



GCSE



**C490UA0-1**

**FRIDAY, 27 MAY 2022 – AFTERNOON**

**ELECTRONICS – Component 1**

**Discovering 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>9</b>	
<b>2.</b>	<b>9</b>	
<b>3.</b>	<b>13</b>	
<b>4.</b>	<b>11</b>	
<b>5.</b>	<b>12</b>	
<b>6.</b>	<b>13</b>	
<b>7.</b>	<b>13</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 4(b).

(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

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

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

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

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

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

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

$$I_C = h_{FE} I_B$$

$$T = 1.1RC$$

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

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

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

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

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

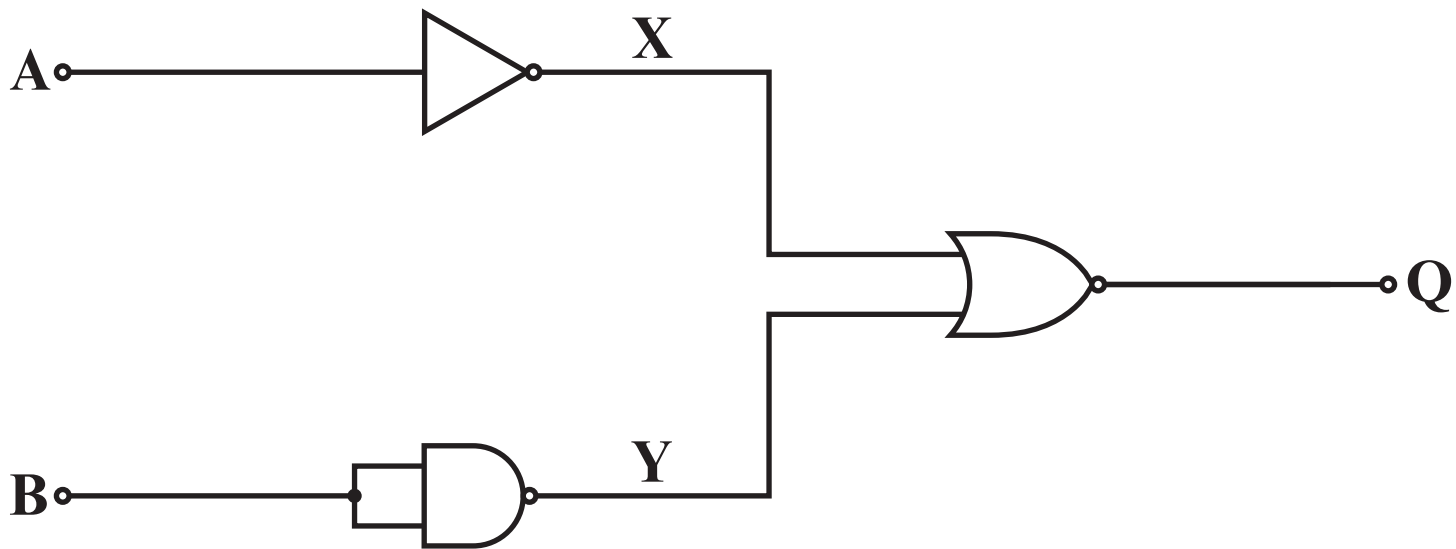
$$\frac{T_{ON}}{T_{OFF}} = \frac{R_1 + R_2}{R_2}$$

**Answer ALL questions.**

**1 (a) Draw the circuit symbol for each of the following logic gates:**

**(i) AND gate**

**(ii) OR gate [2 marks]**



1 (b) (i)

Complete the truth table for the logic system opposite. [3 marks]

B	A	X	Y	Q
0	0			
0	1			
1	0			
1	1			

(ii) Which single logic gate could produce the same output Q? [1 mark]

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(Turn over)

- 1 (c) Which logic gate has an output of logic 0 ONLY when both inputs are at logic 1? [1 mark]
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- (d) Which of the TWO following Boolean equations are correct? TICK (✓) both correct answers.

[2 marks]

$$\overline{\overline{X + Y}} = \overline{\overline{X.Y}}$$

$$\overline{\overline{X + Y}} = \overline{\overline{X.Y}}$$

$$\overline{\overline{X + Y}} = \overline{\overline{X}} + \overline{\overline{Y}}$$

$$\overline{\overline{X.Y}} = \overline{\overline{X.Y}}$$

$$\overline{\overline{X.Y}} = \overline{\overline{X}} + \overline{\overline{Y}}$$

A—

X

—Q

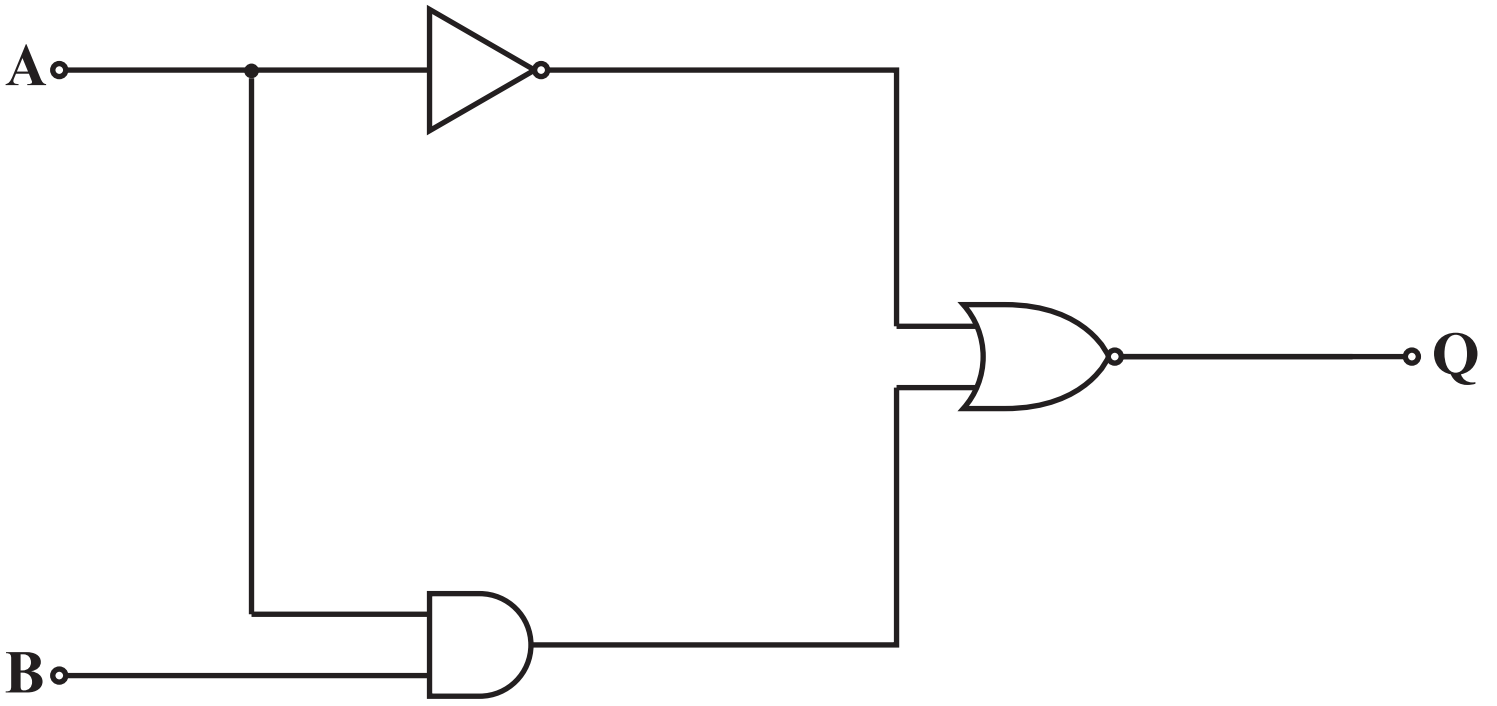
B—

Y

2. The truth table for a logic system is shown below:

B	A	X	Y	Q
0	0	1	0	1
0	1	0	0	0
1	0	0	0	0
1	1	0	1	1

- (a) Draw the logic system on the page opposite that will produce the output **Q** using **ONLY AND, OR and NOT gates**. [3 marks]



A —

B —

— Q

**2 (b) A different logic system is shown opposite.**

**(i) Redraw the circuit on the page opposite using NAND gates only. [3 marks]**

**(ii) CROSS OUT all redundant NAND gates. [2 marks]**

**(c) Give ONE advantage of converting logic systems to NAND gates. [1 mark]**

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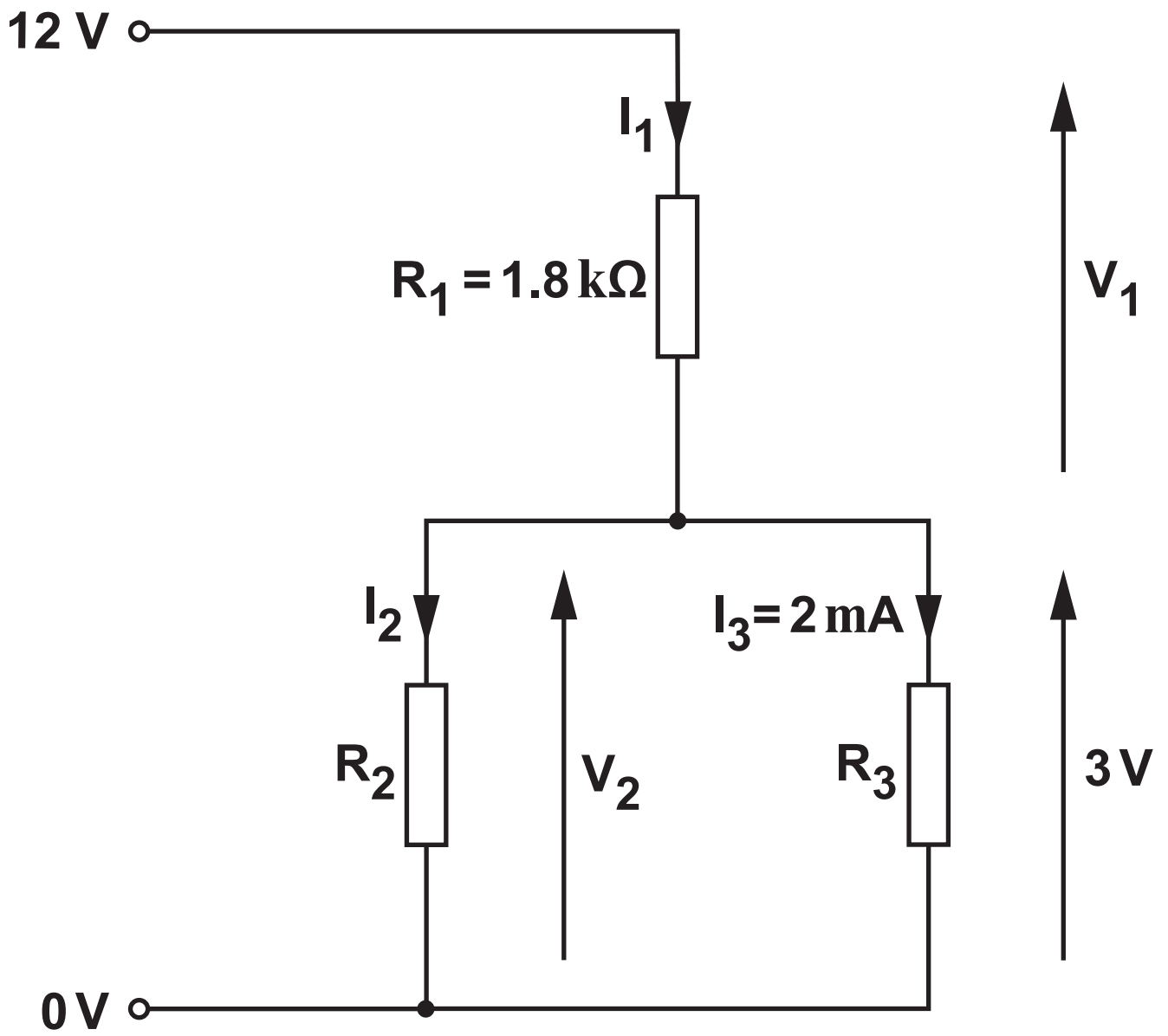
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3. The circuit diagram opposite shows a network of resistors connected to a 12 V power supply.

(a) What is the colour code on resistor  $R_1$  which has a tolerance of  $\pm 5\%$ ? [4 marks]

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(b) Calculate the value of:

(i)  $V_1$  [2 marks]

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3 (b) (ii)

$I_1$  [4 marks]

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(iii)  $I_2$  [2 marks]

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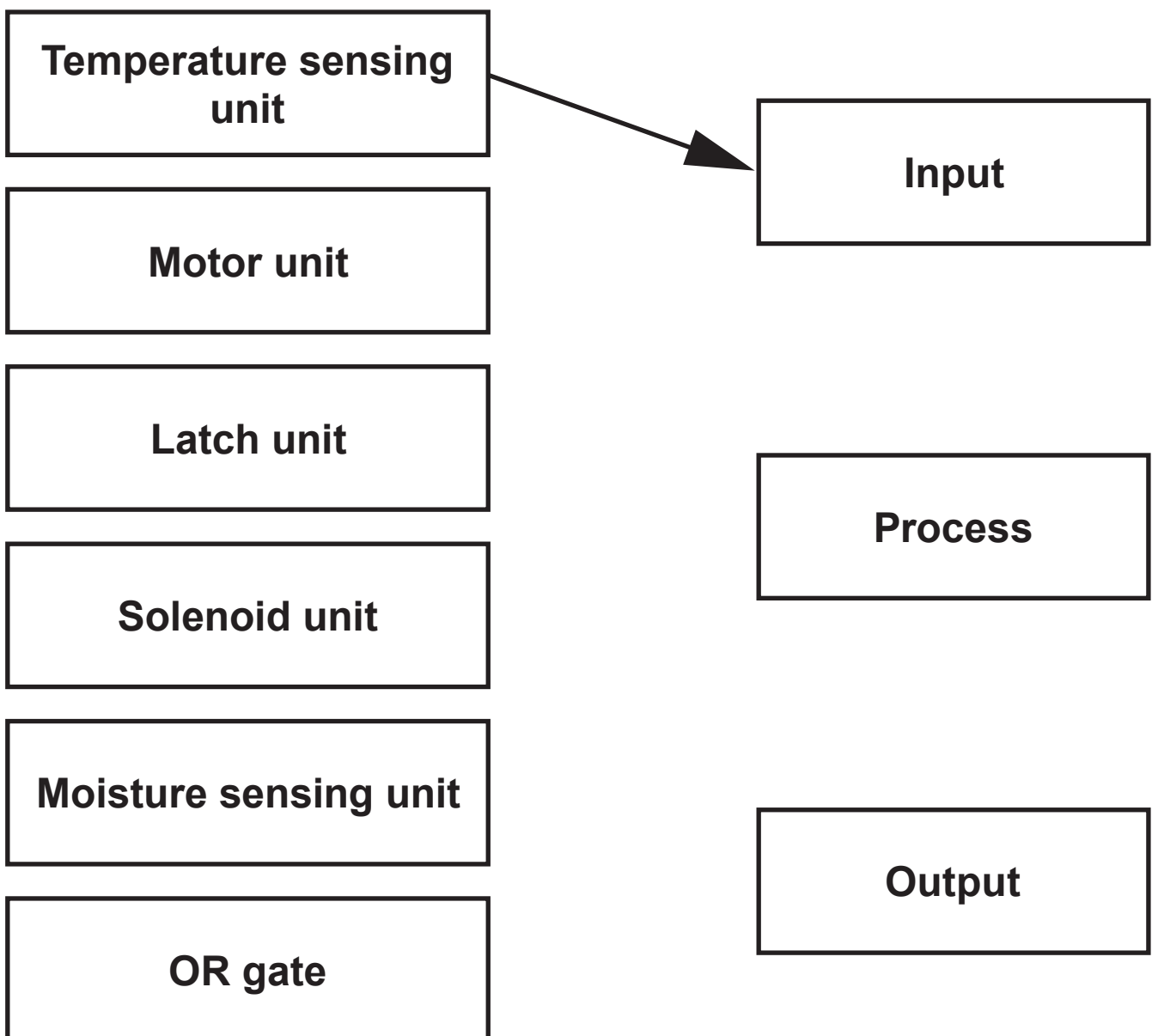
3 (c) Determine the value of  $V_2$ . [1 mark]

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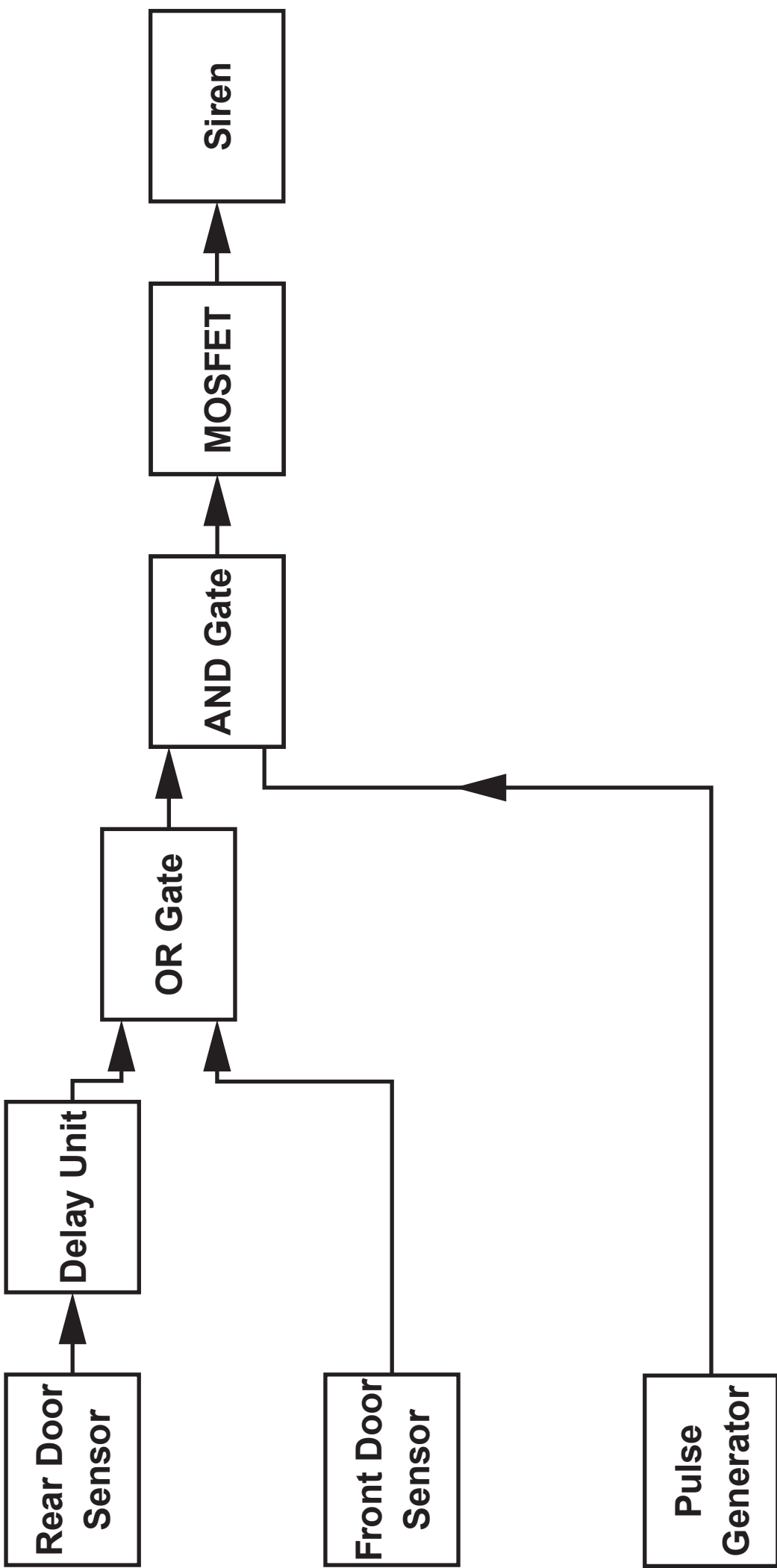
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4. All electronic systems can be broken down into three main system blocks – Input, Process and Output.

(a) Link the units on the left to their system block on the right. One has been done for you. [5 marks]



(Turn over)



**4 (b) The block diagram opposite shows a burglar alarm designed to protect a small business property.**

**The specification for the alarm is as follows:**

- There are two entry doors to the property to be protected.**
- When the front door is opened a 30 second delay should be started to allow the owner time to turn off the alarm when entering the building before the alarm is triggered.**
- When the rear door is opened the alarm should be triggered immediately.**
- The alarm siren pulses on and off continually once triggered.**
- If either door is closed after being opened the alarm should continue to sound.**

**Evaluate the design against the specification and if necessary, suggest any modifications needed to meet the specification fully. [6 marks QER]**

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**(Turn over)**





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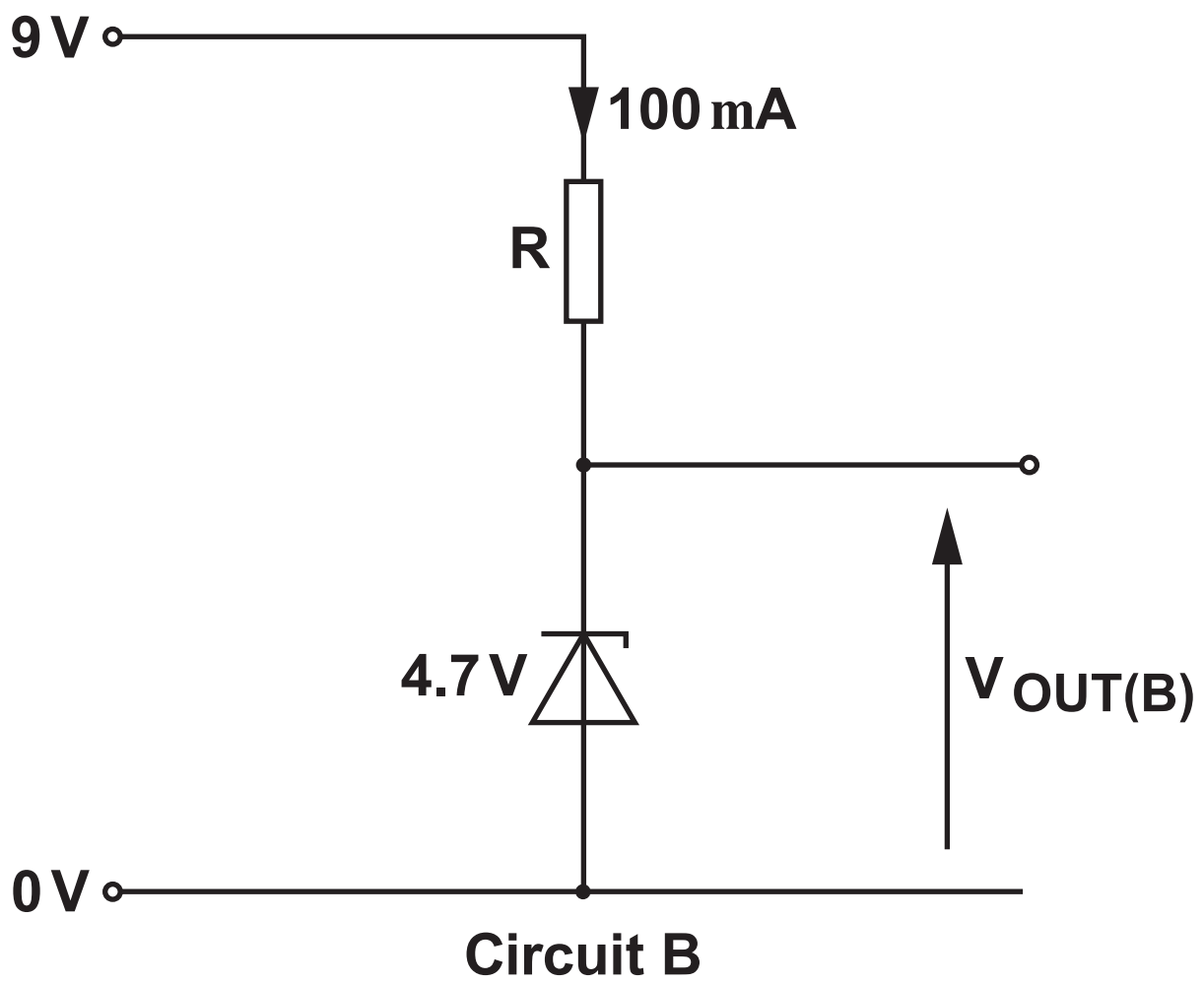
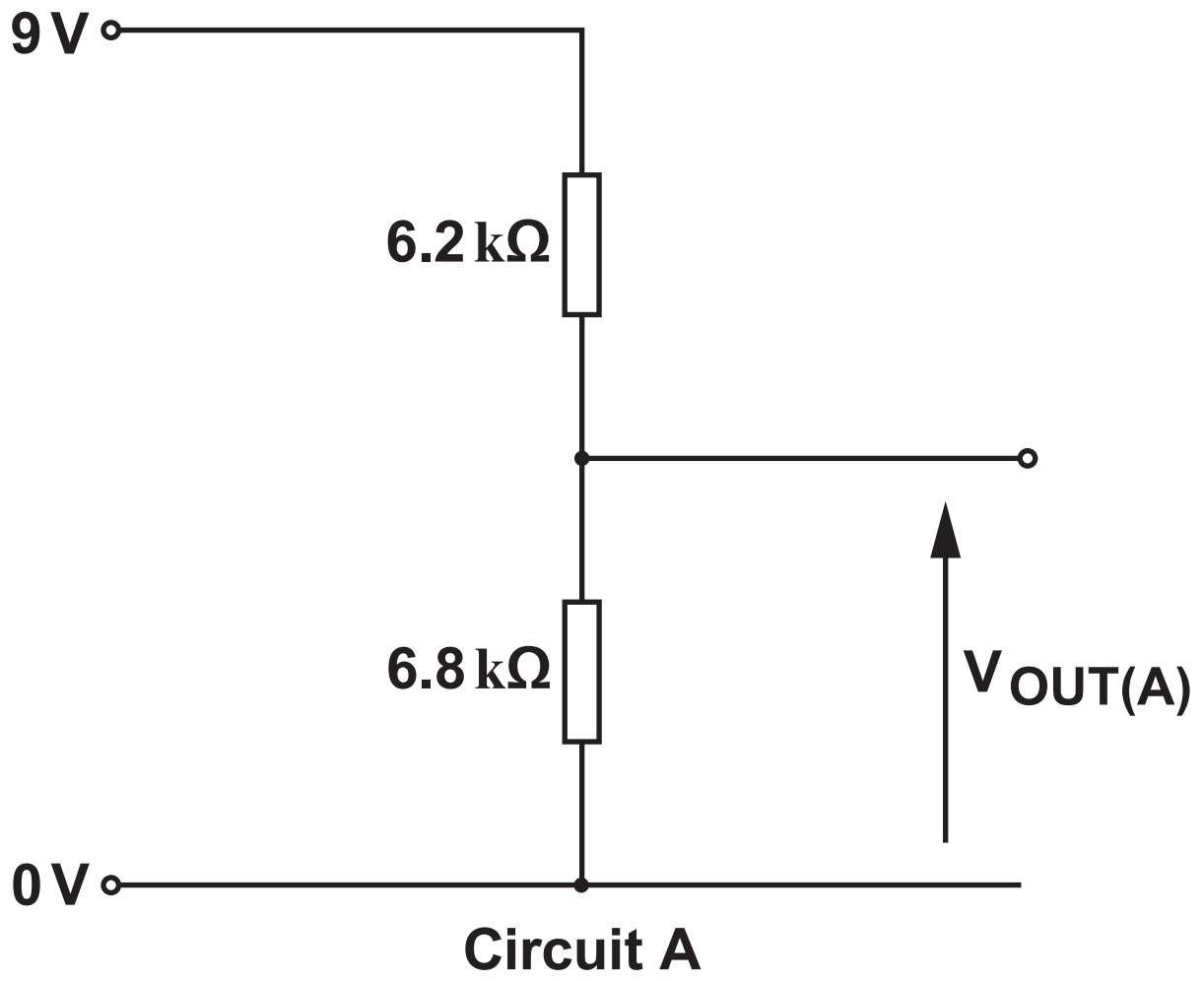
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(Turn over)



5. Two designs for a simple power supply to operate from a 9 V battery are shown opposite. The holding current for the zener diode in circuit B is 8 mA.

(a) Calculate the output voltage  $V_{OUT(A)}$ . [3 marks]

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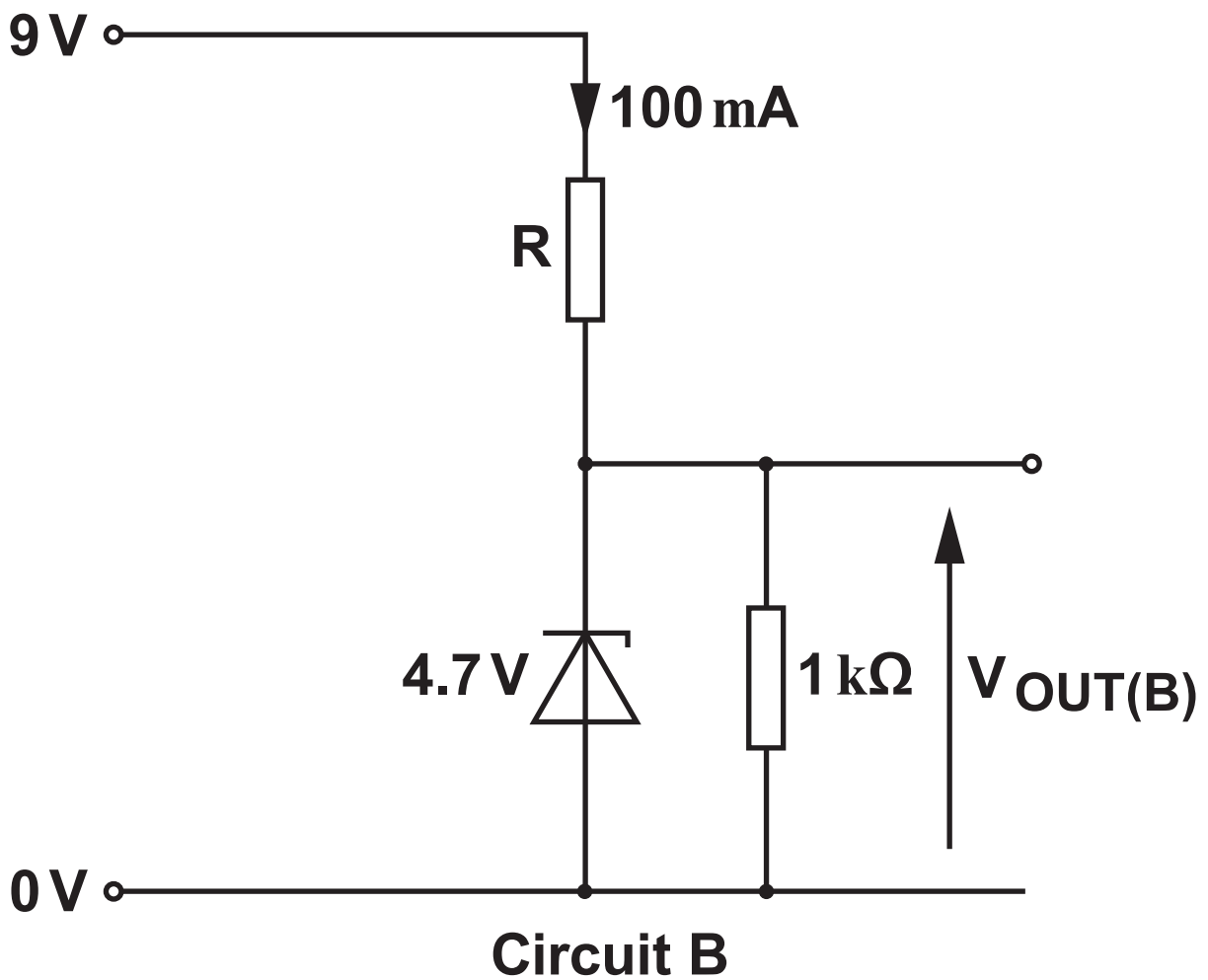
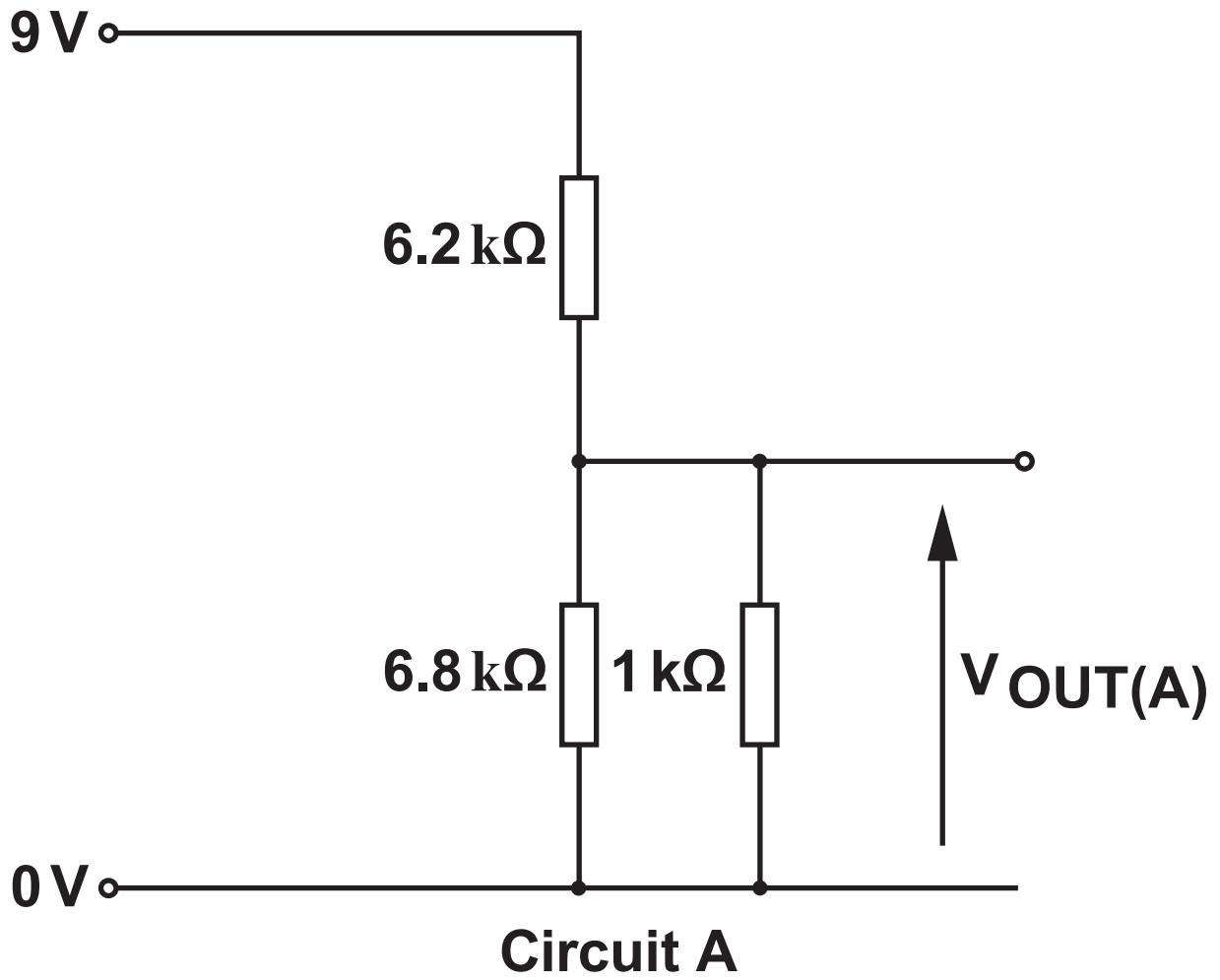
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(b) What is the output voltage  $V_{OUT(B)}$ ? [1 mark]

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5 (d) The load resistance is now changed to  $500\ \Omega$ .  
CIRCLE how this would affect the output voltage  
in each circuit. [2 marks]

Circuit A:

equals 0 V

decreases

stays the same

increases

equals 9 V

Circuit B:

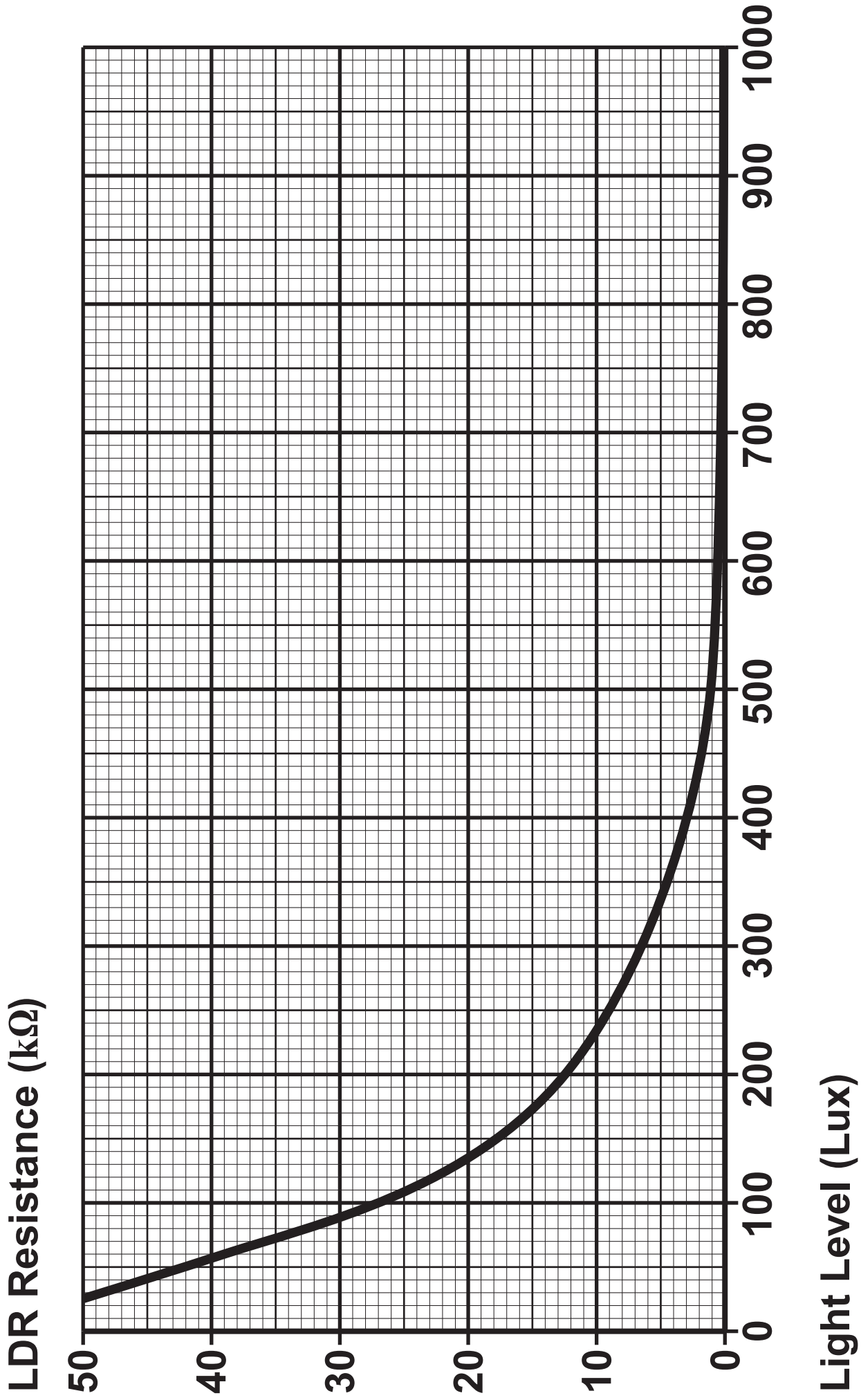
equals 0 V

decreases

stays the same

increases

equals 9 V



6. A student has designed a system to switch on a light in a shop window when it becomes dark.

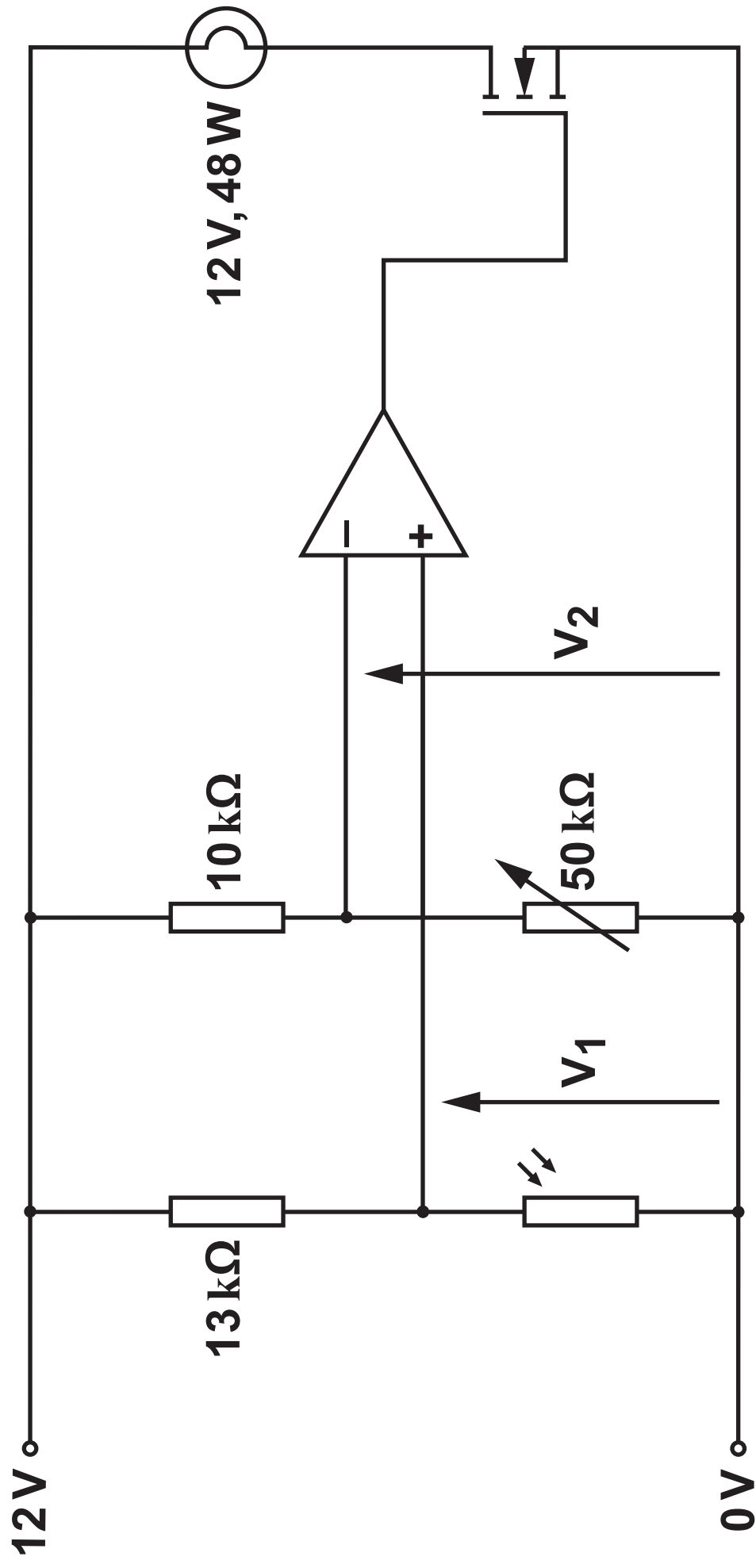
The characteristic of the LDR used in the design is shown opposite.

The light switches on when the light level drops to 60 lux.

- (a) Use the LDR characteristic to determine the resistance of the LDR at 60 lux. [1 mark]

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6 (c) What value of  $V_2$  ensures that the light comes on when the light level falls to 60 lux? [1 mark]

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(d) Calculate the current flowing through the light when it is operating at the rated value shown on the circuit diagram. [4 marks]

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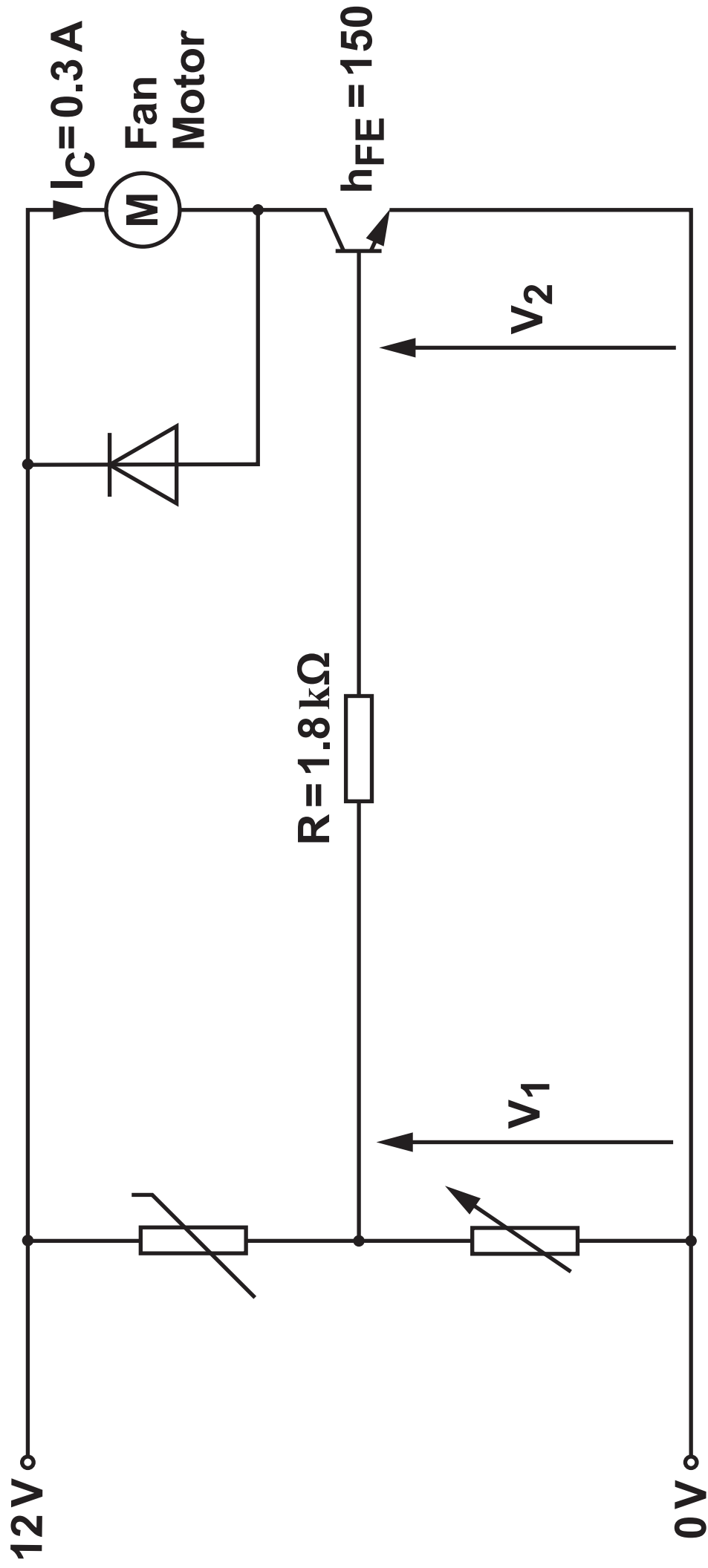
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7. The diagram opposite shows the circuit for a temperature controlled fan.

The transistor is **JUST SATURATED** and the current through the fan motor is 0.3 A.

- (a) Calculate the power dissipated in the fan motor.

[3 marks]

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7 (b) (i)

Calculate the current flowing through the  $1.8\text{ k}\Omega$  resistor. [4 marks]

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7 (b) (ii)

Calculate the voltage across the  $1.8\text{ k}\Omega$  resistor.

[3 marks]

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(c) What is the value of  $V_2$ ? [1 mark]

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7 (d) Calculate the minimum value of  $V_1$  that will ensure the transistor is just saturated. [2 marks]

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END OF PAPER



