Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
June 2012

Electronics ELEC1

Unit 1 Introductory Electronics

Tuesday 15 May 2012 9.00 am to 10.00 am

For this paper you must have:
- a pencil and ruler
- a calculator
- a Data Sheet (enclosed).

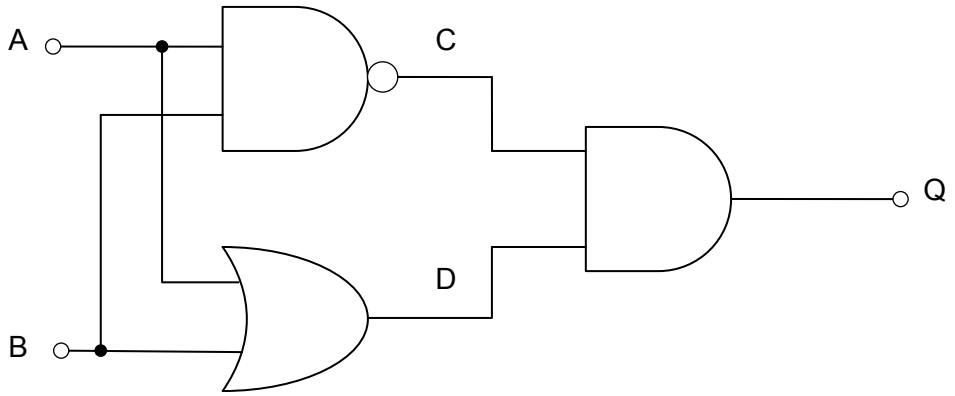
Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 67.

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

1 A student constructs a circuit from the following logic diagram.



1 (a) Complete the truth table below for this logic diagram.

A	B	C	D	Q
0	0			
0	1			
1	0			
1	1			

(3 marks)

1 (b) Write down Boolean expressions for the logic signals at C, D and Q in terms of the inputs A and B.

C = ...

(1 mark)

D = ...

(1 mark)

Q = ...

(2 marks)

1 (c) What single logic gate could perform the function of the whole circuit above?

.....

(1 mark)

8

2 A student designs a high power lamp system which flashes when the music reaches a certain sound level at a party. The system will automatically switch on when the volume of music received by a microphone, that gives only a low output voltage, exceeds a set level which can be adjusted. 5 Hz pulses generated in the system are then gated through to a driver which controls a lamp.

2 (a) Draw a system diagram as a possible plan for this system.

(8 marks)

2 (b) In which subsystem(s) could

2 (b) (i) an op-amp be used?

.....

.....

(2 marks)

2 (b) (ii) a potentiometer be used?

.....

(1 mark)

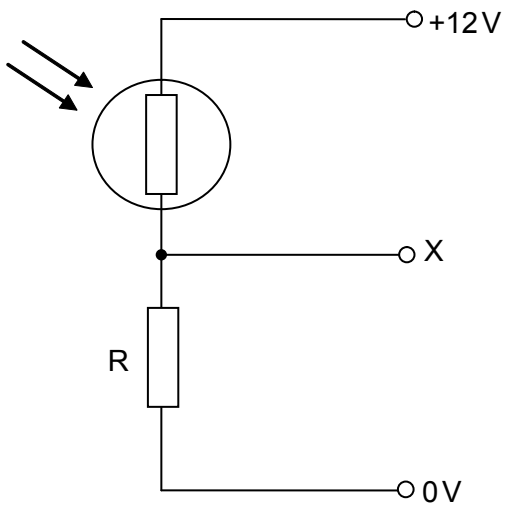
2 (b) (iii) a MOSFET be used?

.....

(1 mark)

12

3 A light sensor circuit and the LDR data sheet are shown below.



LDR Data Sheet	
Light level (lux)	Resistance (kΩ)
0	100
10	10
100	3.5

3 (a) A student finds that the lowest resistance of the LDR in bright sunlight is 100 Ω. The LDR maximum power dissipation is 100 mW.

3 (a) (i) Show that the maximum current that could flow safely through the LDR in bright sunlight is approximately 32 mA.

.....

.....

(2 marks)

3 (a) (ii) Calculate the total resistance of the LDR and fixed resistor, R, that would limit the current through the LDR to the value given in part (i).

.....

.....

(2 marks)

3 (a) (iii) Calculate the minimum resistance that could safely be used for R, and then choose the lowest appropriate value from the E24 series.

.....

.....

(2 marks)

3 (b) Calculate the output voltage of the circuit at point X when the light level is:

3 (b) (i) 10 lux .....

.....

(2 marks)

3 (b) (ii) 0 lux .....

.....

(1 mark)

3 (c) State why the value of resistance chosen in part (a)(iii) is a poor choice for measuring low light levels.

.....

(1 mark)

3 (d) How would you change the value of R calculated in part (a)(iii) to improve the situation at low light levels?

.....

(1 mark)

3 (e) The circuit is powered from a 12 V battery of low capacity. State **one** other advantage of changing the value of R.

.....

(1 mark)

12

Turn over for the next question

4 An engineer designs a circuit that is used to control the ventilation of an indoor sporting venue at the Olympics. When the temperature rises above a set level, this automatically opens vents set high above the reach of spectators.

4 (a) Explain how the air temperature could be converted into an electrical signal.

.....

.....

(2 marks)

4 (b) The circuit is to be based on an op-amp. What type of circuit could provide a switching action when the temperature rose above the set level?

.....

(1 mark)

4 (c) Describe the switching operation of the circuit chosen in part (b) with reference to the two op-amp inputs and its output.

.....

.....

.....

(2 marks)

4 (d) Draw a suitable circuit diagram, based on your choices above, that would give a high output voltage when the temperature exceeded the set level.

(3 marks)

4 (e) On a single rail supply (0 V, 12 V) the output voltage from the op-amp never drops completely to zero.

State why this is so.

.....

.....

(1 mark)

4 (f) A (logic level) MOSFET is connected to the op-amp circuit to switch the current to a powerful solenoid which operates the vents.

Give **two** reasons why this is a good choice.

.....

.....

.....

(2 marks)

4 (g) Add to your circuit diagram in part (d) by drawing the MOSFET, solenoid, and any other components required.

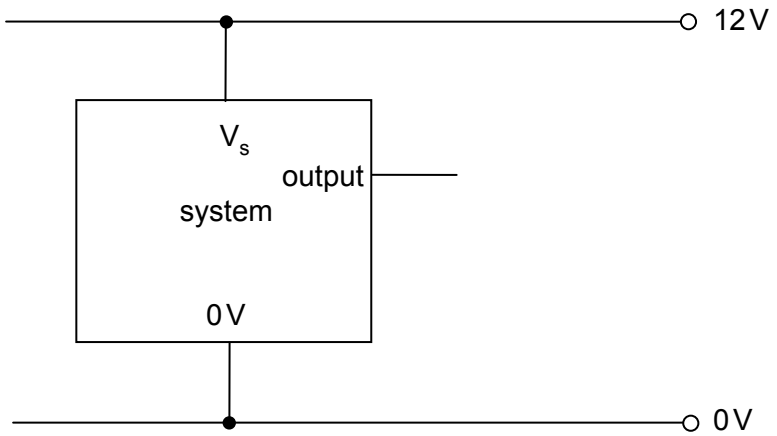
(3 marks)

14

Turn over for the next question

5 An LED is used as the output device in a digital system that gives an output voltage of 0 V or 12 V.

5 (a) Show on the diagram below how the LED and another component should be connected to the system to light when the output is high.



(2 marks)

5 (b) (i) The LED forward voltage drop is 2 V when it is conducting the required 25 mA. Calculate the value of the component you have chosen in part (a).

.....

.....

(2 marks)

5 (b) (ii) Calculate the power dissipated by this component.

.....

(2 marks)

5 (b) (iii) Choose an appropriate preferred value for this component, given that 25 mA is the maximum allowable current through the LED.

.....

(1 mark)

5 (b) (iv) Give the colour code for the chosen value in part (b)(iii) if it has a tolerance of 5%.

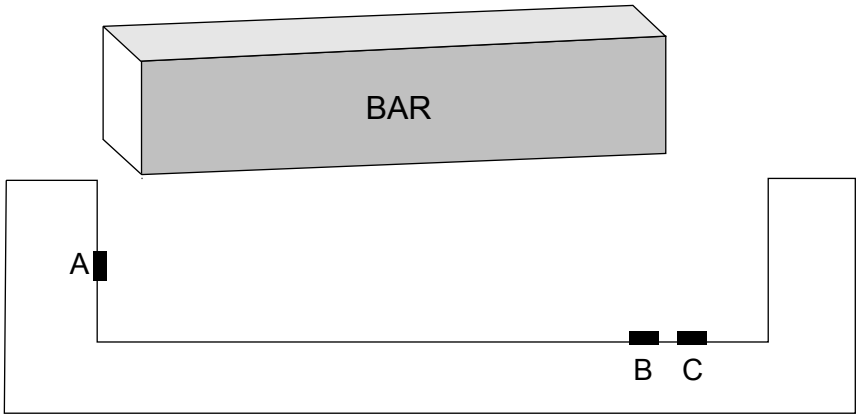
.....

(2 marks)

9

6 A student is designing a simple testing device to check that metal bars used in a factory are cut to a set length. The device uses three sensitive switches, A, B, and C, which give a logic 1 when pressed.

The bar is placed in the device and pressed against switch A.



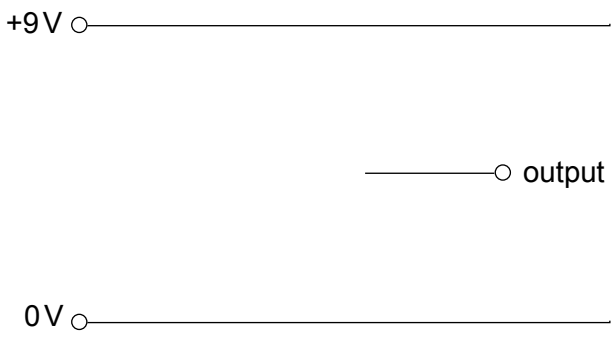
6 (a) The device operates from a 9 V power supply.

6 (a) (i) State what is meant by logic 1 in this system.

.....

(1 mark)

6 (a) (ii) Complete the circuit diagram below, adding a resistor and switch so that the output gives a logic 1 when the switch is pressed.



(2 marks)

6 (b) If the bar is the correct length when placed against switch A, it presses switch B, but not switch C.

There are three outputs:
L is high if the bar is too long
R is high if the bar length is the right length
S is high if the bar length is too short.

If the bar is not pressed against switch A, all outputs are low.

Write Boolean expressions for the outputs, in terms of A, B, and C.

L = ...

(1 mark)

R = ...

(*1 mark*)

S = ...

(*1 mark*)

6 (c) Draw a logic diagram, using any logic gates, to show how output R can be produced from inputs A, B and C.

A ○——

B ○—— ——○ output R

C ○——

(3 marks)

6 (d) Convert your logic diagram in part (c) to one that uses only NOR gates, drawing the converted system with the smallest number of gates possible in the space below.

(3 marks)

12

END OF QUESTIONS

There are no questions printed on this page

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