



**GCSE**

**4161/01**

**ELECTRONICS**

**UNIT E1: Paper replacement test**

**P.M. MONDAY, 13 June 2016**

**1 hour plus your additional time allowance**

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

**Other Names** \_\_\_\_\_

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

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

<b>For Examiner's use only</b>		
<b>Question</b>	<b>Maximum Mark</b>	<b>Mark Awarded</b>
<b>1.</b>	<b>4</b>	
<b>2.</b>	<b>7</b>	
<b>3.</b>	<b>3</b>	
<b>4.</b>	<b>3</b>	
<b>5.</b>	<b>3</b>	
<b>6.</b>	<b>3</b>	
<b>7.</b>	<b>3</b>	
<b>8.</b>	<b>4</b>	
<b>9.</b>	<b>5</b>	
<b>10.</b>	<b>2</b>	
<b>11.</b>	<b>3</b>	
<b>12.</b>	<b>2</b>	
<b>13.</b>	<b>3</b>	
<b>14.</b>	<b>2</b>	
<b>15.</b>	<b>3</b>	
<b>16.</b>	<b>2</b>	
<b>17.</b>	<b>4</b>	
<b>18.</b>	<b>4</b>	
<b>Total</b>	<b>60</b>	

## **ADDITIONAL MATERIALS**

**In addition to this paper you may require a calculator and a ruler and a separate insert.**

## **INSTRUCTIONS TO CANDIDATES**

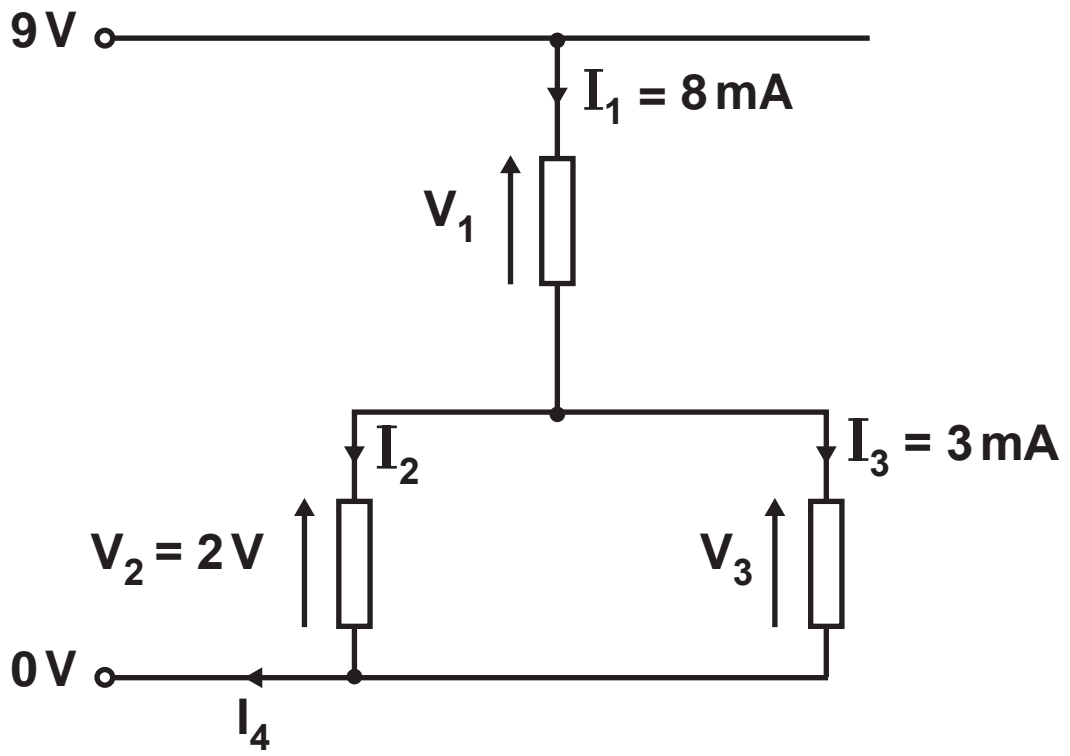
**Use black ink, black ball-point pen or your usual method.**

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

**Answer ALL questions 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.**



Answer ALL questions.

1. Study the circuit on the opposite page.

Select the correct answers to the following questions.

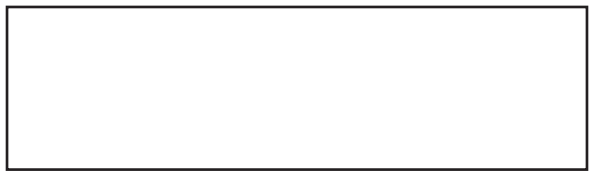
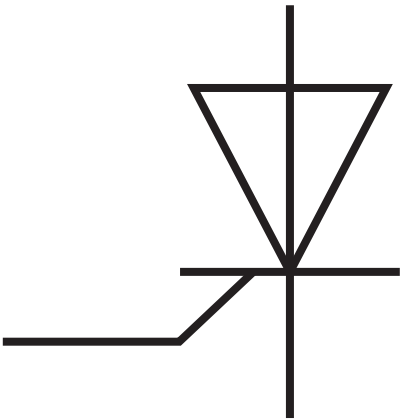
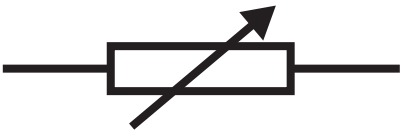
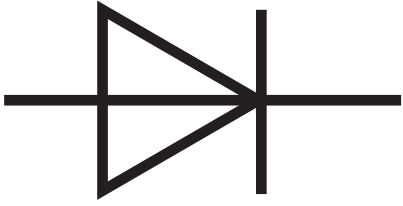
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
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(a) What is the value of  $V_1$ ? \_\_\_\_\_ V [1]

(b) What is the value of  $I_2$ ? \_\_\_\_\_ mA [1]

(c) What is the value of  $V_3$ ? \_\_\_\_\_ V [1]

(d) What is the value of  $I_4$ ? \_\_\_\_\_ mA [1]



**2(a) Below is a list of electronic components.**

**Diode      LED      Thermistor      Thyristor**  
**Transistor      Variable resistor**

**Select the correct name from the list above for EACH component shown opposite. [3]**

2(b) Link each sub-system box on the left to the correct function box on the right. One has been done for you. [4]

**SUB-SYSTEM**

**FUNCTION**

NOR gate

Input

Latch unit

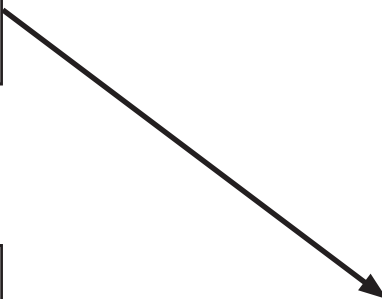
Process

Motor unit

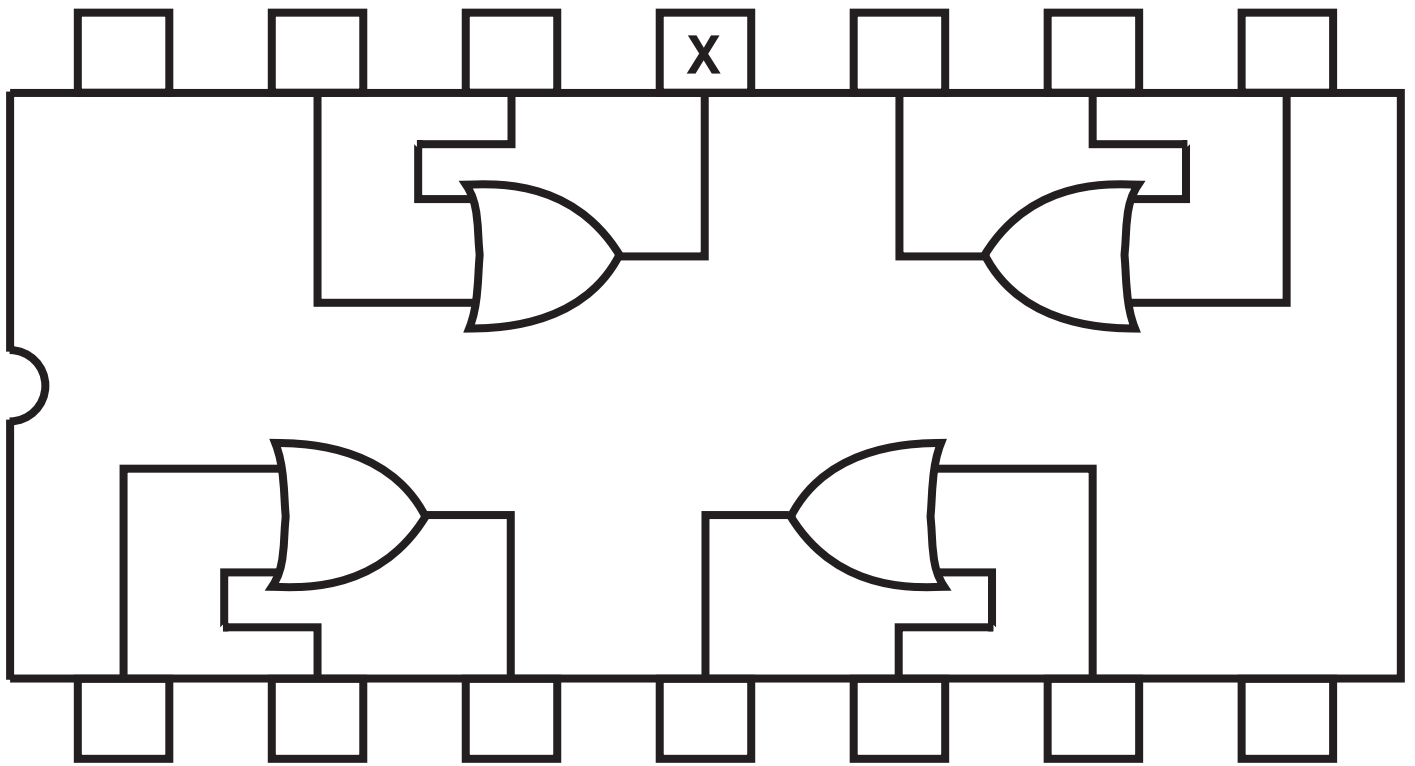
Transistor switch

Output

Light sensing unit







3. Opposite is the pinout for a logic gate IC.

(a) How many logic gates are there? \_\_\_\_\_ [1]

(b) Circle the type of logic gate shown in the IC. [1]

AND gate

NAND gate

NOR gate

NOT gate

OR gate

(c) What is the number of the pin labelled X?

\_\_\_\_\_ [1]

4. Select the name of each logic gate shown below.

[3]

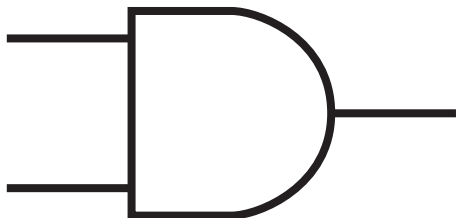
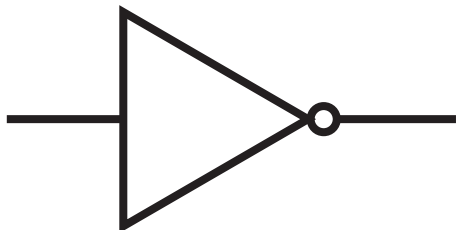
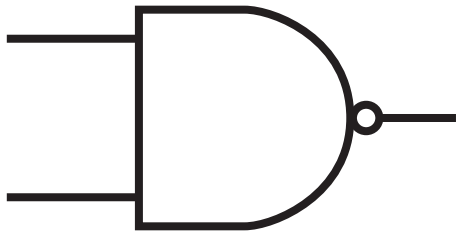
AND gate

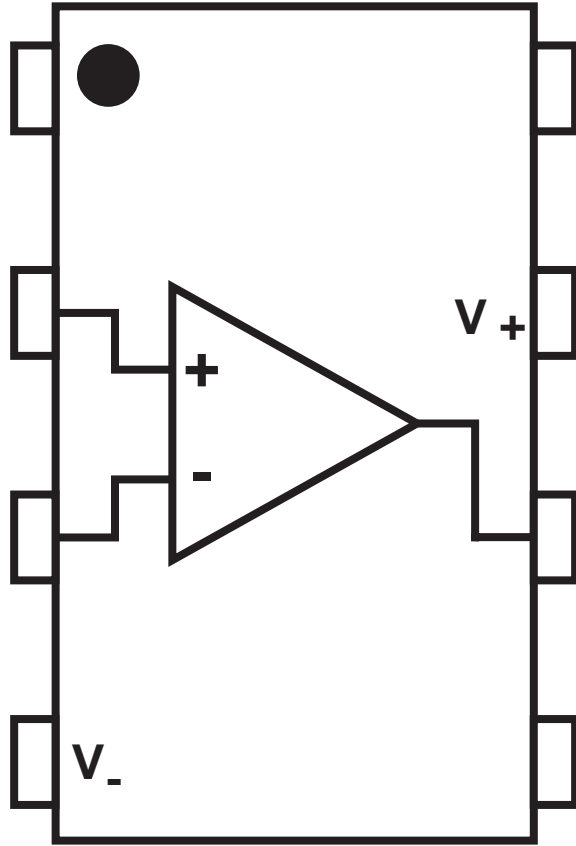
NAND gate

NOR gate

NOT gate

OR gate





5. The diagram opposite shows the pinout of a comparator IC.

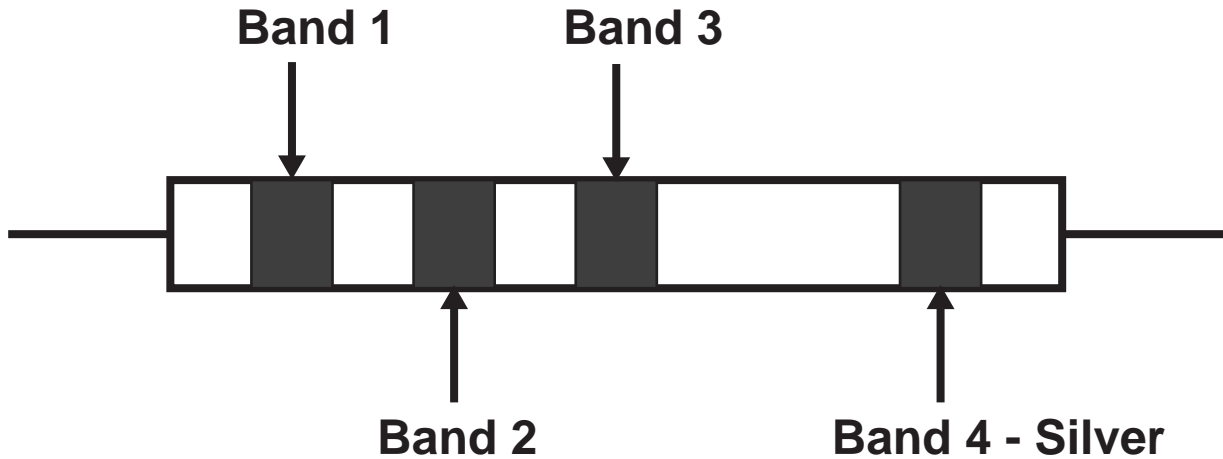
Write each of the following labels below next to the correct pin on the comparator IC. [3]

positive supply

output

inverting input

6. The diagram shows a  $270\text{ k}\Omega \pm 10\%$  resistor.

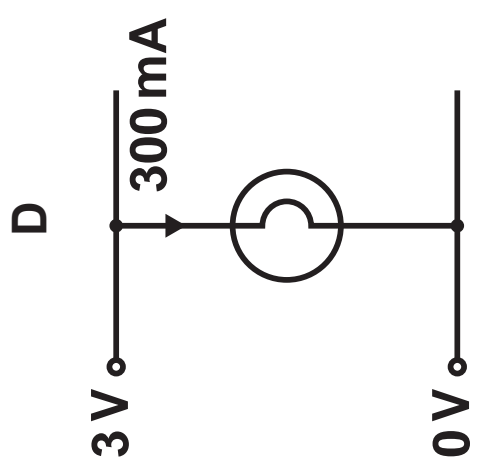
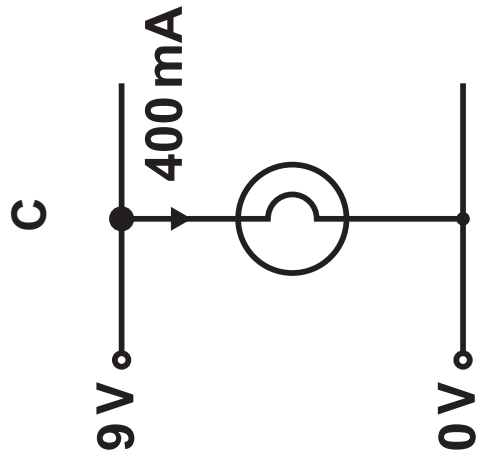
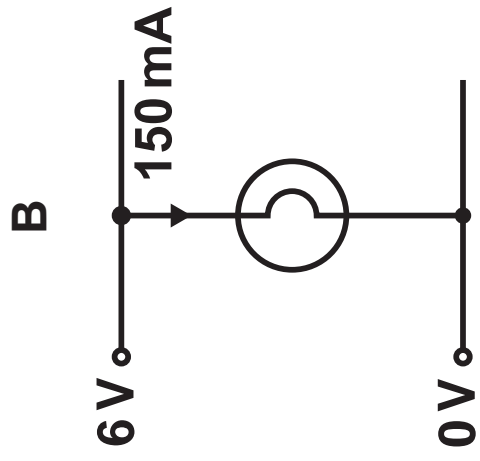
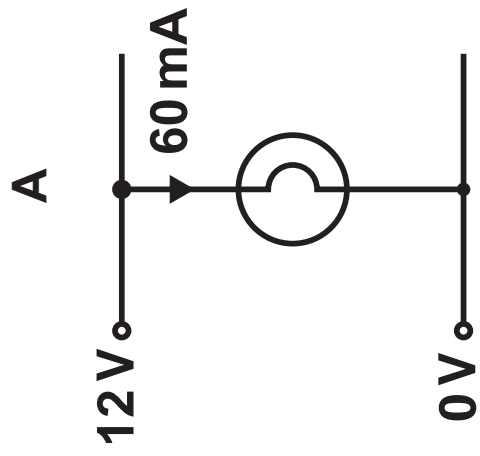


Use the information sheet on the separate insert to write down the correct colours of bands 1, 2 and 3 present on this resistor. [3]

Band 1 \_\_\_\_\_

Band 2 \_\_\_\_\_

Band 3 \_\_\_\_\_



7. Opposite are four lamps.

(a) (i) Select the correct equation to calculate the power used in Lamp C in watts (W). [1]

$P = \frac{9}{4}$

$P = \frac{40}{9}$

$P = 9 \times 400$

$P = 9 \times 0.4$

$P = \frac{9}{0.4}$

$P = \frac{400}{9}$



7(a) (ii) Calculate the power used in Lamp C. [1]

Power = \_\_\_\_\_ W

7(b) Which TWO lamps from the diagram opposite page 11 use the same power?  
(Tick (✓) the correct answer.) [1]

**A & B**

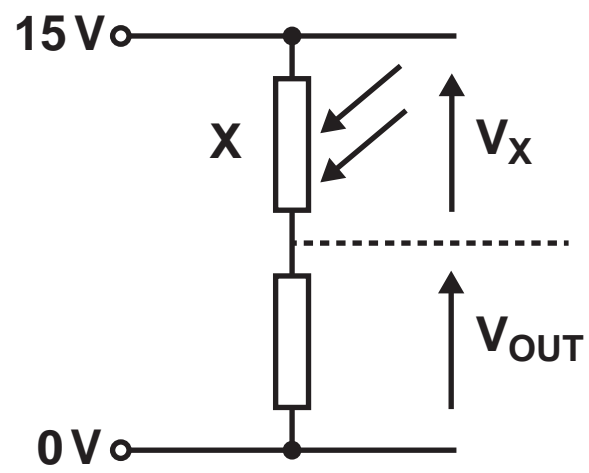
**A & C**

**A & D**

**B & C**

**B & D**

**C & D**



8. Opposite is an analogue sensing circuit.

(a) Circle the name of the component labelled X. [1]

LDR

Resistor

Thermistor

Variable resistor

(b)  $V_{OUT} = 6\text{ V}$ . Circle the correct voltage across component X. [1]

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
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8(c) (i) What would happen to the voltage  $V_{OUT}$  if a torch was used to shine light on to the circuit? (Tick (✓) the correct answer.) [1]

$V_{OUT}$  would increase

$V_{OUT}$  would decrease

$V_{OUT}$  would stay the same

$V_{OUT}$  would become 0 V

(ii) Give a reason for your answer. [1]

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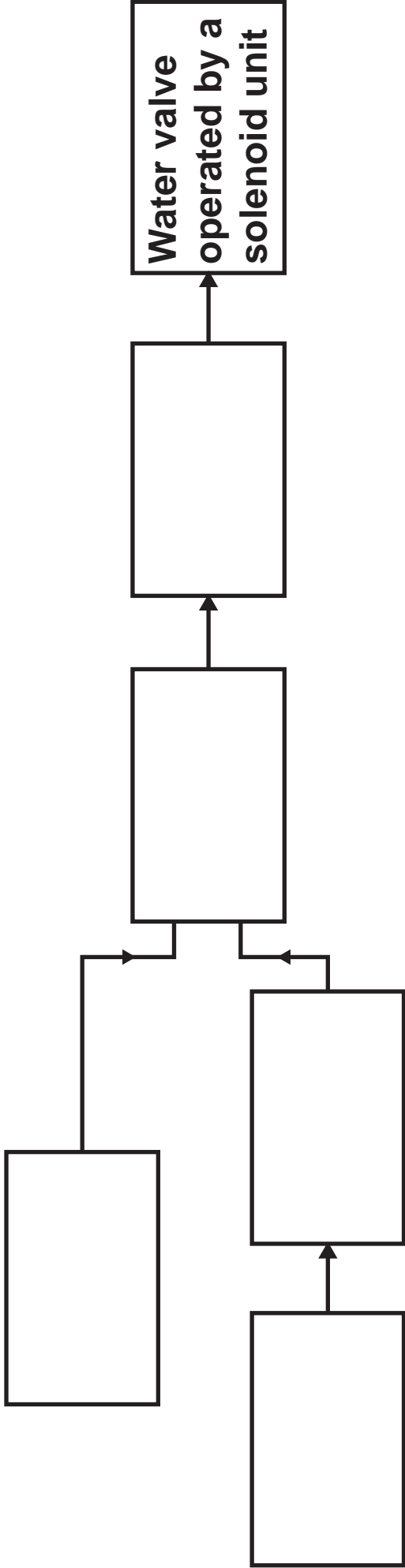
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9. A garden centre requires an automatic system to water flowers in the customer display areas. The system should switch on the water only when the soil is dry and it is dark to avoid soaking any customers. It should switch off automatically when the soil is damp or it gets light.

The light sensor outputs a Logic 1 when in daylight and Logic 0 when it is dark.

The temperature sensor outputs a Logic 0 when it is cold and Logic 1 when it is warm.

The moisture sensor outputs a Logic 0 when wet and Logic 1 when dry.

Thyristor      OR gate      Inverter

Pulse generator      Temperature sensing unit

Moisture sensing unit      Switch unit

MOSFET      Light sensing unit      AND gate

Select the correct sub-systems above to complete the block diagram opposite for the watering system. [5]

10(a) Circle the logic gate that has the following truth table. [1]

INPUTS		OUTPUT
A	B	Q
0	0	1
0	1	1
1	0	1
1	1	0

AND gate

NAND gate

NOR gate

NOT gate

OR gate

(b) Circle the logic gate that outputs a logic 0 signal ONLY when both inputs are at logic 0. [1]

AND gate

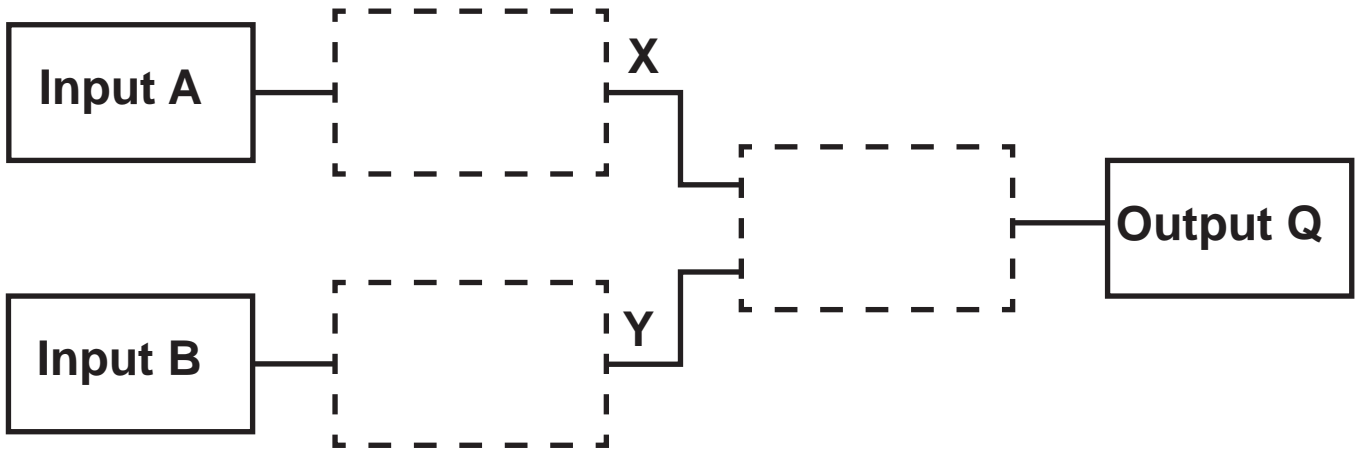
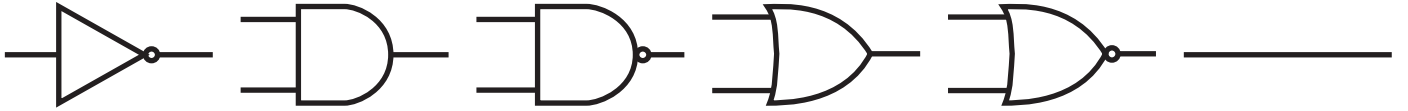
NAND gate

NOR gate

NOT gate

OR gate





11. A logic system has the following truth table.

INPUTS		OUTPUTS		
A	B	X	Y	Q
0	0	1	1	0
0	1	1	0	0
1	0	0	1	0
1	1	0	0	1

- (a) Add the correct logic gates / connections to the circuit opposite to produce the truth table given above. [2]
- (b) Circle the single logic gate that could replace the above combination. [1]

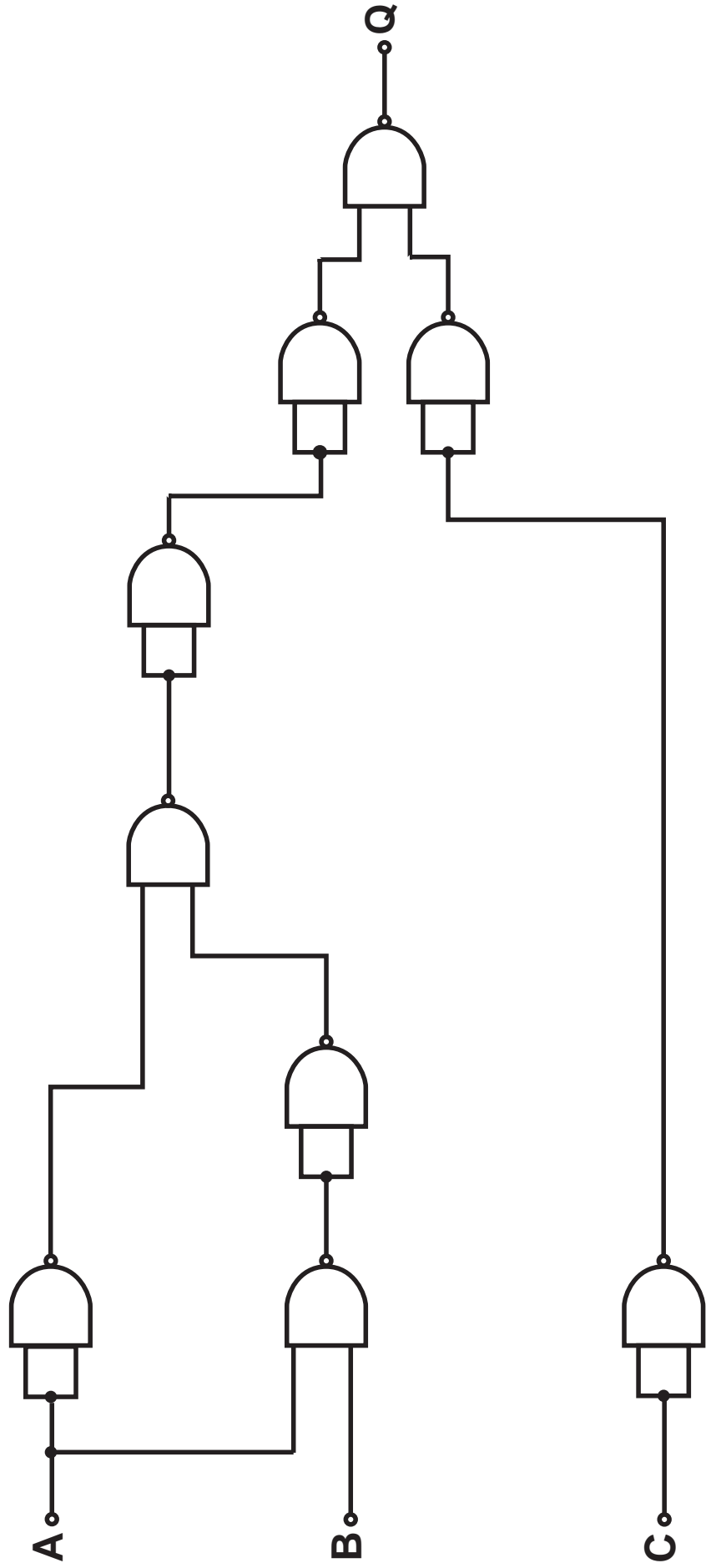
AND gate

NAND gate

NOR gate

NOT gate

OR gate



12. Some of the NAND gates in the logic circuit opposite are redundant.  
Circle all redundant NAND gates. [2]

13. The diagrams opposite show three different combinations of two resistors. Calculate the effective resistance of each combination in  $k\Omega$ . [3]



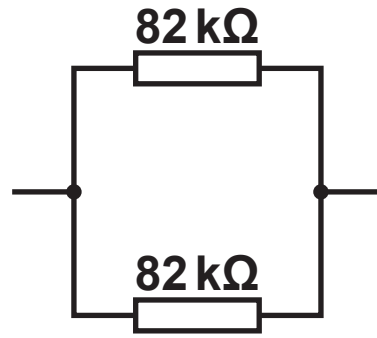
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\_\_\_\_\_  $\text{k}\Omega$



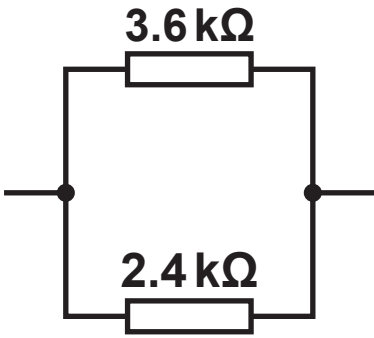
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\_\_\_\_\_  $\text{k}\Omega$



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\_\_\_\_\_  $\text{k}\Omega$

14. There are two truth tables.

Select the correct Boolean equation that represents the function described by each truth table. (Tick (✓) the correct answers.)

(a)

INPUTS		OUTPUT
A	B	Q
0	0	1
0	1	0
1	0	0
1	1	0

[1]

$Q = A.B$

$Q = \bar{A} + B$

$Q = \bar{A}.\bar{B}$

$Q = A + \bar{B}$

14(b)

INPUTS		OUTPUT
A	B	Q
0	0	0
0	1	1
1	0	1
1	1	0

[1]

$$Q = A.B + \overline{A}.B$$

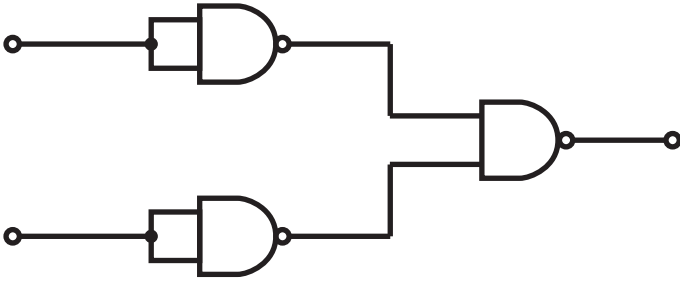
$$Q = \overline{A}.B + \overline{A}.B$$

$$Q = \overline{A}.B + A.\overline{B}$$

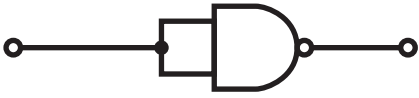
$$Q = A.\overline{B} + A.B$$



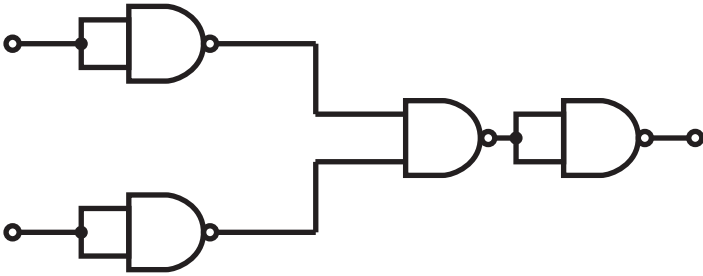
**A**



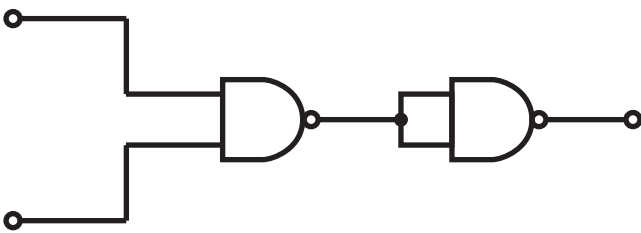
**B**



**C**



**D**

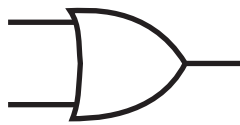


15. The opposite page shows the NAND equivalent circuits for a number of standard gates.

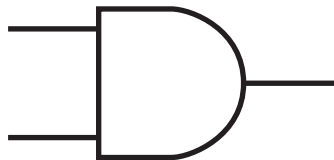
Write the letter of the NAND equivalent circuit which represents each of the standard gates below. [3]

**STANDARD GATE**

**NAND EQUIVALENT CIRCUIT**



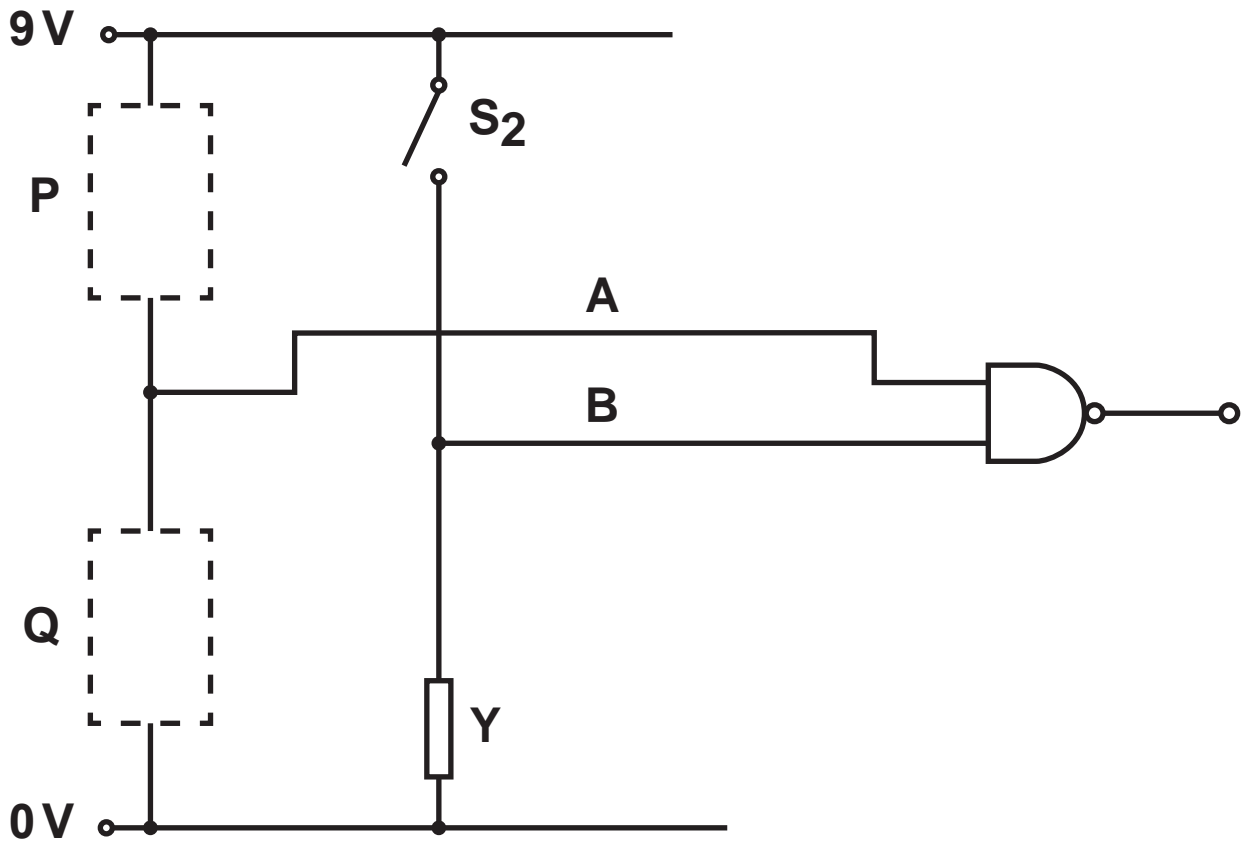
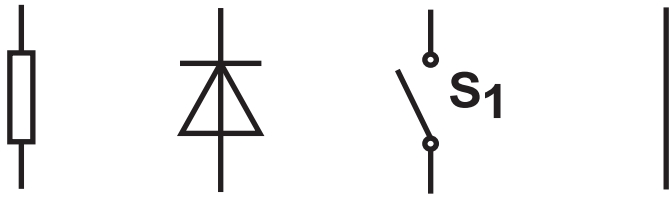
\_\_\_\_\_



\_\_\_\_\_



\_\_\_\_\_



**16. The circuit opposite is PART OF a burglar alarm.**

**(a) Input A needs to be at logic 0 when a switch is pressed.**

**Draw the components required in boxes P and Q.**

**[1]**

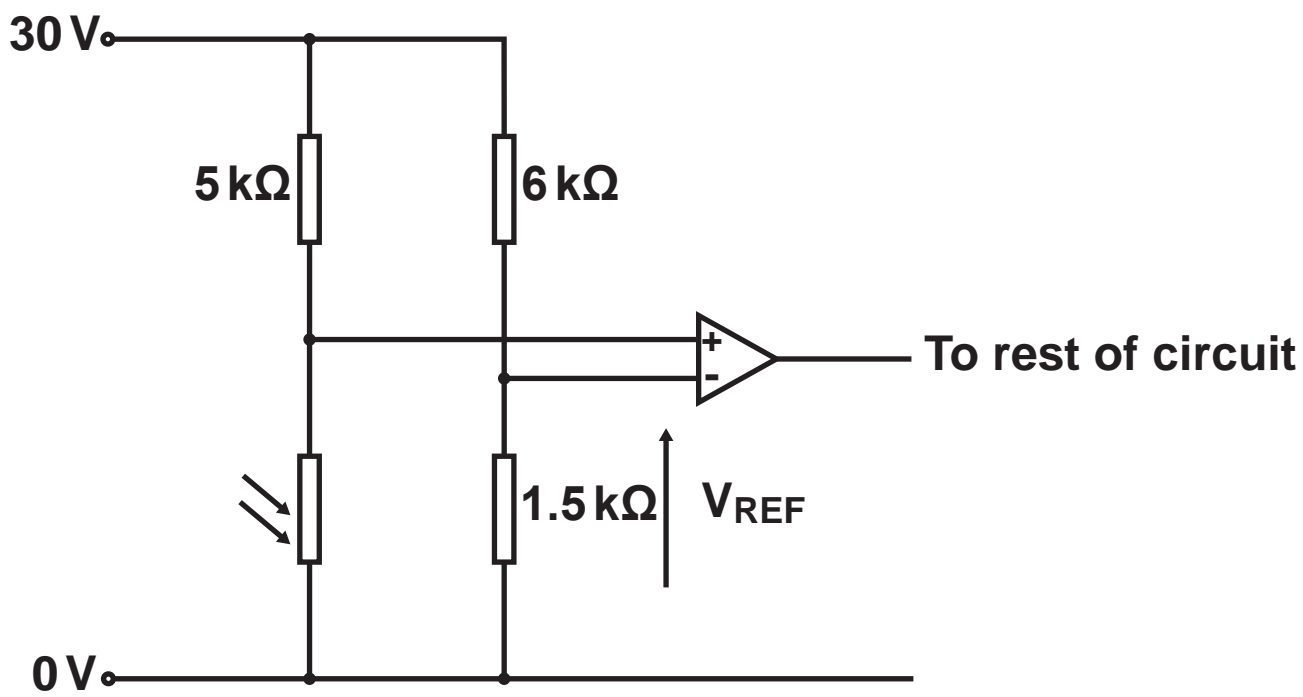
**(b) What is the purpose of the component labelled 'Y' in the circuit opposite? [1]**

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17. The INCOMPLETE circuit opposite shows a comparator used to switch on a floodlight when it gets dark.

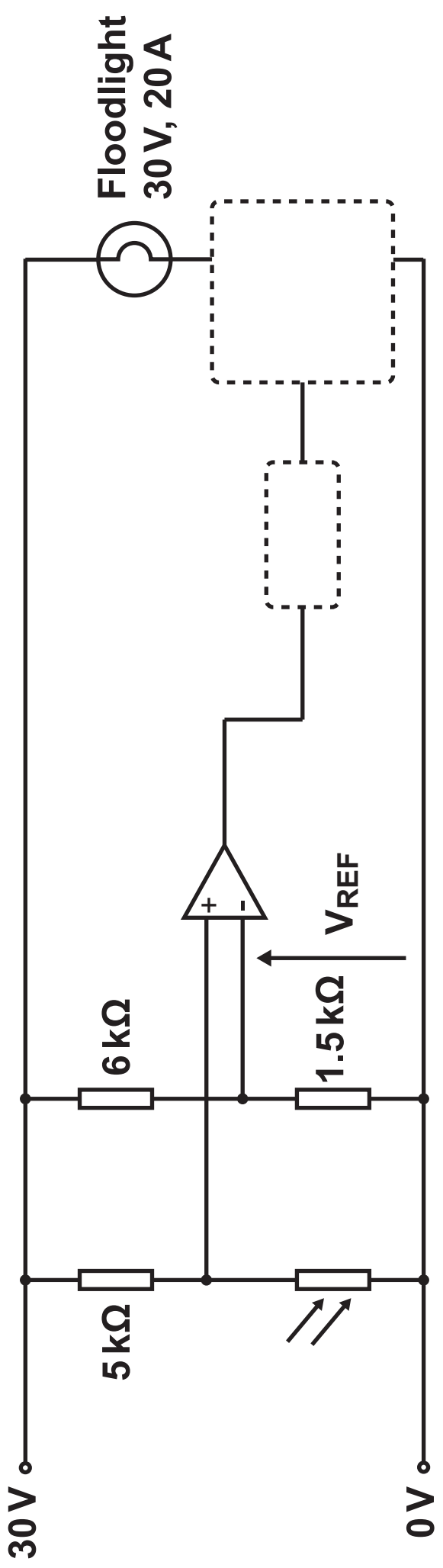
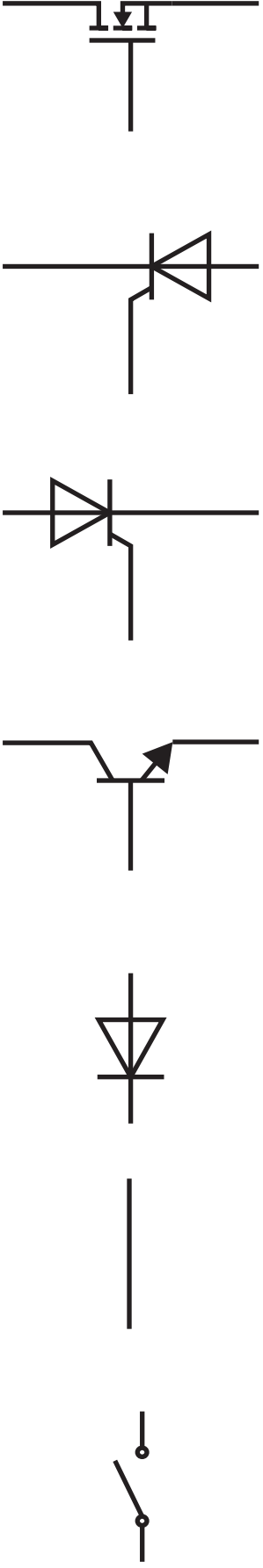
(a) Select the correct formula to calculate the voltage  $V_{REF}$ . [1]

<input type="checkbox"/>	$V_{REF} = \frac{6}{5 + 1.5} \times 30$	<input type="checkbox"/>	$V_{REF} = \frac{1.5}{6 + 1.5} \times 30$
<input type="checkbox"/>	$V_{REF} = \frac{5}{6 + 1.5} \times 30$	<input type="checkbox"/>	$V_{REF} = \frac{1.5}{1.5 + 5} \times 30$

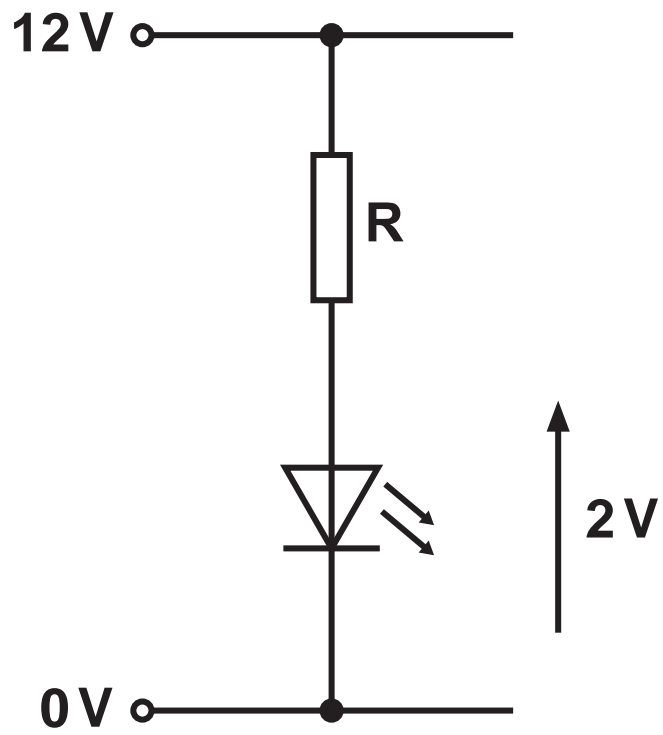
(b) Calculate the voltage  $V_{REF}$  at the inverting input. [1]

$$V_{REF} = \underline{\hspace{10cm}} \text{ V}$$

**17(c) Complete the output circuit for the comparator using the components shown opposite. [2]**







18. A LED is to be used as a power on indicator as shown opposite.

The LED requires a current of 16 mA.

(a) What is the voltage across the resistor R?

\_\_\_\_\_ V [1]

(b) Select the correct equation to calculate the ideal resistance of resistor R (in  $k\Omega$ ). [1]

$R = 12 \times 16$

$R = \frac{2}{16}$

$R = \frac{10}{16}$

$R = 10 \times 6$

$R = 12 \times 2$

$R = \frac{12}{16}$

$R = \frac{12}{2}$

$R = 10 \times 16$

18(c) Calculate the ideal resistance of resistor R. [1]

R = \_\_\_\_\_ k $\Omega$

(d) The current through the LED must be LESS than 16mA. Use the E24 resistor series on the separate insert to select the preferred value for resistor R IN OHMS. [1]

\_\_\_\_\_  $\Omega$

END OF PAPER

## INFORMATION SHEET FOR UNIT E1

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  $\pm 5\%$

SILVER  $\pm 10\%$

### 2 PREFERRED VALUES FOR RESISTORS – E24 SERIES

10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91.

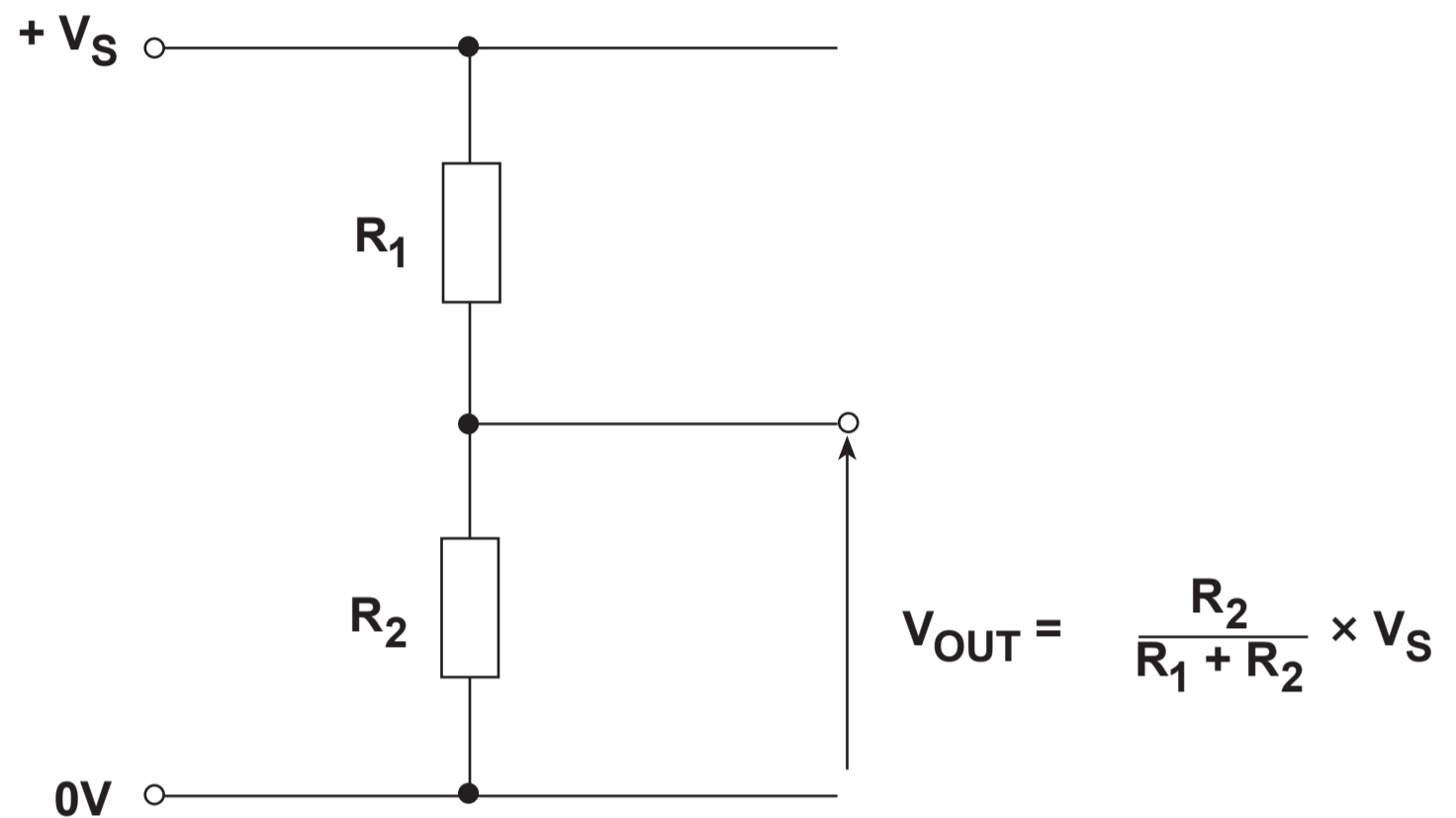
3 RESISTANCE =  $\frac{\text{voltage}}{\text{current}}$  ;  $R = \frac{V}{I}$

4 EFFECTIVE RESISTANCE, R, of two resistors  $R_1$  and  $R_2$  in series is given by  $R = R_1 + R_2$ .

5 EFFECTIVE RESISTANCE, R, of two resistors  $R_1$  and  $R_2$  in parallel is given by

$$R = \frac{R_1 R_2}{R_1 + R_2}$$

6 VOLTAGE DIVIDER



7 POWER = voltage  $\times$  current;  $P = VI = I^2 R = \frac{V^2}{R}$

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

9 NPN TRANSISTORS

(i) Current gain =  $\frac{\text{Collector current}}{\text{Base current}}$  ;  $h_{FE} = \frac{I_C}{I_B}$  .

(ii) The forward voltage drop across the base emitter junction is 0.7 V.