



Monday 12 May 2014 – Afternoon

AS GCE ELECTRONICS

F611/01 Simple Systems

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:

- Scientific calculator

Duration: 1 hour 30 minutes



Candidate forename		Candidate surname	
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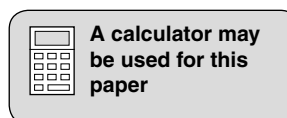
Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **90**.
- Quality of Written Communication will be assessed in this paper.
- You are advised to show all the steps in any calculations.
- This document consists of **20** pages. Any blank pages are indicated.



Data Sheet

Unless otherwise indicated, you can assume that:

- op-amps are run off supply rails at +15V and -15V.
- logic circuits are run off supply rails at +5V and 0V.

resistance	$R = \frac{V}{I}$
power	$P = VI$
series resistors	$R = R_1 + R_2$
time constant	$\tau = RC$
monostable pulse time	$T = 0.7 RC$
relaxation oscillator period	$T = 0.5 RC$
frequency	$f = \frac{1}{T}$
Boolean Algebra	$A \cdot \bar{A} = 0$ $A + \bar{A} = 1$ $A \cdot (B + C) = A \cdot B + A \cdot C$ $\overline{A \cdot B} = \bar{A} + \bar{B}$ $\overline{A + B} = \bar{A} \cdot \bar{B}$ $A + A \cdot B = A$ $A \cdot B + \bar{A} \cdot C = A \cdot B + \bar{A} \cdot C + B \cdot C$

3

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4

Answer **all** questions.

1 Fig. 1.1 shows the incomplete circuit for controlling a buzzer.

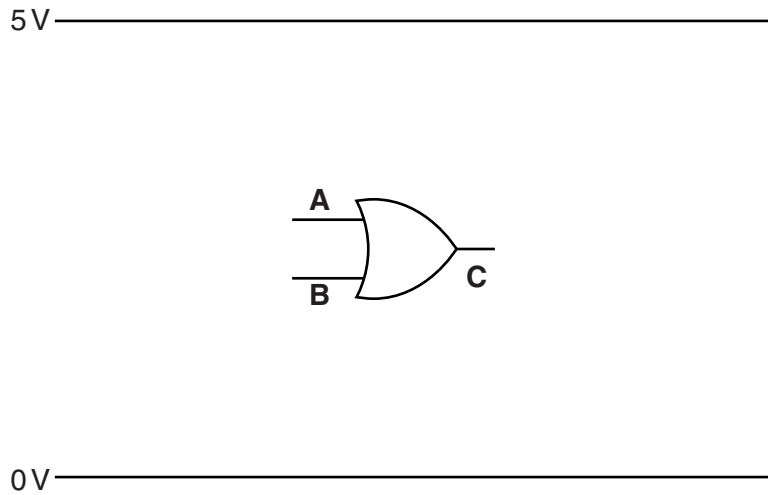


Fig. 1.1

(a) Name the logic gate in Fig. 1.1.

..... [1]

(b) Complete the truth table for the logic gate in Fig. 1.1.

A	B	C

[2]

(c) Write a Boolean expression for the output of the logic gate in Fig. 1.1 **C** in terms of **A** and **B**.

C = [1]

5

- (d) The buzzer is loud, it needs a voltage of 5V and a current of 200 mA to operate correctly. Explain why the buzzer cannot be directly connected to the output of the logic gate but should be connected through a MOSFET.

.....

.....

..... [2]

- (e) Draw on Fig. 1.1 to show how a MOSFET should be connected to operate the buzzer when the output of the logic gate is high. [4]

[Total: 10]

2 Fig. 2.1 shows a light sensing circuit.

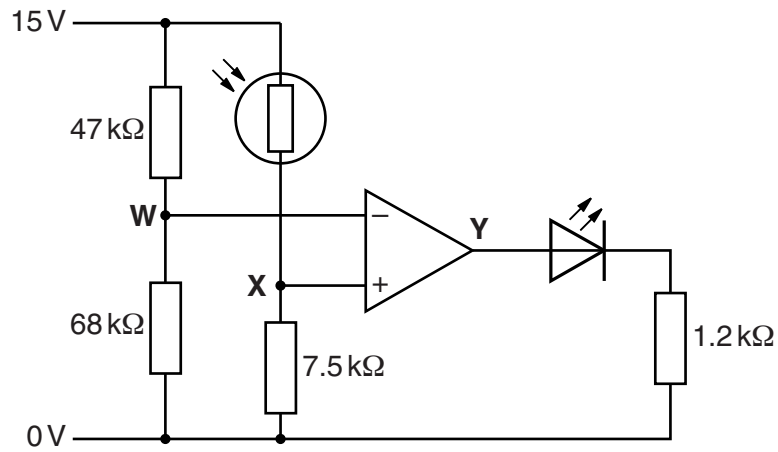


Fig. 2.1

(a) Show that the voltage at W is about 9V.

[4]

(b) An LED is designed to emit light.
Describe the electrical properties of an LED.

.....

.....

..... [2]

(c) Calculate the maximum resistance of the LDR that will make the LED glow.

resistance of LDR = Ω [4]

(d) Explain why the LED does not glow when the LDR is in the dark.
Refer to the voltages at **W**, **X** and **Y** in your answer.

.....
.....
.....
.....
..... [4]

[Total: 14]

3 Fig. 3.1 is a circuit for a flashing light.

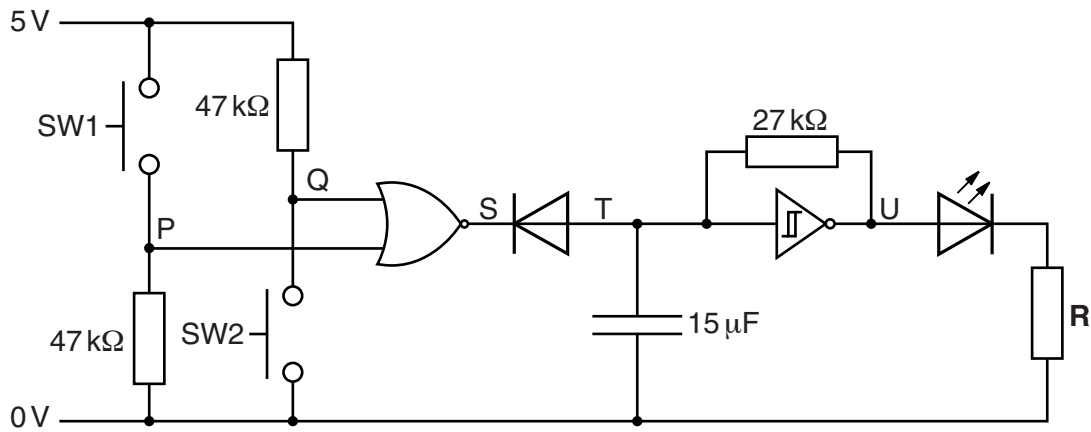
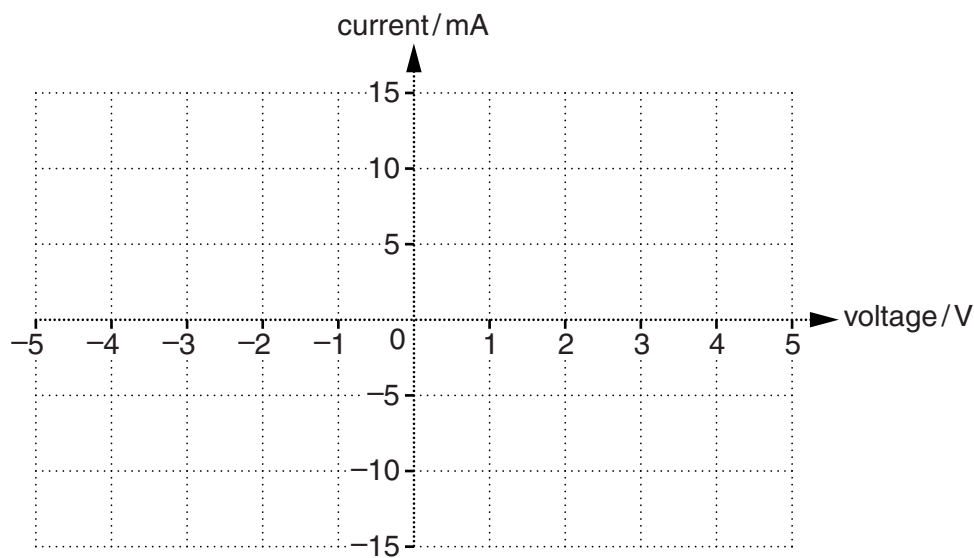


Fig. 3.1

(a) The circuit of Fig. 3.1 contains a diode. Put a ring around the diode. [1]

(b) Draw a graph of the current against voltage for the diode.



[2]

(c) Calculate the value of the resistor **R** to make the LED in Fig. 3.1 operate at 1.8V, 6mA.

resistor value = Ω [3]

- (d) Explain the state of the LED when both of the switches are open. Refer to the signal at P, Q, S, T and U in your answer.

.....

.....

.....

..... [4]

- (e) Describe the state of the switches (open or closed) to make the LED flash.

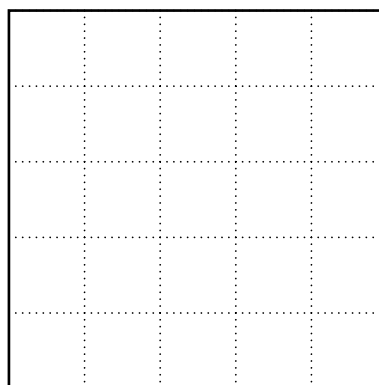
SW1 SW2 [1]

- (f) Calculate the frequency of the signal at U when the LED flashes.

frequency = Hz [4]

- (g) Draw on Fig. 3.1 to show how an oscilloscope should be connected to display the output of the astable. Use the correct symbol for the oscilloscope. [1]

- (h) Draw the signal on the oscilloscope screen shown below when the LED is flashing. The oscilloscope sensitivity is set to 2 V/division and the timebase is adjusted to show two periods of the signal on the oscilloscope screen.



[3]

[Total: 19]

4 This question is about using the rules of Boolean algebra.

(a) Put a (ring) around the truth table which matches the Boolean expression.

$$Q = \bar{A} + \bar{B}$$

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

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

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

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

[1]

(b) Put a (ring) around the truth table which matches the Boolean expression.

$$P = \bar{C} \cdot (C + \bar{D})$$

C	D	P
0	0	1
0	1	0
1	0	0
1	1	0

C	D	P
0	0	0
0	1	0
1	0	1
1	1	0

C	D	P
0	0	0
0	1	1
1	0	0
1	1	0

C	D	P
0	0	1
0	1	0
1	0	1
1	1	1

[1]

(c) Put a (ring) around the truth table which matches the Boolean expression.

$$R = E + (\bar{F} \cdot \bar{E})$$

E	F	R
0	0	1
0	1	1
1	0	0
1	1	0

E	F	R
0	0	1
0	1	1
1	0	1
1	1	0

E	F	R
0	0	0
0	1	1
1	0	0
1	1	0

E	F	R
0	0	1
0	1	0
1	0	1
1	1	1

[1]

(d) Put a (ring) around the truth table which matches the Boolean expression.

$$S = (\bar{G} \cdot H) \cdot (G + \bar{H})$$

G	H	S
0	0	0
0	1	0
1	0	0
1	1	0

G	H	S
0	0	1
0	1	1
1	0	1
1	1	0

G	H	S
0	0	0
0	1	1
1	0	1
1	1	0

G	H	S
0	0	1
0	1	1
1	0	1
1	1	1

[1]

11

(e) For each expression in the left hand column draw a line to the equivalent expression in the right hand column.

$$\overline{\overline{v}} \cdot y$$

$$v \cdot \overline{x} + \overline{v + y}$$

$$\overline{v + x + y}$$

$$\overline{v \cdot x \cdot y}$$

$$v \cdot \overline{x} + \overline{v \cdot y} + \overline{x \cdot y}$$

$$\overline{\overline{v} \cdot \overline{x} \cdot \overline{y}}$$

$$v \cdot \overline{x} \cdot y$$

$$(\overline{\overline{v + x}}) \cdot (\overline{v \cdot y} + v \cdot \overline{x \cdot y})$$

$$v \cdot \overline{x} \cdot y + \overline{v \cdot x \cdot y}$$

$$\overline{v \cdot x \cdot y}$$

$$\overline{v \cdot y} + \overline{v \cdot x \cdot y}$$

[4]

[Total: 8]

5 Fig. 5.1 is an incomplete circuit diagram for a logic circuit.

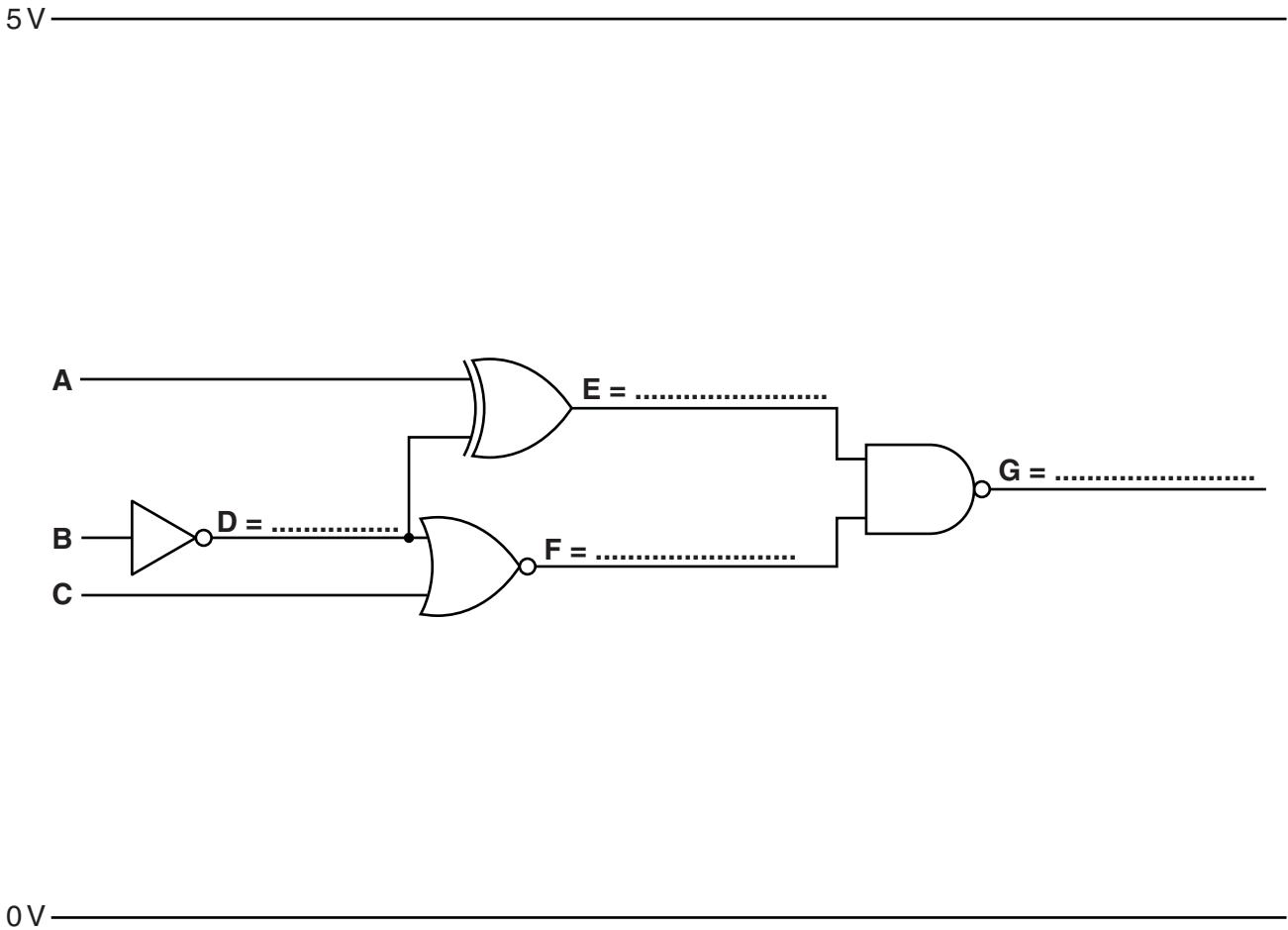


Fig. 5.1

(a) Using only the letters **A**, **B**, **C**, write a Boolean expression for the output of each gate D, E, F and G in Fig. 5.1. You are **not** expected to use Boolean algebra to simplify the expressions. [4]

(b) Explain why the circuit diagram shows no connections from the logic gates to the power supply lines.

.....

 [2]

(c) Add a resistor, LED and ammeter to the diagram in Fig. 5.1 so that the LED glows when G is high and the ammeter shows the current through the LED. [3]

[Total: 9]

Question 6 follows on page 14

6 Fig. 6.1 shows a circuit containing a switch.

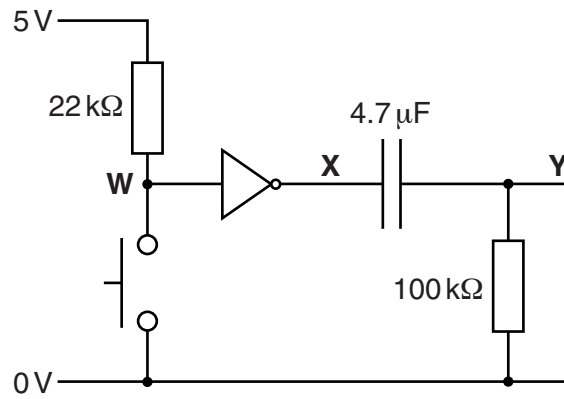


Fig. 6.1

(a) State the voltage at **W** when the switch is pressed.

voltage at **W** = V [1]

(b) Calculate the time constant of the section of the circuit between **X** and **Y**.

time constant = s [1]

(c) The first graph in Fig. 6.2 shows voltage at **W** against time.

Draw on the other two graphs to show how the voltages at **X** and **Y** change with time.

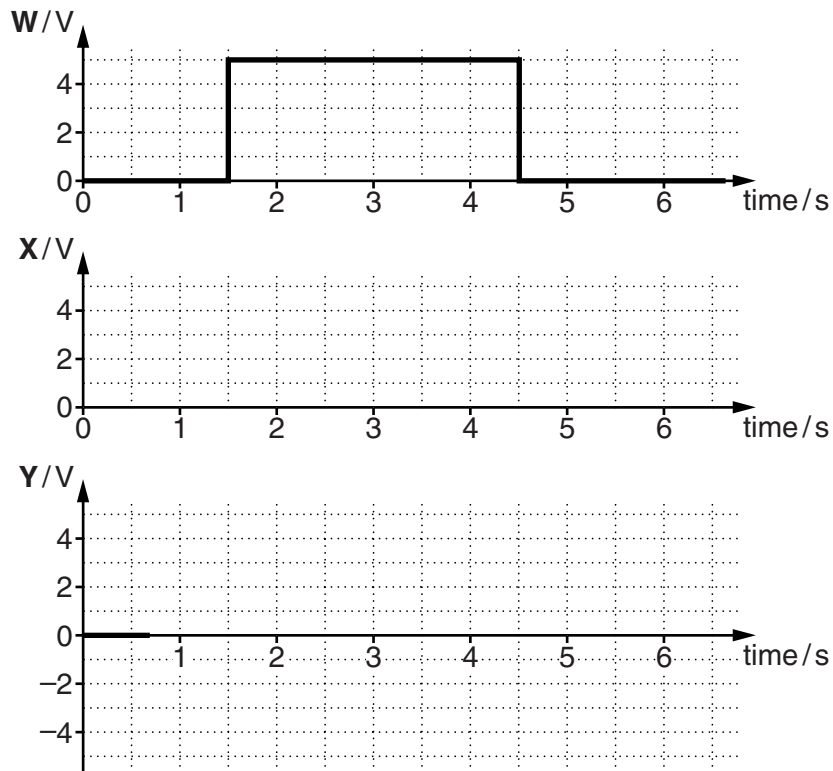


Fig. 6.2

[5]

(d) Some more components are added to the circuit to operate an LED.

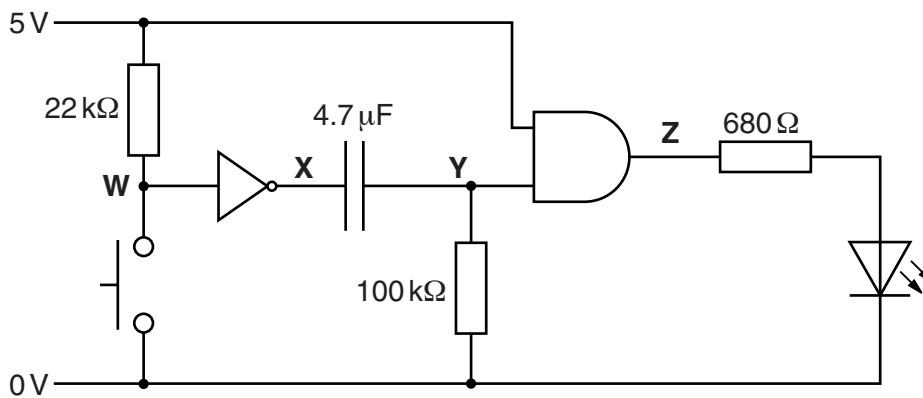


Fig. 6.3

(i) Explain the effect of the new components on the signal at Y.

.....

.....

.....

..... [3]

(ii) Describe in detail what happens to the LED when someone presses and holds down the switch in Fig. 6.3.

.....

.....

.....

..... [3]

(iii) The LED operates at 2V. Calculate the current in the LED when it operates.

current in LED = mA [3]

[Total: 16]

- 7 This question is about a system for sounding a buzzer to warn a car driver that they have left their headlights on when they open the car door.

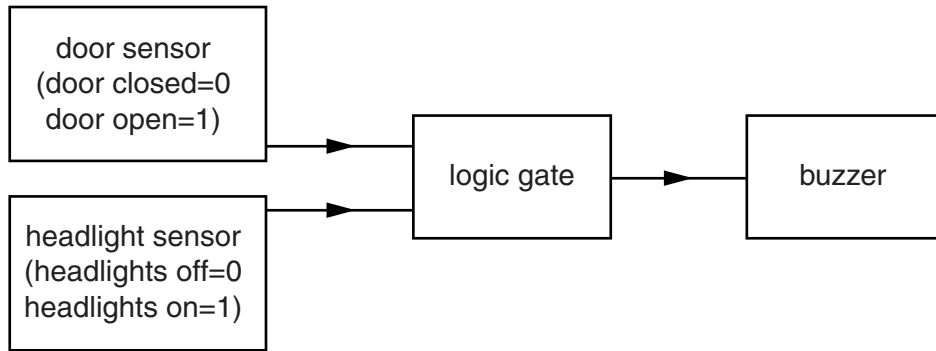


Fig. 7.1

- (a) The buzzer sounds when the output of the logic gate is high. State the name of the logic gate in Fig. 7.1. Explain your answer.

.....

 [2]

- (b) The door sensor contains a switch which opens when the door opens. Draw a circuit for only the door sensor on Fig. 7.2. Label the sensor output.

5V —————

0V —————

Fig. 7.2

[3]

(c) State why block diagrams are sometimes used instead of circuit diagrams.

..... [1]

(d) State the meaning of the arrows on Fig. 7.1.

..... [1]

(e) The car uses a 12V battery to power two headlights connected in parallel.
Each headlight is rated 55W, 12V.
Show that the current required from the battery for both headlights is about 9 A.

[2]

(f) The table below shows a selection of switches in a catalogue.

Part number	Max current	Max voltage	Price
AC955	2 A	20V	£2.16
JP234	8 A	12V	£1.83
MB426	6 A	400V	£3.66
SB683	12 A	250V	£2.33

Select the most suitable switch for the car headlights. Explain your choice.

.....

 [2]

[Total: 11]

Quality of written communication [3]

END OF QUESTION PAPER

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