Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4161/01

ELECTRONICS

UNIT E1 – Paper replacement test

A.M. WEDNESDAY, 22 May 2013

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**3**	
2.	**3**	
3.	**3**	
4.	**3**	
5.	**2**	
6.	**4**	
7.	**3**	
8.	**3**	
9.	**4**	
10.	**3**	
11.	**3**	
12.	**4**	
13.	**2**	
14.	**1**	
15.	**2**	
16.	**4**	
17.	**2**	
18.	**1**	
19.	**5**	
20.	**5**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

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

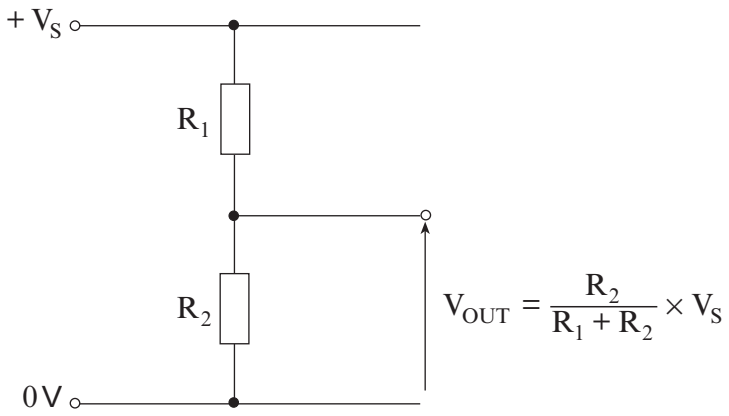
10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91.

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 $R = \frac{R_1R_2}{R_1 + R_2}$.

6. Voltage Divider



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

8. LED The forward voltage drop across an 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.

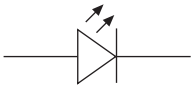
Examiner only

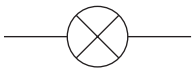
Answer **all** *questions.*

1. Here is a list of electronic output components.

buzzer *lamp* *LED* *motor* *solenoid*

Select the correct name for **each** component.





[3]

2. The following electronic sub-systems can be used to build larger systems.

AND gate *delay unit* *lamp unit* *latch unit* *pulse generator*

Select the names of the sub-systems above that answer the questions below.

(a) Which of these sub-systems is an output sub-system?

(b) Which of these sub-systems will keep an output on for a fixed period of time?

(c) Which of these sub-systems can be used to produce a flashing light?

[3]

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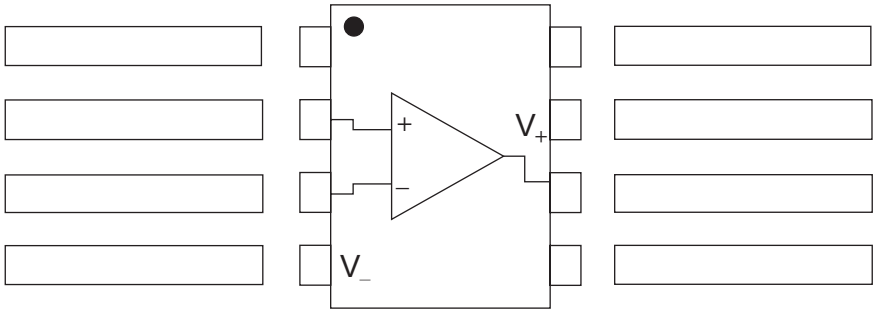
3. The following diagram shows the pinout of a comparator IC.

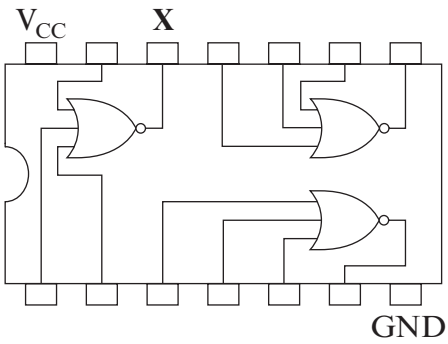


Label the pins on the comparator IC which connect to the:

positive supply negative supply non-inverting input

[3]

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



(a) What type of logic gate is contained in this IC? (**Circle** the correct answer.)

AND gate OR gate NAND gate NOR gate NOT gate [1]

(b) How many inputs does each gate have? ..... [1]

(c) What is the pin number of the terminal labelled '**X**'? ..... [1]

Examiner only

5. Choose from the following logic gates to answer both parts of this question.

AND NAND NOR NOT OR

(a) What is the logic gate that has the following truth table?

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

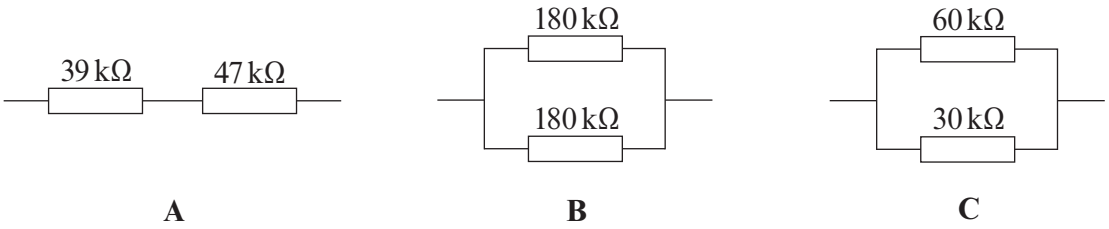
Logic gate ..... [1]

(b) Which logic gate outputs a logic 0 signal only when both inputs are at logic 0? [1]

.....

Examiner only

6. Here are some resistor networks.



A **B** **C**

(a) The resistors in networks **B** and **C** are connected in

Series Parallel

(**Circle** the correct answer.) [1]

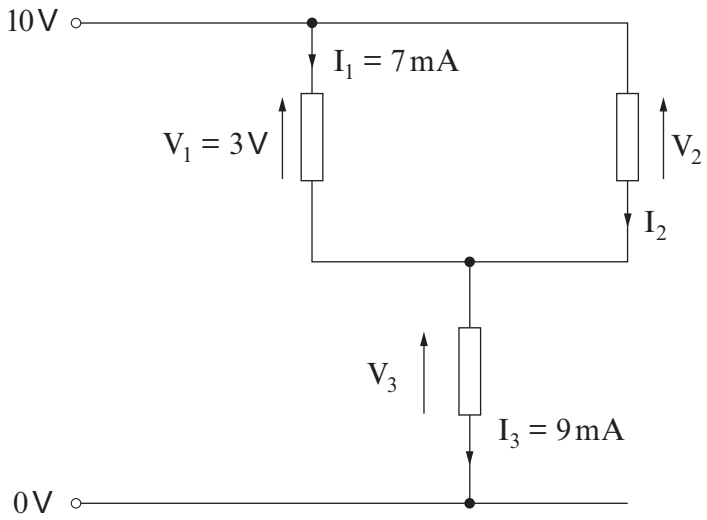
(b) Which network **A**, **B** or **C** has the lowest total resistance? ..... [1]

(c) What is the total resistance of network **A**? ..... kΩ [1]

(d) What is the total resistance of network **C**? ..... kΩ [1]

Examiner only

7. Study the following circuit containing three resistors.



(a) What is the value of V_2 in volts? (**Circle** the correct answer.) [1]

0 1 2 3 4 5 6 7 8 9 10

(b) What is the value of V_3 in volts? (**Circle** the correct answer.) [1]

0 1 2 3 4 5 6 7 8 9 10

(c) What is the value of I_2 in mA? (**Circle** the correct answer.) [1]

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

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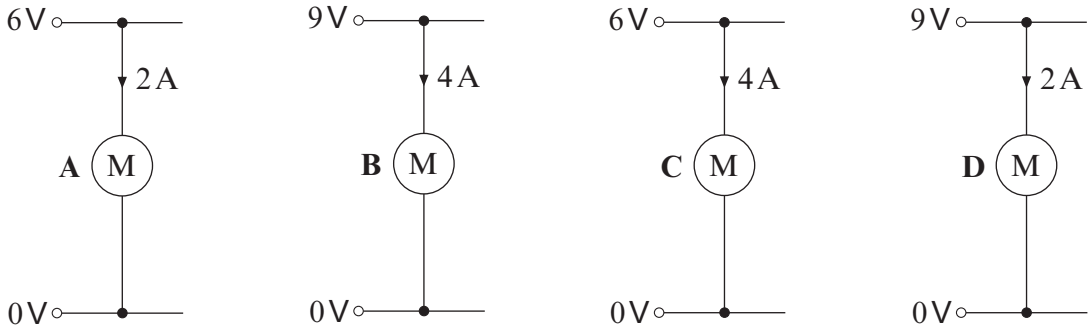
8. Here are four motors.



(a) Which motor is using the least power? ..... [1]

(b) (i) Tick (✓) the correct equation to calculate the power of Motor **B.** [1]

☐ $\mathbf{P} = 9 + 4$ ☐ $\mathbf{P} = \frac{9}{4}$ ☐ $\mathbf{P} = 9 \times 4$

☐ $\mathbf{P} = 9 - 4$ ☐ $\mathbf{P} = 4 + 9$ ☐ $\mathbf{P} = \frac{4}{9}$

(ii) Calculate the power of Motor **B**. [1]

Power = ... W

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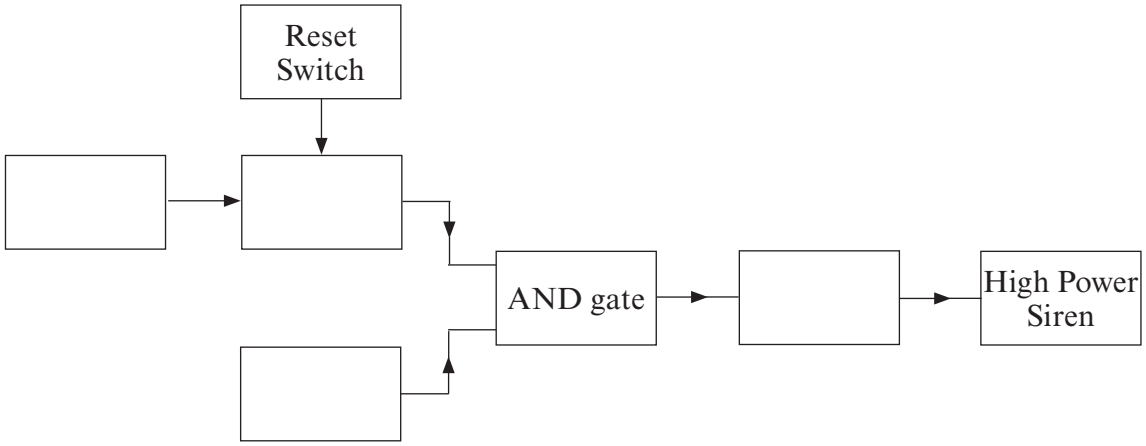
9. A shopkeeper wants to install a burglar alarm in his shop to protect his business. The alarm should provide a pulsed output, and once activated the alarm must remain on until reset manually.

Delay Unit ***Latch Unit*** ***Magnetic Switch Unit*** ***MOSFET***

OR Gate ***Pulse Generator*** ***Thyristor***

Complete the block diagram for the alarm system.



[4]

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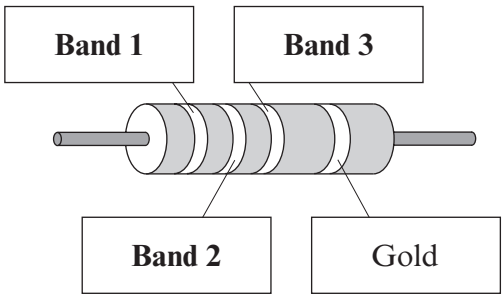
10. The diagram shows a resistor.



The resistor has a value of 91 Ω, ± 5%.

Use the information sheet to write down the correct colour for bands 1, 2 and 3 present on this resistor.

Band 1 **Band 2** **Band 3**

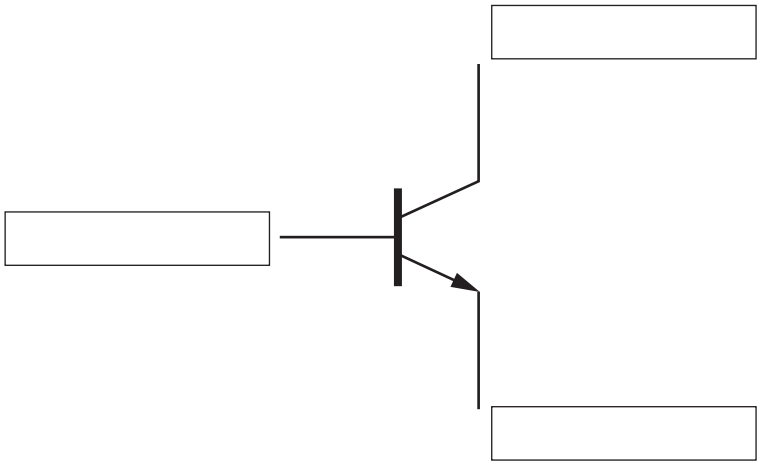
....

[3]

Examiner only

11. Here are some labels:

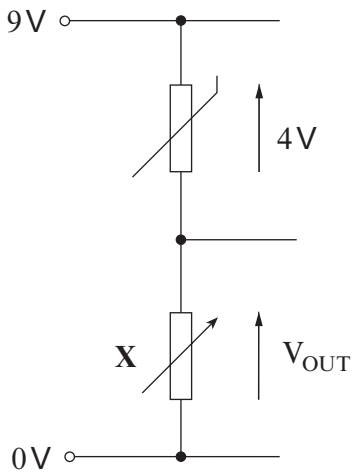
Base	Collector	Drain	Source	Emitter	Gate



Use the labels to complete the diagram of a transistor. [3]

Examiner only

12. Here is the circuit diagram for a temperature sensing unit.



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

Resistor Variable resistor LDR Thermistor [1]

(b) What is the value of V_{OUT}? ..... V [1]

(c) (i) What happens to the resistance of the thermistor as the temperature increases? (Tick (✓) the correct answer.)

- ☐ It increases
- ☐ It is not affected by temperature
- ☐ It stays the same
- ☐ It decreases

[1]

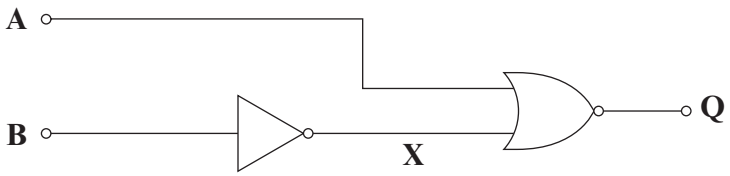
(ii) What happens to the value of V_{OUT} when the temperature increases? (Tick (✓) the correct answer.)

- ☐ It increases
- ☐ It stays the same
- ☐ It decreases
- ☐ It depends on how good the power supply is

[1]

Examiner only

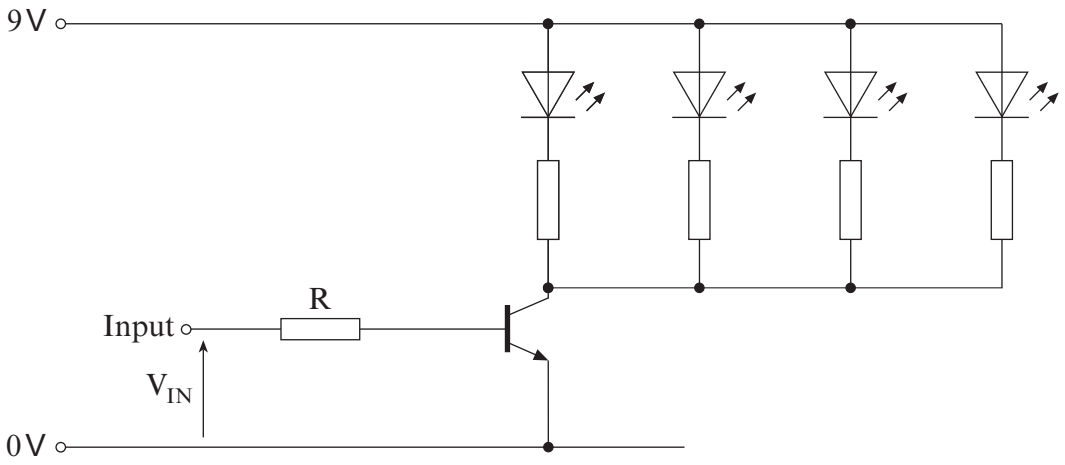
13. Complete the truth table for the following logic system.



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

[2]

14. The circuit diagram shows part of a system used to switch on an array of LEDs.



Complete the table with the word '**ON**' or '**OFF**' to show what happens to the LEDs for each value of V_{IN}.

V_{IN}	LEDs **ON/OFF?**
0·4V	
2·5V	

[1]

Examiner only

15. *(a)* **Circle** the correct Boolean Equation that represents an OR gate.

A.B **A + B** $\overline{\mathbf{A}}$**.B** **A.**$\overline{\mathbf{B}}$ [1]

(b) Select the correct Boolean Equation that represents the function described by the truth table. (Tick (✓) the correct answer.)

Input A	Input B	Output Q
0	0	0
0	1	0
1	0	1
1	1	0

☐ **Q** = **A** AND **B**

☐ **Q** = **A** OR **B**

☐ **Q** = NOT **A** AND **B**

☐ **Q** = **A** AND NOT **B**

[1]

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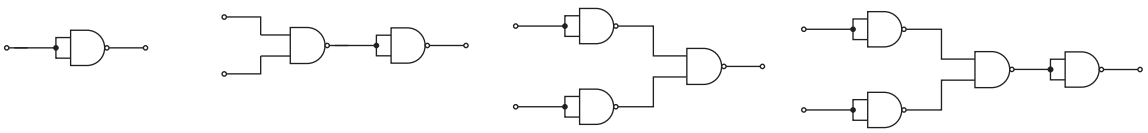
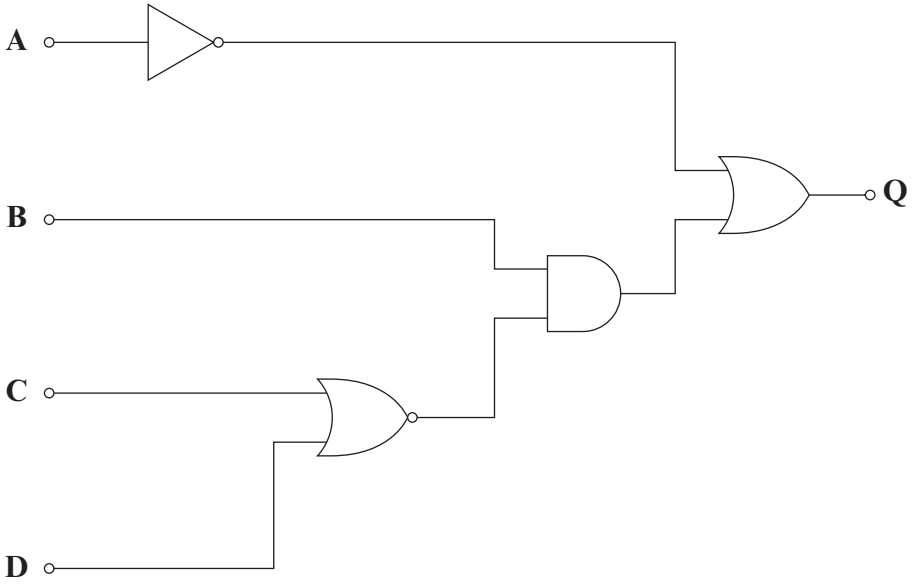
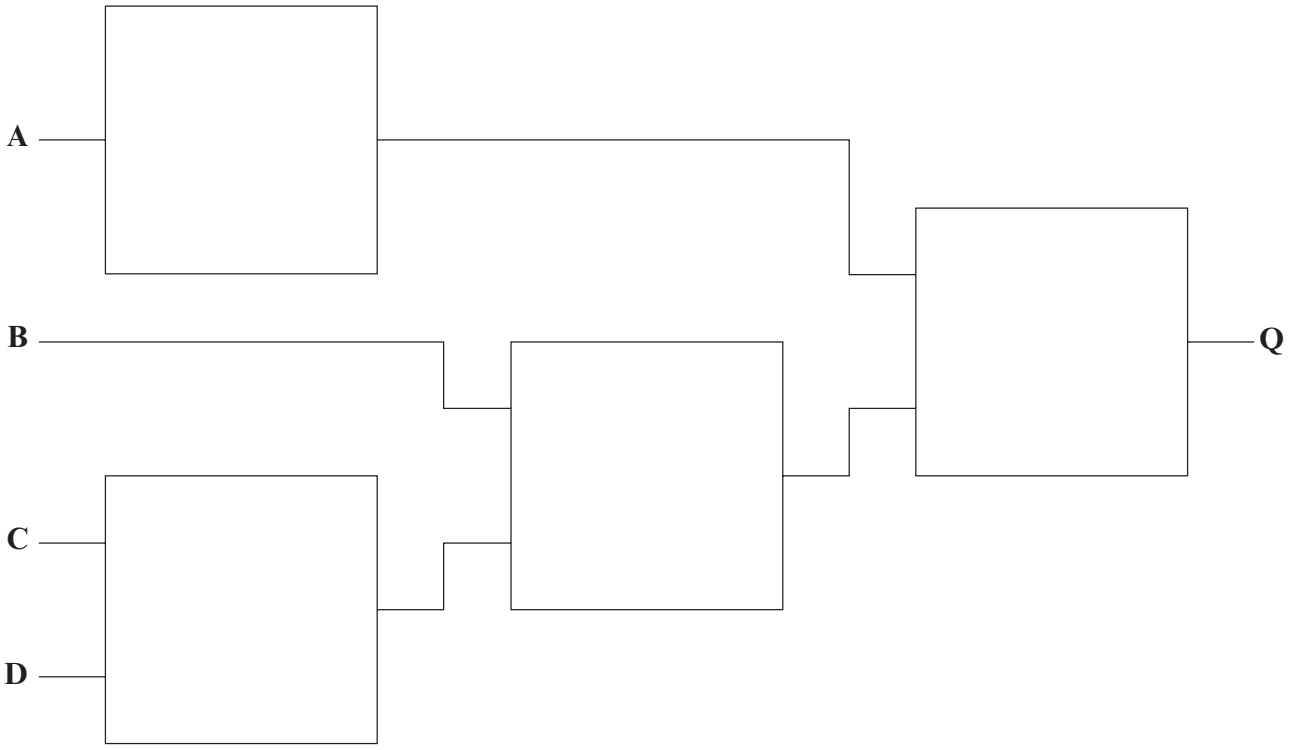
16. The following show the NAND equivalent circuits of a number of standard gates.





The circuit above is constructed from standard logic gates.
Complete the circuit below to show how the same circuit can be made using NAND gates only.



[4]

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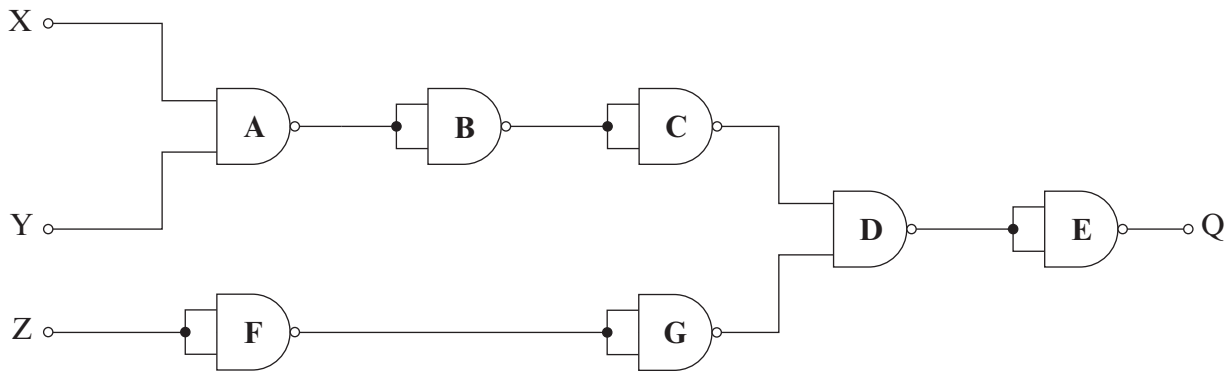
17. Look at the following circuit.

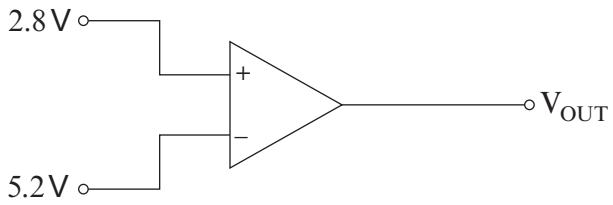


Which of the following pairs of gates are redundant? (Tick (✓) the correct answers.)

☐ **A & B**	☐ **B & C**	☐ **C & D**	☐ **D & E**
☐ **A & F**	☐ **F & G**	☐ **C & G**	☐ **G & D**

[2]

18. The following diagram shows a comparator. The output V_{OUT} of the comparator saturates at 0 V and 9.0 V.



The output of the comparator is: (Tick (✓) the correct answer.)

☐ 0 V

☐ 2.8 V

☐ 3.4 V

☐ 5.2 V

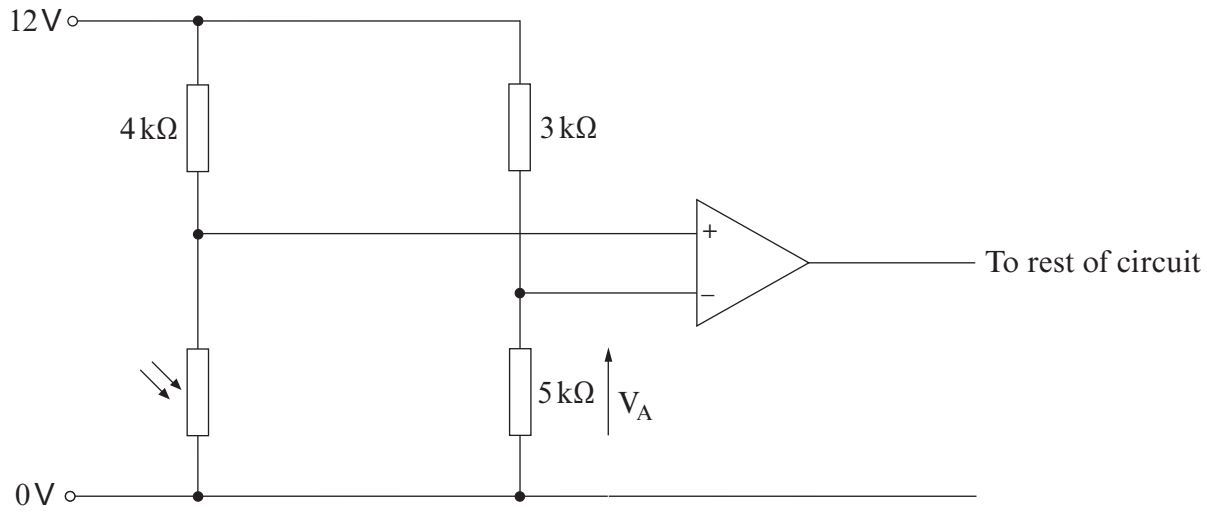
☐ 8.0 V

☐ 9.0 V

[1]

Examiner only

19. The following **incomplete** circuit shows a comparator used to switch on a floodlight when it gets dark.



(a) (i) Which of the following is the correct formula to calculate the voltage V_A? (Tick (✓) the correct answer.) [1]

☐ $V_A = \frac{3}{3+5} \times 12$ ☐ $V_A = \frac{4}{3+5} \times 12$

☐ $V_A = \frac{5}{3+5} \times 12$ ☐ $V_A = \frac{5}{3+4} \times 12$

(ii) Calculate the voltage V_A at the inverting input of the comparator.

V_A = ... V
[1]

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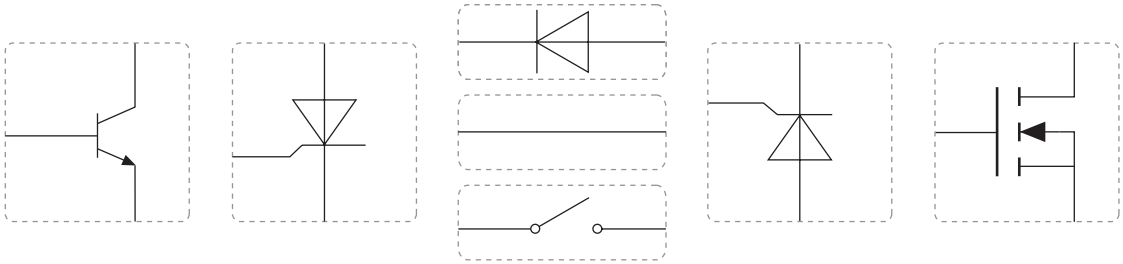
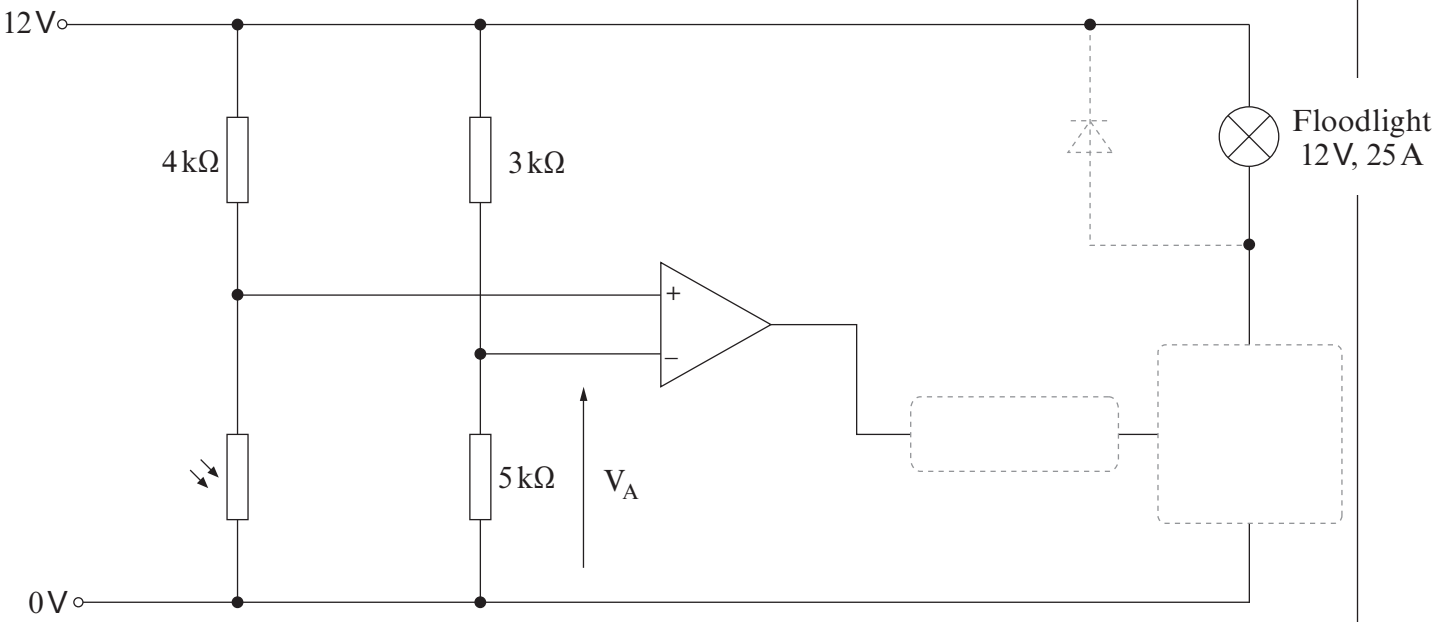
(b) The following **incomplete** circuit shows a comparator used to switch on a floodlight when it gets dark.

When the light level gets too dark the floodlight comes on, and then switches off automatically when it gets light.

(i) Complete the output circuit using the components shown below.





[2]

(ii) A diode is shown 'dotted' around the floodlight. The diode is **not** required in this circuit. Give a reason why. [1]

.....

.....

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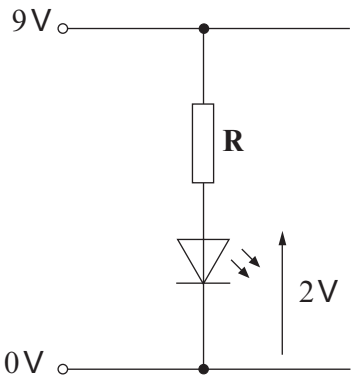
20. An LED is to be used as a power-on indicator as shown below.
The LED requires a current of 14 mA.



(a) What is the current through resistor **R** when the LED is lit? ..... mA [1]

(b) What is the voltage drop across the resistor **R** when the LED is lit? ..... V [1]

(c) (i) Select the correct formula to calculate the ideal resistance of resistor **R** (in kΩ). (Tick (✓) the correct answer.)

☐ $\mathbf{R} = 2 \times 14$ ☐ $\mathbf{R} = \frac{2}{14}$

☐ $\mathbf{R} = \frac{7}{14}$ ☐ $\mathbf{R} = 7 \times 14$

☐ $\mathbf{R} = 9 \times 2$ ☐ $\mathbf{R} = \frac{9}{14}$

☐ $\mathbf{R} = \frac{9}{2}$ ☐ $\mathbf{R} = 9 \times 14$

[1]

(ii) 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** to ensure that the current through the LED is no more than 14 mA. [1]

..... kΩ

END OF PAPER

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