Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4161/01

S16-4161-01

ELECTRONICS

UNIT E1: Paper replacement test

P.M. MONDAY, 13 June 2016

1 hour

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

4161 010001

ADDITIONAL MATERIALS

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

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

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.

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 ± 5%

SILVER ± 10%

2. Preferred Values for Resistors – E24 series

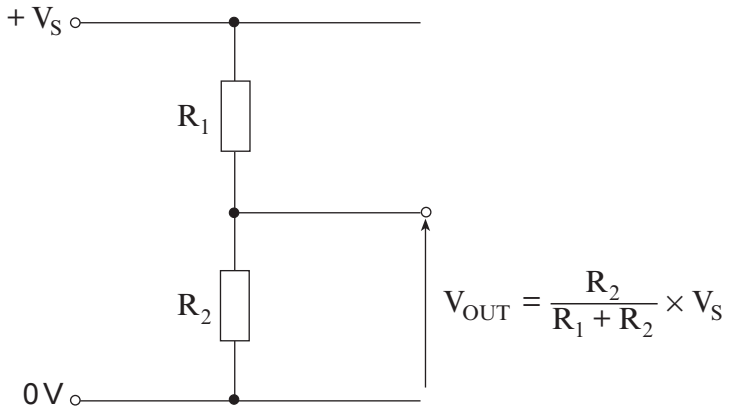
10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91.

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 × current; $P = VI = I^2R = \frac{V^2}{R}$.

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

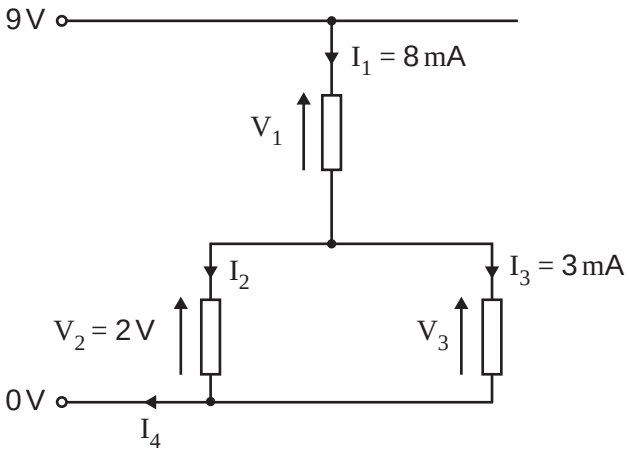
9. NPN Transistors (i) Current gain = $\frac{\text{Collector current}}{\text{Base current}}$; $h_{FE} = \frac{I_C}{I_B}$.

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

Examiner only

Answer **all** *questions.*

1. Study the following circuit.



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

(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]

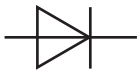
(d) What is the value of I_4? ..... mA [1]

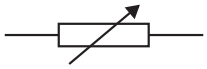
Examiner only

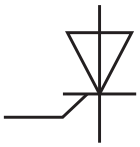
2. *(a)* Here is a list of electronic components.

Diode LED Thermistor Thyristor Transistor Variable resistor

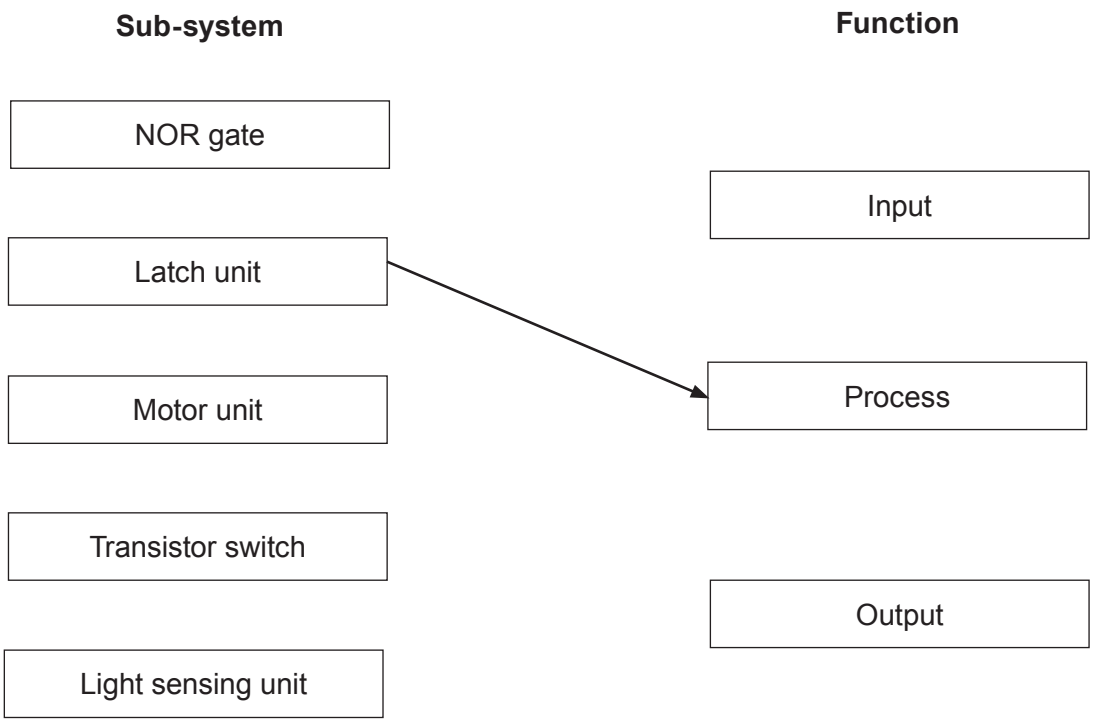
Select the correct name for **each** component. [3]





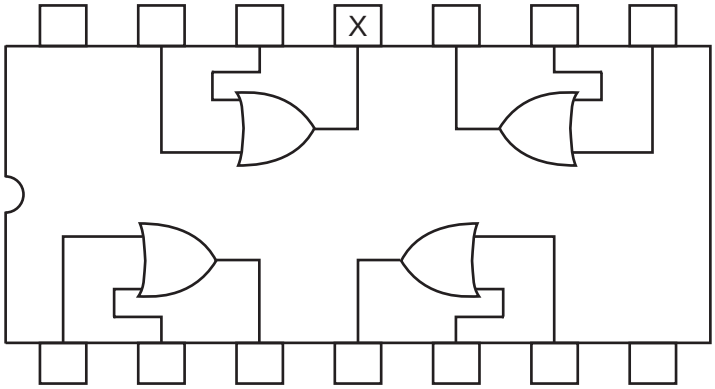


(b) Link each sub-system box on the left to the correct function box on the right. One has been done for you. [4]



Examiner only

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



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

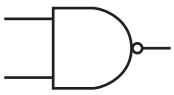
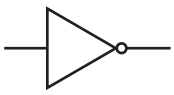
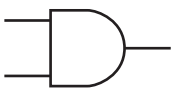
(b) Circle the type of logic gate shown in the IC. [1]

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

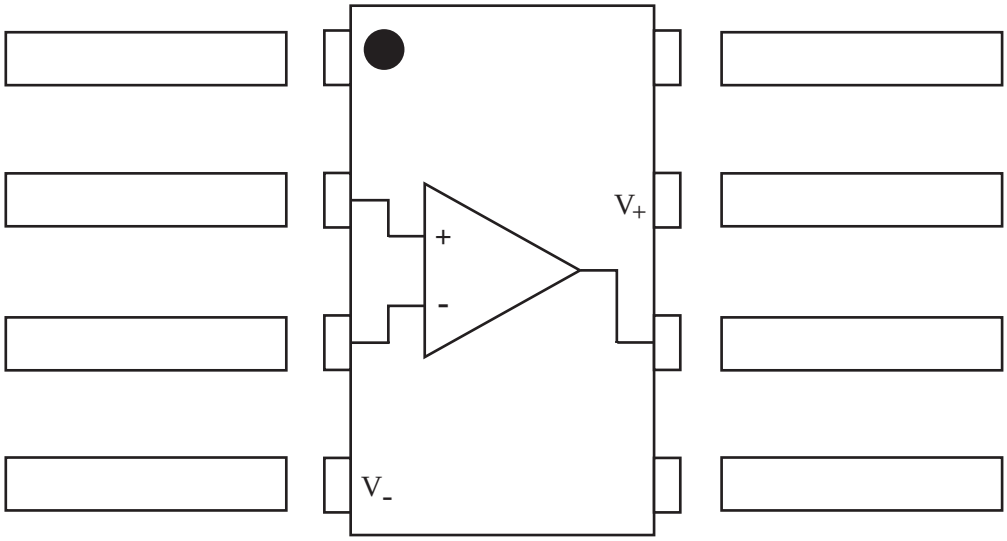




....

Turn over.

Examiner only

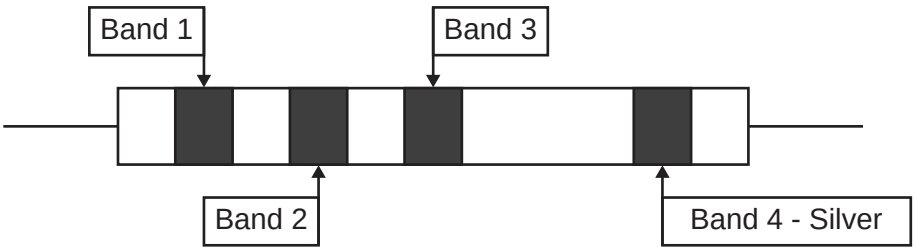
5. The following diagram shows the pinout of a comparator IC.



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

positive supply output inverting input

6. The diagram shows a 270 kΩ ± 10% resistor.

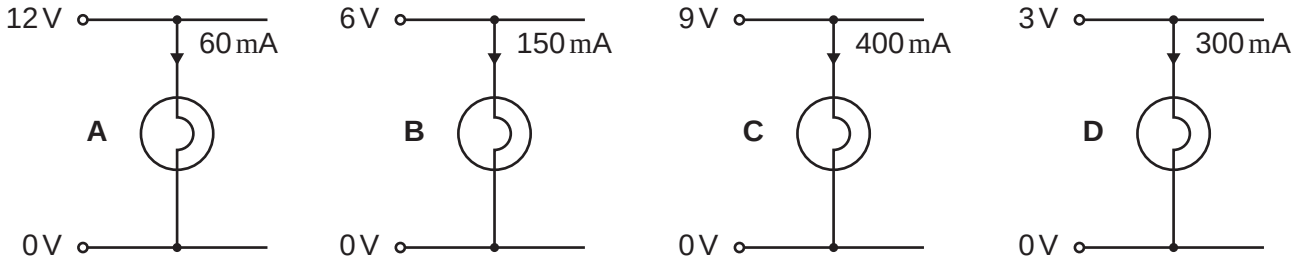


Use the information sheet on page 2 to write down the correct colours of bands 1, 2 and 3 present on this resistor. [3]

Band 1 ..... Band 2 ..... Band 3 .....

Examiner only

7. Here are four lamps.



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

☐ $P = \frac{9}{4}$ ☐ $P = \frac{40}{9}$ ☐ $P = 9 \times 400$

☐ $P = 9 \times 0.4$ ☐ $P = \frac{9}{0.4}$ ☐ $P = \frac{400}{9}$

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

Power = ... W

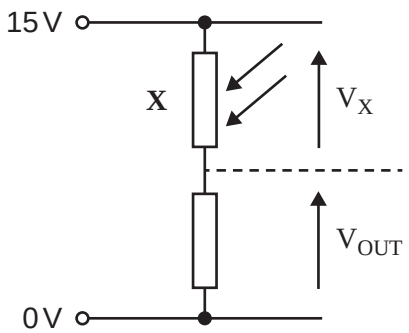
(b) Which **two** lamps use the same power? (Tick (✓) the correct answer.) [1]

☐ A & B ☐ A & C ☐ A & D

☐ B & C ☐ B & D ☐ C & D

Examiner only

8. Here is an analogue sensing circuit.



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

LDR Resistor Thermistor Variable resistor

(b) V_{OUT} = 6 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

(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]

.....

.....

.....

Examiner only

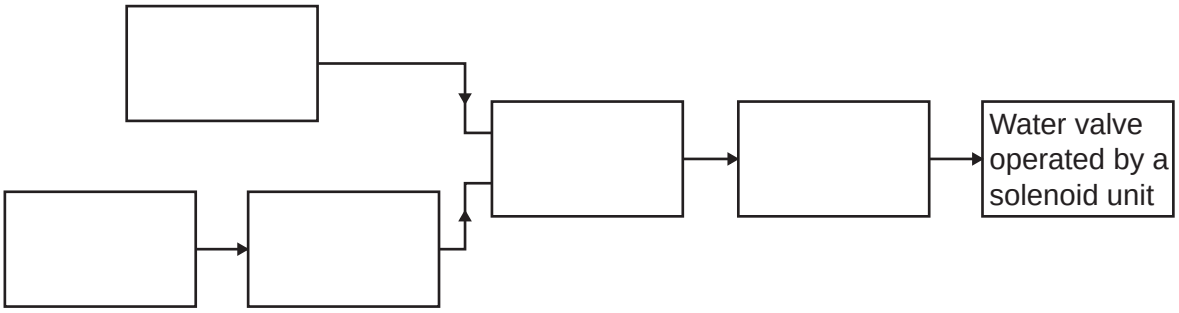
9. A garden centre requires an automatic system to water flowers in the customer display areas. The system should switch on the water only when the soil is dry and it is dark to avoid soaking any customers. It should switch off automatically when the soil is damp or it gets light.

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 to complete the block diagram 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

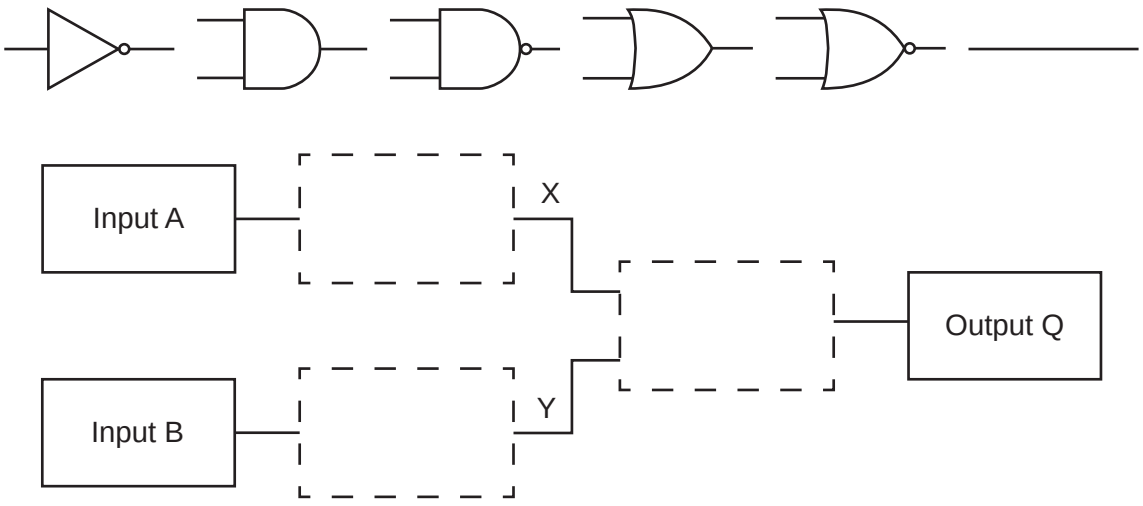
Turn over.

Examiner only

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 following circuit to produce the truth table given above. [2]

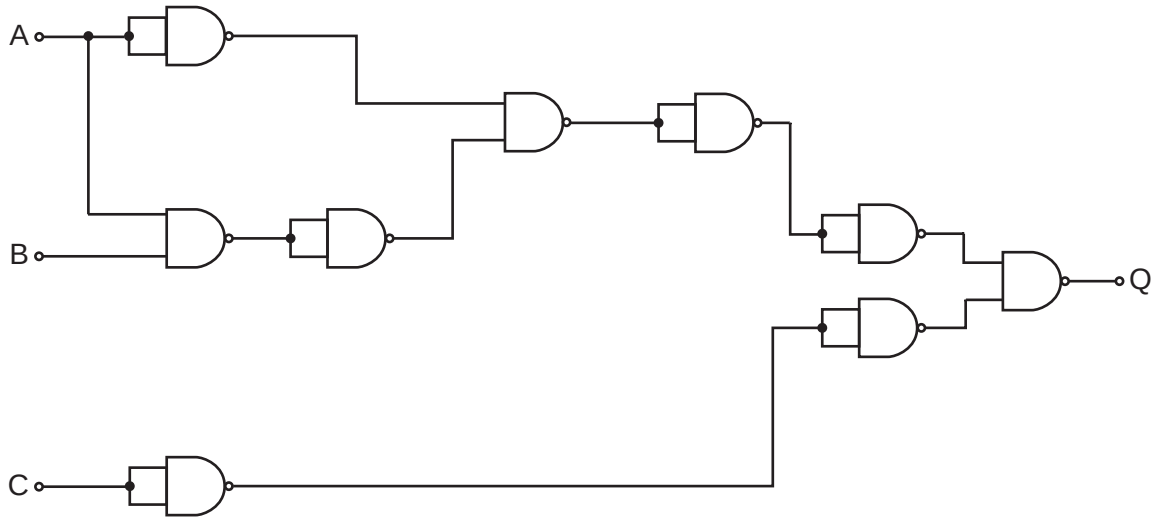


(b) Circle the single logic gate that could replace the above combination. [1]

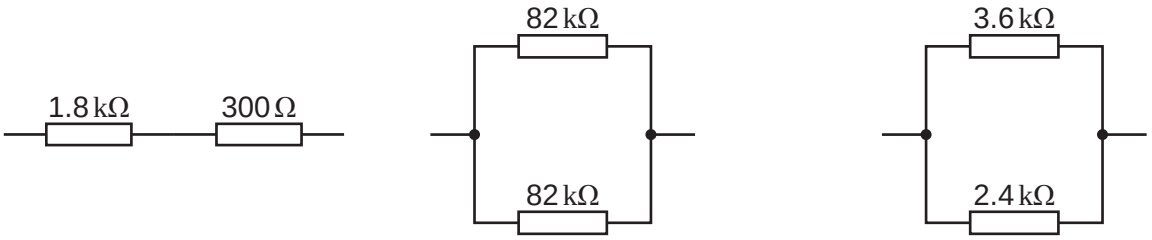
AND gate NAND gate NOR gate NOT gate OR gate

Examiner only

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



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



..... kΩ ..... kΩ ..... kΩ

Examiner only

14. Here are two truth tables.

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

(a) [1]

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

☐ **Q = A.B**

☐ **Q = $\bar{A}$ + B**

☐ **Q = $\bar{A}$.$\bar{B}$**

☐ **Q = A + $\bar{B}$**

(b) [1]

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

☐ **Q = A.B + $\overline{\bar{A}.\bar{B}}$**

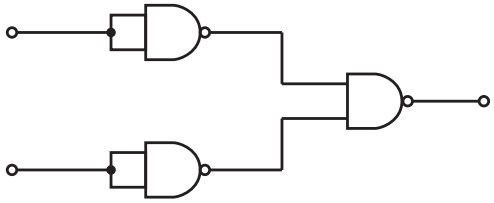
☐ **Q = $\bar{A}$.B + $\overline{\bar{A}.\bar{B}}$**

☐ **Q = $\bar{A}$.B + A.$\bar{B}$**

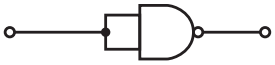
☐ **Q = A.$\bar{B}$ + A.B**

Examiner only

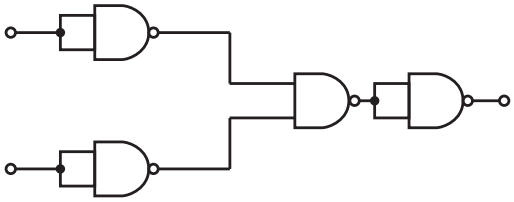
15. The following show the NAND equivalent circuits for a number of standard gates.



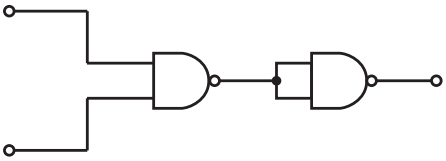
A



B

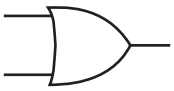
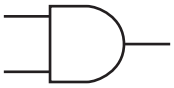
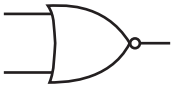


C



D

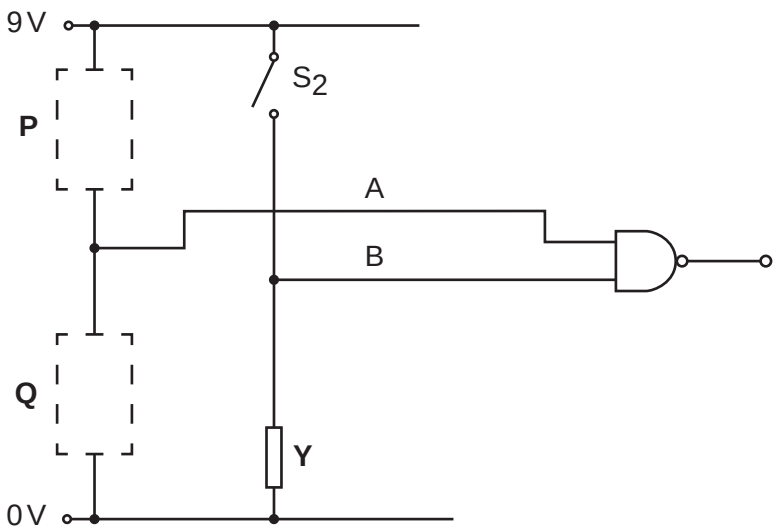
Write the letter of the NAND equivalent circuit which represents each of the standard gates below. [3]

Standard gate	NAND equivalent circuit
	.....
	.....
	.....

Examiner only

16. The following circuit 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 above? [1]

.....

.....

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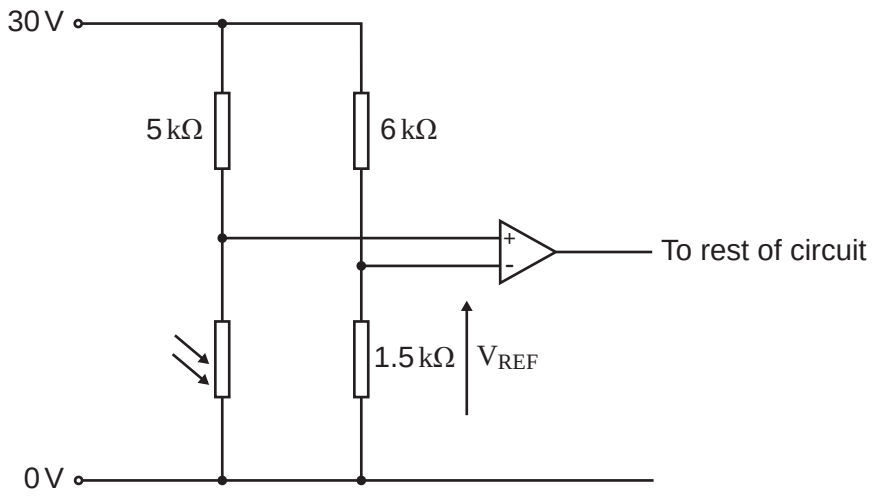
Examiner only

17. The following **incomplete** circuit 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]

☐ $V_{REF} = \frac{6}{5 + 1.5} \times 30$

☐ $V_{REF} = \frac{1.5}{6 + 1.5} \times 30$

☐ $V_{REF} = \frac{5}{6 + 1.5} \times 30$

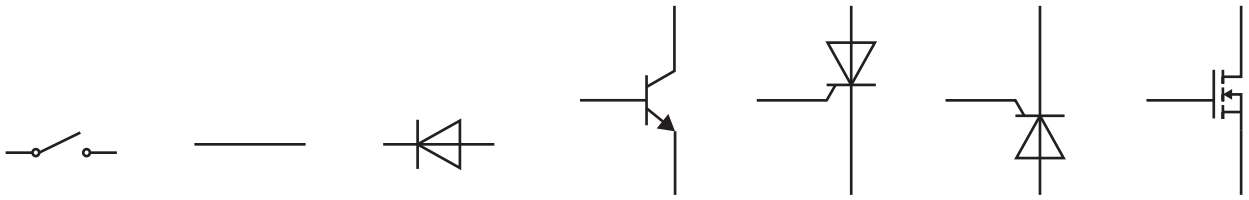
☐ $V_{REF} = \frac{1.5}{1.5 + 5} \times 30$

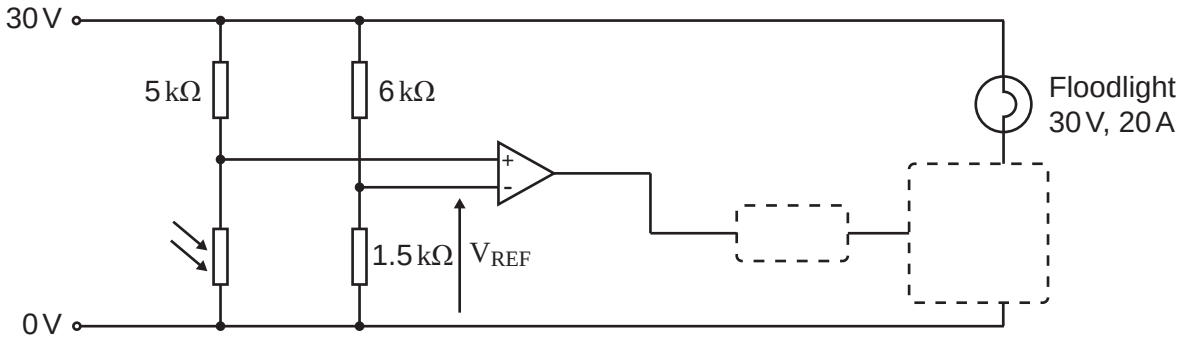
(b) Calculate the voltage V_{REF} at the inverting input. [1]

V_{REF} = ... V

Examiner only

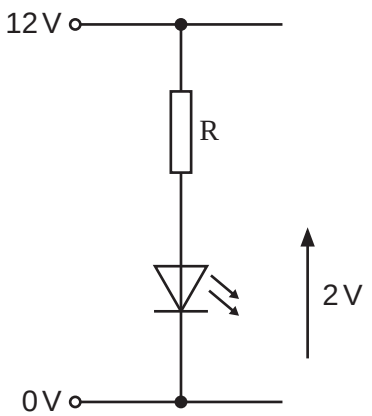
(c) Complete the output circuit for the comparator using the components shown below. [2]





Examiner only

18. A LED is to be used as a power on indicator as shown below.
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 kΩ). [1]

☐	$R = 12 \times 16$	☐	$R = \frac{2}{16}$
☐	$R = \frac{10}{16}$	☐	$R = 10 \times 6$
☐	$R = 12 \times 2$	☐	$R = \frac{12}{16}$
☐	$R = \frac{12}{2}$	☐	$R = 10 \times 16$

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

R = ... kΩ

(d) The current through the LED must be **less** than 16 mA. Use the E24 resistor series on the information sheet on page 2 to select the preferred value for resistor R **in OHMS**. [1]

..... Ω

END OF PAPER

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