BOARD OF STUDIES
NEW SOUTH WALES

STUDENT NUMBER

CENTRE NUMBER

HIGHER SCHOOL CERTIFICATE EXAMINATION

1998

INDUSTRIAL TECHNOLOGY

2 UNIT

SECTION III—ELECTRONICS

Total time allowed for Sections I, II and III—One hour and a half
(Plus 5 minutes reading time)

DIRECTIONS TO CANDIDATES

- Write your Student Number and Centre Number at the top right-hand corner of this page.
- Where appropriate, show working for solutions neatly and clearly.
- You may use Board-approved drawing instruments and calculators.

Section III—Electronics (15 marks)

- Attempt ALL questions.
- Answer the questions in the spaces provided in this paper.

MARKER'S USE ONLY

Question		
13		
14		
15		

SECTION III—ELECTRONICS

DATA SHEET

Circuit Laws

$E = RI$

$P = EI$

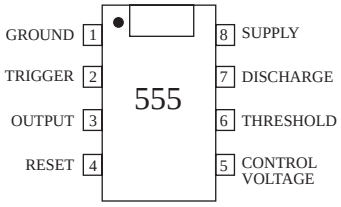
$R_r = R_1 + R_2 + R_3 + \ldots$

$\frac{1}{R_r} = \frac{1}{R_1} = \frac{1}{R_2} = \frac{1}{R_3} + \ldots$

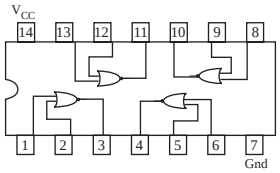
$C_r = C_1 + C_2 + C_3 + \ldots$

$\frac{1}{C_r} = \frac{1}{C_1} = \frac{1}{C_2} = \frac{1}{C_3} + \ldots$

$T = RC$

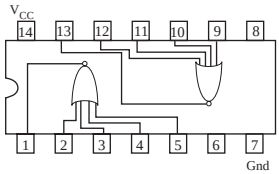


CD4001



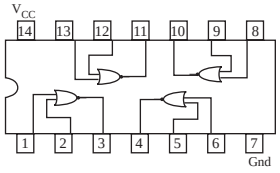
QUAD 2–INPUT NOR GATE

CD4002



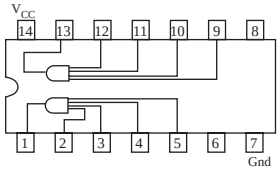
DUAL 4–INPUT NOR GATE

CD4011



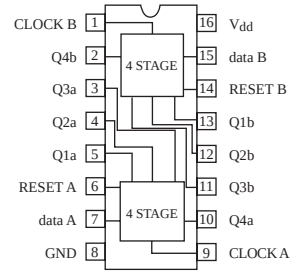
QUAD 2–INPUT NAND GATE

CD4012



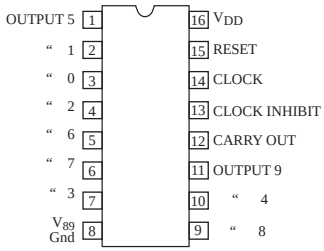
DUAL 4–INPUT NAND GATE

CD4015



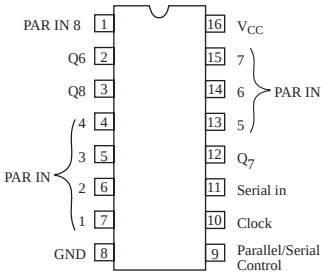
DUAL 4–BIT STATIC SHIFT REGISTER

CD4017 B



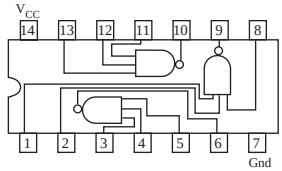
DECADE COUNTER/DIVIDER

CD 4021 CN



8–BIT STATIC SHIFT REGISTER

CD4023 B



TRIPLE 3–INPUT NAND GATE

Resistors

Black	0	Blue	6	Red	2%
Brown	1	Violet	7	Gold	5%
Red	2	Grey	8	Silver	10%
Orange	3	White	9	No band	20%
Yellow	4	Gold	× 0·1		
Green	5	Silver	× 0·01		

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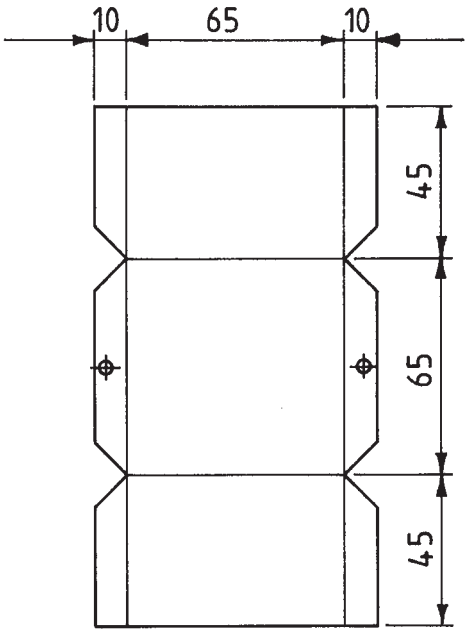
Please turn over

QUESTION 13. (5 marks)

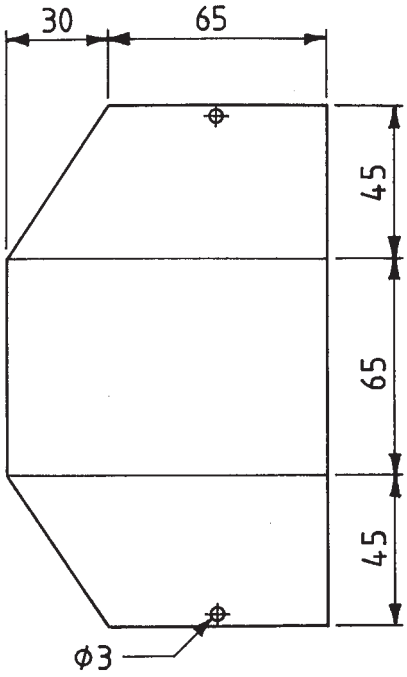
MARKER'S USE ONLY

(a) (i) The manufacturer of a mini-box for a small alarm wants to produce the box from aluminium sheet. From the top and base developments given below in Figure 1, accurately draw the top, front and right side view of the box when assembled. Use third angle projection and a scale of 1 : 1.

(ii) Show all hidden detail on your drawing.



BASE DEVELOPMENT OF MINI-BOX



TOP DEVELOPMENT OF MINI-BOX

All dimensions are in millimetres.

NOT TO SCALE

FIG. 1. DEVELOPMENT OF MINI-BOX PARTS

QUESTION 13. (Continued)

MARKER'S USE ONLY

FRONT VIEW

RIGHT SIDE VIEW

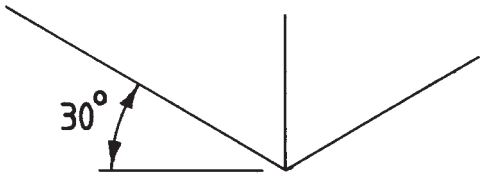
SCALE 1 : 1

Question 13 continues on page 6

QUESTION 13. (Continued)

MARKER'S USE ONLY

(b) Draw a freehand isometric projection of the assembled mini-box. Show all relevant sizes. A starting point is given below.



QUESTION 13. (Continued)

MARKER'S USE ONLY

(c) Using the correct electrical standards, draw the symbol for each of the components below:

Component	*Symbol*
NPN transistor	
LED	
Coil	
Battery	
Electrolytic capacitor	
SPST switch	
Transformer	
Zener diode	

Question 13 continues on page 8

QUESTION 13. (Continued)

MARKER'S USE ONLY

(d) (i) Draw the standard circuit symbol that represents a simple digital device that has memory.

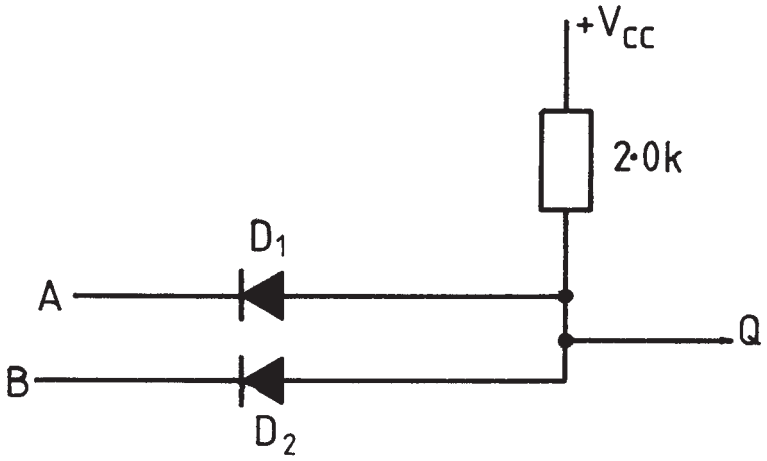
(ii) Name this device.

.....

QUESTION 14. (5 marks)

MARKER'S USE ONLY

(a) (i) Name a single digital device that would replace Circuit Diagram 1 below.



CIRCUIT DIAGRAM 1

Digital device .....

(ii) Complete the truth table for Circuit Diagram 1.

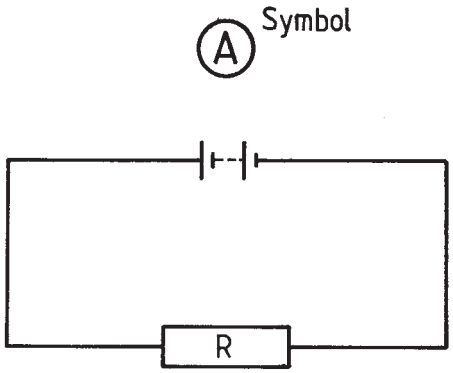
Inputs		*Output*
A	B	Q
0	0	
0	1	
1	0	
1	1	

Question 14 continues on page 10

QUESTION 14. (Continued)

MARKER'S USE ONLY

(iii) The circuit shown is to be tested for current using the device represented by the circuit symbol. Modify the circuit diagram to show how this would be done.



CIRCUIT DIAGRAM 2

(b) Using the 4 band code for resistors, complete the table below. ALL resistors have a tolerance of five per cent (5%).

RESISTOR	COLOUR			
Value	*Band 1*	*Band 2*	*Band 3*	*Band 4*
1 M				
100 Ω				

QUESTION 14. (Continued)

MARKER'S USE ONLY

(c) As part of a class exercise, students are required to construct a printed circuit board. Give a brief explanation of how and why each of the following steps is carried out.

Step 1—Clean

How .....

.....

Why .....

Step 2—Application of resist material

How .....

.....

Why .....

Step 3—Etch

How .....

.....

Why .....

Step 4—Rinse

How .....

.....

Why .....

Step 5—Drill

How .....

.....

Why .....

Step 6—Protect

How .....

.....

Why .....

Question 14 continues on page 12

QUESTION 14. (Continued)

MARKER'S USE ONLY

(d) A solar cell module (760 mm × 500 mm) can produce up to 750 mA at a nominal operating voltage of 24 V.

(i) Calculate the nominal maximum power output of this module.

Power output ..... W

(ii) What current would a device with an internal resistance of 120 Ω draw from this module?

Current ..... A

(iii) Describe how a solar cell functions.

.....

.....

.....

.....

QUESTION 14. (Continued)

MARKER'S USE ONLY

(iv) Transformers are used to convert high voltages to lower voltages for domestic and industrial use. Describe how a transformer works.

.....

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(e) Protective devices are used to protect circuits from serious damage. List THREE protective devices, their method of operation, and one main advantage for each device.

(i) Protective device .....

Method of operation .....

.....

Advantage .....

(ii) Protective device .....

Method of operation .....

.....

Advantage .....

(iii) Protective device .....

Method of operation .....

.....

Advantage .....

QUESTION 15. (5 marks)

MARKER'S USE ONLY

(a) (i) Design a circuit that can be used as a temperature alarm. The alarm is to trigger when the temperature exceeds a set temperature. The circuit may be based on the following components list.

COMPONENTS LIST

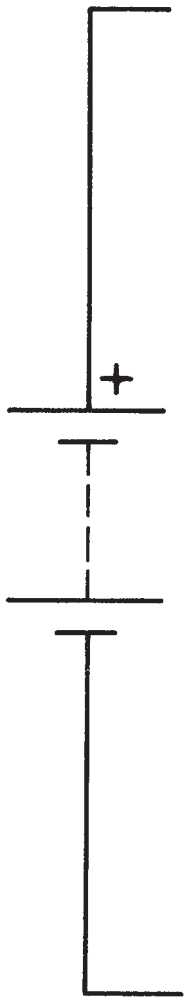
R1	Resistor	4k7	$\frac{1}{2}$ W	5%	C1	Capacitor 1 nf	polyester
R2	"	1 M	"	"	D1	Diode	1N4001
R3	"	47 k	"	"	IC1	555 Timer	
R4	"	100 Ω	"	"			

RV1 Potentiometer 100 k Trim type

Thermistor 47 k (25°C) Philips type 2322 642 11473

Speaker 8 Ω

PC board ETI 066 or Veroboard
9 V battery



CIRCUIT DIAGRAM 3

QUESTION 15. (Continued)

MARKER'S USE ONLY

(ii) Give the function of the components as they are used in your Circuit Diagram 3.

1. C1 capacitor 1 nf

   Function .....

   .....

   .....

2. D1 diode 1N4001

   Function .....

   .....

   .....

(iii) Describe how the temperature alarm works.

.....

.....

.....

.....

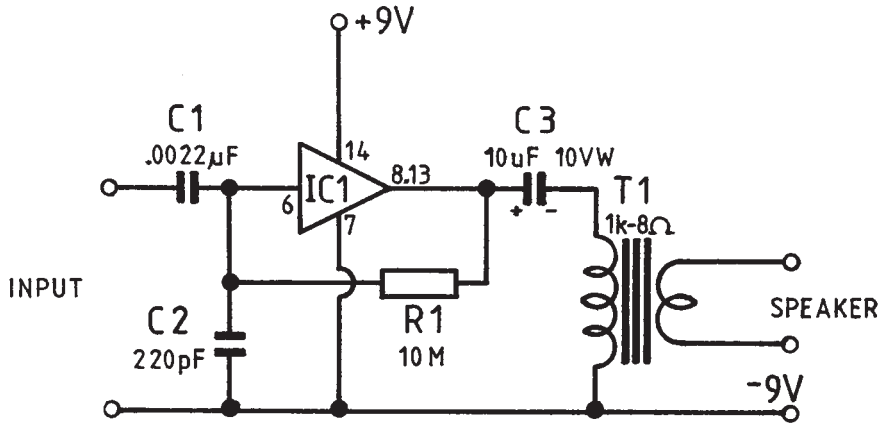
.....

Question 15 continues on page 16

QUESTION 15 (Continued)

MARKER'S USE ONLY

(b) The circuit for a low power amplifier is given in circuit diagram 4, with a part-completed PCB in Figure 2.



CIRCUIT DIAGRAM 4

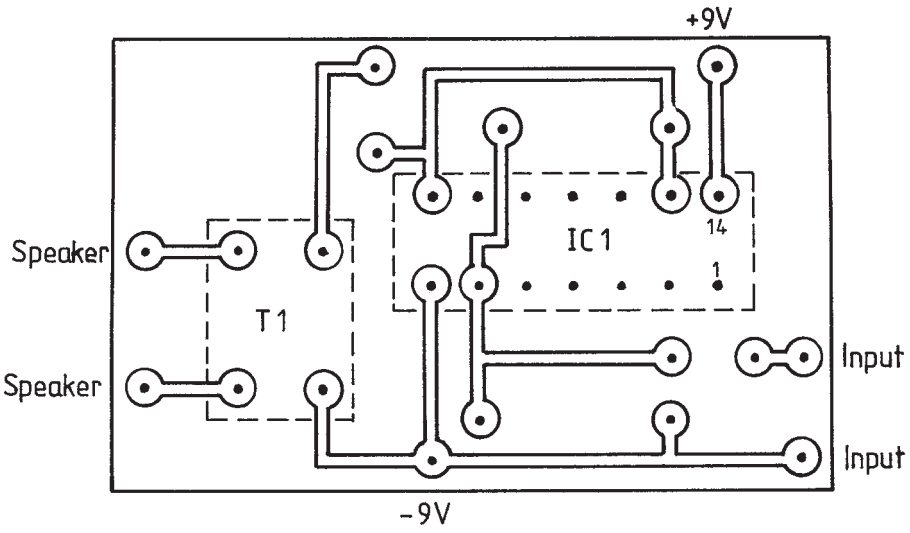


FIG. 2. REVERSE SIDE OF AMPLIFIER PCB

(i) Complete the placement of components on the PCB drawing above, according to the amplifier circuit.

(ii) What is the function of the transformer in the circuit?

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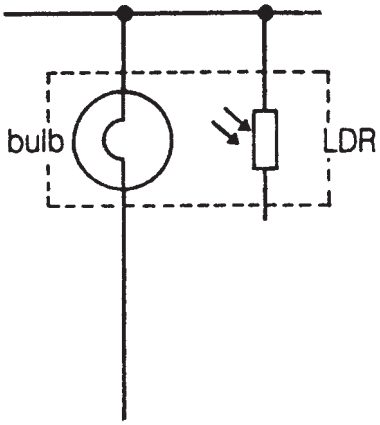
QUESTION 15. (Continued)

MARKER'S USE ONLY

(iii) Draw a flowchart to show the physical relationship between the input device (LDR) and the output device (bulb) shown below.



CIRCUIT DIAGRAM 5

FLOWCHART

Question 15 continues on page 18

QUESTION 15. (Continued)

MARKER'S USE ONLY

(c) Students need to construct a container to house the components for the amplifier. Materials available to them include:

- a sheet of 3 mm Perspex
- joining solvents
- small nuts and bolts.

The container must house:

- a 9 V battery — 50 mm long × 25 mm wide × 16 mm thick
- a circuit board — 70 mm long × 30 mm wide × 15 mm thick
- an indicator bulb — ∅8 mm
- a toggle switch — ∅8 mm.

(i) List TWO problems that may occur in assembling components onto the circuit board. Describe a procedure to overcome each problem.

Problem 1 .....

Procedure .....

.....

.....

.....

Problem 2 .....

Procedure .....

.....

.....

.....

(ii) List TWO major considerations in the design of the amplifier container.

Consideration 1 .....

.....

Consideration 2 .....

.....

QUESTION 15. (Continued)

MARKER'S USE ONLY

(iii) In the space provided below, draw a freehand pictorial sketch of an amplifier container to house all the components listed on page 18. Include ALL major dimensions on the sketch. On the sketch, show how each major consideration listed in part (c) (ii) will be used.

End of paper

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