Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

For Examiner's Use

General Certificate of Secondary Education
June 2008

ELECTRONICS
Written Paper
Foundation Tier

3432/F

F

Friday 23 May 2008 1.30 pm to 3.00 pm

For this paper you must have:
- a pencil and a ruler
- a calculator.

Time allowed: 1 hour 30 minutes

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. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show the working of your calculations.

Information
- The maximum mark for this paper is 120.
- The marks for questions are shown in brackets.
- A list of formulae and other information, which you may wish to use in your answers, is provided on page 2.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use			
Question	Mark	Question	Mark
1		9	
2			
3			
4			
5			
6			
7			
8			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Information Sheet

The following information may be useful in answering some of the questions in this examination paper.

1. **Power**

   Power = voltage × current; $P = VI$

2. **Amplifiers**

   Voltage gain $G_v = \frac{V_{out}}{V_{in}}$

3. **Resistor colour code**

   The colours in the resistor colour code correspond to the following values.

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.

   GOLD ±5% SILVER ±10% No fourth band ±20%

4. **Resistor printed code** (BS 1852)

   R means × 1
   K means × 1000
   M means × 1 000 000
   Position of letter gives the decimal point.
   Tolerances are indicated by adding a letter at the end.

   J ±5% K ±10% M ±20%

   e.g. 5K6J = 5.6 kΩ ± 5%

5. **Preferred value for resistors** (E24 SERIES)

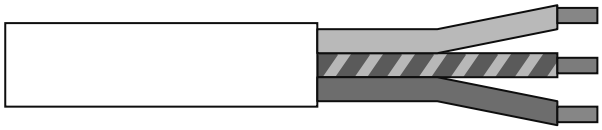
   1.0 1.1 1.2 1.3 1.5 1.6 1.8 2.0 2.2 2.4 2.7 3.0 3.3 3.6 3.9 4.3 4.7 5.1 5.6 6.2 6.8 7.5 8.2 9.1 and multiples of 10

6. $\text{Resistance} = \frac{\text{voltage}}{\text{current}}$; $R = \frac{V}{I}$

7. Effective resistance, R, of resistors in series is given by $R = R_1 + R_2 + R_3$

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

1 (a) A length of mains electrical cable is shown below.
Label each wire with its correct colour.



Neutral .....

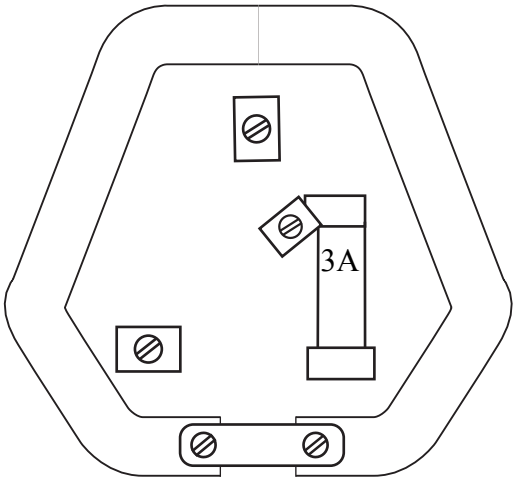
Earth ..... and .....

Live .....

(4 marks)

1 (b) The inside of a mains plug is shown below.
The cable is to be fitted to this mains plug. Draw arrows from the labels below to show where each wire should be fitted in the plug.

Earth **Live** **Neutral**



(3 marks)

1 (c) Name **three** parts of the mains plug which are included for safety reasons.

1 .....

2 .....

3 .....

(3 marks)

10

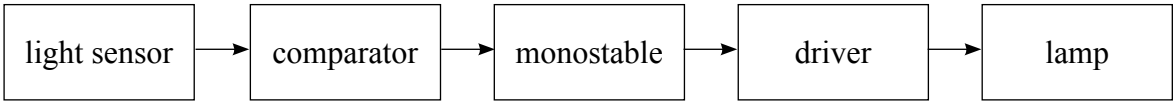
2 For each component named, draw its circuit symbol in the symbol column and tick **one** of the other columns on each line to show whether the component is an active or passive device.

Name	Symbol	Active	Passive
Resistor			
Bipolar Transistor			
Diode			
MOSFET			
Capacitor			

(10 marks)

10

3 A block diagram of an automatic porch light is shown below.



3 (a) Which block represents

3 (a) (i) an input .....

3 (a) (ii) an output .....

3 (a) (iii) an analogue to digital converter? .....

(3 marks)

3 (b) In which block could

3 (b) (i) an op-amp be found .....

3 (b) (ii) an LDR be found .....

3 (b) (iii) a 555 IC be found? .....

(3 marks)

3 (c) Complete the gaps in this description of the operation of the system.

When the light level falls, the output of the ..... goes low and triggers the ..... . This gives a high voltage signal to the ..... which switches on the ..... for a period of ..... .

(4 marks)

10

4 (a) (i) Draw the logic symbol for an OR gate in the space below.
Label its inputs as **A** and **B**, and its output as **Q**.

4 (a) (ii) Complete the truth table below to show the operation of the OR gate.

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

(7 marks)

4 (b) A different type of logic gate has the following truth table:

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

4 (b) (i) Name this logic gate. .....

4 (b) (ii) Describe the operation of this logic gate by completing the gaps in the sentence below.

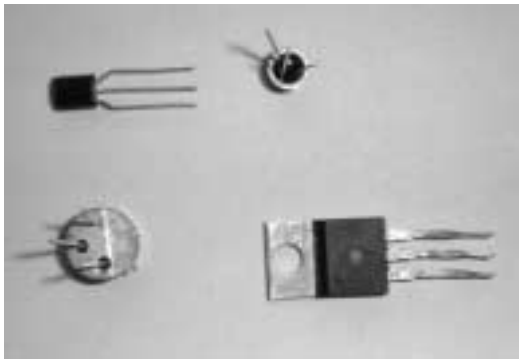
The output **Q** is only ..... when inputs **A** and **B** are both

..... .

(3 marks)

10

5 (a) (i) The photograph shows four examples of a common type of component. Name, and state the function of, this type of component.



Component type.....

Function.....

.....

5 (a) (ii) For the component you have chosen in part (a)(i), state the names of its three leads.

1 .....

2 .....

3 .....

(5 marks)

5 (b) (i) Name, and state the function of, the type of component shown in this photograph.

Component type.....

Function.....

.....

For this component, state

5 (b) (ii) its marked value in ohms .....

5 (b) (iii) its power rating .....

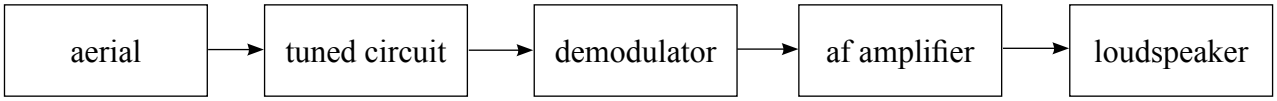
5 (b) (iv) its tolerance. .....

(5 marks)

10

Turn over ▸

6 A block diagram of a simple radio receiver system is shown below.



6 (a) Which subsystem

6 (a) (i) boosts the audio frequency signal .....

6 (a) (ii) converts the rf signal to af .....

6 (a) (iii) selects the required channel .....

6 (a) (iv) converts the af signal to sound .....

6 (a) (v) converts radio waves to electric signals ? .....

(5 marks)

6 (b) One way of making an af amplifier is to use separate components (transistors, diodes and passive components).

What is another way of producing an af amplifier? .....

(1 mark)

6 (c) State what effect the af amplifier in part (a) has on the following properties of its input signal.

6 (c) (i) The signal current .....

6 (c) (ii) The signal frequency .....

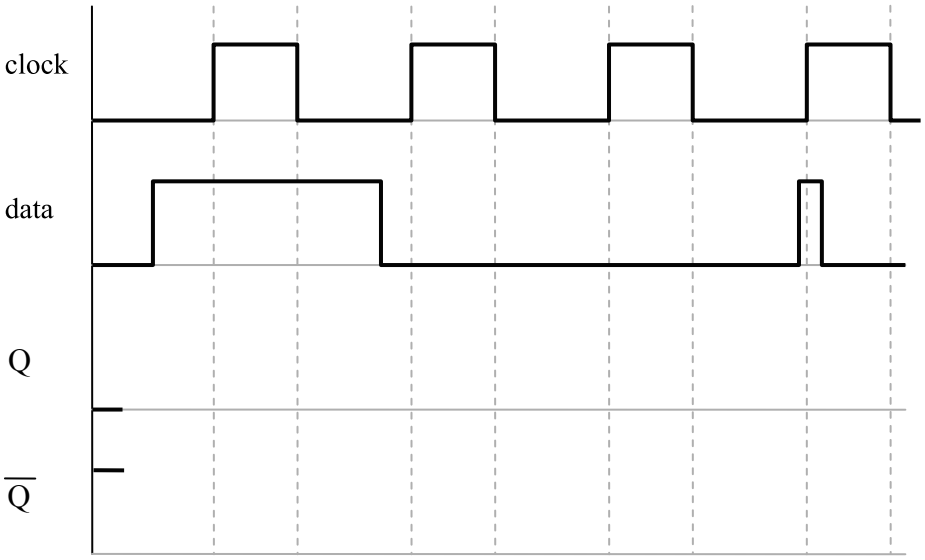
6 (c) (iii) The signal power .....

6 (c) (iv) The signal voltage .....

(4 marks)

10

7 (a) The following clock and data signals are fed into a 4013 type D-type flip-flop. Complete the timing diagram below to show the output signals that would be produced.



(5 marks)

An LED has a forward voltage of 2.2 V when conducting a current of 10 mA, (0.01 A). It is to be operated from a 6 V battery.

7 (b) (i) What component is needed to protect the LED from too much current?

.....

For this component

7 (b) (ii) calculate the voltage across it .....

7 (b) (iii) calculate its required value .....

.....

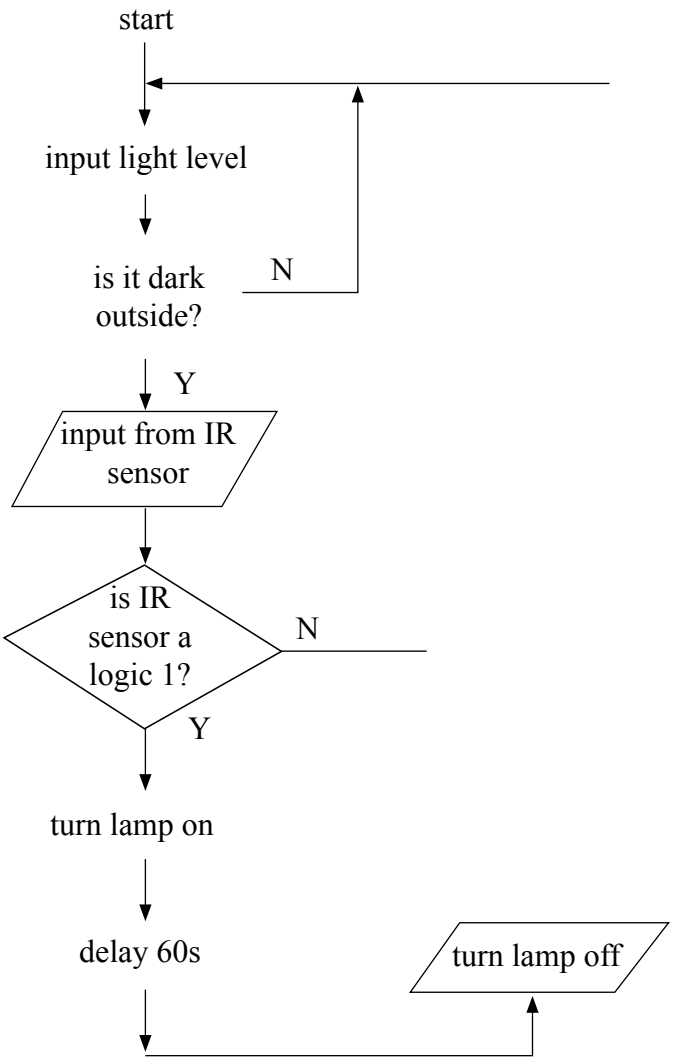
7 (b) (iv) choose the preferred value from the E24 series .....

7 (b) (v) calculate the power dissipated by it. .....

(5 marks)

10

8 A student designs a system to save energy by only switching on a light in a room when it is dark outside and when an infrared (IR) sensor detects the presence of a person in the room. The IR sensor gives a logic 1 output when it detects a person.
The flowchart below is not complete and some of the symbols have been omitted.



8 (a) Draw the correct flowchart symbols at **five** places where they are missing above.

(5 marks)

8 (b) (i) Label on the flowchart:

a decision box, an input box, a loop, an output box and a process box

8 (b) (ii) Some of the lines are missing from the flowchart, complete them on the flowchart.

(7 marks)

8 (c) Describe in words the operation of the complete system.

.....

.....

.....

.....

(4 marks)

When the system is working, the student notices that the lamp annoyingly switches off and then quickly back on again every minute.

8 (d) (i) Explain why the lamp switches in this way.

.....

.....

8 (d) (ii) It is suggested that this switching can be avoided by changing the sequence of operations. Which box on the flowchart should be moved to avoid this switching?

.....

8 (d) (iii) Alter the flowchart on **page 10** to show the improved operation.

(4 marks)

20

Turn over for the next question

9 A student decides to construct an energy saving system similar to that described in Question 8.

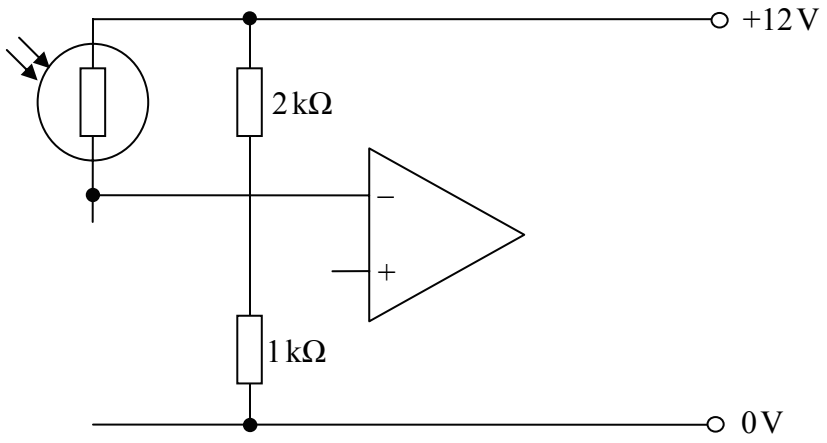
It is not necessary to have completed your answer to Question 8 before attempting this question.

A logic gate has inputs from two subsystems. Subsystem one detects the light level, sending its output signal to another subsystem which produces an output signal logic 1 when it gets dark.
Subsystem two uses an infrared (IR) detector which produces a logic 1 output signal when a person is present in the room.
The two logic signals form the inputs to a logic gate whose output signal triggers a timer which in turn controls a lamp.

9 (a) Draw a system diagram consisting of six subsystems for this complete system. Label **all** the subsystems with their respective functions.

(6 marks)

9 (b) (i) Complete the circuit diagram below to show how an op-amp should be connected as a comparator. Add the power supply connections to the op-amp. Mark and label the output of the comparator.



9 (b) (ii) Calculate the voltage on the non-inverting input of the op-amp.

.....

9 (b) (iii) On the circuit diagram on **page 12** draw a ring around the light sensor voltage divider circuit that provides the input signal to the comparator.

9 (b) (iv) The LDR has a resistance of 200 kΩ when it gets dark. Give a suitable value for the other component you have drawn in the light sensor circuit.

.....

(7 marks)

The logic subsystem must only produce a logic 0 output signal to trigger the timer when the room is dark so that the comparator gives an output signal of logic 1, and the IR module indicates the presence of a person by giving out a logic 1.

9 (c) (i) Complete the truth table for this logic subsystem.

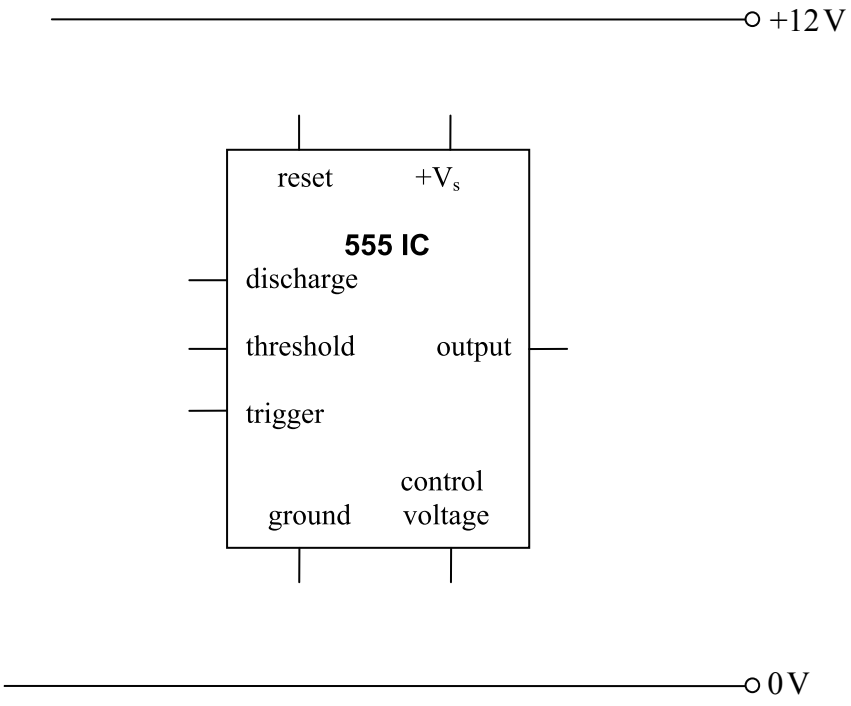
light sensor	**IR module**	**output**
0	0	
0	1	
1	0	
1	1	

9 (c) (ii) What type of logic gate is required? .....

(5 marks)

Question 9 continues on the next page

9 (d) (i) Complete the circuit diagram below to show how a 555 IC should be connected to form a timer subsystem. Include a timing resistor, capacitor and any other components or connections required. Label the connection from the logic gate and the output to control the lamp.



9 (d) (ii) Draw a ring round the two components in the circuit diagram which could be changed to make the lamp stay on longer. *(10 marks)*

The output from the timer cannot directly control the lamp in the room.

9 (e) (i) Name the electromechanical device that has an electrically isolated switching action that could control the lamp.

.....

9 (e) (ii) What component must be added to the timer circuit to protect it as the device in part (e)(i) switches off?

.....

(2 marks)

30

END OF QUESTIONS

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