
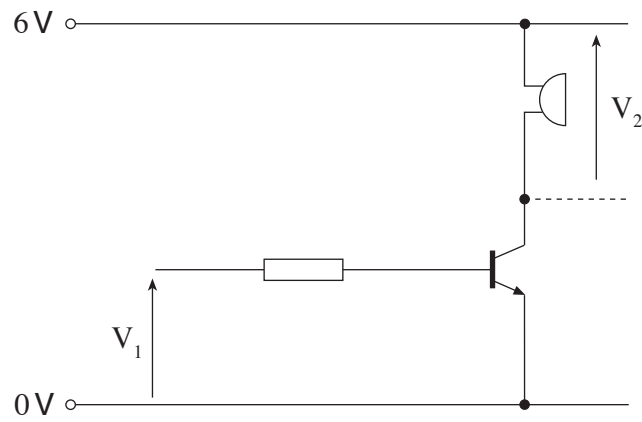
switch	
Transistor switch/transducer driver	
comparator	

(b)   Name a suitable sub-system for block **D**.   [1]

....

Turn over.

4. The following circuit diagram shows part of a system used to switch on a buzzer .

The transistor is **just** saturated when the input voltage V_1 is 2·2 V.
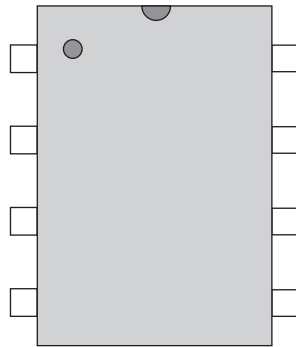
Complete the following table to show:

- the voltage V_2 for the input voltages V_1 given,
- whether the buzzer will be **On** or **Off**. [4]

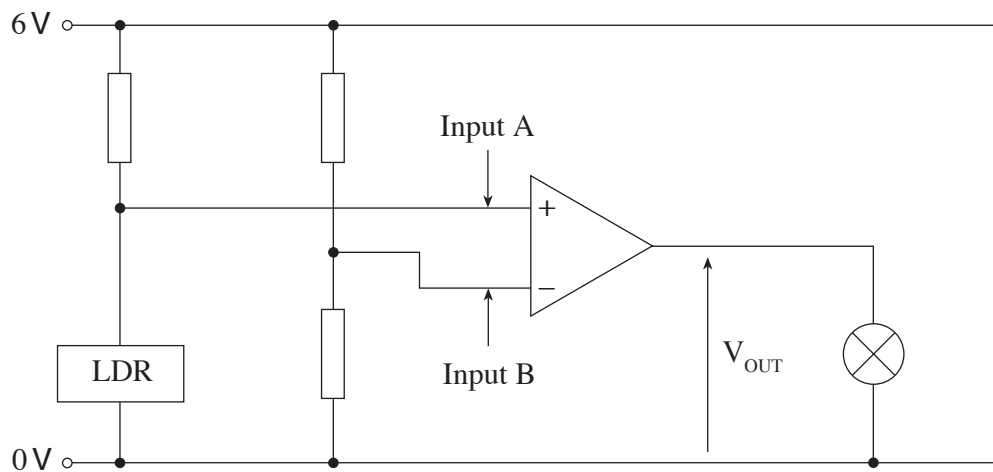| V_1	V_2	Buzzer On/Off?
0·3 V		
2·8 V		

BLANK PAGE

Turn over.

5. *(a)* The diagram shows a comparator IC seen from above.

(i) Label pin 8 with the number '8'. [1]

(ii) Label pin 5 with the number '5'. [1]

(b) This comparator circuit uses an LDR to switch on a nightlight when it becomes dark. The circuit diagram is shown below.

(i) The circuit makes use of an LDR. Draw the circuit symbol for an LDR in the space below. [1]

(ii) The output V_{OUT} of the comparator saturates at $+6\,V$ and $0\,V$.

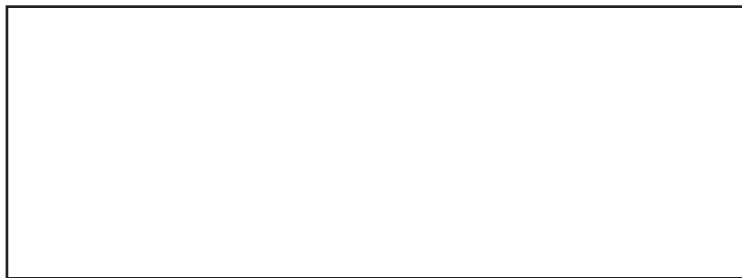Complete the table for the given values of the input voltages. [2]

Input A (V)	Input B (V)	Output V_{OUT} (V)
4·2	3·9	
4·5	5·1	

(c) The circuit is modified by connecting a thyristor between the comparator output and the bulb.

(i) Draw the circuit symbol for a thyristor in the space below. [1]

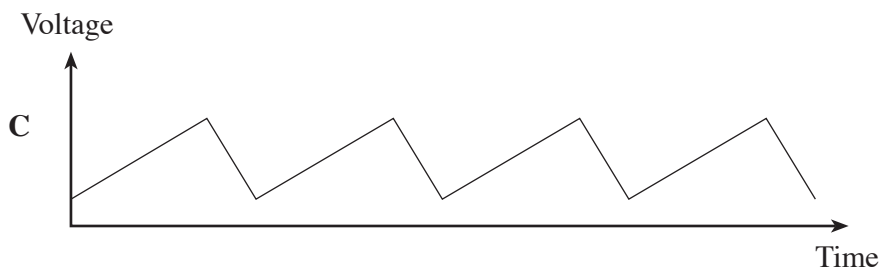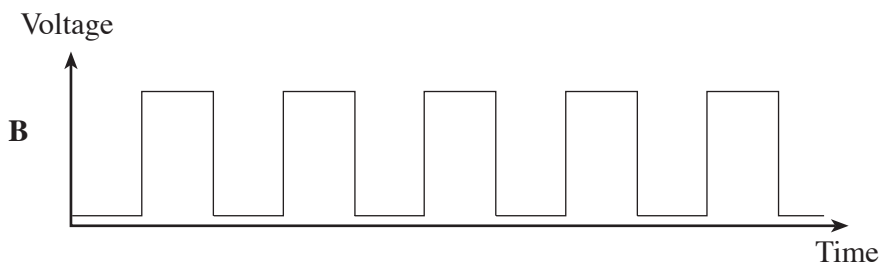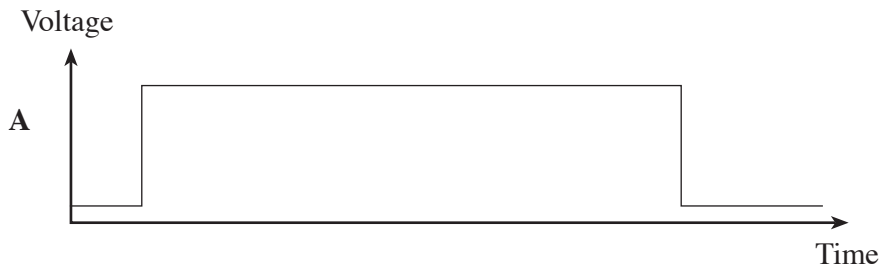(ii) How will the addition of the thyristor affect the way the circuit behaves? [1]

....

6. *(a)* Which of the following is another name for an astable circuit?

    A   Inverter

    B   Time delay

    C   Pulse generator

    D   Latch

    Answer .... [1]

(b) Which one of the following is the output signal produced by an astable circuit?

Voltage

A

Time

Voltage

B

Time

Voltage

C

Time

    Answer .... [1]

(c) Give one use of an astable circuit. [1]

....
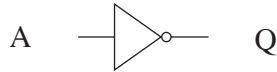
BLANK PAGE

Turn over.

7. *(a)* Write the name of the logic gates in the space provided and complete the truth tables.   [4]

(i)   Gate 1

A ———▷o——— Q

Input	Output
A	Q
0	
1	

Name of gate ....

(ii)   Gate 2

A ——┐
)D——— Q
B ——┘
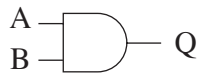
Input		Output
A	B	Q
0	0	
0	1	
1	0	
1	1	

Name of gate ....

(b) (i)   Give the name of the logic gate whose output is the **inverse** of the output of Gate 2.
    [1]

    ....

(ii)   Draw the symbol of this gate in the space below.   [1]

(c) Complete the truth table for the following logic system. [3]
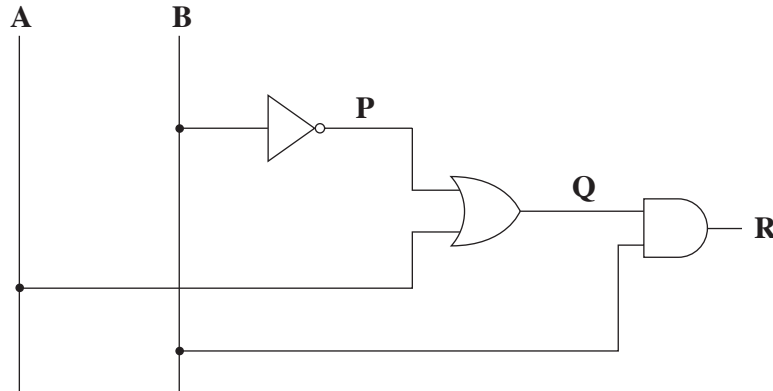
Input		Output		
A	B	P	Q	R
0	0			
0	1			
1	0			
1	1			

Turn over.

8. Here is a diagram of a seven segment display. It can be used to display numbers or letters.
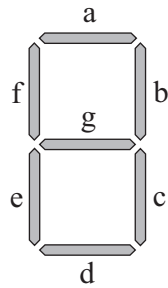
Complete the following table to show which segments are lit and which number or letter is displayed. [3]

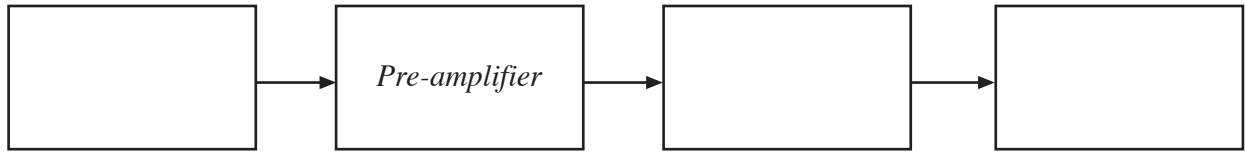| Number or letter	Segment						
	a	b	c	d	e	f	g
4	0	1	1				
H							
	1	0	0	0	1	1	1

9. The block diagram for a public address system used in a school hall is shown below.

(a) Write the names of the other three blocks in the boxes on the above diagram. Choose from the following list.

Power amplifier   *Loudspeaker*   *Comparator*   *Microphone*   [3]

(b) The following waveforms were produced by two microphones **A** and **B**.
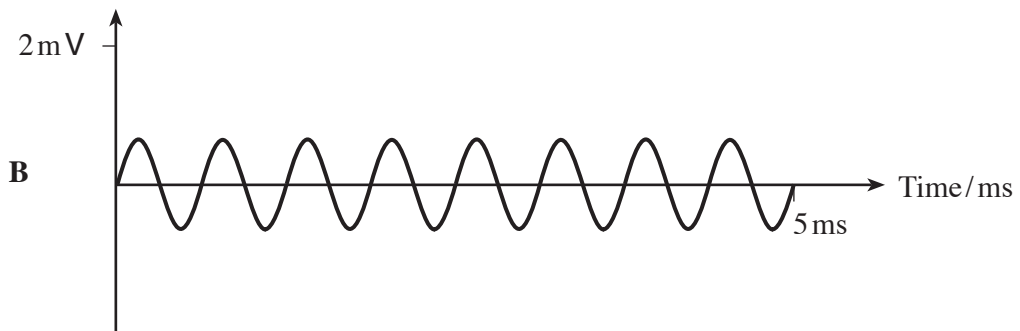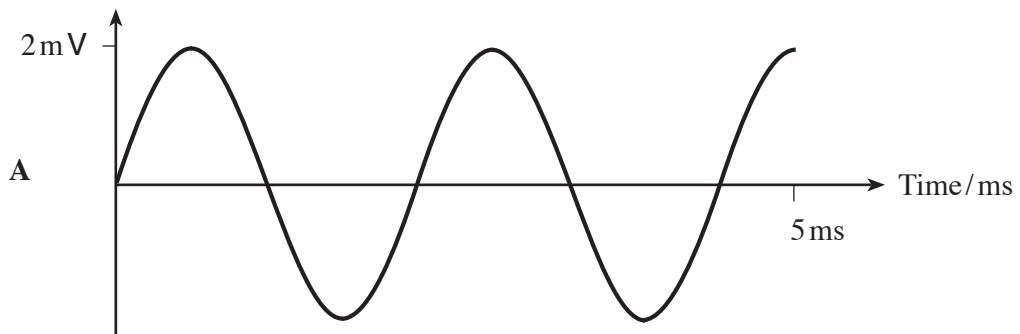
(i) Which signal, **A** or **B**, is the **quieter**?   ....   [1]

(ii) Which signal, **A** or **B**, has the **lower** pitch?   ....   [1]

Turn over.

10. The following is an incomplete block diagram for a simple radio receiver.

```
┌──────────┐      ┌──────────┐      ┌──────────┐      ┌──────────┐
│          │      │          │      │          │      │          │
│          │ ───▶ │          │ ───▶ │          │ ───▶ │          │
│          │      │          │      │          │      │          │
└──────────┘      └──────────┘      └──────────┘      └──────────┘
```
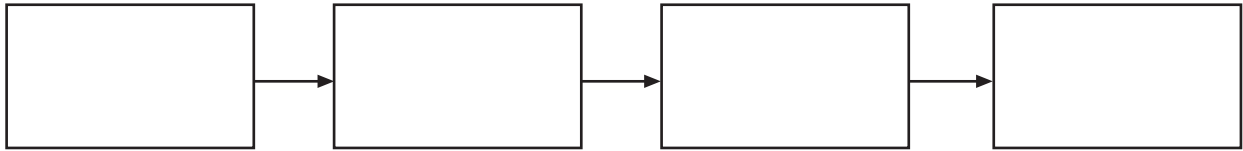
    (a) Label the blocks on the diagram above, choosing from the following list of sub-systems. [4]

         tuned circuit   *headphones*   *microphone*   *aerial*   *demodulator*

    (b) Which of the sub-systems :

       (i)   detects the radio waves;   ....

       (ii)   enables the audio signal to be heard;   ....

       (iii)   selects the radio station you want to listen to;   ....

       (iv)   separates the audio signal from the radio signal?   ....

                                                                               [4]

(c) The graph shows a modulated carrier wave.
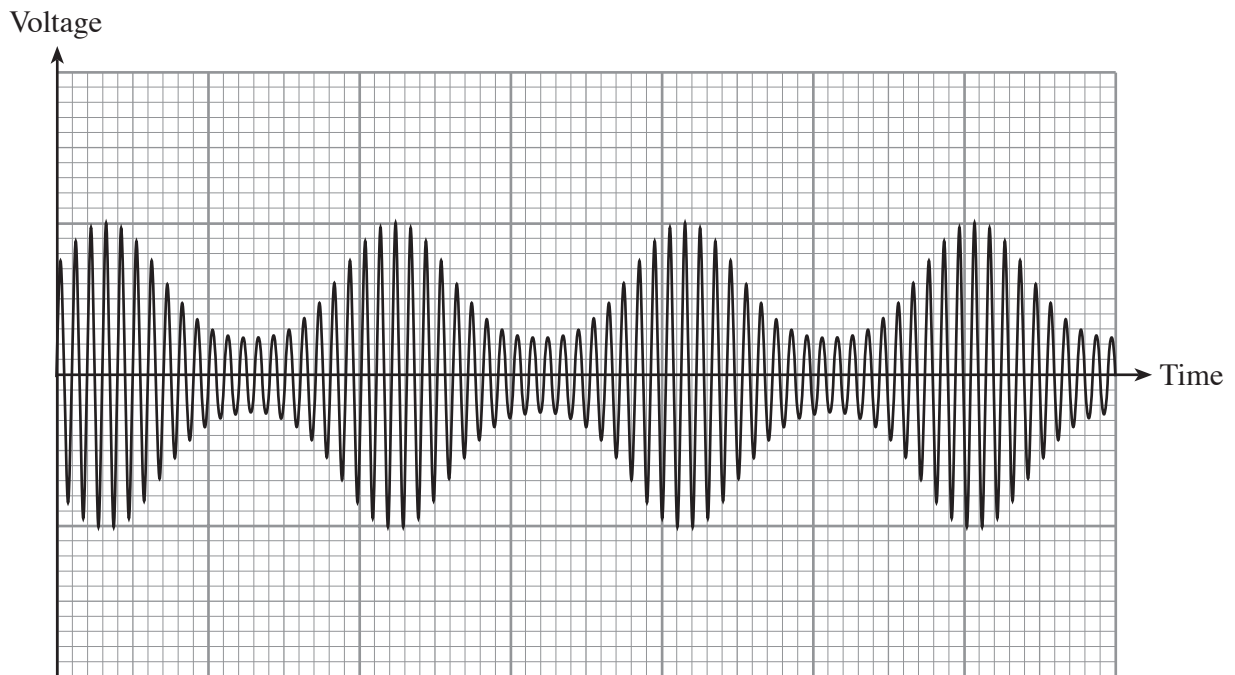
Voltage

Use this information to sketch the audio signal which is being carried. [2]

Voltage

Turn over.

11. The following diagram shows a **non-inverting** amplifier.
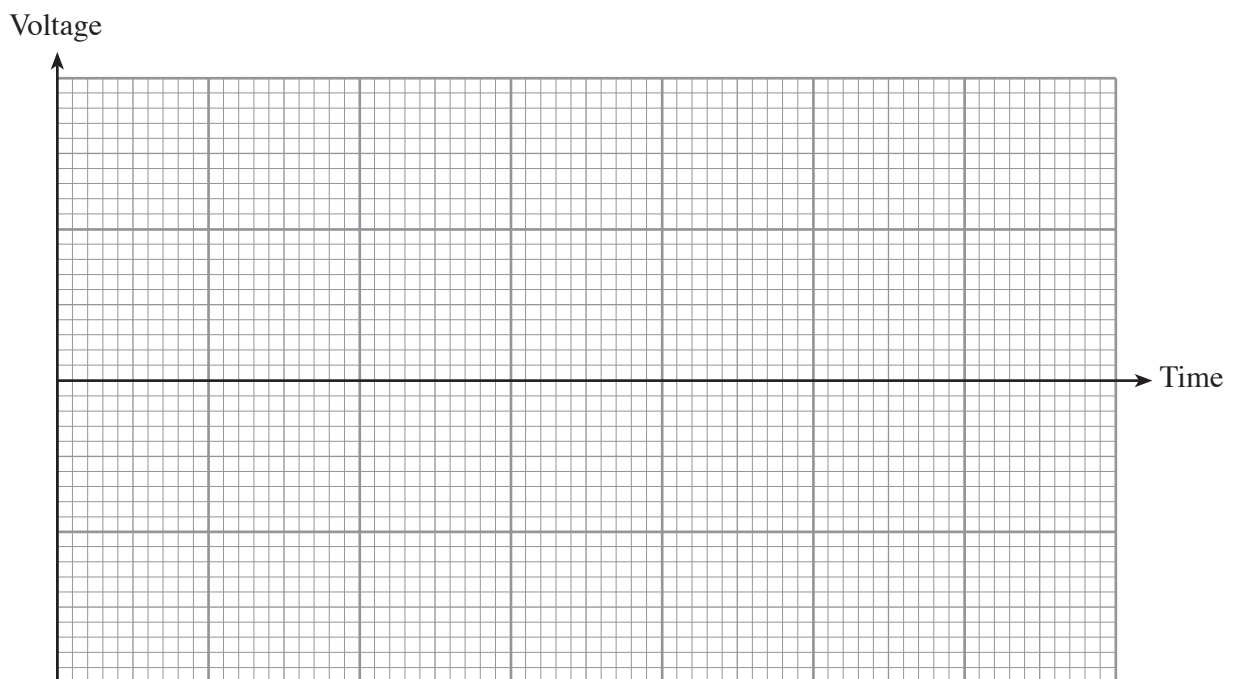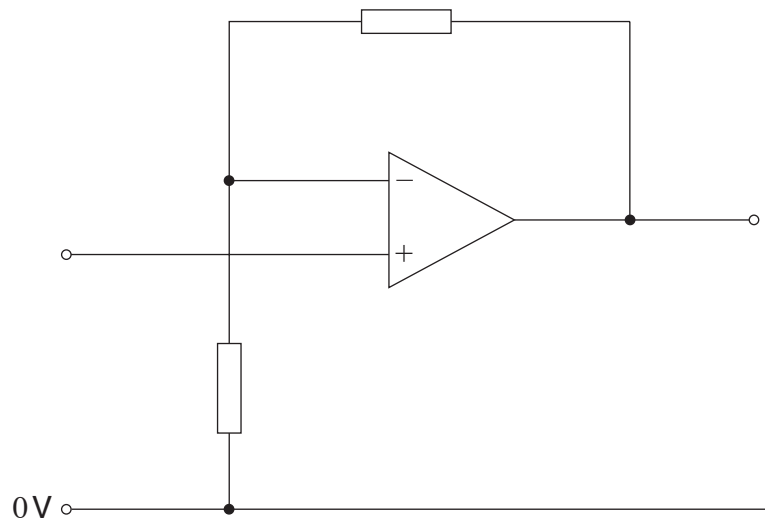

(a) Label each of the following on the diagram above.

- Feedback resistor (label it R_F)

- Output voltage (label it V_o)

- Non-inverting input (label it X) [3]

(b) The input voltage is $5\,\text{mV}$.
The output voltage is $500\,\text{mV}$.

Calculate the *voltage gain*. [2]

....

....

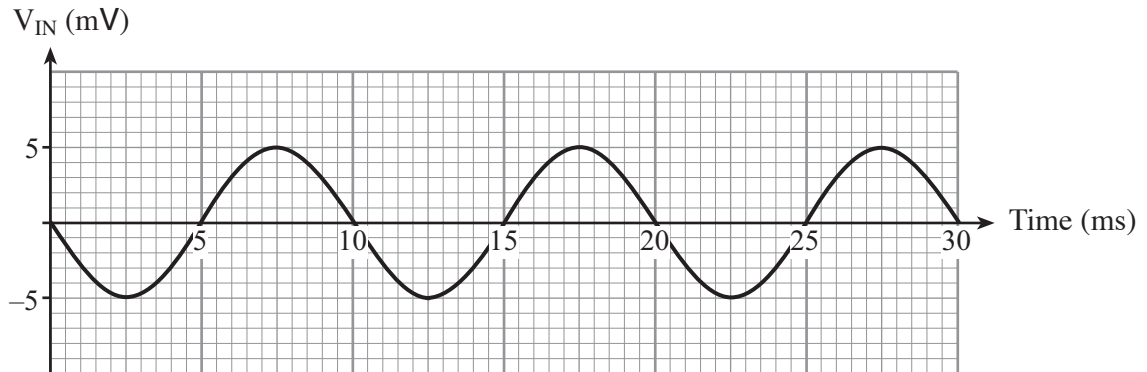..
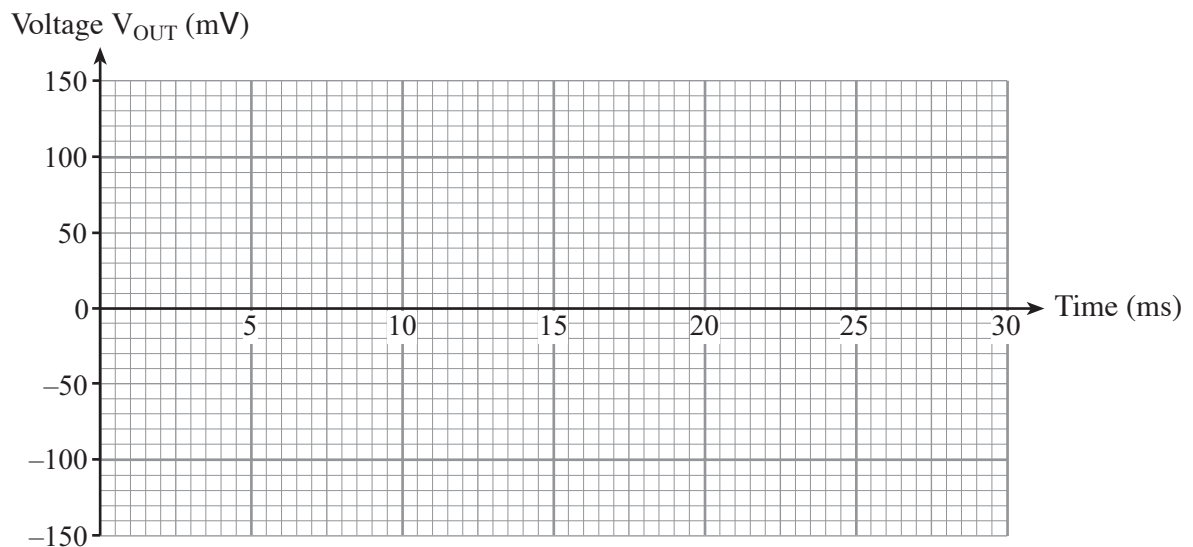
(c) The two resistors are now **changed** to give a gain of **30**.
The following graph shows the input signal.

V_{IN} (mV)

(i) Use the above graph to find the maximum value of the input voltage V_{IN} in mV. [1]

....

(ii) Calculate the maximum value of the corresponding output voltage V_{OUT} in mV. [2]

....

(iii) Draw a graph of this output voltage V_{OUT}. [3]

Voltage V_{OUT} (mV)

Turn over.

12. An analogue signal can be converted into a digital signal and transmitted as a series of binary numbers.

This is done by sampling the analogue signal to make a PAM signal. This is then passed through an ADC to produce a digital signal.

Here are 3 signals:
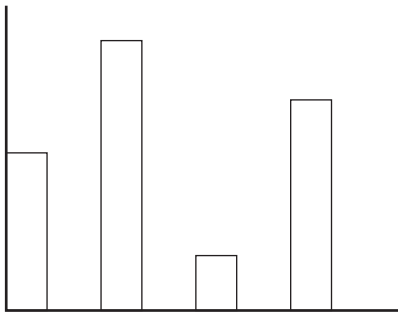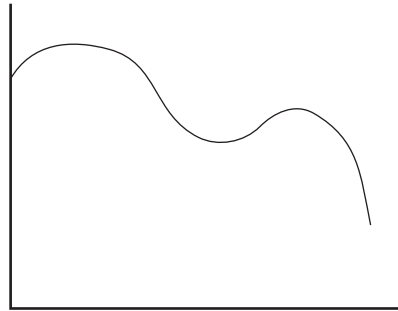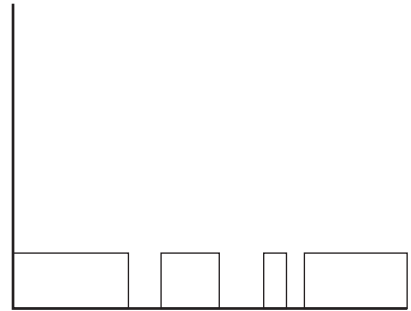
Signal A   **Signal B**   **Signal C**

Which signal, **A**, **B** or **C**, is:

    (i)   the analogue input signal, ...

    (ii)   the PAM signal, ...

    (iii)   the digital output signal?   ....

[3]

13. A maximum of 100 cars can enter a car park. A computer program is used to count the number of cars and close a barrier if 100 cars have entered.

(a) Name a suitable sensor to be used at the entrance. [1]

....

(b) Complete the following flow chart for the program required by :

- writing the instructions in the empty boxes from the following list:

  Is counter = 100 ?   *close barrier*   *counter = counter + 1*

- adding correct loops to the decision boxes. [5]

```
        ┌─────────────────────┐
        │    Start program    │
        └──────────┬──────────┘
                   │
                   ▼
        ┌─────────────────────┐
        │   Set counter to 0  │
        └──────────┬──────────┘
                   │
                   ▼
              ◇ Has car        NO
              ◇ entered?  ──────────▶
                   │ YES
                   ▼
        ┌─────────────────────┐
        │                     │
        └──────────┬──────────┘
                   │
                   ▼
              ◇              NO
              ◇         ──────────▶
                   │ YES
                   ▼
        ┌─────────────────────┐
        │                     │
        └─────────────────────┘
```