Candidate Name	Centre Number	Candidate Number
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WJEC CBAC

GCSE

293/02

ELECTRONICS

MODULE TEST E1

HIGHER TIER

P.M. FRIDAY, 23 May 2008

45 minutes

For Examiner's use only	
Total Mark	

ADDITIONAL MATERIALS

In addition to this examination paper you may need a calculator.

INSTRUCTIONS TO CANDIDATES

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

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

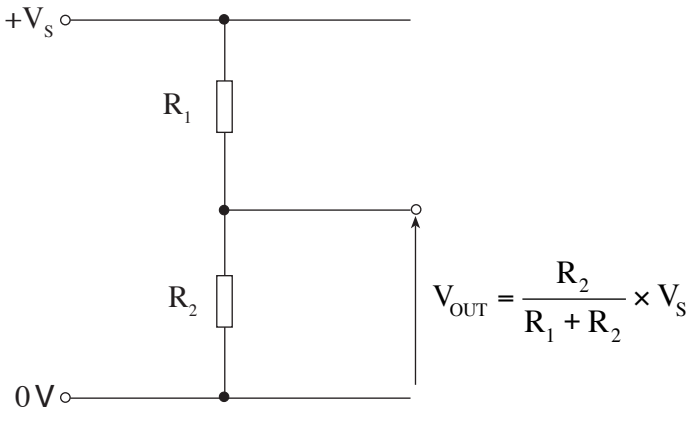
E 12 SERIES OF PREFERRED VALUES
10; 12; 15; 18; 22; 27; 33; 39; 47; 56; 68; 82 and multiples thereafter

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.

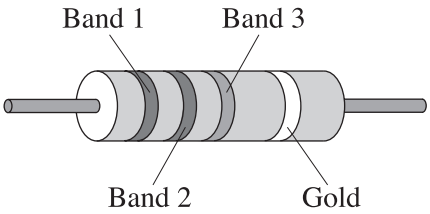
9. Transistors

(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.

Answer **all** *questions in the spaces provided.*

1. The diagram shows a 4·7 kΩ resistor.



(a) Change 4·7 kΩ into ohms. [1]

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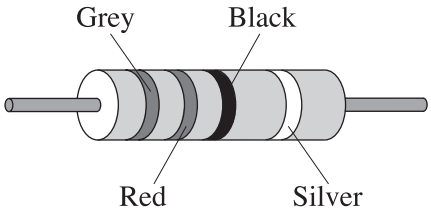
(b) Use the resistor colour code to select the colours of: [3]

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

(c) A **different** resistor is shown below

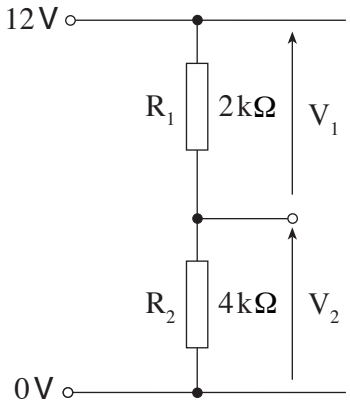


(i) What is its resistance? ..... Ω [2]

(ii) Use the tolerance band to calculate the maximum value of resistance for this resistor. [1]

.....

2. The circuit diagram shows a voltage divider.



(a) What is the combined resistance of R_1 and R_2? ..... [1]

(b) Calculate voltage V_2. [2]
Hint: The equation is given on page 2.

.....

.....

(c) A second 4 kΩ resistor is connected in parallel with R_2.
What is the combined resistance of the two 4 kΩ resistors? [1]

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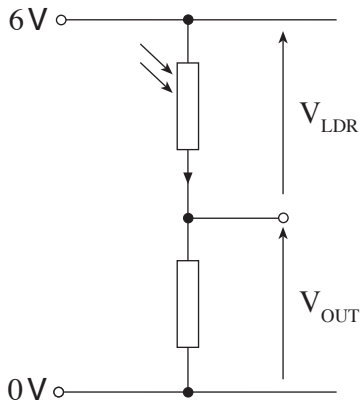
.....

3. Here is the circuit diagram for a light-sensing unit.



A bright light is now shone on the LDR.
As a result, what happens to:

(a) the resistance of the LDR? [1]

.....

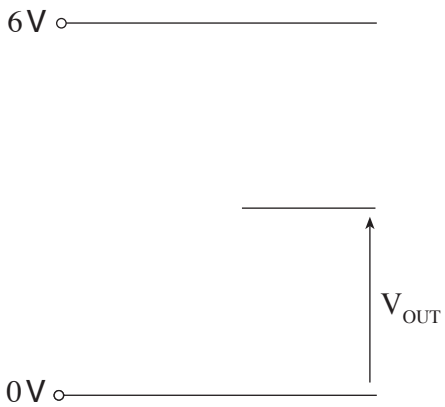
(b) the voltage V_{LDR} across the LDR? [1]

.....

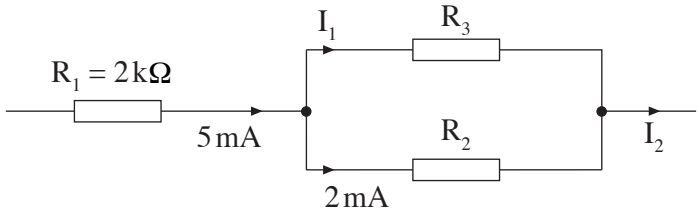
(c) the output voltage V_{OUT}? [1]

.....

(d) Complete the circuit diagram for a temperature sensing unit that has an output voltage which decreases when the temperature rises. [3]



4. The diagram shows part of a circuit.



(a) Calculate current I_1. [1]

.....

(b) Calculate current I_2. [1]

.....

(c) Calculate the voltage across resistor R_1. [2]
Hint: The equation is given on page 2.

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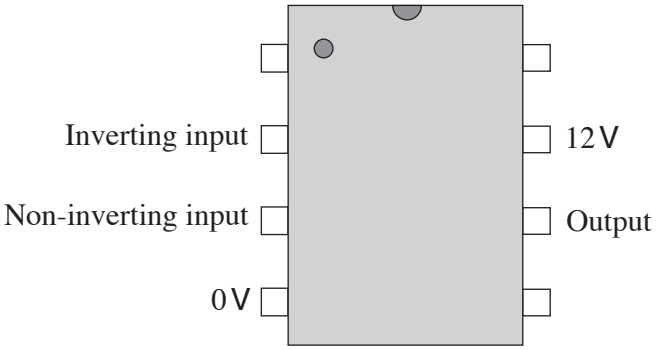
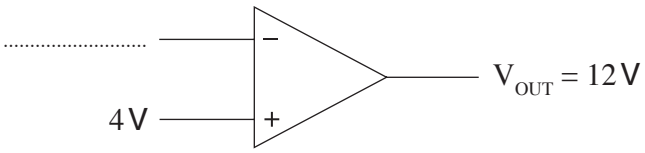
5. The diagram shows the pinout for a comparator IC.



(a) The comparator output saturates at 12 V and 0 V.

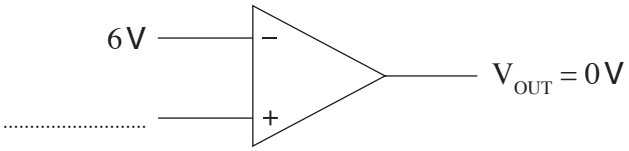
(i) The non-inverting input is set to 4 V.

Write down a voltage at the inverting input that will make the output voltage 12 V. [1]



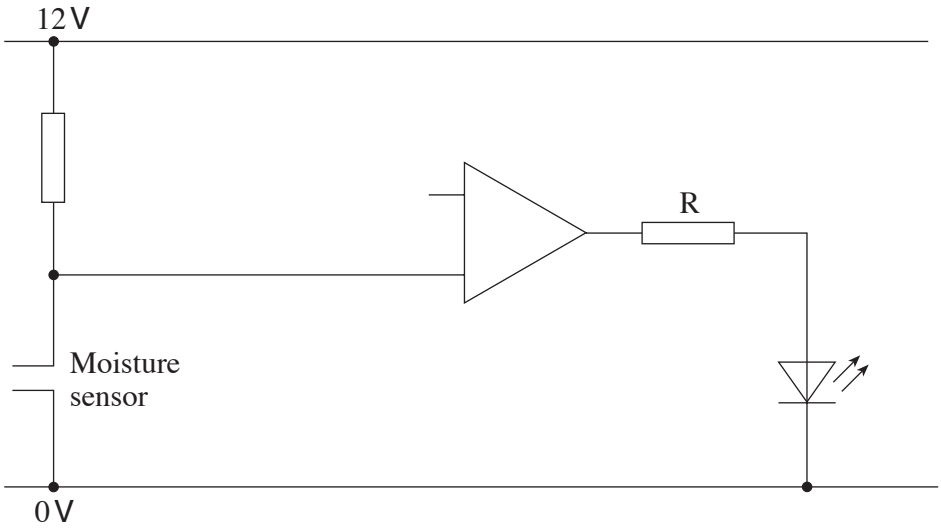
(ii) The inverting input is set to 6 V.

Write down a voltage at the non-inverting input that will make the output voltage 0 V. [1]



(b) A moisture sensor is placed in a plant pot. It is connected to the comparator, which lights an LED when the soil in the plant pot is too dry.

Part of the circuit diagram is shown below.



(i) Add component(s), connected to provide a variable voltage at the other input of the comparator. [1]

(ii) The LED should light when the moisture sensor is **too dry**, giving it a high resistance. Add '+' and '–' labels to the comparator to identify the non-inverting and inverting inputs. [1]

(c) The LED in the moisture sensor is lit, and has a 2V voltage drop across it. The current must be limited to a maximum of 20 mA.

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

(ii) What is the maximum current through resistor? ..... [1]

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

.....

(iv) Use the list of preferred values on page 2.
Select the preferred value needed to limit the current to 20 mA. ..... [1]

(d) What is the advantage of using a comparator rather than a transistor switch for the moisture detector? [1]

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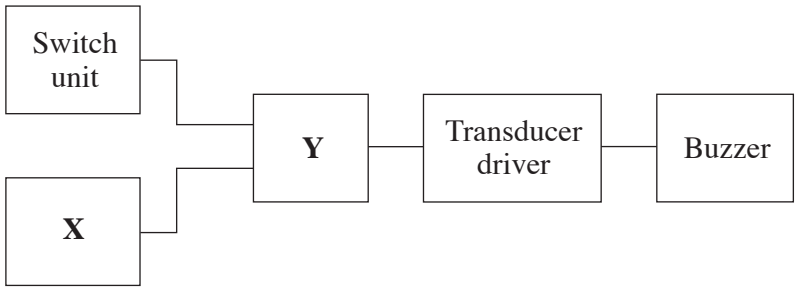
6. Here is the block diagram for a burglar alarm.



The alarm is triggered when a burglar stands on a pressure pad (the switch unit.).
The buzzer then beeps on and off repeatedly.

(a) Subsystem X makes the buzzer beep on and off repeatedly.
What is the name for this subsystem? ..... [1]

(b) Subsystem Y combines the signals from subsystem X and the switch unit so that the buzzer pulses only when the burglar stands on the pressure pad.

What is the name for this subsystem? ..... [1]

(c) The design is faulty because the buzzer stops beeping as soon as the burglar steps off the pressure pad.

(i) What additional subsystem is needed to make sure that the buzzer continues to beep on and off repeatedly even after the burglar steps off the pressure pad? [1]

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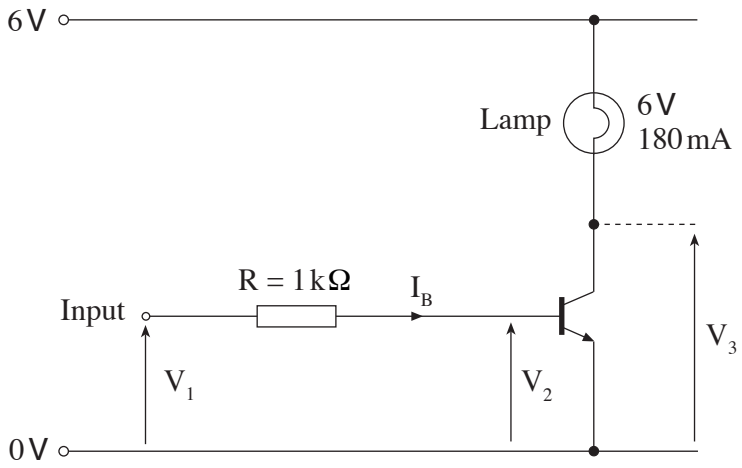
(ii) Redraw the block diagram including this subsystem in its correct position. [1]

7. The circuit diagram shows a transistor switch used as a transducer driver.



(a) The bulb is rated at 6 V 180 mA.
Calculate the power dissipated in the bulb when it is switched on fully. [1]

.....

(b) A transistor with a current gain (h_{FE}) of 90 is used in this circuit.
The input voltage V_1 is increased until the transistor is **just saturated**.

Calculate:

(i) the base current I_B ; [2]

.....

.....

(ii) the voltage across the base resistor; [2]

.....

.....

(iii) the new input voltage V_1. [1]

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