WJEC CBAC

GCSE

4161/01

ELECTRONICS
UNIT E1 - Paper replacement test

A.M. MONDAY, 11 June 2012

1 hour

ADDITIONAL MATERIALS

In addition to this examination paper you may need 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** the 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%
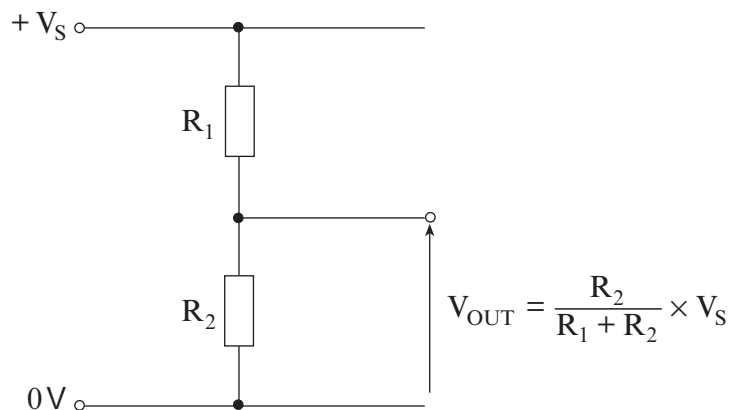
2. Preferred Values for Resistors – E24 series

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 = $\dfrac{\text{voltage}}{\text{current}}$; $R = \dfrac{V}{I}$.

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 $R = \dfrac{R_1 R_2}{R_1 + R_2}$.

6. Voltage Divider

$$V_{OUT} = \dfrac{R_2}{R_1 + R_2} \times V_S$$

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

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

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

(ii)   The forward voltage drop across the base emitter junction is 0·7 V.

Answer **all** *questions.*

1. Here is a list of electronic components.

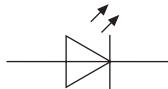microphone   LED   variable resistor   LDR

Label each symbol with the correct component name.

[3]

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

lamp unit   pressure pad   delay unit   latch unit

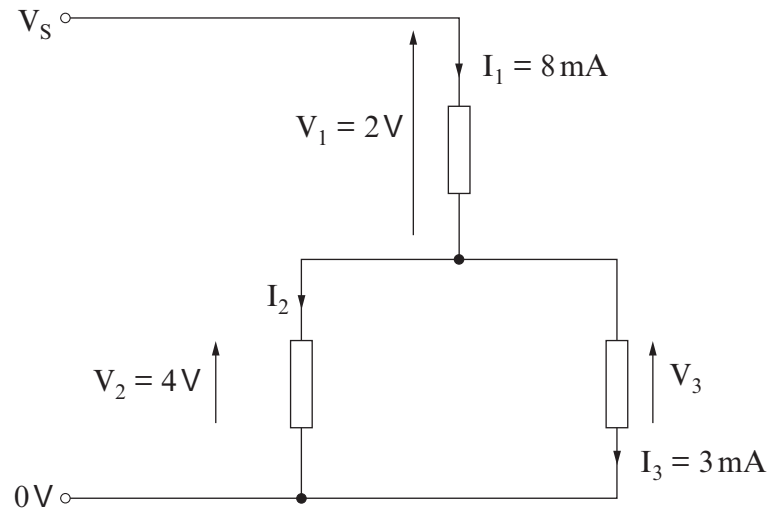Write the names of the sub-systems in the boxes that answer the questions below.

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

(b) Which of these sub-systems can keep an output on until reset manually?

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

[3]

Turn over.

3. Study the following circuit containing three resistors.

Circle the correct answers to the following questions.

(a) What is the value of I_2, in mA?

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

(b) What is the value of V_3, in volts?

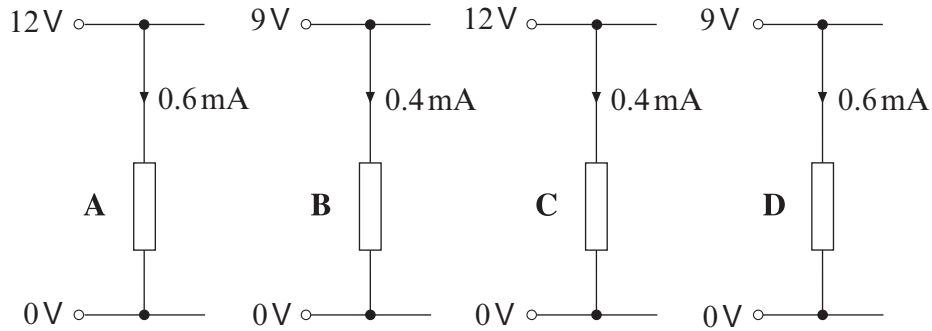   0   1   2   3   4   5   6   7   8   9   10   11

(c) What is the value of V_S, in volts?

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

[3]

4. Here are four resistors.

(a) Which resistor is using the most power, **A**, **B**, **C** or **D**? .... [1]

(b) (i) Circle the correct equation to calculate the power in mW for resistor **C**.

$$P = 12 \times 0.6 \qquad\qquad P = \frac{12}{0.6}$$

$$P = \frac{9}{0.6} \qquad\qquad P = 9 \times 0.4$$

$$P = 9 \times 0.6 \qquad\qquad P = \frac{12}{0.4}$$

$$P = \frac{9}{0.4} \qquad\qquad P = 12 \times 0.4$$

[1]

(ii) Calculate the power in mW for resistor **C**.

....

....

[1]

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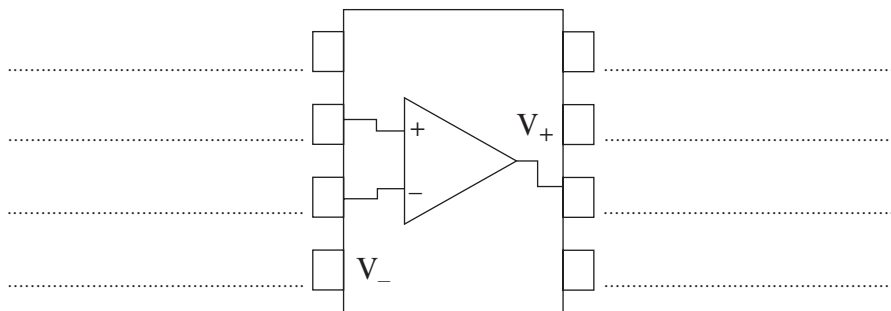
Label the following pins on the comparator IC.

positive supply   output   inverting input

[3]

Turn over.

6. A gardener wants an automatic system to water tomatoes in the greenhouse. The system should switch on the water only when the soil is dry in the daytime and switch off automatically.

|			
Thyristor	*OR gate*	*Pulse Generator*	*Temperature Sensing Unit*
Switch Unit	*MOSFET*	*Light Sensing Unit*	*AND gate*

- The Light Sensing Unit gives out a logic 1 when it is light.
- The Moisture Sensing Unit gives out a logic 1 when it is dry.
- The Temperature Sensing Unit gives out a logic 1 when it is hot.

Use sub-systems from this list to complete the block diagram for the watering system.
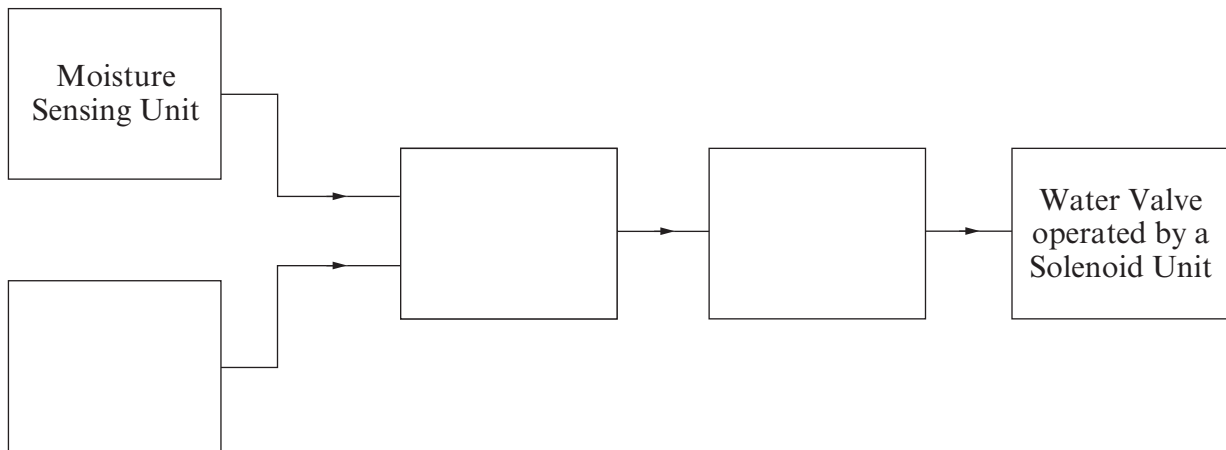
[3]

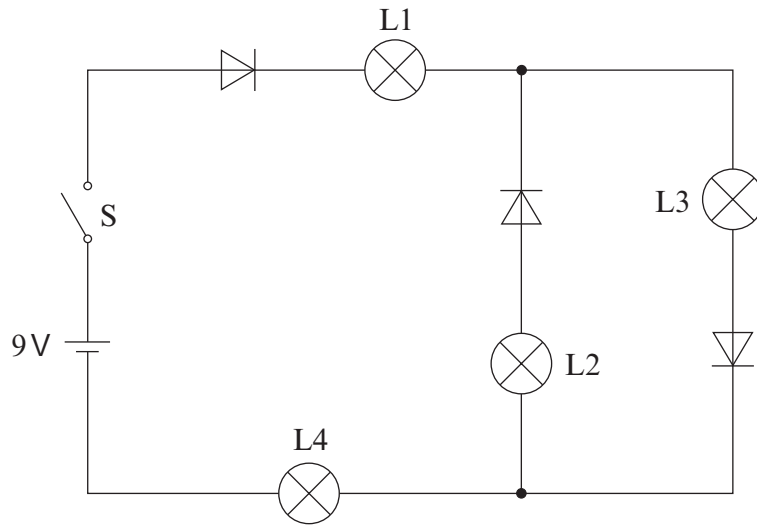**7.** The diagram shows a resistor.
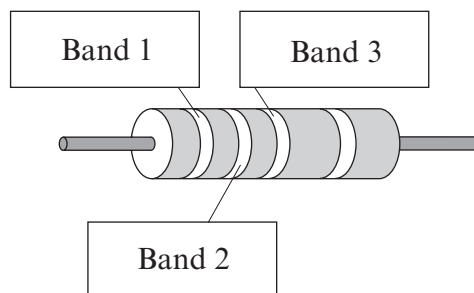
The resistor has a value of 100 kΩ, ± 5%.
Use the information sheet to write down the correct colour for each band of the colour code that would be present on this resistor.

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

[3]

8. The circuit shows some diodes and lamps connected to a battery.

The switch S is now closed. Which lamp(s) will light up? (Circle the correct answer.)

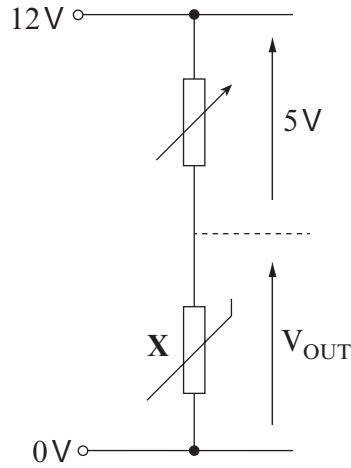|	
All of them	L1, L2, and L3
L1, L2 and L4	L1, L3 and L4
L2, L3, and L4	L2 and L3

[1]

Turn over.

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9. 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}? .... [1]

(c) (i) What happens to the resistance of the thermistor when the temperature decreases?
Tick the correct answer.

☐ It increases

☐ It is not affected by temperature
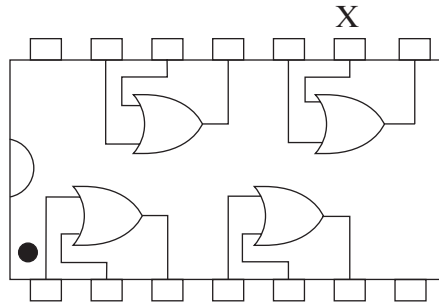
☐ It stays the same

☐ It decreases [1]

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

☐ It increases

☐ It stays the same

☐ It decreases

☐ It depends on how good the power supply is [1]

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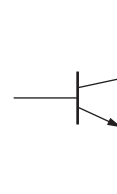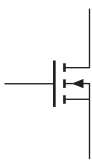

(a) What type of logic gate is contained in this IC? (Circle the correct answer.)

 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]

11. The following list gives the names of some output drivers

transistor   MOSFET   thyristor

(a) Write the correct name to match each symbol below.

....

[3]

(b) Which of these output drivers has a *latching* action? .... [1]

Turn over.

12. 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	0
1	0	0
1	1	0

Logic Gate .... [1]

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

.... [1]

13. Complete the truth table for the following logic system.
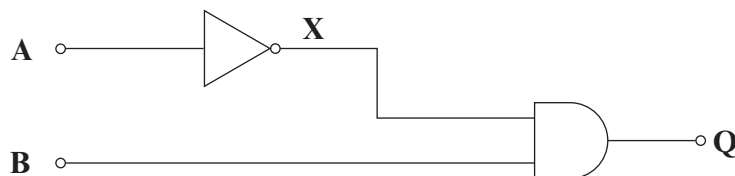
| A	B	X	Q
0	0		
0	1		
1	0		
1	1		

[2]

14. Here are some resistor networks.
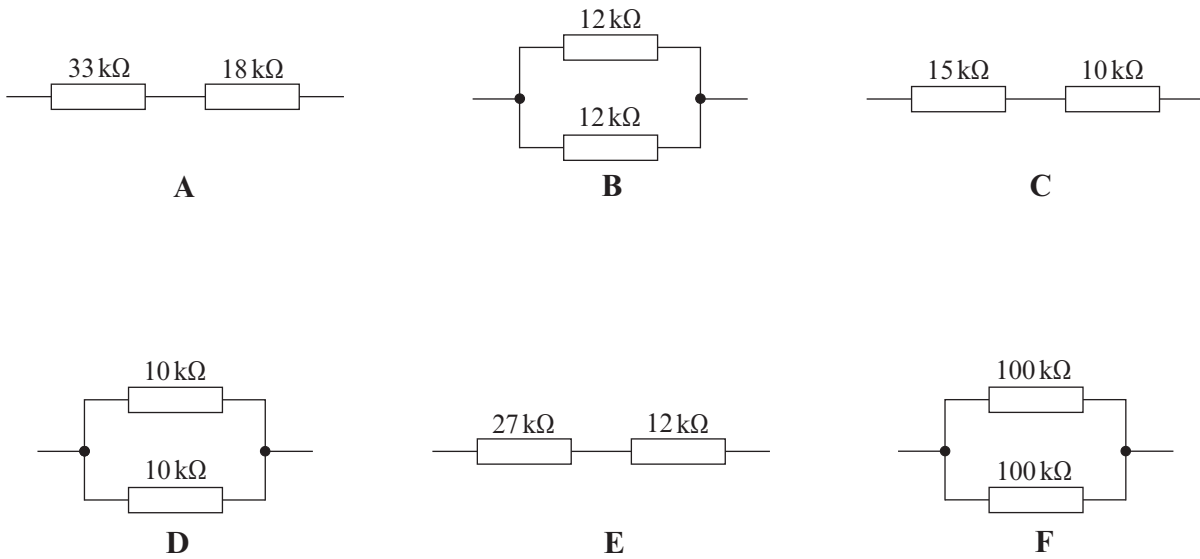
(a) Use the word **series** or **parallel** to complete the following sentence.

The resistors in networks **B**, **D** and **F** are connected in .... [1]

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

(c) What is the total resistance of network **E**? .... kΩ

[1]

(d) Which network **A**, **B**, **C**, **D**, **E**, or **F** has a combined resistance of exactly 50 kΩ?

.... [1]

Turn over.

15. The circuit diagram shows part of a system used to switch on an outside lamp.
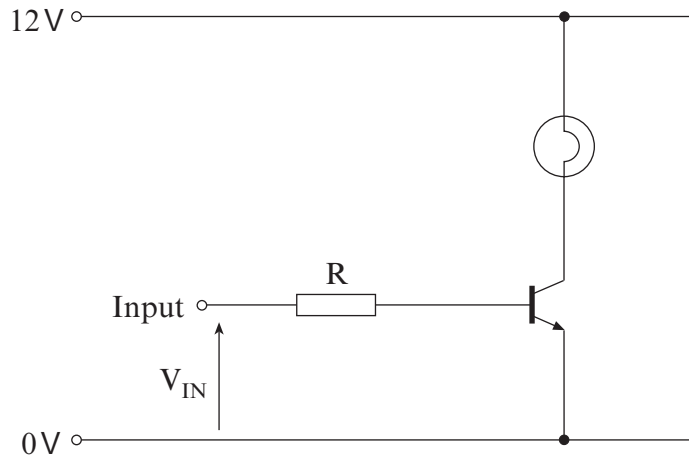
Complete the table with the word **ON** or **OFF** to show what happens to the lamp for each value of V_{IN}.

V_{IN}	Lamp ON / OFF?
1.4 V	
0.5 V	

[1]

16. Here are two truth tables.
For each of them, tick (✓) the correct Boolean equation that represents the function described by the truth table.

(a)

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

☐ **Q = A** AND **B**   (**A.B**)

☐ **Q = A** OR **B**   (**A + B**)

☐ **Q =** NOT **A** AND **B**   ($\overline{\textbf{A}}.\textbf{B}$)

☐ **Q =** NOT **A** AND NOT **B**   ($\overline{\textbf{A}}.\overline{\textbf{B}}$)

[1]

(b)

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

☐ **Q = A** AND **B**   (**A.B**)

☐ **Q = A** OR **B**   (**A + B**)

☐ **Q =** NOT **A** AND **B**   ($\overline{\textbf{A}}.\textbf{B}$)

☐ **Q =** NOT **A** AND NOT **B**   ($\overline{\textbf{A}}.\overline{\textbf{B}}$)
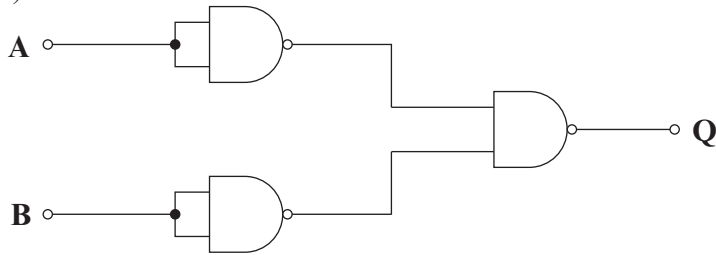
[1]

17. For each arrangement of NAND gates tick (✓) the equivalent 'standard' gate.

(a)

A ○

B ○

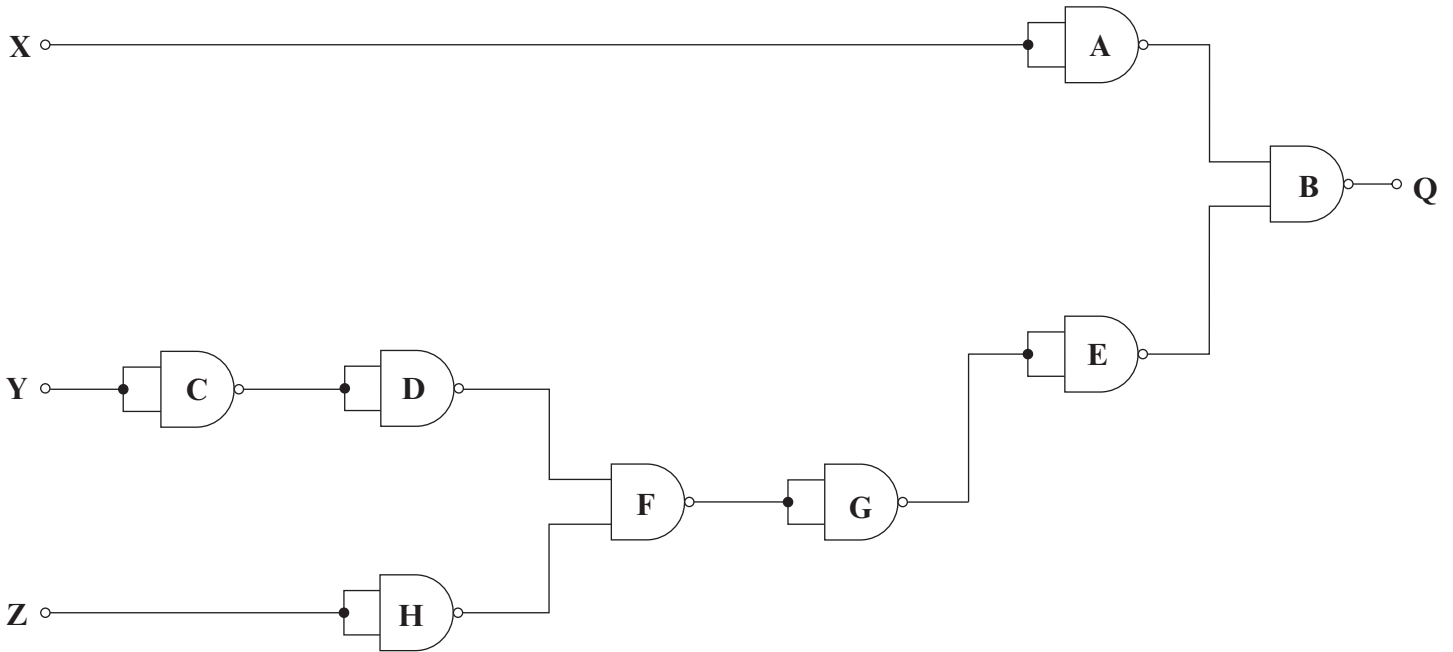Q
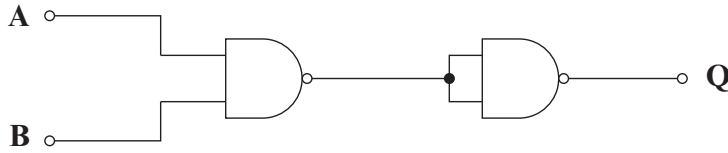
☐ AND Gate

☐ NOR Gate

☐ NOT Gate

☐ OR Gate

[1]

(b)

A ○

B ○

Q

☐ AND Gate

☐ NOR Gate

☐ NOT Gate

☐ OR Gate

[1]

(c)

A ○

B ○

Q

☐ AND Gate

☐ NOR Gate

☐ NOT Gate

☐ OR Gate

[1]

Turn over.
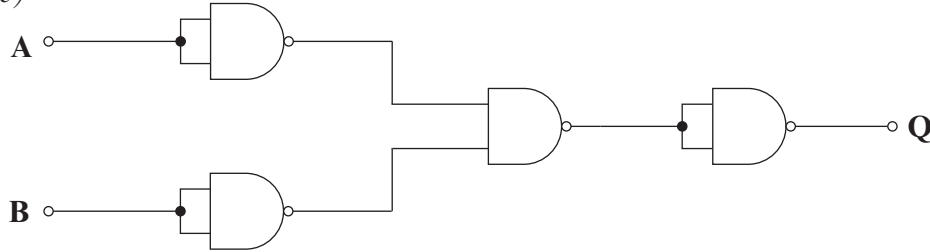
18. Look at the circuit.

Which 2 pairs of gates are redundant? Circle the correct pairs.

A and **B**   **A** and **E**   **C** and **D**   **D** and **H**

F and **G**   **G** and **E**   **E** and **B**   **C** and **H**

[2]

19. The following diagram shows a comparator. The output V_{OUT} of the comparator saturates at 0.5V and 5.5V.
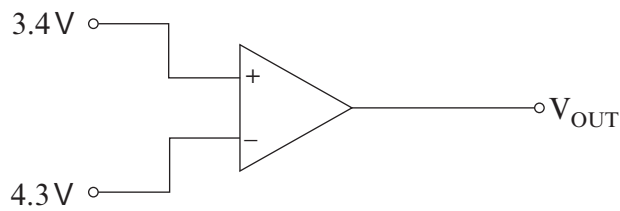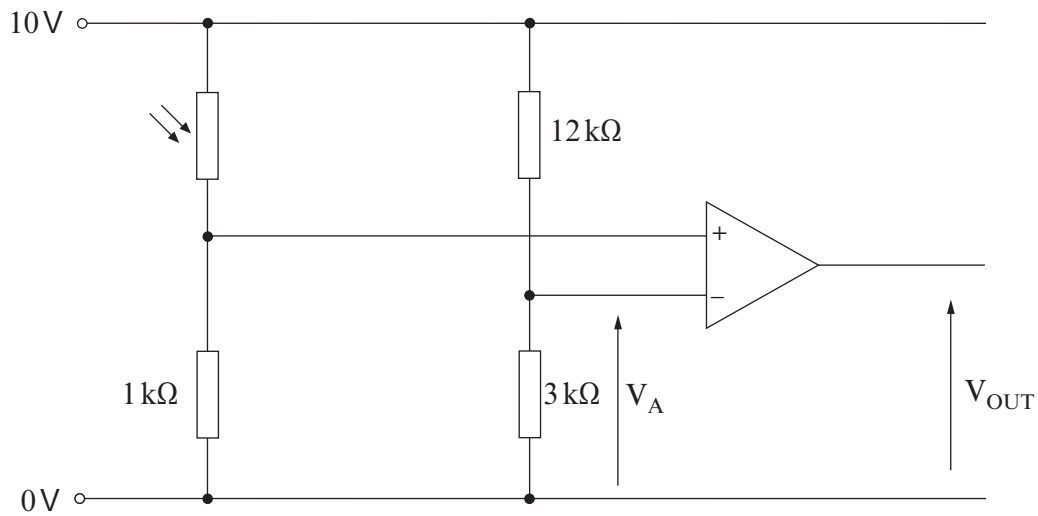

The output of the comparator is: (Tick the correct box.)

☐ 0.5V

☐ 0.9V

☐ 3.4V

☐ 4.3V

☐ 5.5V

☐ 7.7V

[1]

20. The following circuit shows a comparator used to sense different light levels.

(a) (i) Which of the following is the correct formula to calculate the voltage V_A? (Circle the correct answer.)

$$V_A = \frac{3}{1+12} \times 10 \qquad\qquad\qquad V_A = \frac{3}{3+12} \times 10$$

$$V_A = \frac{1}{3+12} \times 10 \qquad\qquad\qquad V_A = \frac{12}{3+12} \times 10$$

[1]

(ii) Calculate the voltage V_A.

....

....
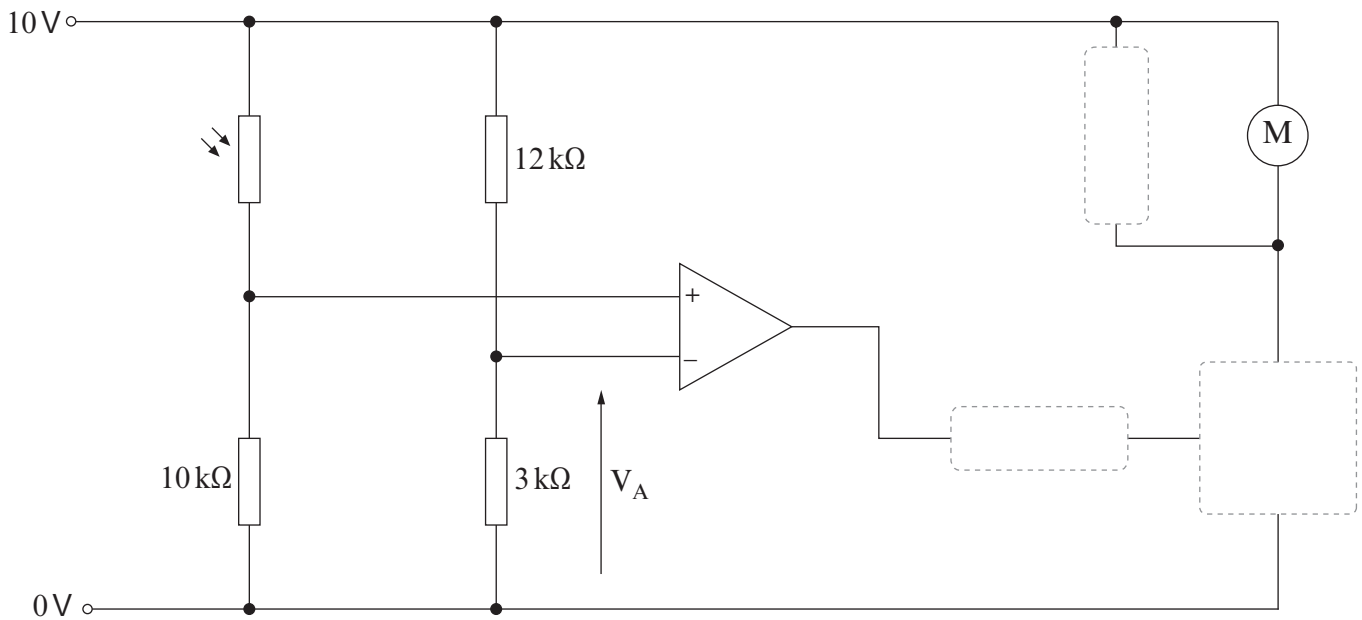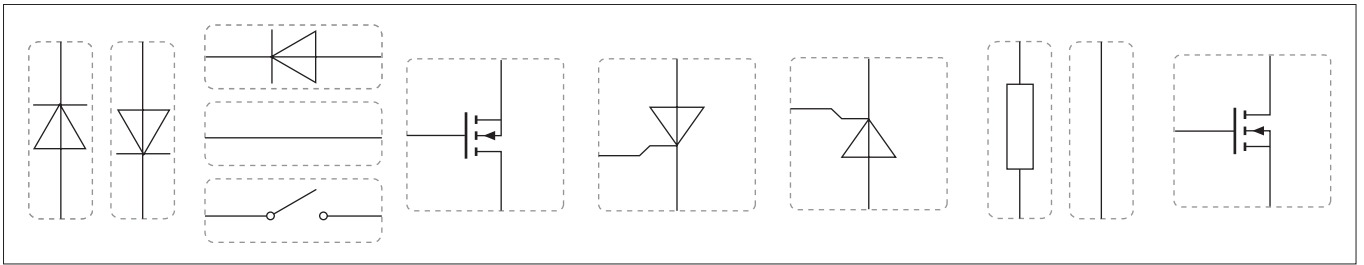
[1]

Turn over.

(b) The comparator circuit is part of a control system used to monitor the light level in a conservatory. When the light level gets too bright a motor operates to close the blinds until the light level drops sufficiently.

Complete the output circuit for the comparator using some of the components shown below.

[3]

21. An LED is to be used as a power on indicator as shown below.
The LED requires a current of 12 mA.
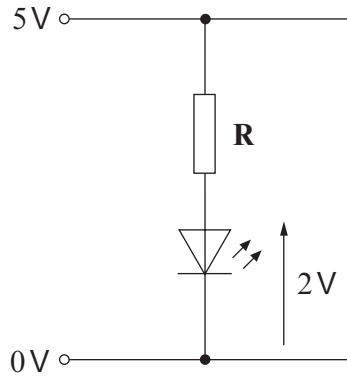
(a) What is the current through resistor **R** when the LED is lit? .... [1]

(b) What is the voltage drop across the resistor **R** when the LED is lit?

....

[1]

(c) (i) Which of the following is the correct formula to calculate the ideal resistance of resistor R in kΩ? (Circle the correct answer.)

$R = 2 \times 12$ $R = \dfrac{2}{12}$

$R = \dfrac{3}{12}$ $R = 3 \times 12$

$R = 5 \times 2$ $R = \dfrac{5}{12}$

$R = \dfrac{5}{2}$ $R = 5 \times 12$

[1]

(ii) Calculate the ideal resistance of resistor **R**.

....

....

[1]

(iii) 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 12 mA.

.... [1]

**THERE ARE NO MORE QUESTIONS
IN THE EXAMINATION.**

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