



GCSE



**C490U20-1**

**FRIDAY, 10 JUNE 2022 – AFTERNOON**

**ELECTRONICS – Component 2**

**Application of Electronics**

**1 hour 30 minutes plus your additional time allowance**

**Surname** \_\_\_\_\_

**First name(s)** \_\_\_\_\_

**Centre Number** \_\_\_\_\_

**Candidate Number** 0 \_\_\_\_\_

**For Examiner's use only**

<b>Question</b>	<b>Maximum Mark</b>	<b>Mark Awarded</b>
<b>1.</b>	<b>8</b>	
<b>2.</b>	<b>17</b>	
<b>3.</b>	<b>11</b>	
<b>4.</b>	<b>9</b>	
<b>5.</b>	<b>20</b>	
<b>6.</b>	<b>9</b>	
<b>7.</b>	<b>6</b>	
<b>Total</b>	<b>80</b>	

**ADDITIONAL MATERIALS**

A calculator and a ruler.

**INSTRUCTIONS TO CANDIDATES**

Use black ink, black ball-point pen or your usual method.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces provided on the front cover.

Answer ALL questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets at the end of each question or part-question.

The assessment of the quality of extended response (QER) will take place in question 7.

(Turn over)

## INFORMATION SHEET

This information may be of use in answering the questions.

### 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**  $\pm$  5%

**SILVER**  $\pm$  10%

### RESISTORS E24 SERIES 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

### USEFUL EQUATIONS (shown opposite)

(Turn over)

## USEFUL EQUATIONS

$$P = \frac{V^2}{R}$$

$$G = 1 + \frac{R_F}{R_1}$$

$$V_{OUT} = \frac{R_2}{R_1 + R_2} V_{IN}$$

$$G = -\frac{R_F}{R_{IN}}$$

$$I_D = g_M(V_{GS} - 3)$$

$$V_{OUT} = -R_F \left( \frac{V_1}{R_1} + \frac{V_2}{R_2} + \dots \right)$$

$$I_C = h_{FE} I_B$$

$$T = 1.1RC$$

$$\overline{A + B} = \overline{A} \cdot \overline{B}$$

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

$$\overline{A \cdot B} = \overline{A} + \overline{B}$$

$$f = \frac{1.44}{(R_1 + 2R_2)C}$$

$$G = \frac{V_{OUT}}{V_{IN}}$$

$$\frac{T_{ON}}{T_{OFF}} = \frac{R_1 + R_2}{R_2}$$

Intensive Dry

Baby Care

Eco Drum Clean

Delicates

Wool

SuperQuick

Spin

Cottons

Prewash

Easy-Care

Mixed Load

Sportswear

HygieneCare

Down

● 95

● 60

● 40

● 30

● 1400

● 800

● 400

● 200

● 

● 

● 

● 

● 




























































































































































































































































































































**Answer ALL questions.**

- 1. A washing machine (opposite) has several programs for washing different types of clothes.**

**A 50 °C wash program is selected. The incomplete flow chart on the next page shows part of the control system program.**

**The specification for this part of the program is as follows:**

- Check door is closed and lock it**
- Fill with correct amount of water**
- Heat water to 50 °C**
- Continue the rest of the wash program**

**(Turn over)**

1 (a) Add these instructions to the correct boxes in the flowchart opposite: [5 marks]

Close water valve

Lock door

Is water level correct?

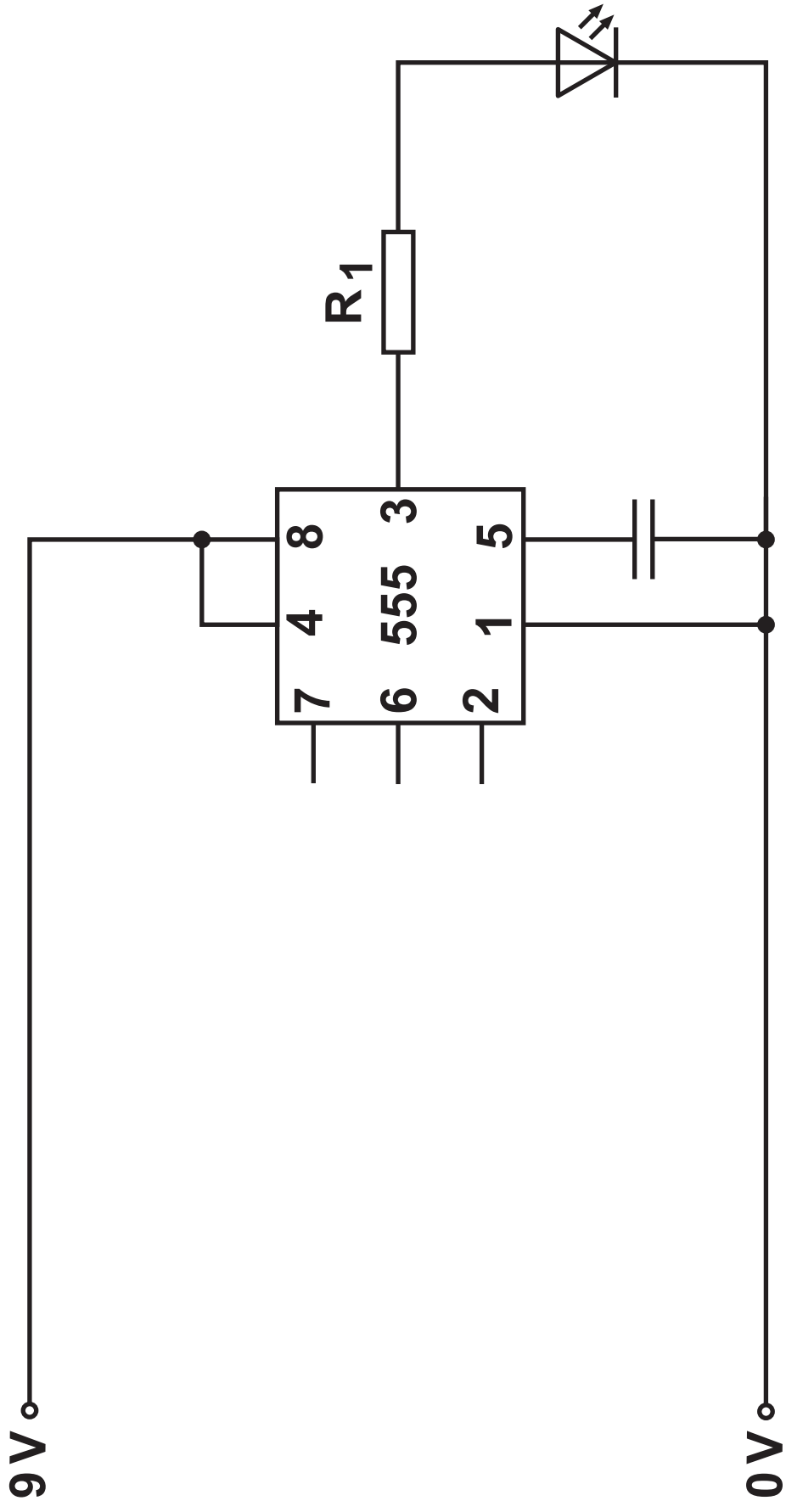
Is door closed?

Is water at 50 °C?

Switch off heater

(b) COMPLETE the 'NO' paths from the decision boxes. [3 marks]

8



2. A 555 timer is used as a monostable timer to switch on a LED for 20 seconds. A partly completed circuit is shown opposite.

(a) COMPLETE THE DESIGN of the monostable circuit by adding:

- The timing sub-system.
- The triggering sub-system, using a PUSH-TO-BREAK switch and resistor to create a falling-edge trigger pulse at pin 2. [5 marks]



2 (b) (ii)

Select the resistor from the E24 series to give a delay closest to 20 seconds, using the  $330\ \mu\text{F}$  capacitor. [1 mark]

---

---

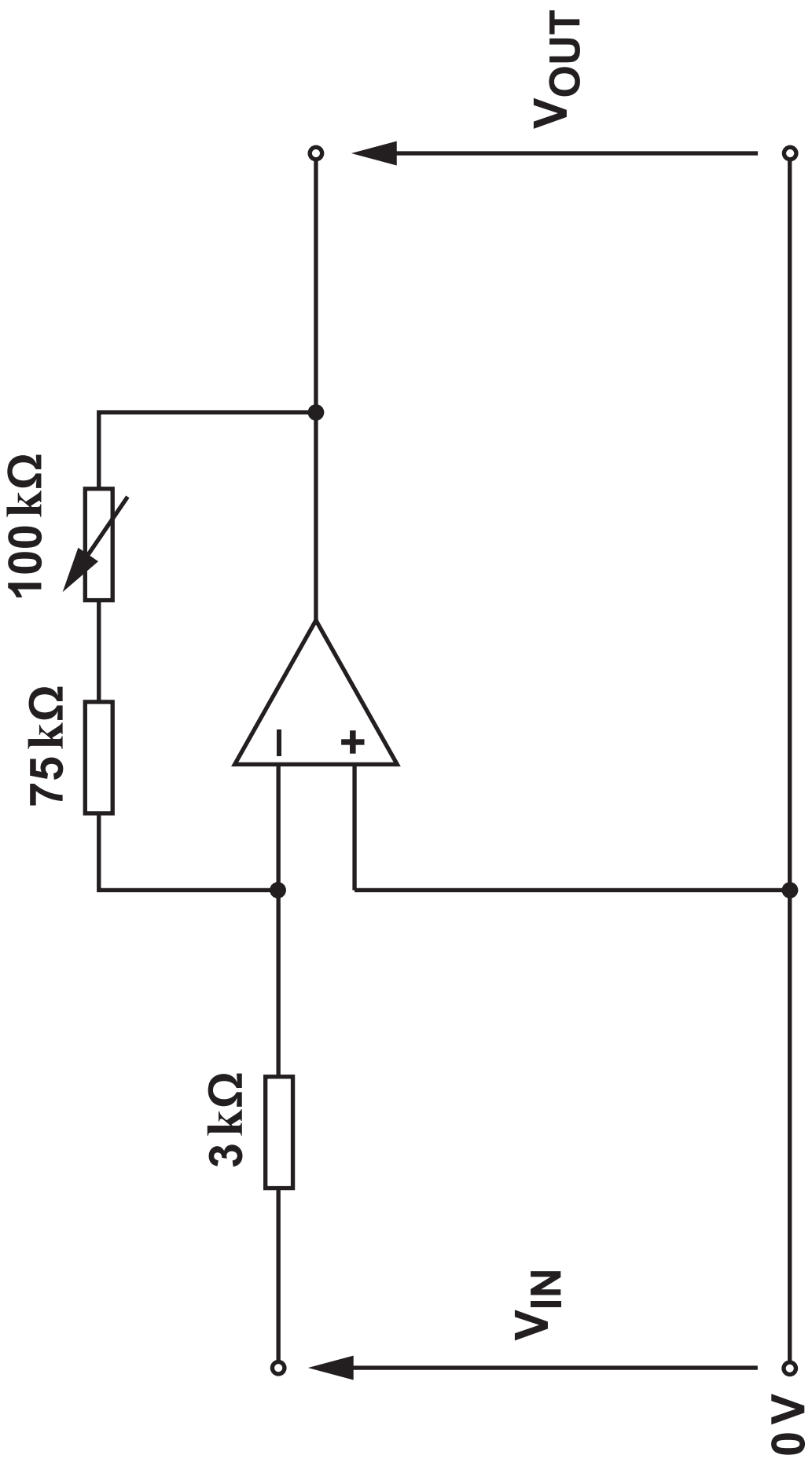
(c) The resistor  $R_1$  has the following colour bands, Yellow, Orange, Brown, Gold.

(i) What is the resistance of this resistor in OHMS? [3 marks]

---

---





3. The voltage amplifier opposite is connected to a  $\pm 15\text{ V}$  power supply. The amplifier saturates at  $\pm 14\text{ V}$ .

(a) Calculate the gain of this voltage amplifier when the variable resistor is set to its:

(i) minimum value; [2 marks]

---

---

---

---

---

---

---

---

---

---

**3 (a) (ii)**

**maximum value. [2 marks]**

---

---

---

---

---

---

---

---

---

---

- 3 (b) The gain is now set to  $-30$ . The input signal opposite is applied to the amplifier.

Use the axes opposite to draw the corresponding output signal. [3 marks]



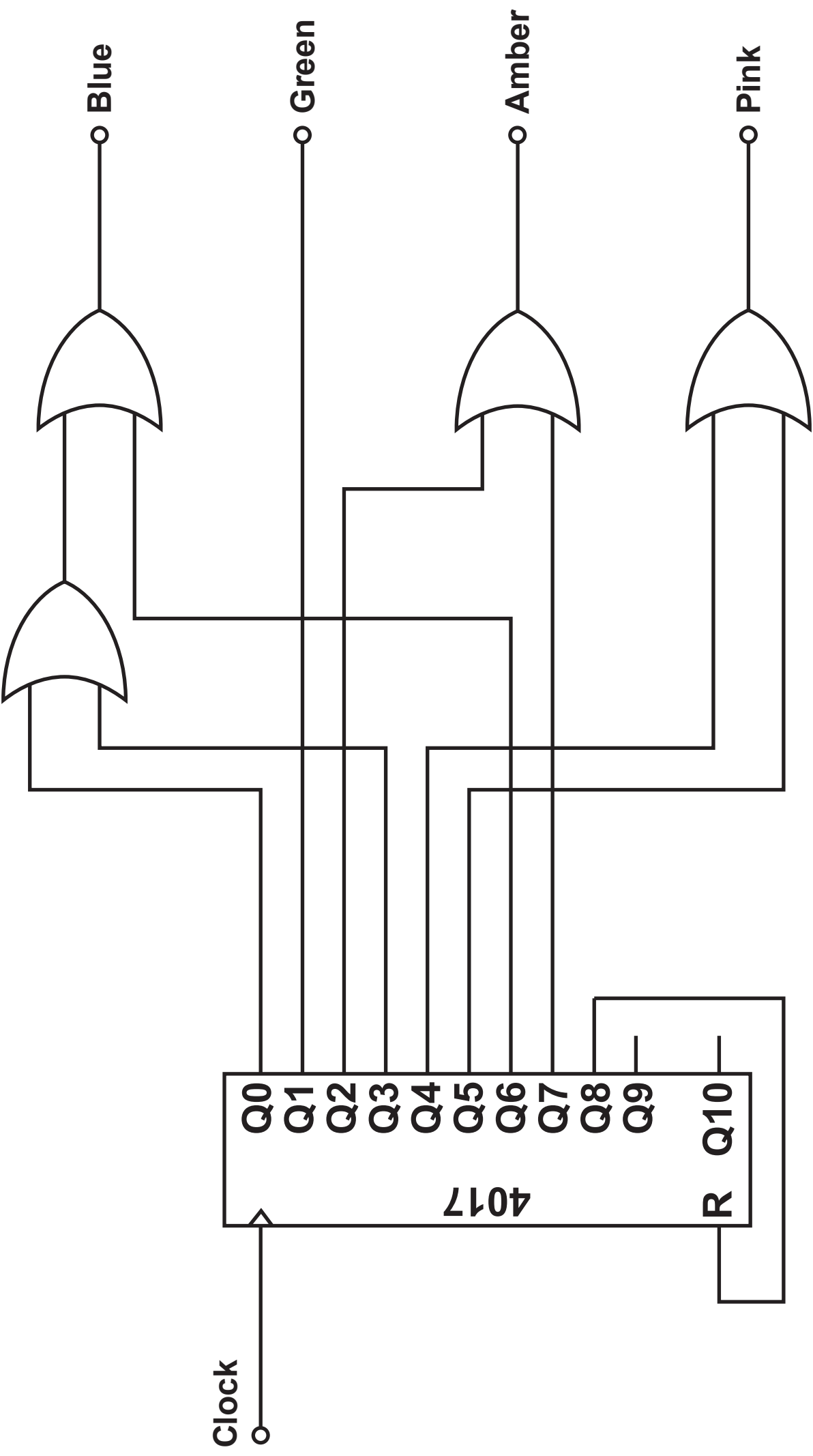
- 4 (a) The design for a disco light sequence generator is shown opposite. It uses a 4017 decade counter connected to a 1 Hz clock.

Complete the table to show the state of each light for each clock pulse.

Initially output Q0 is at logic 1. [5 marks]

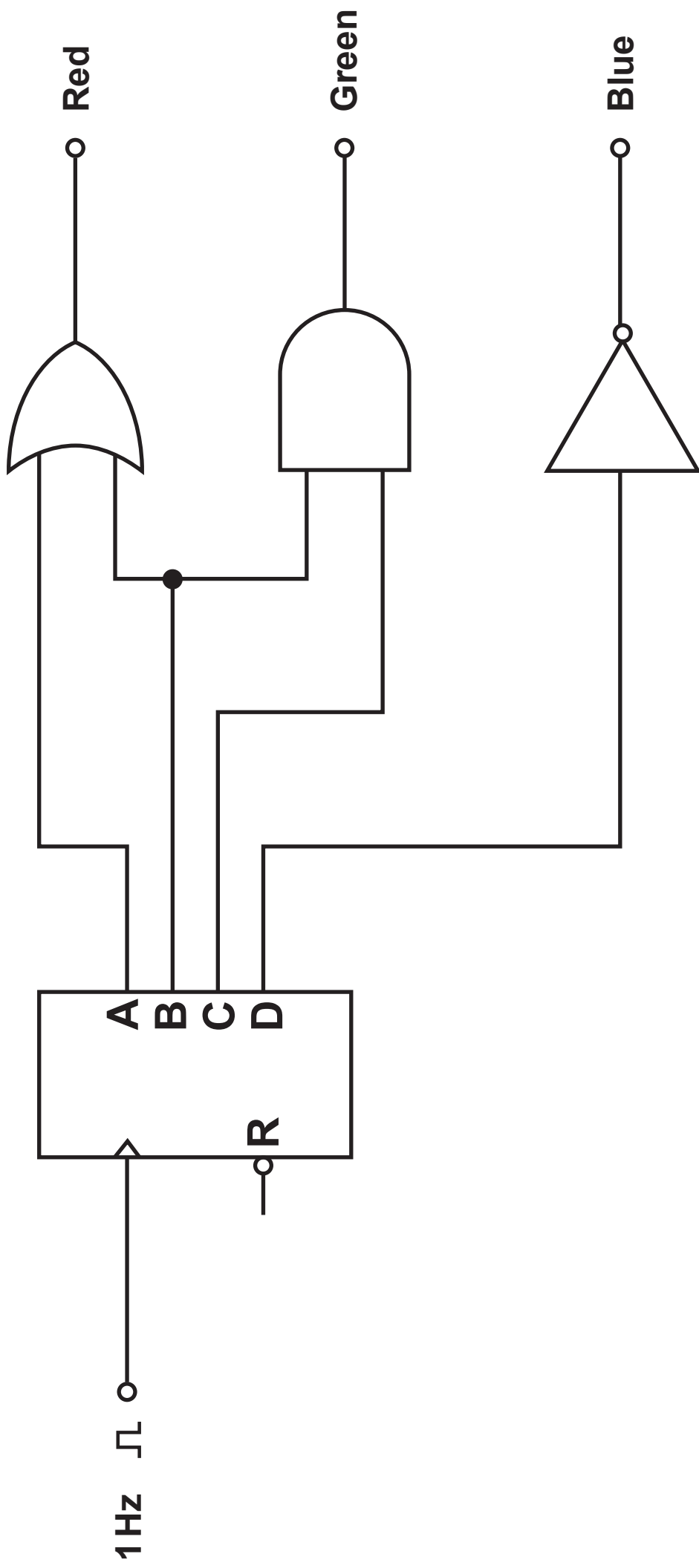
Clock Pulse	Blue	Green	Amber	Pink
0	On	Off	Off	Off
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

(Turn over)

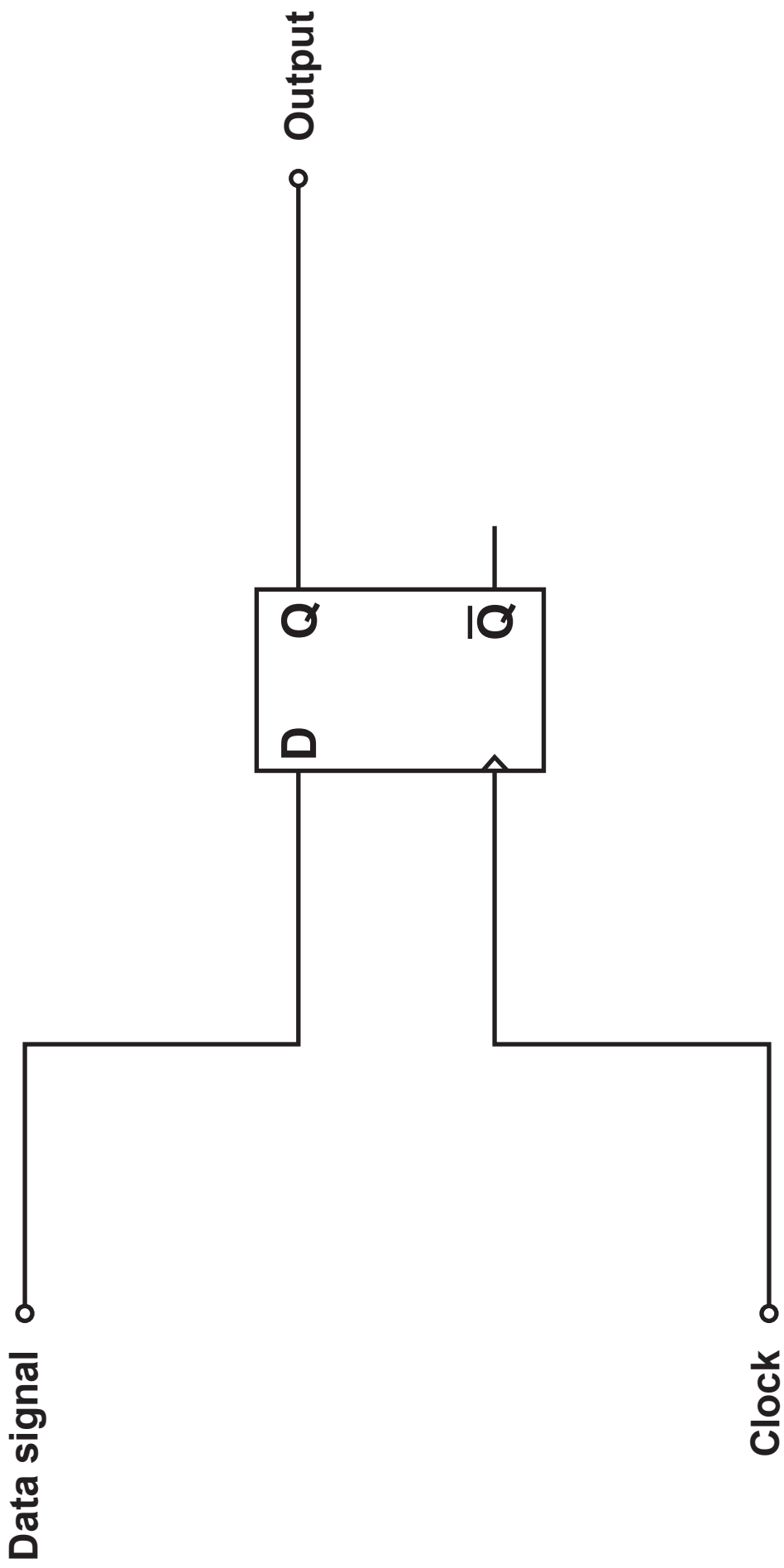


- 4 (b) A dedicated binary counter IC which has an active low reset (opposite) is used to switch on three different coloured lights.

**ADD A LOGIC GATE AND CONNECTIONS** to reset the counter when it reaches a count of 12. Output A is the least significant bit (LSB). [4 marks]



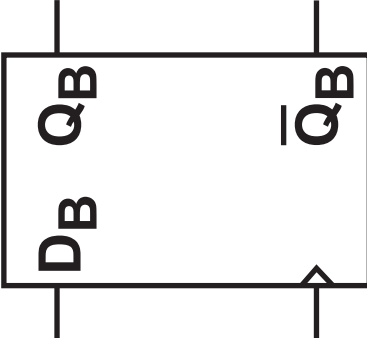
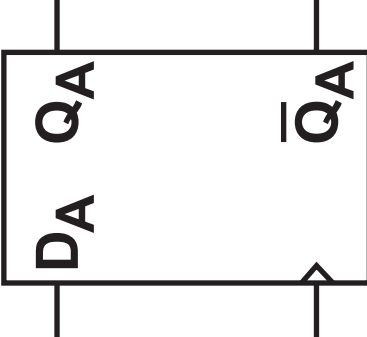
5. The D-type flip-flop can be used in a variety of applications.
- (a) The diagram opposite shows a rising-edge triggered D-type flip-flop connected to a data signal and a clock.



**5 (a) The data signal and clock signal are shown opposite. Use the axes provided to draw the output signal. The output is initially low.**

**[3 marks]**

- 5 (b) The diagram opposite shows two D-type flip-flops and a pulse generator.
- (i) **DRAW THE CONNECTIONS** needed to make a 2-bit binary up-counter. [4 marks]



**5 (b) (ii)**

**The D-type flip-flop is rising-edge triggered.**

- I. LABEL A RISING-EDGE on the pulse generator output graph. [1 mark]**
  
- II. The  $Q_A$  and  $Q_B$  outputs are initially at logic 0. On the axes opposite DRAW THE SIGNALS at the  $Q_A$  and  $Q_B$  outputs. [6 marks]**

**5 (c) Using the information on the graphs.**

**(i) Determine the SPACE time for the pulse generator.**  
**[1 mark]**

---

---

---

---

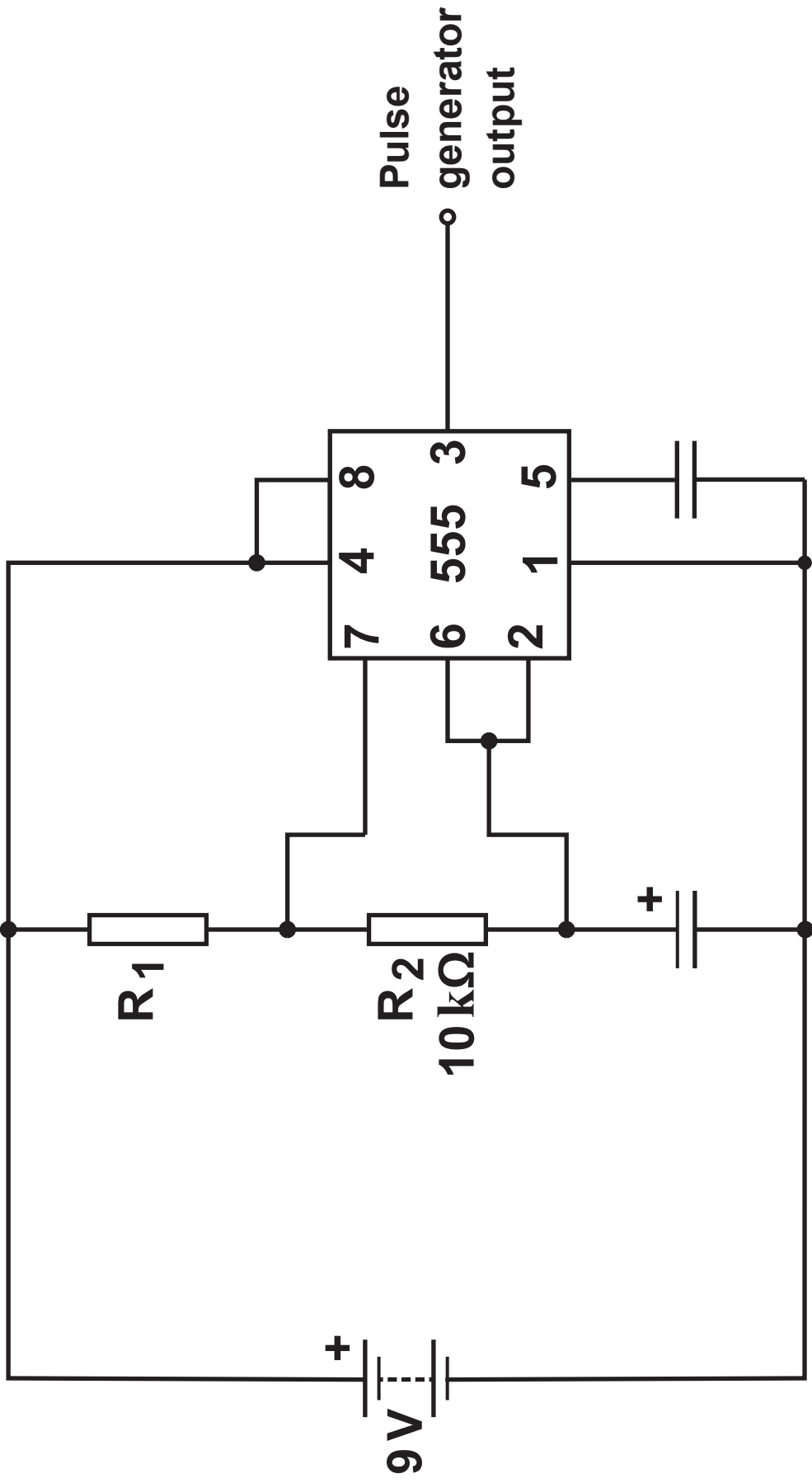
**(ii) Determine the MARK time for the pulse generator.**  
**[1 mark]**

---

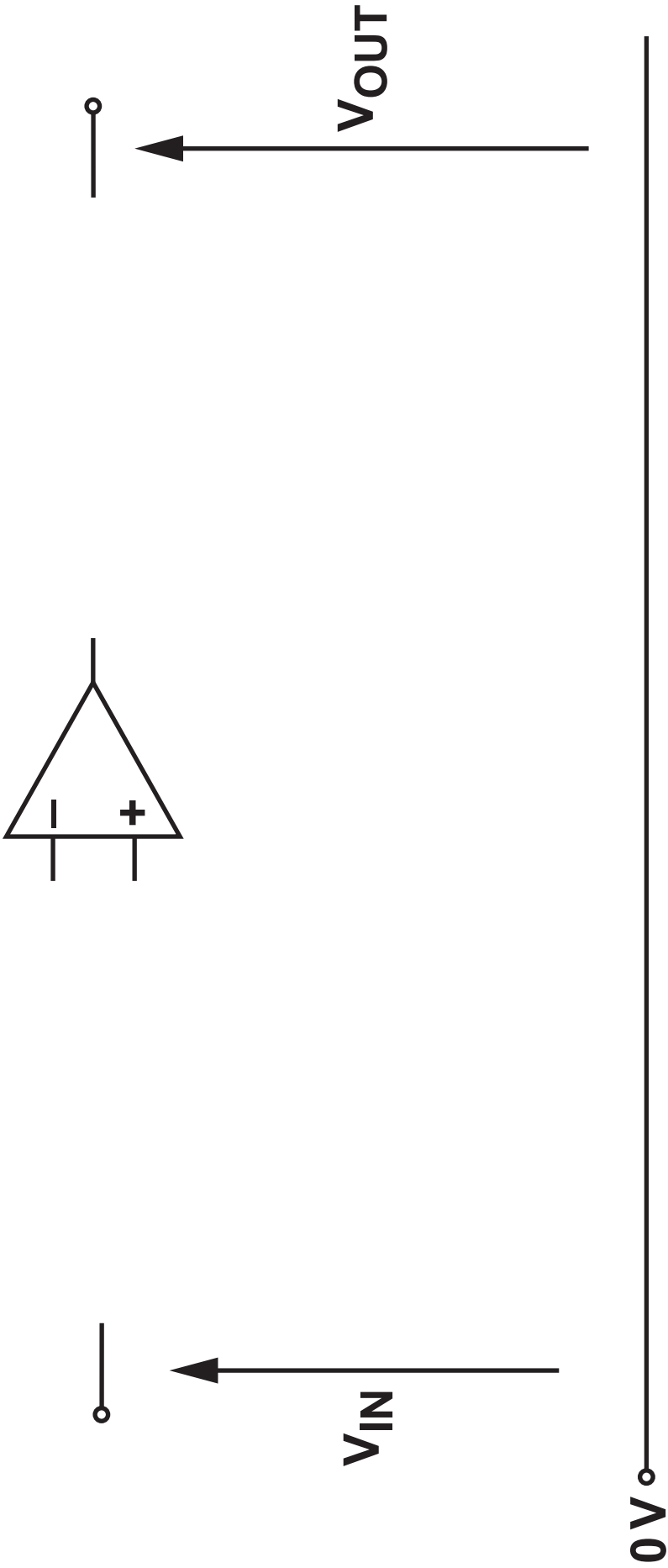
---

---

---

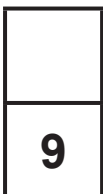


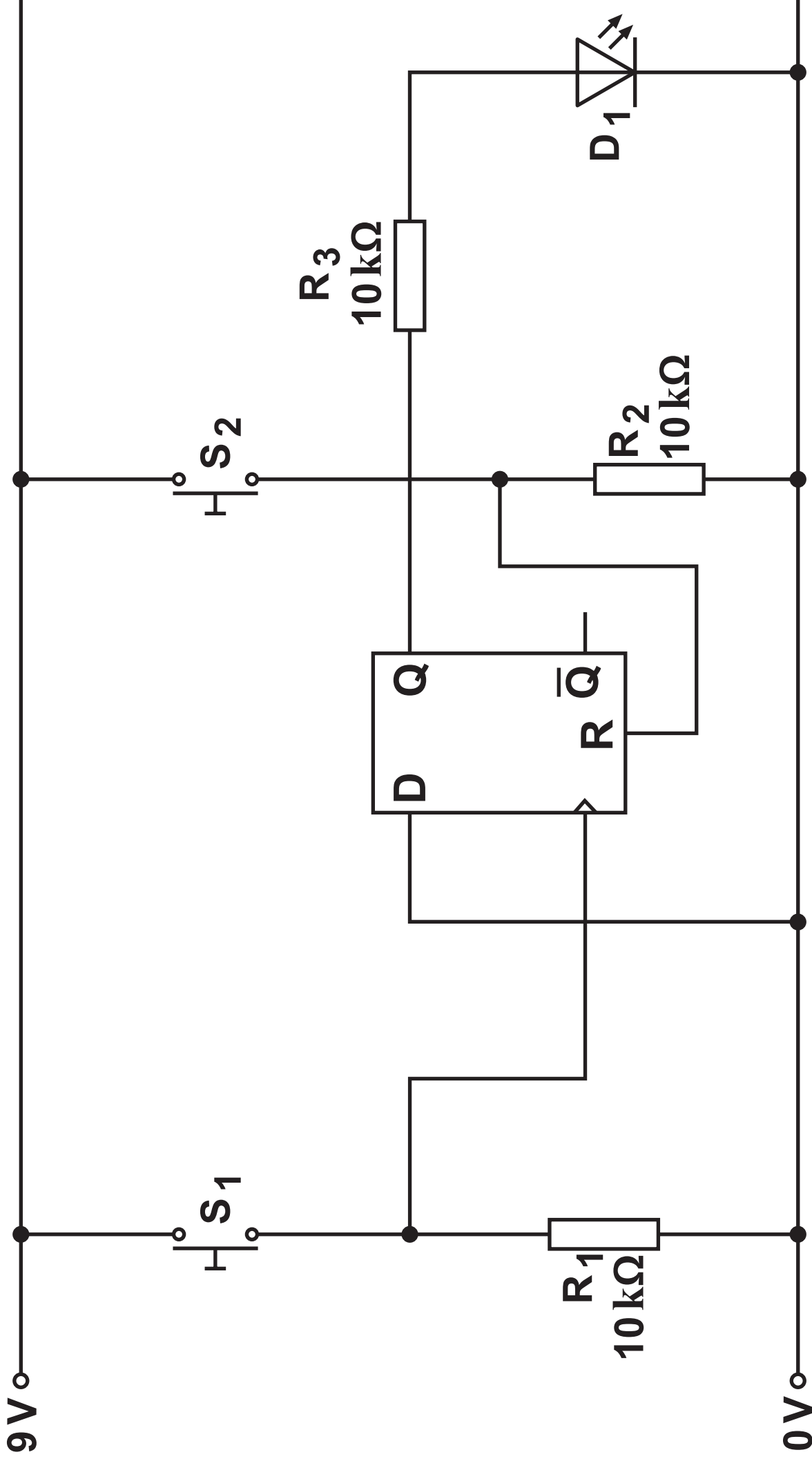






- 6 (c) The op-amp has a bandwidth of 25 kHz when the gain is 48. DRAW the gain-frequency graph opposite for this amplifier. [3 marks]





7. The D-type flip-flop can be configured to act as a latch. A student has made the circuit opposite from a rising-edge triggered D-type flip-flop.

The student's specification states that the circuit should operate as follows:

- pressing switch  $S_1$  makes an LED come on and stay on
- pressing switch  $S_2$  resets the latch so that the LED goes off













## USEFUL EQUATIONS

$$P = \frac{V^2}{R}$$

$$G = 1 + \frac{R_F}{R_1}$$

$$V_{OUT} = \frac{R_2}{R_1 + R_2} V_{IN}$$

$$G = -\frac{R_F}{R_{IN}}$$

$$I_D = g_M(V_{GS} - 3)$$

$$V_{OUT} = -R_F \left( \frac{V_1}{R_1} + \frac{V_2}{R_2} + \dots \right)$$

$$I_C = h_{FE} I_B$$

$$T = 1.1RC$$

$$\overline{A + B} = \overline{A} \cdot \overline{B}$$

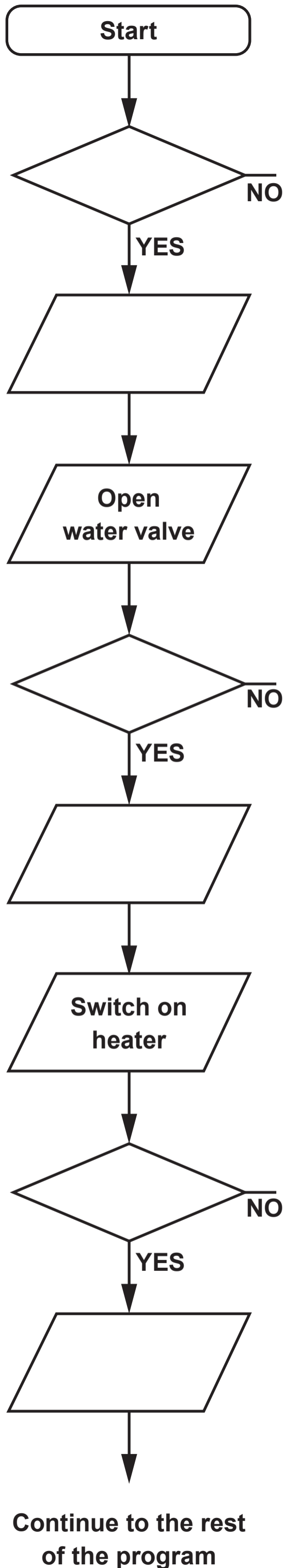
$$f = \frac{1}{T}$$

$$\overline{A \cdot B} = \overline{A} + \overline{B}$$

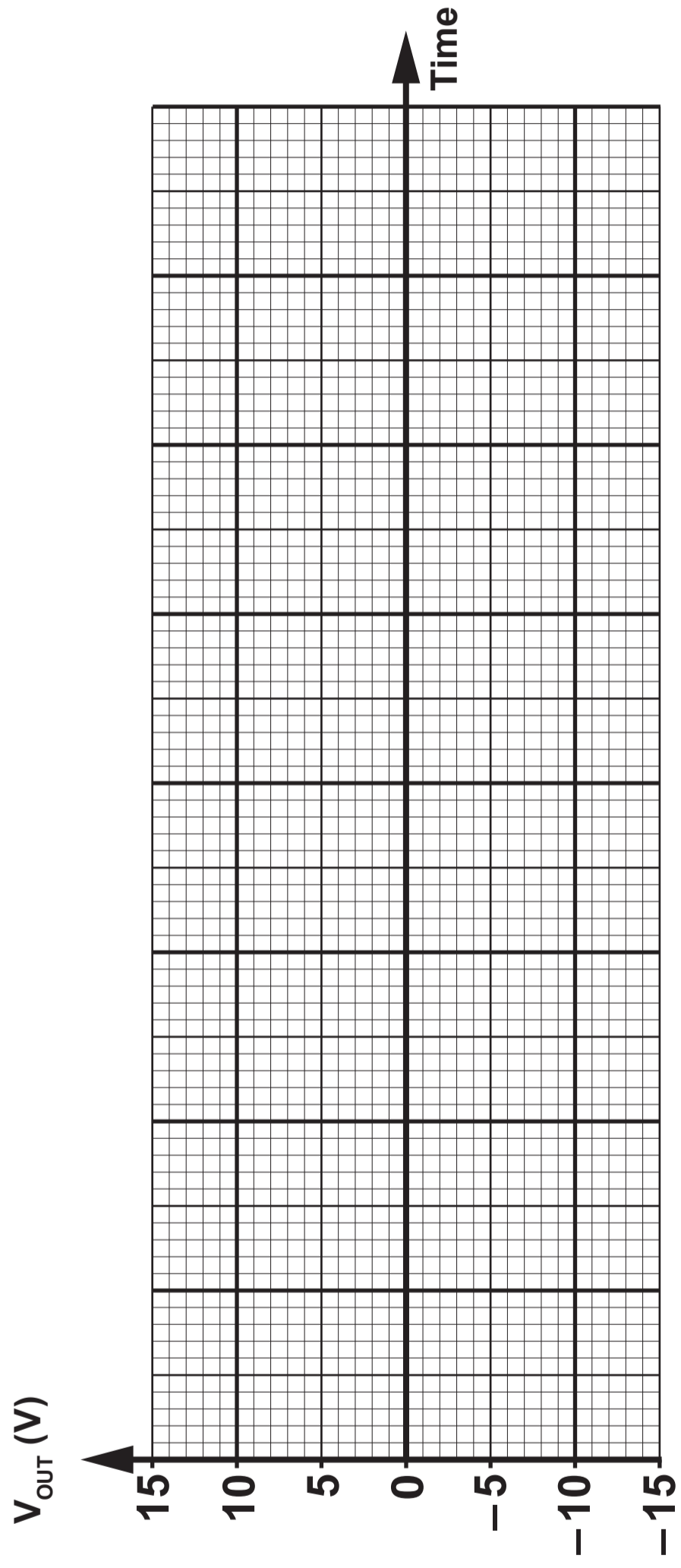
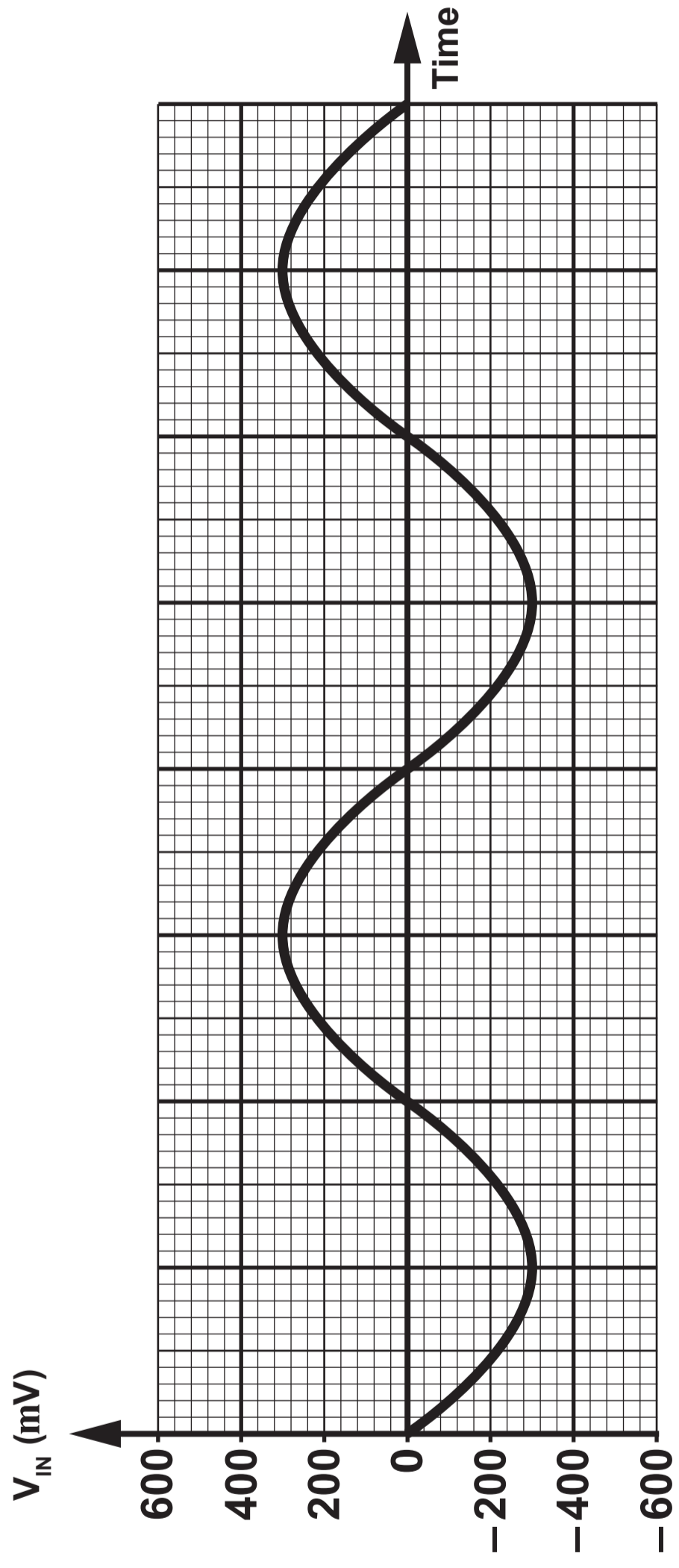
$$f = \frac{1.44}{(R_1 + 2R_2)C}$$

$$G = \frac{V_{OUT}}{V_{IN}}$$

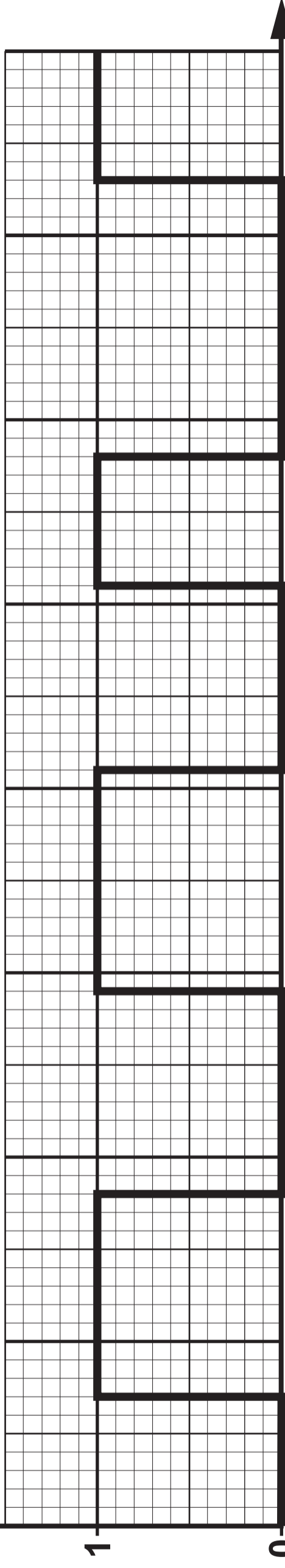
$$\frac{T_{ON}}{T_{OFF}} = \frac{R_1 + R_2}{R_2}$$



**Continue to the rest  
of the program**



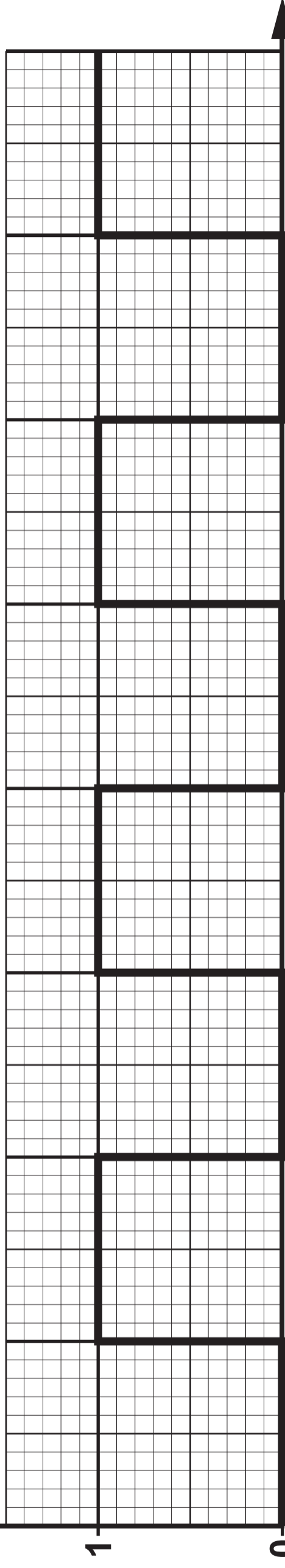
Data  
signal



1

0

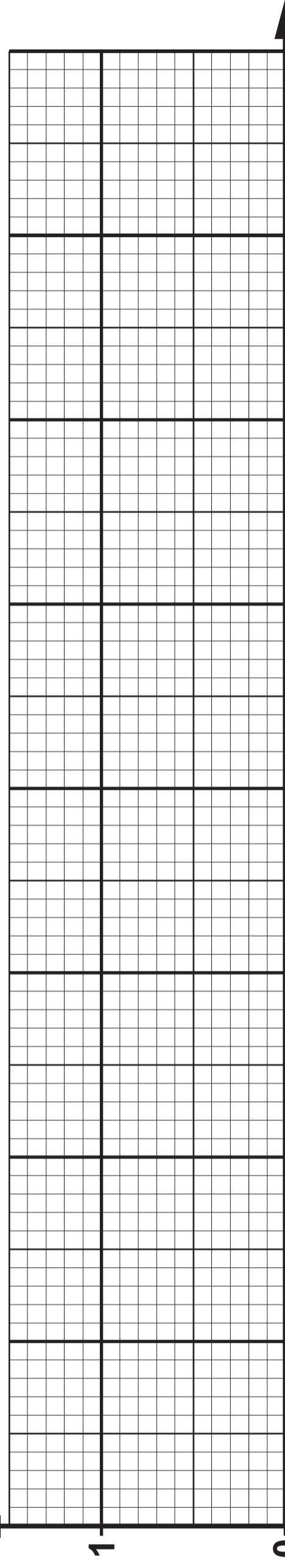
Clock



1

0

Output



1

0

Time

