VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2003

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

										Letter
Figures										
Words										

VCE VET ELECTRONICS

Written examination

Friday 31 October 2003

Reading time: 3.00 pm to 3.15 pm (15 minutes)
Writing time: 3.15 pm to 4.45 pm (1 hour 30 minutes)

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
1 – DC power supplies	5	5	35
2 – Analogue systems	8	8	26
3 – Digital electronics 1 and Digital systems	8	8	52
			Total 113

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, an approved graphics calculator (memory cleared) and/or one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials supplied
- Question and answer book of 23 pages including a formula sheet for Sections 1, 2 and 3 on page 23.

Instructions
- Write your **student number** in the space provided above on this page.
- Answer **all** questions in the spaces provided in this book.
- **Note:** There are no separate items for Mathematics for Electronics 2. Understanding of mathematics has been incorporated into the questions in Sections 1–3.
- State all formulas and calculations.
- All units must be specified in the answers.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other electronic communication devices into the examination room.

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SECTION 1 – DC Power supplies

Question 1

A small power diode is shown in Figure 1.

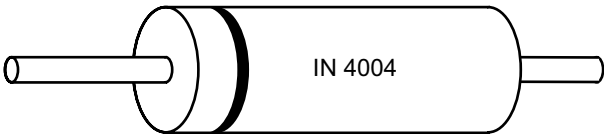


Figure 1

a. Draw an arrow on Figure 1, indicating the direction of conventional current flow through the diode, **and** label the **anode** and **cathode**.

2 marks

b. Draw the matching standard symbol for a diode with the same orientation.

1 mark

Question 2

A simple circuit for an indicator LED is shown in Figure 2.

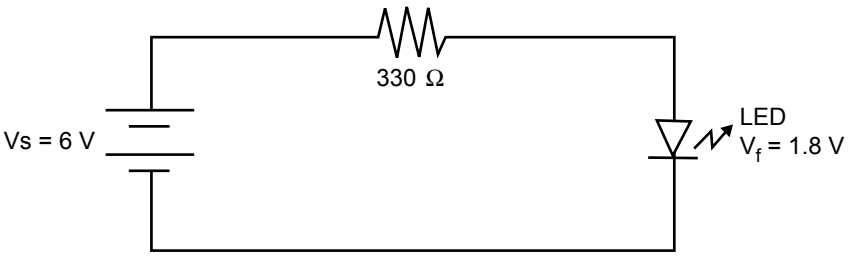


Figure 2

Calculate the LED current.

Formula(s), calculations and correct units must be shown to obtain full marks.

3 marks

Question 3

Use the following information to answer parts a.–f.

A basic rectifier circuit is shown in Figure 3.

Assume an ideal diode (V_f = 0 Volts) for all your calculations.

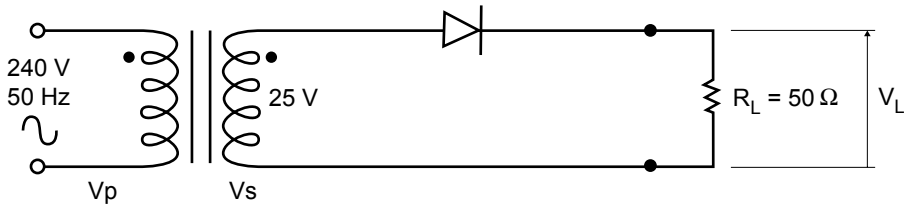


Figure 3

a. State the voltage ratio of the transformer.

1 mark

b. The most appropriate diode to use for the application shown in Figure 3 is

A. 1N914

B. 1N4004

C. 1N5245B (400 mW, 15 V zener)

D. BZX85C75 (1 W, 75 V zener)

1 mark

c. Calculate the period of the waveform over one complete cycle. Correct units must be stated in the answer.

2 marks

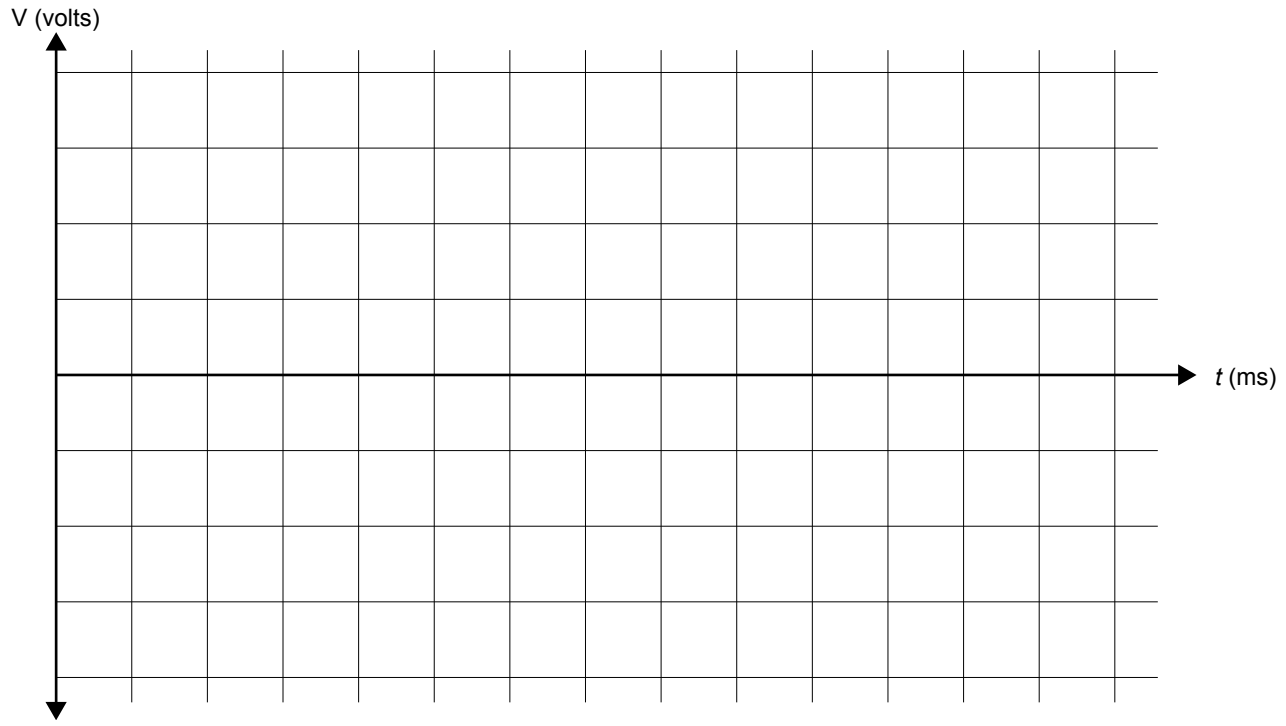
d. Calculate the peak secondary voltage Vs. Correct units must be stated in the answer.

2 marks

e. Calculate the DC (average) load voltage. Correct units must be stated in the answer.

2 marks

f. On the axes provided below, sketch the expected load voltage waveform. Show at least one full cycle of the waveform. Fill in appropriate values for peak voltage and time on each axis.



3 marks

Question 4

Use the following information to answer parts a.–f.

The circuit in Figure 4 is an incomplete variable DC power supply, which uses a LM317T regulator IC.

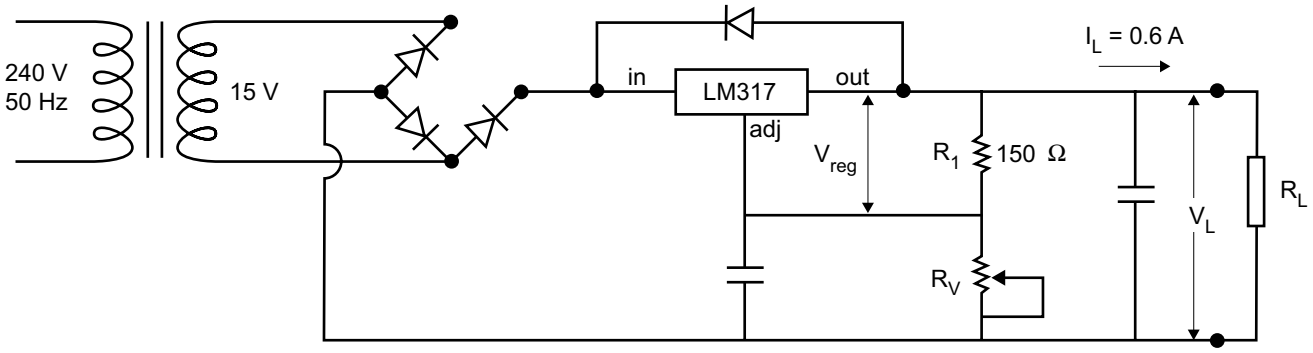


Figure 4

a. Complete the circuit diagram (Figure 4) above by adding the following missing components in the correct position and configuration/polarity.

- power diode
- main filter capacitor

2 + 2 = 4 marks

b. Given that V_{reg} = 1.25 V, calculate the current through R_V (Neglect any effect of I_{adj}) Correct units must be stated in the answer.

2 marks

c. Calculate V_{out} when R_V is set to 700 Ω.
Formula(s), calculations and correct units and the working out must be shown to obtain full marks.

3 marks

d. R_V has been adjusted. Given the working circuit has a V_{in} of 18 V to the regulator and V_{out} of 8.5 V, determine the V_{drop} across the regulator. Correct units must be stated in the answer.

2 marks

e. Given that I_L = 0.6 A, calculate the power dissipation of the regulator. Correct units must be stated in the answer.

2 marks

f. Outline the sequence of events at the regulator if R_L suddenly fell to 0.2 Ω.

3 marks

Question 5

Modern electronic equipment uses high frequency Switch Mode Power Supplies (SMPS).

State two advantages of SMPS in comparison to conventional linear power supplies.

i. _____

ii. _____

2 marks

Total 35 marks

END OF SECTION 1
TURN OVER

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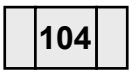
SECTION 2 – Analogue systems

Question 1

a. State the resistance value of the surface mount resistor shown below, using correct engineering notation.



_____

1 mark

b. A capacitor has the figures 104 K printed on it.

What is the nominal capacitance value?

A. 100 nf
B. 104 nf
C. 104 pf
D. 10 000 pf

1 mark

Question 2

a. A resistor has the following colour bands: **Red Red Red Red**.
The nominal resistance value is

A. 220 Ω
B. 2 k 2 Ω
C. 22 Ω
D. 22 kΩ

1 mark

b. A resistor has the following colour bands: **Yellow Violet Black Gold**.
The nominal resistance value is

A. 47 Ω
B. 471 Ω
C. 470 kΩ
D. 47 kΩ

1 mark

Question 3

A single loop conductor is rotating at a uniform rate in a magnetic field in Figure 5.

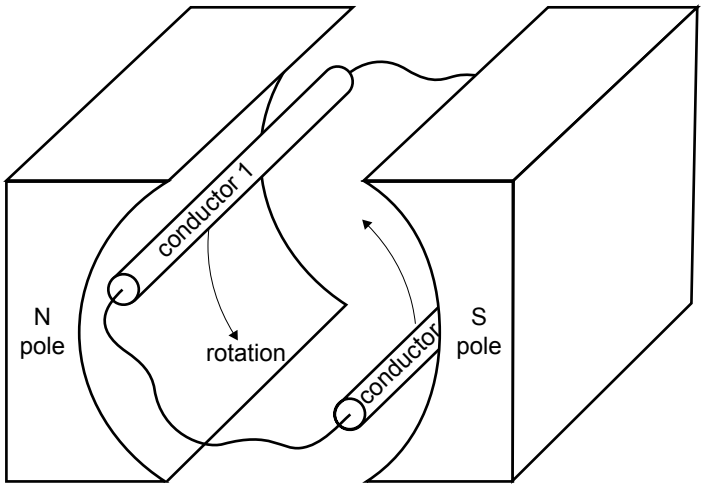
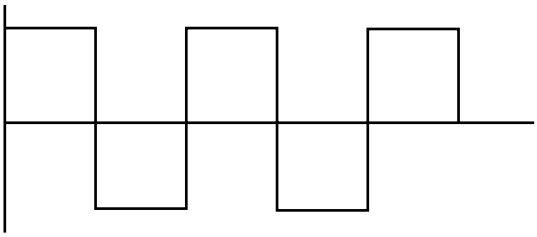


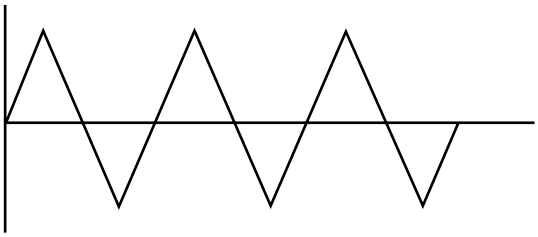
Figure 5

From the waveforms shown below, select the waveform that would be produced within the conductor.

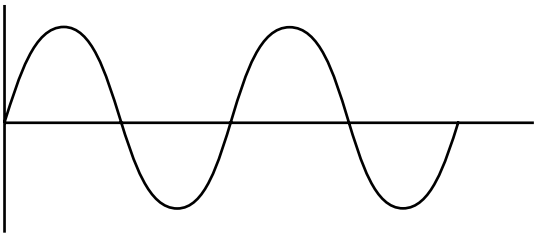
A.



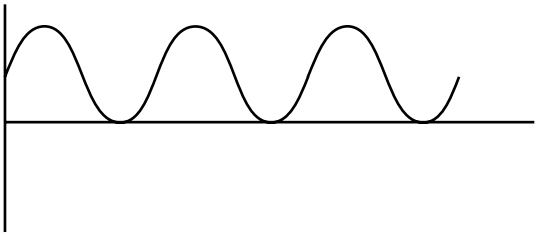
B.



C.



D.



☐

1 mark

Question 4

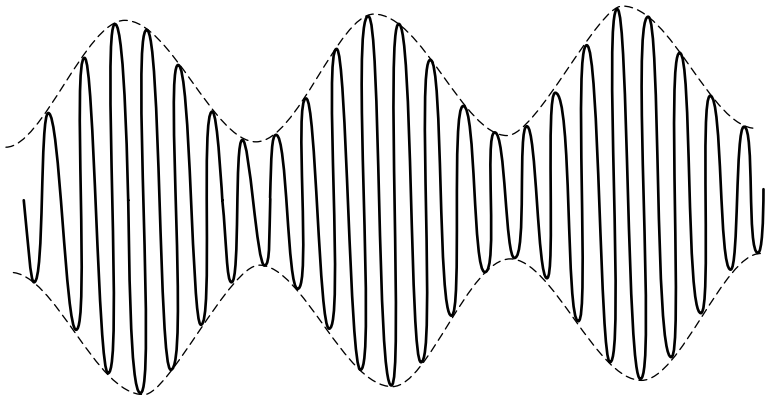


Figure 6

State the type of modulation represented by the waveform in Figure 6.

_____

1 mark

Question 5

In electronics, the term transducer refers to a device that converts one form of energy into another form.

Identify three different transducers that you have used in electronics and state the **device**, the **energy input** and the desired **output**.

The Piezo Effect Sparker has been provided as an example.

transducer device	**energy input**	**output**
Piezo Effect Sparker	*Applied mechanical force*	*High voltage spark*
1		
2		
3		

6 marks

Question 6

Figure 7 is a diagram of a 6 Volt DC electric doorbell.

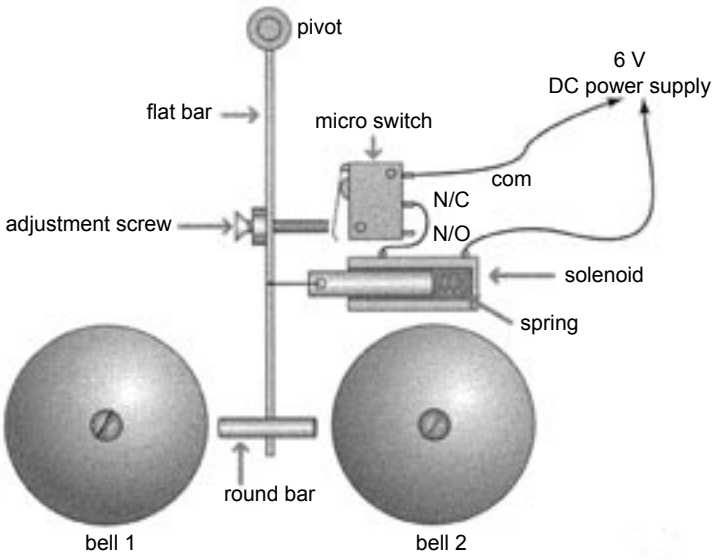


Figure 7

a. Describe in detail the sequence of operation of the circuit. Your answer must include the process of how the bells are made to ring when power is supplied to the circuit.

Your response may be in point form.

4 marks

b. On the axes below, draw the basic shape of the **waveform** and indicate the **voltage levels** at the input to the solenoid when the bells are ringing.

2 marks

c. Which type of switch is most appropriate to use at the front door for this doorbell?

A. SPDT

B. DPDT

C. Momentary PB N/O

D. Momentary PB N/C

1 mark

Question 7

Figure 8 shows a 555 timer configured as an astable oscillator.

The period of the waveform (T) can be determined by components R_1, R_2 and C_1 using the formula

$$\mathbf{T = 0.694\ (R_1 + 2\ R_2)\ C}$$

Base units must be used for the calculation.

Where T – Seconds (one complete cycle)

R – Ohms

C – Farads

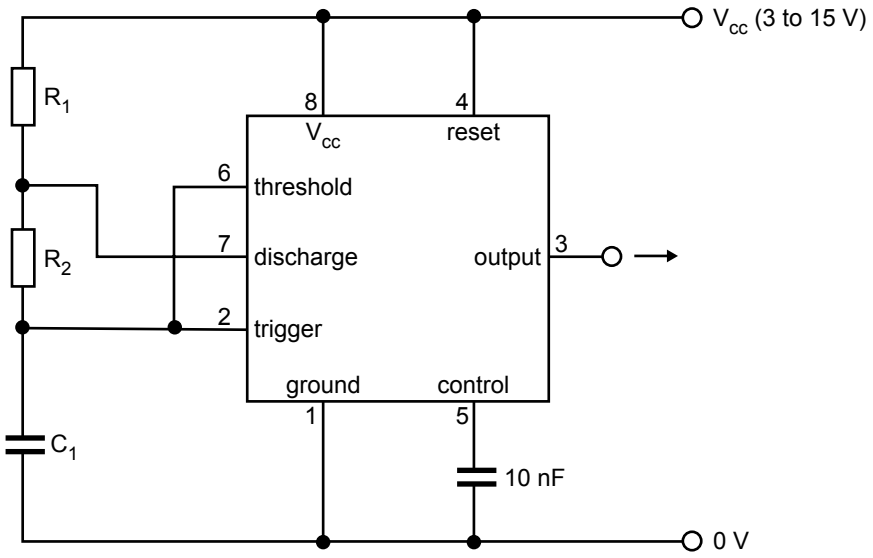


Figure 8

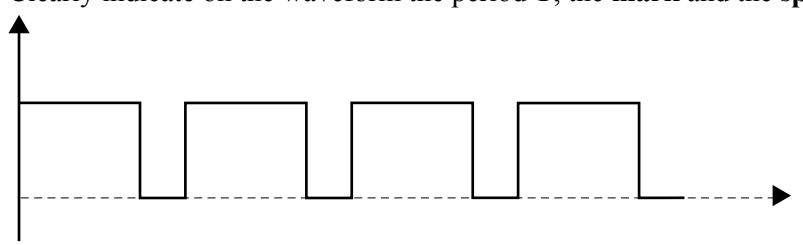
a. Calculate T when R_1 = 1.5 MΩ, R_2 = 220 kΩ and C_1 = 150 nF

The formula used, calculations and correct unit must be shown to obtain full marks.

3 marks

b. The waveform produced by the 555 circuit is drawn below.

Clearly indicate on the waveform the period **T**, the **mark** and the **space** parts of the waveform.



2 marks

Question 8

The response curve for a loudspeaker is shown in Figure 9.

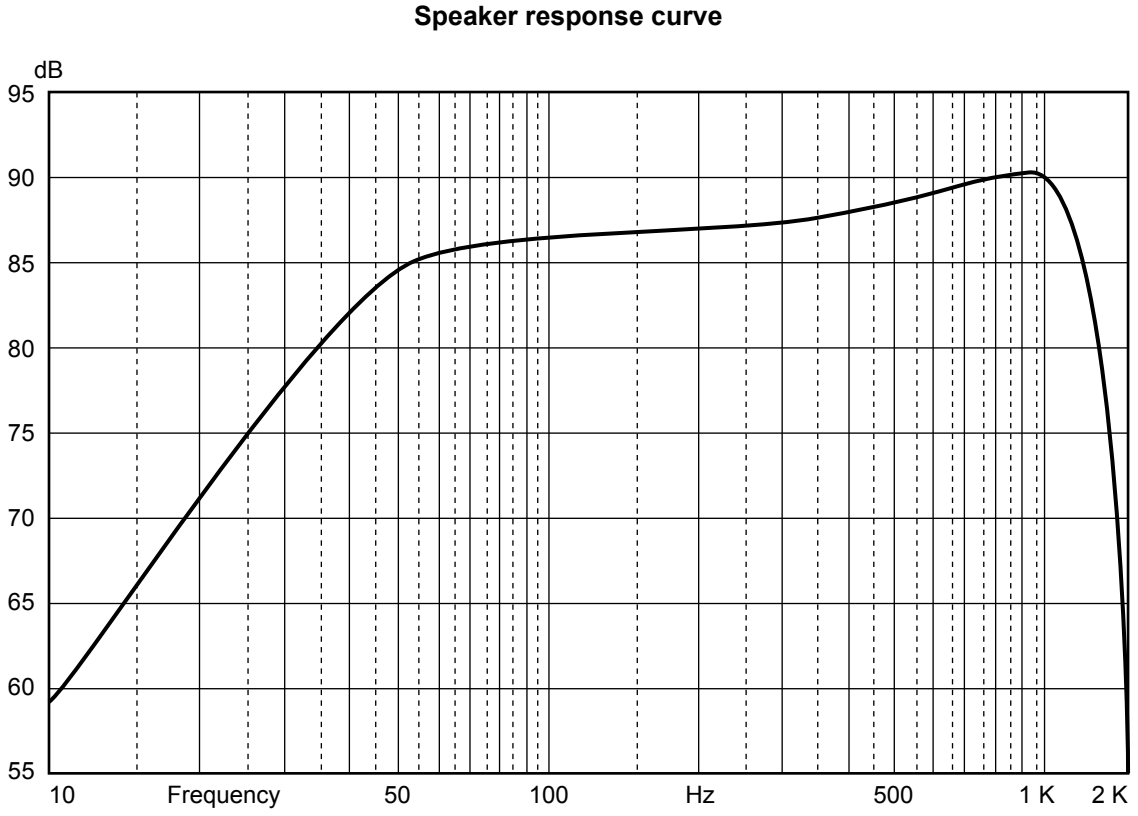


Figure 9

a. State the frequency range where the speaker performs best.

_____

1 mark

b. The speaker is used in a speaker box with crossover circuits to supply separate speakers within the box. What specific application would this speaker perform within the system?

_____

1 mark

Total 26 marks

END OF SECTION 2
TURN OVER

SECTION 3 – Digital electronics 1 and Digital systems

Use the following information to answer Question 1.

FAIRCHILD SEMICONDUCTOR™

October 1987
Revised May 2002

MM74C00 • MM74C02 • MM74C04
Quad 2-Input NAND Gate • Quad 2-Input NOR Gate • Hex Inverter

General Description

The MM74C00, MM74C02, and MM74C04 logic gates employ complementary MOS (CMOS) to achieve wide power supply operating range, low power consumption, high noise immunity and symmetric controlled rise and fall times. With features such as this the 74C logic family is close to ideal for use in digital systems. Function and pin out compatibility with series 74 devices minimizes design time for those designers already familiar with the standard 74 logic family.

All inputs are protected from damage due to static discharge by diode clamps to V_{CC} and GND.

Features

- Wide supply voltage range: 3V to 15V
- Guaranteed noise margin: 1V
- High noise immunity: 0.45 V_{CC} (typ.)
- Low power consumption: 10 nW/package (typ.)
- Low power: TTL compatibility: Fan out of 2 driving 74L

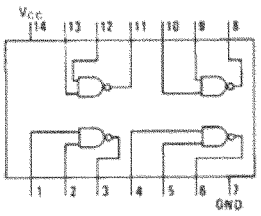
Ordering Code:

Order Number	Package Number	Package Description
MM74C00M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
MM74C00N	N14A	14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
MM74C02N	N14A	14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
MM74C04M	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
MM74C04N	N14A	14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

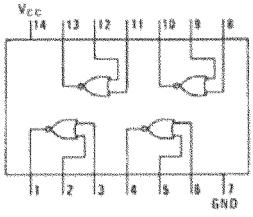
Connection Diagrams

MM74C00



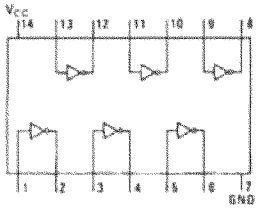
Top View

MM74C02



Top View

MM74C04



Top View

MM74C00 • MM74C02 • MM74C04 Quad 2-Input NAND Gate • Quad 2-Input NOR Gate • Hex Inverter

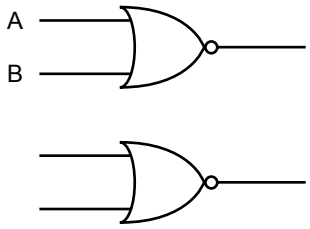
 DS005877 www.fairchildsemi.com

Question 1

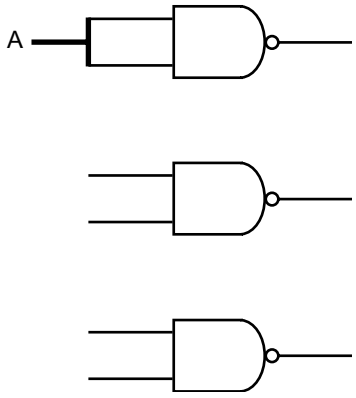
a. On each diagram shown below, complete the wiring of the gates to perform the **logic OR function (A + B = Q)**

No additional gates are to be added.

i. Using the MM74C02 (2 gates)



ii. Using the MM74C00 (3 gates)



2 + 3 = 5 marks

b. State three benefits of using the MM74C00 over the logically equivalent TTL IC (7400).

1. _____

2. _____

3. _____

3 marks

Question 2

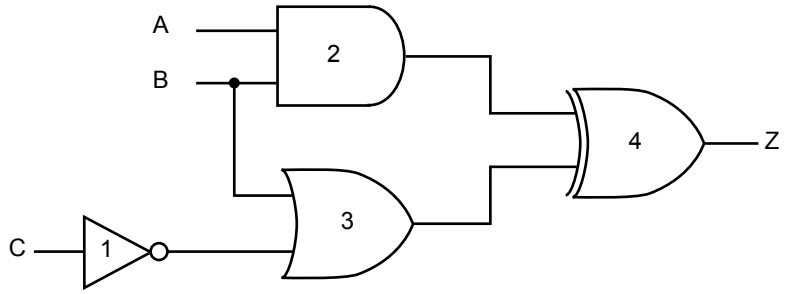


Figure 10

a. Identify the gate types in Figure 10.

Gate number	Gate type
Gate 1	
Gate 2	
Gate 3	
Gate 4	

4 marks

b. Determine the unsimplified Boolean expression of the gate diagram shown in Figure 10.

4 marks

Question 3

Complete the following number conversions.

Decimal	Binary	BCD
199		

Hexadecimal	Binary	Decimal
FEED		

2 + 2 = 4 marks

Question 4

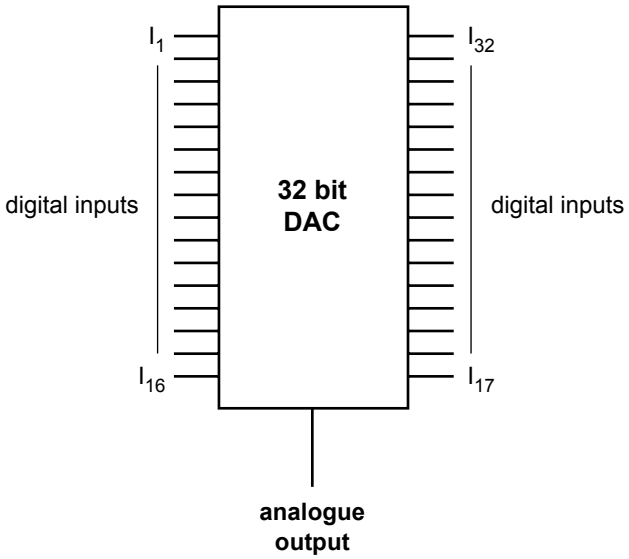


Figure 11

Determine the total number of different analogue output levels that a 32 bit input DAC could produce as shown in Figure 11.

2 marks

Question 5

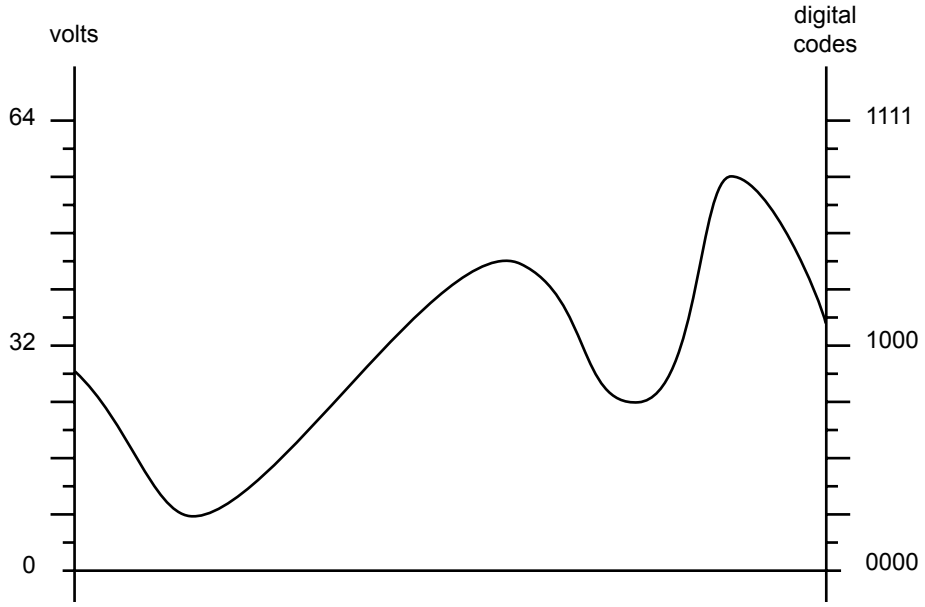


Figure 12

The waveform shown in Figure 12 is digitalised by an ADC.

a. What do the letters ADC stand for?

_____

1 mark

b. Determine the digital code produced from an input voltage of 32 V.

_____

1 mark

Question 6

a. What do the letters ESD stand for?

_____

1 mark

b. From the list of items used in the workplace below,

- indicate items used to **minimise ESD problems** with a tick (✓).
- indicate items that could **create ESD problems** with a cross (✗).

Air dehumidifier	☐	Wrist strap – earthed	☐
Metallised (grey) plastic bags	☐	Grounded soldering iron tips	☐
Grounded metal workbenches	☐	Nylon floor carpet	☐
Polystyrene plastic packaging	☐	Laminated plastic data sheets	☐

8 marks

c. From the list of components used in the workplace below,

- indicate components **likely to be damaged by ESD** with a tick (✓).
- indicate components **unlikely to be affected by ESD** with a cross (✗).

MOS devices	☐	High wattage resistors	☐
TTL ICs	☐	BC109 transistors	☐
CMOS ICs	☐	Microprocessor chips	☐

6 marks

Question 7

Home Internet access has become increasingly popular over recent years and a variety of methods to connect to ISPs are available.

a. What do the letters ISP stand for?

_____

1 mark

b. State two commonly recognised advantages of ADSL over a standard Dial Up connection.

_____

_____

2 marks

Question 8

The American standard code for information interchange is referred to as the ASCII code.

First 3 bits / Last 4 bits	.....	010	011	100	.....
0000	.....	SP	0	@	
0001	.....	!	1	A	.....
0010	.....	“	2	B	.....
0011	.....	#	3	C	
0100	.....	$	4	D	.....

Figure 13

a. For each of the ASCII codes provided in the table below

i. determine the character produced by the code

ii. convert the code to a hexadecimal number

iii. convert the code to a decimal number.

	ASCII	**Character**	**Hexadecimal**	**Decimal**
Sample	*011 0000*	*0*	*30*	*48*
1	010 0011			
2	011 0100			
3	100 0001			

9 marks

b. How many bits would need to be added to each ASCII binary number to make it exactly **one byte** of data?

_____

1 mark

Total 52 marks

END OF SECTION 3

Formulas

$V = IR$

$I = \frac{V}{R}$

$V_{pk} = \sqrt{2}\ V_{RMS}$

$V_{DC(\frac{1}{2}\ wave)} = \frac{1}{\pi}\ V_{pk}$

$V_{reg.} = V_{in} - V_{out}$

$P = V \times I$

$N = 2^{(no.\ of\ bits)} - 1$

$f = \frac{1}{T}$ $\quad$ $T = \frac{1}{f}$

END OF QUESTION AND ANSWER BOOK