Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4161/01

S18-4161-01

ELECTRONICS

UNIT E1: Paper replacement test

WEDNESDAY, 13 JUNE 2018 – AFTERNOON

1 hour

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

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ADDITIONAL MATERIALS

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

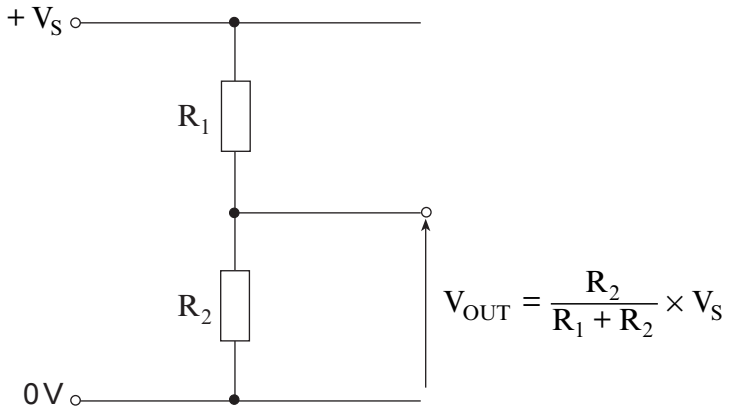
10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91.

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

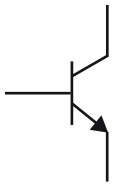
Answer **all** *questions.*

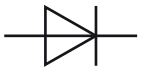
1. *(a)* Here is a list of electronic components.

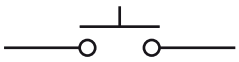
Diode LED Push-to-make switch

Thyristor Push-to-break switch Transistor

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







(b) Different electronic sub-systems are listed below.

OR gate	Transistor switch unit	Buzzer unit
Temperature sensing unit	Delay unit	Switch unit
Light sensing unit	Solenoid unit	Lamp unit

Write each subsystem into the correct column in the table below. [3]

Input sub-system	Processing sub-system	Output sub-system

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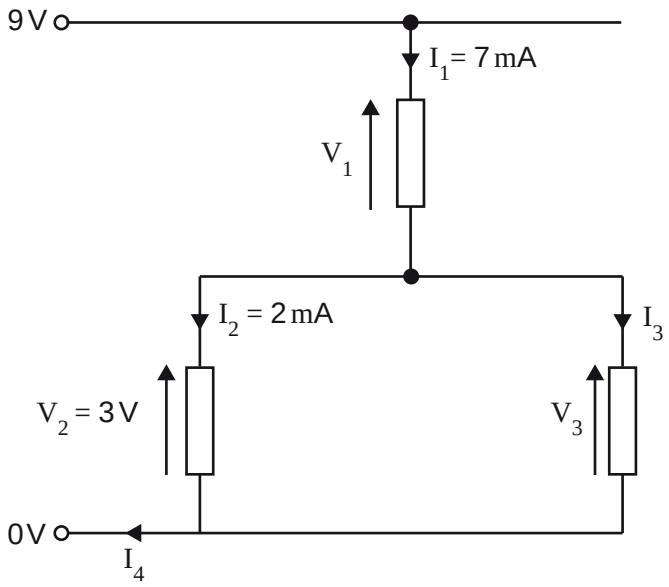
2. Study the following circuit.



Circle the correct answers to the following questions.

(a) What is the value of V_1? [1]

0 V 1 V 2 V 3 V 4 V 5 V 6 V 7 V 8 V 9 V 10 V 11 V 12 V 13 V

(b) What is the value of I_3? [1]

0 mA 1 mA 2 mA 3 mA 4 mA 5 mA 6 mA 7 mA 8 mA 9 mA 10 mA 11 mA 12 mA 13 mA

(c) What is the value of V_3? [1]

0 V 1 V 2 V 3 V 4 V 5 V 6 V 7 V 8 V 9 V 10 V 11 V 12 V 13 V

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

0 mA 1 mA 2 mA 3 mA 4 mA 5 mA 6 mA 7 mA 8 mA 9 mA 10 mA 11 mA 12 mA 13 mA

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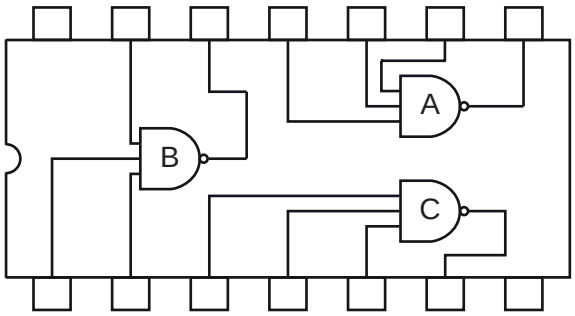
3. Here is the pinout for a logic gate IC.

(a) Number all the pins on the diagram. [1]

1 2 3 4 5 6 7 8 9 10 11 12 13 14



(b) Tick (✓) the box(es) for the input pin(s) for gate B. [1]

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

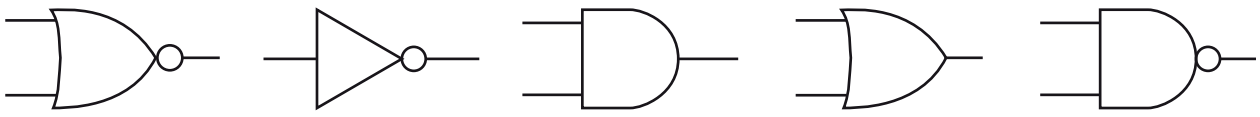
☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14

(c) Tick (✓) the box(es) for the output pin(s) for gate A. [1]

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14

4. Draw the correct logic gate to match the name in the table below. [2]



Logic gate name	Symbol
AND gate	
NOR gate	

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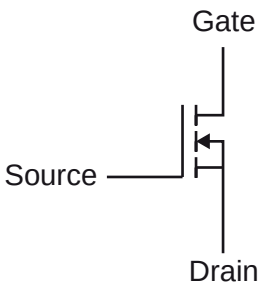
5. The following diagram shows the circuit symbol for a MOSFET.
Tick (✓) the correctly labelled symbol. [1]



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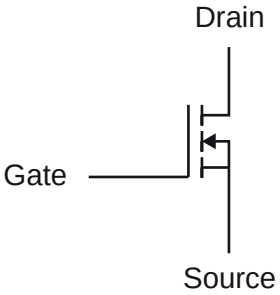

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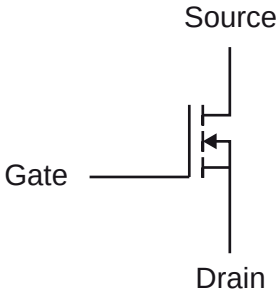
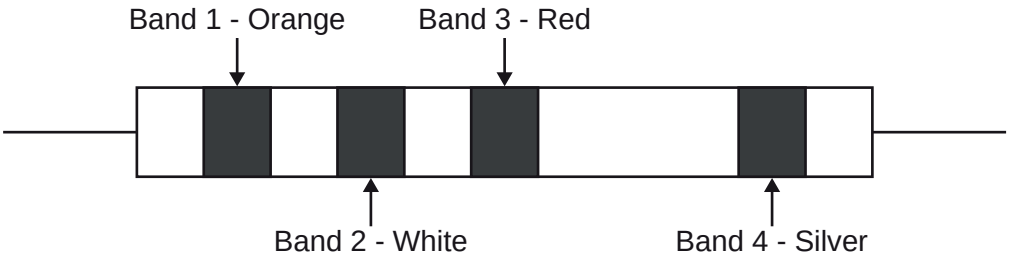


☐

6. The diagram shows a resistor from the E24 series.

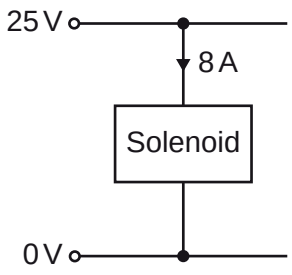


Circle the correct values for each band to show the value of this resistor in ohms. [3]

Band 1	Band 2	Band 3
0	0	No Zeros
1	1	0
2	2	00
3	3	000
4	4	0000
5	5	00000
6	6	000000
7	7	
8	8	
9	9	

Examiner only

7. The circuit shows a solenoid connected to a power supply.



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

☐	$P = \frac{8}{25}$	☐	$P = \frac{25}{8}$	☐	$P = 25 \times 8000$
☐	$P = 25 \times 8$	☐	$P = \frac{8}{2.5}$	☐	$P = \frac{25000}{8}$

(b) Calculate the power used in the solenoid. [1]

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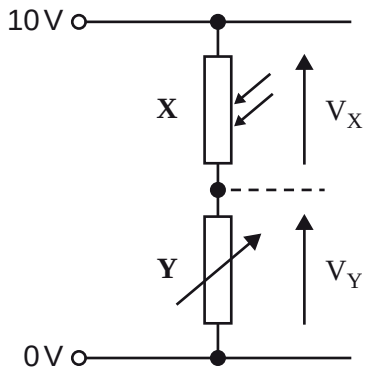
Examiner only

8. The following analogue sensing circuit is used as part of a security system.



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

LDR Resistor Thermistor Variable resistor

(b) V_Y = 2 V. Circle the correct voltage across the component **X**. [1]

0 V 1 V 2 V 3 V 4 V 5 V 6 V 7 V 8 V 9 V 10 V

(c) (i) What would happen to the value of V_Y if the resistance of component Y was increased? [1]

☐ V_Y would increase

☐ V_Y would decrease

☐ V_Y would stay the same

☐ V_Y would become 0 V

(ii) If the resistance value of component Y and the power supply voltage remain fixed, what would cause the output voltage V_Y to decrease? [1]

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Examiner only

9. A garden centre grows a number of plants from seed before making them available for sale. It is important that the soil remains moist while these seeds grow into young plants. A system is needed to monitor the condition of the soil during daylight hours. It continuously pulses a warning LED on and off when the soil is too dry.

A number of sensing sub-systems are available for use, with the following specifications:

- a light sensor that outputs a Logic 1 when in daylight and Logic 0 when it is dark
- a temperature sensor that outputs a Logic 1 when it is cold and Logic 0 when it is warm
- a moisture sensor that outputs a Logic 1 when wet and Logic 0 when dry.

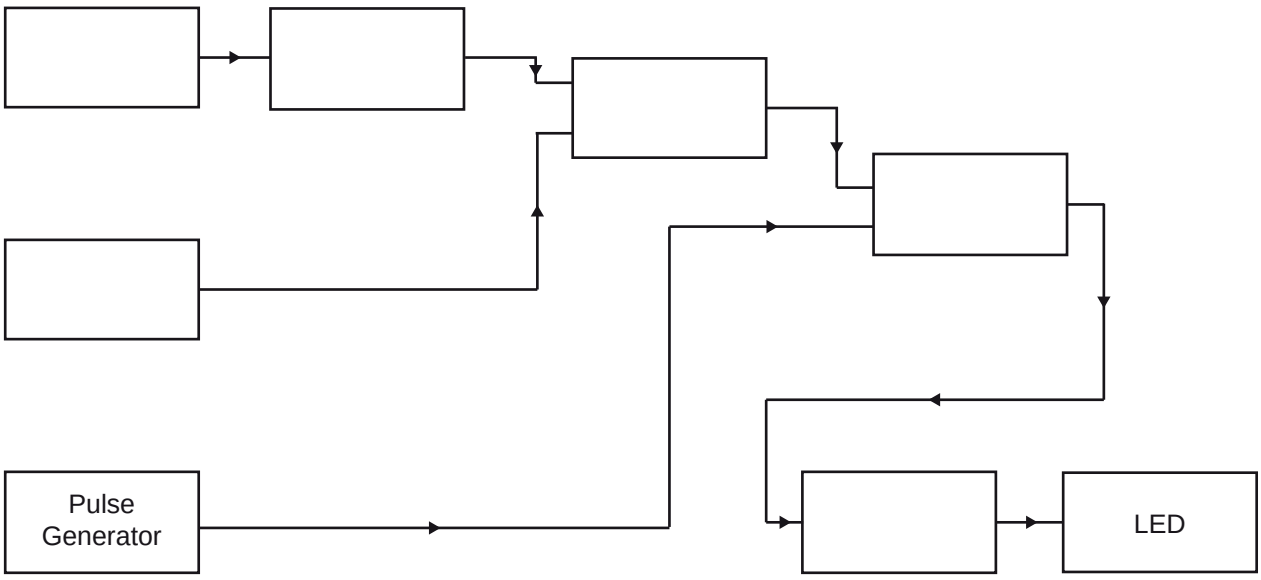
Complete the block diagram for the monitoring system.

Each sub-system may be used more than once. [6]

Thyristor **OR gate** **Delay unit** **Pressure sensing unit**

Temperature sensing unit **Moisture sensing unit** **Pulse generator**

Transistor switch unit **NOT Gate** **Light sensing unit** **AND gate**



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Examiner only

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]

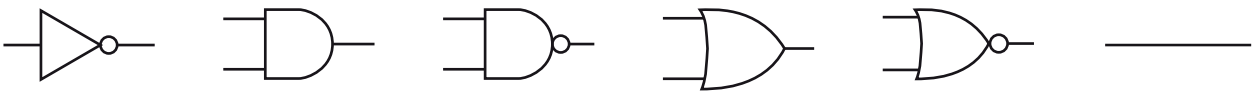
AND gate NAND gate NOR gate NOT gate OR gate

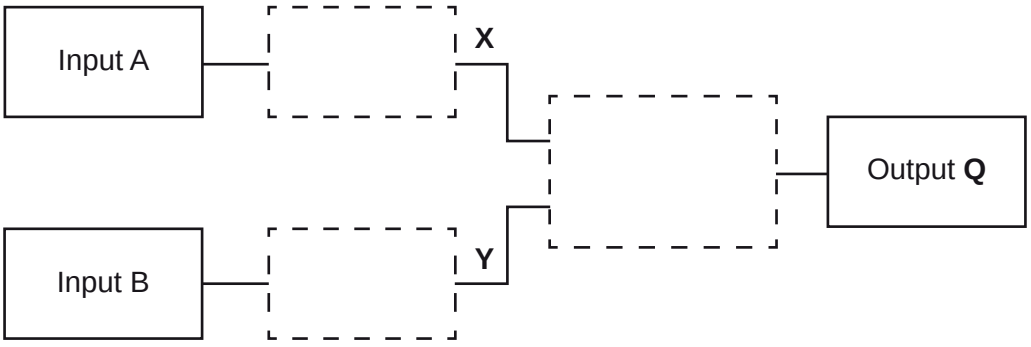
Examiner only

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) Draw the correct logic gates / connections in the following circuit to produce the truth table given above. [3]





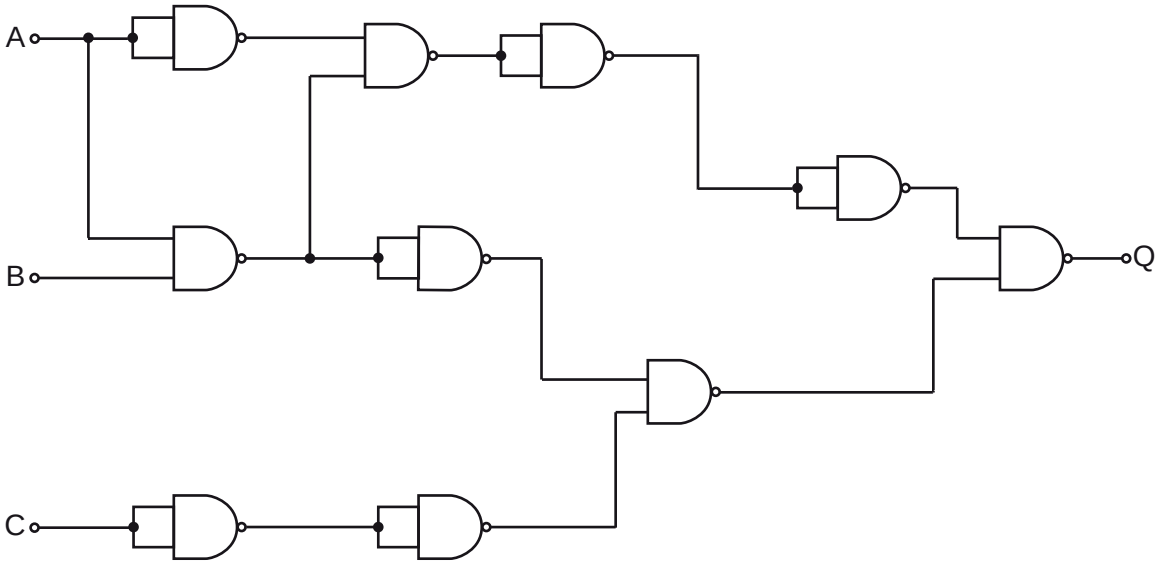
(b) Circle the single gate that can be used to replace the combination above: [1]

AND gate NAND gate NOR gate NOT gate OR gate

Examiner only

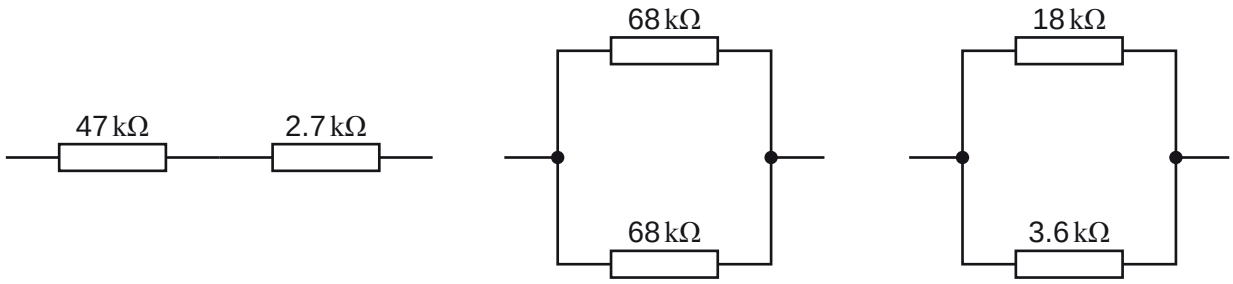
12. The logic circuit below contains some NAND gates that are redundant.

Tick (✓) all the redundant NAND gates. [2]



13. The diagrams below show three different combinations of resistors.

Calculate the effective resistance of each combination in kΩ. [3]



..... kΩ ..... kΩ ..... kΩ

Examiner only

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

(a) **Q = $\overline{A}.\overline{B}$** [1]

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

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

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

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

(b) **Q = $\overline{A.B}$** [1]

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

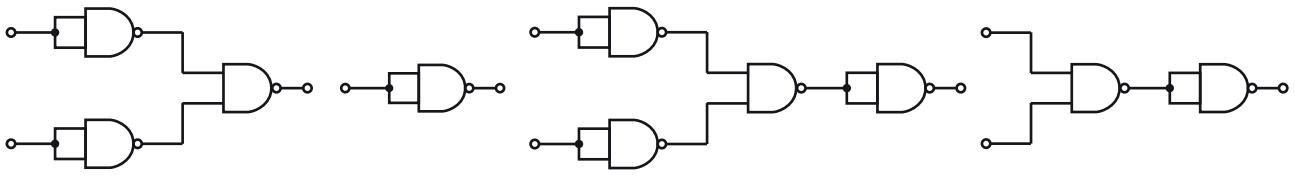
Inputs		Output
A	**B**	**Q**
0	0	1
0	1	1
1	0	1
1	1	1

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

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

Examiner only

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

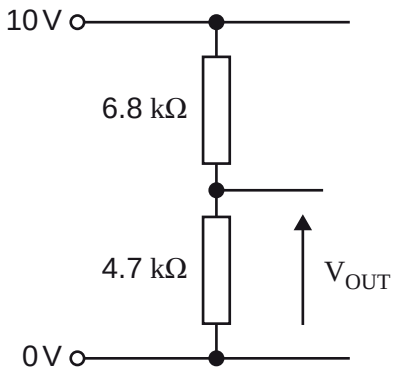


Draw the NAND equivalent circuit to match the standard gate given below. [3]

Standard gate	**NAND equivalent circuit**
NOT gate	
NOR gate	
AND gate	

Examiner only

16. *(a)* The following circuit can be used to provide a reference voltage to a comparator.



(i) Select the correct equation to calculate the voltage V_{OUT}. [1]

☐ $V_{OUT} = \frac{11.5}{6.8 + 4.7} \times 10$ ☐ $V_{OUT} = \frac{6.8}{10 + 4.7} \times 10$

☐ $V_{OUT} = \frac{4.7}{6.8 + 4.7} \times 10$ ☐ $V_{OUT} = \frac{10}{4.7} \times 11.5$

(ii) Calculate the voltage V_{OUT}. [1]

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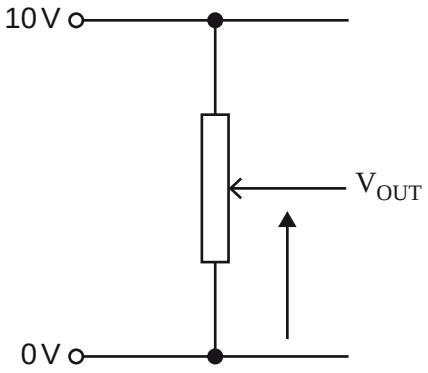
(b) The following circuit using a variable resistor can also be used to provide a reference voltage for a comparator.



Give **two** advantages of the circuit shown in *(b)* compared with the one in *(a)*. [2]

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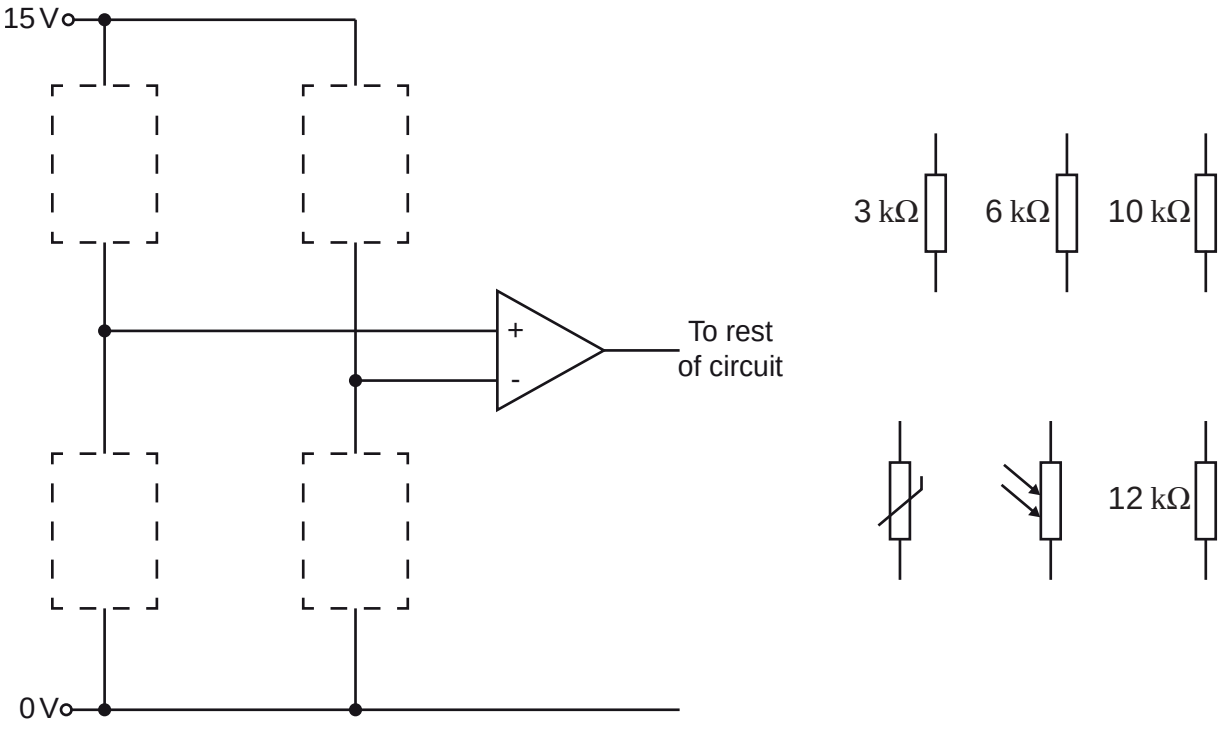
Examiner only

17. The following **incomplete** circuit diagram shows a comparator to be used to switch on a warehouse heating system when the temperature gets too cold.



(a) Draw the components necessary onto the circuit diagram to provide a voltage of 3V at the inverting input of the op-amp. [2]

(b) Draw the components necessary onto the circuit diagram to provide a rising voltage at the non-inverting input when the temperature falls. [2]

(c) How would you alter the circuit so that the temperature at which it switched on could be adjusted? [1]

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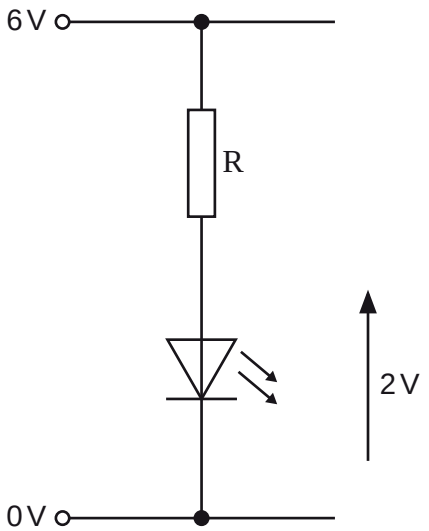
Examiner only

18. A LED is used as a power on indicator as shown below.



(a) What is the voltage drop across the resistor R? [1]

..... V

(b) Select the correct equation to calculate the ideal resistance of resistor R (in kΩ) to provide a current of 25 mA through the LED.
Tick (✓) the correct answer. [1]

☐	$R = 6 \times 25$	☐	$R = \frac{2}{25}$
☐	$R = \frac{4}{25}$	☐	$R = 4 \times 25$
☐	$R = 6 \times 2$	☐	$R = \frac{6}{25}$
☐	$R = \frac{6}{2}$	☐	$R = 6 \times 23$

(c) What is the ideal resistance of resistor R? ..... kΩ [1]

(d) Use the E24 resistor series on the information sheet to select the preferred value for resistor R **in ohms** to ensure that the current through the LED is just **less** than 25 mA. [1]

..... Ω

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